Supplementary Materials

Circulatory Health Risks from Additive Multi-pollutant Models: Short-term Exposure to Three Common Air Pollutants in Canada

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Note: The order of materials in supplementary follows the order of the main text.

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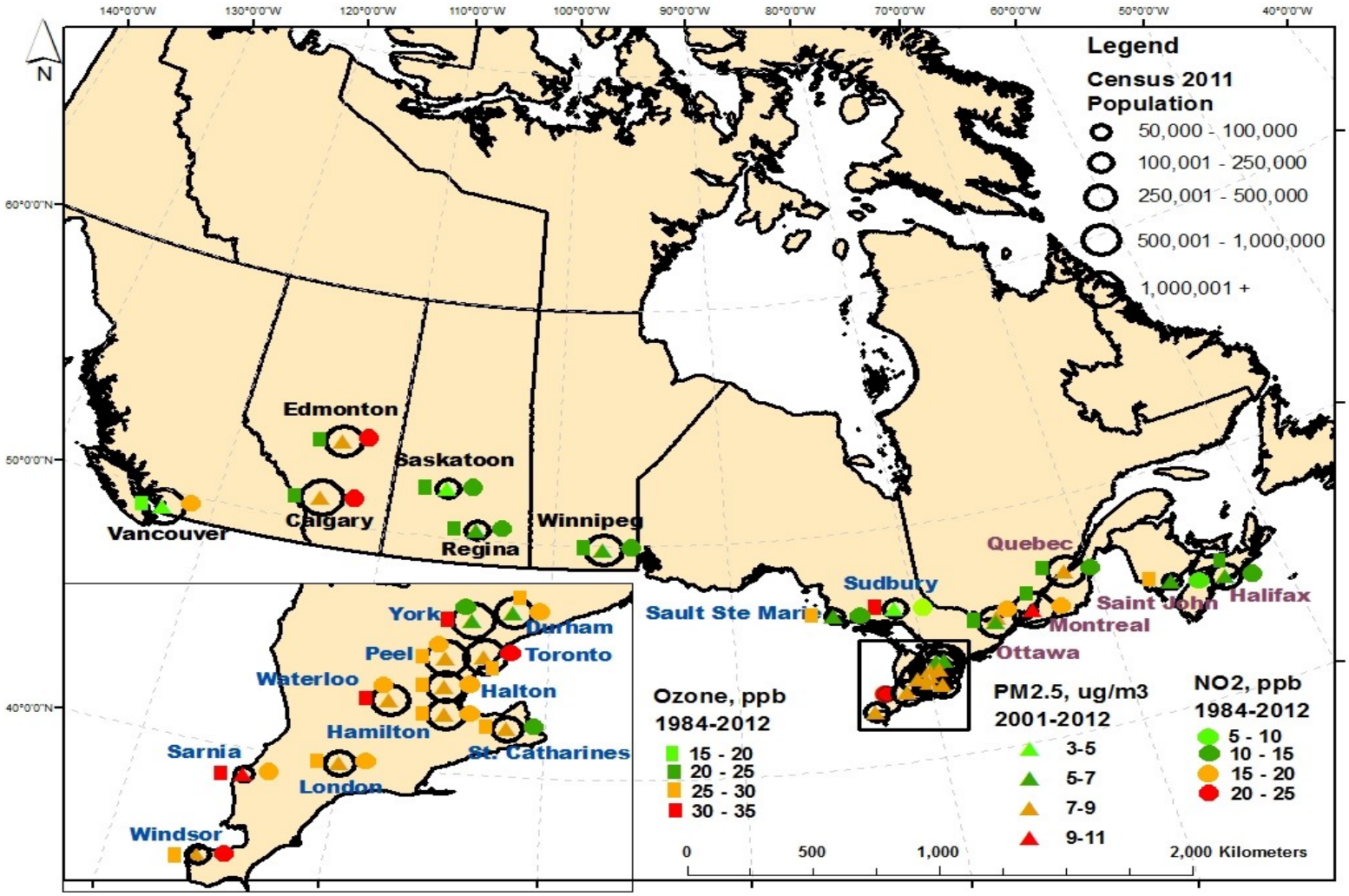

