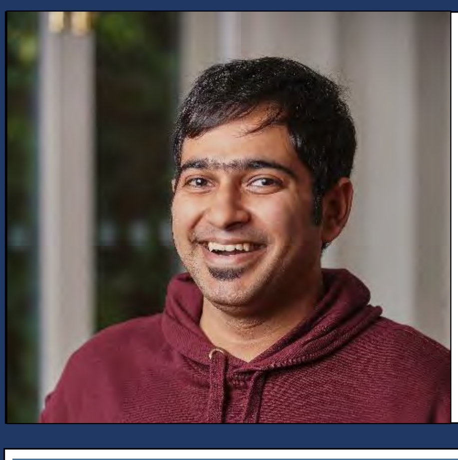
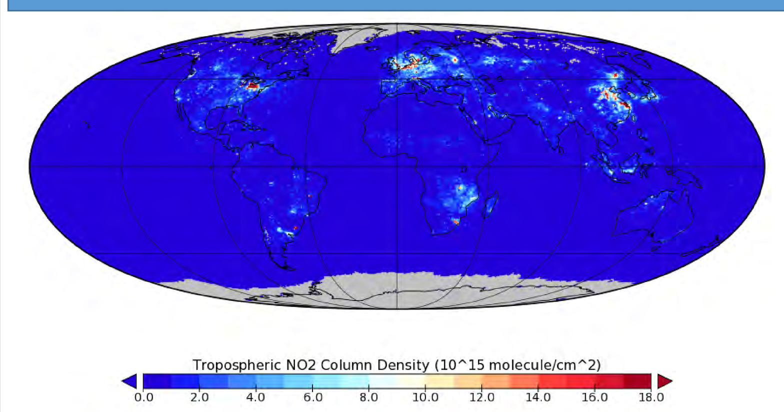


First Steps Developing a Tool to Monitor City-Wide Air Quality Using Earth Observations

Karn Vohra (*kxv745@student.bham.ac.uk*)[1], Eloïse Marais[2], William Bloss[1], Peter Porter[3]

[1] School of Geography, Earth and Environmental Sciences, University of Birmingham, Birmingham, UK;
[2] Department of Physics and Astronomy, University of Leicester, UK; [3] Birmingham City Council, Birmingham, UK

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



30 Second Summary

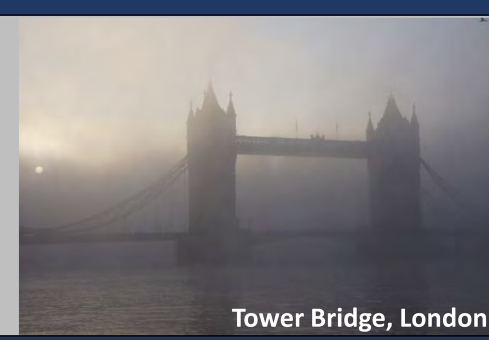
Surface observations are sparse and inconsistent + Satellites provide long-term global observations + Validation of satellite observations with surface observations = Apply satellite observations to monitor air quality

References

- Lamsal et al., JGR, doi:10.1029/2007JD009235, 2008
- Celarier et al., JGR, doi:10.1029/2007JD008908, 2008
- Geddes et al., EHP, doi:10.1289/ehp.1409567, 2016
- Birmingham City Council https://bit.ly/2KbBNTI
- Pope et al., ASL, doi:10.1002/asl.817, 2018
- DEFRA report https://bit.ly/2HU4cPI

1. Introduction

- **40,000** early deaths each year in UK are attributed to fine particles and **NO_2** pollution; Associated health cost : **£6 billion**
- Space-based instruments provide long-term (2005-2017) observations of NO_2 to assess and develop prescient policy
- Here we validate and use satellite observations to assess air quality in **Birmingham** and **London**



