

Welsh Air Quality Forum
Caerphilly Council Chamber 2016

Air Quality Research Using Telematics Data

Dr James TATE

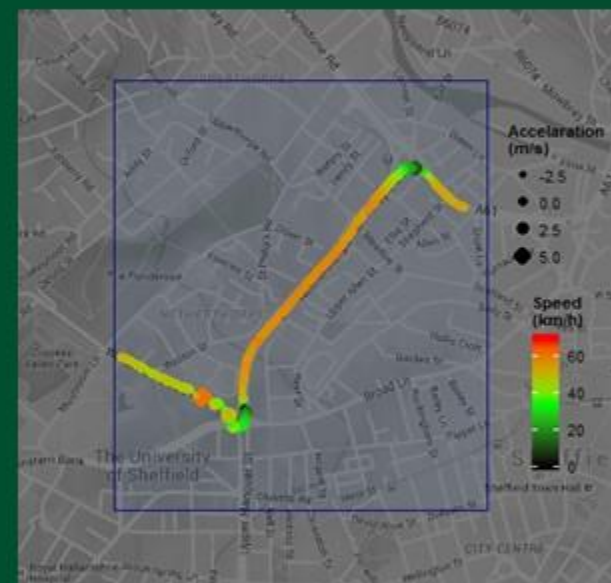
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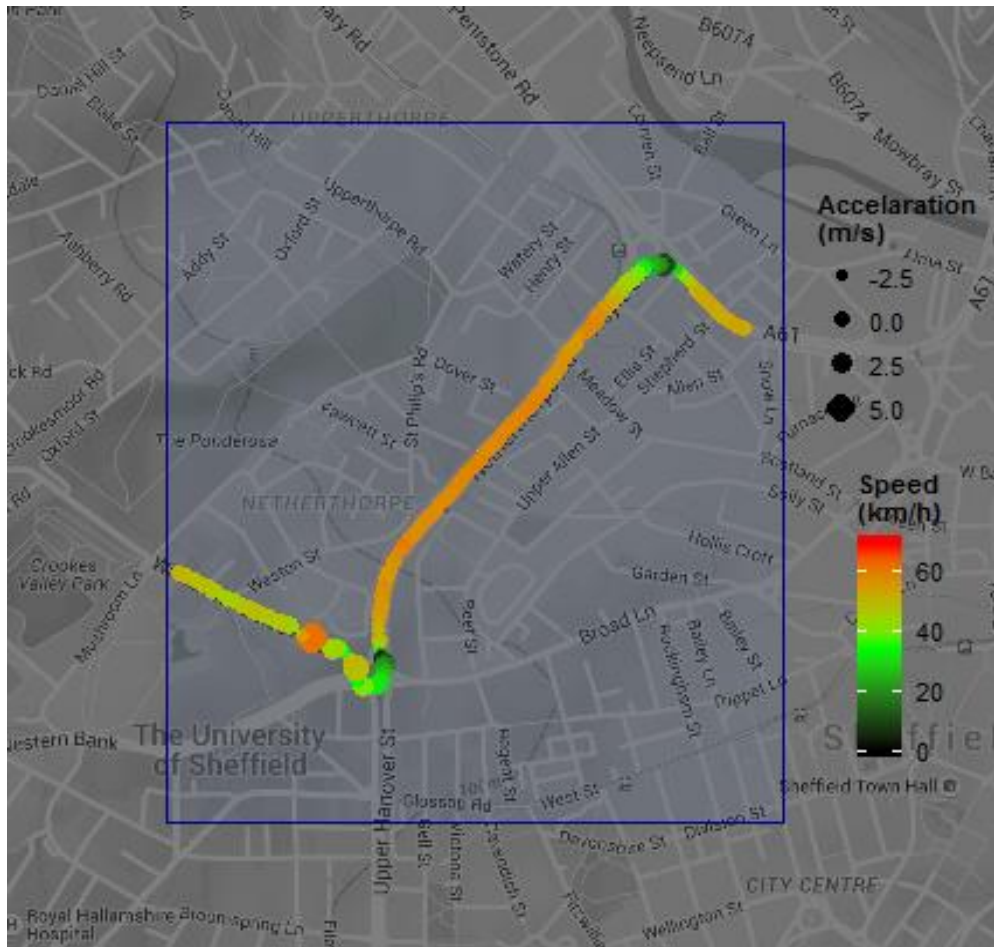
Dr Sam Chapman | Co-founder  THE FLOW

ITS



BIG telematics data

Vehicle tracking



Sources:

- ▶ Fleet surveillance e.g.
 - Eddie Stobbart
 - Taxis*
 - Insurance industry
 - ▶ GPS and CAN link 'black box' tracking
 - ▶ Second-by-second (1Hz) data
 - ▶ Young driver bias
 - ▶ Anonymised

* Nyhan, M., Sobolevsky, S., Kang, C., Robinson, P., Corti, A., Szell, M., Streets, D., Lu, L., Britter, R., Barrett, S., Ratti, C. 2016. Predicting vehicular emissions in high spatial resolution using pervasively measured transportation data and microscopic emissions model. Atmospheric Environment 140 (2016) 352-363. <http://dx.doi.org/10.1016/j.atmosenv.2016.06.018>

