Supplementary Information

for

A methodology for estimating indoor sources contribution to $PM_{2.5}$

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Figures

Figure S1: a) Maps showing schools (red) and monitoring stations(yellow) locations in Santiago b) Schools with lower R2 values according to distance to the nearest monitoring station in one zone

Figure S2: Comparison of outdoor sensor $PM_{2.5}$ data in S12 and S15 with reference monitoring station (daily averages).

Figure S3: projection of the $PM_{2.5}$ fuzzy clustering results for school outdoor, far and near classrooms, using (u,v) as independent variables. The size of the symbols is scaled by its membership value. Green: regional, red: secondary, purple: traffic, yellow: overnight-mix, blue: noise, brown: indoor-generated particles

Figure S4: Boxplot of Indoor-generated $PM_{2.5}$ (far and near classrooms) according to school type for all 19 schools

Figure S5: comparing outdoor and near classroom $PM_{2.5}$ clusters: a) Regional Source, b) Overnight mix Source, c) Traffic Source, d) Secondary source, e) Noise Cluster (Out: outdoor, N: near classrooms and 1 to 6 are the numbers of the clusters).

Figure S6: Polar plots for the fuzzy cluster solution for outdoor and indoor (far and near) $PM_{2.5}$ classroom measurements. Wind speed and wind direction are the polar variables. The left, center and right plots correspond to outdoor, far and near classrooms, respectively.

Figure S7: Polar plots for the fuzzy cluster solution for outdoor and indoor (far and near) $PM_{2.5}$ classroom measurements. Temperature and wind direction are the polar variables. The left, center and right plots correspond to outdoor, far and near classrooms, respectively.

Figure S8: $PM_{2.5}$ infiltration factor for near and far classrooms (a and b respectively) according to different clusters: reg cluster (regional), Overnight mix cluster (overnight), traffic cluster (tr) and secondary cluster (sec).

Figure S9: seasonal variability of F_{inf} for different sources (fuzzy clusters) of $PM_{2.5}$.

Figure S10: Source contributions of $PM_{2.5}$ by cluster in a) outdoor b) far classrooms c) near classrooms ($\mu g/m^3$). The arrows show the highest value in each school cluster.

Figure S11: $PM_{2.5}$ contributions of different clusters according to seasons in outdoor (Out), far (F) and near (N) classrooms ($\mu g/m^3$).

Tables

Table S1: Adjusted R^2 for different pairwise comparisons

Table S2: adjusted R^2 for paired fuzzy clusters.

Figure S1: a) Maps showing schools (red) and monitoring stations(yellow) locations in Santiago. b) A subset of schools showing how R^2 values (between reference monitor and outdoor sensor at school) change according to distance to the nearest reference monitor (Parque O'Higgins in this example).

