



Trends in UK NO_x and NO₂ concentrations: where are we 3 years on from the Covid-19 pandemic?

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IAQM Measuring Air Quality Conference

28th March 2023

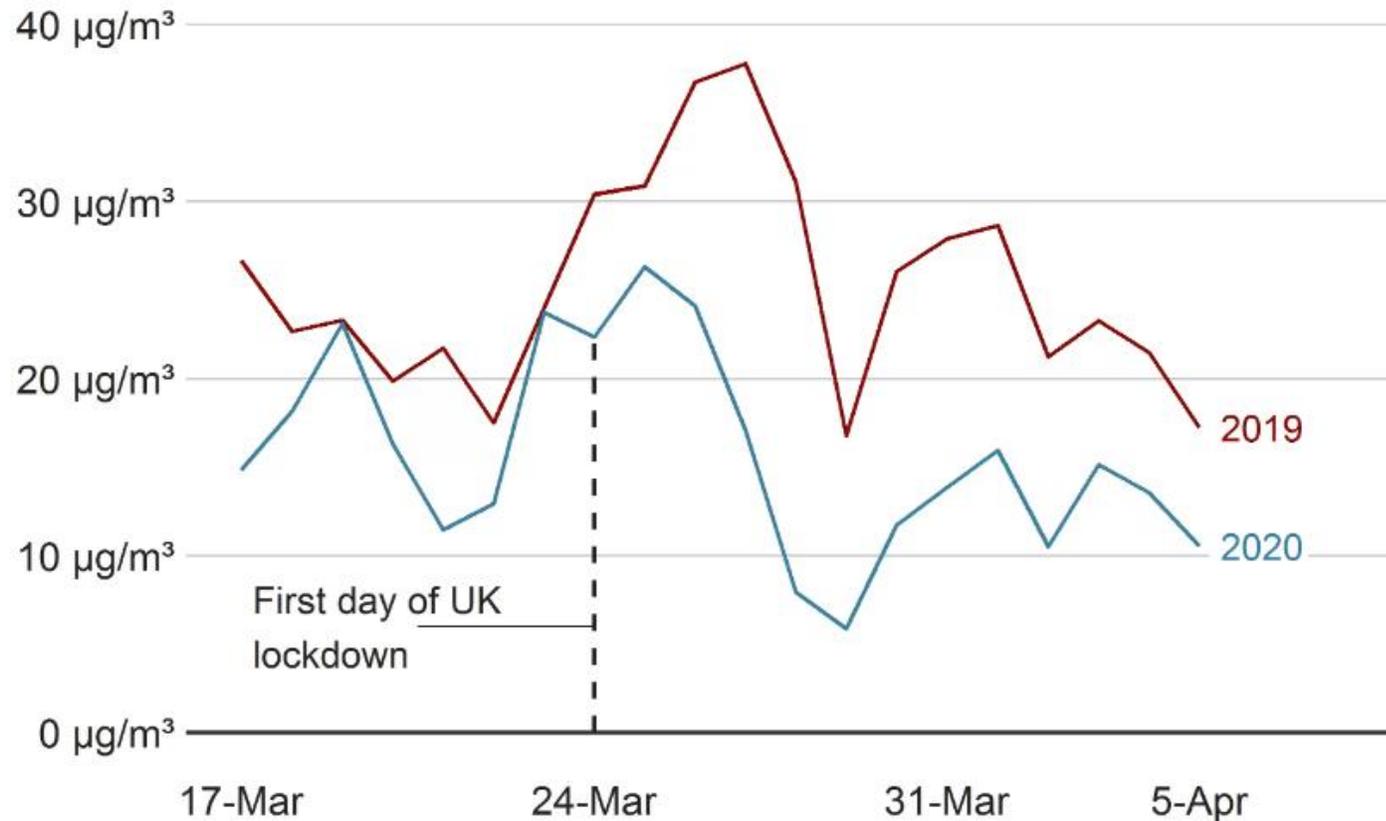
Overview

1. Background
2. Previous Analyses
3. Methodology
4. Results
5. Discussion Points
6. Summary

1. Background

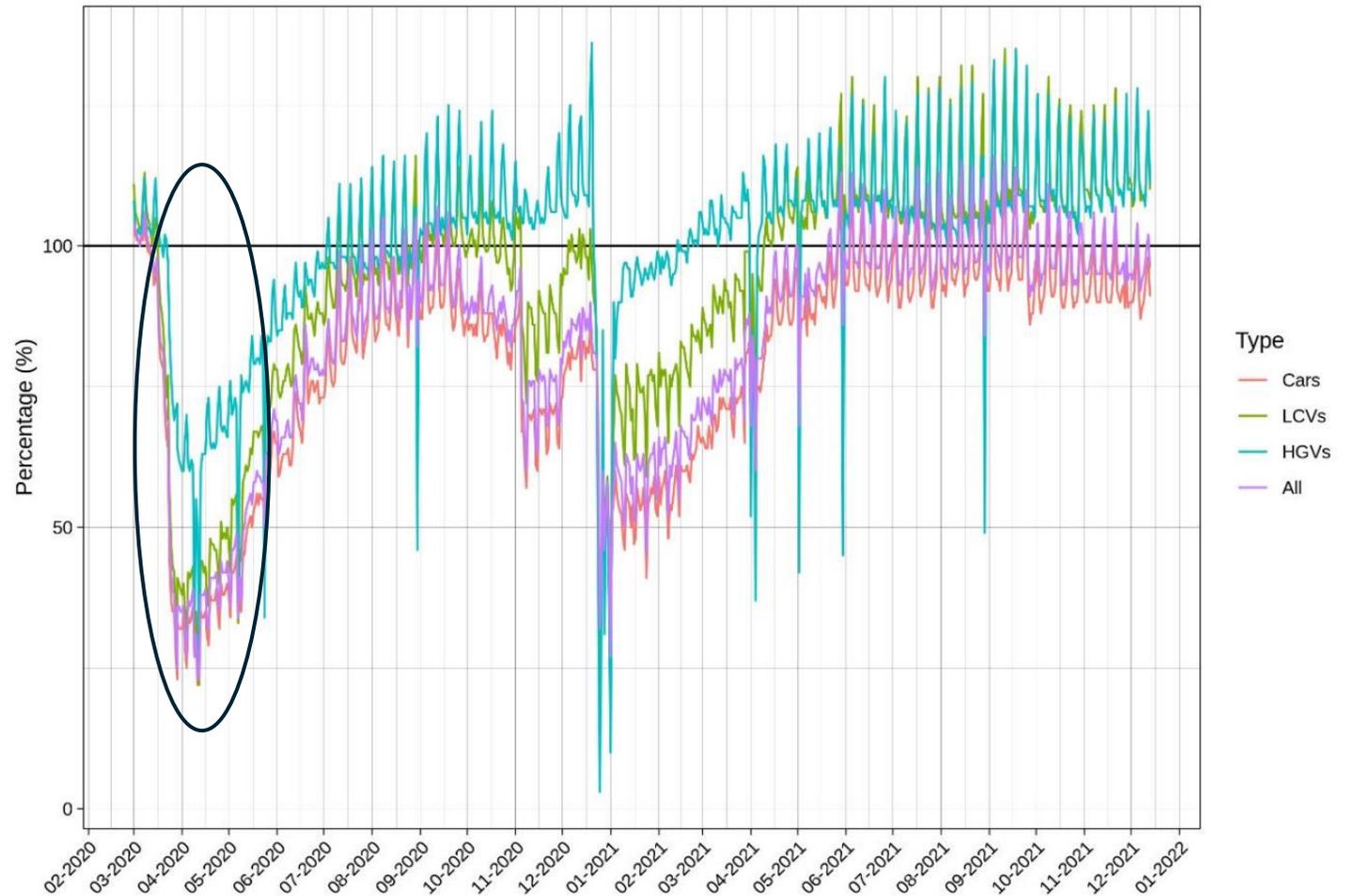
Air pollution in the UK has fallen compared with last year

