

# How much do emissions differ? Testing three calculation methods

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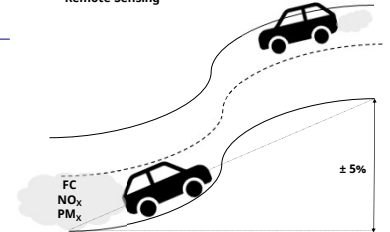
## Introduction – Compliance with air quality standard

- Road traffic remains a major contributor to air pollution putting pressure on cities to meet air quality limits
- Traffic flow needs to be optimized to minimize emissions
- Traffic emissions depend on the emission factors used in calculation – various methods need to be tested for their accuracy



Tested methods:

- SUMO (HBEFA 4.2)
- Remote Sensing

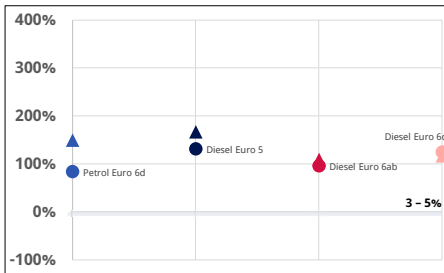


## Methodology – Simulation setup

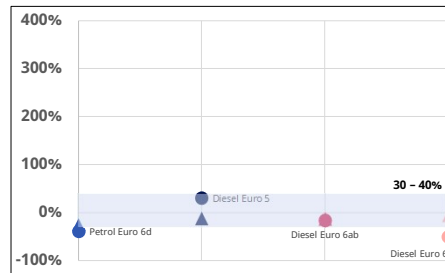
- Taking Handbuch Emissionsfaktoren (HBEFA 5.1) as reference, fuel consumption (FC) and emission ( $\text{NO}_x$  &  $\text{PM}_x$ ) differences are calculated using SUMO and Remote Sensing (RS) measurements
- Diesel and petrol cars in urban driving condition (constant speed at 50 km/h)
- Road with steep gradient ( $\pm 5\%$ ) to investigate effects of engine load

## Results – Emission differences

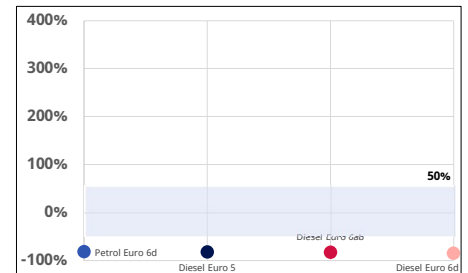
FC



$\text{NO}_x$

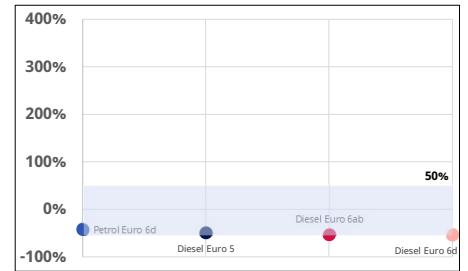


$\text{PM}_x$



Downhill

Uphill



- With only **3 – 5% margin of error**, SUMO & RS estimate fuel consumption at similar levels for uphill section
- For **downhill** section, SUMO & RS result in up to **150% higher values** as HBEFA
- HBEFA may not accurately depict the downhill driving of vehicles as it is an average traffic situation
- By increasing the margin of error 10 times higher compared to fuel consumption, with a **30 – 40% margin of error**, SUMO & RS estimate  $\text{NO}_x$  at similar levels for both sections
- For  $\text{NO}_x$ , both uphill and downhill section are **within the acceptable range**
- However, RS shows 6 times higher emissions for Diesel Euro 6d vehicles in uphill section
- $\text{PM}_x$  emissions consist of **exhaust and non-exhaust** emissions
- With up to **50% margin of error**, SUMO underestimates  $\text{PM}_x$  for both sections
- The underestimation of  $\text{PM}_x$  downhill emissions may be attributed to the updated calculation approach of **non-exhaust emissions** from **braking** in HBEFA 5.1

## Conclusions

- HBEFA depicts the average traffic situation leading to discrepancies in calculated emissions
- SUMO & RS estimate fuel consumption in the accepted range only for the uphill stretch
- SUMO & RS estimate  $\text{NO}_x$  at similar levels – both methods are close to the baseline HBEFA value
- Attention should be given to underestimation of  $\text{PM}_x$  in downhill stretch as non-exhaust emissions will become relevant in the future