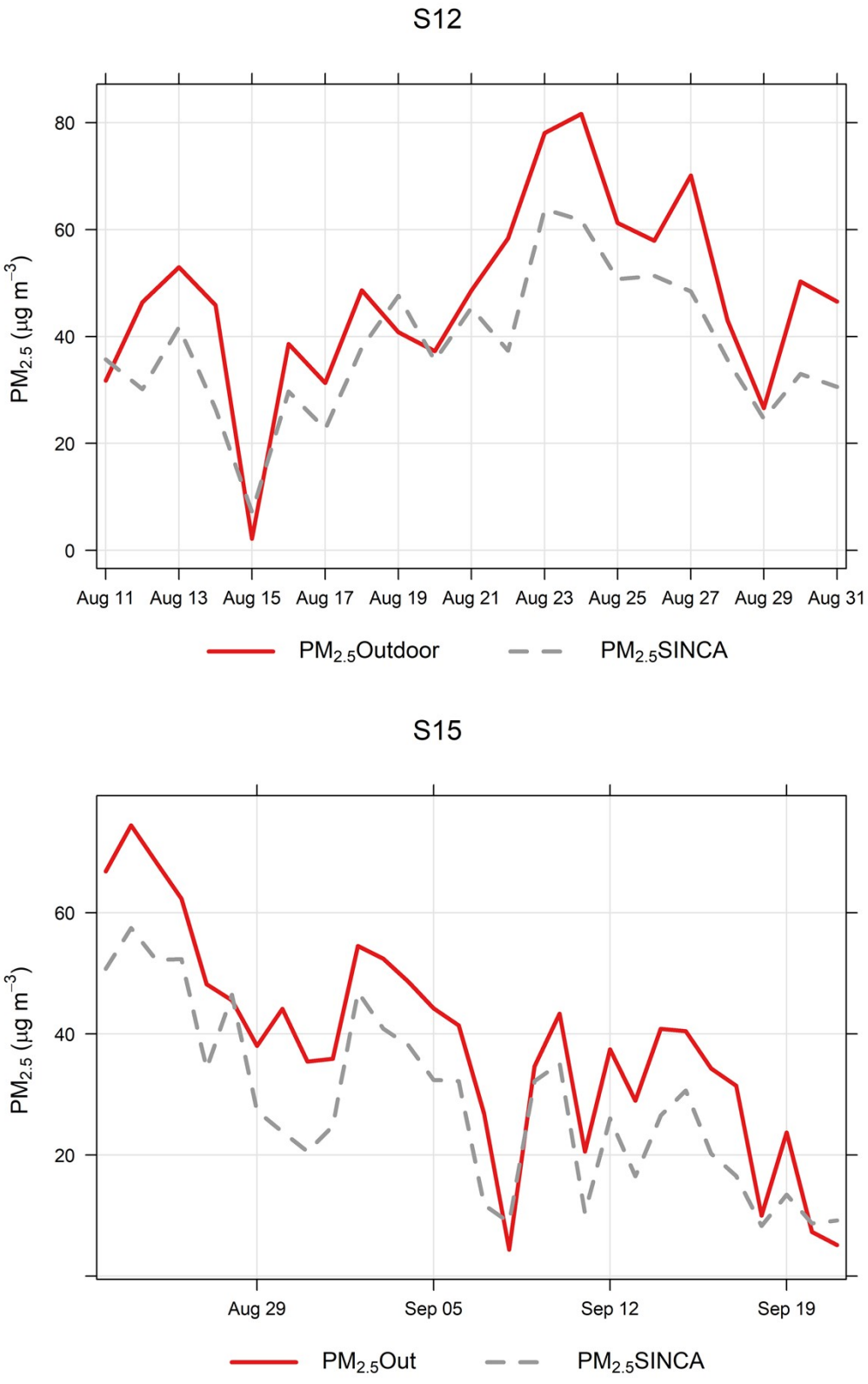

S12
80
60
40
20
0
PM2.5 (µg m−3)
Aug 11
Aug 13
Aug 15
Aug 17
Aug 19
Aug 21
Aug 23
Aug 25
Aug 27
Aug 29
Aug 31
PM2.5Outdoor
PM2.5SINCA
S15
60
40
20
PM2.5 (µg m−3)
Aug 29
Sep 05
Sep 12
Sep 19
PM2.5Out
PM2.5SINCA

