TECHNISCHE UNIVERSITÄT DRESDEN

Professur für Verkehrsökologie der TU Dresden

# Deterioration, temperature and load influence – evidence from pan-European RS data

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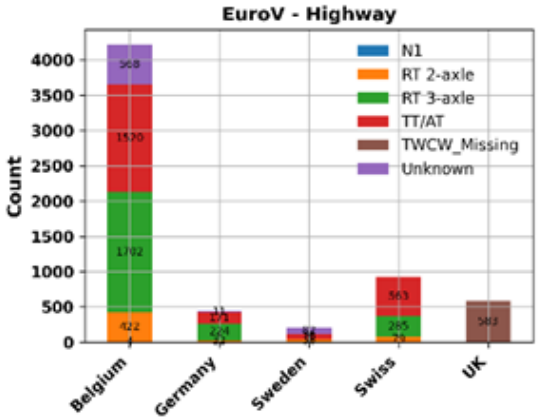
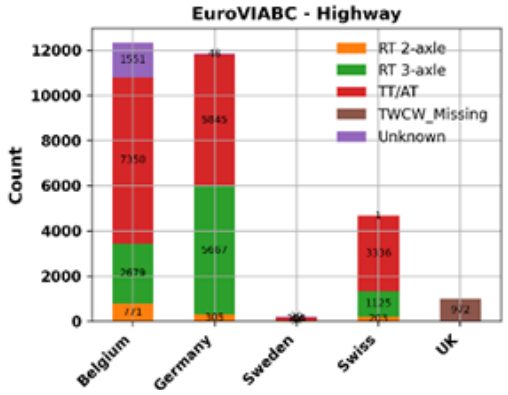
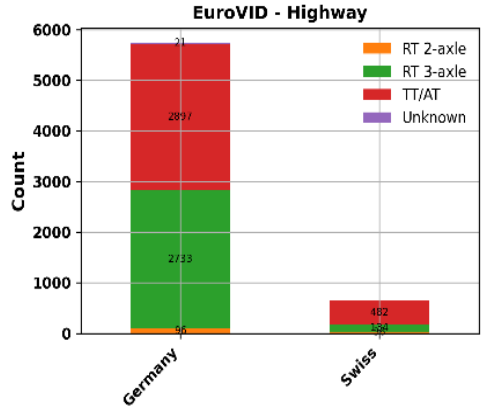
# Analysis of RS-records for deterioration analysis – here: HDTs



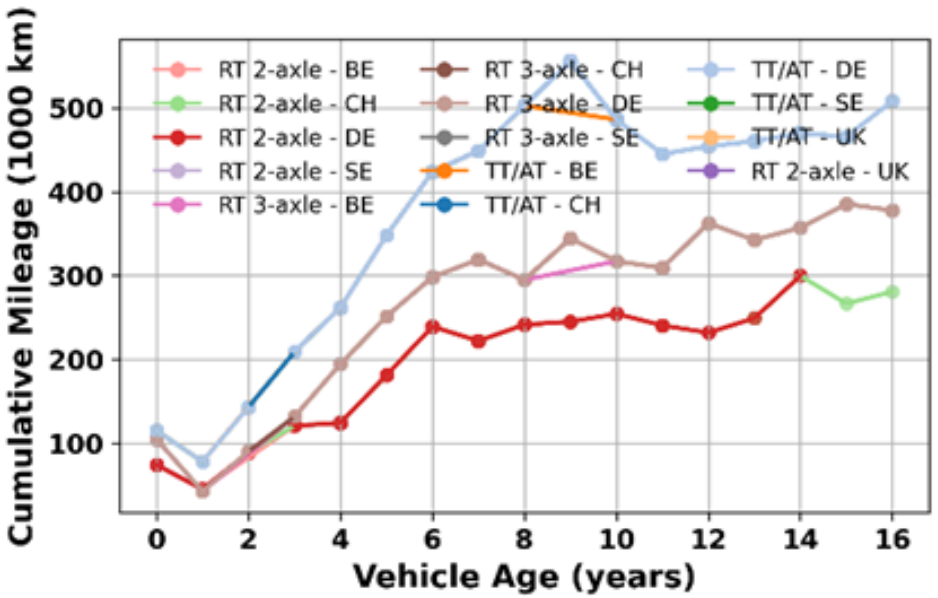




1. Some 20'000 RS records available for trucks, mostly from Belgium (2019) and Switzerland (2022)
   (~40'000 overall, but German highway data cannot yet be used)

