MONITORING AIR POLLUTION FROM THE GROUND UP!!!

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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

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- Celarier et al., JGR, doi:10.1029/2007JD008908, 2008
- Geddes et al., EHP, doi:10.1289/ehp.1409567, 2016
- Ul-Haq 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 **1.2 million** in India are attributed to fine particles, ozone and **NO_2** pollution; Associated health cost in UK : **£6 billion**; dominant NO_2 sources: diesel (UK), industry, coal combustion, vehicles, biomass burning (India)
- Here we choose 4 cities at different stages of development: **London** (developed, $PM_{2.5}$:**12** µg/m^3) and **Birmingham** (urban renewal, $PM_{2.5}$:**10** µg/m^3) in the UK, and **New Delhi** (semi-developed, $PM_{2.5}$:**143** µg/m^3) and **Kanpur** (developing, $PM_{2.5}$:**173** µg/m^3) in India
- Space-based instruments provide long-term (2005-2018) observations of NO_2 to assess the effect of rapid development and policy on air quality; we validate and use satellite observations to assess air quality in London and Birmingham

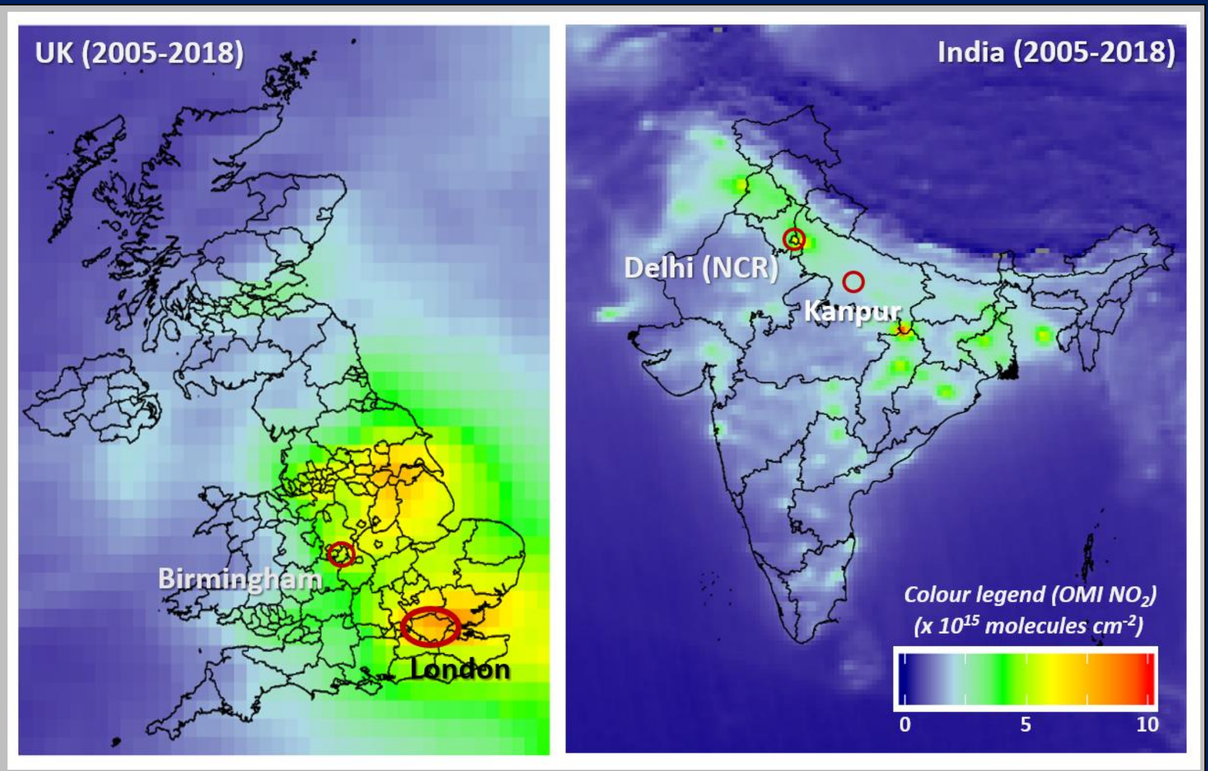

Figure 1. Maps of the UK and India showing hotspots of NO_2 pollution as observed from space

2. METHODOLOGY

- Process GBs of long-term satellite data using BEAR resources (processing time 2-5 days depending on size of city)
- 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 (2005-2018) trend in OMI NO_2 for selected cities in the UK and India

