Vehicle Emissions Remote Sensing in Jersey

Ricardo Energy & Environment

1 Introduction

Between Tuesday 19th and Thursday 21st September 2017 Ricardo deployed vehicle emissions remote sensing instrumentation in Jersey. Measurements were made at three locations in, or close to, St Hellier:

- Route du Forte (A17) eastbound away from city and towards tunnel
- Route du Forte (A17) westbound towards city and tunnel
- Victoria Avenue (A2) westbound away from city

These locations are indicated on the map below. Over 15,000 vehicle measurements were made over the course of the measurement campaign.

Certain aspects of this report are interactive. Hover your mouse over the plots to reveal more information.

These measurements add to Ricardo's extensive, and ever growing, database of real-world vehicle emissions that include data representative of a wide range of driving conditions, fleet mixes and locations. Other measurements have been made at locations on the UK mainland. A summary of the monitoring data from the campaign has been provided to States of Jersey.

The vehicle emissions remote sensing instrument measures accurately measures real-world driving emissions and is configured to measure emissions of nitric oxide, nitrogen dioxide, particulate matter, hydrocarbons, carbon monoxide and ammonia. Emissions are measured as ratios to CO_2 and through combustion equations are converted to grammes of pollutant per unit of fuel (g/kg). A camera records number plates of passing vehicles and vehicle speed and acceleration are recorded. Vehicle emissions are matched to vehicle details provided by State of Jersey including, where available, vehicle manufacturer and model, fuel type, engine size, vehicle weight, date of registration, manufacturer provided vehicle CO_2 emissions and the odometer reading at last sale. The vehicle type has been determined based on vehicle manufacturer and model, and Euro standard has been estimated from the provided date of registration.

This summary report presents a sample of the analysis of the real-world emissions measurements made during the Jersey measurement campaign.

The potential benefits of the study include:

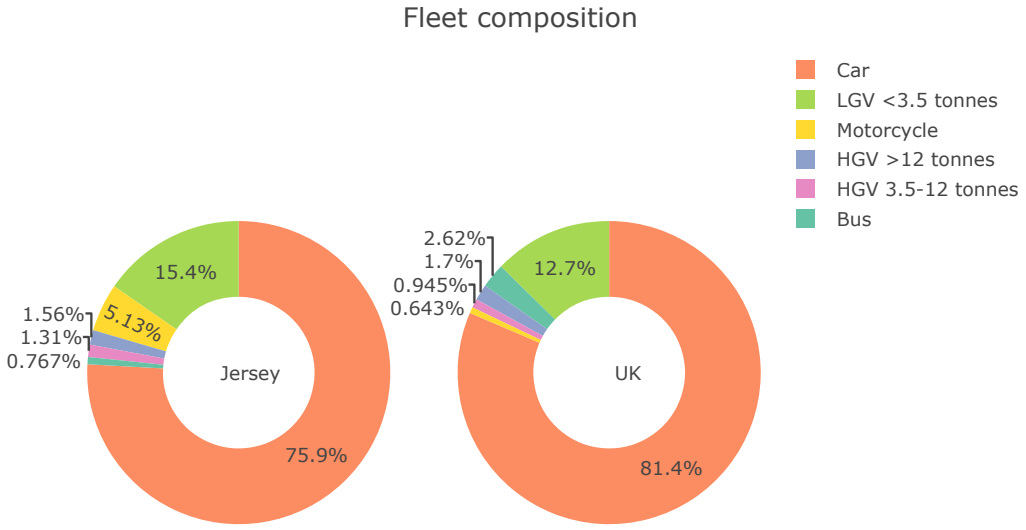
- The design and development of cost effective, evidence-based, pollution mitigation schemes to support any Air Quality Action Plan (AQAP) and Air Quality Strategy through real-world driving emissions measurement data that accurately characterise the vehicle fleet mix, identifying the most polluting vehicle types (i.e. buses, large goods vehicles, vans and cars) and their respective contributions to emissions, and quantified and highly disaggregated emissions data to underpin robust mitigation measures
- Identify the primary sources of local emissions of NOx and Particulate Matter and enable them to be effectively targeted.
- The improvement of local air quality emissions inventories and modelling.
- Raise Public Awareness to the work being carried out by States of Jersey to improve air quality.

