Launching Urban Air Quality Monitoring into the 21st Century

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11th Regional Networking Event

15 May 2019

CATAPULT Satellite Applications

CATAPULT Connected Places

NERC SCIENCE OF THE ENVIRONMENT

UNIVERSITY OF LEICESTER

EPSRC

The Problem

Air pollution is a **global issue** that affects us all

One in six people dying of lung cancer in UK are non-smokers, experts say

Scientists blame rise on car fumes, secondhand smoke and soot from wood-burning stoves

▲ Outdoor air pollution accounted for 8% of lung cancer cases in non-smokers, researchers said. Photograph: Jinny Goodman/Alamy

Growing numbers of non-smokers are being diagnosed with lung cancer, many at a stage when it is incurable, experts in the disease have revealed.

The Guardian

[26 April 2019]

The Problem

The UK appears to take some aspects of air quality seriously

Energy industry

Britain passes one week without coal power for first time since 1882

Landmark follows government pledge to phase out coal-fired electricity by 2025

▲ Twilight for coal: Rugeley power station in Staffordshire, which is now being demolished. Photograph: Northern Nights Photography/Alamy Stock Photo

Jasper Jolly

Wed 8 May 2019 14.05 BST

earch ~ The Guardian UK edition ~

The Problem

Others less so

Scrapping UK grants for hybrid cars 'astounding', says industry

Government ends incentives to buy new hybrids and cuts those for electric vehicles

▲ The plug-in grant has since 2011 knocked £4,500 off the price of a new electric car in the UK. Photograph: Alamy

Gwyn Topham *Transport correspondent*

The Guardian

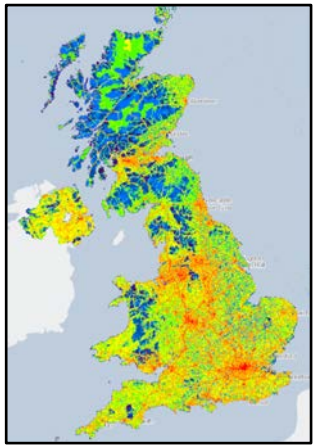
The Current Approach

Air Pollution is Challenging to Monitor:

- **Austerity**
  (need to do more for less)
- **Costly**
  (£52k-£173k per monitor)
- **Laborious**
- Low-cost sensors unreliable
- Models uncertain
  (emissions, trends, chemistry)
- Large **gaps**
  (space, time, frequency, pollutants)

UK network

UK inventory



Impacts efficacy of policy and leads to large fines (>£60M)

The Solution

Earth observations are the only viable solution to address this global challenge!

Tool for Recording and Assessing the City Environment

The Solution

Sensors in space have been providing us with petabytes of data for more than 2 decades

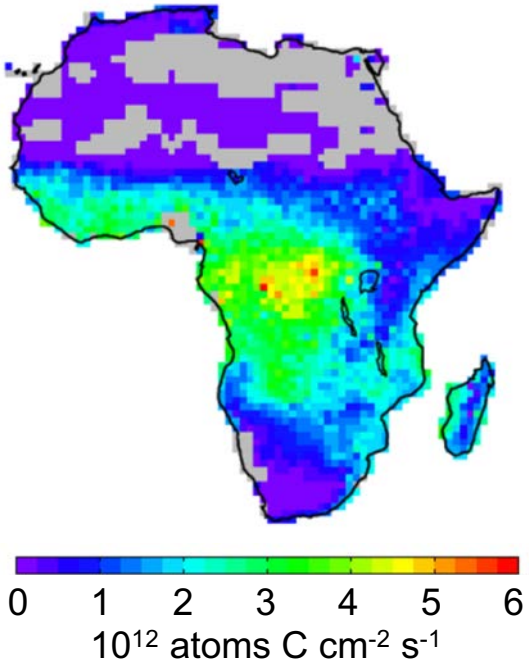
Year	95	96-01	02	03	04	05	06	07-10	11	12	13-15	17	18	19+
GOME														
SCIAMACHY														
OMI														
GOME-2														
OMPS														
TROPOMI														
Sentinel-5														
Sentinel-4														
GEMS														
TEMPO														

