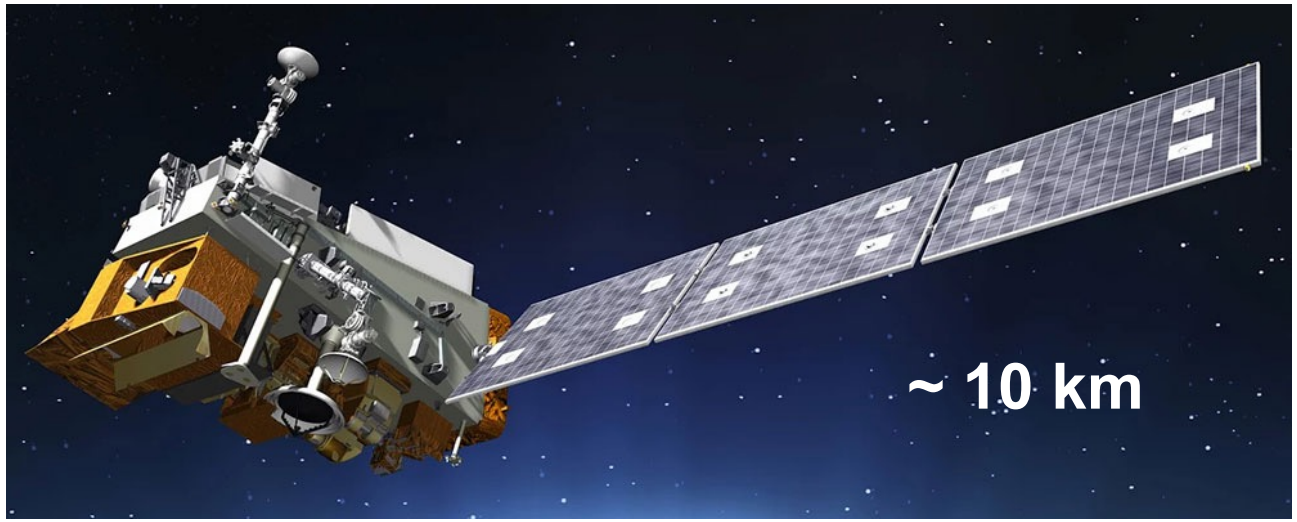
The influence of UK agricultural ammonia (NH_3) emissions on urban air quality and future public health

Satellite Observations



Cross-Track Infrared (CrIS) Intrument

Inventories of Emissions

National Atmospheric Emissions Inventory

1 km

3D Atmospheric Chemistry Model

22-28 km

GEOS-Chem

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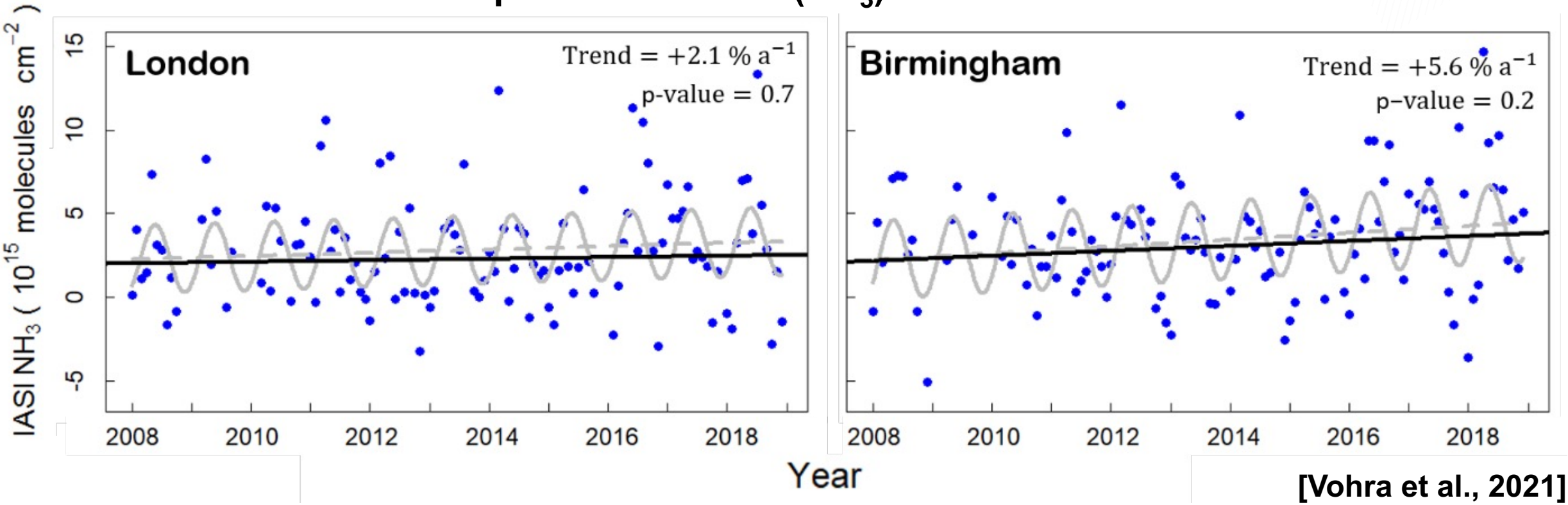
Marais research group in UCL Geography: https://maraisresearchgroup.co.uk/

