



APRIL Meeting  
Tuesday 24<sup>th</sup> February 2015

## EURO VI light-duty emission performance:

- ▶ Recent Remote Sensing Measurements
- ▶ Emission model (PHEM) results

**Dr James TATE**

Email: [j.e.tate@its.leeds.ac.uk](mailto:j.e.tate@its.leeds.ac.uk)

Twitter: [drjamestate](https://twitter.com/drjamestate)

## Acknowledged contributors:

Sheffield City Council

Technical University of Graz (TUG, AT)

Zurich City Council

# Outline

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- Vehicle emission Remote Sensing
  - Method
  - Results
    - Leeds Autumn/ Winter 2014
    - Zurich Summer 2014
- Vehicle emission modelling
  - PHEM (version 11.7.2, released 16/12/2014)
- Outlook

# Method

## Remote Sensing Vehicle Emissions

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Sheffield, May 2013



# Method

## Remote Sensing Vehicle Emissions

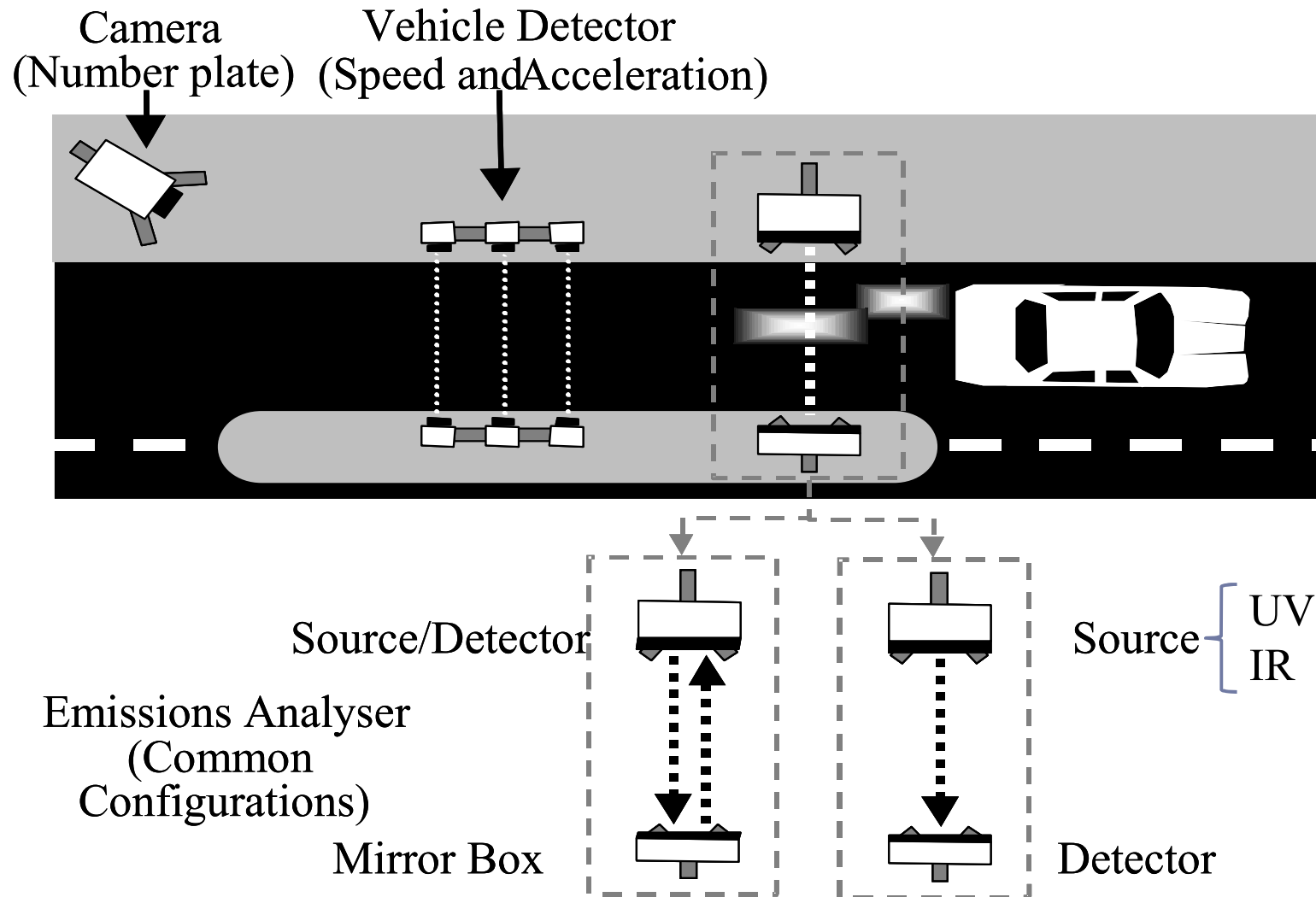
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Leeds, December 2014

# Method

## Remote Sensing Vehicle Emissions



► **ESP RSD-4600 instrument** ([www.esp-global.com](http://www.esp-global.com))

