Supplementary Material to:

Modeling Spatial and Temporal Variability of Residential Air Exchange Rates for the Near-Road Exposures and Effects of Urban Air Pollutants Study (NEXUS)

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Supplementary Material 1. Method for calculation of jackknife estimate and confidence interval. Let θ be the parameter of interest and let $\hat{\theta}_1, \hat{\theta}_2, ..., \hat{\theta}_n$ be the estimates of θ based on n subsamples, each of size $n-1$. The jackknife estimate of θ is the arithmetic average given by

$$\hat{\theta}_J = \frac{1}{n}\sum_{i=1}^{n}\hat{\theta}_i.$$

The $100(1-\alpha)$ percent confidence interval (CI) of the jackknife estimate is

$$\mathrm{CI} = \hat{\theta}_J \pm t_{\alpha/2,n-1}\,\hat{\sigma}_J$$

where $\hat{\sigma}_J$ is the standard error defined as:

$$\hat{\sigma}_J = \left[\frac{n-1}{n}\sum_{i=1}^{n}\left(\hat{\theta}_i - \hat{\theta}_J\right)^2\right]^{0.5}$$

where $t_{\alpha/2,n-1}$ is the upper $\alpha/2$ percentage point of the t-distribution with n-1 degrees of freedom. For the 95 percent confidence interval with n=17 (low-income homes), $t_{0.025,16} = 2.120$, and with n=6 (conventional homes), $t_{0.025,5} = 2.571$.

FIGURE LEGENDS

Supporting Material, Figure S1. Year built for the 24 homes with measured AER (A) and all 213 homes (B).

Supporting Material, Figure S2. Comparison of absolute differences for |ε| between individual modeled and measured AER for the LBLX model. Results are shown for parameters estimated using one house age cluster for the leakage area model (estimated parameters), and results from literature-reported paramters (fixed parameters). Results are separated by house age. Shown are medians with 25th and 75th percentiles.

Supporting Material, Figure S3. Comparison of signed differences for Δ (A) and ε (B) between individual modeled and measured AER for each model. Results are separated by season, road type, and across all days. Shown are medians with 25th and 75th percentiles.

Supporting Material, Figure S4. Comparison of signed differences for Δ (A) and ε (B) between individual modeled and measured AER for the LBLX and LBL models. Results are separated by house age and window status. Shown are medians with 25th and 75th percentiles.

Supporting Material, Figure S5. Scatter plots of model-predicted and measured AER for each home. The points are average AER values for each home. Points above and below the 1:1 line indicate model overestimation and underestimation, respectively.

Table S1. Stack coefficient k_s $\left[(\mathrm{L/s})^2/(\mathrm{cm}^4 \cdot \mathrm{K})\right]$

	House height (stories)		
	One	Two	Three
Stack coefficient	0.000145	0.000290	0.000435

Table S2. Wind coefficient k_w $\left[(\mathrm{L/s})^2/(\mathrm{cm}^4 \cdot (\mathrm{m/s})^2)\right]$

	House height (stories)		
Shelter class	One	Two	Three
1	0.000319	0.000420	0.000494
2	0.000246	0.000325	0.000382
3	0.000174	0.000231	0.000271
4	0.000104	0.000137	0.000161
5	0.000032	0.000042	0.000049

Table S3. Local sheltering

Shelter class for LBL and LBLX models[1]	Shelter class for SF model[2]	Description[1]
1	Exposed	No obstructions or local shielding
2	Normal	Typical shelter for an isolated rural house
3	Normal	Typical shelter caused by other buildings across street from building under study
4	Normal	Typical shelter for urban buildings on larger lots where sheltering obstacles are more than one building height away
5	Well-shielded	Typical shelter produced by buildings or other structures immediately adjacent (closer than one building height): e.g., neighboring houses on same side of street, trees, bushes, etc.