Average daily nitrogen dioxide (NO₂) readings



1. Background

- Department for Transport's index of changes to road vehicle activity between February 2020 and December 2021.
- 275 sites across a range of UK road types.
- First lockdown impact is clear; vehicle activity greatly reduced - cars by 70%, HGVs by 40%.
- Broadly back to pre-pandemic levels by September 2020
- Subsequent lockdowns also evident towards the end of 2020 and early 2021



Motor vehicle flows expressed as a percentage of the equivalent day in the first week of February 2020.

Source: Department for Transport. Available: <https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic>

2. Previous Analyses



Trends in UK NO_x and NO₂ Concentrations – May 2022 Update
Prepared by Helen Pearce and Ben Marner. Approved by Stephen Moorcroft. 13/05/22



The screenshot shows the UK AIR website interface. At the top, it says 'Department for Environment Food & Rural Affairs'. Below that is the 'UK AIR Air Information Resource' header. A navigation menu includes 'Home', 'Air Pollution', 'Data', 'Monitoring Networks', 'Library', and 'Science'. The main content area shows a news article titled 'Estimation of changes in air pollution emissions, concentrations and exposure during the COVID-19 outbreak in the UK' with a date of '28th March 2023' and a publication date of '07/04/2020'.

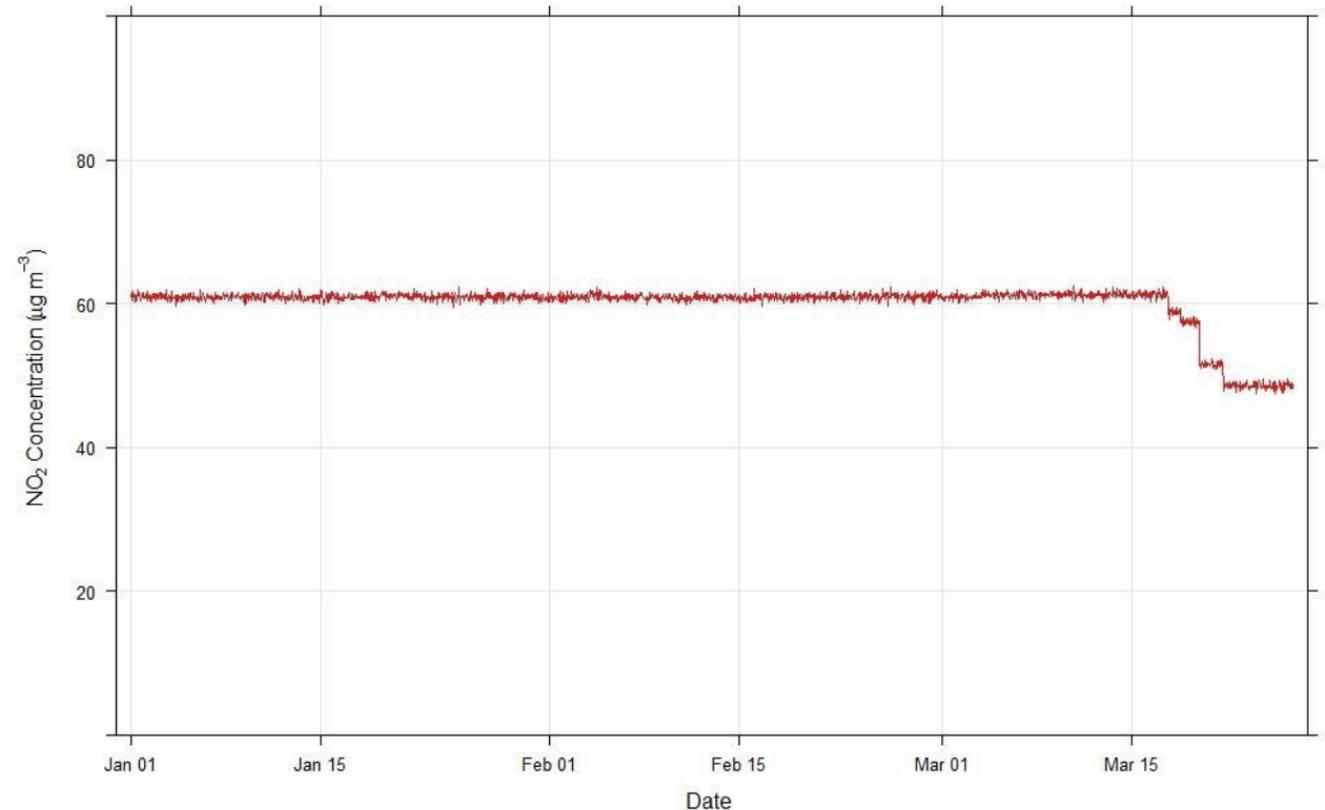
Aims of this talk:

- Discuss what we've learnt from looking at trends with different perspectives
- Assess the degree to which the Covid-19 pandemic impacted the long-term trend in UK NO_x/NO₂ concentrations

2. Previous Analyses

Where it all started...