# Method

## Remote Sensing Vehicle Emissions

### Emission ratios

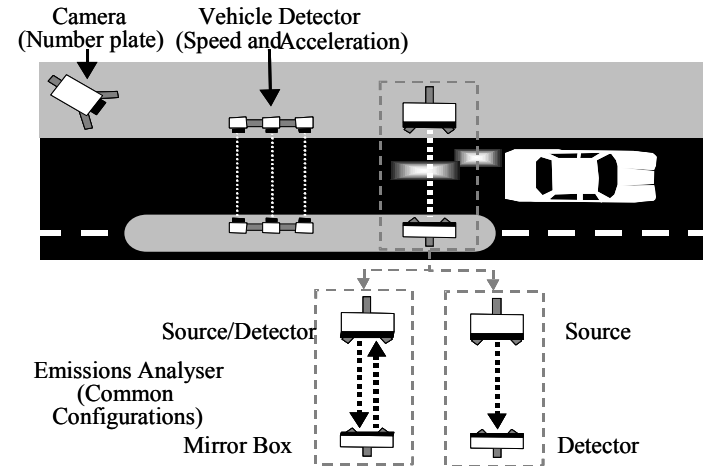
From peak exhaust plume conc.

- $\text{NO} / \text{CO}_2$
- Estimate  $\text{NO}_2 / \text{CO}_2$  &  $\text{NO}_x / \text{CO}_2$
- $\text{CO} / \text{CO}_2$
- $\text{HC} / \text{CO}_2$  &
- $\text{PM}_{10}$

Baseline condition taken from front of the vehicle

### Valid measurement

- ✓ 5 – 60 km/h
  - ✓ Sufficient  $\text{CO}_2$  plume
  - ✓ Number plate record
- Site selection important



### Vehicle Fleet Information

Number plate record **ANPR**

- Detailed vehicle registration info.
- Annoymised DVLA type data
  - vehicle type & euro category
  - fuel type and engine capacity
  - manufacturer & model
  - $\text{CO}_2$  performance etc.

# Method

## Remote Sensing Vehicle Emissions

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### **PROS:**

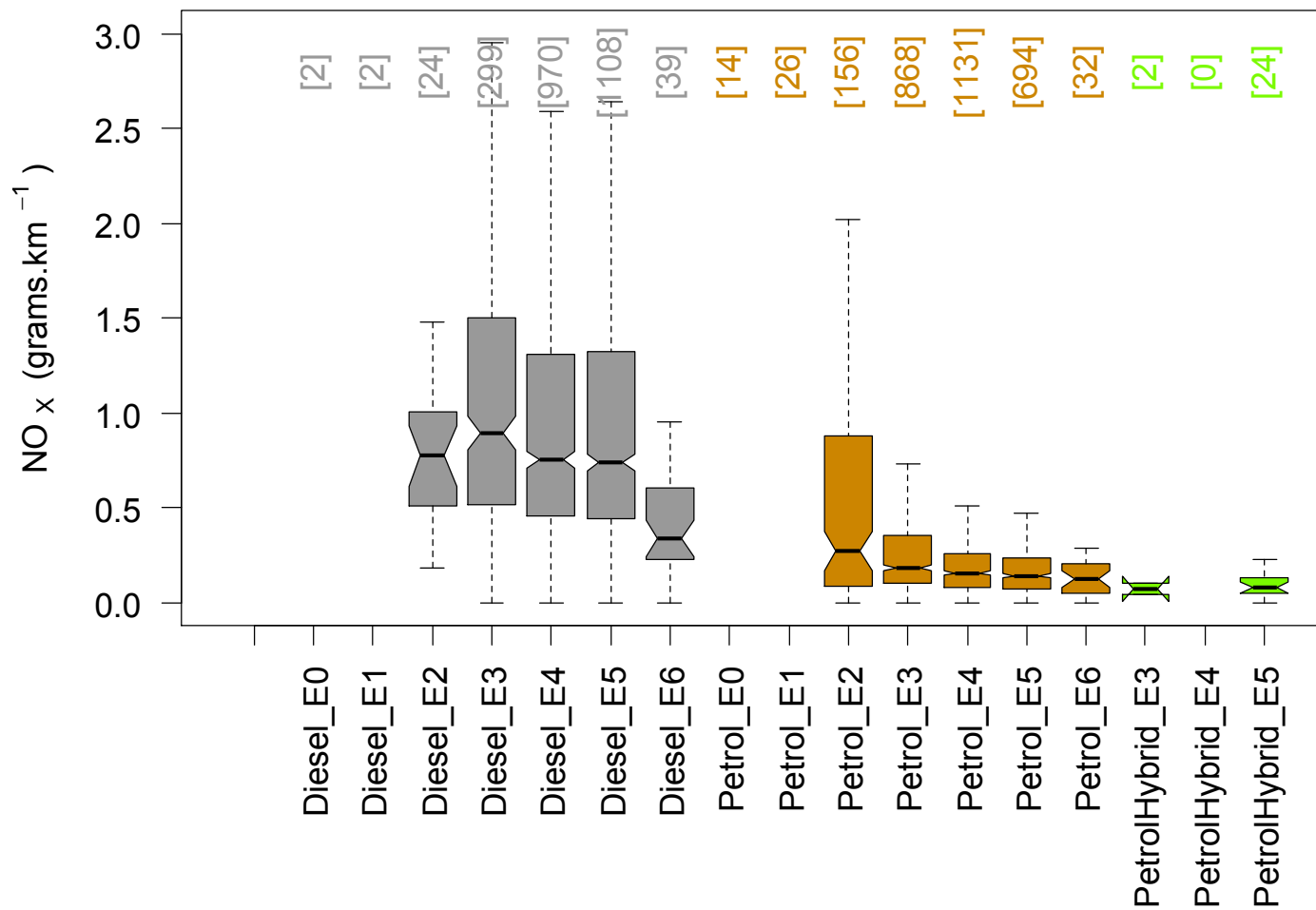
- ▶ “Real-world” or “on road” or “RDE”
- ▶ Understand the emission performance of the vehicle fleet
  - ▶ Trends
  - ▶ Degradation/ ageing technologies
  - ▶ High-emitters
- ▶ Detailed knowledge of the vehicle fleet composition
- ▶ Fast turn-round (one month)
  - ▶ Survey emerging technologies  
e.g. Euro VI compliant vehicles
- ▶ Rich research resource

