A SPACE-BASED PERSPECTIVE OF CITY-WIDE TRENDS IN NO_2 FOR CITIES AT DIFFERENT DEVELOPMENT STAGES

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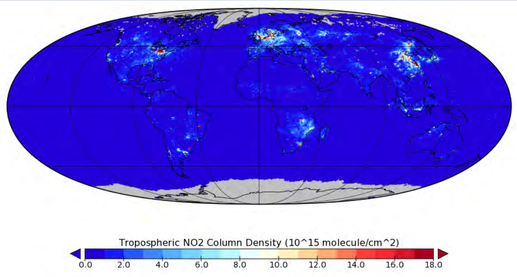
OMI/Aura NO_2 Cloud-Screened Tropospheric Column L3 Global Gridded 0.25 degree x 0.25 degree V3



30 SECOND SUMMARY

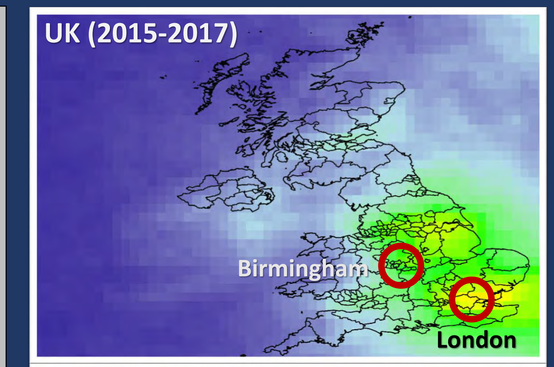
Surface observations are sparse and inconsistent + Satellites provide long-term global observations + Validation of satellite observations with surface observations = Apply satellite observations to monitor air quality

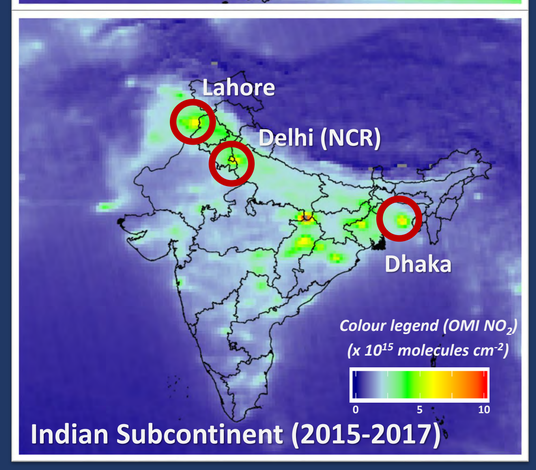
REFERENCES

- 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
- Tariq et al., AIM, doi:10.1155/2015/959284, 2015
- 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

- Each year **40,000** early deaths in UK and **620,000** in India are attributed to fine particles and **NO_2** pollution; Associated health cost in UK : **£6 billion**
- Sources of NO_2: Mainly from vehicular emissions in UK; For India, rapid growth in industries, coal-based electricity production, increase in number of vehicles and biomass burning
- Here we choose 4 cities at different stages of development: **London** (developed) and **Birmingham** (urban renewal) in the UK, and **New Delhi** (semi-developed) and **Kanpur** (developing) in India
- Space-based instruments provide long-term (2005-2017) observations of NO_2 to assess and develop prescient policy; we validate and use satellite observations to assess air quality in London and Birmingham





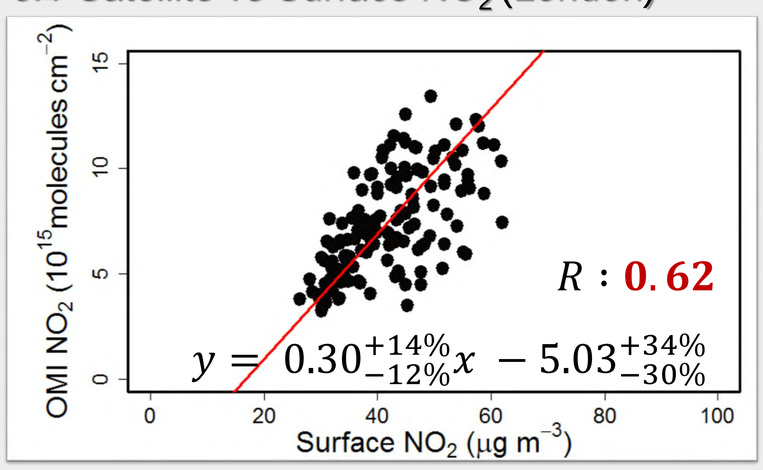
2. METHODOLOGY

- 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
- We compare OMI NO_2 levels of UK and Indian cities at different stages of development

