

Air Pollution Exposure And Impacts Research

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**National Centre for
Atmospheric Science**

NATURAL ENVIRONMENT RESEARCH COUNCIL



What is NCAS?

- ◎ NERC's research centre for atmospheric science
- ◎ ~120 permanent staff, ~ £20M pa budget
- ◎ Long-term strategic research programmes:
 - ▶ Air Pollution
 - ▶ Climate Science and High Impact Weather
 - ▶ Global Change



FAAM research aircraft



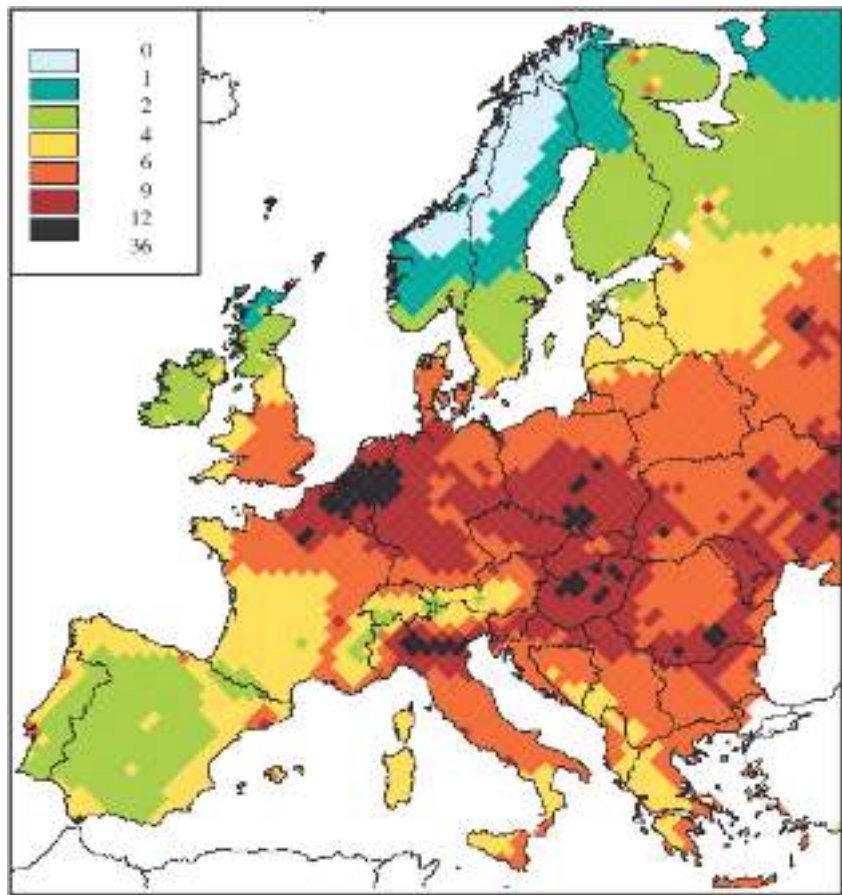
Data Centres / JASMIN HPC



Measurement facilities



Air Quality Challenge – Health Context

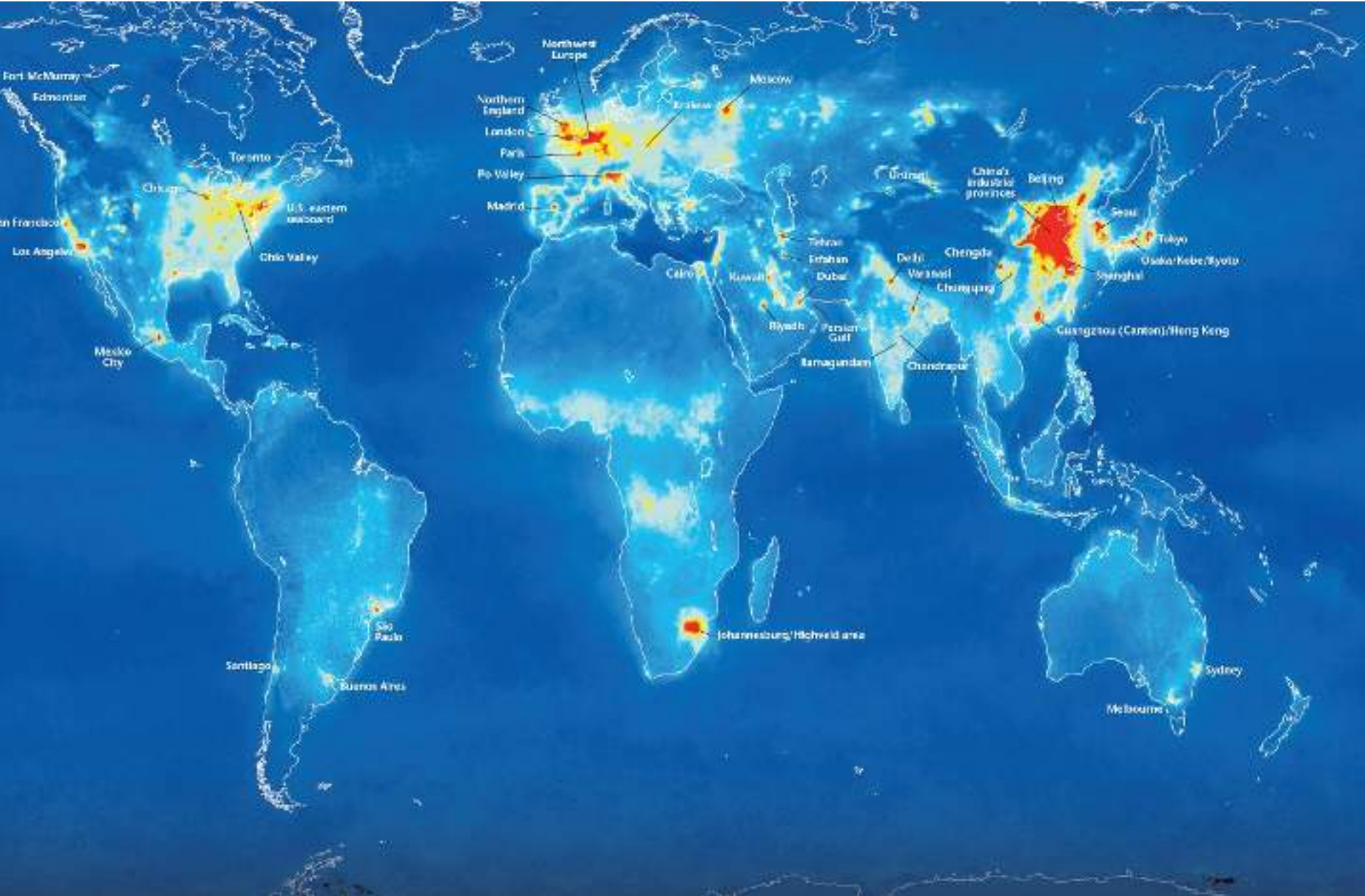


Estimated average reduction in life expectancy due to air pollution in Europe

In the UK air pollutants reduce lifespan on average by around 9 months, and by up to 8 years for the most vulnerable groupings, inducing respiratory