Tower Bridge, London

2. Methodology

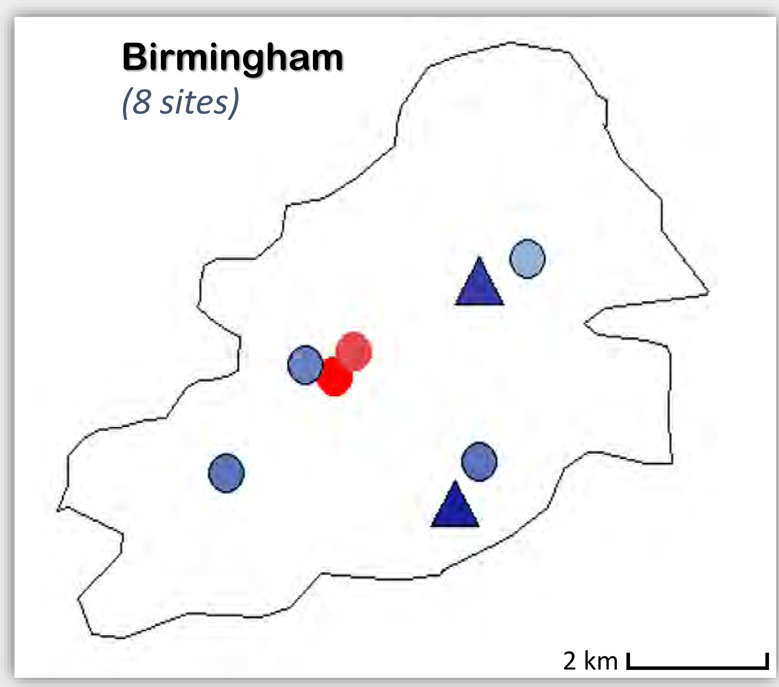
- Validate satellite observations of NO_2 from the ***Ozone Monitoring Instrument (OMI)*** on-board **NASA's Aura satellite** with **DEFRA, Birmingham City Council** and **London Air Quality Network** ground-based observations
- Quantify the long-term (2005-2017) trend in OMI NO_2

