

Retrospective review of air quality data for Quesnel (2014-2024)



Ministry of
Environment
and Parks

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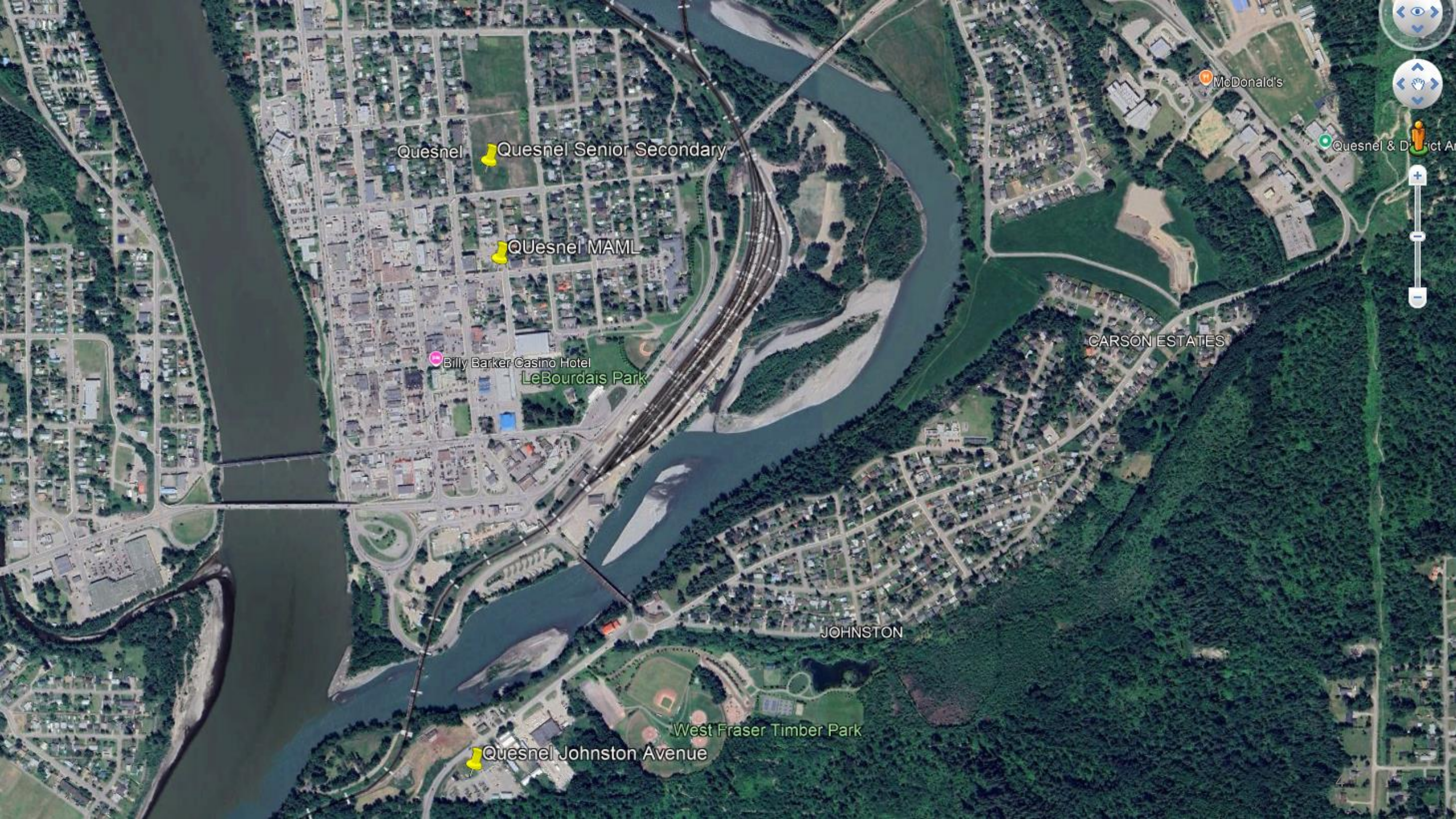
Air quality objectives

Contaminant	Avg. Period	Value	Calculation
NO ₂	1-hour	60 ppb	Annual D1HM averaged over 3 years
	Annual	17 ppb	Annual average of 1h concentration over 1 year
SO ₂	1 –hour	70 ppb	Annual 99 th percentile of DQHM averaged over 3 years
	Annual	5 ppb	Annual average of 1h concentration over 1 year
O ₃	1-hour	82 ppb	Superseded - for advisory purposes
	8-hour	62 ppb	4 th highest daily 8-hour maximum averaged over 3 years
TRS	1-hour	5 ppb	Rescinded Pollution Control Objective
	24-hour	2 ppb	Rescinded Pollution Control Objective
PM ₁₀	24-hour	50 µg/m ³	
PM _{2.5}	24-hour	25 µg/m ³	98 th percentile averaged over 1 year
	Annual	8 µg/m ³	Annual average over 1 year

* Objectives do not indicate that no impacts may occur below target. They are for management purposes.

Study plan

- Time span: 2014-2024 data presented
 - 2012-2013 included for objective calculations
- * 2024 data is not validated data
- Three sites: Quesnel Senior Secondary (2014-01-01 – 2020-04-30)
Quesnel Kinchant St MAML (2020-05-07 – 2021-11-03)
Quesnel Jonston Avenue (2021-11-05 – 2024-12-31)
- *start date for each site denoted by vertical dashed line and highlighted by colour



Quesnel Quesnel Senior Secondary

Quesnel MAML

Billy Barker Casino Hotel
LeBourdais Park

CARSON ESTATES

JOHNSTON

West Fraser Timber Park

Quesnel Johnston Avenue

McDonald's

Quesnel & District Ave

Study plan

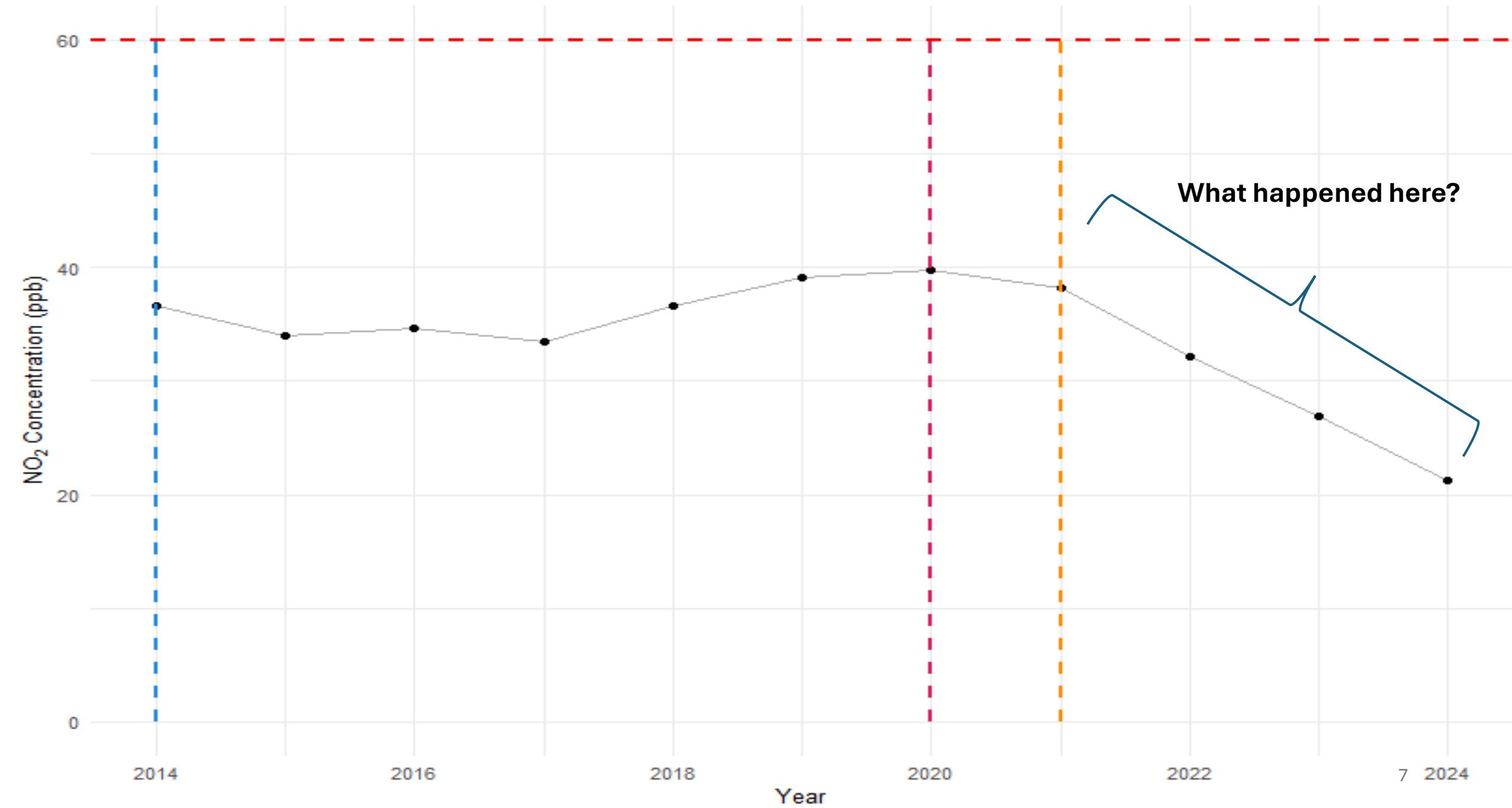
- Contaminants assessed: NO₂, SO₂, O₃, TRS, PM₁₀, PM_{2.5}
- Results presented include a mix of:
 - comparison to the objectives,
 - variation over time,
 - non statistical trends,
 - comparison between sites – box plots and statistical testing

NO₂

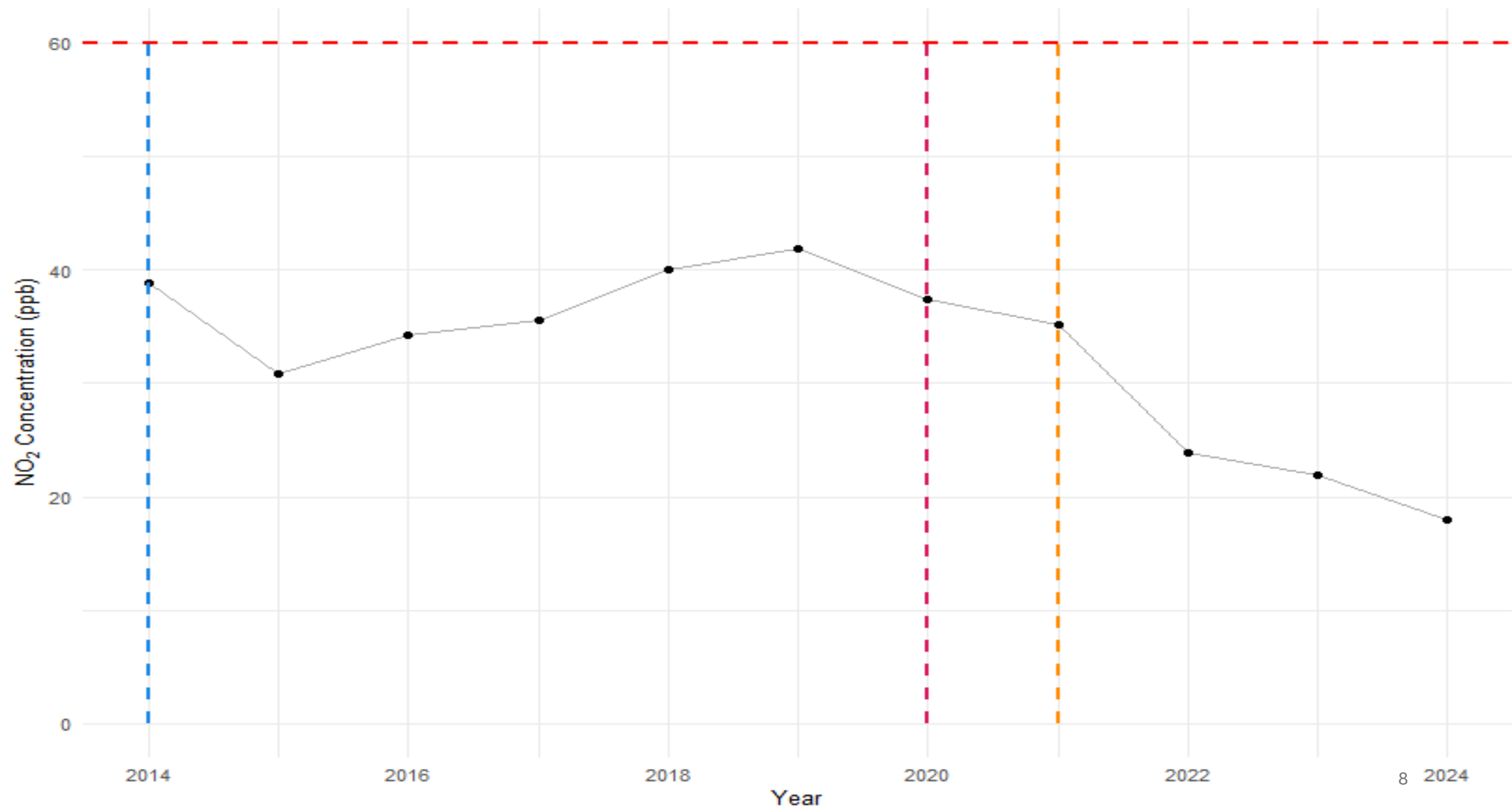
- High temperature combustion
 - vehicles
 - Industrial emissions
 - Space heating
- Forest fires



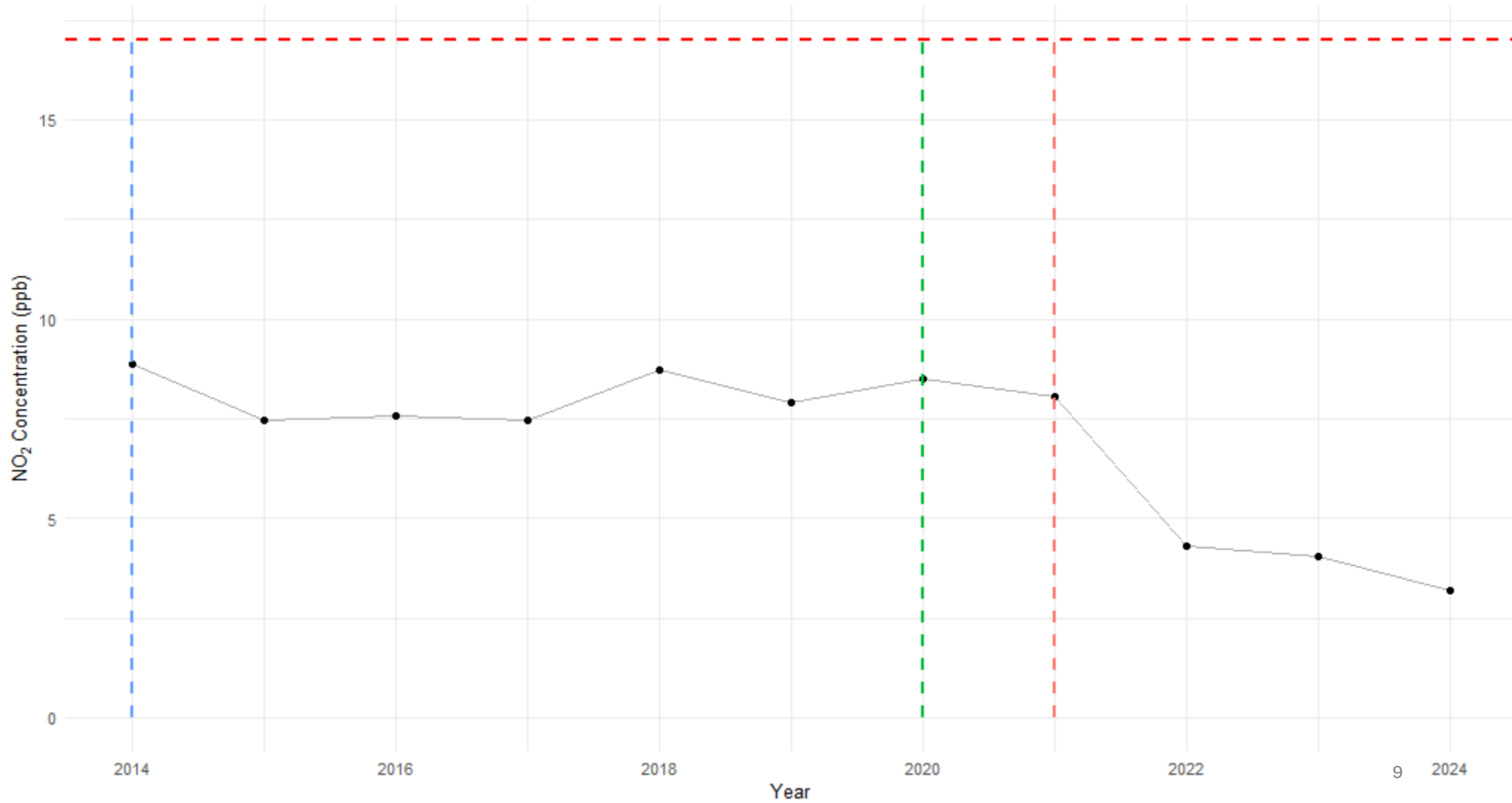
98th Percentile Three Year Rolling Avg of Daily Max NO₂ (2014-2024)



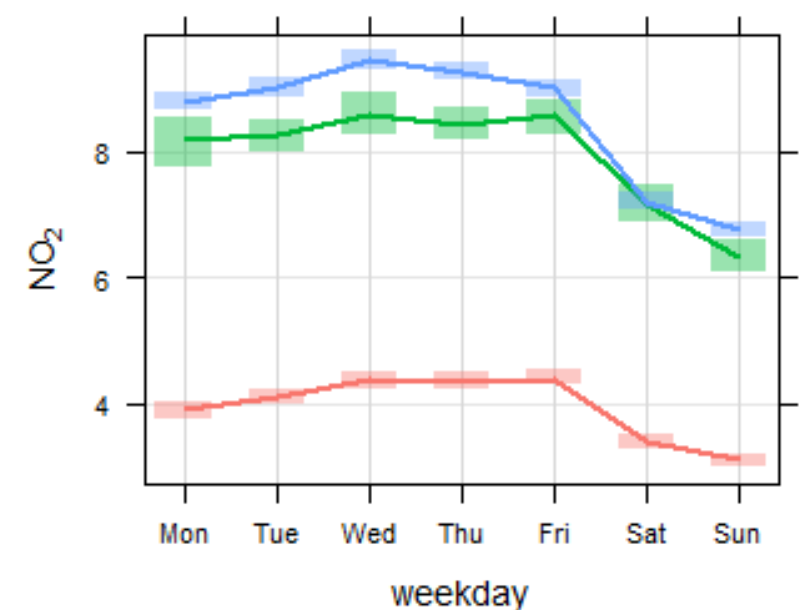
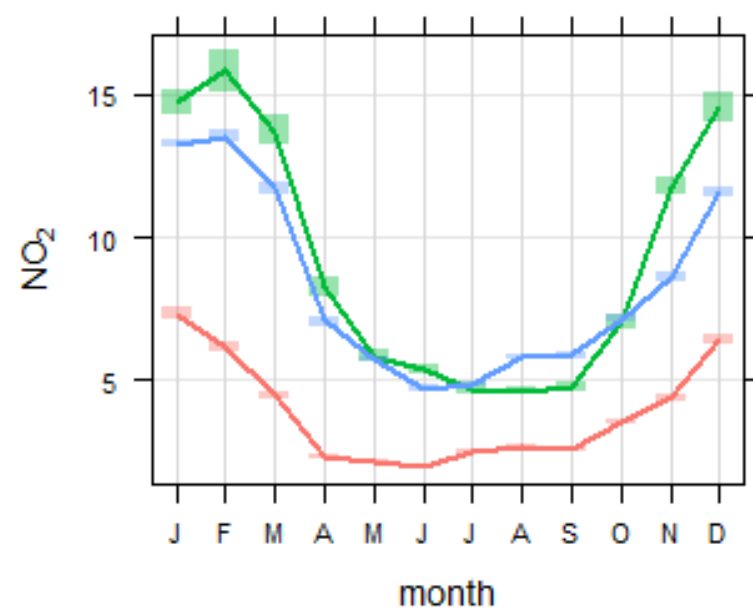
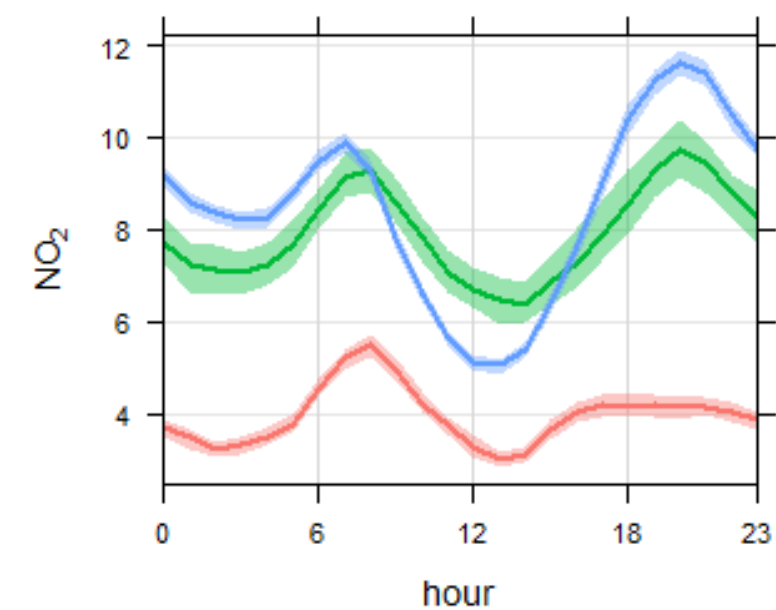
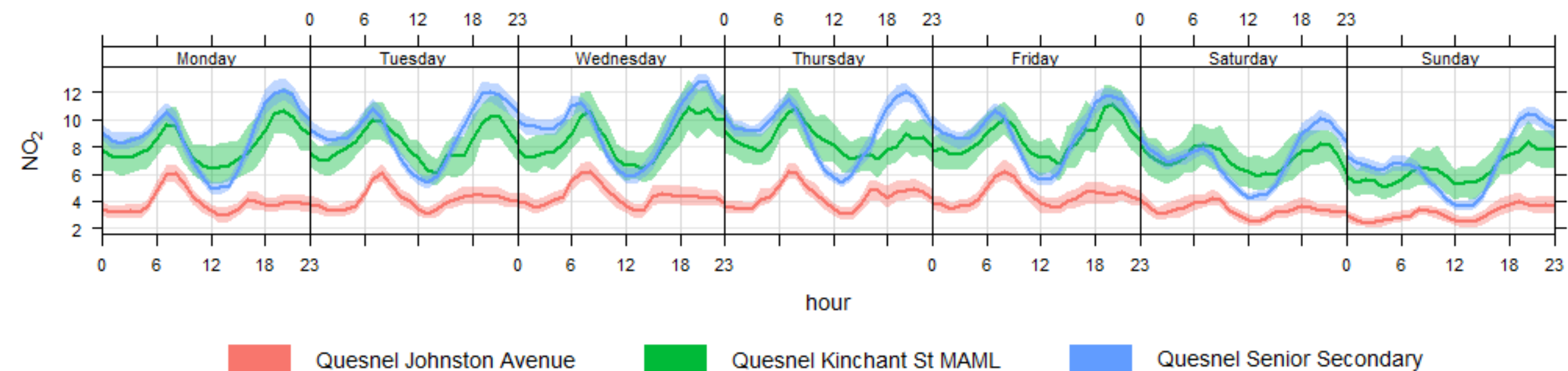
98th Percentile Annual Avg of Daily Max NO₂ (2014-2024)



