## Metadata: Practical Emissions Model for Local Authorities (PEMLA) Development Data

### Supporting Data For:

Article: A Practical Method for Predicting Road Traffic Carbon Dioxide Emissions

Thesis: Enhancing Urban Road Traffic Carbon Dioxide Emissions Models

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### University of Southampton Research Ethics Committee Number

16720

### Context of Data Collection

The aim of this study was to investigate the prediction of carbon dioxide (CO2) emissions from road vehicles at network-level, based on road traffic data readily available to Local Government Authorities (LGAs) from Urban Traffic Control (UTC) systems. The ultimate intention was to develop a road traffic emissions model that was practical for use by LGAs (termed PEMLA).

### Data Collection Method

Data were collected over the period from July 2015 to February 2016. The data were collected as trip segments, defined as segments extracted from trips made by vehicles on Southampton’s road network. For each trip segment, a GPS trace of vehicle movement was collected and used as input to an Emissions Model (EM) called Analysis of Instantaneous Road Emissions (AIRE), which calculated total CO2 emissions for the trip segment, allowing calculation of an accurate Emissions Factor (EF, gCO2/km). AIRE only includes vehicle categories compliant with Euro Standards up to Euro 4 for Light Duty Vehicles and Euro V for Heavy Duty Vehicles. Therefore, for PEMLA categories represented by Euro 5/6 or Euro VI vehicles, a Speed-specific Adjustment Factor (SAF) was calculated for each trip segment as the ratio between emissions from a vehicle of the relevant newer Euro Standard and emissions from a vehicle of Euro 4 Standard using the Transport Research Laboratory (TRL) average speed EM (UK’s officially recommended EM), with vehicle average speed (as calculated from its GPS trace) as input.

Concurrent data were also collected from Inductive Loop Detectors (ILDs, installed under the road surface as part of Southampton’s UTC system) crossed by a vehicle during each trip segment. These data were used to calculate values for three traffic variables (traffic average speed, traffic density and traffic average delay rate) associated with each segment. Access density for each segment was also calculated as a fourth traffic variable.

Additionally, two EFs for each segment were calculated using the TRL Average Speed EM. To account for the TRL EM vehicle categories within the (more aggregate) PEMLA vehicle categories, the TRL average speed emission functions for each vehicle category were weighted by a category’s fraction of total national vehicle-kilometres (VKMs) in urban areas according to the National Atmospheric Emissions Inventory (NAEI) national fleet model (EF from TRL/NAEI EM in the data). One of these EFs was calculated using vehicle average speed (as calculated from its GPS trace) as input, and the other calculated using traffic average speed (as calculated from ILD data) as input.

### Data Confidentiality

In compliance with the Data Protection Act, University of Southampton policy and the Participant Information Sheet, to prevent identification of participating drivers, all data were anonymised. Additionally, to comply further with the Participant Information Sheet, the GPS data collected from participants could only be used for the purposes of the study, and could only be accessed by those involved with the study.

### Data Files

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| **File Name** | **File Description** |
| Cat 01 - Car, Pet, Less 1.4, P-E5.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 01; which is for cars with petrol engines less then 1400cc capacity that comply with European Emissions Standards up to and including Euro 4. |
| Cat 02 - Car, Pet, Less 1.4, E5.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 02; which is for cars with petrol engines less then 1400cc capacity that comply with European Emissions Standard Euro 5. |
| Cat 03 - Car, Pet, Less 1.4, E6.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 03; which is for cars with petrol engines less then 1400cc capacity that comply with European Emissions Standard Euro 6. |
| Cat 04 - Car, Pet, 1.4-2.0, P-E5.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 04; which is for cars with petrol engines 1400 to 2000cc capacity that comply with European Emissions Standards up to and including Euro 4. |
| Cat 05 - Car, Pet, 1.4-2.0, E5.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 05; which is for cars with petrol engines 1400 to 2000cc capacity that comply with European Emissions Standard Euro 5. |
| Cat 06 - Car, Pet, 1.4-2.0, E6.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 06; which is for cars with petrol engines 1400 to 2000cc capacity that comply with European Emissions Standard Euro 6. |
| Cat 07 - Car, Pet, Abv 2.0, P-E5.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 07; which is for cars with petrol engines above 2000cc capacity that comply with European Emissions Standards up to and including Euro 4. |
| Cat 08 - Car, Pet, Abv 2.0, E5.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 08; which is for cars with petrol engines above 2000cc capacity that comply with European Emissions Standard Euro 5. |
| Cat 09 - Car, Pet, Abv 2.0, E6.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 09; which is for cars with petrol engines above 2000cc capacity that comply with European Emissions Standard Euro 6. |
| Cat 10 - Car, Die, Less 2.0, P-E5.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 10; which is for cars with diesel engines less then 2000cc capacity that comply with European Emissions Standards up to and including Euro 4. |
| Cat 11 - Car, Die, Less 2.0, E5.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 11; which is for cars with petrol engines less then 2000cc capacity that comply with European Emissions Standard Euro 5. |
| Cat 12 - Car, Die, Less 2.0, E6.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 12; which is for cars with petrol engines less then 2000cc capacity that comply with European Emissions Standard Euro 6. |
| Cat 13 - Car, Die, Abv 2.0, P-E5.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 13; which is for cars with diesel engines above 2000cc capacity that comply with European Emissions Standards up to and including Euro 4. |
| Cat 14 - Car, Die, Abv 2.0, E5.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 14; which is for cars with diesel engines above 2000cc capacity that comply with European Emissions Standard Euro 5. |
| Cat 15 - Car, Die, Abv 2.0, E6.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 15; which is for cars with diesel engines above 2000cc capacity that comply with European Emissions Standard Euro 6. |
| Cat 16 - LGV, Pet, All.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 16; which is for Light Goods Vehicles (LGVs) with petrol engines, of any weight and any European Emissions Standard compliance. |
| Cat 17 - LGV, Die, All Wts, P-E5.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 17; which is for Light Goods Vehicles (LGVs) with diesel engines, of any weight that comply with European Emissions Standards up to and including Euro 4. |
| Cat 18 - LGV, Die, All Wts, E5.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 18; which is for Light Goods Vehicles (LGVs) with diesel engines, of any weight that comply with European Emissions Standard Euro 5. |
| Cat 19 - LGV, Die, All Wts, E6.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 19; which is for Light Goods Vehicles (LGVs) with diesel engines, of any weight that comply with European Emissions Standard Euro 6. |
| Cat 20 - HGV, Rigid, All.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 20; which is for rigid Heavy Goods Vehicles (HGVs) with diesel engines, of any weight and any European Emissions Standard compliance. |
| Cat 21 - HGV, Artic, All.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 21; which is for articulated Heavy Goods Vehicles (HGVs) with diesel engines, of any weight and any European Emissions Standard compliance. |
| Cat 22 - Bus, All.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 22; which is for Buses with diesel engines, of any weight and any European Emissions Standard compliance. Trip segments BDP106P to BDP165P were collected from a bus with an on-board Portable Emissions Measurement System (PEMS). This allowed real-world measurement of EFs (EF from PEMS in the data). |
| Cat 23 - Coach, All.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 23; which is for Coaches with diesel engines, of any weight and any European Emissions Standard compliance.  |
| Cat 24 - Two-wheel, All.xlsx | Traffic variable and EF values for each trip segment for PEMLA vehicle category 24; which is for two-wheel vehicles with petrol engines of any size, and any European Emissions Standard compliance. AIRE does not include any two-wheel vehicle categories so EFs from AIRE are not available in this file. |