- Why 'deweather'? No control site to represent a 'no lockdown' scenario
- Meteorological effects reduce the ability to identify trends in raw data
- Previous analyses using just 1 site (London Marylebone Roadside)
- Isolating and removing meteorological and temporal effects demonstrates a substantial reduction in NO_x and NO₂ concentrations - reducing by as much as 30% for NO_x and 20% for NO₂

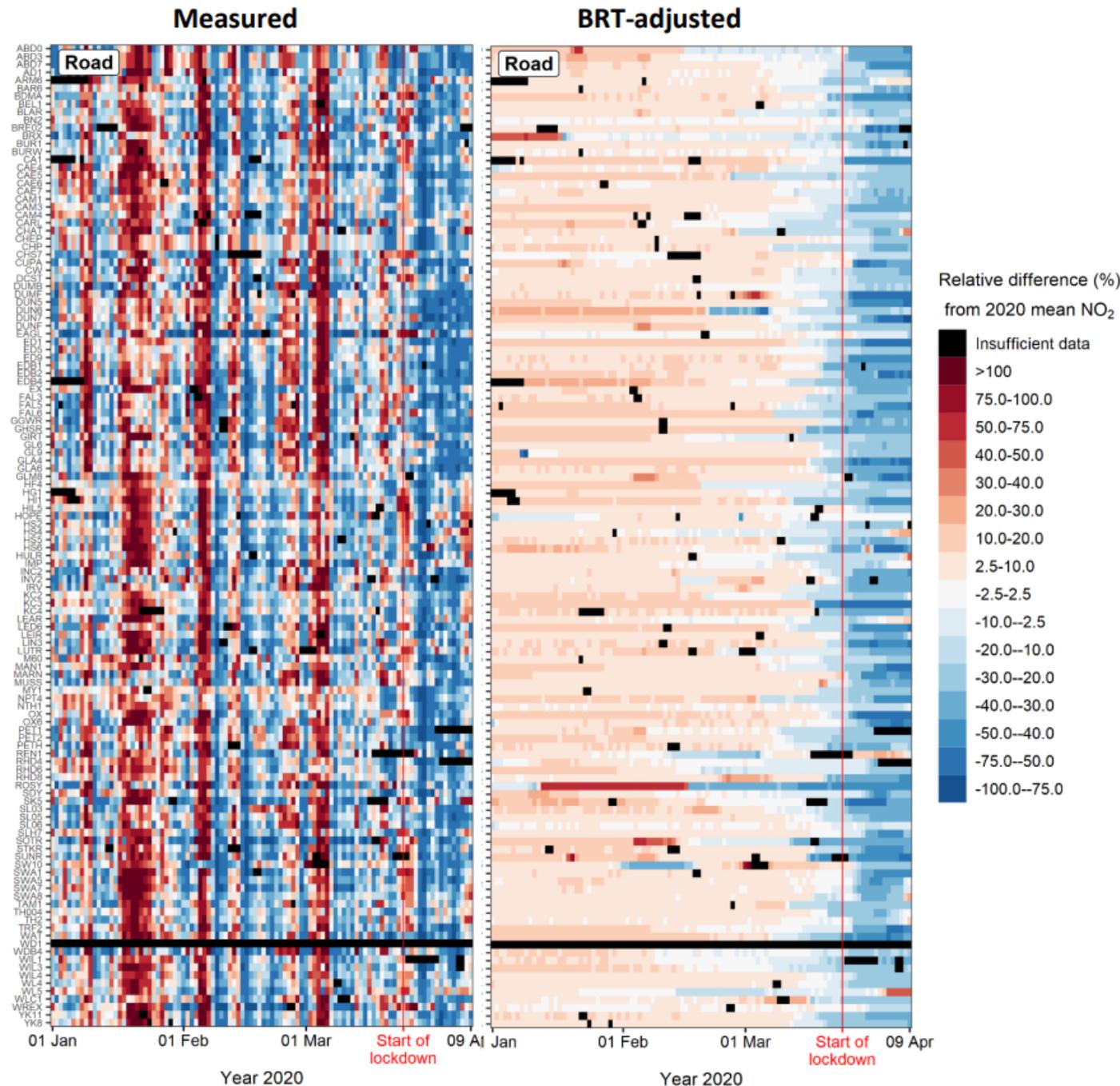


Deweathered NO₂ Concentrations at London Marylebone Road: Jan – 26th March 2020

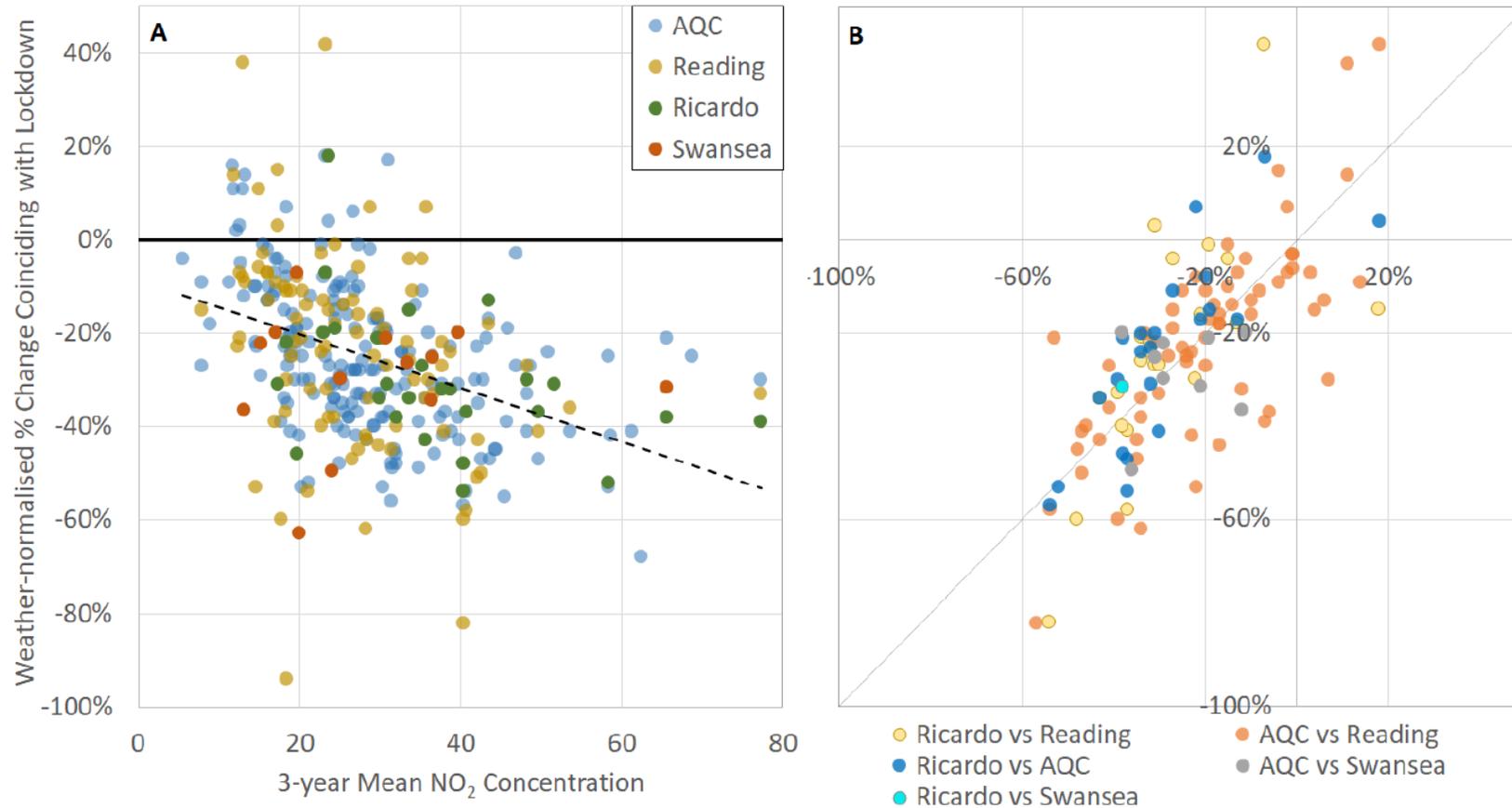
Source: AQC (2020). Available: <https://www.aqconsultants.co.uk/CMSPages/GetFile.aspx?guid=76276080-6c02-489f-97f2-5da0a2fe6bdf>

2. Previous Analyses

- Repeated the process for multiple monitoring sites (y axis)
- Colours indicate the relative difference from the 2020 mean (red is higher, blue is lower than the mean)
- No clear trend/difference in the raw measured data
- The 'deweathered' (BRT-adjusted) concentrations clearly show that after the lockdown was implemented, roadside measured NO₂ concentrations were predominantly lower than the 2020 mean



2. Previous Analyses



3. Methodology

January 2016 → February 2023 (inclusive)

Monitoring Networks:

- UK Automatic Urban and Rural (AURN)
- Scottish Air Quality (SAQN)
- Welsh Air Quality (WAQN)
- King’s College London (KCL)
- Air Quality England (AQE)

Data capture: 90%

Linked with the closest meteorological observation site which satisfied these same data capture criteria.

Removed the effects of wind speed, wind direction, air temperature, and relative humidity.