Annual Average NO₂ (2014-2024)

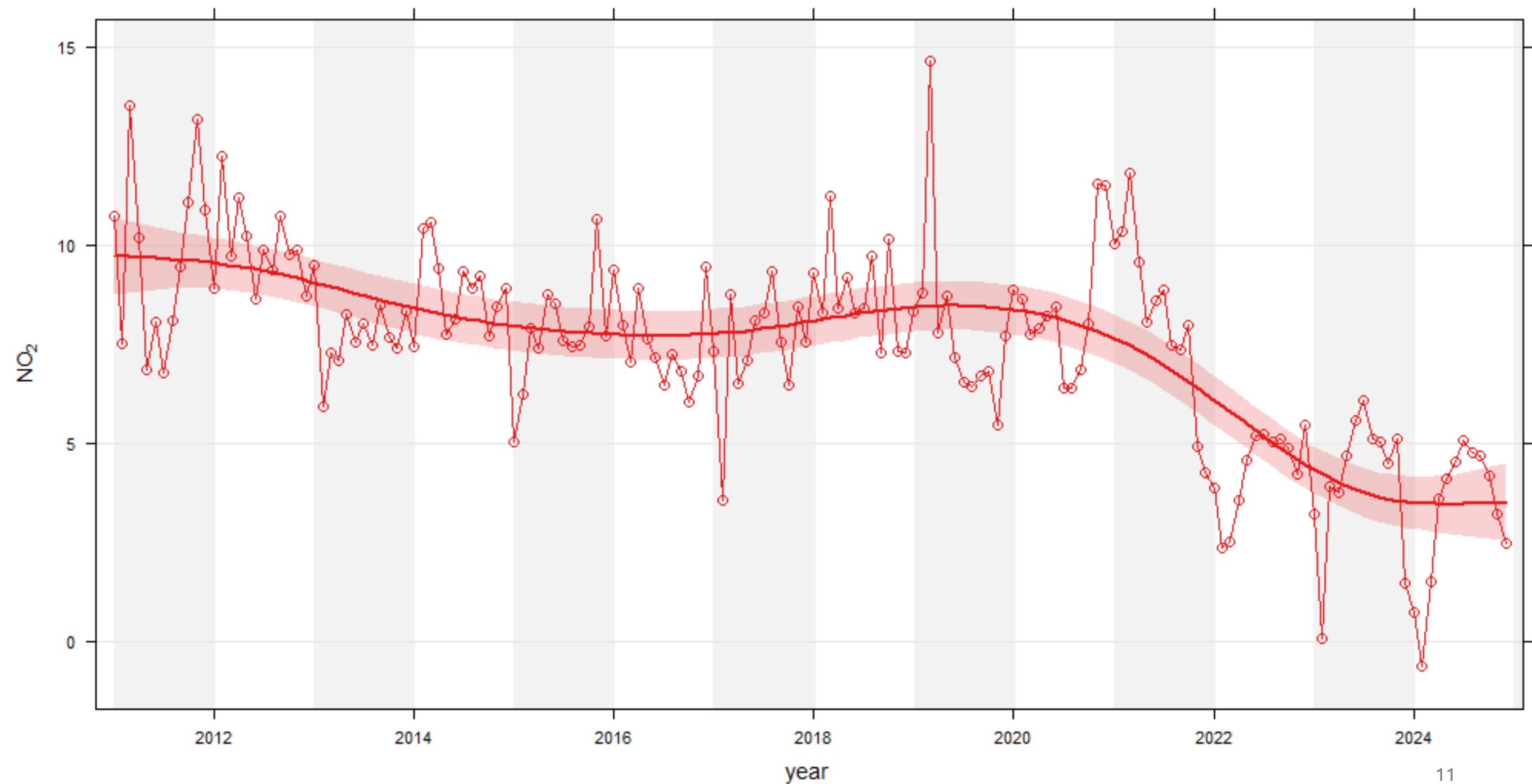


NO₂ Variation by Site

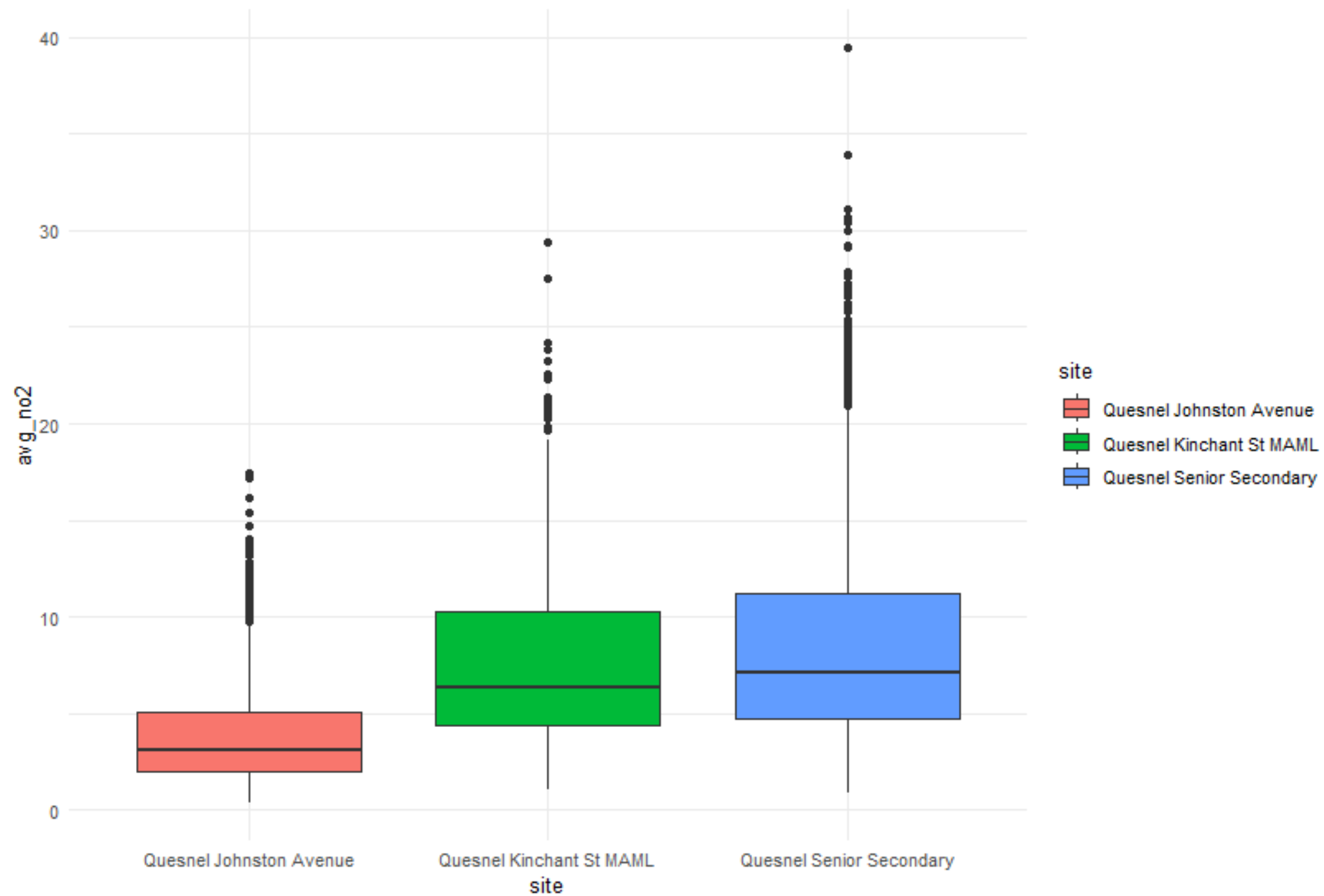


mean and 95% confidence interval in mean

NO₂ deseasoned hourly data

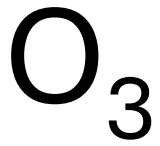


NO₂ Concentrations Across Sites

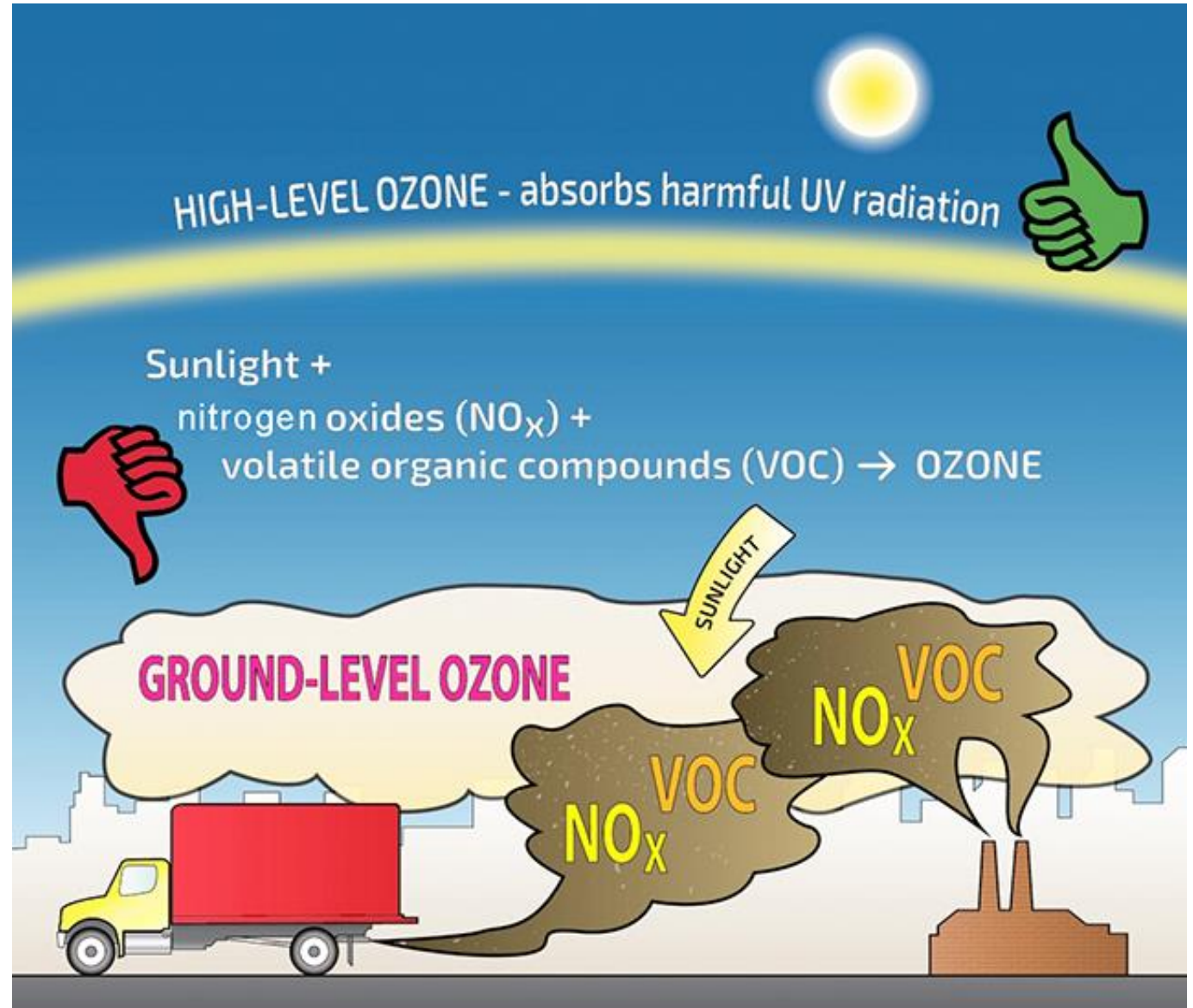


NO₂ - Key points

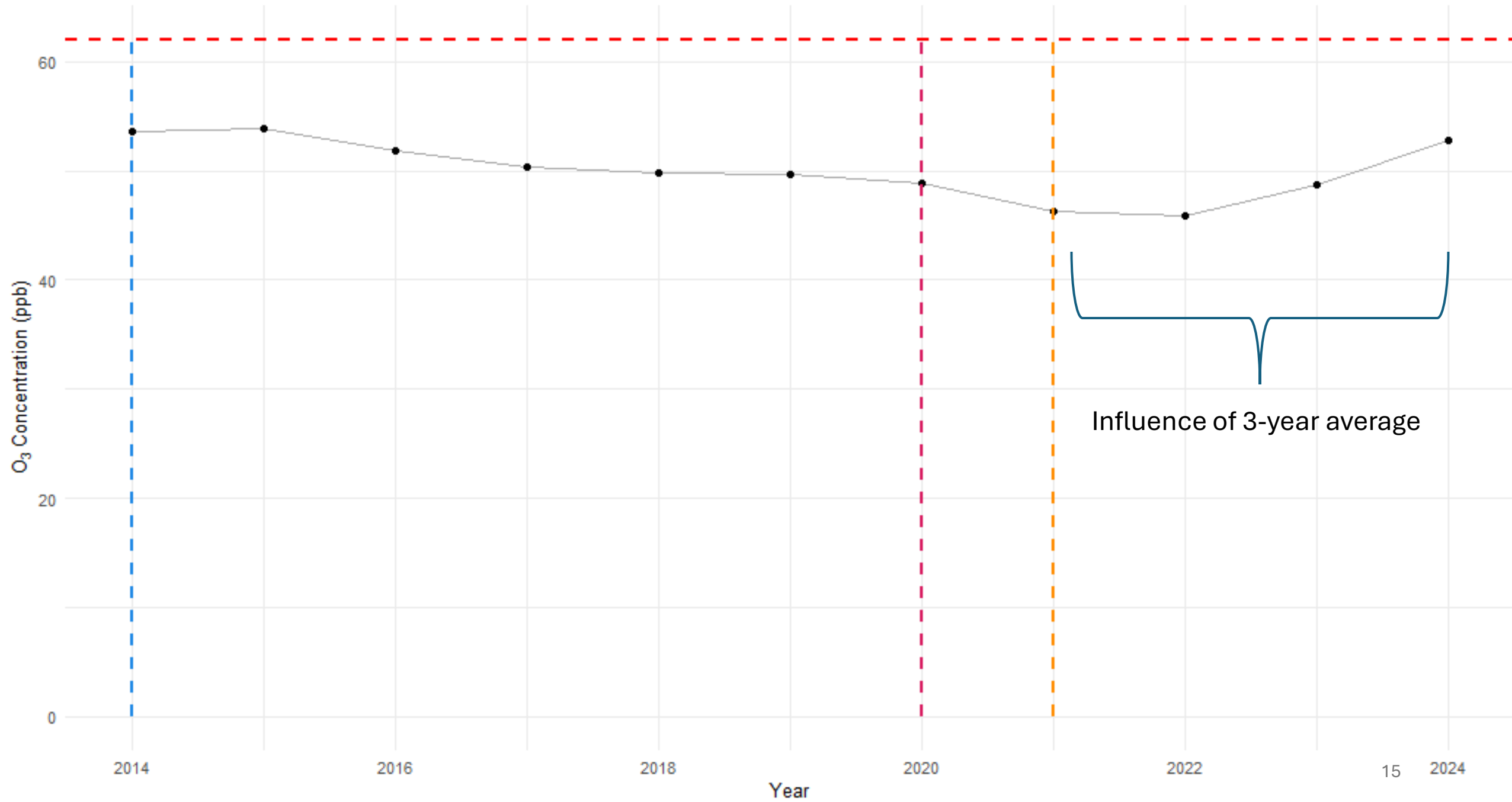
- Below objective criteria
- A clear change in NO₂ due to site change
- Long-term trend is a slow decrease over time (pre site change)



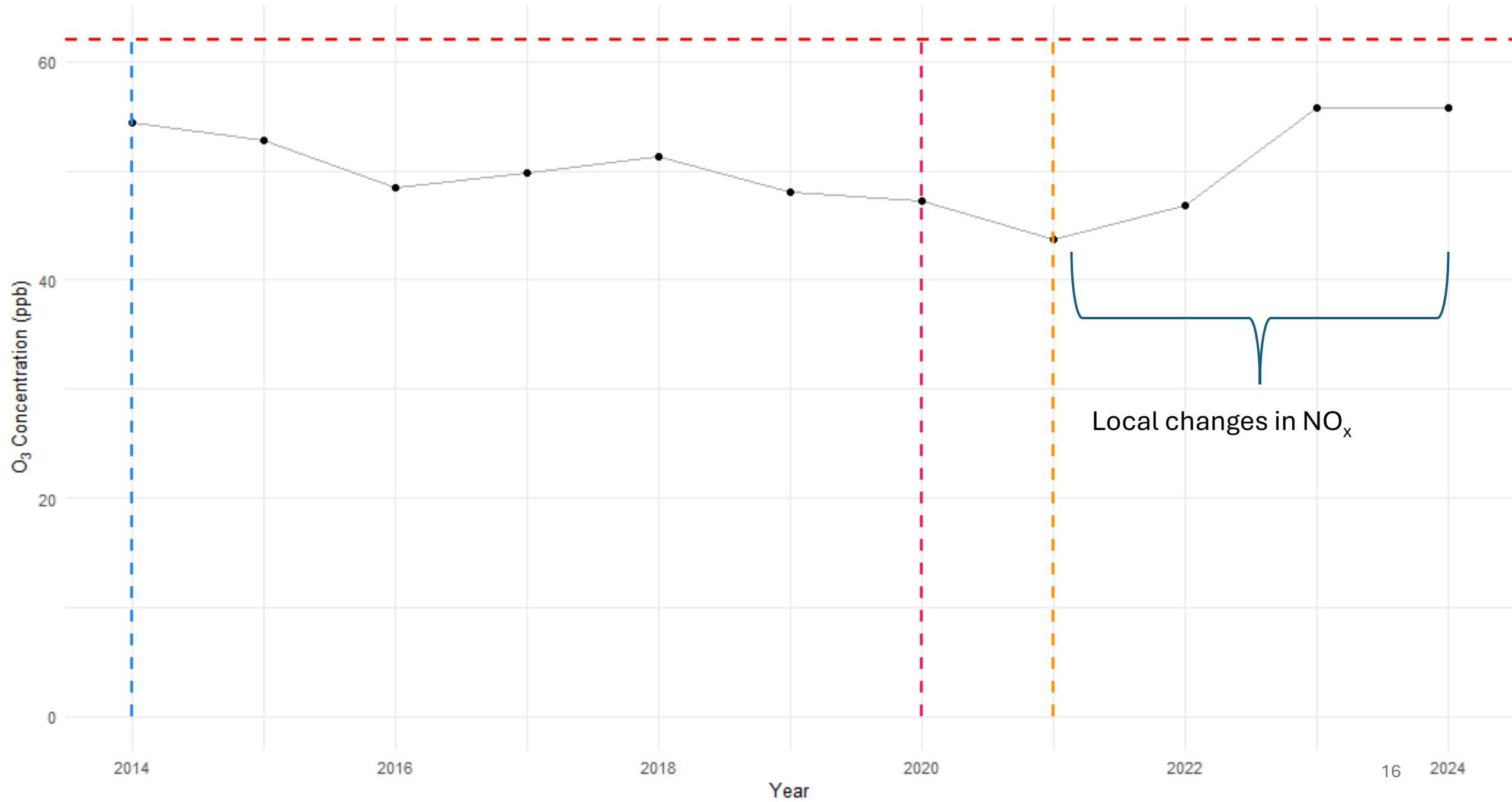
- Ground level O₃ is produced by reactions with other contaminants
- Tropospheric draw down



