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# Real-world emission factors for SUVs using on-board emission testing and geo-computation

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ABSTRACT

A Portable Emissions Measurement System (PEMS) was used to measure emissions of five sports utility vehicles (SUVs) in a wide range of real-world driving conditions. The program included testing of fuel quality, coast-down and emissions in start, hot running and extended idling conditions. Geo-computation methods were used to add critical information (road gradient) to the PEMS data.

Results from this study are generally in good agreement with international PEMS data. Hot running $NO_x$ emission factors are on average seven times higher than the type-approval limit for diesel SUVs, and they reach about 2100 and 400 mg/km in urban conditions for $NO_x$ and $NO_2$, respectively. They are 7 ($NO_x$) and 4 ($NO_2$) times higher than current emission factors in COPERT Australia.

COPERT Australia emission algorithms for $CO_2$ are well behaved and the PEMS data suggest an update is not required. COPERT Australia emission algorithms should be revised for diesel SUVs ($NO_x$, $NO_2$) and petrol SUVs (CO, THC, $NO_2$) to ensure accurate estimation of vehicle emissions at fleet level. Inclusion of logistic regression is proposed for future COPERT updates.

## 1. Introduction

Exposure to motor vehicle emissions is important due to impacts on human health and the environment and associated economic costs (Karner et al., 2010; Kimbrough et al., 2013). Several studies have linked proximity to busy roads with adverse health effects, including asthma and other respiratory symptoms, birth and development effects, premature mortality, cardiovascular effects and cancer (Baldauf et al., 2008; Hood et al., 2018).

Different methods are used to measure vehicle emissions to quantify their impact on air pollution. They include laboratory chassis and engine dynamometer testing, on-board portable emission measurement system (PEMS), remote sensing, near-road air quality measurements, vehicle chase studies and tunnel studies (Ropkins et al., 2009; Smit et al., 2010). Out of the above methods, PEMS plays an important role in vehicle emission model development and generation of emission factors because they enable testing under a wide variety of driving conditions, including traffic density, road type, road gradients, altitude and environmental conditions (Ntziachristos et al., 2016; Gallus et al., 2017; Yang et al., 2020; McCaffery et al., 2020).

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