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Supplement of

Spatial variations and development of land use regression models of levoglucosan in four European study areas

A. Jedynska et al.

Correspondence to: A. Jedynska (aleksandra.jedynska@tno.nl)

Online supplement

Table S1. Predictor variables with predefined variable names, units, defined buffer sizes, transformations of the predictor variables and directions of effect.

GIS dataset	Predictor variable	Name variable1	Unit	Buffer size (radius of buffer in meter)	Transformation	Direction of effect
Background						
-	Coordinate variables2	XCOORD, YCOORD	m	NA	Local decision	NA
CORINE	High density residential land 3	HDRES	m^2	100, 300, 500, 1000, 5000		+
CORINE	Low density residential land 3	LDRES	m^2	100, 300, 500, 1000, 5000	-	+
CORINE	Industry 3	INDUSTRY	m^2	100, 300, 500, 1000, 5000	-	+
CORINE	Port 3	PORT	m^2	100, 300, 500, 1000, 5000	-	+
CORINE	Urban green 3, 4	URBGREEN	m^2	100, 300, 500, 1000, 5000	-	-
CORINE	Semi-natural and forested areas 3, 5	NATURAL	m^2	100, 300, 500, 1000, 5000	-	-
Local land use			m^2	100, 300, 500, 1000, 5000	-	Following CORINE
Population density	Number of inhabitants 3	POP	N(umber)	100, 300, 500, 1000, 5000	-	+
Household density	Number of households	HHOLD	N(umber)	100, 300, 500, 1000, 5000	-	+
Altitude	Altitude	SQRALT	m	NA	square root	-
Traffic 6						
Local road network	Traffic intensity 6 on nearest road	TRAFNEAR	Veh.day-1	NA	-	+
Local road network	Distance to the nearest road	DISTINVNEAR1 DISTINVNEAR2	m-1, m-2	NA	Inverse distance and inverse distance squared	+
Local road network	Product of traffic intensity on nearest road and inverse of distance to the nearest road and distance squared	INTINVDIST INTINVDIST2	Veh.day-m-1 Veh.day-m-2	NA	-	+
Local road network	Traffic intensity on nearest major road 7	TRAFMAJOR	Veh.day-1	NA	-	+
Local road network	Distance to the nearest major road 7	DISTINVMAJOR1 DISTINVMAJOR2	m-1, m-2	NA	Inverse distance and inverse distance squared	+
Local road network	Product of traffic intensity on nearest major road and inverse of distance to the nearest major road and distance squared 7	INTMAJORINVDIST INTMAJORINVDIST2	Veh.day-m-1 Veh.day-m-2	NA	-	+
Local road network	Total traffic load of major roads in a buffer (sum of (traffic intensity * length of all segments)) 7	TRAFMAJORLOAD	Veh.day-m	25, 50, 100, 300, 500, 1000	-	+
Local road network	Total traffic load of all roads in a buffer (sum of (traffic intensity * length of all segments))	TRAFLOAD	Veh.day-m	25, 50, 100, 300, 500, 1000	-	+
Local road network	Heavy-duty traffic intensity on nearest road	HEAVYTRAFNEAR*	Veh.day-1	NA	-	+
Local road network	Product of Heavy-duty traffic intensity on nearest road and inverse of distance to the nearest road and distance squared	HEAVYINTINVDIST HEAVYINTINVDIST2	Veh.day-m-1 Veh.day-m-2	NA	-	+
Local road network	Heavy-duty traffic intensity on nearest major road	HEAVYTRAFMAJOR	Veh.day-1	NA	-	+
Local road network	Total heavy-duty traffic load of major roads in a buffer (sum of (heavy-duty traffic intensity * length of all segments))	HEAVYTRAFMAJORLOAD	Veh.day-m	25, 50, 100, 300, 500, 1000	-	+
Local road network	Total heavy-duty traffic load of all roads in a buffer (sum of (heavy duty traffic intensity * length of all segments))	HEAVYTRAFLOAD	Veh.day-m	25, 50, 100, 300, 500, 1000		+
Central road network	Road length of all roads in a buffer	ROADLENGTH	m	25, 50, 100, 300, 500, 1000	-	+
Central road network	Road length of major roads in a buffer 8	MAJORROADLENGTH	m	25, 50, 100, 300, 500, 1000	-	+
Central road network	Distance to the nearest road	DISTINVNEARC1 DISTINVNEARC2	m-1, m-2	NA	Inverse distance and inverse distance squared	+
Central road network	Distance to the nearest major road 8	DISTINVMAJORC1 DISTINVMAJORC2	m-1, m-2	NA	Inverse distance and inverse distance squared	+
	Aspect ratio (sum height buildings both side of road divided by road width) 9	CANYON 9	m/m	NA		

