

# City Sustainability with Satellites



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**Future Cities Catapult**

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# The Problem

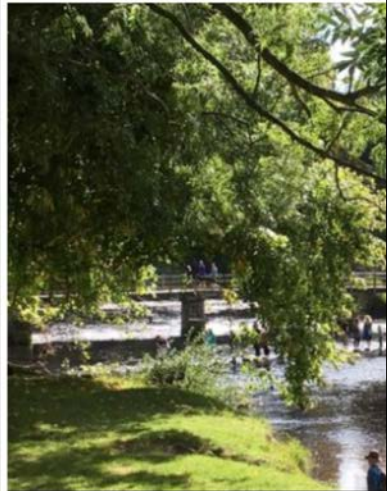
Science & Environment

BBC

## Green spaces worth £2.2bn to public health in England

By Mark Kinver  
Environment reporter, BBC News

20 September 2016



Enjoying the great outdoors has been shown to be good for health

Health

BBC

## Air pollution may harm cognitive intelligence, study says

28 August 2018 227



China is a developing country with severe air pollution in its cities

Health

BBC

## Low levels of air pollution linked to changes in the heart

By Alex Therrien  
Health reporter, BBC News

3 August 2018

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GETTY IMAGES

Worldwide, air pollution attributed to **9 million premature deaths** each year

## **Track Record:**

Associate Professor in EO at the UK EO hub  
Expertise in air quality modelling, atmospheric chemistry, data analytics

Harvard PhD and postdoc

Fulbright scholar

5 years experience

NERC-funded academic residency at the Catapult

26 academic publications (4 Highly Cited)



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## **Support:**

**University:** business training

**PhD student:** data analysis (current PhD student is **Karn Vohra**)

**End Users:** city councils, national agencies, air quality consultants

**Catapult:** design, access to the market and end users



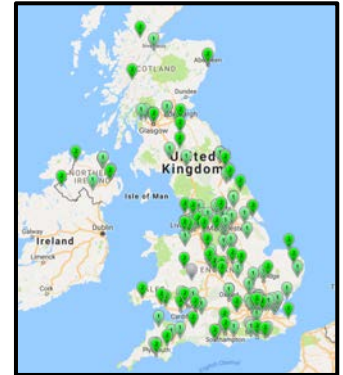


# The Current Approach

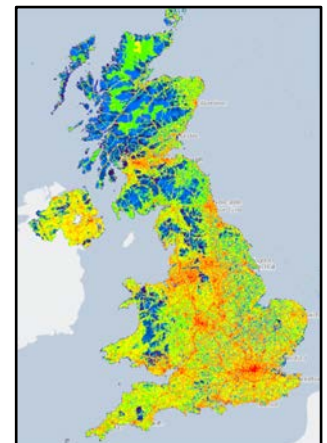
## Shortcomings:

- **Austerity** (need to do more for less)
- **Costly** (£52k-£173k per monitor)
- **Laborious**
- Large **gaps** (space, time, frequency, pollutants)
- **Large uncertainties** (emissions, trends)
- **EO cumbersome** (large, complex, challenging to access and visualise)
- No or little **in-house** expertise to use EO
- Limited **validation** of air quality tools (models and inventories)

