

Possible Effects on Air Quality of Future Emission Interventions

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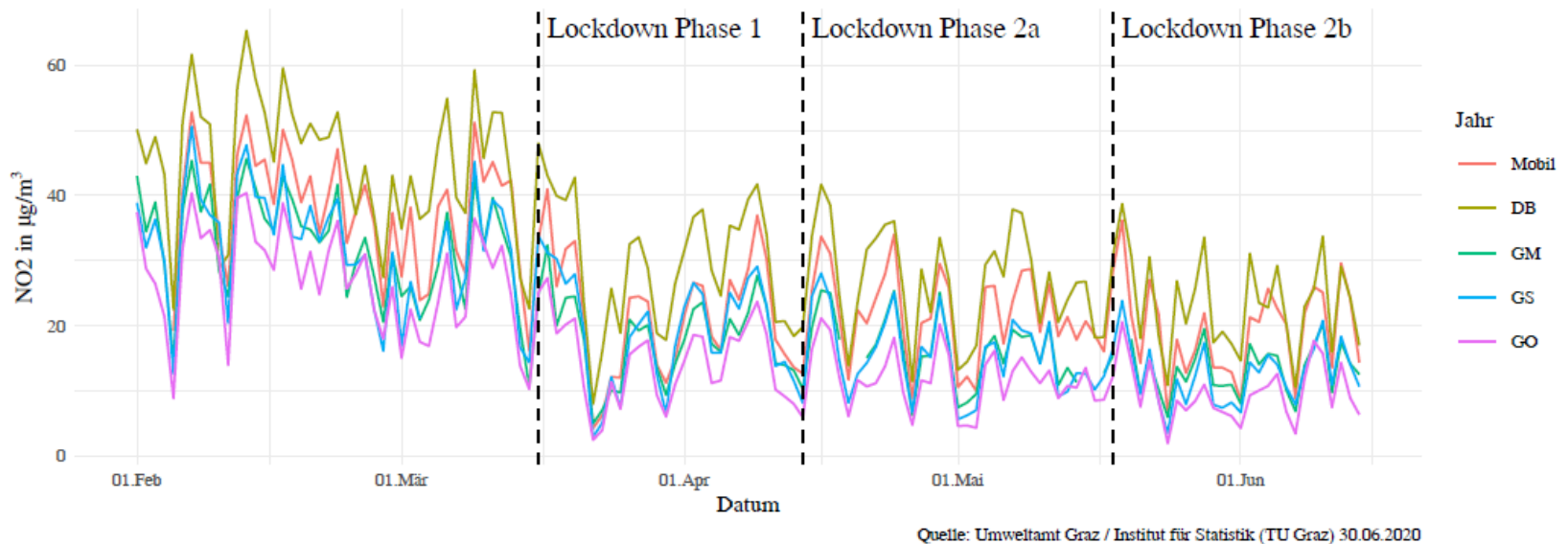
Background

- The Covid-19 lockdown demonstrated the effects of strongly reduced anthropogenic activity on air quality
- This concerned mainly emissions from traffic as well as from industrial activities (reductions)
- Emissions from the “domestic/household” sector remained stable or even increased
- Air quality trends during this period were strongly biased by meteorological conditions, i.e. in Austria change from late winter into almost early summer time (very dry conditions with remarkably high temperatures)

Air Quality during lock-down Graz

- The analysis is focused on three dedicated periods, which relate to different stages of the lock-down
 - ❖ Period 1: March 16th to April 13th
(full lockdown)
 - ❖ Period 2a: April 13th to May 17th
(partly opening of shops and restaurants)
 - ❖ Period 2b: May 18th to June 16th
(school opening – lifting of lock-down)
- Focus on NO₂ and PM₁₀

NO2 concentrations Graz

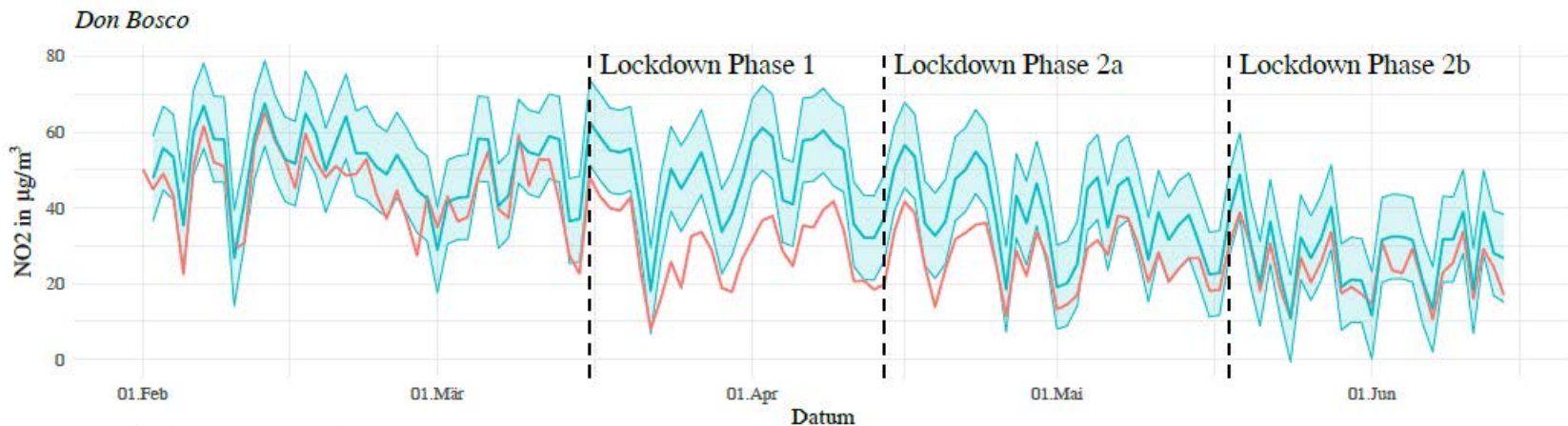


Daily mean values at 5 different (traffic influenced) locations

Source: Umweltamt Graz

NO2 concentrations Graz

- Application of a statistical model including meteorology and emission characteristics for working days, Saturdays, Sundays/bank holidays
- Monitoring station strongly influenced by road traffic



NO2 daily mean value

-- prediction (incl 95% percentile)

