SPF Clean Air Wave 1 Kick Off Event

3rd February 2020

Met Office

NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

Agenda change

Time	Agenda item
09.30 – 10.00	Registration (tea, coffee and pastries available)
10.00 – 10.10	Welcome from UKRI-NERC – Professor Sir Duncan Wingham
10.10 – 10.20	Welcome from Met Office – Professor Stephen Belcher
10.20 – 10.50	Overview from the Champions
10.50 - 12.15	Overview from PIs of each project
12.15 – 13.15	Lunch
13.15 – 13.30	Champions role
13.30 – 15.20	Poster session (tea/coffee to be available throughout)
15.20 – 15.35	Comfort break
15.35 – 15.50 15.50 – 16.00	Event and discussions summary from the Champions Questions from the audience
16.00 – 16.30	Closing statements from Professor Frank Kelly
16.30	Meeting closes

UKRI Met Office NPL National Physical Laboratory Department for Environment Food & Rural Affairs

Natural Environment Research Council

Welcome

Professor Sir Duncan Wingham

Executive Chair UKRI-NERC

Met Office NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

Welcome

Professor Stephen Belcher

Met Office Chief Scientist

Champions overview

Professor Stephen Holgate

Dr Jenny Baverstock

Met Office

NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

UK Research and Innovation

Met Office

SPF Clean Air Wave 1

Programme Overview

Stephen Holgate
UKRI Clean Air Champion.

3rd February 2020

Strategic Priorities Fund

The Strategic Priorities Fund (SPF) is being led by UKRI to: build on Sir Paul Nurse's vision of a 'common fund', to support high quality multidisciplinary and interdisciplinary research programmes, which could have otherwise been missed through traditional funding channels

- Drive an increase in high quality multi- and interdisciplinary research and innovation
- Ensure that UKRI's investment links up effectively with government research priorities and opportunities
- Ensure the system responds to strategic priorities and opportunities

Motivation for a Clean Air Programme

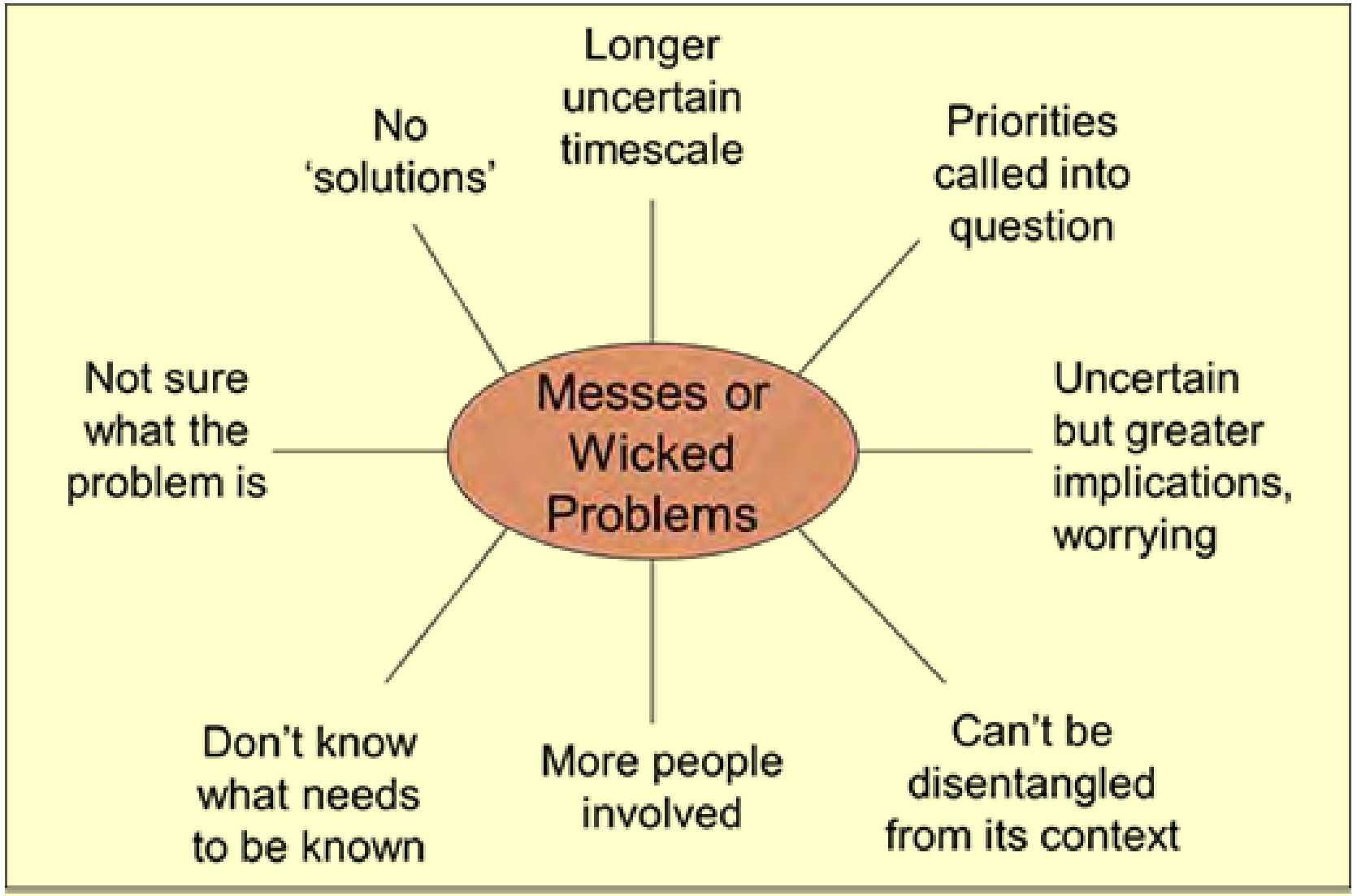
Atmospheric pollution in the UK is responsible for approximately 36-40,000 early deaths and has a cost of around £20 billion to health services and business, per year.

- The UK is entering a transformative period in air quality, as transport, heating, energy, solvent use and agricultural emissions change.
- Most of the 'easy wins' to reduce particulate matter, volatile organic compounds, ammonia and nitrogen oxides have already been implemented in the UK.
- Future improvements will require innovative solutions underpinned by new research to protect the health of society, whilst pursuing clean growth.

UKRI Met Office NPL National Physical Laboratory Department for Environment Food & Rural Affairs Department of Health & Social Care Department for Transport The Scottish Government Riaghaltas na h-Alba Llywodraeth Cymru Welsh Government

Air pollution is an example of a wicked problem

The use of the term "wicked" here has come to denote resistance to resolution



Clean Air Aims

Wave 1 Analysis & Solutions (£19.6m)

Developing solutions to air pollution to help policymakers and businesses protect health and work towards a cleaner economy

- Drive forward new multidisciplinary research and innovation
- Leverage existing UK investments and enable a challenge-focussed multidisciplinary community to work together for the first time
- Inform implementation of the Clean Air Strategy and related strategies
- Develop new solutions to reduce emissions and protect public health, whilst avoiding perverse consequences

Intended outcomes

- Increased knowledge of future changes in sources, emissions and atmospheric processes
- Increased knowledge of exposure and health impacts of vulnerable groups of people
- Catalyse innovation in technology, business models & policy best practice
- Bring coherence to UK air quality research and policy

Wave 1 investments

- **Clean Air Champions** to maximise links across the programme, knowledge exchange, business convening, and links into international efforts, and start to refine the priorities for future investment
- Innovation funding competition for UK businesses with solutions to work on **product and service development**, and first deployments of technologies to tackle non-exhaust and non-road-vehicle air pollution
- Activities to network and leverage existing UKRI major, long-term strategic investments in order to support **intidisciplinary policy-relevant research** to underpin sustainable solutions for air quality
- Activities to develop a **systems framework for clean air analysis**

Innovation Competition

Develop and demonstrate new products or services which reduce the harmful emissions from one or more of:

- Road vehicle brake and tyre wear and/or road surface wear
- Non-road mobile machinery used for construction, such as excavators, bulldozers, front loaders, cranes and compressors
- Transport refrigeration units

Brake, tyre, road wear	**TRU**	**Construction NRMM**

Project
Auto-Align - Reducing Air Pollution through Measurement of Wheel Alignment (RL Capital)
Cool Run: Hubl's solution to multi-temperature last mile delivery (Hubl Logistics Ltd)
CAGE Clean Air Gas Engine (OakTec)
SHIELD: Series Hybrid-capable Intelligent Electric Loader Drive (Edrive engineering services Ltd)
Food Transport Refrigeration with Engine Exhaust and Metal Hydride Reactors (University of South Wales)
ENSO - Low-Emission Tyres for Improved Air Quality (Enso Tyres Ltd)

Multidisciplinary policy-relevant research

- **APEx:** An Air Pollution Exposure model to integrate protection of vulnerable groups into the UK Clean Air Programme. (Ben Barratt, MRC CEH)
- **ANTICIPATE**: Actively anticipating the unintended consequences on air quality of future public policies (Nigel Gilbert, CECAN)
- **DREaM:** Component-Specific Air pollutant Drivers of Disease Risk in Early to Midlife: a pathway approach (Ian Mudway, MRC CEH)
- **OSCA:** Integrated Research Observation System for Clean Air (Hugh Coe, NERC Air pollution supersites)
- **QUANT:** Quantification of Utility of Atmospheric Network Technologies. (Pete Edwards, NCAS)

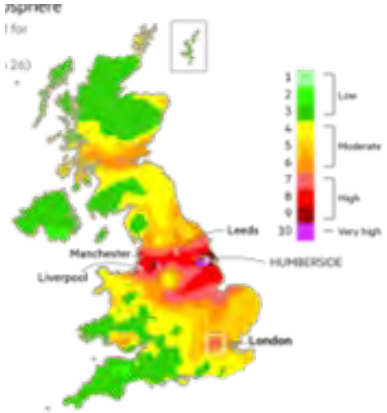
SPF Clean Air Met Office Coordinated Work



External Projects

- NPL - Metrology of air quality measurements
- Recent calls for:
  - UK Community Emission Modelling System
  - Urban outdoor air quality modelling
  - Data integration model for exposure modelling

MetO aircraft – with AQ sensor load



UK forecasting/modelling

Met Office Internal Activities

- Community engagement & events
- Online framework for data discovery, use and analysis
- 12-month air quality flight campaign and model analysis
- 15-year UK air quality reanalysis
- New high resolution (~km grid length) national air quality forecast
- Urban numerical weather prediction (NWP) (~100 m grid length) for air quality

Natural Environment Research Council

Met Office

Innovate UK

Overview of all projects

Met Office

NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

Natural Environment Research Council

Dr Ben Barratt

Met Office

NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

APEx: An Air Pollution Exposure model to integrate protection of vulnerable groups into the UK Clean Air Programme

The Clean Air (W1) programme is led by NERC and the Met Office, with Innovate UK, EPSRC, ESRC, MRC, NPL & Defra as delivery partners.

Ecological method of air quality management

How are we really exposed to air pollution?

Cooking
Heating
Cleaning
Materials

Indoor sources

Outdoor sources

Building design
Ventilation

Location
Infiltration rate

Route
Mode
Infiltration rate

Home

Work / School

Travel

Local
Regional
Transboundary

TIMING DURATION BREATHING RATE

Single pollutant
Multi pollutant
Noise

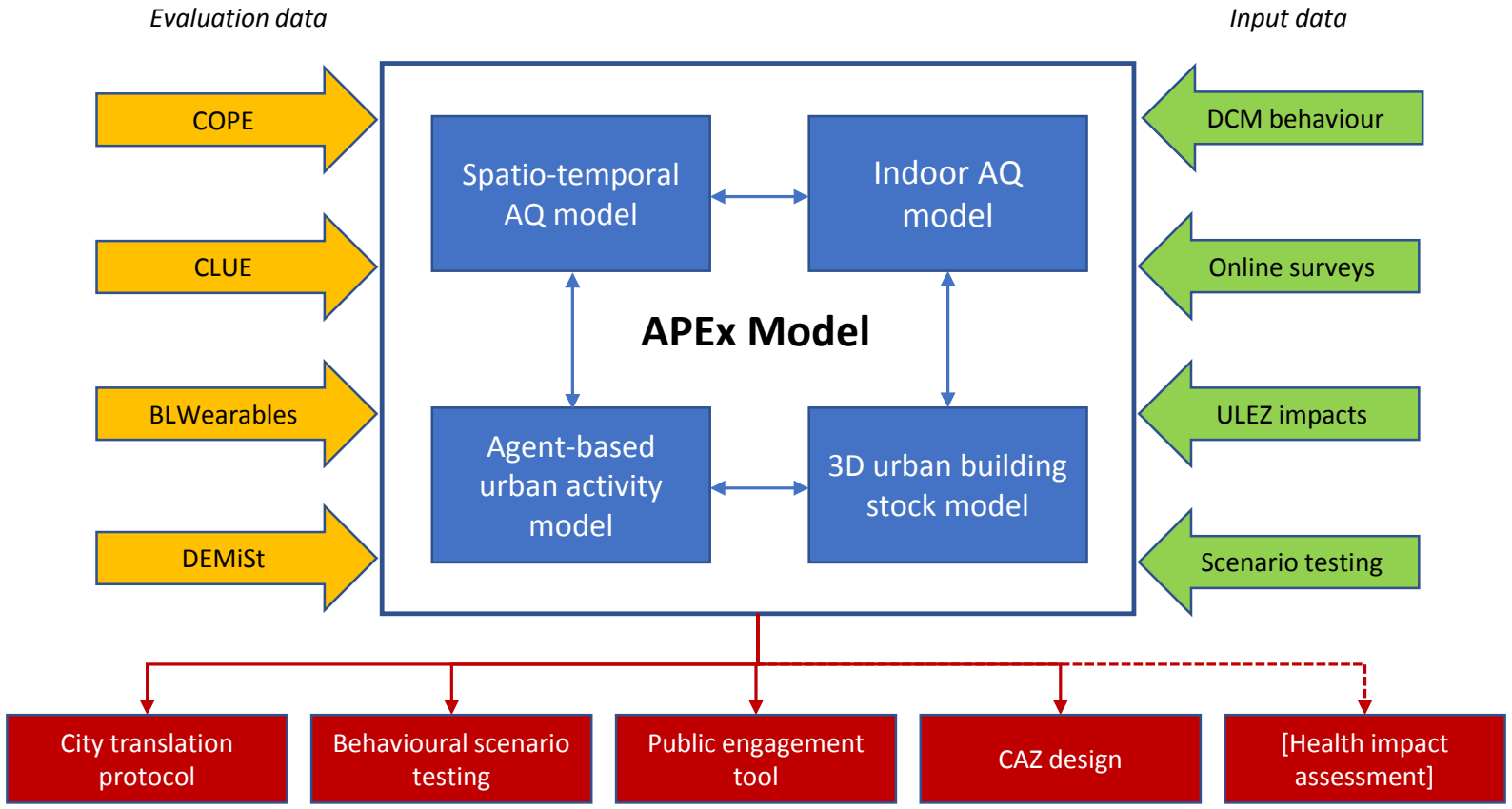
Sensitivity
Age
Ethnicity

Exposure Dose

Heath Impact

Acute Effects
Chronic Effects
Quality of Life

A personalised air pollution exposure model that incorporates urban behaviour



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www.kcl.ac.uk/sspp/departments/lci/people/academicstaff/Dr-Benjamin-Barratt.aspx

Natural Environment Research Council

Professor Hugh Coe

Met Office

NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

Integrated Research Observation System for Clean Air (OSCA)

Hugh Coe, James Allan, David Topping, Nick Marsden, David Green, Anna Font, Anja Tremper, Max Priestman, Mohsen Kazemimanesh, Adam Boies, William Bloss, Zongbo Shi, Roy Harrison, Salim Alam, David Beddows, Loku Ranasinghe, Ally Lewis, Sarah Moller, James Lee, Christine Braban, Eiko Nemitz, Marsailidh Twigg, Carole Helfter

£2.3M Project as part of the UKRI CleanAir Wave 1 Programme – Using important new infrastructure to deliver new insights into the causes of air pollution and its transformation in urban air

O1: To reduce uncertainty in the estimates of current real-world emissions of NOx and PM from road transport, including both tailpipe and non-exhaust sources, using an observations based approach **(WPA; WPD)**

O2: To provide state-of-the-science understanding of current concentrations and trends in UK air pollution, including regulated species and the diverse range of precursors that lead to their secondary formation. (**WPB; WPC; WPD**)

O3: To develop new data and numerical analysis capability to identify the drivers behind changes in ambient air quality, particularly links to policy interventions (**WPB; WPC**)

O4: To quantify the contribution of key sources to urban pollution concentrations in London, Birmingham and Manchester, including woodsmoke and cooking emissions, and their responses to regional air quality policy interventions scheduled during the OSCA project (**WPB; WPC; WPD**)

O5: To provide a data resource and experimental platform to enable the application of further UK science capability to the wider UKRI SPF Clean Air Programme, and more widely to key national and regional stakeholders (**WPB; WPE**)

The University of Manchester

University of York

National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

University of Cambridge

UK Centre for Ecology & Hydrology

MRC Centre for Environment & Health

MRC Medical Research Council

Imperial College London

King's College London

University of Birmingham

WPA: Emission measurements

- New non exhaust vehicle emissions measurements
- Leveraging existing platforms such as BT Tower to obtain NOx fluxes

WPB: Measurement Infrastructure

- Maintaining and quality assuring NERC super-site investments

MANCHESTER 1824
The University of Manchester

UNIVERSITY of York

National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

UNIVERSITY OF CAMBRIDGE

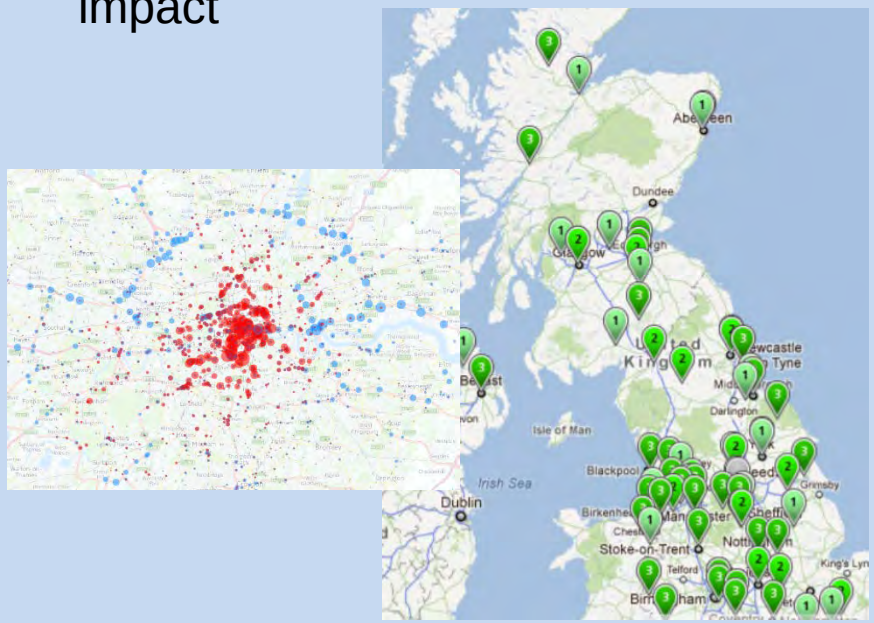
UK Centre for Ecology & Hydrology

MRC Centre for Environment & Health
MRC Medical Research Council
Imperial College London
KING'S College LONDON

UNIVERSITY OF BIRMINGHAM

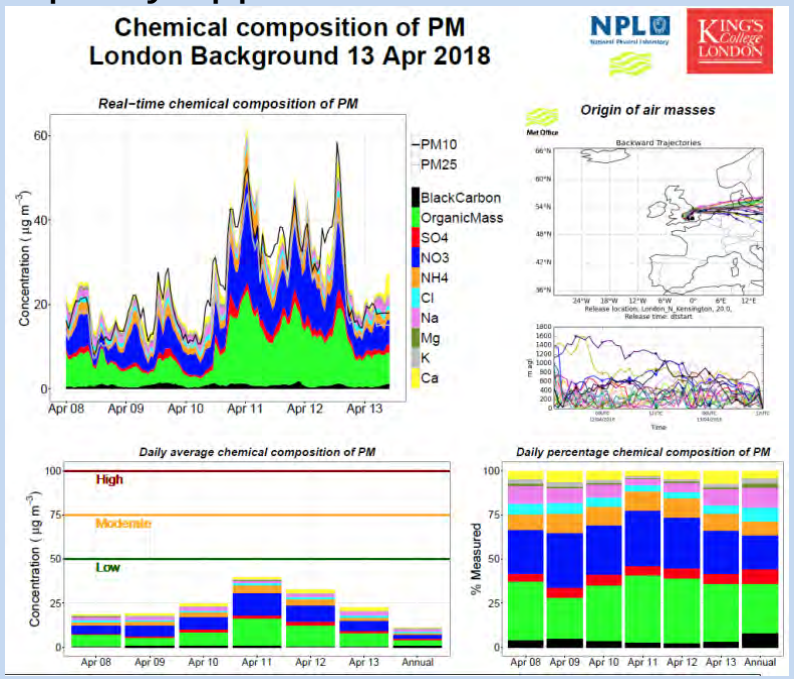
WPC: Data Mining

- Harmonized data sets
- New analysis of trends
- Development of potential tools for real time exploration of policy impact



