

AirGIS Model

AirGIS model,[1] based on a geographical information system (GIS), is used to estimate traffic-related air pollution and has high temporal (an hour) and spatial (individual address) resolution. AirGIS calculates air pollution at a location as the sum of three contributors: (1) local air pollution from street traffic, calculated with the Operational Street Pollution Model[2] (OSPM) from data on traffic (intensity and type), emission factors for each vehicle type and EURO class, street and building geometry, and meteorology; (2) urban background, calculated from a simplified urban background (SUB) procedure[3] that takes into account urban vehicle emission density, city dimensions (transport distance), and average building height (initial dispersion height); and (3) regional background, estimated from trends at rural monitoring stations and from national vehicle emissions.[4] Input data for the AirGIS system come from various sources: a GIS-based national street and traffic database, including construction year and traffic data for the period 1960–2005,[5] and a database on emission factors for the Danish car fleet,[6,7] with data on light- and heavy-duty vehicles dating back to 1960, built and entered into the emission module of the OSPM. A national GIS database with building footprints supplemented with construction year and building height from the national building and dwelling register, national survey and cadastre data-bases, and a national terrain-evaluation model, provided the correct street geometry for a given year at a given address. With a geocoded address and a year, the starting point is specified in place and time, and the AirGIS system automatically generates street configuration data for the OSPM, including street orientation, street width, building heights in wind sectors, traffic intensity and type, and the other data required for the model. The AirGIS system has been successfully validated[3,8] and used in several studies.[9-11]

References:

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Table W1. Distribution of alternative proxies of long-term exposure to traffic-related air pollution at the residential address at baseline (1993-1997) among the Diet, Cancer, and Health cohort participants.

<i>Air pollution proxy (time period)</i>	Total <i>n</i> = 53 695		Asthma <i>n</i> = 997	
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
Model NO ₂ 15-year mean (1991-follow-up/2006) (µg/m ³)	17.1 (6.3)	14.5 (6.4)	18.6 (7.0)	16.3 (7.4)
Model NO ₂ 1-year mean at baseline (1993-1997) (µg/m ³)	18.8 (6.7)	16.6 (6.7)	19.4 (7.0)	17.2 (6.9)
Model NO ₂ 1-year mean at follow-up (admission year/2006) (µg/m ³)	16.8 (6.4)	14.3 (6.4)	17.3 (7.0)	15.3 (7.2)
Traffic load [*] 200 m at baseline (1993-1997) (10 ³ vehicle km/day) [‡]	4.5 (5.3)	2.5 (5.7)	4.9 (5.4)	2.9 (6.0)
Major road [†] 100 m at baseline (1993-1997) <i>n</i> (%) [‡]	6 269 (16.6)		127 (18.4)	
Major road [†] 50 m at baseline (1993-1997) <i>n</i> (%) [‡]	2 921 (7.7)		60 (8.7)	

SD, standard deviation; IQR, interquartile range; NO₂, nitrogen dioxide.

^{*}Total number of kilometers traveled within 200m (sum of product of street length and traffic density for each road);

[†]Road with annual traffic density of 10 000 vehicles or more. [‡]Analyses with baseline traffic proximity proxies (traffic load within 200m, major road within 100m, and major road within 200m) are based on 37 836 (691 asthma cases) people who had same address at baseline and the end of follow-up.

Table W2. Association between alternative proxies of long-term exposure to traffic-related air pollution and hospital admissions for asthma among Diet, Cancer, and, Health cohort subjects.

