

# Using Satellites to Monitor Air Quality



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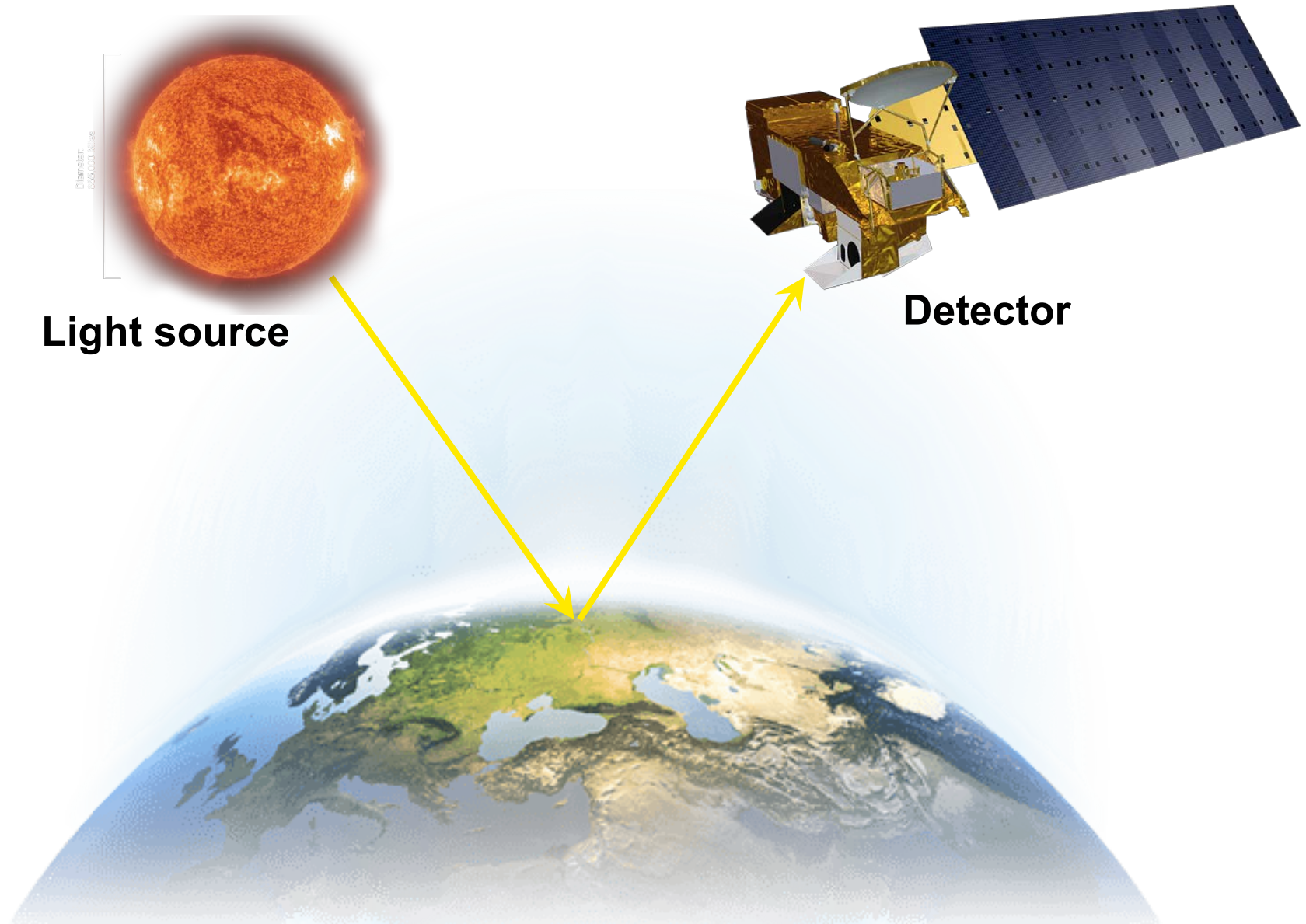
**Resilient Urban Environments**