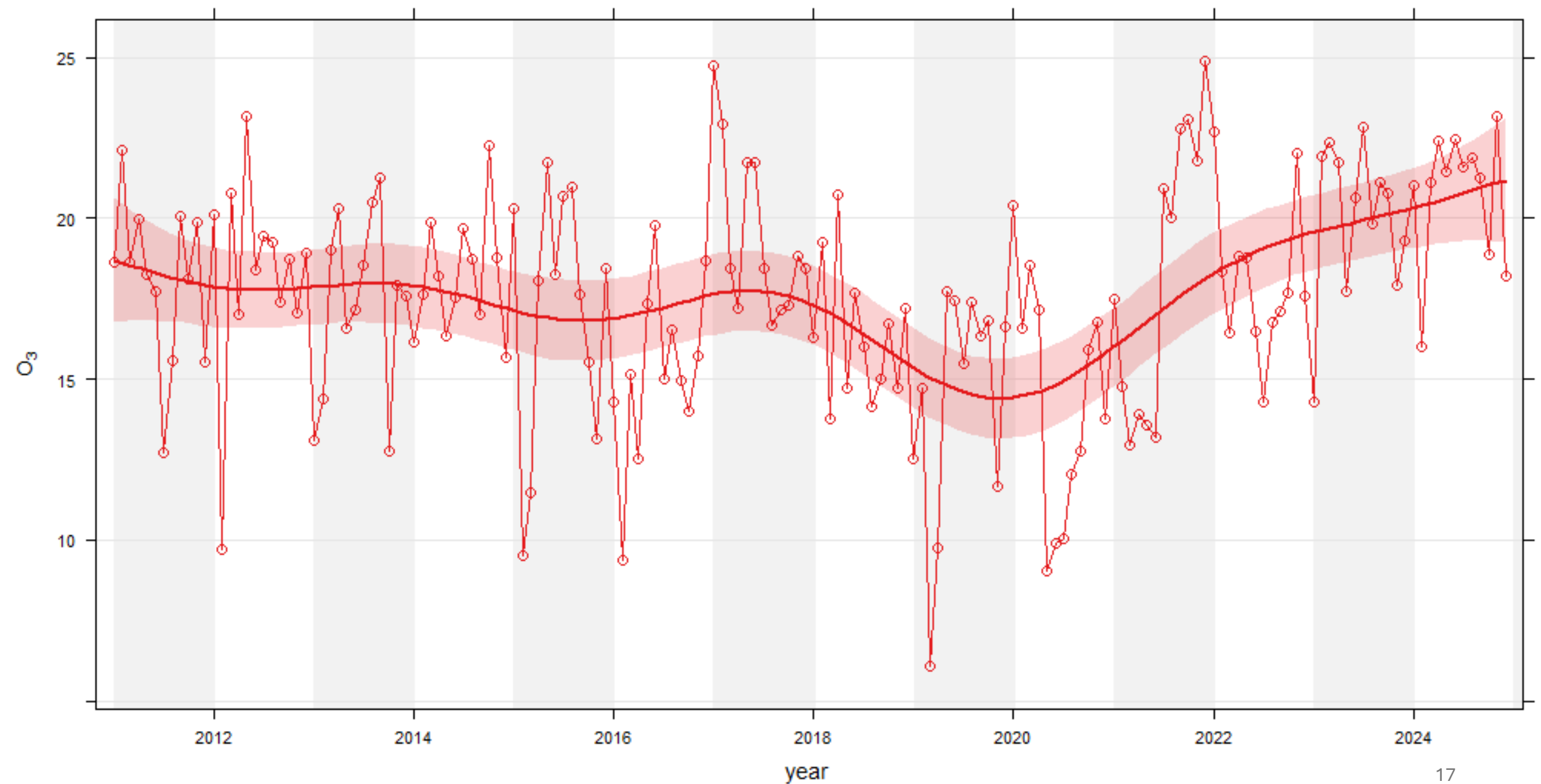
3-Year Avg of Annual 4th Highest 8h Max O₃ (2014-2024)



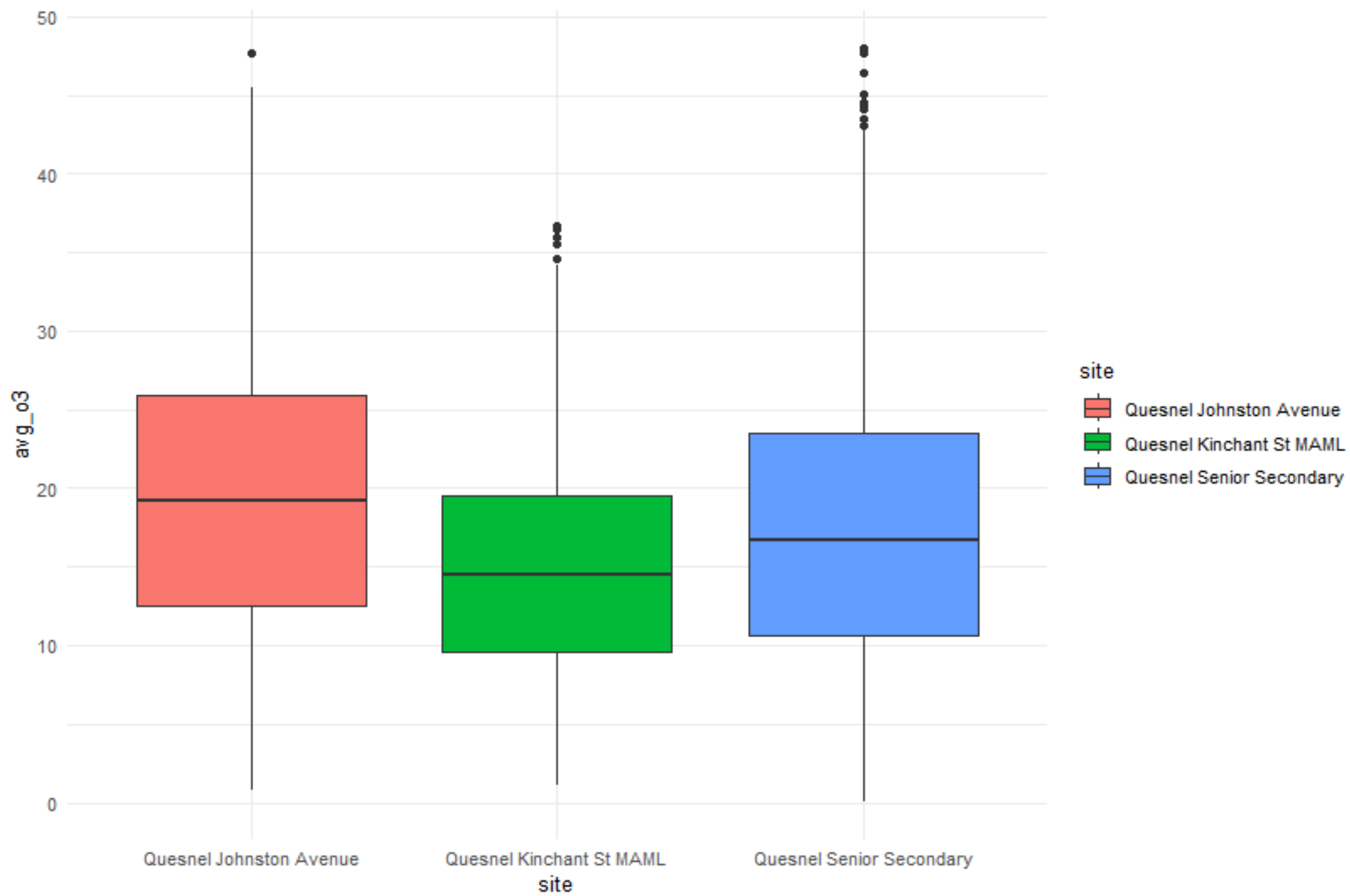
Annual 4th Highest 8h Max O₃ (2014-2024)



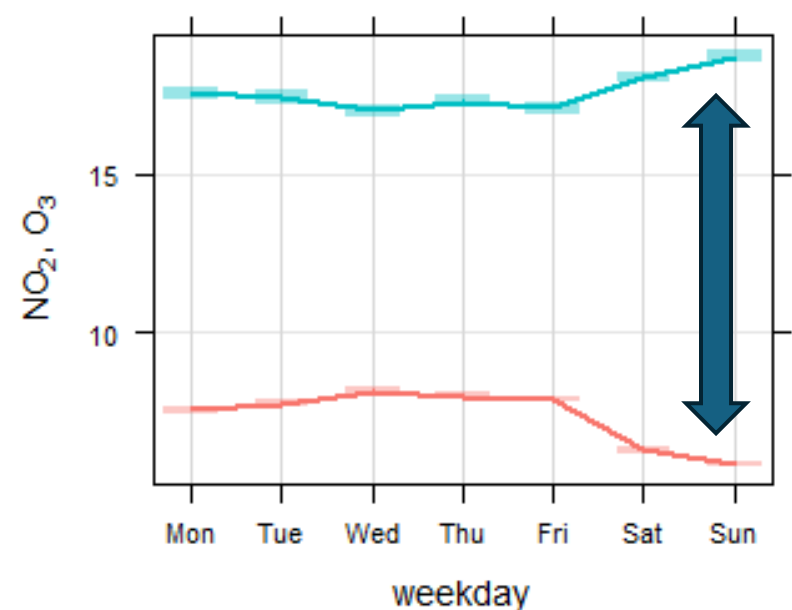
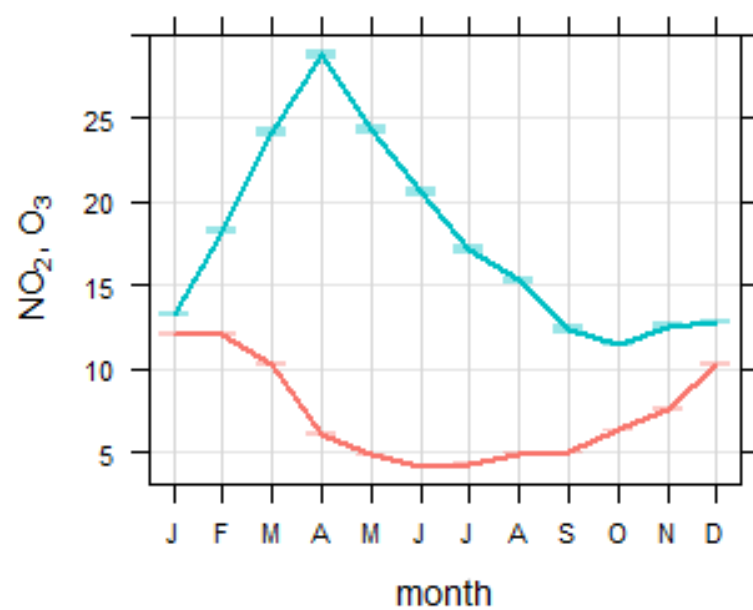
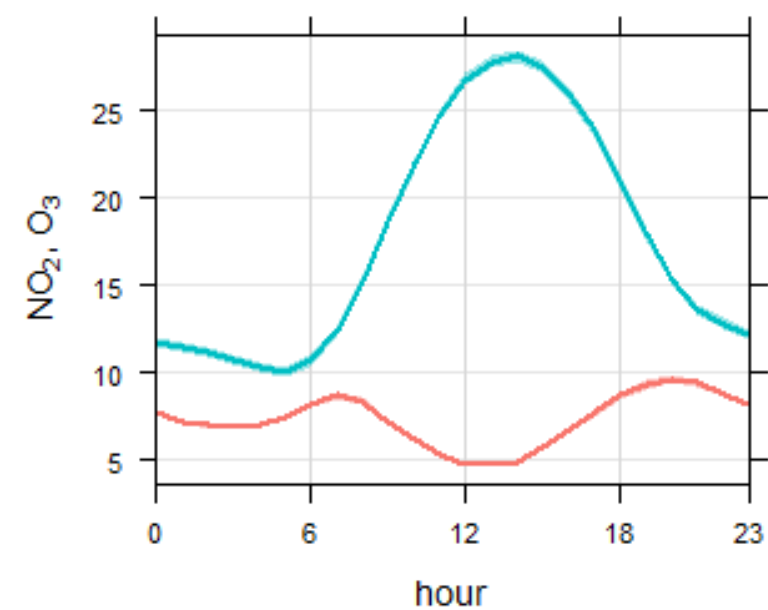
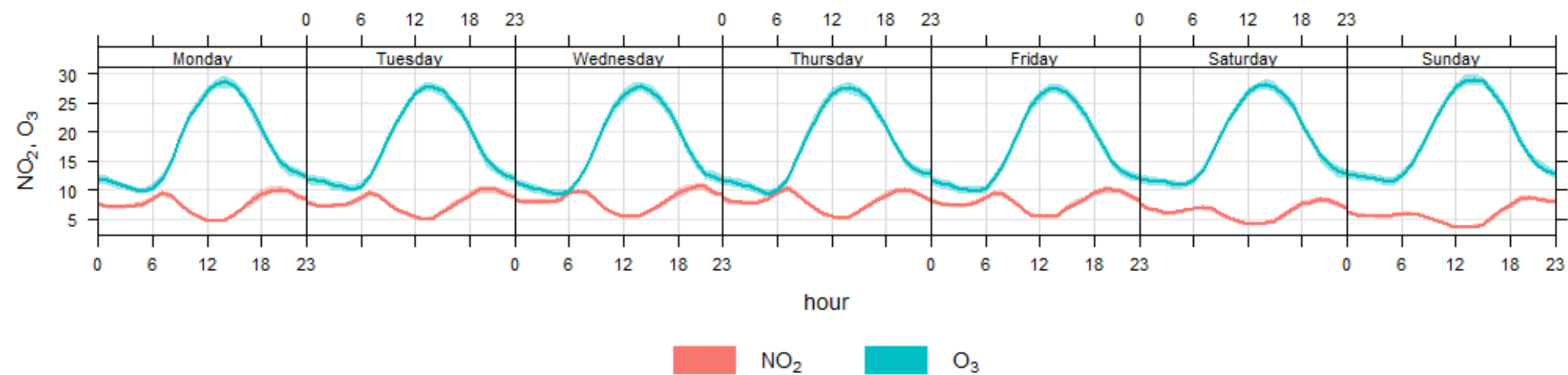
O₃ deseasoned hourly data



O₃ Concentrations Across Sites



NO₂ and O₃ Variation



mean and 95% confidence interval in mean

O₃- Key Points

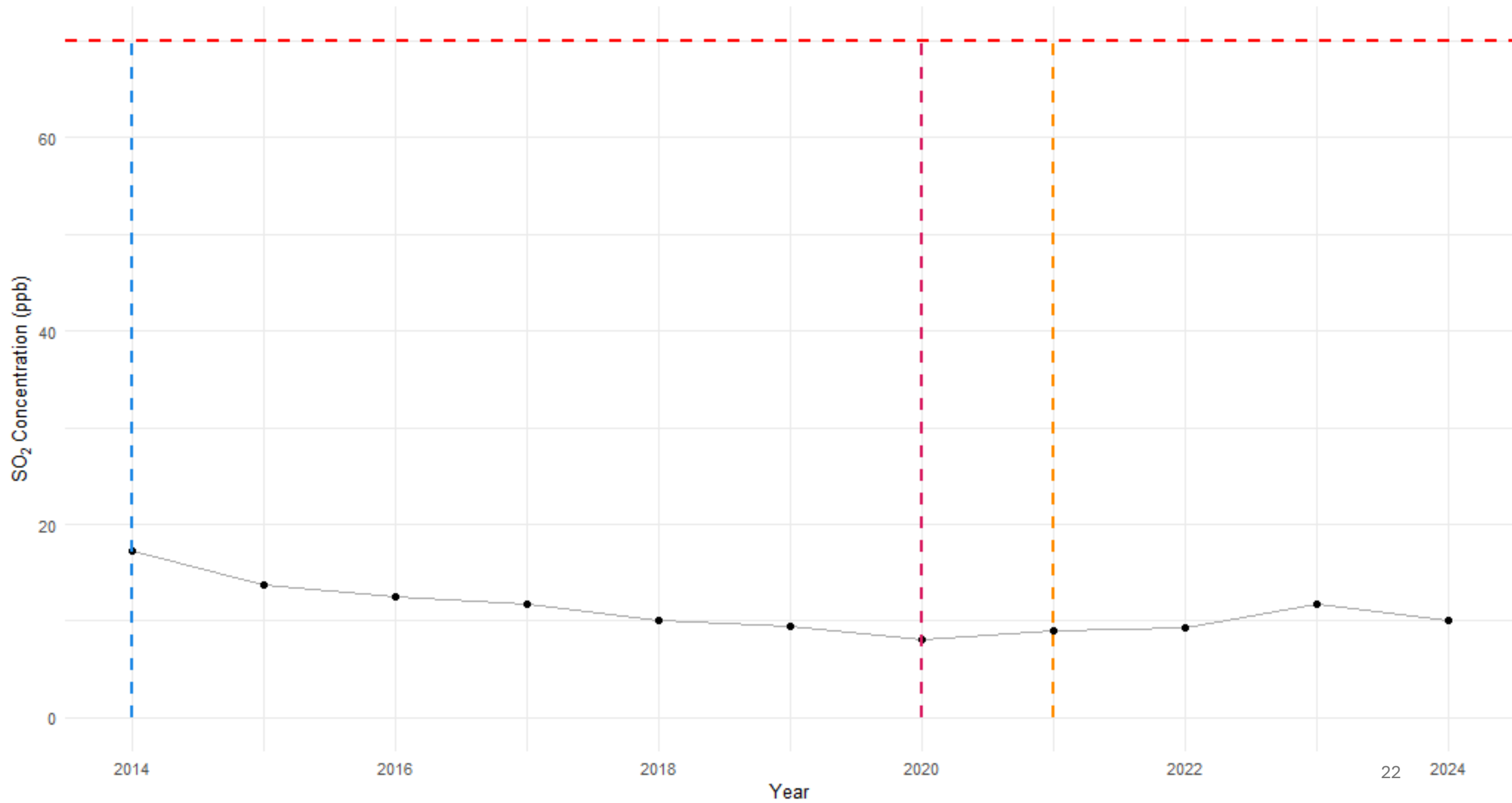
- Below objectives
- Generally considered a regional contaminant
- Interesting local variation with Johnston Ave highlighting the synergistic relationship between different contaminants



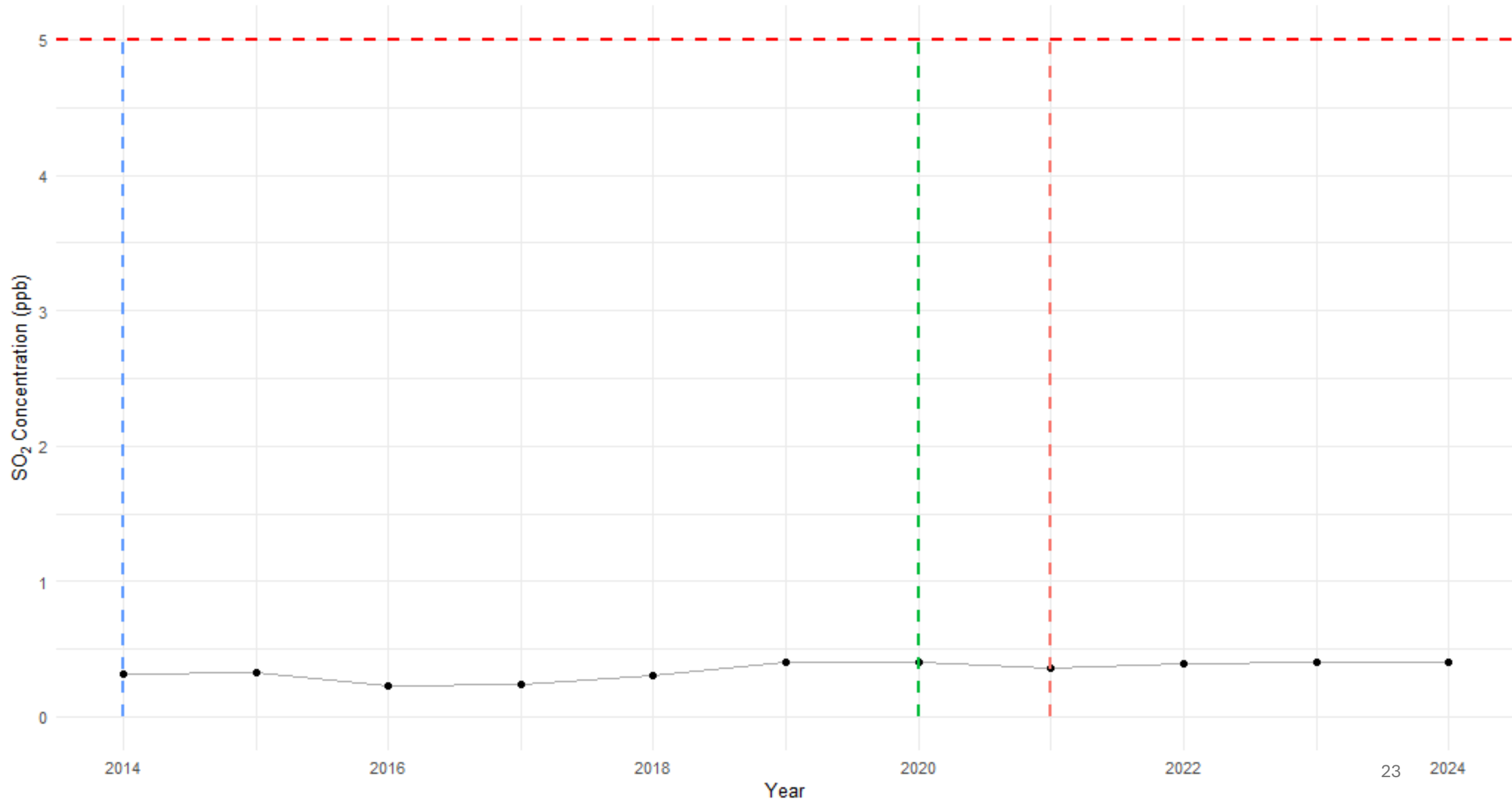
- Industrial sources
- Burning fossil fuels
- Metal smelting
- Volcanos