2. Given is vehicle age from registration data – translated to mileage

3. Distinguish 2-axle (RT2) // 3-axle (RT3) & tractor trailors (TT)

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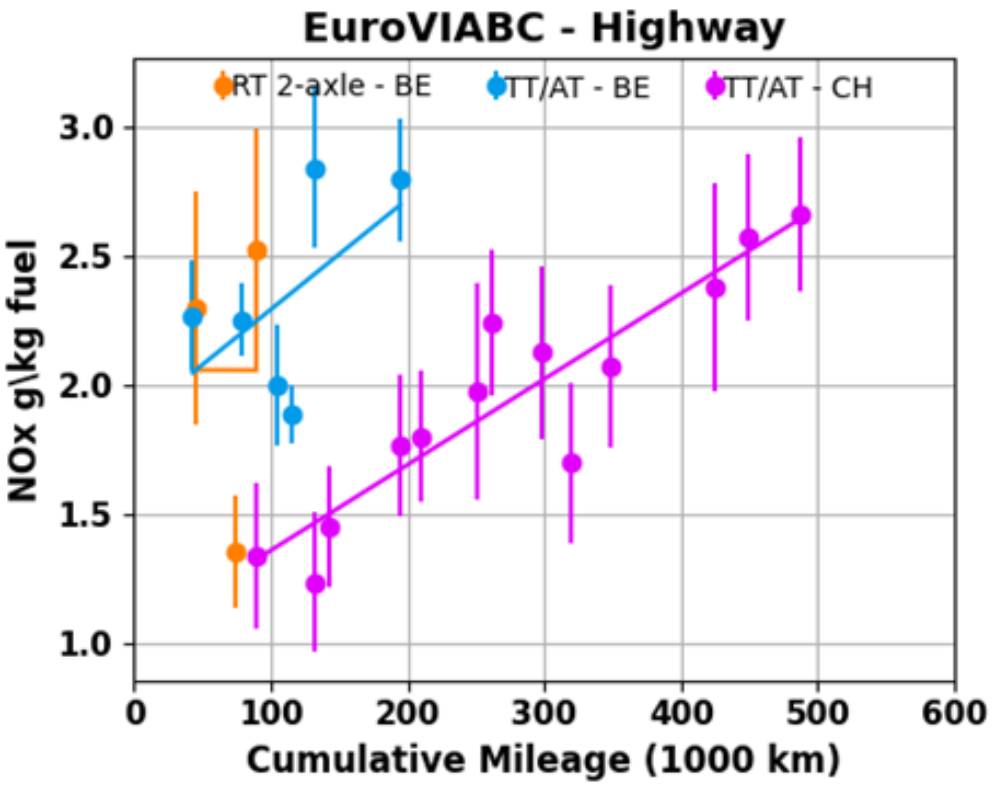
# NOx over mileage for Euro VI ABC trucks

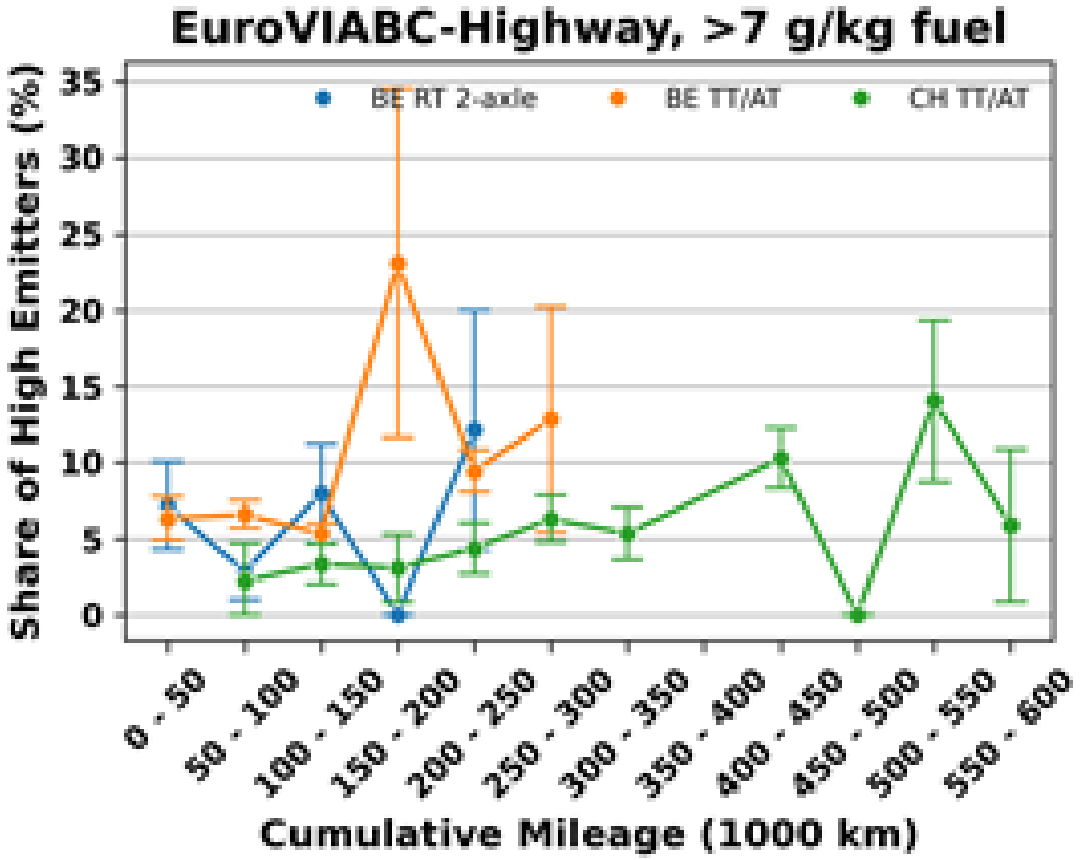



- Similar deterioration trends in BE and CH – good and consistent
- Somewhat different emission levels
- Take weighted average between BE and CH for deterioration function.
- Yet, higher emissions might results from high-emitters in the fleet.

TUG: Emission behaviour (per second) rather stable for trucks on highways as
stable 85 km/h driving, after-treatment hot.

