

# Applications of remote sensing and recommendations for Europe

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# Remote emission sensing: Useful applications

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- 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

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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

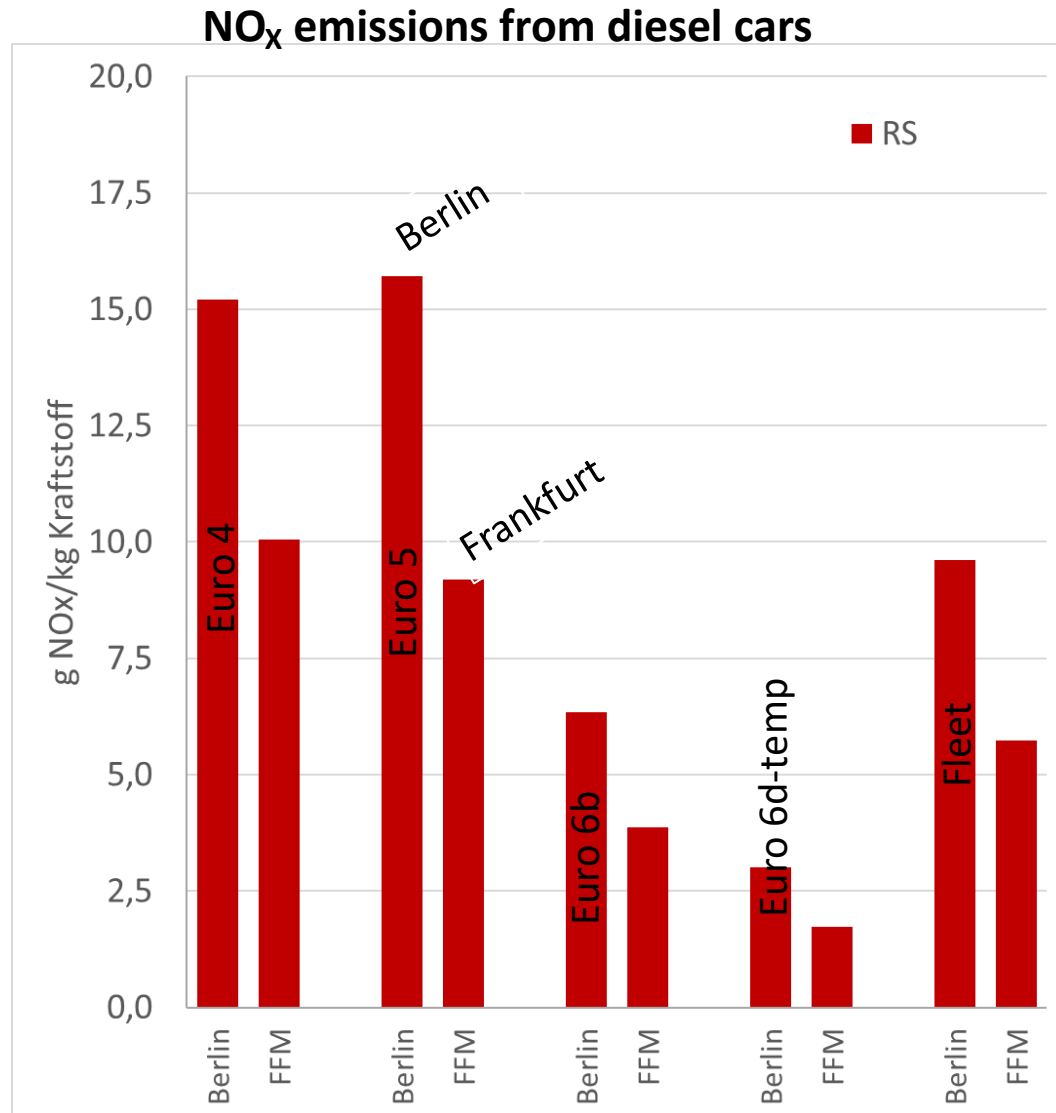
## **Recommended:**

- **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



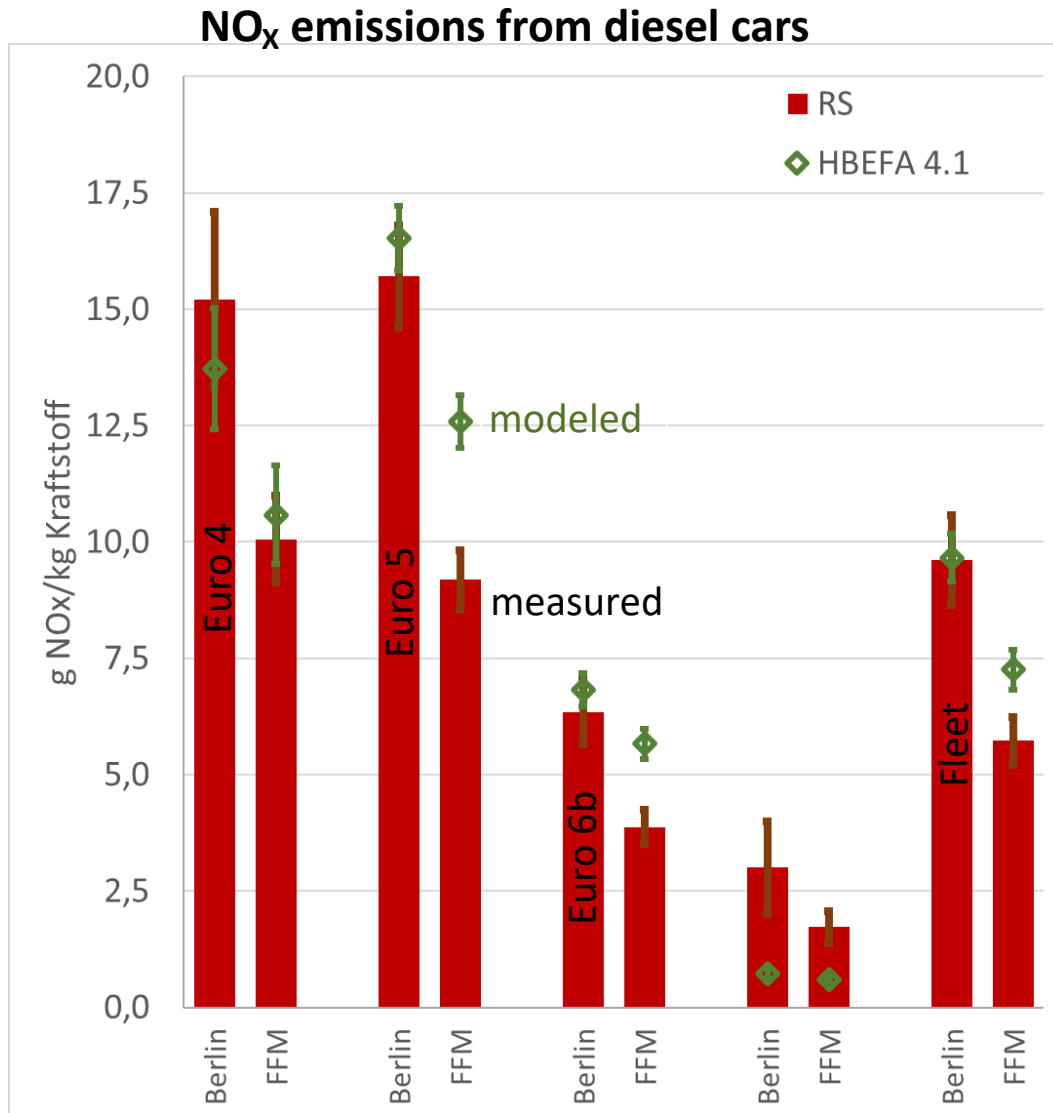
The local situation – even in the same country – can be quite different:

