

Supplementary Materials:

Combined Eulerian-Lagrangian Hybrid Modelling System for PM_{2.5} and Elemental Carbon Source Apportionment at the Urban Scale in Milan

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Received: 1 September 2020; Accepted: 7 October 2020; Published: 10 October 2020

Table S1. Lambert Conformal coordinates for Po valley and Milan metropolitan area nested domains in WRF and CAMx model.

	<i>WRF CAMx</i> (<i>Po Valley</i>)		<i>WRF CAMx</i> (<i>Milan area</i>)	
SW X corner [km]	−439.5	−429.5	−249.7	−246.2
SW Y corner [km]	−108.5	−98.5	66.8	69.8
NE X corner [km]	160.5	150.5	−164.7	−167.8
NE Y corner [km]	311.5	301.5	151.8	148.2
DX-DY [km]	5	5	1.7	1.7
N cells X [n]	120	116	51	47
N cells Y [n]	84	80	51	47

Table S2. Emission categories defined considered for source apportionment.

<i>Category</i>	<i>Sub-categories</i>	<i>Label</i>
Energy production by industrial plants	Electrical energy production	01-ELE
	Non-electrical energy production	01-OTH
Residential and commercial heating	Biomass burning	02-BIO
	Fossil fuels burning	02-OTH
Road traffic	Passenger cars	07-CAR
	Light duty vehicles (weight < 3.5 tons)	07-LDV
	Heavy duty vehicles (weight > 3.5 tons)	07-HDV
	Mopeds and motorcycles	07-MOT
Natural sources	Fires, volcanic eruptions, marine salt (only for Po Valley area)	11-NAT
Other anthropogenic sources	Agriculture, waste treatment and landfilling, off-road transports	OATHS
Sources located outside Italy	No source category disaggregation provided	EMEP

34 **Table S3.** Annual and seasonal average concentrations of PM2.5 and relative contributions by source regions.

	Annual average			Cold season average			Warm season average		
	PARK	DUOMO	TRAFFIC	PARK	DUOMO	TRAFFIC	PARK	DUOMO	TRAFFIC
PM2.5 (µg/m³)	17.6	18.4	20.6	25.6	27.1	29.8	10.6	10.9	12.7
REGIONAL CONTRIBUTION									
LONG RANGE	22.2%	21.3%	19.0%	17.0%	16.1%	14.6%	30.6%	29.8%	25.4%
POV	10.5%	10.1%	9.0%	10.5%	9.9%	9.0%	8.9%	8.6%	7.4%
LOM	22.9%	21.9%	19.5%	23.3%	22.1%	20.1%	19.7%	19.2%	16.4%
PRO	10.7%	10.3%	9.2%	10.2%	9.7%	8.8%	10.6%	10.3%	8.8%
MIL	29.9%	28.6%	25.5%	34.1%	32.3%	29.3%	27.2%	26.5%	22.6%
LOCAL	3.7%	7.9%	17.8%	5.0%	10.0%	18.2%	3.0%	5.7%	19.4%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%
CAMx Background	96.3%	92.1%	82.2%	95.0%	90.0%	81.8%	97.0%	94.3%	80.6%
LOCAL	3.7%	7.9%	17.8%	5.0%	10.0%	18.2%	3.0%	5.7%	19.4%

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Table S4. Contributions (µg/m³) by source regions to the annual PM2.5 concentrations.

Emission region	Emission category											Total contribution
	01-ELE	01-OTH	02-BIO	02-OTH	07-CAR	07-LDV	07-HDV	07-MOT	11-NAT	OAS	LONG	
LONG RANGE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.91	3.91
POV	0.09	0.06	0.35	0.08	0.20	0.10	0.28	0.01	0.01	0.67	-	1.85
LOM	0.04	0.04	1.16	0.11	0.55	0.16	0.39	0.03	0.07	1.49	-	4.03
PRO	0.01	0.00	0.36	0.07	0.40	0.13	0.25	0.03	0.08	0.55	-	1.89
MIL	0.00	0.00	2.10	0.29	1.17	0.48	0.52	0.14	0.32	0.25	-	5.26
LOCAL @ Park	-	-	0.25	0.03	0.18	0.09	0.08	0.03	-	-	-	0.66
LOCAL @ Duomo	-	-	0.63	0.07	0.37	0.17	0.16	0.05	-	-	-	1.45
LOCAL @ Traffic	-	-	0.61	0.07	1.46	0.68	0.66	0.20	-	-	-	3.67
TOTAL @ Park	0.14	0.10	4.21	0.59	2.51	0.95	1.52	0.23	0.48	2.96	3.91	17.6
TOTAL @ Duomo	0.14	0.10	4.59	0.63	2.69	1.04	1.60	0.26	0.48	2.96	3.91	18.4
TOTAL @ Traffic	0.14	0.10	4.57	0.63	3.78	1.54	2.09	0.40	0.48	2.96	3.91	20.6