3. VALIDATION OF SATELLITE OBSERVATIONS

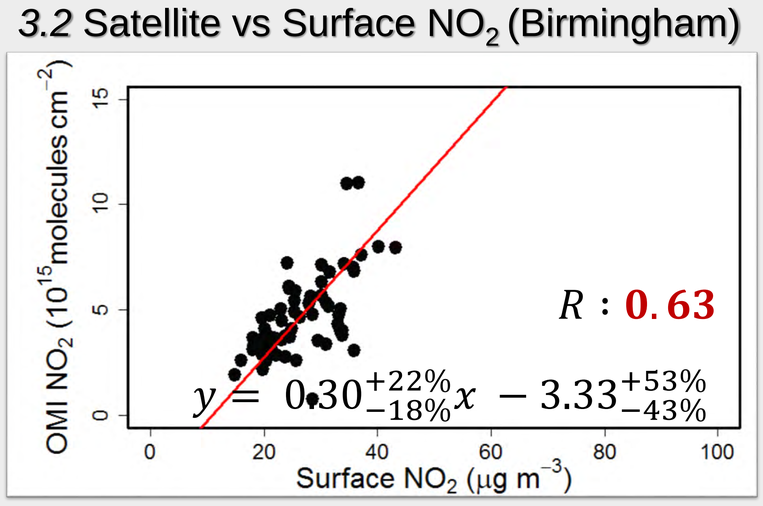
- Monthly means of surface and OMI NO_2 are temporally correlated for London and Birmingham

3.1 Satellite vs Surface NO_2 (London)



(January 2005 – April 2018)

3.2 Satellite vs Surface NO_2 (Birmingham)

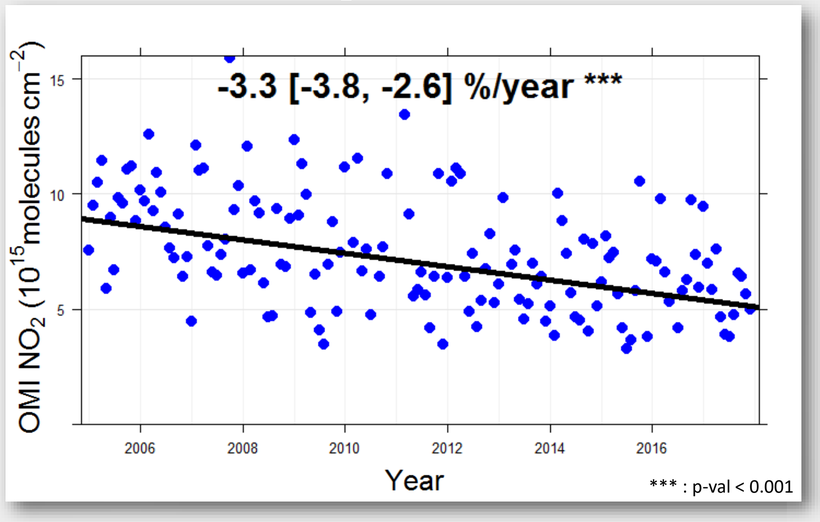


(March 2011 – September 2016)

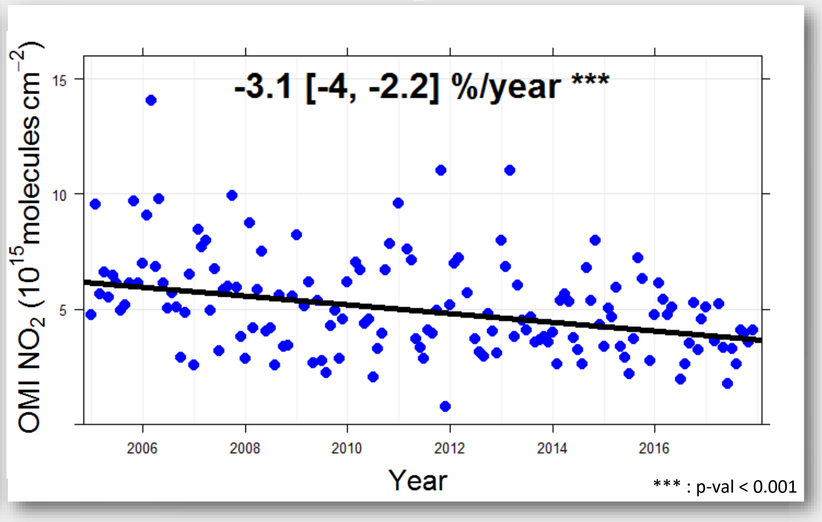
4. TRENDS IN OMI NO_2 IN UK AND IN INDIA