26 June 2018

# Spectrometers in Space



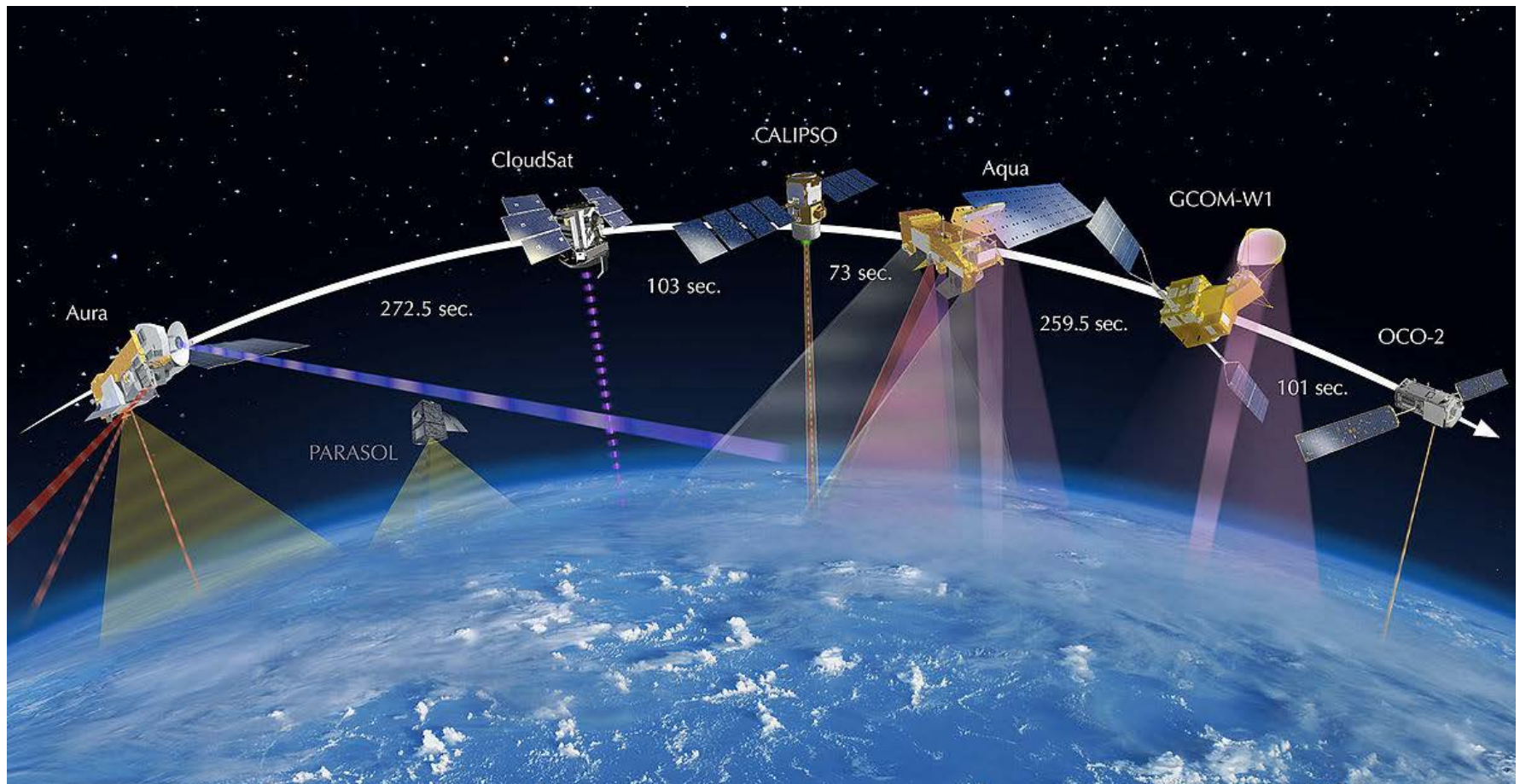
# Spectrometers in Space





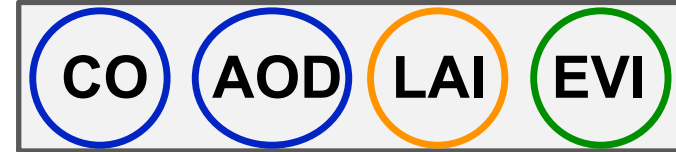
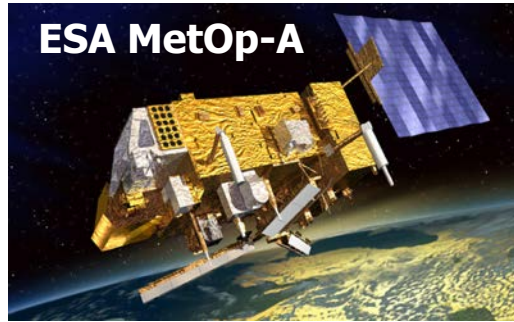
# Satellite observations as the Solution

## NASA Afternoon-Train (A-Train)



# Long record of diverse observations

12+ years of air pollutants and vegetation dynamics  
from NASA and ESA satellites



