A space-based perspective of trends in air quality in major cities in the UK and India

Karn Vohra[1*], Eloise A. Marais[2], Shannen Suckra[1,a], Louisa Kramer[1,b], William J. Bloss[1], Ravi Sahu[3], Abhishek Gaur[3], Sachchida N. Tripathi[3], Martin Van Damme[4], Lieven Clarisse[4], Pierre F. Coheur[4]

[1]University of Birmingham, Birmingham, UK
[2]University of Leicester, Leicester, UK
[3]Indian Institute of Technology Kanpur, Kanpur, India
[4]Université libre de Bruxelles, Brussels, Belgium
[a]Now at: National Environment & Planning Agency, Kingston, Jamaica
[b]Now at: Ricardo Energy & Environment, Harwell, UK

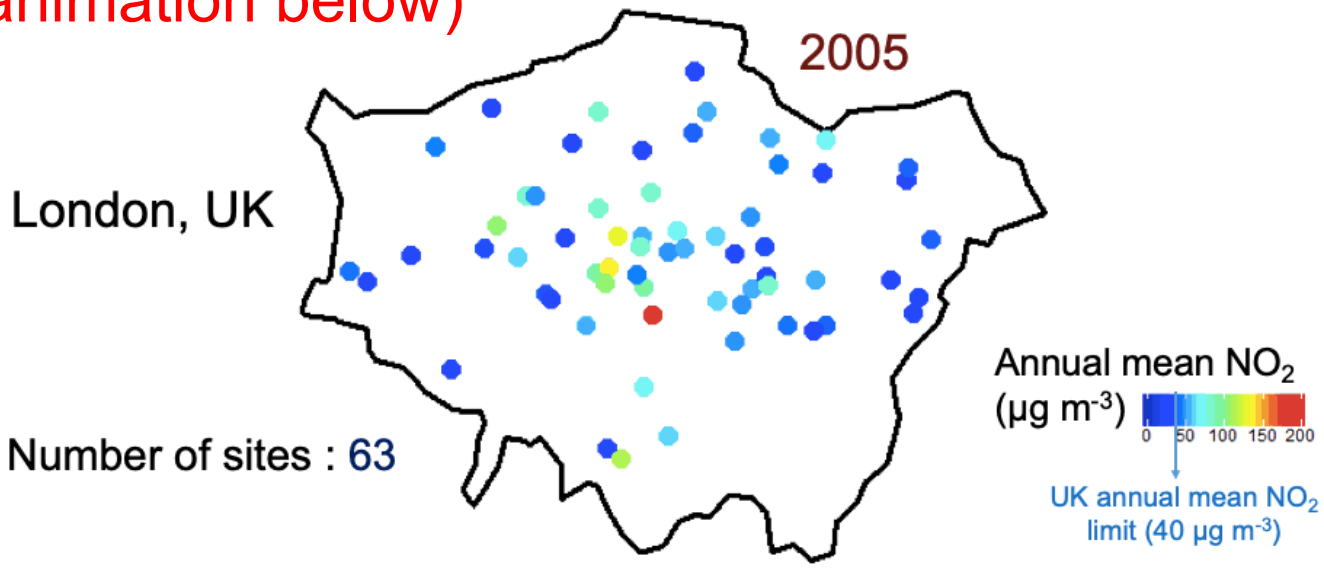
* **kxv745@bham.ac.uk**

Check out the website for more information
http://maraisresearchgroup.co.uk

TRACE

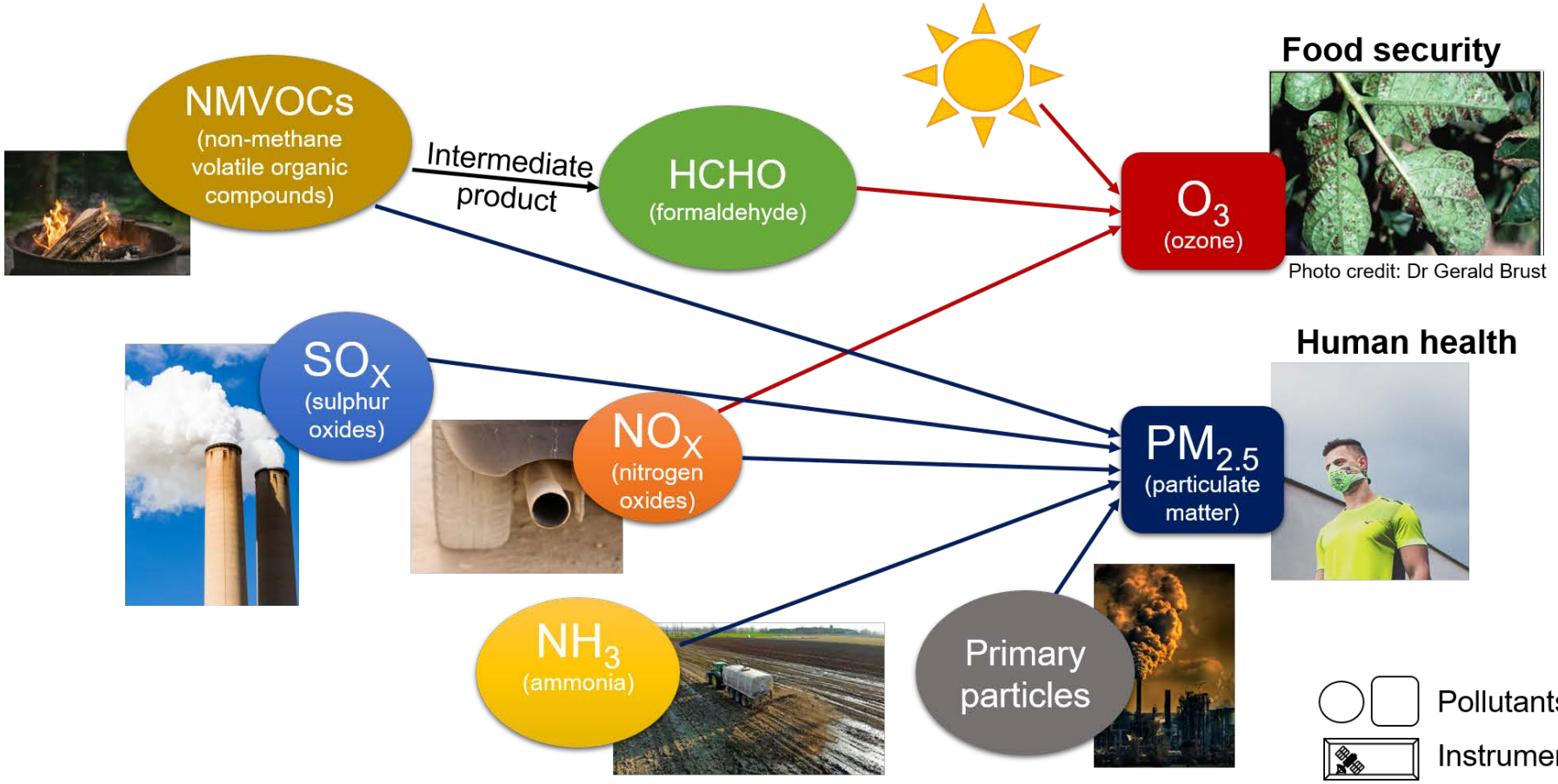
Surface monitoring networks have their limitations

