Monitoring Air Pollution in Birmingham using Satellite Observations

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UNIVERSITY OF BIRMINGHAM

defra
Department for Environment Food and Rural Affairs

Birmingham City Council

U3A Science Group discussion (7th Feb'19)

Courtesy – Library of Birmingham

TARGET CITIES & POLLUTANTS IN UNITED KINGDOM

40,000 early deaths each year in UK attributed to ***fine particles*** and ***NO_2*** pollution

£6 billion -Associated health cost to UK each year

Birmingham

Population[A] – 1.13 Mn
Area – 268 km^2
Premature deaths[B] - **900**

Lethal legacy of dash for diesel: Air pollution is 'killing 40,000 a year in the UK'

- Diesel cars fuel a health crisis that kills 40,000 people a year in the UK
- Emissions linked to asthma, heart disease, cancer, diabetes and dementia
- Ownership of diesel cars has more than trebled in the past 15 years

LIFESTYLE 28/08/2018 08:54 BST

Air Pollution May Reduce Intelligence And Increase Risk Of Dementia

Men are more affected than women, according to the study.

Birmingham's air is so bad the European Union has waded in

Birmingham one of 16 UK cities told to clean up its act

Birmingham air pollution: 'This is a public health emergency'

Ring of cameras around city centre to target pollution

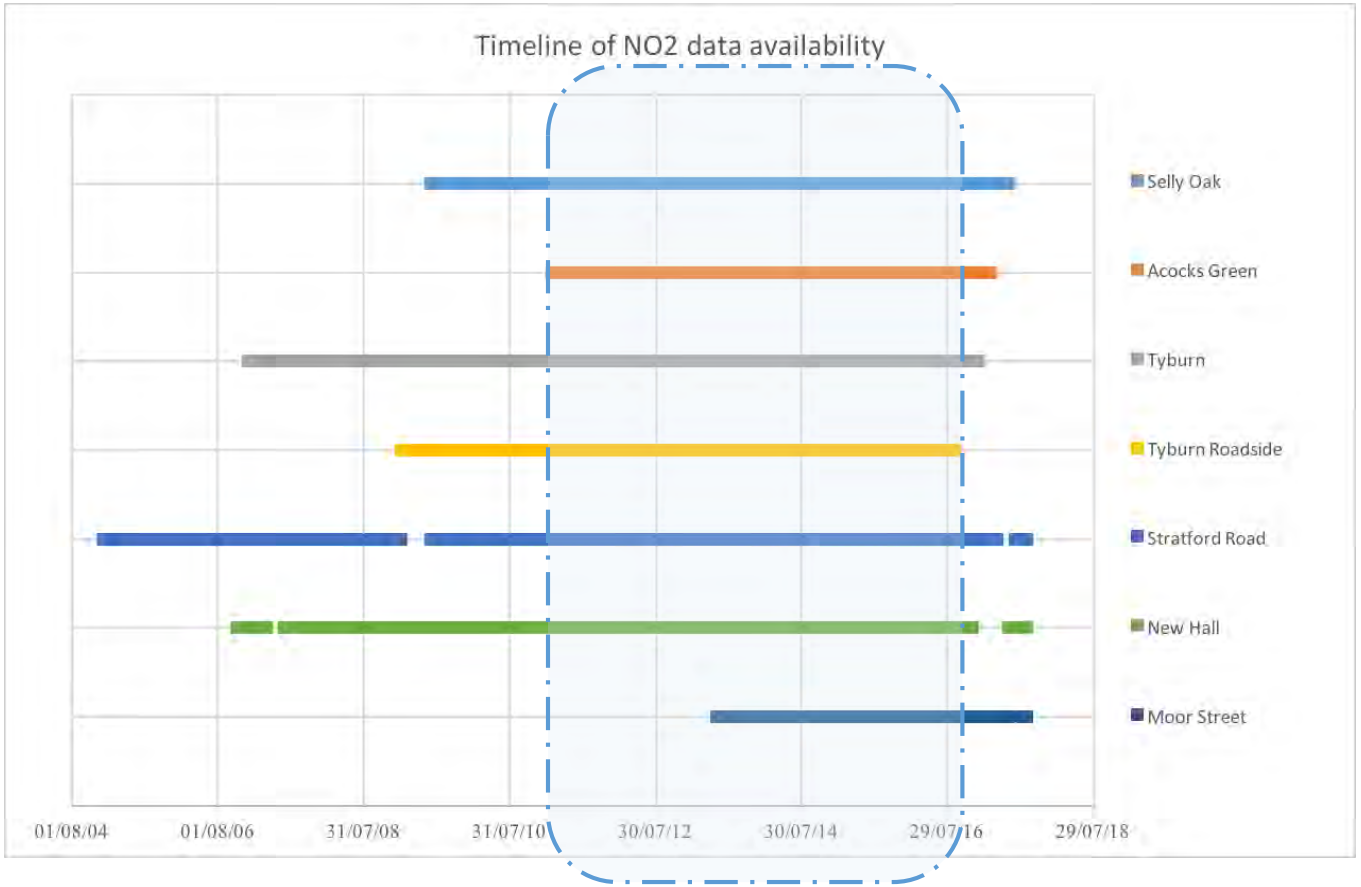
Automatic number plate recognition cameras on key commuter routes will count high polluting lorries and buses passing through Birmingham city centre to pave way for clean air zone