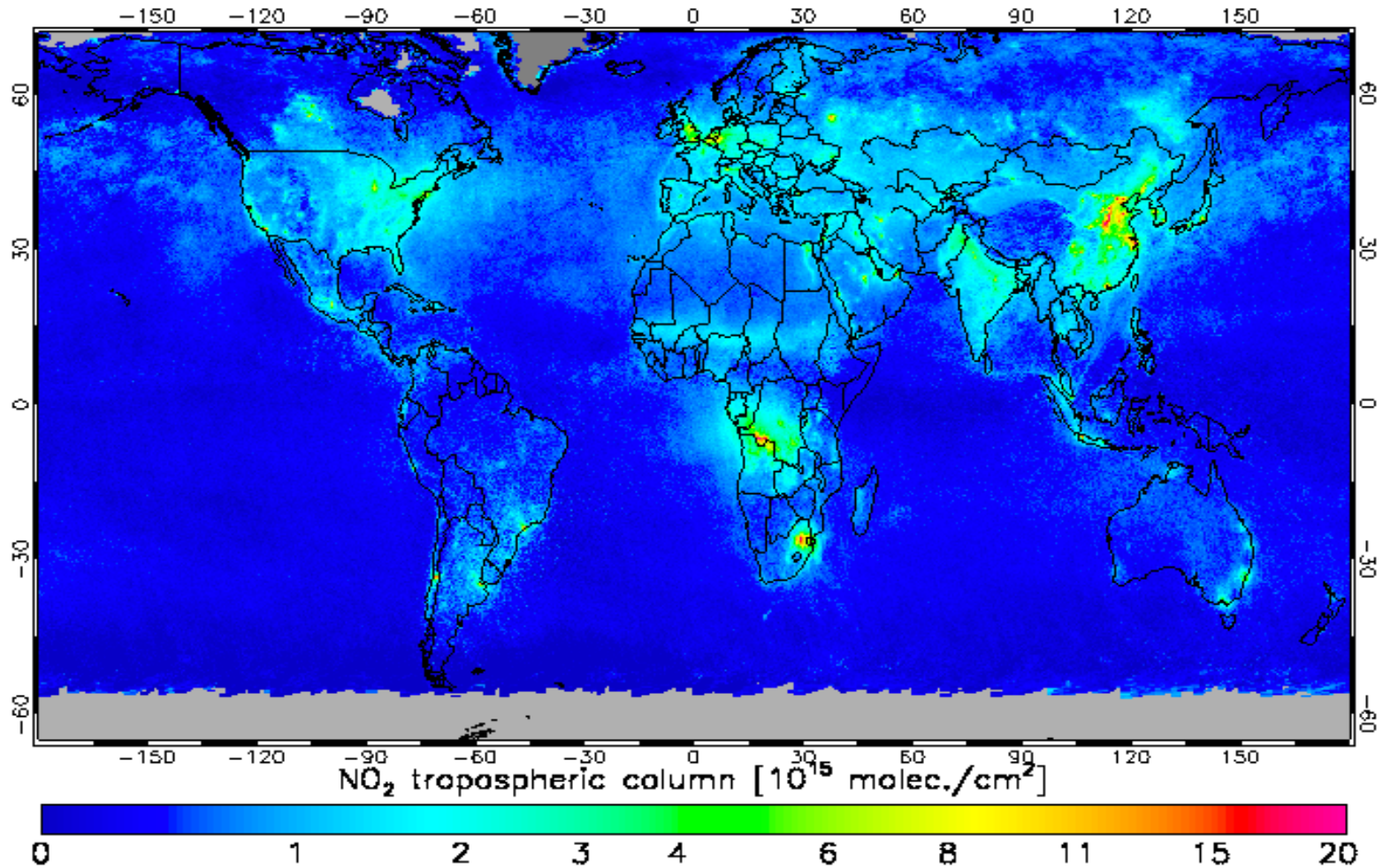
○ Air pollutants regulated by EU

○ Constraints on regulated air pollutants

○ Vegetation extent/cover

○ Vegetation greenness

# Air Pollution



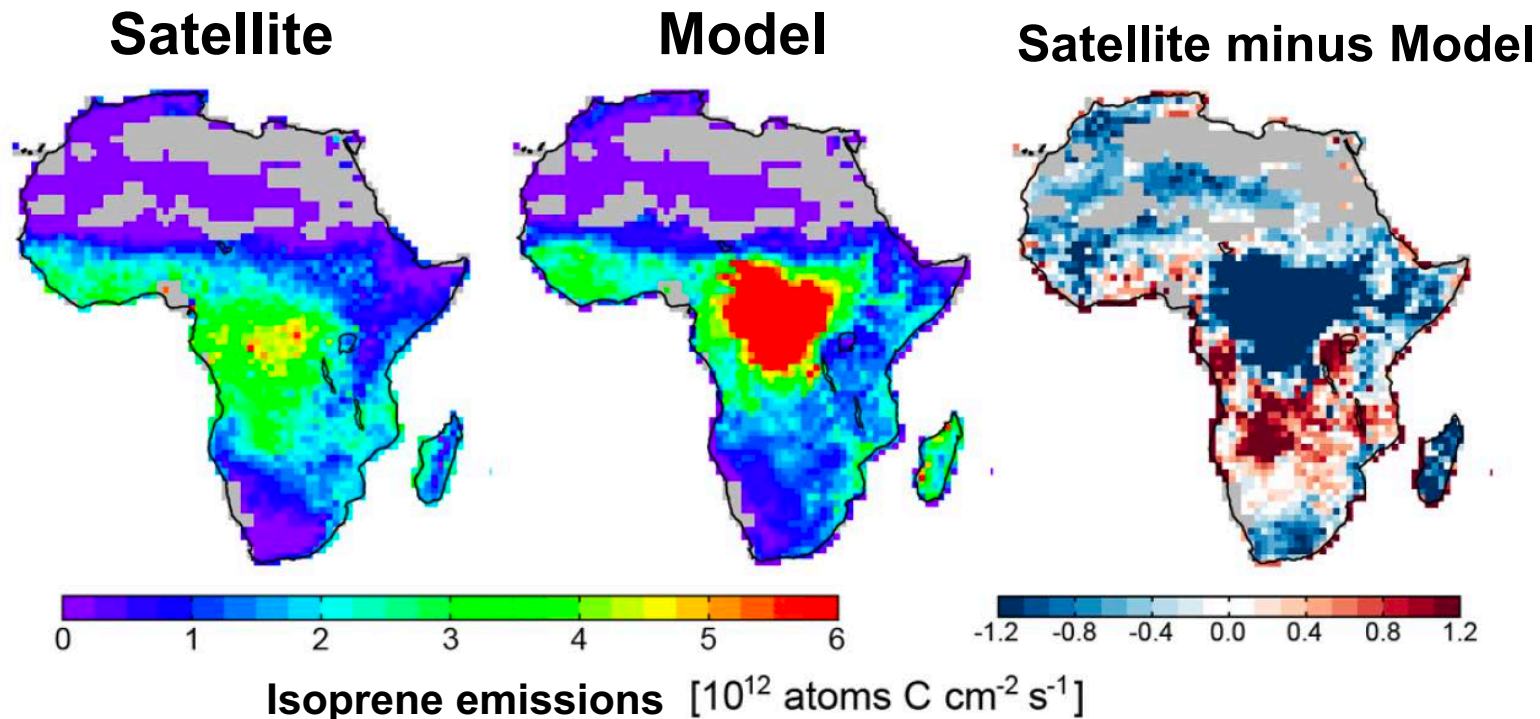
**Nitrogen dioxide (NO<sub>2</sub>) in June 2008**  
(KNMI/NASA OMI sensor)