- Expensive to set up and maintain
- Limited spatial and temporal coverage
- Limited pollutants monitored
- Issues with data quality
- Inconsistent (sites come and go over time like in animation below)

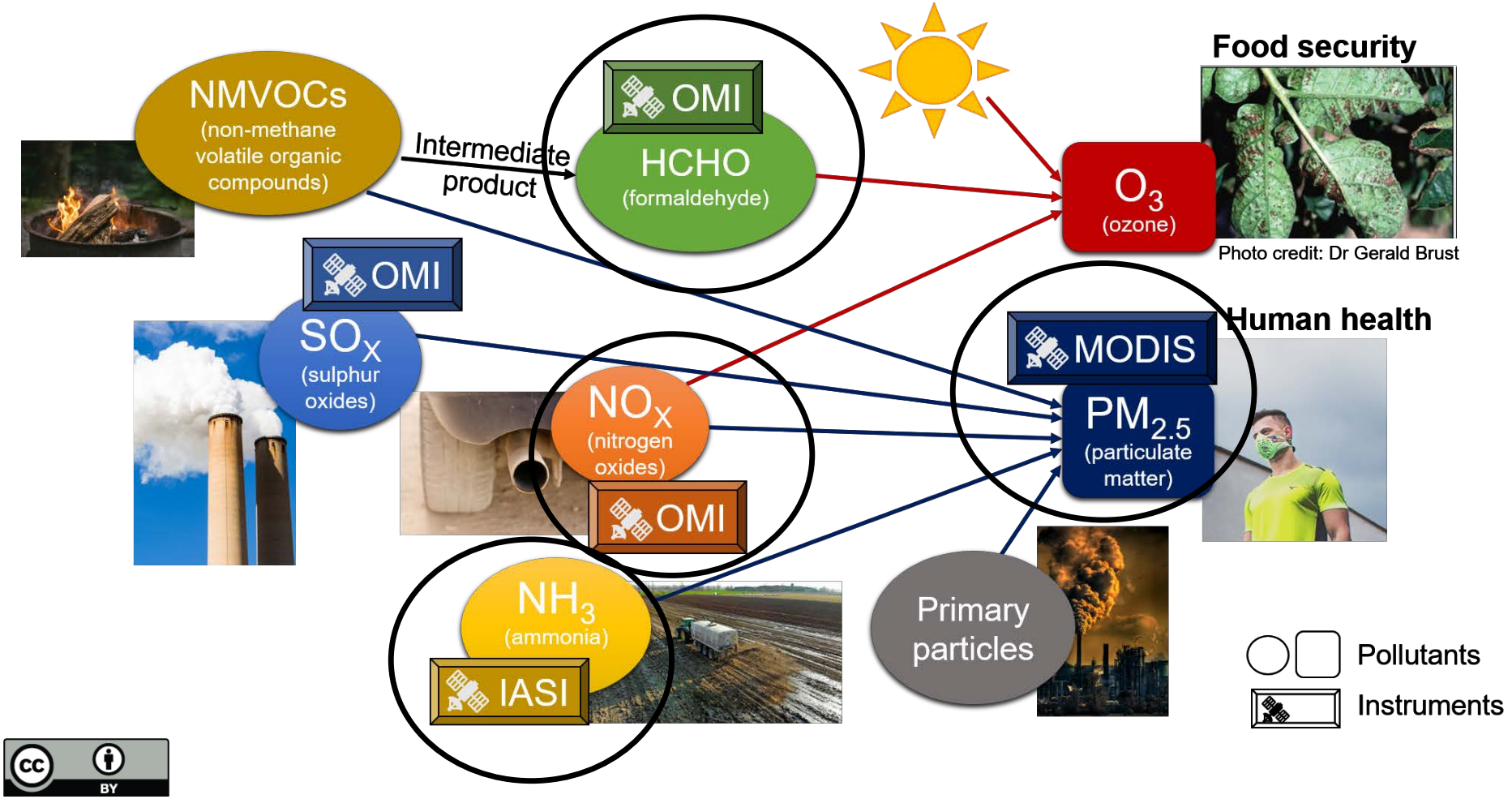


Data from *London Air Quality Network (LAQN)*

Air pollutants emitted from multiple sources, undergo chemical changes and impact health & food security

