

Gathering Scientifically Useful and Socially Actionable Environmental Data

Near future air quality monitoring



Top 5 causes of death in children under 5 years linked to the environment

A companion report, *Don't pollute my future! The impact of the environment on children's health*, provides a comprehensive overview of the environment's impact on children's health, illustrating the scale of the challenge. Every year:

- 570 000 children under 5 years die from respiratory infections, such as pneumonia, attributable to indoor and outdoor air pollution, and second-hand smoke.
- 361 000 children under 5 years die due to diarrhoea, as a result of poor access to clean water, sanitation, and hygiene.
- 270 000 children die during their first month of life from conditions, including prematurity, which could be prevented through access to clean water, sanitation, and hygiene in health facilities as well as reducing air pollution.
- 200 000 deaths of children under 5 years from malaria could be prevented through environmental actions, such as reducing breeding sites of mosquitoes or covering drinking-water storage.
- 200 000 children under 5 years die from unintentional injuries attributable to the environment, such as poisoning, falls, and drowning.

- Around 3 billion people cook and heat their homes using open fires and simple stoves burning biomass (wood, animal dung and crop waste) and coal.
- Over 4 million people die prematurely from illness attributable to the household air pollution from cooking with solid fuels.
- More than 50% of premature deaths due to pneumonia among children under 5 are caused by the particulate matter (soot) inhaled from household air pollution.
- 3.8 million premature deaths annually from noncommunicable diseases including stroke, ischaemic heart disease, chronic obstructive pulmonary disease (COPD) and lung cancer are attributed to exposure to household air pollution.

Indoor air pollution and household energy: the forgotten 3 billion

Environment sustainabilit

Global development is supported by BILL & MELINDA GATES foundation About this content John Vidal Thu 20 Oct 2016 07.00 BST f t e ... This article is over 1 year old 1737 ▲ Heavy traffic causes gridlock in the Kenyan capital Nairobi. Across Africa, annual deaths from ambient particulate matter pollution increased by 36% between 1990 and 2013. Photograph: Tony Karumba/AFP/Getty Images

Air pollution more deadly in Africa than malnutrition or dirty water, study warns

Annual human and economic cost of tainted air runs to 712,000 lost lives and £36.4bn, finds Organisation for Economic Co-operation and Development

<https://www.theguardian.com/global-development/2016/oct/20/air-pollution-deadlier-africa-than-dirty-water-or-malnutrition-oecd>

THE ISSUE

Air pollution causes 1 in 9 deaths. It is the biggest environmental health crisis we face.

We may not always see it, but air pollution is the cause of some of our most common illnesses.

LEARN MORE

THE CONVERSATION

Academic rigour. Journalistic flair

Arts + Culture Business + Economy Cities Education Environment + Energy Health + Medicine Politics + Society Science + Technology Brexit

Africa has an air pollution problem but lacks the data to tackle it

November 24, 2016 9.33pm GMT

<https://theconversation.co m/africa-has-an-air-pollution-problem-but-lacks-the-data-to-tackle-it-69057>

Author Janine Wichmann Associate Professor, University of Pretoria Disclosure statement Janine Wichmann receives funding from the National Research Foundation. Partners UNIVERSITY OF PRETORIA UNIVERSITAS VAN PRETORIA

PROTECTING CHILDREN FROM THE ENVIRONMENT

Air Pollution: An unseen threat to children's health.

Each year, air pollution causes **570,000 deaths** in children under 5. This includes indoor, outdoor and second-hand smoke.

In children, air pollution can:

- Stunt brain development
- Reduce lung function & trigger asthma
- Cancers
- Chronic respiratory illnesses
- Stroke
- Cardiovascular disease

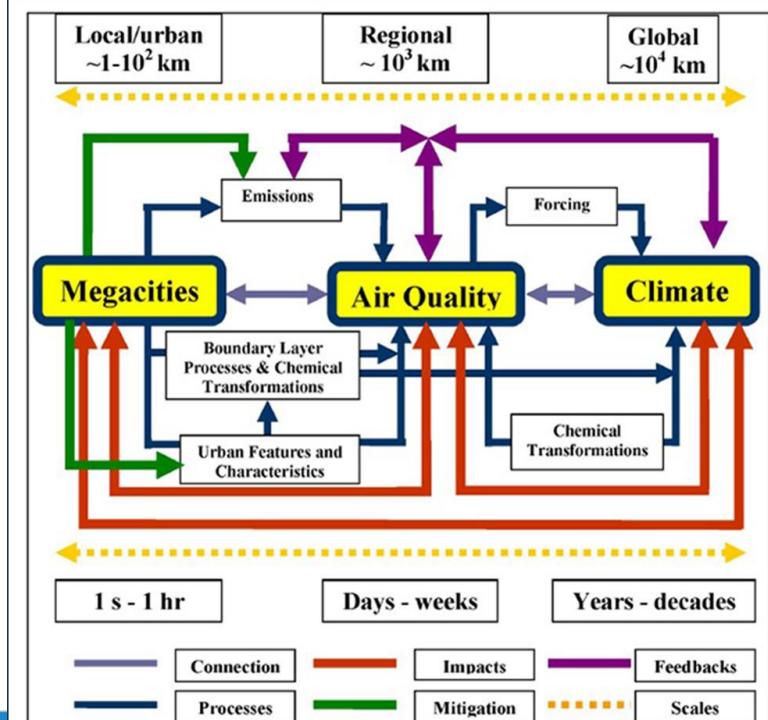
It can also set the stage for problems later in life from:

Nearly a million children die from pneumonia each year. Half of those are linked to air pollution.

World Health Organization

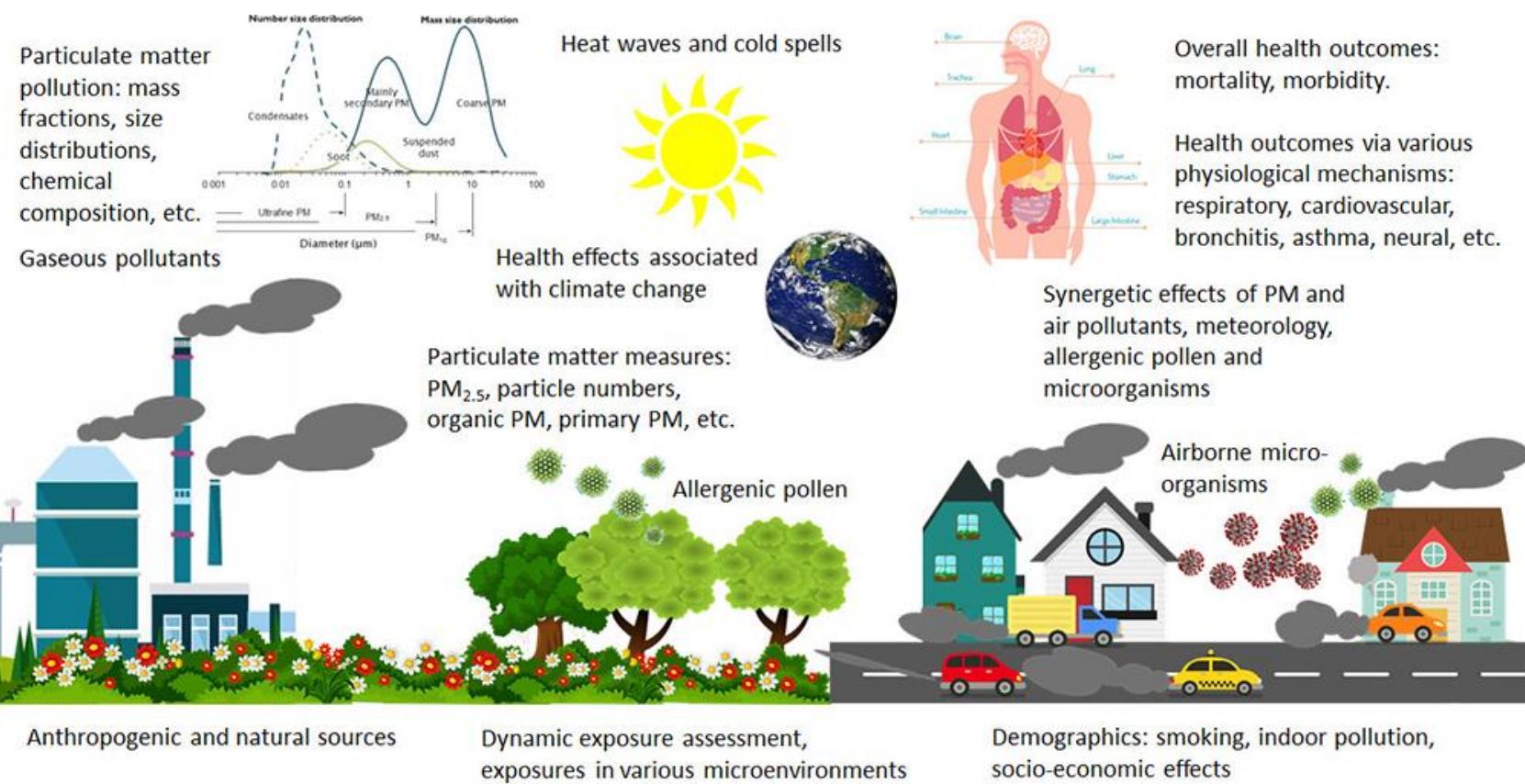
Advances in air quality research – current and emerging challenges

Ranjeet S. Sokhi Nicolas Moussiopoulos, Alexander Baklanov, John Bartzis, Isabelle Coll, Sandro Finardi, Rainer Friedrich, Camilla Geels, Tiia Grönholm, Tomas Halenka, Matthias Ketzel, Androniki Maragkidou, Volker Matthias, Jana Moldanova, Leonidas Ntziachristos, Klaus Schäfer, Peter Suppan, George Tsegas, Greg Carmichael, Vicente Franco, Steve Hanna, Jukka-Pekka Jalkanen, Guus J. M. Velders, and Jaakko Kukkonen



The main linkages between urban emissions, air quality, and climate. (Baklanov et al., 2010).

Figure 15A schematic diagram that illustrates some of the main factors in the evaluation of the exposure and health impacts of particulate matter.