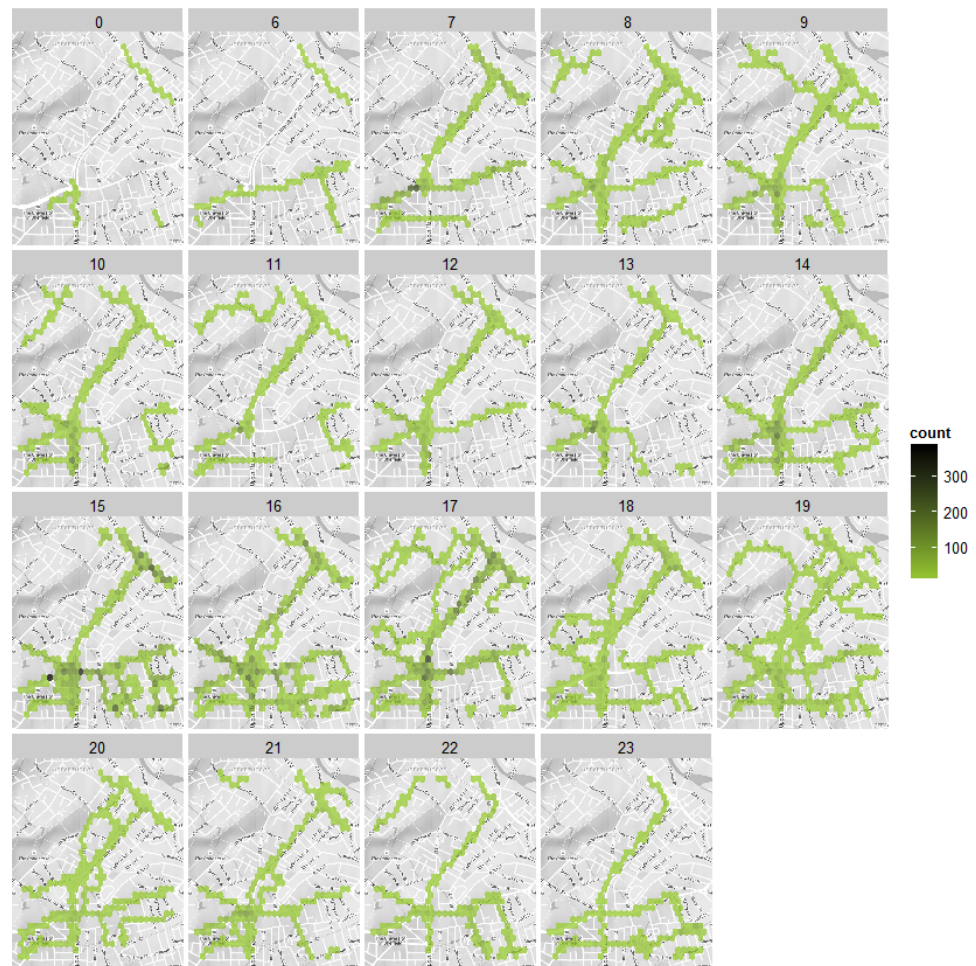
BENEFITS

BIG telematics data

Emission assessments account for local, real-driving conditions:

- ▶ Network-wide: No boundaries
- ▶ Vehicle acceleration, deceleration, cruising & idling
- ▶ Variability in traffic flow
 - Month of year
 - Day of week
 - Hour of day
 - Holidays
 - Special events
 - Weather
 - etc

FIGURE | Sample weekday GPS data by hour



CASE STUDIES

BIG telematics data

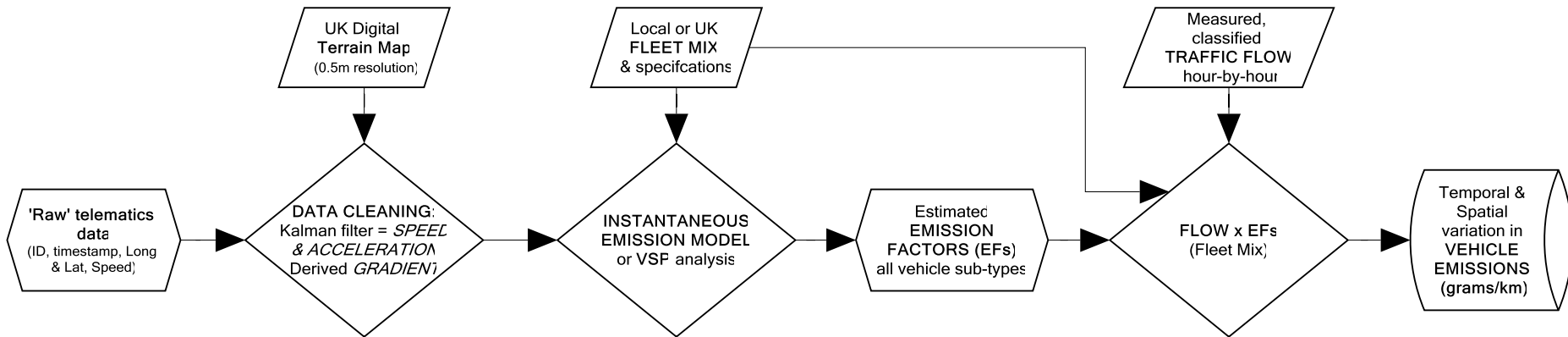
1. **Variable Speed Limits & 'Smart' Motorway operation**
 - ▶ One calendar year
 - ▶ Comparative STANDARD and SMART sections of motorway
 - ▶ Comparison of EMISSION FACTORS in the different controlled & non-controlled conditions

2. **Sheffield City Centre**
 - ▶ One calendar year (May 2014 – May 2015)

3. **Leeds BREACH area**
 - ▶ One calendar year (May 2015 – May 2016)
 - ▶ Detailed fleet analysis from ANPR study (April 2016)
 - ▶ EFs weighted by Fleet mix & Flow

