The impact of hourly and / or averaged traffic emissions on modelled concentrations

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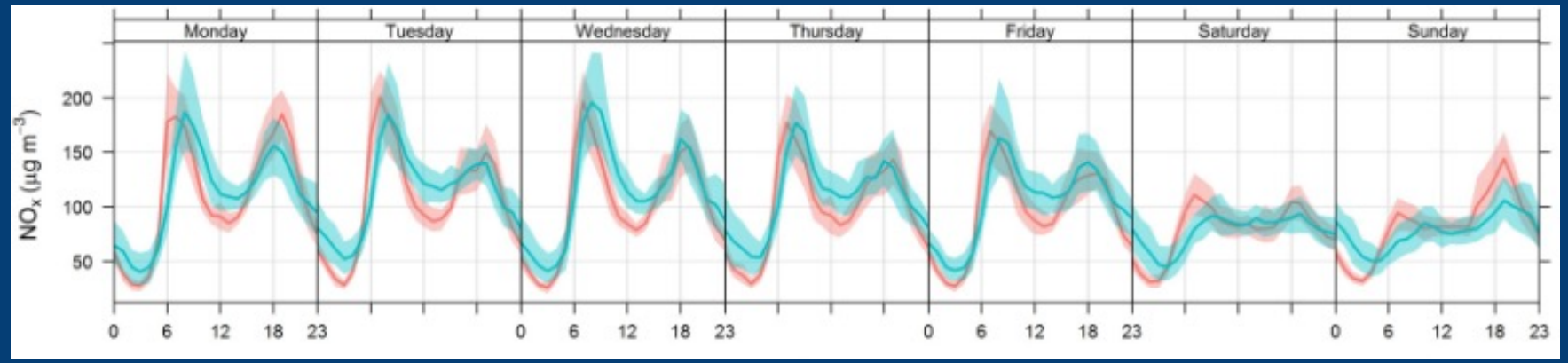


FAIRMODE

8th October 2021

Online

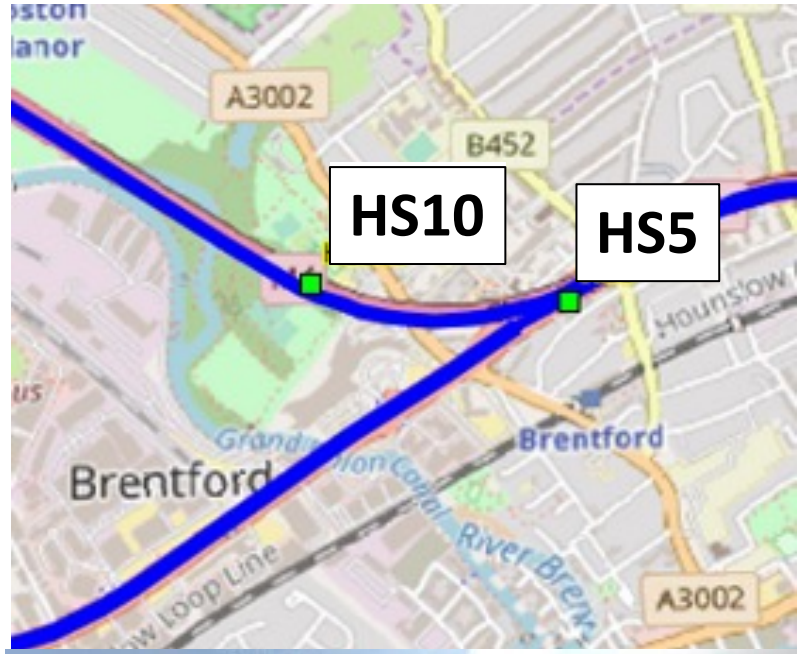
Motivation and study setup – Brentford, London, UK

