

Launching Urban Air Quality Monitoring into the 21st Century



Dr Eloise A Marais

eloise.marais@le.ac.uk

maraisresearchgroup.co.uk

Free Cake Fridays

26 April 2019



UNIVERSITY OF
LEICESTER



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

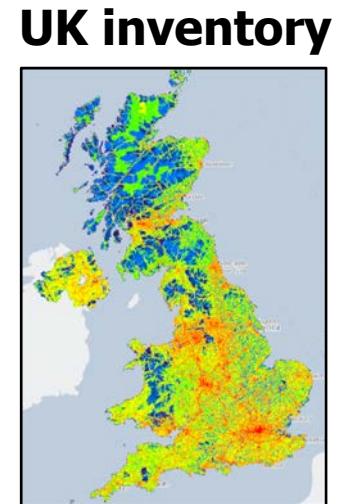
Growing numbers of non-smokers are being diagnosed with lung cancer, many at a stage when it is incurable, experts in the disease have revealed.

Search ▾ UK edition ▾
**The
Guardian**
[26 April 2019]

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)



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

The Solution

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



TRACE

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

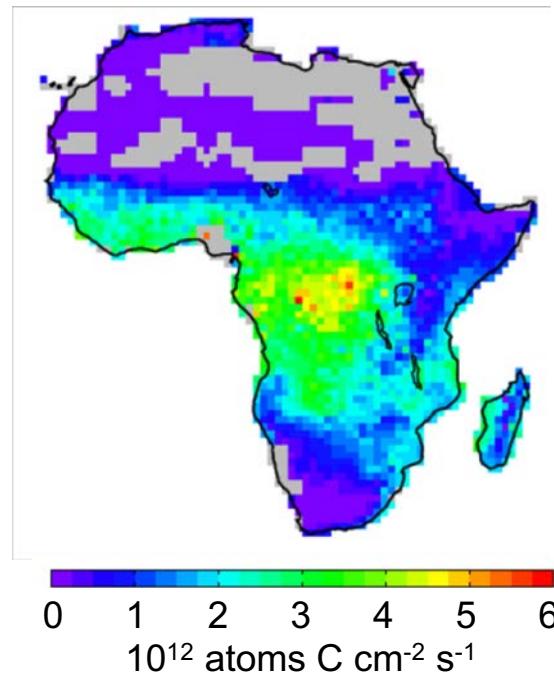
Year	95	96-01	02	03	04	05	06	07-10	11	12	13-15	17	18	19+
GOME														
SCIAMACHY														
OMI														
GOME-2														
OMPS														
TROPOMI														
Sentinel-5														
Sentinel-4														
GEMS														
TEMPO														

But the data from these are cumbersome to use

The Solution

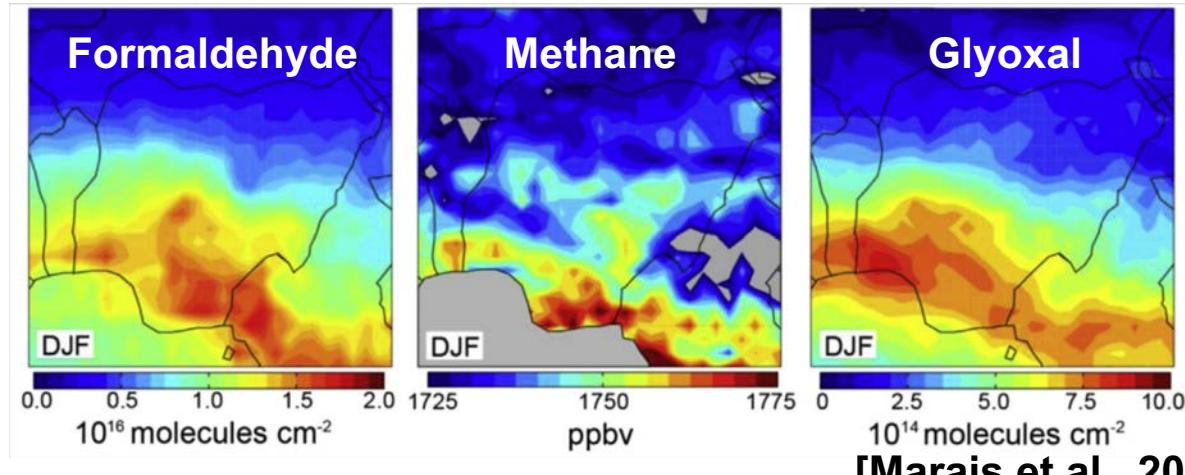
Widespread use in research; limited application in policy