METHOD

BIG telematics data ► vehicle emissions

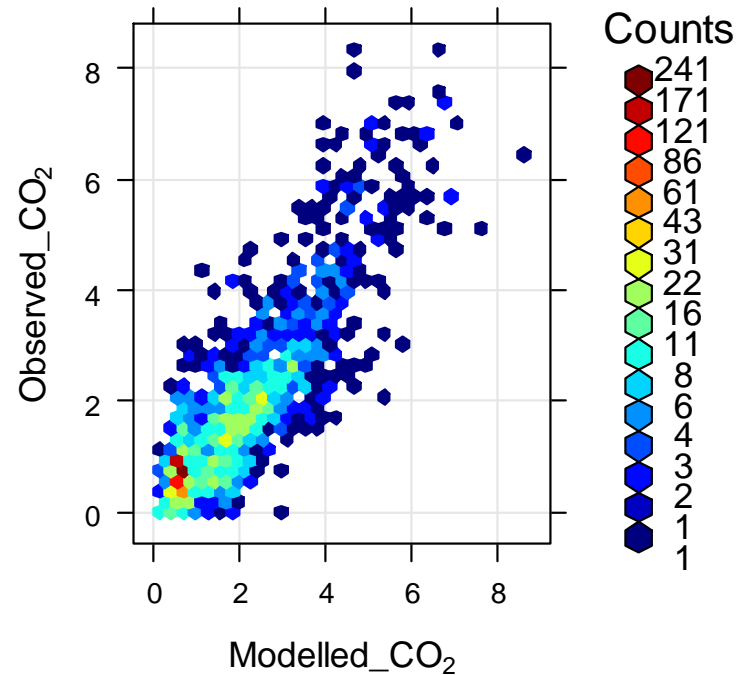
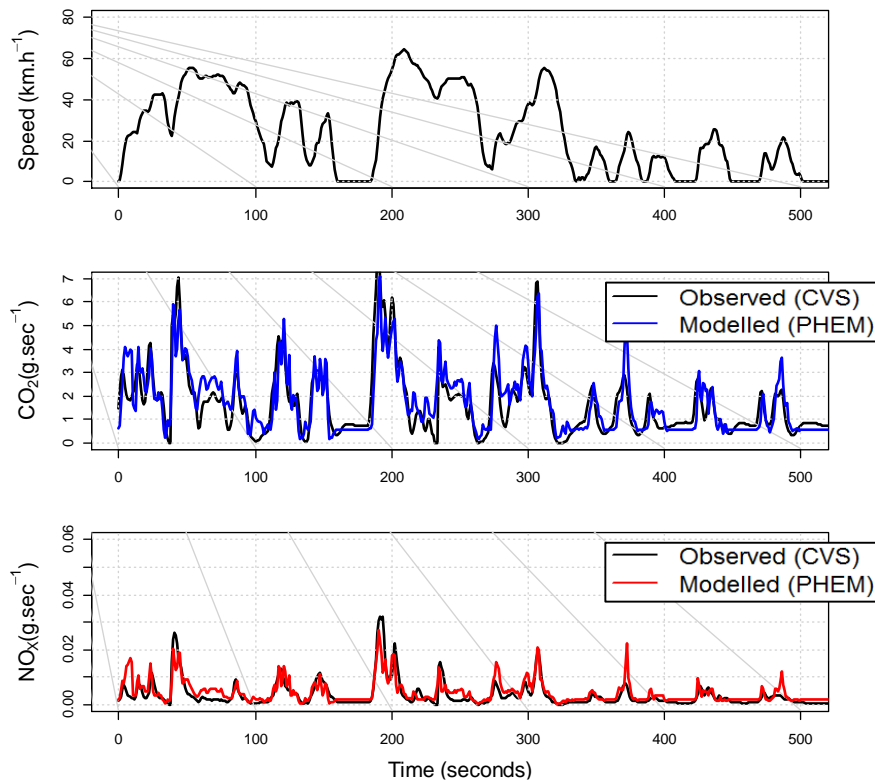


UNDER-PINNING MODEL

*Instantaneous Emission Model PHEM**

Passenger car and Heavy-duty Emission Model

FIGURES | Sample time series, TfL London Drive Cycle, Euro 5 small family diesel

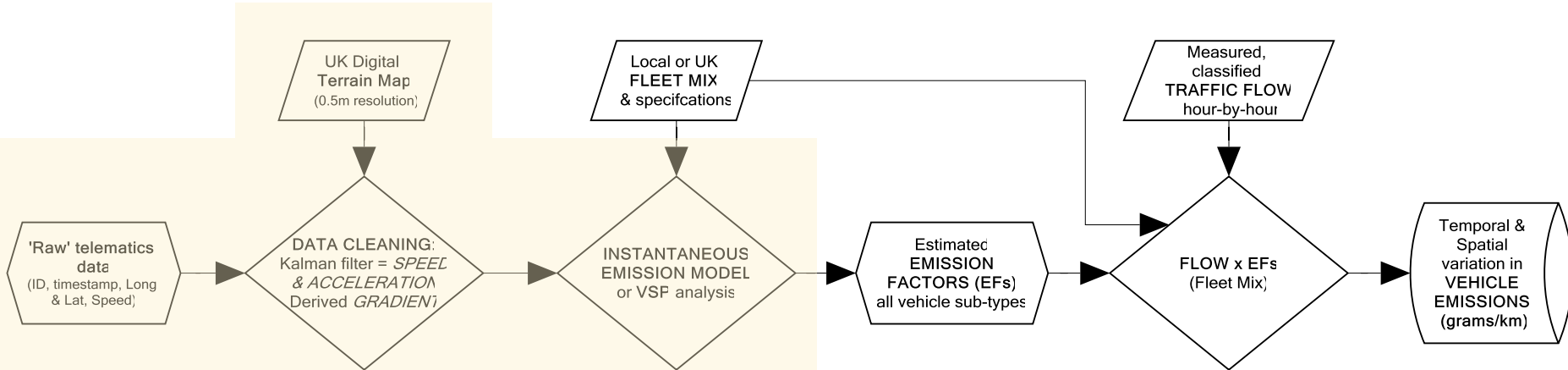


* Zallinger, M., Tate, J., and Hausberger, S. 2008. An instantaneous emission model for the passenger car fleet. Transport and Air Pollution conference, Graz 2008

Moody, A., Tate, J. 2016. In service CO₂ and NO_x emissions of Euro 6/VI cars, light- and heavy-duty goods vehicles in real London driving: Taking the road into the Laboratory. The 21st International Transport and Air Pollution (TAP) Conference, Lyon, France, May 24-26, 2016.