**UK network**



**UK inventory**



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

# The Solution

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



# TRACE

**Tool for Recording and Assessing the City Environment**

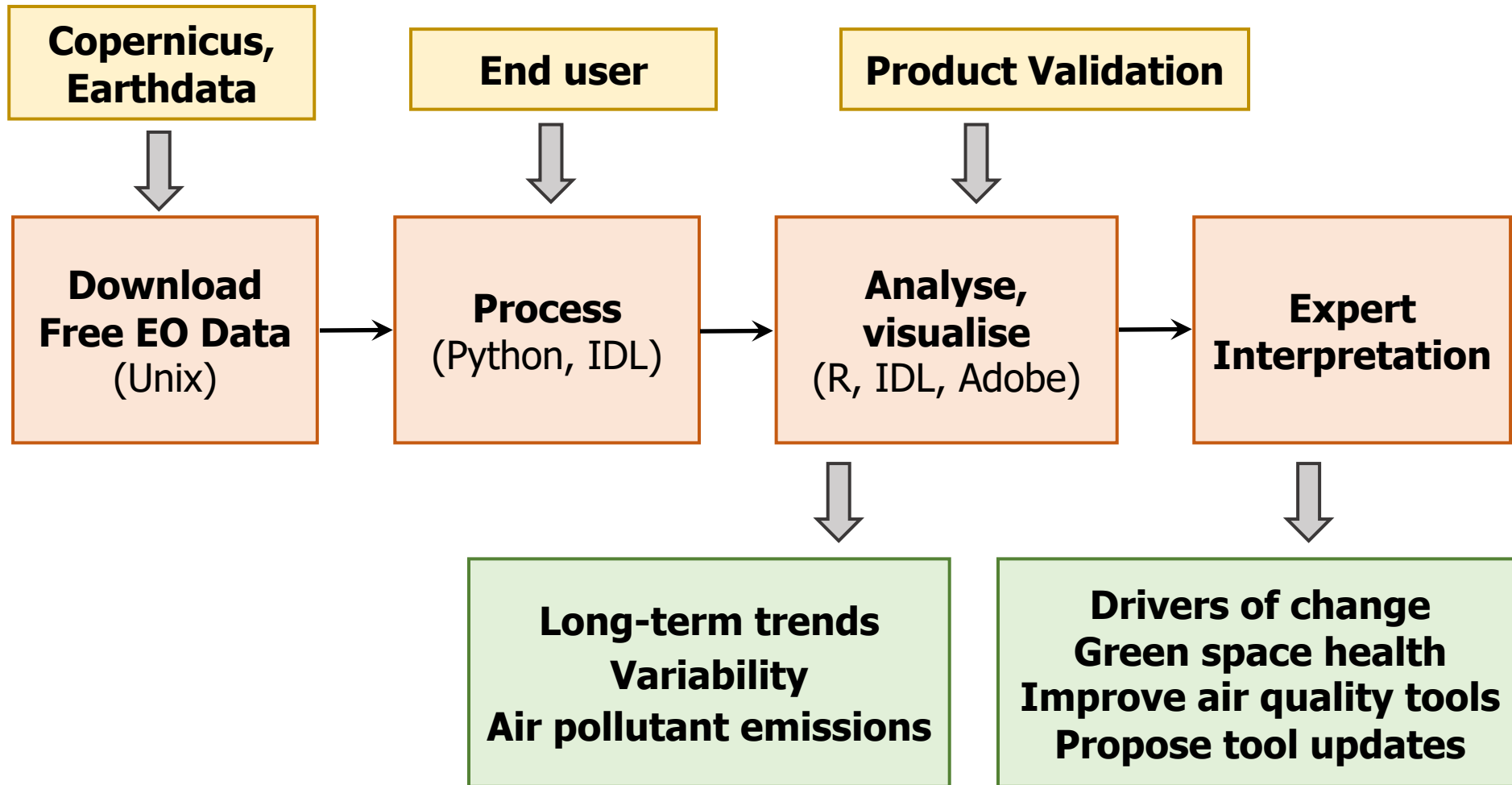