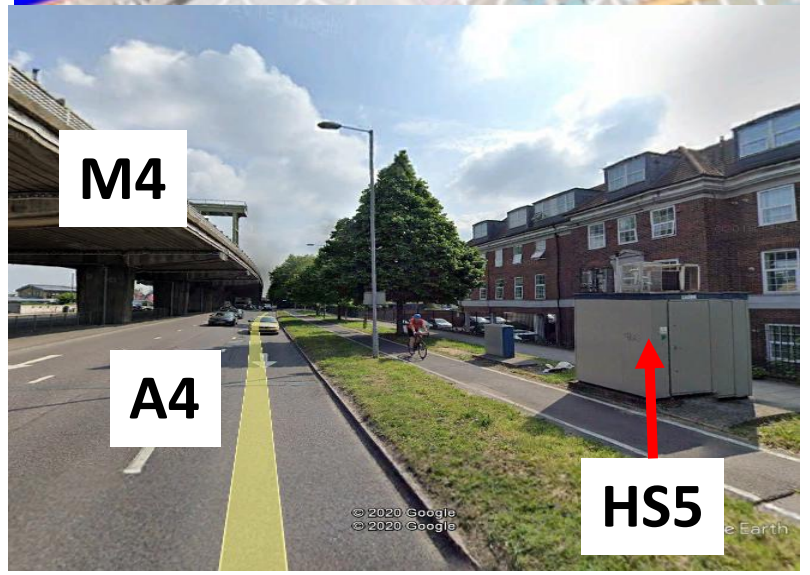
Motivation

- Highways England project to model elevated roads
- Project involved evaluation of new module in ADMS-Roads / Urban
- Model performance very good for one study where hourly traffic flows and speeds were available as input to emissions calculations
- We usually use average diurnal variations of emissions for traffic, so its interesting to understand how sensitive model performance is

Model set up

- Elevated road ‘M4’, above ground level road ‘A4’
- Monitor HS010 at ground level below M4, HS5 beside the A4
- Full year of hourly average flow and speed data available on the M4 for 4 vehicle length types
- 12 hour weekday count for one day on the A4
- Generic 3-day (weekday/Saturday/Sunday) London profile used in conjunction with 12-hour count for A4
- ‘Other’ emissions modelled as volume sources in the region with the same profile as the A4