2 Fleet composition

2.1 Fleet by vehicle type

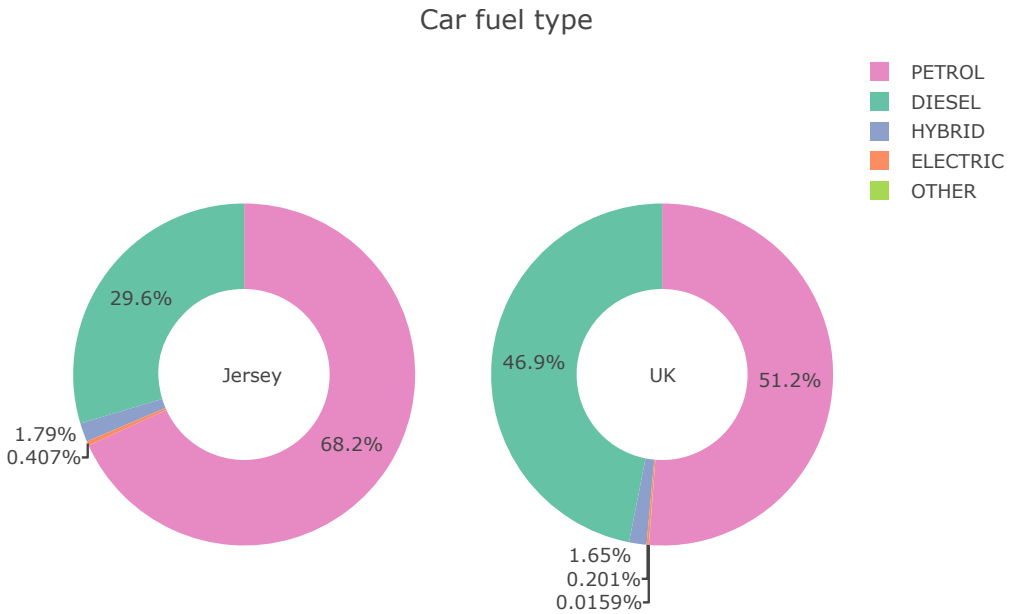
The pie charts below show the proportions of cars, HGVs, LGVs, buses and motorcycles sampled in Jersey compared to the wider Ricardo database of real-world vehicle emissions in the UK. The fleet recorded during the Jersey measurement campaign is similar to the fleet recorded at UK locations. A higher proportion of motorcycles and LGVs are seen than is typical of UK sites within the database.

Click a category on the key to remove / add it.



