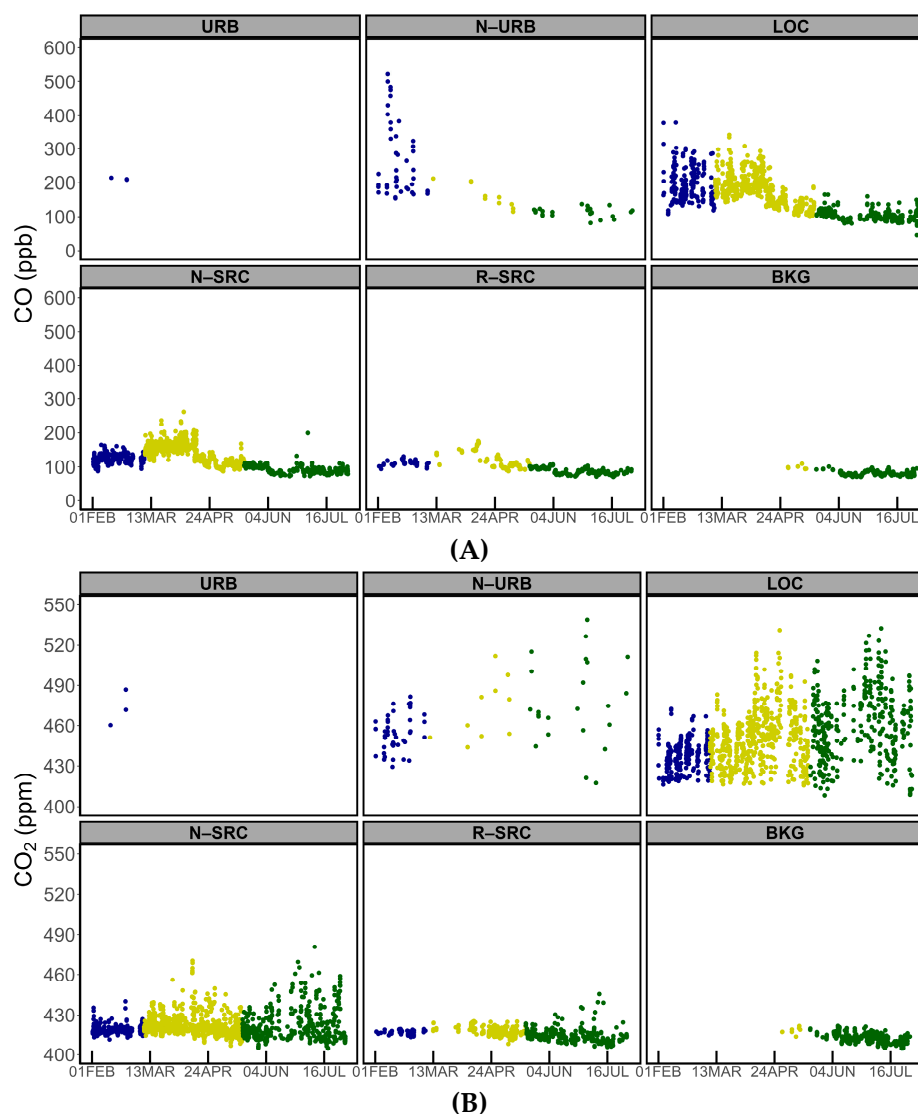


Article

Analysis of local-to-remote source variability during the first 2020 COVID-19 lockdown in Calabria, Southern Italy: new insights from the implementation of the ONRPI methodology

Supplementary Materials

Supplementary Materials for the research paper “Analysis of local-to-remote source variability during the first 2020 COVID-19 lockdown in Calabria, Southern Italy: new in-sights from the implementation of the ONRPI methodology” include figures S1, S2 and tables S1, S2. Please refer to the main article for additional information.