# TRACE

## **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 Value Chain

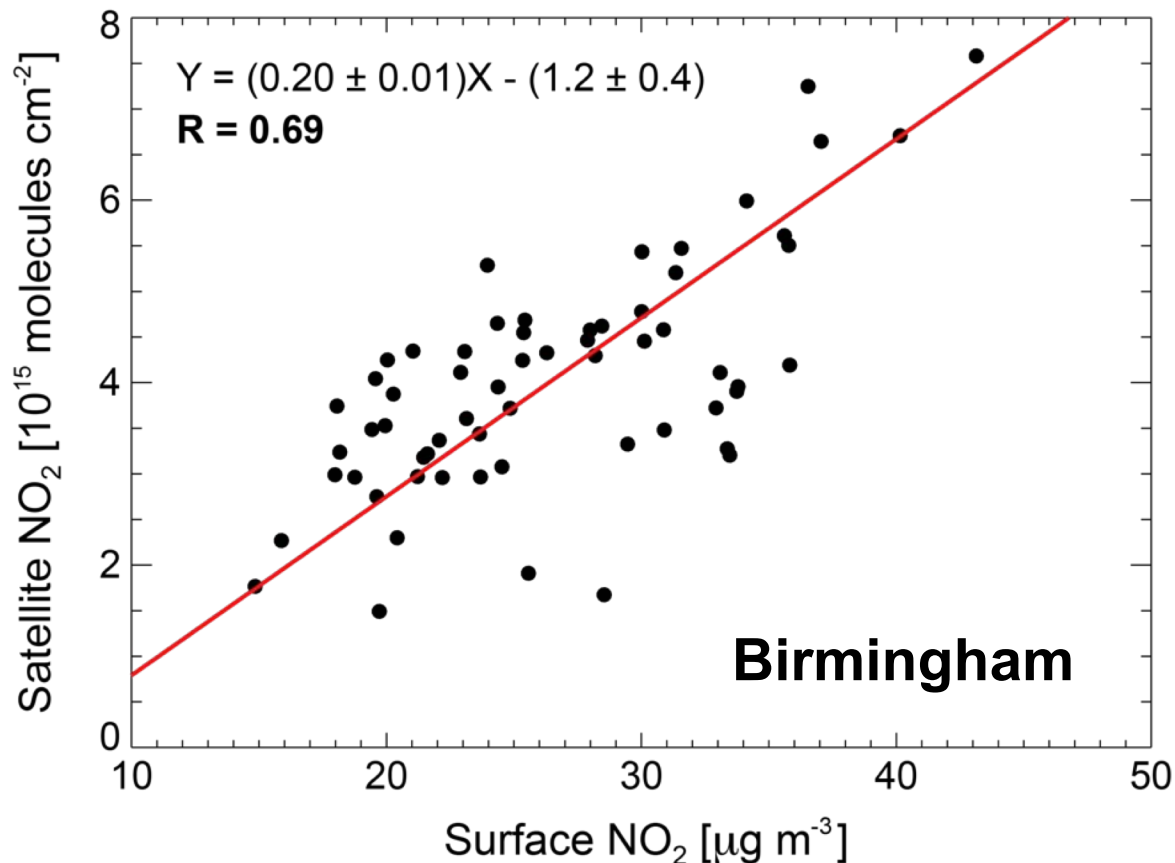


**Efficient, versatile, near fully automated**  
**Substantial added value**

# The Product

**Validate:**

**Regress satellites against surface observations**

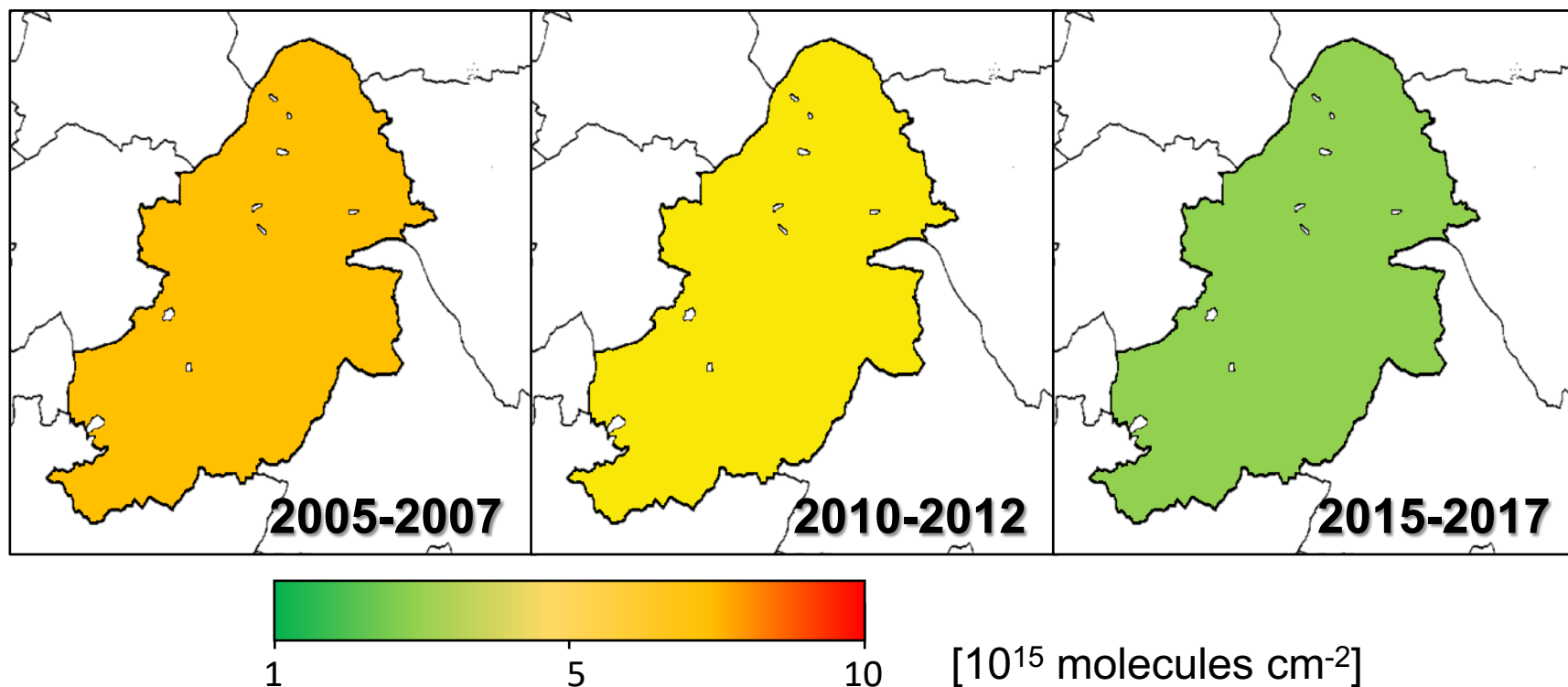