Figure S2

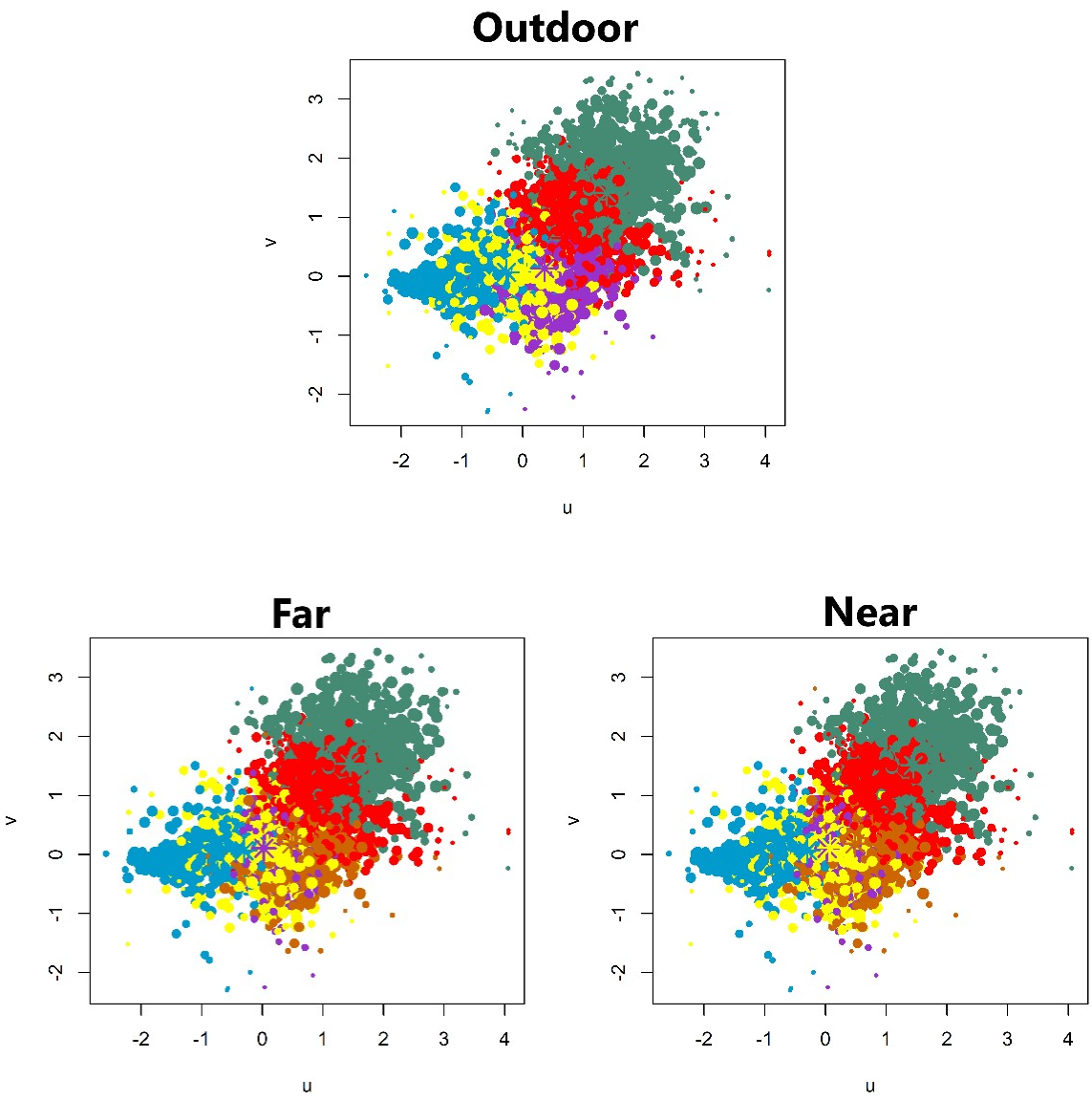


Figure S3

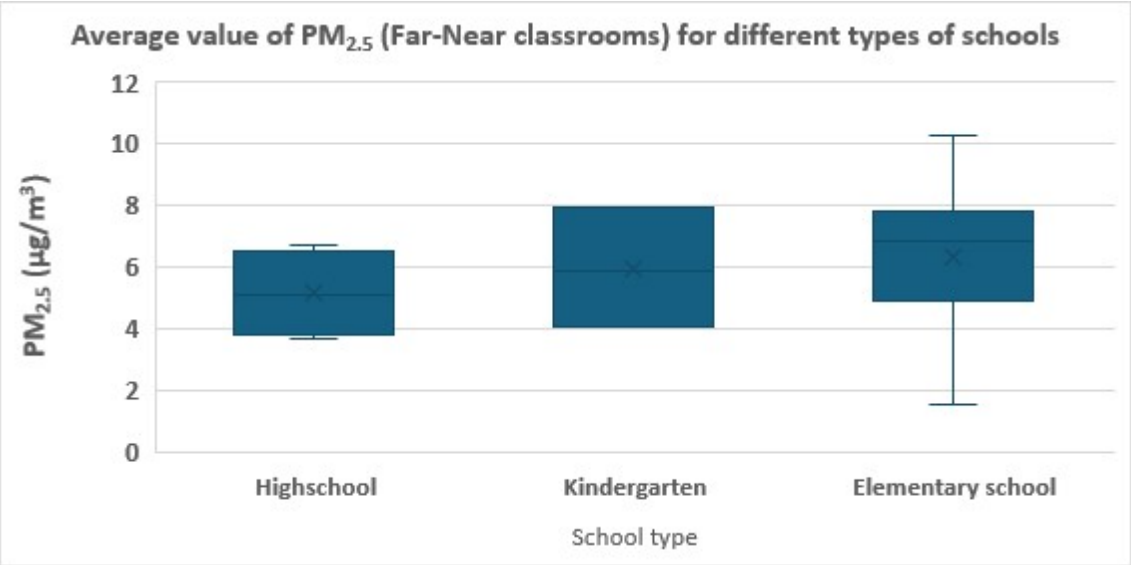

Average value of PM2.5 (Far-Near classrooms) for different types of schools
PM2.5 (µg/m3)
12
10
8
6
4
2
0
Highschool
Kindergarten
Elementary school
School type

Figure S4

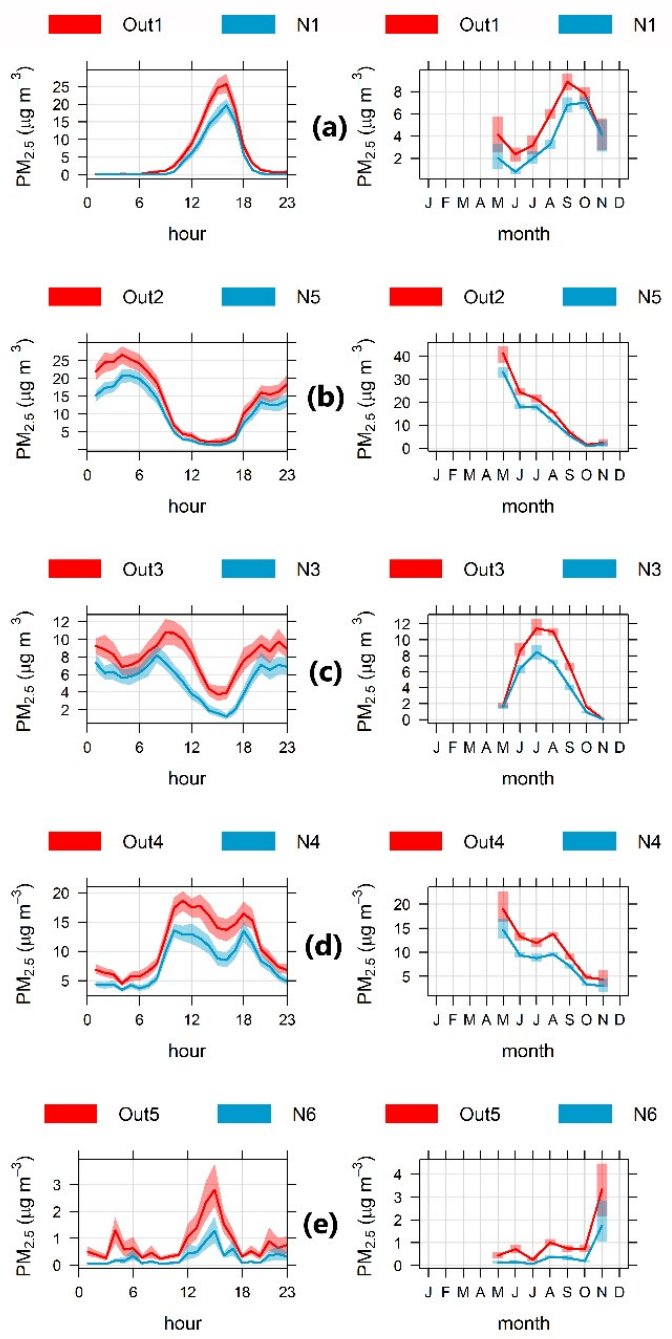

Out1
N1
Out1
N1
PM2.5 (μg m-3)
hour
month
(a)
Out2
N5
Out2
N5
(b)
Out3
N3
Out3
N3
(c)
Out4
N4
Out4
N4
(d)
Out5
N6
Out5
N6
(e)
J F M A M J J A S O N D

