Supplement of

Development and intercity transferability of land-use regression models for predicting ambient PM_{10}, $PM_{2.5}$, NO_2 and O_3 concentrations in northern Taiwan

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Table S1 Description of potential predictor variables.

GIS dataset	Predictor variable	Unit	Buffer size (m)	Direction of effect	
				All[a]	O_3
Land use data	Agriculture	m^2	50, 100, 300, 500, 700, 1000, 2000, 3000, 4000, 5000	-	+
	Forest	m^2	50, 100, 300, 500, 700, 1000, 2000, 3000, 4000, 5000	-	+
	Transportation	m^2	50, 100, 300, 500, 700, 1000, 2000, 3000, 4000, 5000	+	-
	Water bodies	m^2	50, 100, 300, 500, 700, 1000, 2000, 3000, 4000, 5000	-	+
	Built-up	m^2	50, 100, 300, 500, 700, 1000, 2000, 3000, 4000, 5000	+	-
	Public utilities	m^2	50, 100, 300, 500, 700, 1000, 2000, 3000, 4000, 5000	+	-
	Recreation	m^2	50, 100, 300, 500, 700, 1000, 2000, 3000, 4000, 5000	-	+
	Mining or salt production	m^2	50, 100, 300, 500, 700, 1000, 2000, 3000, 4000, 5000	+	-
	Others	m^2	50, 100, 300, 500, 700, 1000, 2000, 3000, 4000, 5000	-	+
Normalized difference vegetation index	NDVI value	NU[b]	50, 100, 300, 500, 700, 1000, 2000, 3000, 4000, 5001	-	+
Traffic	Length of the local road	m	50, 100, 300, 500, 700, 1000, 2000, 3000, 4000, 5000	+	-
	Length of the major road	m	50, 100, 300, 500, 700, 1000, 2000, 3000, 4000, 5001	+	-
	Length of the expressway	m	50, 100, 300, 500, 700, 1000, 2000, 3000, 4000, 5002	+	-
	Area of the local road	m^2	50, 100, 300, 500, 700, 1000, 2000, 3000, 4000, 5003	+	-
	Area of the major road	m^2	50, 100, 300, 500, 700, 1000, 2000, 3000, 4000, 5004	+	-
	Area of the expressway	m^2	50, 100, 300, 500, 700, 1000, 2000, 3000, 4000, 5005	+	-
	Distance to the nearest major road	m	NA	-	+
	Distance to the nearest expressway	m	NA	-	+
Population density	Population density	Person/km^2	50, 100, 300, 500, 700, 1000, 2000, 3000, 4000, 5005	+	+/-
Digital elevation data	Elevation	m	NA	-	+
Meteorology	Temperature	^oC	NA	+/-	+
	Wind speed	m/s	NA	-	-
	Relative humidity	%	NA	+/-	+/-

Note: a. all air pollutants except ozone. b. No unit for NDVI value.

Table S2 Comparison of this study with previous LUR studies in Taiwan.

Study area	PM_{10}	$PM_{2.5}$	NO_2	O_3	Reference
Taipei–Keelung metropolitan area	R^2: 0.80	R^2: 0.72	R^2: 0.91	R^2: 0.80	This work
	LOOCV R^2: 0.72	LOOCV R^2: 0.53	LOOCV R^2: 0.88	LOOCV R^2: 0.72	
Taipei and New Taipei City	-	R^2: 0.75	-	-	Ho et al., 2015
	-	EV R^2: 0.62	-	-	
Taipei and New Taipei City	-	R^2: 0.90	-	-	Wu et al., 2017
	-	EV R^2: 0.83	-	-	
Taipei and New Taipei City	-	-	R^2: 0.74	-	Lee et al., 2014
	-	-	LOOCV R^2: 0.63	-	
Taipei and New Taipei City	R^2: 0.87	R^2: 0.95	-	-	Lee et al., 2015
	LOOCV R^2: 0.74	LOOCV R^2: 0.91	-	-	
Entire Taiwan region	-	-	-	R^2: 0.74	Hsu et al., 2019
	-	-	-	10-fold CV R^2: 0.70	
Entire Taiwan region	-	R^2: 0.66	-	-	Wu et al., 2018
Entire Taiwan region	-	-	R^2: 0.90	-	Chen et al., 2020
	-	-	10-fold CV R^2: 0.87	-	

Note:
LOOCV: leave-one-out cross validation
EV: external validation
10-fold CV: 10-fold cross validation

Table S3 Description of the 2019 annual average LUR models for ambient PM_{10}, $PM_{2.5}$, NO_2, and O_3 using Taipei data.