=> Records > 7 g NOx/kg fuel to be skimmed off

# NOx over mileage for Euro VI ABC trucks



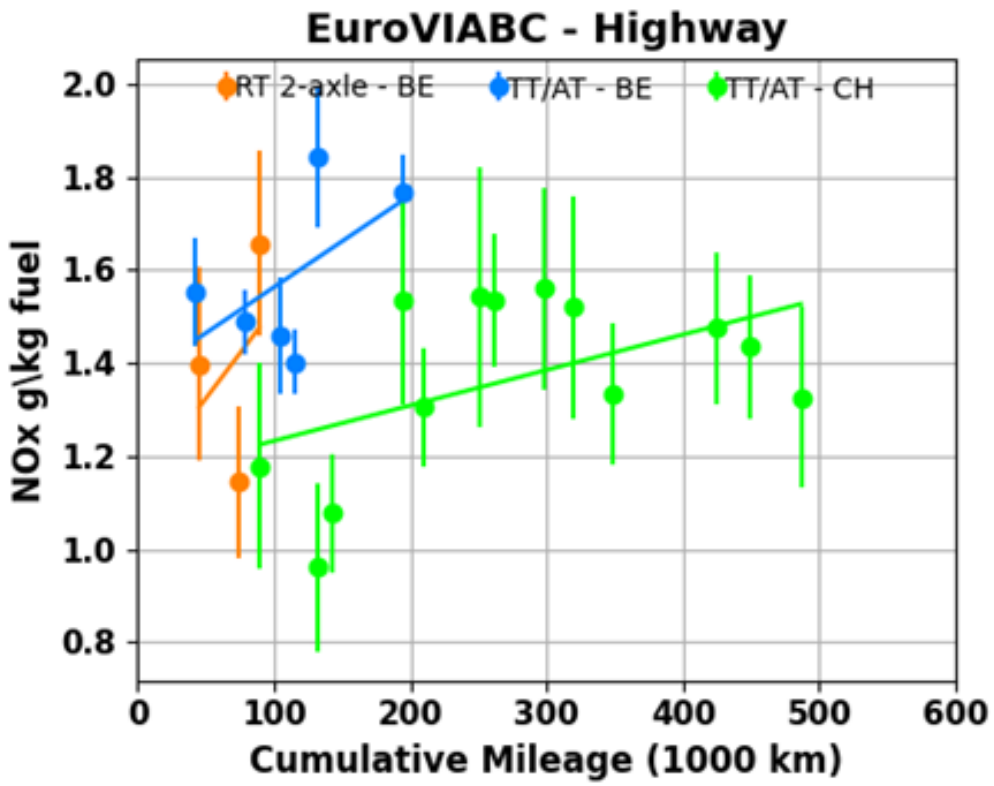

- Yet, higher emissions might results from high-emitters in the fleet.

TUG: Emission behaviour (per second) rather stable for trucks on highways as
stable 85 km/h driving, after-treatment hot.

