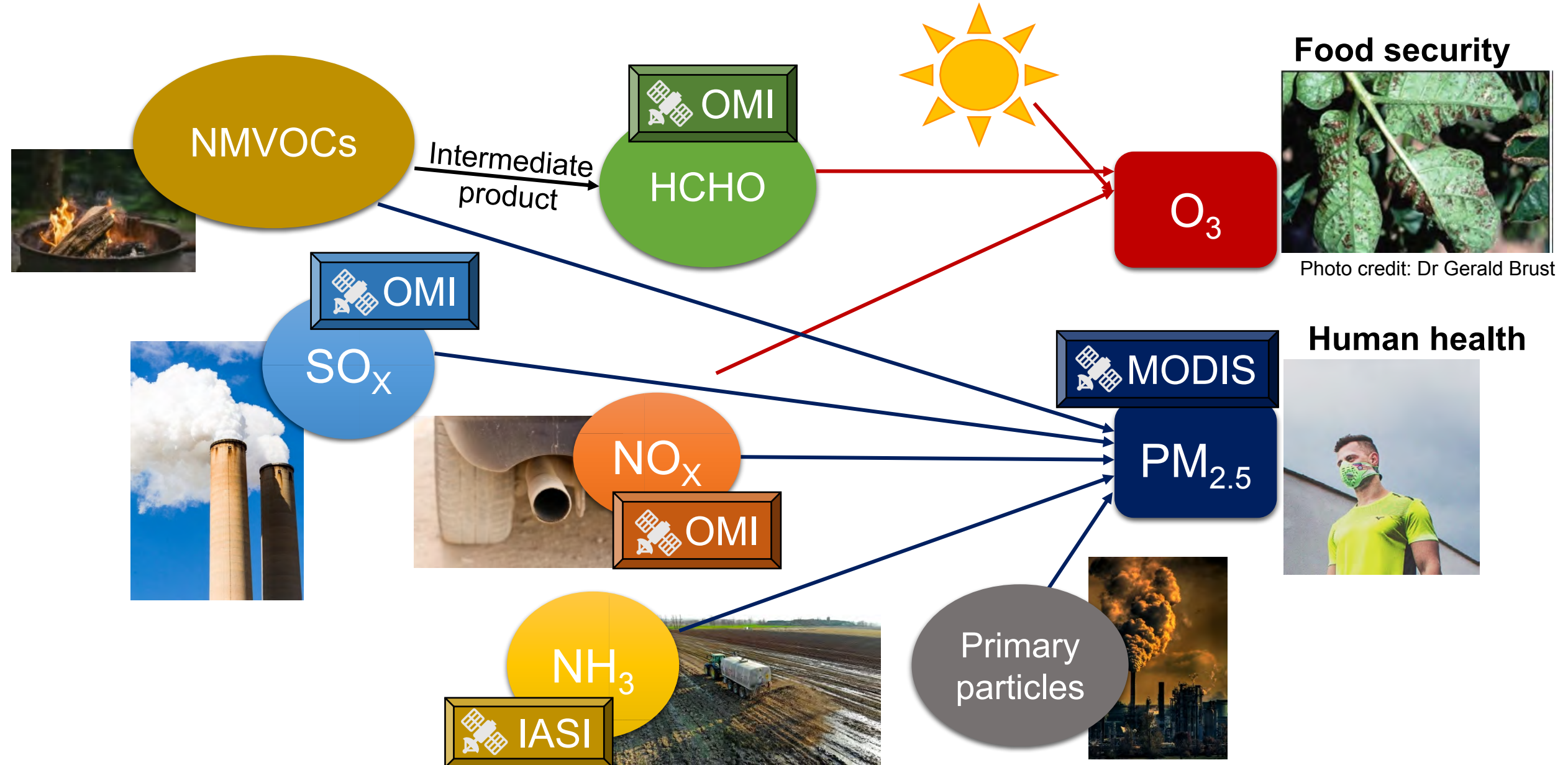


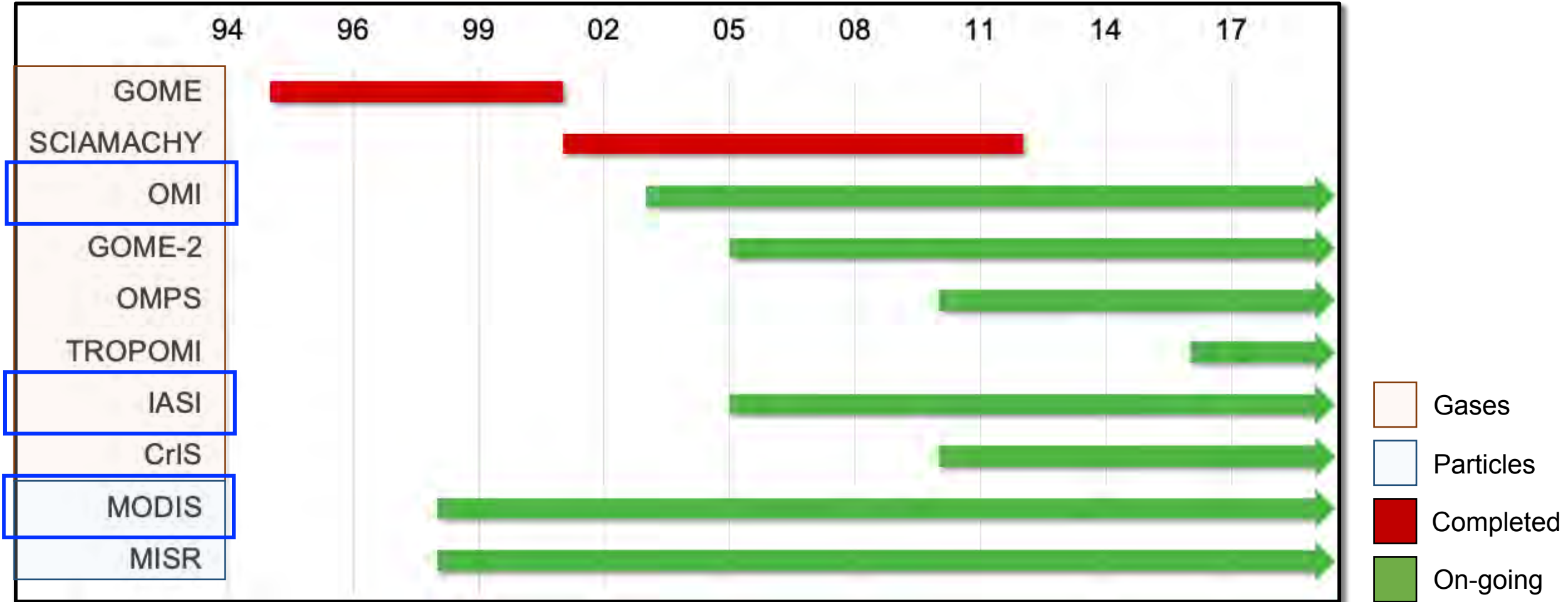
Air Pollution in the UK Constrained with In Situ, Remote and Synthetic Data



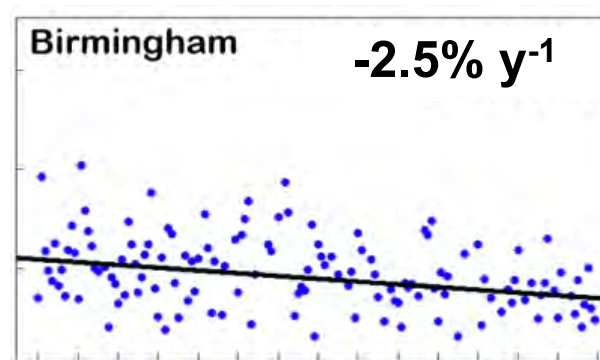