2.2 Car fleet by fuel type

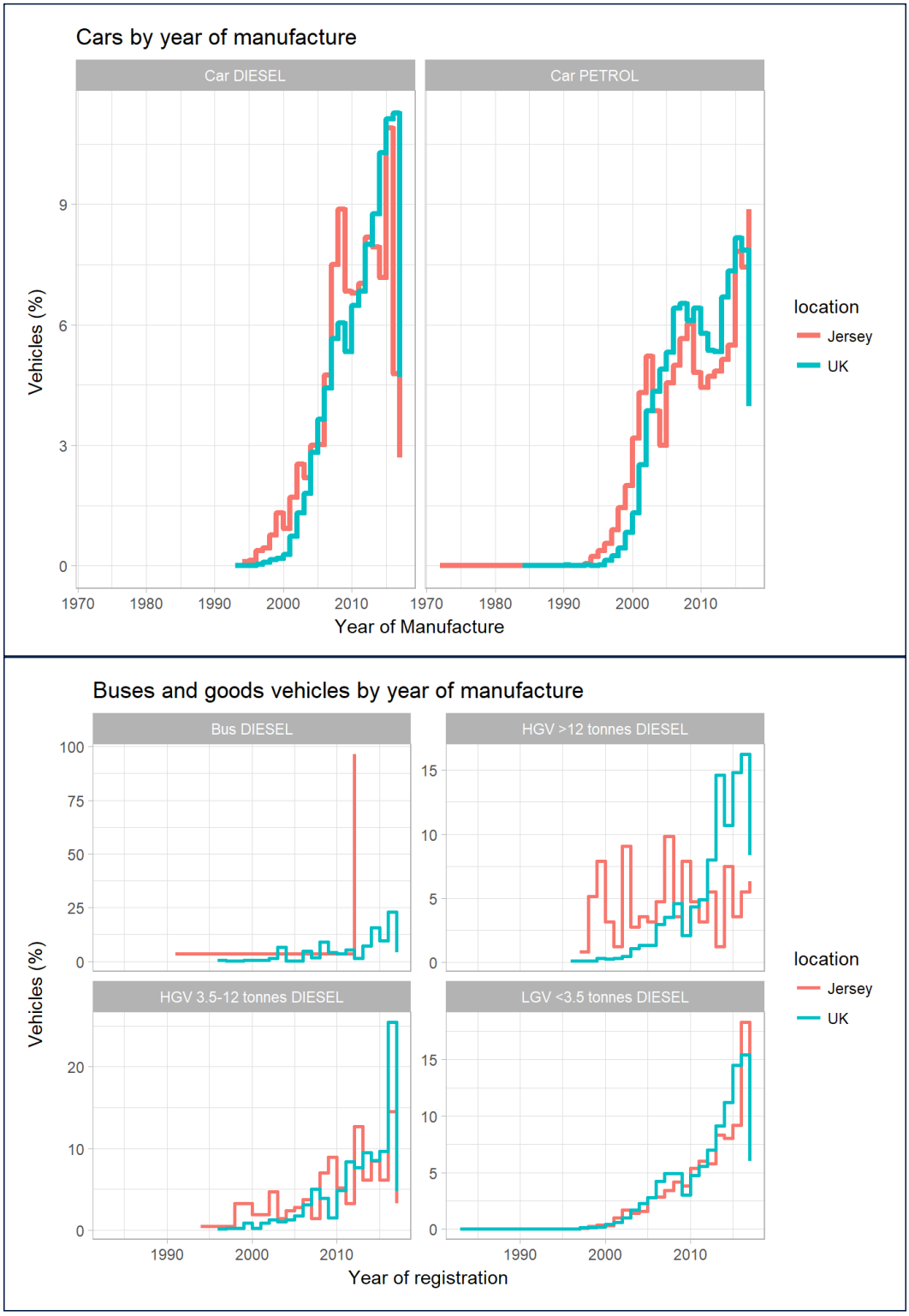
Cars may be fuelled by petrol, diesel or an alternative fuel such as electricity, hybrid diesel/petrol and electric or petrol mixed with an alternative such a LPG or alcohol. The pie charts below show that alternative fuels make up a small share of around 2% of the total car fleet recorded during the Jersey measurement campaign. Petrol cars made up 68% of the fleet recorded in Jersey, a significantly higher proportion than recorded at locations on the UK mainland.



2.3 Fleet by year of manufacture

The age of the fleet is a significant factor when considering vehicle emissions. European exhaust emission standards set out emissions limits that new vehicles must meet under test conditions and these emissions standards are periodically updated to increase the stringency of emissions limits. The age distribution of the petrol car fleet in Jersey shows the majority of vehicles were