- 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

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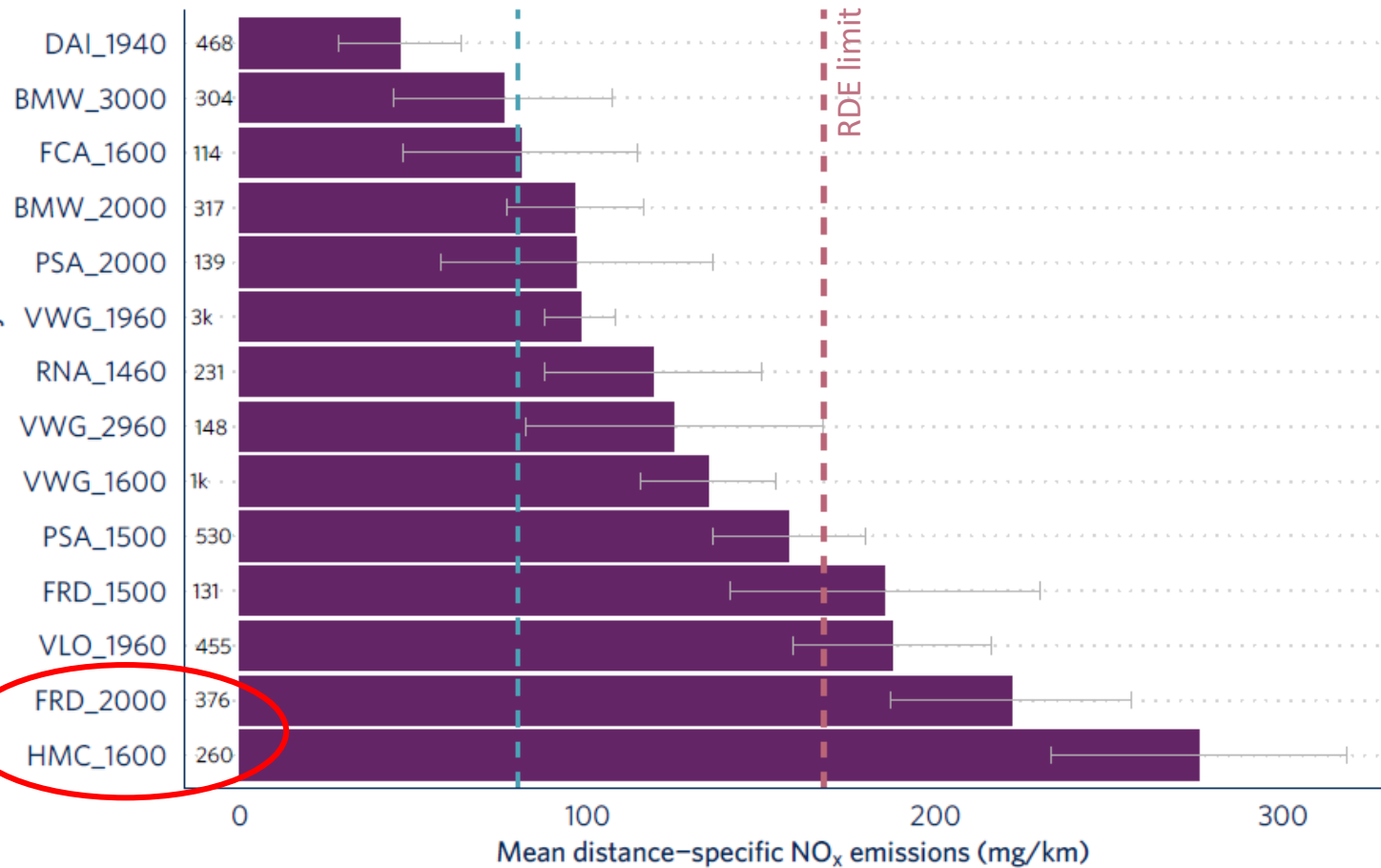
- Focus on compliance of in-use fleet and vehicle classes
- Identify worst performing vehicle families (or models, technologies, series, ...) for dedicated confirmatory measurements

**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

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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?