⇒ remove records > 7 g NOx/kg fuel ~ 1.4 g/kWh

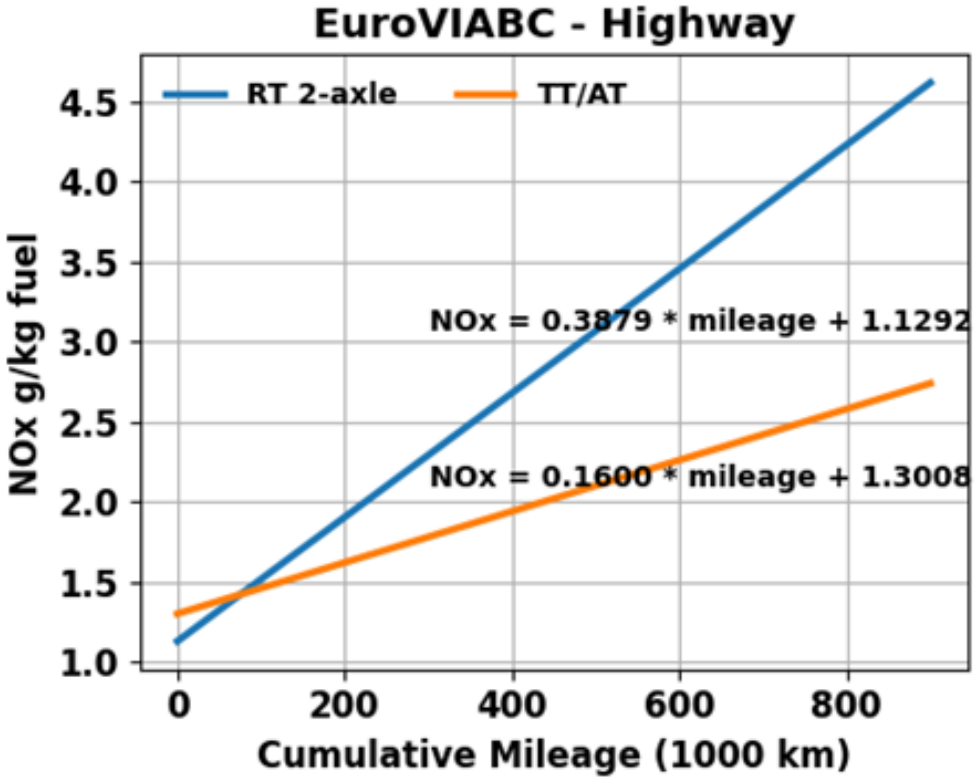
⇒ High-emission share from 2%/6% to 10%

# NOx over mileage for Euro VI ABC trucks – high-emissions removed

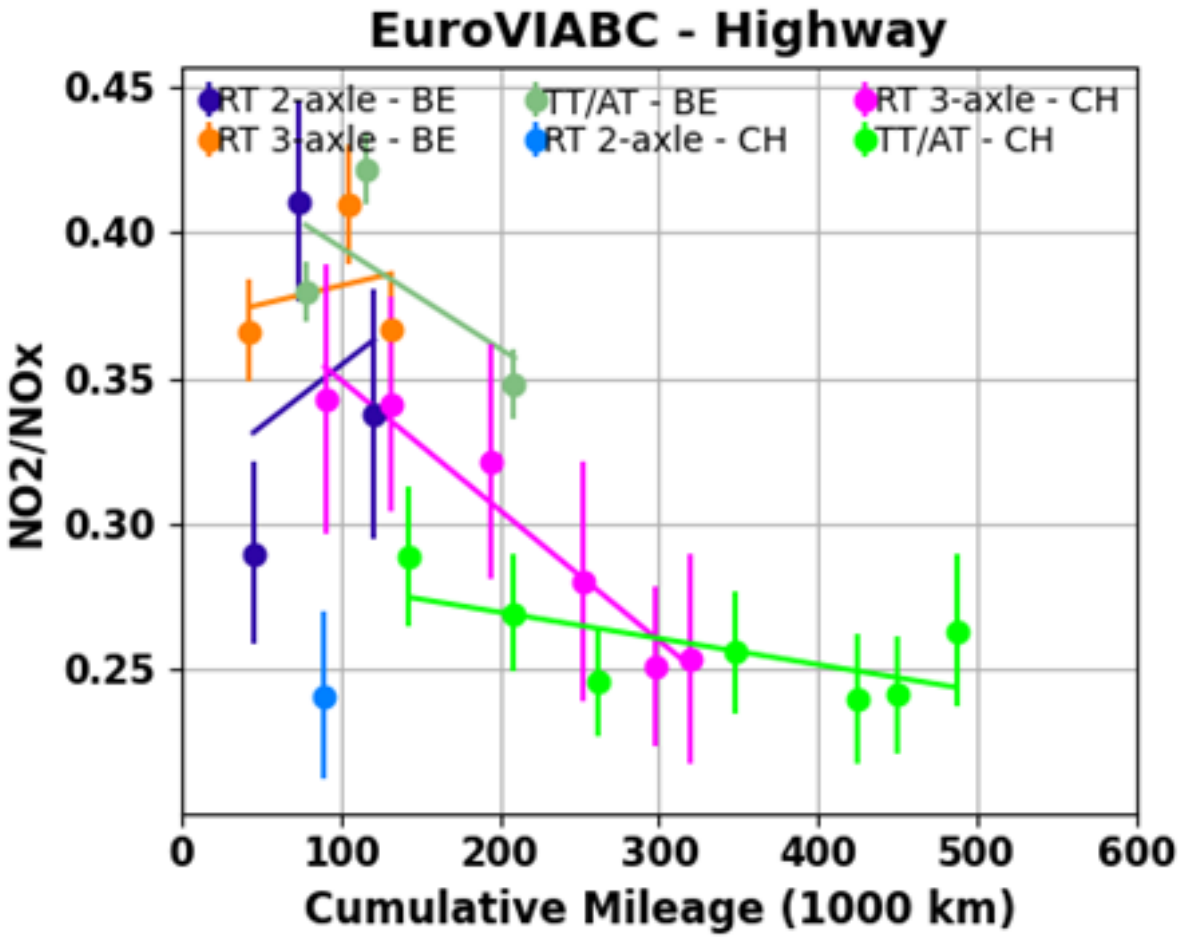



Deterioration trend **after** removal of high-emission records now „lower“
0.16 vs. 0.40 gNOx/kg fuel per 100‘000 km

=> Both, regular ageing and high-emitting behavior important!

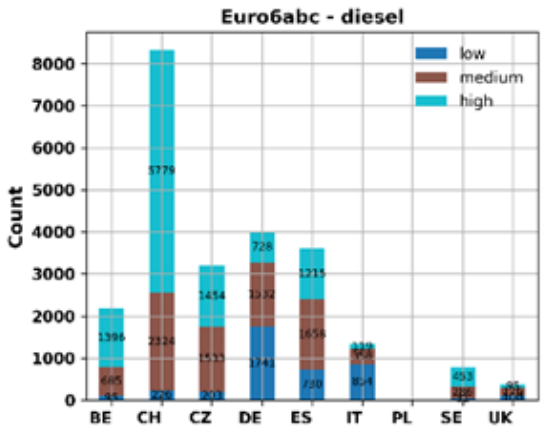


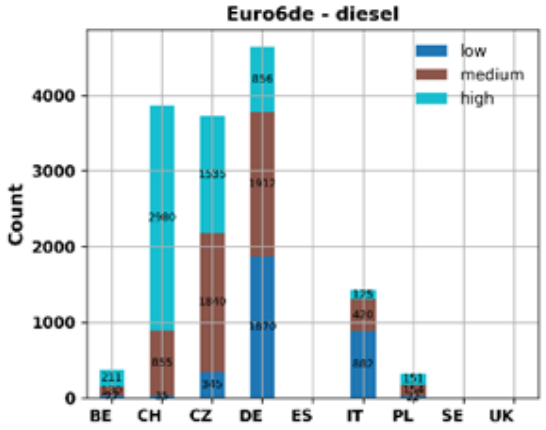
# NO2/NOx ratio with mileage for trucks

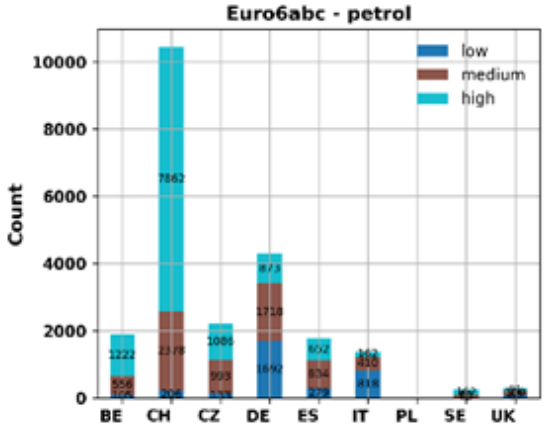


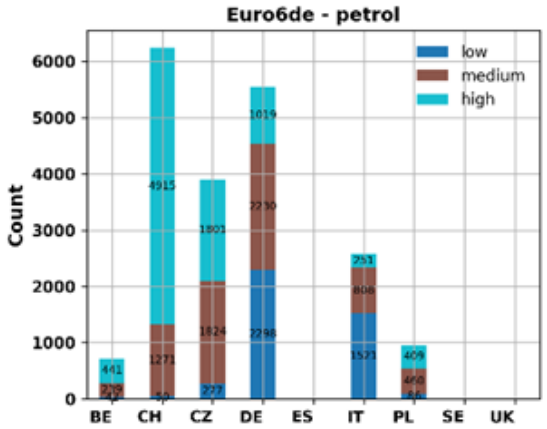

NO2 shares in exhaust with mileage decreases from ~35% to 25% over vehicle mileage

