

Applications of remote sensing and recommendations for Europe

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Remote emission sensing: Useful applications

- 1. Representative emission factors** of fleets, by emission standard, by vehicle class...
Important for rational air quality planning and models
- 2. Monitor emissions by vehicle classes** / families / model years & technologies...
Important for effective monitoring (PTI/ISC)
- 3. Evaluate policy effectiveness:** Emission standards, fuels, technologies,
Low Emission Zones:
- 4. Identifying individual high-emitting vehicles**
For effective enforcement

1) Representative emission factors

Remote sensing = Mass sampling without interference with vehicle, driver or traffic

- Measure emissions per Euro class / model year / manufacturer / engine family... under wide range of ambient and driving conditions

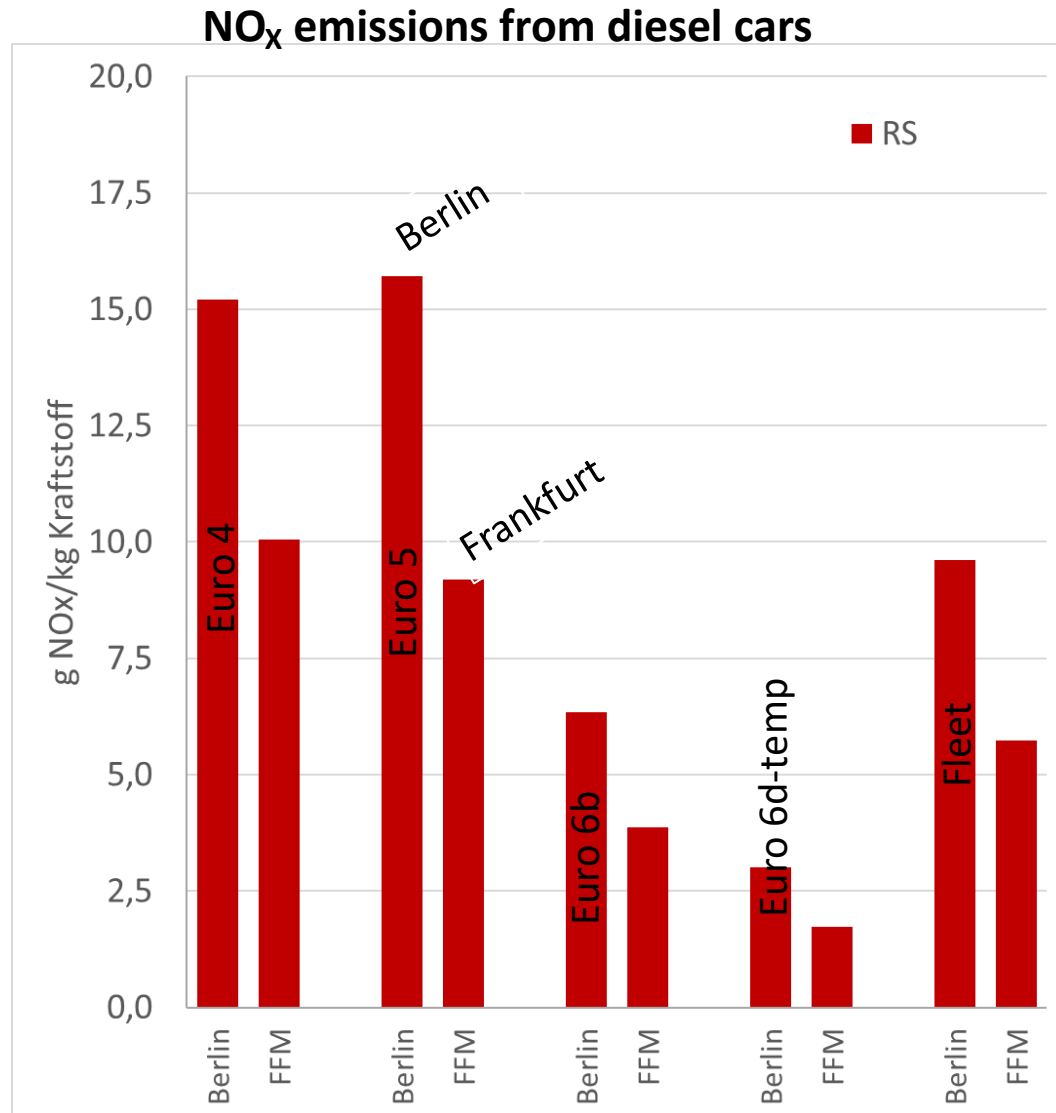
Recommended:

- **Monitor Euro 6d** long-term performance or deterioration
- **Monitor trucks**
- **Measure on highways**

Recommendation:

Coordinated low-intensity campaigns e.g. with 4 states participating every year, exchanging data, and rotating across Europe.