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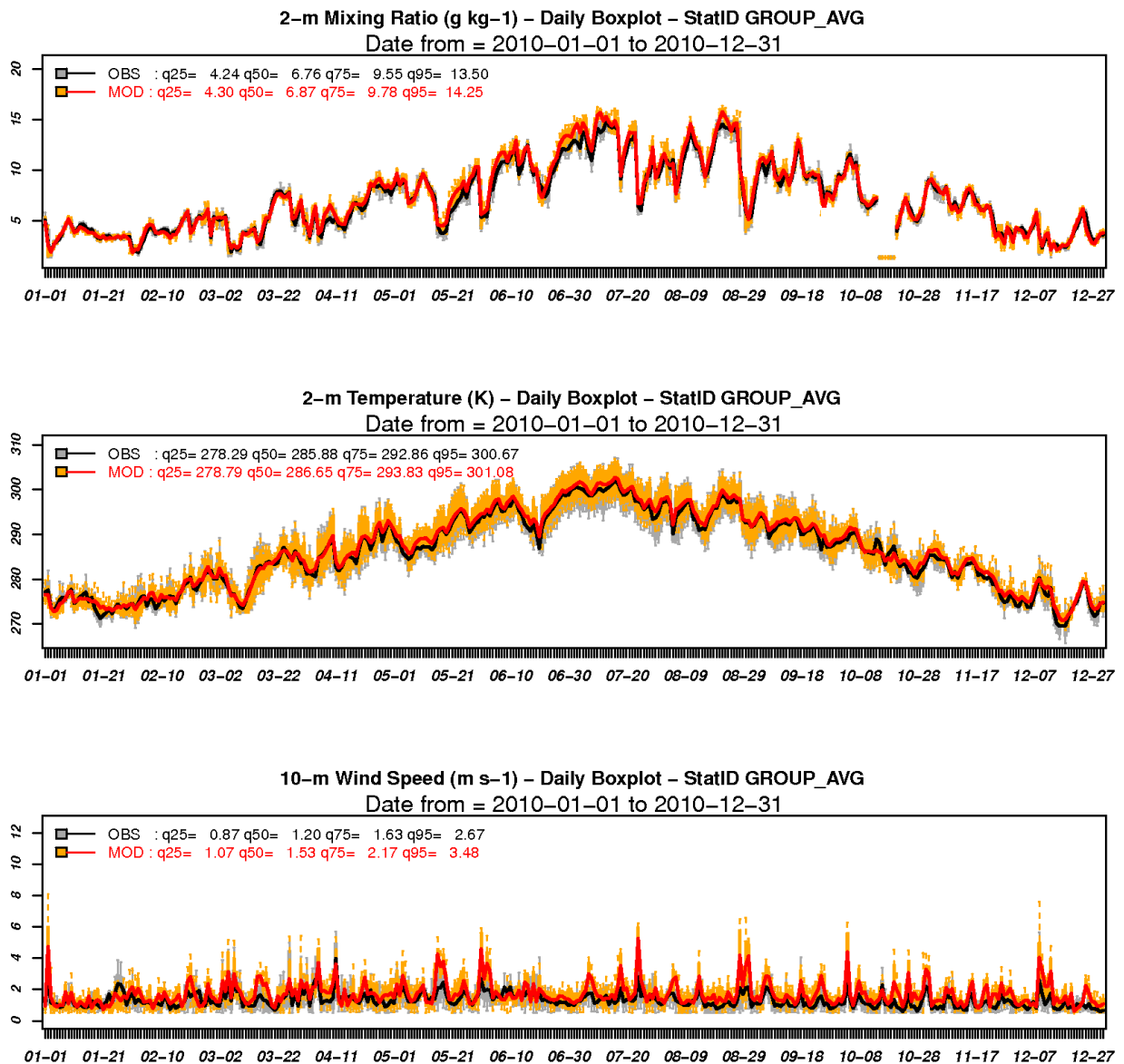


Figure S1. Time series of the box and whisker plots for the distribution of the observed (black/grey) and computed (red/orange) daily mean values of mixing ratio, temperature and wind speed over Milan metropolitan area for 2010. Bars show the interquartile range (IR), lines the median values, dashed vertical bars ($25^{\text{th}} - 1.5 \cdot \text{IR}$) and the ($75^{\text{th}} + 1.5 \cdot \text{IR}$) value. Values for the 25th, 50th, 75th, and 95th quantiles of the whole yearly time series are reported too. (Pepe et al, 2006).