# Analysis of RS-records for deterioration analysis – here: Cars



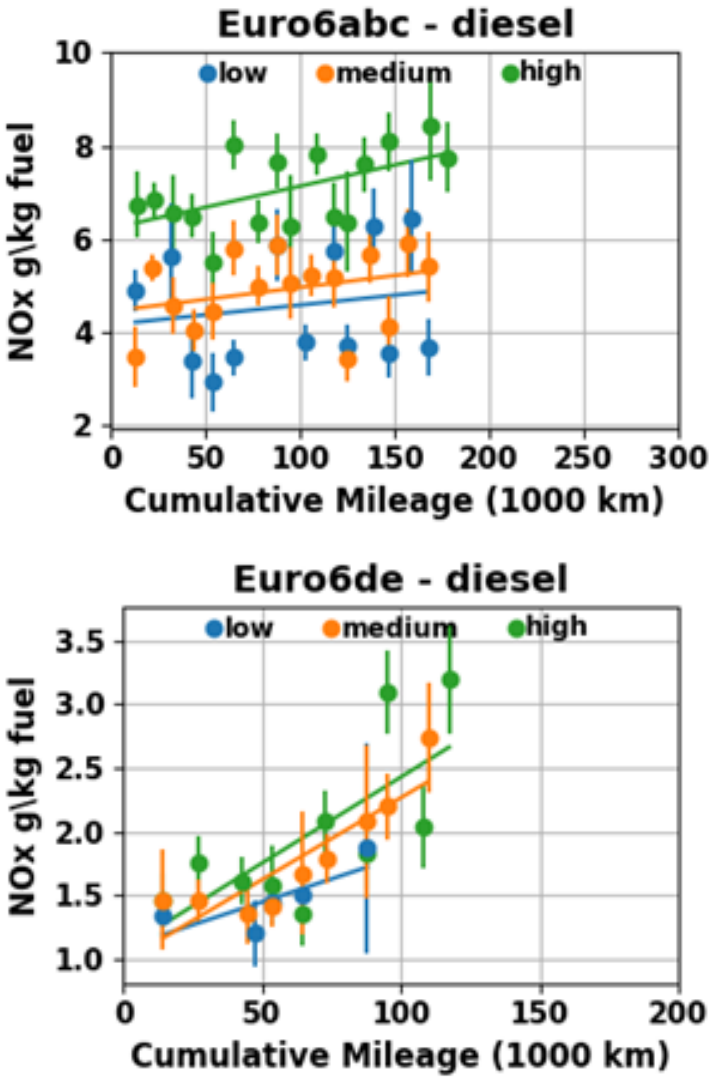

- Many more records available from diverse countries,
  For Euro 6: Campaigns from 2014 to 2022.
- Many urban records, but recent campaigns added data from highways
- Differentiate

  low – medium – high VSP bands / loads
  [2-6] - 6-12] - [12-23] kW/t

and

different temperature bins
to avoid double counting of effects.

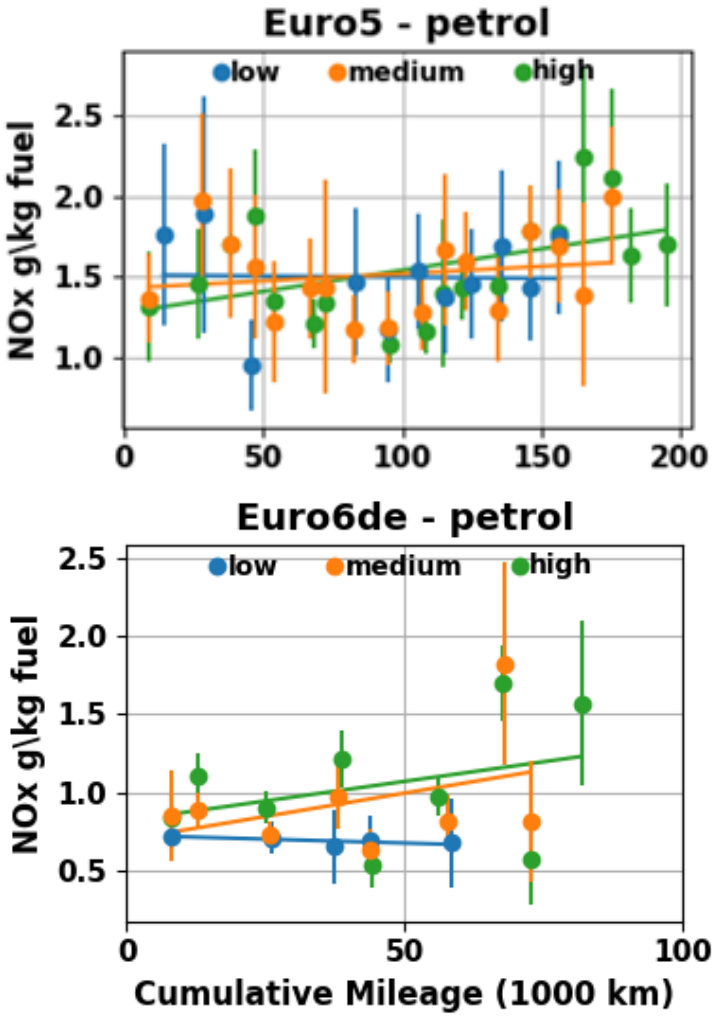
# Analysis of RS-records for deterioration analysis – here: Cars diesel




Diesel cars

- Clearly increasing NOx trends with mileage
- For Euro 6abc differentiation by VSP relevant – but trends very similar
- For Euro 6de clear increase over (first) years.