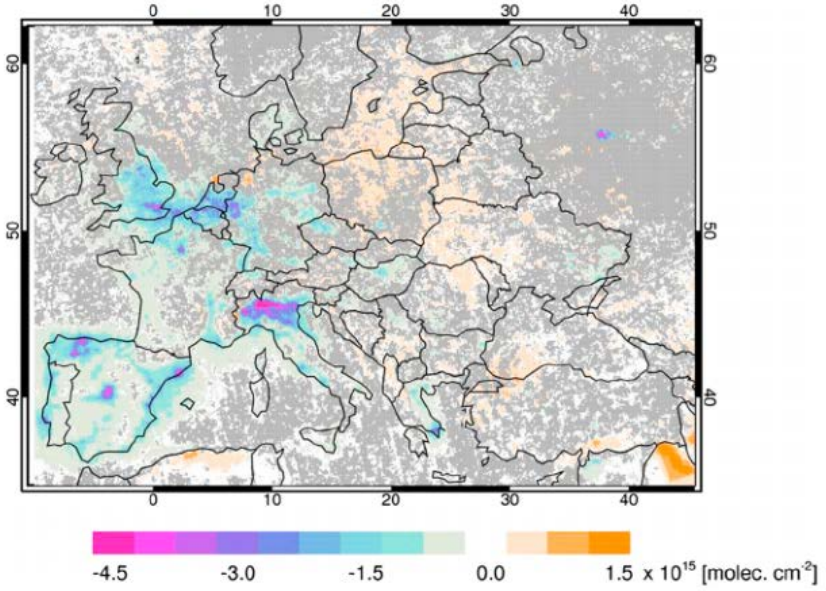


Instruments on-board satellites help monitor these air pollutants



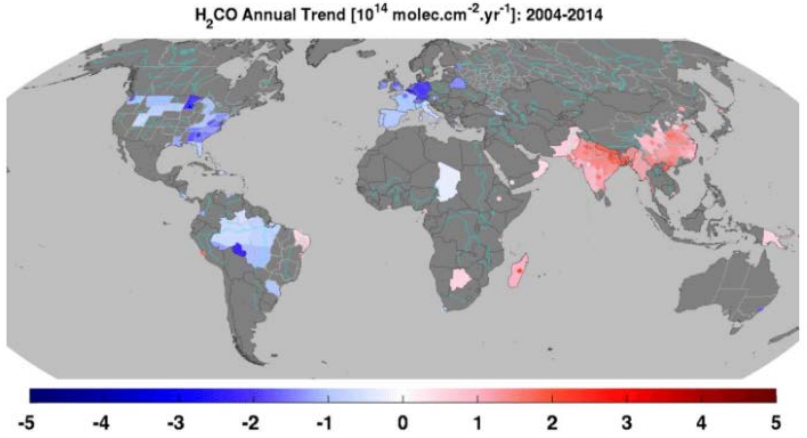
And are being used to determine long-term trends in air quality

Change in OMI NO_2 across Europe from 2005 to 2014



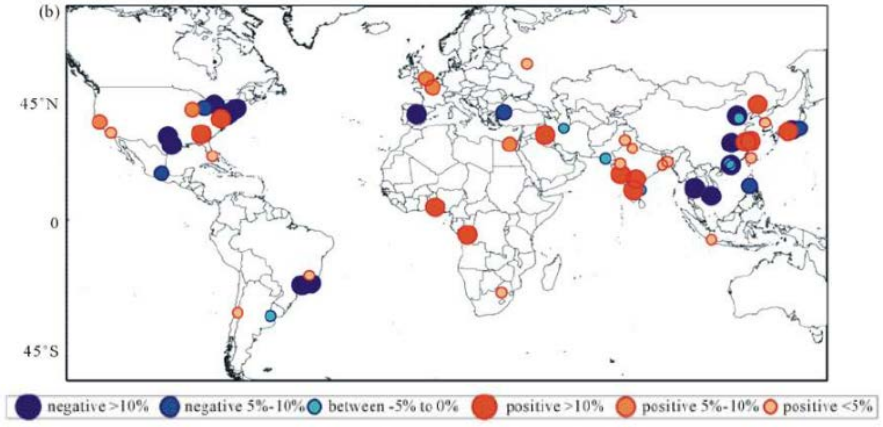
[Duncan et al., 2016]

Absolute trends in OMI HCHO for 2004-2014



[De Smedt et al., 2015]