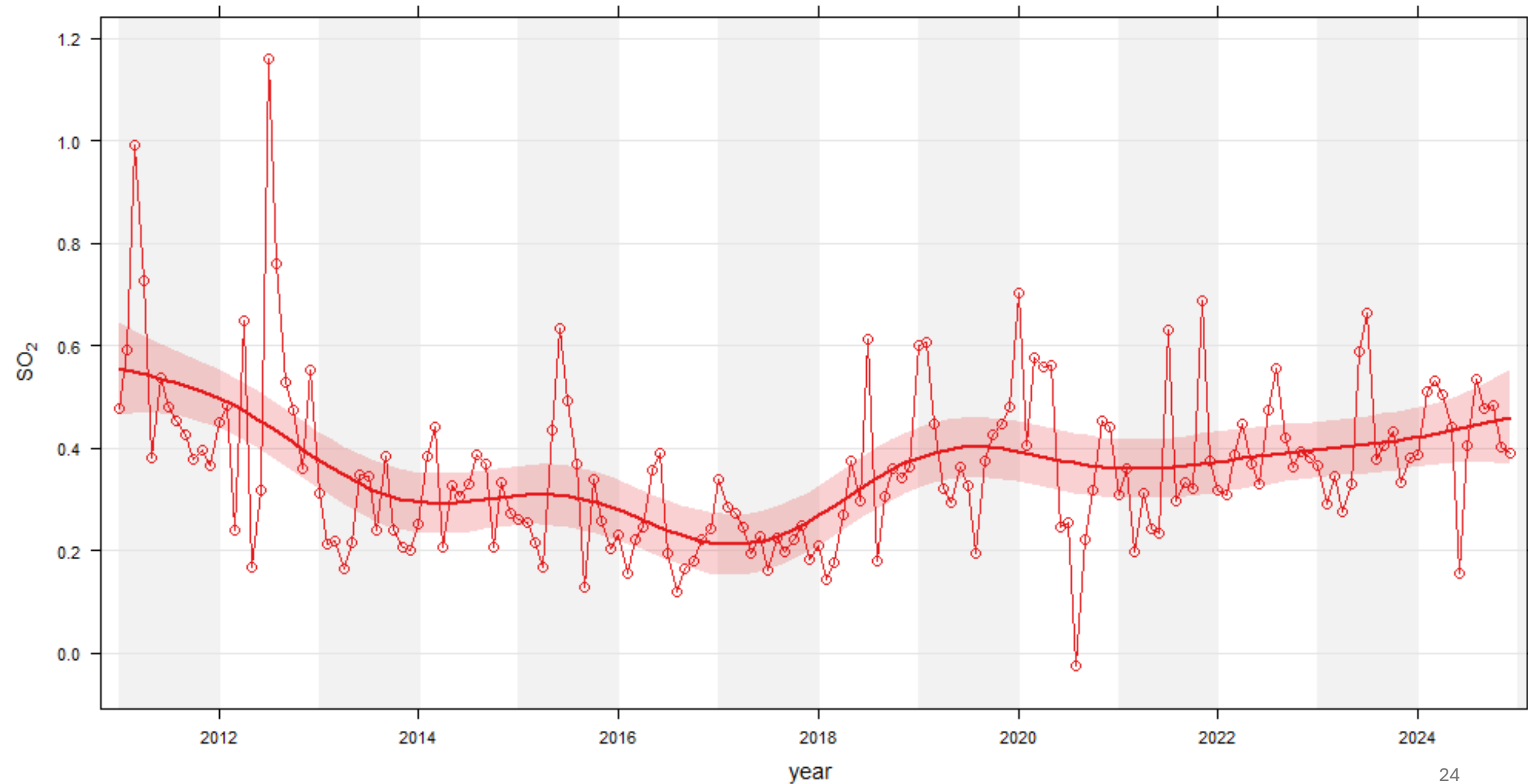
3-Year Avg of Annual 99th Percentile Daily Max SO₂ (2014-2024)



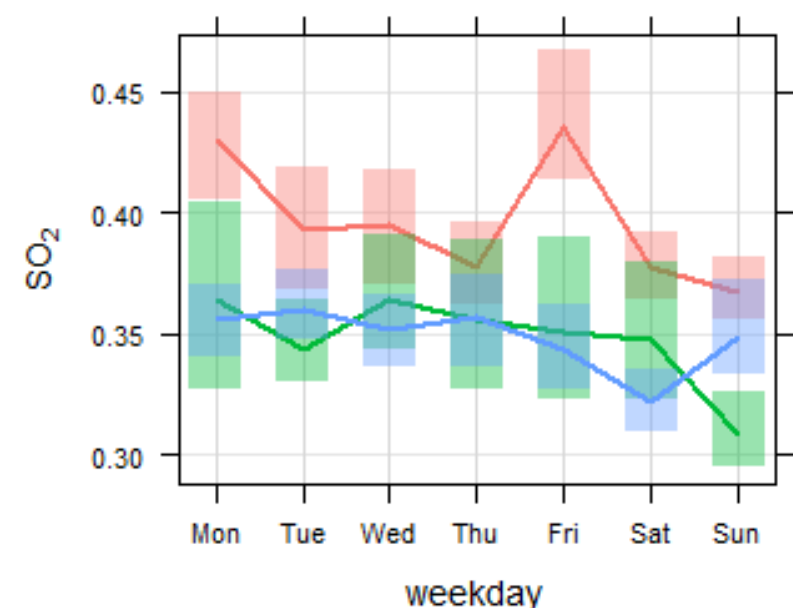
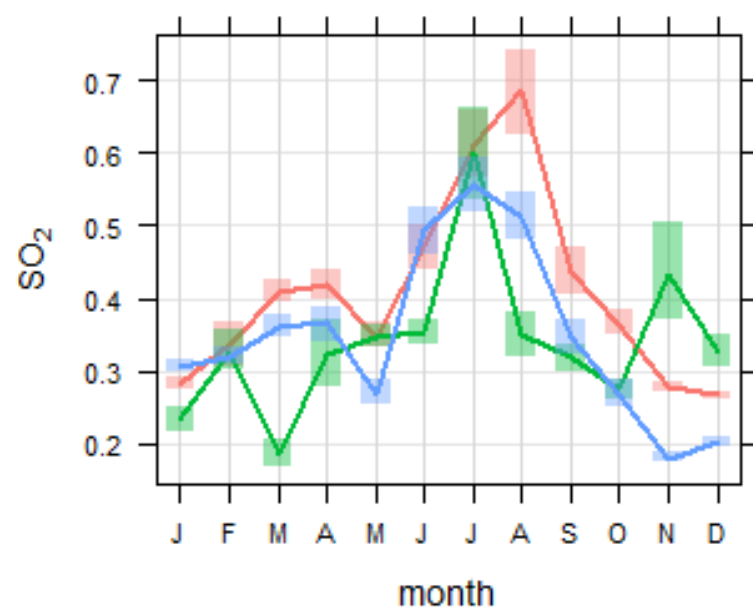
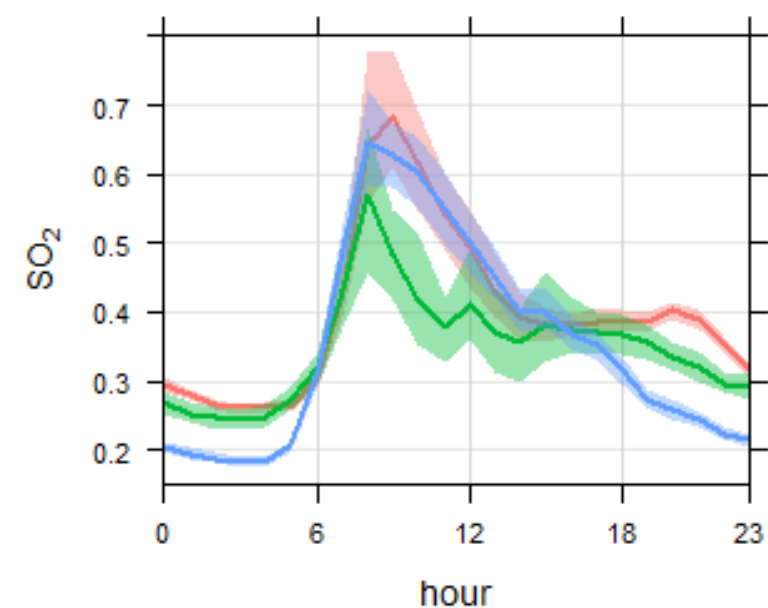
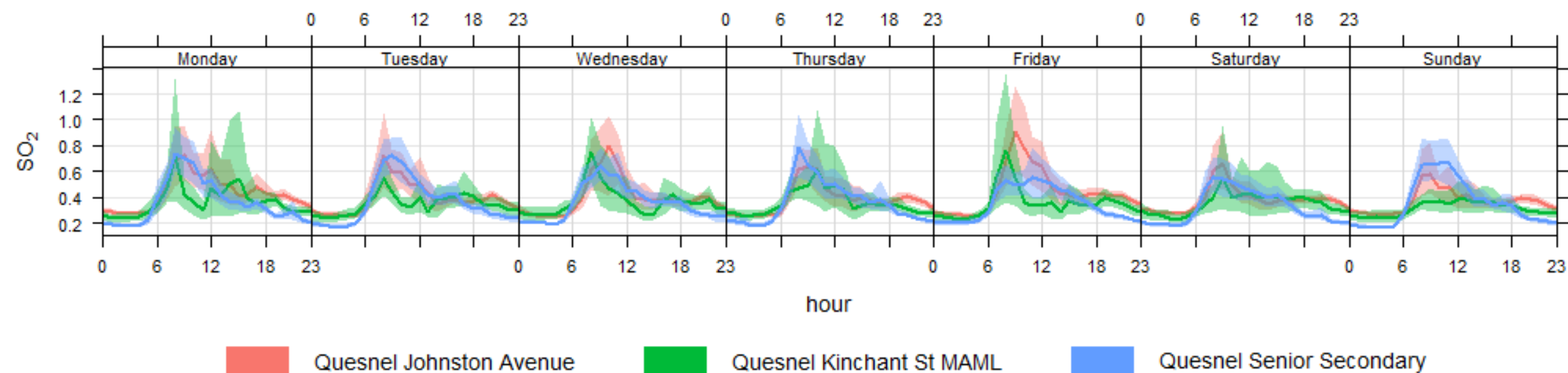
Annual Average SO₂ (2014-2024)



SO₂ deseasoned hourly data

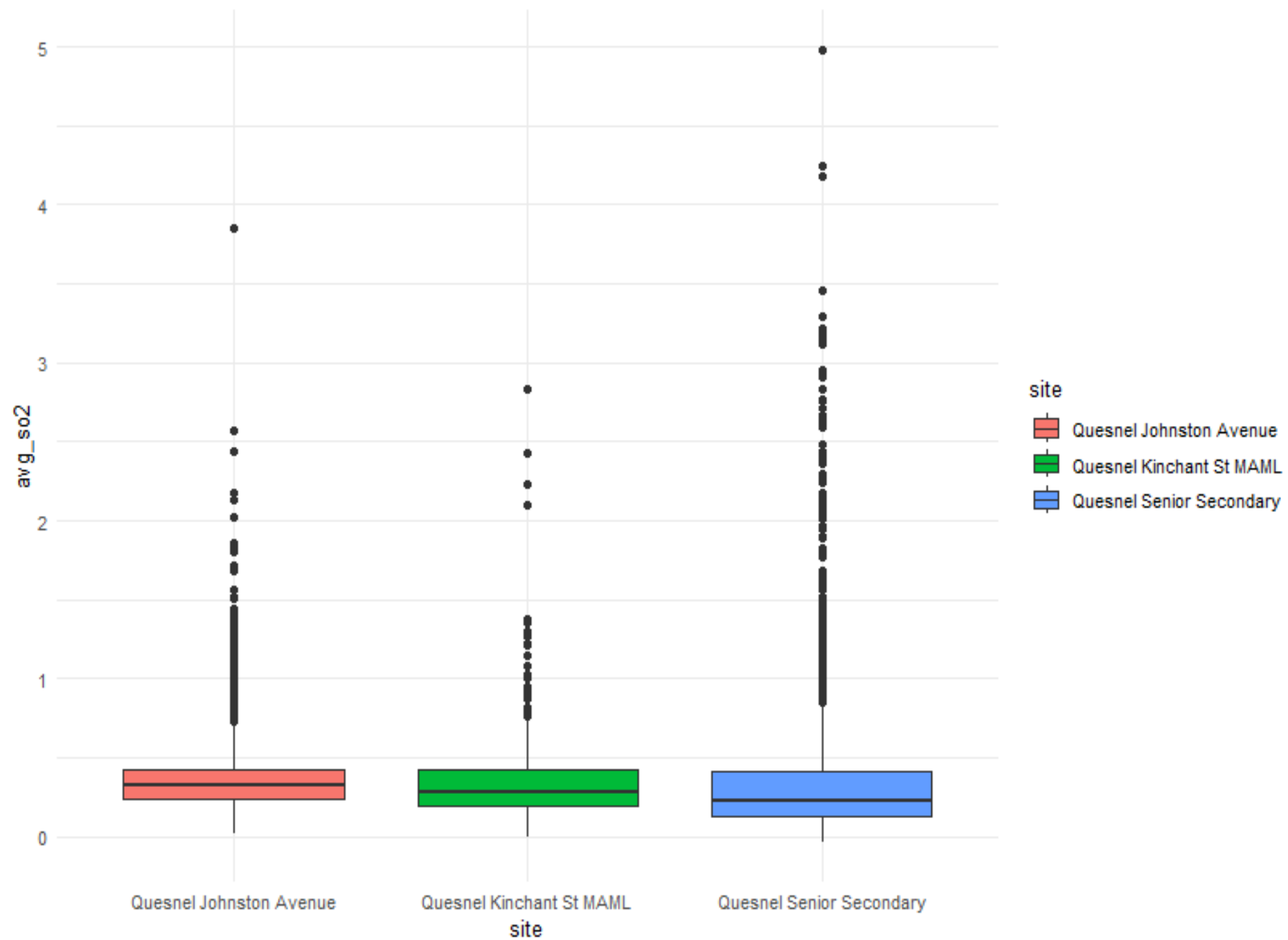


SO₂ Variation by site



mean and 95% confidence interval in mean

SO₂ Levels Across Sites



SO₂ – Key Points

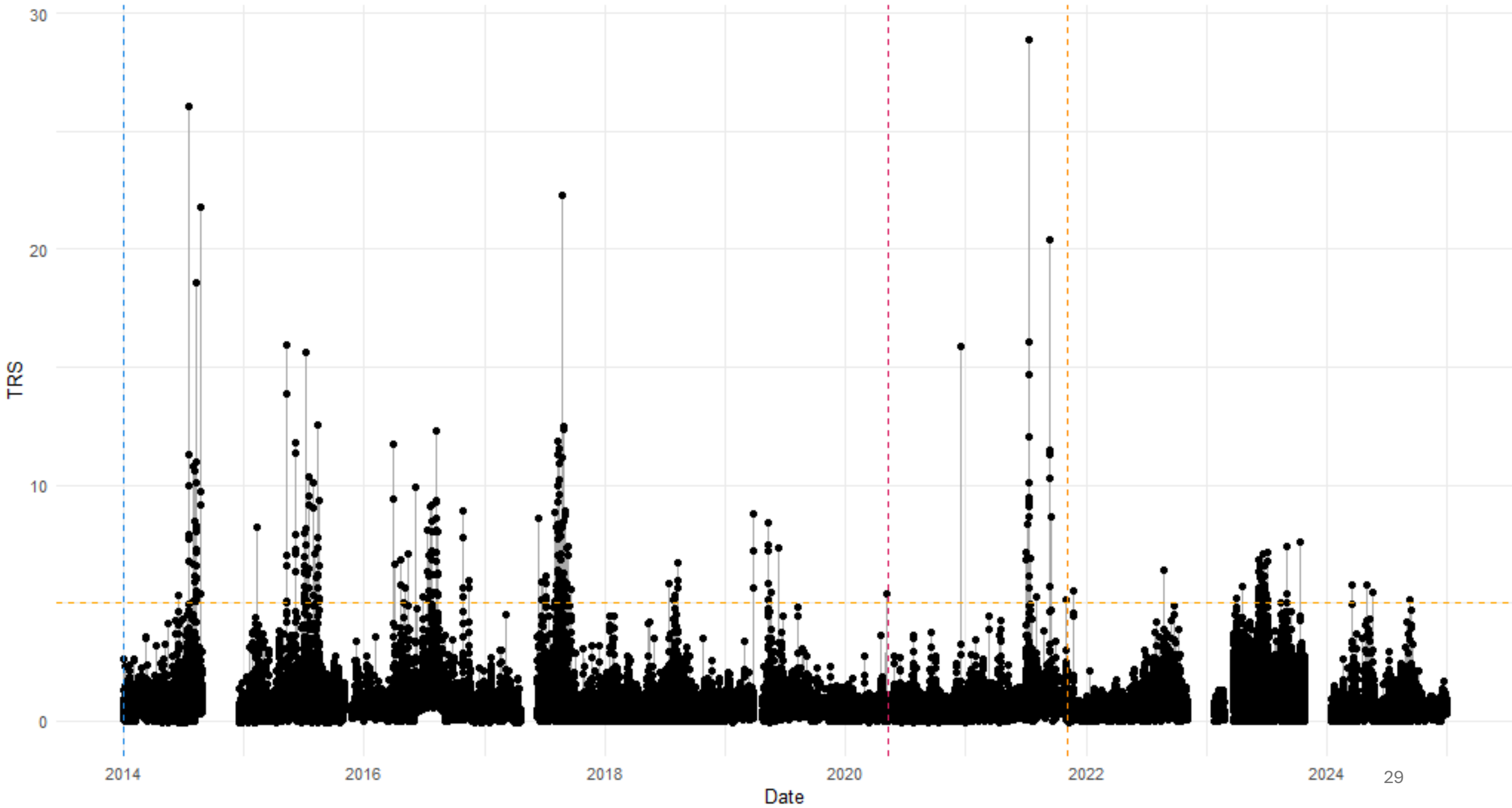
- Well below objectives
- No significant trend
- Between site variation is significant but immaterial at the concentrations

TRS

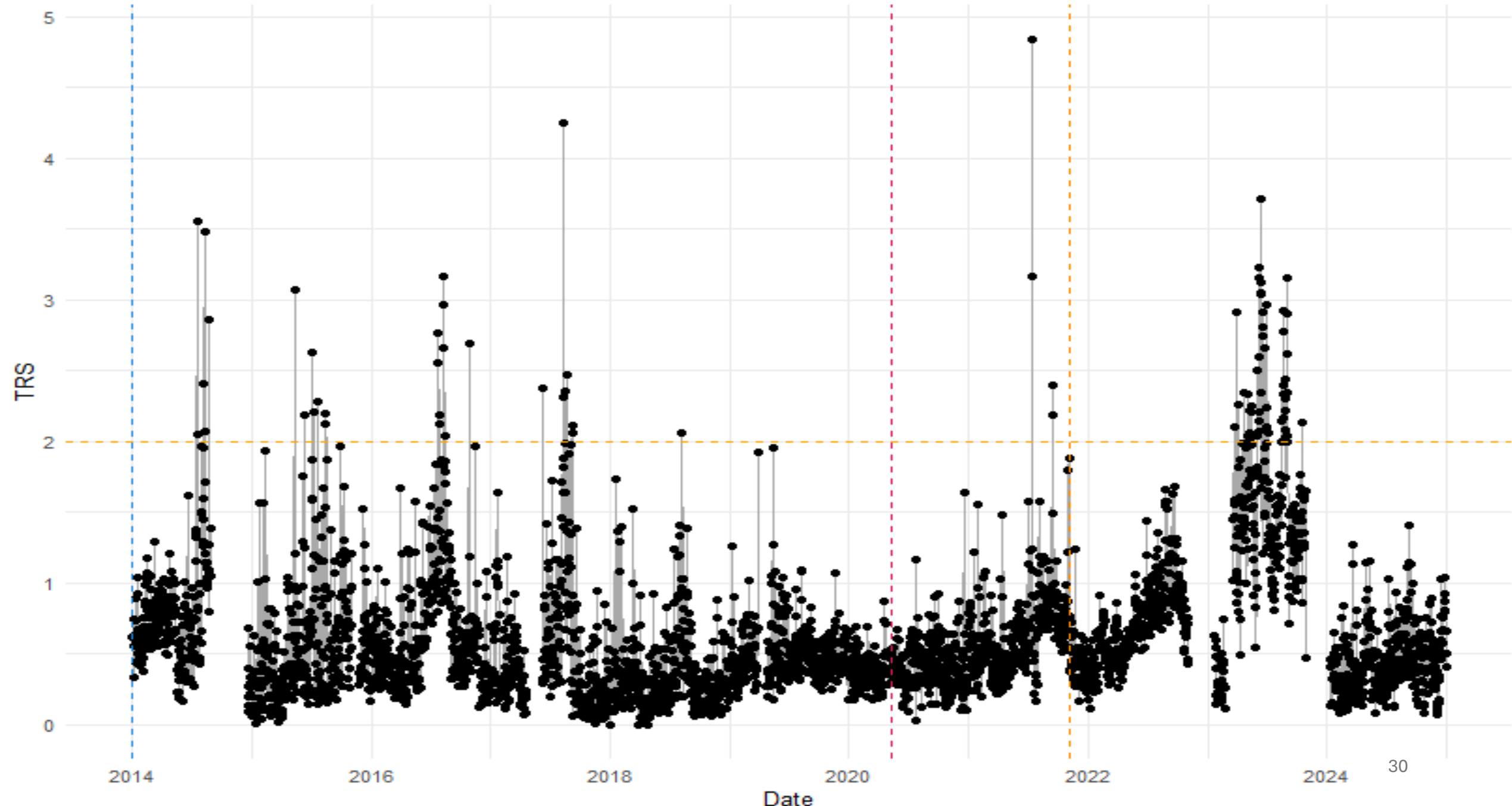
- Industrial sources
 - Pulp mills
- Sewage plants
- Swamps