and pulmonary diseases that affect disproportionately the elderly and children, with health costs (~£15B pa) estimated to be comparable to that of alcohol misuse.

House of Commons environmental audit committee report:
<http://www.publications.parliament.uk/pa/cm200910/cmselect/cmen/aud/229/22906.htm#a11>

Global scale problem



Large complex data problem

Thousands of individual
chemical pollutants



10,000's of surface
measurement locations

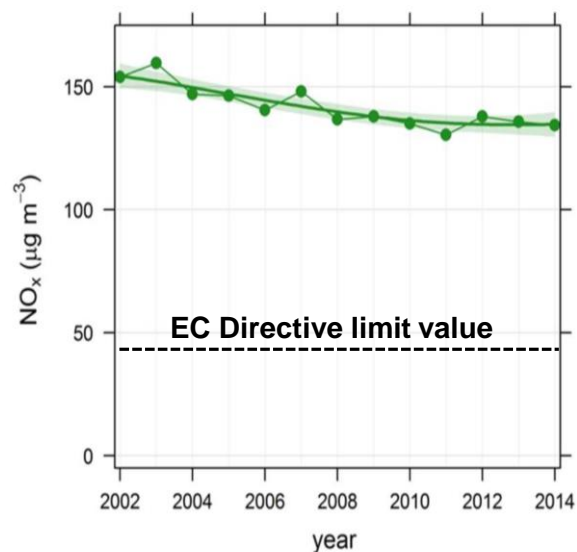
Millions of point and
diffuse sources



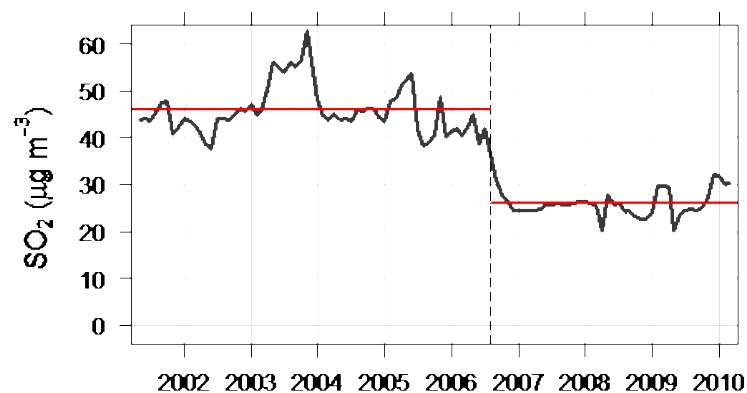
Billions of unique
receptors

Re-analysis of public data holdings

- Huge ongoing public collection of air quality data (~£5M pa)
- Collected to support compliance with legal standards
- Massively under-exploited
- Defra archives are terrible to use
- EEA data-holdings are even worse