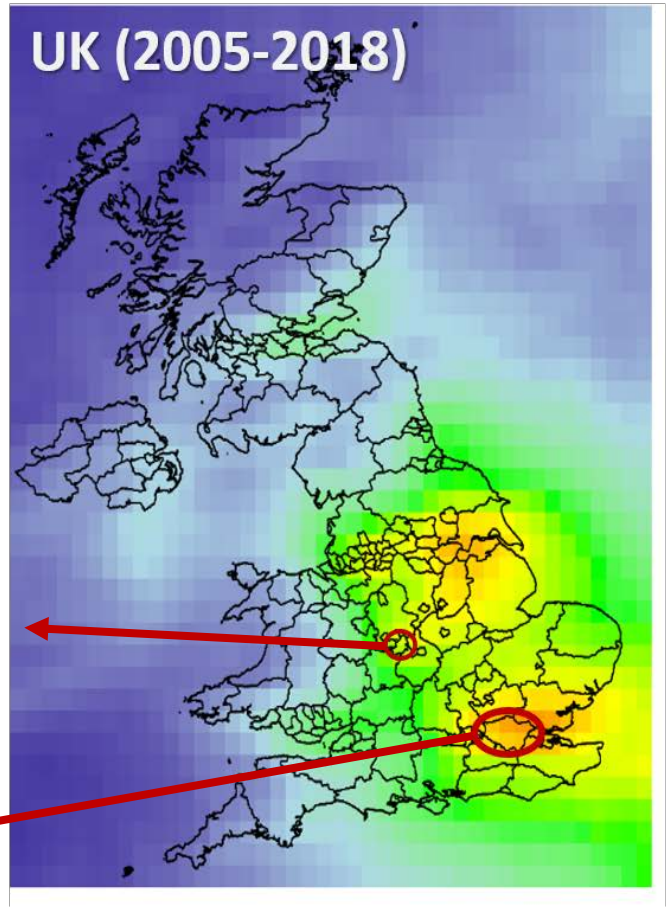
Relative trends in MODIS AOD for 2002-2010

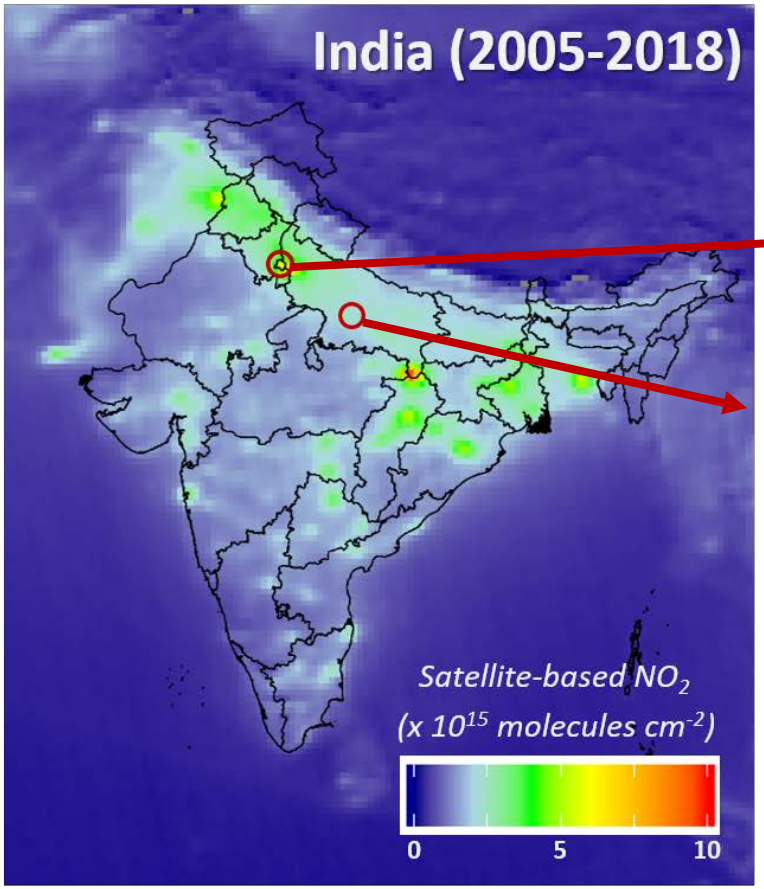


[Alpert et al., 2012]

