Monitoring city-wide air quality using Earth observations

Karn Vohra[1] , Eloïse A Marais[1] , William J Bloss[1] , Peter Porter[2]

[1]University of Birmingham, United Kingdom;

[2]Birmingham City Council, Birmingham, United Kingdom

kxv745@student.bham.ac.uk

UNIVERSITY OF BIRMINGHAM

defra
Department for Environment Food and Rural Affairs

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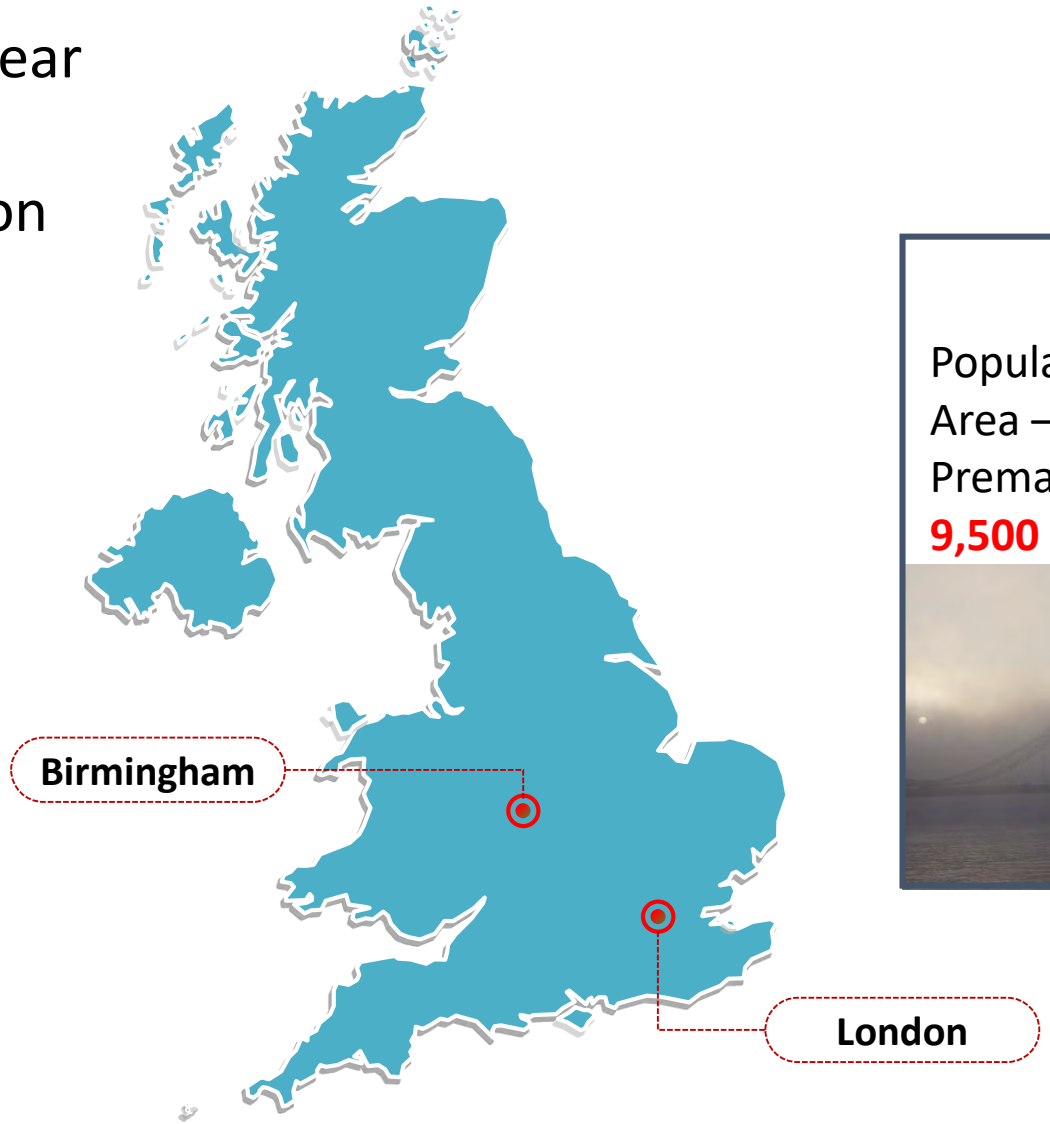
TARGET CITIES & POLLUTANTS IN UNITED KINGDOM