[1] ASHRAE Handbook-Fundamentals, 2009

[2] US EPA, Energy Star Home Sealing Specification, 2001

Table S4. Summary statistics for building characteristics of 24 homes with AER measurements

Model input	Number of homes	Value (Year built, Floor area)						
		Mean	SD	Min	p25	p50	p75	Max
Year built	24	1939	20	1900	1927	1942	1948	1997
Floor area (m^2)	24	139	40	63	115	133	175	230
Housing-type								
Low-income	18							
Conventional	6							
Number of stories								
One-story	2							
Two-story	21							
Three-story	1							
Local sheltering								
Class 2	1							
Class 3	3							
Class 4	4							
Class 5	16							

Table S5. Summary statistics for building characteristics of all 213 homes

Model input	Number of homes	Value (Year built, Floor area)						
		Mean	SD	Min	p25	p50	p75	Max
Year built	213	1938	24	1888	1924	1938	1949	2007
Floor area (m^2)	213	117	44	36	81	112	139	307
Housing-type								
Low-income	185							
Conventional	28							
Number of stories								
One-story	30							
Two-story	178							
Three-story	5							
Local sheltering								
Class 2	1							
Class 3	13							
Class 4	106							
Class 5	93							

Table S6. Summary statistics of LBLX modeled air exchange rates (24 h average) for 24 homes with AER measurements

Season:year[1] or road type classification of home	Number of homes	Number of days windows opened[2]	Air Exchange Rates (h^{-1})											
			Sample size	Mean	SD	Min	p5	p10	p25	p50	p75	p90	p95	Max
Fall:2010	24	19 (16%)	119	0.72	0.43	0.15	0.26	0.28	0.42	0.60	0.97	1.35	1.41	2.39
Spring:2011	17	9 (12%)	78	0.85	0.45	0.39	0.40	0.42	0.46	0.72	1.11	1.44	1.83	2.37
HTHD[3]	7	12 (22%)	55	0.78	0.38	0.26	0.28	0.29	0.44	0.74	1.14	1.35	1.39	1.46
HTLD[3]	5	2 (5%)	44	0.80	0.46	0.25	0.27	0.29	0.39	0.69	1.17	1.39	1.61	1.92
LTLD[3]	12	14 (14%)	98	0.75	0.47	0.15	0.29	0.40	0.46	0.65	0.87	1.35	2.07	2.39
All	24	28 (14%)	197	0.77	0.44	0.15	0.27	0.33	0.45	0.65	0.99	1.36	1.55	2.39

[1] Fall: September, October, and November; spring: March, April, and May

[2] Percentage of days windows opened relative to corresponding sample size are shown in parentheses

[3] HTHD: high traffic high diesel, HTLD: high traffic low diesel, LTLD: low traffic low diesel

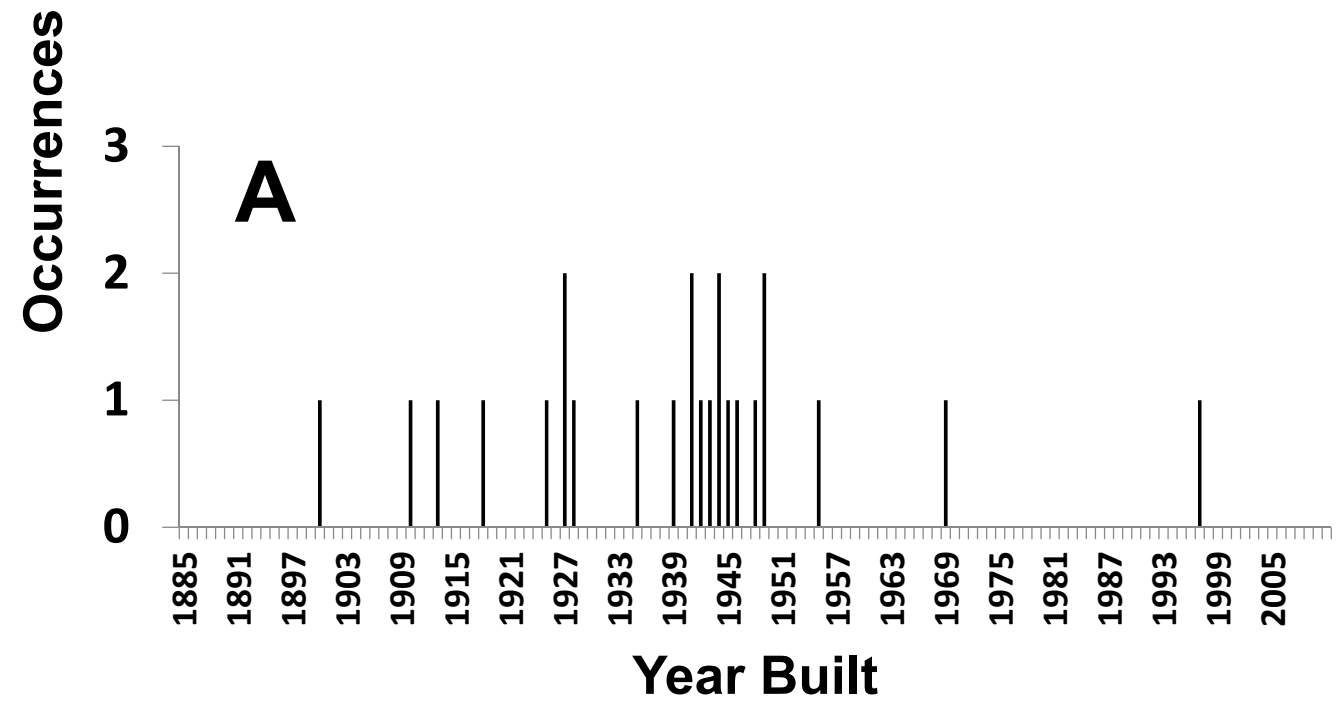
Table S7. Summary statistics of LBL modeled air exchange rates (24 h average) for 24 homes with AER measurements