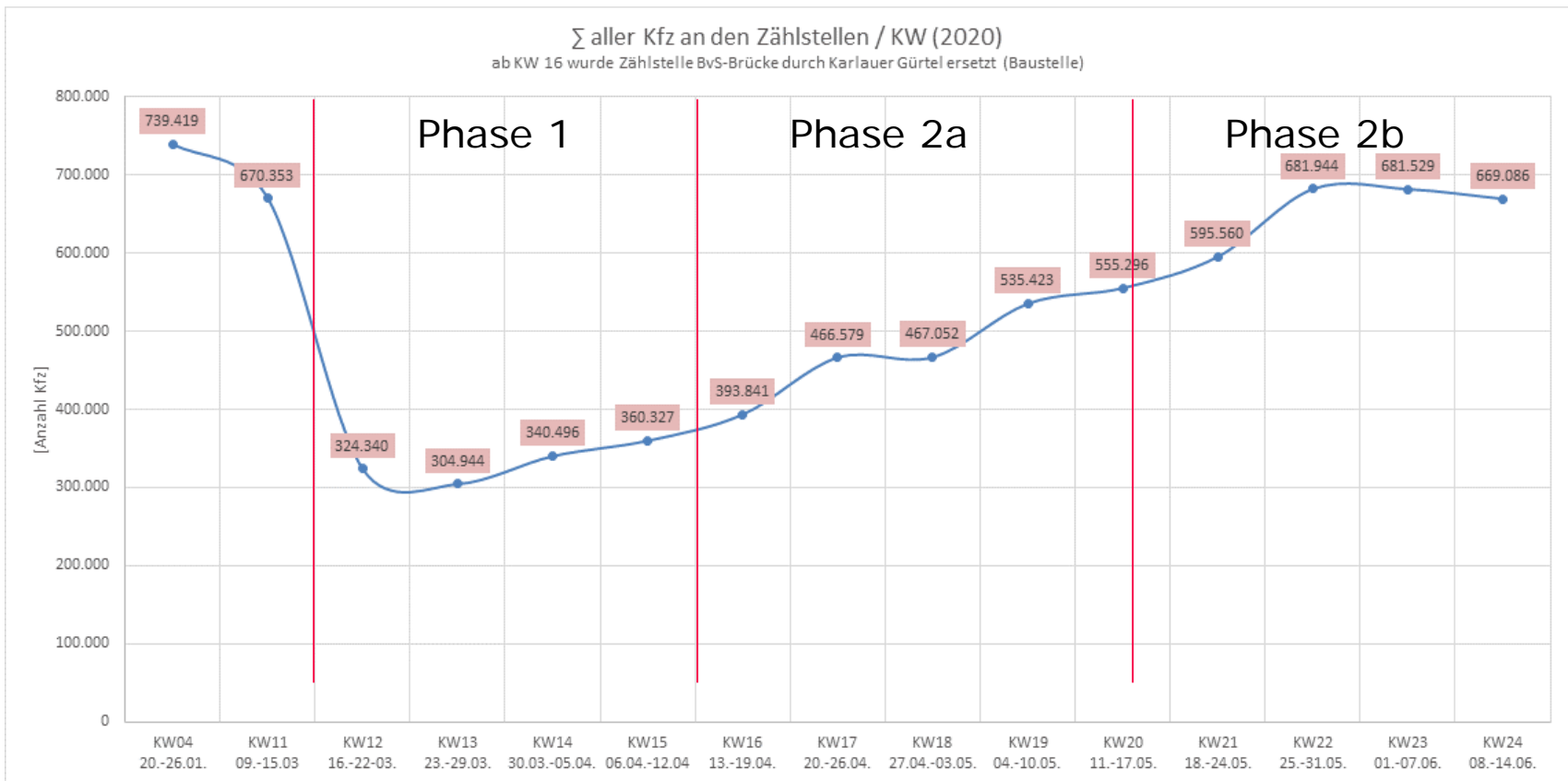
-- observation

Remarkable influence in phase 1
predicted

Source: Umweltamt Graz

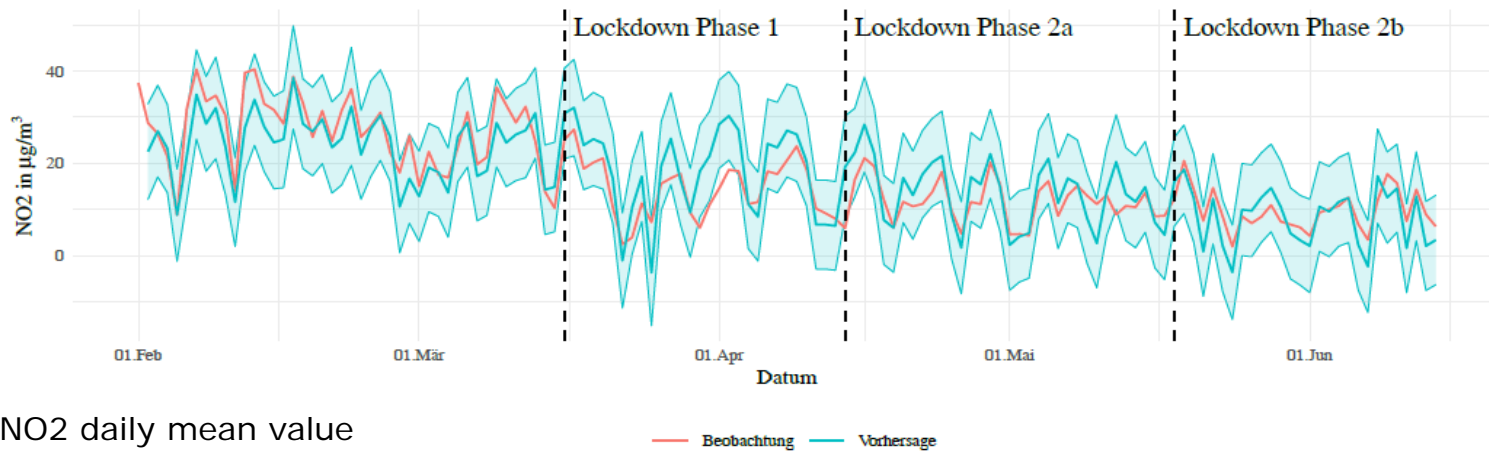
Traffic volume during lock-down

- Traffic volume at 6 counting stations



NO2 concentrations Graz

- Application of a statistical model including meteorology and emission characteristics for working days, Saturdays, Sundays/bank holidays
- Monitoring station in a 'typical' urban environment with commuter and 'school' traffic



Quelle: Umweltamt Graz / Institut für Statistik (TU Graz) 30.06.2020

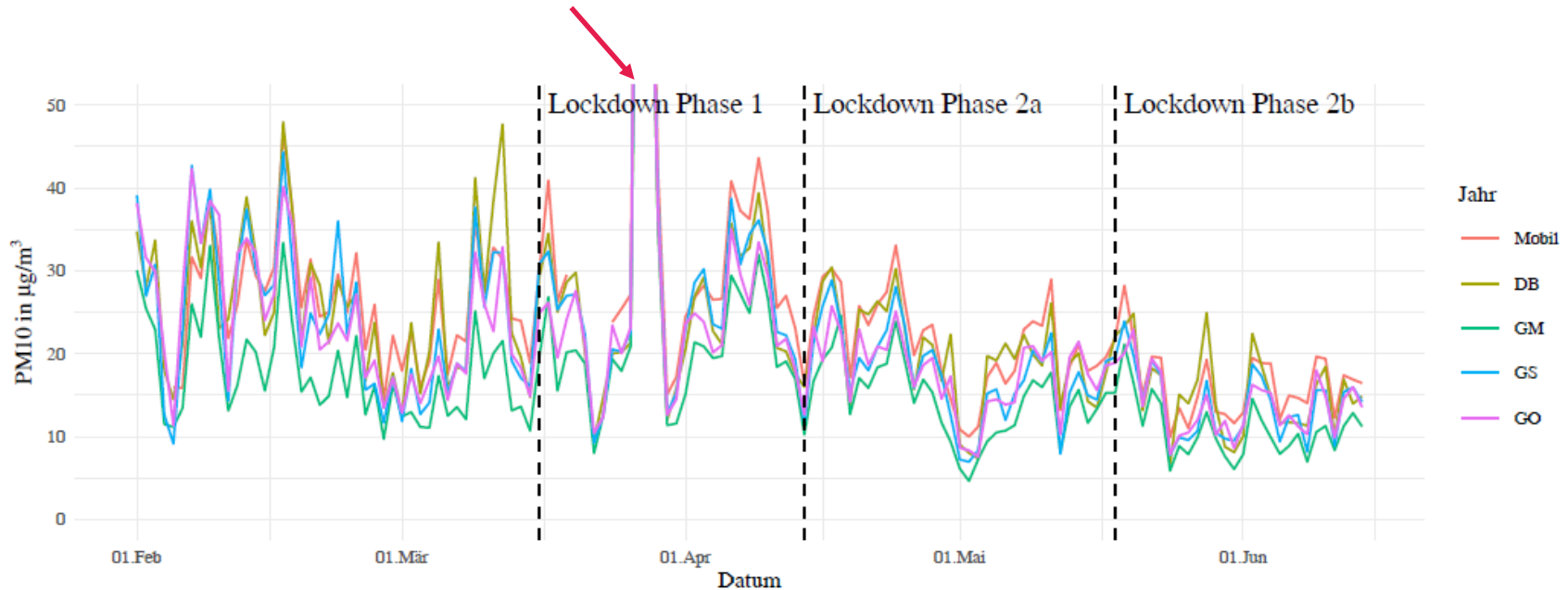
- prediction (incl 95% percentile)
- observation