But the data from these are cumbersome to use

The Solution

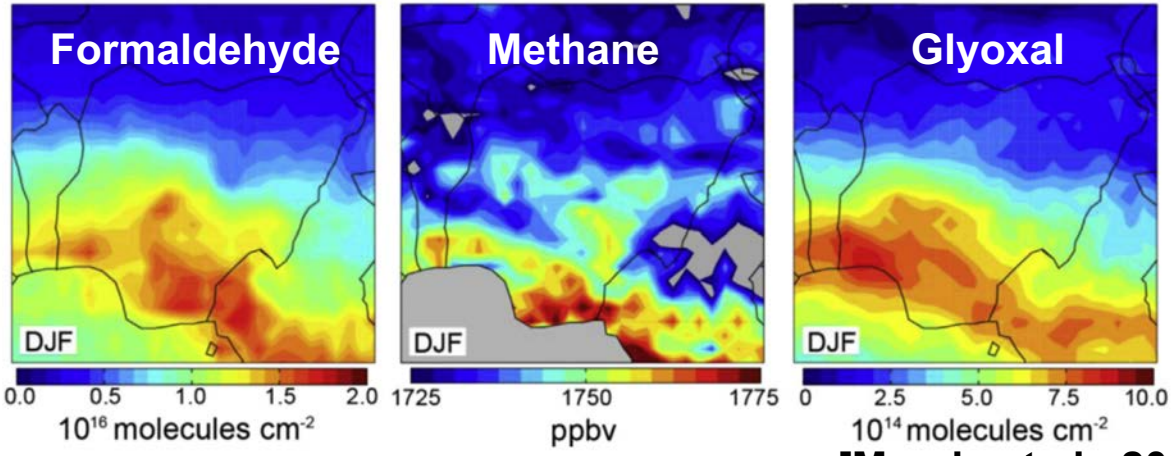
Widespread use in research; limited application in policy

Biogenic Emissions from Trees in Africa



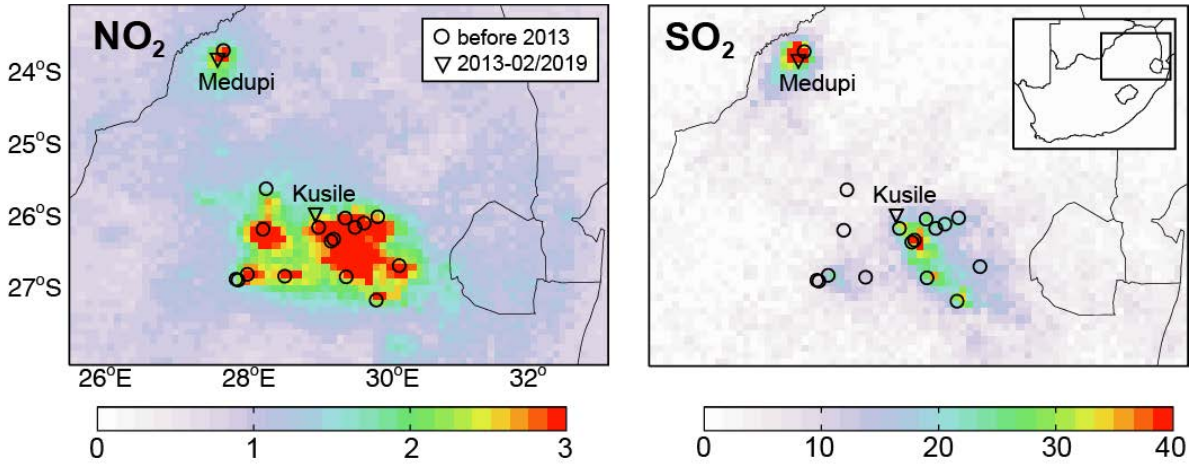
[Marais et al., 2012]

Identify Pollution Sources in Nigeria



[Marais et al., 2014]

Combustion Emission Hotspots in South Africa



[Marais et al., 2019]