### **CONS:**

- ▶ “Snap-shot” or “single-point” measurement
- ▶ Vehicle operating condition unknown
  - ▶ Loading
  - ▶ Cold-start or Hot-running
- ▶ Elevated exhausts – NULL
- ▶ Lorries “open” chassis
- ▶ Practical limitations
  - ▶ Dry weather conditions
  - ▶ Relatively labour intensive
  - ▶ Suitable survey locations limited

# Results

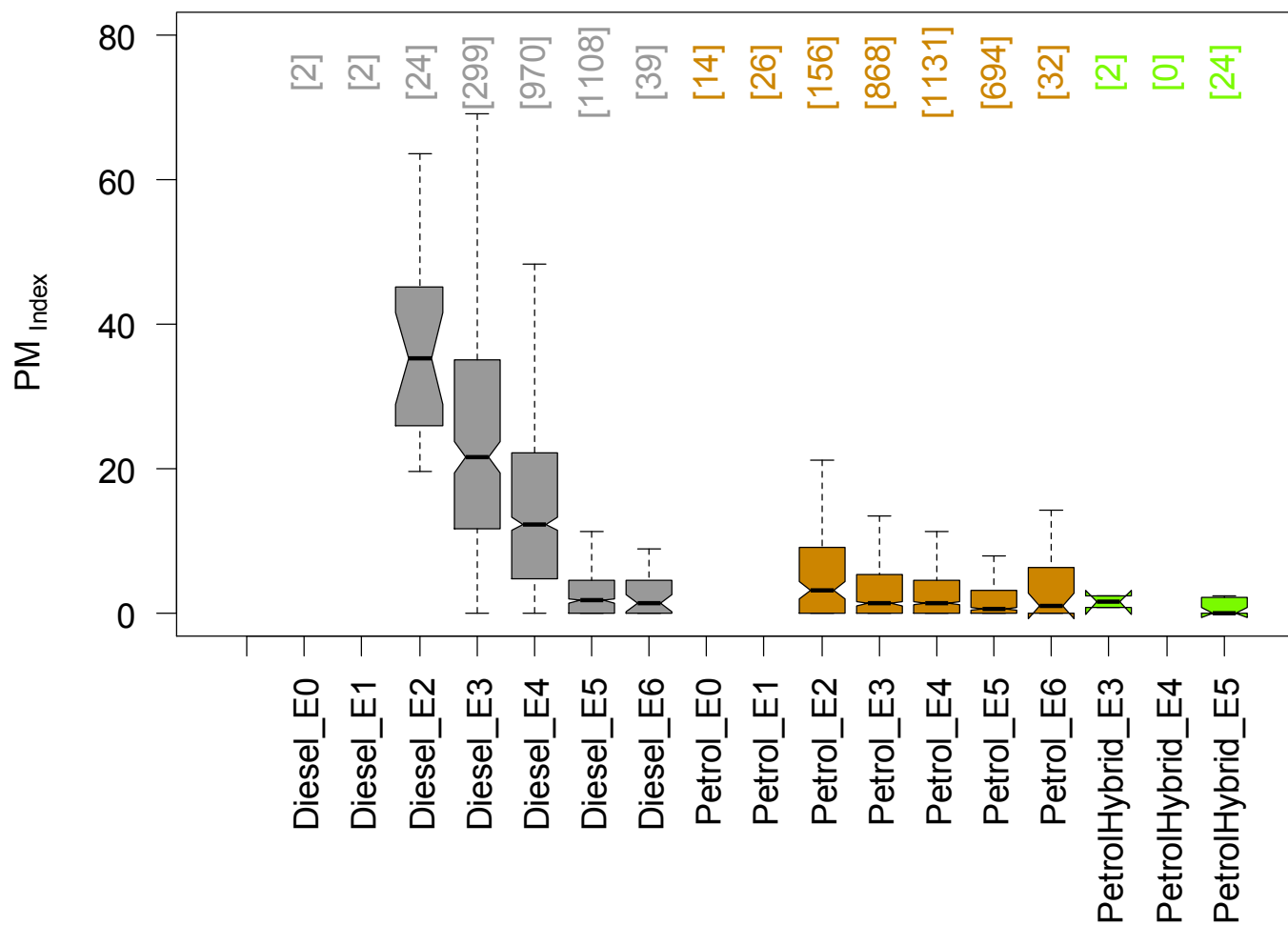
Leeds Autumn/ Winter 2014





# Results

Leeds Autumn/ Winter 2014



# Method

## Remote Sensing Vehicle Emissions

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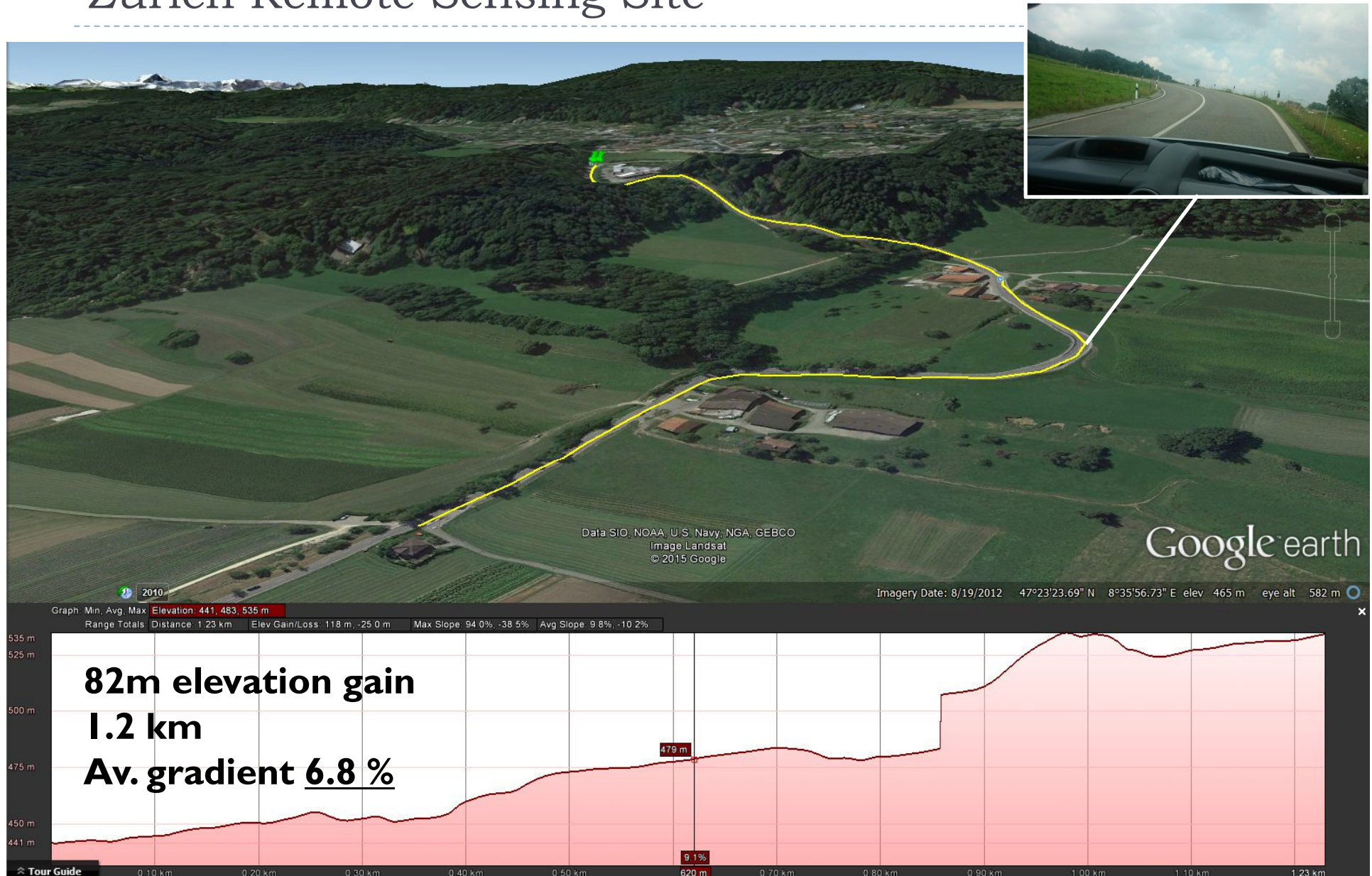