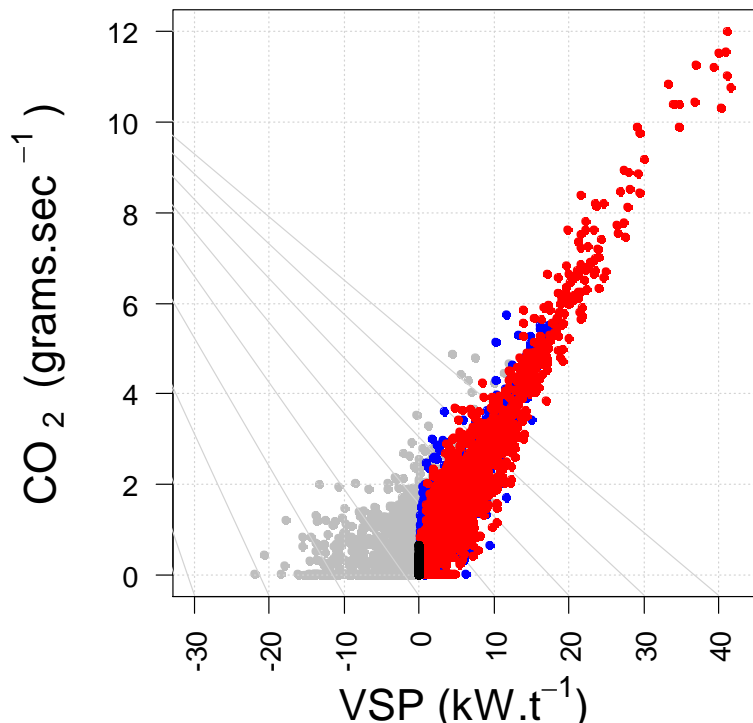
METHOD

BIG telematics data ► vehicle emissions

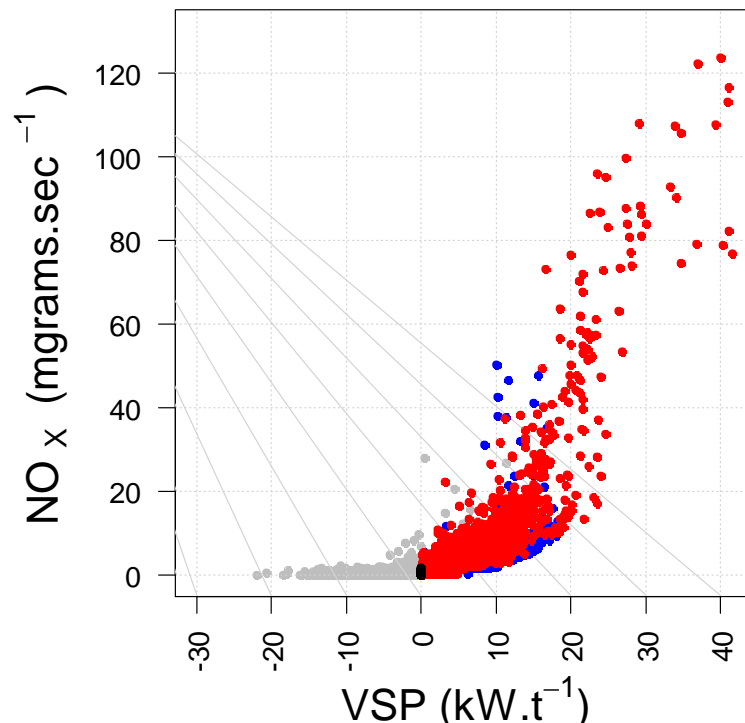


METHOD

Vehicle Specific Power



VSP on CO₂ emission rates for an illustrative Euro 6 diesel small family car



VSP on NO_x emission rates for an illustrative Euro 6 diesel small family car

- Accelerating Acceleration > 0.1 ms⁻²
- Cruising Vehicle speed > 0.5 ms⁻² and Acceleration in range ± 0.1 ms⁻²
- Decelerating Deceleration < - 0.1 ms⁻².
- Idling Vehicle speed < 0.5 ms⁻² and Acceleration in range ± 0.1 ms⁻²

Moody, A., Tate, J. 2016. In service CO₂ and NO_x emissions of Euro 6/VI cars, light- and heavy-duty goods vehicles in real London driving: Taking the road into the Laboratory. The 21st International Transport and Air Pollution (TAP) Conference, Lyon, France, May 24-26, 2016.

BIG telematics data

Case Study & Sample

SHEFFIELD centre
near University:

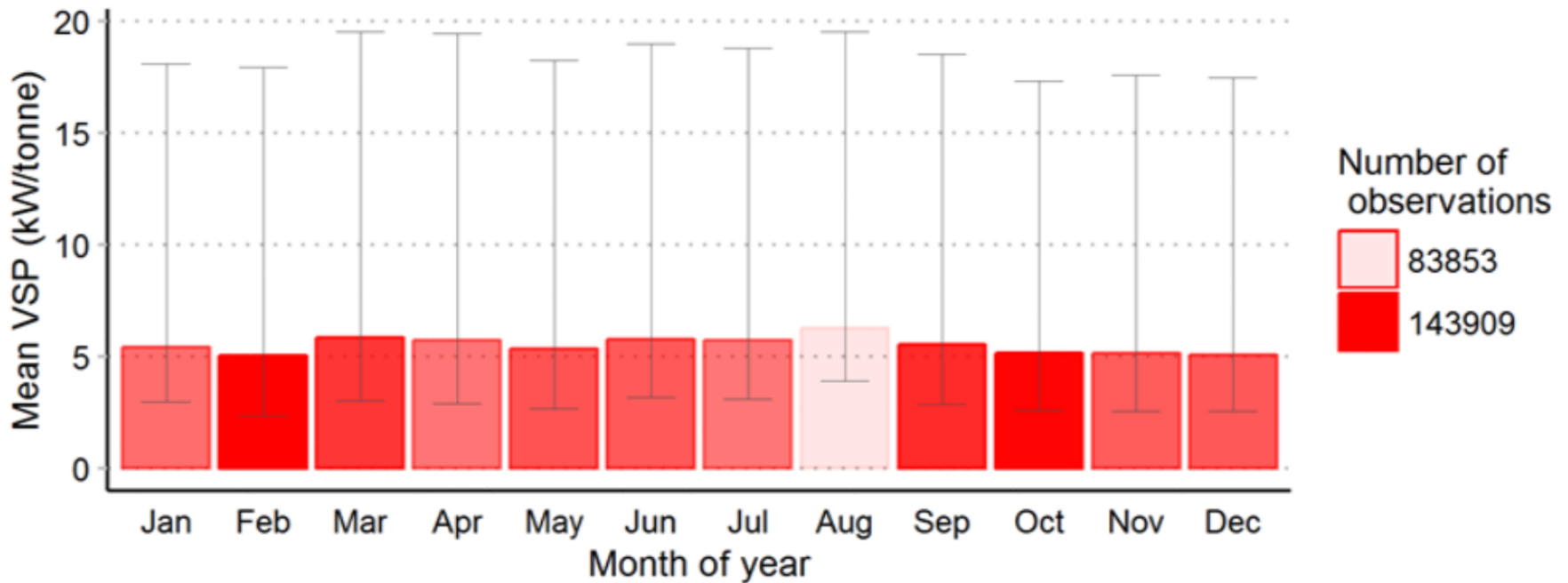
- 1 calendar year
01/05/2014 to 30/04/2015
- Area 1.8 km²
- 34 425 journeys
- 2 440 580 records
- 15 000 km