UCL

Long-term trends in urban atmospheric concentrations of NH_3

Long-term, consistent observations from satellites, though limited evaluation possible

Trends in urban atmospheric ammonia (NH_3) deduced with satellite observations



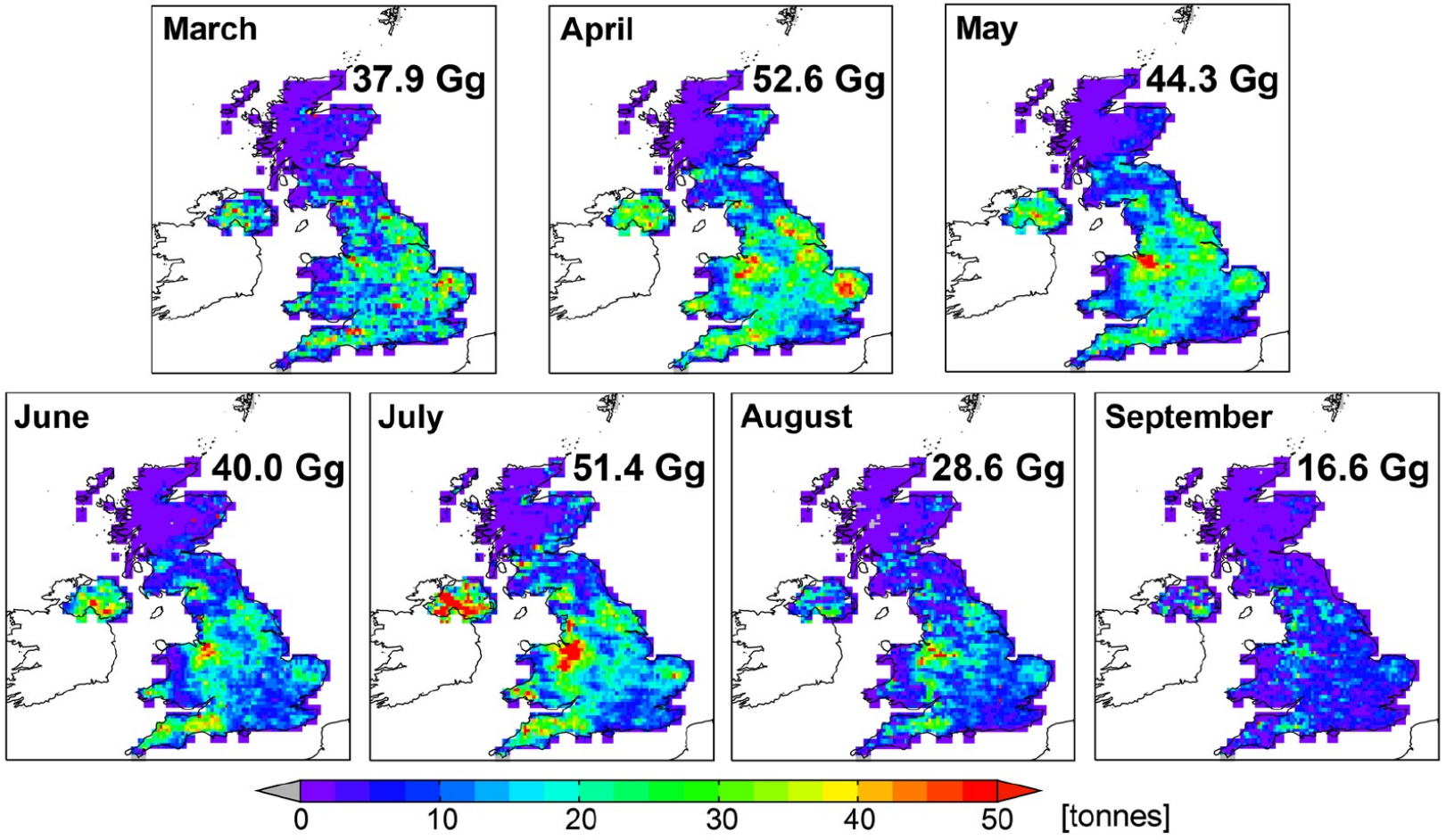
[Vohra et al., 2021]