Space-based instruments provide extensive data coverage

We focus on 4 dynamic cities





Birmingham

London

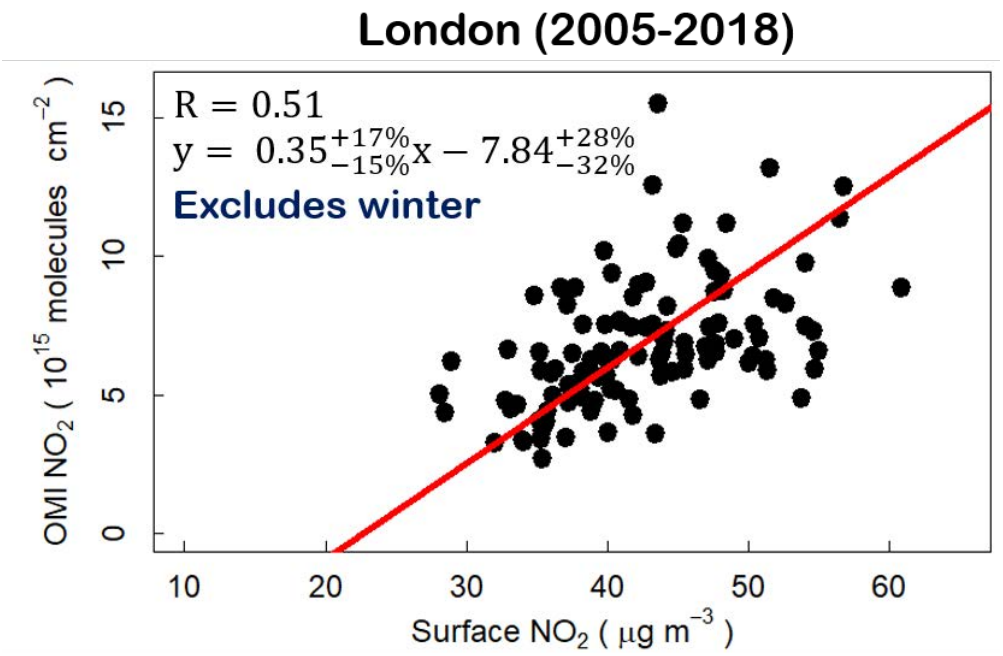
Delhi

Kanpur

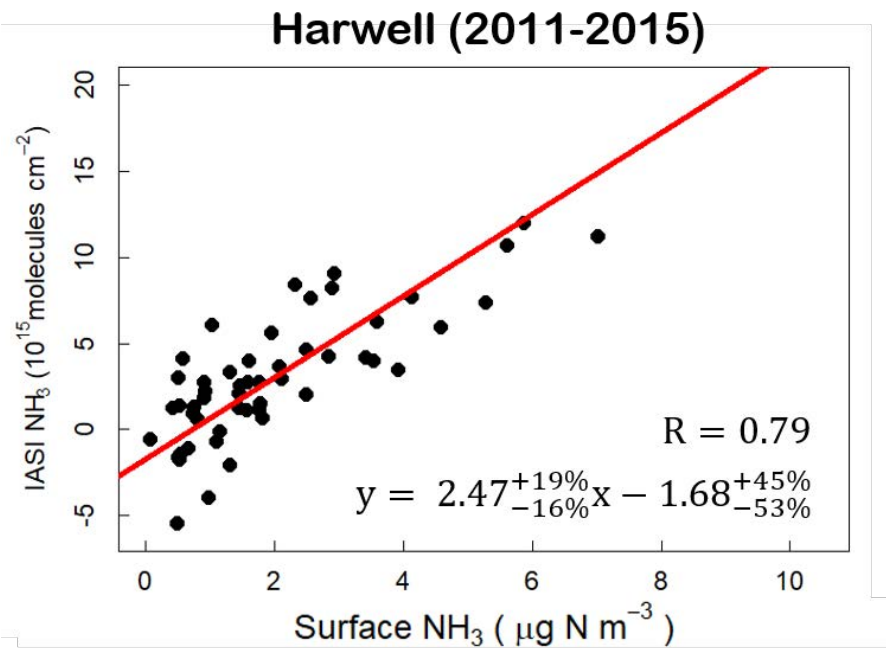
* Maps on different scales

We conduct careful assessment with surface monitors (where available)

Satellite versus surface NO_2 in London



Satellite versus surface NH_3 in Harwell



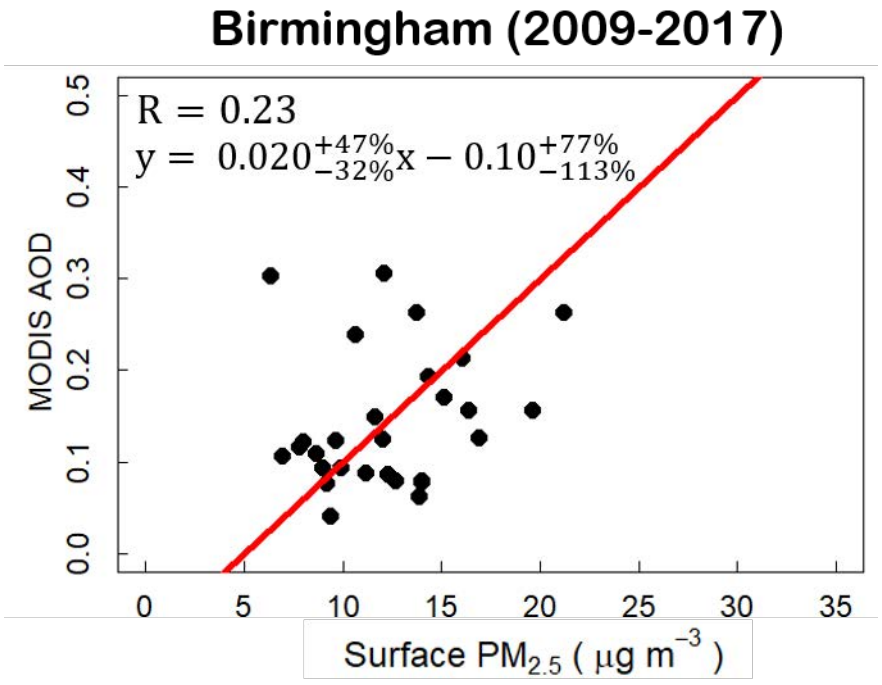
Points are monthly averages.