Biogenic Emissions from Trees in Africa

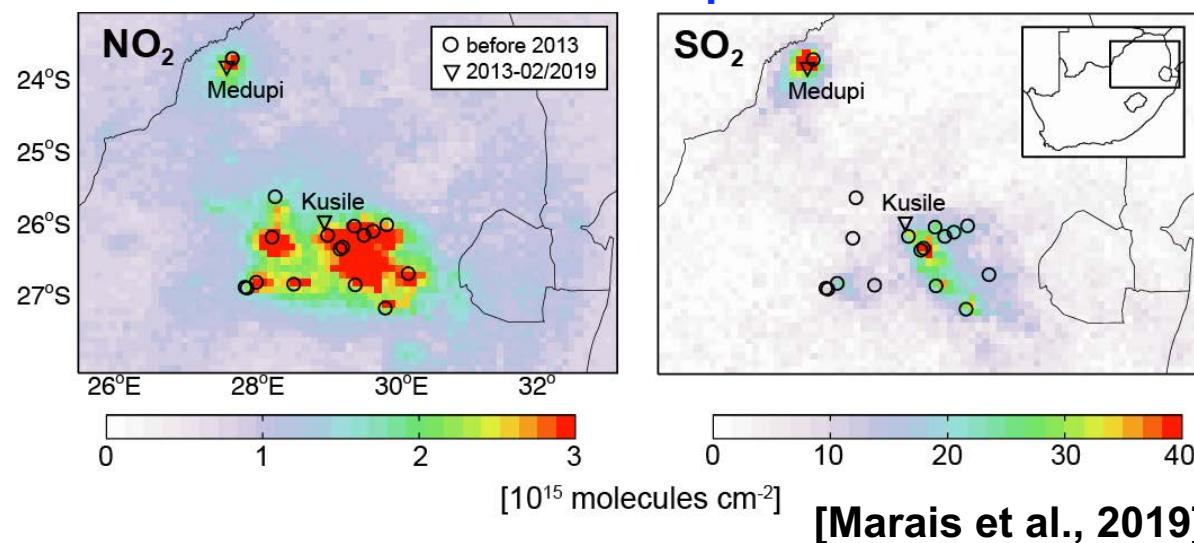


[Marais et al., 2012]