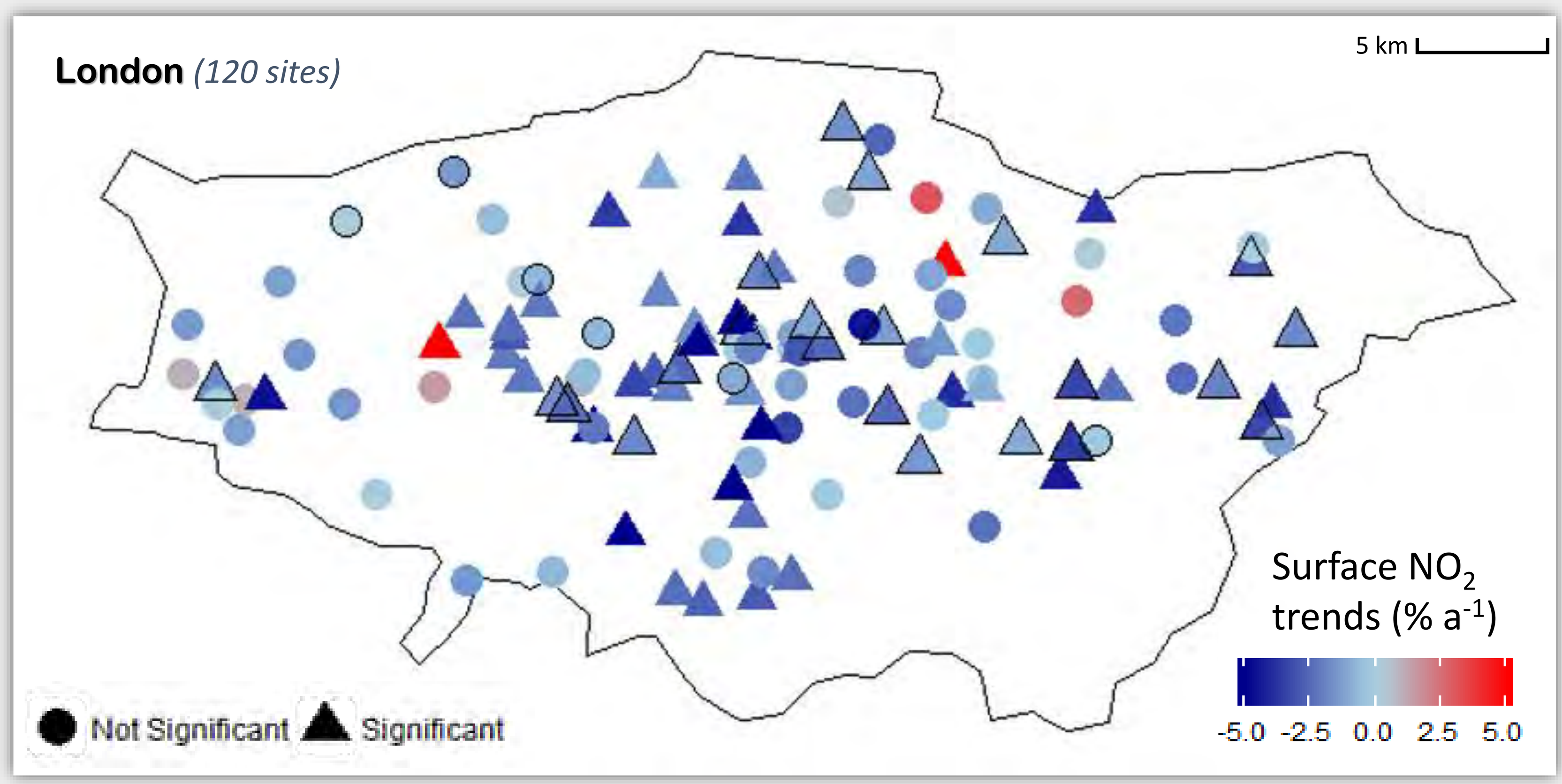
Source: KNMI.nl

Ozone Monitoring Instrument (OMI)

3. Surface Monitoring of NO_2

- Sparse and periodic network of 8 sites in Birmingham
- Dense but periodic network of 120 monitoring sites in Greater London
- Sites with temporal overlap and consistent month-to-month variability are outlined (6 for Birmingham and 28 for London)