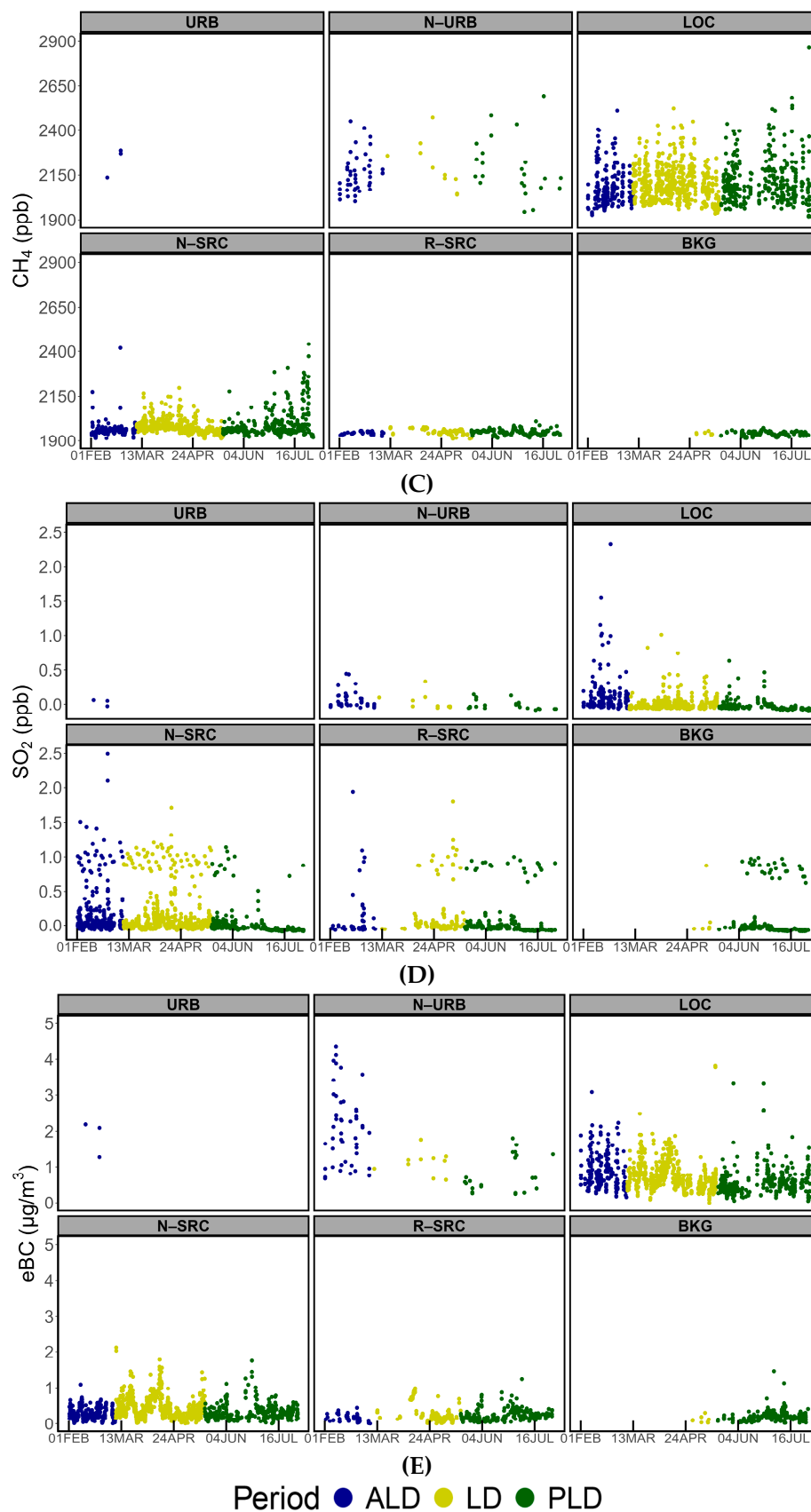
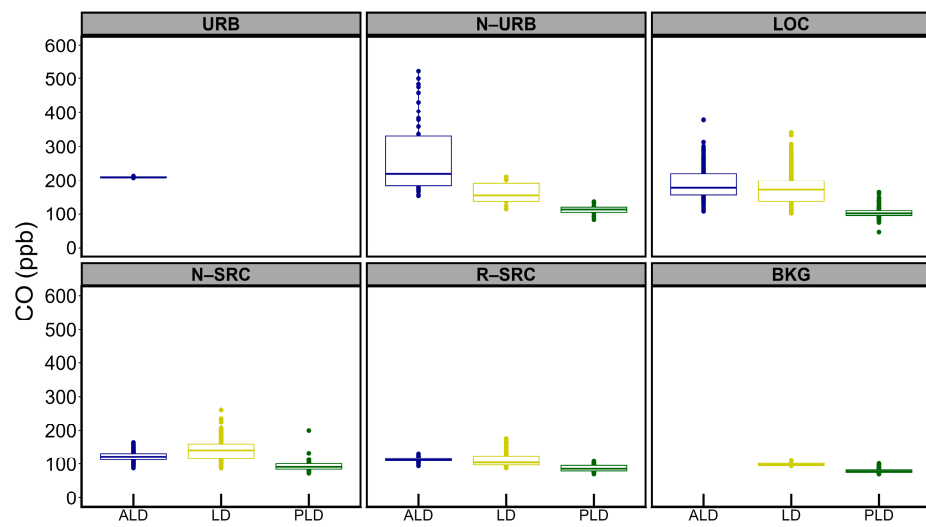
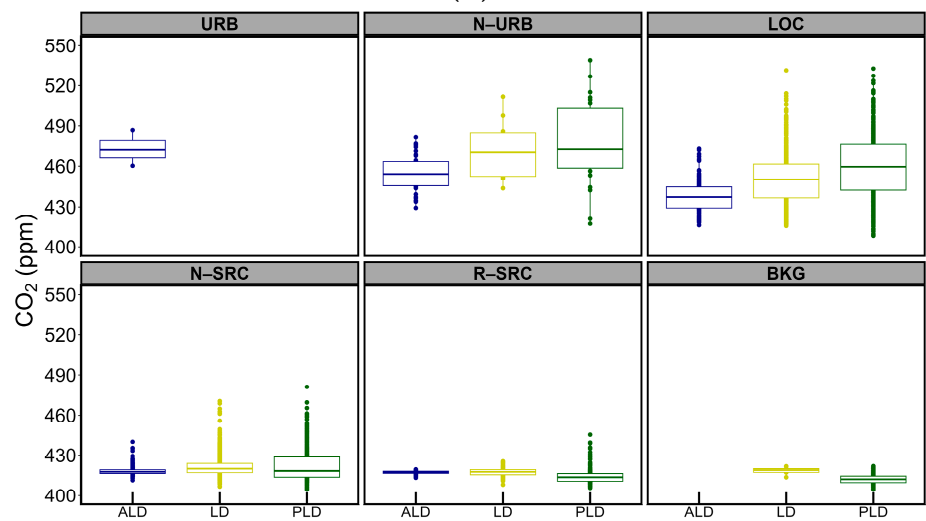