Almost no influence predicted

Source: Umweltamt Graz

PM10 concentrations Graz

Sahara dust event



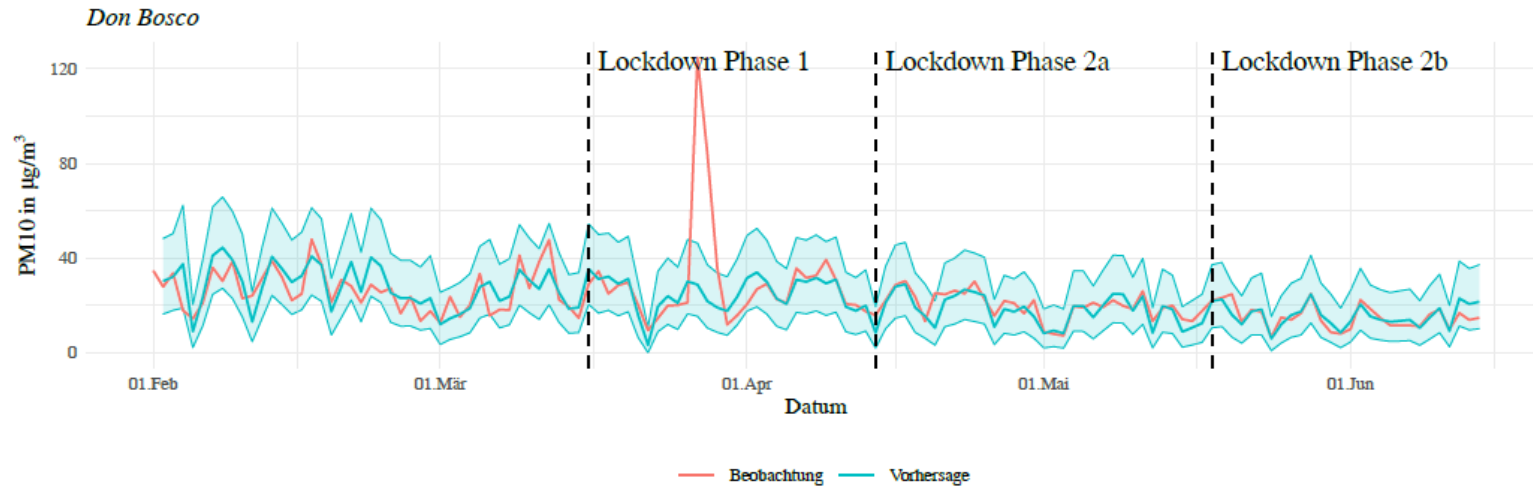
Quelle: Umweltamt Graz / Institut für Statistik (TU Graz) 30.06.2020

Daily mean values at 5 different locations

Source: Umweltamt Graz

PM10 concentrations Graz

- Application of a statistical model including meteorology and emission characteristics for working days, Saturdays, Sundays/bank holidays
- Monitoring station strongly traffic influenced



Quelle: Umweltamt Graz / Institut für Statistik (TU Graz) 30.06.2020

-- prediction (incl 95% percentile)
-- observation

no influence predicted

Source: Umweltamt Graz

Conclusion AQ analysis

- Statistical model shows strong influences of lock down for NO₂ at strongly traffic influenced monitoring locations
- Model fails to show influences on NO₂ at a monitoring station with pronounced commuter and school traffic peaks
- Model shows no effect of lock-down on PM₁₀ (was expected)
- Detailed analysis of traffic/emission related interventions only on bases of a detailed model possible (including time series of meteorology and traffic data)

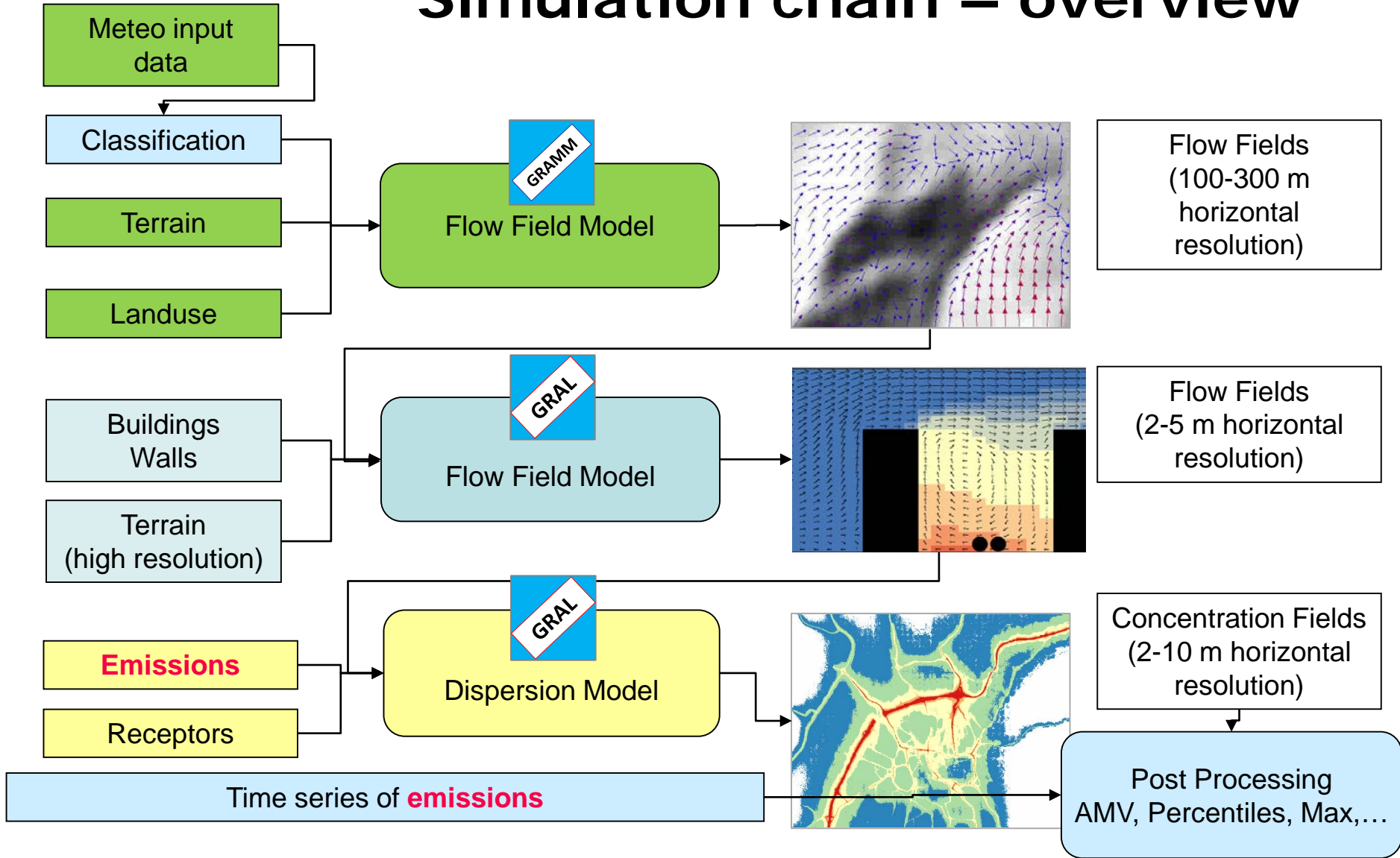
Effects of future emission interventions