RESULTS

MONTH of the year

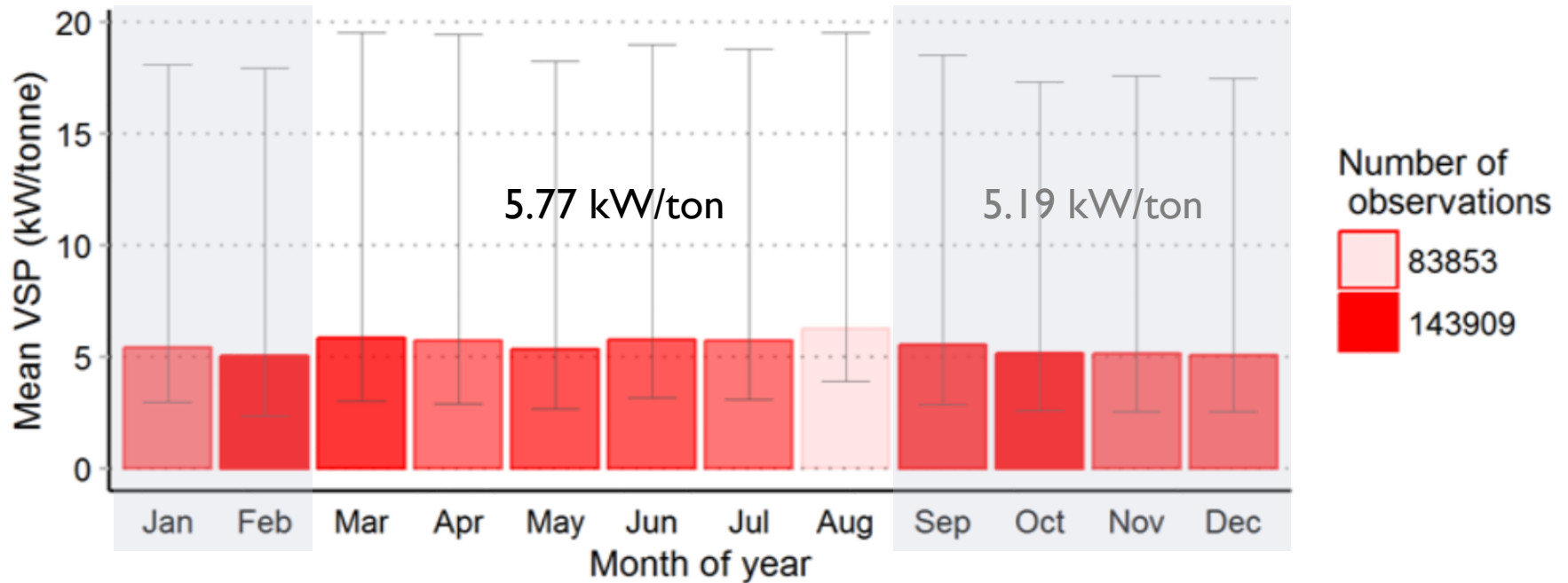
FIGURE | Variation in positive VSP with MONTH of the year



RESULTS

MONTH of the year

FIGURE | Variation in positive VSP with MONTH of the year

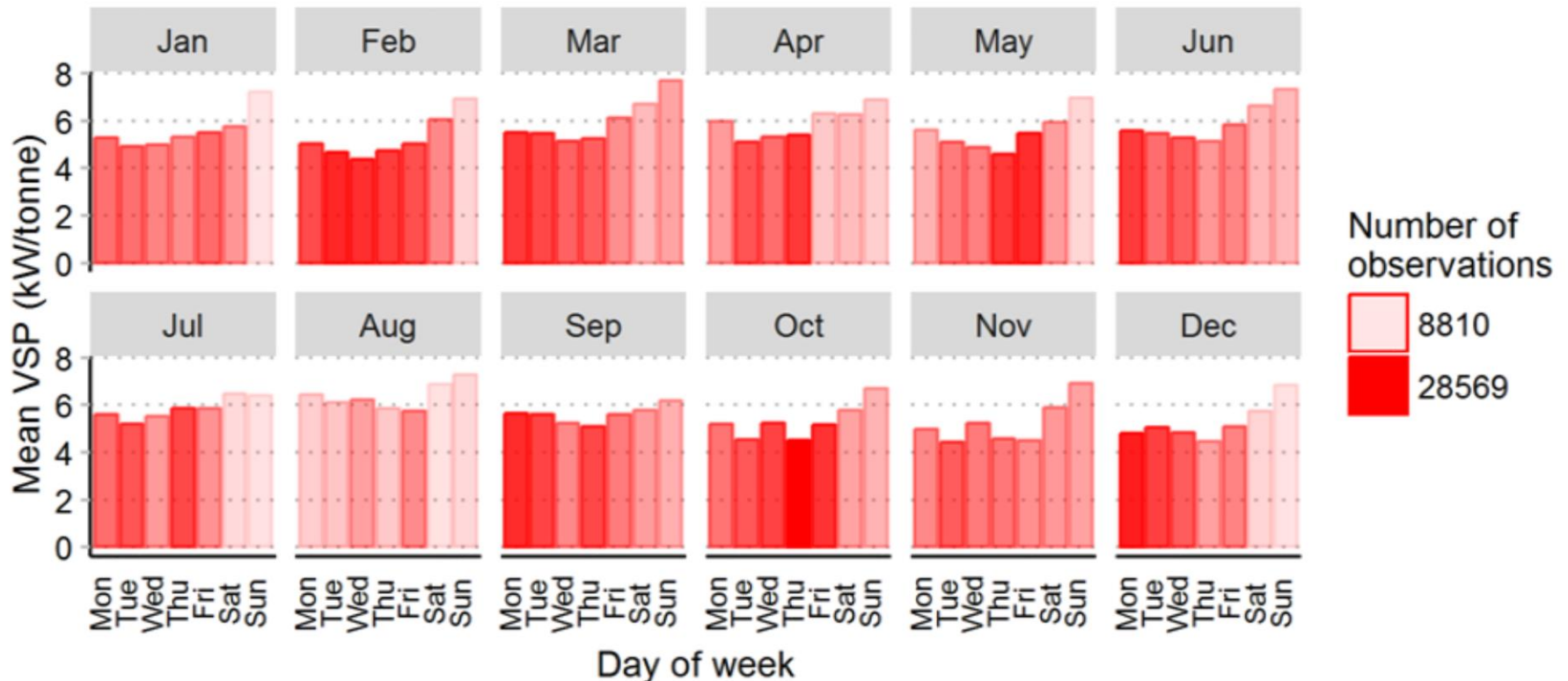


Natural driving behaviour: Less constrained by poor weather conditions?
Average positive VSP +11% 'summer' months