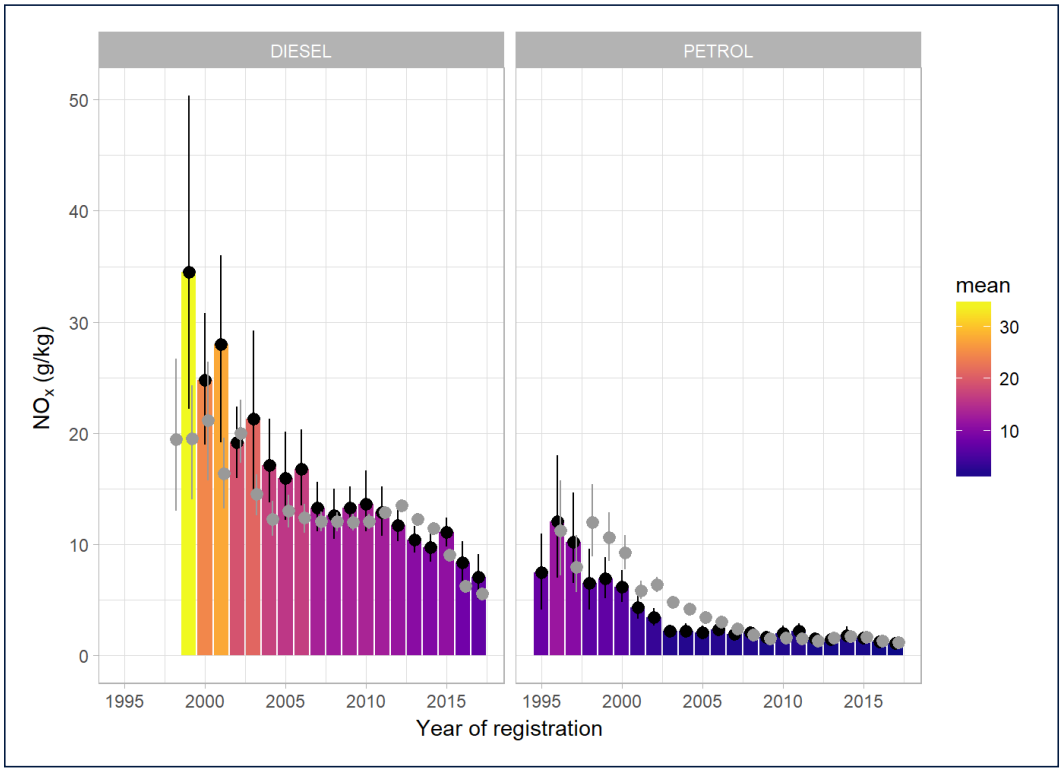
registered after the 1990s. The age distribution shows three peaks in the distribution at 2002, 2008 and 2015-2017. The age distribution of the diesel car fleet shows that diesel cars are generally newer, with the majority of vehicles registered after 2005.



3 Emissions from Cars

3.1 NO_x by year of registration

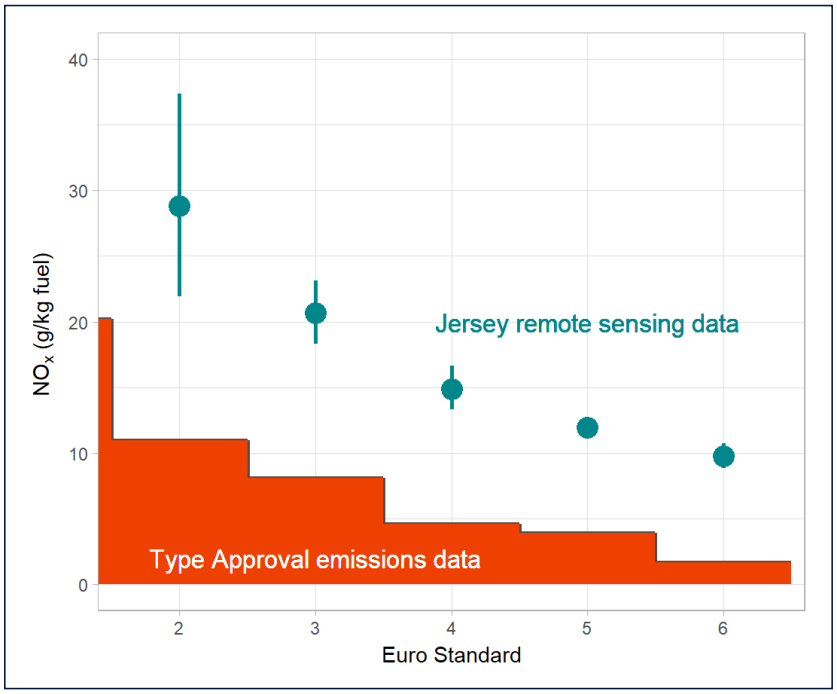
The plot shows the mean NO_x emissions from cars by fuel type derived from data taken during the Jersey measurement campaign. The error bars show the 95% confidence interval in the mean. Data points for which 20 or fewer valid vehicle emissions measurements were recorded have been excluded from the plot. The black points and coloured bars present the data derived from Jersey campaign whilst the grey points represent data from measurements in the wider Ricardo database of real-world vehicle emissions for comparison. Overall, the trends in the Jersey data and that collected on the UK mainland are similar.