Zurich, July 2014

*And 2000, 2001, 2002..... 2013*

# Method

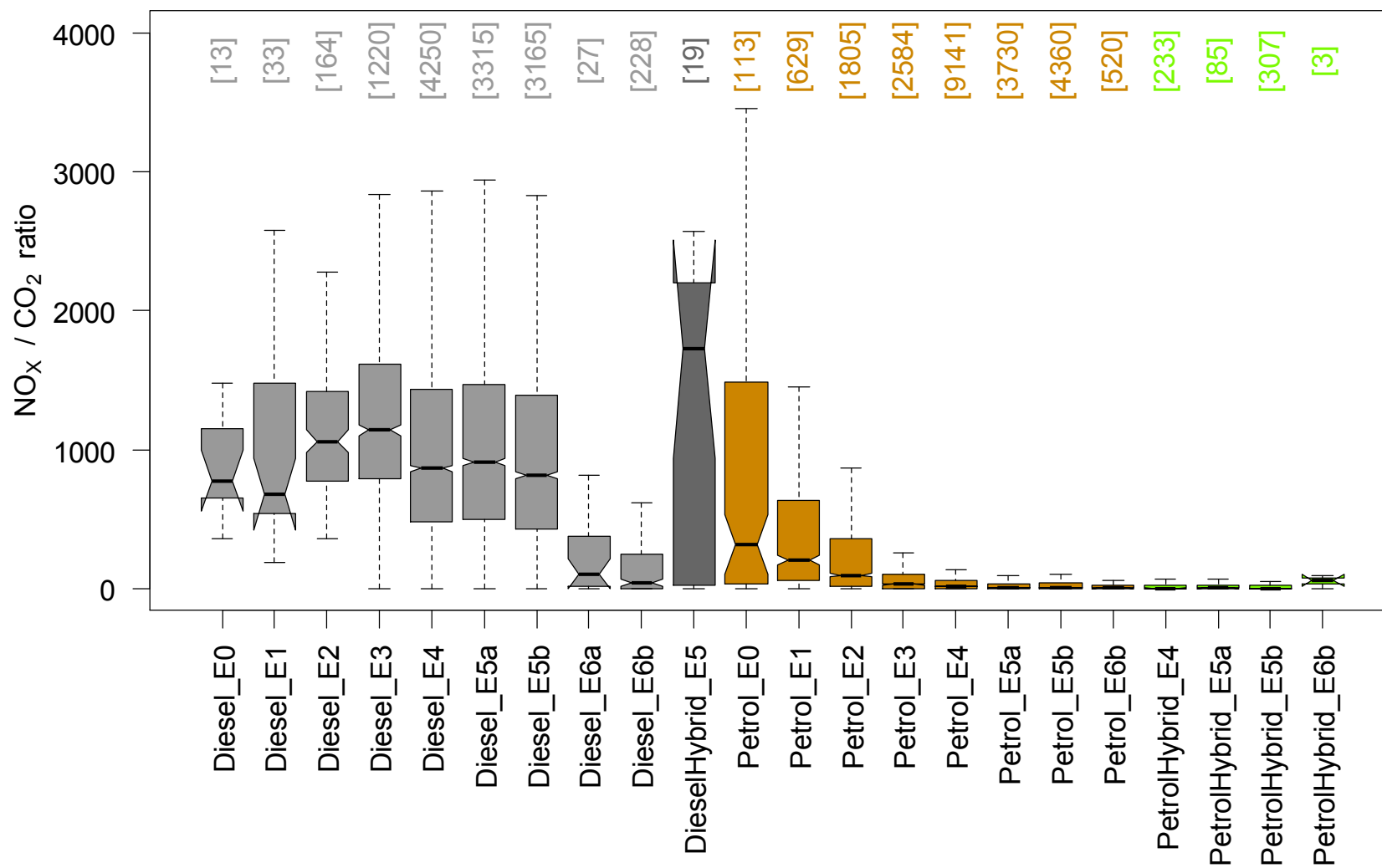
## Zurich Remote Sensing Site





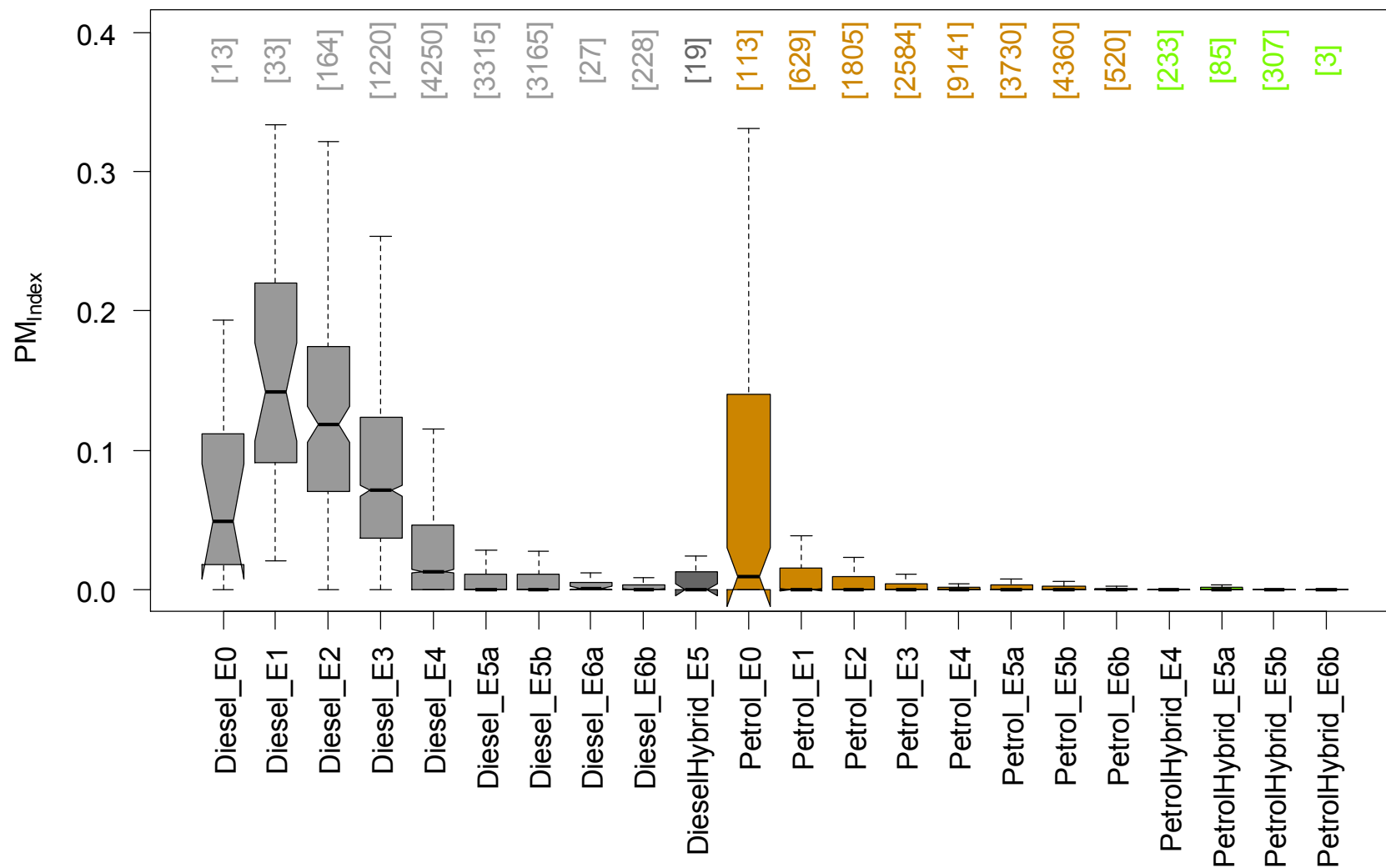
# Results

Zurich, Summer 2014