- This is a question for a

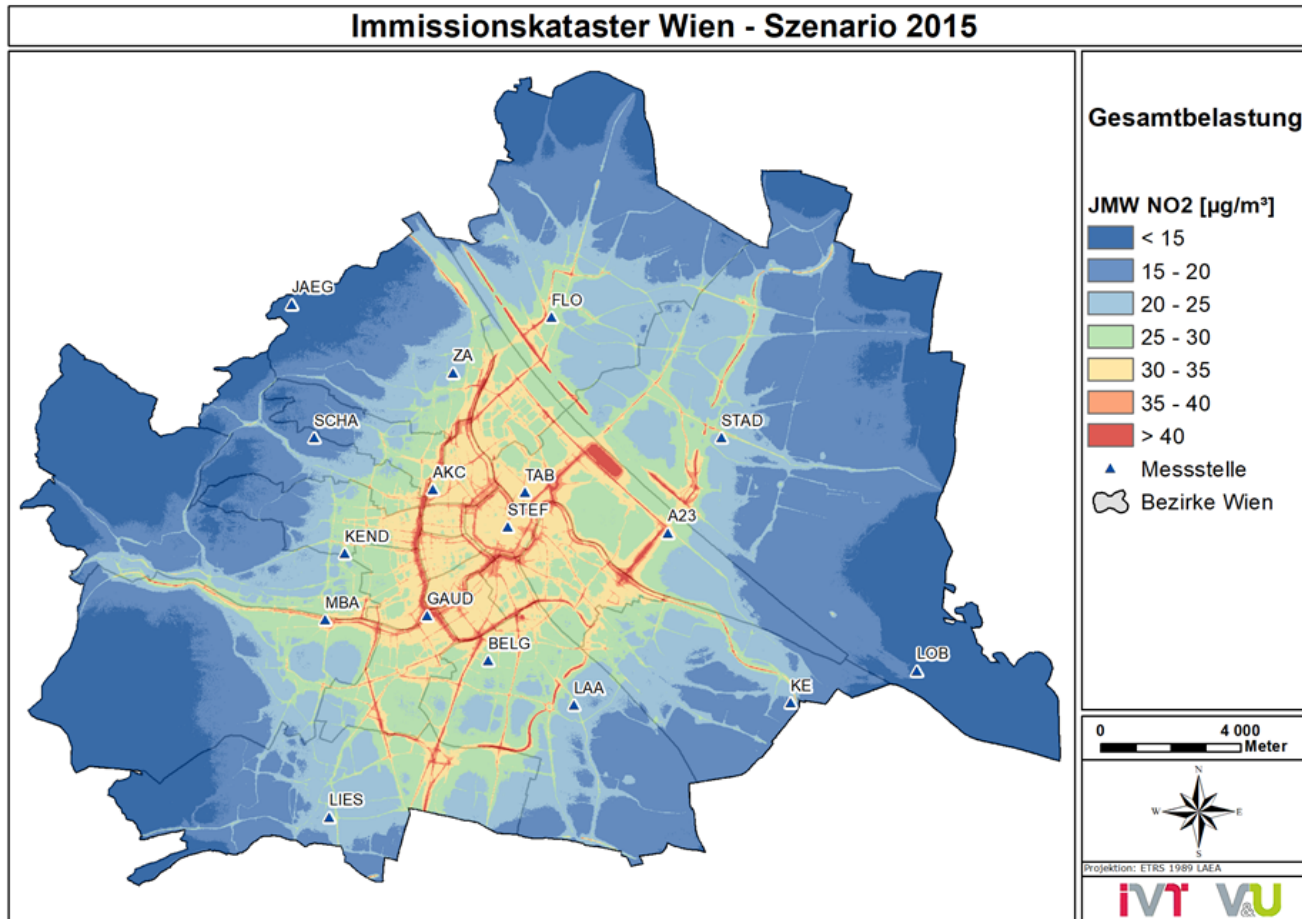


- Emission standards give a direction, real world/humans tends to reduce possible achievements by tampering
- NO_x is strongly related to (road) traffic
- PM₁₀ is mainly dominated by other sources than traffic
- Ultrafine PM: traffic is a strong contributor