Figure S5

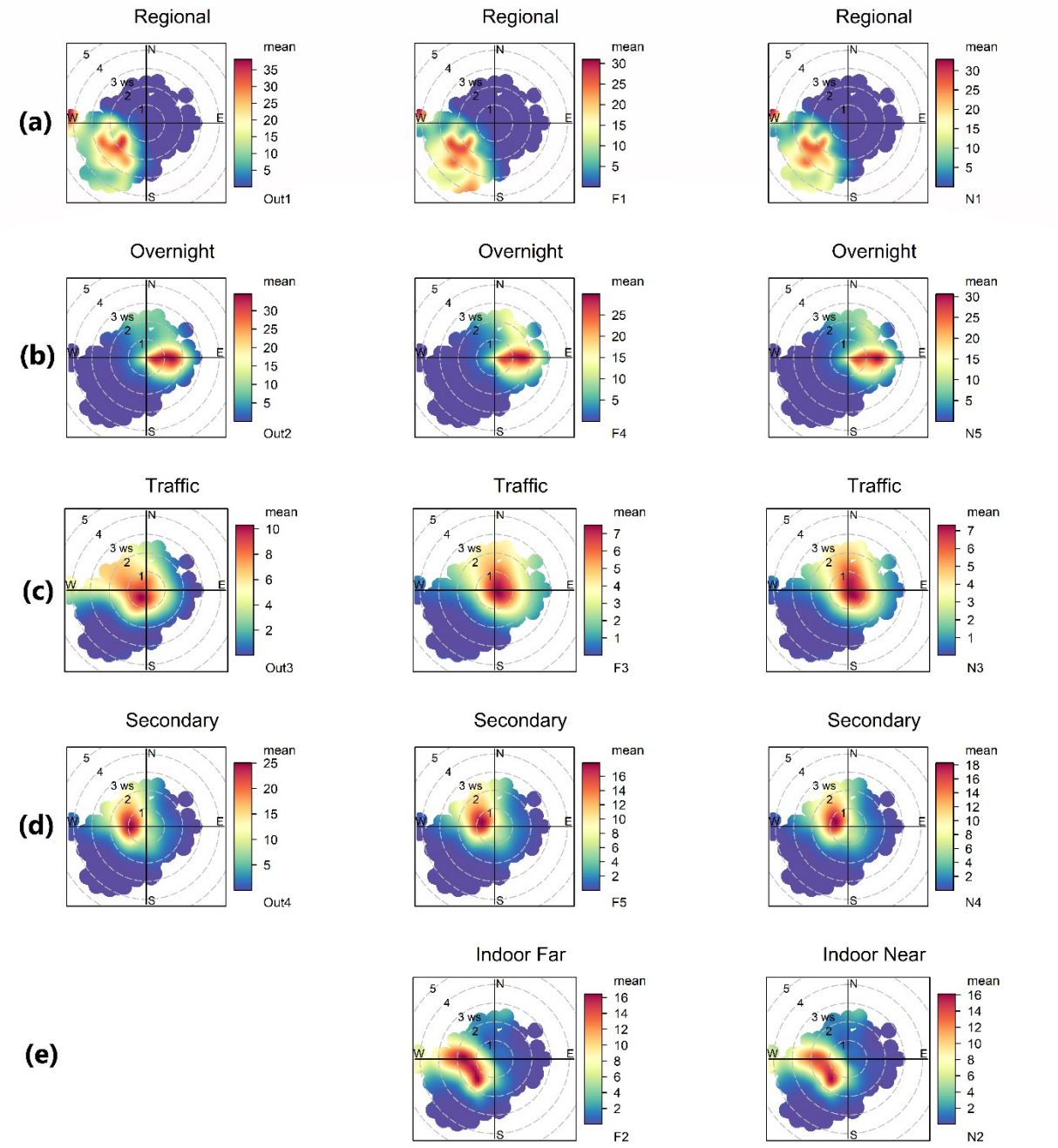

Regional
Regional
Regional
(a)
Out1
F1
N1
Overnight
Overnight
Overnight
(b)
Out2
F4
N5
Traffic
Traffic
Traffic
(c)
Out3
F3
N3
Secondary
Secondary
Secondary
(d)
Out4
F5
N4
Indoor Far
Indoor Near
(e)
F2
N2
mean
3 ws
N
E
S
W