Season:year[1] or road type classification of home	Number of homes	Number of days windows opened[2]	Air Exchange Rates (h^{-1})											
			Sample size	Mean	SD	Min	p5	p10	p25	p50	p75	p90	p95	Max
Fall:2010	24	19 (16%)	119	0.69	0.42	0.15	0.24	0.27	0.40	0.59	0.90	1.30	1.38	2.39
Spring:2011	17	9 (12%)	78	0.83	0.45	0.39	0.40	0.42	0.46	0.71	1.08	1.40	1.83	2.37
HTHD[3]	7	12 (22%)	55	0.74	0.38	0.24	0.26	0.28	0.42	0.67	1.12	1.32	1.35	1.46
HTLD[3]	5	2 (5%)	44	0.80	0.46	0.25	0.27	0.29	0.39	0.69	1.17	1.39	1.61	1.92
LTLD[3]	12	14 (14%)	98	0.72	0.46	0.15	0.23	0.40	0.46	0.62	0.78	1.25	2.06	2.39
All	24	28 (14%)	197	0.75	0.44	0.15	0.26	0.31	0.43	0.64	0.97	1.32	1.55	2.39

[1] Fall: September, October, and November; spring: March, April, and May

[2] Percentage of days windows opened relative to corresponding sample size are shown in parentheses

[3] HTHD: high traffic high diesel, HTLD: high traffic low diesel, LTLD: low traffic low diesel


A
Occurrences
0
1
2
3
1885
1891
1897
1903
1909
1915
1921
1927
1933
1939
1945
1951
1957
1963
1969
1975
1981
1987
1993
1999
2005
Year Built