DECEMBER 1, 2023

Air Pollution Is Really Dangerous, Even More New Evidence Shows

Dirty air has been linked to poor health outcomes, ranging from suicidality to low birth weight

BY JESSE GREENSPAN

[Air Pollution Is Really Dangerous, Even More New Evidence Shows | Scientific American](#)



The Journal of Climate Change and Health

Volume 3, August 2021, 100035

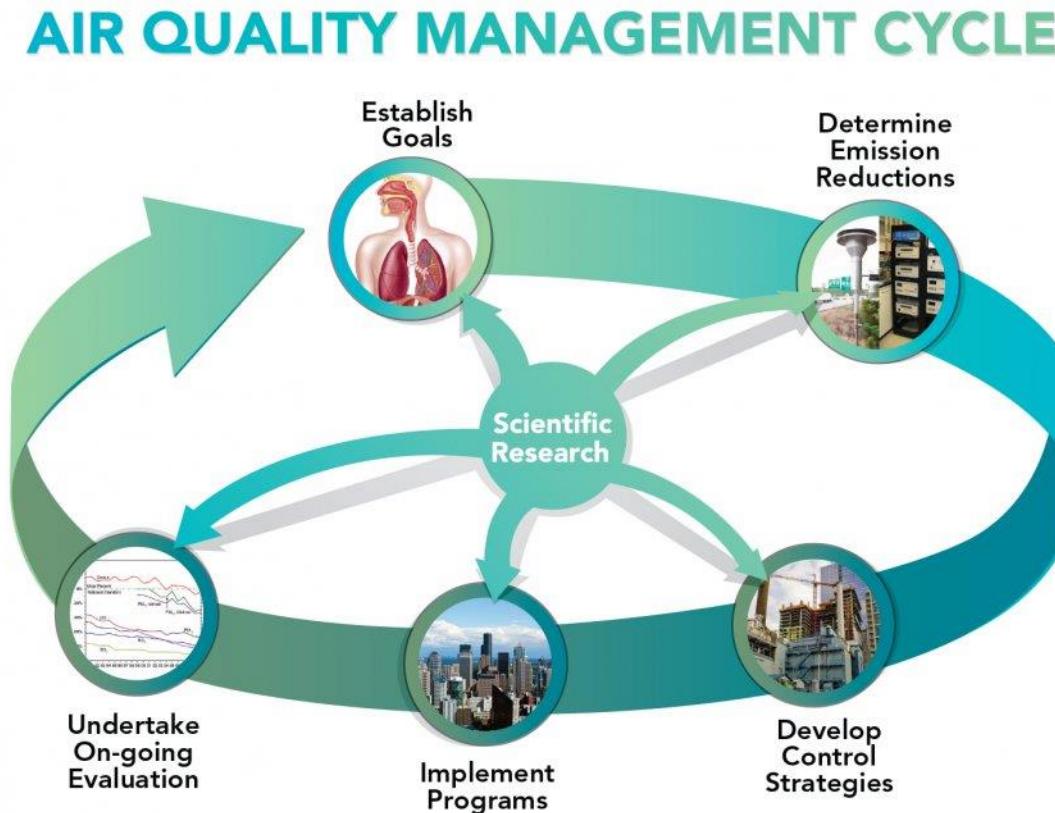


Review

Air pollution as a social and structural determinant of health

[Lisa Patel](#)^a   , [Elizabeth Friedman](#)^b, [Stephanie Alexandra Johannes](#)^c, [Stephanie Sophie Lee](#)^d,
[Haley Grace O'Brien](#)^e, [Sarah E. Schear](#)^f

Air Quality Management



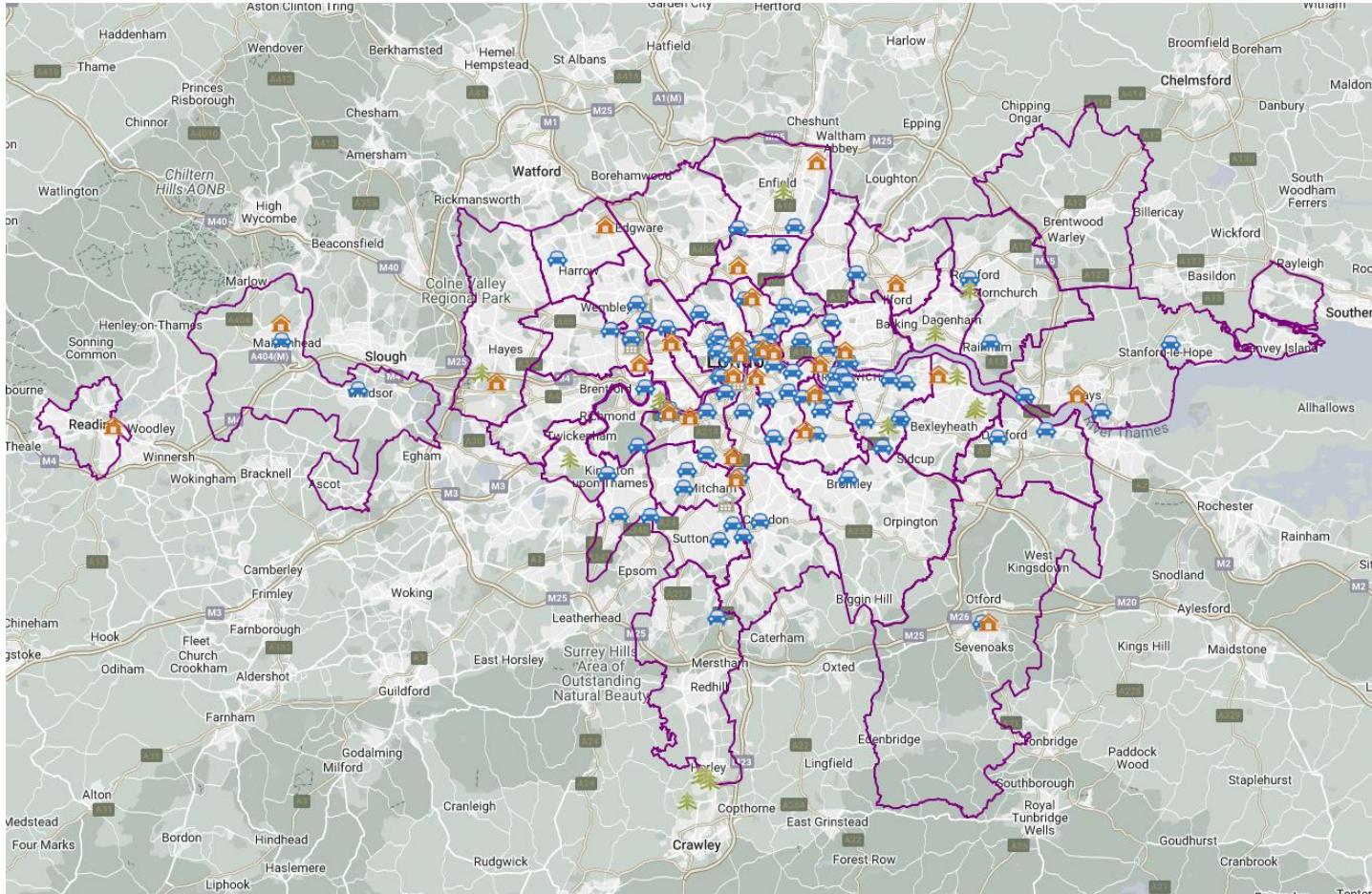
- National monitoring activities can be constrained
- Cities becoming the focus of coupled air quality and climate goal setting
- Future: Integrated local scale needs driven observations

Air Quality and Emissions Monitoring

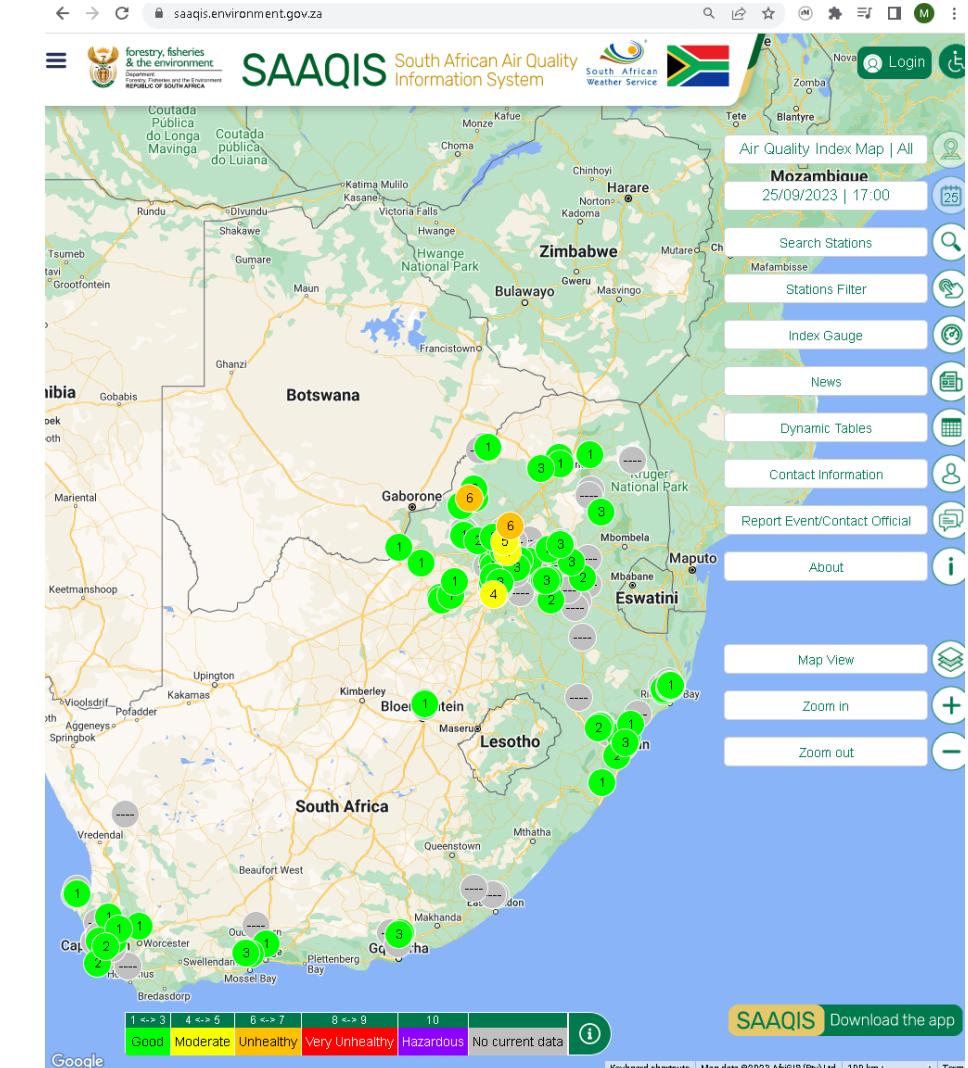
- Local councils, Defra, environment agencies
- ~ 200 automatic monitoring stations – SO_x, NO_x, fine particles, ozone, rainfall, wind speed
- Industrial emissions monitored by companies then reported to agencies
- Certified and accredited systems
- Agencies audit monitoring systems and use check monitoring
- Polluting emissions register reported to Europe from designated industrial sources



Regulatory Networks



London Air



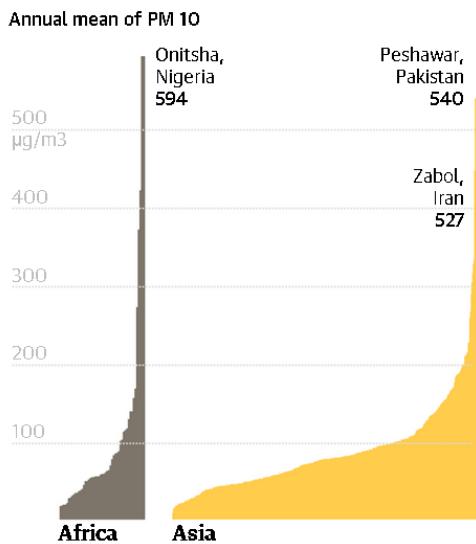
<https://uk-air.defra.gov.uk/interactive-map?network=aurn>
<https://www.londonair.org.uk/LondonAir/Default.aspx>

Pollution

Air pollution rising at an 'alarming rate' in world's cities

Outdoor pollution has risen 8% in five years with fast-growing cities in the developing world worst affected, WHO data shows

● Air pollution: how does it affect you?