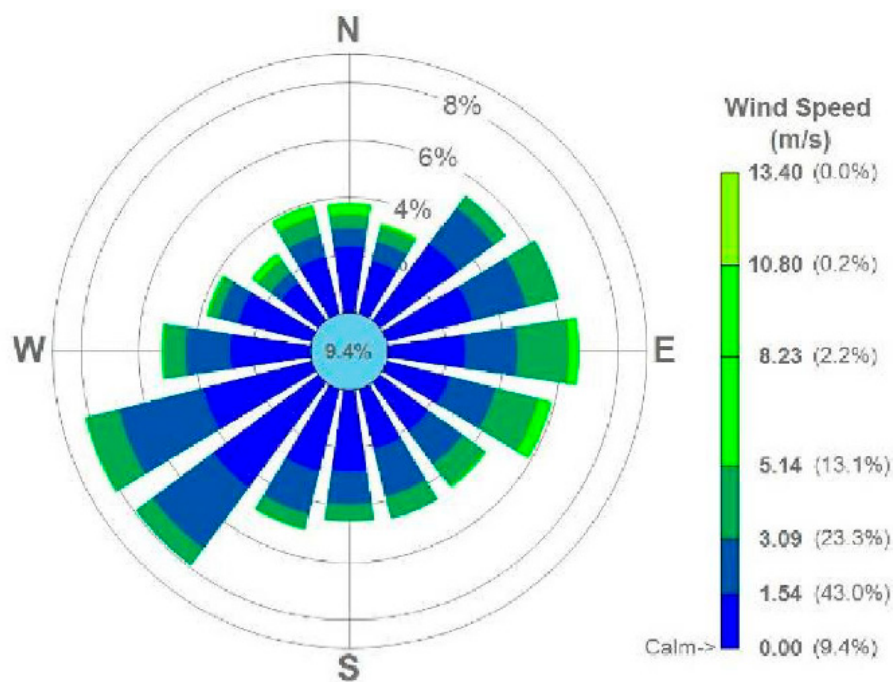


Figure S2. Wind rose for calendar year 2010 at Milano Linate airport (5 km crow-fly distance East from Milano city centre).