Air pollutant	Variables	Coefficient	Standard error	p	VIF	Predictive accuracy
PM_{10}	Constant	39.1	2.66	< 0.001	NA	R^2 = 0.91; RMSE = 1.52; LOOCV R^2 = 0.82; LOOCV RMSE = 2.21.
	LU2_100	-1.00E-03	1.28E-04	< 0.001	2.8	
	LU3_50	1.84E-03	2.91E-04	< 0.001	1.1	
	LU7_2000	-8.34E-06	1.76E-06	< 0.001	2.4	
	POP_500	-2.15E-04	7.20E-05	0.011	1.5	
$PM_{2.5}$	(Constant)	8.43	1.5	< 0.001	NA	R^2 = 0.64; RMSE = 1.73; LOOCV R^2 = 0.48; LOOCV RMSE = 2.07.
	LU3_300	7.13E-05	1.87E-05	0.002	1.0	
	R2_100	3.32E-04	1.45E-04	0.038	1.0	
NO_2	(Constant)	19.3	1.9	< 0.001	NA	R^2 = 0.89; RMSE = 2.14; LOOCV R^2 = 0.83; LOOCV RMSE = 2.64.
	LU2_3000	-8.39E-07	1.24E-07	< 0.001	1.2	
	LU3_50	2.27E-03	3.93E-04	< 0.001	1.1	
	LU7_1000	-1.52E-05	4.76E-06	0.007	1.2	
O_3	(Constant)	41.9	2.66	< 0.001	NA	R^2 = 0.76; RMSE = 2.81; LOOCV R^2 = 0.64; LOOCV RMSE = 3.45.
	LU3_700	-2.75E-05	6.85E-06	0.001	1.1	
	LU3_50	-1.95E-03	5.10E-04	0.002	1.1	

Note:
LU2_100, LU2_3000: the area of forest in buffer sizes of 100 m and 3000 m
LU3_50, LU3_300, and LU3_700: the area of transportation land in buffer sizes of 50 m, 300 m, and 700 m
LU7_1000 and LU7_2000: the area of recreational land in buffer sizes of 1000 m and 2000 m
POP_500: the number of population in a buffer size of 500 m
R2_100: the area of major roads in a buffer size of 100 m
VIF: the variance inflation factor
LOOCV: leave-one-out cross validation
RMSE: root mean square error
NA: not available

Table S4 Description of the 2019 annual average LUR models for ambient PM_{10}, $PM_{2.5}$, NO_2, and O_3 using New Taipei & Keelung data.

Air pollutant	Variables	Coefficient	Standard error	p	VIF	Predictive accuracy
PM_{10}	Constant	-964	287	0.007	NA	R^2 = 0.63; RMSE = 3.08; LOOCV R^2 = 0.35; LOOCV RMSE = 4.29.
	Lat	39.7	11.5	0.006	1.0	
	LU4_1000	-8.83E-06	3.12E-06	0.018	1.0	
$PM_{2.5}$	(Constant)	13.3	0.28	< 0.001	NA	R^2 = 0.65; RMSE = 0.61; LOOCV R^2 = 0.54; LOOCV RMSE = 0.70.
	LU2_100	-1.33E-03	3.15E-04	0.002	2.0	
	LU8_5000	1.11E-05	4.95E-06	0.049	2.0	
NO_2	(Constant)	0.34	1.26	0.8	NA	R^2 = 0.95; RMSE = 1.58; LOOCV R^2 = 0.87; LOOCV RMSE = 2.60.
	LU3_2000	7.80E-06	8.56E-07	< 0.001	2.6	
	LU3_50	2.31E-03	3.52E-04	< 0.001	1.3	
	LU7_2000	-1.00E-05	1.97E-06	0.001	2.9	
O_3	(Constant)	41.7	0.95	< 0.001	NA	R^2 = 0.93; RMSE = 1.27; LOOCV R^2 = 0.88; LOOCV RMSE = 1.62.
	LU3_3000	-2.13E-06	2.08E-07	< 0.001	1.0	
	LU8_2000	-4.39E-05	1.41E-05	0.012	1.0	