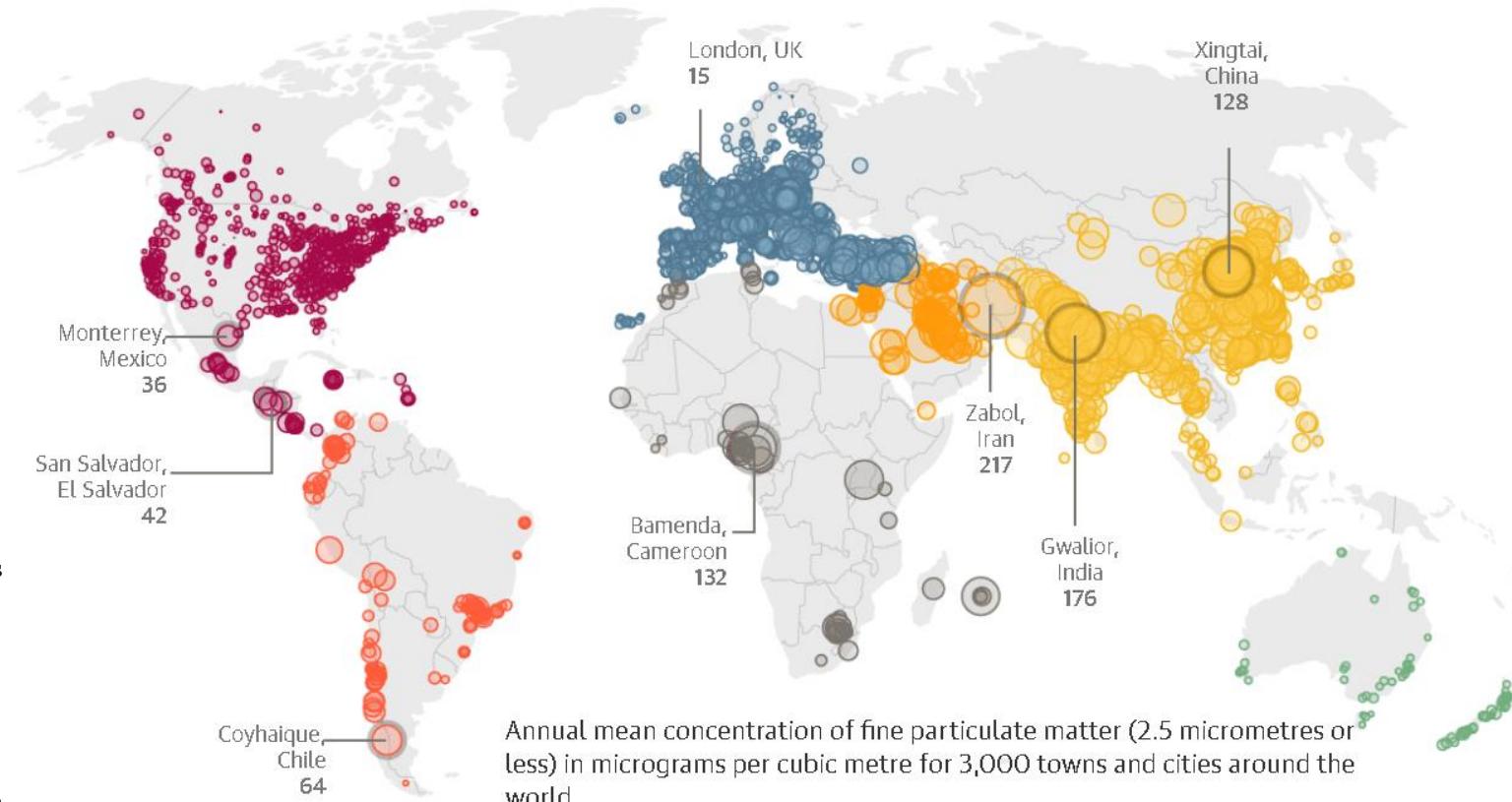


Air pollution levels were generally much lower for cities in developed countries with Sydney, New York and London registering 17, 16 and 22 micrograms per cubic metre for PM10s respectively. However, the data only includes measurements for particulates and does not include forms of air pollution such as NO₂ and ozone.

"We have a public health emergency in many countries. Urban air pollution continues to rise at an alarming rate, wreaking havoc on human health. It's dramatic, one of the biggest problems we are facing globally, with terrible future costs to society," said Dr Maria Neira,

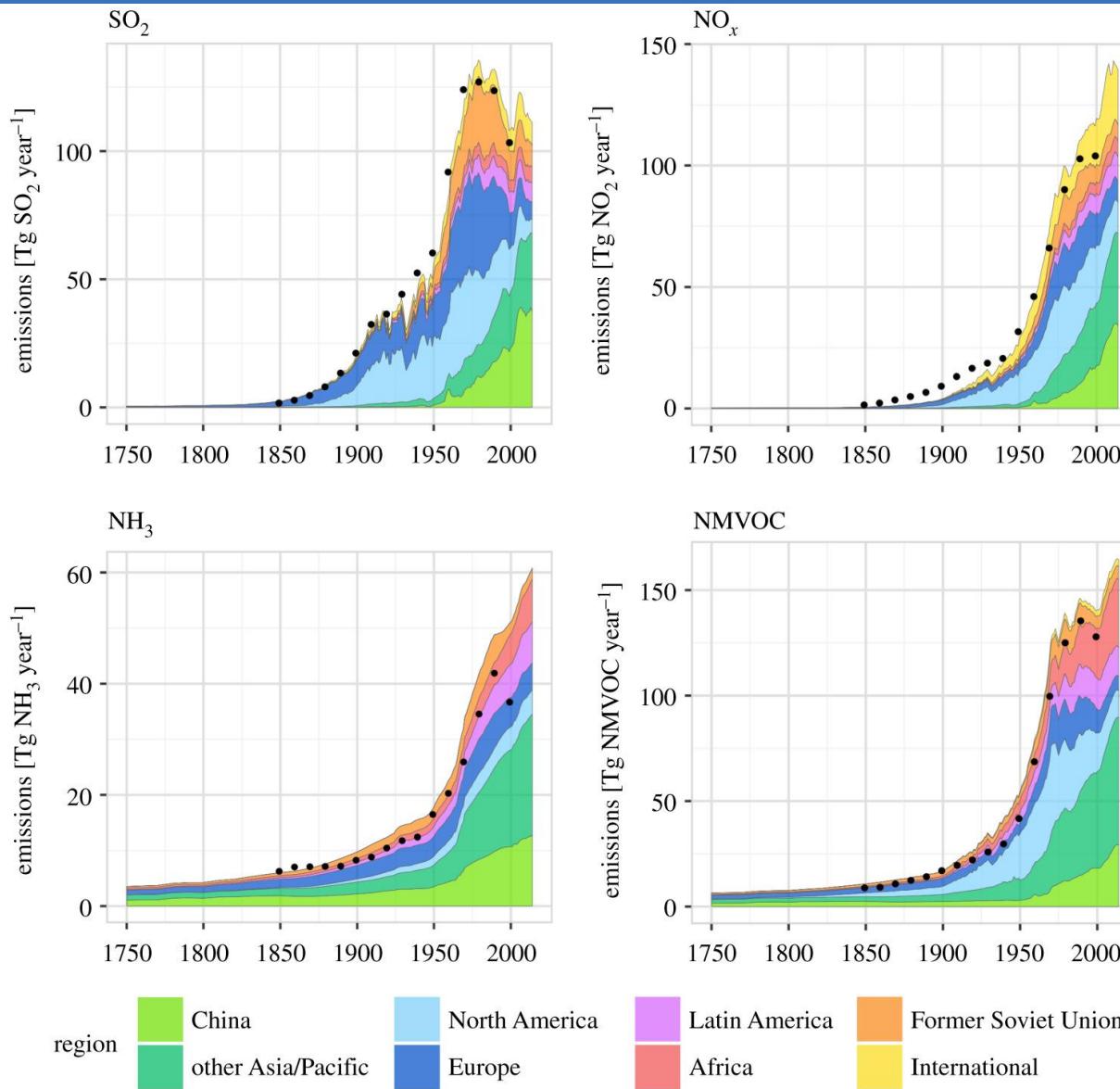
director of public health at the WHO in Geneva.

"The cost for countries is enormous. Air pollution affects economies and people's quality of life. It leads to major chronic diseases and to people ultimately dying," she said.



<https://www.theguardian.com/environment/2016/may/12/air-pollution-rising-at-an-alarming-rate-in-worlds-cities>

Global Air Quality



Global and regional emissions of SO_2 , NO_x , NH_3 and NMVOC between 1750 and 2010.

Adapted from Hoesly *et al.*

The dots show global estimates from the earlier Coupled Model Intercomparison Project Phase 5 (CMIP5).

CMIP5 was designed to provide a framework for coordinated climate change studies.

Ref: Fowler et al 2020. A Chronology of Global Air Quality

Hyperlocal Monitoring

- Hyperlocal monitoring identifies hotspots
- Source apportionment finds causes
- Pinpoint sources and transport of pollution
- Enable targeted, cost-effective, impactful strategies to improve air quality



What source apportionment studies show us

DEFINITIONS

SOURCE CATEGORIES:

Source categories, like light-duty gasoline vehicles or power plants, are **groups of similar sources** that could be managed by similar control technologies or policies.