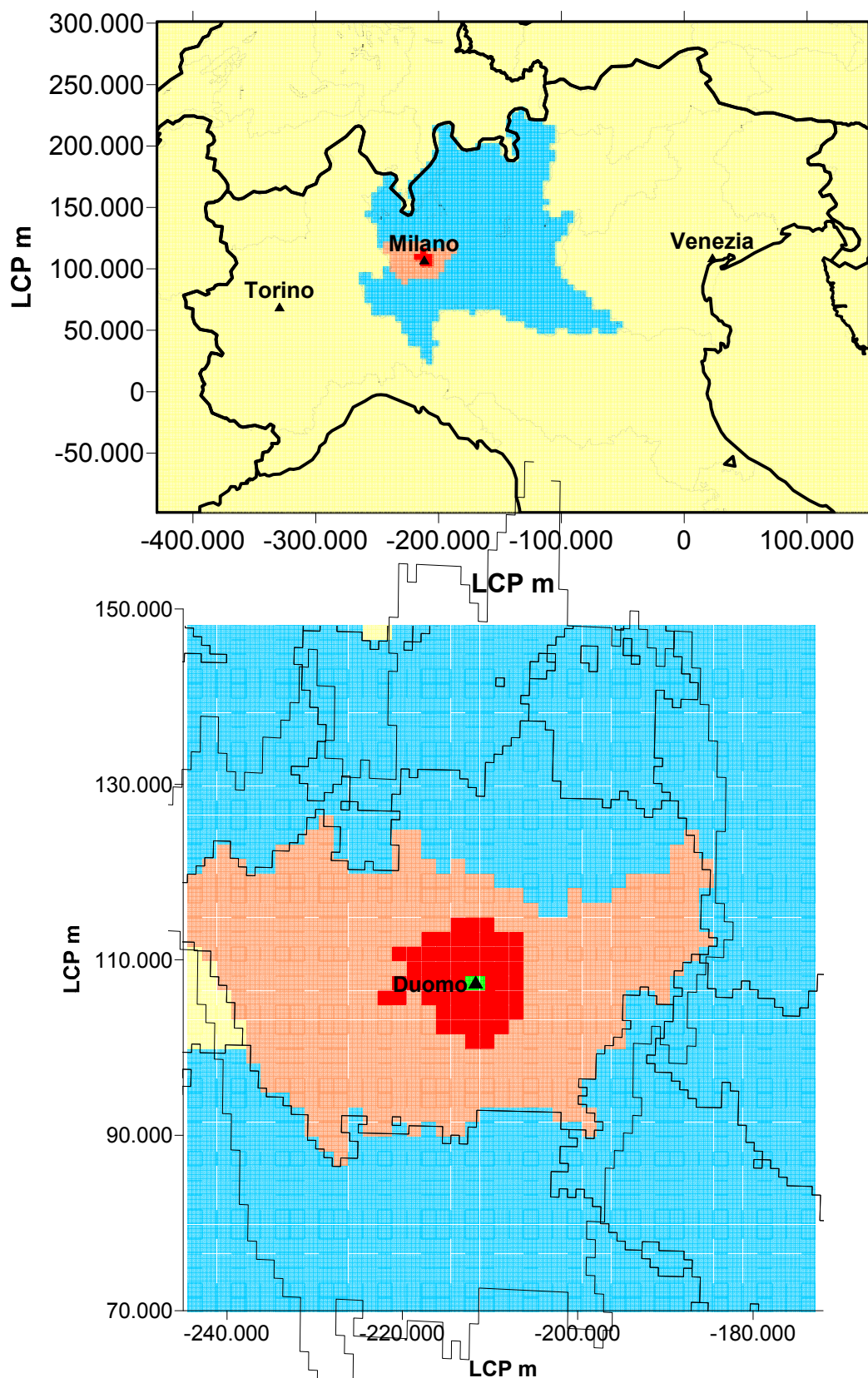


Figure S3. Emission regions within Po Valley (top panel, 5 km grid step) and Milan metropolitan area (bottom panel, 1.7 km grid step) computational domains: Po Valley region (POV) in yellow, Lombardy region (LOM) in blue, Metropolitan area of Milan region (PRO) in orange, municipality of Milan region (MIL) in red, local region (LOCAL), where the receptors considered for source apportionment analysis are located in green.