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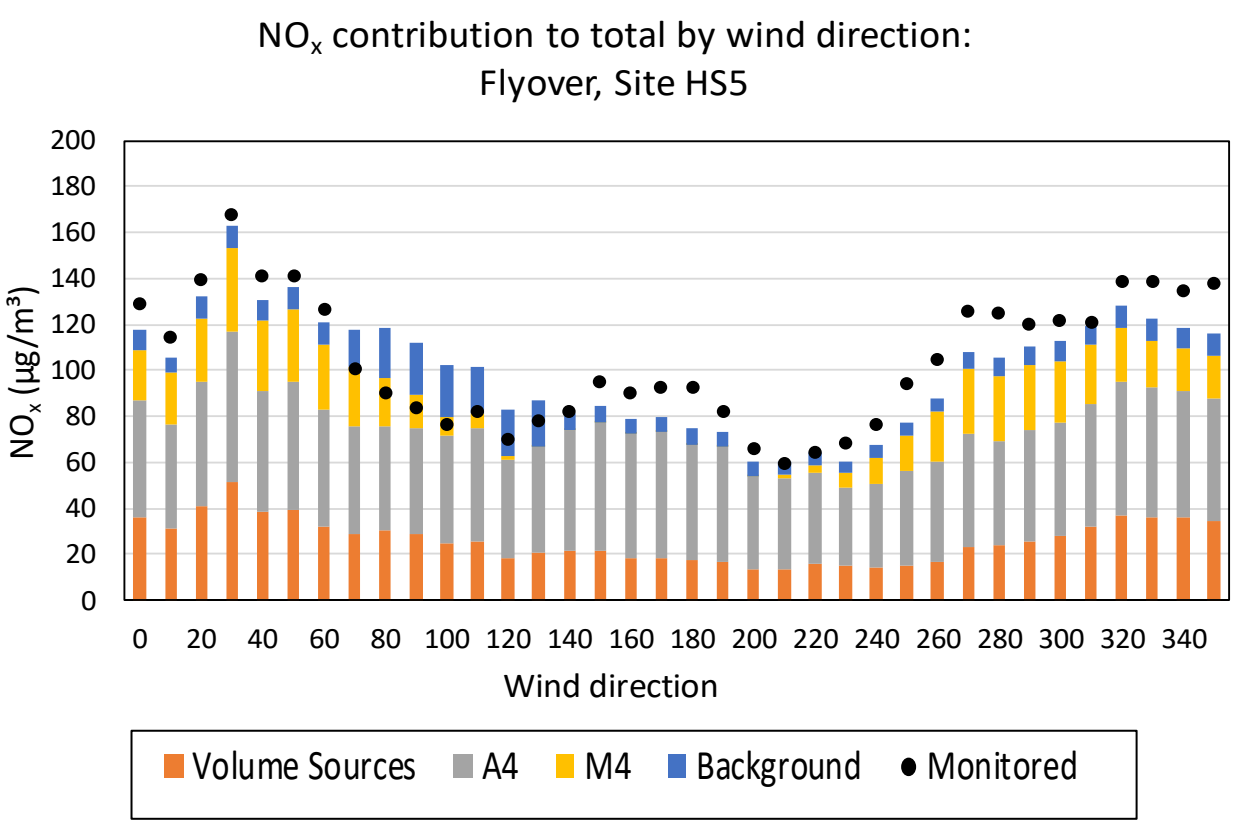