- Air pollution measurement

OBJECTIVES & IMPACT

Understanding which groups of similar emissions sources are **contributing to pollution in a specific area**—and in what quantities—can help policymakers and communities **develop more targeted approaches to improving air quality**.

Defining source regions—and how much the sources contribute to pollution within them—designates which jurisdictions can regulate emissions within specific boundaries.



SINGLE SOURCE:

Emissions sources may be **singled out** if they are considered particularly polluting, harmful to human health or require more study.



By identifying individual sources of emissions, we can understand how much they contribute to pollution in a neighborhood or specific city block.



SOURCE REGION:

Source regions are typically areas within political boundaries—**cities, states, countries**—where pollution is managed.



Measuring plumes from a single source

can also help scientists and regulators calculate how much that source is emitting and when, which **can serve as a game-changer for enforcement**.



THE ROLE OF WEATHER:

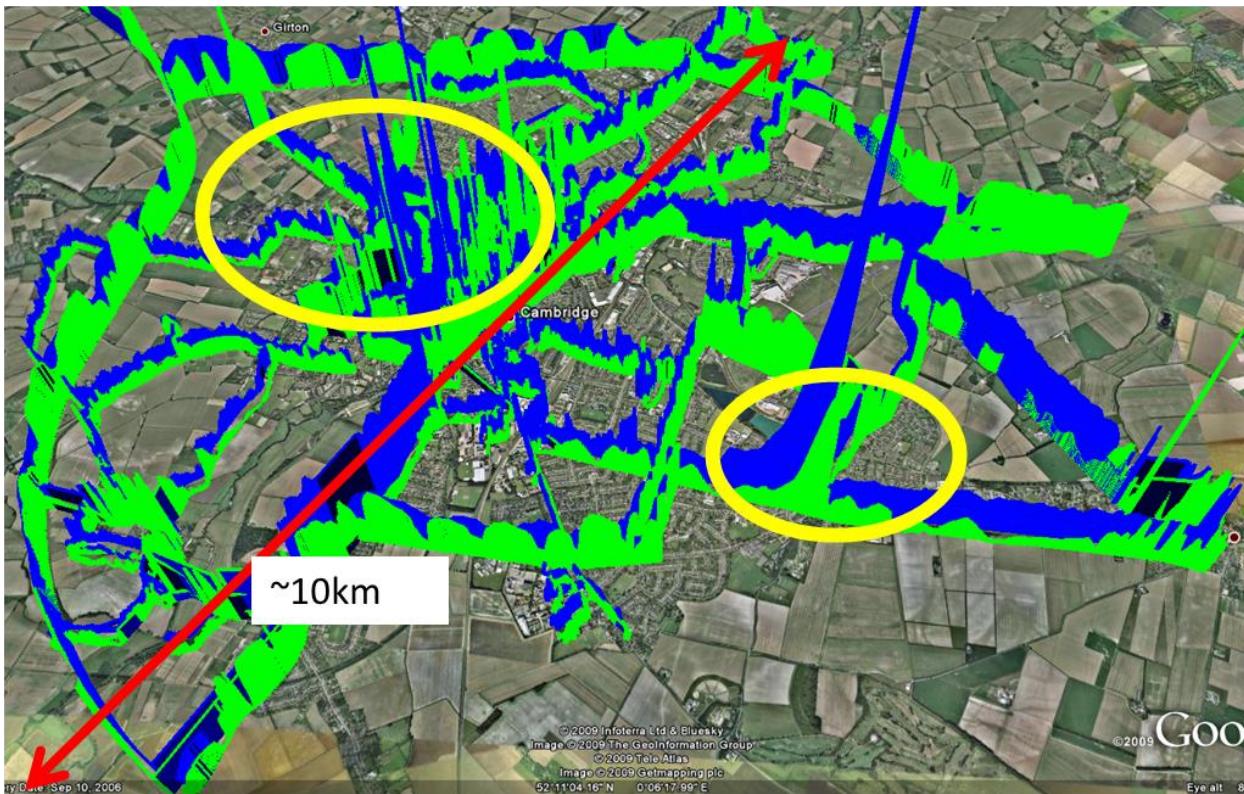
Wind, rain, sunlight and temperature interact with emissions, **impacting pollution, how it develops and where it travels**.



Accounting for weather conditions can help us both better track where pollution eventually goes as well as determine where it started.



Bridging Scales. Distribution to Exposure

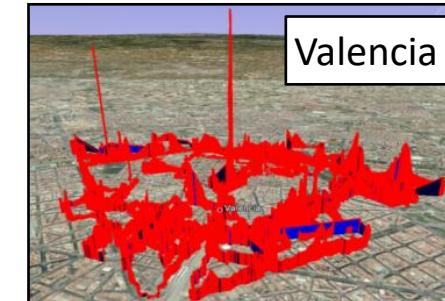
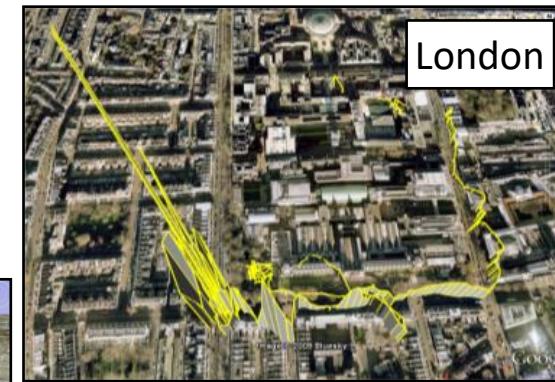


- > 40 sensors (CO, NO, NO₂, CO₂, VOCs)
- 3 transport modes (walk, cycle, cars)
- > 100,000 measurements
- ~ 3hr deployment

- High density mapping
- Structure present on all measured scales

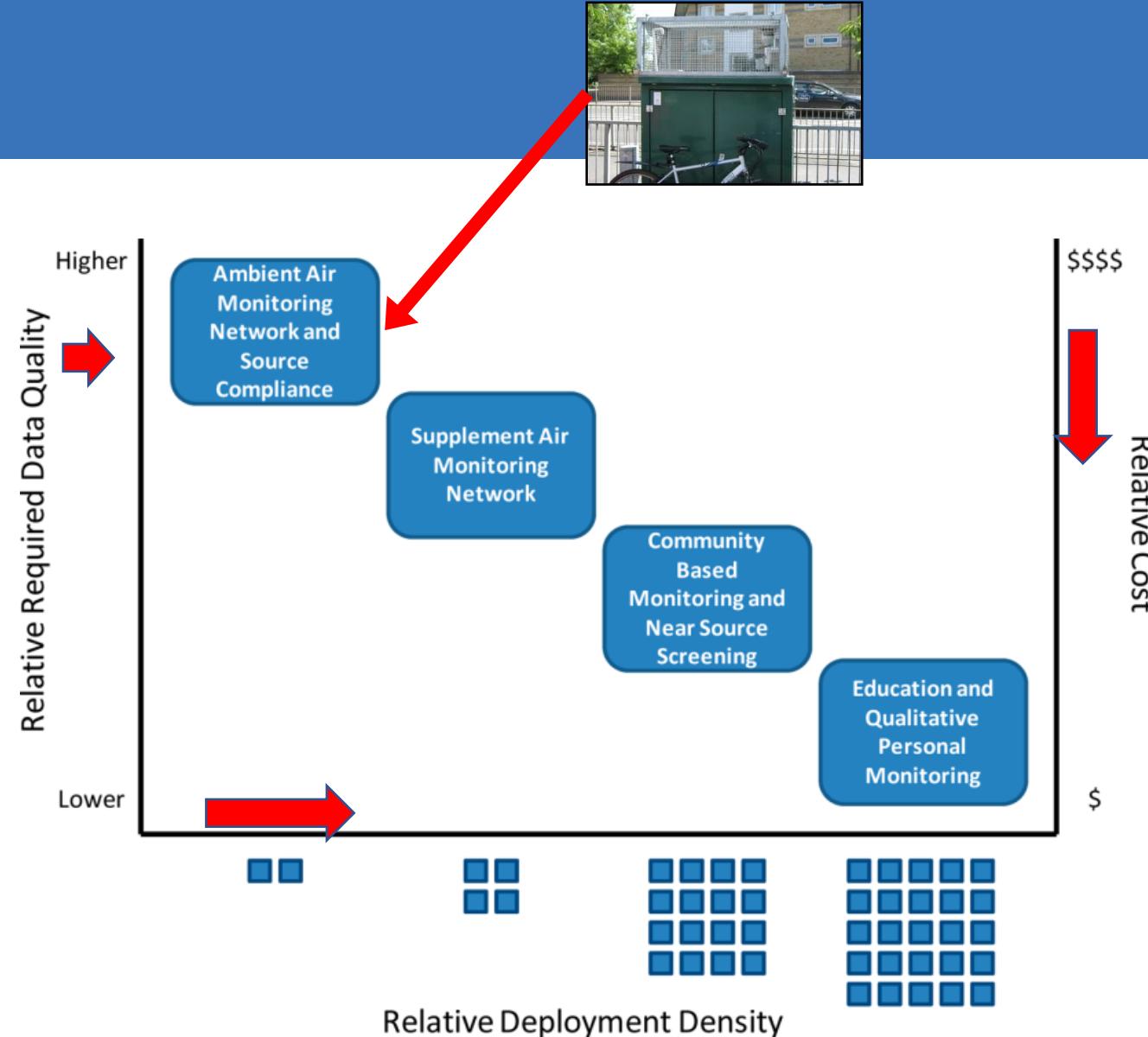


Detail.
Road vs Cyclepath



Emerging Approaches

- Substantial inhomogeneity in urban A/Q on all measured scales.
- Less sensitive measurements in the right place vs precise measurements in a compromised position.
- Augmenting sparse precision monitoring sites.
- Replacing existing low cost solutions.
- Explore alternative solutions.



Hybrid City Wide Monitoring

Breathe London: A community-led air quality sensing network for London

- Close integration of lower cost sensors and the Londonair network
- Core network funded by the Mayor
- Bloomberg addition community nodes and research

Supplementing London's reference quality network

- Hyperlocal data monitoring
- Expand monitoring into different types of area
- Monitor in places difficult to reach with reference monitors
- Community focus, allow organisations to host their own sensor
- Create a scalable and operational network

Gathering socially actionable and scientifically useful data



Breathe London
the community sensing project

The Breathe London Network is an air quality sensing community made by Londoners for Londoners. Anyone can join.

[Learn more](#)

Scope

For individuals



For community groups



For business



For local government



Anyone can join the Breathe London Network. Join a network of people passionate about improving air quality across London.

Small, affordable and backed by Imperial College London, the Breathe London Node can empower communities to monitor and take action.

Businesses and estates are joining the effort to help improve air quality for all. Find out how your business can get involved in the fight for cleaner air.