Note:
Lat: Latitude
LU4_1000: the area of waterbody land in a buffer size of 1000 m
LU2_100: the area of forest in a buffer size of 100 m
LU8_2000, LU8_5000: the area of mining or salt production land in buffer sizes of 2000 m and 5000 m
LU3_50, LU3_2000, and LU3_3000: the area of transportation land in buffer sizes of 50 m, 2000 m, and 3000 m
LU7_2000: the area of recreational land in a buffer size of 2000 m
VIF: the variance inflation factor
LOOCV: leave-one-out cross validation
RMSE: root mean square error
NA: not available

Table S5 Statistical description of PM_{10}, $PM_{2.5}$, NO_2, and O_3 exposure estimates using nearby-station measurements and LUR-model-based estimates.

Method	Nearby	PM_{10} (μg/m^3)	$PM_{2.5}$ (μg/m^3)	NO_2 (ppb)	O_3 (ppb)
Nearby station measurements	Mean	27.7	13.8	16.3	28.6
	SD	2.19	1.01	2.47	1.65
	Min	22.3	10.6	2.90	15.2
	Max	40.3	21.3	32.2	42.2
LUR model-based estimates	Mean	36.0	14.2	18.0	29.2
	SD	3.84	1.54	3.94	2.98
	Min	13.0	6.96	0.70	17.5
	Max	45.2	19.9	32.2	44.0
	Difference	8.23	0.41	1.73	0.60

Note: SD means the standard deviation; Min and Max refer to the minimum and maximum values of the air pollutant concentrations, respectively.