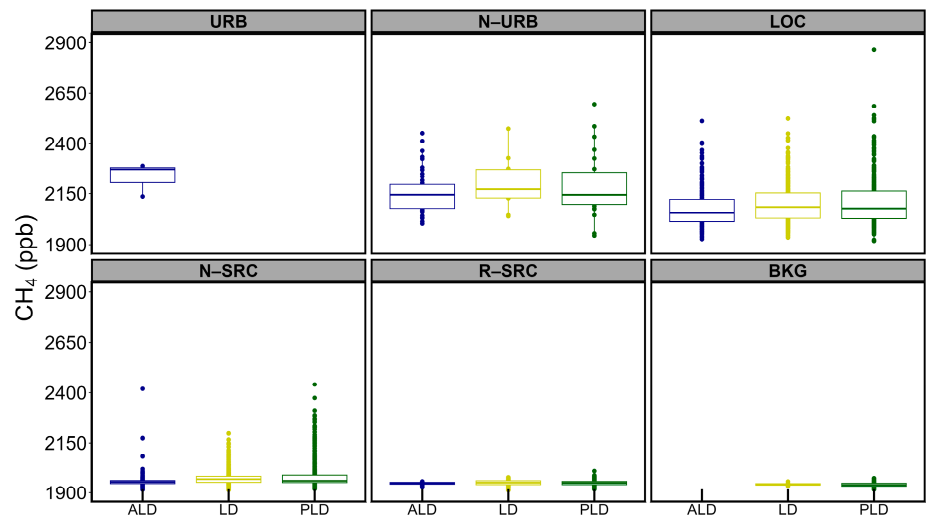
Figure S1. Concentrations of (A) CO (ppb), (B) CO₂ (ppm), (C) CH₄ (ppb), (D) SO₂ (ppb), and (E) eBC (µg/m³) based on standard proximity categories and differentiated by period. The URB category has only three measurements linked to the ALD period.



(A)



(B)



(C)