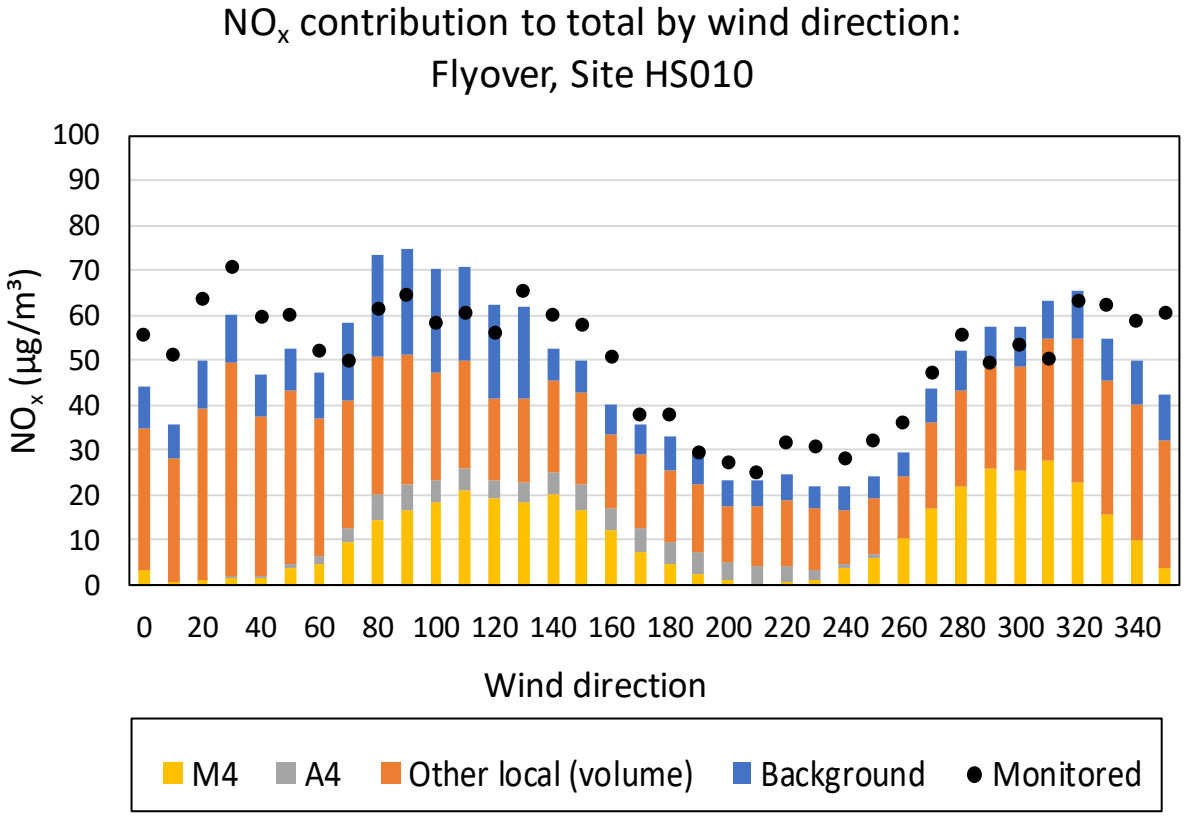
Original results – source apportionment by wind direction