All analysis conducted using the ‘deweather’ R package (part of the openair suite of packages)

Site Type	Number of Sites
Roadside	125
Urban	53
Industrial	13
Rural	11
Total	202

Country	Number of Sites
England	142
Scotland	41
Wales	16
Northern Ireland	4
<i>London</i>	<i>34 (16 roadside)</i>

3. Methodology

What's changed?

- The approach which was used in March, April, and November 2020 to quantify their effect on air quality is no longer appropriate since NO_x concentrations have changed appreciably over two years irrespective of the pandemic. Therefore, **normalising for non-weather temporal factors is inappropriate over such an extended period.**
- Understanding the extent to which recent NO_x and NO₂ measurements are affected by mobility restrictions, and **to what extent they are a broader response to long-term measures to improve air quality,** will assist in devising strategies for future air quality management.

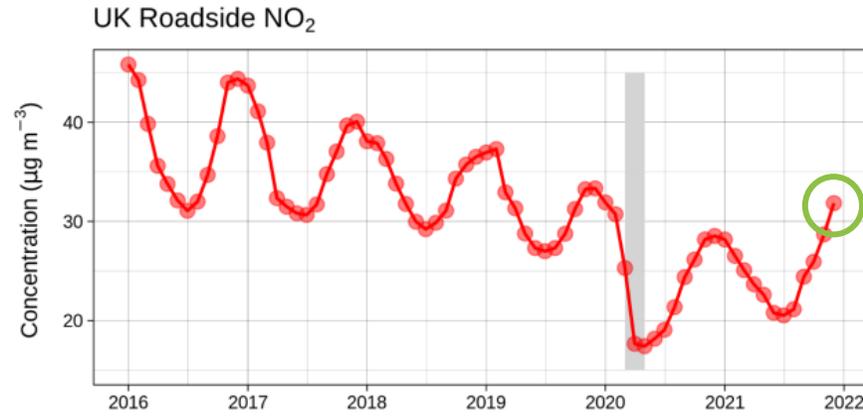
Limitations

- It should be noted that the raw data have not been carefully **quality controlled** and there may be some isolated instances of erroneous reported measurements. However, the large number of sites included, particularly at roadsides, means that the multi-site averages presented are likely to be representative.
- The **sites selected in this analysis differ slightly** from those selected in previous reports; the time period has been extended and so the ability of each site to meet the data capture thresholds has changed.
- Data in the last ~6 months are unlikely to be **ratified** and should therefore be treated with caution.