Simulation chain – overview



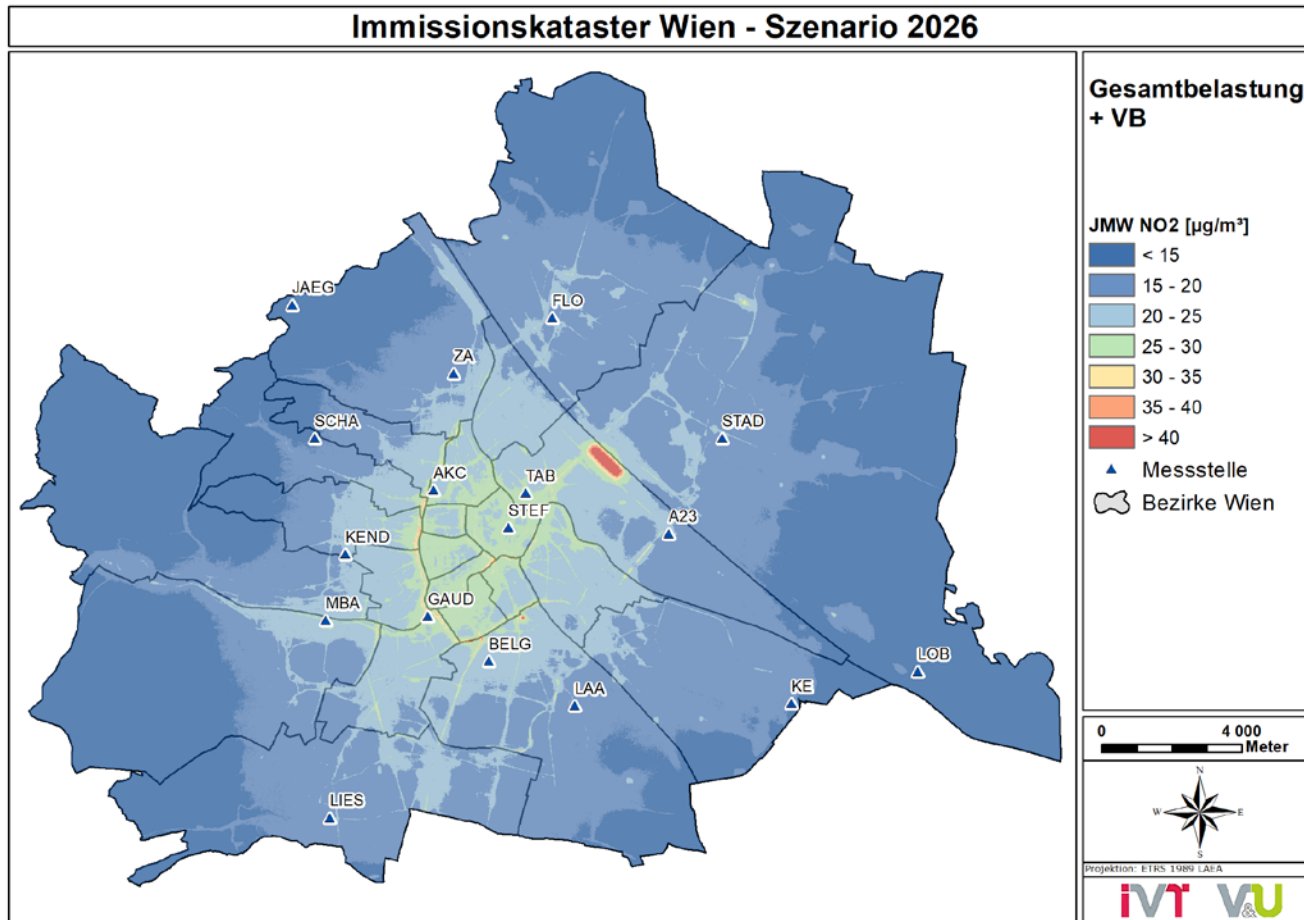
Air Quality simulation Vienna 2015



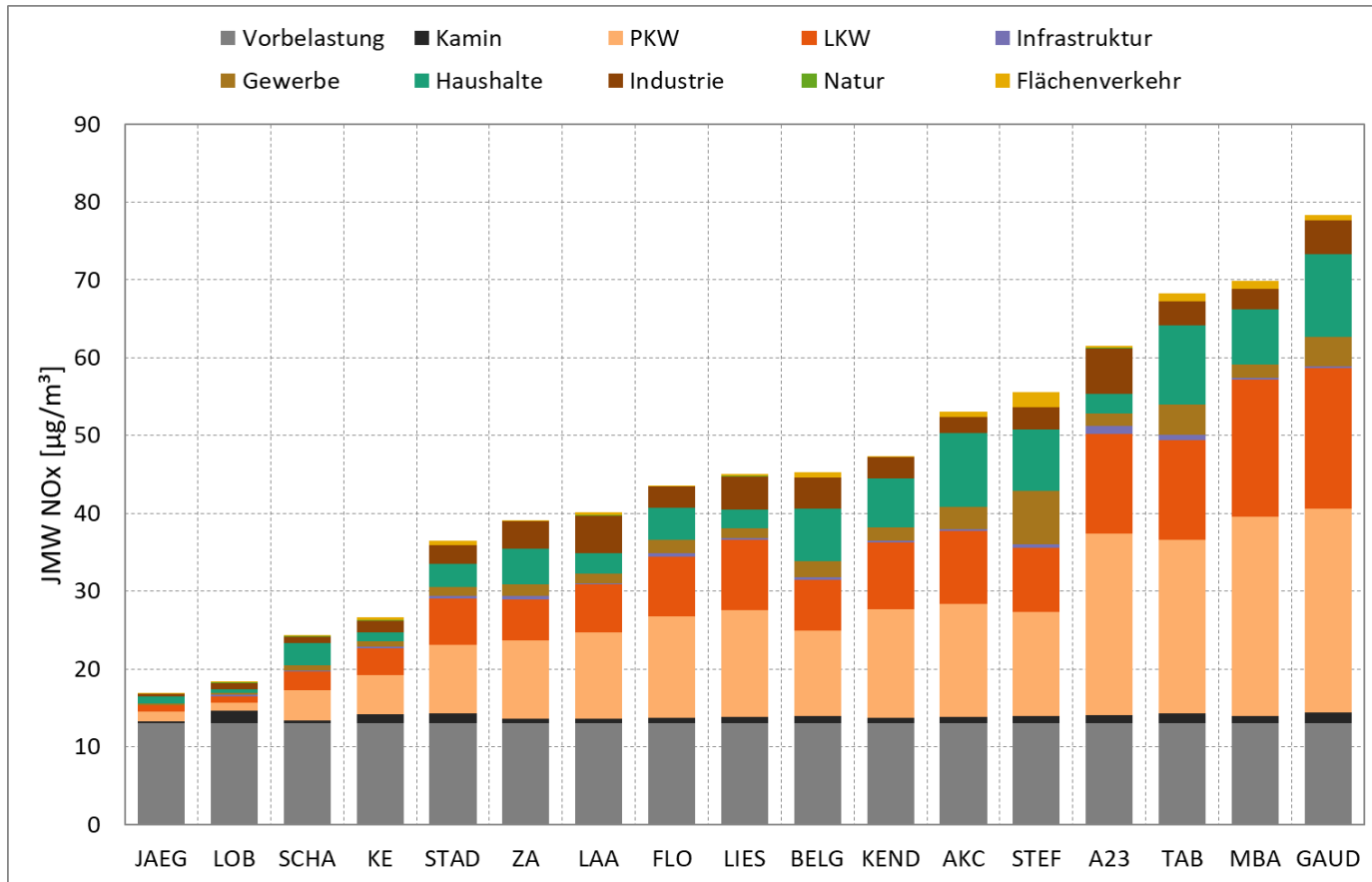
NO₂

Air Quality simulation Vienna 2026

NO2



Air Quality Simulation Vienna 2015



Annual mean value NOx

Traffic area sources

Industry

Domestic heating/cooking

Trade

HGV

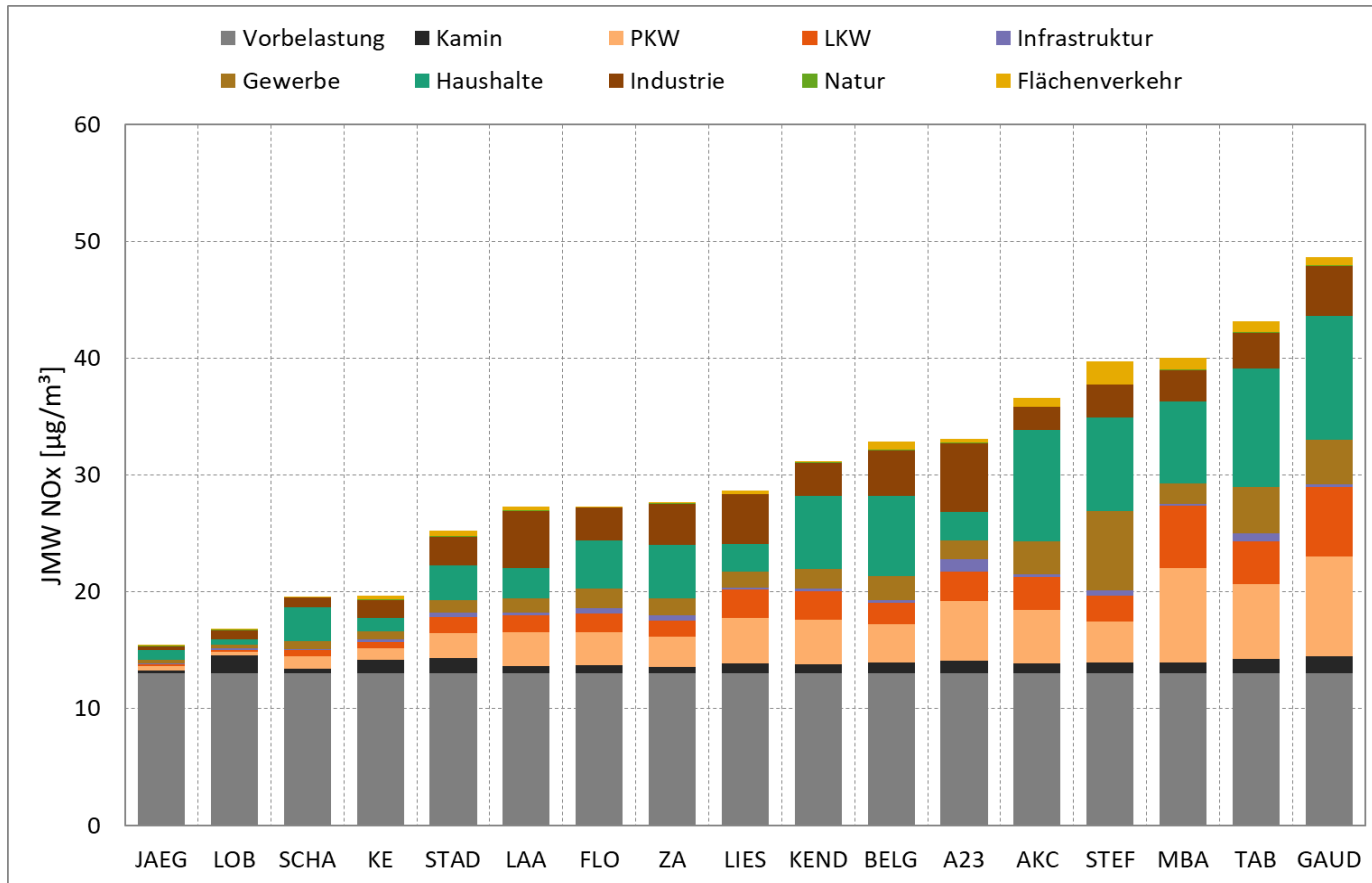
Passenger cars

Point sources

Background

Monitoring locations

Air Quality Simulation Vienna 2026



Annual mean value NO₂

Traffic area sources

Industry

Domestic heating/cooking

Trade

HGV

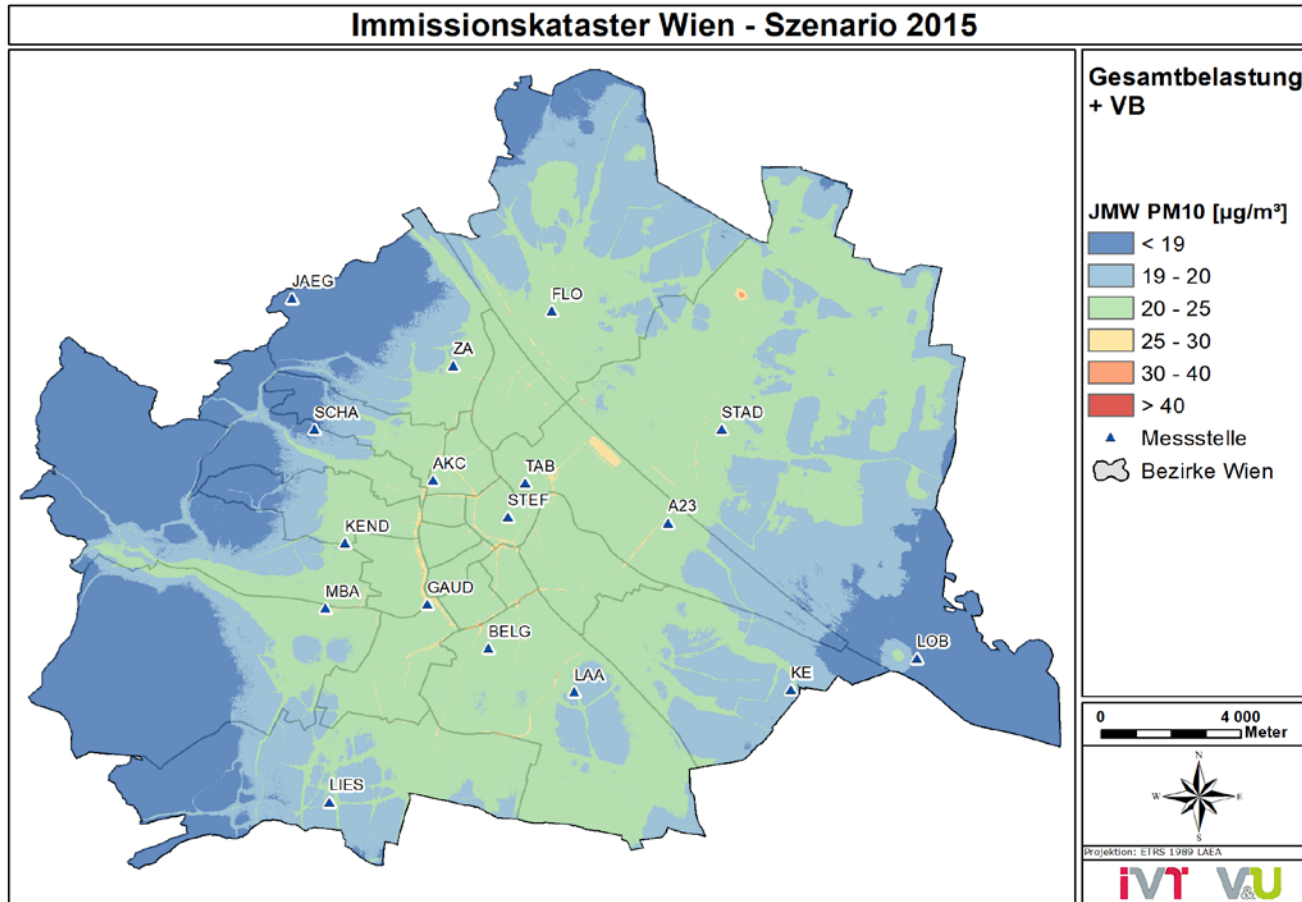