# Results

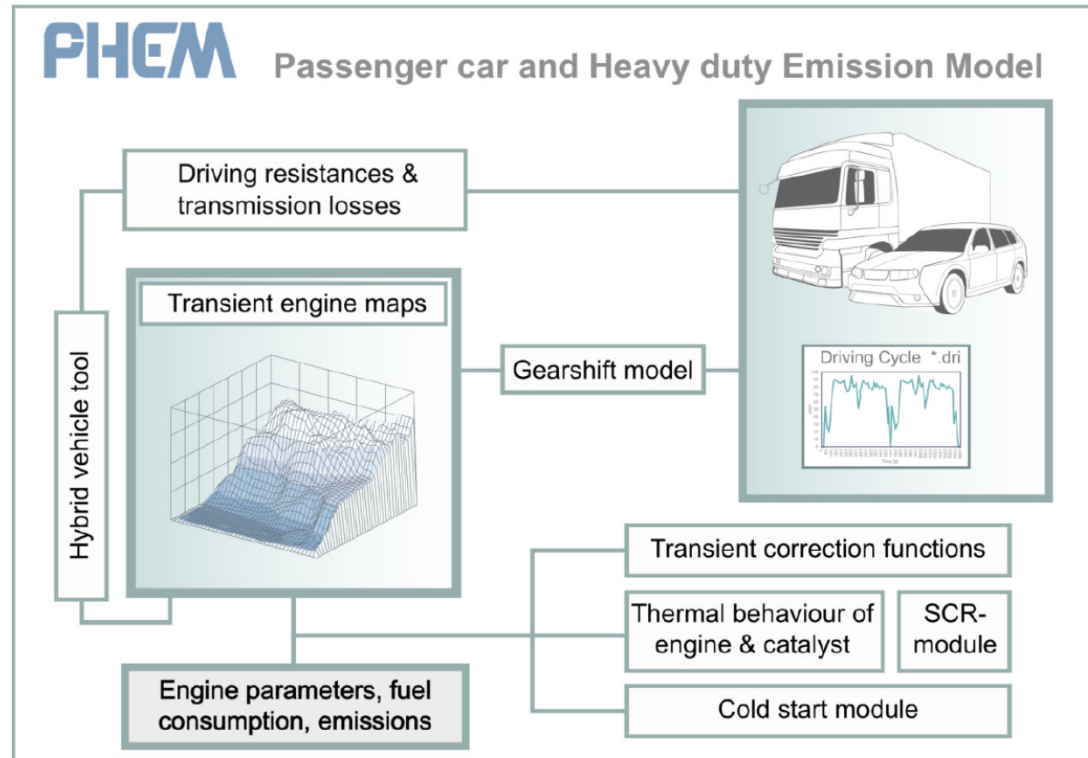
Zurich, Summer 2014





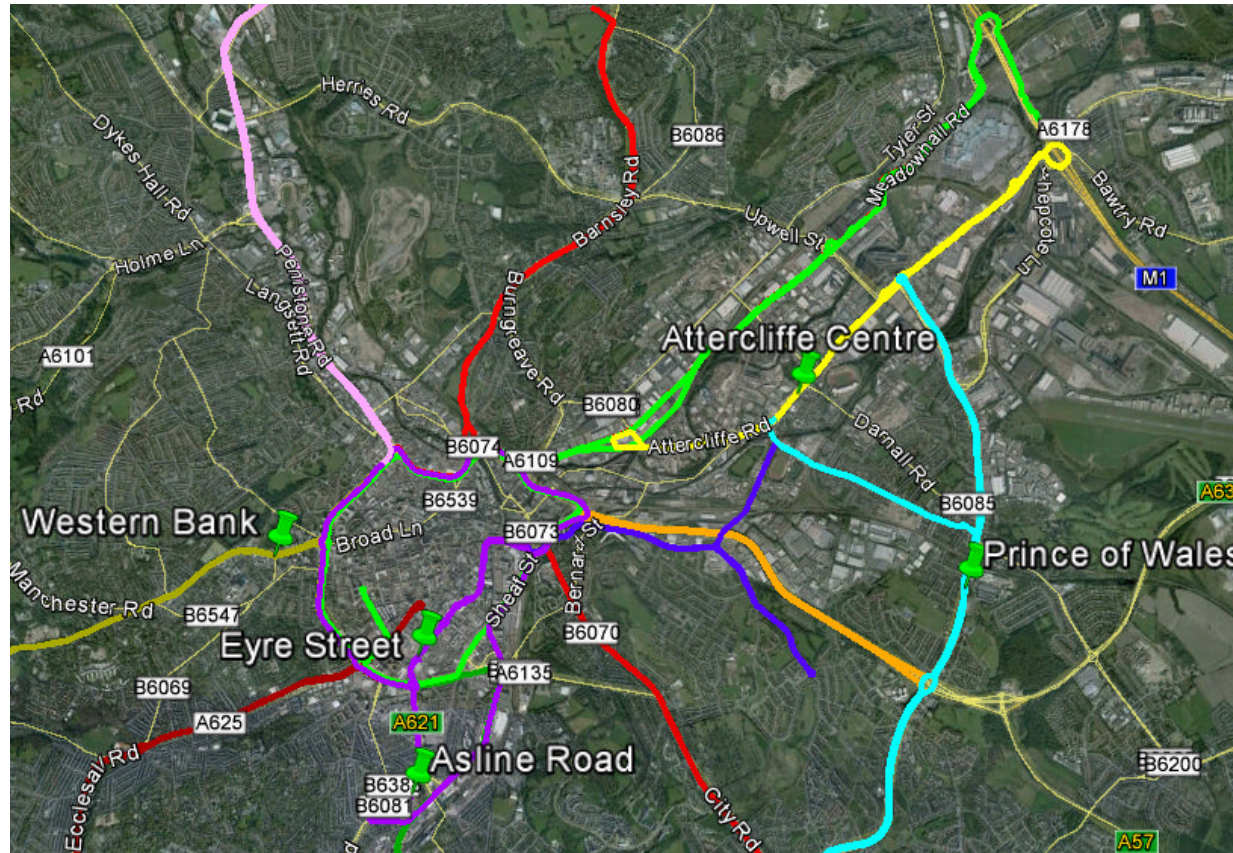
# PHEM

Version 11.7.2, released 16/12/2014



- HBEFA update version 3.2 (Dec '13)
  - CADC drive cycle
  - ERMES drive cycle
- Modal data 5 Euro VI diesel cars
- Bag data 19 Euro VI diesel cars (TUG, TNO)
  - Premium vehicles
  - Large, higher powered vehicles