# Air Quality in Africa

Map pollution sources from satellites and compare to state-of-art models

Isoprene: chemical produced and release by trees



# Air Quality in Africa

Identify sources that contribute to severe ozone pollution in Nigeria

## Seasonal open fires

CO + fires

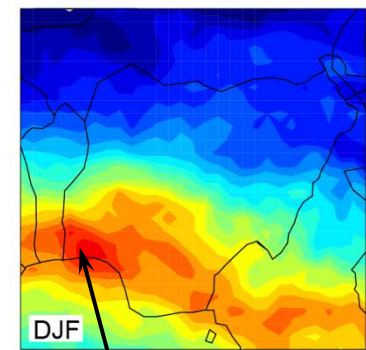
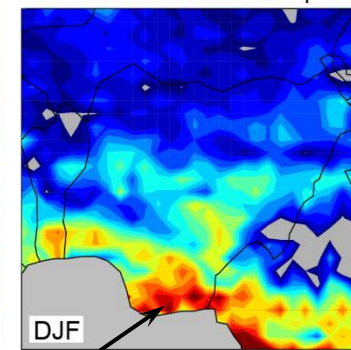
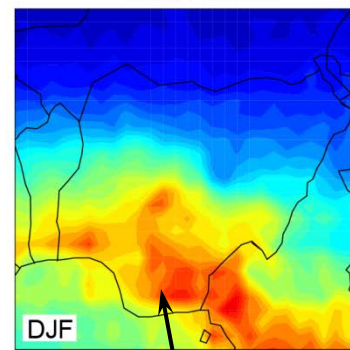
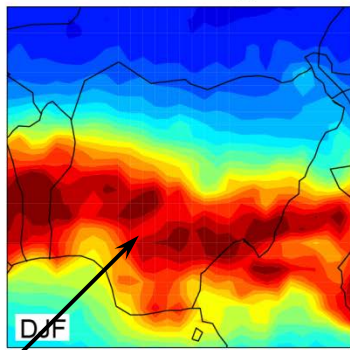
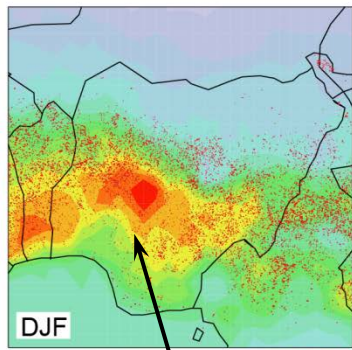
NO<sub>2</sub>

## Anthropogenic Volatile Organic Compounds

HCHO

Methane (CH<sub>4</sub>)