1) Representative emission factors, here different cities



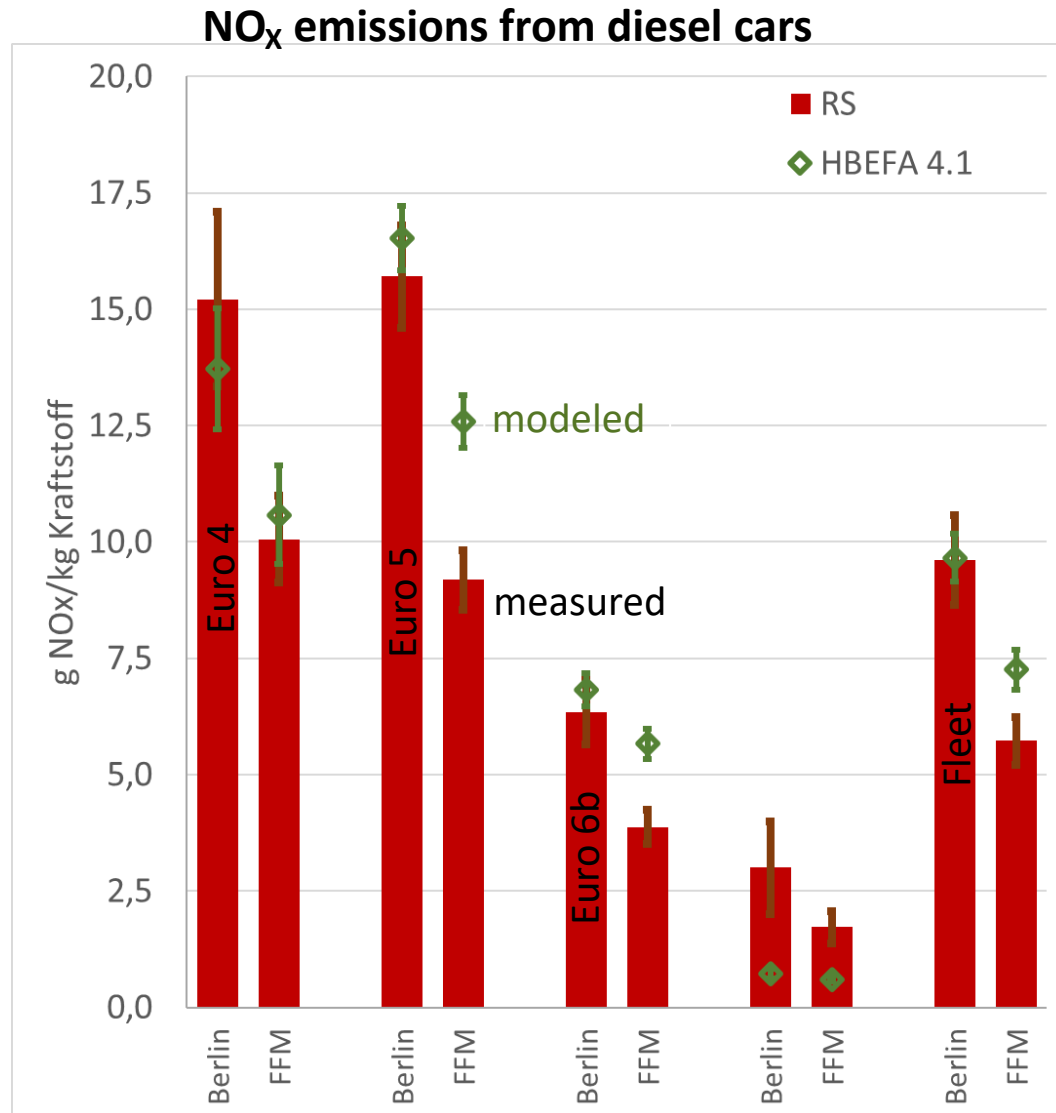
The local situation – even in the same country – can be quite different:

- Different ambient conditions
- Different driving conditions
- Different fleets

Useful to understand the local situation!