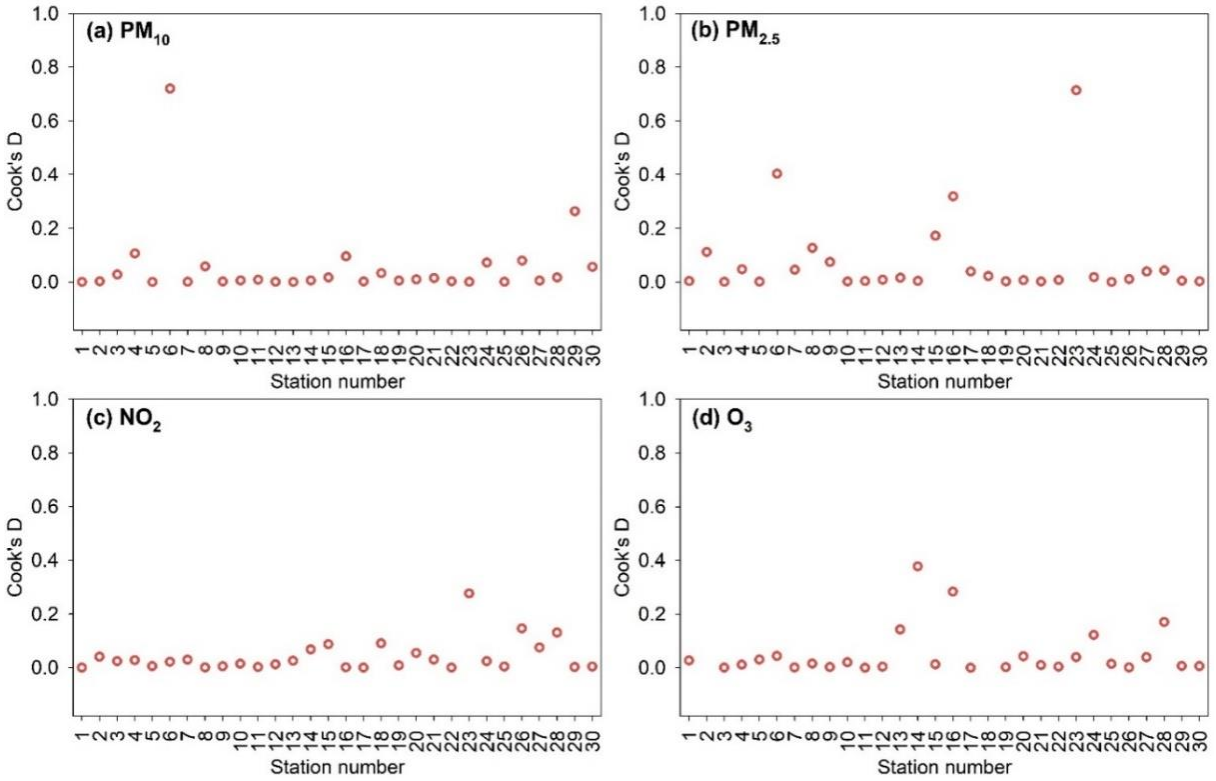
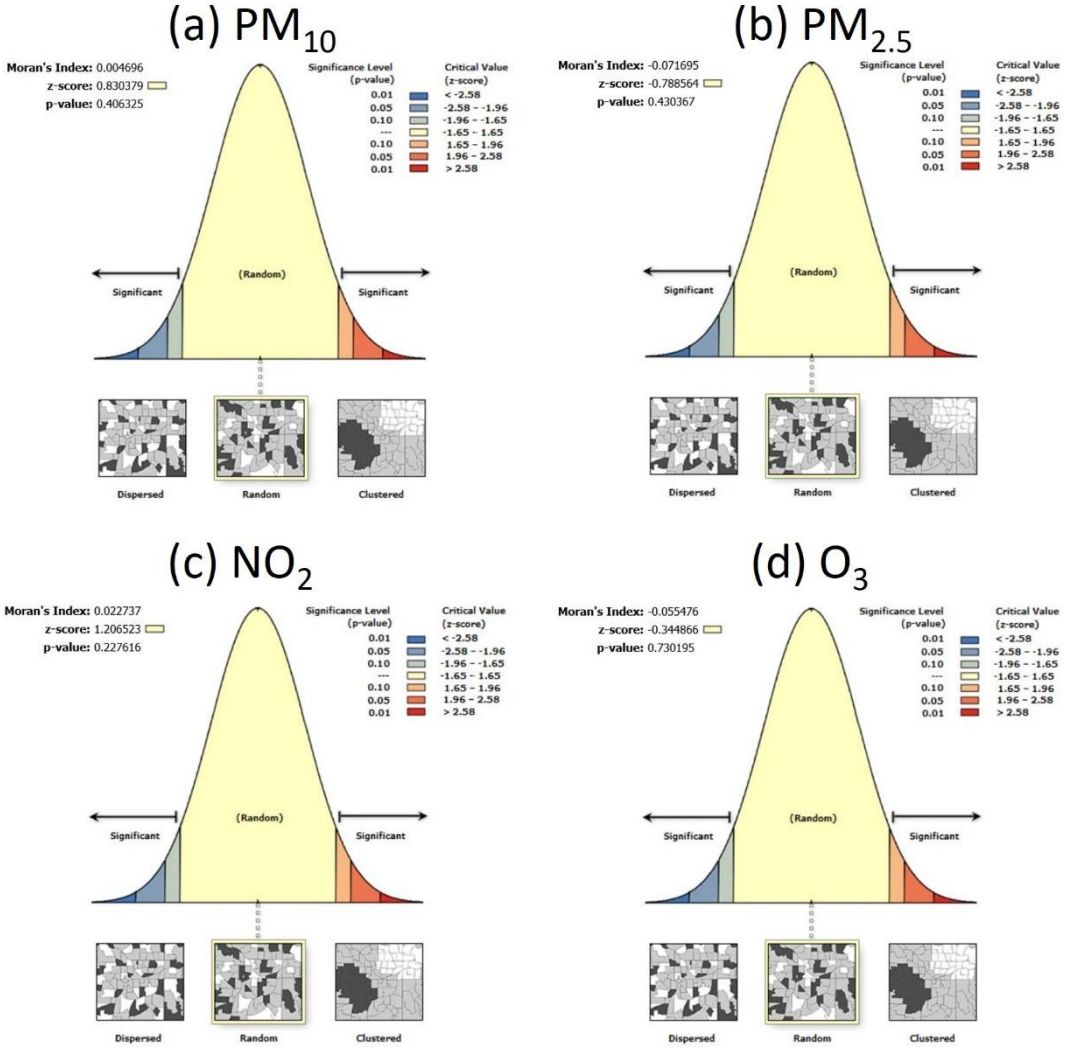


Figure S1. Cook's distance values of all the stations in establishing LUR models. (a) PM_{10}, (b) $PM_{2.5}$, (c) NO_2, and (d) O_3.