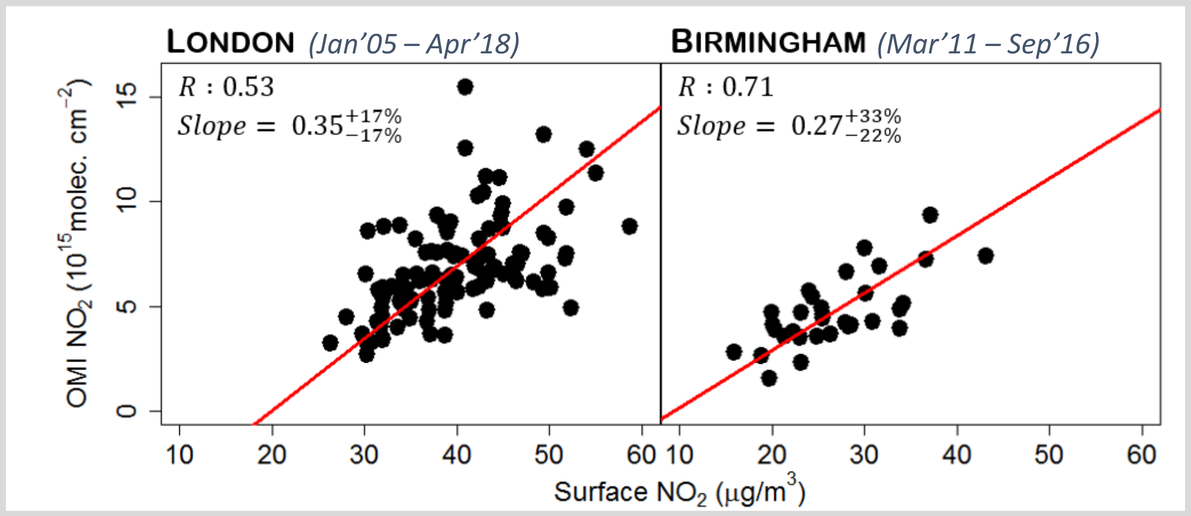

Figure 2. Evaluation of monthly means of satellite-based NO_2 against surface NO_2 concentrations

3. TRENDS IN SATELLITE-BASED NO_2 IN THE UK AND IN INDIA

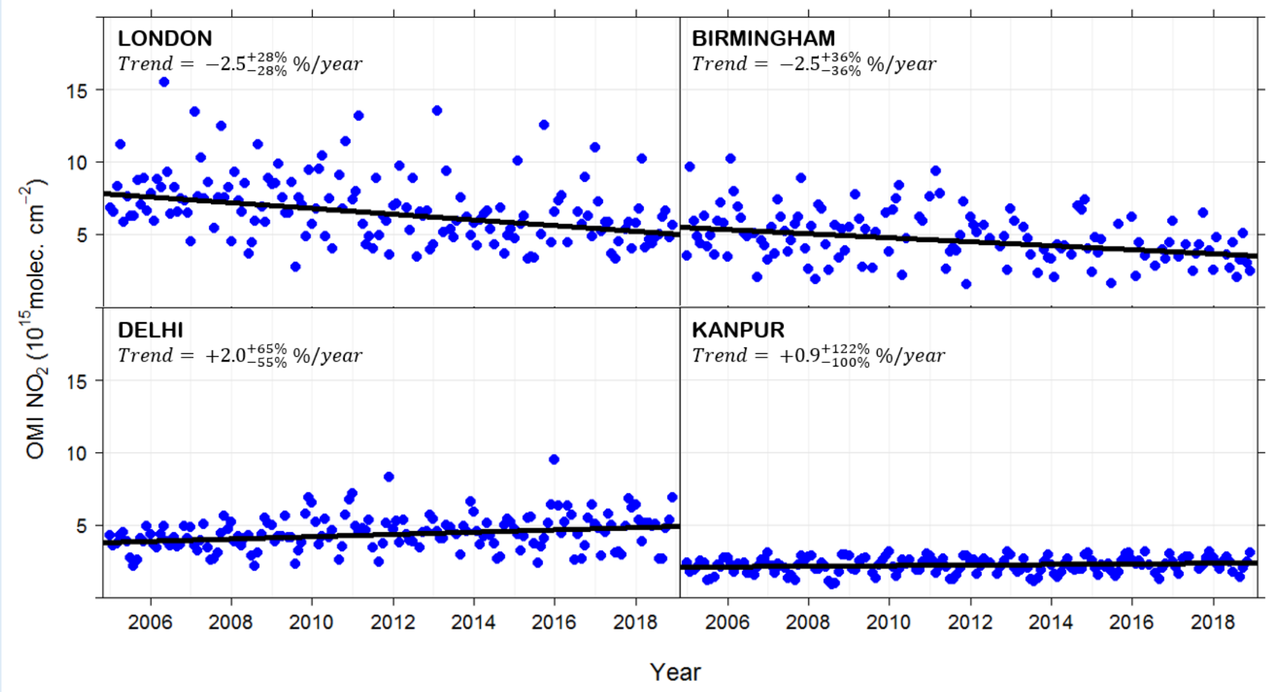

Figure 3. Linear trends in monthly means of satellite-based NO_2 levels in target cities of the UK and India

- We observe linear trends in monthly means of OMI NO_2 in the target cities; OMI NO_2 decreased by **35 %** for both London and Birmingham (2005-2018); Significant increase (**28 %**) in OMI NO_2 levels in Delhi compared to no significant change in Kanpur for 2005-2018
- OMI NO_2 levels are similar now over London and Delhi
- Our work shows that NO_2 concentrations and NO_x precursor emissions in UK cities have decreased by ***2.5*** %/year. This is less than the UK-wide decrease in NO_x emissions from the national bottom-up emission inventory (***3.9*** %/year), and, for London, it is more than the decline obtained with the surface network (***1.8*** %/year)
- Annual trends in OMI NO_2 for Delhi and Kanpur from 2005 to 2015 are comparable to Ul-Haq et al., 2015 (***2.1*** % for Delhi and ***0.5*** % for Kanpur)

4. NEXT STEPS

- Validate satellite-based NO_2 observations for **New Delhi** and **Kanpur** and evaluate existing **air quality models**
- Extend analysis to other compounds visible from space: ammonia, aerosol optical depth (AOD), and formaldehyde