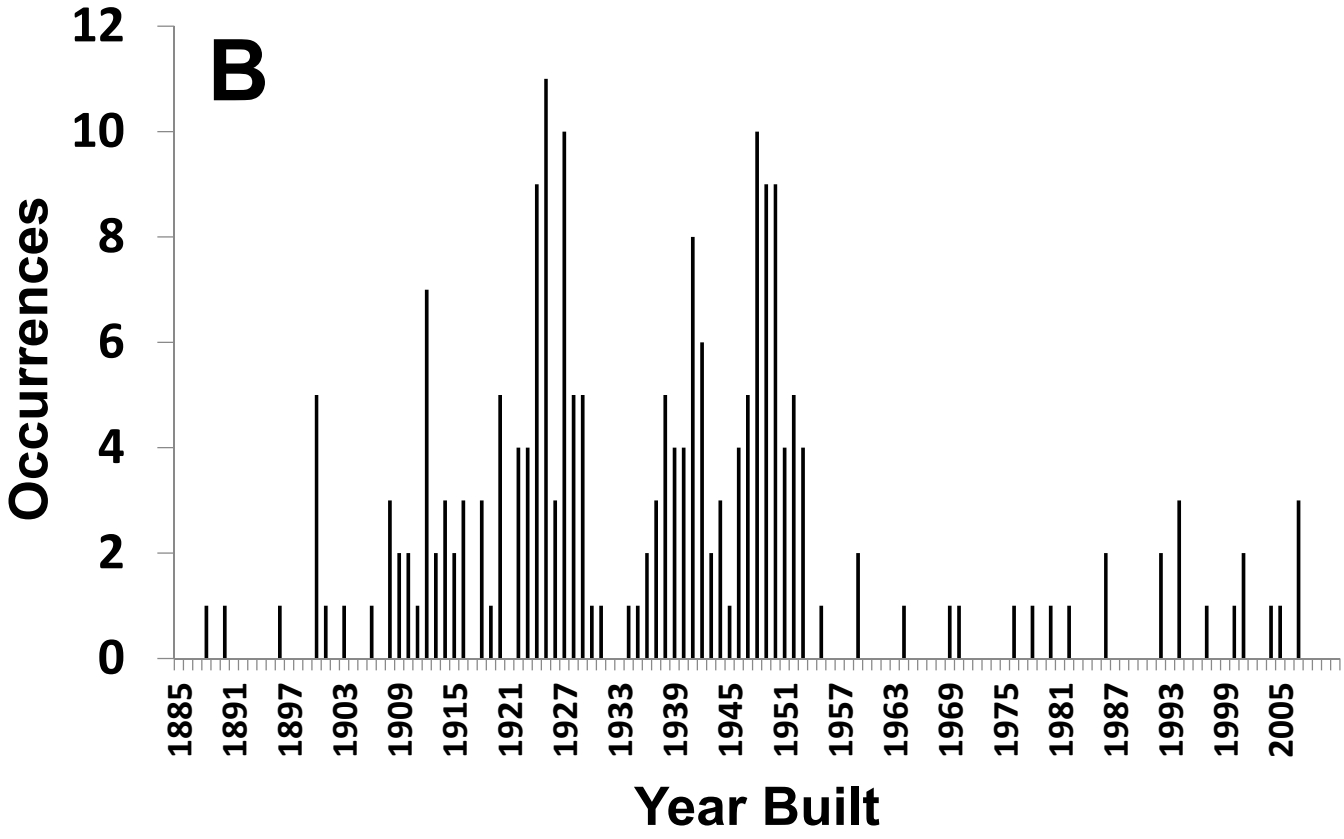

B
Occurrences
0
2
4
6
8
10
12
1885
1891
1897
1903
1909
1915
1921
1927
1933
1939
1945
1951
1957
1963
1969
1975
1981
1987
1993
1999
2005
Year Built