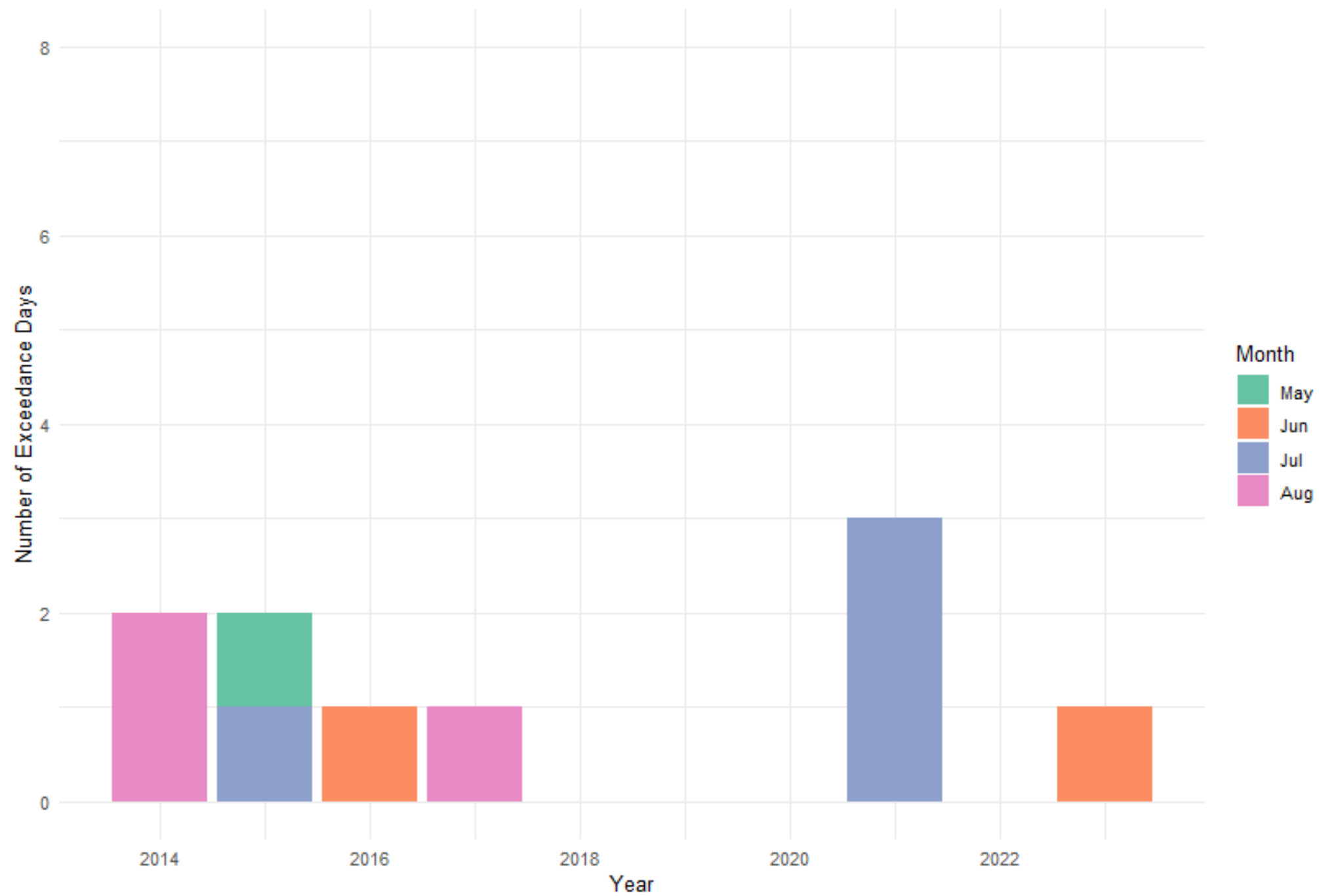
Hourly TRS Levels Over Time, 2014-2024



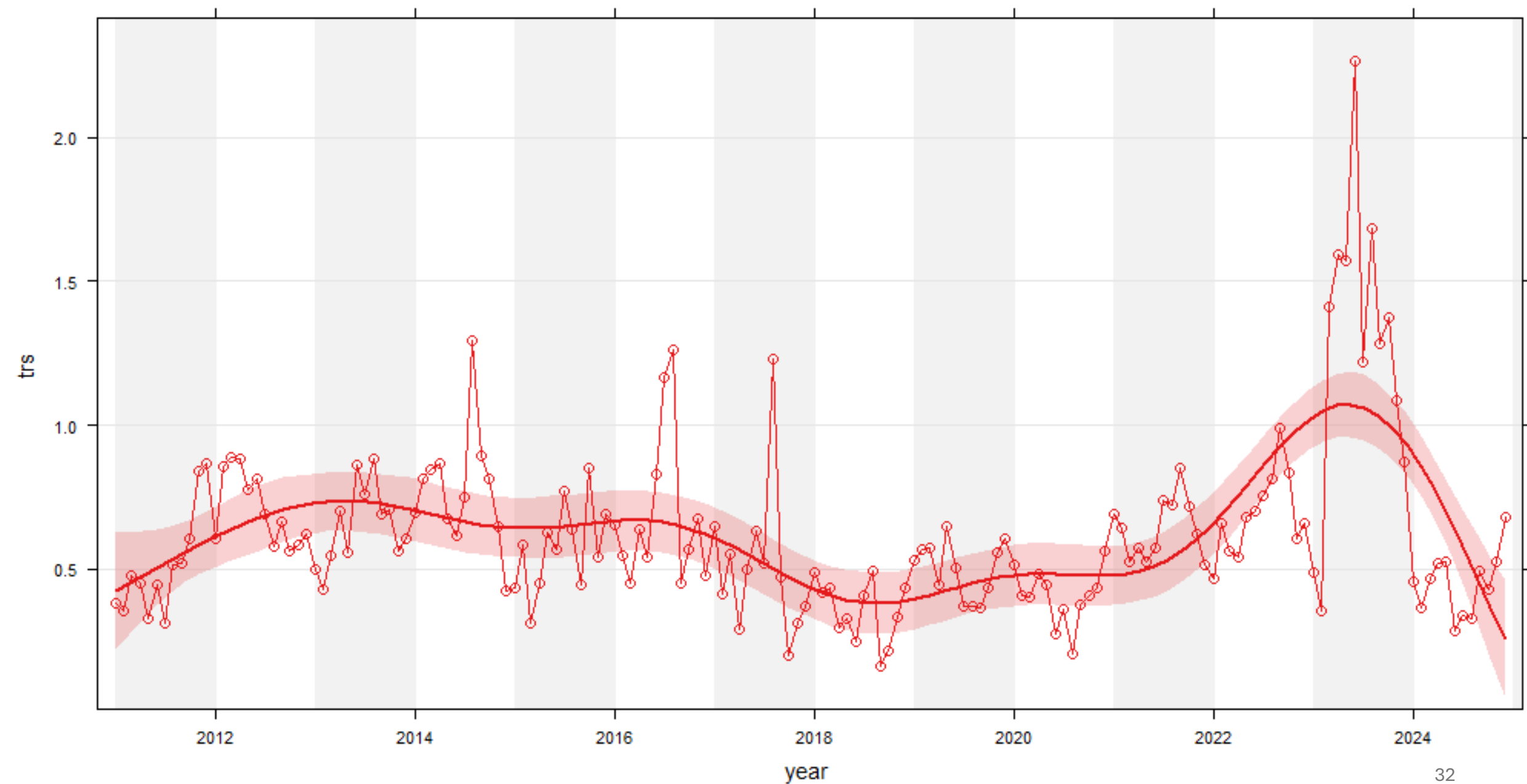
Daily TRS Levels Over Time, 2014-2024



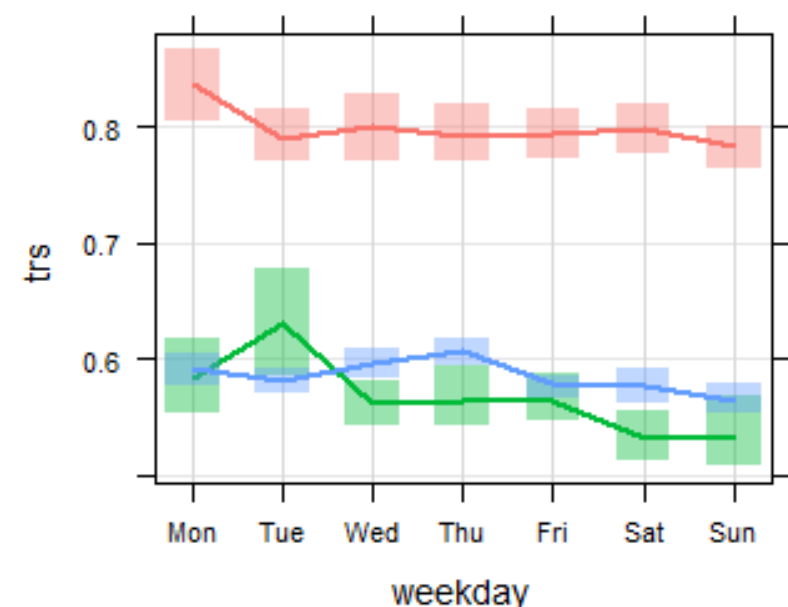
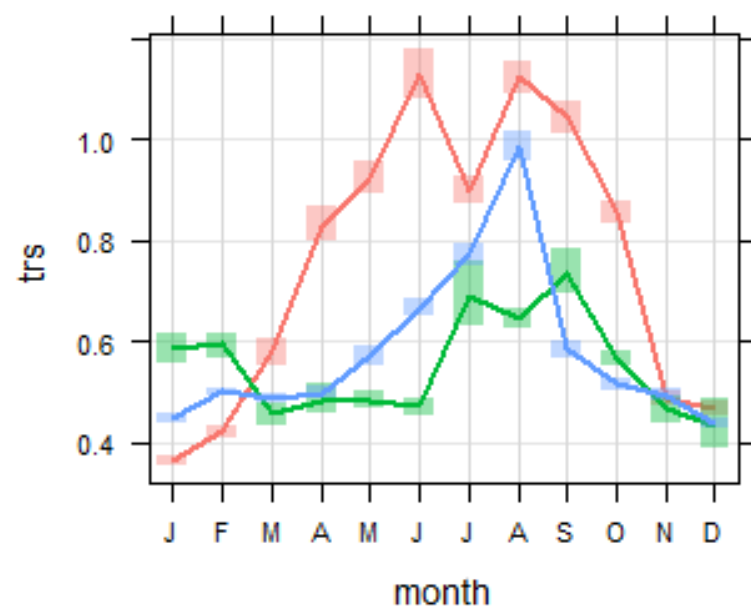
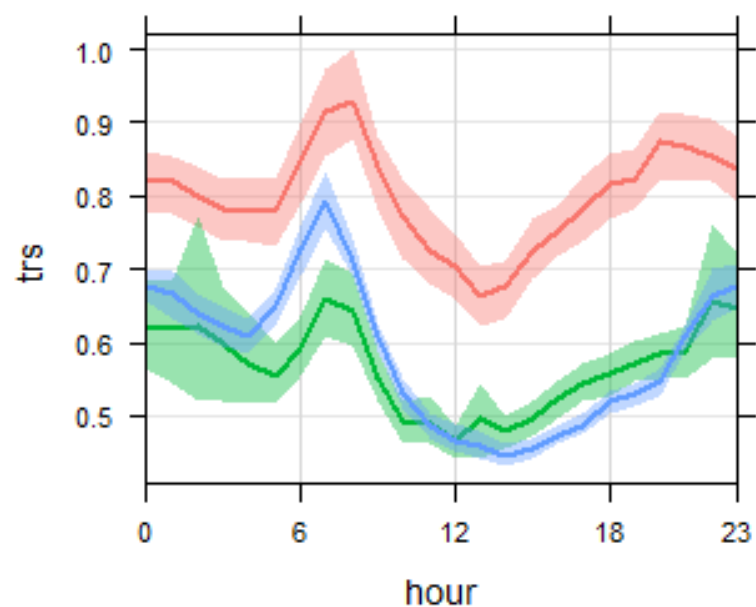
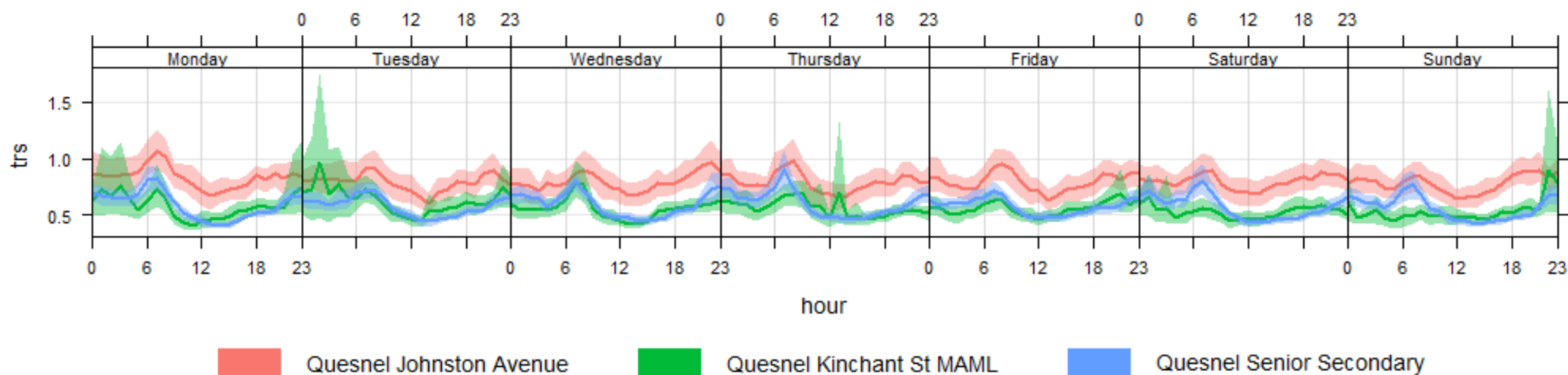
Monthly Count of Days with 6+ Hours Exceeding TRS Threshold



TRS deseasoned hourly data



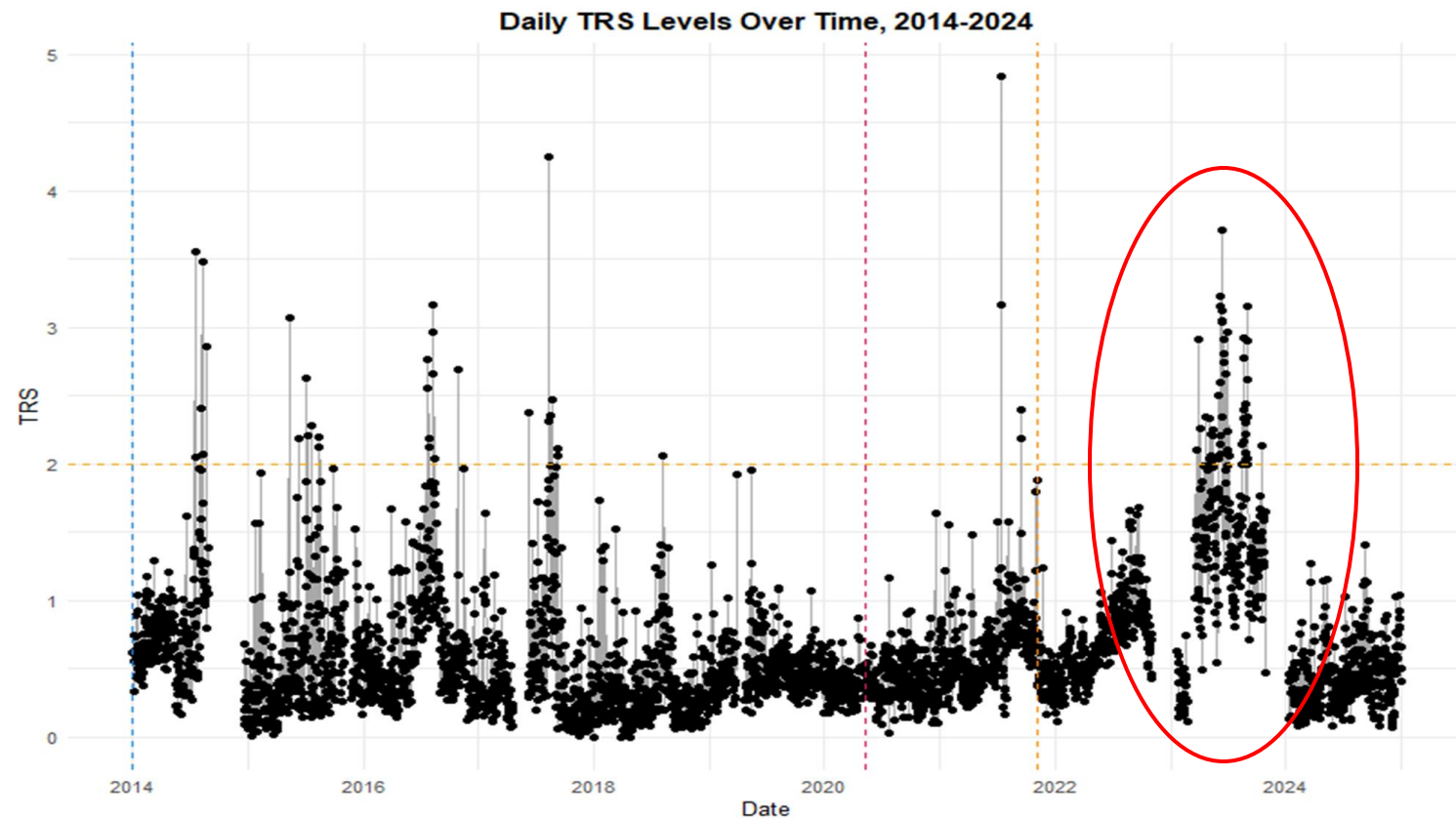
TRS Variation by site



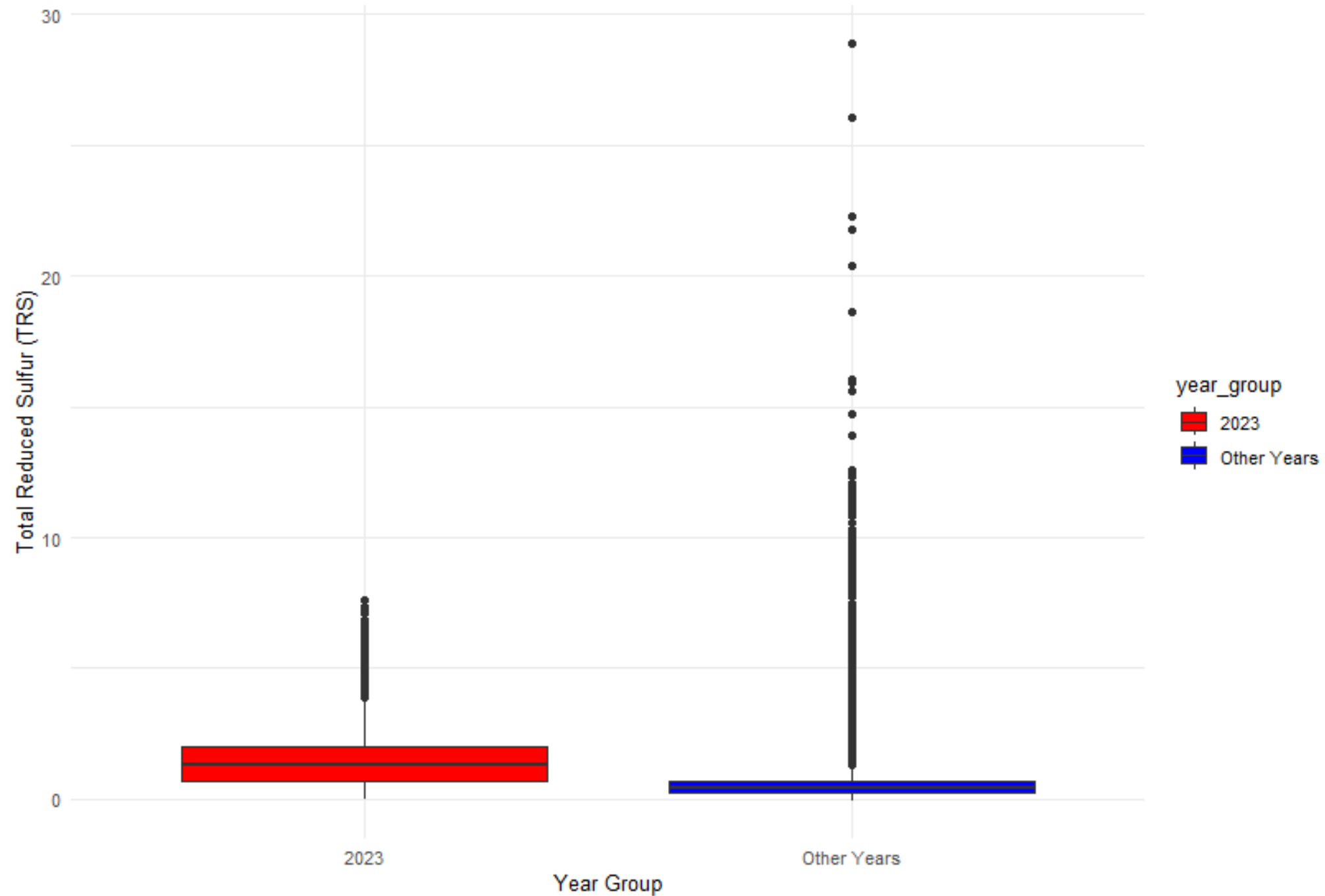
mean and 95% confidence interval in mean

What happened in 2023?