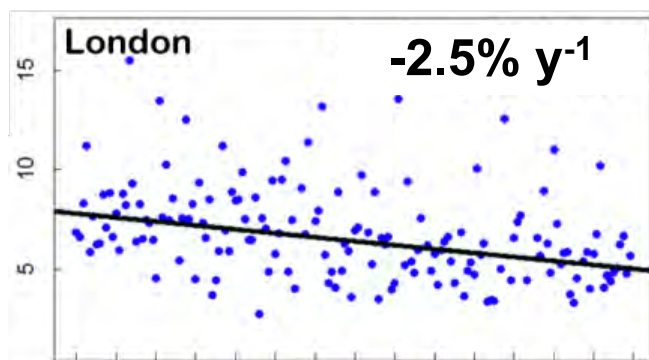
Air pollutants Directly or Indirectly Observed from Space



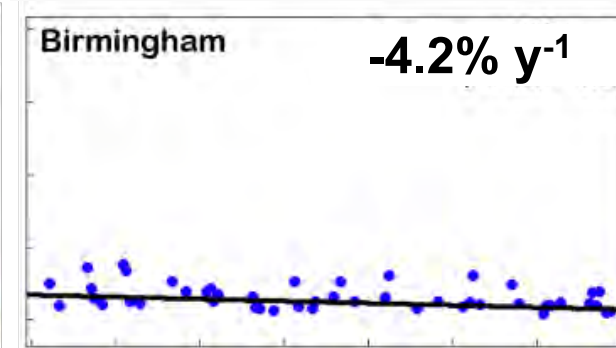
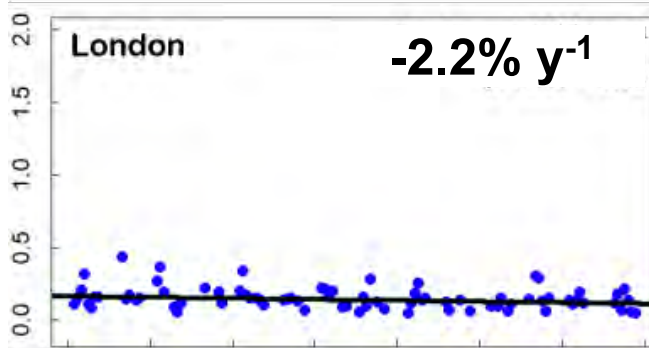
Exploit the Long-term Record from OMI, IASI, and MODIS