4. Results

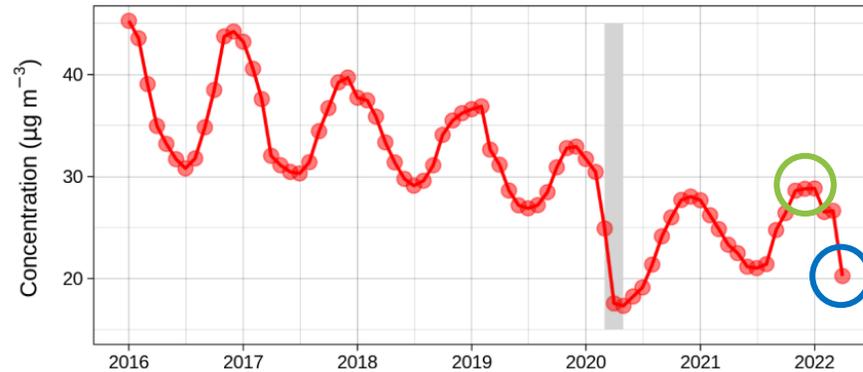
Jan 2022 Report

1st Jan 2016 → 19th Dec 2021



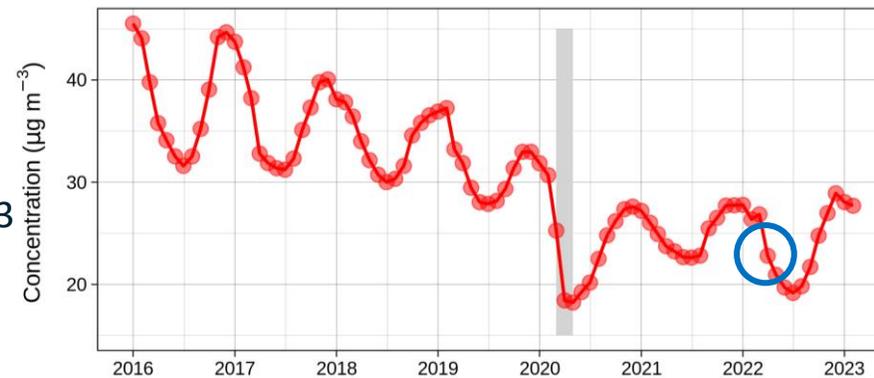
May 2022 Report

1st Jan 2016 → 30th Apr 2022



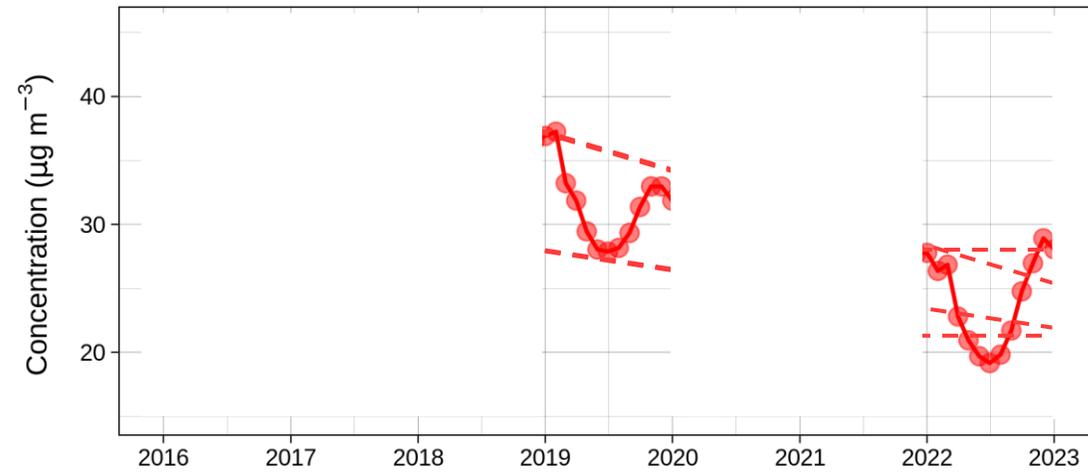
Now

1st Jan 2016 → 28th Feb 2023

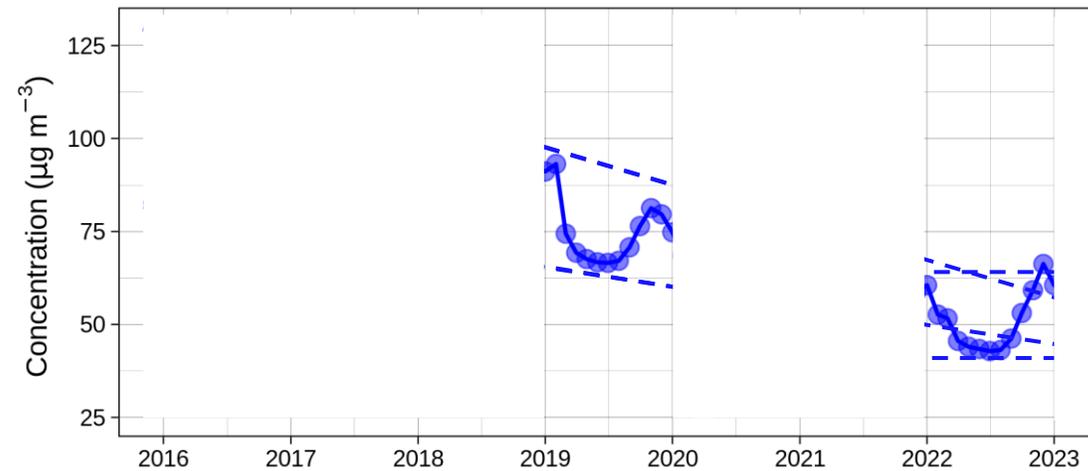


4. Results