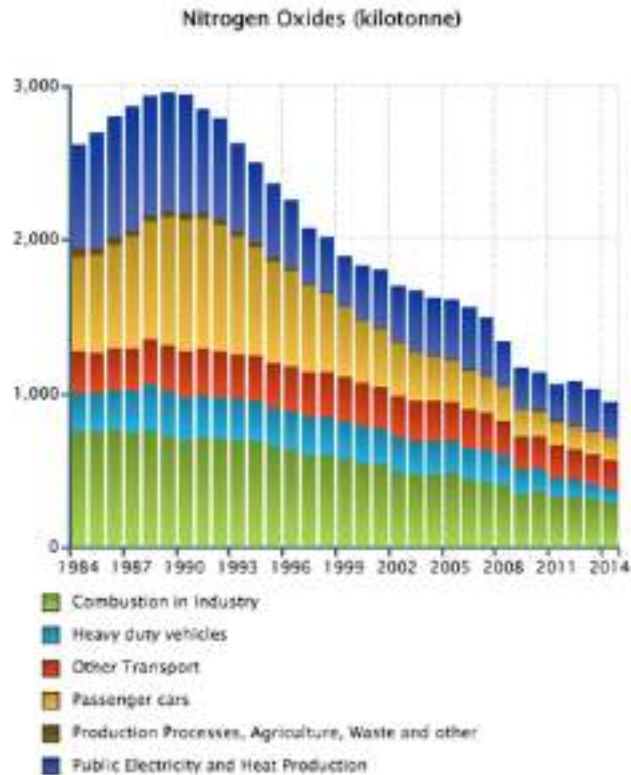


Problem trends of roadside NO₂ in central London

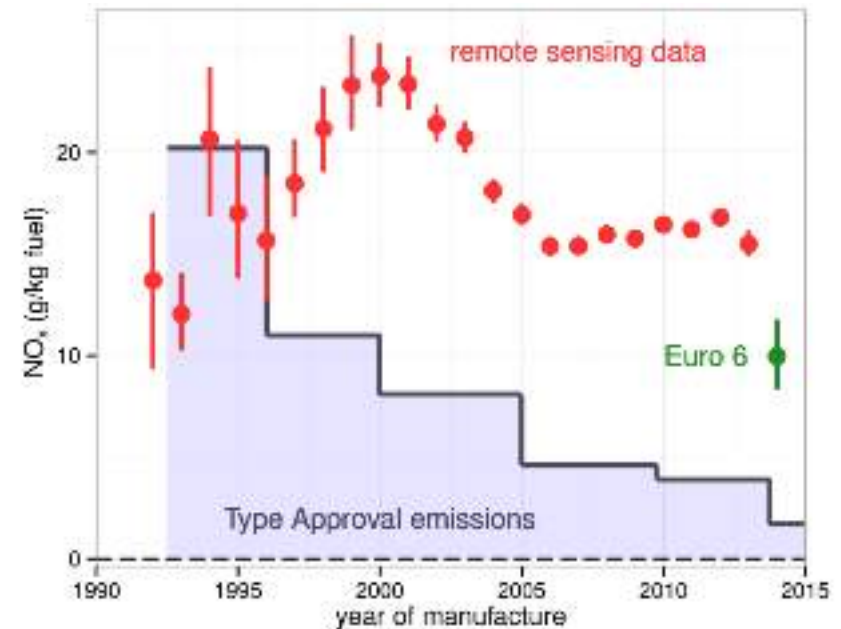


Rapid SO₂ improvements from reduced shipping sulfur content (UK Coastal monitors)