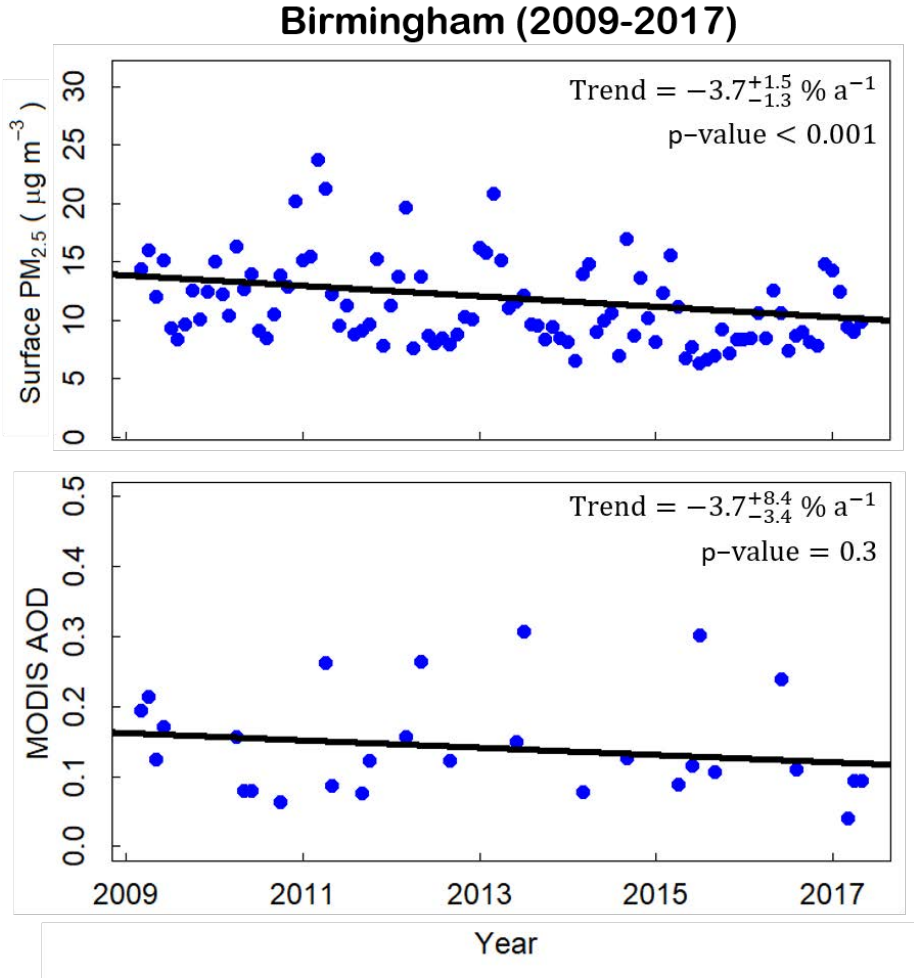
Pearson's correlation coefficient (R-value) indicates consistency

[Vohra et al., submitted, *ACP*]

We conduct careful assessment with surface monitors (where available)

Satellite versus surface $PM_{2.5}$ in Birmingham



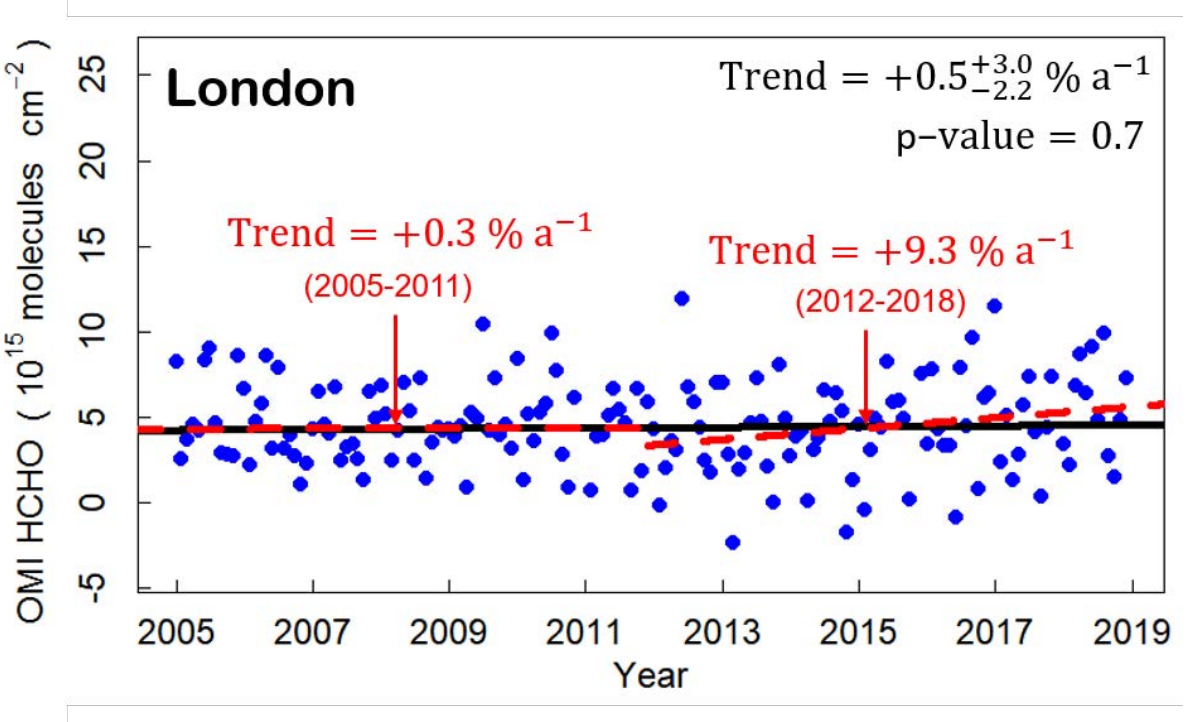


Similar results were obtained for London

[Vohra et al., submitted, *ACP*]