WPD: Analysis and Insight

- Non-exhaust emissions
- Wood smoke
- Ammonia trends
- Contrasting potentially divergent policy approaches



WPE: Community Mobilization

- The UK AQ observation community is strong and highly collaborative
- OSCA provides platforms and resources to engage this community in the CleanAir programme

Data, Links and Impact

- Quality assurance to AURN standards
- Data uploaded in real time to www.ukatmosphere.org
- Data archived at CEDA
- QUANT baseline station
- Use of supersite data to inform DREaM
- Providing background information to APEx
- Close links to DEFRA through Moller and SAQN
- Links to DfT
- AQEG
- Close links to TfL, TfGM and WMCA

Natural Environment Research Council

Professor Nigel Gilbert

Met Office

NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

ANTICIPATE

Actively anticipating the unintended consequences on air quality of future public policies

UNIVERSITY OF SURREY

UNIVERSITY OF BIRMINGHAM

UCL

UNIVERSITY of York

NERC SCIENCE OF THE ENVIRONMENT

A NERC funded research project

Project Aims

- Improve understanding of the unanticipated consequences of public policy on air quality
- Develop better methods to aid effective horizon scanning of future policies at the appraisal stage
- Provide access to a multidisciplinary community of academic expertise

Key Stakeholders

- National Government (i.e. Defra, BEIS, DoH&SC, MHCLG)
- Public bodies and agencies (i.e. NHS England, NHS digital services, General Medical Conucil)
- Devolved administrations and local authorities

UNIVERSITY OF SURREY

UNIVERSITY OF BIRMINGHAM

UCL

UNIVERSITY of York

Work plan

Work Package 1: Public policy horizon scanning

- Core strategy review and policy extraction
- NHS Long Term Plan, Clean Growth Strategy, 25-Year Environment Plan, Industrial strategy
- Selection of policy case studies by document review

Work Package 2: Policy exploration

- Utilise a range of methods, tools and techniques for detailed exploration of selected case study policies

  Stakeholder mapping -> inception meeting -> exploration workshops -> dissemination

Work Package 3: Method evaluation and synthesis

- Evaluation of different policy exploration tools
  - Objectives and suitability for policymakers
  - Practicality
  - Time and Resource

Work Package 4: Managing relationships

- Foster interest and engagement and facilitate impact

Work Package 1: Strategy Review

- Detailed contextual, structural and content review including extraction of free text fields:
  - ***Goal*** – identified fiscal or outcome-related target
    - Example: *Every patient will have the right to choose digital first primary care*
  - ***Strategy –*** broad approach to achieve strategic goal/target
    - Example: *support the development of apps and online resources to support good health and enable recovery*
  - ***Policy –*** specified course of action to achieve overarching goal
    - Example: T*he NHS App will create a standard online way for people to access the NH*
- All identified statements also coded by relationship to air quality (yes/no)

NHS App

Being tested in the NHS

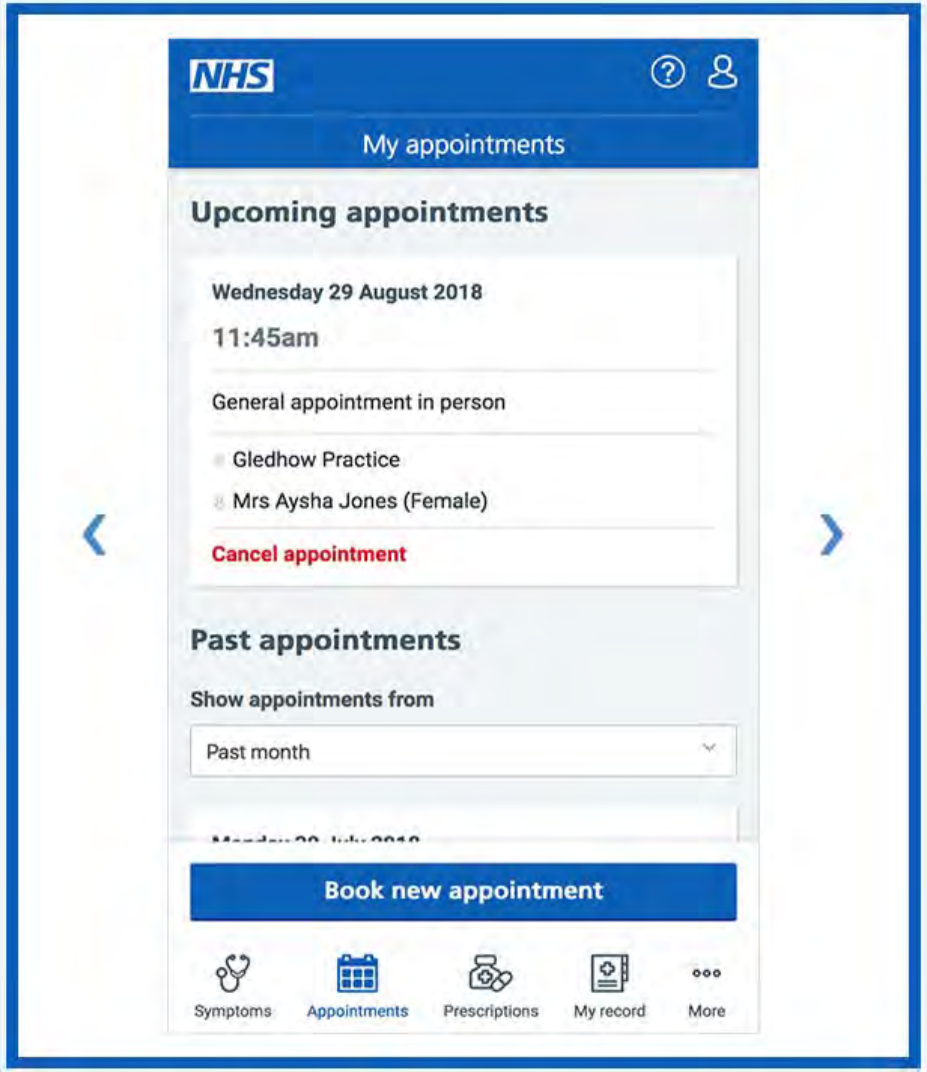
Category: NHS services

Free

The NHS App lets you book GP appointments, order repeat prescriptions and access a range of other healthcare services

Download on the App Store

GET IT ON Google Play



The NHS App enables people to:

- Symptom checker
- NHS 111 online
- Register as an organ donor
- Control use of data choose for research and planning
- Book and manage appointments
- Order their repeat prescriptions
- View their GP medical record securely

Next steps

- System impacts and relevant stakeholders for each core strategy
- Inception & follow-on workshops
- Method evaluation

Project deliverables

- Methods manual
- Summary report and short briefing note per policy case study
- Stakeholder and system maps
- Final conference

HM Government

A Green Future: Our 25 Year Plan to Improve the Environment

Support for the research provided by:

Natural Environment Research Council

NERC SCIENCE OF THE ENVIRONMENT

Principal Investigator: Professor Nigel Gilbert (University of Surrey)
Co-Investigators:
Dr Suzanne Bartington (University of Birmingham
Dr Ian Hamilton (UCL Energy Institute)
Dr Sarah Moller (NCAS, University of York)

UNIVERSITY OF SURREY

UNIVERSITY OF BIRMINGHAM

UCL

UNIVERSITY of York

Natural Environment Research Council

Dr Ian Mudway

Met Office NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

Component-Specific Air pollutant Drivers of **D**isease **R**isk in **Ea**rly to **M**idlife: a pathway approach

DREaM

Dr Ian Mudway, Dr Sean Beevers, Dr Benjamin Barratt, Prof. Brian Castellani, Prof. Paolo Vineis, Prof. Rod Jones, Dr Queenie Chan, Dr Daniela Fecht

The Clean Air (W1) programme is led by NERC and the Met Office, with Innovate UK, EPSRC, ESRC, MRC, NPL & Defra as delivery partners.

Aim: *"In this study we aim to focus **on early to mid-life exposures**, as **potential predictors of poor health outcomes in later life**, by both linking air pollution exposures to known pre-clinical risk factors in both children (a group with established vulnerability to air pollution) and , as well as by examining epigenetic changes to DNA, triggered by environment stress."*

DREaM Airwave
Health Monitoring Study

DREaM CHILL
Children's Health in London & Luton

WP2a: "*to develop innovative techniques to predict exposure of vulnerable groups and **determine mechanistic pathways by which air pollution leads to health impacts**…. (to) catalyse early research to decode molecular effects of life-long exposures on health through **identifying biomarkers of exposure** and effect from established cohorts*"

CHILL – ULEZ intervention study
Children's Health in London and Luton

Population: Children aged 6-9 yrs old, recruited in 26 London primary schools (years 2, 3, 4) within the Central London ULEZ area

Intervention: Ultra Low Emission Zone

Comparison: Children aged 6-9 yrs old, recruited in 26 Luton primary schools (years 2, 3, 4)

Outcome:

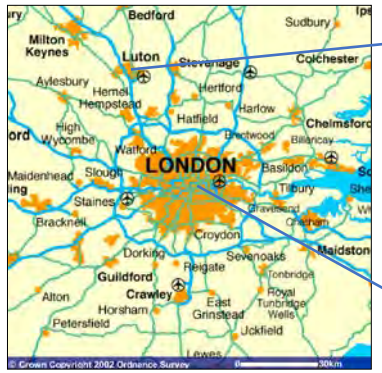
PRIMARY: Lung growth (post-bronchodilator forced expiratory volume in one second, FEV_1)

SECONDARY: Air quality, forced vital capacity (FVC), health status (respiratory symptoms), respiratory infections, QOL, health care use, health costs

Funded by NIHR

CHILL – DREaM enhancements

London: 44 schools
Luton: 38 schools
Total: 3065: 1526 London; 1539 Luton
Spirometry: 82% London; 83% Luton



Luton Comparison Cohort

2018 | Year 2 | Year 3 | Year 4

Yearly assessments

ULEZ implementation

2018 | Year 2 | Year 3 | Year 4

London ULEZ Intervention Cohort

Child respiratory h… costs data collection,
Phys… itoring

PM sub-study

DREaM – Yr1
Sept '19 – Apr '20

DREaM – Yr2
Sept '20 – Apr '21

Air quality data collection and modelling

GP record collection

Linkage & Analysis

WP1 — $CMAQ_{urban}$

WP2 — DNA collection
Methylation analysis
Telomere analysis

WP3 — Linkage & analysis

WP4 — Personal monitoring

DREaM CHILL
Children's Health in London & Luton

DREaM Airwave
Health Monitoring Study

Airwave Health Monitoring Study
Tissue Bank

Occupational cohort of employees of 28 police forces from across Great Britain.

Recruitment and baseline assessment was performed between **2006-2012**, with follow-up between 2015-18.

At the end of 2012 the study had recruited 42,112 participants (63% male, mean age 40±9 years), of whom 83.6% had attended a baseline health screening

Imperial College London

Table 2
Clinical and biological measurements by gender[a].

	Women	Men	Total
N (%)	13,239 (37.6)	21,960 (62.4)	35,199 (1 0 0)
BMI (kg/m^2) (n=35,117)	26.1 (4.8)	28.1 (3.7)	27.3 (4.3)
BMI < 25 kg/m^2 (%)	48.7	19.1	30.2
25 kg/m^2 ≤ BMI < 30 kg/m^2 (%)	33.9	54.6	46.8
BMI ≥ 30 kg/m^2 (%)	17.3	26.3	23.0
WC (cm) (n=34,846)	82.3 (11.6)	94.8 (9.8)	90.1 (12.1)
WC < 80/94 cm (W/M) (%)	47.1	48.0	47.7
80/94 cm ≤ WC < 88/102 cm (W/M) (%)	24.8	30.4	28.3
WC ≥ 88/102 cm (W/M) (%)	28.0	21.6	24.0
SBP (mmHg) (n=35,131)	123.1 (14.1)	136.2 (13.6)	131.3 (15.2)
DBP (mmHg) (n=35,131)	76.6 (9.6)	81.8 (10.0)	79.8 (10.1)
Hypertension[b] (%)	14.2	38.8	29.5
Total cholesterol (mmol/l) (n=34,875)	5.1 (1.0)	5.4 (1.1)	5.3 (1.0)
Total cholesterol ≥ 5 mmol/l (%)	54.0	66.5	61.8
HDL (mmol/l) (n=34,829)	1.7 (0.4)	1.3 (0.3)	1.5 (0.4)
HDL ≤ 0.9 (%)	0.6	4.7	3.2
Haemoglobin (g/dl) (n=34,713)	13.2 (1.0)	15.0 (1.0)	14.3 (1.3)
Haemoglobin < 11.5/13 g/dl (W/M) (%)	3.6	1.5	2.3
HbA1c (%) (n=34,708)	5.6 (0.5)	5.6 (0.6)	5.6 (0.6)
HbA1c < 6% (%)	80.7	84.9	83.4
6% ≤ HBA1C < 6.5% (%)	15.6	11.9	13.3
HbA1c ≥ 6.5% (%)	3.7	3.2	3.4
C-reactive protein (mg/l) (n=28,924)	2.3 (3.4)	1.7 (2.7)	1.9 (3.0)
C-reactive protein ≥ 3 mg/l (%)	21.5	12.4	15.9
Abnormal ECG[c] (n=35,159) (%)	1.3	3.8	2.8

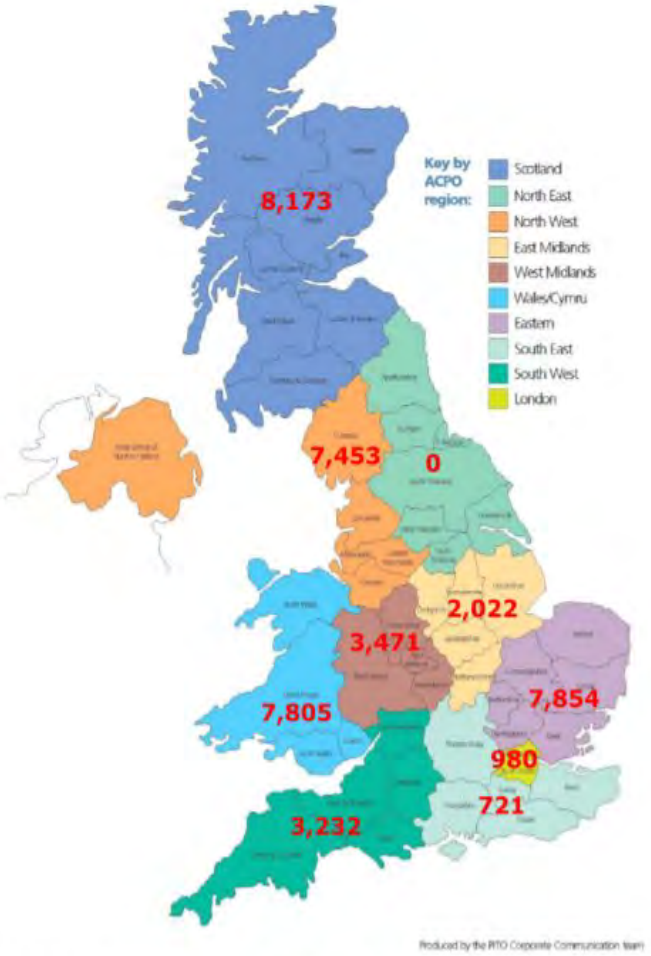
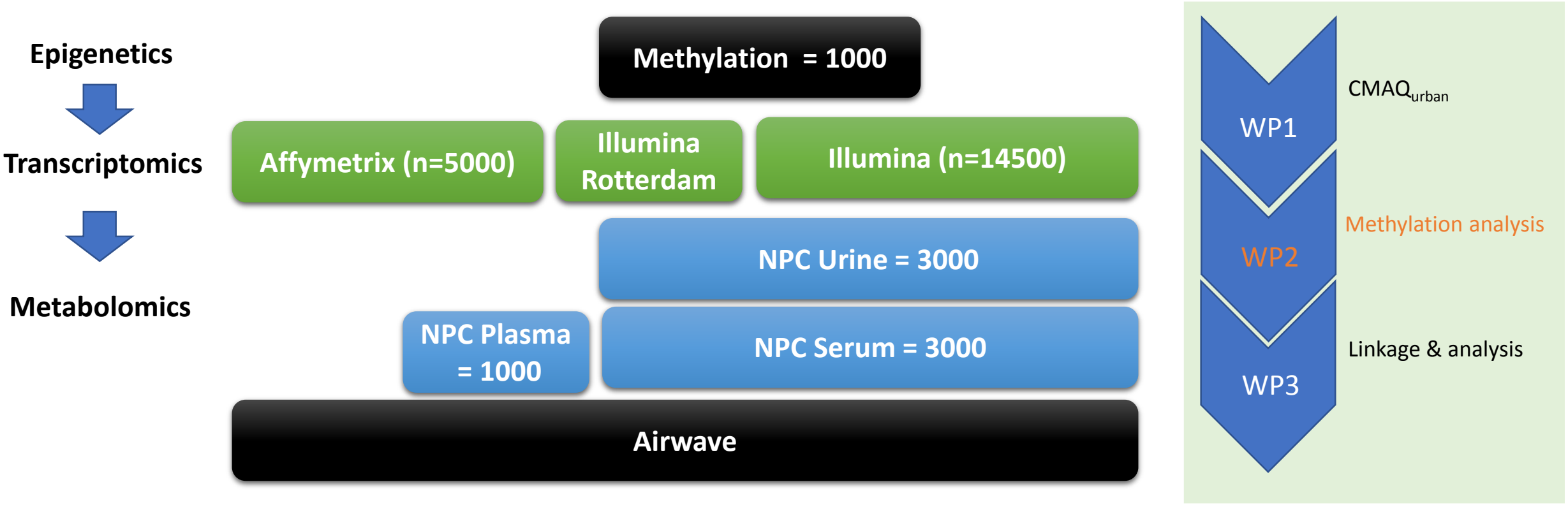


Fig. 2. (A) Cumulative enrolment from 2004 to 2012. (B) Enrolment per region by the end of 2012.

Available ‘omic data within Airwave



Overall aims

1. To model high resolution exposure to pollutant gases and particles (including source specific fractions and components) for children within the Children's Health in London and Luton (CHILL) cohort and adults in the Airwave Health Monitoring Study (AIRWAVE), focusing on exposure intervals between 1-12 months (**WP1**).
2. To provide linkage of air pollution and geospatial data across both cohorts, including potential confounders (noise, green space and socioeconomic factors) of associations between the modelled pollutants and study endpoints at baseline and follow-up (**WP2**-**3**).
3. To perform personal exposure measurements on a subset of children within the CHILL cohort to provide data to interrogate the impact of acute exposures on lung function and transient epigenetic responses to air pollution. (**WP4**)
4. Analysis of the association of baseline clinical and blood biomarkers with air pollution measures across the complete AIRWAVE study (n=42,112). (**WP2**)
5. Identification of epigenetic signatures of long-term air pollution exposures in cohort participants. (**WP3**)
6. Examination of the association between markers of biological age; telomere attrition and age-related methylation changes with modelled long-term pollutant exposures (**WP2**-**3**) 111

Natural Environment Research Council

Dr Pete Edwards

Met Office

NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

Natural Environment Research Council

Department for Environment Food & Rural Affairs

Quantification of Utility of Atmospheric Network Technologies (QUANT)

Assess and enable low-cost sensors for UK urban air pollution monitoring and enhance the value of low-cost sensor data for UK AQ challenges

Dr Pete Edwards (pete.edwards@york.ac.uk)

University of York

University of Cambridge

University of Birmingham

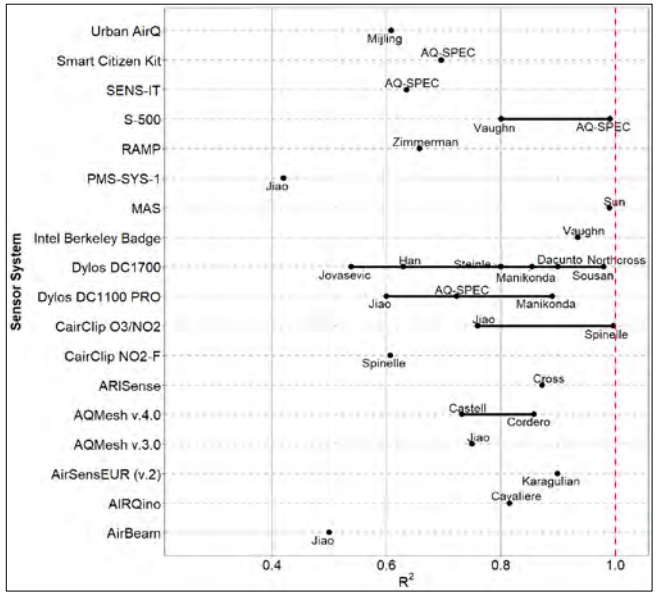
Cranfield University

UK Centre for Ecology & Hydrology

QUANT – Work Package 1

Conduct a comprehensive and transparent assessment of commercial low-cost air pollution sensor devices in UK urban environments, and enable these technologies through the provision of real-world sensor test-bed infrastructure and data methods.