- Significant change in TRS

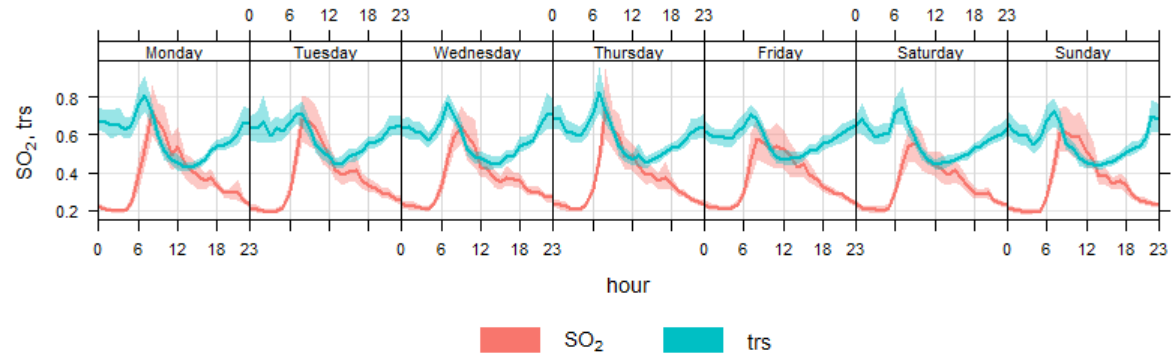


TRS Levels: 2023 vs Other Years

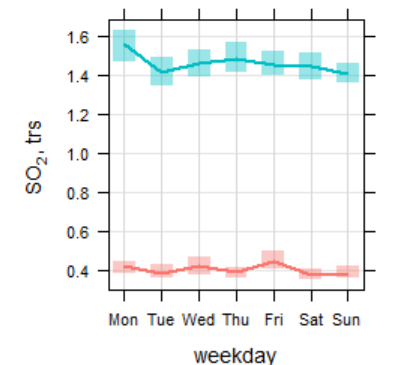
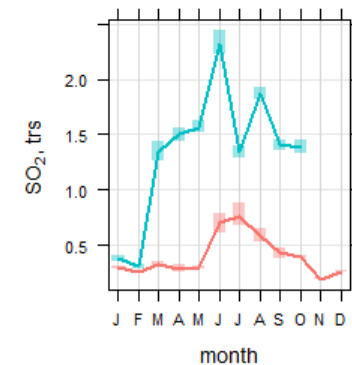
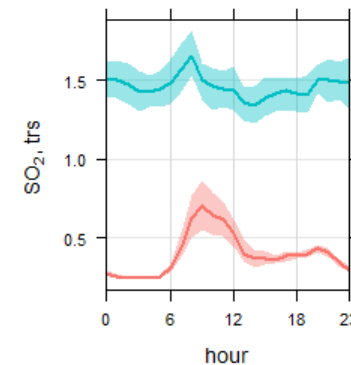
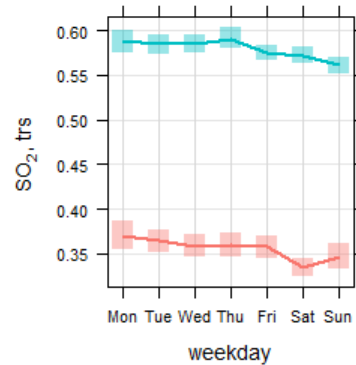
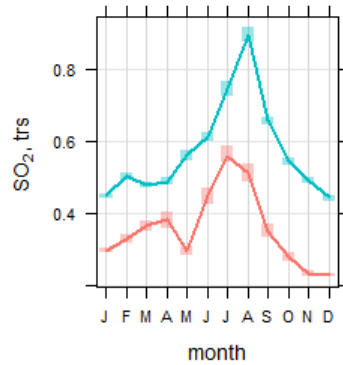
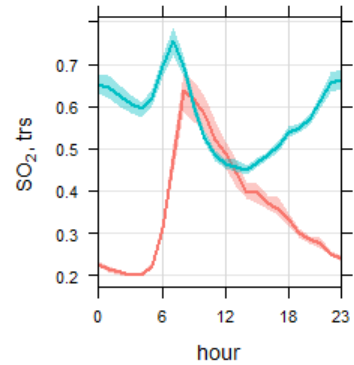
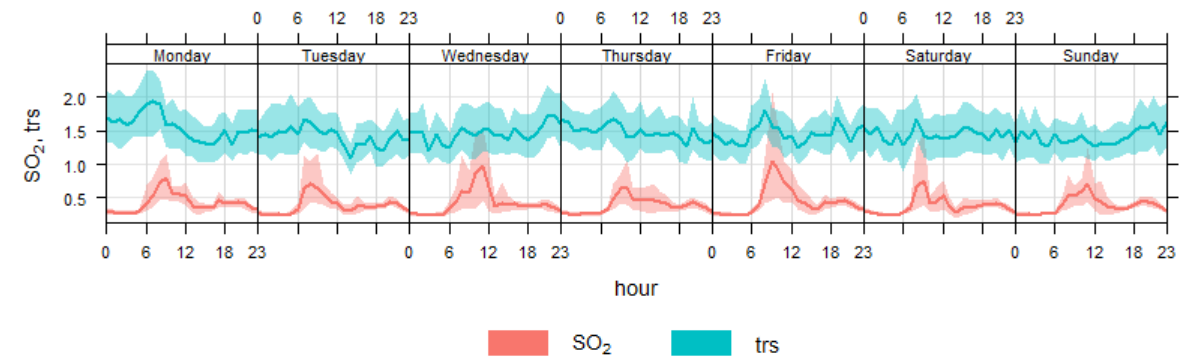


Pattern of emissions

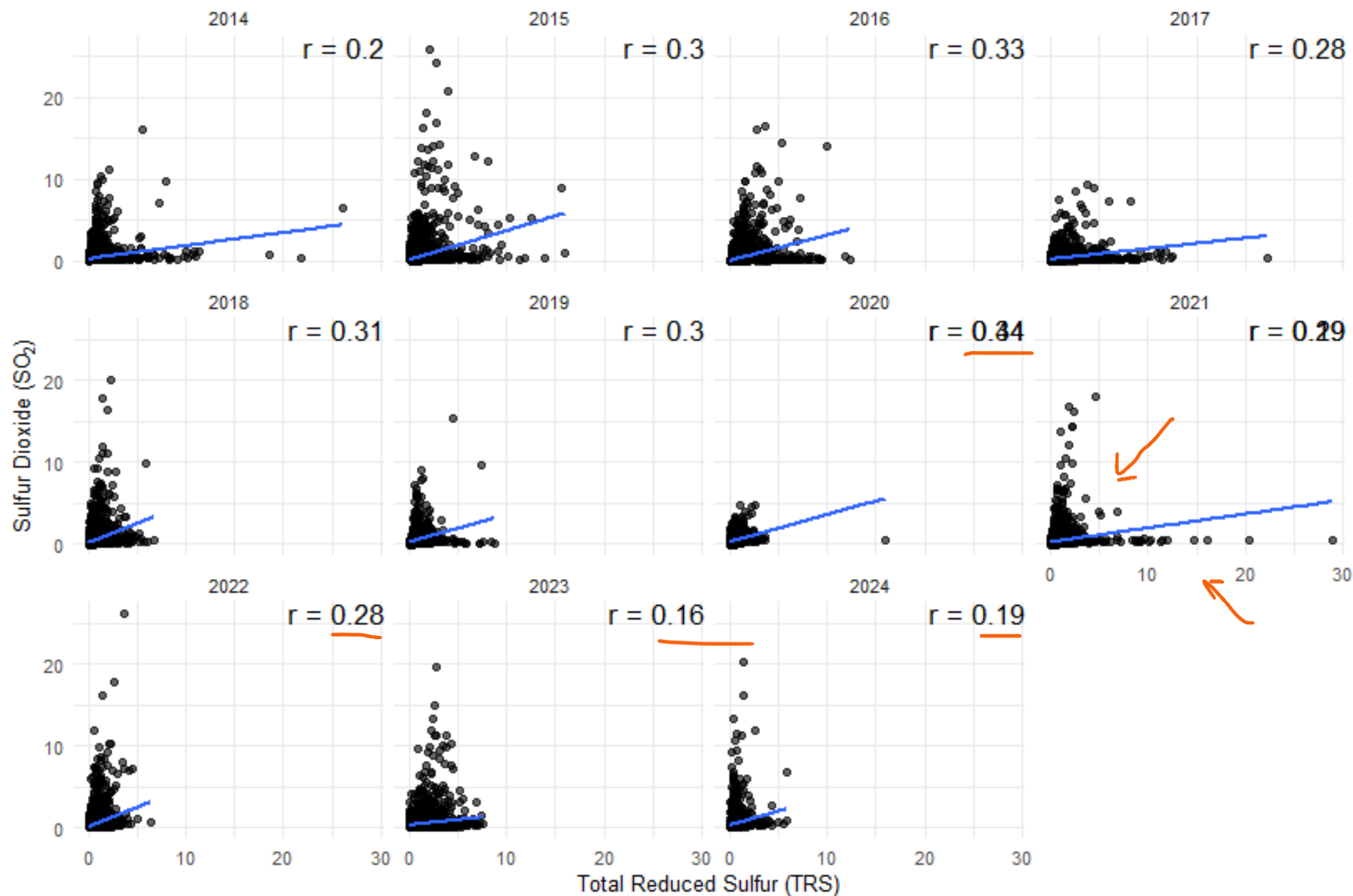
SO₂ and TRS (Excluding 2023)



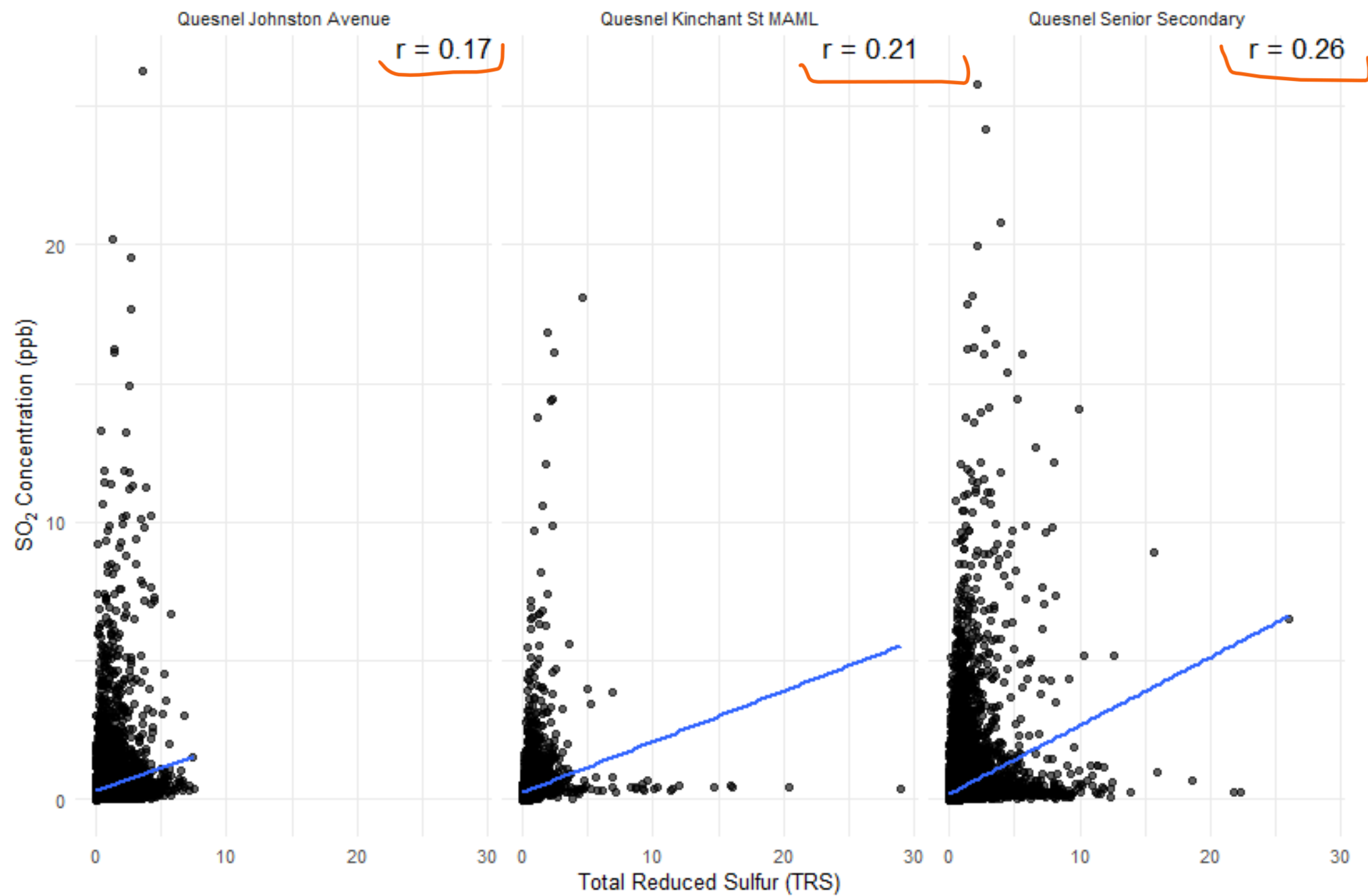
2023 SO₂ and TRS



Yearly Correlation Between TRS and SO₂



TRS vs SO₂ Relationship by Site



TRS - Key Points

- No significant trend
- Decrease in extreme events over time
- It is unclear what impact the site move has had.
- 2023 was an abnormal year followed by what seems to be a low year.
 - TRS tends to be a “disturbance”, meaning sub hourly peaks can be impactful

PM

- Key PM data concern is how to “manage” the impact of wildfires.
- Steps taken to identify days that are impacted by wildfire:
 - Reviewed Air Quality Warnings – wildfire smoke 2017- 2024
 - Smoke season May – October
 - Subset daily PM data when $PM_{2.5}$ was $>25 \mu\text{g}/\text{m}^3$ OR if $PM_{2.5}$ monitor was down when $PM_{10} >50 \mu\text{g}/\text{m}^3$
- Challenges with processing method: wildfire smoke under $25 \mu\text{g}/\text{m}^3$, abnormal conditions during the season, or fires out of range

Number of Wildfire Days by Year (Grouped by Month)