Passenger cars

Point sources

Background

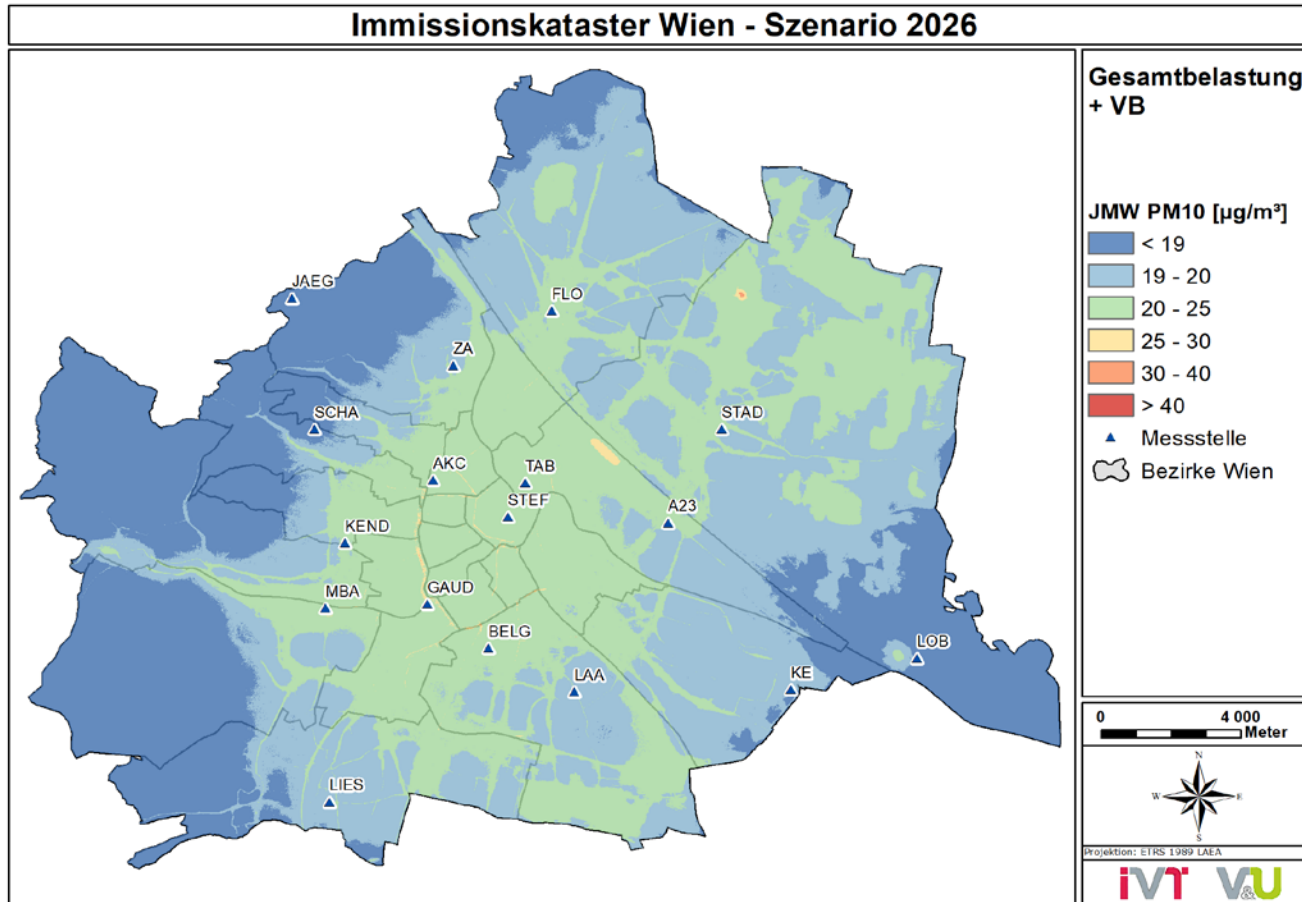
Monitoring locations

Air Quality simulation Vienna 2015



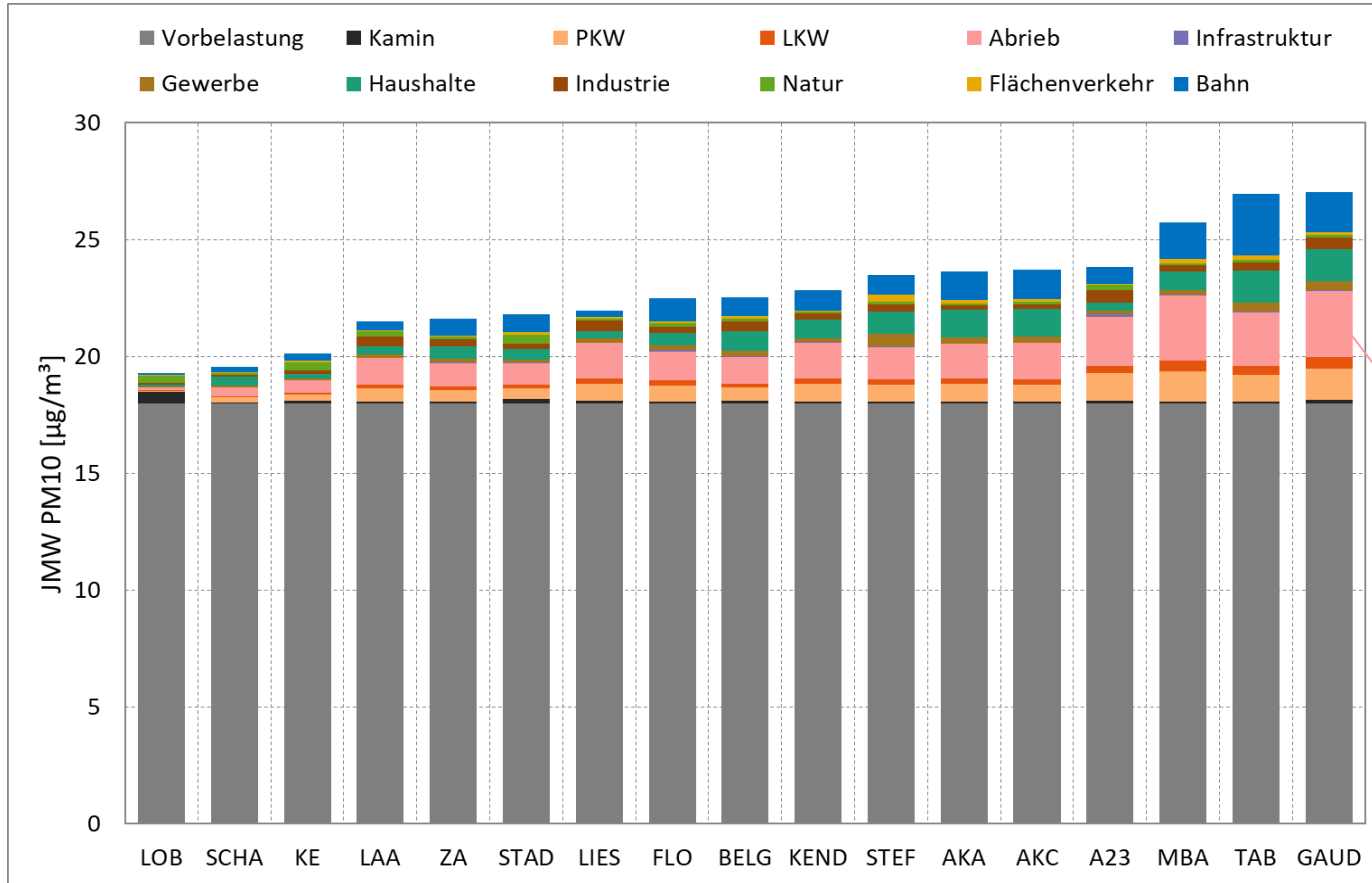
PM10

Air Quality simulation Vienna 2026



PM10

Air Quality Simulation Vienna 2015



Annual mean value PM10

Railways

Traffic area sources

Industry

Domestic

heating/cooking

Trade

Resuspension road

HGV

Passenger cars

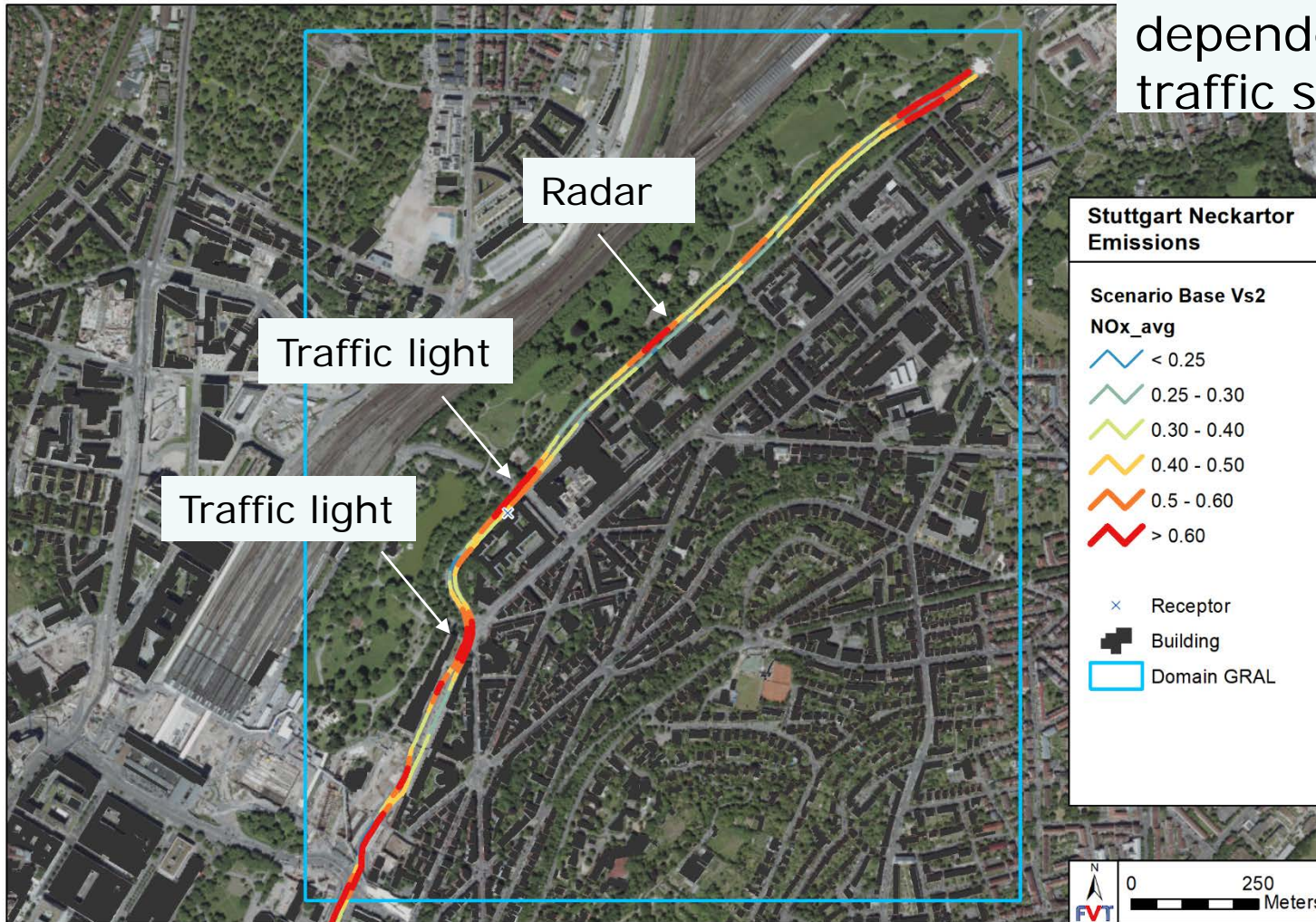
Point sources

Background

Monitoring locations

Traffic emissions

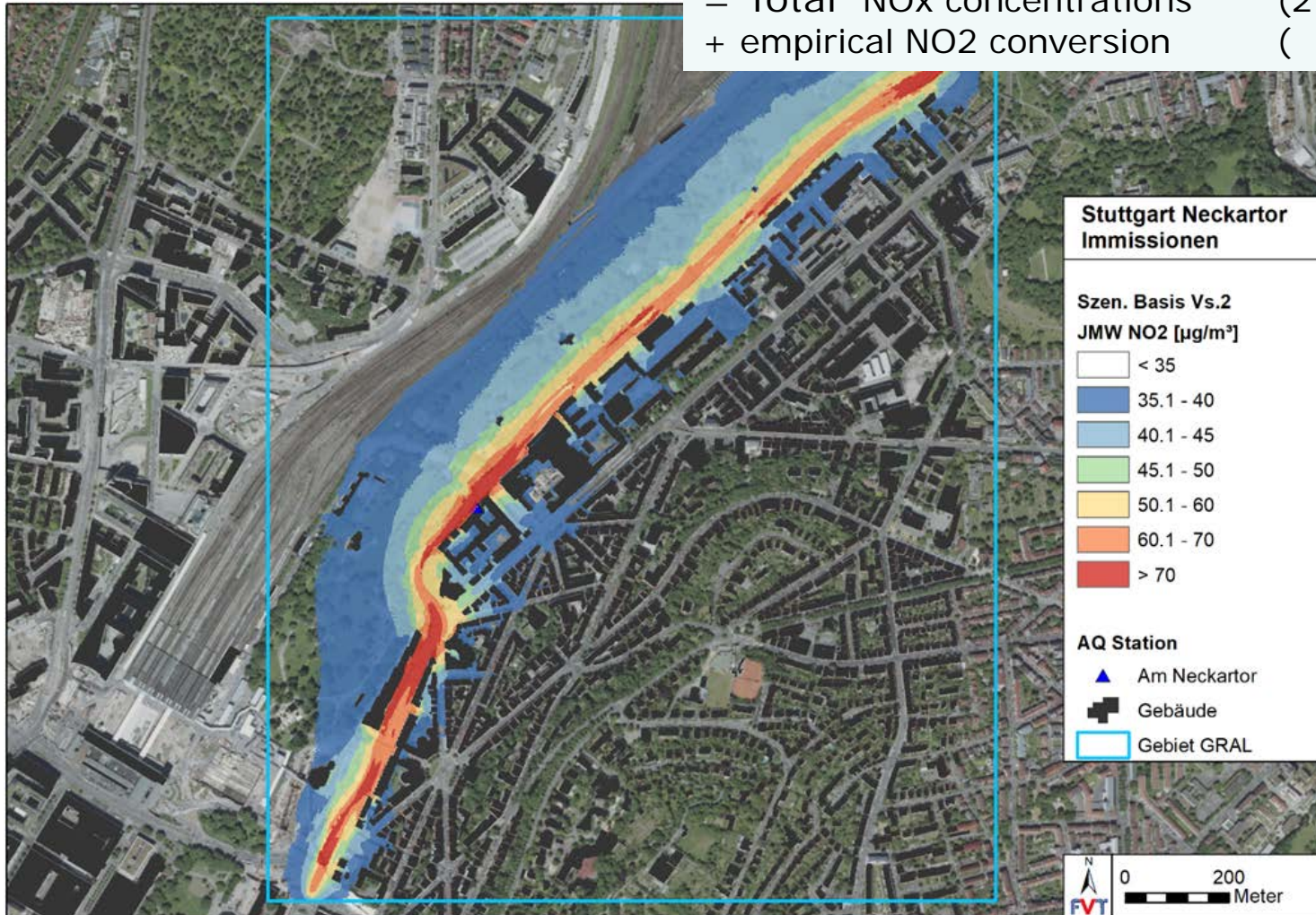