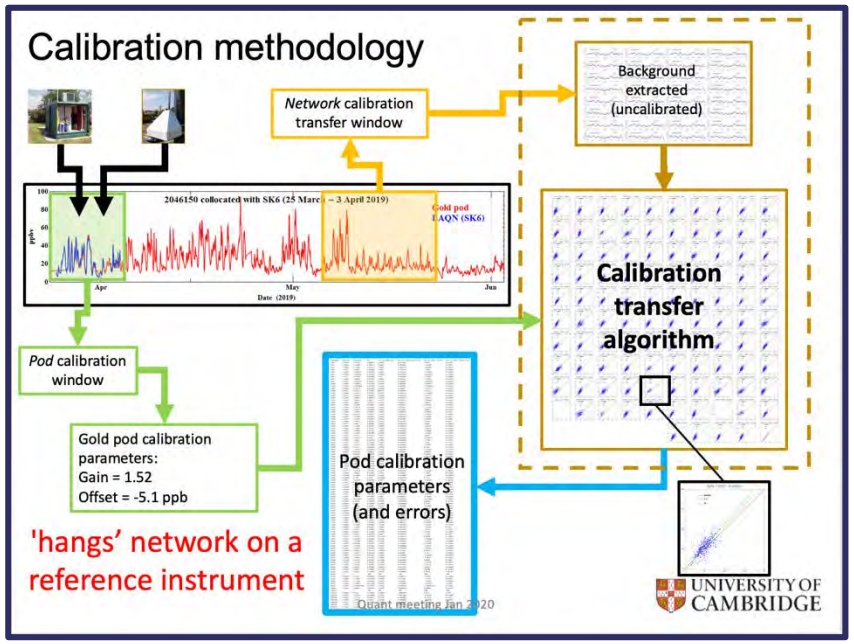
(York lead)



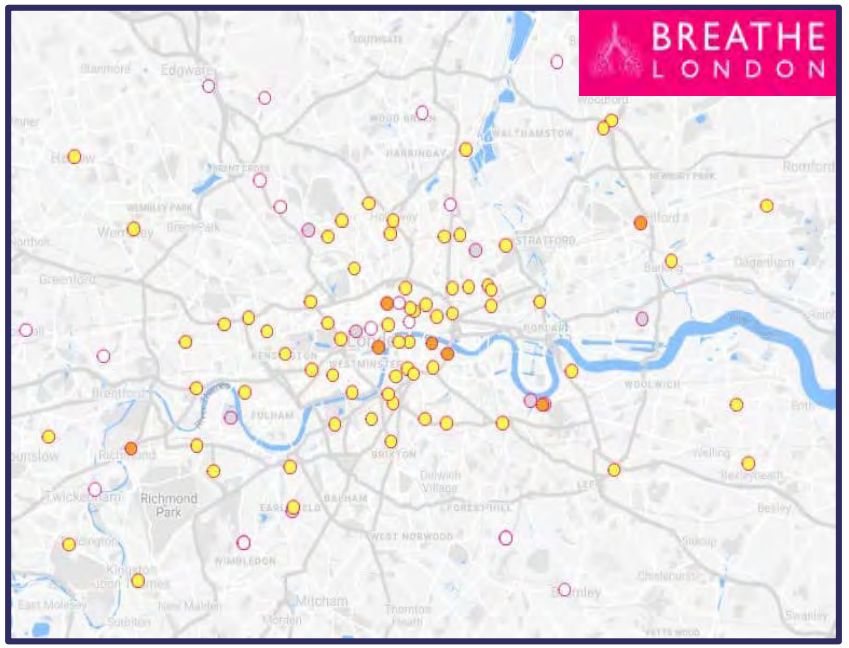
Taken from EC Joint Research Centre report "Review of sensors for air quality monitoring" 2019.

QUANT – Work Package 2

Demonstrate the power of low-cost sensor networks for addressing key UK air pollution challenges, and provide the required methodologies to enable their use. (Cambridge lead)



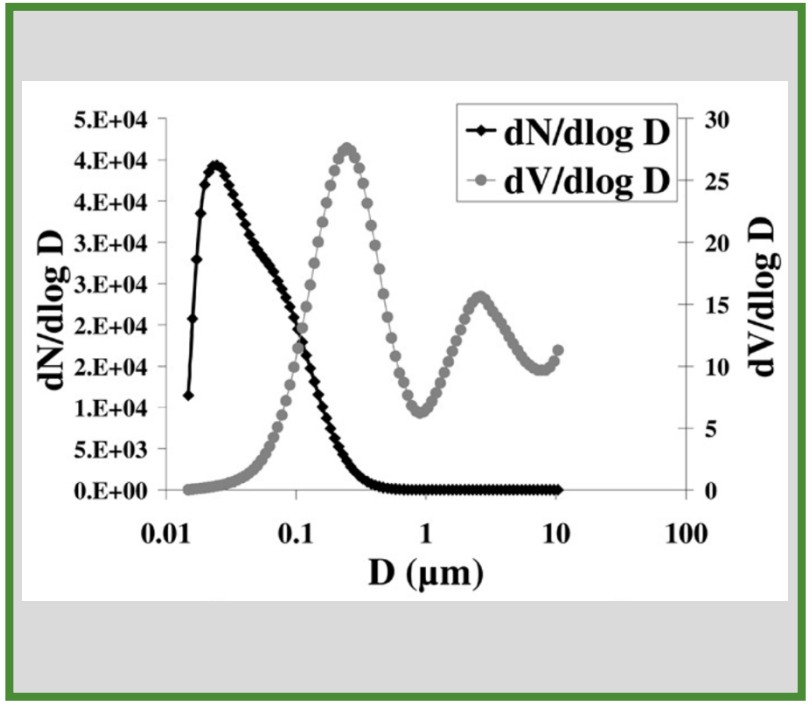
Cloud based network calibration methods



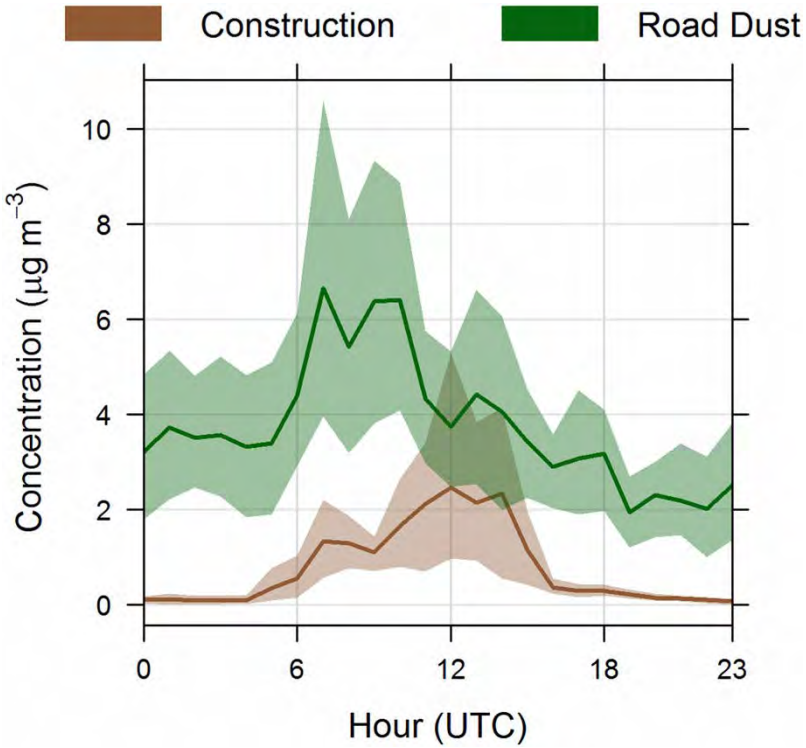
https://www.breathelondon.org

QUANT – Work Package 3

Develop novel particulate matter source apportionment techniques that utilize low-cost sensor ensembles and provide key data to guide mitigation strategies. (Birmingham lead)



Harrison et al. (2011) Environ. Sci. Technol.



Crilley et al. (2017) Environmental Pollution

Met Office

Dr Matt Hort

Met Office NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

Met Office

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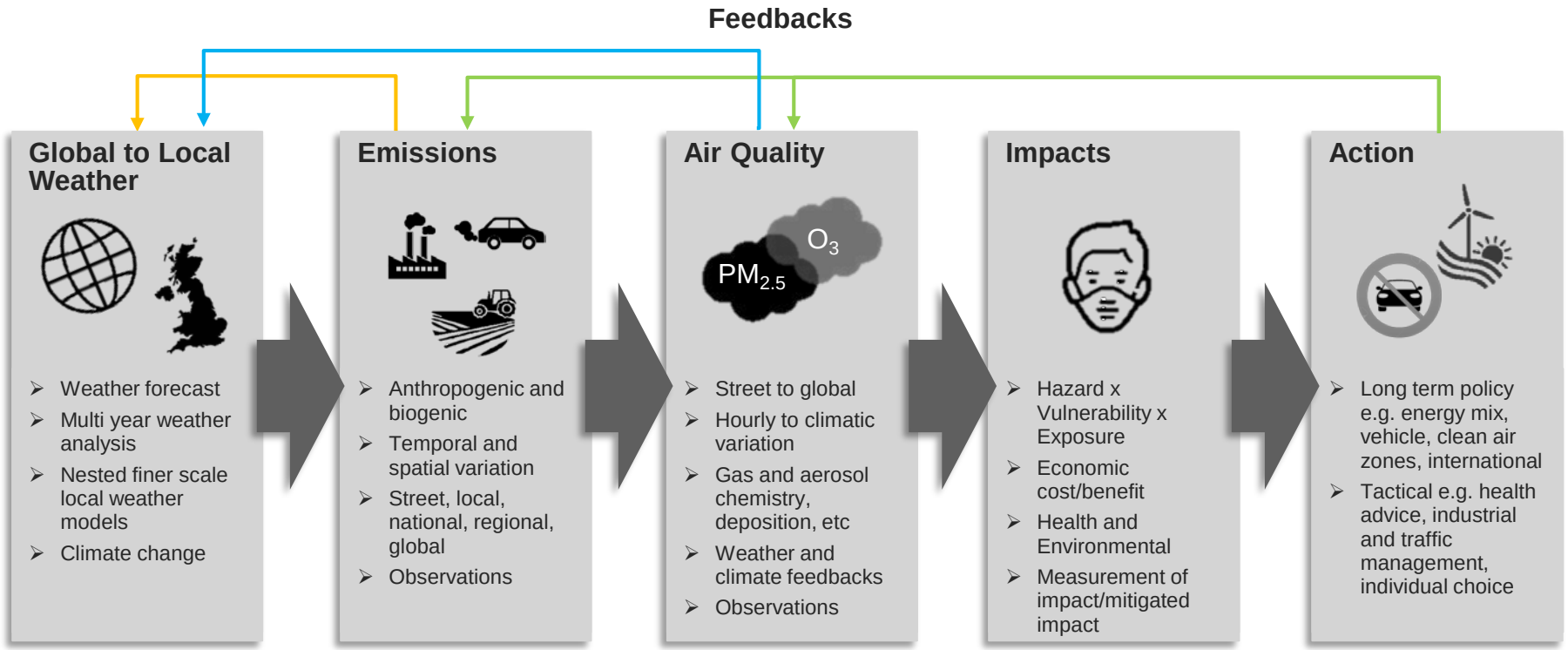
SPF Clean Air

Integrated Approach to Air Quality Risk: Linking models, data and policy



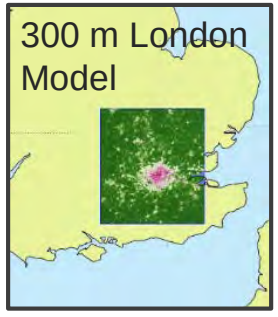
Met Office

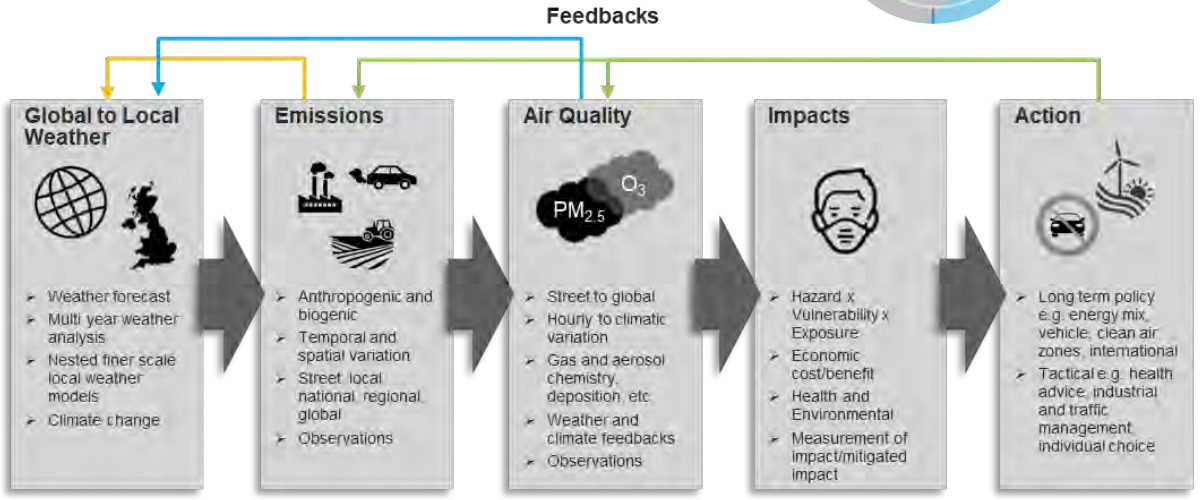
Met Office NPL Department for Environment Food & Rural Affairs

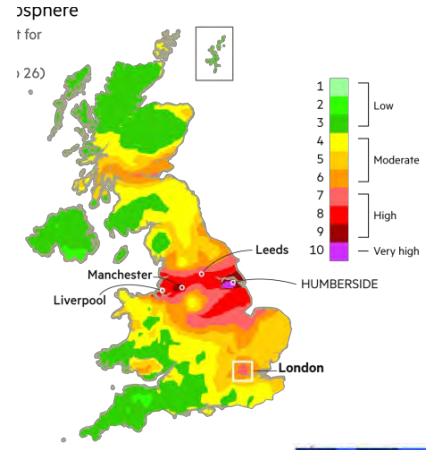
The Clean Air (W1) programme is led by NERC and the Met Office, with Innovate UK, EPSRC, ESRC, MRC, NPL & Defra as delivery partners.

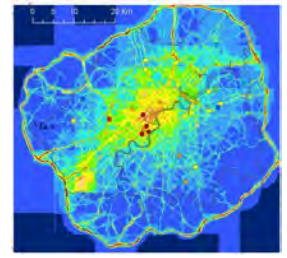
SPF Clean Air

Integrated Approach to Air Quality Risk: Linking models, data and policy









Met Office

Dr Humphrey Lean

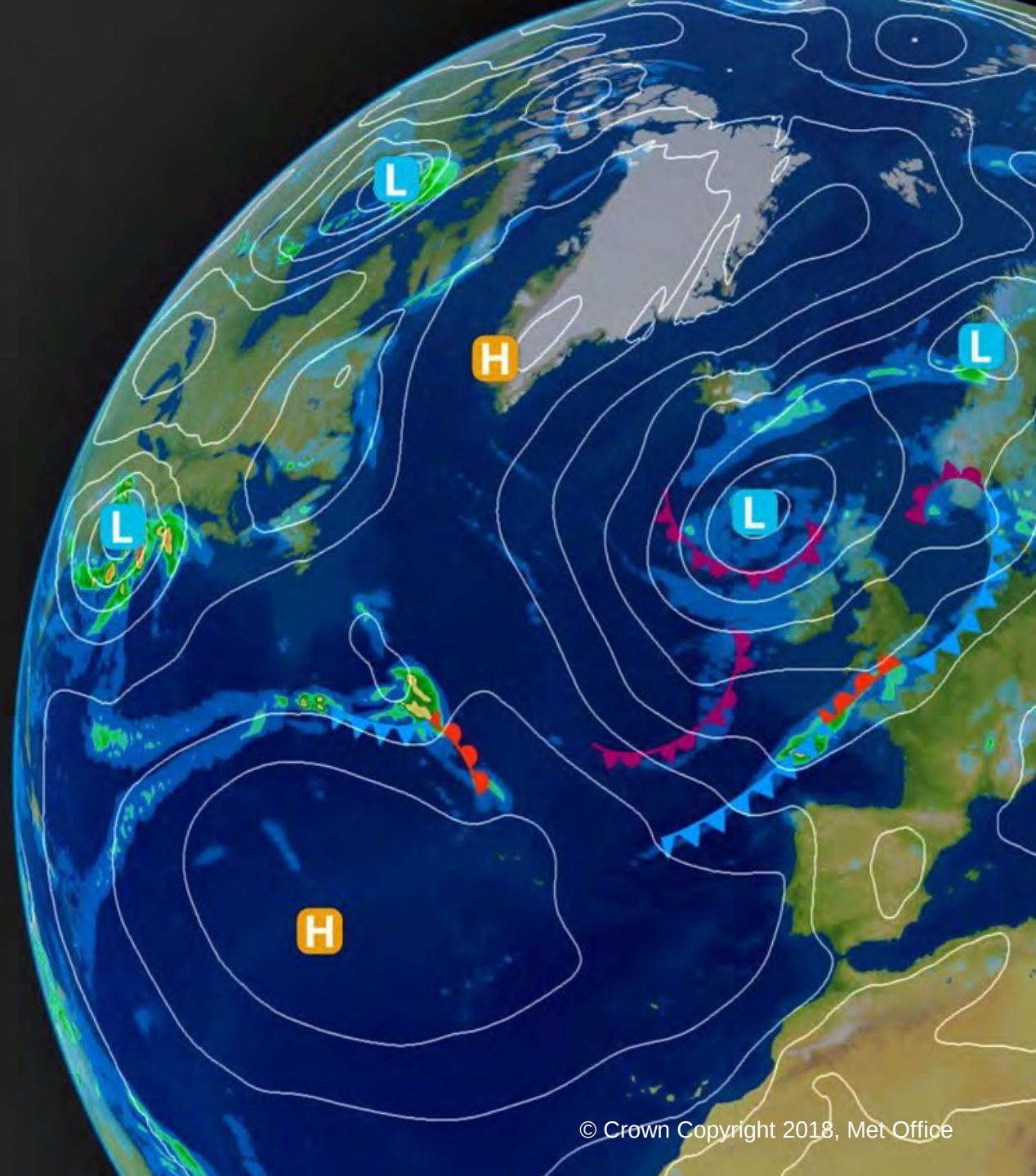
Met Office NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

High Resolution NWP for Air Quality

Humphrey Lean[1], Anke Finnenkoeter[2], Adrian Hill[2], Janet Barlow[3] LewisBlunn[3]

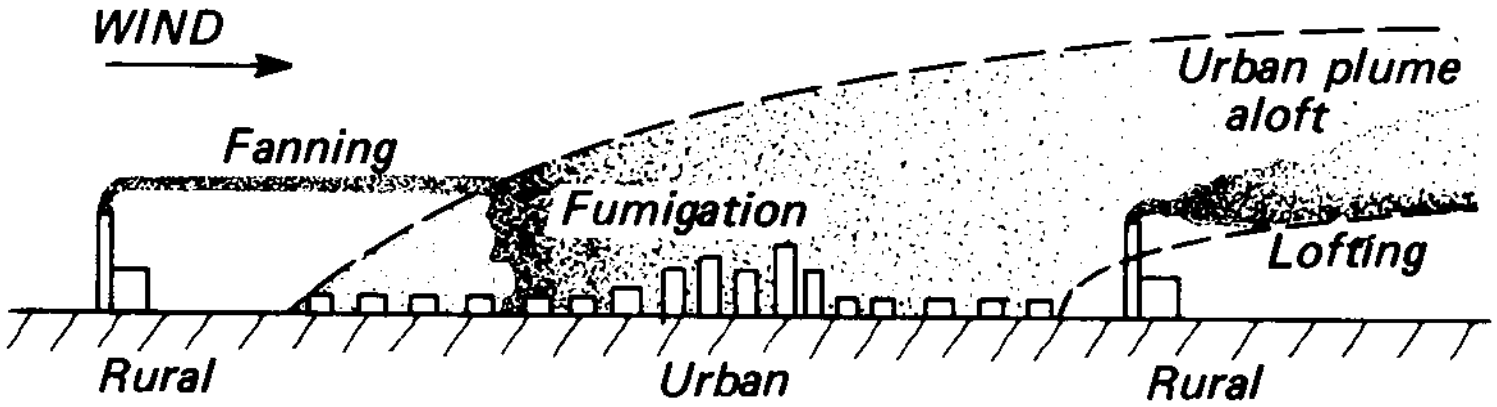
[1]Met Office, MetOffice@Reading
[2]Met Office, Exeter
[3]University of Reading



Why high resolution NWP?