3.2 Comparison with Type Approval measurements of NO_x

The Vehicle Emissions Remote Sensing data can be used to compare actual real-world emissions with Type Approval measurements. In the UK, the Vehicle Certification Agency (http://carfueldata.direct.gov.uk/downloads/default.aspx) (VCA) are responsible for measuring the emissions from new models of vehicles that enter the UK market. These measurements currently consist of 1000s of cars assessed over the NEDC test cycle under laboratory conditions.

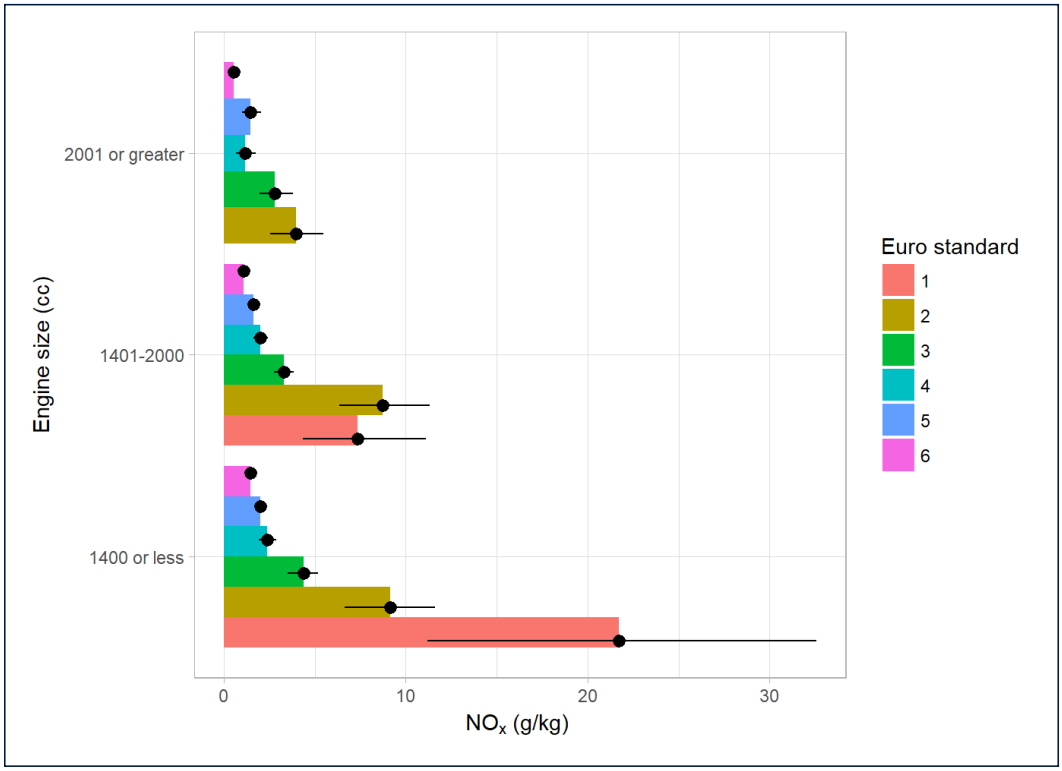
The plot below shows how the Type Approval emission measurements of NO_x have changed over the Euro classes from **diesel cars** (shown by the shaded region). For comparison, the points and the uncertainties represent data within Ricardo's real-world vehicle emissions database recorded during the Jersey measurement campaign. Euro 5 and 6 car real-world measurements are, on average around a factor of 4 higher than the Type Approval measurements. It should be noted that there is a much wider range of values when individual vehicle manufacturers are considered - as such understanding of the local and regional fleet mixes may be important in the design of emissions reduction schemes.