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

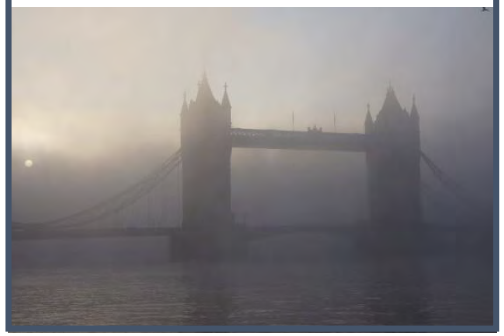


Birmingham

Population[A] – 0.98 Mn
Area – 267.8 km^2
Premature deaths[B] - **900**

London

Population[A] – 7.56 Mn
Area – 1572 km^2
Premature deaths[B] – **9,500**



[A] Population for 2018; Source worldpopulationreview.com
[B] Figures by Royal College of Physicians and King's College London

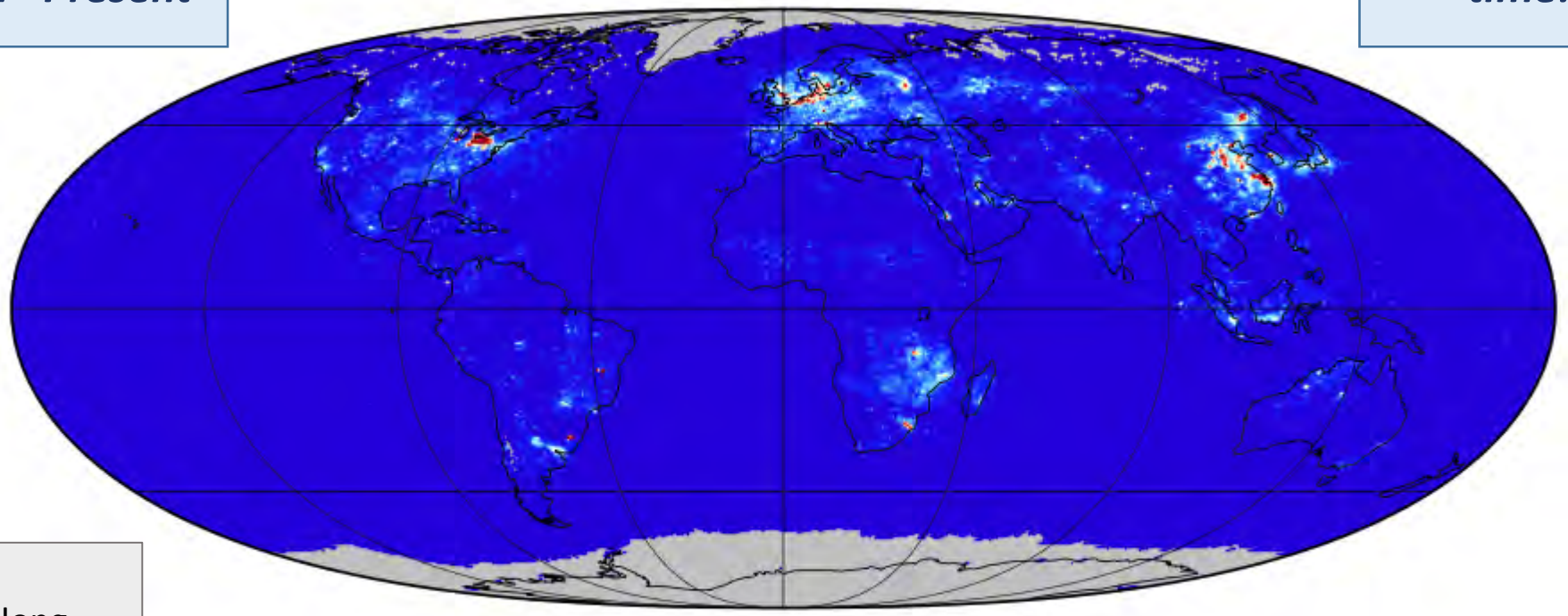
LONG-TERM RECORD OF NO_2 FROM OZONE MONITORING INSTRUMENT (OMI)