Non-significant steady increase in concentrations

Opposite to significant decline in particular matter and nitrogen dioxide pollution, observable from space

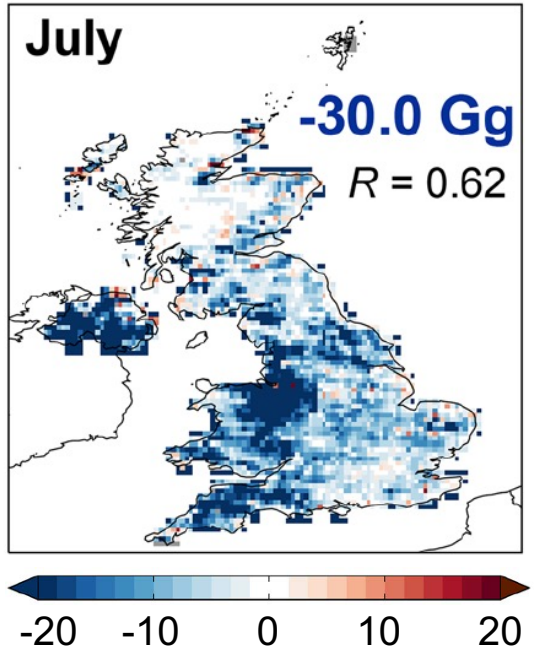
Satellite-derived UK agricultural emissions of NH_3

Climatological mean monthly NH_3 emissions at ~10 km resolution



1 Gg = 1 kilotonne

Inventory minus satellite-derived NH_3 emissions



[Marais et al., 2021]