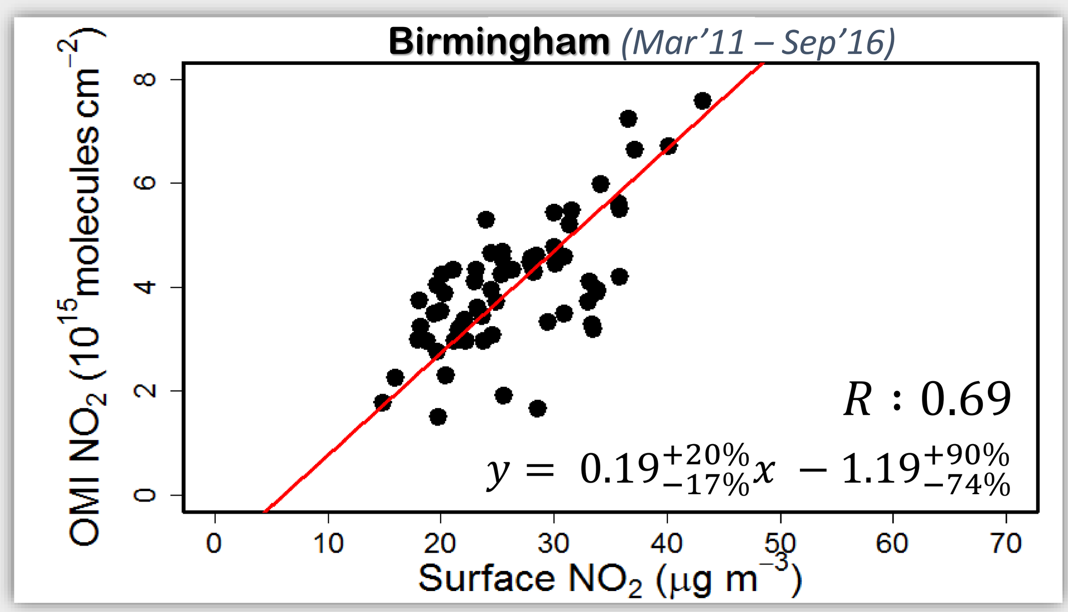




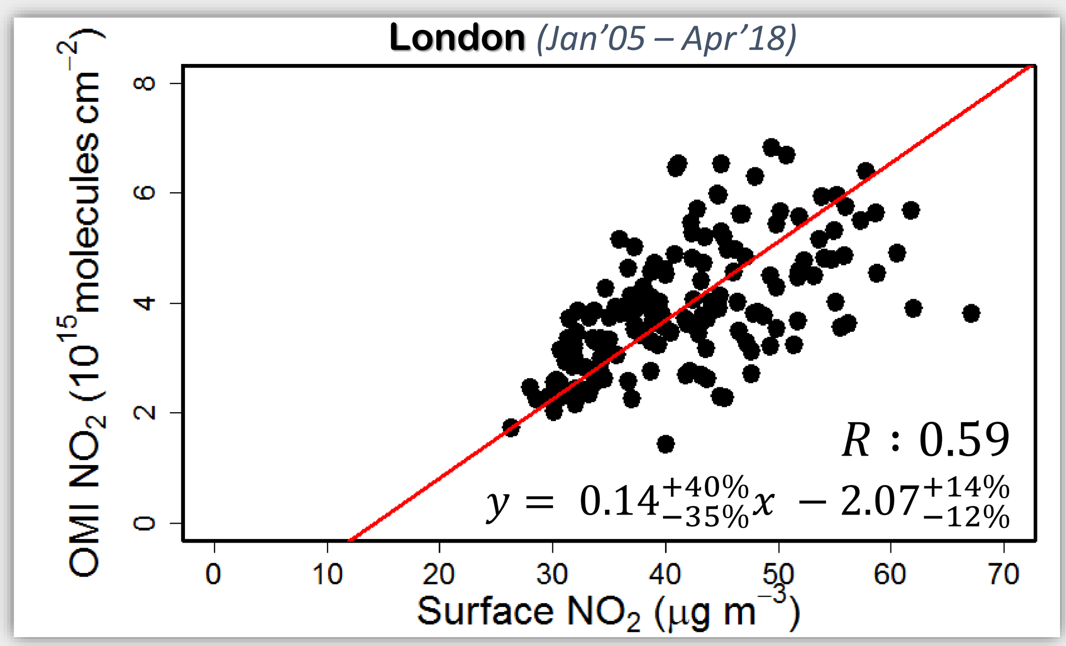
Trends and locations of NO_2 monitoring sites in Birmingham and London

4. Validation of Satellite Observations

- Surface NO_2 observations (from sites with temporal overlap and consistent month-to-month variability) are compared with OMI NO_2
- Surface and OMI NO_2 are temporally correlated for Birmingham

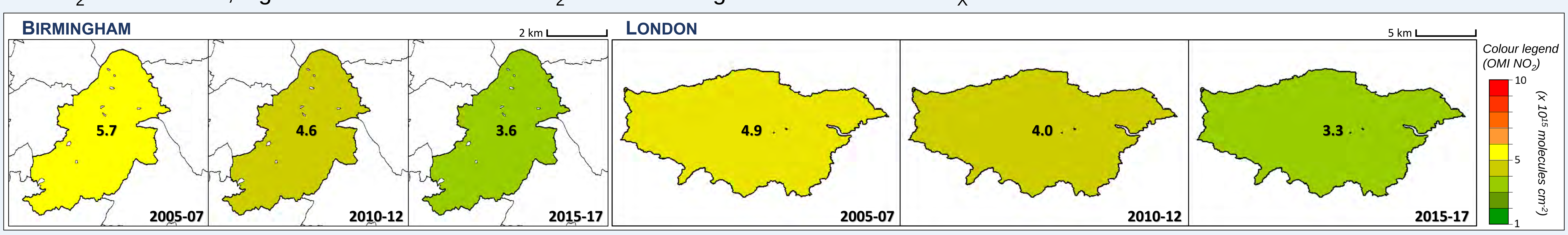


- For London, OMI NO_2 only explains 35% variability in surface NO_2



5. OMI NO_2 Trends in Birmingham and London

- OMI NO_2 has decreased by 42% (Birmingham) and 40% (London) for 2005-2017
- NO_2 is short lived, significant decline in OMI NO_2 indicates a significant decline in NO_X emissions



6. Discussion

- Surface sites provide detailed information about spatial variability in NO_2
- Consistent satellite and ground-based NO_2 give us confidence to apply satellite observations to monitor air quality in Birmingham
- For London, weaker correlation may be due to transport from continental Europe. Further investigation is underway
- We find from OMI that NO_2 has declined by 3.2% a^{-1} (Birmingham) and 3.1% a^{-1} (London) from 2005 to 2017, similar to the UK-wide decrease in NO_x emissions (3.9% a^{-1}) and more than the decline in London (1.8% a^{-1}) determined with surface NO_2 observations
- Trends in OMI NO_2 from 2005 to 2015 are steeper for Birmingham (37%) and less steep for London (21%) compared to Pope et al. (2018)

7. Next Steps

- Similar validation to be completed for satellite observations of other air pollutants (sulphur dioxide, particulate matter and formaldehyde)
- Apply this approach to monitor rapidly developing cities like **New Delhi**, **Kathmandu**, **Jakarta**, **Ontisha**, **Johannesburg** and **Sao Paulo**