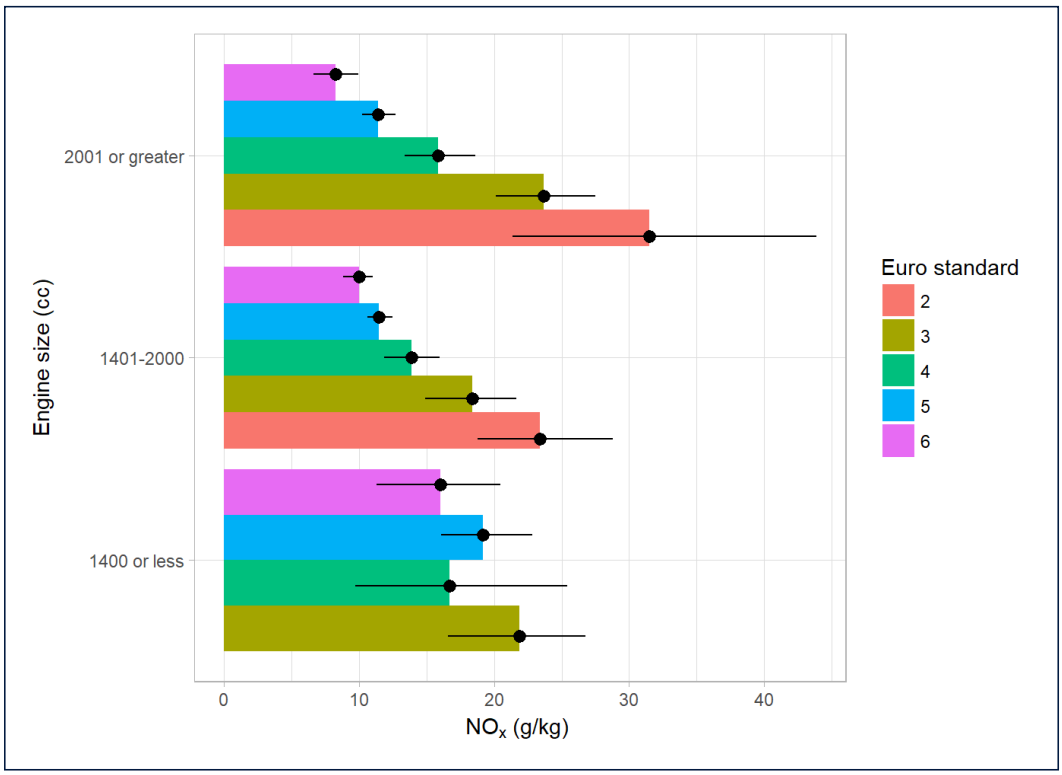
3.3 NOx emissions by engine size

The plots below show NO_x emissions from petrol and diesel cars grouped by euro standard and three categories of engine size from measurements made during the Jersey campaign. Note that emissions are presented in units of grammes of NO_x per kg fuel used and therefore does not factor in the higher fuel use that would be expected for larger vehicles.