<i>Asthma definition and population</i>	<i>Air pollution proxy (time period)</i>	Adjusted for age	Adjusted for age plus smoking*	Fully adjusted†	
		HR (95%CI)	HR (95%CI)	HR (95%CI)	
Full cohort n = 53 695	Model NO ₂ 15-year mean (1991-follow-up/2006) (µg/m ³)	1.13 (1.05-1.22)	1.12 (1.04-1.21)	1.11 (1.03-1.20)	
	Model NO ₂ 1-year mean at baseline (1993-1997) (µg/m ³)	1.10 (1.01-1.18)	1.09 (1.01-1.18)	1.08 (1.00-1.17)	
	Model NO ₂ 1-year mean at follow-up (admission year/2006) (µg/m ³)	1.20 (1.11-1.30)	1.19 (1.10-1.29)	1.18 (1.09-1.28)	
	Non-movers** N = 37 836	Traffic load‡ 200 m at baseline (1993-1997) (10 ³ vehicle km/day)	1.03 (0.90-1.18)	1.01 (0.88-1.16)	0.99 (0.87-1.14)
	Major road§ 100 m at baseline (1993-1997)	1.02 (0.84-1.24)	1.00 (0.82-1.21)	0.98 (0.81-1.19)	
	Major road§ 50 m at baseline (1993-1997)	0.99 (0.75-1.29)	0.97 (0.74-1.27)	0.96 (0.73-1.26)	
No asthma hospitalizations before baseline n = 53 143	Model NO ₂ 15-year mean (1991-follow-up/2006) (µg/m ³)	1.12 (1.03-1.21)	1.10 (1.02-1.20)	1.08 (0.99-1.17)	
	Model NO ₂ 1-year mean at baseline (1993-1997) (µg/m ³)	1.08 (0.99-1.18)	1.08 (0.99-1.17)	1.07 (0.98-1.16)	
	Model NO ₂ 1-year mean at follow-up (admission year/2006) (µg/m ³)	1.18 (1.08-1.29)	1.17 (1.07-1.28)	1.16 (1.06-1.27)	
	Non-movers** N = 37 448	Traffic load‡ 200 m at baseline (1993-1997) (10 ³ vehicle km/day)**	0.96 (0.82-1.12)	0.94 (0.81-1.10)	0.92 (0.79-1.08)
	Major road§ 100 m at baseline (1993-1997)**	0.91 (0.73-1.14)	0.89 (0.71-1.12)	0.88 (0.70-1.09)	
	Major road§ 50 m at baseline (1993-1997)**	0.87 (0.64-1.19)	0.86 (0.63-1.17)	0.85 (0.62-1.16)	
History of asthma hospitalizations before baseline n = 552	Model NO ₂ 15-year mean (1991-follow-up/2006) (µg/m ³)	1.37 (1.14-1.65)	1.35 (1.12-1.60)	1.32 (1.10-1.60)	
	Model NO ₂ 1-year mean at baseline (1993-1997) (µg/m ³)	1.32 (1.08-1.60)	1.30 (1.07-1.58)	1.33 (1.09-1.63)	
	Model NO ₂ 1-year mean at follow-up (admission year/2006) (µg/m ³)	1.47 (1.19-1.81)	1.44 (1.17-1.78)	1.47 (1.19-1.82)	
	Non-movers** n = 388	Traffic load‡ 200 m at baseline (1993-1997) (10 ³ vehicle km/day)**	1.18 (0.90-1.55)	1.15 (0.87-1.52)	1.23 (0.93-1.62)
	Major road§ 100 m at baseline (1993-1997)**	1.14 (0.76-1.72)	1.12 (0.73-1.70)	1.22 (0.80-1.86)	
	Major road§ 50 m at baseline (1993-1997)**	1.58 (0.92-2.73)	1.54 (0.89-2.68)	1.74 (0.99-3.05)	

HR, hazard ratio; CI, confidence interval; NO₂, nitrogen dioxide.

*Smoking status (never, previous, current), smoking intensity, smoking duration, and environmental tobacco smoke; †Smoking status (never, previous, current), smoking intensity, smoking duration, environmental tobacco smoke, occupational exposures, gender, body mass index, and educational level. ‡ Defined as a total number of km traveled within 200m (sum of product of street length and traffic density for each road); § Defined as road with annual traffic density of 10 000 vehicles or more; ** Analyses with baseline traffic proximity proxies (traffic load within 200m, major road within 100m, and major road within 200m) are based on 37 836 (691 asthma cases) people who had same address at baseline and the end of follow-up.