Figure S6

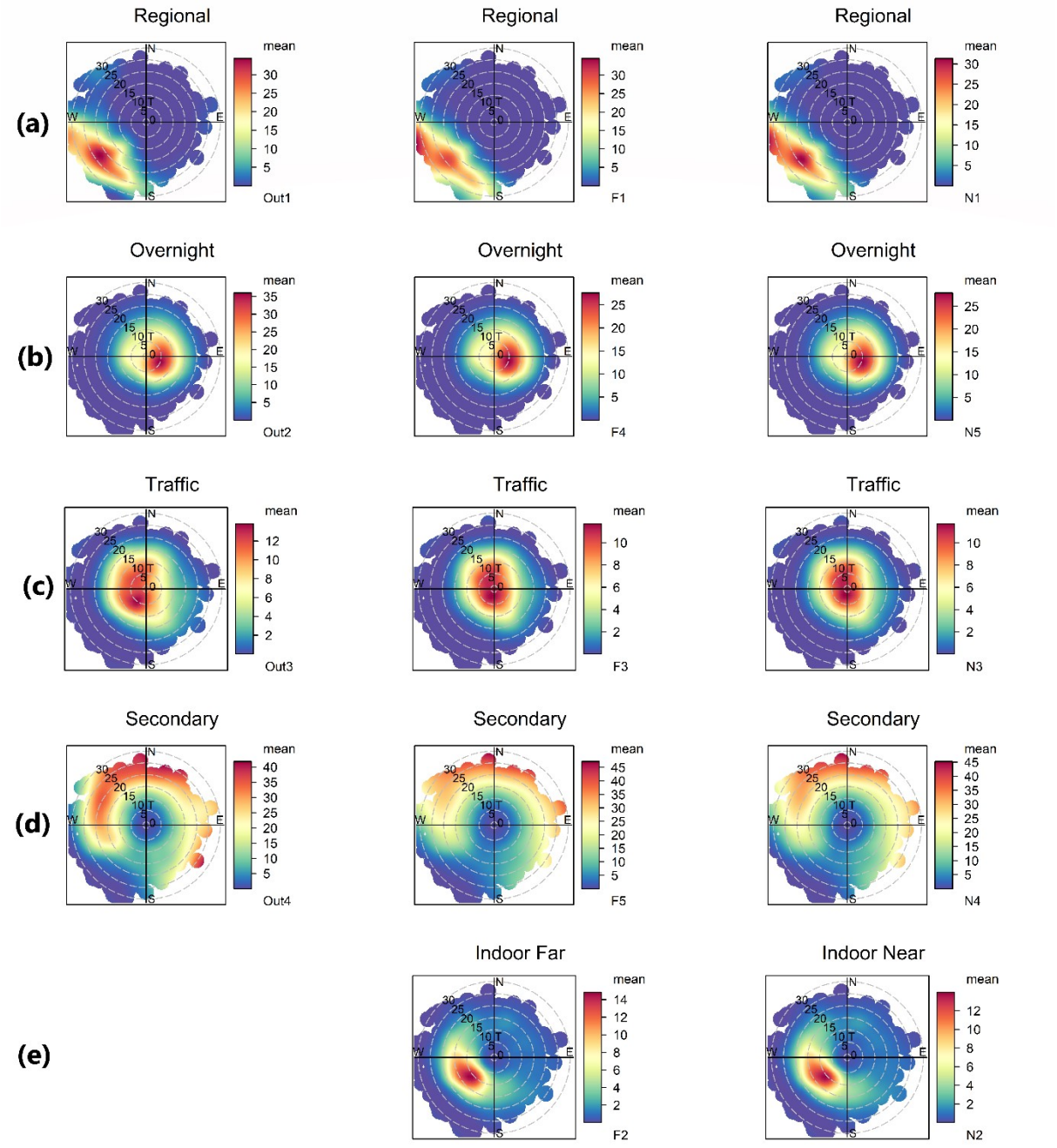
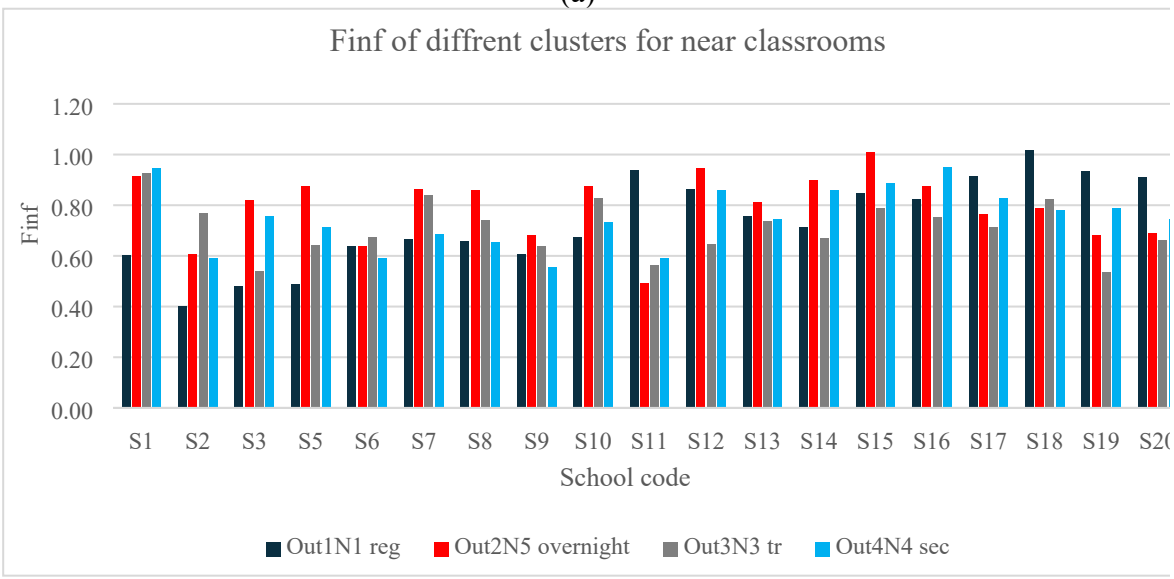

(a)
Regional
mean
Out1
Regional
mean
F1
Regional
mean
N1
(b)
Overnight
mean
Out2
Overnight
mean
F4
Overnight
mean
N5
(c)
Traffic
mean
Out3
Traffic
mean
F3
Traffic
mean
N3
(d)
Secondary
mean
Out4
Secondary
mean
F5
Secondary
mean
N4
(e)
Indoor Far
mean
F2
Indoor Near
mean
N2

Figure S7

(a)


Finf of diffrent clusters for near classrooms
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Finf
S1 S2 S3 S5 S6 S7 S8 S9 S10 S11 S12 S13 S14 S15 S16 S17 S18 S19 S20
School code
Out1N1 reg
Out2N5 overnight
Out3N3 tr
Out4N4 sec

(b)