OMI/Aura NO2 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

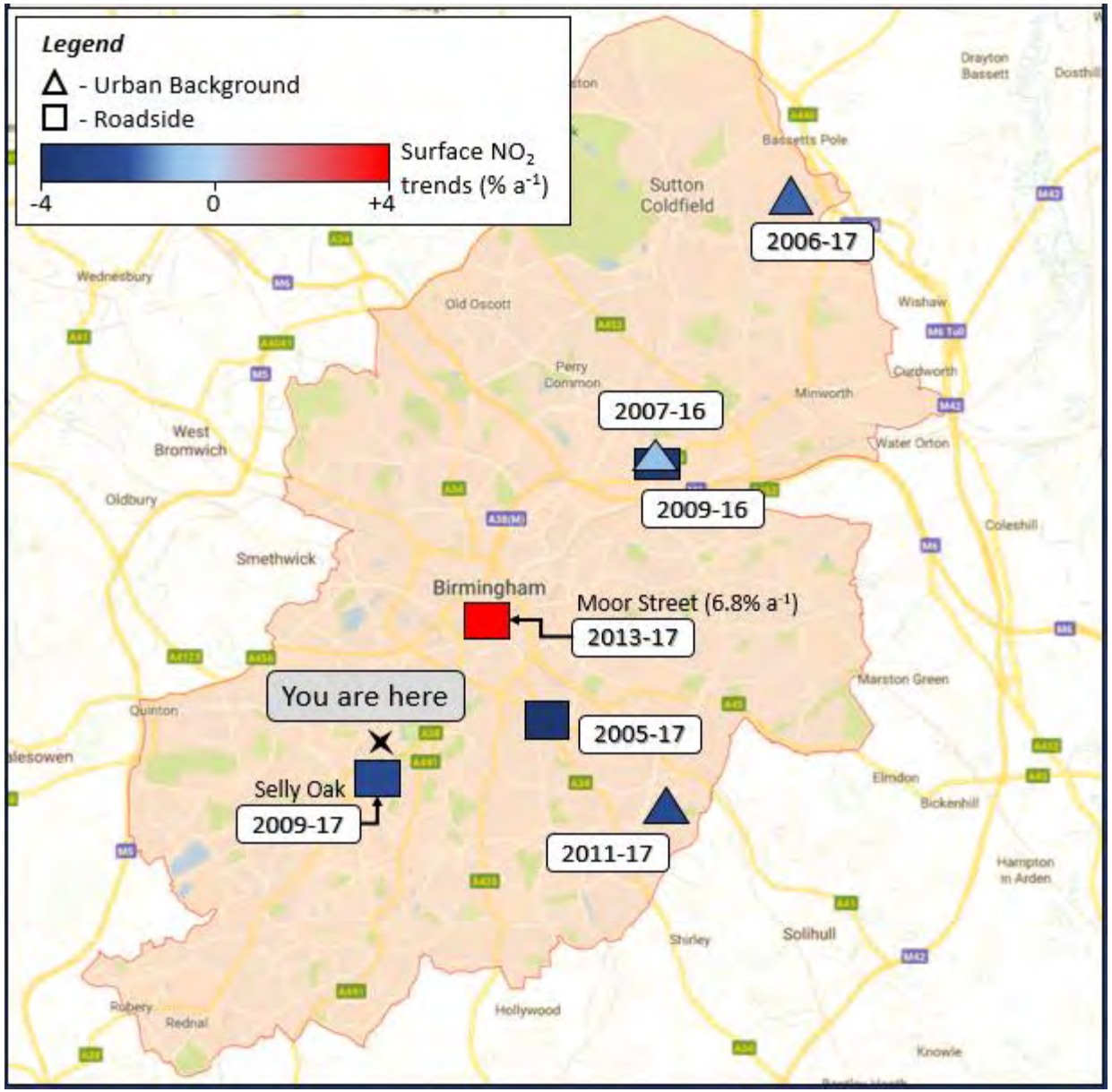
1) Concentration along the viewing path (SCD)
2) Use AMF to compute the vertical column (VCD)