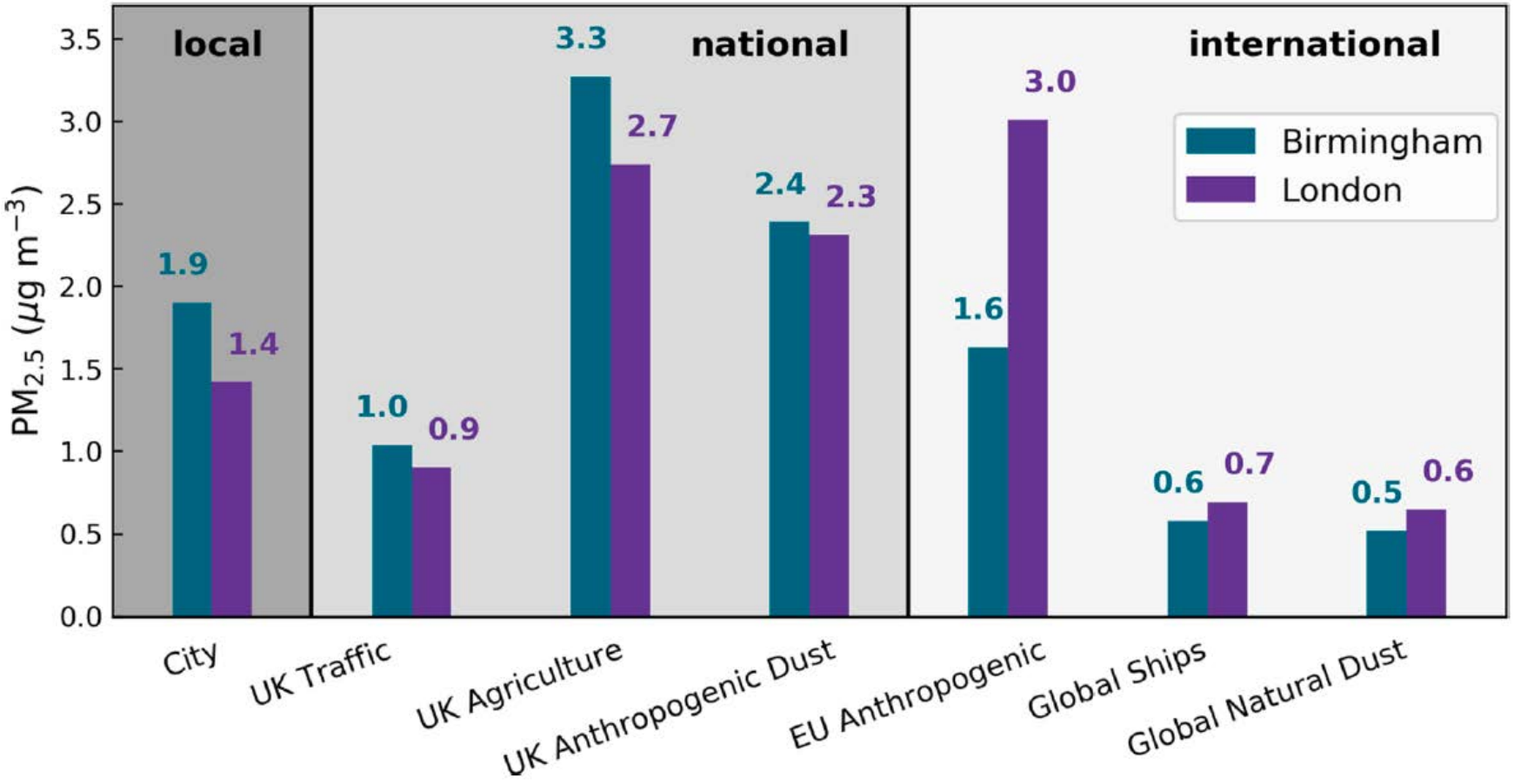
NH_3 emissions peak in April due to fertiliser and July due to livestock (beef cattle farming)

Inventory reproduces April peak, but not the July peak in Northern Ireland and Shropshire/Cheshire

Contribution of rural NH_3 to urban fine particulate matter ($PM_{2.5}$) pollution in the UK

GEOS-Chem

Model sensitivity runs to quantify contribution of specific sources to $PM_{2.5}$ in cities covering a wide size spectrum