Glyoxal



Open fires



Oil and Gas Industry



Ad-hoc oil refining



Gas Flares

Traffic congestion

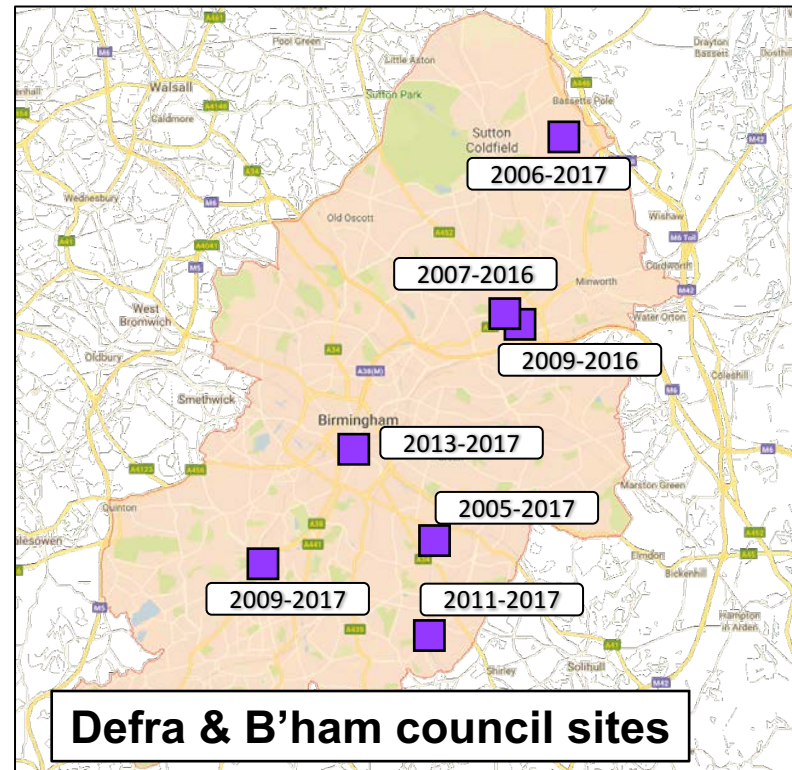
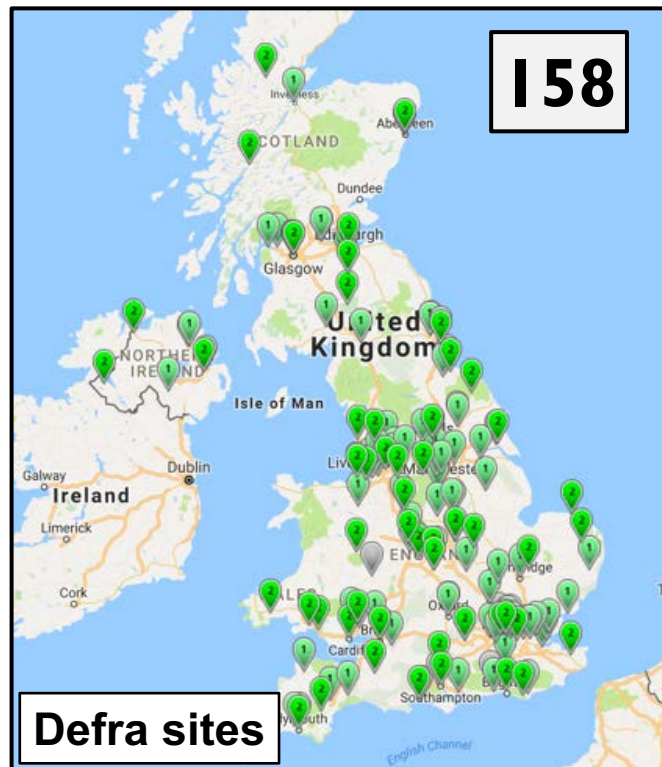