- Comparison of city-wide OMI NO_2 levels in UK and in India

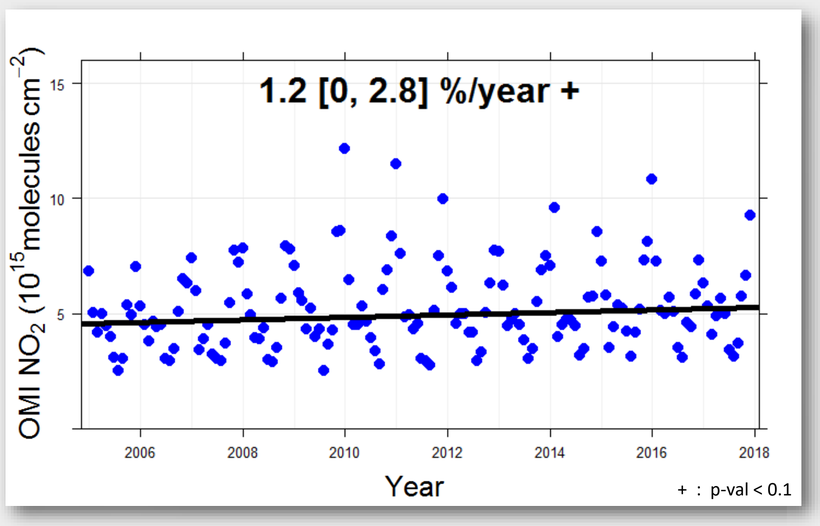
4.1 London OMI NO_2 (2005-2007)



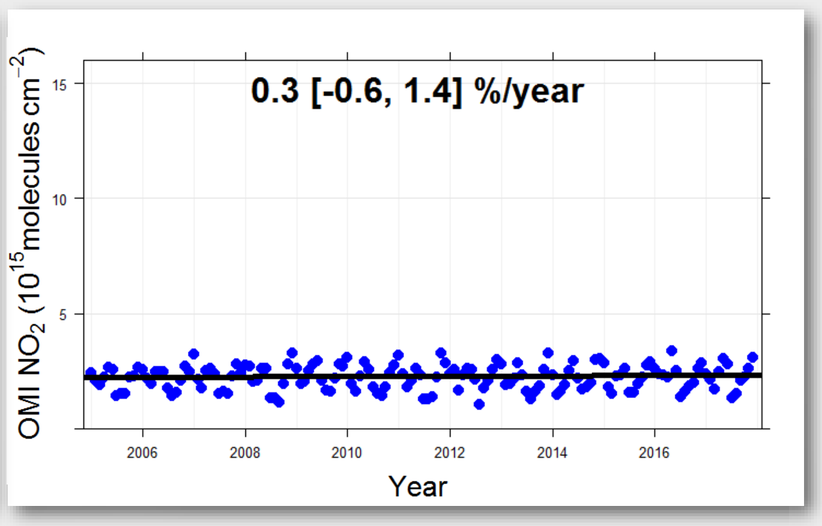
4.2 Birmingham OMI NO_2 (2015-2017)



4.3 Delhi OMI NO_2 (2005-2007)



4.4 Kanpur OMI NO_2 (2015-2017)



5. DISCUSSION

- Consistent satellite and ground-based NO_2 give us confidence to apply satellite observations to monitor air quality for cities
- Successful adoption of vehicular emission mitigation measures indicate a decline in OMI NO_2 levels in UK, similar to the UK-wide decrease in NO_X emissions (3.9% a^{-1}), compared to the rise in NO_2 levels for Indian cities owing to on-going development (2005-2017)
- OMI NO_2 decreased by **40%** for Birmingham and by **43%** for London (2005-2017)
- Significant increase (**15%**) in OMI NO_2 levels in Delhi compared to no significant change in Kanpur for 2005-2017
- OMI NO_2 trends for Delhi from 2005 to 2015 are comparable to Tariq et al., 2015
- Multi-year OMI NO_2 means (2015-2017) suggest similar levels of OMI NO_2 in London (***6.2***) and in Delhi (***5.4***) in the future

6. NEXT STEPS

- Validate satellite-based NO_2 observations for **New Delhi** and **Kanpur** and interpret NO_X emission trends with a chemical transport model
- Similar validation to be completed for satellite observations of other air pollutants (sulphur dioxide, formaldehyde and ammonia)