3.3.1 Petrol cars



3.3.2 Diesel cars

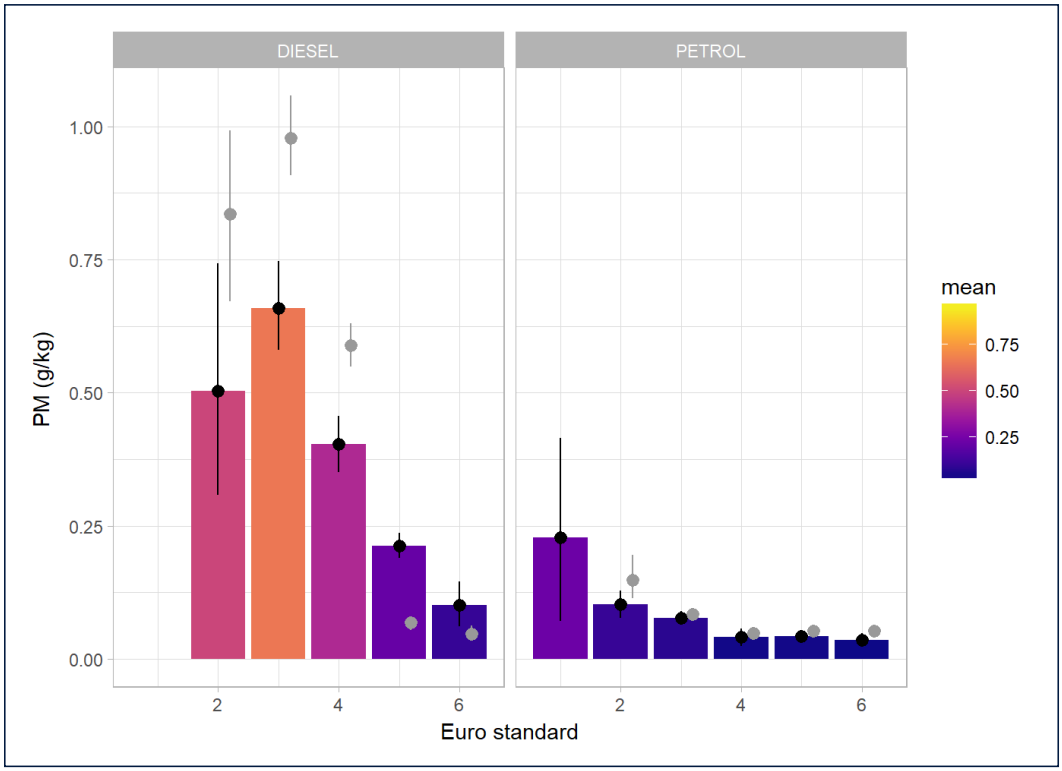


3.4 PM by Euro standard

The plot below shows the mean emissions of particulate matter (PM) from cars by fuel type derived from Ricardo's vehicle emissions remote sensing measurements. The results from the Jersey campaign (coloured bars and black points) are presented alongside the results from measuerments across the UK (grey points). The error bars show the 95% conficence interval in the mean. Data points for which 20 or fewer valid vehicle emissions measurements were excuded from the plot.

The plot shows PM emissions are low for petrol cars. The UK measurements show PM emissions for Euro 5 and 6 vehicles show a sharp decline for Euro 5 and 6 vehicles compared to earlier Euro standards. This reflects the tightening of limits on PM emissions from diesel cars from Euro 5 onwards, which required that all diesel vehicles are fitted with a DPF from Euro 5 onwards. The measurements demonstrate the success of diesel particulate filters (DPF) in reducing PM emissions. Some Euro 4 vehicles are also fitted with DPFs and this is reflected in the measurements. The trend in emissions of PM from diesel cars in Jersey differ from

the trends in emissions of PM measured at UK mainland locations. Emissions of PM show a steady decline between Euro 3 to Euro 6. This suggests that DPFs may not work as effectively under standard driving conditions in Jersey which are likely to consist of short journeys at low speed. DPFs require active regeneration every few hundred miles which requires driving at speeds greater than 40 mph for at least 10 minutes which may be difficult to achieve on Jersey. Alternatively, it may be that the practice of removing DPFs is widespread.



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