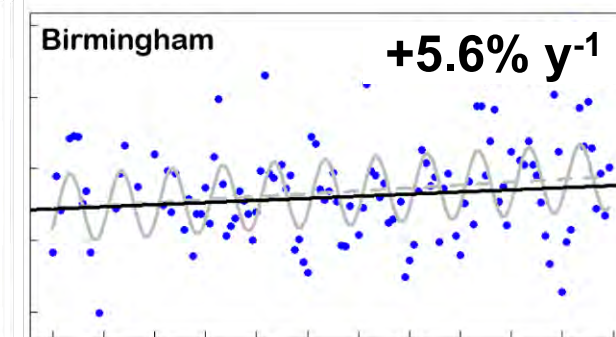
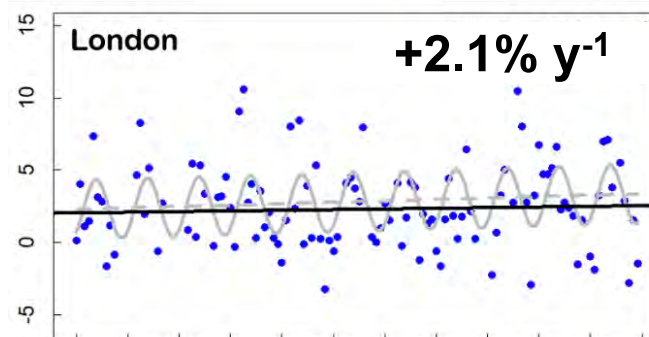
NO₂
[10¹⁵ molecules cm⁻²]
2005-2018



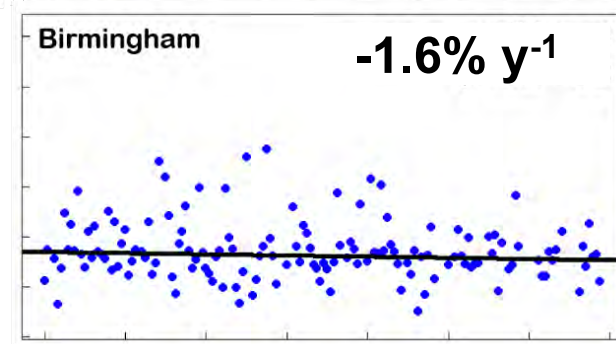
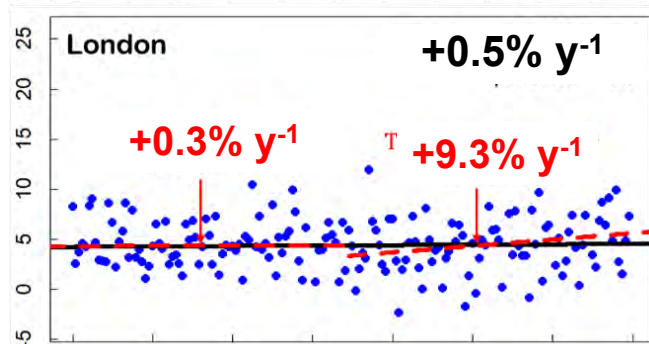
AOD
[unitless]
2005-2018
Proxy for PM_{2.5}