Would like to forecast neighbourhood scale air quality.
Essential to know structure of boundary layer on these scales.

From Oke 1987

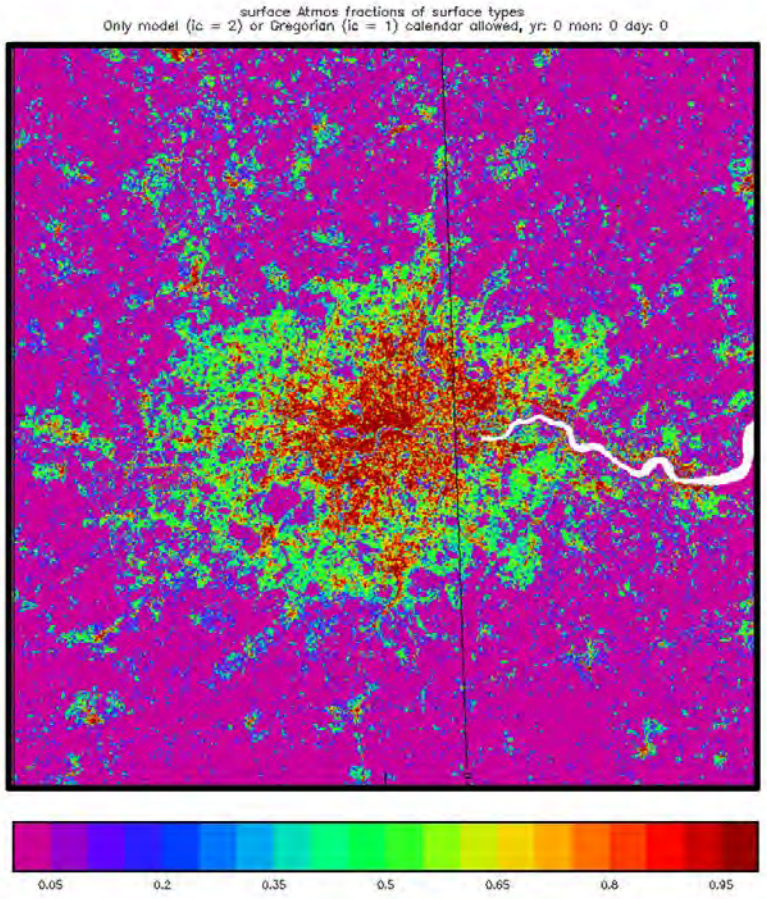


- Key issues are representation of urban surfaces and representation of partially resolved turbulence and how these affect transport of pollutants in the model.

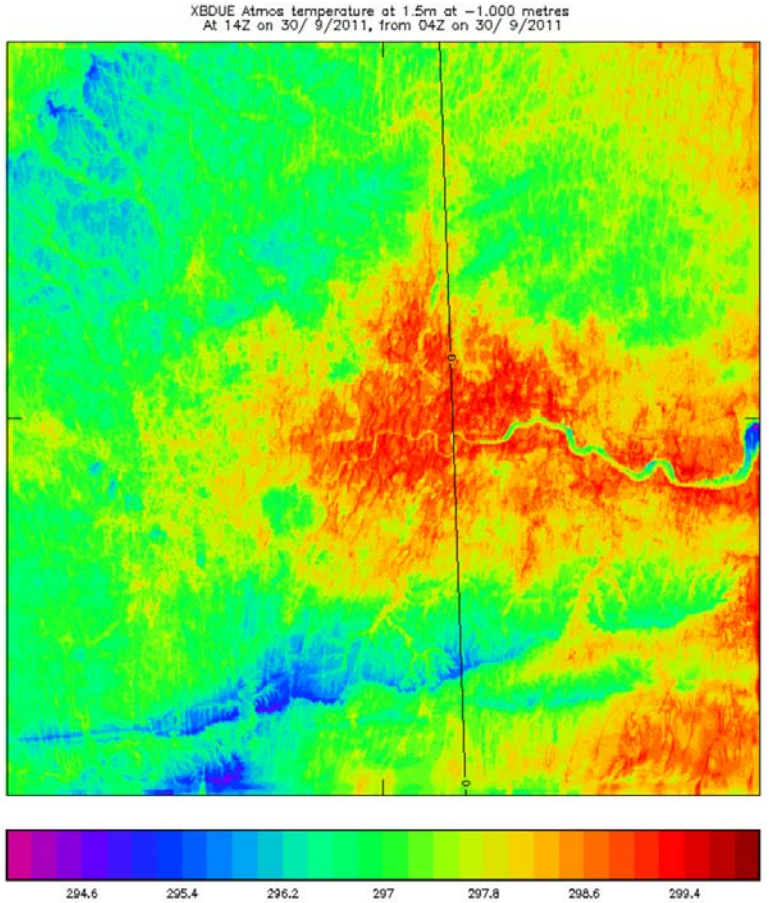
100m Research Model of London.

Met Office

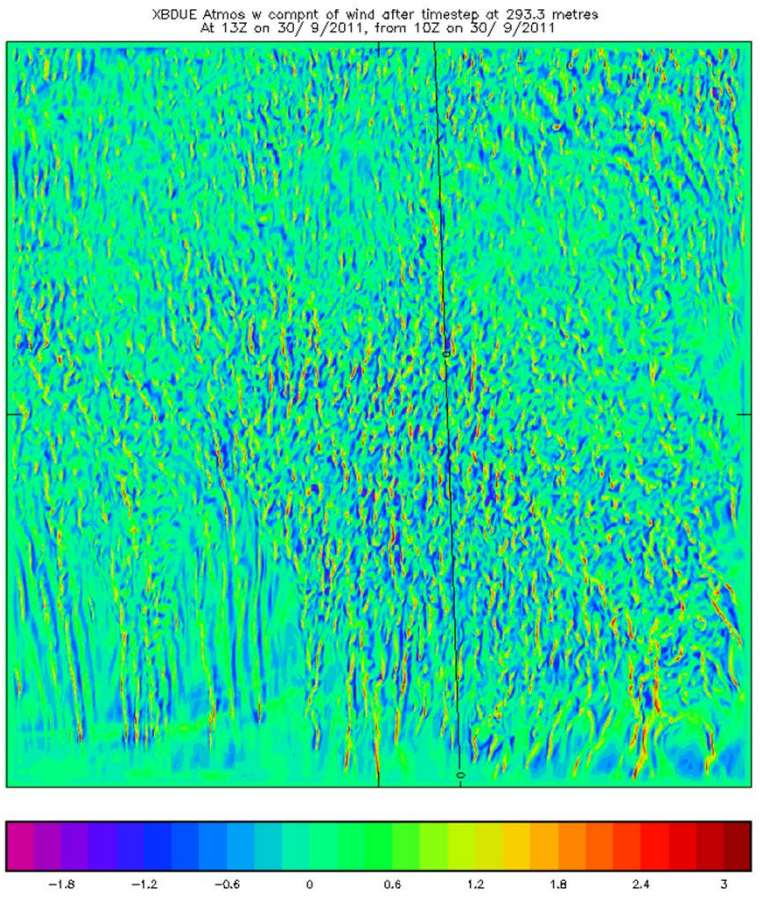
Urban Fraction



1.5m temperature



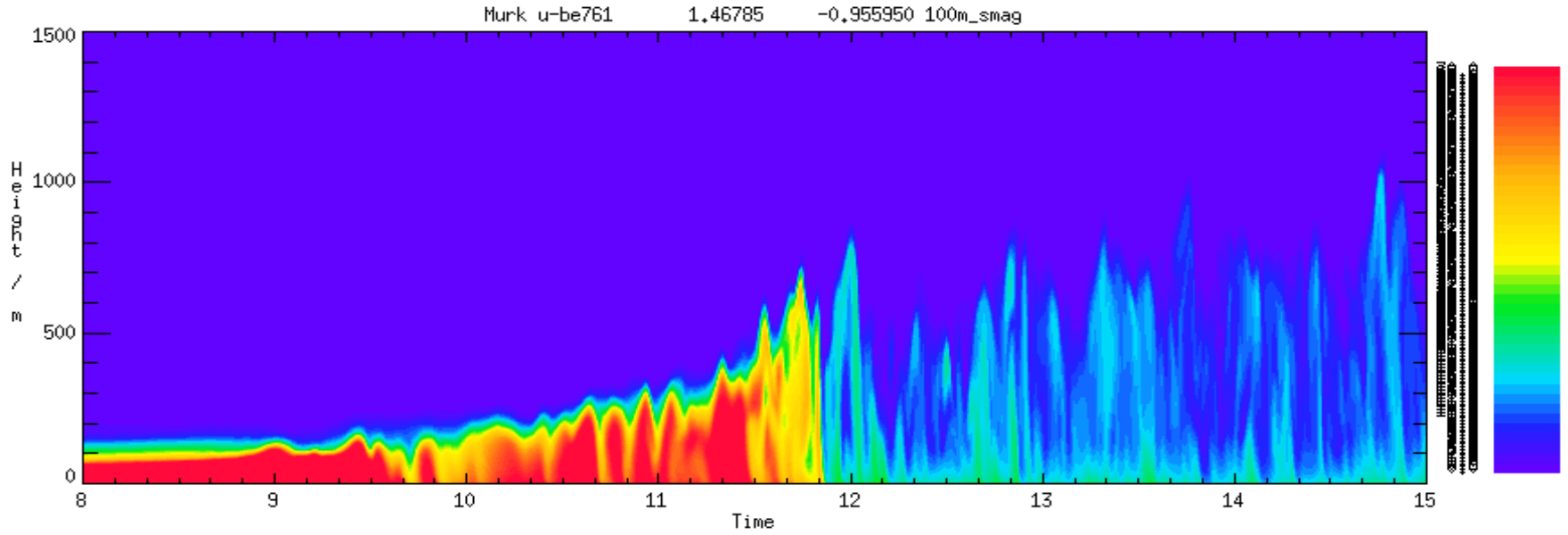
w at 293m



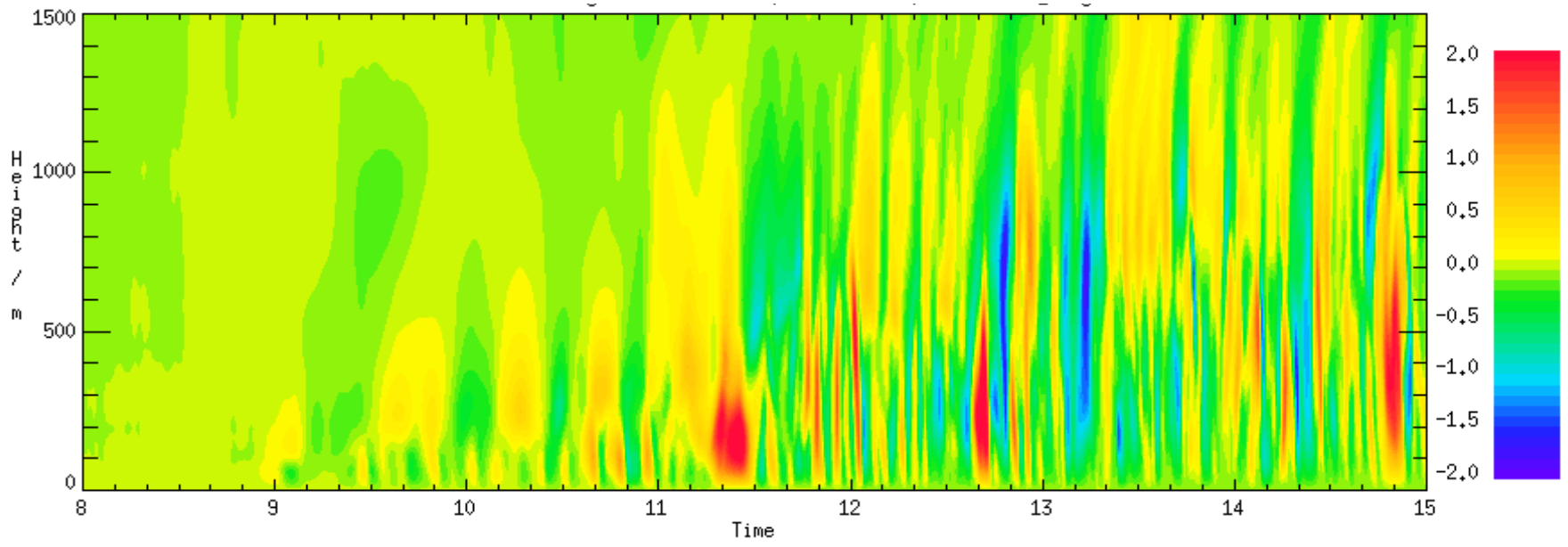
- Clear convective boundary layer case with southerly breeze.
- 1.5m Temperature follows surface characteristics.
- Model captures convective overturning (more pronounced over city).

Growth of mixed layer in morning.

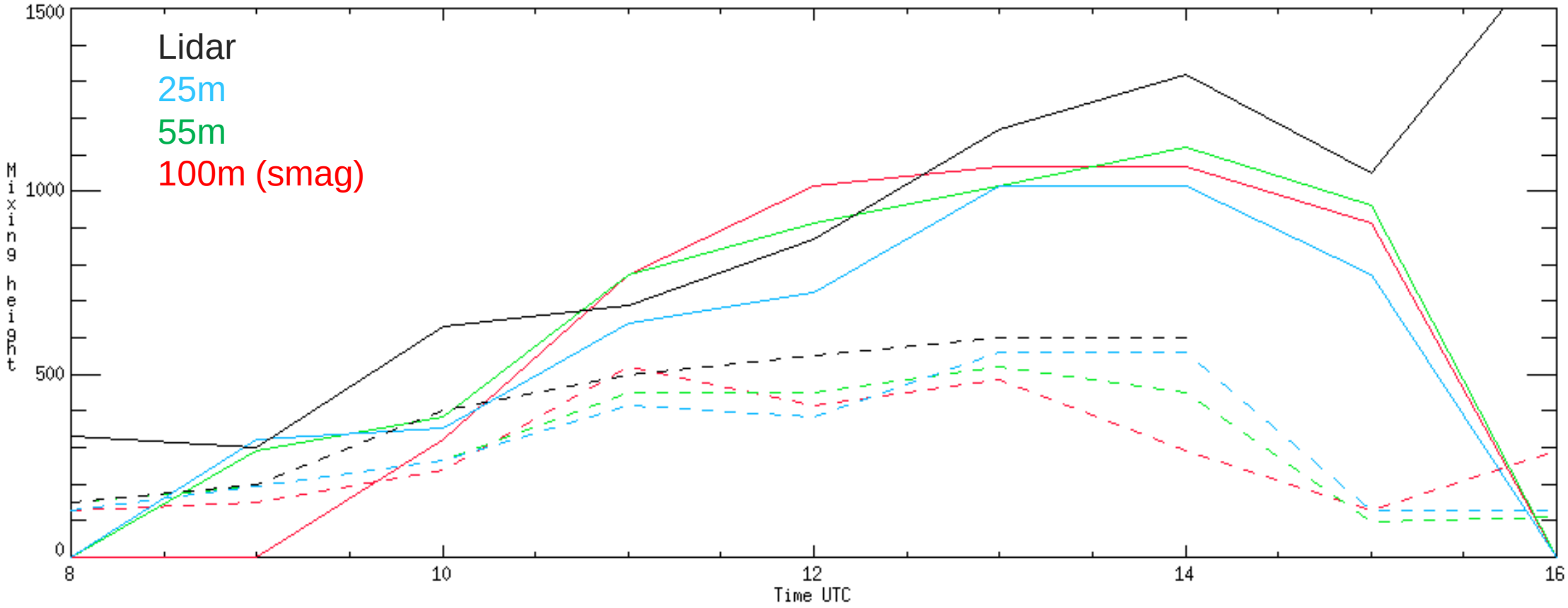
Murk aerosol



Vertical velocity



Growth of mixed layer in morning.



Solid lines – mixed layer height from 0.1m^2s^{-2}variance threshold
Dashed – height murk aerosol gets to.

100m model slow to start overturning. Important to correctly handle grey zone – see effect of 3d tke scheme

Poster also presents:

- New subgrid turbulence scheme for O(100m) models and how it copes with grey zone.
- Configuration improvements to routinely running 300m London Model.
- First look at 1km model including UKCA.
- Transport of tracers in 100m model.

Met Office

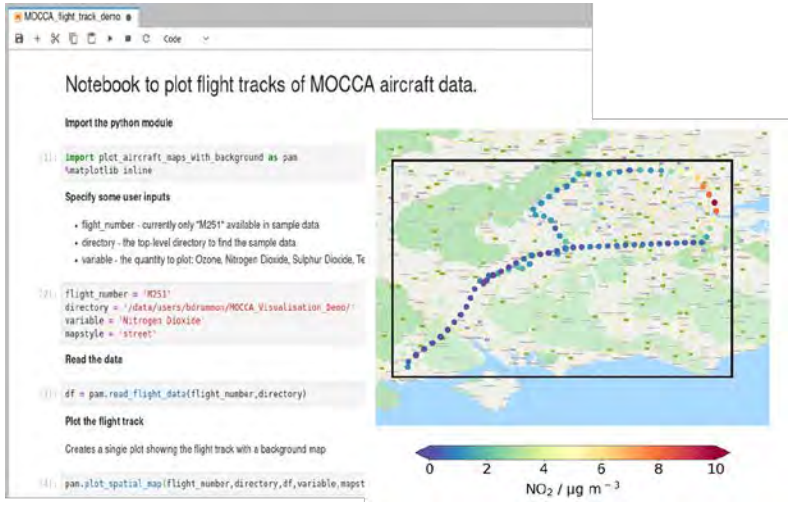
Dr Niall Robinson
Dr Rachel McInnes

Met Office NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

A Flexible Framework for Clean Air Analyses

Rachel N. McInnes et al.



- Ambition to support and stimulate communities centred around this planned Clean Air 'Framework'.
- Aim to work with and connect to exciting and established activities in this arena.
- Driven by user-requirements.
- Used by diverse members of the Air Quality community.

Goals:

- Leverage and pull through science more effectively.
- Provide summary information products for a range of users.
- Enable discovery of, access to, and analysis across multiple datasets.
- Provide interactive capability to analyse and model aspects of Air Quality e.g. for health.