[A] Population for mid 2017; Source Office for National Statistics
[B] Figures by Royal College of Physicians and King's College London

Timeline of NO_2 monitoring sites (Birmingham City Council)

Automatic monitoring locations

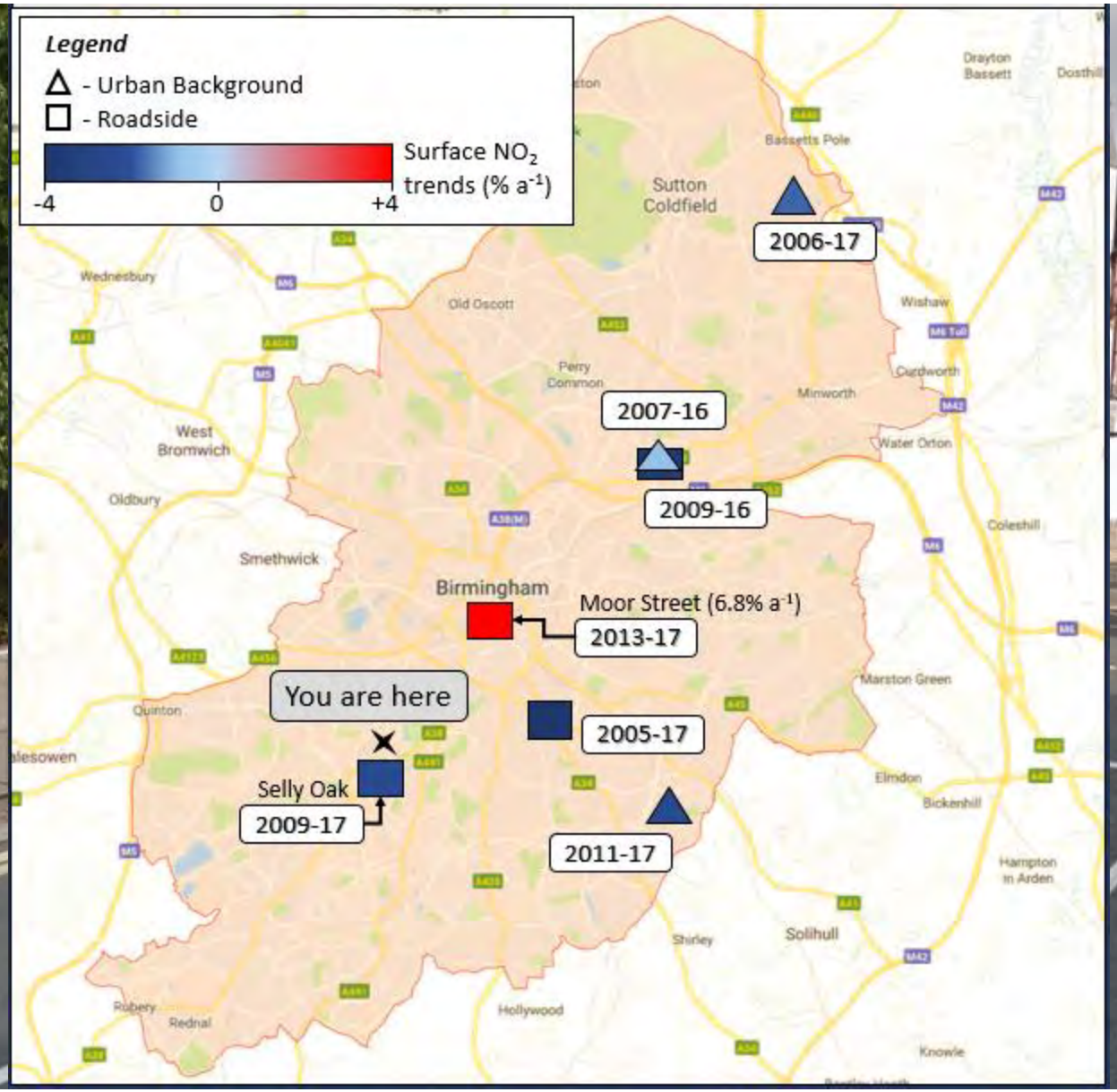
Timeline of NO_2 monitoring sites (Birmingham City Council)



