



Supplement of

Building-resolving simulations of anthropogenic and biospheric CO₂ in the city of Zurich with GRAMM/GRAL

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S1. Emissions

The following table provides an overview of the grouping of source sectors for the GRAL simulations.

Table S1: Source groups simulated with GRAL. Source groups are usually composed of multiple emission sectors of the original inventory. MapLuft is the inventory for all sources within the city boundaries, Meteotest the inventory for sources outside. Note that source groups 71, 72 and 14 were not used in this study.

ID	Source	Group Name	Inventory Sector
1	MapLuft	shipping	c1101.Linienschiffe c1102.PrivaterBootsverkehr
6	MapLuft	light duty traffic	c1301.Personenwagen c1303.Motorraeder c1306.StartStopTankatmung c1307.Lieferwagen c1308.Reisebusse
7	MapLuft	heavy duty traffic	c1302.Lastwagen
9	MapLuft	public transport	c1304.Linienbusse
11	MapLuft	heating - fossil	c2101.Oelheizungen c2102.Gasheizungen c2105.Warmwassererzeuger c2201.BHKW
12	MapLuft	heating - non-fossil	c2103.HolzheizungenLokalisiert c2104.HolzheizungenDispers
14	MapLuft	waste-to-energy-plant	c2401.Klaerschlammmverwertung c2301.KHKWKehricht c2302.KHKWErdgas c2303.KHKWHeizuel
15	MapLuft	industry	c3201.Notstromanlagen c3301.Prozessenergie c3410.Bierbrauereien c3411.Brotproduktion c3414.Krematorium c3416.Tankstellen
17	MapLuft	construction	c3104.MaschinenTiefbau c3101.MaschinenHochbau c3419.IndustrielleFZ c4101.ForstwirtschaftlicheFZ c4201.LandwirtschaftlicheFZ
18	MapLuft	garden	c5201.Gruenabfallverbrennung c5301.HolzoefenKleingarten c5401.AbfallverbrennungHaus
34	Meteotest	traffic - CH	Strassenverkehr (evstr_co2) Zonenverkehr, Kaltstart/Verdampfung (evzon) Schiffahrt Seen (evsee)
35	Meteotest	heating - fossil CH	AWEL-Modell (ehfoe) Geschosshöhen Modell (ehgws)

36	Meteotest	heating - non-fossil CH	Gebäudetyp/AS (ehare)
37	Meteotest	industry and rest - CH	Holz und Kohle (ehfho)
			Haushalte andere Private etc (ehhan)
			Maschinen Garten und Hobby (ehmgh)
			Baumaschinen (eibau)
			Industriefahrzeuge (eifrz)
			Lösungsmittel Industrie (eilmi)
			Dienstleistungen Landschaftspflege (eipf)
			Feuerungen Dienstleistungen Öl und Gas (eiprd)
			Punktquellen KVA (eipkv)
			Schienenverkehr Bau-/Dienstzüge (evsch)
			Flugverkehr Zürich (evfzhr)
			landwirtschaftliche Maschinen (ellwm)
			forstwirtschaftliche Maschinen (elfwm)
			Verluste Gasnetz (eivgn)
			Flächenquellen Industrie (eipro)
50	Land cover	evergreen	Evergreen trees
51	Land cover	deciduous	Deciduous trees
52	Land cover	mixed	Mixture of evergreen and deciduous
53	Land cover	grassland	Land covered by grass
54	Land cover	cropland	Land covered by crops
61	QuartierAnalyse	respiration inhabitants	Human respiration inhabitants
62	QuartierAnalyse	respiration employees	Human respiration employees
71	MapLuft	heating - fossil oil	c2101_Oelheizungen
72	MapLuft	heating - fossil other	c2102_Gasheizungen
			c2105_Warmwassererzeuger
			c2201_BHKW
74	MapLuft	waste-to-energy-plant	c2301_KHKWKehricht
		Hagenholz only	

S2. Heating rates

Table S2 presents normalized diurnal cycles of hot water demand on weekdays (pHW_WD) and weekends (pHW_WE) and of general heating of residential buildings (pHDD).