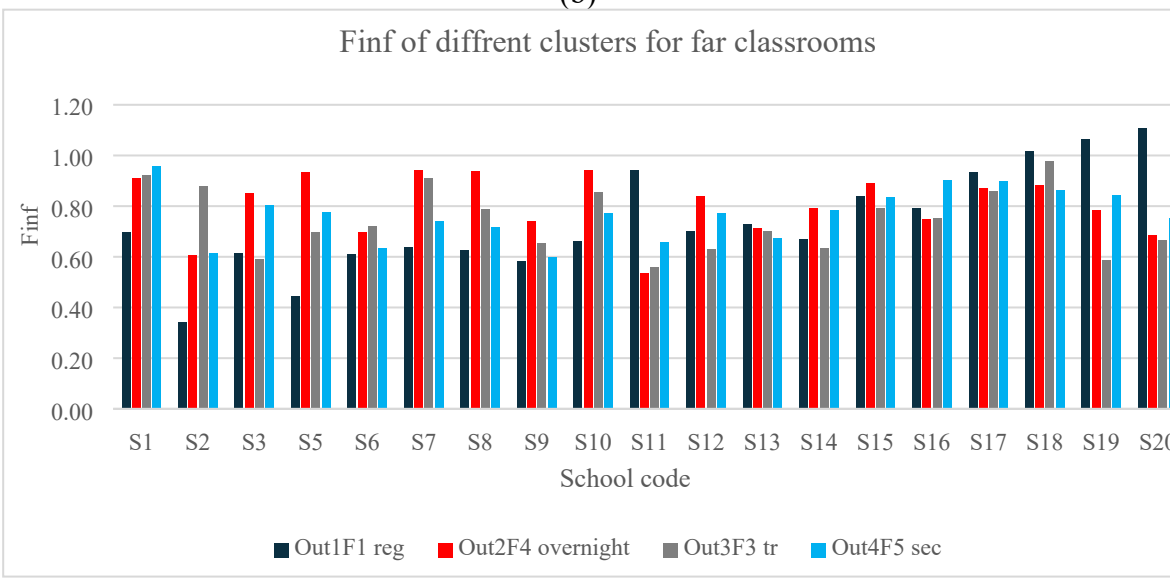
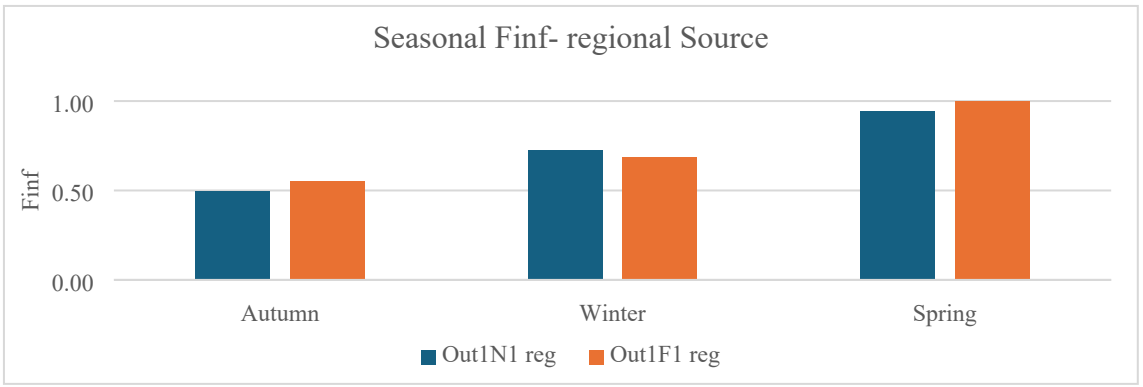
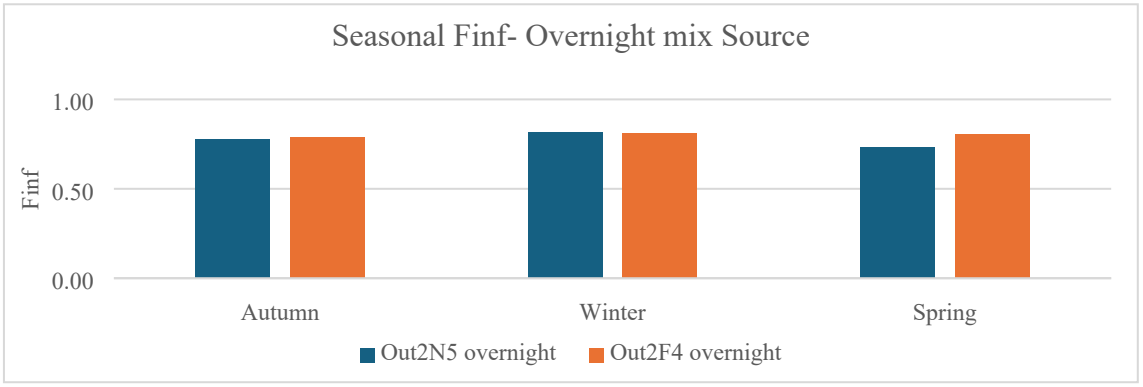
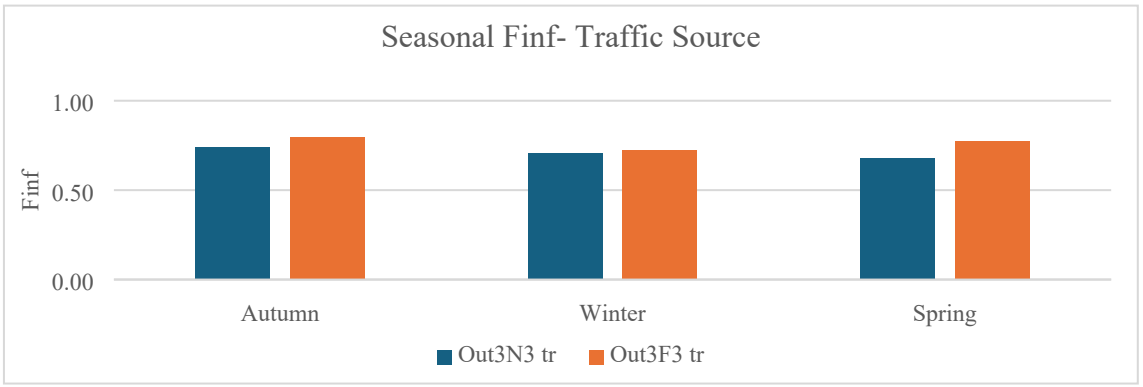

Finf of diffrent clusters for far classrooms
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Finf
S1 S2 S3 S5 S6 S7 S8 S9 S10 S11 S12 S13 S14 S15 S16 S17 S18 S19 S20
School code
Out1F1 reg
Out2F4 overnight
Out3F3 tr
Out4F5 sec

Figure S8


Seasonal Finf- regional Source
1.00
0.50
0.00
Finf
Autumn
Winter
Spring
Out1N1 reg
Out1F1 reg


Seasonal Finf- Overnight mix Source
1.00
0.50
0.00
Finf
Autumn
Winter
Spring
Out2N5 overnight
Out2F4 overnight


Seasonal Finf- Traffic Source
1.00
0.50
0.00
Finf
Autumn
Winter
Spring
Out3N3 tr
Out3F3 tr