And apply trend analysis to long-term record of satellite observations

A) Trend in London NMVOCs

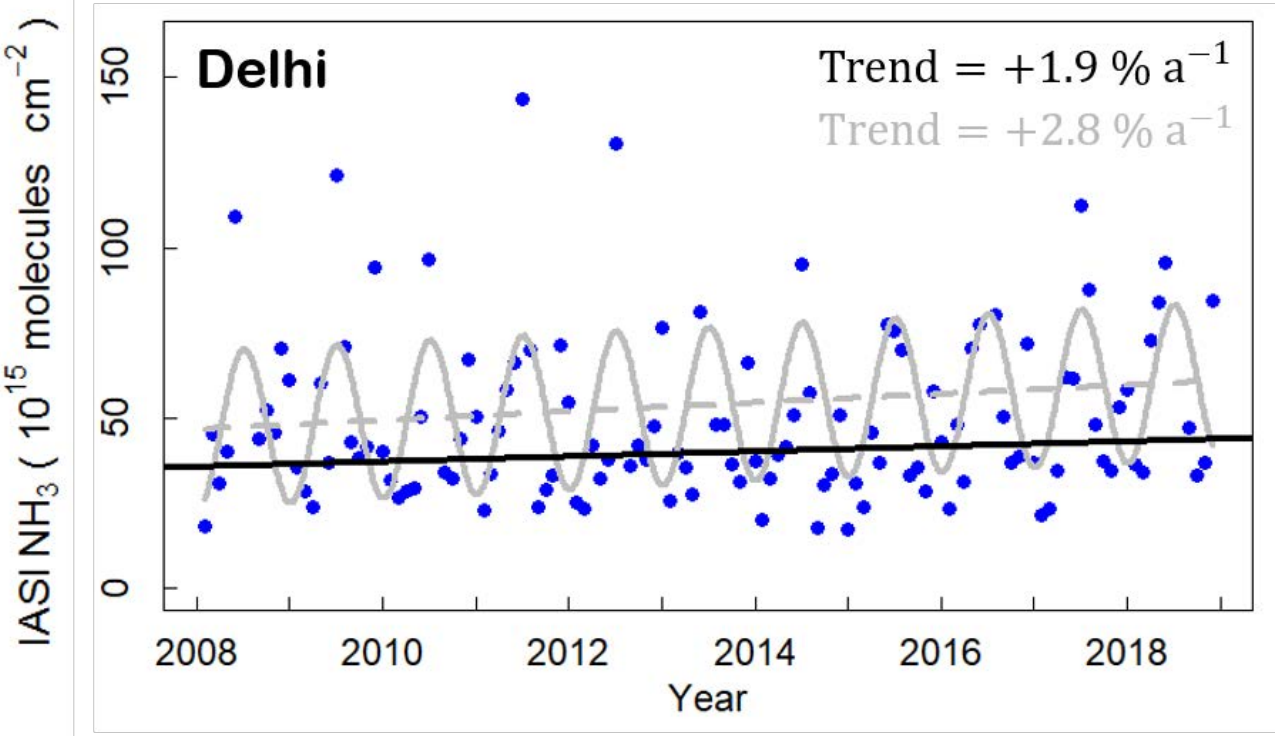


Reactive NMVOCs have increased by over **65** % in London since 2012

[Vohra et al., submitted, *ACP*]