Figure S1: Canada map on the 24 cities selected for the study. (1) empty circle size: population size; (2) shape: solid square (ozone), solid circle (NO2) and solid triangle (PM2.5); and (3) color: concentrations in 4 levels of low to high in green to red

Table S1. City-specific annual average concentrations of Ozone, NO2, PM2.5, and temperature concentrations by season for 2001-2012

City	Ozone[a] in ppb (SD[b])		NO2[c] in ppb (SD)		PM2.5[d] in μg/m^3 (SD)		Temperature[e] in °C (SD)	
	Warm[f]	Cold[f]	Warm[f]	Cold[f]	Warm[f]	Cold[f]	Warm[f]	Cold[f]
Halifax	26 (3.9)	27 (2.7)	12 (3.8)	13 (4.3)	6 (0.9)	4 (1.1)	14 (0.6)	1 (1.0)
Saint John	32 (1.0)	**32** (1.1)	7 (3.0)	6 (2.3)	7 (1.4)	5 (1.0)	12 (0.5)	0 (1.0)
Quebec City	33 (2.4)	26 (1.2)	9 (1.8)	14 (2.9)	8 (0.7)	9 (1.4)	15 (0.6)	-4 (1.2)
Montreal	35 (2.1)	23 (1.4)	13 (2.9)	18 (2.9)	9 (1.0)	**10** (1.6)	16 (0.7)	-2 (1.3)
Ottawa	37 (2.9)	27 (2.5)	9 (5.8)	14 (5.3)	7 (1.6)	6 (1.3)	16 (0.6)	-2 (1.1)
Durham	41 (3.0)	29 (2.0)	9 (4.9)	12 (4.2)	8 (1.9)	6 (1.1)	16 (0.7)	0 (1.2)
York	45 (2.7)	**32** (1.2)	7 (1.5)	11 (1.8)	8 (1.7)	5 (0.9)	17 (0.7)	0 (1.1)
Toronto	41 (2.4)	25 (1.2)	**18** (3.4)	21 (2.8)	9 (1.6)	6 (0.9)	17 (0.7)	2 (1.0)
Peel	43 (2.4)	28 (1.3)	12 (3.3)	17 (3.4)	9 (1.7)	6 (0.9)	17 (0.9)	1 (1.2)
Halton	44 (2.9)	28 (1.4)	12 (2.7)	15 (2.3)	9 (2.2)	6 (1.0)	17 (0.7)	2 (1.0)
Hamilton	43 (2.4)	27 (2.3)	14 (3.8)	16 (3.4)	10 (1.9)	7 (1.0)	16 (0.7)	1 (1.1)
Niagara	44 (2.7)	28 (2.7)	10 (3.2)	13 (3.2)	9 (1.5)	6 (0.7)	17 (0.6)	2 (1.0)
Waterloo	45 (2.8)	30 (1.7)	8 (2.3)	13 (2.9)	9 (1.5)	6 (0.8)	16 (0.6)	0 (1.2)
Windsor	**47** (2.9)	25 (3.4)	14 (3.2)	19 (2.8)	11 (1.7)	7 (0.7)	**18** (0.7)	2 (1.0)
Sarnia	45 (3.1)	29 (2.3)	10 (3.3)	13 (3.1)	**13** (1.4)	**10** (0.9)	17 (0.6)	1 (1.1)
London	44 (2.9)	27 (2.0)	10 (3.0)	14 (3.8)	10 (2.5)	7 (1.9)	16 (0.7)	1 (1.1)
Sudbury	39 (2.8)	**32** (1.6)	6 (0.7)	10 (1.2)	NA[h]	NA	14 (0.8)	-5 (1.1)
Sault Sainte Marie	39 (2.3)	**32** (1.1)	5 (2.0)	8 (2.6)	NA	NA	14 (0.8)	-3 (1.2)
Winnipeg	34 (3.6)	25 (2.3)	6 (1.5)	11 (1.7)	6 (0.9)	5 (0.8)	15 (1.1)	-7 (1.4)
Regina	30 (5.5)	21 (4.8)	9 (1.6)	14 (2.2)	7 (1.8)	5 (1.3)	13 (0.9)	**-8** (1.2)
Saskatoon	33 (2.5)	24 (1.9)	8 (1.5)	14 (1.2)	NA	NA	13 (0.9)	**-8** (1.1)
Calgary	36 (2.0)	24 (1.8)	14 (3.4)	**25** (3.0)	8 (2.4)	7 (2.1)	12 (0.8)	-3 (0.9)
Edmonton	37 (1.9)	23 (1.5)	12 (2.9)	23 (3.4)	7 (2.1)	8 (3.1)	12 (0.7)	-6 (1.1)
Vancouver	29 (1.2)	21 (2.0)	12 (1.7)	16 (1.8)	5 (0.5)	5 (0.8)	14 (0.7)	6 (0.8)
Combined[g]	38 (6.0)	27 (3.3)	10 (3.1)	15 (4.3)	8 (1.9)	6 (1.7)	15 (1.8)	-1 (3.4)