SPARSE & EXPENSIVE SURFACE MONITORING OF NO_2

- Sampled surface observations over midday (around the satellite overpass time)
- Derived a city level NO_2 concentration from the 6 spatially correlated sites

Surface NO_2 decreases at 3.1% a^{-1} from 2011 to 2016

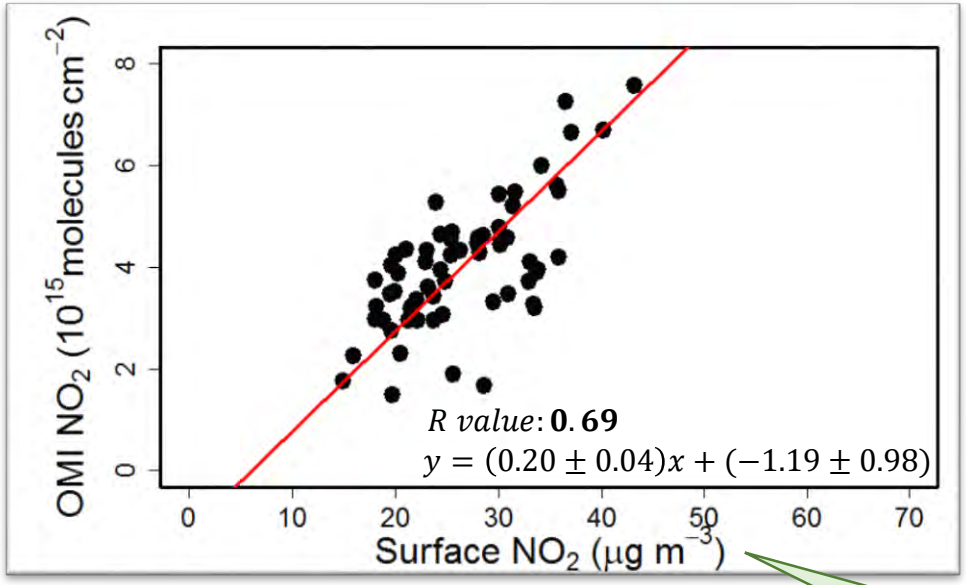
Trends and locations of monitoring sites in Birmingham