Data sources: RS measurements in Berlin & Frankfurt

1) Representative emission factors, here vs. HBEFA model



The local situation – even in the same country – can be diverse:

For good air quality planning good input data - from measurement & models - needed.

RES provides unique input to emission modeling!

Data sources: RS measurements in Berlin & Frankfurt

2) Monitoring in-use fleet

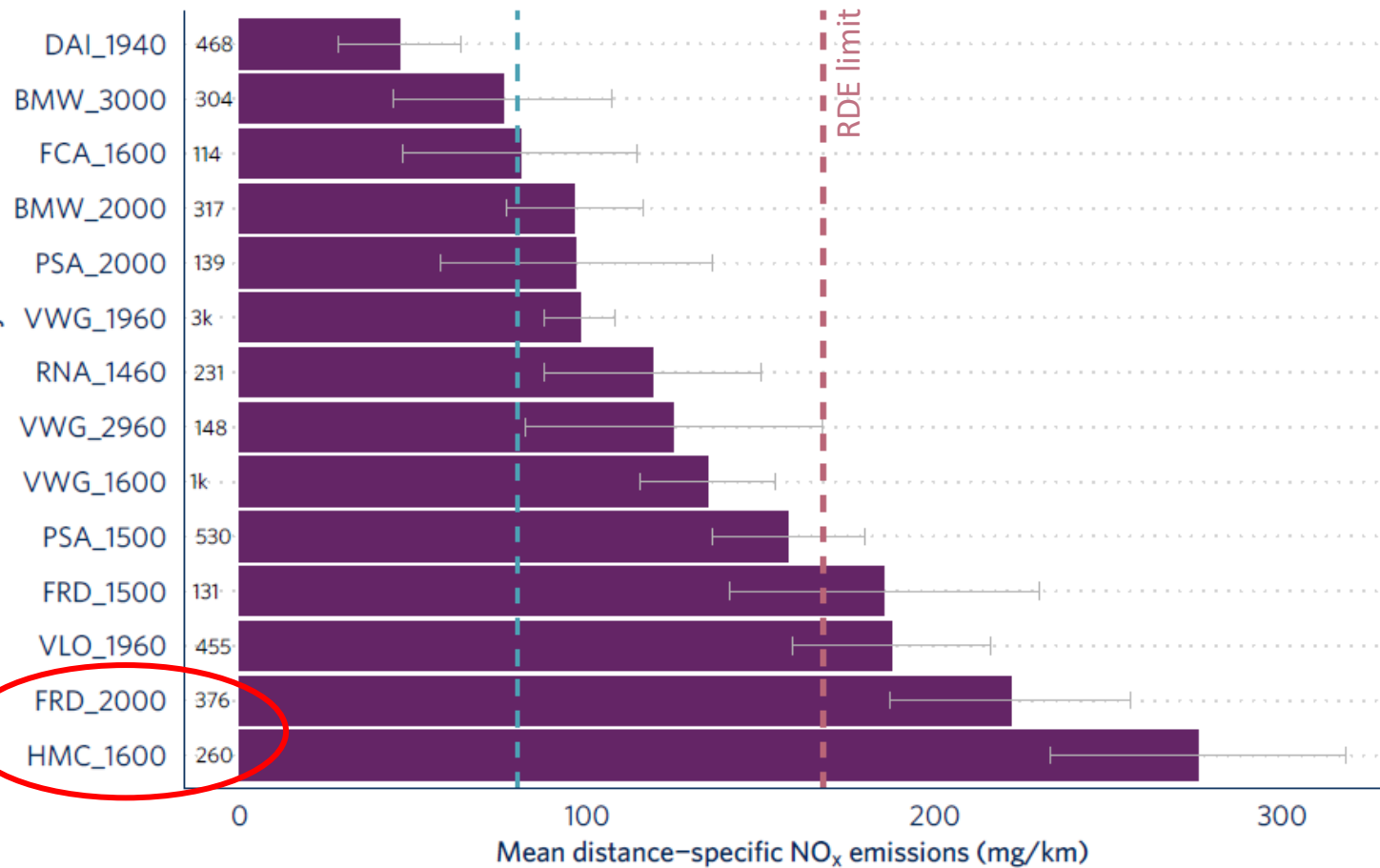
- Focus on compliance of in-use fleet and vehicle classes
- Identify worst performing vehicle families (or models, technologies, series, ...) for dedicated confirmatory measurements

Recommendation: Coordinated low-intensity campaigns e.g. with 4 states participating every year, exchanging data, and rotating across Europe.