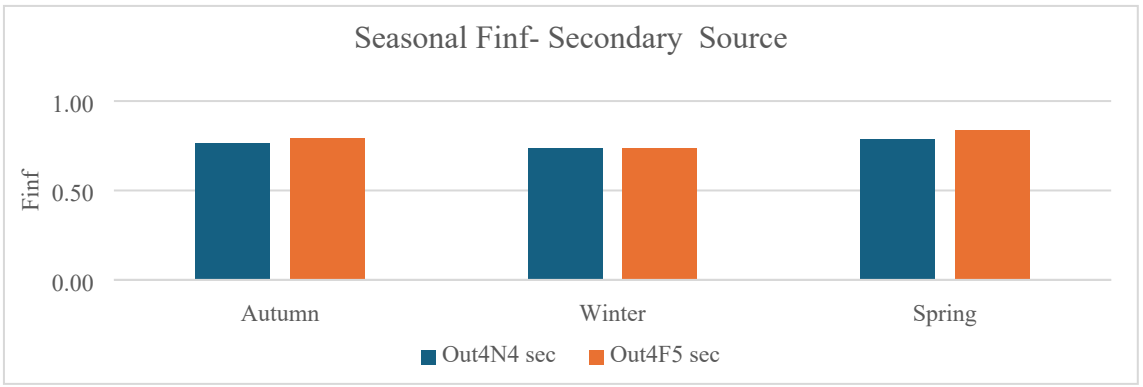
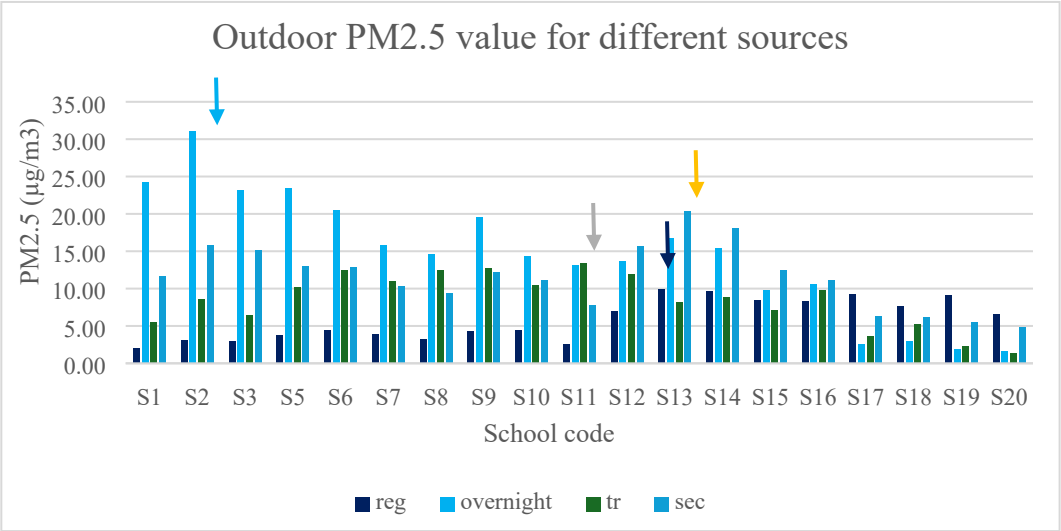
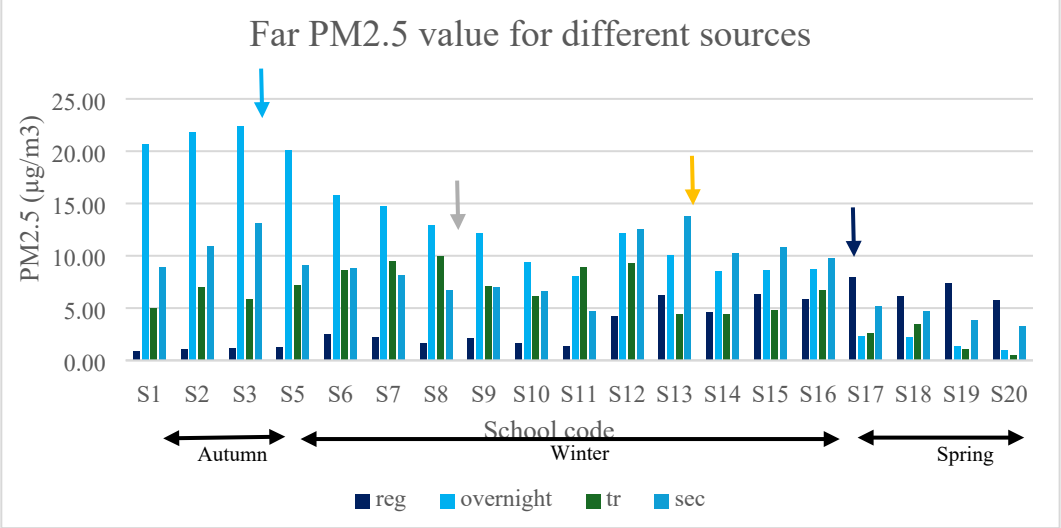

Seasonal Finf- Secondary Source
1.00
0.50
0.00
Finf
Autumn
Winter
Spring
Out4N4 sec
Out4F5 sec

