Supplementary information

Supplementary Table S1. Studies comparing LUR models with other exposure models for estimation of NO$_2$

Study, country, pollutant average	Exposure models compared	Methods of comparison	Comments
Buteau et al, 2017 Canada; Predictions made for 96 postal codes (Buteau et al. 2017)	NO$_2$ (daily averages) Nearest-monitor vs IDW Nearest monitor vs LUR	Levels of agreement ICC=0.81 ICC=0.60	Maximum differences in NO$_2$ for given days: 74 ppb 108 ppb
Hennig et al, 2016; Germany; Predictions for 4809 cohort addresses. (Hennig et al. 2016)	LUR vs CTM (4809 cohort addresses) LUR vs CTM at NO$_2$ sites (Background & traffic-all sites)	Difference of -7.4 ± 4.9 ug/m3 R^2=0.55	Better R^2 when CTM method restricted to local traffic areas only.
Wang et al, 2015; The Netherlands; Predictions for 1058 cohort addresses. (Wang et al. 2015)	LUR (ESCAPE) vs DM (NO$_2$)	R^2=0.47-0.85	
De Hoog et al, 2014; Predictions for 13 ESCAPE cohort addresses (total n=112971). (de Hoogh et al. 2014)	LUR vs DM	R^2=0.19-0.89 B-A plots, no ICCs reported	Pearson R^2 varied substantially between the 13 LURs from 13 different countries
Sellier et al, 2014; France; Predictions for 776 addresses. (Sellier et al. 2014)	LUR vs AQMS LUR vs TAG LUR vs DM	R^2=0.46-0.76 R^2=0.73-0.87 R^2=0.77-0.87	Difficult to draw overall comparisons as individual R^2 were provided by distance from AQMS and type of area
Wu et al, 2011; California, US;	LUR vs DM (CALINE4) (NOx) LUR vs AQMS (NO$_2$)	R^2=0.49 R^2=0.57	

Predictions for >81,000 addresses. (Wu et al. 2011)	LUR vs AQMS (NOx) LUR vs traffic density (NO_2)	R^2=0.46 R^2=0.27	
Beelen et al, 2010; The Netherlands; Predictions made at N =69 975 grid points (Beelen et al. 2010)	LUR vs DM (NO_2) DM vs validation sites (NO_2) LUR vs validation sites (NO_2)	R^2=0.55 R^2=0.77 R^2=0.47	Good agreement at mid-range but larger differences at high and low concentrations. Perhaps due to coarse category for "industrial land use" used in LUR
Marshall et al, 2008; Canada; Predictions for 56,099 postal codes. (Marshall et al. 2008)	LUR vs IDW (NO_2) LUR vs DM (CMAQ) (NO_2) LUR vs AQMS (nearest) (NO_2)	R^2=0.52 R^2=0.49 R^2=0.54	LUR produced lowest estimates. Attributed to postcode centroids not located along roads, hence leading to under-estimation.

AQMS Air Quality Monitoring Station
DM Dispersion model
CTM Chemical transport model
TAG Temporally adjusted geostatistical model

Supplementary Table S2. LUR variables and sources of data

	GIS Data source	Variable Description	Buffer size (m)	SYDNEY NAME	ESCAPE NAME	Calc/units
Land use	Australian Bureau of Statistics (ABS)	Residential - Mesh Block	100, 300, 500, 700, 1000, 2500, 5000	Resmb		Proportion of land area
Land use	ABS	Industrial - Mesh Block	100, 300, 500, 700, 1000, 2500, 5000	Indmb		Proportion of land area
Land use	ABS	Commercial - Mesh Block	100, 300, 500, 700, 1000, 2500, 5000	Commmb		Proportion of land area
Land use	ABS	Parkland - Mesh Block	100, 300, 500, 700, 1000, 2500, 5000	Openmb		Proportion of land area
Land use	ABS	Water - Mesh Block	100, 300, 500, 700, 1000, 2500, 5000	Openmb		Proportion of land area
Land use	ABS	Park/Water/Agric - Mesh Block	100, 300, 500, 700, 1000, 2500, 5000	Openmb		Proportion of land area
Population Density	ABS	Population within buffers	100, 300, 500, 700, 1000, 2500, 5000			Number
Dwelling density	ABS	Dwellings within buffers	100, 300, 500, 700, 1000, 2500, 5000			Number
Distance to coast	Geoscience Australia	Distance to Coast				m
Altitude	Geoscience Australia	Altitude - SRTM 1 arc second derived DEM	NA	Elevation		m