NH₃
[10¹⁵ molecules cm⁻²]
2008-2018

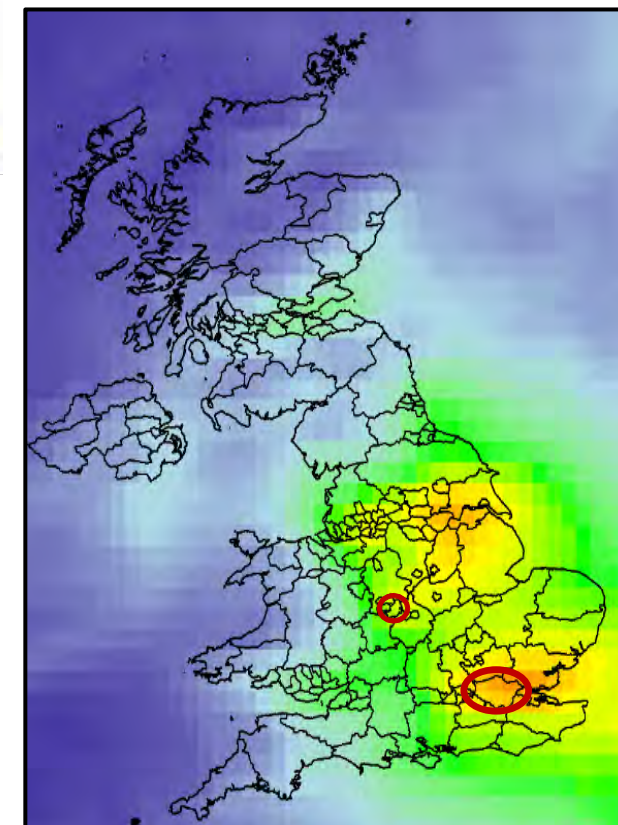


HCHO
[10¹⁵ molecules cm⁻²]
2005-2018
Proxy for NMVOCs



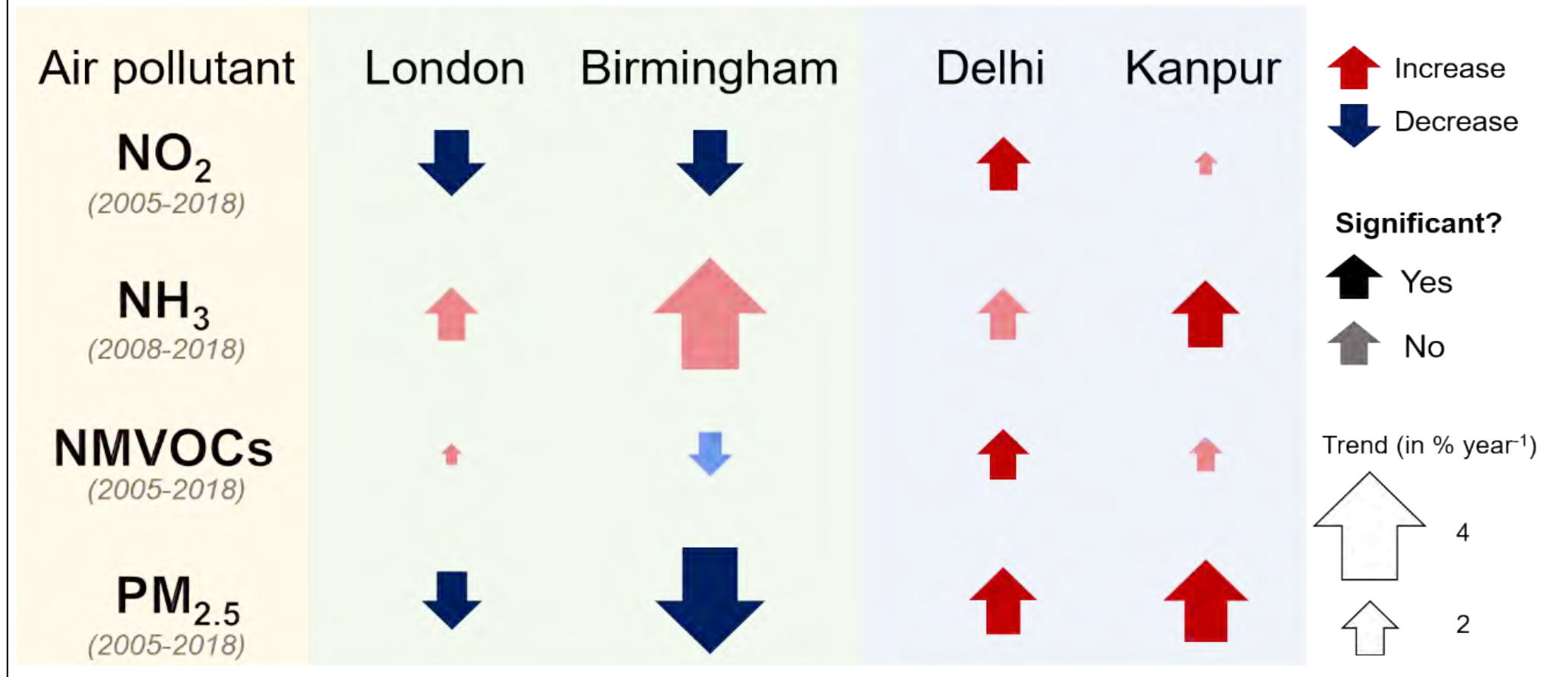
Trends in Air Quality in London and Birmingham

Multiyear (2005-2018)
Annual Mean OMI NO₂



Air Pollution Trends Summary

Long-term trends in pollutants



Work by Karn Vohra (PhD student supervised by Eloise A Marais)

Top-down Estimate of Ammonia Emissions in the UK

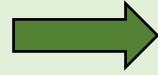


E. A. Marais, R. Siddans, B. Kerridge, G. Luo, F. Yu, I. Tsagatakis, S. Moniz

Top-down Estimate of Ammonia Emissions in the UK

APPROACH:

ABUNDANCES

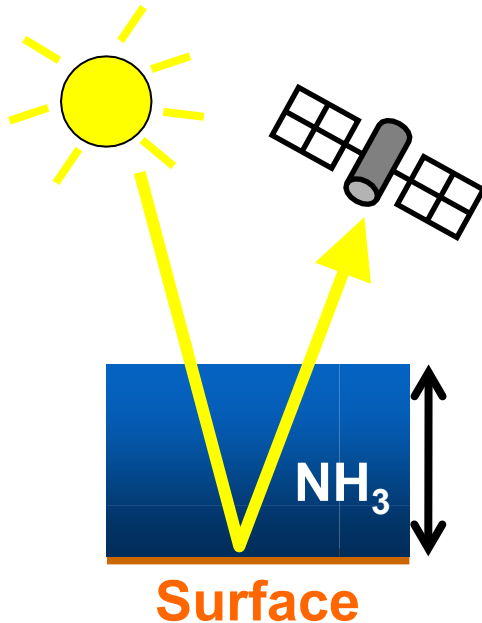


Conversion Factor



EMISSIONS

Satellite (CrIS) column
densities of NH_3

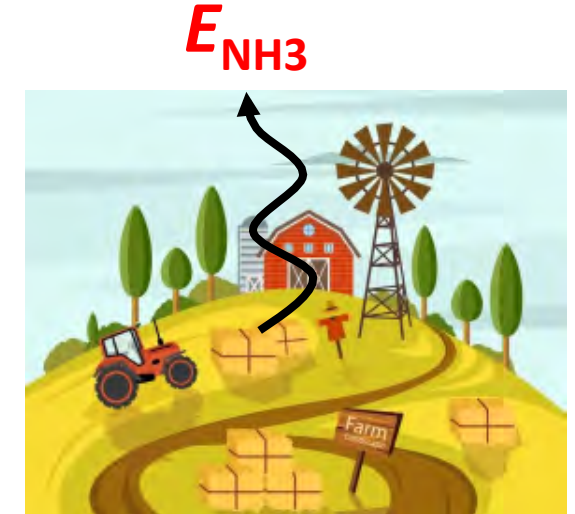


Model (GEOS-Chem)