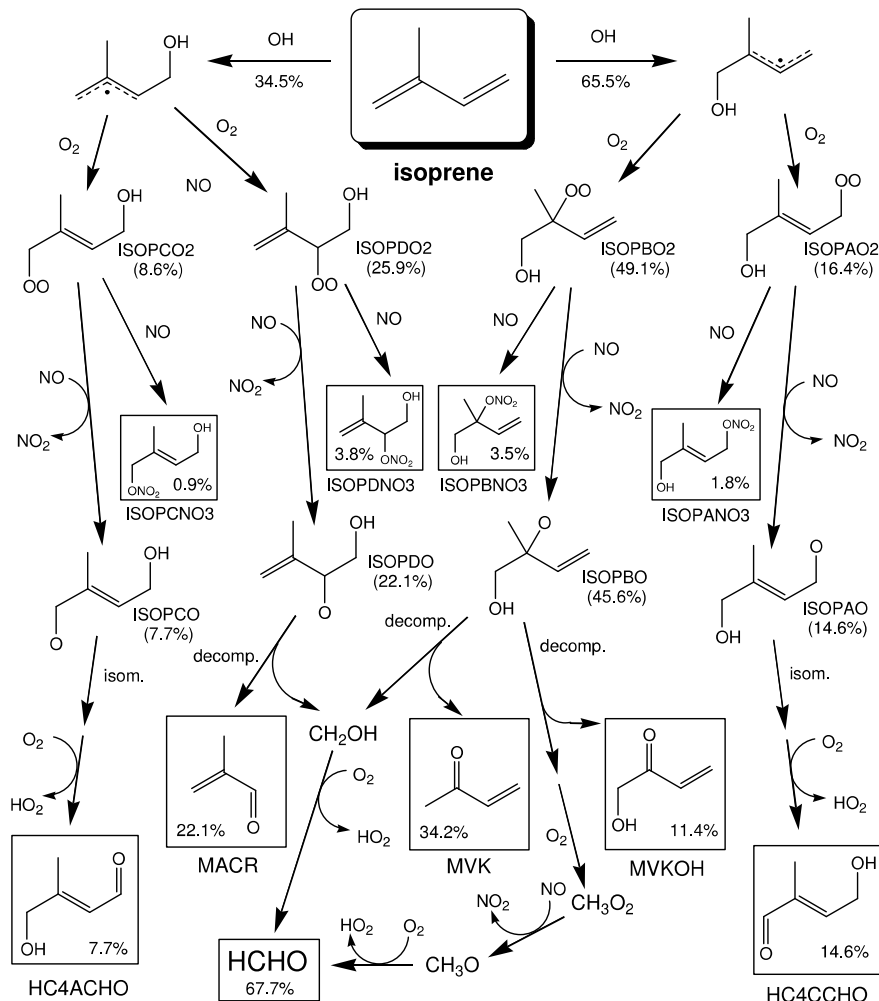
Understanding emissions



The UK has been effective in cutting many pollution emissions... just not where most people live.