Emissions are very dependent on the traffic situation!



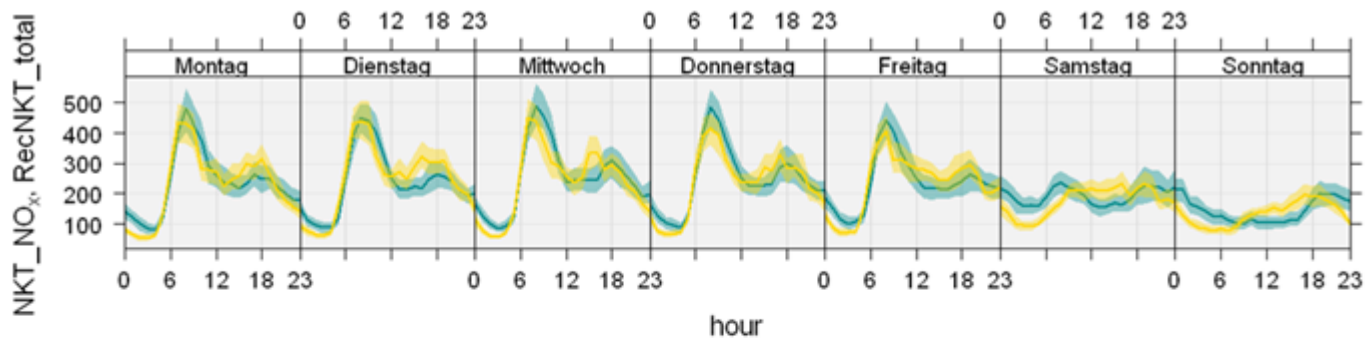
GRA

Hot Spot:

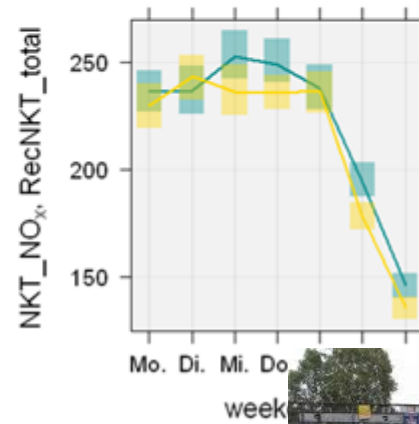
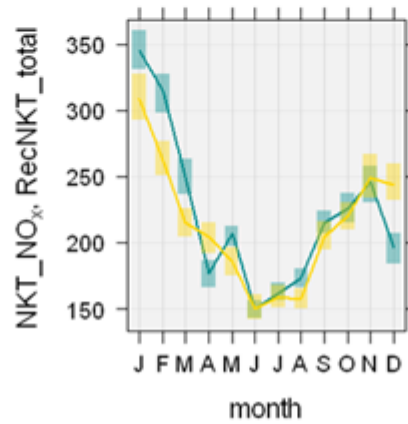
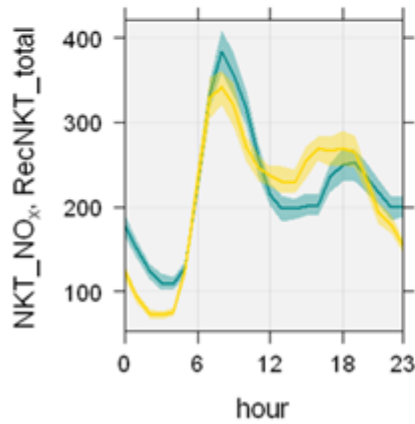
Modelled NOx concentrations (229 $\mu\text{g}/\text{m}^3$)
 + Measured background concentration (48 $\mu\text{g}/\text{m}^3$)
 = Total NOx concentrations (277 $\mu\text{g}/\text{m}^3$)
 + empirical NO2 conversion (70 $\mu\text{g}/\text{m}^3$)



NO_x concentrations in a complex topography



Measurement ■ NKT_NO_x ■ RecNKT_total **Calculation**



mean and 95% confidence interval in mean



Conclusion

- Road traffic is the major contributor to NO₂ concentration levels in urban areas
- Any future emission intervention for NO_x has a direct effect on local air quality levels
- Detailed (physical) modelling is required in order to evaluate the effects of 'realistic' emission projections on urban air quality
- PM₁₀ concentration levels are (at least in Austria) strongly dominated by other sources than traffic
This is somewhat different for UFP, but reliable emission data on UFP are rare

Thank you for your attention



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