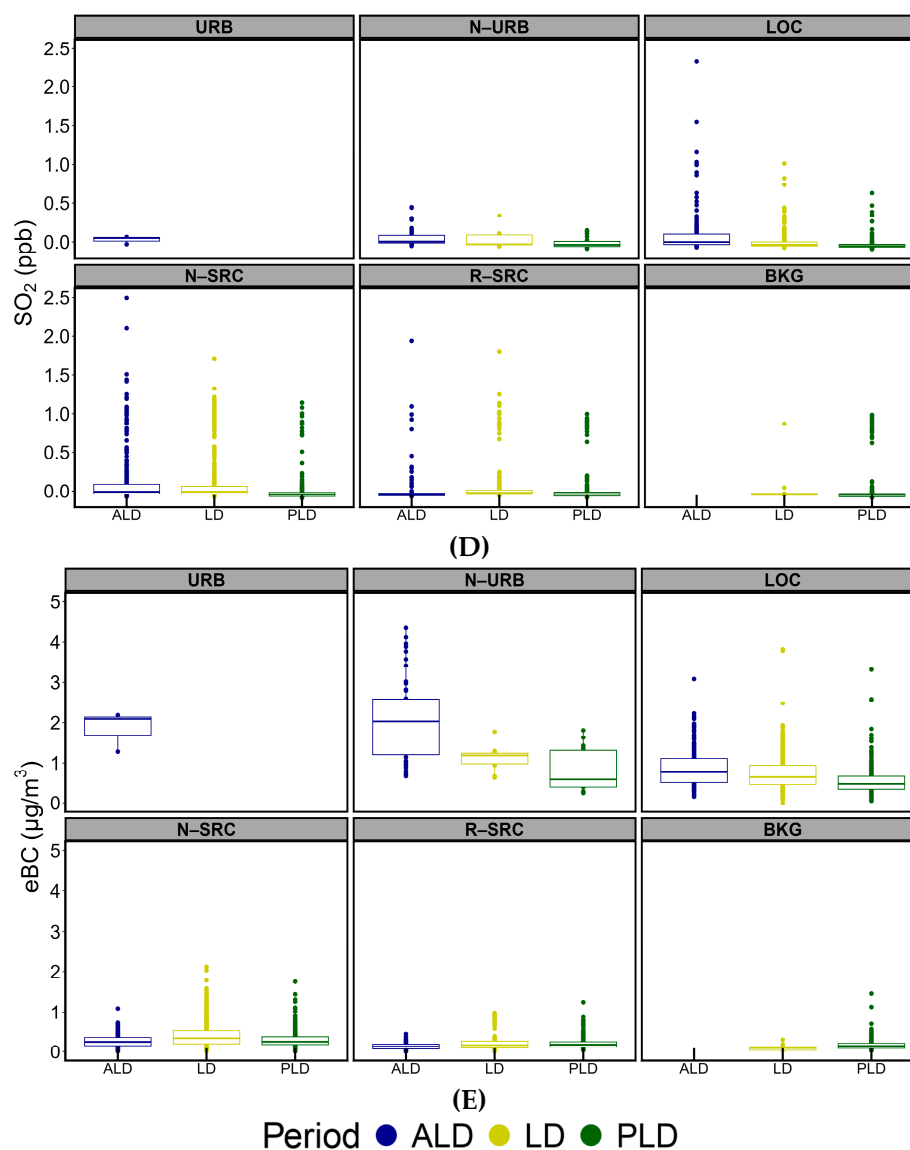


Figure S2. Concentrations of (A) CO (ppb), (B) CO₂ (ppm), (C) CH₄ (ppb), (D) SO₂ (ppb), and (E) eBC (µg/m³) based on standard proximity categories and differentiated by period. This figure is an alternate versions of Fig. S1, computed using boxplots. The URB category has only three measurements linked to the ALD period.

Table S1-A. Concentrations of CO, CO₂, CH₄, SO₂, and eBC during the ALD period, divided by standard (STND) category, with their respective standard deviation interval ($\pm 1\sigma$). The URB category has only three measurements.

Category	CO (ppb)	CO ₂ (ppm)	CH ₄ (ppb)	SO ₂ (ppb)	eBC (µg/m ³)
URB	211.29 $\pm$ 2.8	472.96 $\pm$ 13.31	2232.00 $\pm$ 83.5	0.05 $\pm$ 0.0	1.85 $\pm$ 0.5
N-URB	269.32 $\pm$ 108.7	454.43 $\pm$ 13.46	2156.57 $\pm$ 105.2	0.10 $\pm$ 0.1	2.08 $\pm$ 1.0
LOC	192.55 $\pm$ 48.3	437.39 $\pm$ 11.15	2079.33 $\pm$ 99.7	0.20 $\pm$ 0.3	0.87 $\pm$ 0.4
N-SRC	121.84 $\pm$ 14.4	418.29 $\pm$ 3.11	1957.40 $\pm$ 32.8	0.31 $\pm$ 0.4	0.28 $\pm$ 0.1
R-SRC	112.49 $\pm$ 14.4	417.29 $\pm$ 1.133	1947.65 $\pm$ 6.9	0.46 $\pm$ 0.5	0.14 $\pm$ 0.0
BKG	-	-	-	-	-

Table S1-B. Concentrations of CO, CO₂, CH₄, SO₂, and eBC during the LD period, divided by standard (STND) category, with their respective standard deviation interval ($\pm 1\sigma$).