+ dedicated campaigns focusing on the pre-identified vehicle families, models, technologies...

2) Monitoring, here worst-in-class vehicle family

Euro 6d-TEMP diesel cars



Vehicle family := Vehicle manufacturer x engine displacement in ccm

Data sources: RS measurements in Krakow, Milan & Prague

3) Evaluating impact of measures

Some important real-world questions:

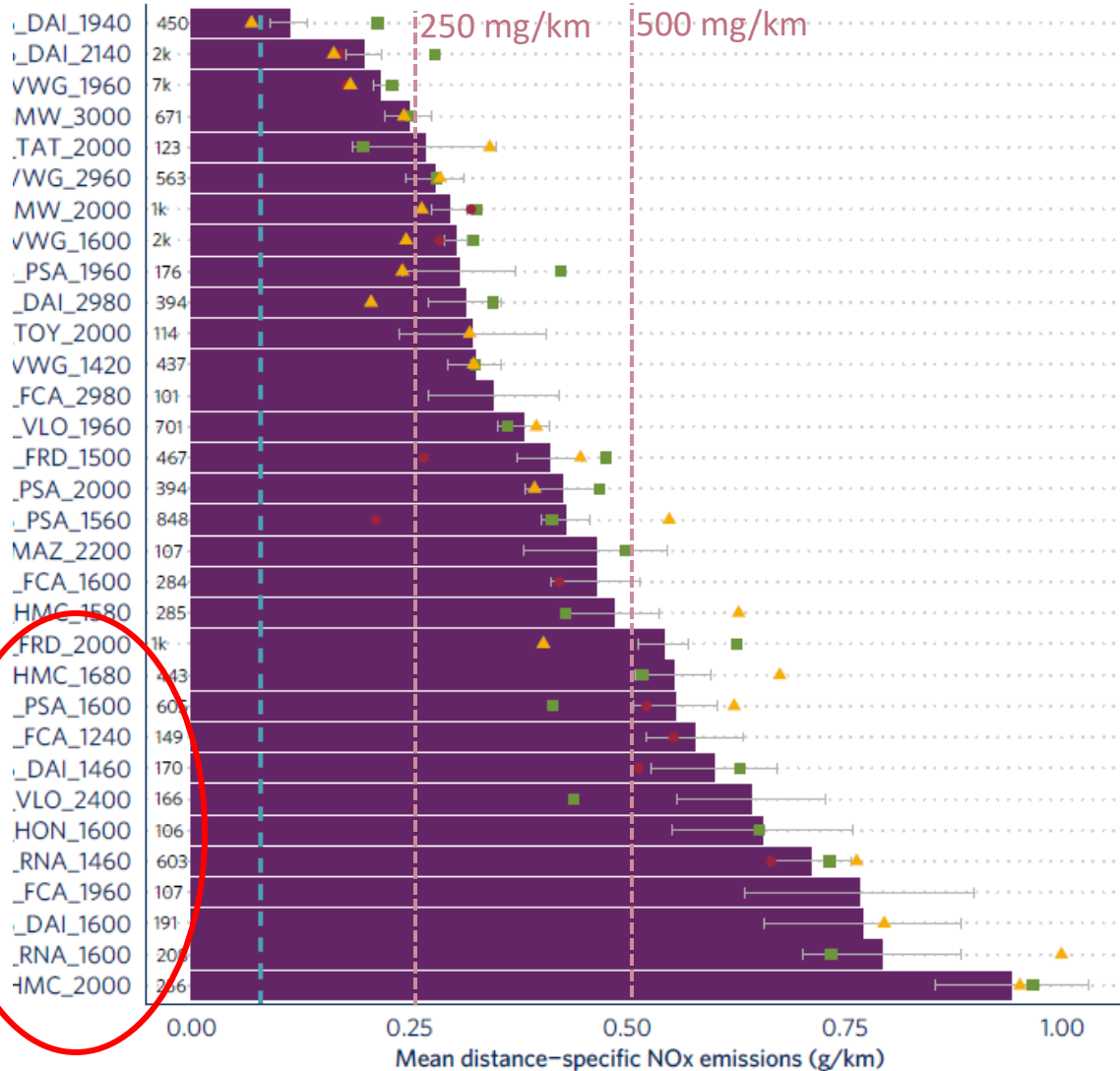
- Is the **software update** for cars/trucks (Euro 5/6) effective?
- How durable are Euro 6d emission controls for passenger cars and light-commercial vehicles?
- What is actual on-road performance of Euro 7 for light- and heavy-duty vehicles?
- Are emissions from CNG/LPG powered cars lower than from petrol?
- What is actual electric share of PHEVs?
- How much emissions can be reduced by different stages of a Low Emission Zone?