Figure S9

a



b



c

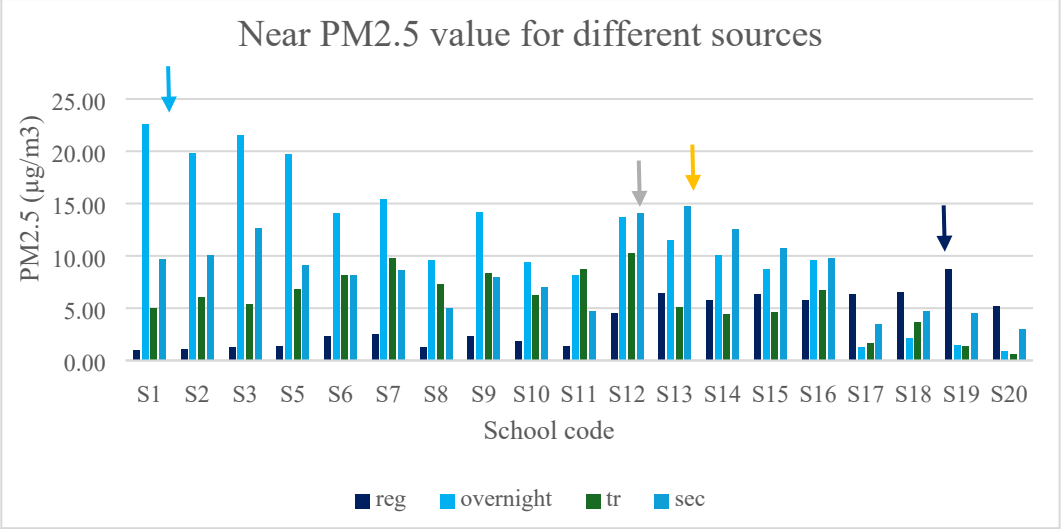


Figure S10

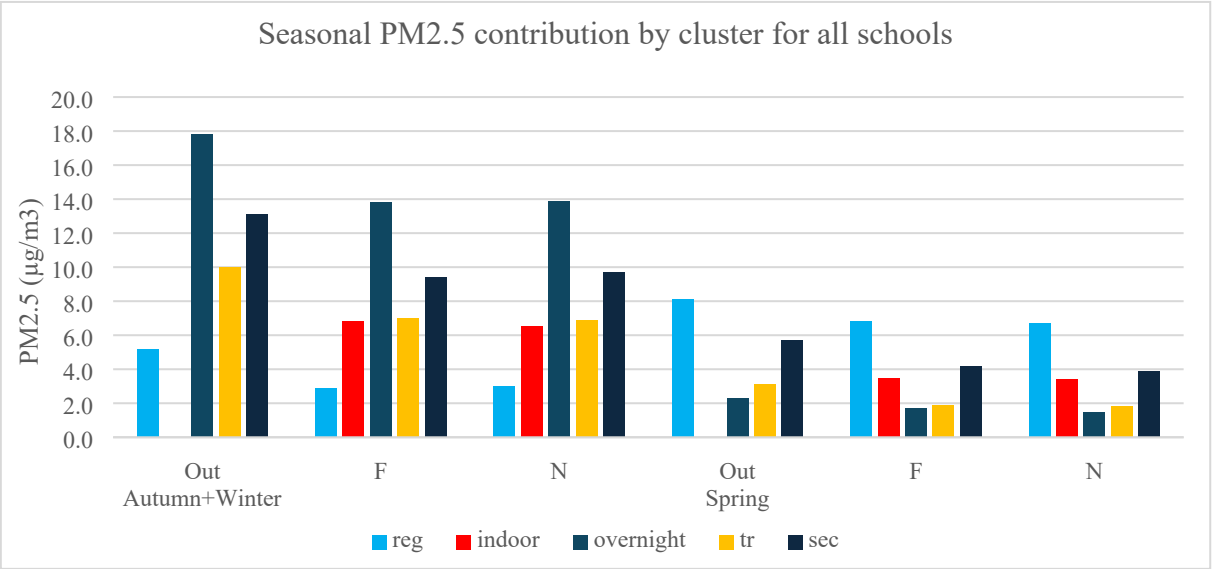

Seasonal PM2.5 contribution by cluster for all schools
PM2.5 (µg/m3)
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Out
Autumn+Winter
F
N
Out
Spring
F
N
reg
indoor
overnight
tr
sec

Figure S11

Table S1: Adjusted R^2, Outdoor/SINCA concentration ratio and types of schools for different pairwise comparisons.

School Code	R^2 Outdoor-SINCA	Concentration ratio Outdoor/SINCA	Type of school
S1	0.74	1.5	Highschool
S2	0.61	1.2	Kindergarten
S3	0.57	1.4	Highschool
S5	0.71	1.4	Elementary school
S6	0.85	1.5	Elementary school
S7	0.69	1.3	Elementary school
S8	0.82	1.7	Elementary school
S9	0.79	1.5	Elementary school
S10	0.37	1.3	Kindergarten
S11	0.62	1.5	Elementary school
S12	0.73	1.3	Elementary school
S13	0.70	1.5	Elementary school
S14	0.51	1.4	Highschool
S15	0.74	1.3	Elementary school
S16	0.69	1.1	Kindergarten
S17	0.62	1.4	Elementary school
S18	0.55	0.9	Highschool
S19	0.65	1.3	Elementary school
S20	0.67	1.2	Elementary school

Table S2: adjusted R^2 for paired fuzzy clusters.

School Code	Out1-N1 reg	Out2-N5 Overnight	Out3-N3 tr	Out4-N4 sec	Out1-F1 reg	Out2-F4 Overnight	Out3-F3 tr	Out4-F5 sec
S1	0.82	0.83	0.86	0.81	0.73	0.77	0.85	0.73
S2	0.86	0.80	0.85	0.80	0.63	0.76	0.86	0.76
S3	0.69	0.76	0.54	0.74	0.57	0.78	0.54	0.73
S5	0.57	0.86	0.71	0.73	0.51	0.88	0.68	0.72
S6	0.80	0.80	0.58	0.76	0.76	0.77	0.57	0.73
S7	0.82	0.83	0.58	0.79	0.78	0.83	0.58	0.78
S8	0.60	0.82	0.59	0.65	0.57	0.87	0.63	0.64
S9	0.81	0.80	0.53	0.76	0.77	0.78	0.52	0.74
S10	0.81	0.80	0.58	0.74	0.78	0.82	0.57	0.73
S11	0.64	0.73	0.39	0.61	0.62	0.66	0.36	0.55
S12	0.74	0.87	0.68	0.76	0.70	0.85	0.68	0.71
S13	0.88	0.85	0.78	0.83	0.85	0.84	0.77	0.78
S14	0.84	0.84	0.73	0.78	0.80	0.82	0.72	0.71
S15	0.86	0.90	0.71	0.87	0.84	0.90	0.73	0.85
S16	0.82	0.93	0.71	0.85	0.78	0.89	0.73	0.81
S17	0.83	0.86	0.67	0.72	0.87	0.95	0.73	0.81
S18	0.87	0.90	0.73	0.81	0.88	0.93	0.79	0.88
S19	0.82	0.81	0.63	0.77	0.71	0.93	0.73	0.84
S20	0.79	0.89	0.68	0.80	0.68	0.92	0.64	0.85