[a] Ozone concentrations were calculated using the imputed daily rolling average of the maximum eight hours.
[b] SD: standard deviation of 12-year annual averages.
[c] NO2 concentrations were calculated using the imputed 24-hour daily average.
[d] PM2.5 concentrations were calculated using the imputed unadjusted 24-hour daily average.
[e] Temperature concentrations were calculated using 24-hour daily average.
[f] Warm (April to September); Cold (October to March).
[g] Average (SD) over 24 cities.
[h] PM2.5 concentrations are not available due to limited data in Sudbury, Sault Sainte Marie, and Saskatoon.

Table S2. City-specific annual average Pearson's correlations between Ozone, NO2, and PM2.5 for 2001-2012

City[a]	Ozone & NO2 (SD)			Ozone & PM2.5 (SD)			PM2.5 & NO2 (SD)		
	Warm[b]	Cold[b]	Year[b]	Warm[b]	Cold[b]	Year[b]	Warm[b]	Cold[b]	Year[b]
Halifax	-0.1 (0.13)	-0.2 (0.15)	-0.1 (0.09)	0.3 (0.17)	0.1 (0.21)	0.2 (0.18)	0.1 (0.19)	0.1 (0.14)	0.1 (0.16)
Saint John	0.3 (0.15)	0.0 (0.21)	0.1 (0.14)	0.3 (0.09)	0.1 (0.16)	0.2 (0.08)	0.4 (0.15)	0.5 (0.16)	0.4 (0.13)
Quebec City	0.2 (0.08)	-0.3 (0.12)	-0.2 (0.06)	0.5 (0.13)	-0.3 (0.11)	0.1 (0.13)	0.4 (0.09)	**0.8 (0.08)**[d]	0.6 (0.09)
Montreal	0.3 (0.10)	-0.2 (0.11)	-0.2 (0.07)	0.6 (0.08)	-0.3 (0.10)	0.2 (0.15)	0.4 (0.08)	**0.8 (0.04)**	0.6 (0.10)
Ottawa	0.3 (0.10)	-0.3 (0.10)	-0.2 (0.07)	0.6 (0.11)	-0.2 (0.09)	0.3 (0.10)	0.3 (0.13)	**0.7 (0.09)**	0.4 (0.09)
Durham	0.3 (0.15)	-0.3 (0.18)	-0.1 (0.09)	**0.7 (0.14)**	-0.1 (0.22)	0.5 (0.10)	0.4 (0.16)	0.6 (0.23)	0.4 (0.17)
York	0.3 (0.09)	-0.3 (0.15)	-0.2 (0.08)	**0.7 (0.07)**	0.0 (0.15)	0.5 (0.10)	0.3 (0.07)	0.6 (0.09)	0.3 (0.06)
Toronto	0.3 (0.08)	-0.2 (0.13)	-0.1 (0.06)	**0.7 (0.07)**	-0.1 (0.14)	0.5 (0.08)	0.4 (0.08)	0.6 (0.06)	0.4 (0.06)
Peel	0.1 (0.08)	-0.3 (0.11)	-0.2 (0.05)	**0.7 (0.07)**	-0.1 (0.12)	0.5 (0.09)	0.3 (0.07)	0.6 (0.07)	0.3 (0.06)
Halton	0.2 (0.07)	-0.3 (0.13)	-0.1 (0.07)	**0.7 (0.07)**	-0.1 (0.14)	0.5 (0.10)	0.3 (0.11)	0.6 (0.09)	0.4 (0.09)