The Solution

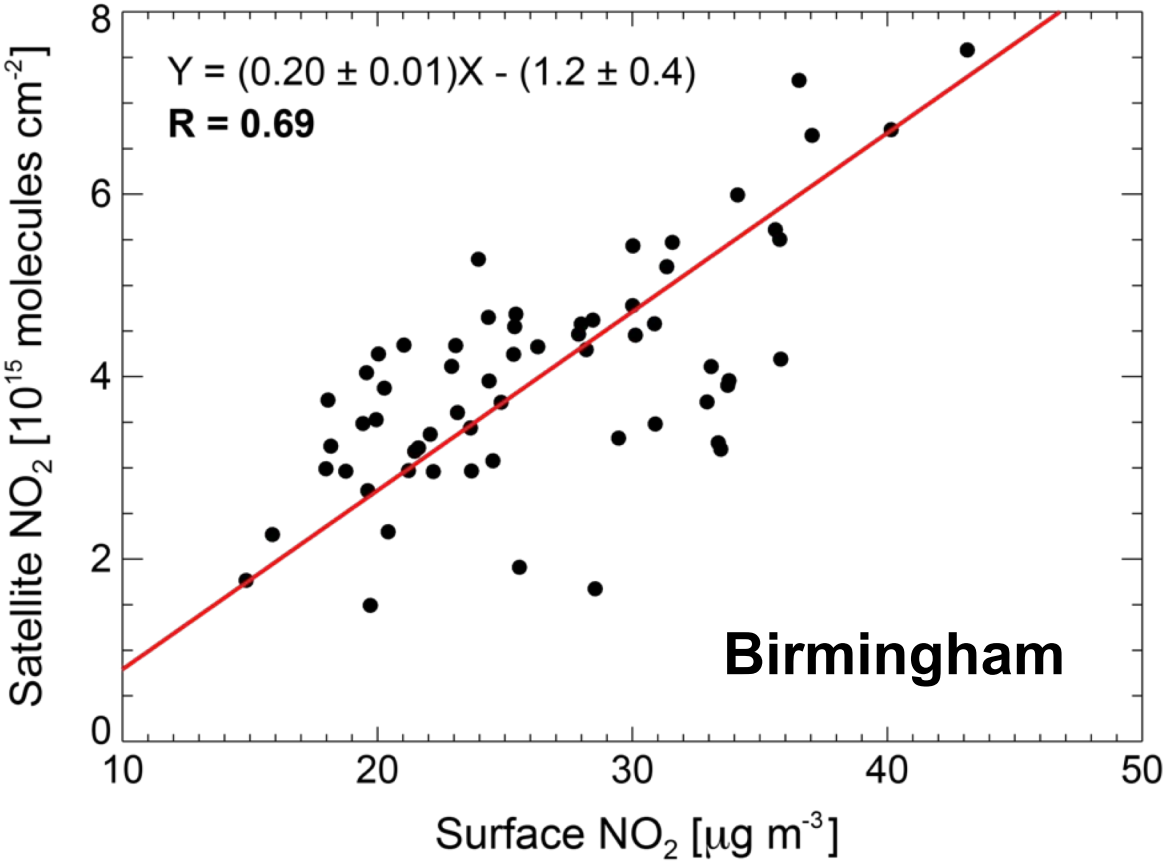
Unique Selling Point:

A data transformation and interpretation service that I provide to convert large and cumbersome EO into useful information that end users can use to understand and interpret air quality and green space health.

The Product

Quality Assurance:

Regress satellites against surface observations

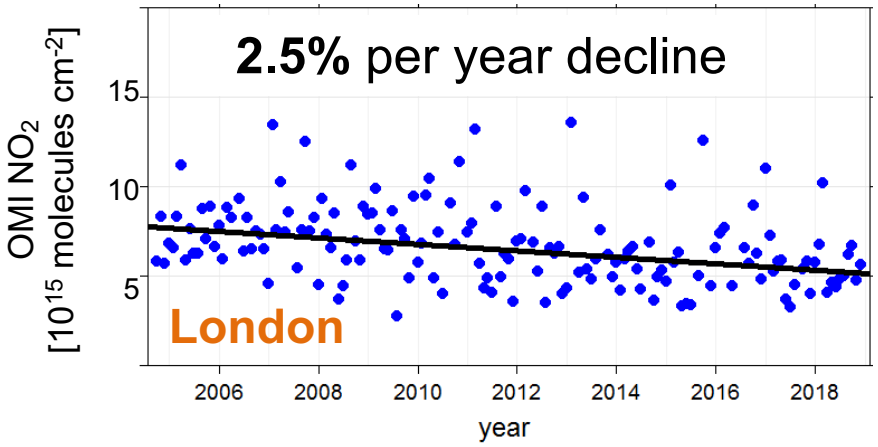


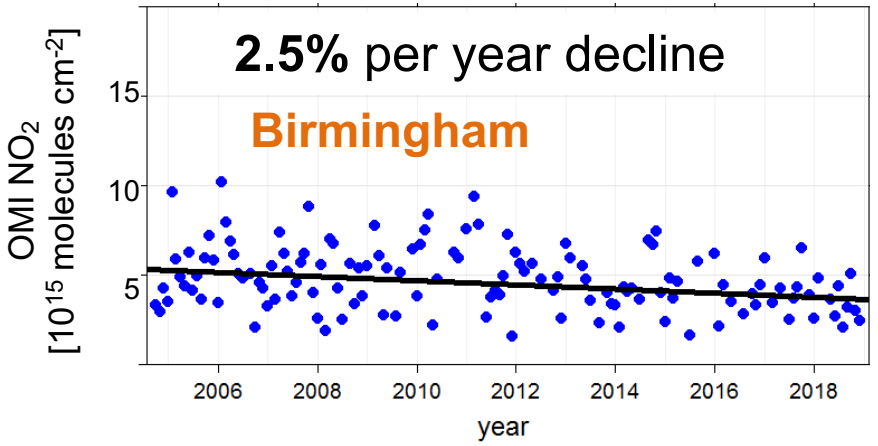
Pearson's correlation coefficient (R = 0.69) indicates consistency

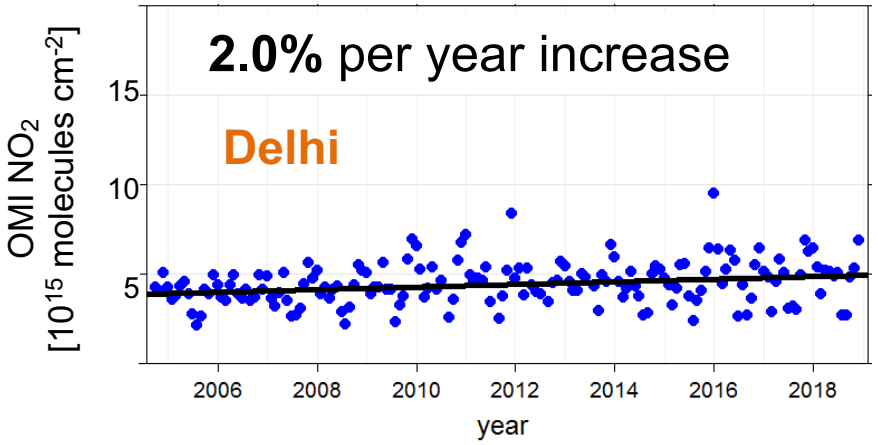
The Product

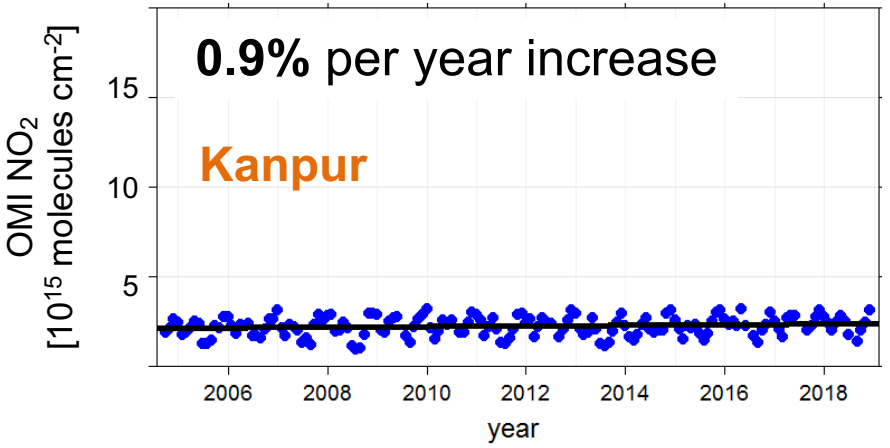
Obtain Long-term Trends:

Nitrogen Dioxide (NO_2):