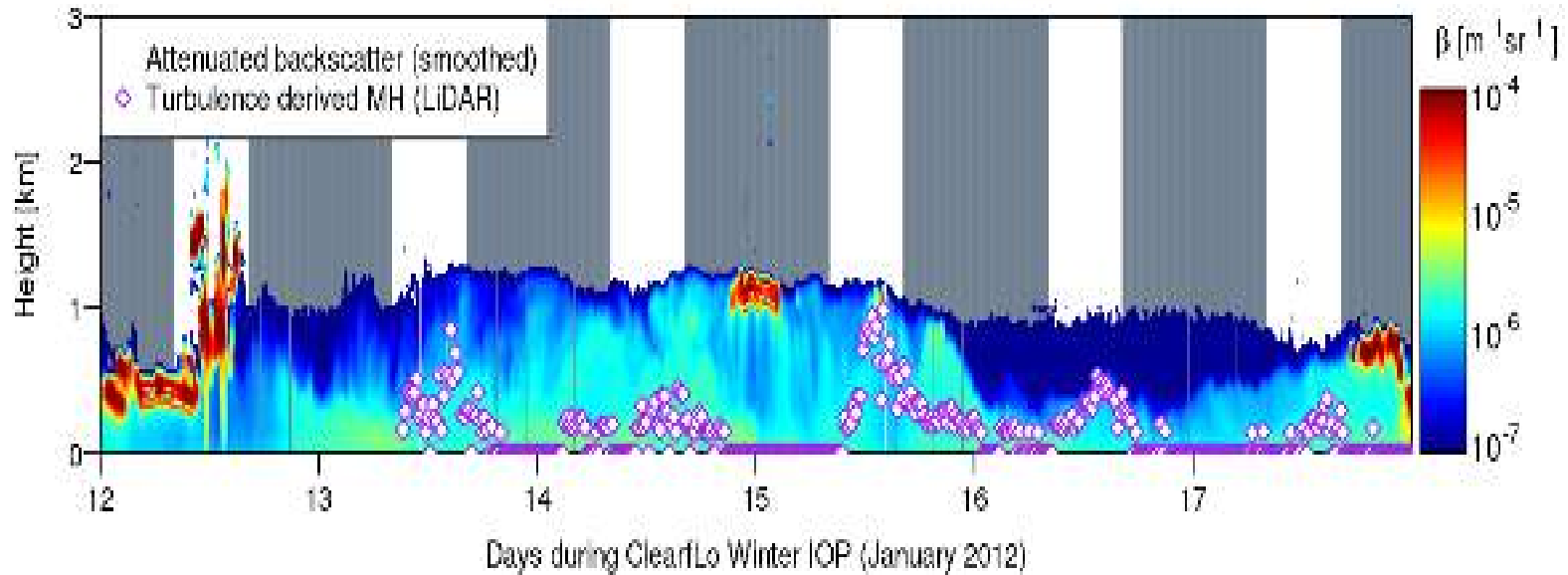


Understanding the chemistry

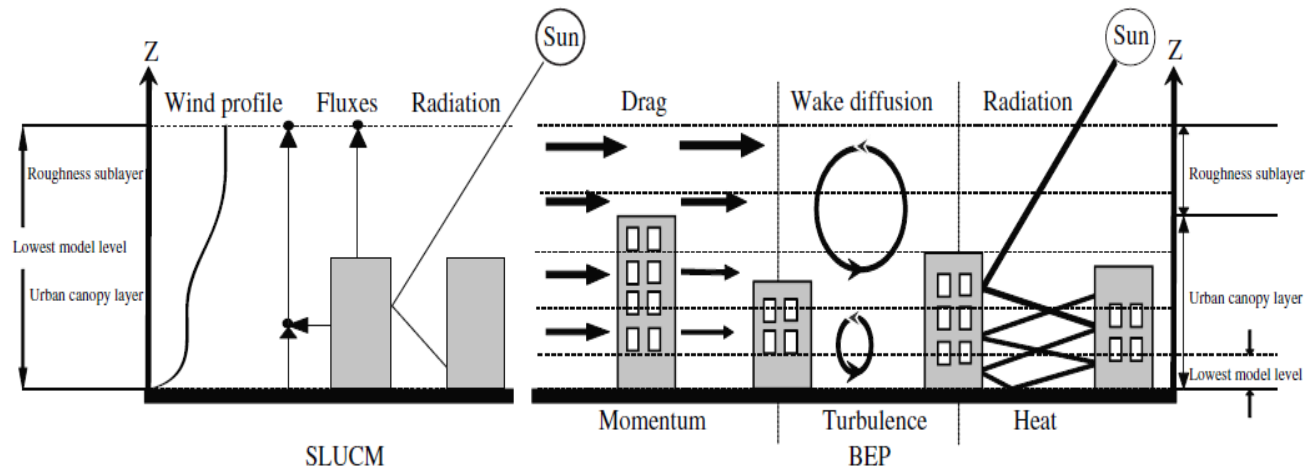


- York is home to the global reference ‘**Master Chemical Mechanism**’
- >12,000 reactions describe almost all we know about atmospheric reactions
- **Example: MCMv3.2** isoprene scheme contains **1428** reactions of **447** species

Understanding the physics

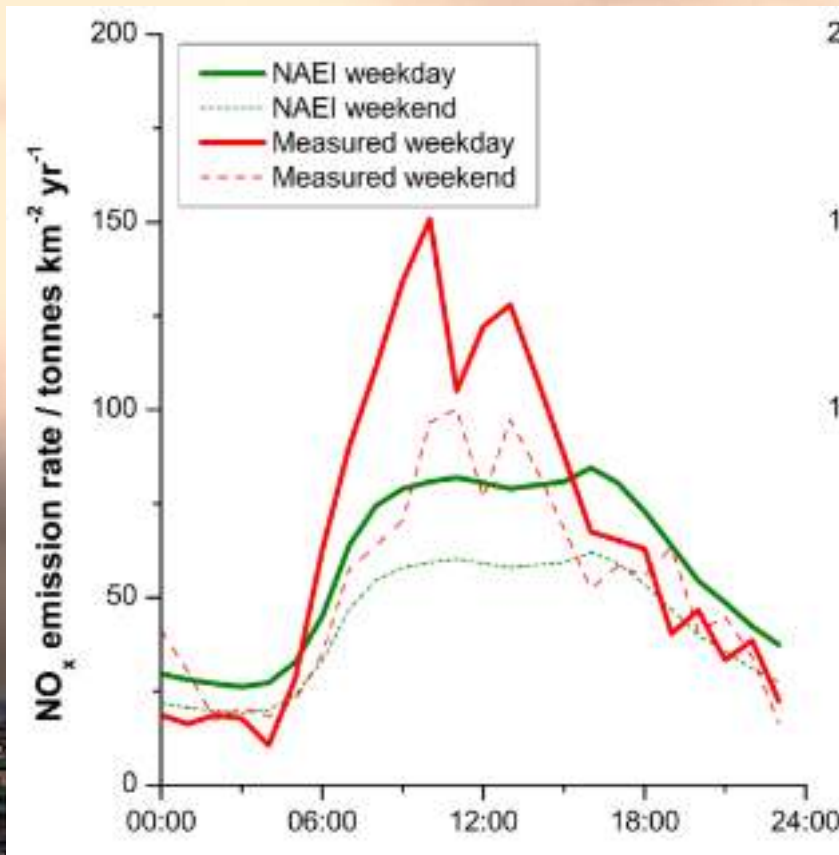


- Exposure = Emissions x chemistry x mixing/dilution
- Meteorology is complex in high-density and high-rise cities