Small, light and affordable with tight integration with the London Air Quality Network; the Breathe London Node is a perfect complement to regulatory monitoring.

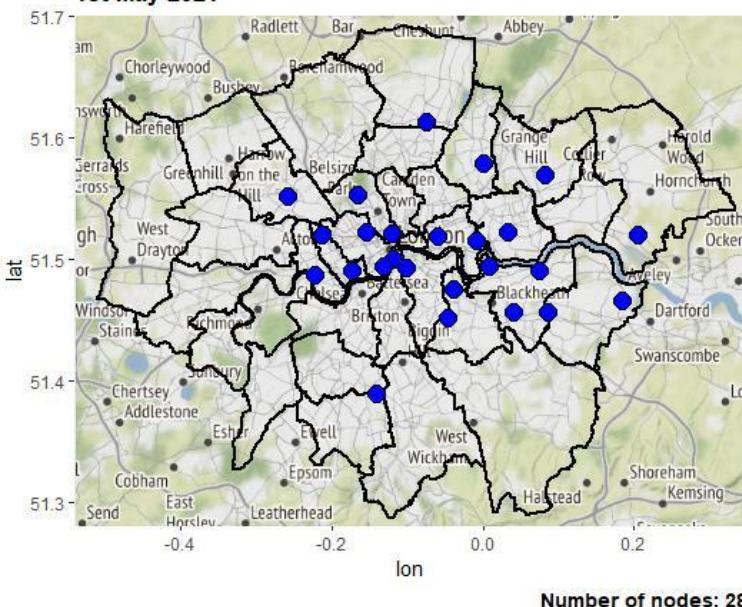
~ 422 sites currently (→)

more in preparation currently

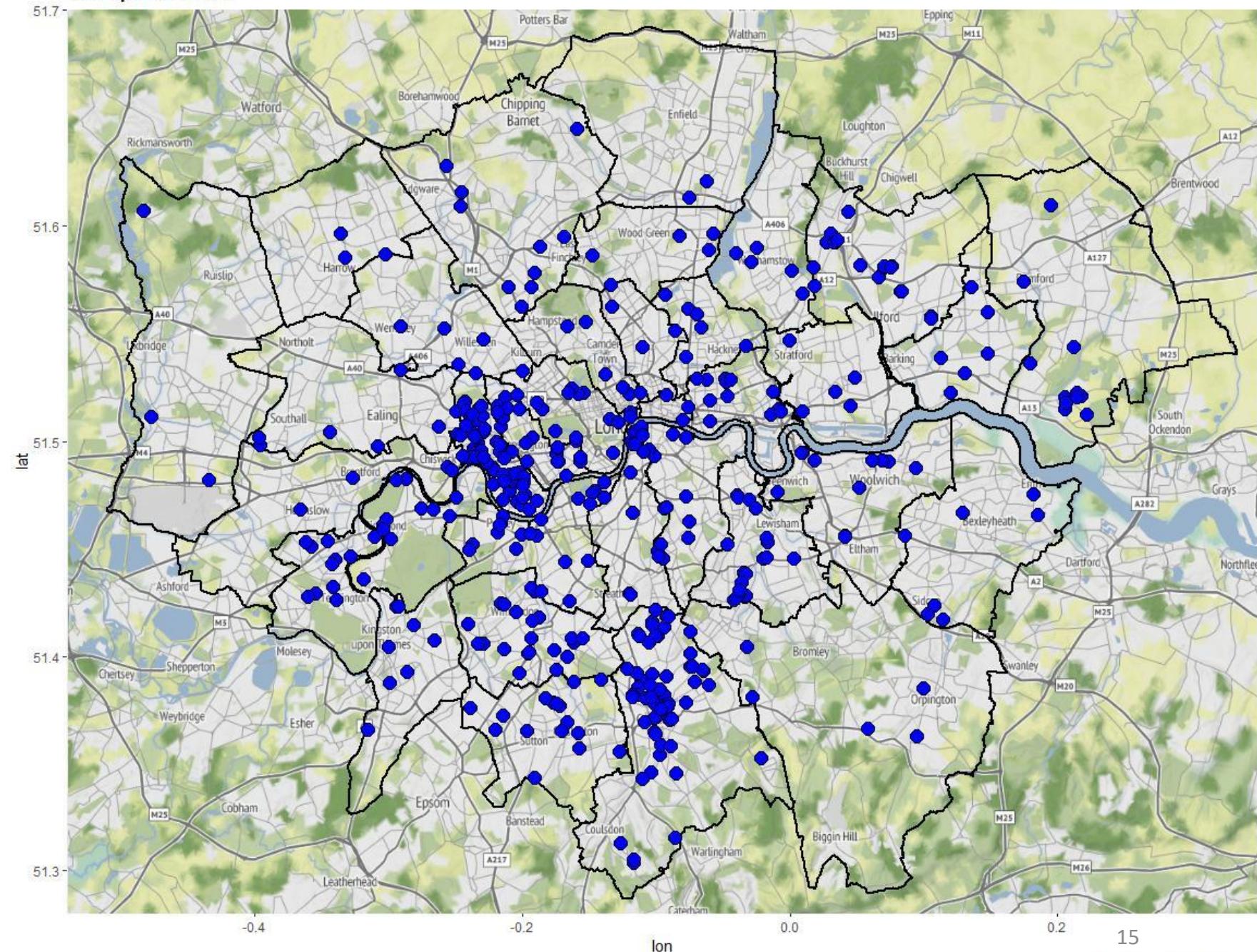
Remaining community installs
also in preparation

Growth since May 2021 (↓)

Breathe London nodes operational
1st May 2021



Breathe London nodes operational
1st September 2023



Access to Knowledge

- Build on 28 yrs of information for Londoners
- Access to community Stories
- Awareness of pollution changes/challenges
- Opportunity to assess impact of initiatives
- Helping quantification of benefits e.g. Health
- Compare with AQ standards



London Air

FORECAST TODAY LOW TOMORROW LOW

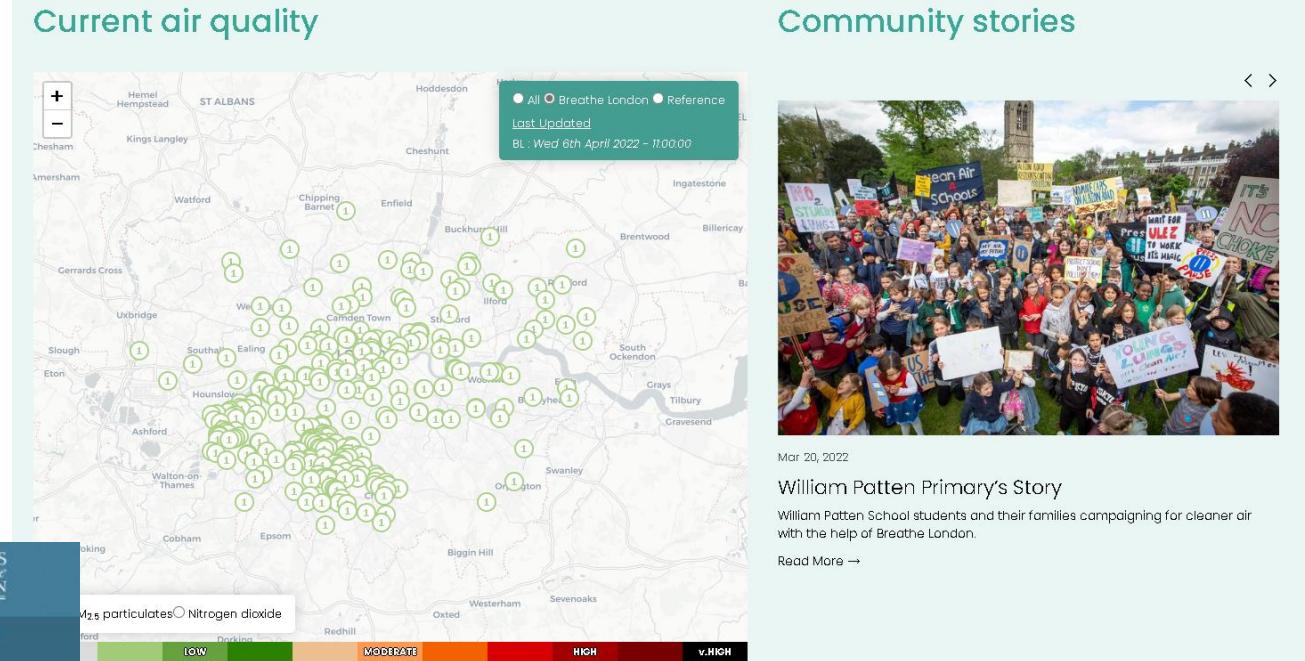
KING'S COLLEGE LONDON

Air Pollution ▾ Information ▾ Monitoring ▾ Tools ▾ Quick Links (Public) ▾

You are on this page >> Home >> Air Pollution Guide

Pollutants London Health effects Health advice Actions Can I monitor? Reduce exposure