VALIDATION OF SATELLITE OBSERVATIONS

Birmingham *(Mar'11 – Sep'16)*

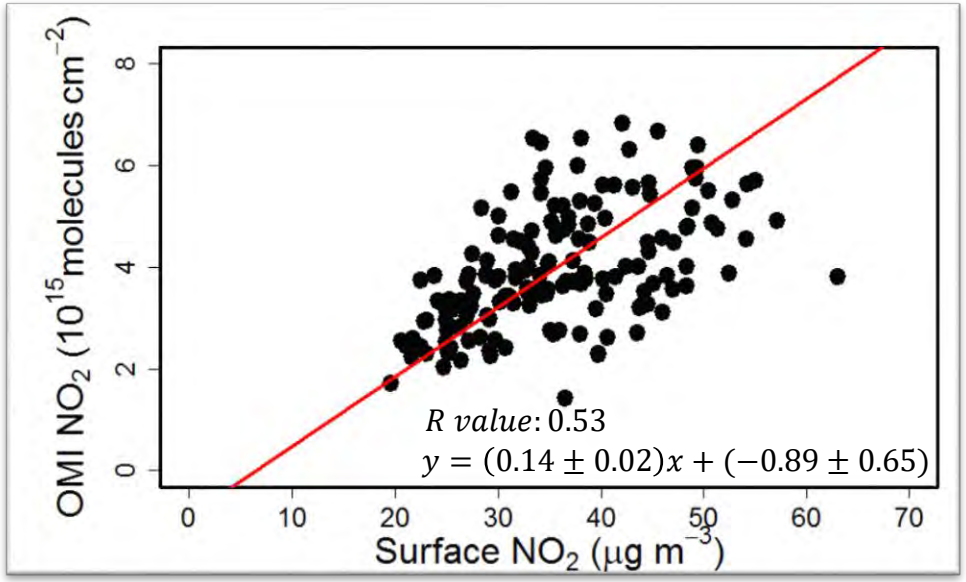
Area-weighted mean



Mean concentration of spatially correlated sites

London *(Jan'05 – Apr'18)*

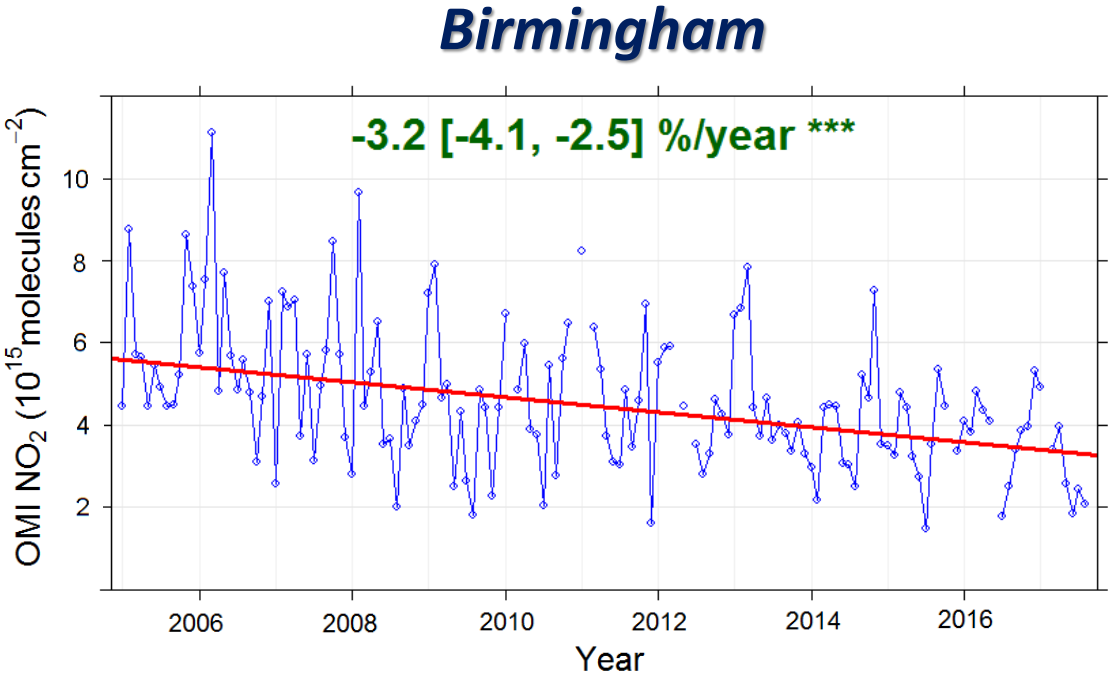
PRELIMINARY

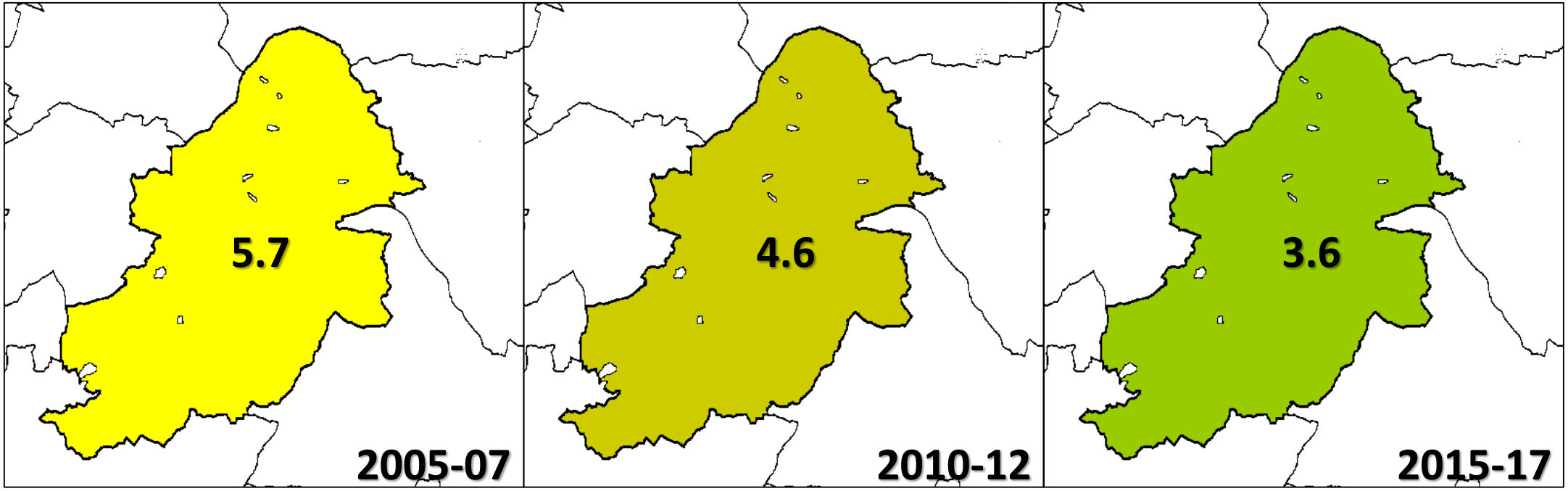


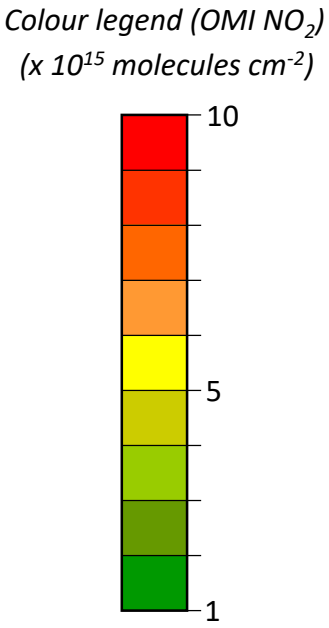
- Surface and OMI NO_2 are temporally correlated for Birmingham
- For London, OMI NO_2 only explains 28% variability in surface NO_2

OMI NO_2 TRENDS IN BIRMINGHAM

- Significant decline in NO_2
- Decreased by **38%** over the last decade
- NO_2 is short lived, indicates a significant decline in NO_X emissions