# Current Approach to Air Quality Monitoring

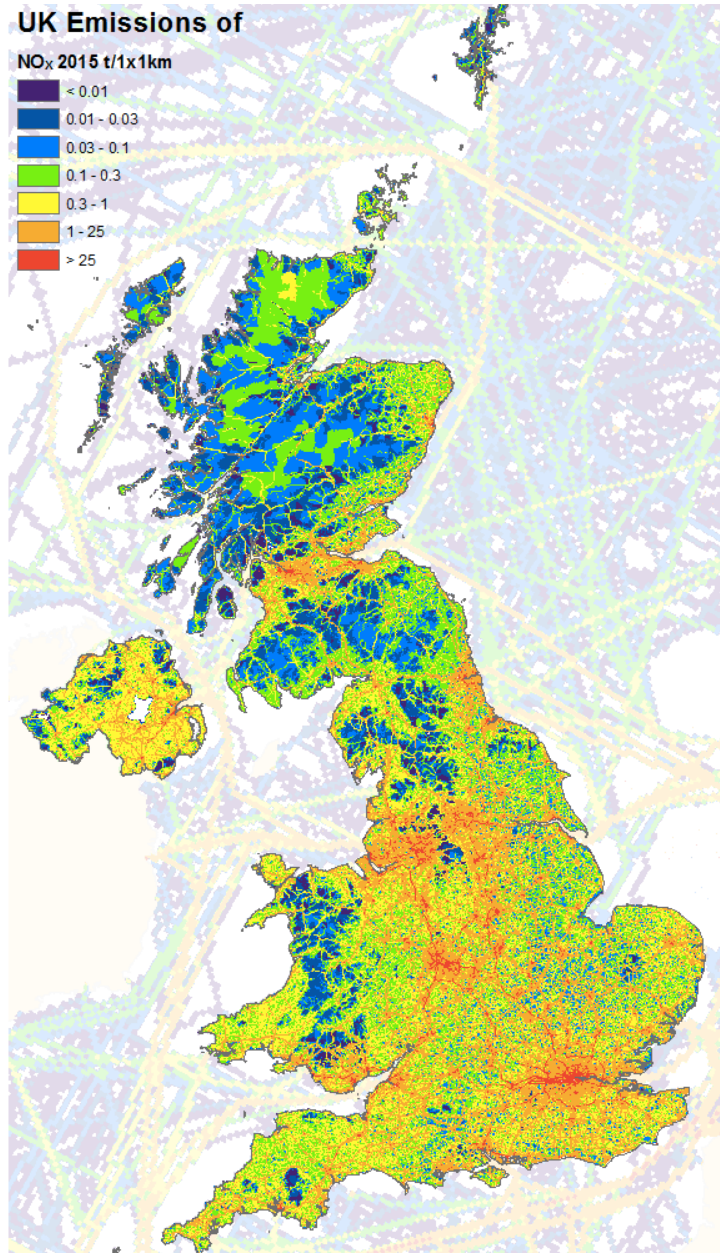
## **COSTLY to MONITOR**

**£52,000-£173,000 per monitor**



## **LARGE GAPS**

# Long-term Changes in Emissions



## UK Emissions of NO<sub>x</sub> in 2015

**Missing information:**  
long-term changes in pollution sources

[[naei.beis.gov.uk](http://naei.beis.gov.uk)]

# Tool for Recording and Assessing the City Environment

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# TRACE

**Online database of air pollution concentrations  
and vegetation dynamics from EO to evaluate  
AQ and green space at the city level**