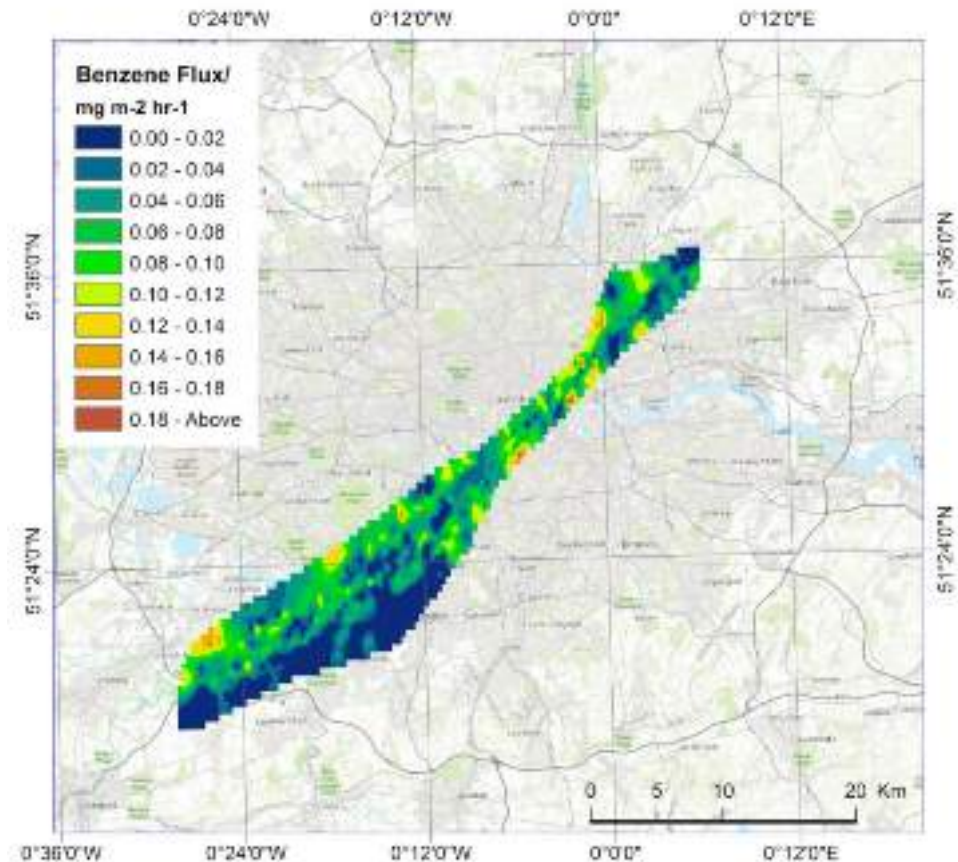
NCAS Urban observatories

Quantifying London emissions.