And apply trend analysis to long-term record of satellite observations

B) Trend in Delhi NH_3

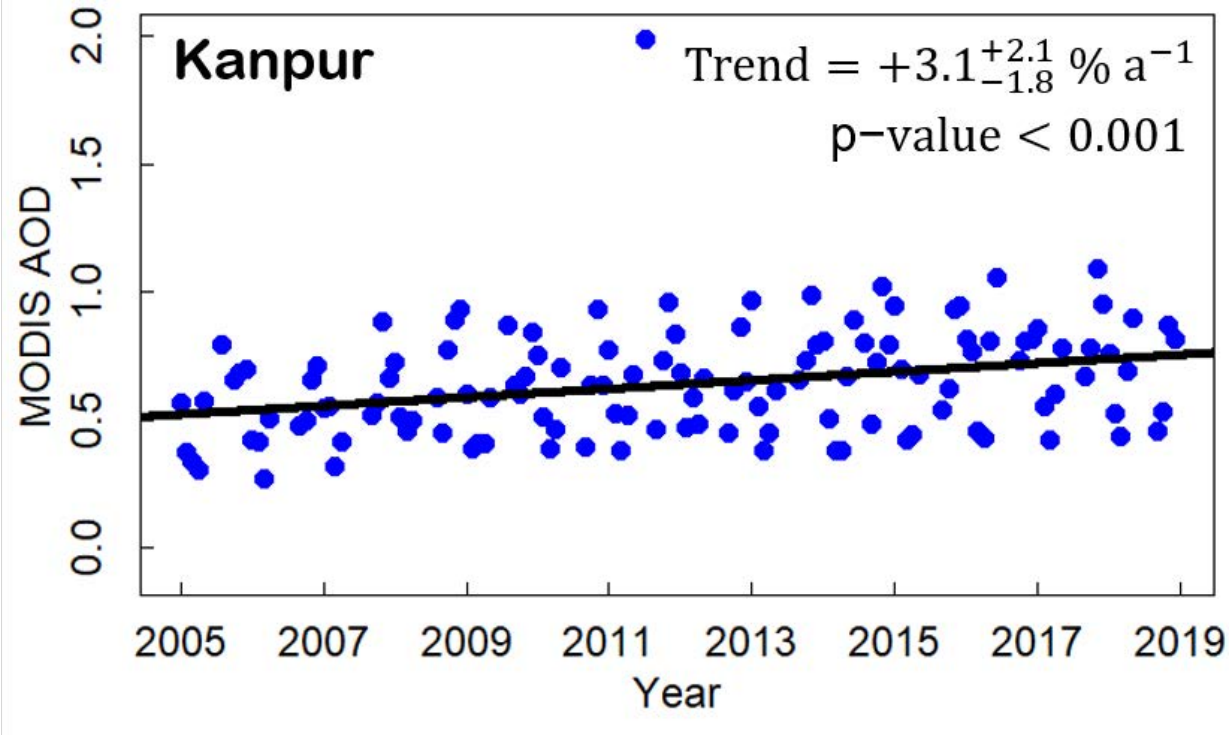


Ammonia has increased by over **30** % in Delhi during 2008-2018

[Vohra et al., submitted, *ACP*]

And apply trend analysis to long-term record of satellite observations

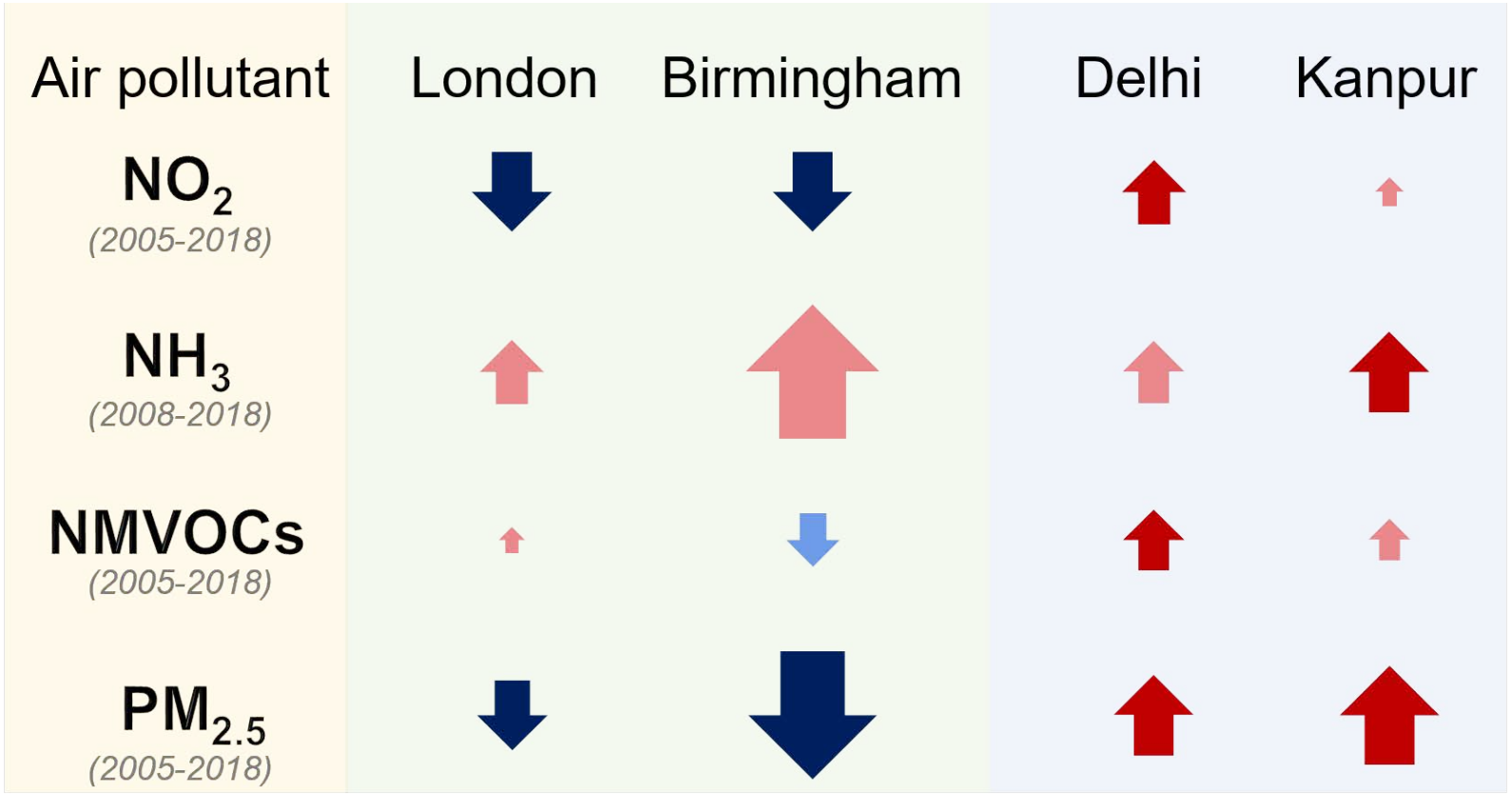
C) Trend in Kanpur $PM_{2.5}$



$PM_{2.5}$ has increased by over **43** % in Kanpur during 2005-2018

[Vohra et al., submitted, *ACP*]

Long-term trends in pollutants



Unregulated NH_3 increases in all four target cities

Concentrations of all other pollutants increase in Delhi & Kanpur

NO_2 and $PM_{2.5}$ decline in London & Birmingham due to successful emission controls **[Vohra et al., submitted, *ACP*]**

Any Questions? Contact Karn (kxv745@bham.ac.uk)