RESULTS

DAY of week

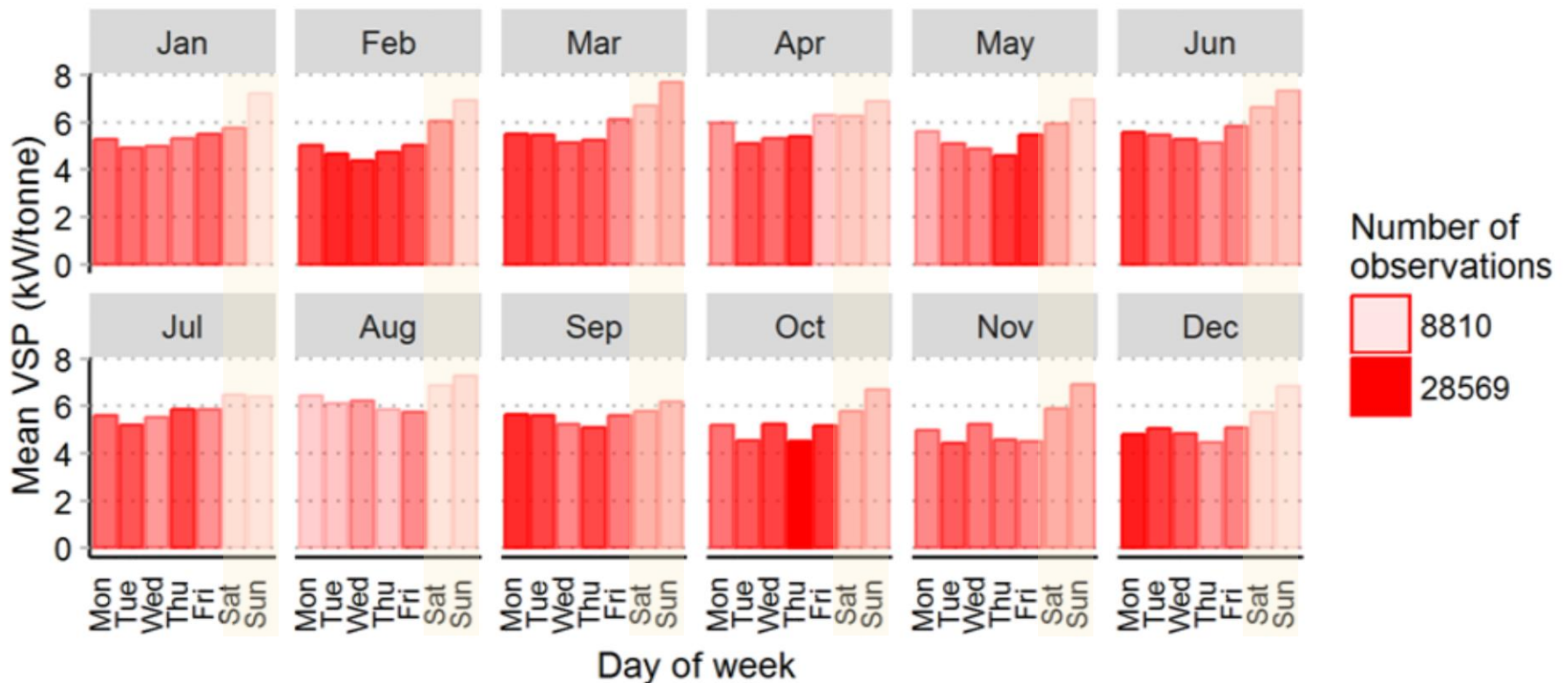
FIGURE | Variation in positive VSP with DAY of the week



RESULTS

DAY of week

FIGURE | Variation in positive VSP with DAY of the week



Weekend driving: Less constrained by traffic?