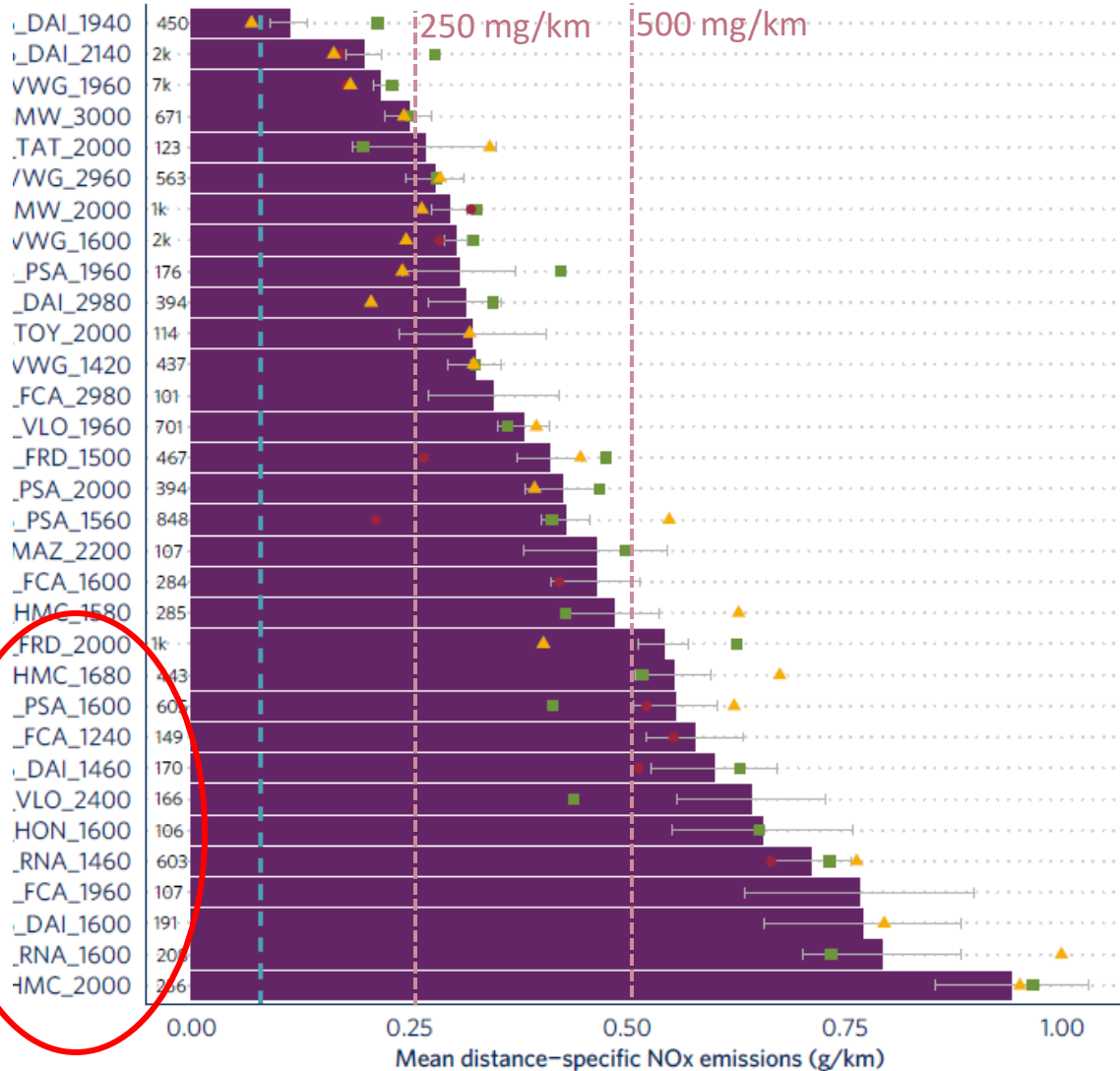
**Recommendation: Dedicated campaigns + data mining.**

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



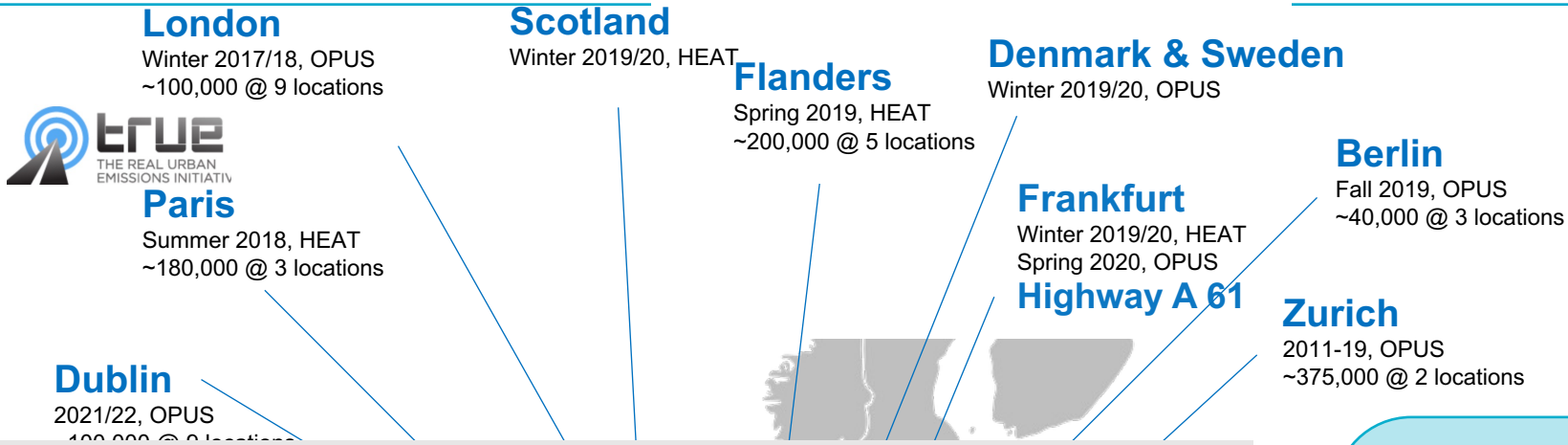
## 4) Identifying individual high-emitting vehicles

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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