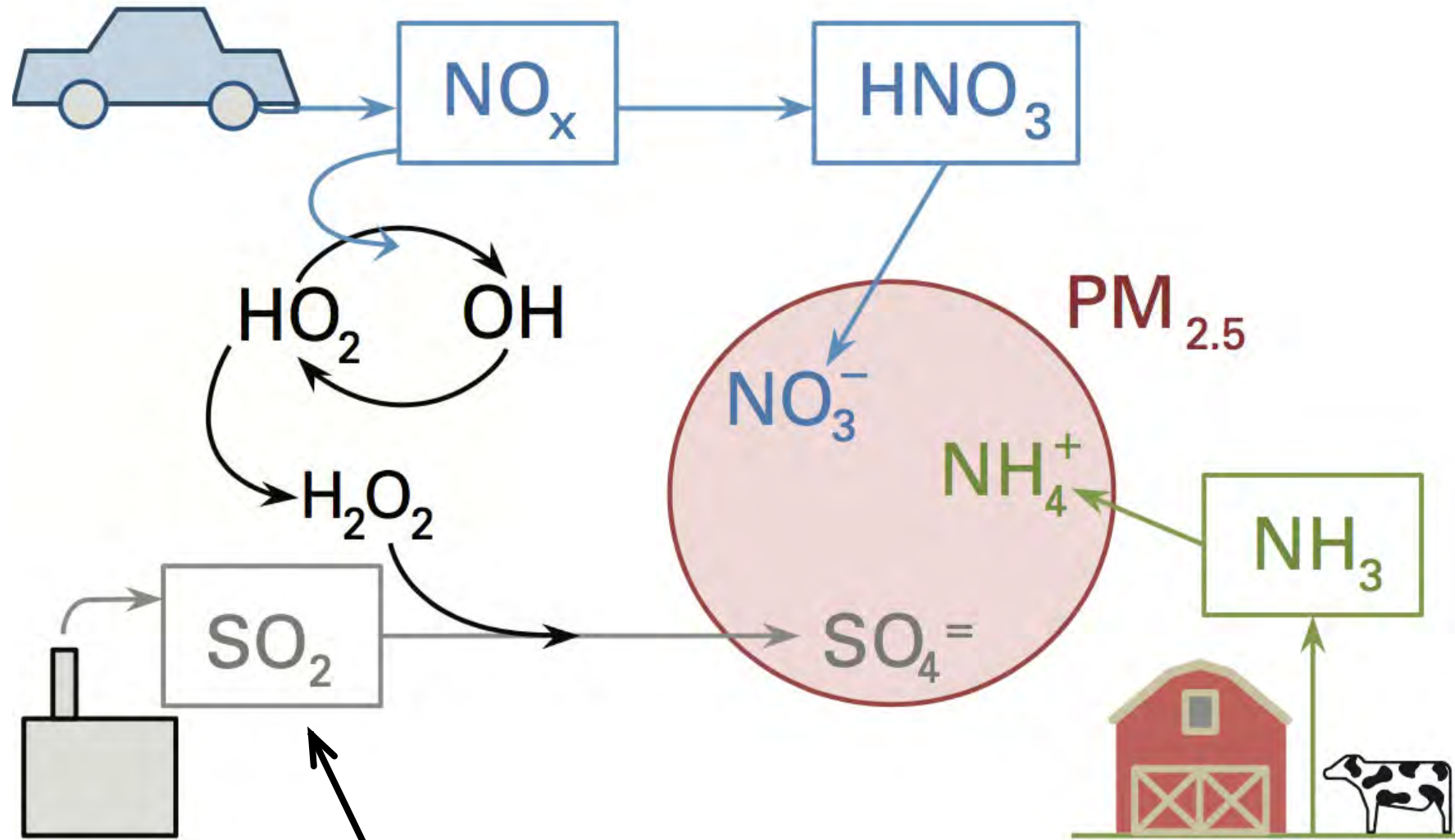


Relationship between NH_3
abundances and emissions

Satellite-derived NH_3
Emissions



Atmospheric Processing of NH_3 is Complicated



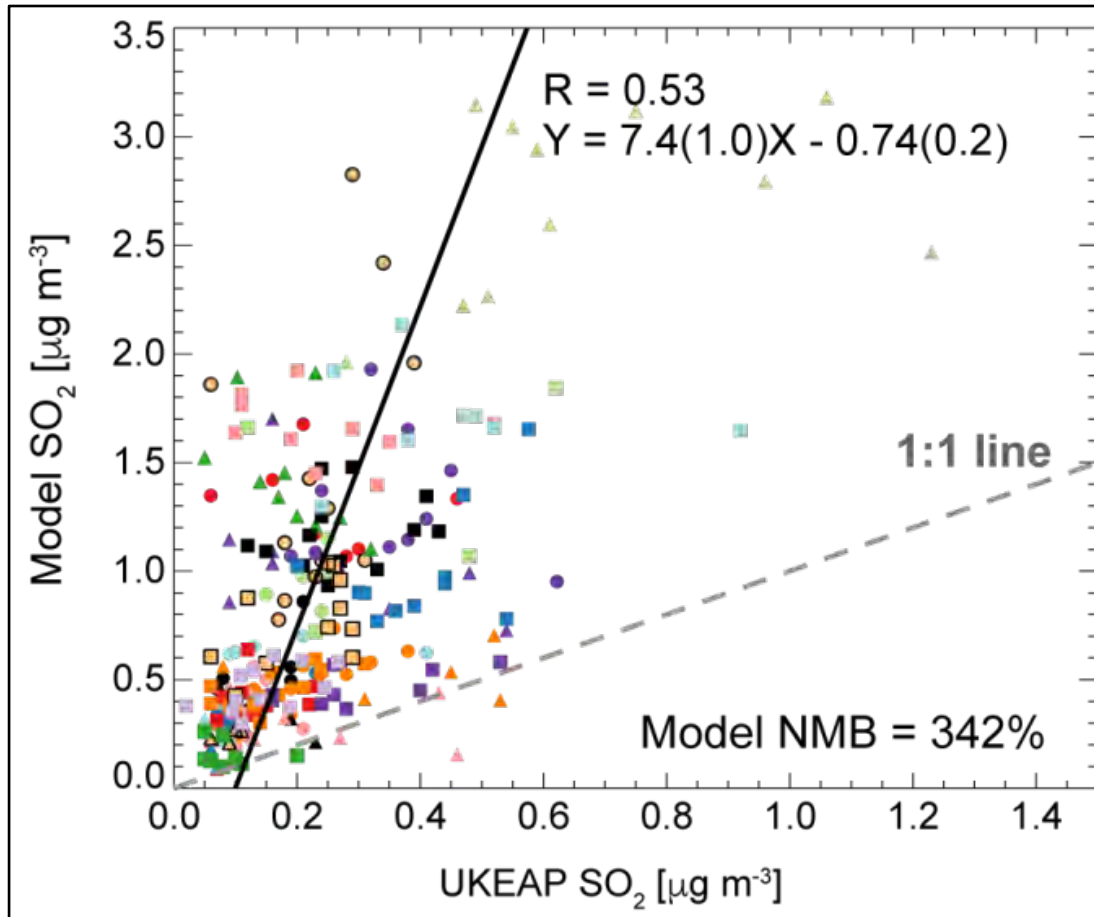
[<http://climate-science.mit.edu/>]