Figure S1

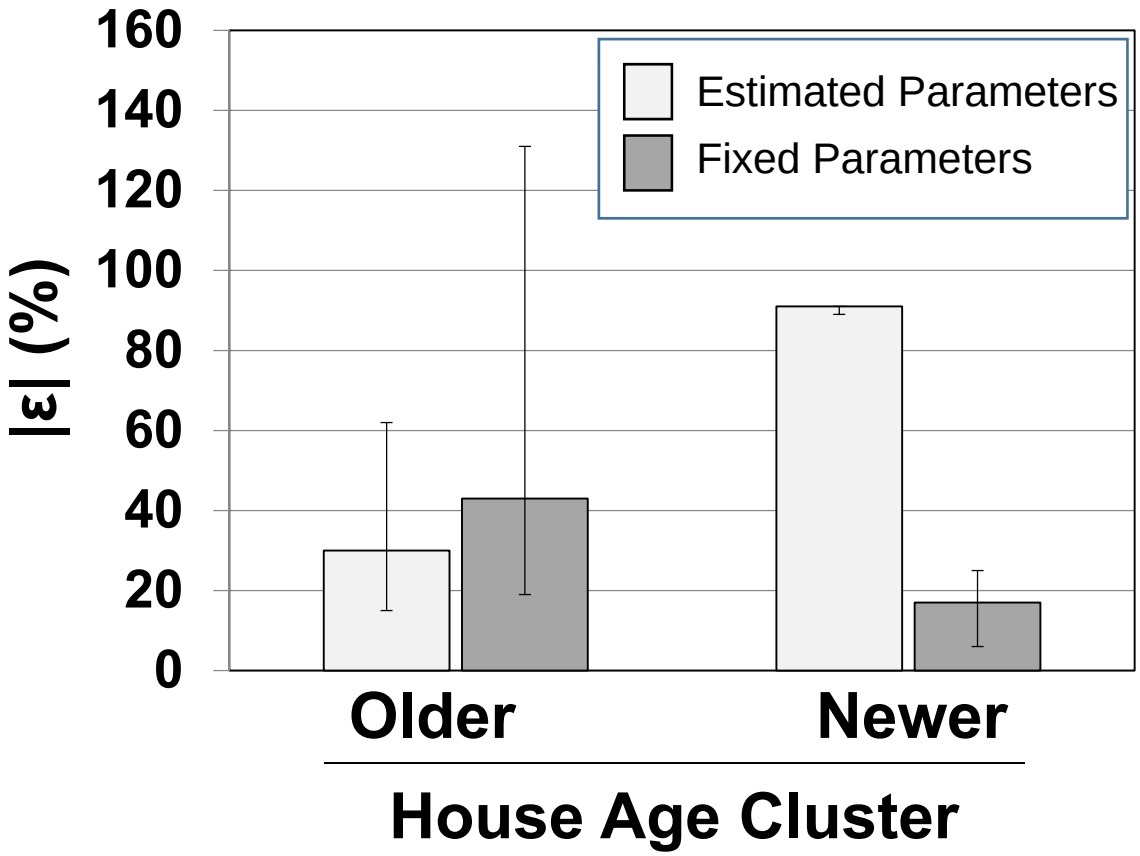

160
140
120
100
80
60
40
20
0
|ε| (%)
Estimated Parameters
Fixed Parameters
Older
Newer
House Age Cluster