Hamilton	-0.1 (0.10)	-0.3 (0.12)	-0.3 (0.08)	0.6 (0.11)	-0.1 (0.14)	0.5 (0.11)	0.3 (0.13)	0.6 (0.12)	0.3 (0.12)
Niagara	0.0 (0.17)	-0.1 (0.16)	-0.2 (0.10)	**0.7 (0.08)**	0.0 (0.12)	0.5 (0.08)	0.1 (0.17)	0.4 (0.23)	0.1 (0.18)
Waterloo	0.2 (0.15)	-0.2 (0.14)	-0.2 (0.08)	**0.7 (0.10)**	0.0 (0.14)	0.5 (0.10)	0.2 (0.15)	0.5 (0.13)	0.2 (0.11)
Windsor	0.2 (0.12)	-0.2 (0.15)	-0.3 (0.06)	**0.7 (0.07)**	0.0 (0.15)	0.5 (0.10)	0.3 (0.09)	0.5 (0.09)	0.2 (0.08)
Sarnia	0.5 (0.06)	-0.3 (0.15)	0.0 (0.10)	**0.7 (0.08)**	-0.2 (0.15)	0.4 (0.10)	0.6 (0.08)	**0.7 (0.08)**	0.5 (0.09)
London	0.4 (0.09)	-0.1 (0.16)	-0.2 (0.06)	0.6 (0.18)	0.1 (0.14)	0.5 (0.07)	0.3 (0.18)	0.5 (0.26)	0.2 (0.18)
Sudbury	0.2 (0.12)	0.1 (0.04)	-0.1 (0.05)	NA[e]	NA	NA	NA	NA	NA
Sault Sainte Marie	0.2 (0.12)	-0.1 (0.22)	-0.1 (0.10)	NA	NA	NA	NA	NA	NA
Winnipeg	0.3 (0.12)	-0.2 (0.17)	-0.2 (0.09)	0.3 (0.13)	-0.2 (0.12)	0.3 (0.14)	0.3 (0.13)	0.4 (0.17)	0.2 (0.15)
Regina	0.1 (0.16)	-0.1 (0.23)	-0.2 (0.15)	0.2 (0.21)	-0.1 (0.16)	0.2 (0.15)	0.0 (0.17)	0.2 (0.17)	0.0 (0.17)
Saskatoon	0.1 (0.18)	-0.1 (0.19)	-0.3 (0.13)	NA	NA	NA	NA	NA	NA
Calgary	0.1 (0.13)	-0.4 (0.10)	-0.5 (0.07)	0.3 (0.13)	-0.5 (0.10)	0.0 (0.18)	0.3 (0.17)	0.5 (0.11)	0.2 (0.15)
Edmonton	0.2 (0.12)	-0.4 (0.11)	-0.5 (0.07)	0.3 (0.14)	-0.4 (0.13)	-0.1 (0.13)	0.4 (0.11)	0.5 (0.10)	0.4 (0.11)
Vancouver	0.1 (0.14)	-0.5 (0.13)	-0.4 (0.11)	0.2 (0.11)	-0.6 (0.09)	-0.1 (0.17)	**0.7 (0.08)**	0.6 (0.08)	0.5 (0.10)
Combined[c]	0.2 (0.13)	-0.2 (0.14)	-0.2 (0.13)	0.5 (0.18)	-0.1 (0.18)	0.3 (0.20)	0.3 (0.14)	0.5 (0.16)	0.3 (0.16)

[a] Cities are ordered geographically from east to west.

[b] Warm (April to September); Cold (October to March); Year (January to December).

[c] Average over 24 cities.

[d] Bold indicates high correlation ≥ 0.7.

[e] Pearson's correlation is not available due to limited PM2.5 data in Sudbury, Sault Sainte Marie, and Saskatoon.