Number of Wildfire Days

30
25
20
15
10
5
0

month
May
Jun
Jul
Aug
Sep

2014

2016

2018

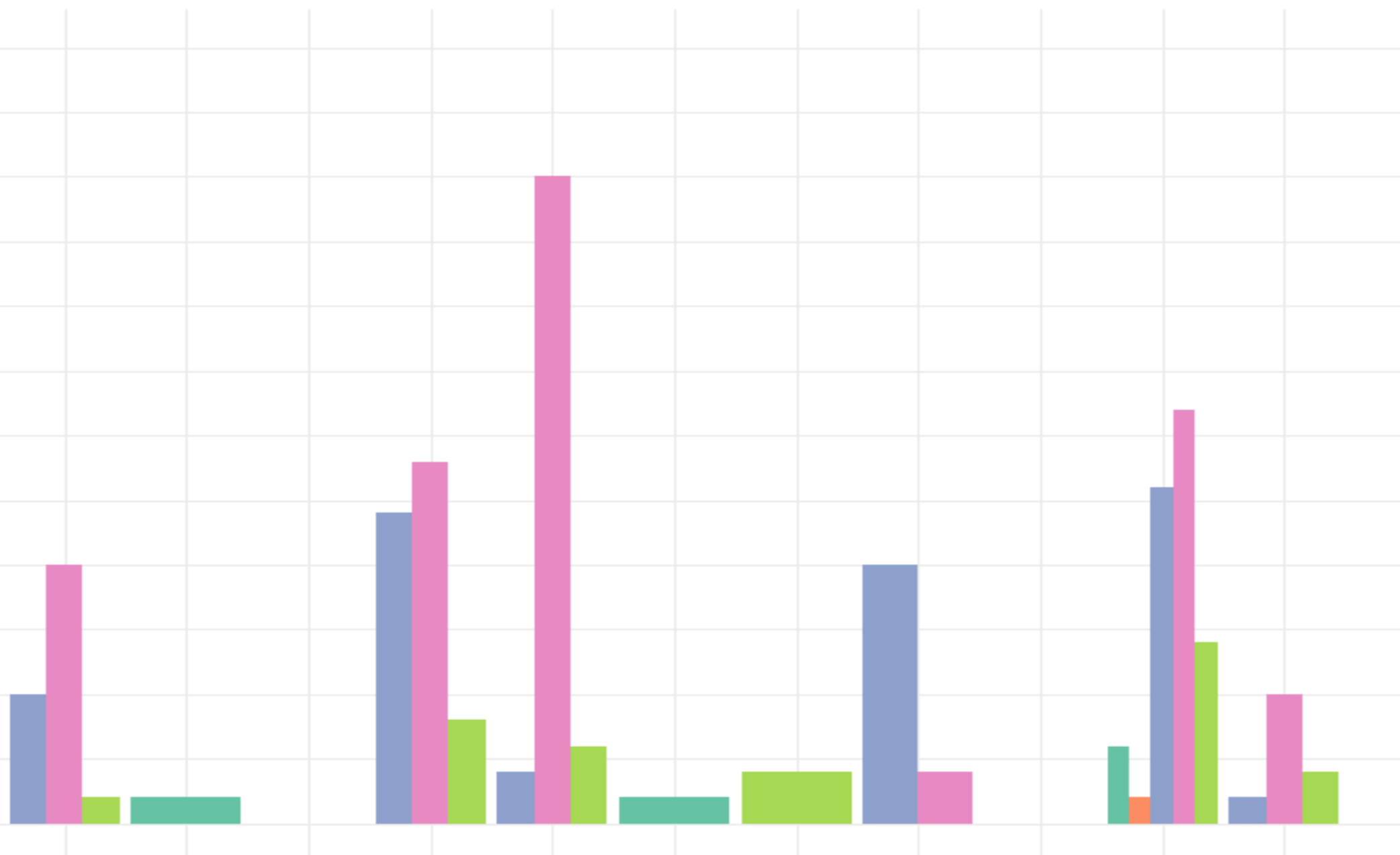
2020

2022

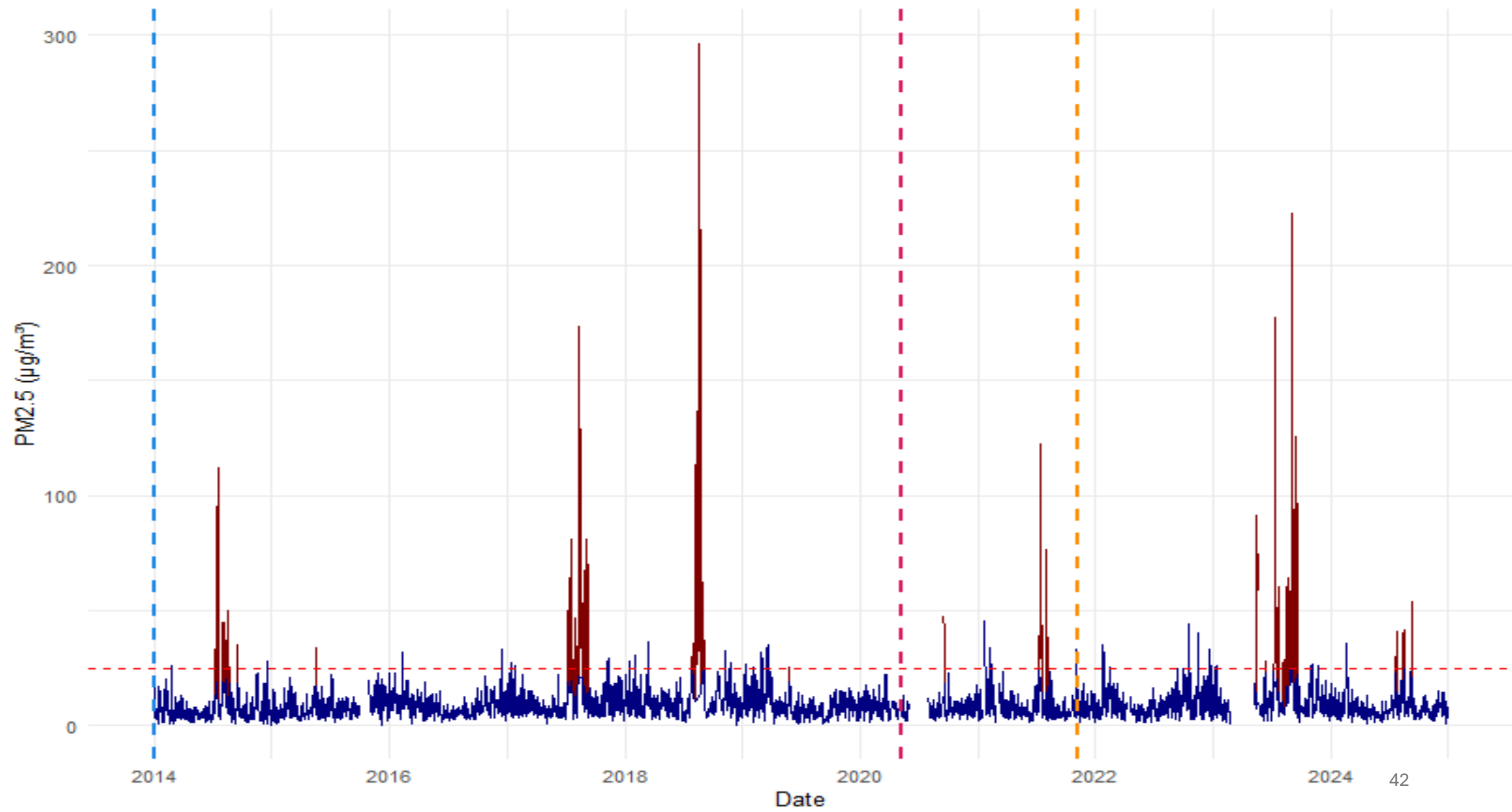
2024

Year

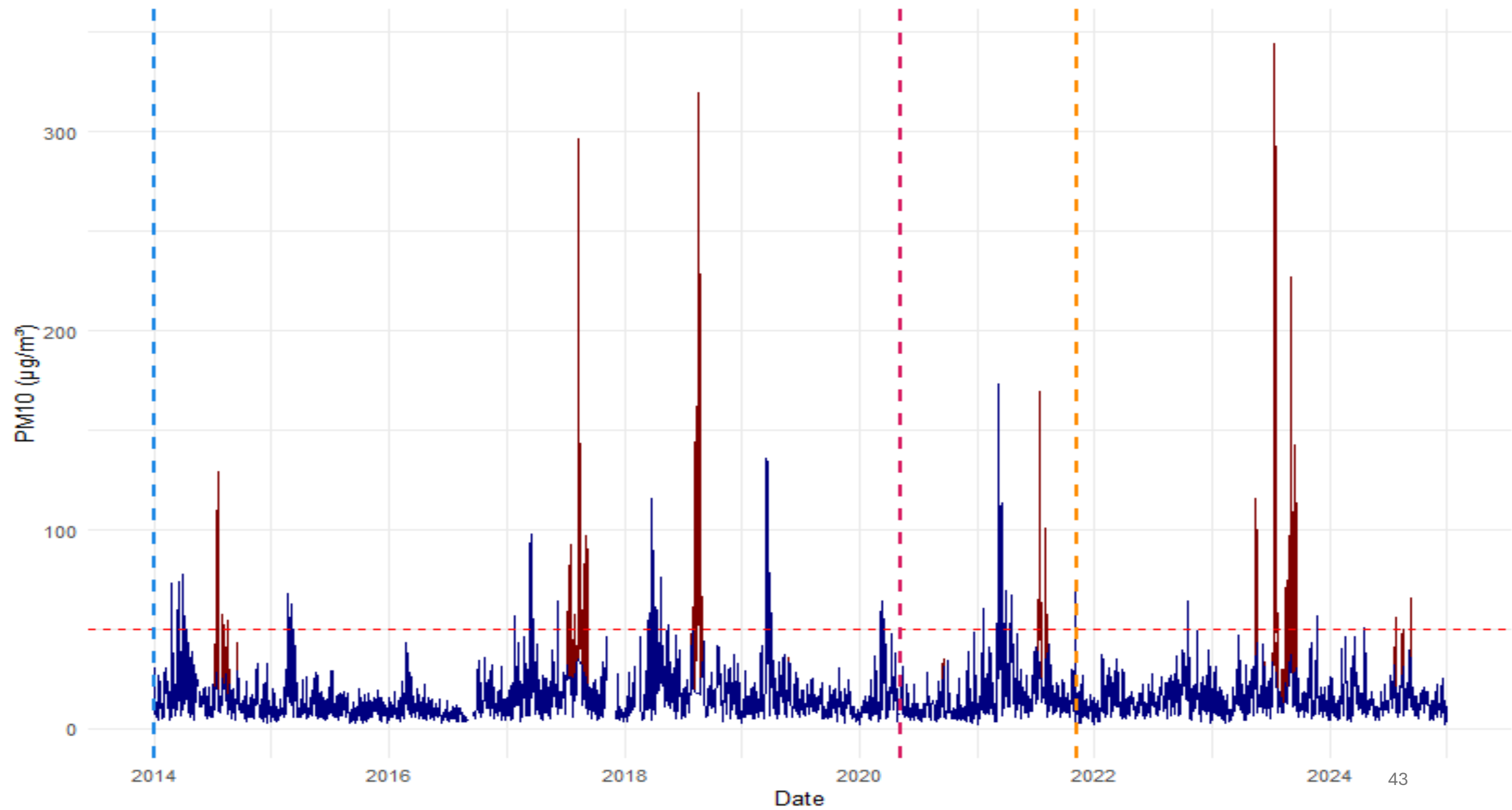
41



PM_{2.5} Concentrations with Wildfire Influence shown in Maroon

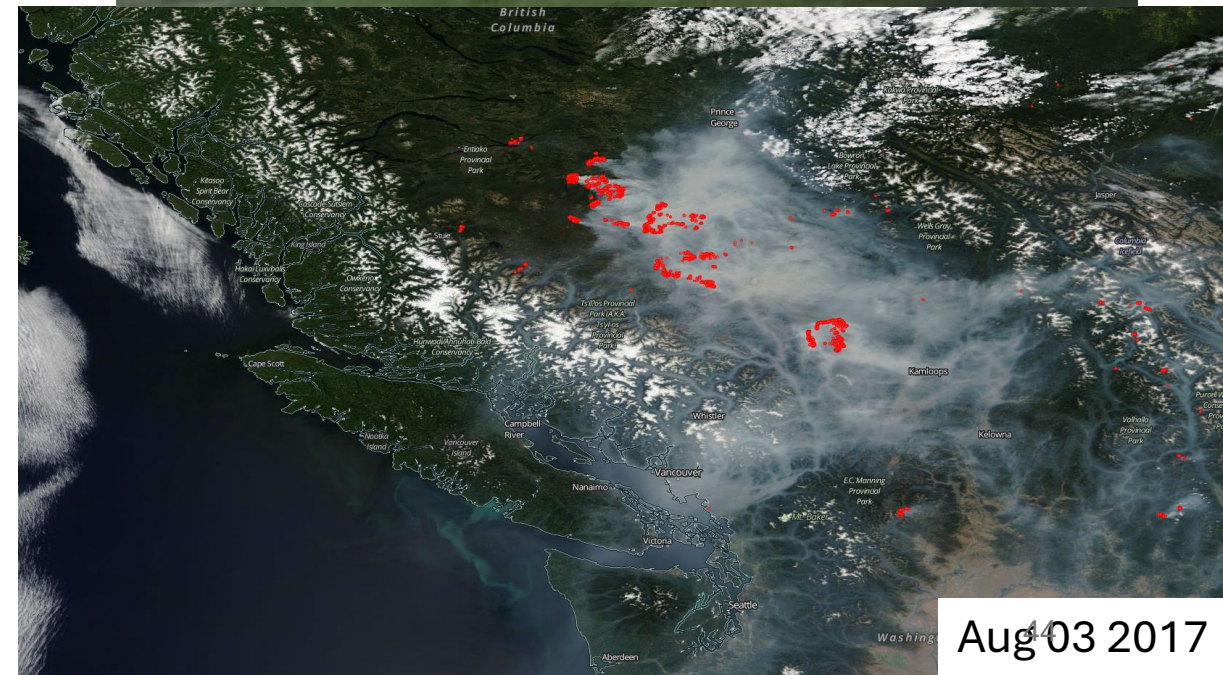


PM₁₀ Concentrations with Wildfire Influence shown in Maroon

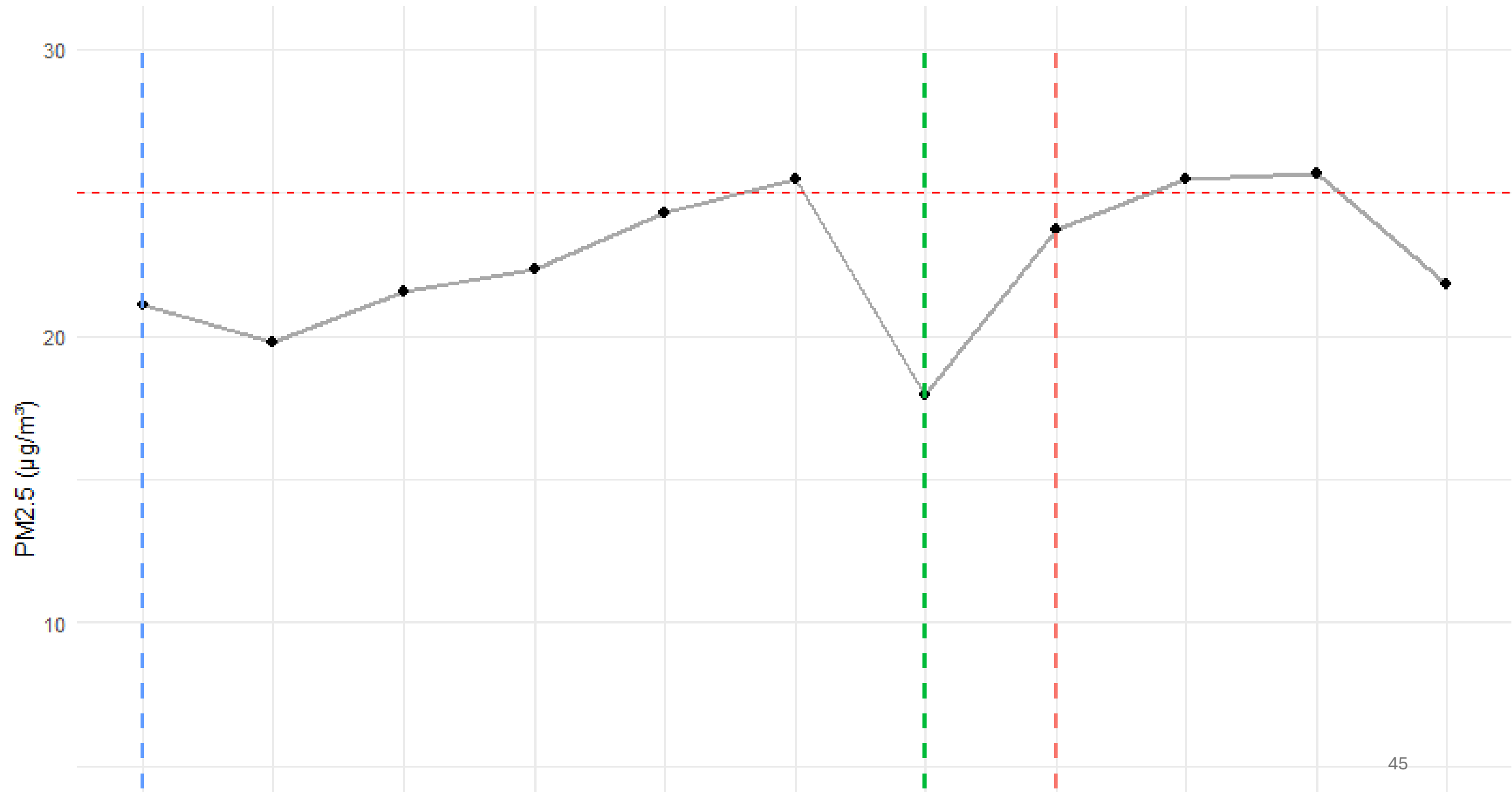


PM_{2.5}

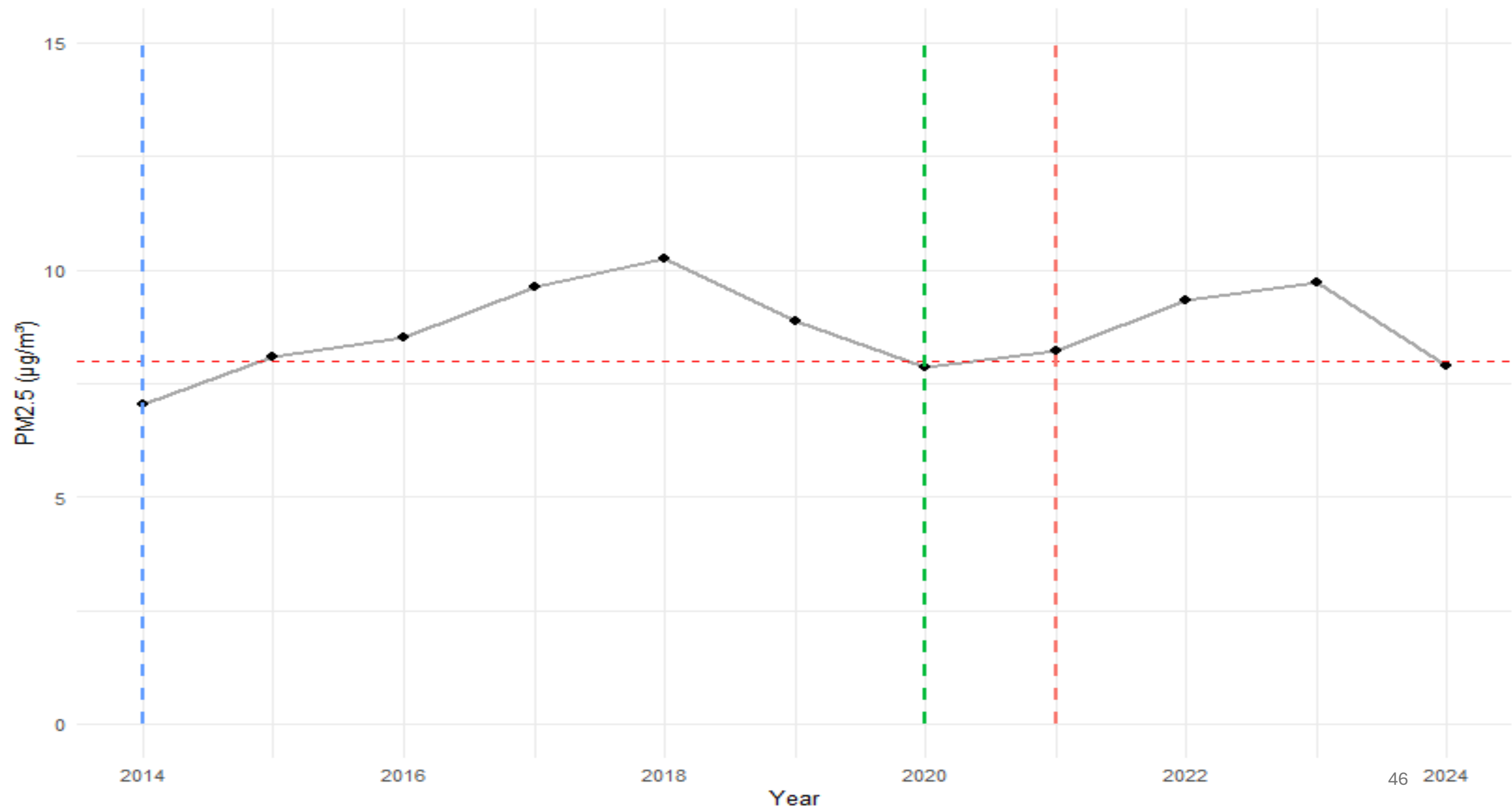
- Vehicle traffic
- Space heating
- Wildfires