UK Roadside NO₂

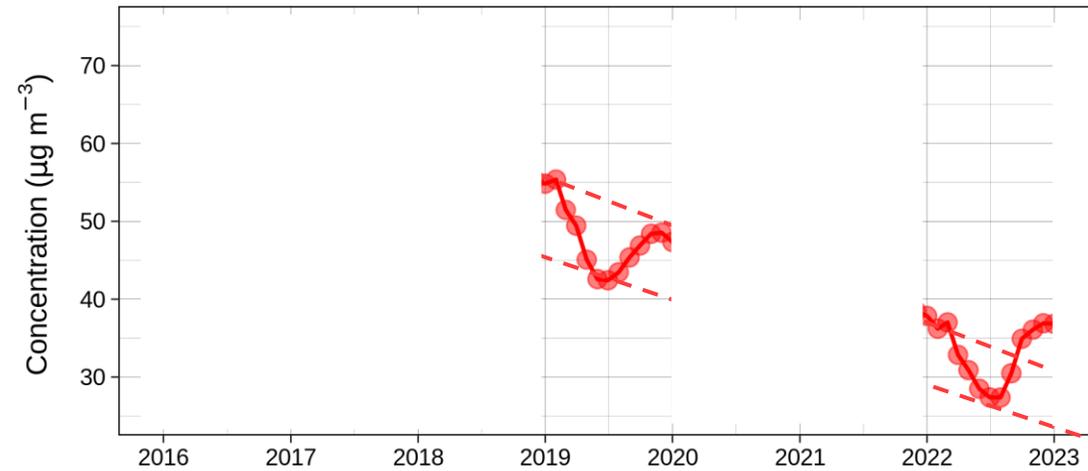


UK Roadside NO_x

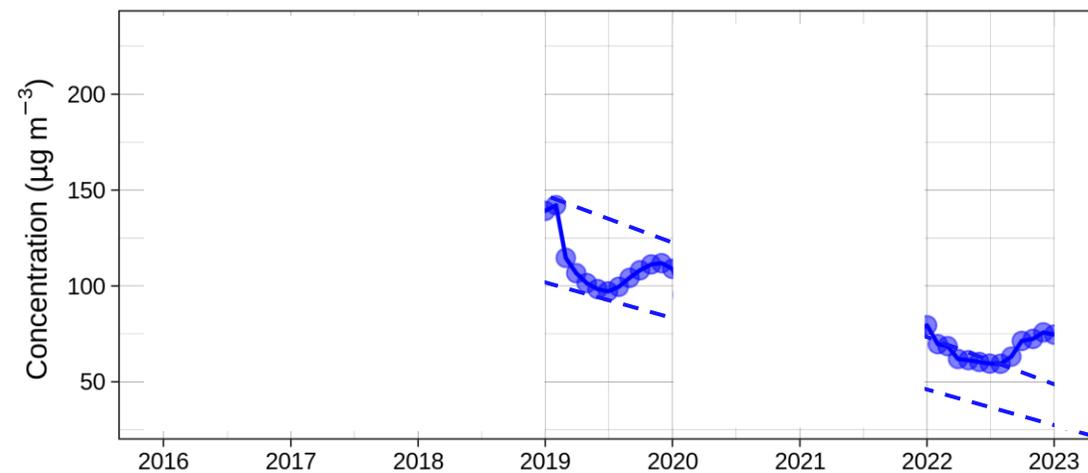


4. Results

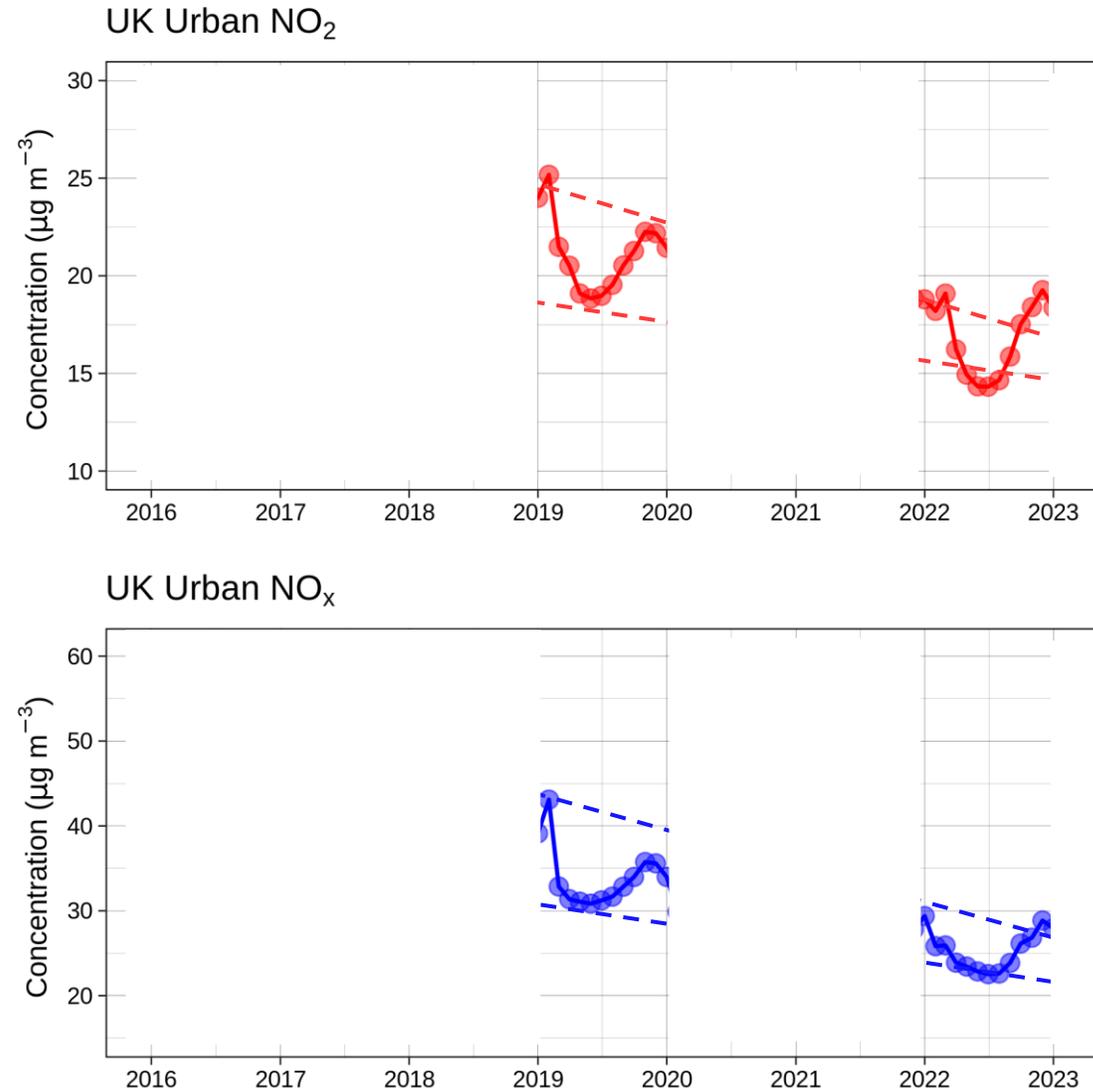
London Roadside NO₂



London Roadside NO_x

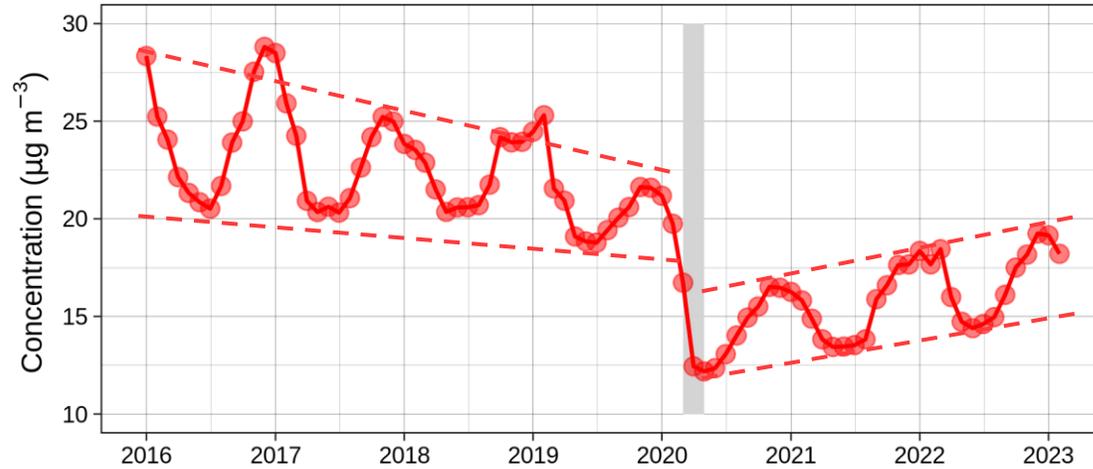


4. Results

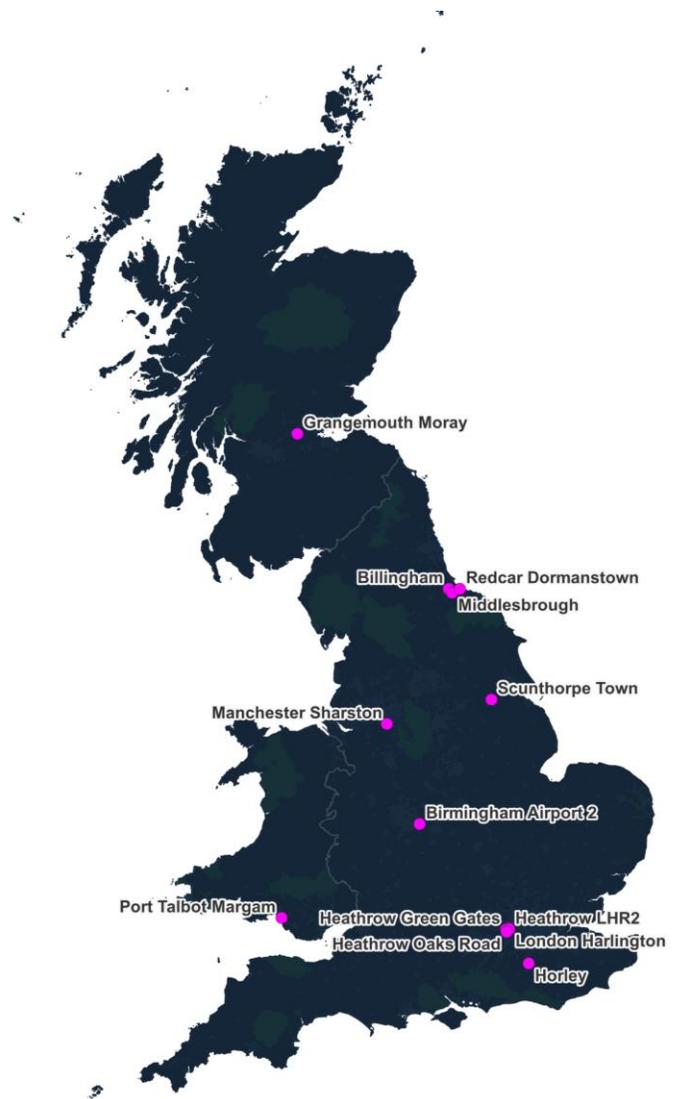