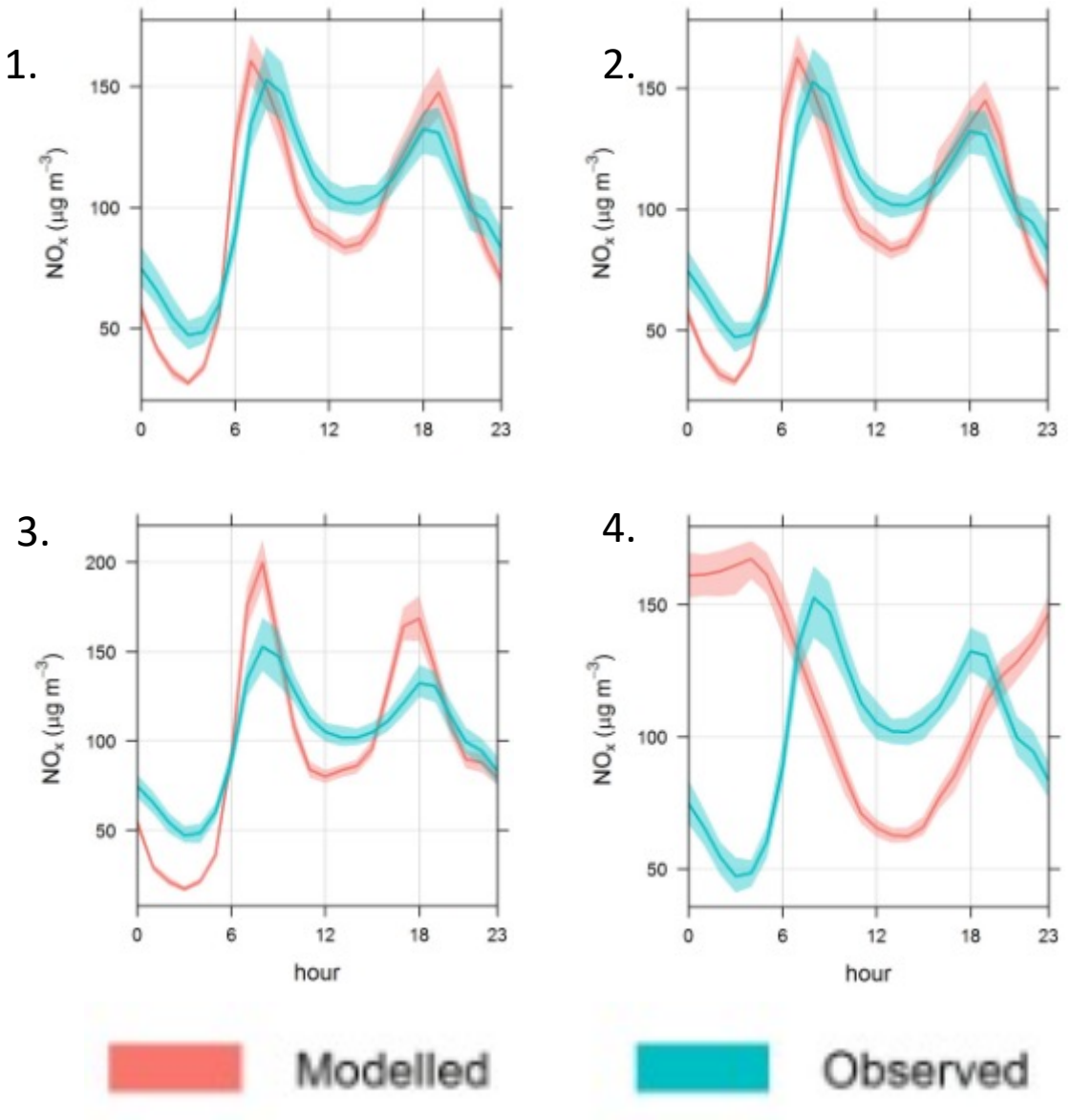


Notes

- Both monitors at ground level
- HS5 scale of concentrations double that of HS010
- HS5 should show a larger impact to profile changes
- Good model performance

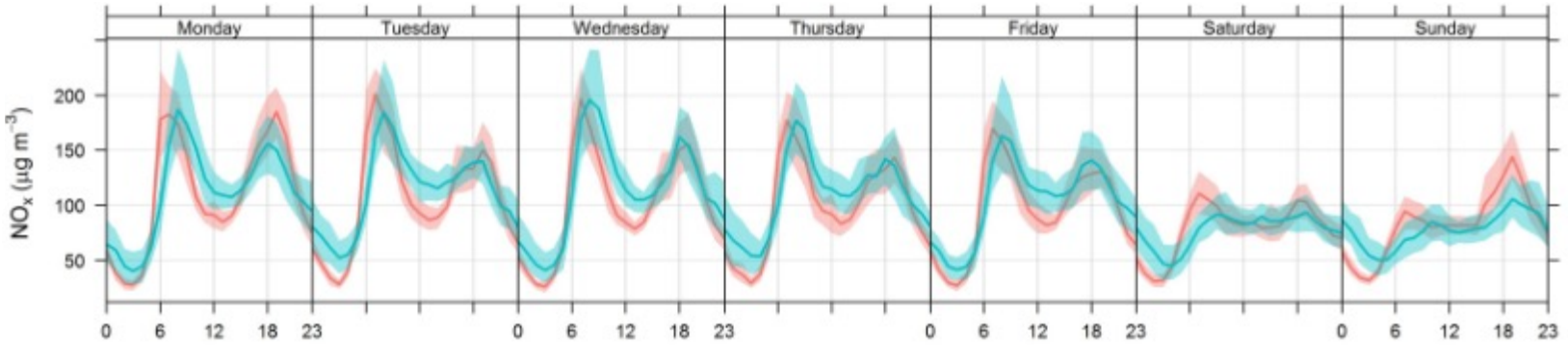
Simplifications and average diurnal profiles at HS5

1. Use all available time variation data.
2. Use a 3-day profile throughout – **not much impact, HS5 is influenced mainly by the A4 which used a 3-day profile initially.**
3. Use the generic TNO factors to create a 7 day profile and monthly factors
   https://atmosphere.copernicus.eu/sites/default/files/2019-07/MACC_TNO_del_1_3_v2.pdf
   Daily variation accuracy reduced.
4. Use average emissions for all hours (no variation)
   High emissions during stable night-time periods gives large over-estimates. Diurnal pattern incorrect.