Figure S2

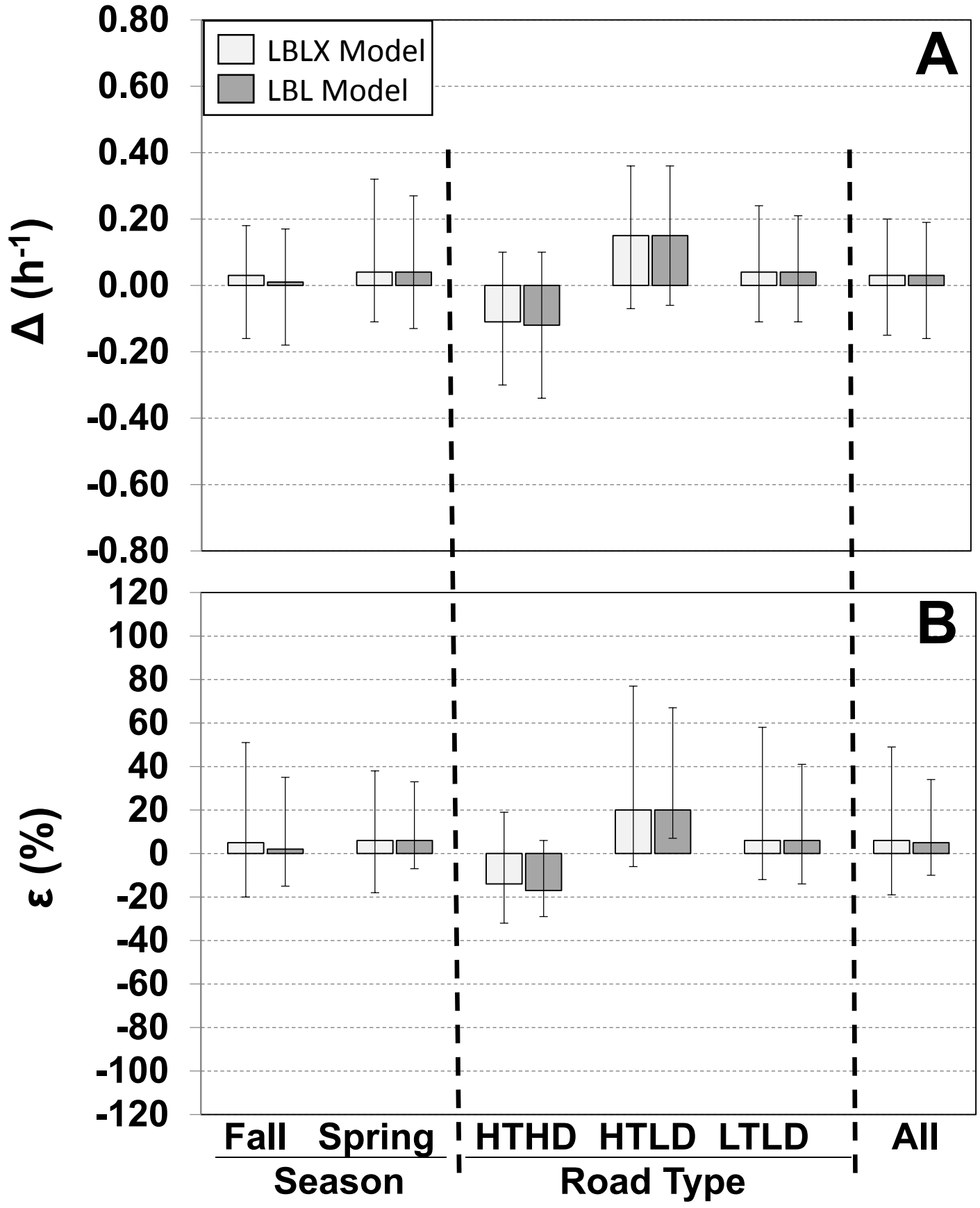

LBLX Model
LBL Model
A
B
Δ (h-1)
ε (%)
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
Fall
Spring
HTHD
HTLD
LTLD
All
Season
Road Type

Figure S3

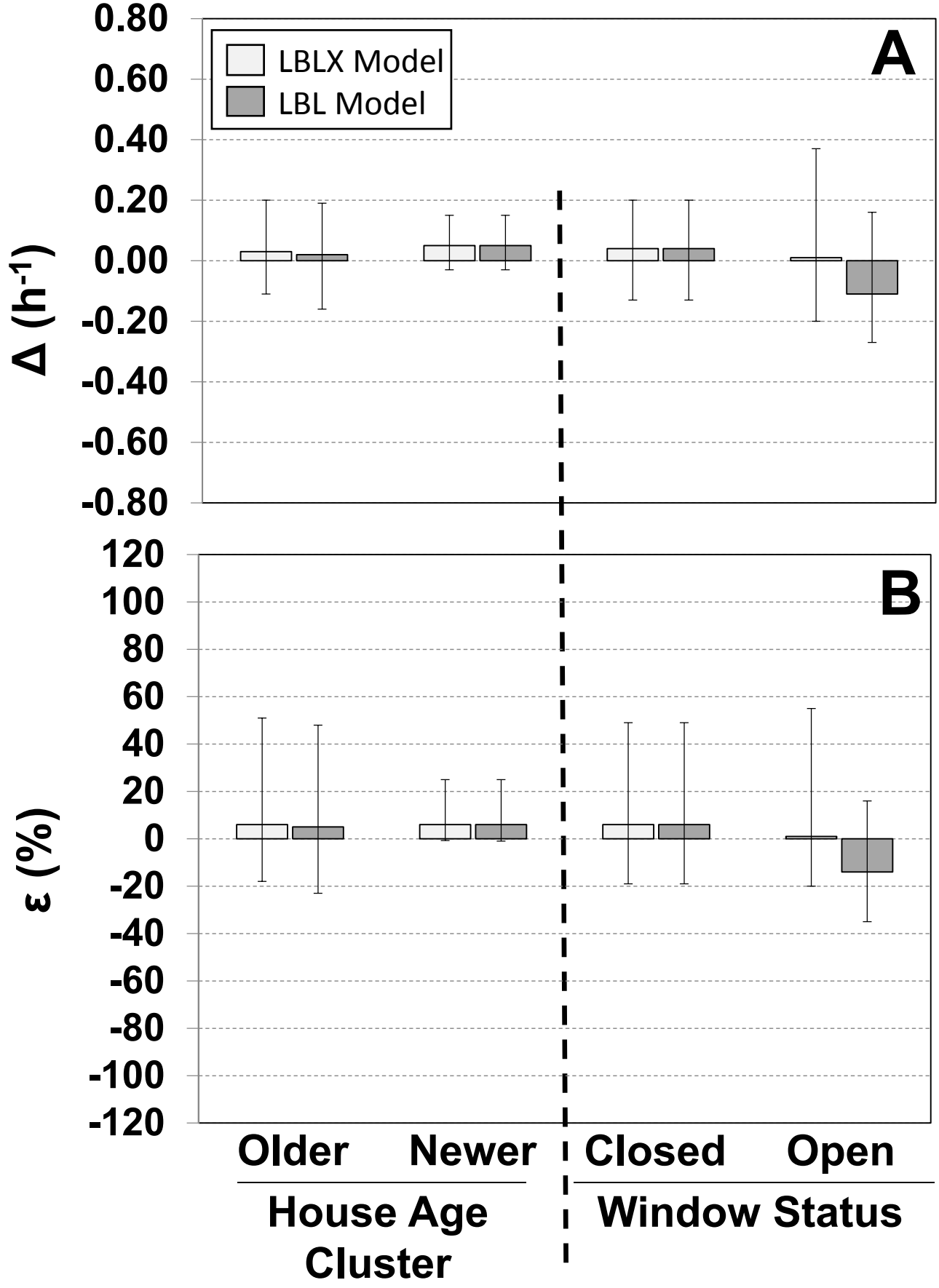
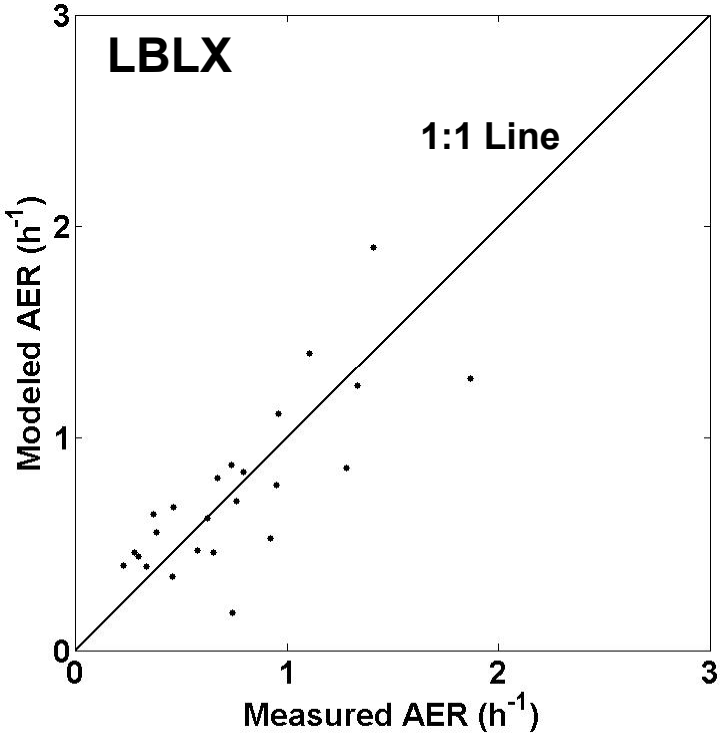