Identify Pollution Sources in Nigeria



Combustion Emission Hotspots in South Africa



The Solution



TRACE

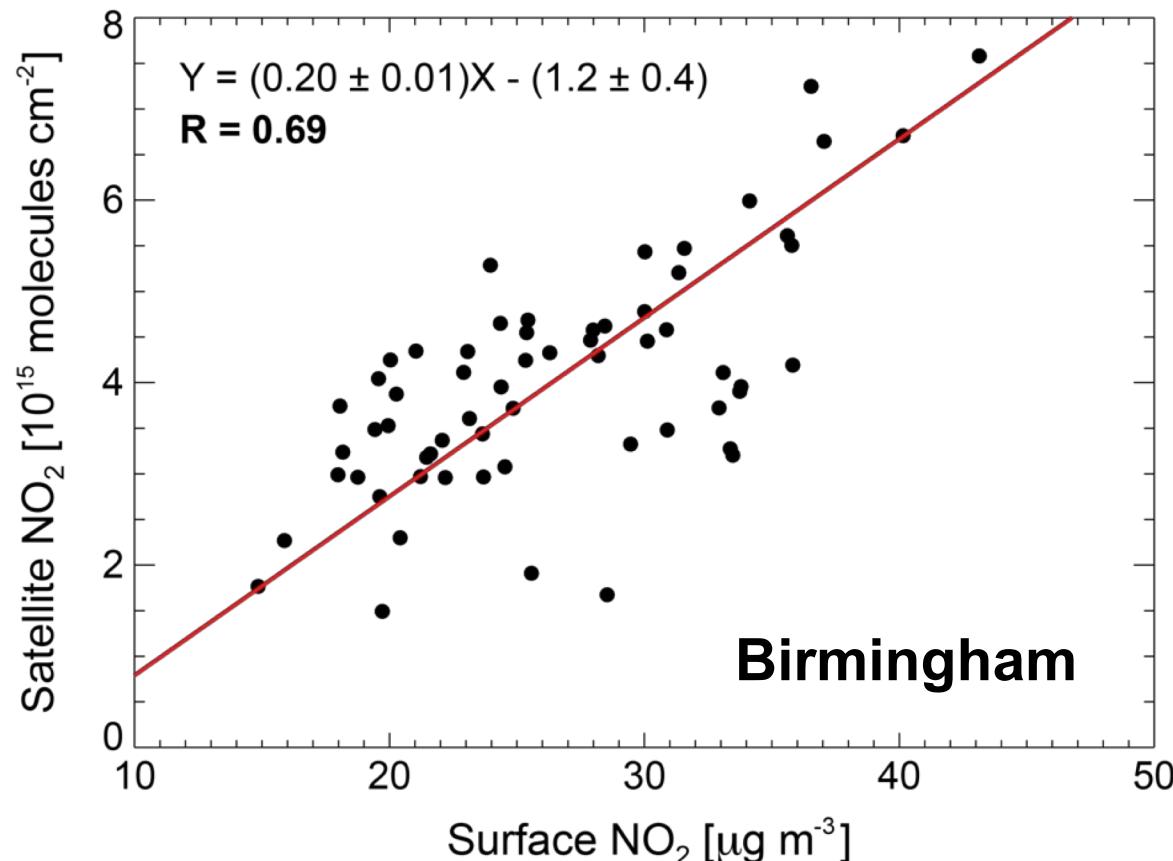
Unique Selling Point:

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 Product

Quality Assurance:

Regress satellites against surface observations

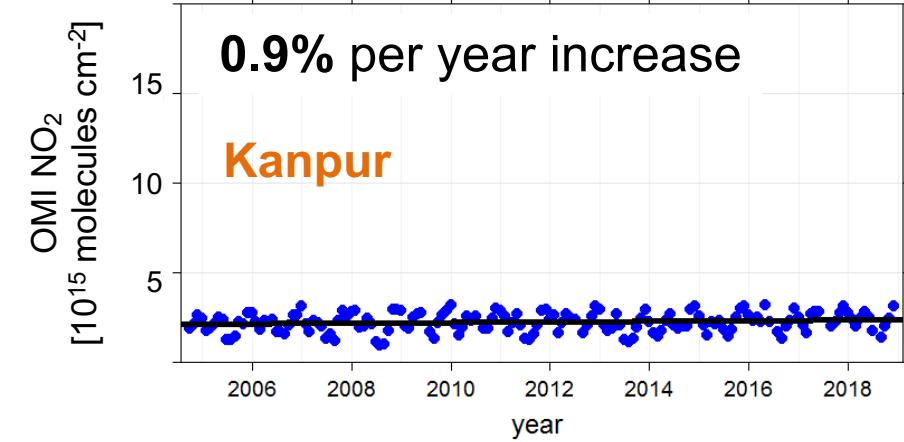
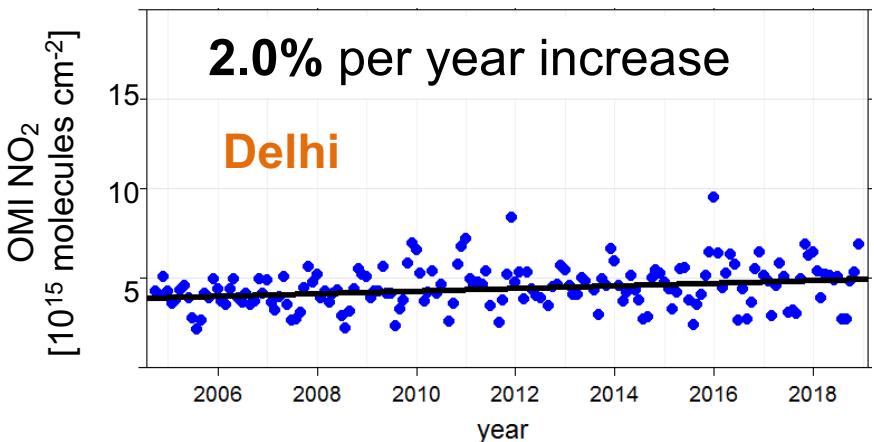
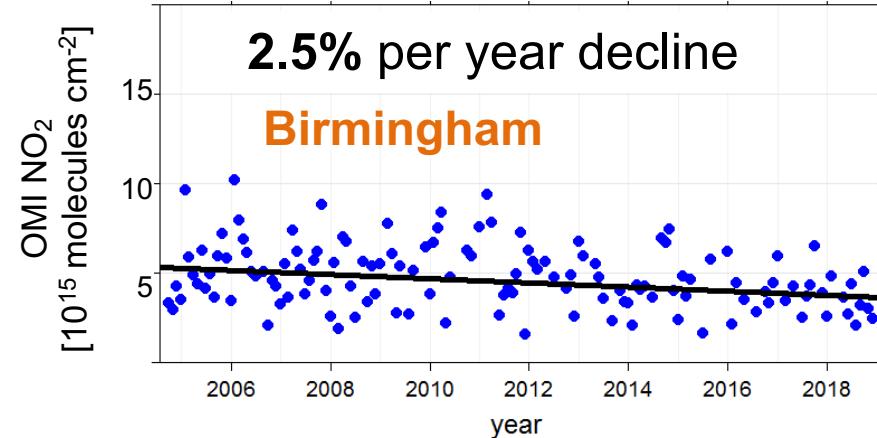
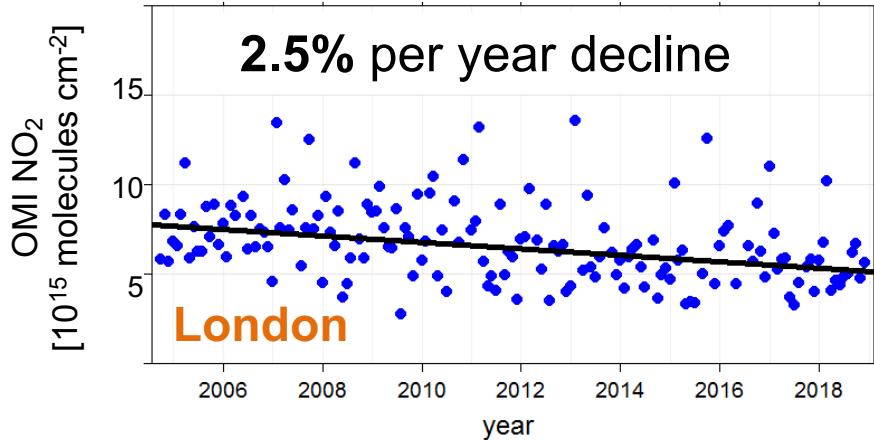


Pearson's correlation coefficient (R = 0.69) indicates consistency

The Product

Obtain Long-term Trends:

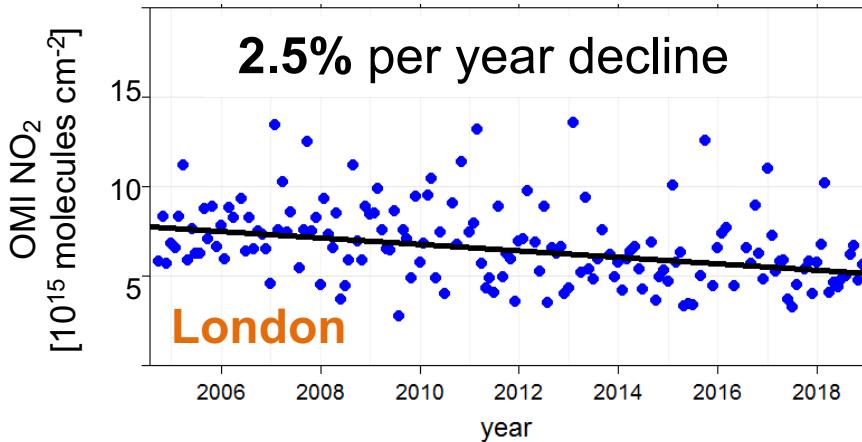
Nitrogen Dioxide (NO_2):



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

The Product

Assess Targets:



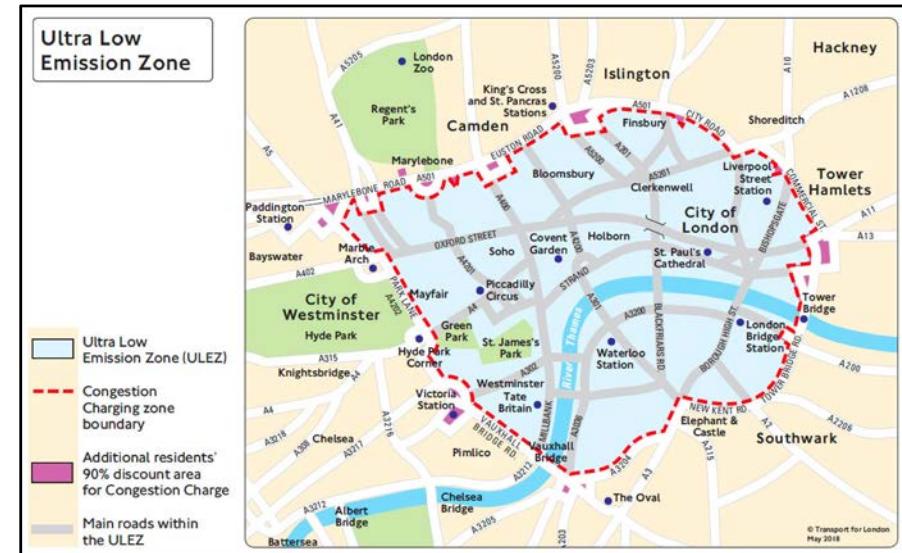
NO₂ standard for UK and India:
40 µg m⁻³ (annual mean)

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**:

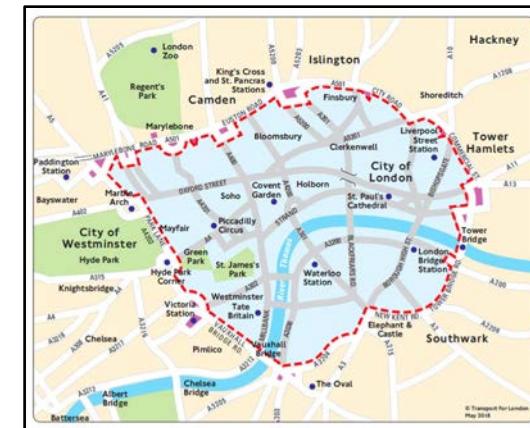
Birmingham City Council



Bath City Council



Monitor and assess success of the **ULEZ**



Thank you for your time!