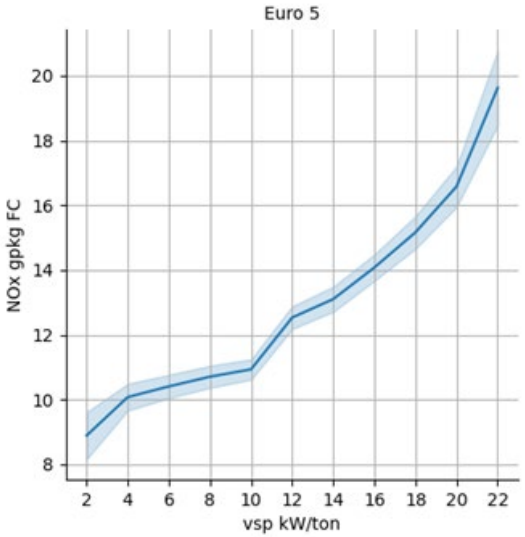
# Analysis of RS-records for deterioration analysis – here: Cars petrol

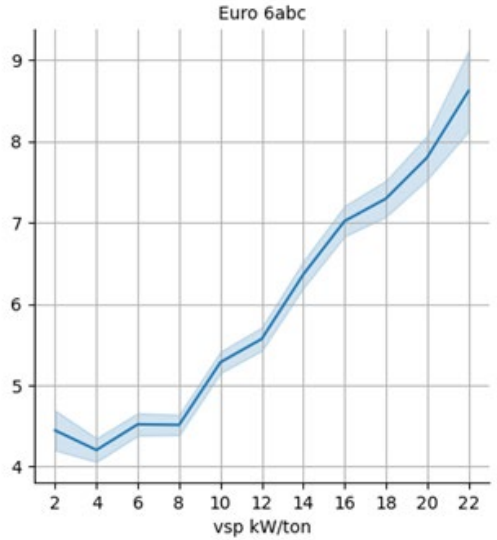


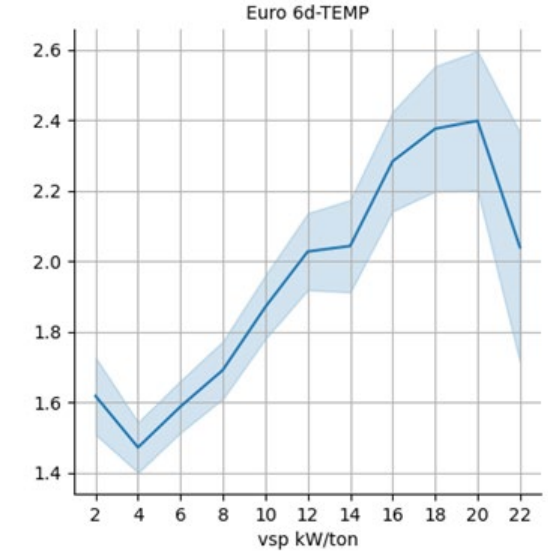

Petrol cars

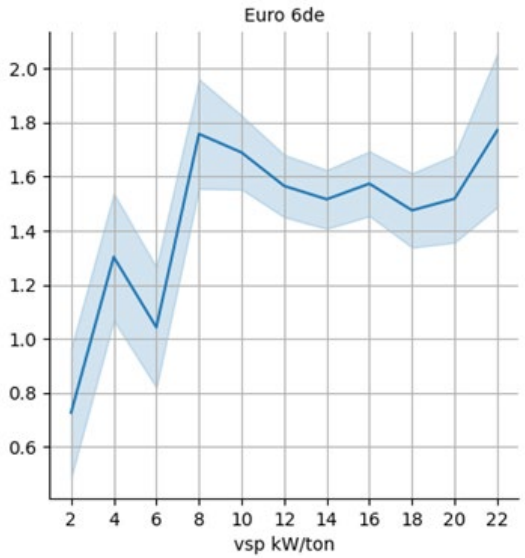
- Slightly increasing NOx trends with mileage
- VSP / load differentiation not relevant for gasoline cars

# Impact of load on NOx emissions – diesel cars




Euro 5 and Euro 6abc:

- Clear linear increase of NOx emissions with engine loads >10 kW/t, i.e. rural driving conditions.