Mar-11 – Sep-16 (5 years,7 months)

Automatic monitoring locations

SPARSE AND INCONSISTENT SURFACE OBSERVATIONS



LONG-TERM RECORD OF NO_2 FROM OZONE MONITORING INSTRUMENT (OMI)

OMI/Aura NO_2 Cloud-Screened Total and Tropospheric Column L3 Global Gridded 0.25 degree x 0.25 degree V3

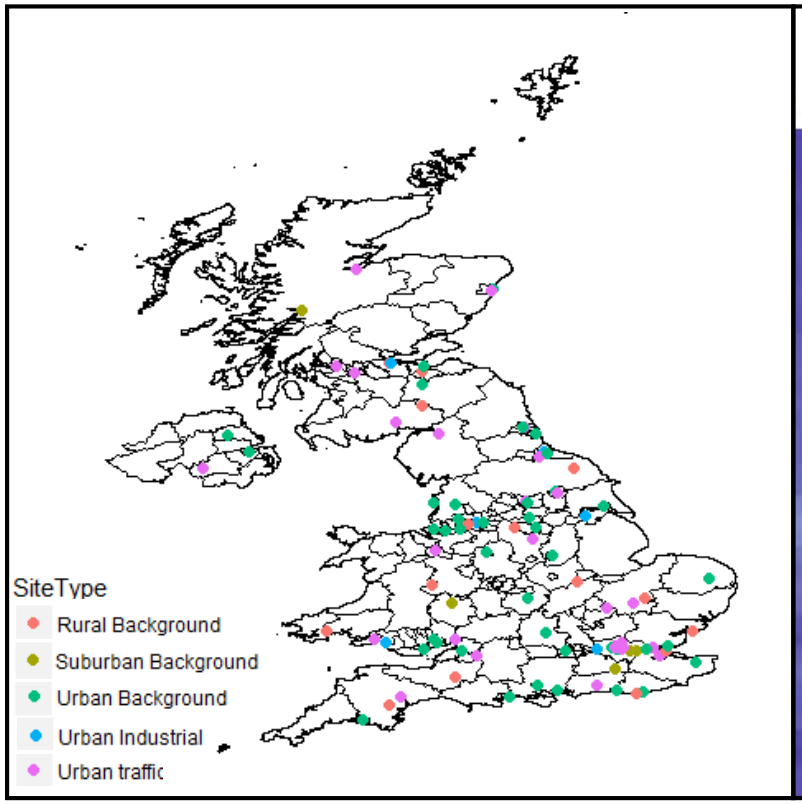