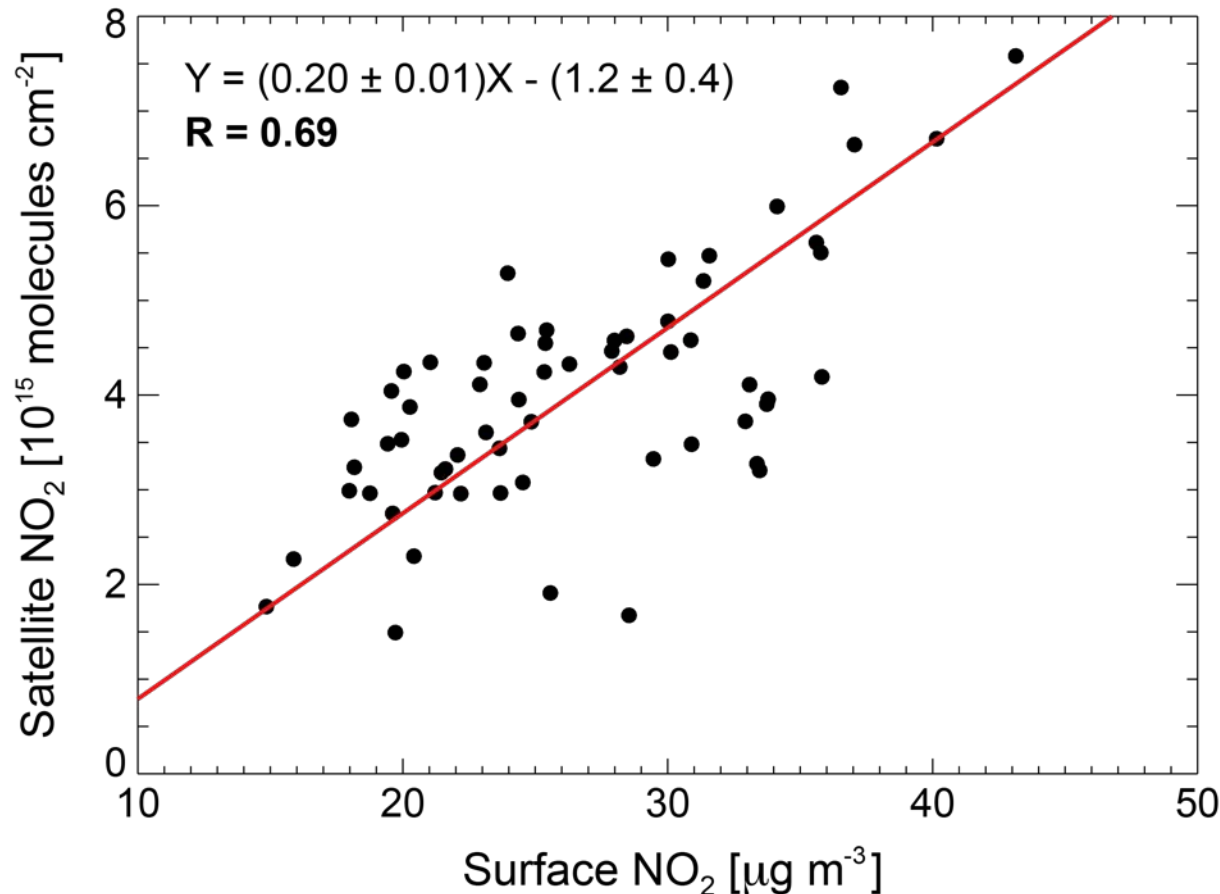
# Multi-sector Engagement and Support



# Data Validation (Birmingham)

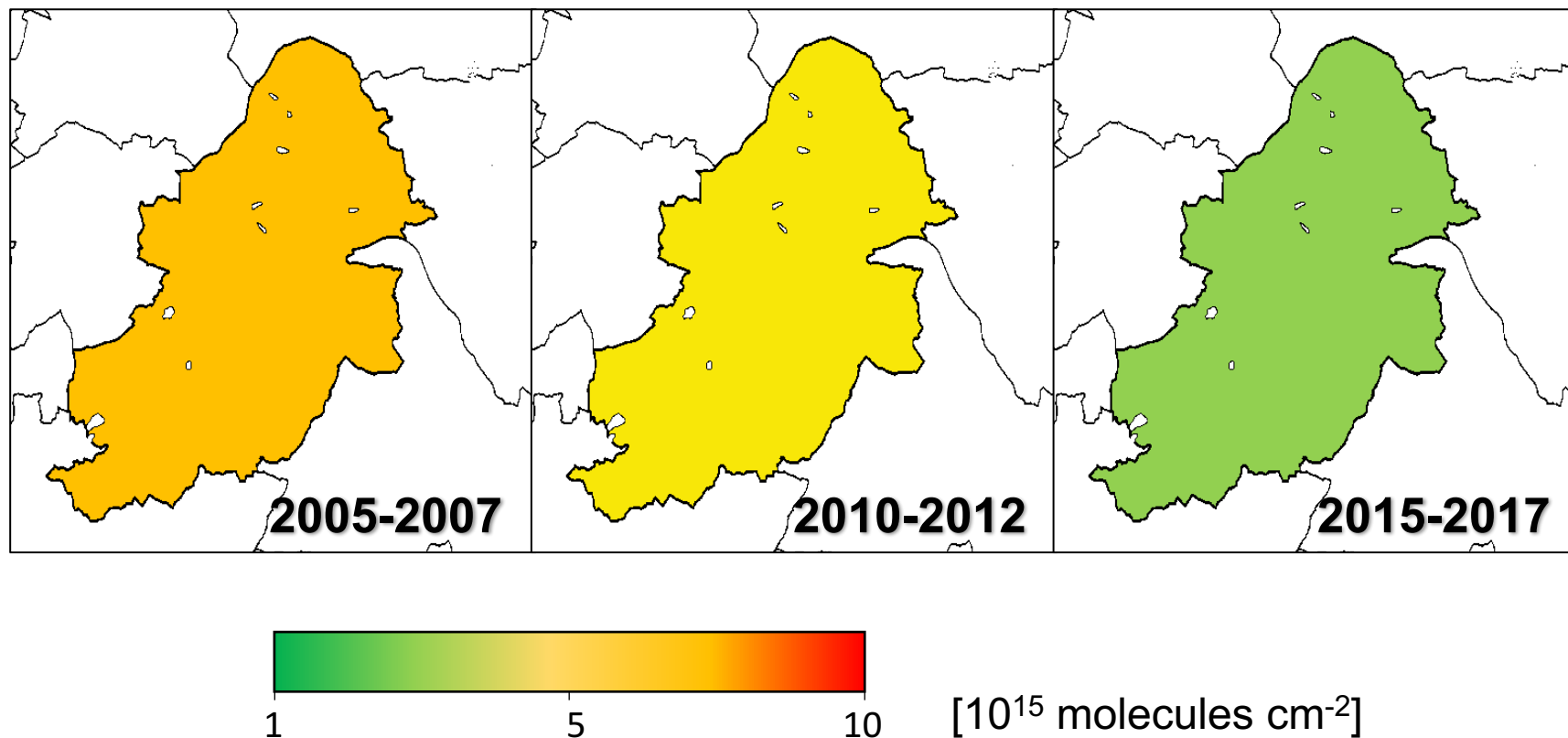
**UK NO<sub>2</sub> out of compliance with EU standards**