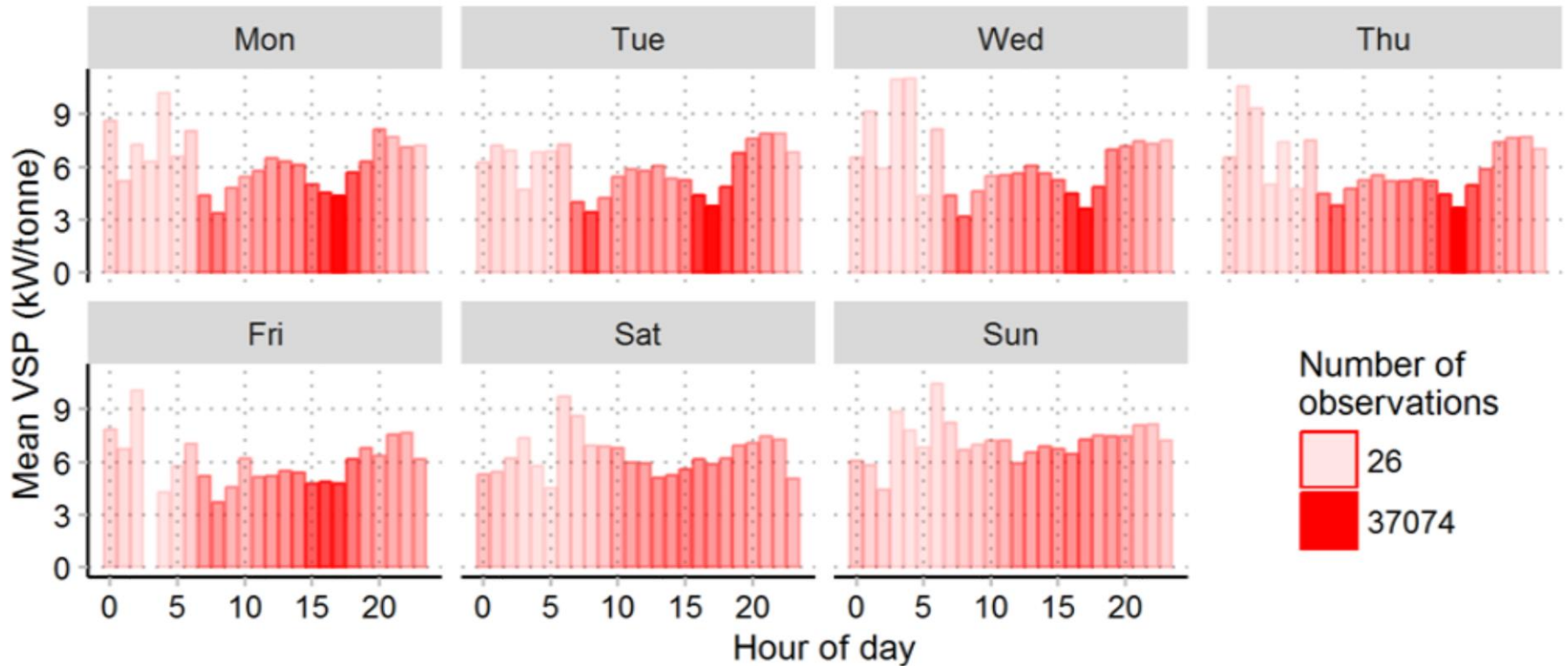
Average positive VSP +24% on weekends



RESULTS

HOUR of day

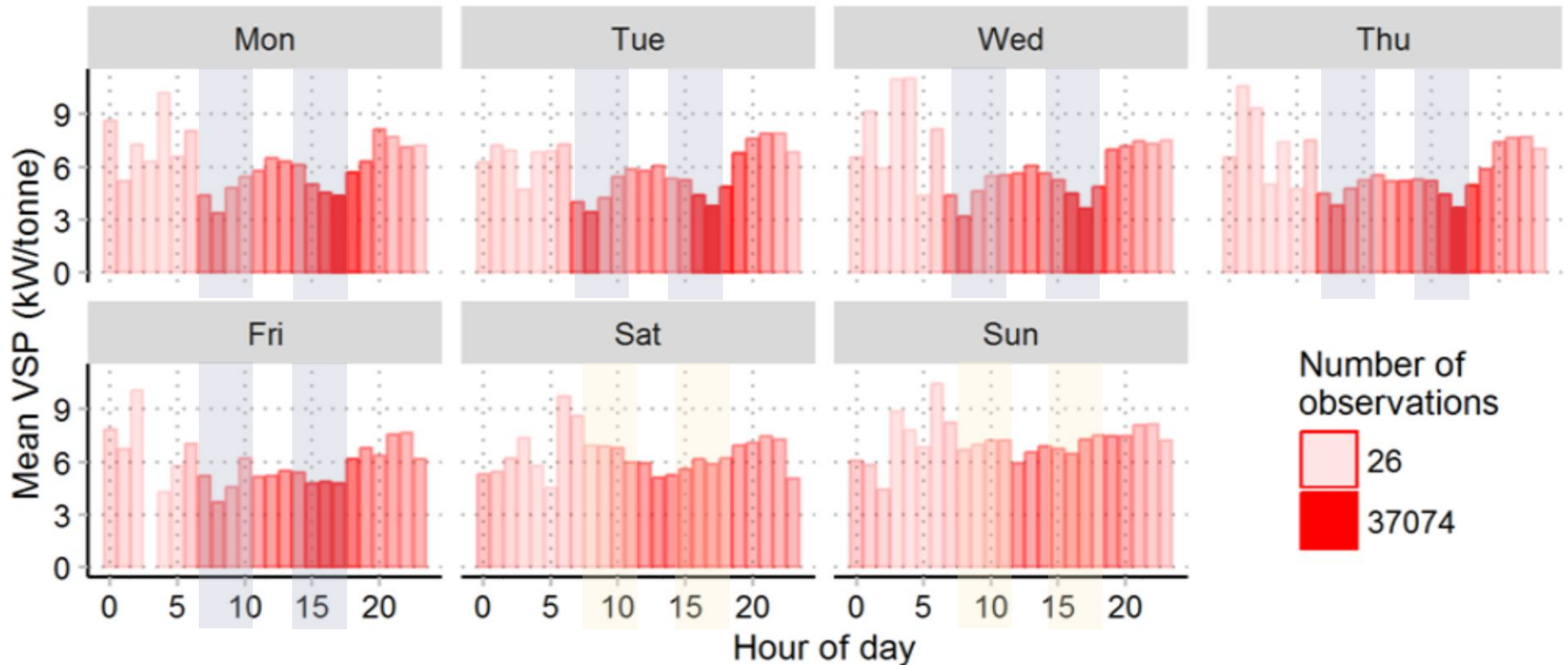
FIGURE | Variation in positive VSP with HOUR of the day