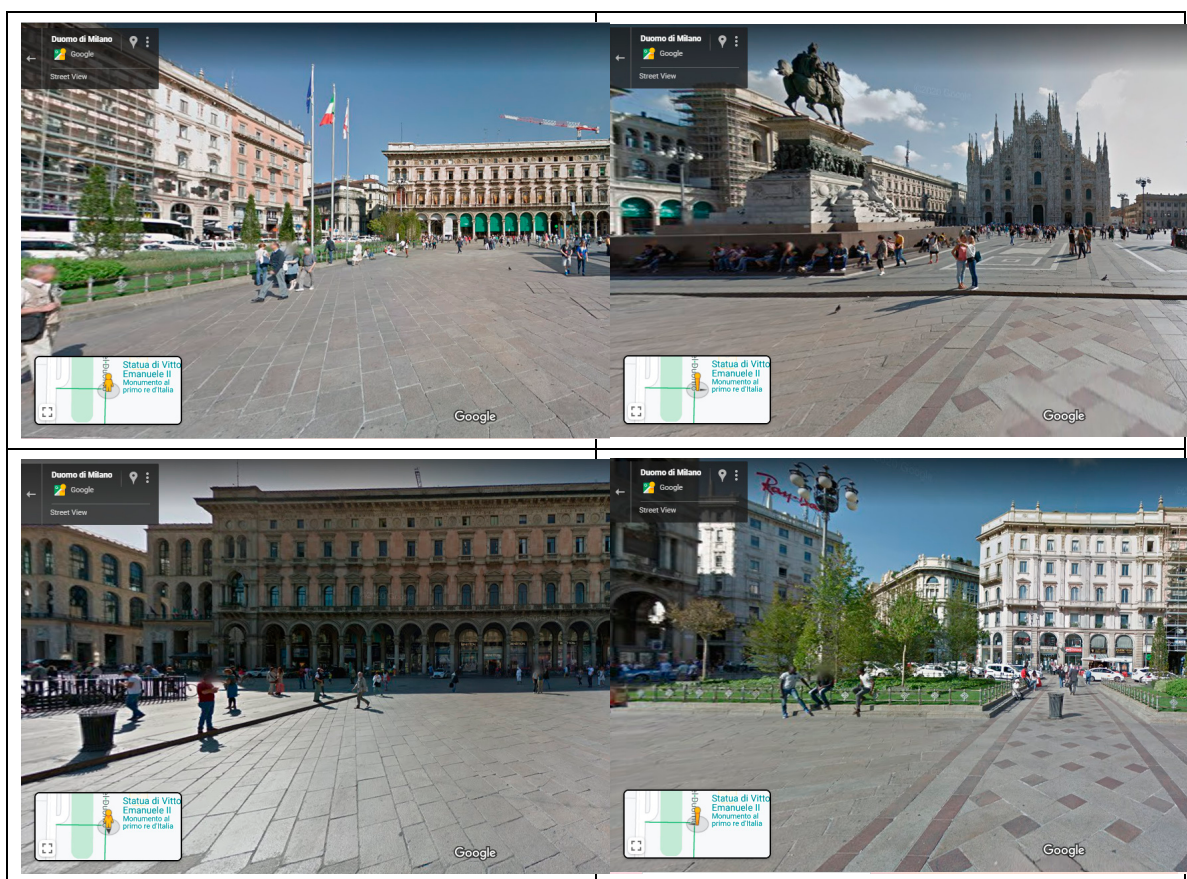


Figure S4. Google street views of the surroundings of DUOMO receptor.

