

Future directions for outdoor air quality monitoring

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The purpose of measurements?

Government and local authority

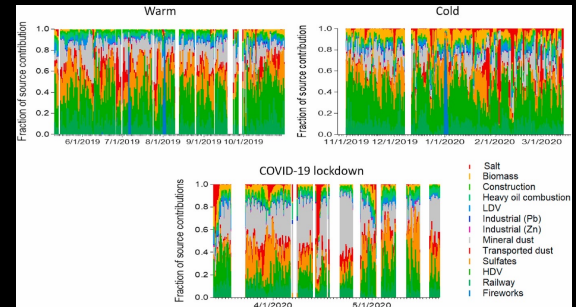
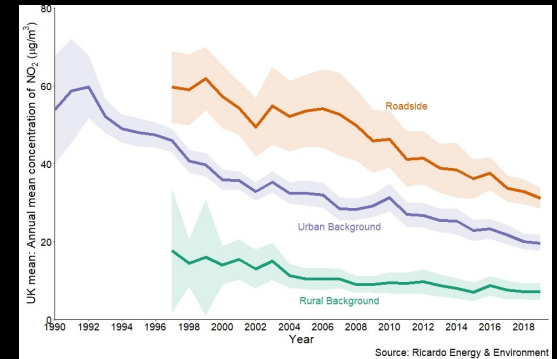
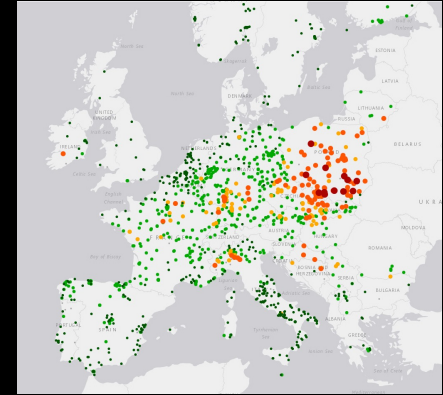
Inform and advise

Regulation and compliance

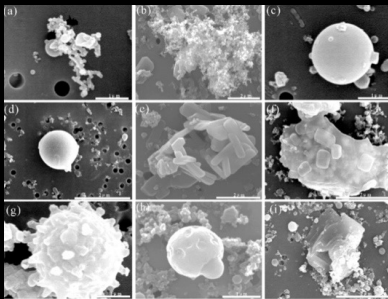
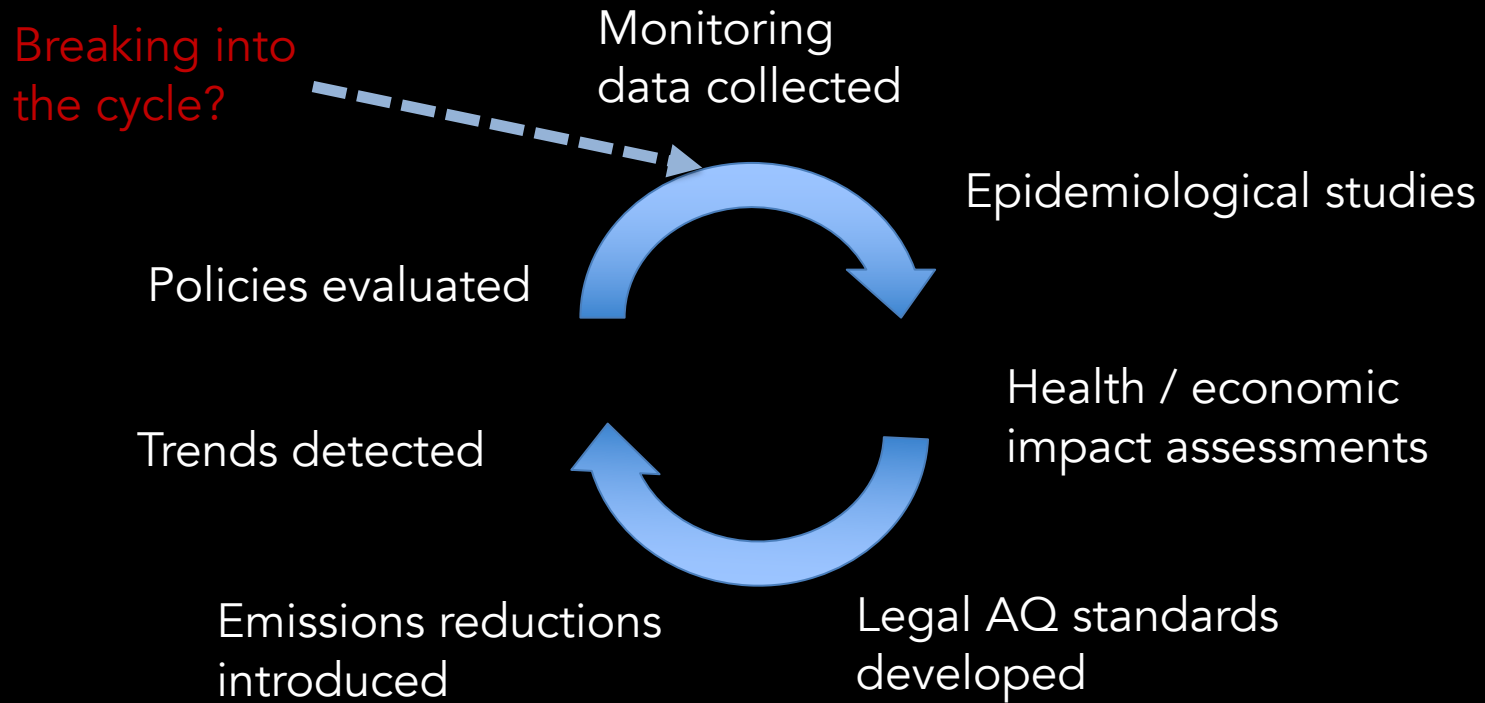
Trends and change