Recommendation: Dedicated campaigns + data mining.

Data mining requires accumulation of data in the first place!

3) Evaluating impact of measures, here software update?

Euro 6b diesel cars



Vehicle family := Vehicle manufacturer x engine displacement in ccm

Data sources: RS measurements in Krakow, Milan & Prague

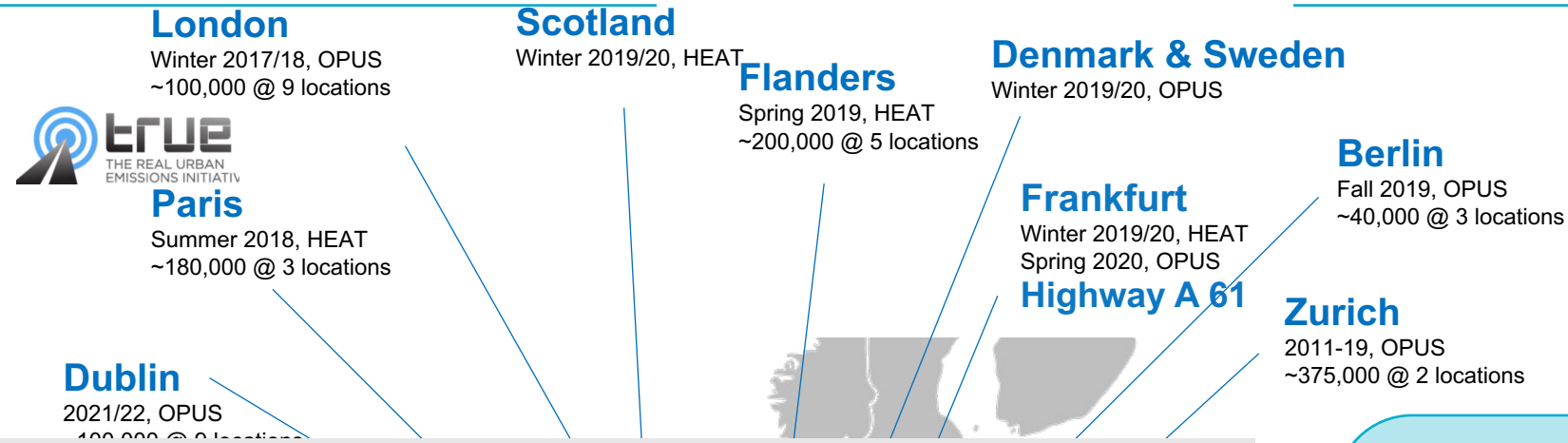


4) Identifying individual high-emitting vehicles

Needs robust classification, i.e. several measurements per vehicle. **Recommended:**

- For **trucks**: Plume chasing measurements on highways.
Inspector should be in the chasing car for immediate inspection as in Denmark.
- For **light-duty vehicles**: Point samplers on both road sides in not too dense traffic.
Inspectors to be on stand-by & vehicle data be quickly available.
- With **cross-road & top-down remote sensing** both light and heavy vehicles:
Set-up several (3+) sensors in a row to have several valid emissions.
For live enforcement: Inspectors on stand-by & vehicle data be quickly available.
- Under development: Profiling vehicle emissions to avoid number plate recording, i.e. relieve GDPR requirements.

RES campaigns so far & recommendations for more



Low-intensity campaigns with 4 states participating every year, exchanging data, and rotating across Europe.

+ dedicated campaigns focusing on trucks & highways

+ dedicated campaigns for high-emitter detection

Krakow
Summer 2019, OPUS
Winter 2020/21, OPUS

Prague
Fall 2022, OPUS

Milan
2021, HEAT



Spring 2019, OPUS

Switzerland

Autumn 2020-21, OPUS / HEAT

adapted from P. Mock