Air pollution Episodes



Increase in Available Direct Data

Figure 1: Number of AURN funded automatic measurement stations in the UK

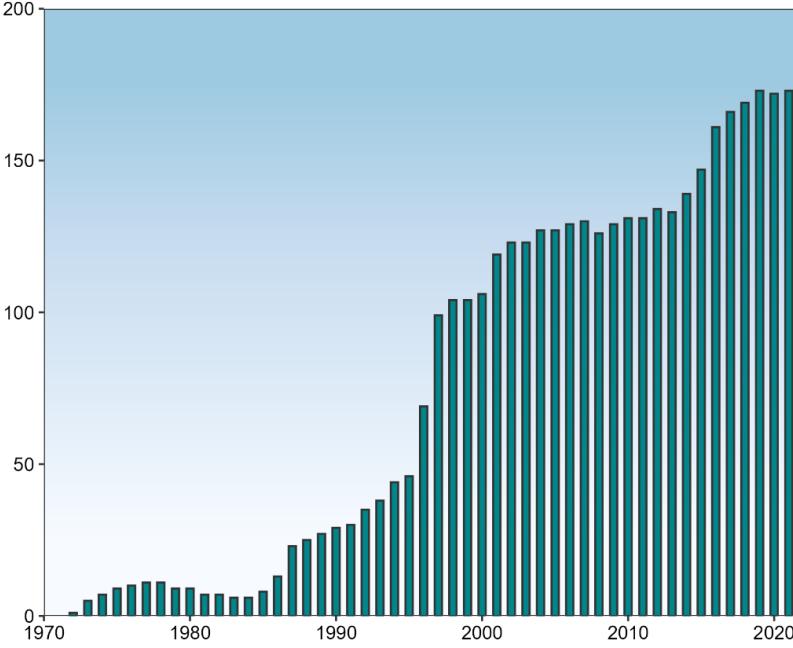
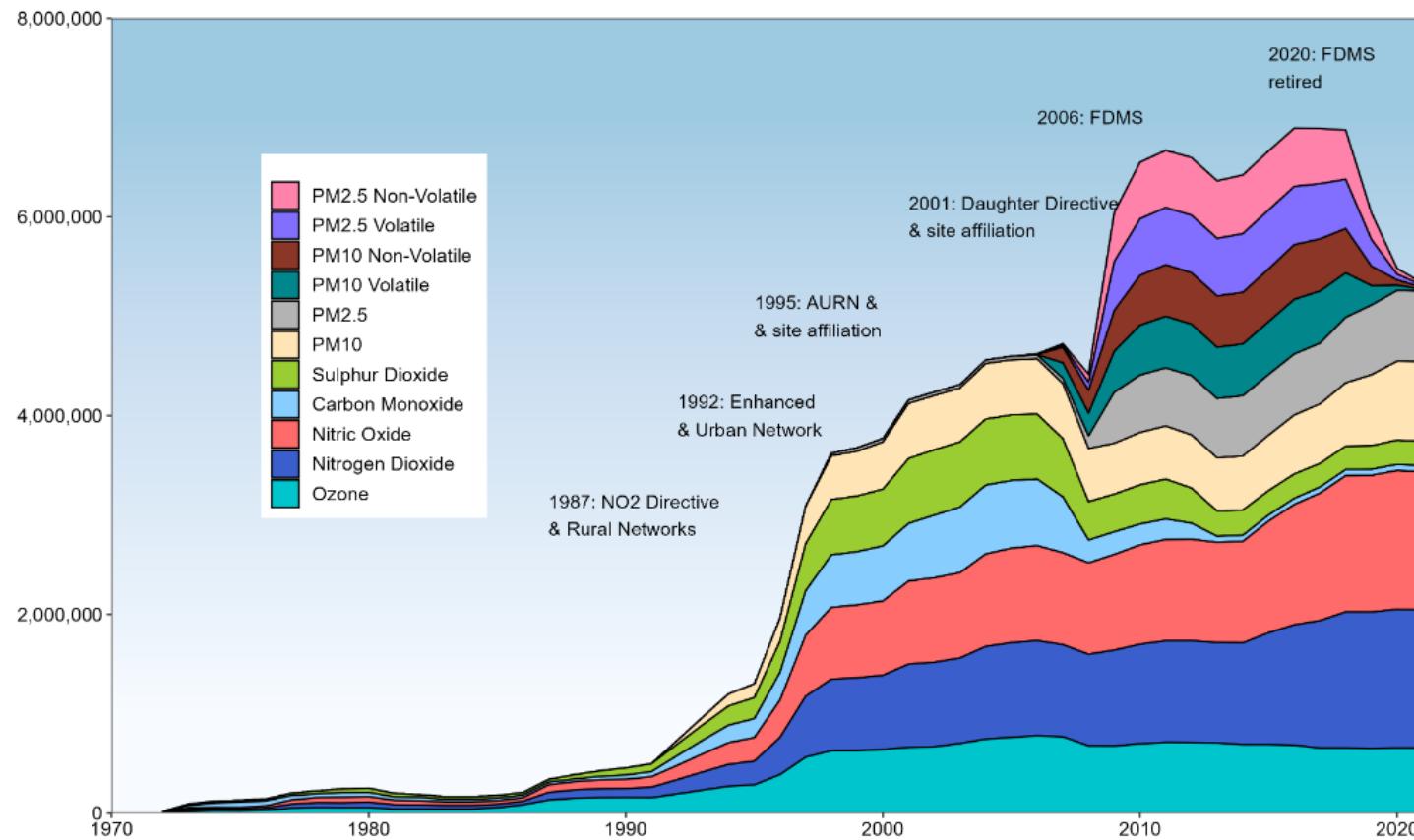
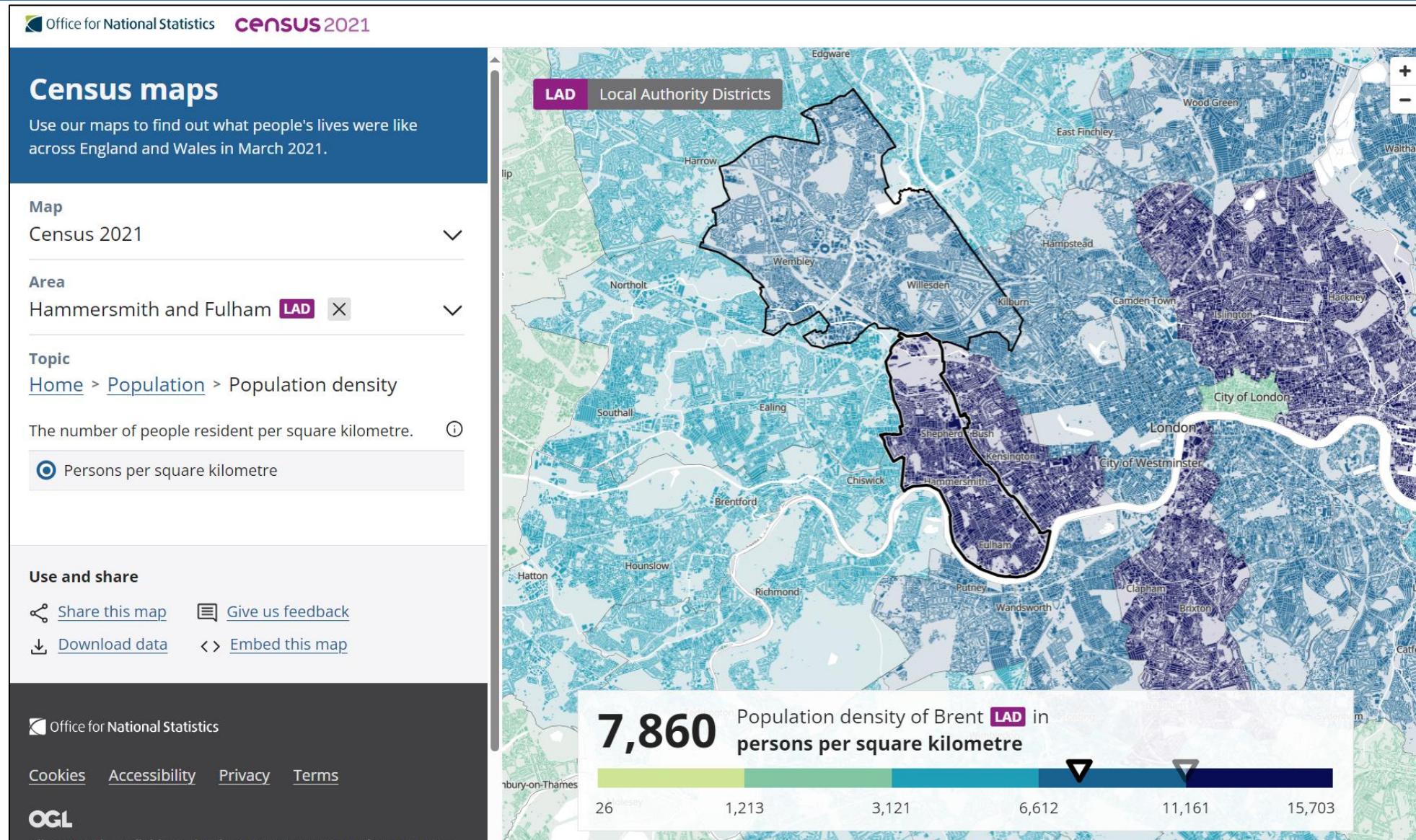