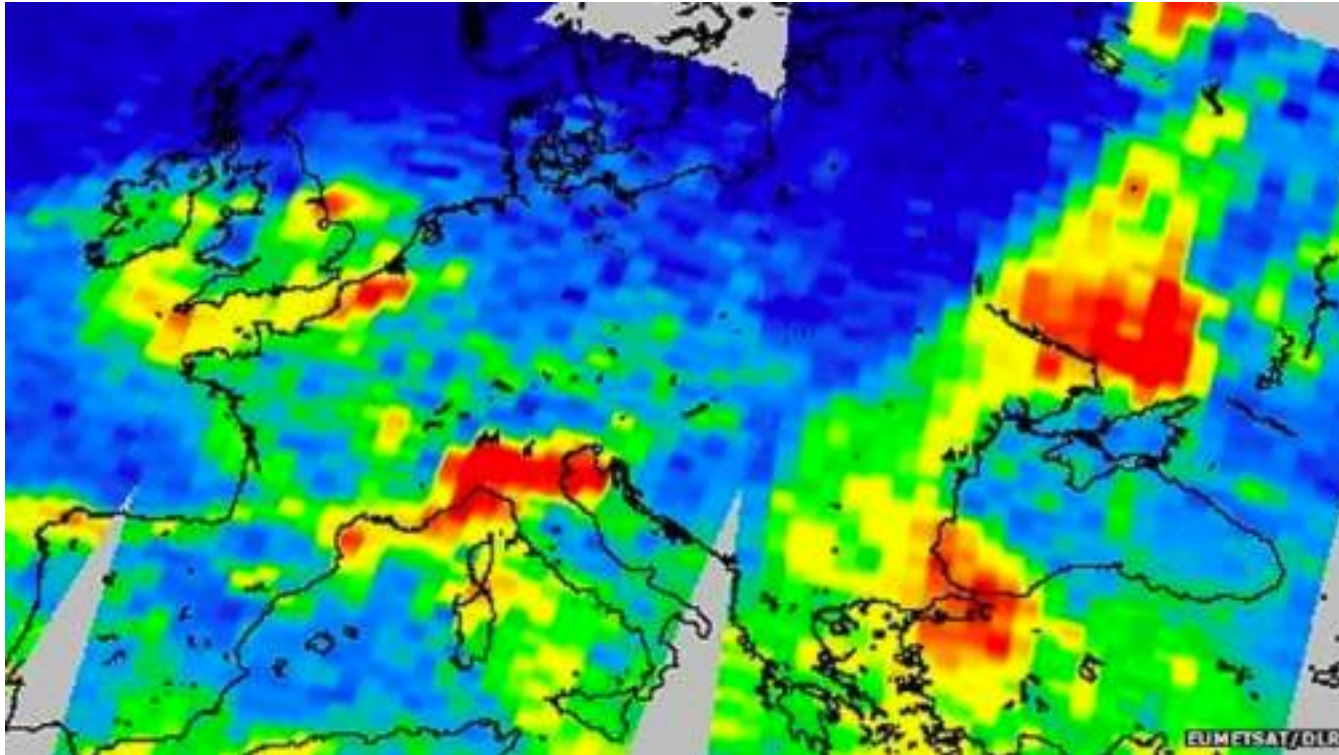


Mapping pollution from the air

- London has one of the worlds most dense air quality networks, one monitor / 100,000 people.
- Surface monitors still leave many gaps where little is known
- Siting of surface monitors follows legal requirements, not research needs

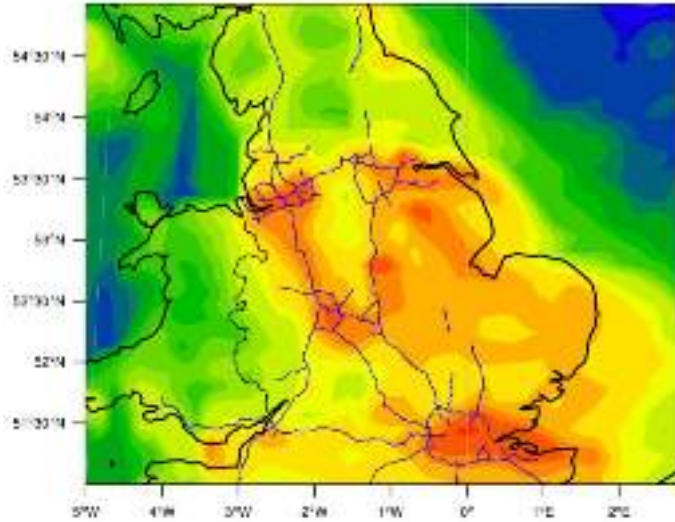


Earth Observation

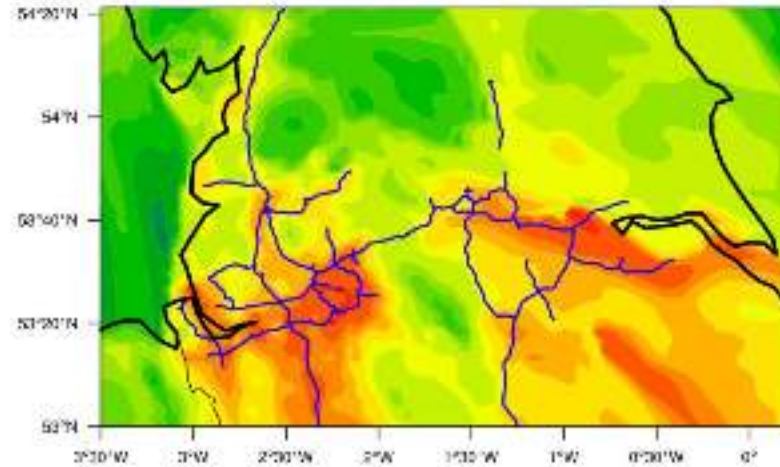


- High multi-billion euro investments in Sentinel satellites, but exploiting this data is in its infancy
- Some issues: clouds, surface vs column, spatial resolution...