Temporal coverage: 2004-10-01 - Present

Satellite overpass time: 1345 LT

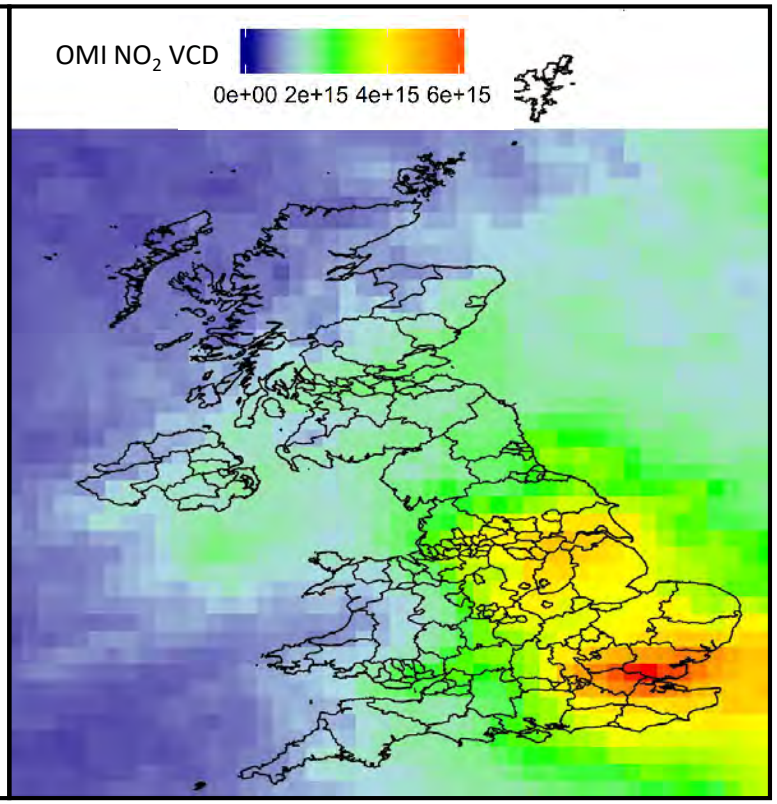
Nadir-viewing
UV/Visible
270-500nm

Retrieval of NO_2
1) Concentration along the viewing path (SCD)
2) Use AMF to compute the vertical column (VCD)

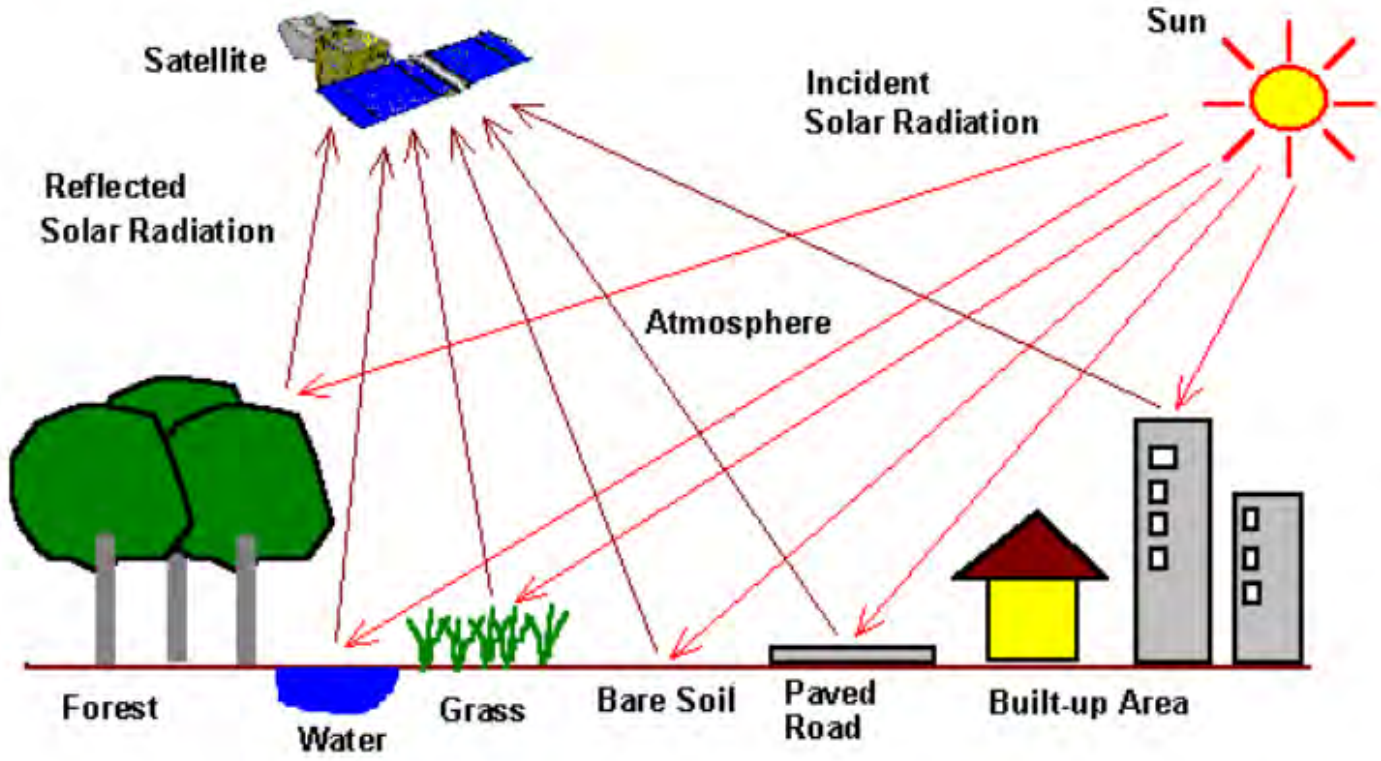
DEFRA NO_2 coverage (2017)