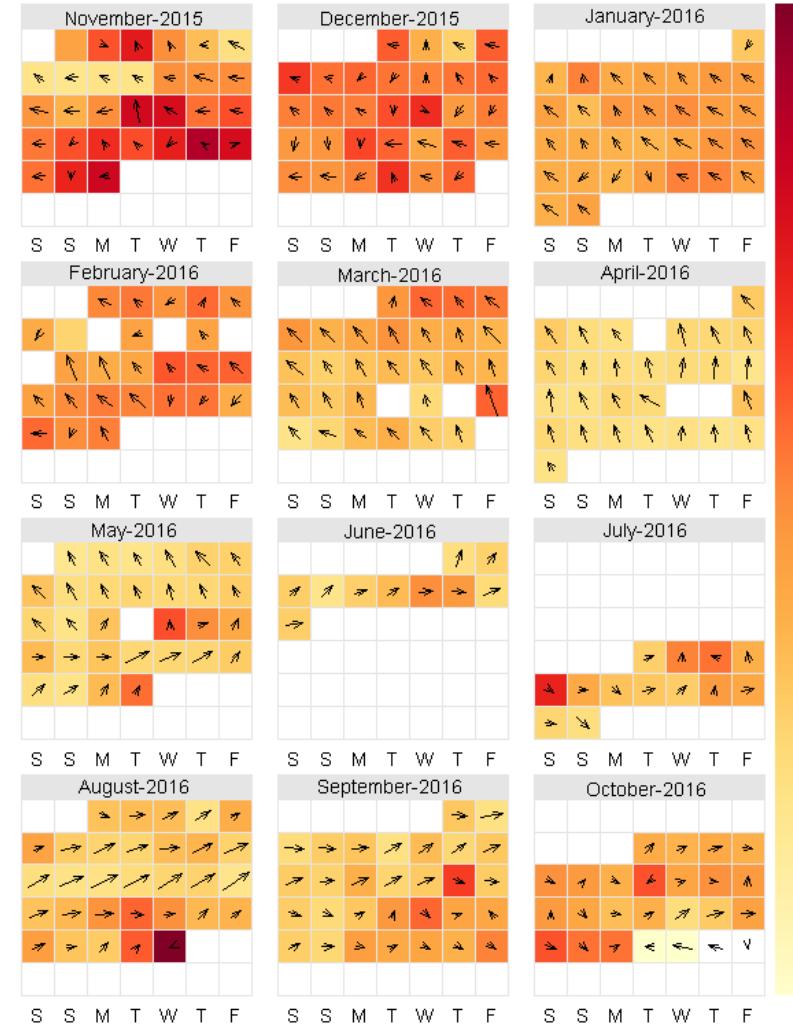
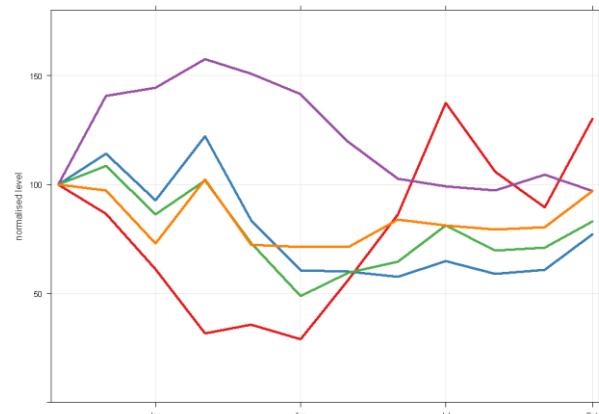
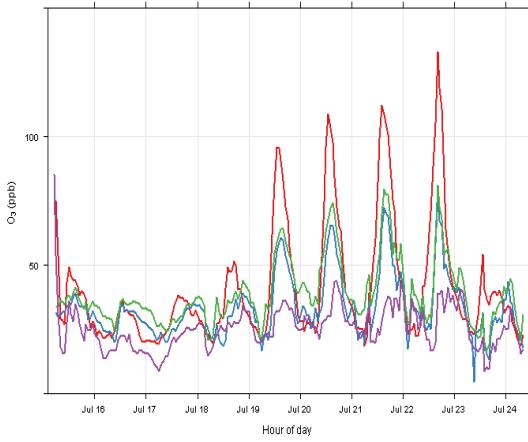
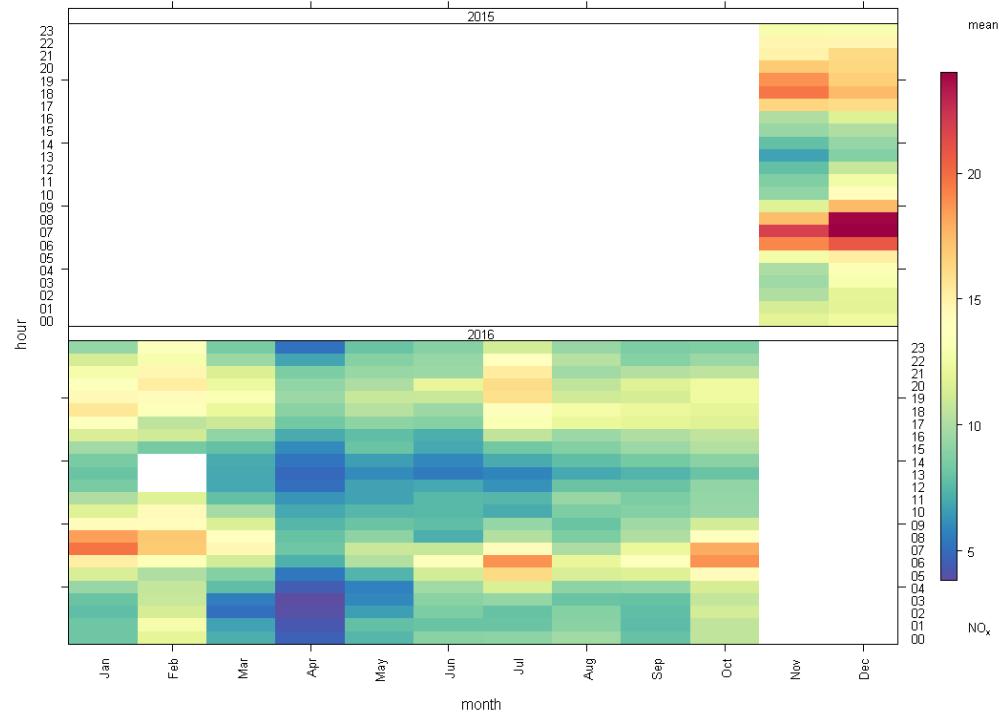
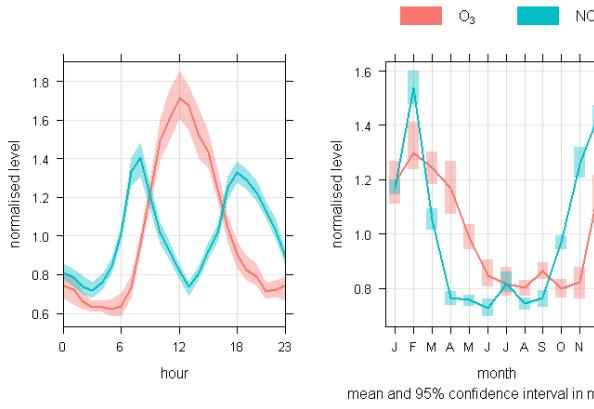
Figure 2: The number of hourly measurements made every year has increased dramatically for all pollutants in the automatic monitoring networks (O_3 , NO_2 , CO, SO_2 and PM_{10}) and for other UK Strategy pollutants



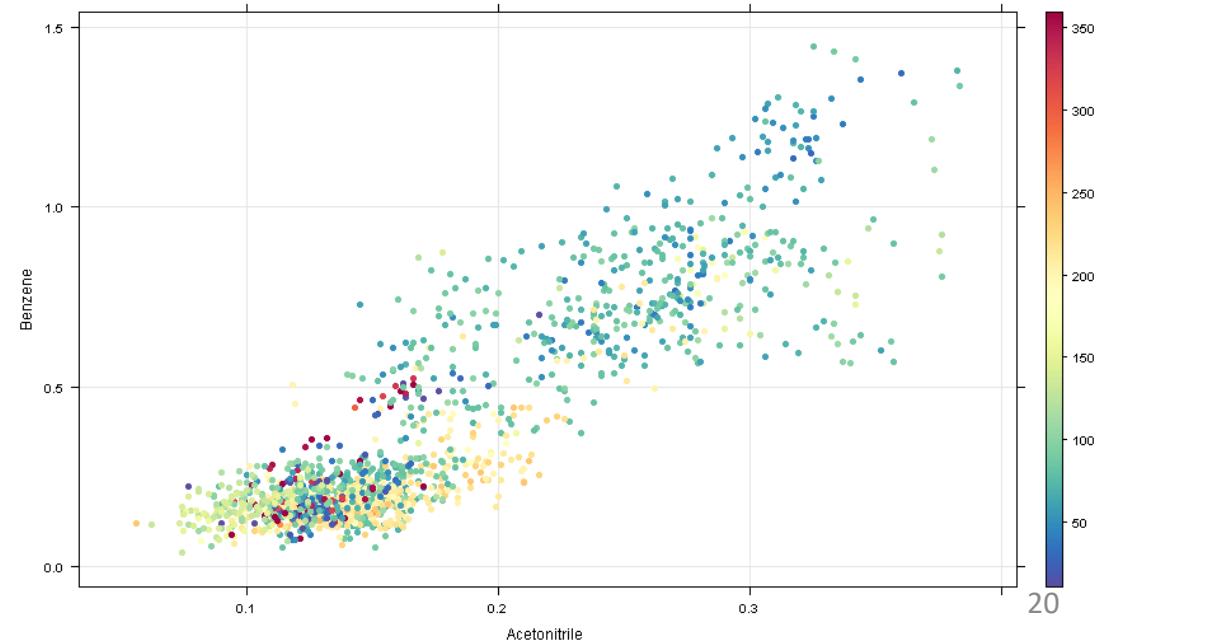
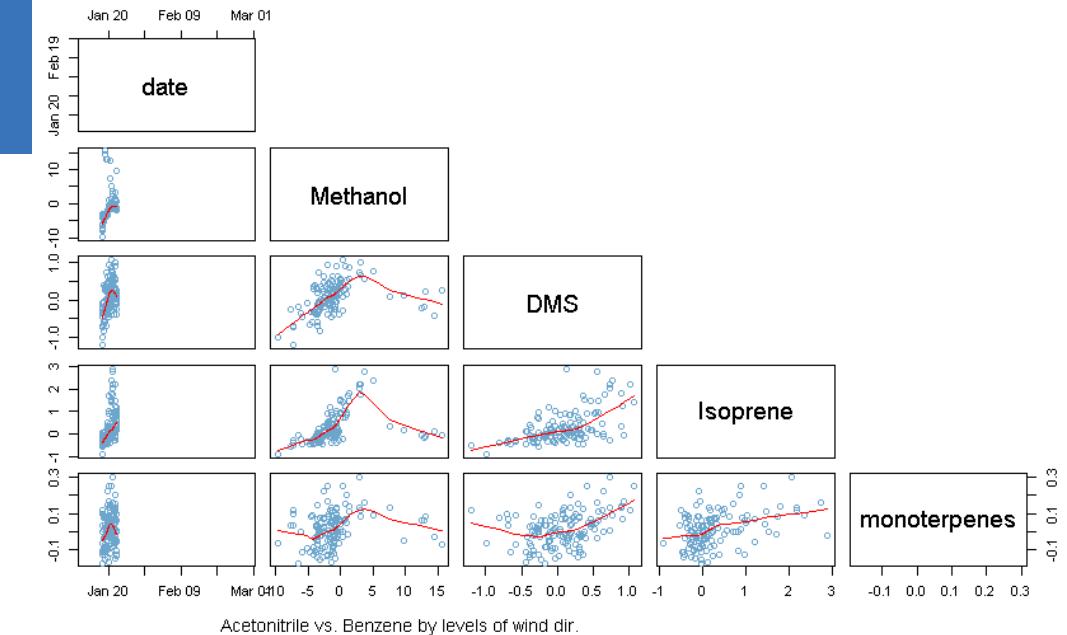
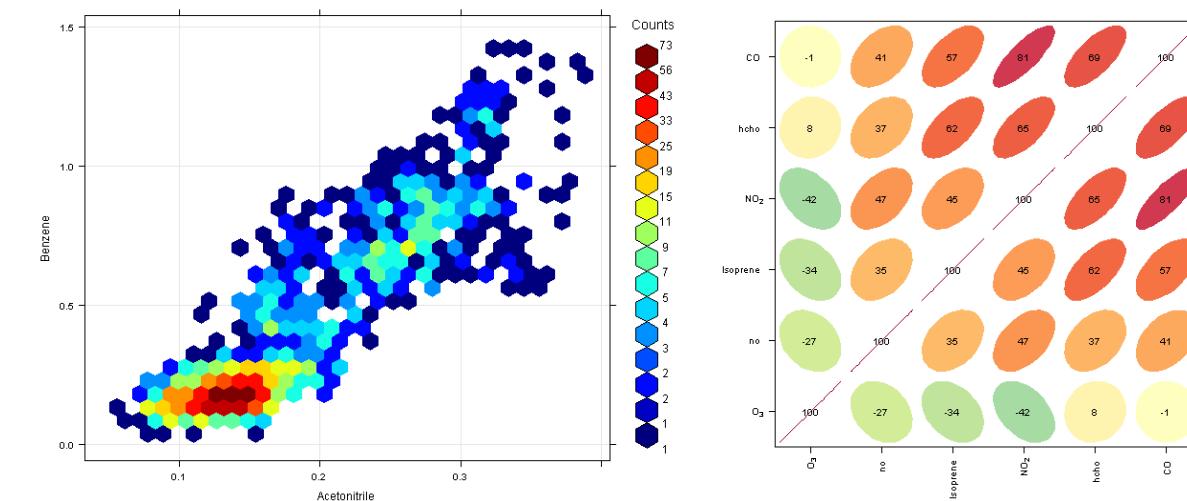
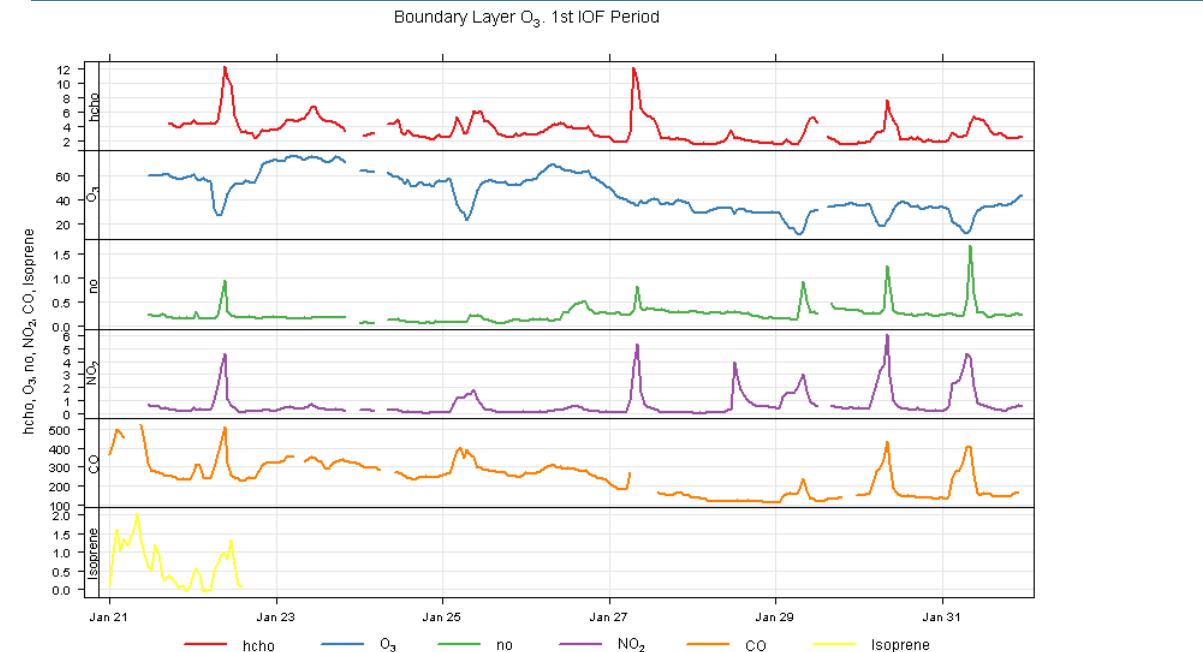
Increase in Available Wider Data