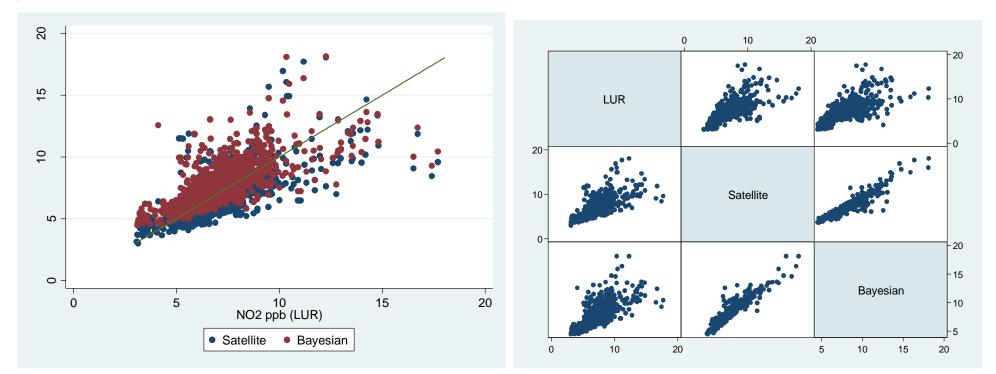| Traffic	Zenith_plus_local	Traffic intensity on nearest road	N/A	TRAFNEAR	TRAFNEAR	vpd
Traffic	Zenith_plus_local	Distance to nearest road	N/A	DISTINVNEAR1, DISTINVNEAR2	DISTINVNEAR1, DISTINVNEAR2	m^{-1}, m^{-2}
Traffic	Zenith_plus_local	Product of traffic count on nearest road & inverse of distance to nearest road & distance squared	N/A	INTINVDIST, INTINVDIST2	INTINVDIST, INTINVDIST2	vpd/m; vpd/m2
Traffic	Zenith_plus_local	Traffic intensity on nearest major road	N/A	TRAFMAJOR	TRAFMAJOR	vpd
Traffic	Zenith_plus_local	Distance to nearest major road	N/A	DISTINVMAJOR1, DISTINVMAJOR2	DISTINVMAJOR1, DISTINVMAJOR2	m^{-1}, m^{-2}
Traffic	Zenith_plus_local	Product of traffic intensity on nearest major road & inverse of distance to nearest major road & distance squared	N/A	INTMAJORINVDIST, INTMAJORINVDIST2	INTMAJORINVDIST, INTMAJORINVDIST2	vpd/m; vpd/m2
Traffic	Zenith_plus_local	Traffic load of major roads in buffer (sum of (traffic intensity*length of all major road segments))	25, 50, 75, 100, 300, 500, 700, 1000	LOADMAJ	TRAFMAJORLOAD	Sum of (count*length) major roads
Traffic	Zenith_plus_local	Traffic load of all roads in buffer (Sum(traffic counts*length) all segments)	vpd	LOAD	TRAFLOAD	vpd
Traffic	Zenith_plus_local	Heavy Traffic intensity on nearest road	vpd	HEAVYTRAFNEAR	HEAVYTRAFNEAR	vpd
Traffic	Zenith_plus_local	Product of heavy traffic intensity on nearest road & inverse of distance to nearest rd & distance squared	vpd/m, vpd/m2	HEAVYINTINVDIST, HEAVYINTINVDIST2	HEAVYINTINVDIST, HEAVYINTINVDIST2	vpd/m, vpd/m2
Traffic	Zenith_plus_local	Heavy traffic intensity on nearest major road	vpd	HEAVYTRAFMAJOR	HEAVYTRAFMAJOR	vpd

Traffic	Zenith_plus_local	Heavy Traffic load of major roads in buffer (sum of (heavy traffic intensity*length of all major road segments))	25, 50, 75, 100, 300, 500, 700, 1000	HEAVYLOADMAJ	HEAVYTRAFMAJORLOAD	vpd/m
Traffic	Zenith_plus_local	Heavy Traffic load of all roads in buffer (sum of (heavy traffic intensity*length of all road segments))	25, 50, 75, 100, 300, 500, 700, 1000	HEAVYLOAD	HEAVYTRAFLOAD	vpd/m
Traffic	NSW Land & Property Information (LPI)	Weighted Road Density	25, 50, 75, 100, 300, 500, 700, 1000			
Traffic	LPI	Road Length of all roads in buffer	25, 50, 75, 100, 300, 500, 700, 1000	ALLROAD	ROADLENGTH	m
Traffic	LPI	Road Length of minor roads in buffer	25, 50, 75, 100, 300, 500, 700, 1000	MINROAD	**Not in ESCAPE**	m
Traffic	LPI	Road length of major roads in buffer	25, 50, 75, 100, 300, 500, 700, 1000	MAJROAD	MAJORROADLENGTH	m
Other NO2 Sources	National pollutant inventory (NPI)	Number of Oxides of Nitrogen sources in buffers	50, 75, 100, 150, 200, 300, 500, 700, 1000, 2500, 5000, 10000		**Not in ESCAPE**	

Supplementary Table S3. Summary statistics for NO₂/NOx passive sampler concentrations (ppb) by site type

Site type (n)	Mean	CIs	SD	Min	Max	25th%	75th%
NO₂							
Overall (n=46)	9.0	8.1-9.9	3.1	3.7	17.3	7.1	10.4
Traffic (n=16)	11.6	9.9-13.2	3.4	6.0	17.3	8.7	13.6
Urban background (n=24)	7.7	6.9-8.4	1.8	4.8	12.4	6.0	8.4
Urban Background <100 m to main road (n=4)	8.5	7.7-9.3	1.2	7.1	9.8	7.7	9.4
Regional (n=2)	5.3	2.2-8.4	2.2	3.7	6.9	4.5	6.1
NOx							
Overall (n=46)	17.1	14.9-19.4	7.9	6.6	43.4	12.4	18.2
Traffic (n=16)	24.1	19.7-28.5	9.0	12.4	43.4	17.0	31.2
Urban background (n=24)	13.2	11.7-14.7	3.7	6.6	24.0	11.1	15.0
Urban Background <100 m to main road (n=4)	17.0	15.8-18.2	1.2	15.5	18.2	16.3	17.9
Regional (n=2)	9.4	5.6-13.2	2.8	7.4	11.4	8.4	10.4

Supplementary Table S4. Comparison of measurements by passive samplers vs fixed site monitors

Period	Passive sampler	Regulatory fixed site monitor	Comments
Winter (July 2013 period)			Excluded due to duplicates exceeding 30% variability and because OEH monitored data was missing for 4 days of the period
Summer (Dec 2013)	5.5	8.5	
Autumn (Mar 2014)	9.2	10.4	

Supplementary Figure S1. Scatter plots of a) LUR vs Sat-LUR (blue) and vs BME (red) NO$_2$ estimates; b) Scatter plot matrix (ppb)