Table S2: Normalized diurnal cycles of hot water production and heating.

hour(LT)	pHW_WD	pHW_WE	pHDD
1	0.01698302	0.01905717	0.02717
2	0.00899101	0.01203611	0.02775
3	0.004995	0.00702106	0.02859
4	0.002997	0.00401204	0.02934
5	0.003996	0.00200602	0.03692
6	0.00599401	0.00401204	0.04409
7	0.03296703	0.00300903	0.04576
8	0.06193806	0.00902708	0.04767
9	0.08391608	0.02808425	0.04942
10	0.05794206	0.05416249	0.04409
11	0.04995005	0.09027081	0.04492
12	0.04995005	0.08726179	0.04834
13	0.05794206	0.0772317	0.04601
14	0.05994006	0.07522568	0.04409
15	0.04695305	0.06018054	0.04226
16	0.04095904	0.05315948	0.03892
17	0.03796204	0.0551655	0.03892
18	0.04495504	0.05315948	0.04351
19	0.05594406	0.06118355	0.04884
20	0.06593407	0.06218656	0.05559
21	0.06393606	0.07121364	0.05018
22	0.06093906	0.05015045	0.04451
23	0.04995005	0.03410231	0.03951
24	0.03396603	0.02708124	0.03359

S3. Time series of hourly CO₂

Complementing Figures 13-15 showing timeseries of daily afternoon mean CO₂ concentrations, the following figures Fig. S1 - Fig. S3 present the corresponding time series of hourly concentrations.

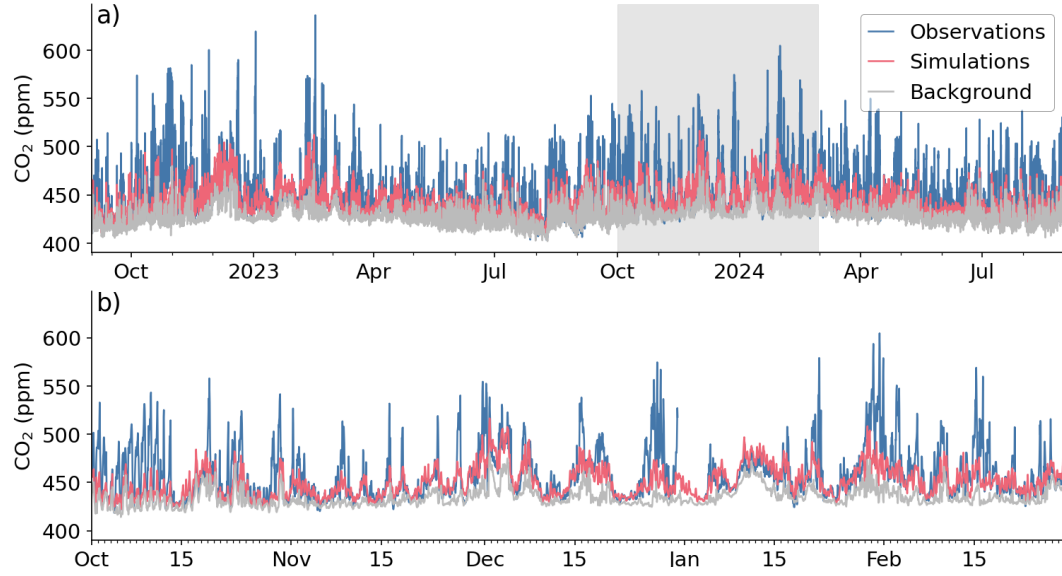


Figure S1: Time series of measured and simulated hourly CO₂ at the station Zurich Kaserne. (a) Full period of 2 years. (b) Zoom into five winter months from October 2023 to February 2024.