Met Office
rachel.mcinnes@metoffice.gov.uk

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Met Office

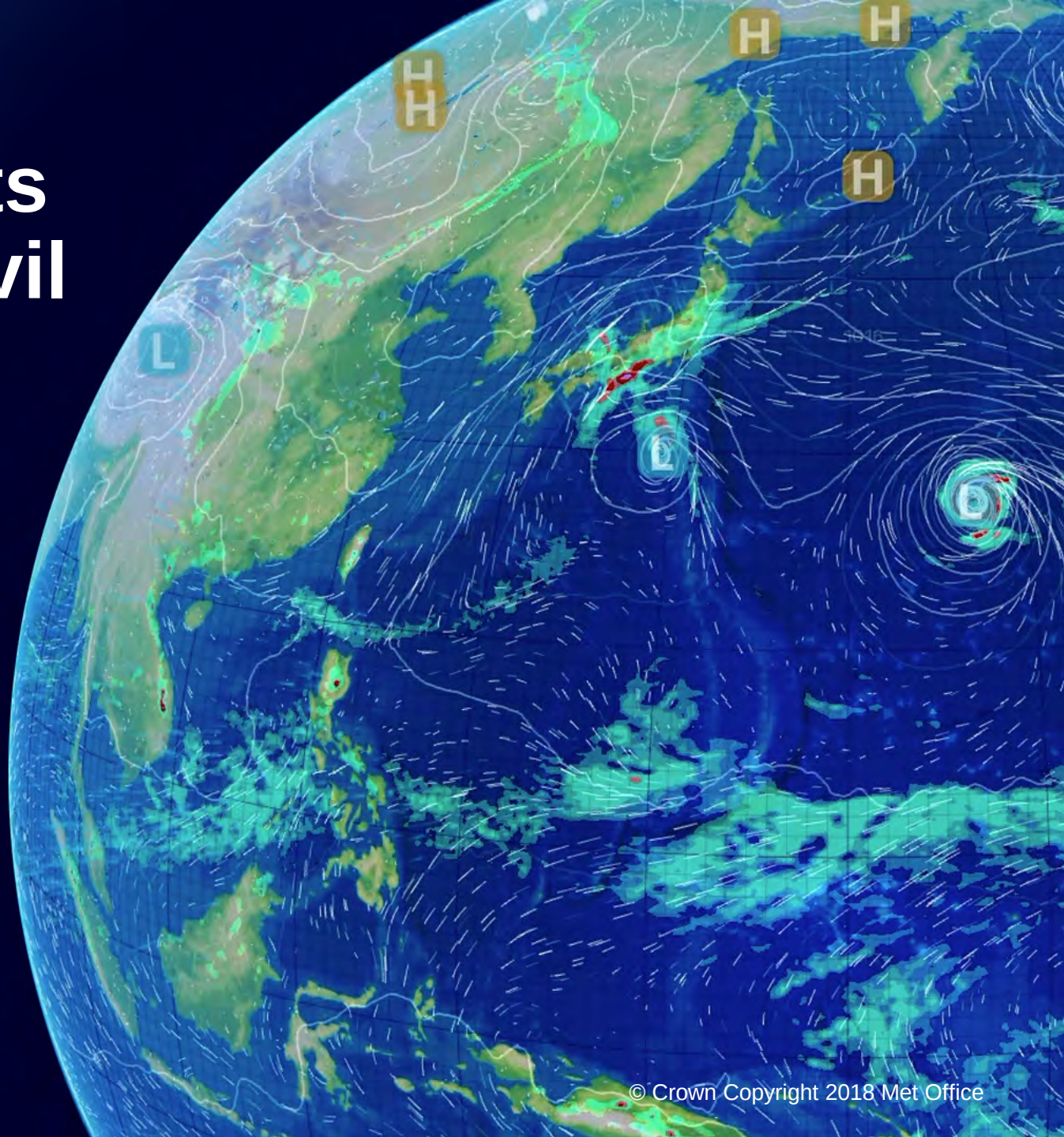
Mrs Angela Maynard

Met Office NPL National Physical Laboratory

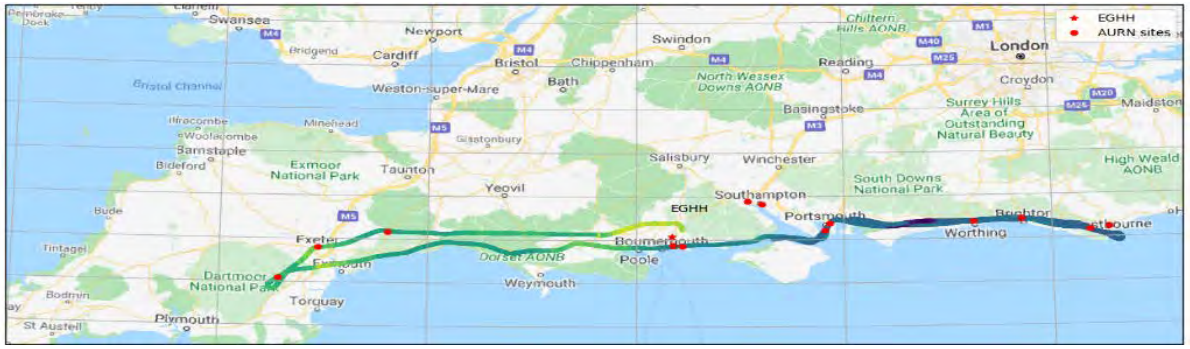
Department for Environment Food & Rural Affairs

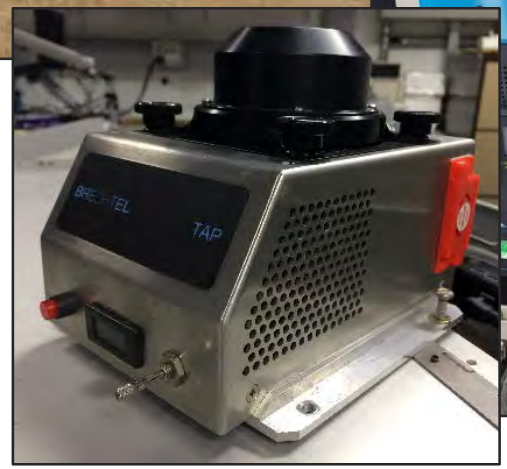
Clean Air measurements using the Met Office Civil Contingency Aircraft

Angela Mynard



Met Office





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Met Office

Dr Eleanor Smith

Met Office NPL National Physical Laboratory

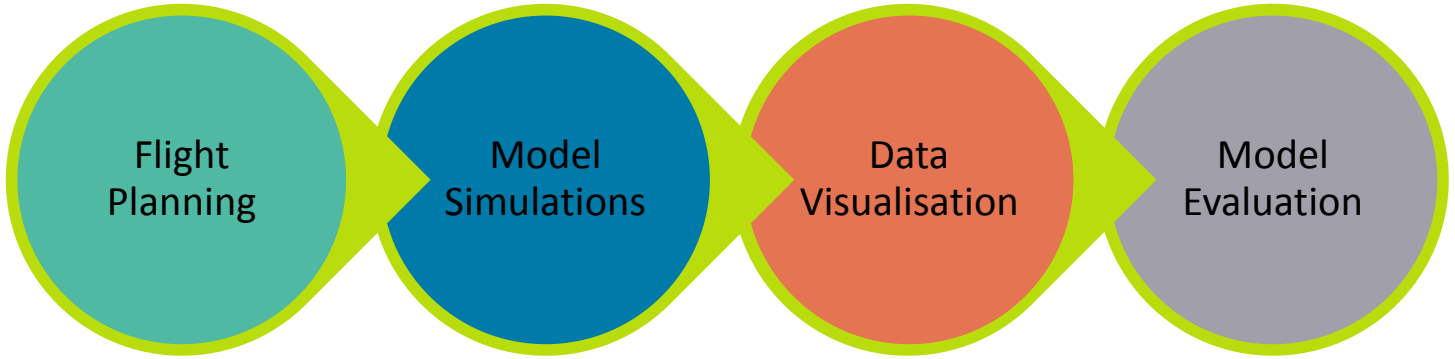
Department for Environment Food & Rural Affairs

Evaluating air quality forecasts using airborne observations

Eleanor Smith et al.

Airborne observations from the Met Office Civil Contingencies Aircraft (MOCCA) will be used alongside the existing network of ground based observations to evaluate the national air quality forecasts produced by the Met Office and investigate model performance throughout the boundary layer.

Data and analysis code will be openly available.



Met Office

eleanor.smith@metoffice.gov.uk

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Met Office

Dr Benjamin Drummond

(presented by Dr Eleanor Smith)

Met Office NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

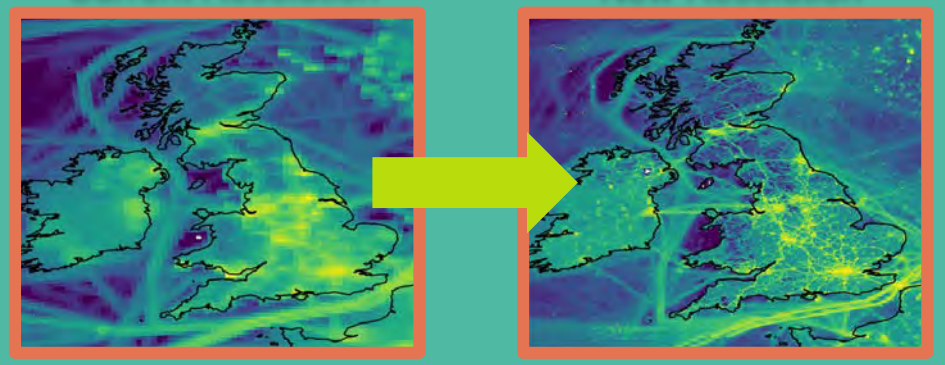
Future air quality services: High resolution forecasts and reanalysis

Benjamin Drummond, Eleanor Smith et al.

High resolution air quality forecasting

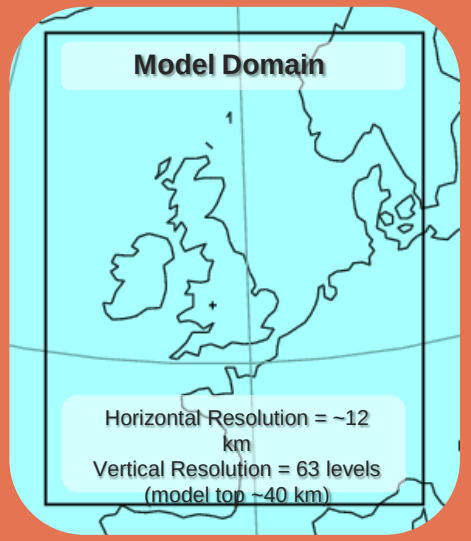
Current Resolution

New Resolution



A kilometre-scale UK operational air quality forecast model to bridge the gap between the regional and urban scales

Reanalysis of UK atmospheric composition



A 15 year, 3-dimensional, hourly data set of atmospheric composition over the UK

Met Office

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eleanor.smith@metoffice.gov.uk

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Met Office

Dr David Carruthers

Met Office NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

Coupled national and local scale air quality modelling

University of Hertfordshire UH | The University of Edinburgh | CERC | Lancaster University | University of Birmingham

Requirement

- "High resolution prediction capability to support personal exposure for health impacts, through national and local model developments" (objective of Work Package 2B within the SPF Clean Air Programme)

Science

- Development & evaluation of a coupled air quality modelling system spanning national to urban street scales
- Flexible modular system linking advanced widely used regional chemical transport & local models
- Accounts for physical & chemical processes occurring at all relevant spatial and temporal scales
- Includes a verification system for validation of model predictions

Community

- An open structure free at the point of use facilitating system development and modification by stakeholders
- Available to the UK research community via the SPF Clean Air Framework platform
- Compatibility with associated SPF projects "UK Emissions Modelling System" and "Air Quality Exposure Modelling"

UKRI | Met Office | NPL National Physical Laboratory | Department for Environment Food & Rural Affairs

The Clean Air (W1) programme is led by NERC and the Met Office, with Innovate UK, EPSRC, ESRC, MRC, NPL & Defra as delivery partners.

Coupled national and local scale air quality modelling

LOCAL MODEL COMPONENT

- Pollutant concentration estimates are needed at resolutions of a few metres at roadside locations in urban areas to assess population exposure accurately
- At short times, local-scale models capture fine details of dispersion and fast chemistry
- Open access road source tool: **ADMS-Local** (based on ADMS-Urban)

REGION MODEL COMPONENT

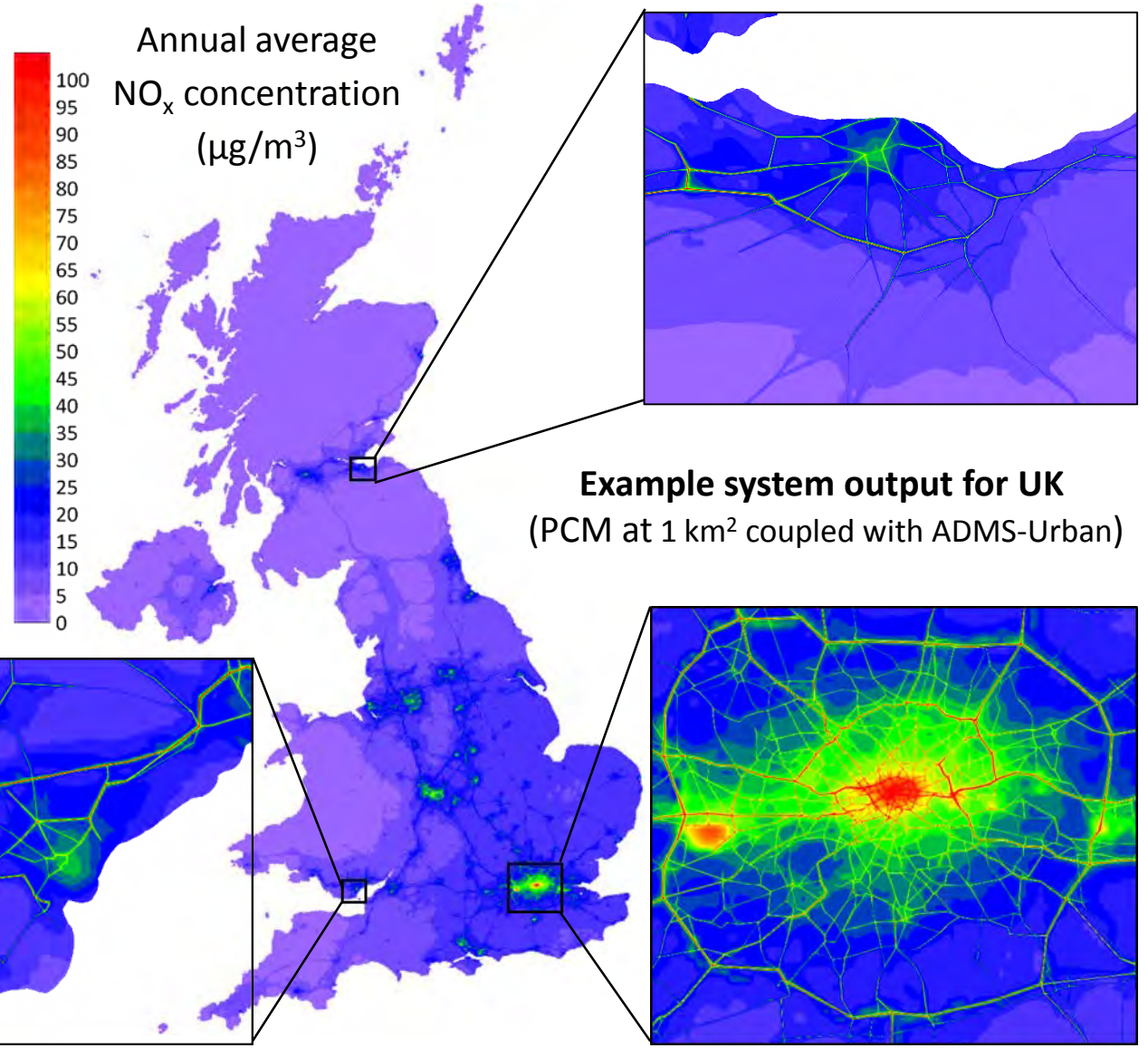
- Regional pollution levels contribute significantly to pollution levels in urban areas
- Eulerian chemical transport models (CTMs) model regional and global pollutant transport and complex atmospheric chemistry
- Range of RM options to include: **CMAQ, CAMx, EMEP, WRF-Chem & UKCA (tbc)**

COUPLED SYSTEM

- Local-scale and regional models must be coupled within a single system
- Computational linkage complexities include avoidance of double counting emissions + chemistry

VERIFICATION SYSTEM

- Automated comparisons of modelled / measured



Example system output for UK
(PCM at 1 km² coupled with ADMS-Urban)

Coupled national and local scale air quality modelling

PROJECT OVERVIEW

- Close liaison with Met Office
- Stakeholder engagement
- Project team comprises CERC with expertise in software development, support and application of local dispersion models (ADMS), in addition to regional modelling experts from academia

Stakeholder engagement I

- Stakeholder requirements *Workshop 1*
- User requirements summary

System design & development

- Design derived from user requirements
- Local model, coupled system & verification tool

Testing phase

- Project partners test system components
- System modifications

Stakeholder engagement II

- System demonstration *Workshop 2*
- Stakeholders & project partners use model
- Results presented at *Workshop 3*
- System refinements & release
- Publications and reports

CERC · The University of Edinburgh · Lancaster University · University of Hertfordshire UH · University of Birmingham

Met Office

Professor Stefan Reis

Met Office NPL National Physical Laboratory

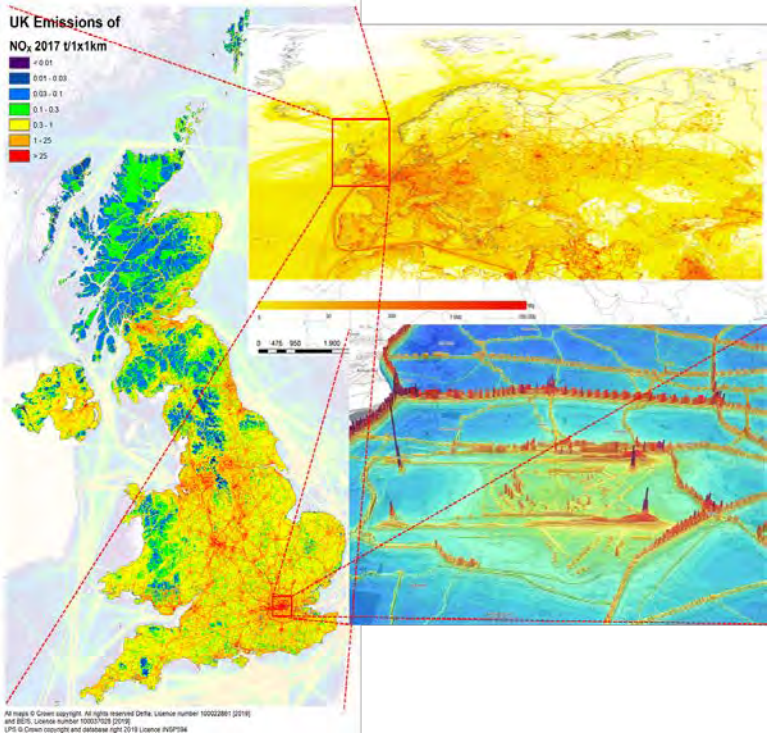
Department for Environment Food & Rural Affairs

Developing a UK Community Emission Modelling System (DUKEMS)

UKRI SPF Wave 1 – UK MetOffice CA19/3:
Clean Air Programme - UK Emissions Modelling System

Key deliverables

- **D1:** An **operational framework** for a flexible, scalable and future-proof community Emission Modelling System (EMS) implemented on JASMIN
- **D2:** A process for a **community-driven**, **co-designed** UK-EMS enabling the atmospheric modelling community to **generate emission input data at the spatial, temporal and substance resolution required** for a wide range of use cases
- **D3:** An open, accessible **system and demonstrators for the integration of novel emission calculation methods**, including approaches for future expansion.
- **D4:** The operational **integration of anthropogenic and biogenic emissions** into consolidated output datasets.
- **D5:** A consistent approach for the provision of **temporally and spatially resolved emission data** across a range of scales.
- **D6:** A demonstrated **output generation process for frequently used data formats**, including meta-data and supporting documentation of the calculations included, and **open for future extension to new formats**.



The core objectives are the delivery of a **framework and tools** designed to be operational long term in supporting the atmospheric modelling community by providing a flexible, user-friendly system to deliver **emission input data** for modelling in **a transparent, traceable and reproducible** manner.