Pearson's correlation coefficient ( $R = 0.69$ ) indicates consistency



## Obtain Long-term Trends:

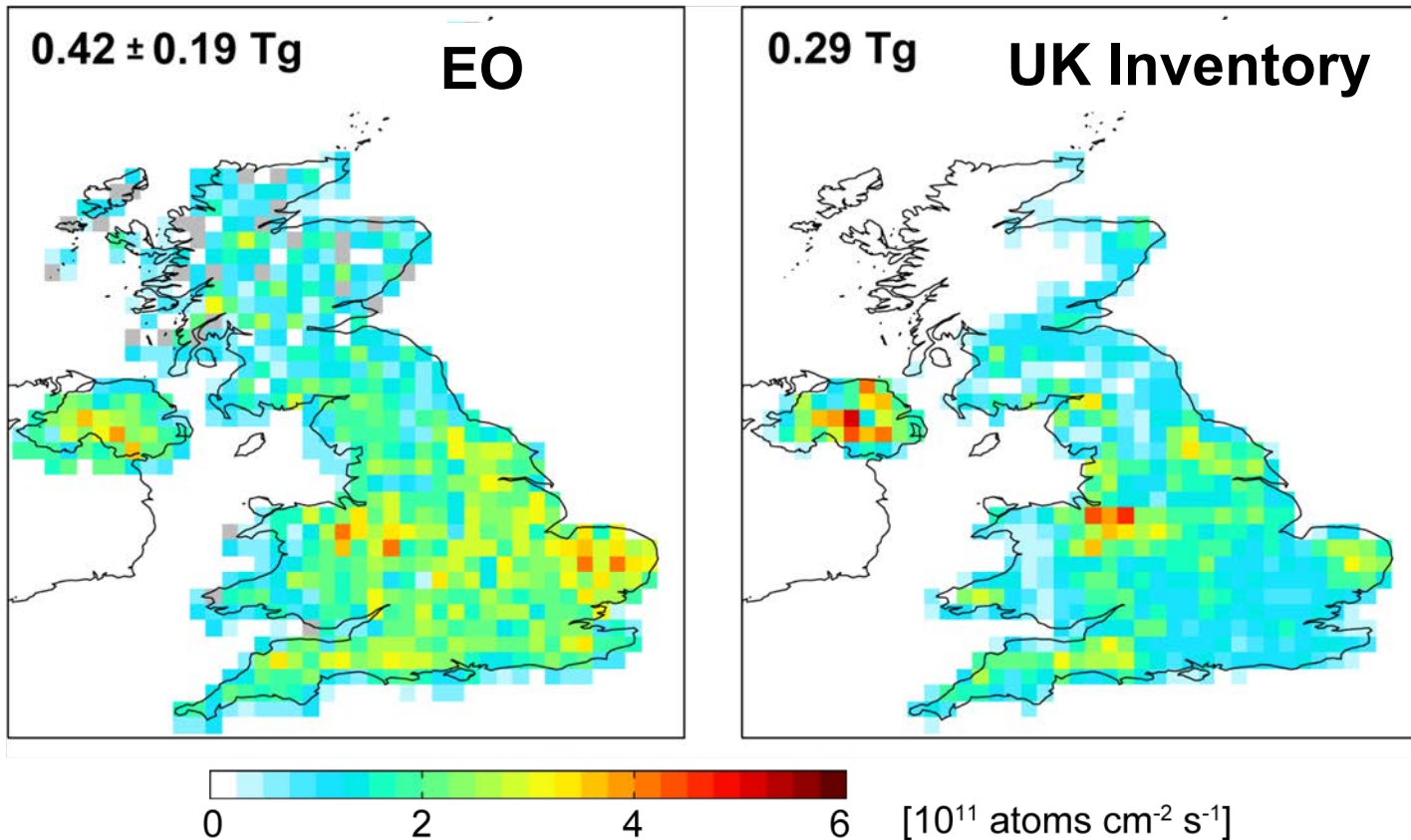
**Decline in the air pollutant NO<sub>2</sub> over Birmingham**  
**3.4% per year decrease**



NO<sub>2</sub> is toxic at high concentrations and reacts to form secondary pollutants

## Estimate Emissions:

### Ammonia Emissions



Ammonia is mostly from agriculture and is a precursor of fine particles

# The Product

## Interpret:

- Satellite observations reproduce month-to-month variability in the surface observations, giving us confidence we can use EO to assess changes in air quality in cities