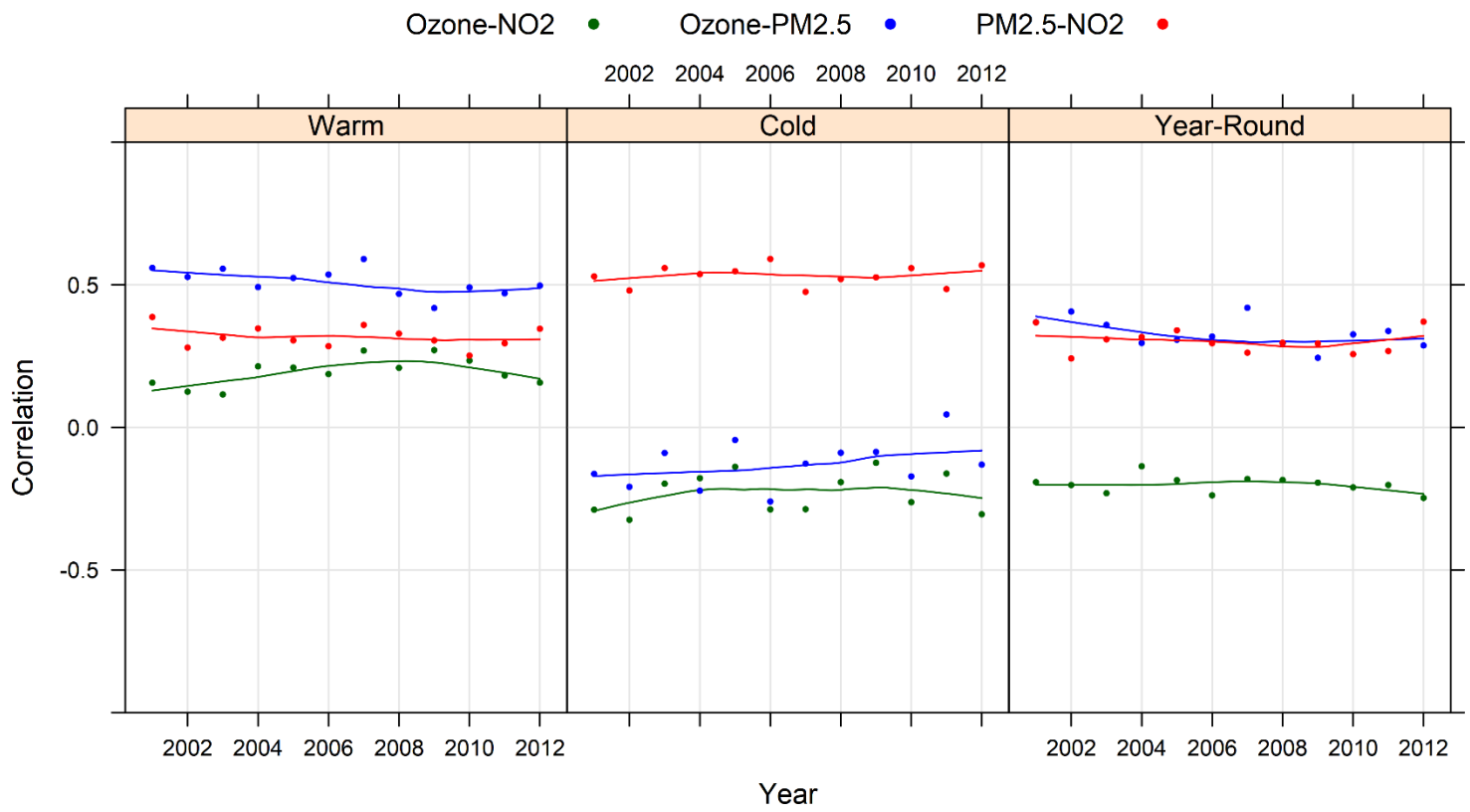

Figure S2: Annual Pearson correlation between three air pollutants for 2001-2012 by season: (left) warm season (April to September); (middle) cold season (October to March); and (right) year-round (January to December). In color, (green) correlation between ozone and NO2, (blue) correlation between ozone and PM2.5, and (red) correlation between NO2 and PM2.5. Lines are generated by a LOESS smoother (span = 0.75, degree= 1)