UK Centre for Ecology & Hydrology · Aether · RICARDO · ROTHAMSTED RESEARCH · University of York · University of Birmingham · Manchester 1824 The University of Manchester · King's College London · Imperial College London

UKRI · Met Office · NPL National Physical Laboratory · Department for Environment Food & Rural Affairs

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Met Office

Professor Gavin Shaddick

Met Office NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

PROF GAVIN SHADDICK, PROF KARYN MORRISSEY (EXETER)

DR DAVID TOPPING, PROF HUGH COE, PROF JAMES EVANS (MANCHESTER)

DATA INTEGRATION MODEL FOR EXPOSURE MODELLING (DIMEX-UK)

The Clean Air (W1) programme is led by NERC and the Met Office, with Innovate UK, EPSRC, ESRC, MRC, NPL & Defra as delivery partners.

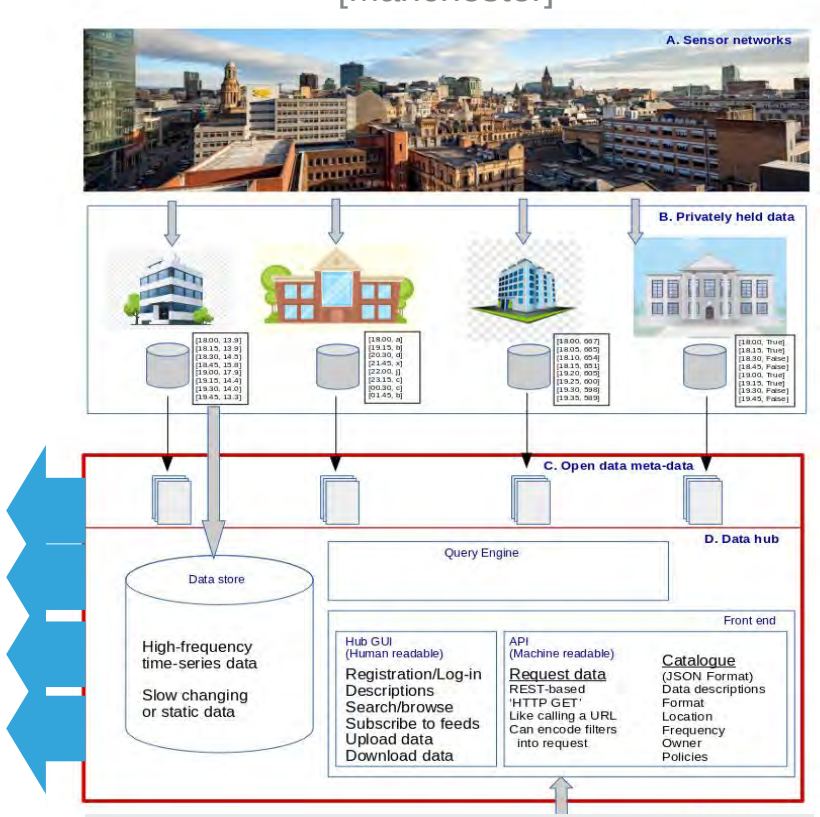
DATA INTEGRATION MODEL FOR EXPOSURE MODELLING

- **Aim: Estimate personal exposures to air pollution**
- Combine activity data with spatio-temporal estimates of air pollution
  - Agent based modelling
  - Simulate the daily exposure of different population groups
- Framework for integrating data from different sources
  - Bayesian hierarchical model
  - Measures of uncertainty
- Evaluation

VALIDATION

- Validate the results using personal exposure measurements
  - City of Manchester
  - Replicate commuter routes using a combination of mobile and static measurements
- Use the results to refine the model
- Two additional UKRIC network cities

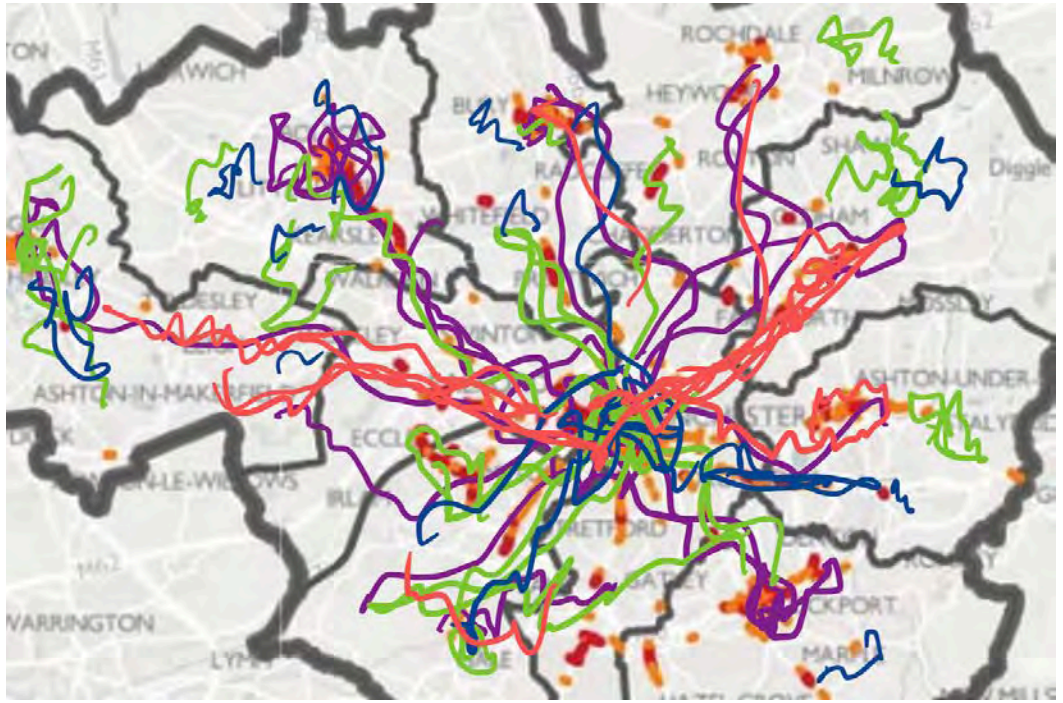
UKCRIC Urban Observatory Data Hub [Manchester]



NERC Air Quality Supersite
Community projects [inc Bee Network / Looper]
AQ simulations
DIMEX measurements

OUTPUTS

- Estimates of concentrations at any user defined level (variable resolution output)
  - Measures of uncertainty
  - Individual's personal trajectory maps
  - Map differences between personal exposures and concentrations
- Tools to allow users to incorporate the outputs from the personal exposure model into health impact analyses and epidemiological risk models.
- Allow the effects of interventions, both real and hypothetical, on personal exposures to be assessed



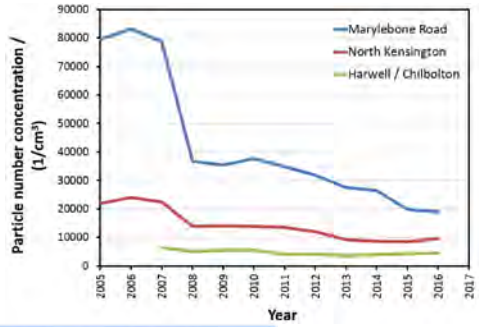
Met Office

Mr Tom Gardiner

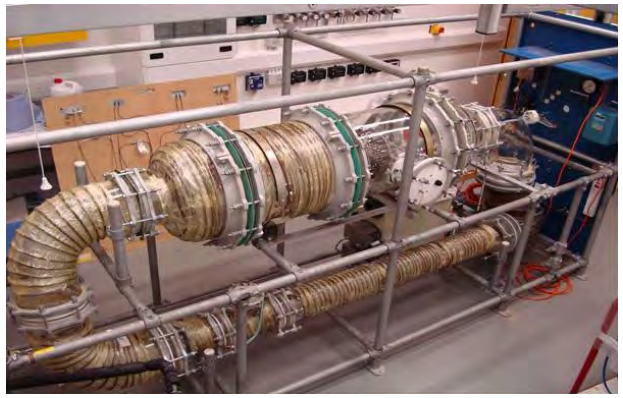
Met Office NPL National Physical Laboratory

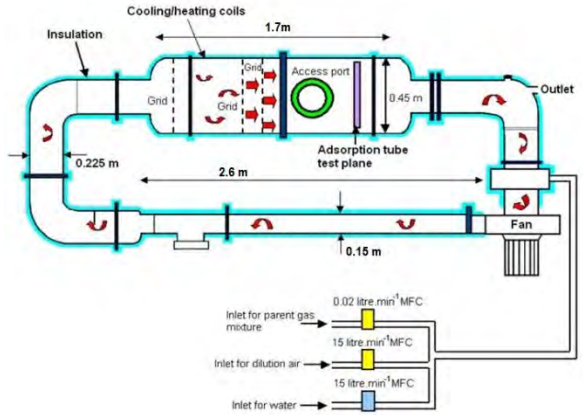
Department for Environment Food & Rural Affairs

NPL involvement in SPF Clean Air Programme



- The National Physical Laboratory (NPL) is one of the PSRE partners in the Clean Air Programme.
- NPL is providing metrology support across both the UKRI and Met Office research activities through collaboration with project partners.
- Metrology provides a measurement infrastructure which is **stable** over time, **comparable** between locations, and **coherent**, allowing measurements of different properties using different methods to be combined.
- Particular areas of collaboration within Clean Air include:
  - Performance assessment of key sensor technologies using NPL laboratory and field test facilities;
  - Development of (sensor and network) calibration methodologies;
  - Evaluation of (sensor and network) uncertainties.
- Providing linkage to other activities (e.g. Breath London; DEFRA Black Carbon, Heavy Metals and new UK Urban NO_2 networks)
- NPL will also help feed key project outputs into European standardisation activities through CEN TC264 (Air Quality) WG42 on Air Quality Sensors.





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Innovate UK

Mr Paul Andrews

Met Office

NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

C.A.G.E.
CLEAN AIR GAS ENGINE

Project summary
Feb 2020

Met Office NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

OakTec efficient power

The Clean Air (W1) programme is led by NERC and the Met Office, with Innovate UK, EPSRC, ESRC, MRC, NPL & Defra as delivery partners.

OAKTEC….WHO ARE WE?

Specialist in design and development of efficient, low emission gas engines. 7 years concentrated R&D into dedicated gas engine development.

Inventors of the Pulse-R engine technology …now at late stage prototype

Focus on displacing diesel with equivalent small and medium ultra-clean gas engines

Currently developments;

- Bio-gas Pulse-R engines for sub Saharan Africa and Asia to power off grid communities
- Small gas generators for domestic construction sector to improve air quality
- Developing world class engines for LPG, CNG, biogas and hydrogen

OakTec efficient power

CAGE BROAD OBJECTIVES

To displace diesel engines with ultra low emission gas engines to power equipment in the construction and other sectors. Engines will target elimination of NOx emissions by using clever combustion strategies.

No customer penalty! To develop gas powered solutions that match the performance of incumbent technologies with lower or equivalent ownership costs and equivalent ease of use.

Focus on the range between 2kW and 56kW where there is a high demand and lack of competitive product. First CAGE engine will be a 25kW unit in a Sutton generator

To build a powerful consortium of stake holders to create a clear commercial path for our new gas engine technologies

Create world leading products that benefit customers, the environment and the UK businesses that produce and adopt the technologies.

OakTec efficient power

THE CAGE PROJECT

- Follows an invitation from Autocraft to develop the engine from one of their vehicle OEM customers engine range for non-automotive applications using gas fuels. The OEM was keen to support with free supply of engines

- The CAGE engine platform has state of the art automotive efficiency and emission reduction technologies.

- The project will focus on development of Stage V emission certified bio-LPG generators with class leading performance and air quality emission benefits

- Calor will support the project by deploying their latest fuel supply innovations to suit customer needs and supply bioLPG for demonstration in the project.

- Prototype systems will be trialled on HS2 rail construction sites managed by their Clean Air team.

- CAGE emission performance will be monitored in real time by Kings College London and compared to existing data for equivalent diesel engines. Predictions on air quality benefits will then be made assuming wide scale adoption.

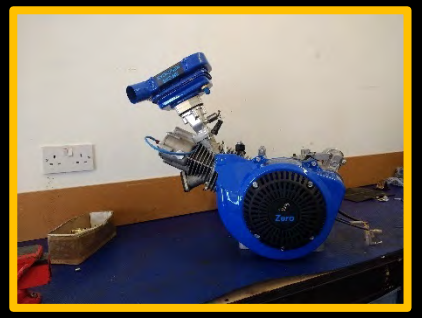
SUSTAINABILITY

- LPG and CNG the current solution. Equivalent performance to diesel and petrol but greatly reduced emissions from dedicated gas engine technology.
- Bio methane/BioLPG. Vast opportunities for growth from genuinely sustainable fuels
- Hydrogen. The zero carbon fuel for the long term future of the combustion engine.

All engines being developed by OakTec and partners can use any of the above fuels with high efficiency and ultra low emissions without modification to engine hardware.

LPG

Biogas



OakTec hydrogen engine

Pulse-R

Multi-Gas Engine

Paul.andrews@oaktec.net

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+44 7711 631984

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Innovate UK

Mr Mark Longden

Met Office

NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

Optimising wheel alignment

to Reduce Vehicle Particulate Emissions

Mark Longden

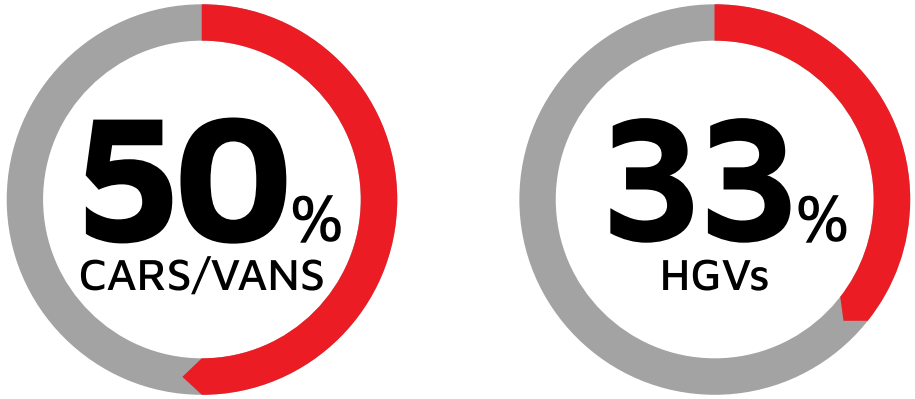
Project Lead and Technical Director

AutoAlign

Reducing Vehicle Particulate Emissions
by Continuously Monitoring Wheel Alignment

The Challenge

On the UK roads today



are operating with incorrect wheel alignment, according to Tyre Industry Research

That's

16.3 million cars

2.1 million vans

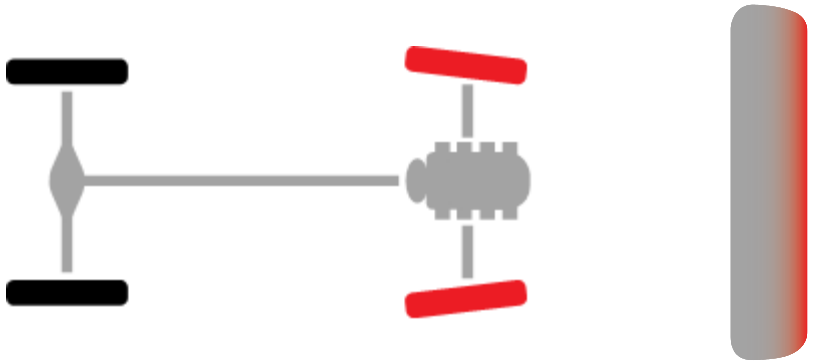
262,000 HGVs

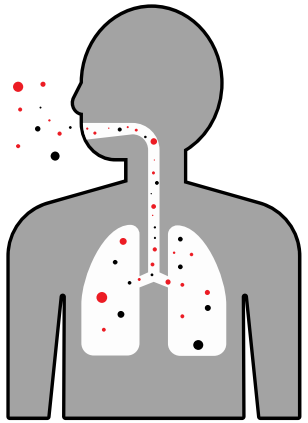
Vehicle Licensing Statistics 31/03/2019

Wheel Misalignment

Causes 20% excessive and premature tyre tread wear

Tyre tread abrasion is the major contributor to vehicle particulate emissions PM2.5 & PM10





- Wheels become out of alignment during routine day to day use
- Today, alignment is corrected not very often
- Our project will create a system to continuously monitor for misalignment - on board the vehicle
- As soon as misalignment occurs the driver and fleet operator are notified, together with the ongoing environmental impact without correction

UKRI Engineering and Physical Sciences Research Council · Economic and Social Research Council · Natural Environment Research Council · Innovate UK · Medical Research Council

Met Office

NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

Our Technology Partners

RL VMS www.rlvms.com

SOLUTION DESIGN, CONNECTIVITY
MATHEMATICAL MODELLING

Aston University BIRMINGHAM UK

WHEEL SENSOR DESIGN
AND SIGNAL PROCESSING

University of Chester

COMPUTATIONAL AND
FE MODELLING

McLaren APPLIED TECHNOLOGIES

ARTIFICAL INTELLIGENCE

DYNAMON

BIG DATA ANALYTICS
STANDARDISED TEST PROTOCOL

Our Industry Partners

webfleet solutions

SCANIA

DAY GROUP LTD

TESCO

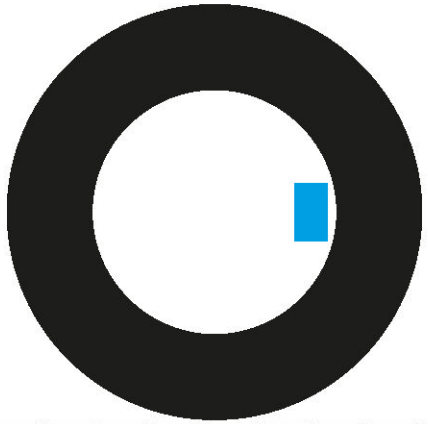
Wincanton

AutoAlign

Reducing Vehicle Particulate Emissions
by Continuously Monitoring Wheel Alignment

Our project will design and build wheel sensors to detect and map orientation

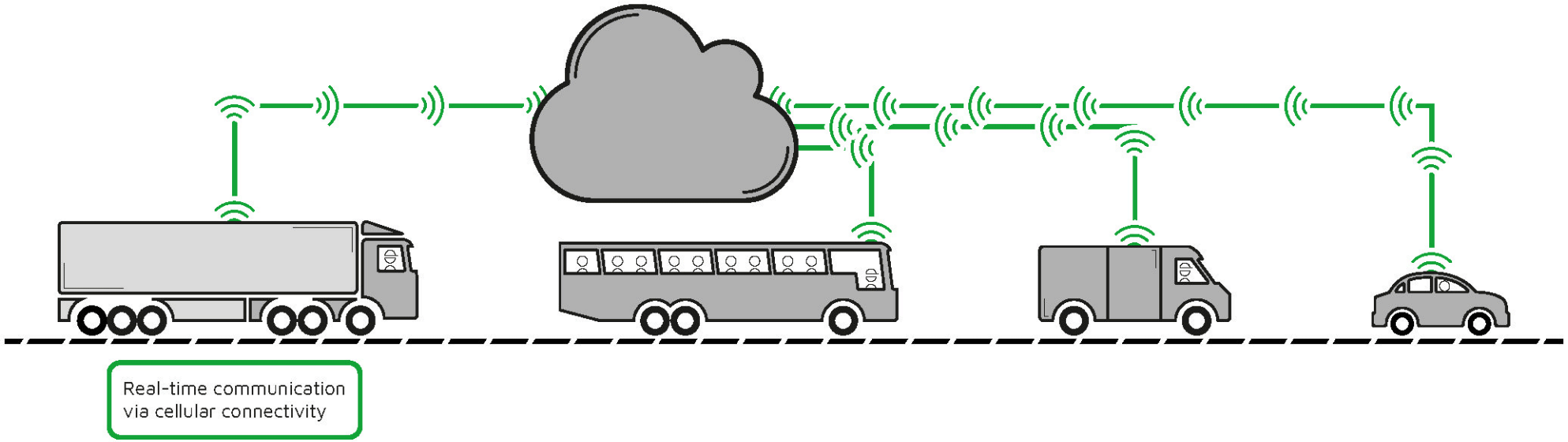
- Quick and easy to fit
- Self-calibrating
- Durable and waterproof
- Retrofit and OE
- Low cost



AutoAlign uses bespoke retro-fit wheel sensors

...and connect the data to mobile apps and the cloud for alignment analysis, fleet reporting

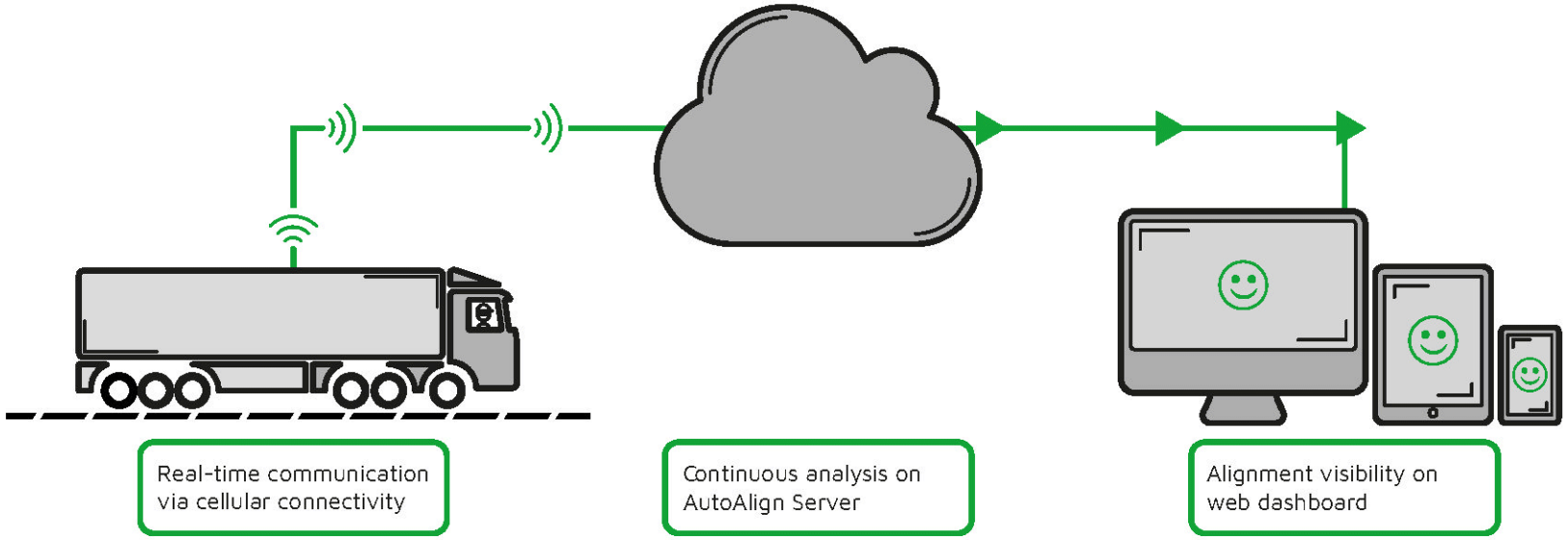
Real Time Connectivity



...building on a platform already created through CAV1 development of

remote tyre pressure monitoring

Detecting misalignment from the off



Project Deliverables

- A misalignment alerting system that suits all types of vehicle, new, used, electric, combustion engine

- A standardised, live test protocol for tyre wear measurement to establish real world wear rates & particulate emissions from different makes of tyre – for both aligned and misaligned wheels

- At project completion; a low cost quick ROI commercial solution for truck fleets, scalable for swift deployment, designed to extend to other vehicle categories.