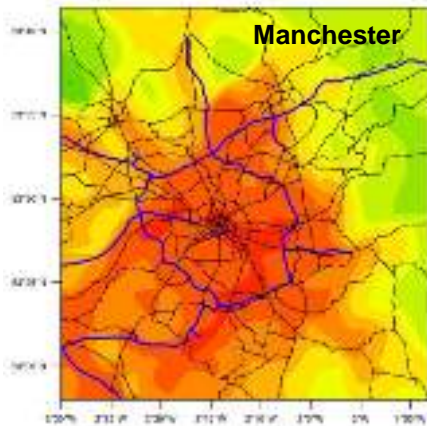
Modeling and forecasting



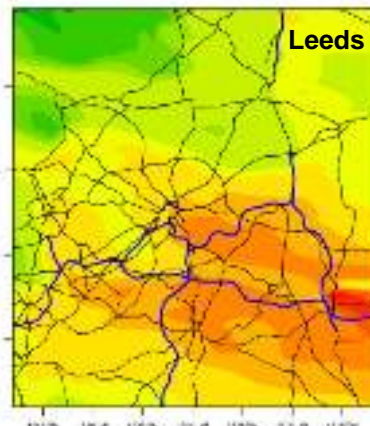
Regional domain 12 x 12km



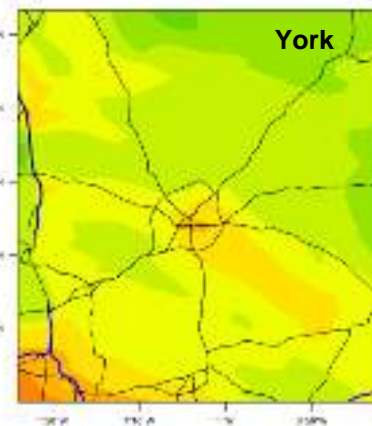
Pennine domain 2.4 x 2.4km



Manchester



Leeds



York

City domains 800m x 800m

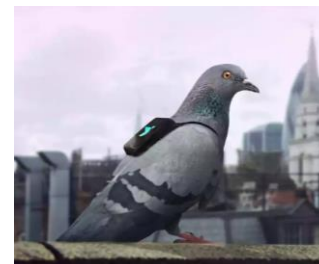
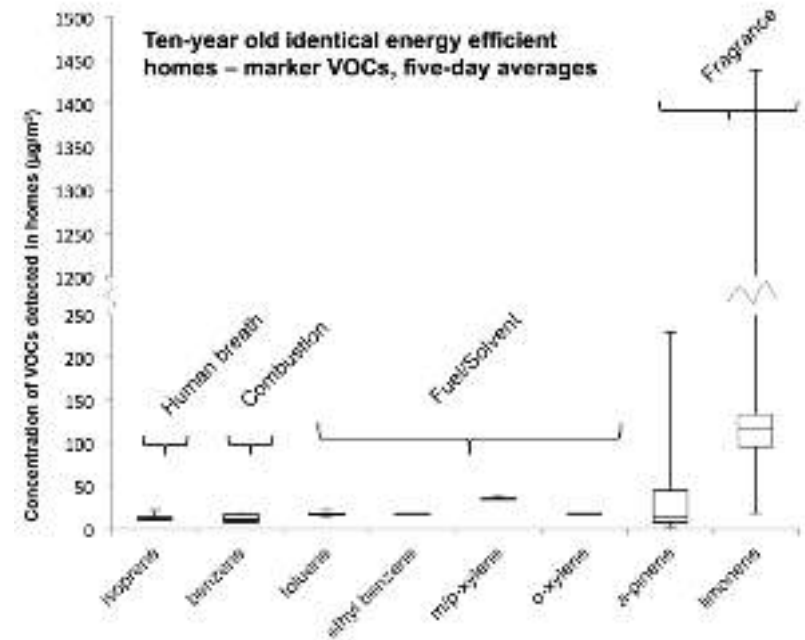
- Rebalancing of emphasis to other UK cities outside London
- London not always the optimal case study for pollution/health research

Personal exposure

- Increased emphasis on indoor air as a route to exposure
- Changing chemical blends
- Energy efficiency vs indoor air quality
- Decoupling of indoor and outdoor pollution

Sensors and citizen science

- Lots of hype and new sensor products
- Very questionable data quality
- Publication bias
- Lack of research engagement
- But huge longer term research opportunity



Pigeon patrol takes flight to tackle London's air pollution crisis

Flock of racing pigeons equipped with pollution sensor and Twitter account take to the skies in bid to raise awareness of capital's illegally dirty air



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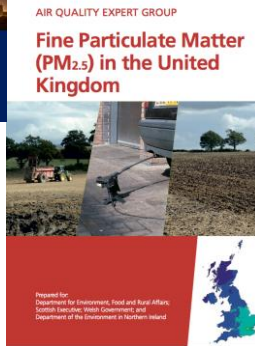
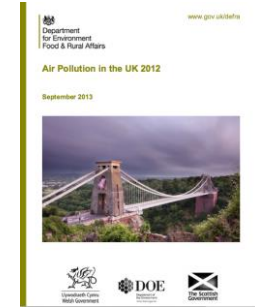
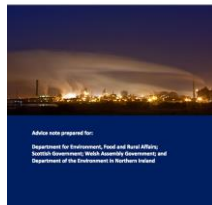
Air pollution monitors fitted to schools

NCAS research to policy and advice

- An established range of local, national, regional and international mechanisms.



AIR QUALITY EXPERT GROUP
**UNDERSTANDING PM₁₀
IN PORT TALBOT**



Local and National
Advisory reports

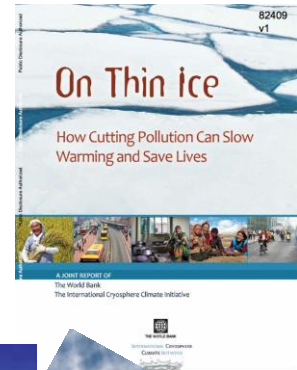
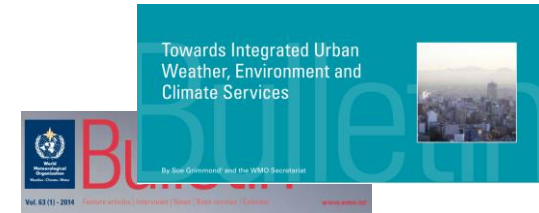
Defra AQEG



Regional advice
e.g. EU - level



International
advice and
policy, e.g. UNEP,
WMO



Journal outputs