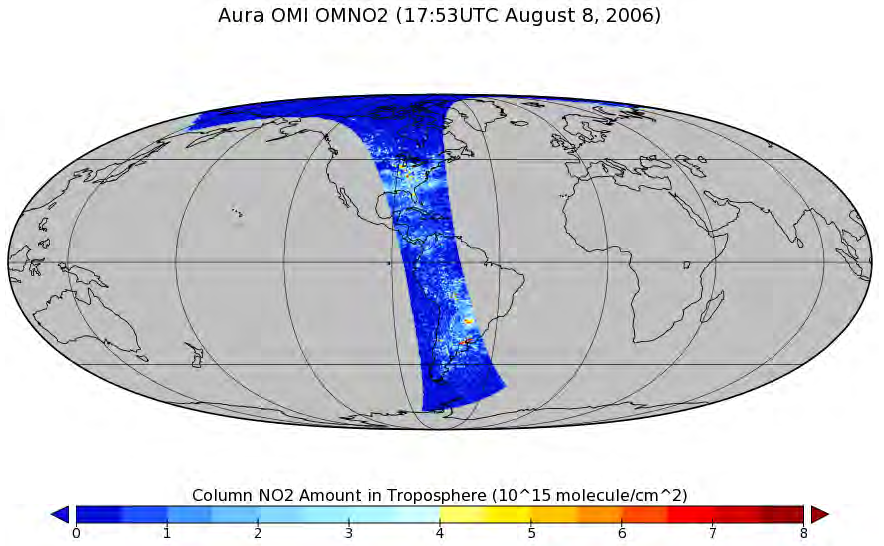
Mean OMI NO_2 (2017)