Project Benefits

- Cleaner Air
- Reduction in microplastics in fresh water and the oceans
- Reduction in tailpipe emissions, tyre costs and tyre manufacturing
- Test data and protocols available for other projects
- Improved UK skillset in data analytics for dynamic repair & maintenance
- Significant economic return on UK taxpayers' money

... working towards alignment being part of MOT checks and access to Low Emission Zones

Every year, vehicle wheel misalignment causes

- 25,000 extra tons of microplastic emissions in Europe
- Worldwide manufacture of an extra 50m car tyres and 5m truck tyres
- In the UK alone - 2bn extra tons of CO2 tailpipe emissions

UKRI Engineering and Physical Sciences Research Council | Economic and Social Research Council | Natural Environment Research Council | Innovate UK | Medical Research Council

Met Office

NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

An immediate impact solution that reduces pollution & saves costs

Innovate UK

Mr Hugh Frost
Mr Graham Allen

Met Office NPL National Physical Laboratory Department for Environment Food & Rural Affairs

hubl cool run.

Delivering Clean Air Solutions

The Clean Air (W1) programme is led by NERC and the Met Office, with Innovate UK, EPSRC, ESRC, MRC, NPL & Defra as delivery partners.

BIG issue

We all have this problem

Transport industry is searching for a solution

CO^2 NOX EMISSIONS

INEFFICIENCY

CONGESTION

The Clean Air (W1) programme is led by NERC and the Met Office, with Innovate UK, EPSRC, ESRC, MRC, NPL & Defra as delivery partners.

On our streets

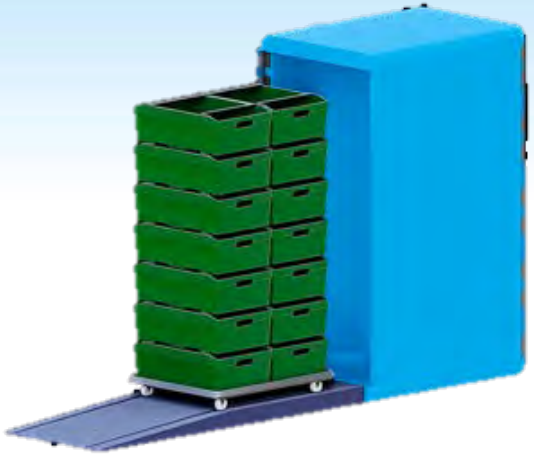
Annual UK emissions of

120 Million Kg of CO2 and associated Nox from Van and Truck refrigeration systems.

The Clean Air (W1) programme is led by NERC and the Met Office, with Innovate UK, EPSRC, ESRC, MRC, NPL & Defra as delivery partners.

The energy for chilling is on board the pod and not on board the vehicle

This is achieved by using Phase Change Material (PCM).



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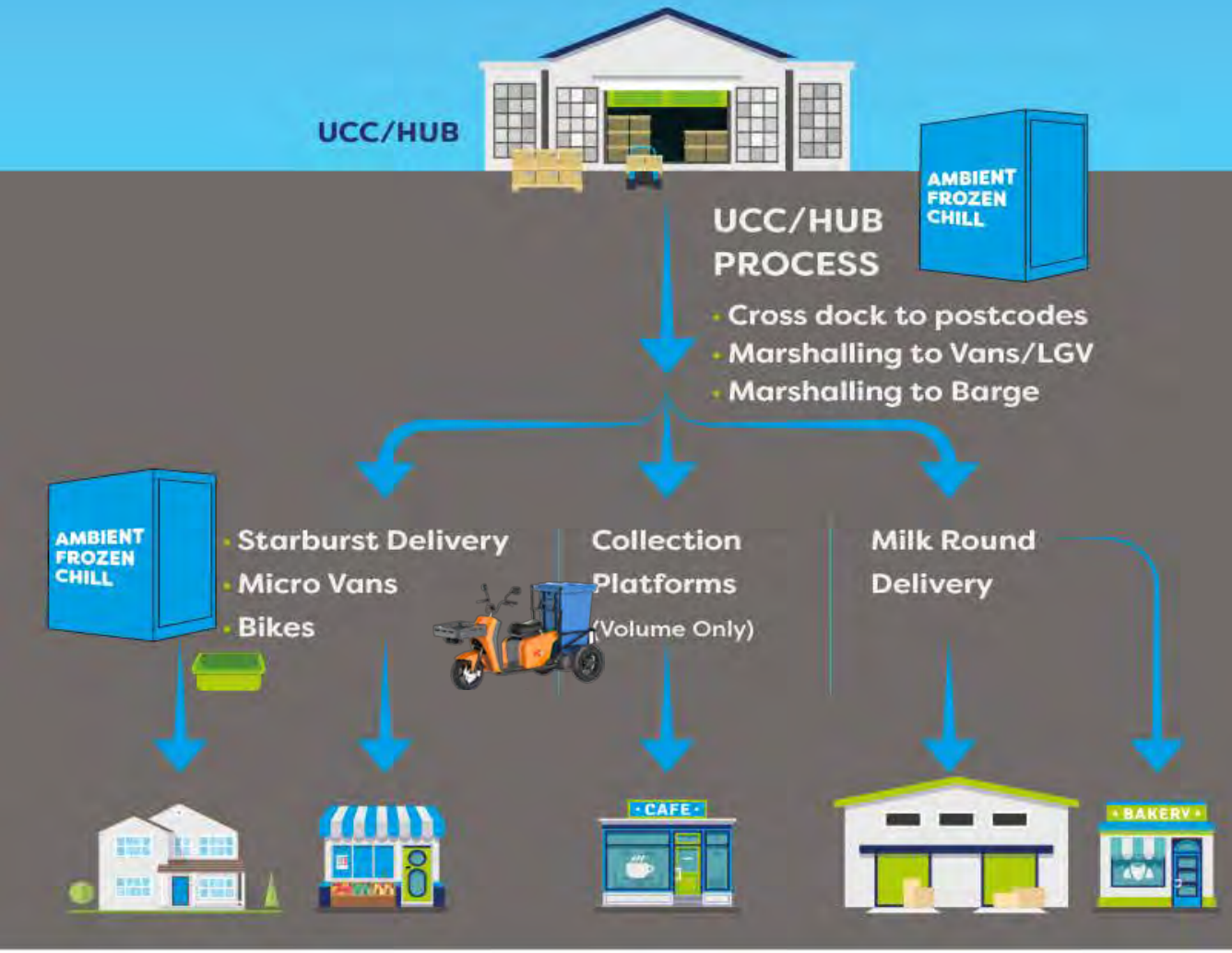
The Cool Run Multi-Temperature Pod Journey Cycle



Urban Delivery Semi-trailer:

Capacity 48 pods

7.5 tonne urban delivery E-vehicle:

Capacity 10 pods

Final mile urban delivery E-scooter:

Capacity 1 pod

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Talk to us

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07913 852 041

Graham Allen

Commercial Director, Hubl

Graham@hubl.co.uk

07738 462 121

www.hubl.co.uk

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Lunch

Met Office

NPL National Physical Laboratory

Department for Environment Food & Rural Affairs

Champions Role

Professor Stephen Holgate

Dr Jenny Baverstock

UKRI Clean Air Champion Team

Clean Air Programme

UNIVERSITY OF Southampton
UK Research and Innovation

KING'S College LONDON

Prof Stephen T Holgate, MRC Clinical Professor,
Clinical and Experimental Sciences, Faculty of Medicine University of Southampton.

- Respiratory medicine, clinical science and environmental health

Dr. Jenny Baverstock, Senior Collaboration Fellow,
Faculty of Environmental and Life Sciences, University of Southampton.

- Interdisciplinary research, research networks facilitator and delivery manager.

Prof Martin Williams, Head, Science Policy Unit,
Environmental Research Group, King's College, London

- Application of atmospheric science to policy on air quality, the relationship between air quality and health, and on the linkages between air quality and climate change.

Air quality dependencies and basis for Clean Air systems analysis framework

Failure of engagement and ownership of the health problems by medical community

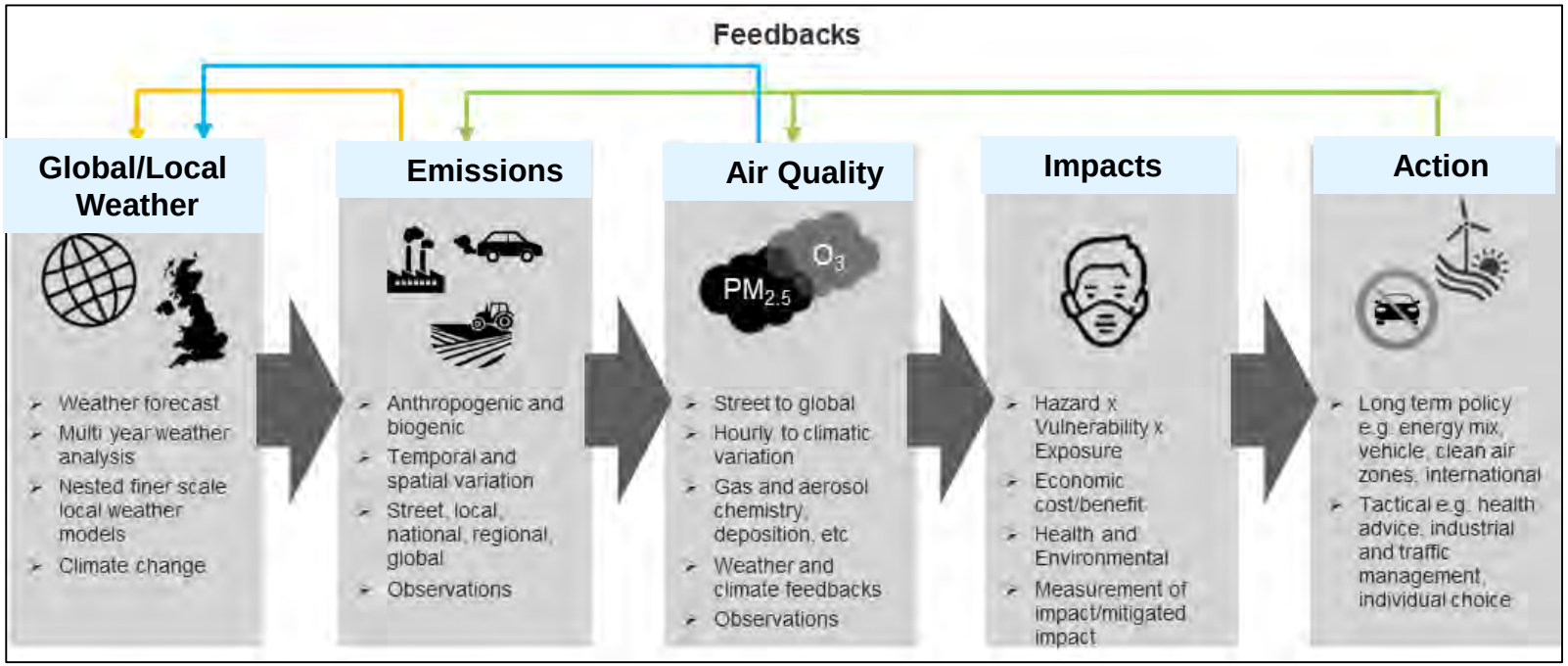
CleanAir — CHAMPIONS —

Communication barriers between physical and biological/health scientists

Lack of public understanding

Little motivation for behaviour change

X X X X



X

Lack of interfaces to promote innovations

X

Industry/economic pushback

Capability/Linkages limited, fragmented and not aligned: Street ⟺ Global a particular challenge

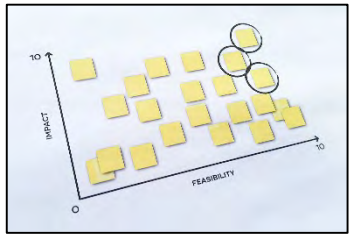
Objectives of the UKRI SPF Clean Air Programme

UK Research and Innovation

CleanAir CHAMPIONS

1. **Drive forward new interdisciplinary research and innovation.**
2. **Leverage existing UK investments and enable a challenge-focussed interdisciplinary community to work together.**
3. **Inform implementation of the UK Government's Clean Air Strategy.**
4. **Develop new solutions to reduce emissions and exposures of atmospheric pollution and protect public health, whilst avoiding perverse consequences.**
5. **Present information to stakeholders and public in an accessible way.**

Clean Air Champions provide a solution-focused approach to air pollution research and its uptake



Strategy

1) **Map competences** and **dimensions** of currently funded air pollution projects - overlay these to identify effective activities or gaps to target.

2) **Unify key researchers** and **stakeholders** around visionary missions using horizon. scanning, workshops, sandpit sessions to scenario simulations.

3) **Uncover** and **challenge** barriers/obstacles and **produce** interdisciplinary solutions.

4) **Create** an "opportunities **ideas portfolio**" leading to innovations to test.

5) **Translate** ideas into **practical interventions** targeted at the right people.

6) **Develop** a **professional** and **public communications** strategy using the best available evidence and exemplars.

People will change their behaviour only if they see the new behaviour as easy, rewarding, empowering and normal

Poster session

Met Office

NPL
National Physical Laboratory

Department
for Environment
Food & Rural Affairs

Closing statements

Professor Frank Kelly

Chair in Environmental Health, Kings College London

Air Quality & Health
Challenges & Opportunities for Multi-Disciplinary Research

Professor Frank Kelly
King's College London

2012 Annual UK Review Meeting on Outdoor and Indoor Air Pollution Research
Cranfield University, 3-4thth May 2012

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The problem is still with us

Smog in London, seen from the edge of Hampstead Heath on Easter weekend 2012. Photograph: Matt Dunham/AP

Linkages between poor AQ and health are clearer (and stronger) than ever

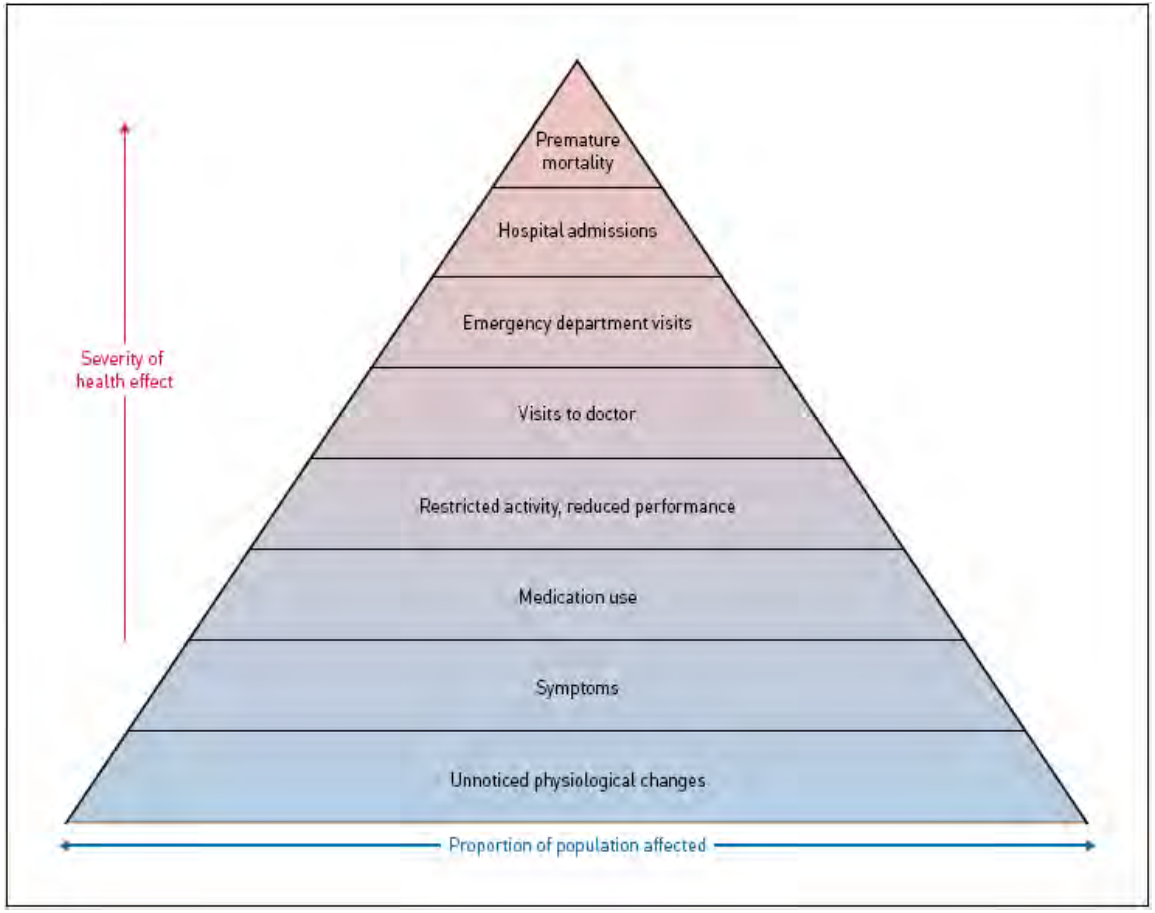
Across the UK poor air quality.....