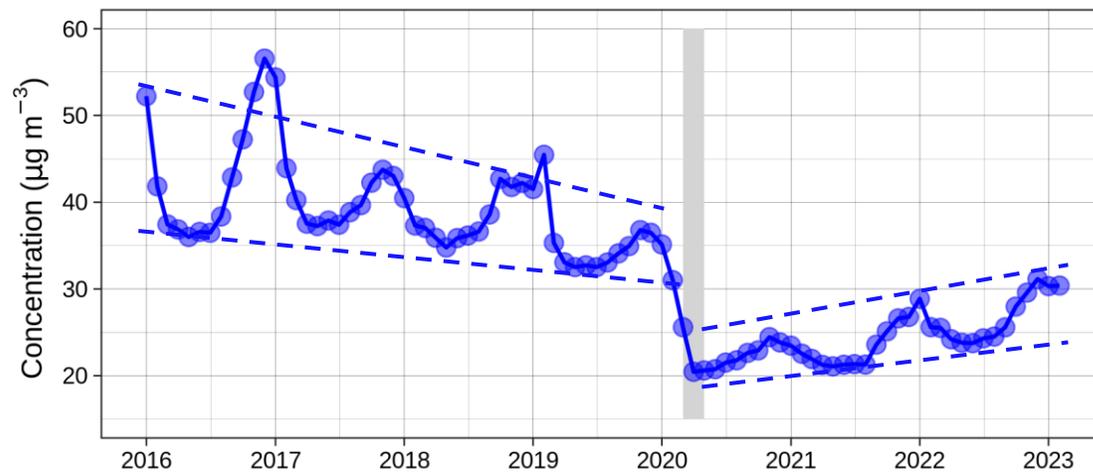


4. Results

UK Industrial NO₂



UK Industrial NO_x



5. Discussion Points

Perspective

As time has moved on our analysis has needed to be adapted. We found normalising for temporal effects (hour of the day, day of the week, week of the year) was misleading when looking at trends over a longer period.