RESULTS

HOUR of day

FIGURE | Variation in positive VSP with HOUR of the day



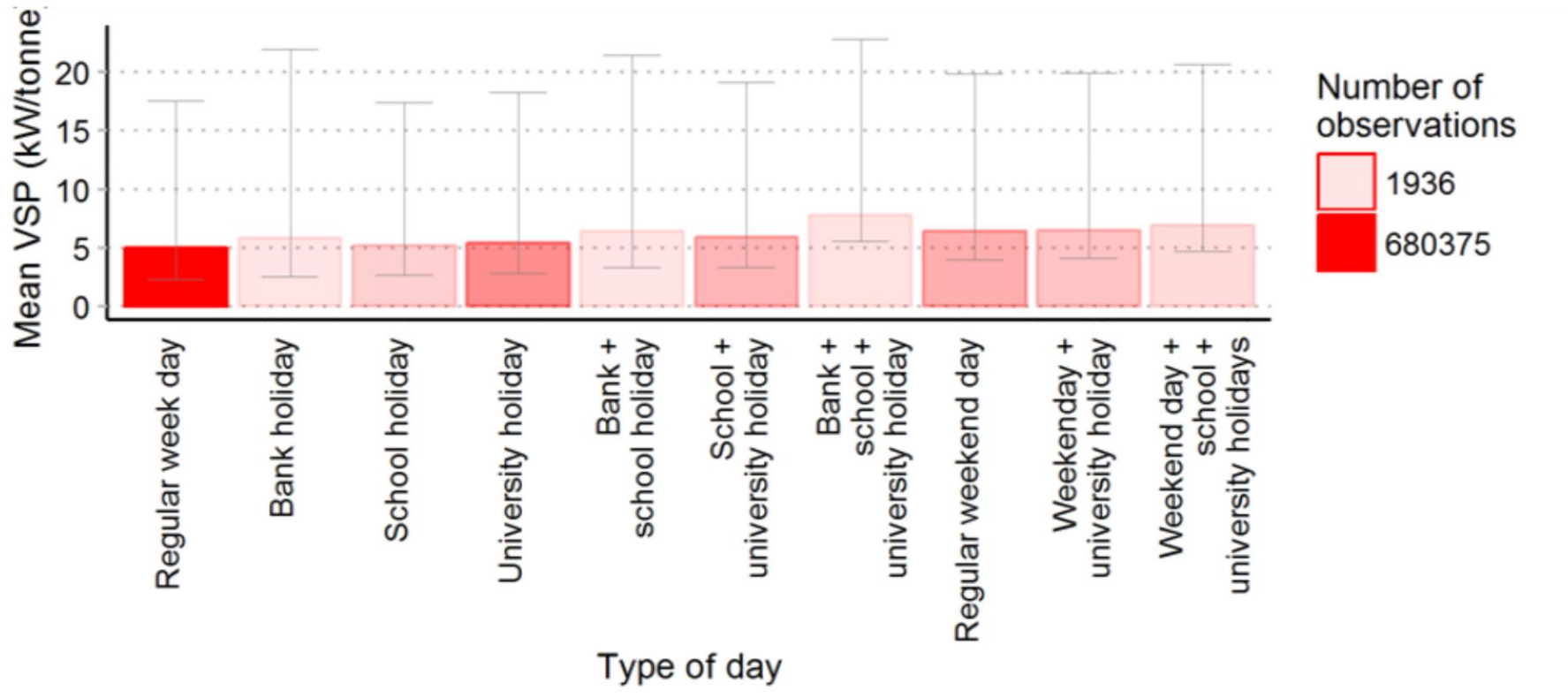
Driving in peak periods: Behaviour constrained by available road space?

Average positive VSP -31% during weekday, peak periods

RESULTS

HOLIDAYS

FIGURE | Variation in positive VSP with type of DAY / HOLIDAY



RESULTS

Influence WEATHER conditions

FIGURE | Variation in positive VSP with RAINFALL

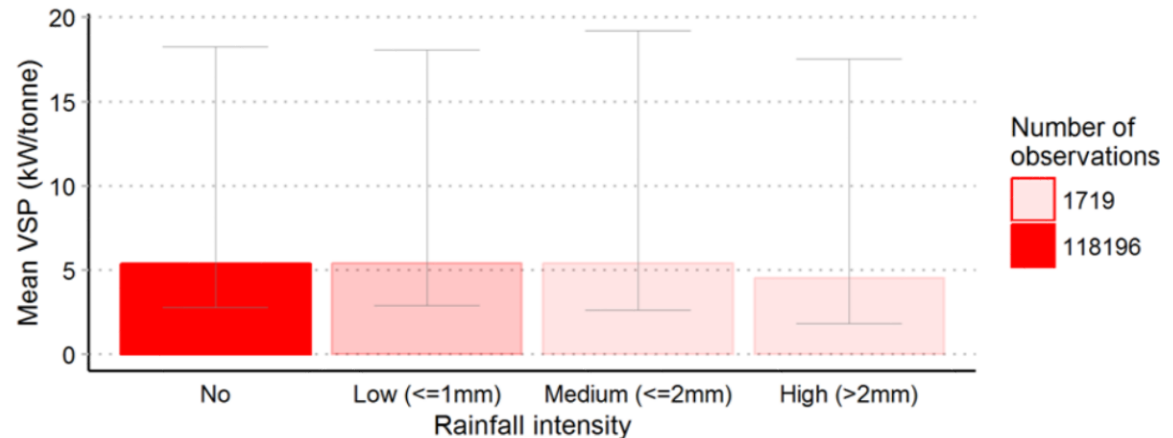
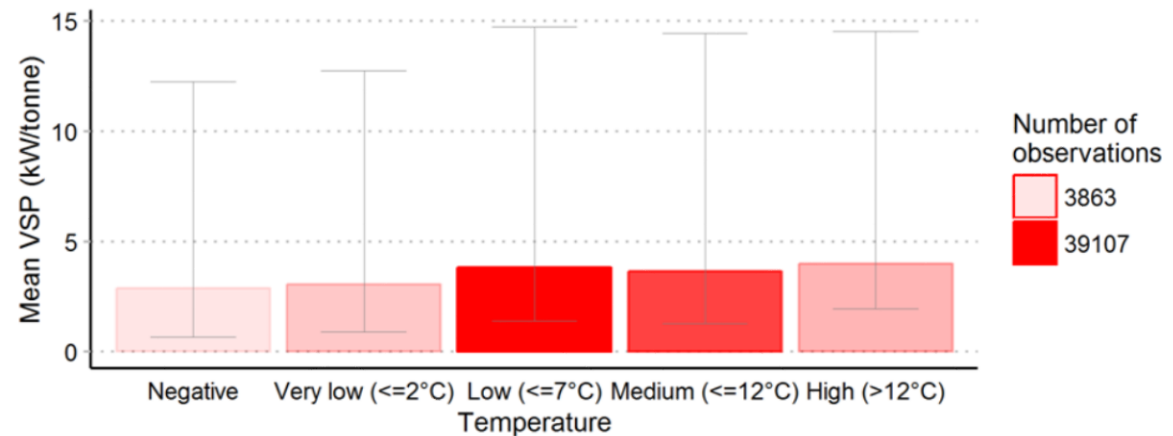


FIGURE | Variation in positive VSP with TEMPERATURE



OUTLOOK

BIG telematics data

CASE STUDIES

- ▶ Traffic management interventions
 - ▶ Variable Speed Limits (VSL) & 'Smart' motorways
 - ▶ Demand management to alleviate congestion
 - ▶ Smoothing traffic flow including ecoDriving
- ▶ Complex, unstable, congested networks
 - ▶ Challenging to observe & model traffic flow

FUTURE, 2020?

- ▶ Network wide, system approach
- ▶ Real-time: fusing telematics, IEM & in-situ flow monitoring
- ▶ All vehicle types: Buses (e.g. iBus London) and HGVs

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ITS