- equivalent of 29,000 premature deaths due to breathing tiny particles released into the air (2008 data)

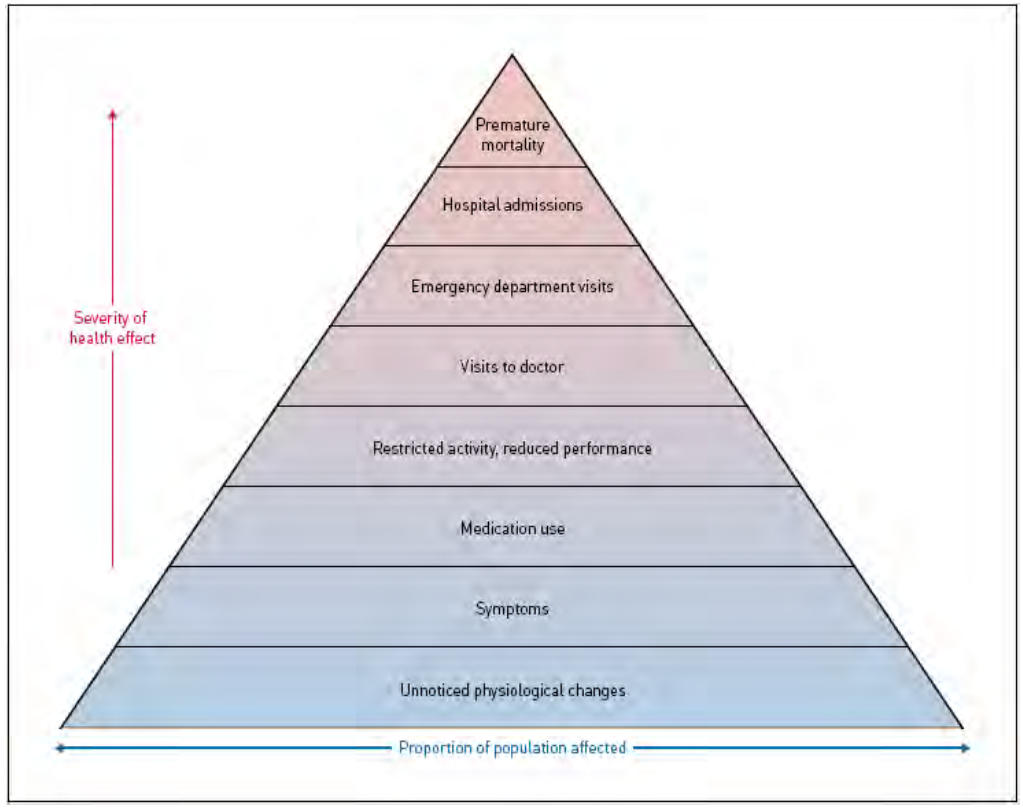
- the average loss of life was 6 months, (although the actual amount varies between individuals, from a few days to many years)

Published December 2010

Early death is only the tip of the health pyramid...



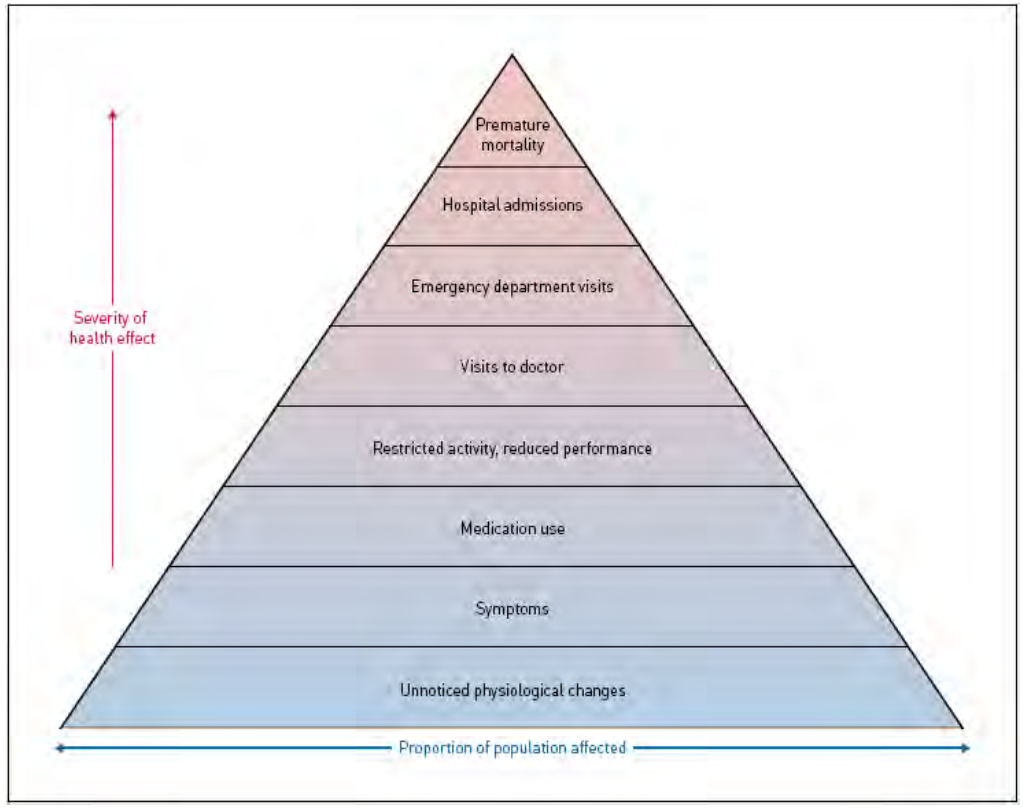
Early death is only the tip of the health pyramid...



In the last 12 months poor AQ has been linked with...

- Compromised fetal growth (Estarlich et al 2011)
- Low birth weight (Wilhelm et al 2012)
- Stroke (Chen et al. 2010)
- Infant cognitive function (Freire et al 2010)
- Hypertension during pregnancy (van den Hooven et al. 2011)
- Childhood leukaemia (Amigou et al. 2011)

Early death is only the tip of the health pyramid...



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"...it seems doubtful that we have yet identified the full scope of outcomes having statistical relationships to measures of air pollution and it is certain that we have not discovered all of the subclinical and physiological responses that might be associated with air pollution." (Mauderly, 2010)

What we have learnt: 1993-2012

1. The epidemiological observed association between premature death & long term residence in areas with high PM concentrations is robust.
2. Deaths are largely due to cardio-pulmonary causes.
3. Similar associations have been observed with asthma exacerbations and aggravation of other respiratory disease and in many locations, the prevalence of asthma and allergy.
4. Proximity to busy roads, with a high density of diesel vehicles increases the risk of negative health effects.

2012: What we still don’t fully understand

1. How does inhaling relatively low concentrations of ambient particles result in the wide range of health effects reported?
2. Are all particles equally active & where does the toxicity reside?
3. To what extent are vehicle-derived particles responsible for the health effects observed?


What’s in this?

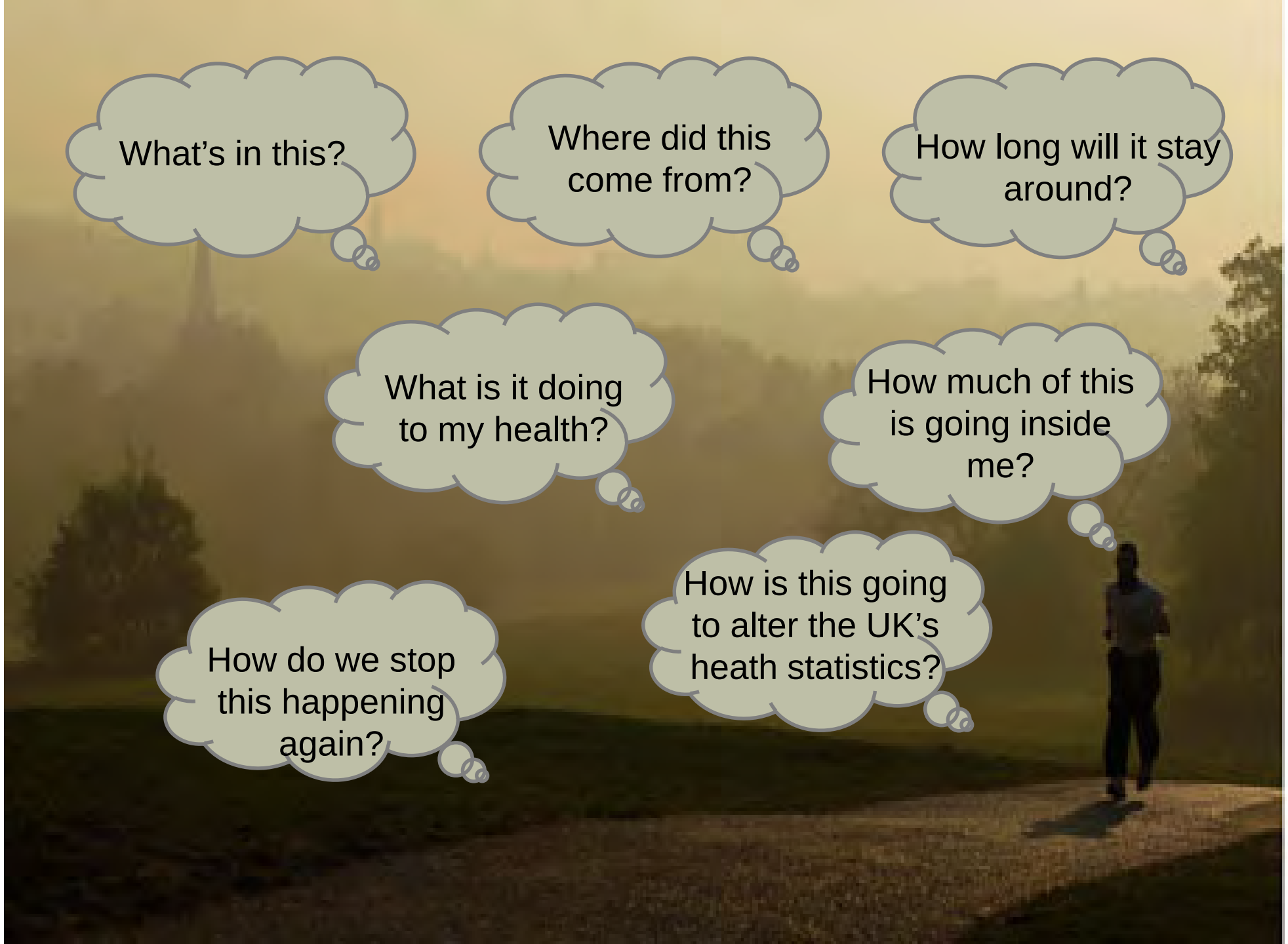

What's in this?
Where did this come from?


What's in this?
Where did this come from?
How long will it stay around?


What's in this?
Where did this come from?
How long will it stay around?
How much of this is going inside me?


What's in this?
Where did this come from?
How long will it stay around?
What is it doing to my health?
How much of this is going inside me?


What's in this?
Where did this come from?
How long will it stay around?
What is it doing to my health?
How much of this is going inside me?
How is this going to alter the UK's heath statistics?


What's in this?
Where did this come from?
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What is it doing to my health?
How much of this is going inside me?
How is this going to alter the UK's heath statistics?
How do we stop this happening again?


Measurement expert
Where did this come from?
How long will it stay around?
What is it doing to my health?
How much of this is going inside me?
How is this going to alter the UK's heath statistics?
How do we stop this happening again?


Measurement expert
Modeller
How long will it stay around?
What is it doing to my health?
How much of this is going inside me?
How do we stop this happening again?
How is this going to alter the UK's heath statistics?


Measurement expert
Modeller
Meteorologist
What is it doing to my health?
How much of this is going inside me?
How do we stop this happening again?
How is this going to alter the UK's heath statistics?


Measurement expert
Modeller
Meteorologist
What is it doing to my health?
Physiologist/ Toxicologist
How do we stop this happening again?
How is this going to alter the UK's heath statistics?


Measurement expert
Modeller
Meteorologist
Epidemiologist
Physiologist/ Toxicologist
How do we stop this happening again?
How is this going to alter the UK's heath statistics?

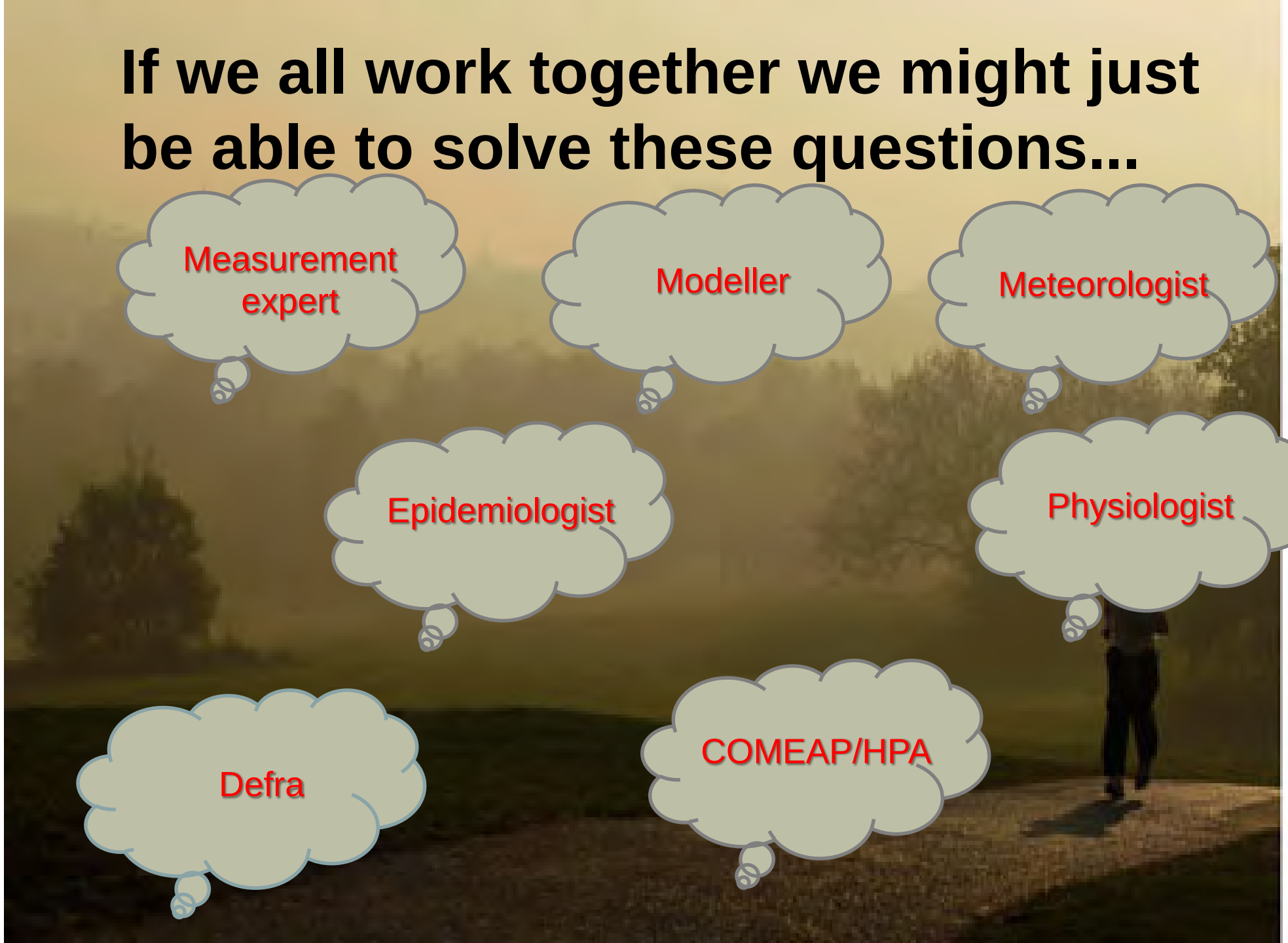

Measurement expert
Modeller
Meteorologist
Epidemiologist
Physiologist/ Toxicologist
How do we stop this happening again?
COMEAP/HPA


Measurement expert
Modeller
Meteorologist
Epidemiologist
Physiologist/ Toxicologist
Defra
COMEAP/HPA


If we all work together we might just be able to solve this...
Measurement expert
Modeller
Meteorologist
Physiologist/ Toxicologist
Epidemiologist
Defra
COMEAP/HPA

2020 - What we still don’t fully understand

1. How does inhaling relatively low concentrations of ambient particles result in the wide range of health effects reported?
2. Are all particles equally active and where does the toxicity reside?
3. To what extent are vehicle-derived particles responsible for the health effects observed?


If we all work together we might just be able to solve these questions...
Measurement expert
Modeller
Meteorologist
Epidemiologist
Physiologist
Defra
COMEAP/HPA

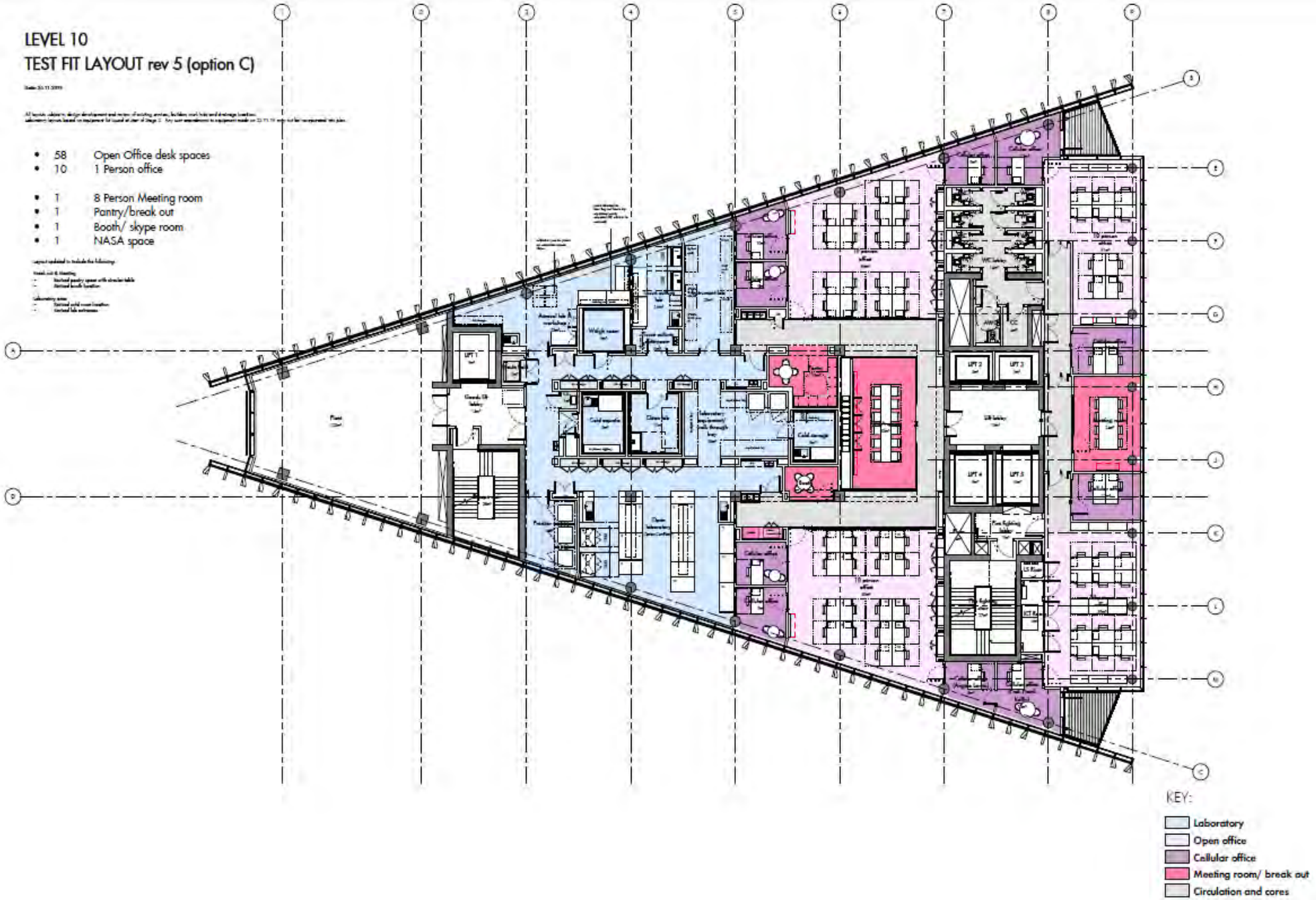
2020 ERG at Imperial

- Sir Michael Uren Biomedical Engineering Research Hub will combine the latest medical research and engineering to improve the treatment and diagnosis of diverse medical conditions, from finding ways to cure dementia to creating bionic limbs.

LEVEL 10
TEST FIT LAYOUT rev 5 (option C)

- 58 Open Office desk spaces
- 10 1 Person office

- 1 8 Person Meeting room
- 1 Pantry/break out
- 1 Booth/ skype room
- 1 NASA space



Thanks for listening

SPF Clean Air Wave 1 Kick Off Event

Meeting closed

Thank you

Any questions or comments:
pcd@nerc.ukri.org