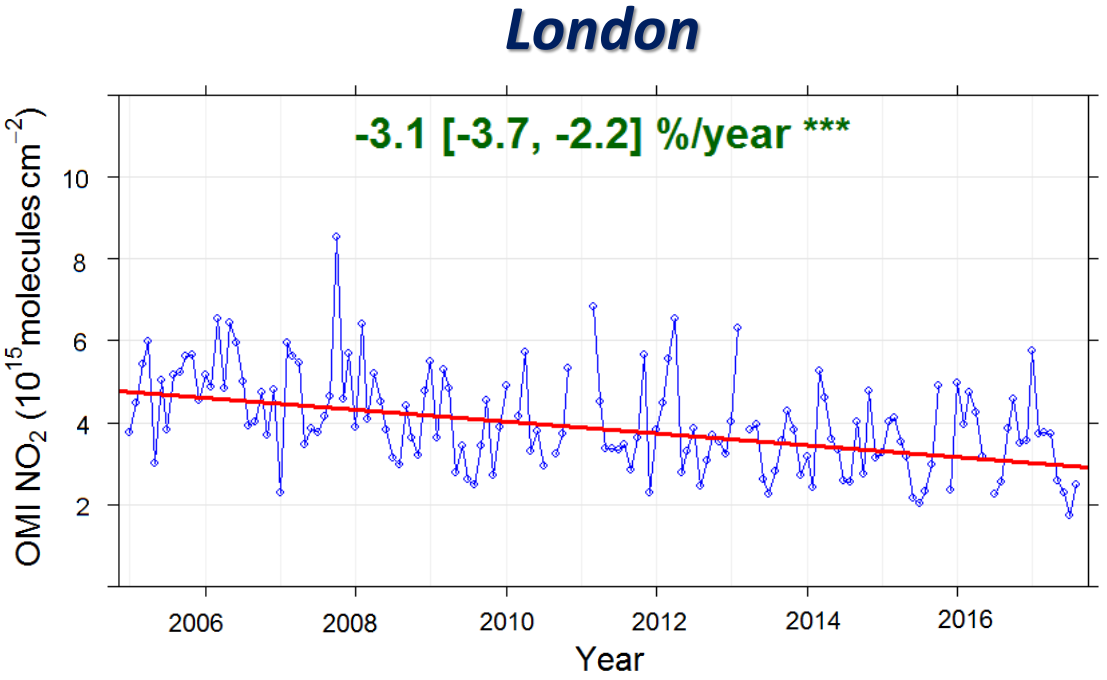


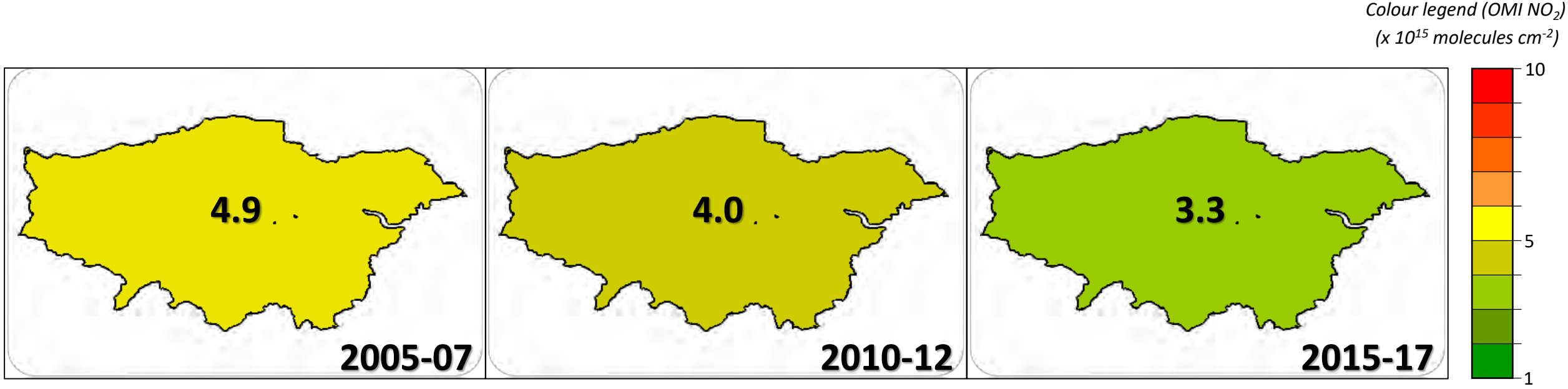




SIMILAR OMI NO_2 TRENDS IN LONDON

- Significant decline in OMI NO_2
- Decreased by **31%** over the last decade





NEXT STEPS

- Apply the same approach to **New Delhi** and **Kanpur**
- Interpret **NO_x emission** trends with a model
- Apply the same approach to other pollutants:

  SO_2, fine particles, formaldehyde

- Validate Defra air quality monitoring tools

Thank You!