Assessing tunnel emissions with Australian emissions software

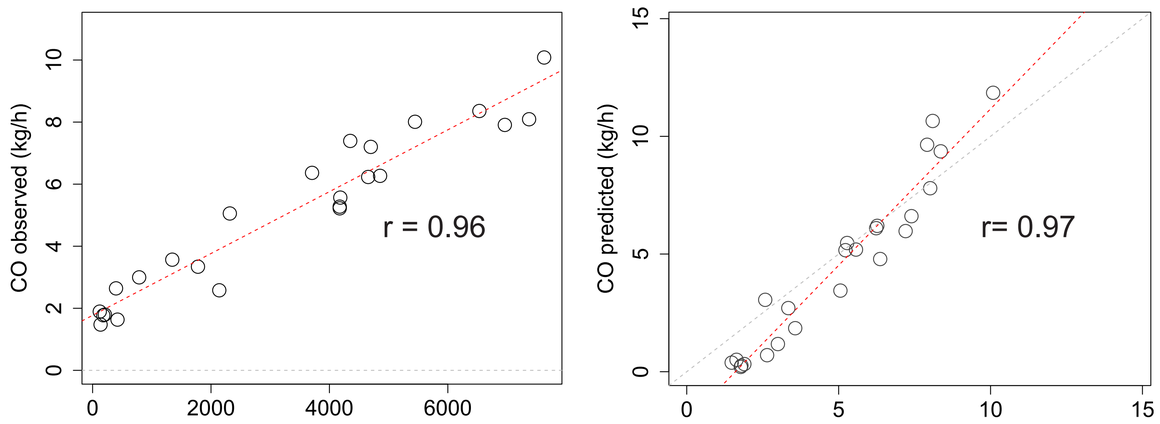
Tunnel air quality impact assessment requires several types of data:

- meteorological data
- ambient air quality data (background correction)
- traffic data (in-tunnel and surface roads)
- simulated emissions data (in-tunnel and surface roads)
- measured tunnel vent emissions data (concentration x flow rate)

Benefits of employing emission models:

- estimate vehicle emissions on surrounding roads
- cost-effective estimate a large range of key pollutants (benzene, $PM_{2.5}$, etc.)
- quality checking of tunnel air monitoring data
- input for tunnel emission management
- vehicle emission model validation

Emission data verification and model validation



Vehicle emission prediction software is well-developed in Europe and the US. However, they do not adequately reflect Australian conditions (fleet mix, vehicle technology, fuel quality, climate) therefore two software packages were recently developed (2013) using data from major Australian emission testing programs (~ 2500 modal vehicle emission tests and ~ 12,000 vehicle emission bag tests).

Two types of Australian vehicle emission models are used to assess tunnel impacts:

- average speed model (COPERT Australia)
- power based model (PΔP)

- COPERT is a software tool that is used world-wide to calculate air pollutant and greenhouse gas emissions from road transport (http://www.emisia.com/copert/)
- COPERT is comprehensive in its characterisation of vehicle emissions and includes all relevant types of emissions (hot, cold, evaporative, non-exhaust)
- Dedicated Australian version was developed in 2013.

PΔP

The University Of Queensland AUSTRALIA

- Power-delta-power or PΔP model.
- Model input: second-by-second data on vehicle speed, air-flow, road grade, vehicle loading and use of air conditioning (on/off).
- The predictor variables are instantaneous engine power (P) and the change in engine power over past seconds (ΔP). Hence the name “PΔP”.
- P and ΔP were derived from chassis dynamometer load profiles during the tests.
- 73 Australian vehicle classes including trucks, cars, SUVs, LCVs, buses.
- Statistical time-series models that use engine power and change in engine power in t_{-3}, t_{-2}, t_{-1}

COPERT Australia is used to generate vehicle base emission factors (g/km) and PΔP is used to to compute correction factors for in-tunnel road grade, air flow and driving conditions.