TRACE



PINT OF SCIENCE FESTIVAL COMES TO LEICESTER

20-22 MAY

Atoms to Galaxies at Manhattan34



Manhattan34
34 Rutland St, Leicester, LE1 1RD, United Kingdom

20 MAY

The Next Frontier >

21 MAY

Black Holes and Revelations >

An Evening of Earth Observations

22 MAY

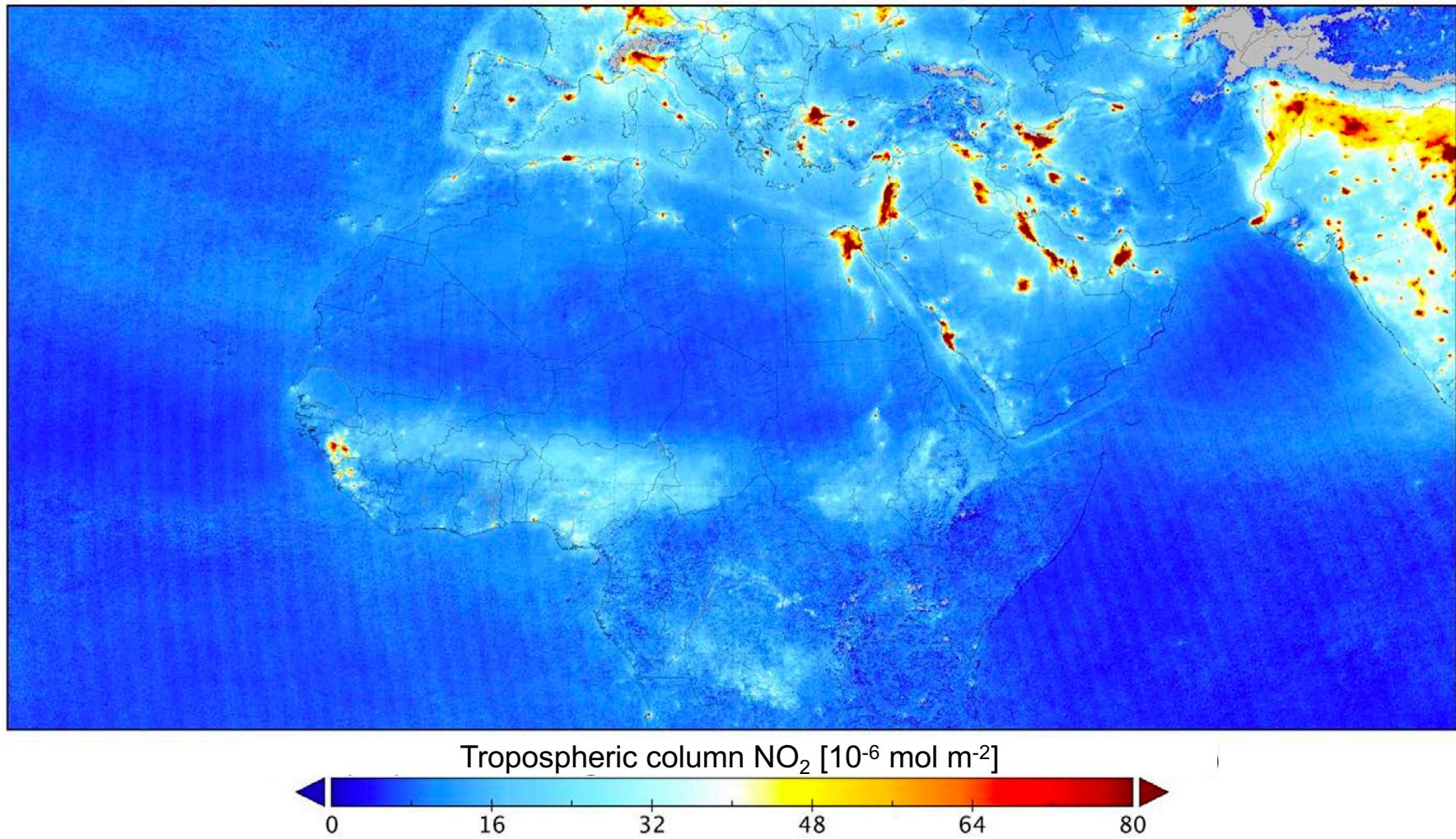
Mission to Planet Earth >

Includes a space-themed drinks menu!

Info & tickets: <https://pintofscience.co.uk/organisation/leicester>

The Solution

Earth observations provide extensive coverage



[Image courtesy of ESA, 2018]