How Satellites Collect Data

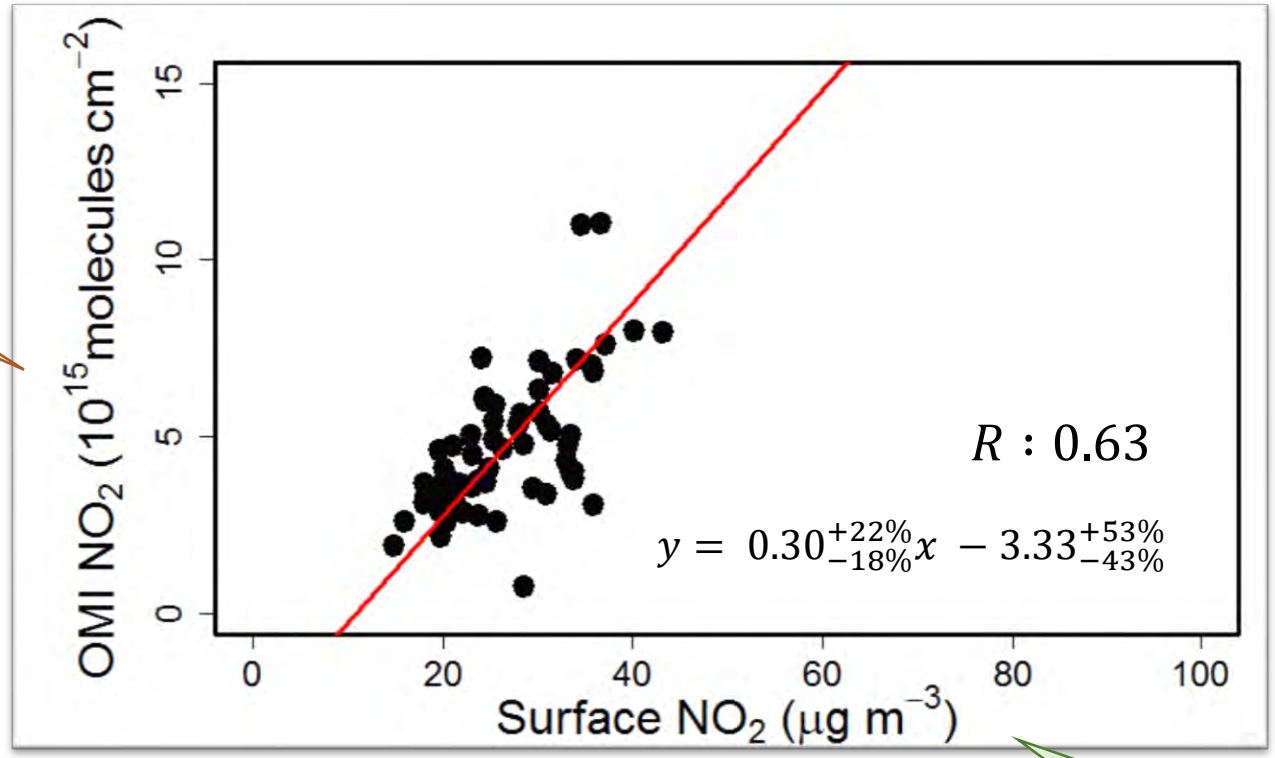


Ozone Monitoring Instrument (OMI)
Each grid square: 0.25° × 0.25°
Measures Vertical Column Density of NO_2



VALIDATION OF SATELLITE OBSERVATIONS

Satellite vs Surface NO_2 (Birmingham)