Requires a model with accurate representation of SO_2

Comparison of GEOS-Chem and Surface Observations of SO₂

SO₂ observations from denuders and MARGAs for 2016

Model versus Observations



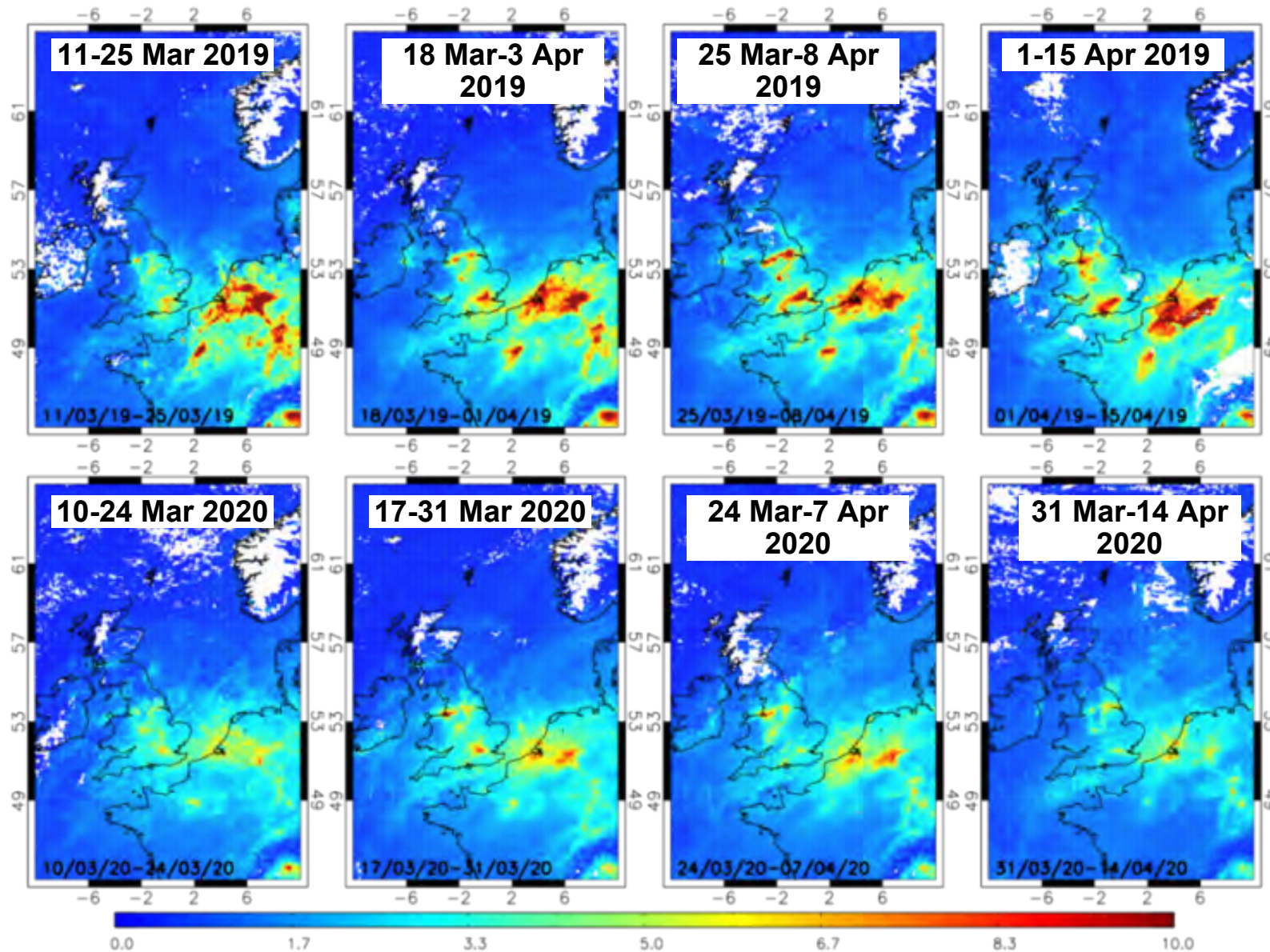
Site locations



Model includes NAEI (UK) and EMEP (mainland Europe) 2016 anthropogenic NH₃ emissions

Comparison suggests NAEI SO₂ emissions are biased high by a factor of 3

Interpreting Satellite Observations during the Lockdown with GEOS-Chem



TROPOMI NO₂ multiday means

TROPOMI changed product versions on 27 March 2019

Column NO₂ influenced by meteorology and pollution transported from nearby and distant sources