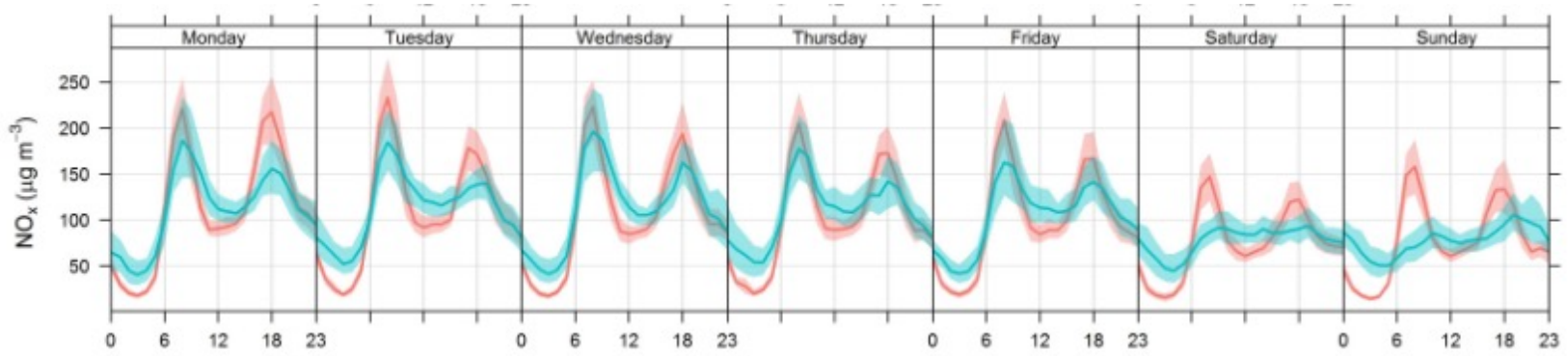


Diurnal profiles by weekday

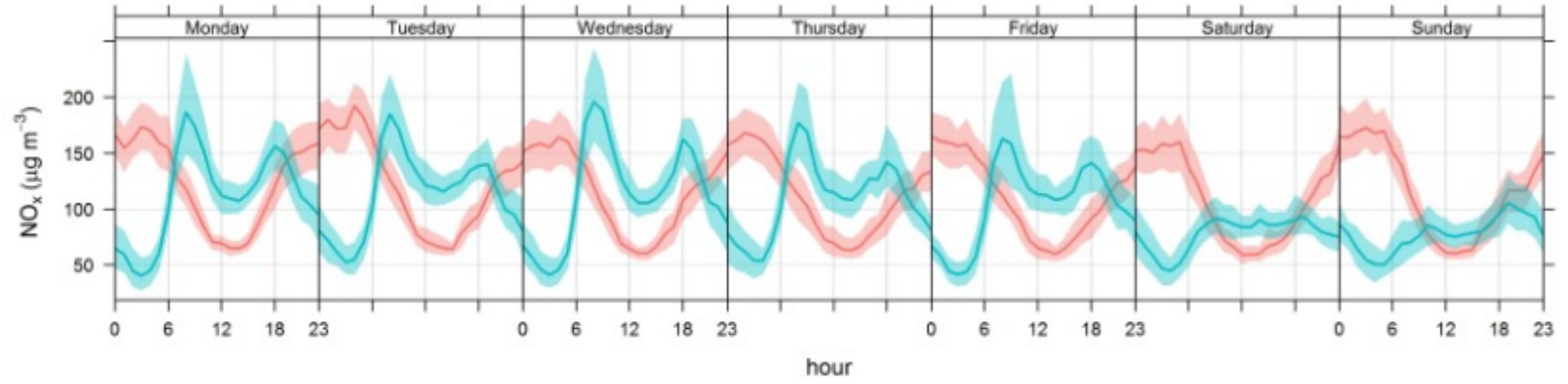
1. / 2. Both scenarios give the same image