Discovery and foresight

Research community



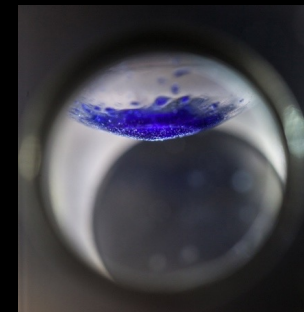
What to measure? *A chicken and egg problem*



Particulate matter – PM_{2.5}



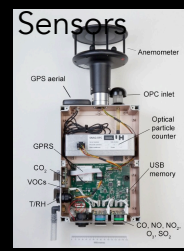
Nitrogen Dioxide



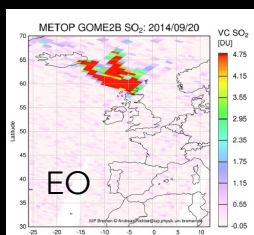
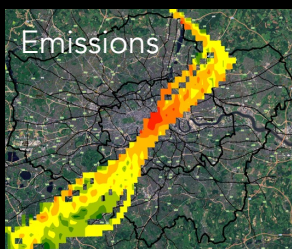
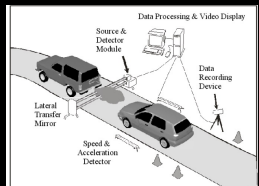
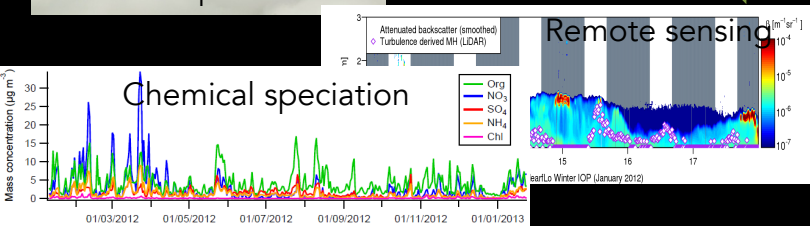
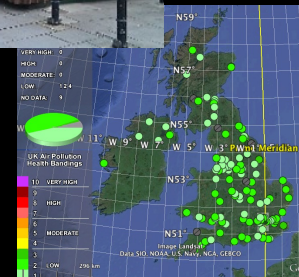
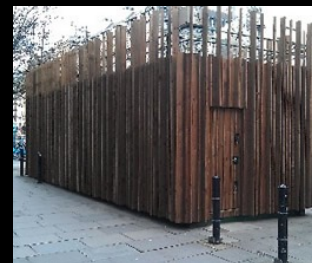
Ozone

How we measure

- Research grade capabilities
Overseas and campaign-based focus with track record of excellent outputs



- National infrastructure
Focus on meeting statutory requirements, strong emphasis on QA/QC.



Research observations in the UK



What to measure?

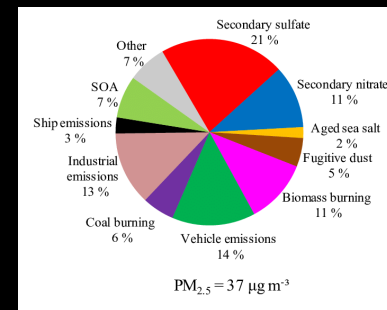
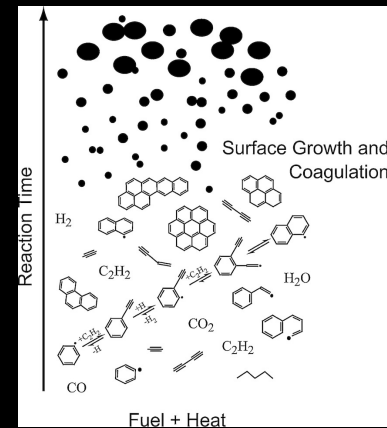
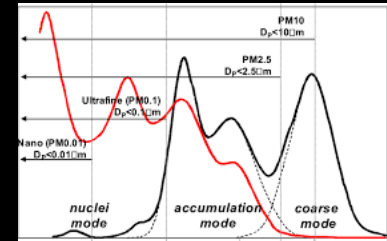
- Research community is keen on technology and instruments
- E.g. many possible PM / aerosol metrics beyond PM_{2.5}
- PM₁, PM_{0.1}, Ultra Fine Particles, Black carbon, particle number size distribution, particle number, POA, SOA, metals, PAHs, N-PAHs, PFAS, microplastics...
- All are implicated to some degree in specific or enhanced detrimental toxicological effects but limited community epidemiological evidence

The chicken and egg problem

...Without epidemiological evidence its hard to set evidence-based ambient air quality standards....