Does this provide a net benefit or net disbenefit in terms of exposure?

The same behavioural changes that have reduced NO_x emissions and concentrations are also likely to have changed the way in which most people are exposed to air pollution. Roadside → indoor.

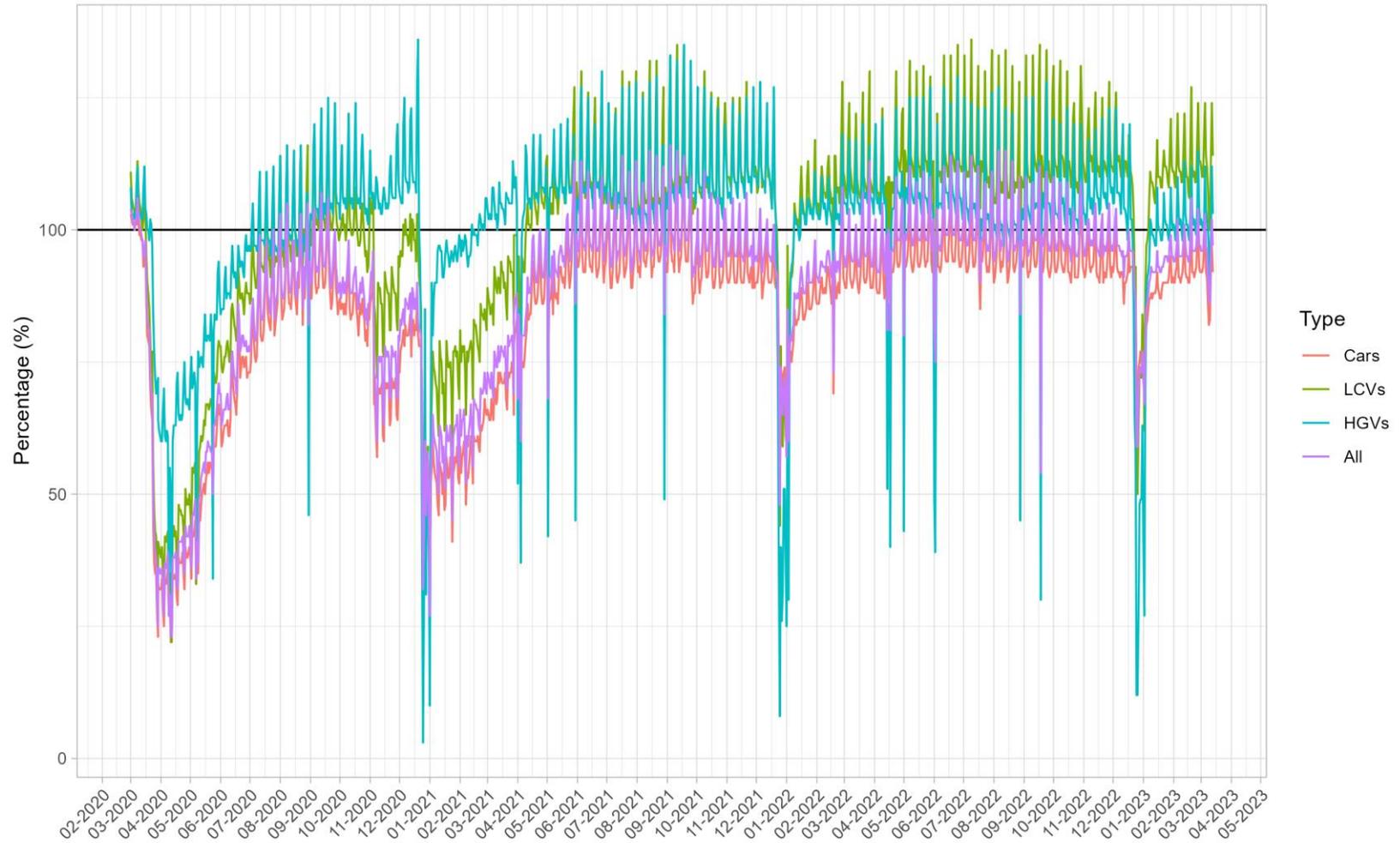
Does the evidence presented give weight to start using 2022 as the base year for assessments?

What are concentrations in 2024 going to look like?

Is the lack of reduction between 2021 and 2022 because traffic activity was still rebounding?

Or was there going to be a plateau in concentration change anyway?

5. Discussion Points



6. Summary

Discuss what we've learnt from looking at trends with different perspectives

- Normalising for temporal effects (time of day, day of week, week of year) is useful on a short period (e.g., 6 months) but it is not appropriate for comparison across multiple years when longer-term trends are likely.
- Treat the end of the time series using this approach with caution.

Assess the degree to which the Covid-19 pandemic impacted the long-term trend in UK NO_x/NO₂ concentrations

Roadside & Urban

- There was already an existing downward trend pre-pandemic which was accelerated in 2020.
- Since 2020 concentrations have increased but remain largely within what would have been expected if the pandemic hadn't occurred.
- There is no indication that concentrations have, or will, reach pre-pandemic levels again.

Industrial

- There was already an existing downward trend pre-pandemic which was accelerated in 2020.
- Since 2020 there is a more distinct upwards trend in NO_x and NO₂ concentrations, and it is currently difficult to tell whether concentrations at these sites will reach pre-pandemic levels again



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Thank you

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