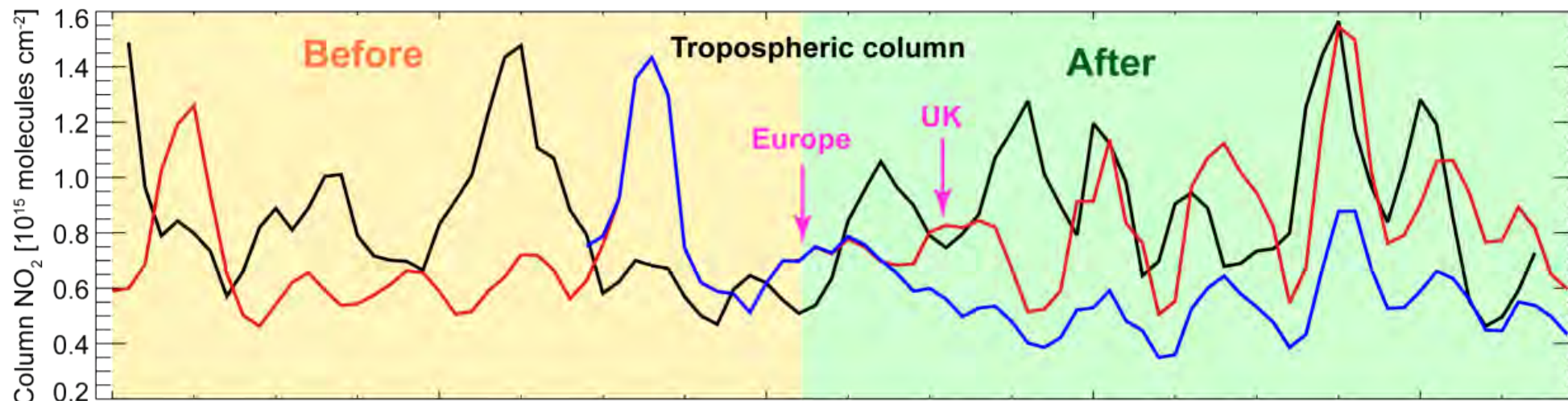
Source:

<https://www.nceo.ac.uk/article/using-sentinel-5p-to-monitor-air-quality-changes-since-the-coronavirus-outbreak-a-uk-expert-view/>

Data and plots by R. Pope

Time series of daily model data before and during the lockdown

GEOS-Chem NO₂ over London for business-as-usual and for emissions reduced by 60%



Speculative 60% emissions reduction applied to the model

Concentration changes before and after the UK lockdown:

Column:

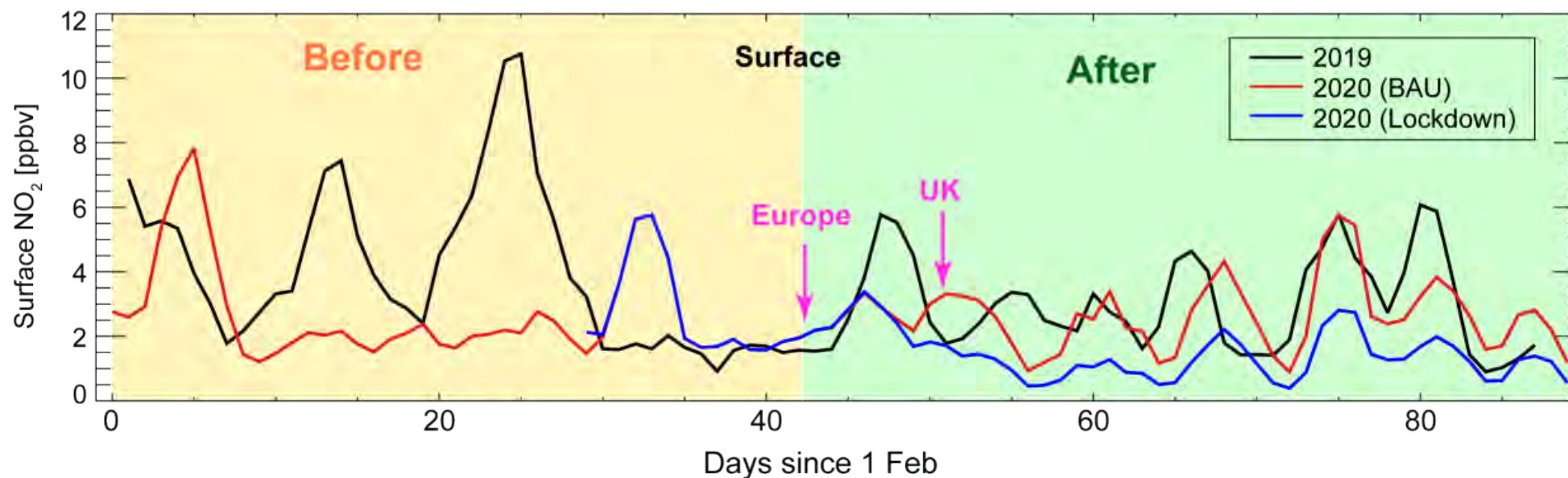
BAU: 9.1%

Lockdown: -32.1%

Surface:

BAU: -0.3%

Lockdown: -52.2%



3-day running mean is used to smooth the day-to-day variability in the data.