City annual mean $PM_{2.5}$

Birmingham: 10.1 $\mu g\ m^{-3}$

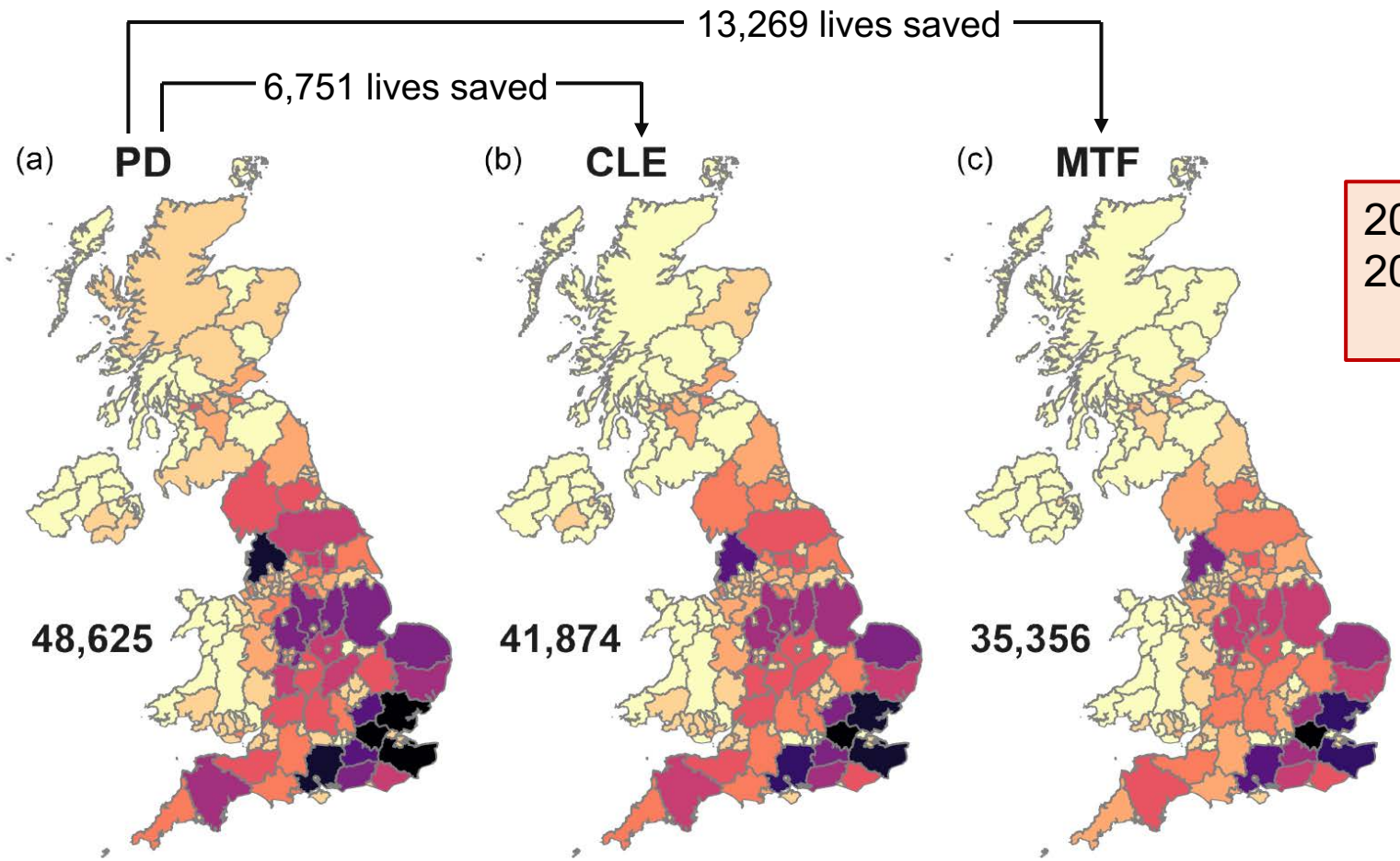
Greater London: 10.9 $\mu g\ m^{-3}$

[Kelly et al., 2023]

Urban $PM_{2.5}$ includes 25-38% contribution from rural agricultural emissions of NH_3

Local measures to address urban $PM_{2.5}$ pollution insufficient. Need national regulation targeting agriculture

Comparison of efficacy of legislated and best-available measures at mitigating pollution and improving public health



GEOS-Chem

2019: **79%** UK exceeds WHO guideline
2030: **58%** with legislation
36% with best available measures

Adult (age 25+) premature deaths

[Marais et al., 2023]

Most beneficial to public health when agricultural NH_3 emissions are regulated

Measures are affordable and feasible (feed, fertiliser, manure spreading/covers, air scrubbers)