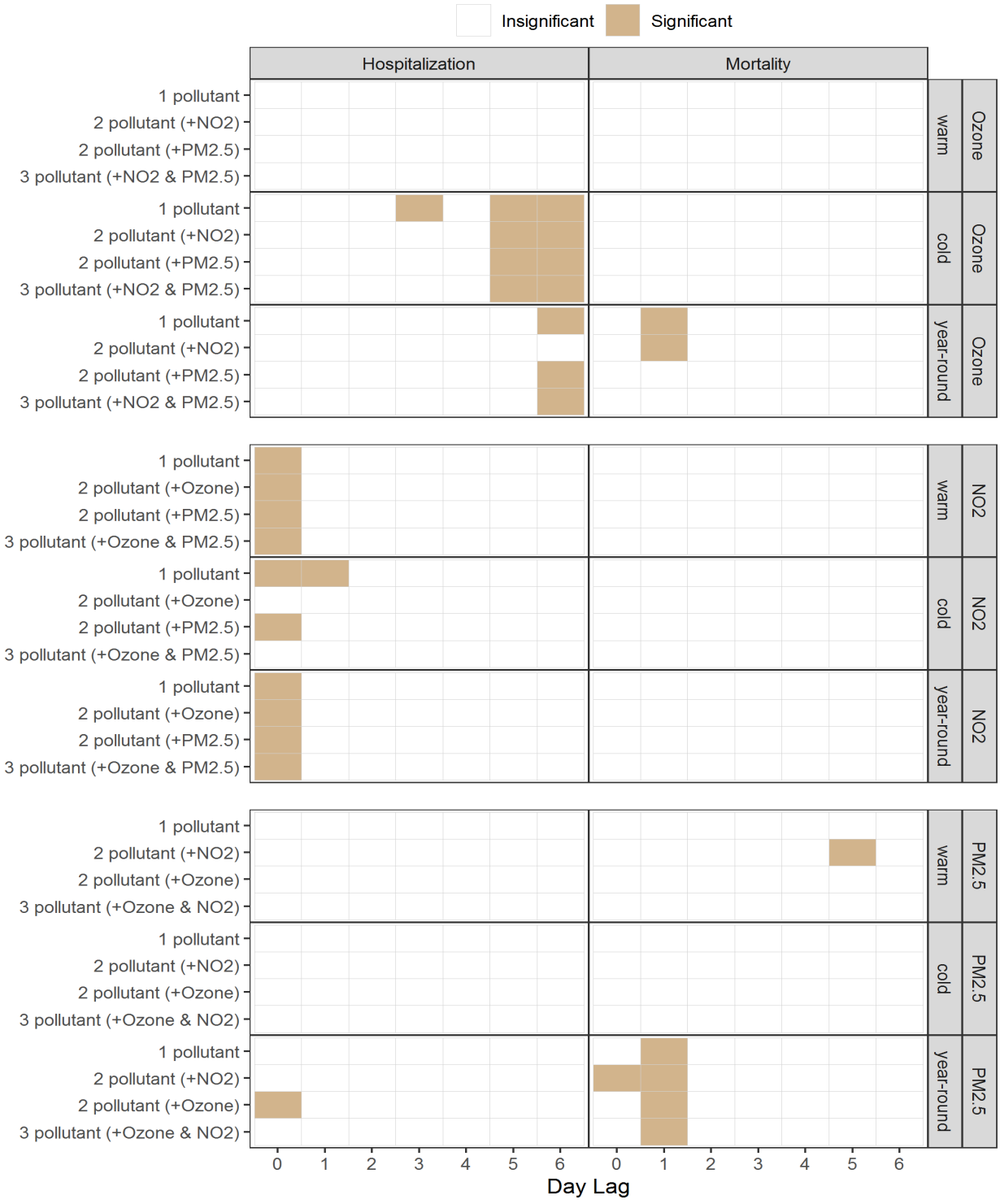

Figure S3: Diagram on significance of associations between 3 air pollutants and circulatory hospitalization and mortality, respectively, by model, season and lag: (a) 4 models of 1-, 2-, or 3-pollutants together; (b) 3 seasons of warm (Apr to Sept), cold (Oct to Mar) and year-round (Jan to Dec); and (c) 7 lags of 0- to 6-day lagged air pollutant. The highlighted indicate significance, and the blank does insignificance