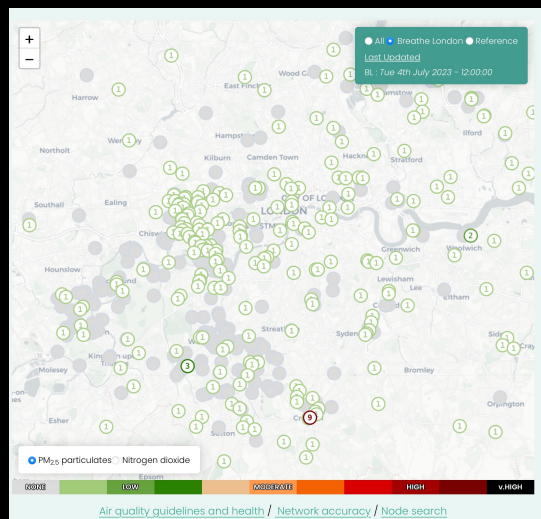
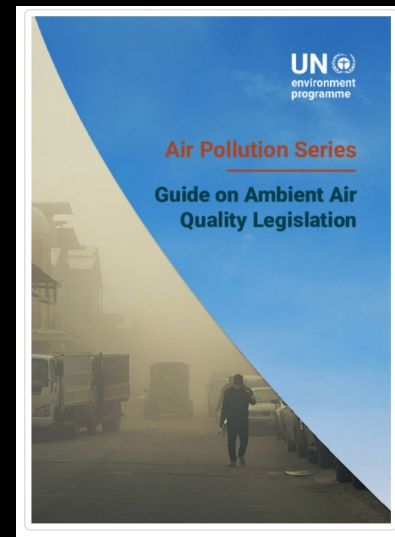
..... But without long-term observations its hard to do epidemiology and assemble the evidence....

Greater emphasis on use of advanced tools applied to long-term evidence building and foresight of new threats.



Where we measure?

- Campaigns and field sites work very hard to be 'representative' of the wider atmospheric environment.
- Existing Air Quality laws require representative ambient monitoring as a function of geography, but not demography or social factors.
- Before adding more instruments potentially change outdoor monitoring to better represent the most harmed?



Sensor networks offer a route to better reflect air quality in deprived communities

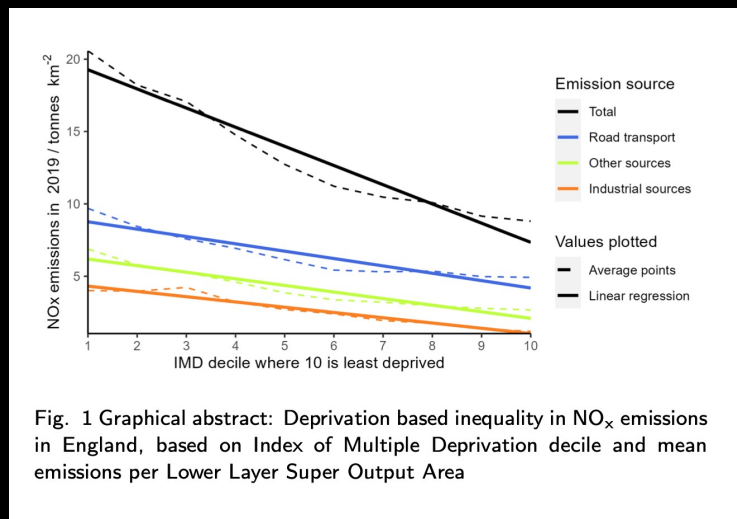


Fig. 1 Graphical abstract: Deprivation based inequality in NO_x emissions in England, based on Index of Multiple Deprivation decile and mean emissions per Lower Layer Super Output Area

Emissions in the UK are skewed towards those in the most deprived groups

Trade-offs and consequences

- Money will always be limited, so choose wisely....
- A more complex future for air quality standards, regulation and control would inevitably change where/how pollution is measured
- There will always be skills and people capacity limitations too



City monitoring station



National monitoring network station



Air Quality Supersite

UK	~500	~150	7
France	?	>900	7
Germany	?	>350	8

- More complex AQ measurements and metrics would add significant cost and might inadvertently create inequity in public protections and access to evidence

Summary

- Existing monitoring has proved remarkably durable; their longevity has supported the health evidence base
- Chicken and egg problem – what we measure impacts what standards and protections are created.
- Greater blurring of lines needed between discovery science and long-term monitoring - creates challenges around who is responsible.
- Foresight from research measurements is still very undervalued. Fix problems before they've become big ones.
- Money will always be limited so beware the unintentional introduction of inequity in access to evidence.
- Consider carefully where to measure, the quest for representativity may underserve those that are most affected.
- Measurement is both a money and a skills challenge – buying instruments is easier than running them well and getting value from data.



*New AQEG report due
autumn 2023*