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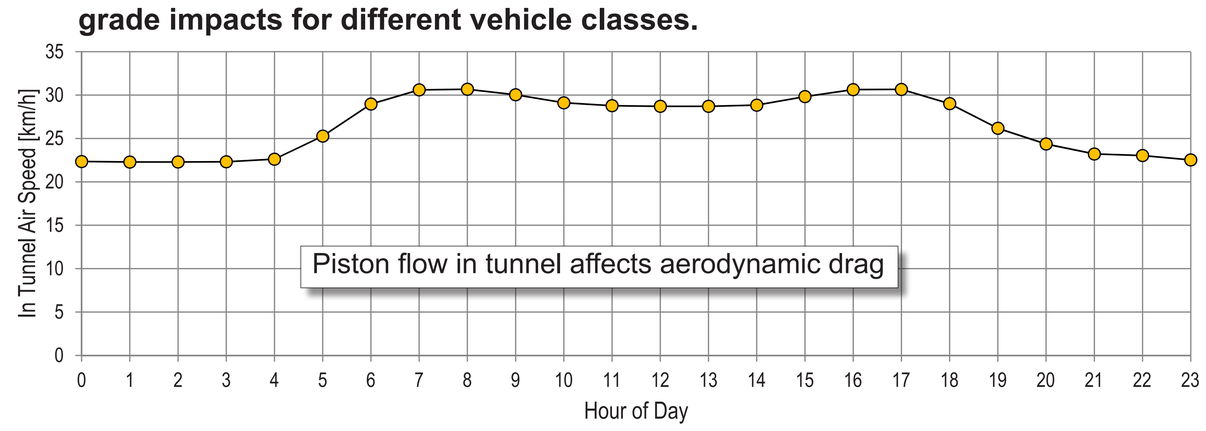
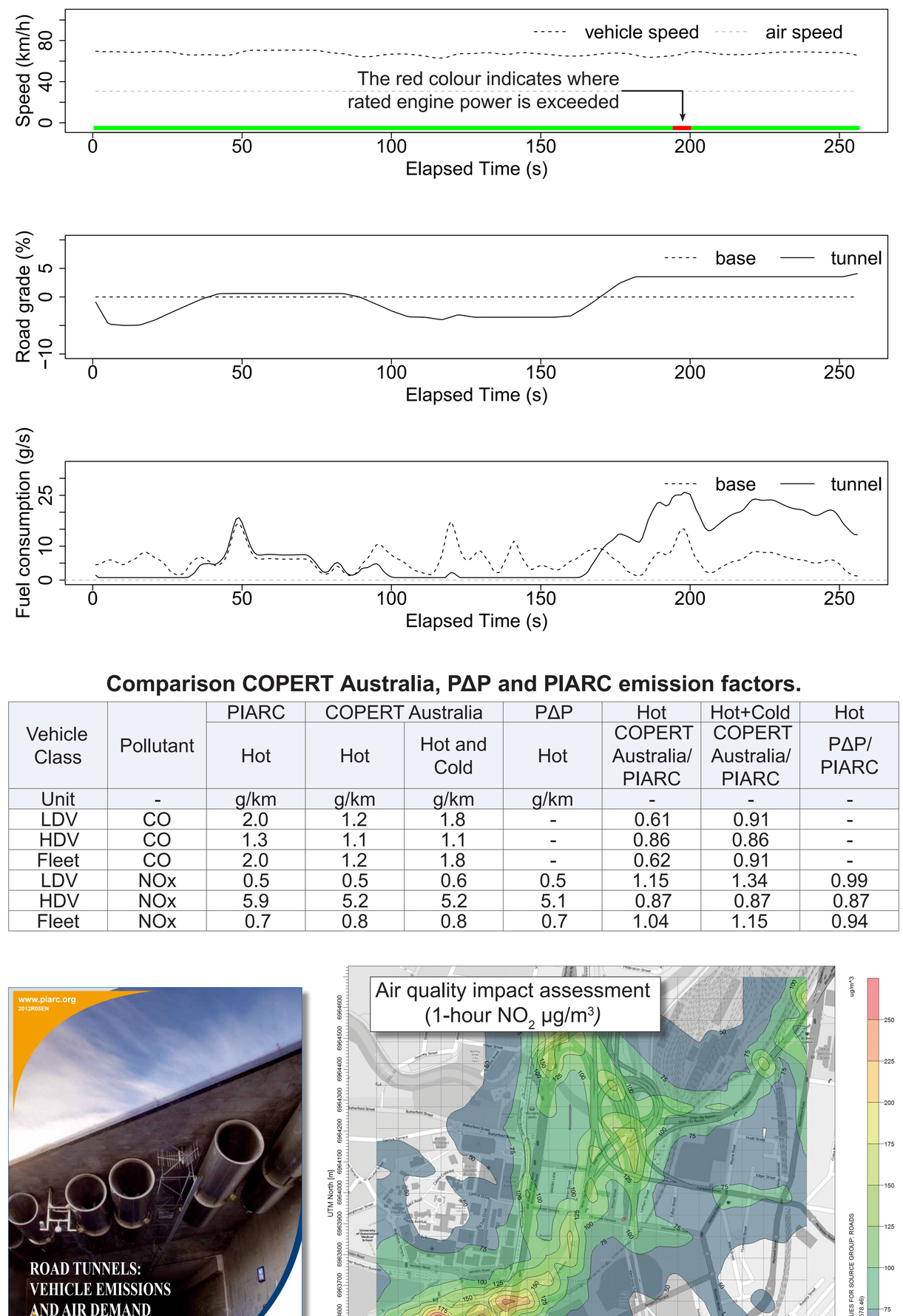
PΔP model simulates the effects of both air-flow (piston effect) and road grade impacts for different vehicle classes.





Comparison COPERT Australia, PΔP and PIARC emission factors.

Vehicle Class	Pollutant	PIARC	COPERT Australia		PΔP	Hot	Hot+Cold	Hot
		Hot	Hot	Hot and Cold	Hot	COPERT Australia/ PIARC	COPERT Australia/ PIARC	PΔP/ PIARC
Unit	-	g/km	g/km	g/km	g/km	-	-	-
LDV	CO	2.0	1.2	1.8	-	0.61	0.91	-
HDV	CO	1.3	1.1	1.1	-	0.86	0.86	-
Fleet	CO	2.0	1.2	1.8	-	0.62	0.91	-
LDV	NOx	0.5	0.5	0.6	0.5	1.15	1.34	0.99
HDV	NOx	5.9	5.2	5.2	5.1	0.87	0.87	0.87
Fleet	NOx	0.7	0.8	0.8	0.7	1.04	1.15	0.94