Euro 6d-TEMP:

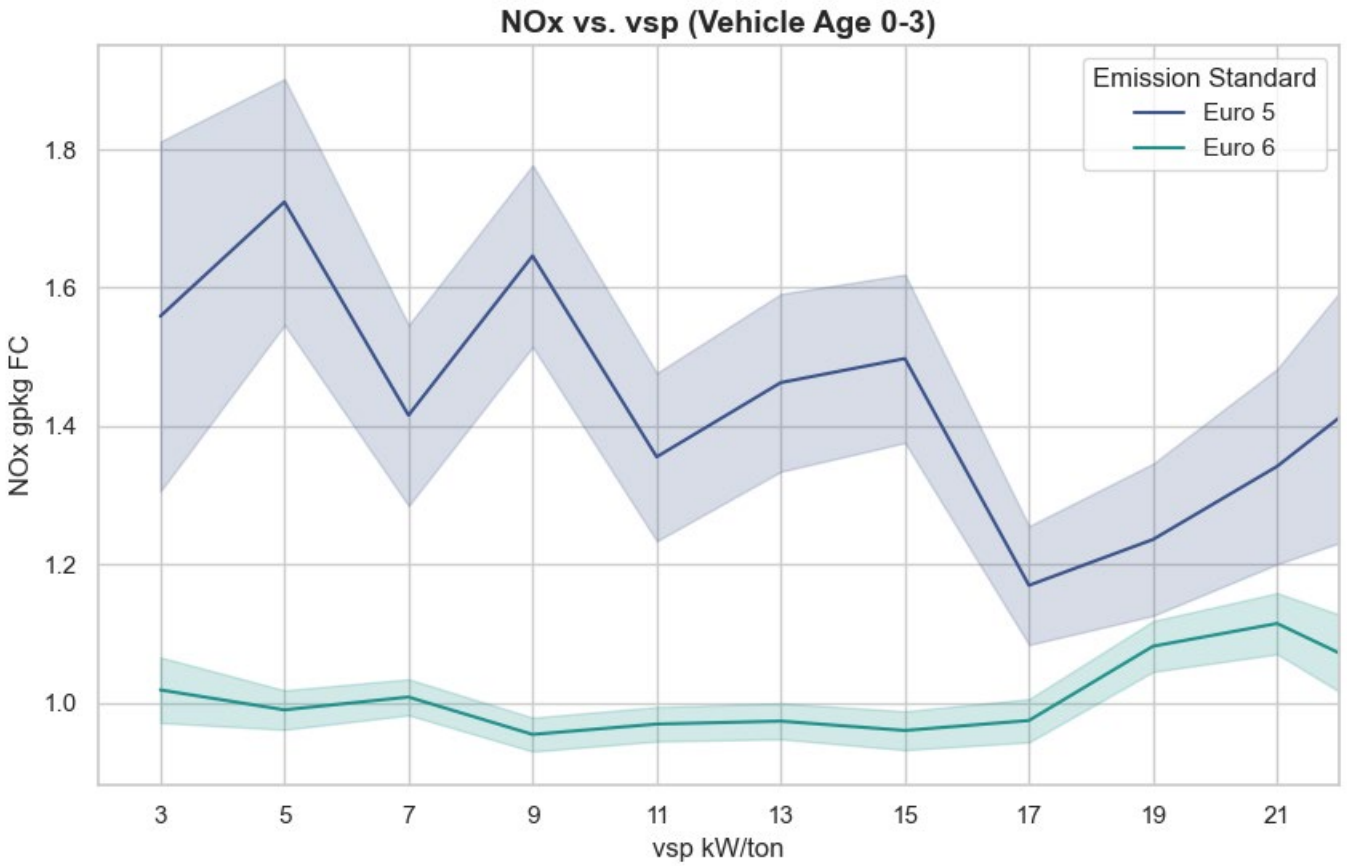
- Linear increase – but at very low levels

- No relevant change for Euro 6d

Data filtering:

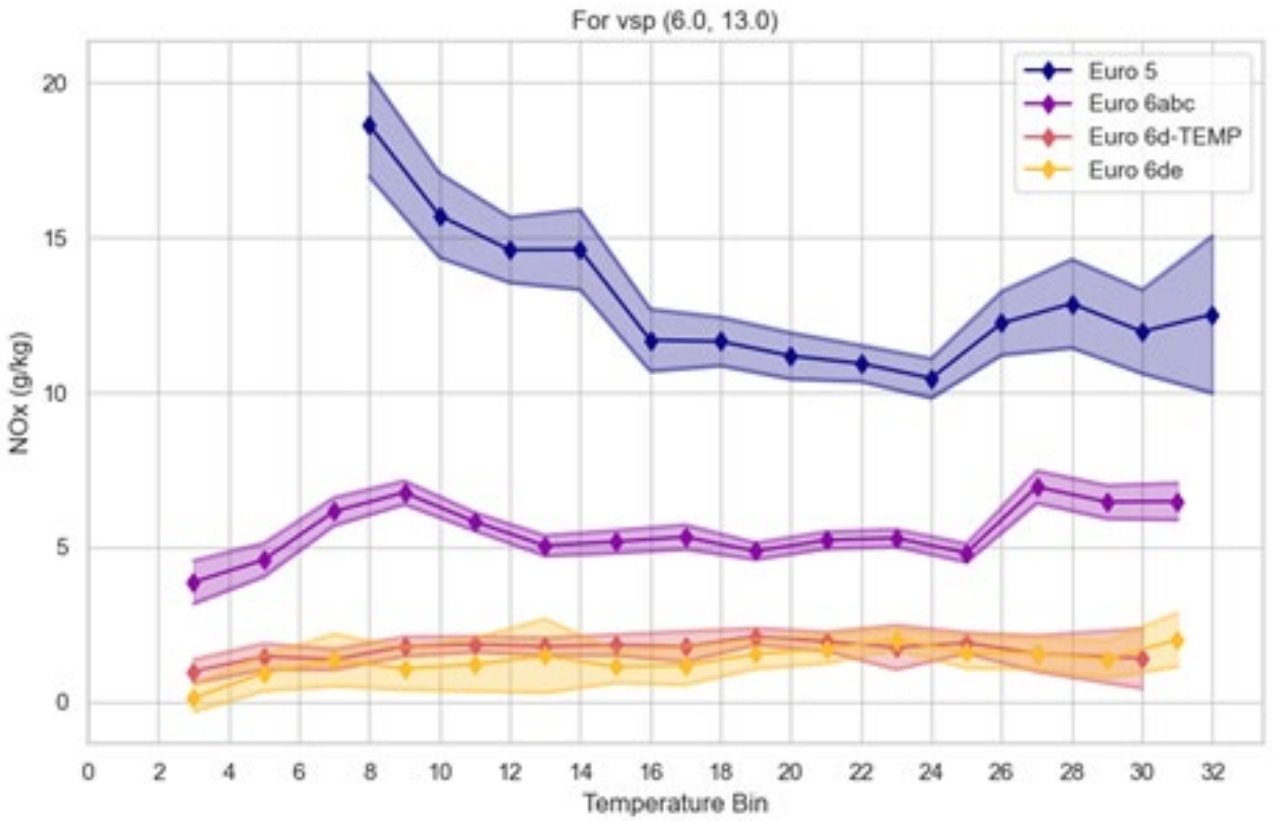
Age 0-3 to exclude effect of ageing; ambient temperatures
18-23°C for Euro 5 & 6abc and
10-30°C for Euro 6d/temp