3. TNO factors

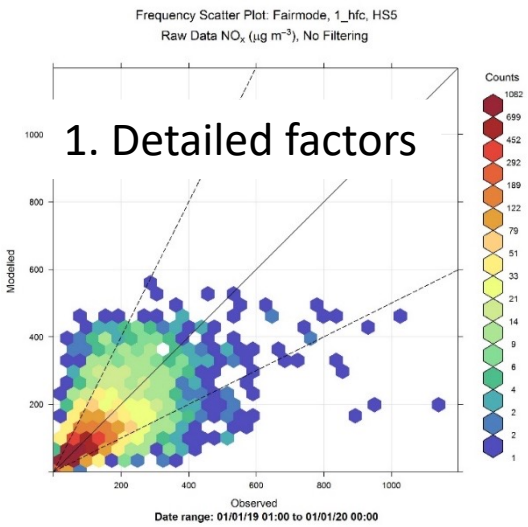


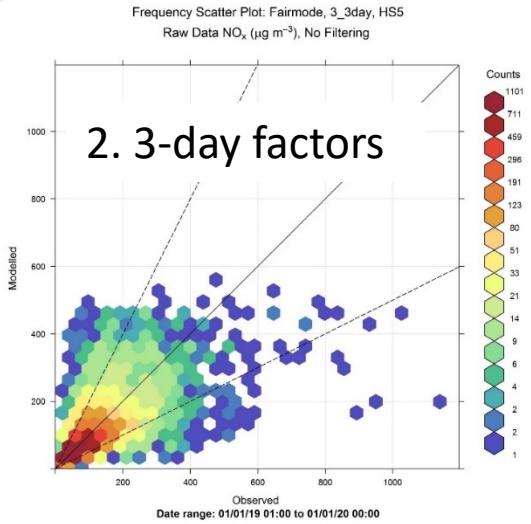
4. No factors

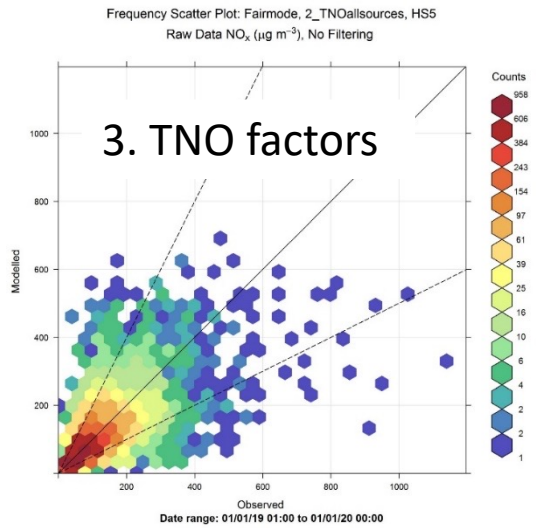


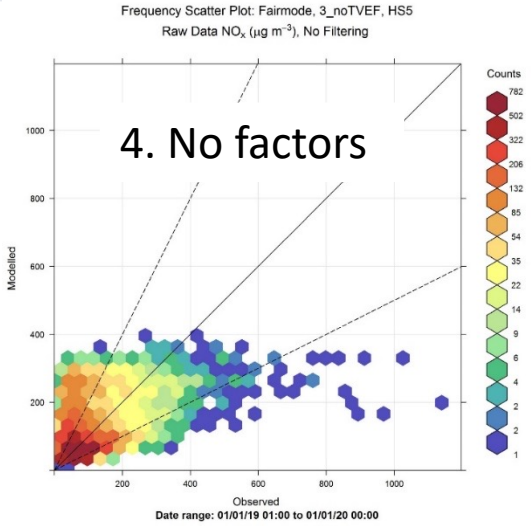
Summary statistics

HS5 NOx	Average Observed (µg/m³)	Average Modelled (µg/m³)	Correlation	Fractional bias
1. All	101	95	0.69	-0.06
2. 3-day profile	101	96	0.68	-0.05
3. TNO profile	101	95	0.69	-0.06
4. No profile	101	116	0.38	0.15









Conclude:

- For this study, the hourly and 3-day profile perform similarly. But note that the elevated section for which we have hourly emissions make a relatively small contribution to total concentrations
- TNO average profile demonstrates good performance on average, but misses peaks / troughs and 7-day detail
- Poor performance when no profile is used

Thank you for listening

Any Questions?