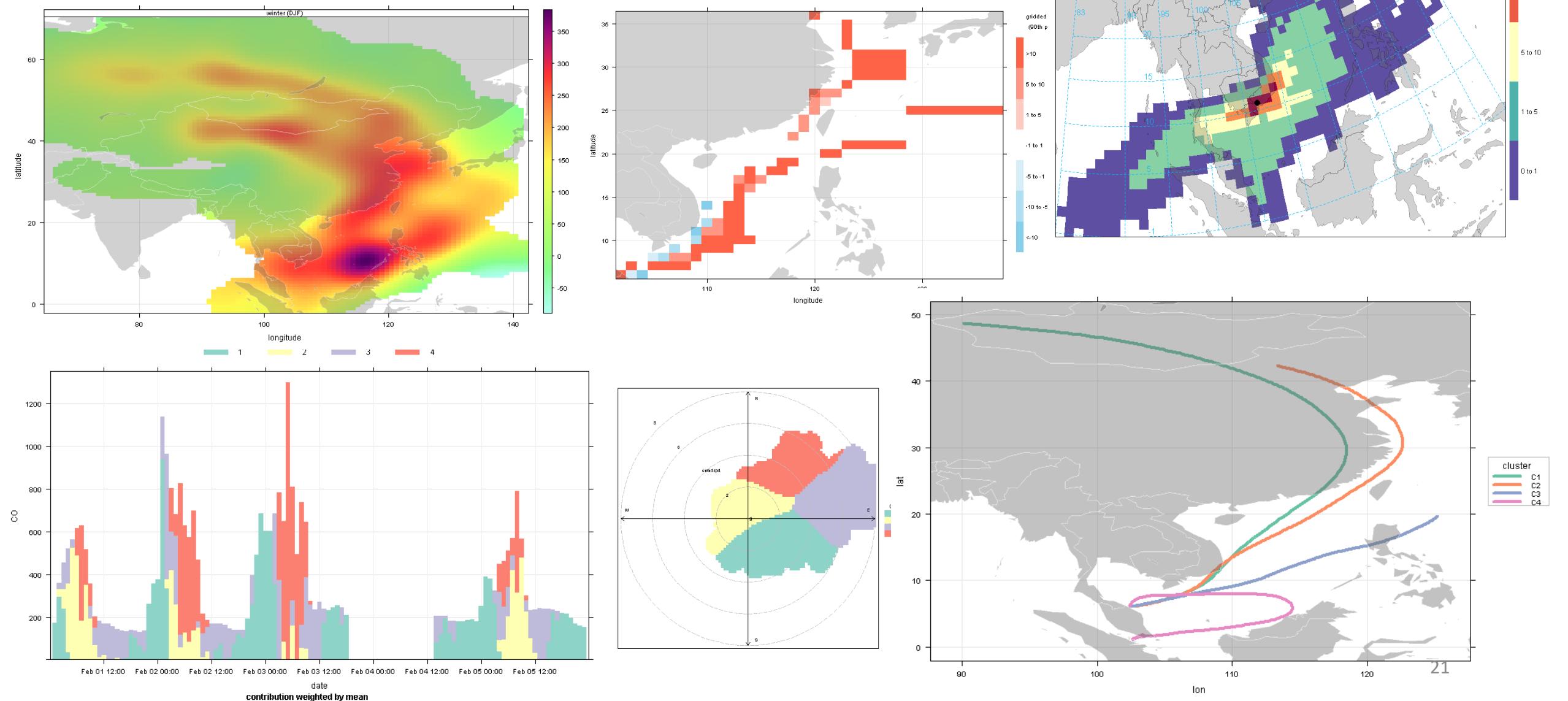
Behaviour in Time



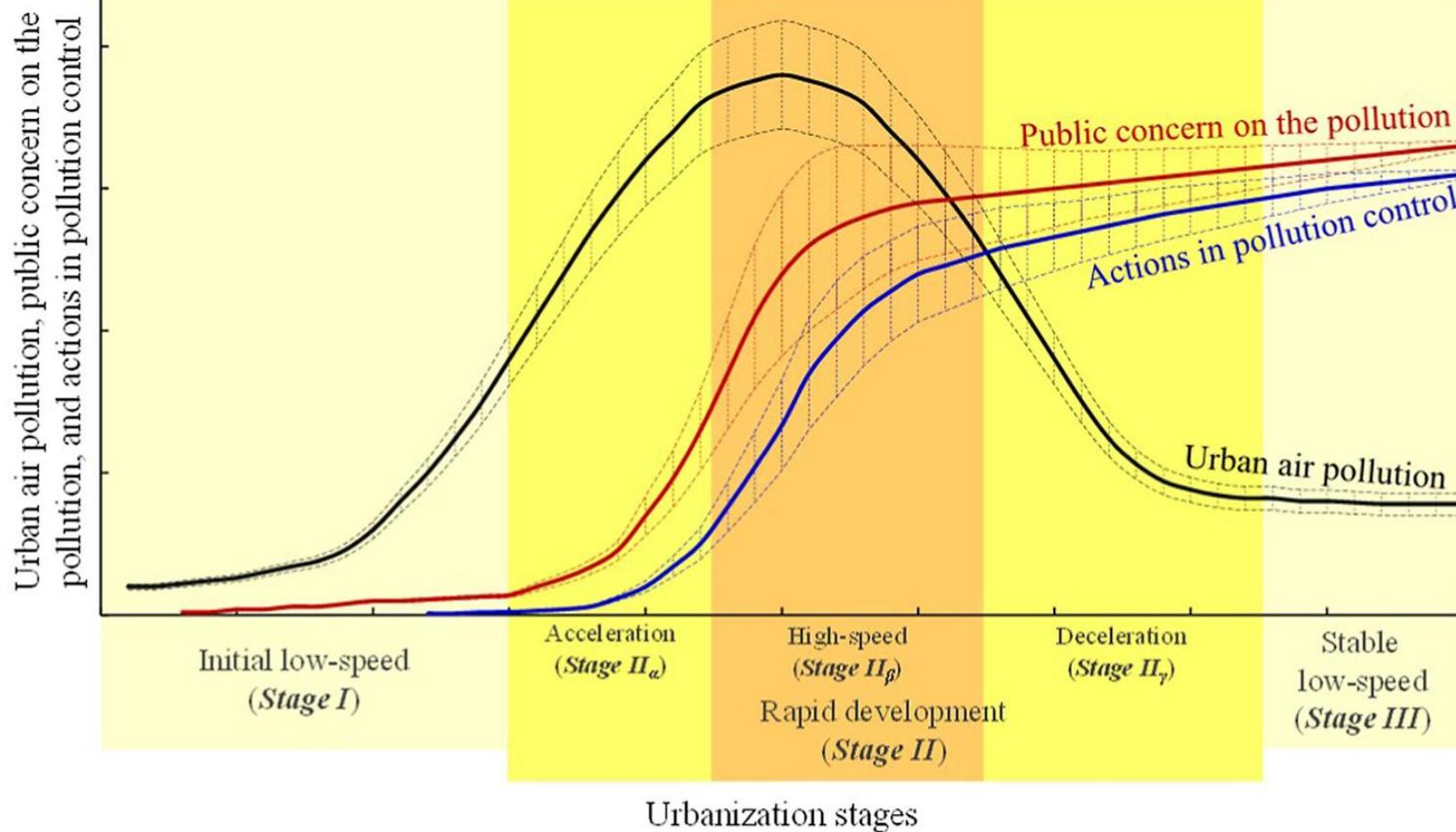
Relationships Between Species



Source Apportionment



Socially Actionable and Scientifically Useful Data



Vumbi + Moshi



Same
Questions?