Category	CO (ppb)	CO ₂ (ppm)	CH ₄ (ppb)	SO ₂ (ppb)	eBC (µg/m ³)
URB	-	-	-	-	-
N-URB	160.53 ± 34.4	471.68 ± 22.85	2201.88 ± 134.5	0.14 ± 0.1	1.12 ± 0.3
LOC	173.76 ± 44.6	450.79 ± 19.77	2099.72 ± 94.9	0.09 ± 0.1	0.74 ± 0.4
N-SRC	139.38 ± 28.1	421.65 ± 7.56	1973.22 ± 33.7	0.23 ± 0.3	0.40 ± 0.2
R-SRC	113.98 ± 23.6	417.68 ± 2.92	1950.49 ± 15.4	0.29 ± 0.4	0.25 ± 0.2
BKG	98.15 ± 5.0	418.59 ± 2.50	1943.13 ± 7.2	0.45 ± 0.5	0.11 ± 0.0

Table S1-C. Concentrations of CO, CO₂, CH₄, SO₂, and eBC during the PLD period, divided by standard (STND) category, with their respective standard deviation interval ($\pm 1\sigma$).

Category	CO (ppb)	CO ₂ (ppm)	CH ₄ (ppb)	SO ₂ (ppb)	eBC (µg/m ³)
URB	-	-	-	-	-
N-URB	112.84 ± 13.8	476.98 ± 31.85	2193.45 ± 161.0	0.06 ± 0.0	1.00 ± 1.2
LOC	103.46 ± 14.8	460.11 ± 25.10	2110.70 ± 123.6	0.11 ± 0.1	0.56 ± 0.3
N-SRC	92.46 ± 11.1	422.57 ± 12.30	1986.88 ± 74.4	0.21 ± 0.3	0.31 ± 0.2
R-SRC	87.01 ± 9.4	414.32 ± 5.26	1950.71 ± 14.3	0.32 ± 0.3	0.21 ± 0.1
BKG	79.33 ± 6.1	412.38 ± 3.49	1940.56 ± 11.1	0.53 ± 0.3	0.17 ± 0.1

Table S1-D. Concentrations of CO, CO₂, CH₄, SO₂, and eBC during the ALD period, divided by corrected (COR) category, with their respective standard deviation interval ($\pm 1\sigma$). The URB_{cor} category has only one measurement, hence the standard deviation of 0.0.

Category	CO (ppb)	CO ₂ (ppm)	CH ₄ (ppb)	SO ₂ (ppb)	eBC (µg/m ³)
URB _{cor}	214.50 ± 0.0	460.26 ± 0.00	2136.07 ± 0.0	0.06 ± 0.0	2.18 ± 0.0
N-URB _{cor}	291.57 ± 130.8	456.29 ± 13.80	2172.29 ± 109.0	0.09 ± 0.0	2.46 ± 1.1
LOC _{cor}	209.04 ± 56.8	441.59 ± 12.80	2100.80 ± 100.3	0.19 ± 0.3	1.11 ± 0.6
N-SRC _{cor}	133.60 ± 20.4	422.05 ± 6.86	1981.43 ± 68.4	0.24 ± 0.3	0.36 ± 0.2
R-SRC _{cor}	117.65 ± 13.5	417.31 ± 1.83	1950.93 ± 12.3	0.39 ± 0.5	0.25 ± 0.1
BKG _{cor}	112.45 ± 5.2	417.50 ± 1.22	1948.18 ± 6.3	0.24 ± 0.2	0.13 ± 0.0

Table S1-E. Concentrations of CO, CO₂, CH₄, SO₂, and eBC during the LD period, divided by corrected (COR) category, with their respective standard deviation interval ($\pm 1\sigma$).

Category	CO (ppb)	CO ₂ (ppm)	CH ₄ (ppb)	SO ₂ (ppb)	eBC (µg/m ³)
URB _{cor}	-	-	-	-	-
N-URB _{cor}	151.87 ± 10.5	479.22 ± 19.41	2236.05 ± 160.4	0.22 ± 0.1	1.34 ± 0.2
LOC _{cor}	179.05 ± 48.5	457.30 ± 20.18	2134.29 ± 96.2	0.10 ± 0.1	0.79 ± 0.4
N-SRC _{cor}	153.96 ± 33.9	430.39 ± 15.21	2009.11 ± 65.9	0.13 ± 0.2	0.55 ± 0.3
R-SRC _{cor}	128.30 ± 24.1	418.95 ± 4.05	1959.96 ± 19.8	0.32 ± 0.4	0.30 ± 0.2
BKG _{cor}	113.73 ± 23.2	417.78 ± 2.89	1950.89 ± 13.6	0.29 ± 0.4	0.25 ± 0.2

Table S1-F. Concentrations of CO, CO₂, CH₄, SO₂, and eBC during the PLD period, divided by corrected (COR) category, with their respective standard deviation interval ($\pm 1\sigma$).