LBLX Model
LBL Model
A
B
Δ (h-1)
ε (%)
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
Older
Newer
Closed
Open
House Age Cluster
Window Status

Figure S4


LBLX
1:1 Line
Modeled AER (h-1)
Measured AER (h-1)
0
1
2
3

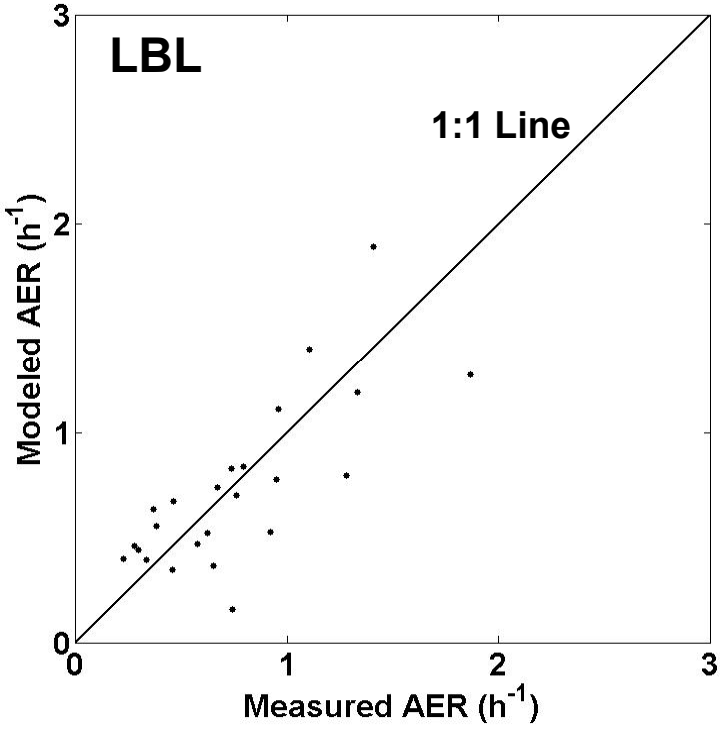

LBL
1:1 Line
Modeled AER (h-1)
Measured AER (h-1)
0
1
2
3

Figure S5