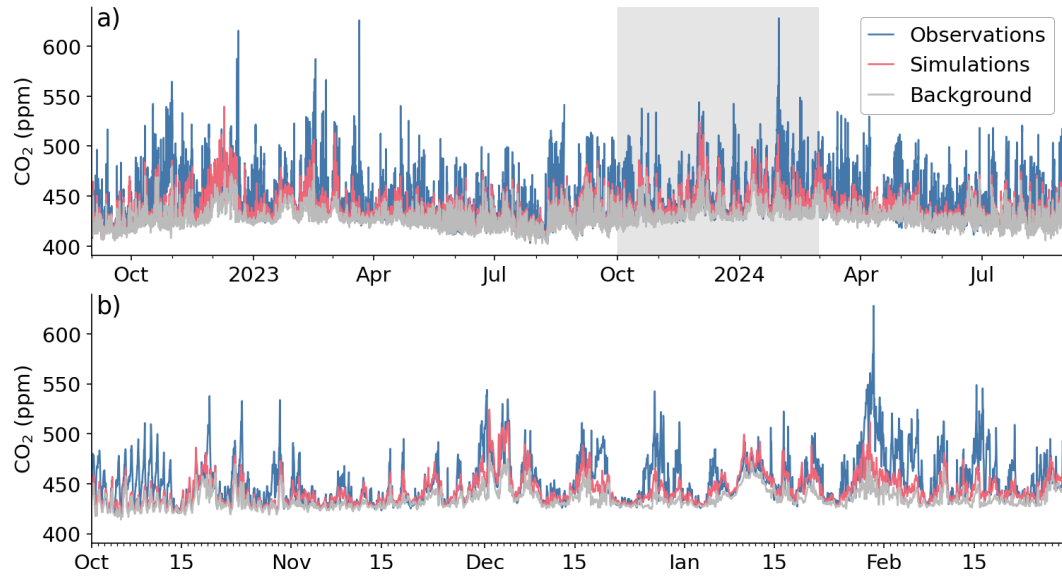


Figure S2: Time series of measured and simulated hourly CO₂ at the station Wollishofen. (a) Full period of 2 years. (b) Zoom into five winter months from October 2023 to February 2024.

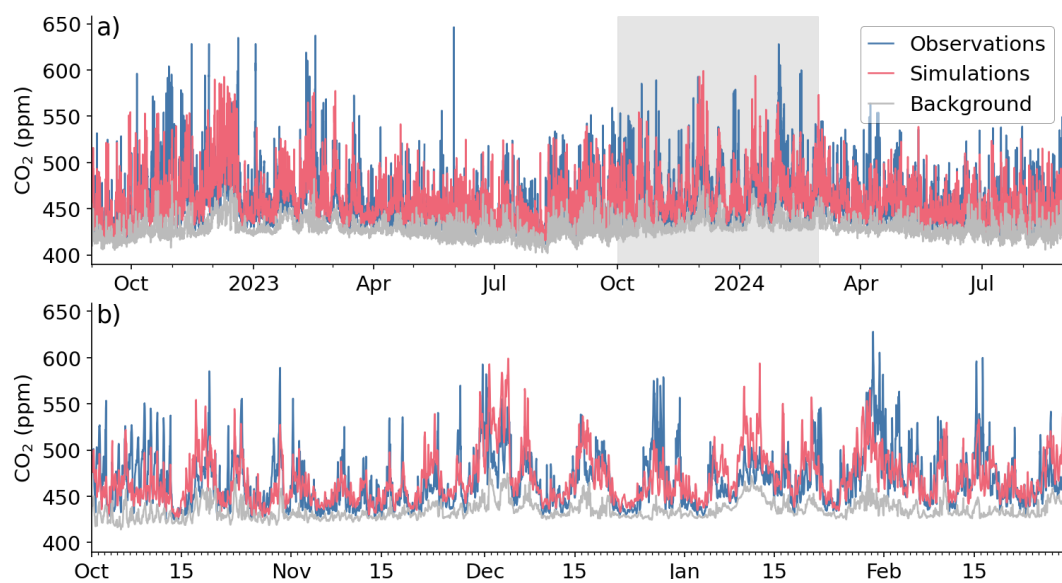


Figure S3: Time series of measured and simulated hourly CO₂ at the station Schimmelstrasse. (a) Full period of 2 years. (b) Zoom into five winter months from October 2023 to February 2024.