## Sheffield 2013 : VBox GPS + CAN (1Hz) + Road gradient (%)

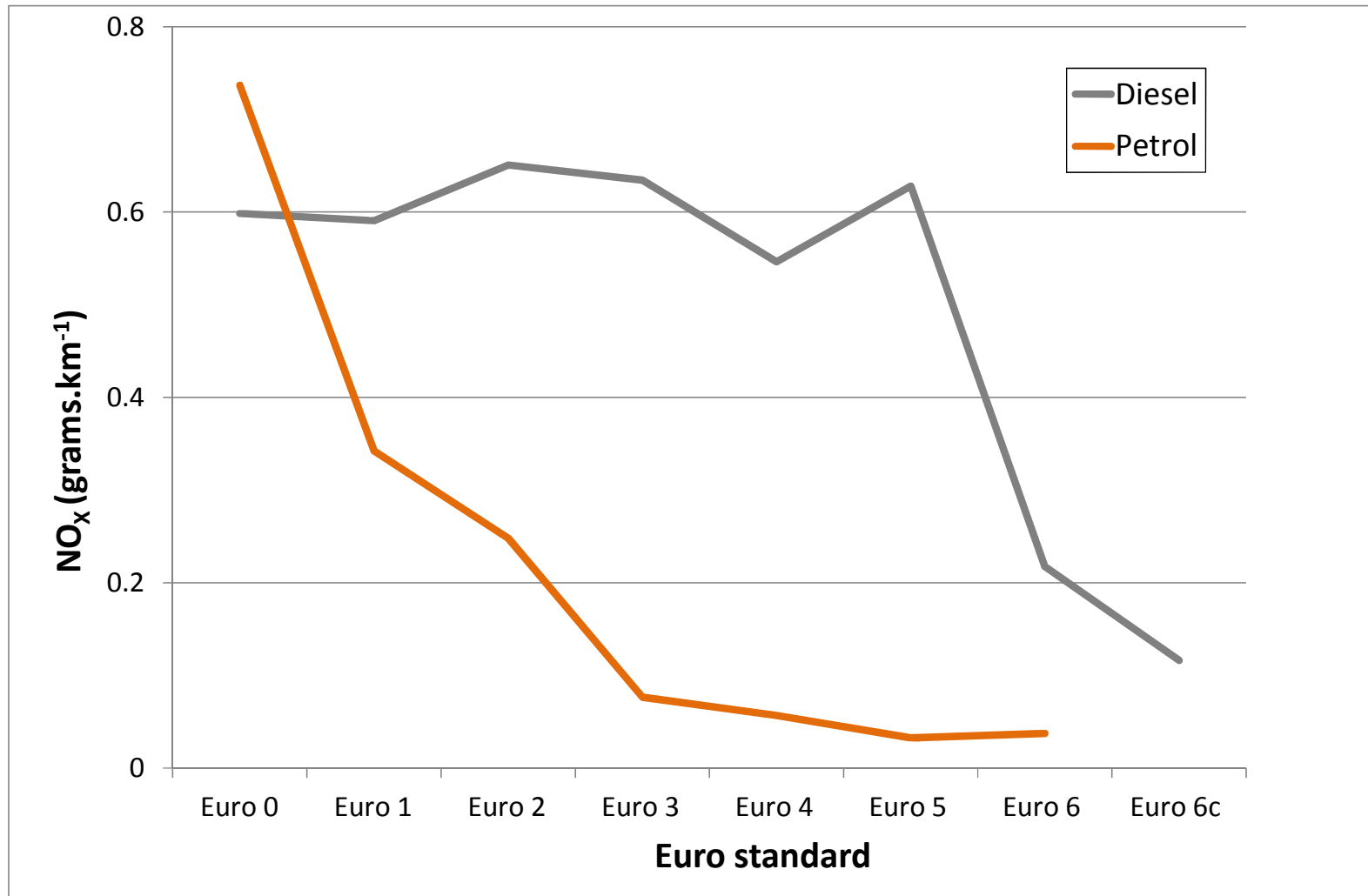


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Wyatt, D., Li, H., Tate, J. 2014. The impact of road grade on carbon dioxide (CO<sub>2</sub>) emission of a passenger vehicle in real-world driving. *Transportation Research Part D: Transport and Environment*, 32, pp 160-170, October 2014, DOI: [10.1016/j.trd.2014.07.015](https://doi.org/10.1016/j.trd.2014.07.015)

# PHEM NO<sub>x</sub> Emission Factors

Sheffield 2013 activity data (with grade)



# Outlook

## Diesel Euro VI passenger cars

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- Initial assessment – good improvement over Euro V
  - RDE far in excess of emission standard limits
- Worst performance expected in congested, urban driving conditions
- Demands continuous review
  - Not simply an evaluation of the first generation of Euro VI vehicles from premium manufacturers
- Deterioration of technology unknown
  - SCR dosage a concern
- Significance of engine re-mapping and emission control removal (e.g. DPF removal) unknown
  - Considered minor new cars (warranty and leasing schemes)





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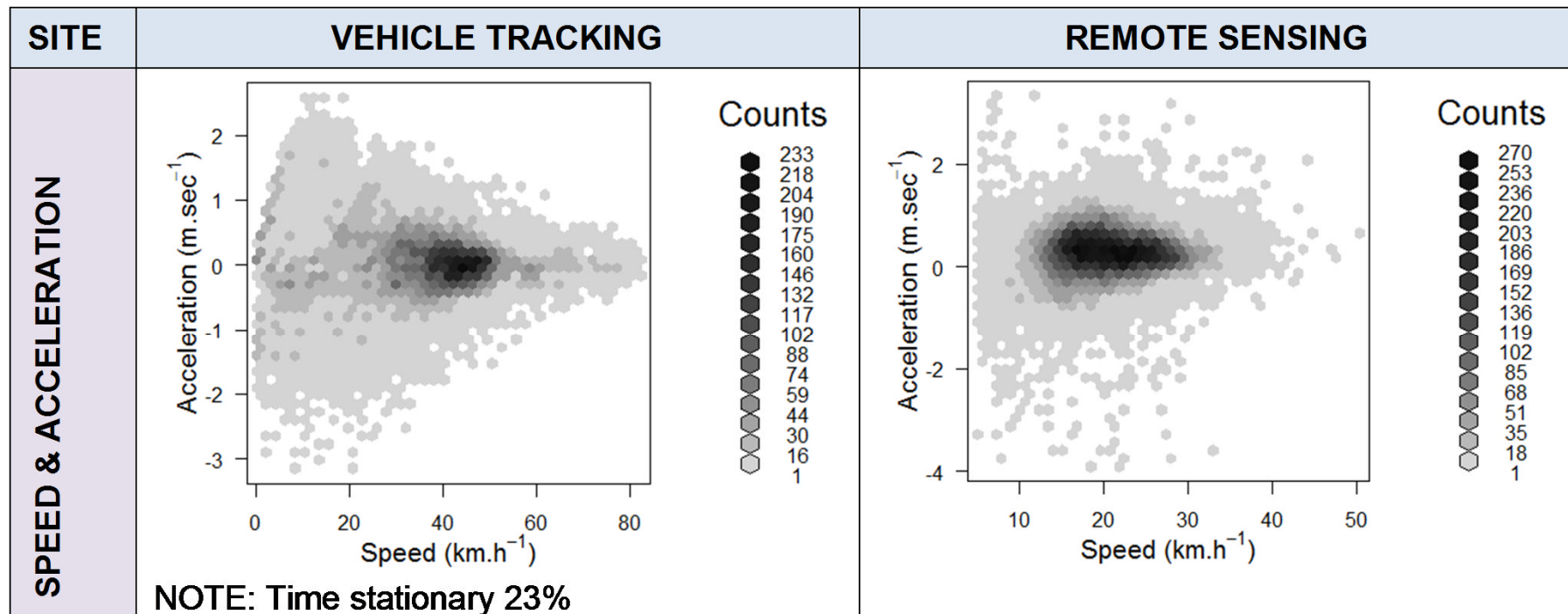
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# PAMS & Remote Sensing comparison

## Speed & Acceleration



*Frequency diagrams of the observed Speed and Accelerations distributions from the Vehicle tracking surveys and those recorded by the Remote Sensing Device (Sheffield, 2013)*