55 **Figure S2.** Moran's *I* index values of concentration residuals of LUR models. (a) PM_{10}, (b) $PM_{2.5}$, (c) NO_2, and (d) O_3.

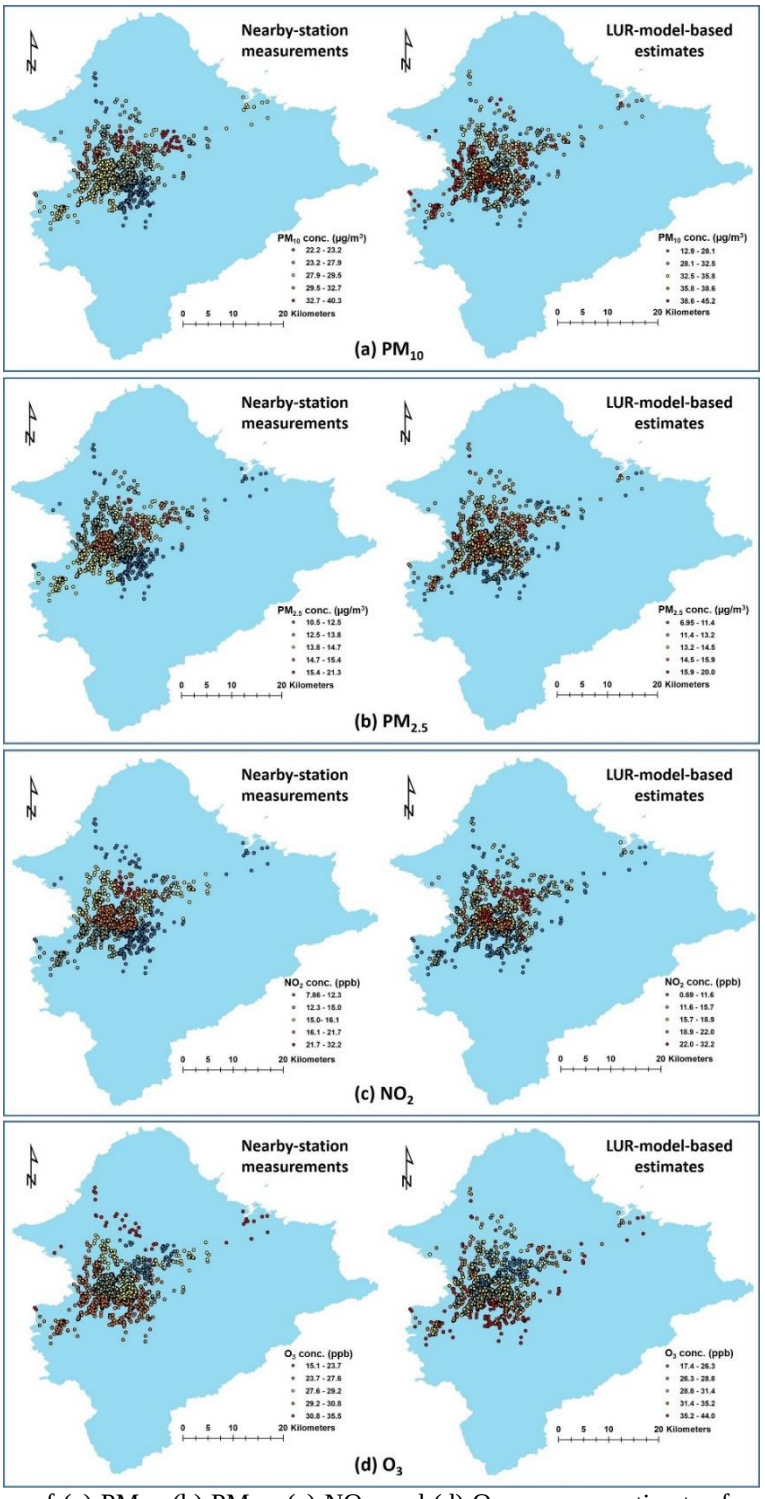


Fig. S3. Spatial distributions of (a) PM_{10}, (b) $PM_{2.5}$, (c) NO_2, and (d) O_3 exposure estimates for a cohort study using LUR-model-based estimates and nearby-station measurements.

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