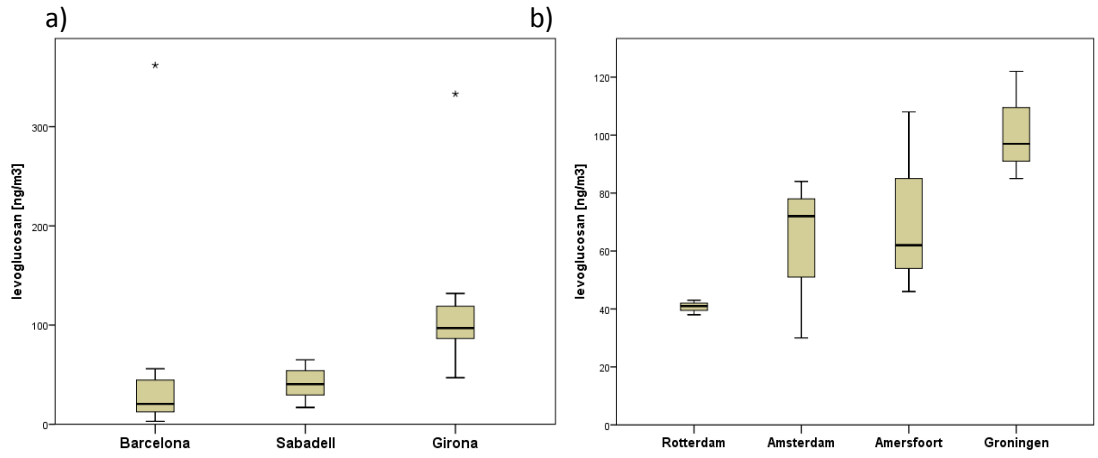

Figure S1. Distribution of the adjusted year average concentration of levoglucosan within study areas. Median, 25th and 75th percentiles are shown in the box, whiskers indicate 10th and 90th percentiles and individual outliers are shown. a) Catalonia, from south to north b) The Netherlands, from west to east.

Table S2: List of components used for temporal correction of levoglucosan with median Pearson temporal correlation (r)

Study area	Component	median r
Oslo	PM2.5abs	0.987
Netherlands	NOx	0.916
Munich/Augsburg	NOx	0.829
Catalonia	NOx	0.980

r is the correlation between measurements of levolglucosan at a measurement site and the standard component measured at the reference site (e.g. $PM_{2.5}$ absorbance for Oslo). Correlations are calculated per site and thus reflect the temporal correlation. The median of site-specific individual correlation coefficients are calculated and presented in the table.

Table S3: Pearson correlation (r) between unadjusted and ratio-adjusted concentrations of levoglucosan

Study area	r
Oslo	0.97
Netherlands	0.94
Munich/Augsburg	0.94
Catalonia	0.93

Table S4. Difference of levoglucosan annual concentrations between site types (ratios RB/UB and S/UB)

Study area	n	RB/UB	S/UB
Oslo	19	0.15	0.99
Netherlands	16	1.37	1.46
Munich/Augsburg	20	1.39	1.04
Catalonia	40	2.63*	1.19

*Significant difference between site types with $p<0.01$

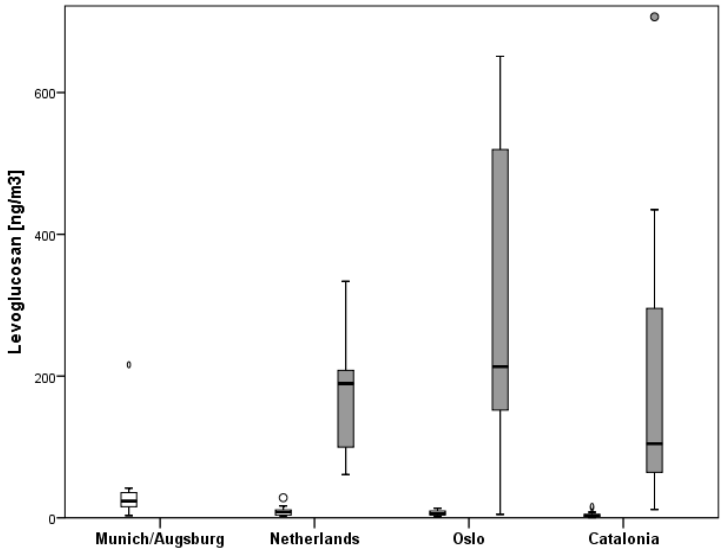

Figure S2. Seasonal differences of levoglucosan. White box – summer, grey box – winter

Table S5 Temporal correlation of levoglucosan with other components (median)

	PM2.5	PM2.5abs	NOX	EC	OC	ΣPAH	B[a]P	Σhopanes/steranes	K
Oslo	0.931	0.984	0.997	0.999	0.927	0.999	0.998	0.963	0.909
Netherlands	0.674	0.913	0.916	0.920	0.611	0.930	0.946	0.604	0.796
Munich/Augsburg	0.980	0.662	0.996	0.773	-0.016	0.996	0.997	0.760	0.997
Catalonia	0.482	0.913	0.980	0.878	0.988	0.985	0.989	0.922	0.622

Table S6 Median concentration ratios

	Levo/PM2.5	Levo/OC	levo/EC	levo/PAH	levo/K	K/levo	
Oslo	0.009	0.056	0.086	71.094	0.931	1.074	Based on annual averages
Netherlands	0.004	0.039	0.048	52.885	0.575	1.739	
Munich/Augsburg	0.007	0.040	0.075	77.663	0.377	2.653	
Catalonia	0.003	0.017	0.019	36.963	0.247	4.043	
Oslo	0.004	0.027	0.046	66.032	0.335	2.989	All individual measurements
Netherlands	0.004	0.040	0.057	53.379	0.683	1.463	
Munich/Augsburg	0.004	0.031	0.057	78.210	0.502	1.993	
Catalonia	0.002	0.011	0.013	23.074	0.108	9.236	
Oslo	0.027	0.153	0.173	72.397	2.832	0.353	Cold season
Netherlands	0.006	0.066	0.082	53.379	0.929	1.077	
Munich/Augsburg	0.011	0.108	0.137	78.118	1.186	0.843	
Catalonia	0.004	0.024	0.028	46.171	0.363	2.754	
Oslo	0.002	0.013	0.020	60.799	0.235	4.260	Warm season
Netherlands	0.001	0.014	0.024	46.054	0.221	4.517	
Munich/Augsburg	0.003	0.018	0.038	82.535	0.375	2.668	
Catalonia	0.0004	0.003	0.003	7.644	0.034	29.532	