**Confidence in the product**  
**Value for money**

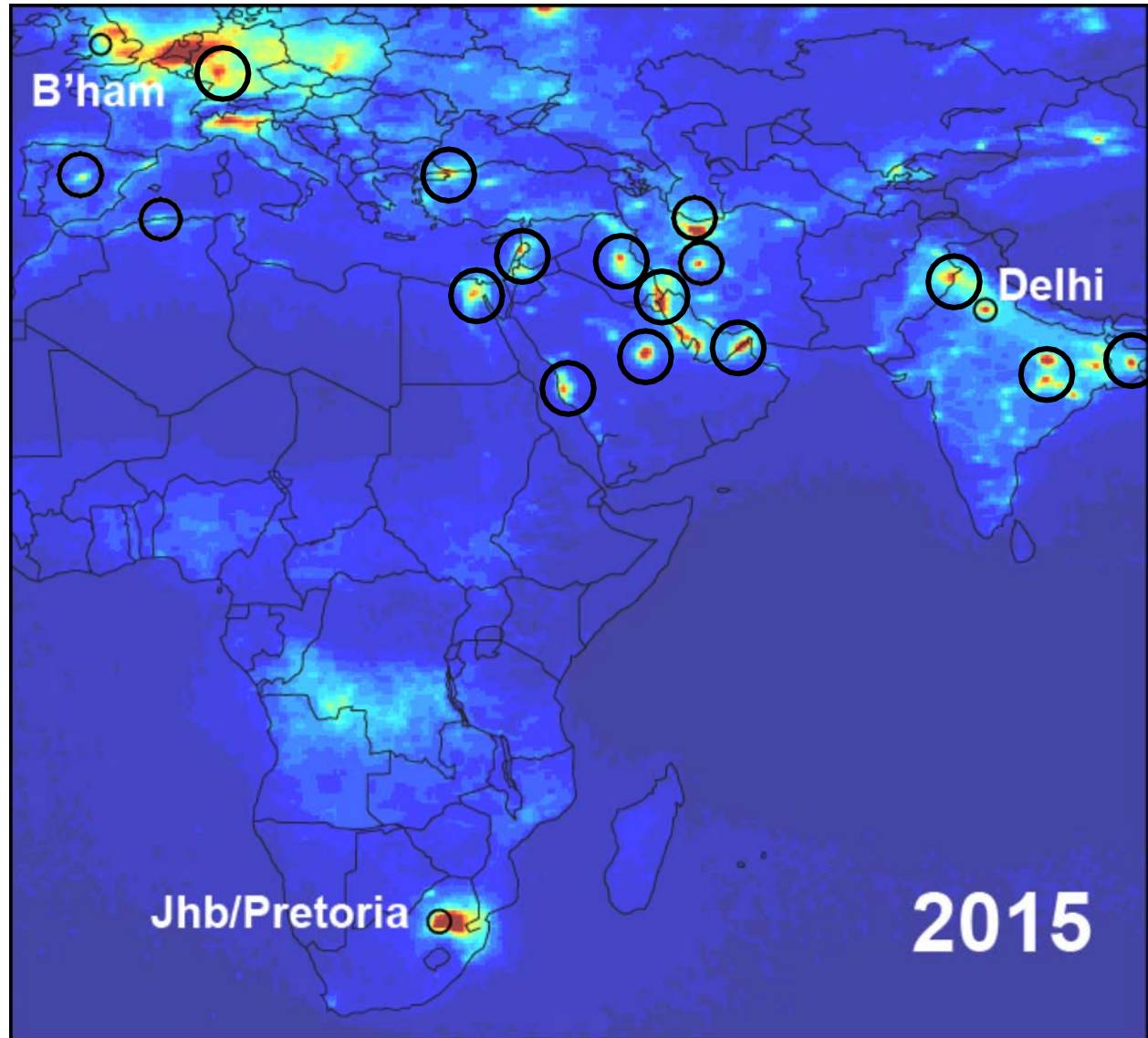
- Large and significant decline in nitrogen dioxide ( $\text{NO}_2$ ) and its precursor emissions ( $\text{NO}_x$ ) in Birmingham (and London)

**Demonstrate effective policy**  
**Improve air quality models**

- UK national emission inventory, used to make policy decisions, underestimates agricultural emissions of ammonia at locations with intensive crop, pig, horticulture and poultry farming

**Improve inventories**  
**Assess individual sources**

# Scalable Solution



Can be applied to any city in the world

# The End Users

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## **Environmental consultants**

**Continued market growth**

Benefits: Add value to existing products and services, expand international reach

## **Local Authorities**

**Air quality top priority**

Benefits: Widespread monitoring, redirect resources, mitigate fines, enhance productivity, demonstrate effective policy

## **National Government**

**Emphasis on uptake of EO**

Benefits: Develop effective policies, use superior tools, mitigate fines, reduce national health burden

## **Global development community**

Benefits: Address monitoring deficits in developing nations

## **Space Sector**

**Strategic growth area**

Benefits: Direct development of next-generation instruments

## **Data Transformation Services**

Benefits: Advise on increasing accessibility and enhancing user experience with open data



**Thank you for your time!**



**TRACE**