Category	CO (ppb)	CO ₂ (ppm)	CH ₄ (ppb)	SO ₂ (ppb)	eBC (µg/m ³)
URB _{cor}	-	-	-	-	-
N-URB _{cor}	106.23 ± 17.5	476.33 ± 54.96	2078.73 ± 110.0	0.04 ± 0.0	0.81 ± 0.6
LOC _{cor}	107.13 ± 15.2	467.58 ± 24.38	2140.69 ± 131.5	0.13 ± 0.1	0.66 ± 0.5
N-SRC _{cor}	94.87 ± 10.4	433.06 ± 18.57	2025.59 ± 97.7	0.14 ± 0.2	0.37 ± 0.2
R-SRC _{cor}	90.47 ± 11.8	418.63 ± 8.33	1964.97 ± 41.3	0.25 ± 0.3	0.25 ± 0.1
BKG _{cor}	82.56 ± 8.6	413.06 ± 4.27	1944.86 ± 13.3	0.42 ± 0.4	0.19 ± 0.1

Table S1-G. Concentrations of CO, CO₂, CH₄, SO₂, and eBC during the ALD period, divided by enhanced corrected (ECOR) category, with their respective standard deviation interval ($\pm 1\sigma$). The URB_{ecor} category has only one measurement, hence the standard deviation of 0.0.

Category	CO (ppb)	CO ₂ (ppm)	CH ₄ (ppb)	SO ₂ (ppb)	eBC (µg/m ³)
URB _{ecor}	214.50 ± 0.0	460.26 ± 0.0	2136.07 ± 0.0	0.06 ± 0.0	2.18 ± 0.0
N-URB _{ecor}	291.57 ± 130.8	456.29 ± 13.80	2172.29 ± 109.0	0.09 ± 0.0	2.46 ± 1.1
LOC _{ecor}	208.61 ± 57.0	441.46 ± 12.88	2100.09 ± 100.5	0.19 ± 0.3	1.11 ± 0.6
N-SRC _{ecor}	133.44 ± 20.4	422.02 ± 6.86	1981.21 ± 68.3	0.25 ± 0.3	0.36 ± 0.2
R-SRC _{ecor}	117.68 ± 13.6	417.31 ± 1.84	1950.94 ± 12.3	0.39 ± 0.5	0.24 ± 0.1
BKG _{ecor}	112.45 ± 5.2	417.50 ± 1.22	1948.18 ± 6.3	0.24 ± 0.2	0.13 ± 0.0

Table S1-H. Concentrations of CO, CO₂, CH₄, SO₂, and eBC during the LD period, divided by enhanced corrected (ECOR) category, with their respective standard deviation interval ($\pm 1\sigma$).

Category	CO (ppb)	CO ₂ (ppm)	CH ₄ (ppb)	SO ₂ (ppb)	eBC (µg/m ³)
URB _{ecor}	-	-	-	-	-
N-URB _{ecor}	151.87 ± 10.5	479.22 ± 19.41	2236.05 ± 160.4	0.22 ± 0.1	1.34 ± 0.2
LOC _{ecor}	178.97 ± 48.4	457.18 ± 20.27	2133.82 ± 96.4	0.10 ± 0.1	0.79 ± 0.4
N-SRC _{ecor}	149.33 ± 33.3	427.66 ± 14.48	1998.55 ± 62.1	0.20 ± 0.3	0.50 ± 0.3
R-SRC _{ecor}	123.55 ± 24.2	418.94 ± 4.58	1957.95 ± 20.6	0.28 ± 0.4	0.28 ± 0.2
BKG _{ecor}	109.34 ± 20.0	418.98 ± 2.61	1949.35 ± 14.2	0.20 ± 0.3	0.22 ± 0.2

Table S1-I. Concentrations of CO, CO₂, CH₄, SO₂, and eBC during the PLD period, divided by enhanced corrected (ECOR) category, with their respective standard deviation interval ($\pm 1\sigma$).