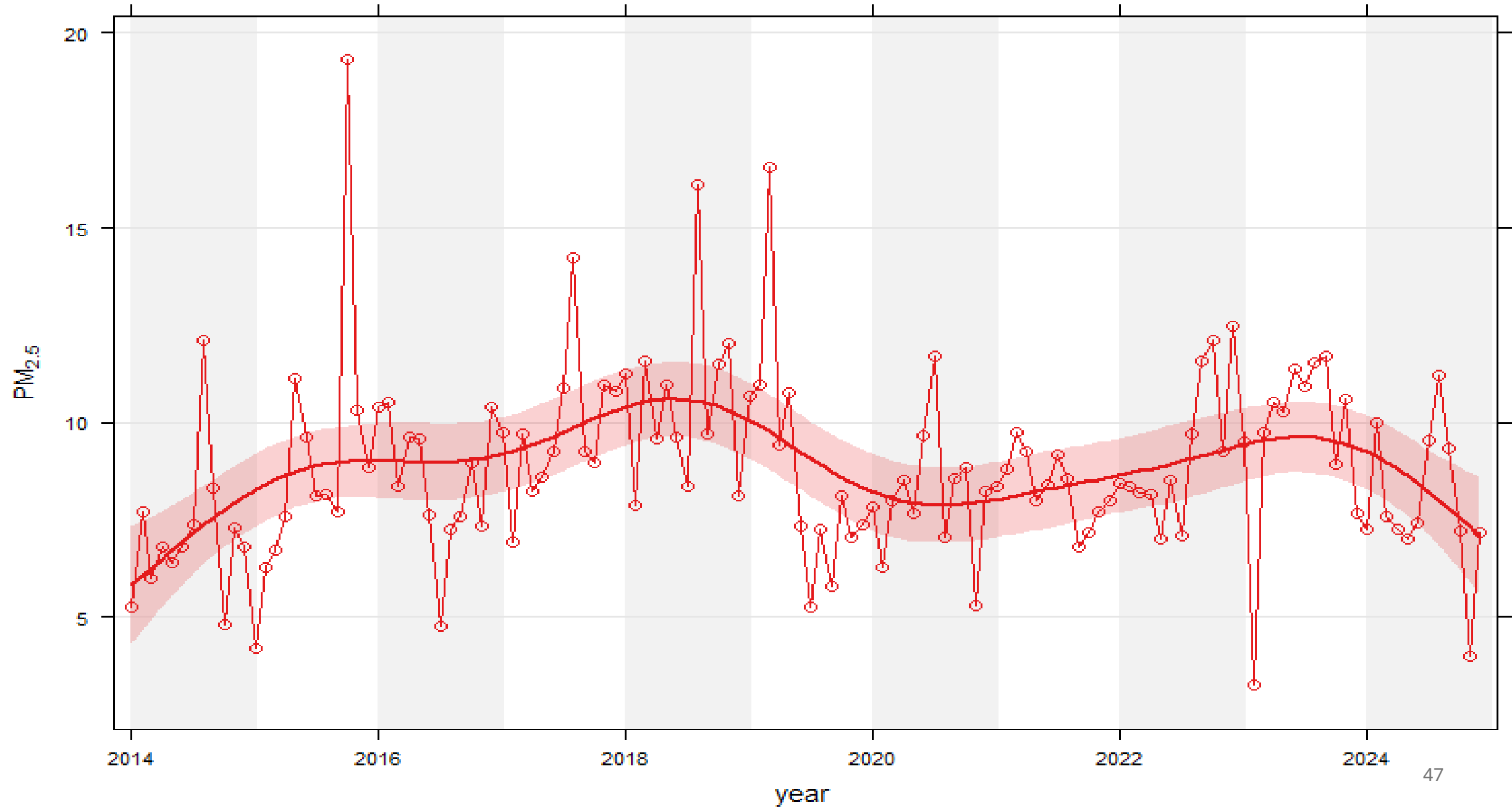
Annual 98th Percentile of PM_{2.5}



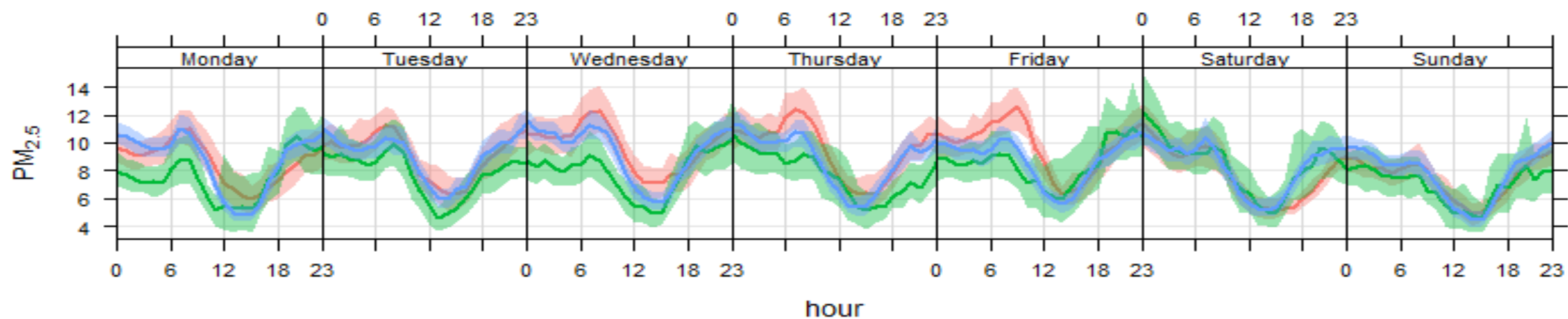
Annual Average of PM_{2.5}



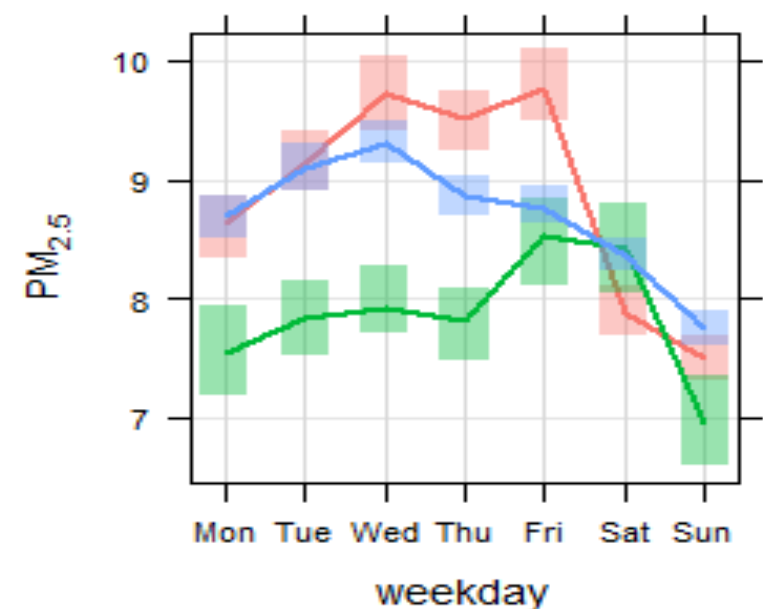
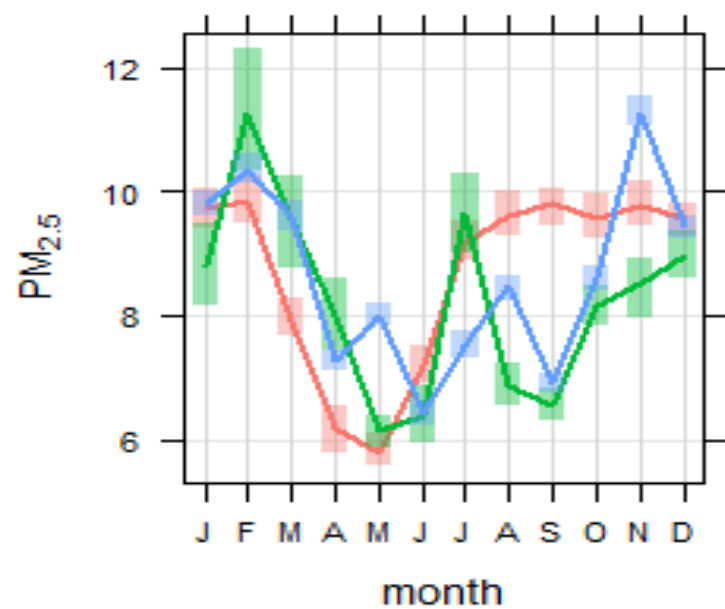
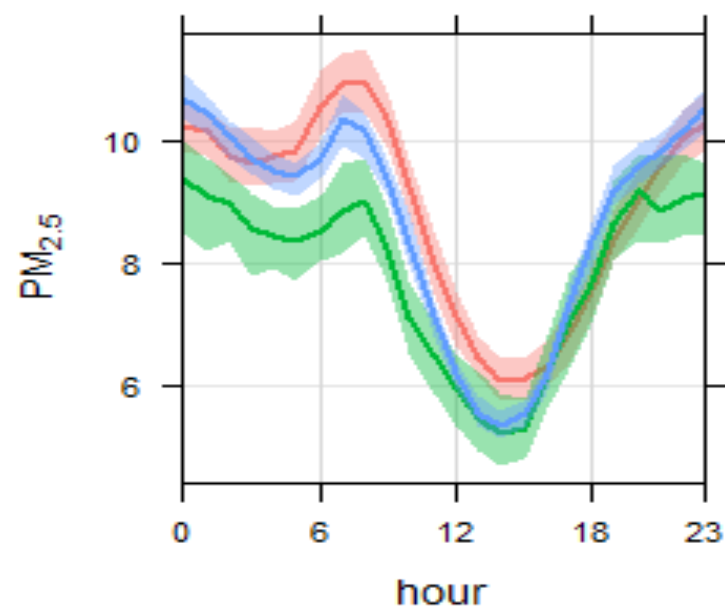
PM_{2.5} deseasoned hourly data



PM_{2.5} Variation by Site

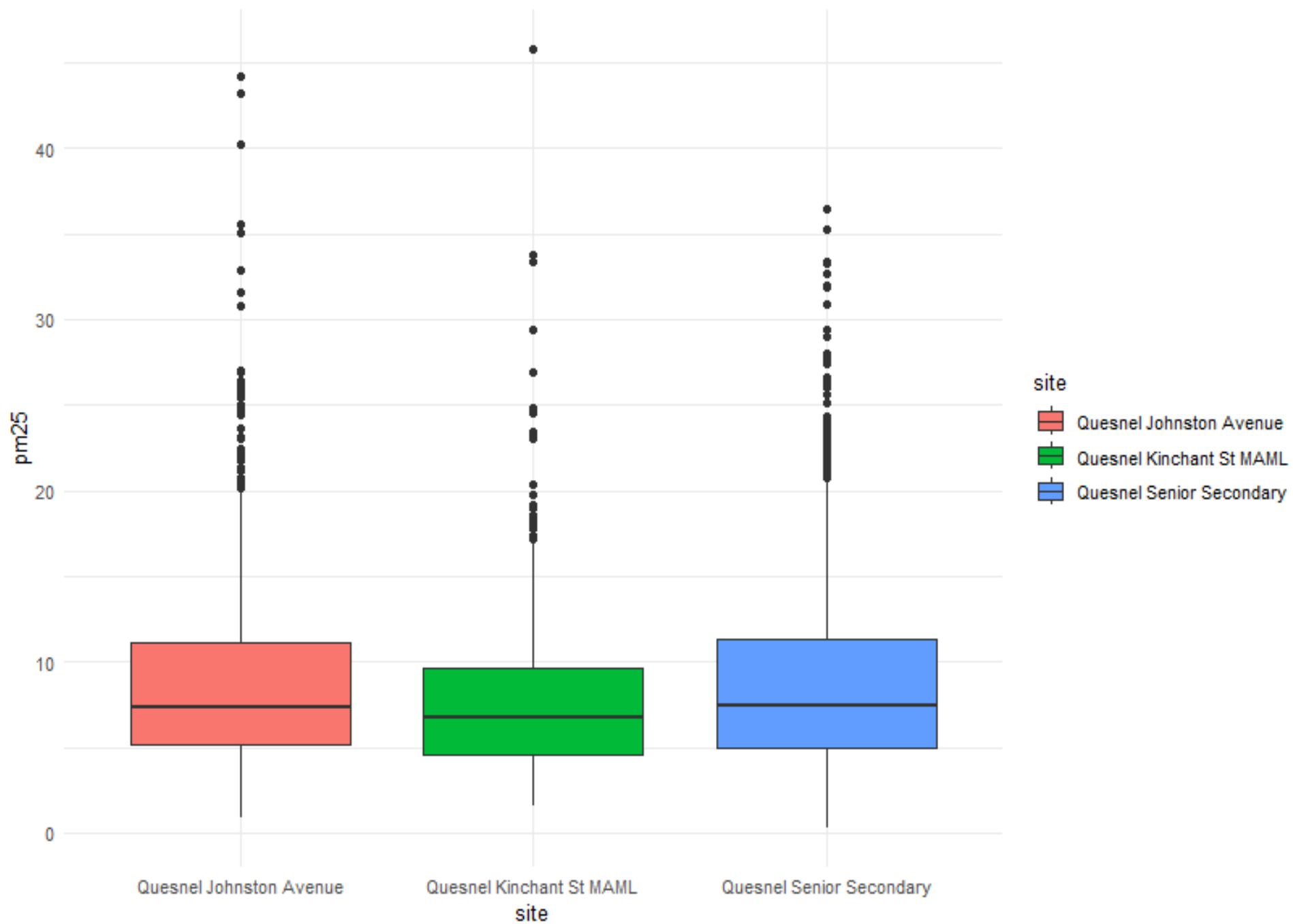


Quesnel Johnston Avenue Quesnel Kinchant St MAML Quesnel Senior Secondary



mean and 95% confidence interval in mean

PM_{2.5} Concentrations Across Sites



PM_{2.5} – Key points

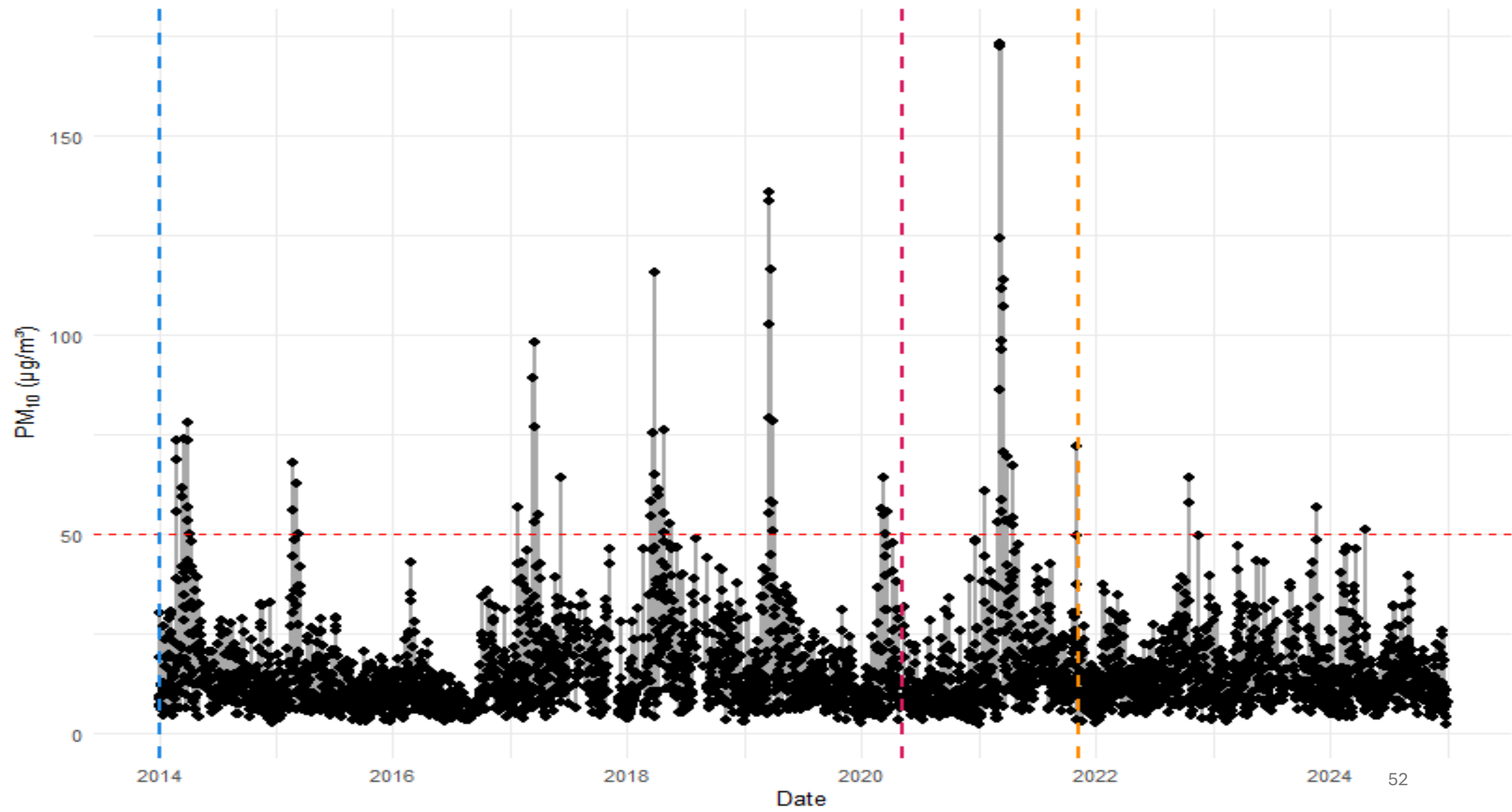
- Generally above objective
- There is a lot of context around this given the impact of wildfire smoke
- This is the most significant air quality concern in the community

PM₁₀

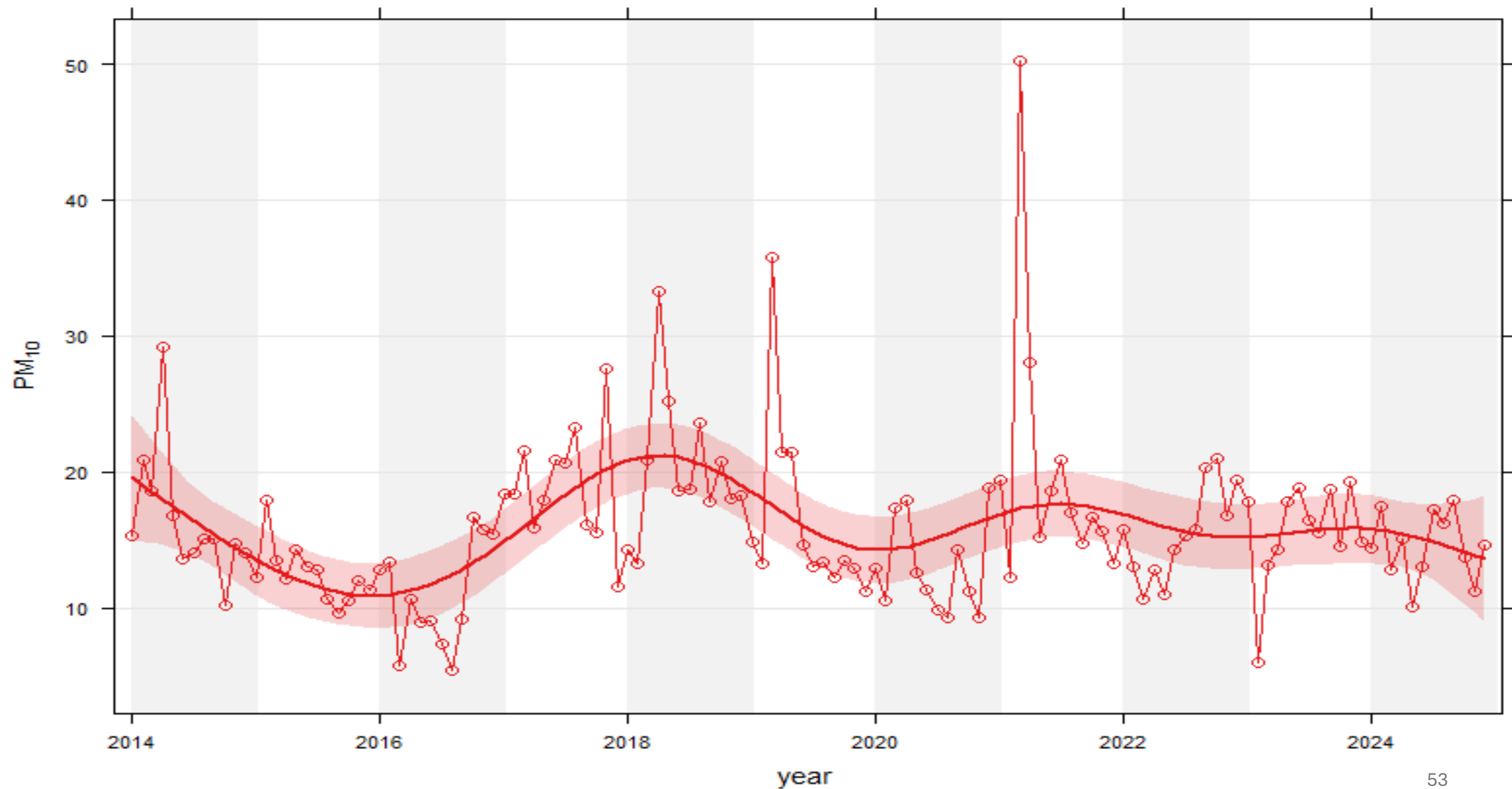
- Vehicle traffic
- Windblown material
- Wildfires



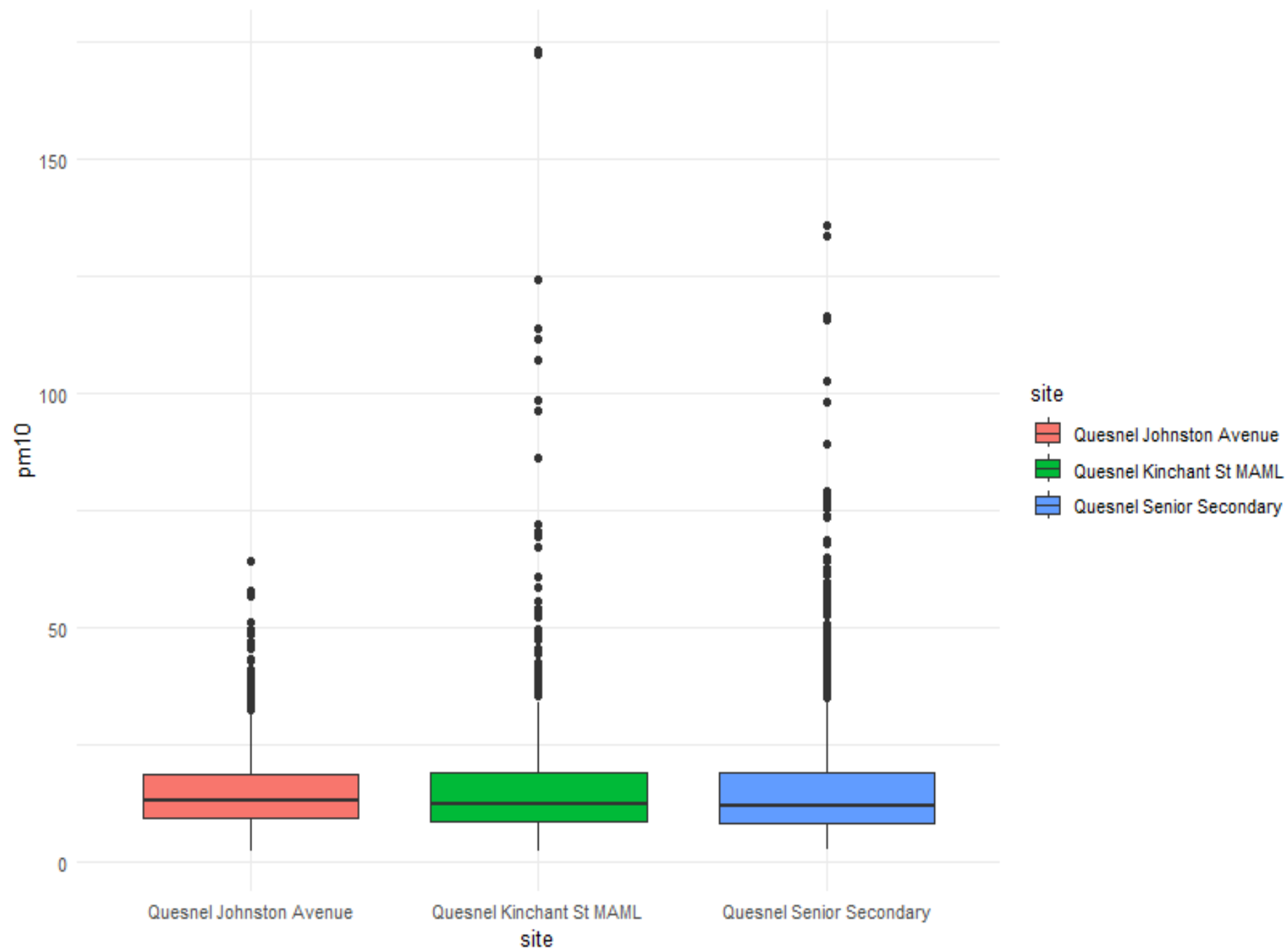
Daily PM₁₀ Levels Across Sites



PM₁₀ deseasoned hourly data



PM₁₀ Levels Across Sites



PM₁₀ – Key Points

- PM₁₀ is also heavily wildfire impacted
- The context around Warnings is confusing given the sudden change in frequency of Warnings
- Further work is being undertaken to better understand this issue

Summary

- O_3 , SO_2 and NO_2 are below objectives and not currently a concern
 - O_3 is a regional contaminant, but it's interesting to see the impact of local conditions
- TRS does not have objectives but is still an annoyance for the community and seems to maintaining a consistent level
 - 2023 stands out as an oddity and further investigation could provide some clarity
 - Generally, less extreme concentrations over time

Summary

- Particulate matter continues to be the major concern
- PM₁₀ has remained very consistent over time however we have had less Warning level conditions after the site move.
 - We are currently conducting a study to better understand this
- PM_{2.5} remains a concern, and we should consider the wider range of sources

Recommendations

- Focus on PM, but remember that air quality is synergistic, and the air quality health burden is made up from all exposures.
- Conduct PM₁₀ study to better understand the variation in data between sites (ongoing)
- Further work can be done to better understand PM_{2.5} (e.g. refine temporal emissions)
- Regardless of the source Quesnel has a PM_{2.5} problem
 - Managing public exposure to wildfire smoke
 - Winter emissions
 - Burn management

Questions and Discussion