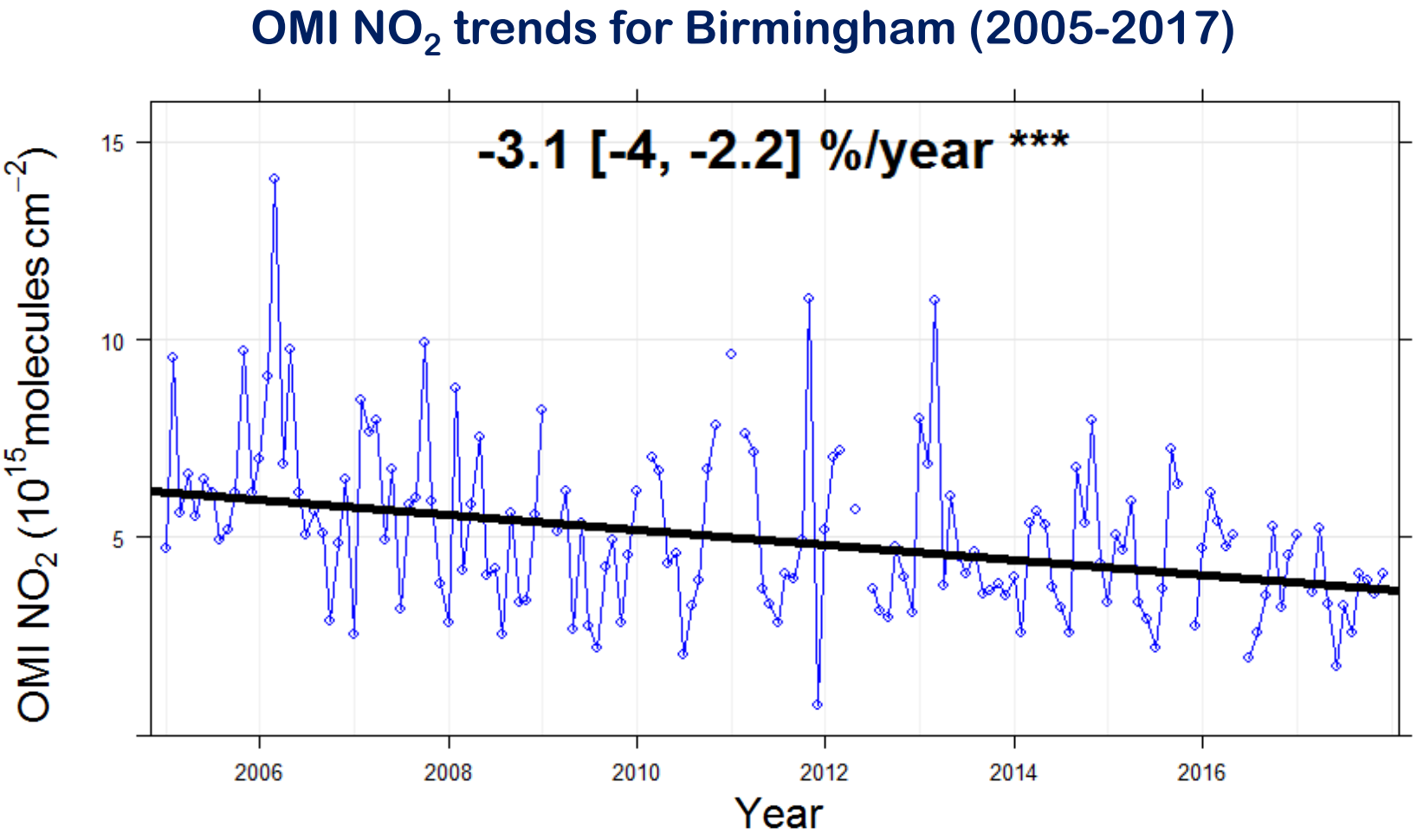
Area-weighted mean

Mean concentration of spatially correlated sites

(March 2011 – September 2016)

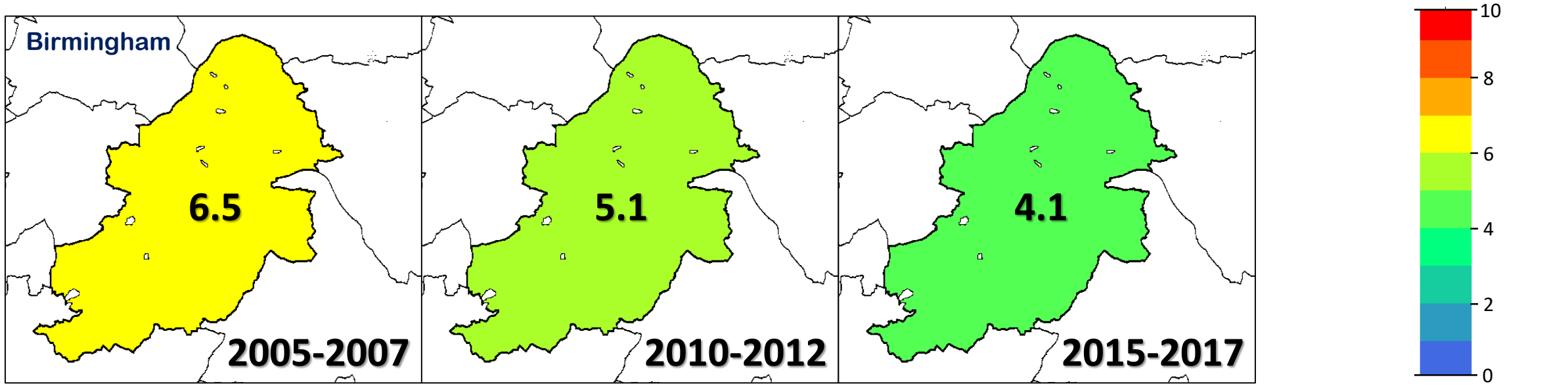
- Long-term record of OMI NO_2 can be used to monitor long-term changes in city-wide NO_2

DECLINE IN LONG TERM OMI NO_2 RECORDS IS SIGNIFICANT



MULT-YEAR MEANS OF OMI NO_2 VCD IN BIRMINGHAM

- OMI NO_2 decreased by **40%** for Birmingham (2005-2017)



CONCLUSION

- Consistent satellite and ground-based NO_2 give us confidence to apply satellite observations to monitor air quality in Birmingham
- OMI NO_2 declined by 40% in Birmingham from 2005 to 2017

NEXT STEPS

- Apply the same approach to **London, New Delhi** and **Kanpur**
- Apply the same approach to other pollutants:

  SO_2, formaldehyde, ammonia
- Validate DEFRA air quality monitoring tools