Category	CO (ppb)	CO ₂ (ppm)	CH ₄ (ppb)	SO ₂ (ppb)	eBC (µg/m ³)
URB _{ecor}	-	-	-	-	-
N-URB _{ecor}	104.44 ± 16.7	468.37 ± 54.41	2062.05 ± 109.7	0.04 ± 0.0	0.77 ± 0.5
LOC _{ecor}	107.04 ± 15.3	467.32 ± 24.67	2139.80 ± 132.0	0.13 ± 0.1	0.66 ± 0.5
N-SRC _{ecor}	95.05 ± 9.9	429.93 ± 18.33	2013.81 ± 92.8	0.22 ± 0.3	0.35 ± 0.2
R-SRC _{ecor}	87.02 ± 11.2	416.12 ± 7.92	1957.82 ± 36.6	0.36 ± 0.4	0.25 ± 0.1
BKG _{ecor}	81.57 ± 8.0	413.37 ± 4.52	1944.06 ± 12.9	0.38 ± 0.3	0.17 ± 0.1

Table S2-A. Results (*p*-values) of Kruskal-Wallis analyses on the statistical significance of weekly cycles (differences between WD, weekdays, MON-FRI, and WE, weekends, SAT-SUN), based on periods and standard (STND) categories.

Period	Parameter	URB	N-URB	LOC	N-SRC	R-SRC	BKG
ALD	CO	-	0.939	< 0.001	< 0.001	0.096	-
	CO ₂	-	0.391	0.245	0.001	0.737	-
	CH ₄	-	0.464	< 0.001	< 0.001	0.099	-
	SO ₂	-	0.064	0.874	0.928	-	-
	eBC	-	0.811	0.333	0.008	0.819	-
LD	CO	-	-	0.160	0.538	0.018	0.121
	CO ₂	-	-	< 0.001	0.724	0.004	0.121
	CH ₄	-	-	< 0.001	0.574	0.309	0.121
	SO ₂	-	-	0.012	0.091	0.007	0.317
	eBC	-	-	0.003	< 0.001	0.012	0.121
PLD	CO	-	0.522	0.094	0.036	0.109	0.004
	CO ₂	-	0.411	0.976	0.512	0.007	0.124
	CH ₄	-	0.411	0.353	0.381	0.087	0.640
	SO ₂	-	-	0.224	0.973	0.407	0.196

eBC	-	0.648	0.578	0.481	0.969	0.078
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Table S2-B. Results (*p*-values) of Kruskal-Wallis analyses on the statistical significance of weekly cycles (differences between WD, weekdays, MON-FRI, and WE, weekends, SAT-SUN), based on periods and corrected (COR) categories.

Period	Parameter	URB _{cor}	N-URB _{cor}	LOC _{cor}	N-SRC _{cor}	R-SRC _{cor}	BKG _{cor}
ALD	CO	-	0.149	0.028	< 0.001	0.025	0.402
	CO ₂	-	0.407	0.467	0.061	< 0.001	0.402
	CH ₄	-	0.176	< 0.001	< 0.001	0.136	0.529
	SO ₂	-	0.028	0.893	0.688	0.610	-
	eBC	-	0.095	0.319	0.007	0.087	0.706
LD	CO	-	-	0.565	0.147	0.340	< 0.001
	CO ₂	-	-	< 0.001	< 0.001	0.268	0.054
	CH ₄	-	-	< 0.001	< 0.001	0.209	0.004
	SO ₂	-	-	0.343	0.014	0.630	0.025
	eBC	-	-	0.560	< 0.001	0.028	< 0.001
PLD	CO	-	-	0.095	0.937	0.003	< 0.001
	CO ₂	-	-	0.729	0.294	0.825	0.010
	CH ₄	-	-	0.378	0.036	0.467	0.025
	SO ₂	-	-	0.128	0.247	0.178	0.831
	eBC	-	-	0.602	0.811	0.540	0.076

Table S2-C. Results (*p*-values) of Kruskal-Wallis analyses on the statistical significance of weekly cycles (differences between WD, weekdays, MON-FRI, and WE, weekends, SAT-SUN), based on periods and enhanced corrected (ECOR) categories.

Period	Parameter	URB _{ecor}	N-URB _{ecor}	LOC _{ecor}	N-SRC _{ecor}	R-SRC _{ecor}	BKG _{ecor}
ALD	CO	-	0.149	0.020	< 0.001	0.020	0.402
	CO ₂	-	0.407	0.391	0.109	< 0.001	0.402
	CH ₄	-	0.176	< 0.001	< 0.001	0.125	0.529
	SO ₂	-	0.028	0.901	0.794	0.738	-
	eBC	-	0.095	0.273	0.007	0.104	0.706
LD	CO	-	-	0.558	0.674	0.082	0.513
	CO ₂	-	-	< 0.001	0.002	0.071	0.331
	CH ₄	-	-	< 0.001	0.093	0.653	0.581
	SO ₂	-	-	0.302	0.017	0.569	0.023
	eBC	-	-	0.555	< 0.001	< 0.001	0.232
PLD	CO	-	-	0.103	0.727	0.013	0.001
	CO ₂	-	-	0.677	0.082	0.529	0.129
	CH ₄	-	-	0.343	0.003	0.145	0.056
	SO ₂	-	-	0.128	0.556	0.541	0.282
	eBC	-	-	0.627	0.160	0.604	0.142

Table S2-D. Results (*p*-values) of Kruskal-Wallis analyses on the statistical significance of day-night contrasts (differences between daytime and nighttime), based on periods and standard (STND) categories.