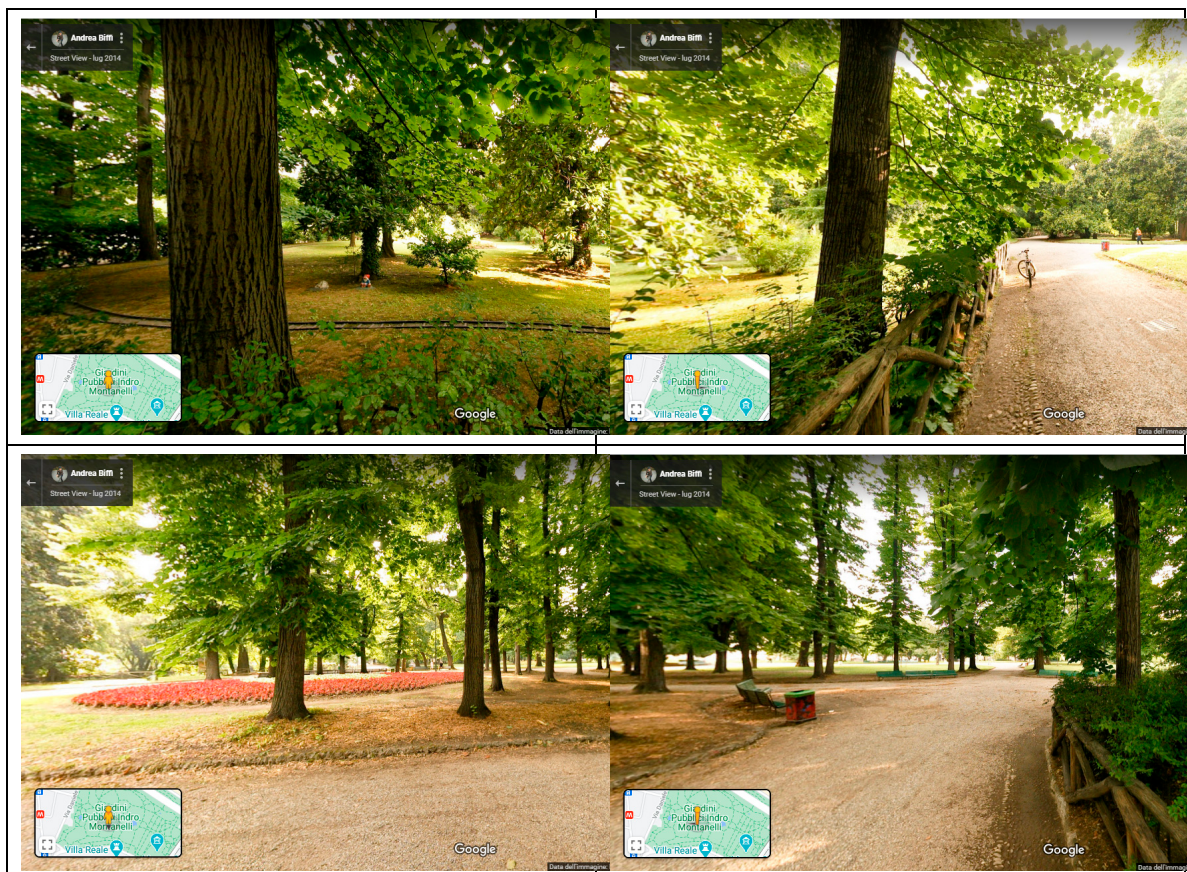


Figure S5. Google street views of the surroundings of PARK receptor.

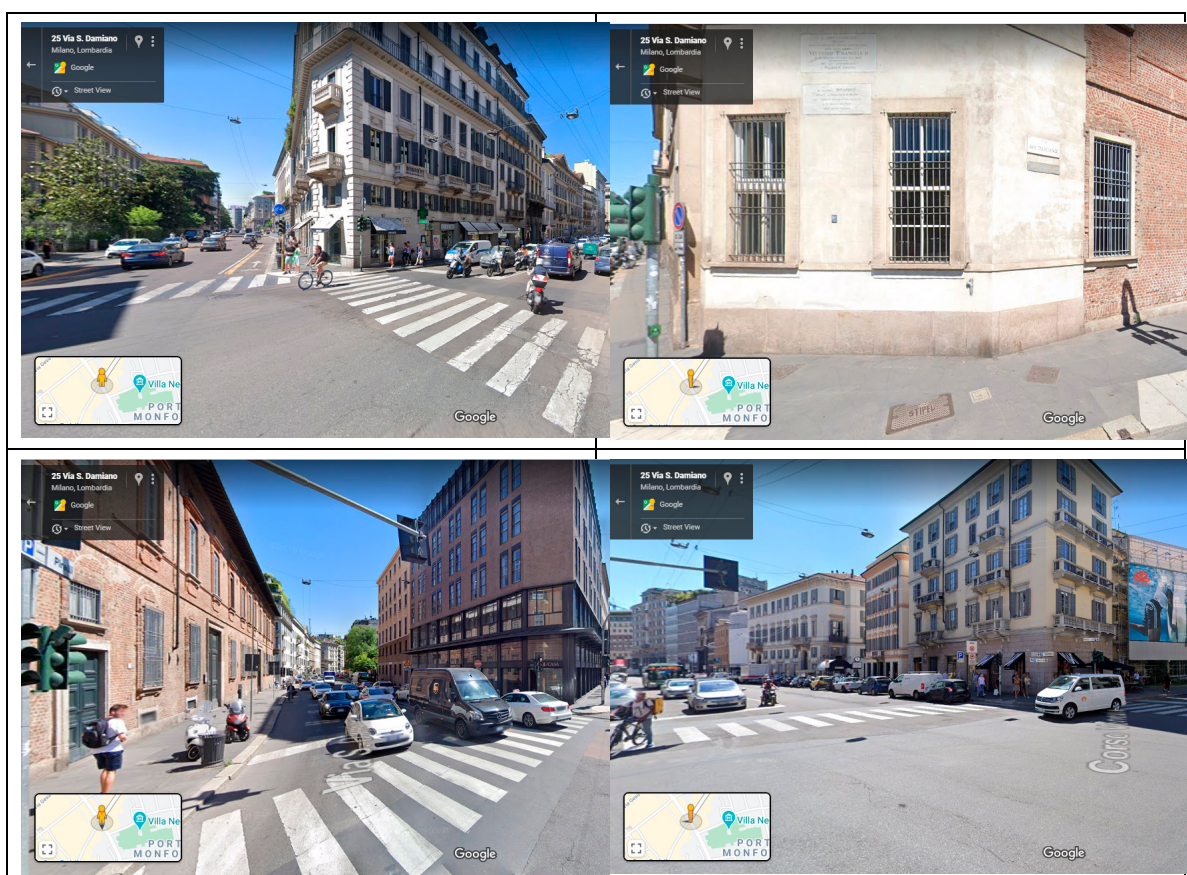


Figure S6. Google street views of the surroundings of TRAFFIC receptor.