**Consistency between surface and satellite NO<sub>2</sub>:**



# Application to Birmingham

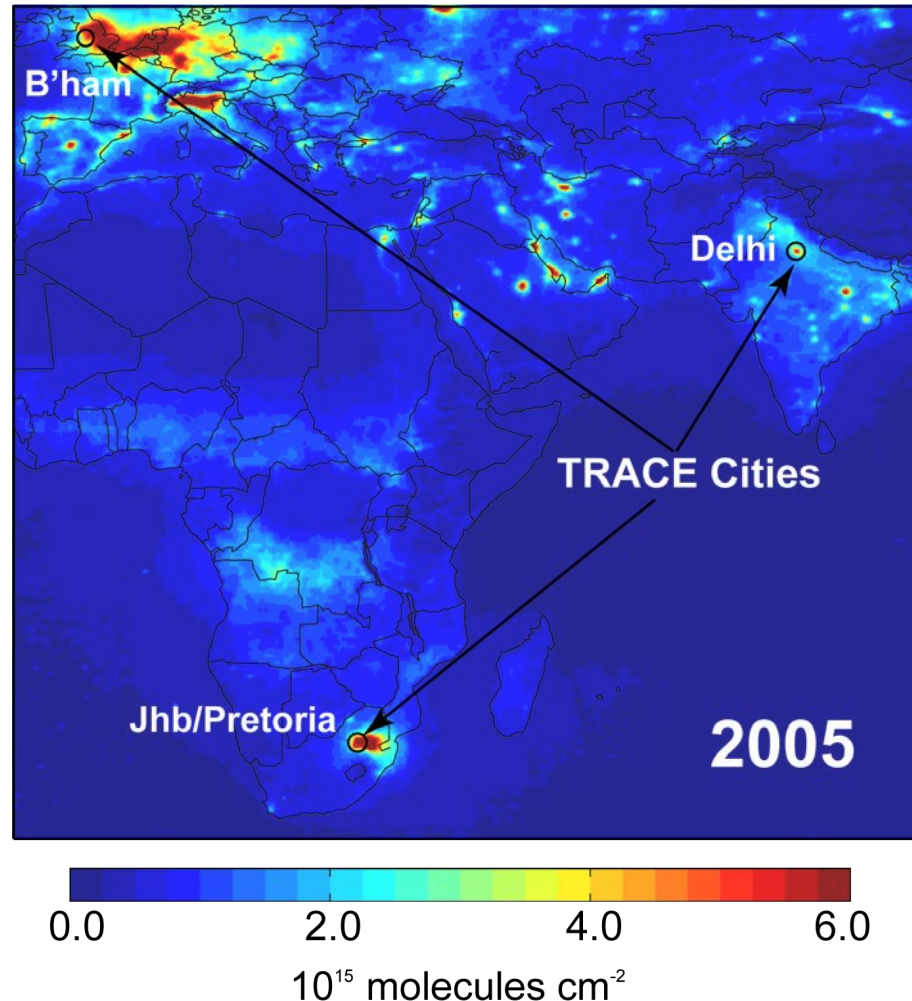
**Decline in NO<sub>2</sub> over Birmingham: 3.4% per year**





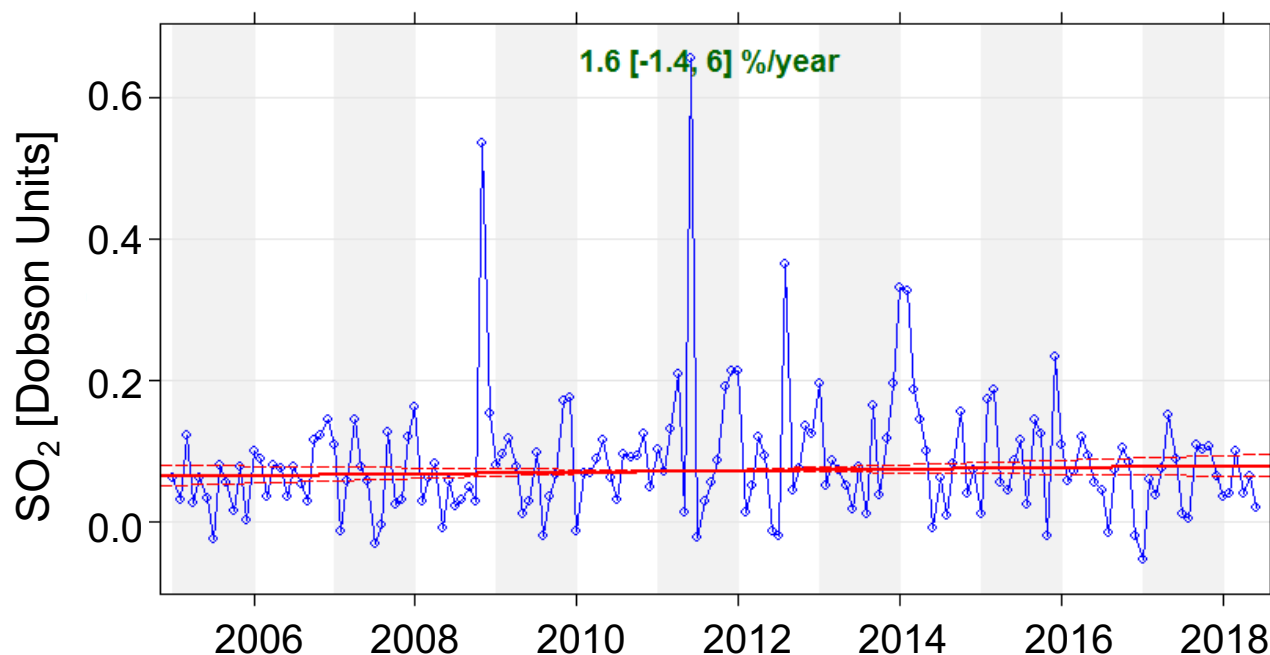
# Apply to cities at different development stages

Target cities on maps of OMI NO<sub>2</sub> in 2005 and 2015



**Develop an approach that can be flexibly applied to any city**

# Early results for Delhi: SO<sub>2</sub>



Increase across Delhi,  
but not significant

1 Dobson Unit =  $2.687 \times 10^{16}$  molecules cm<sup>-2</sup>

**+12-40 % per year  
(significant)**



**-1.2 % per year  
(not significant)**