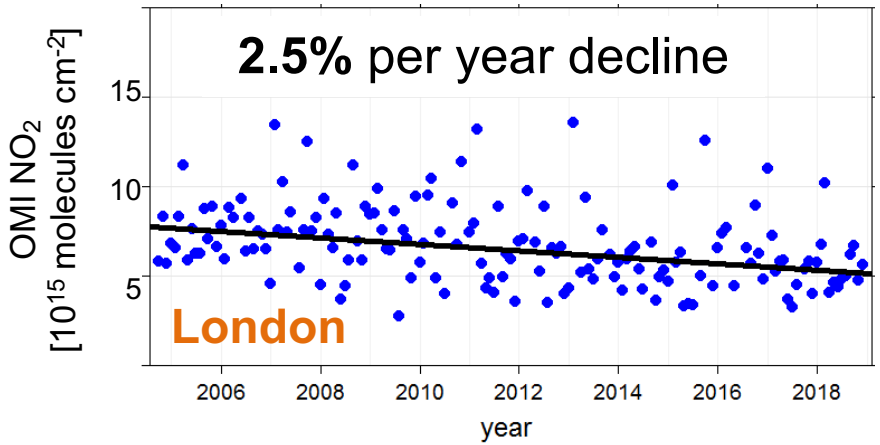




NO_2 is toxic at high concentrations and reacts to form secondary pollutants

The Product

Assess Targets:



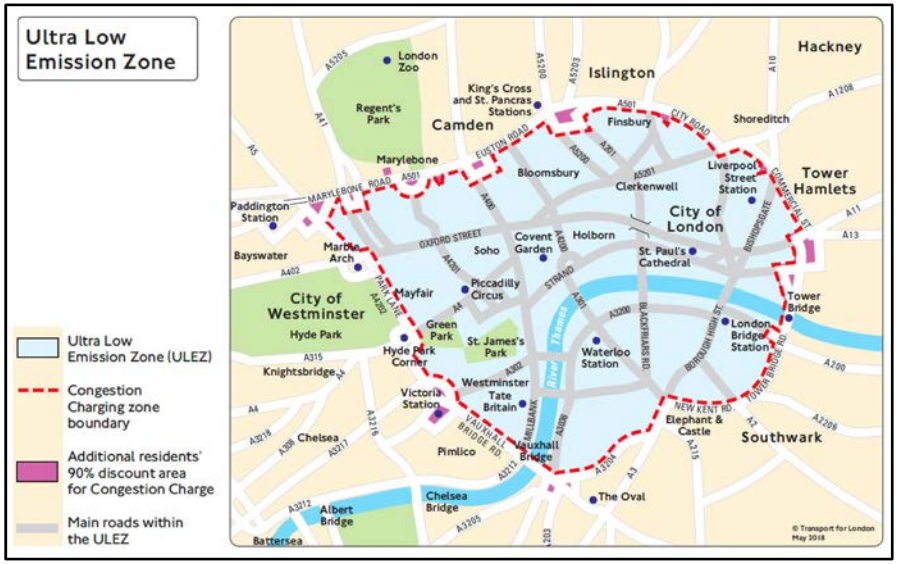
NO_2 standard for UK and India:
40 μg m^{-3} (annual mean)

London Marylebone site:
85 μg m^{-3} in 2018
(take 45 years to be compliant)

Requires draconian measures

Will the ULEZ be enough?

Use TRACE to monitor efficacy of ULEZ



Product Progress

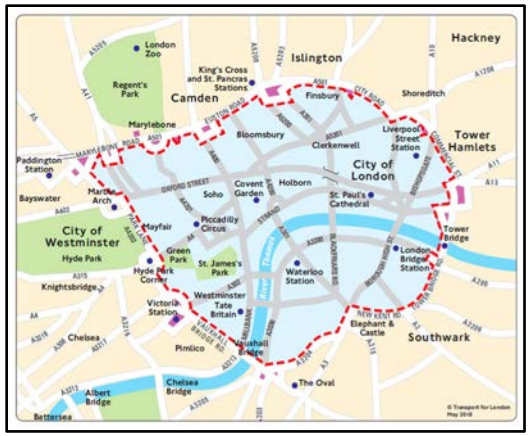
Finalist in the Copernicus Masters Challenge

Providing outputs to **end users**:

Birmingham City Council

DEFRA

Monitor and assess success of the **ULEZ**



Thank you for your time!

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