Period	Parameter	URB	N-URB	LOC	N-SRC	R-SRC	BKG
ALD	CO	-	< 0.001	< 0.001	0.210	0.658	-
	CO ₂	-	0.004	< 0.001	< 0.001	< 0.001	-

LD	CH ₄	-	0.738	<0.001	0.357	0.293	-
	SO ₂	-	0.027	<0.001	0.037	0.308	-
	eBC	-	<0.001	<0.001	0.148	0.278	-
	CO	-	0.052	0.009	0.024	<0.001	0.558
	CO ₂	-	0.052	<0.001	<0.001	<0.001	0.241
	CH ₄	-	0.052	<0.001	<0.001	0.056	0.558
	SO ₂	-	-	0.507	<0.001	0.024	-
	eBC	-	0.052	0.856	0.864	0.029	0.078
	CO	-	0.745	0.008	<0.001	0.488	0.041
	CO ₂	-	0.004	<0.001	<0.001	<0.001	<0.001
PLD	CH ₄	-	0.014	<0.001	<0.001	0.027	0.218
	SO ₂	-	0.563	0.885	0.002	0.140	0.105
	eBC	-	0.179	<0.001	0.578	0.002	<0.001

Table S2-E. Results (*p*-values) of Kruskal-Wallis analyses on the statistical significance of day-night contrasts (differences between daytime and nighttime), based on periods and corrected (COR) categories.

Period	Parameter	URB _{cor}	N-URB _{cor}	LOC _{cor}	N-SRC _{cor}	R-SRC _{cor}	BKG _{cor}
ALD	CO	-	<0.001	<0.001	<0.001	<0.001	0.479
	CO ₂	-	0.112	<0.001	<0.001	0.015	0.024
	CH ₄	-	0.198	<0.001	<0.001	<0.001	0.967
	SO ₂	-	0.063	0.017	0.007	0.405	-
	eBC	-	<0.001	<0.001	0.309	0.458	0.312
LD	CO	-	0.179	0.030	<0.001	0.001	<0.001
	CO ₂	-	0.179	<0.001	<0.001	<0.001	<0.001
	CH ₄	-	0.179	<0.001	<0.001	0.405	0.072
	SO ₂	-	-	0.584	0.001	0.122	0.021
	eBC	-	0.179	0.730	<0.001	<0.001	0.012
PLD	CO	-	0.512	0.008	0.001	<0.001	0.040
	CO ₂	-	0.049	<0.001	<0.001	<0.001	<0.001
	CH ₄	-	0.126	<0.001	<0.001	<0.001	0.449
	SO ₂	-	0.179	1	0.023	0.106	0.026
	eBC	-	0.033	<0.001	0.867	0.796	<0.001

Table S2-F. Results (*p*-values) of Kruskal-Wallis analyses on the statistical significance of day-night contrasts (differences between daytime and nighttime), based on periods and enhanced corrected (ECOR) categories.

Period	Parameter	URB _{ecor}	N-URB _{ecor}	LOC _{ecor}	N-SRC _{ecor}	R-SRC _{ecor}	BKG _{ecor}
ALD	CO	-	<0.001	<0.001	<0.001	<0.001	0.479
	CO ₂	-	0.112	<0.001	<0.001	0.016	0.024
	CH ₄	-	0.198	<0.001	<0.001	<0.001	0.967
	SO ₂	-	0.063	0.019	0.009	0.343	-
	eBC	-	<0.001	<0.001	0.293	0.494	0.312
LD	CO	-	0.179	0.029	<0.001	0.700	0.005
	CO ₂	-	0.179	<0.001	<0.001	<0.001	<0.001
	CH ₄	-	0.179	<0.001	<0.001	0.014	0.354
	SO ₂	-	-	0.419	<0.001	0.448	0.064
	eBC	-	0.179	0.737	<0.001	0.003	0.098
PLD	CO	-	0.288	0.012	<0.001	0.669	0.930

CO ₂	-	0.033	< 0.001	< 0.001	< 0.001	< 0.001
CH ₄	-	0.077	< 0.001	< 0.001	< 0.001	0.605
SO ₂	-	0.179	1	0.001	0.054	0.034
eBC	-	0.025	< 0.001	0.008	0.836	< 0.001