# Impact of load on NOx emissions – gasoline cars



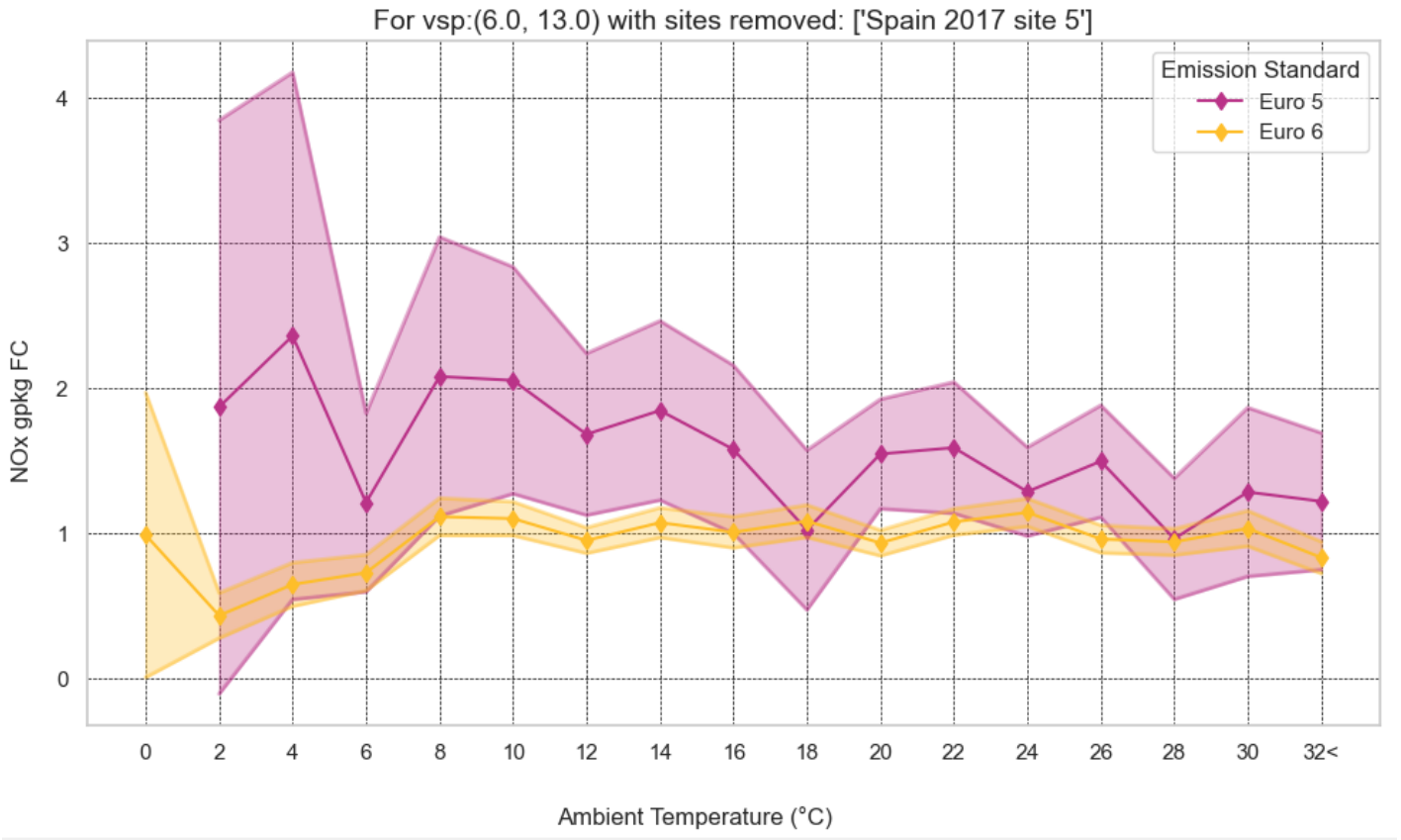

- For Euro 5 : Very minor increase of NOx emissions with lower engine loads
- For Euro 6 : No relevant load influence

# Impact of temperature on NOx emissions – diesel cars




- Clear increase of NOx emissions with higher and lower temperatures fir Euro 5 („temperature window“)
- Some temperture influence for Euro 6abc as well
- No relevant temperature influence from Euro 6d/temp

# Impact of temperature on NOx emissions – gasoline cars




- For Euro 5 :
  Very minor increase of NOx emissions with lower ambient temperatures

- For Euro 6 :
  No relevant temperature influence

# HDV: NOx and ambient temperature – remote sensing data

- **Euro V and Euro VI ABC no relevant temperature impact on NOx emissions, when hot.**