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Origin, transport and processing of organic aerosols at different altitudes in coastal Mediterranean urban areas

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Section S1

Figure S1. Map with the sampling sites, ceilometer location, air quality stations, meteorological stations and Harbour location. Source: Google Eath Pro©.

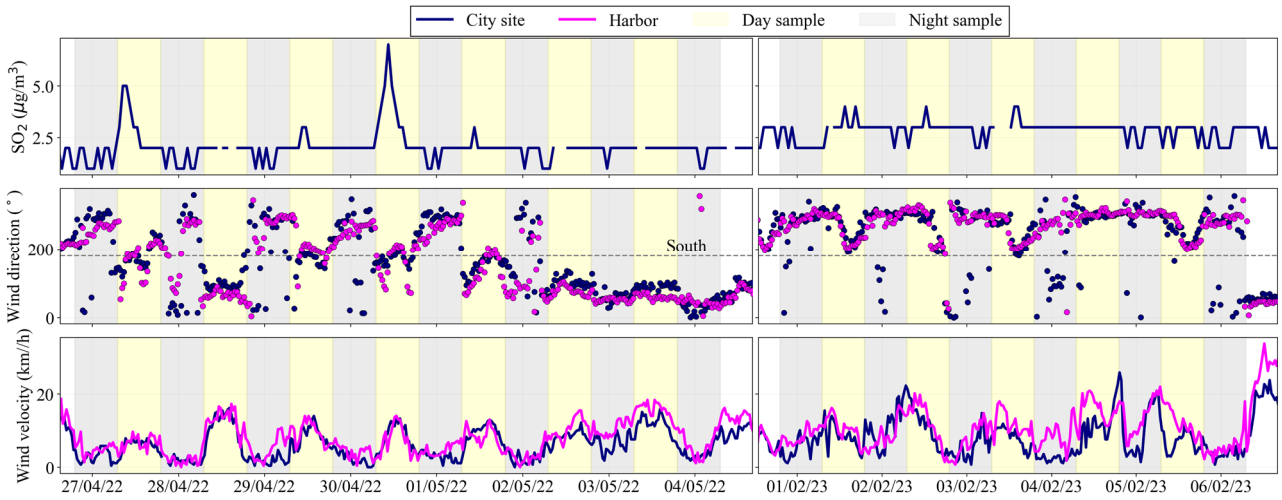

Figure S2. SO_2 , mean wind direction and velocity at the city site and harbour meteorological station.

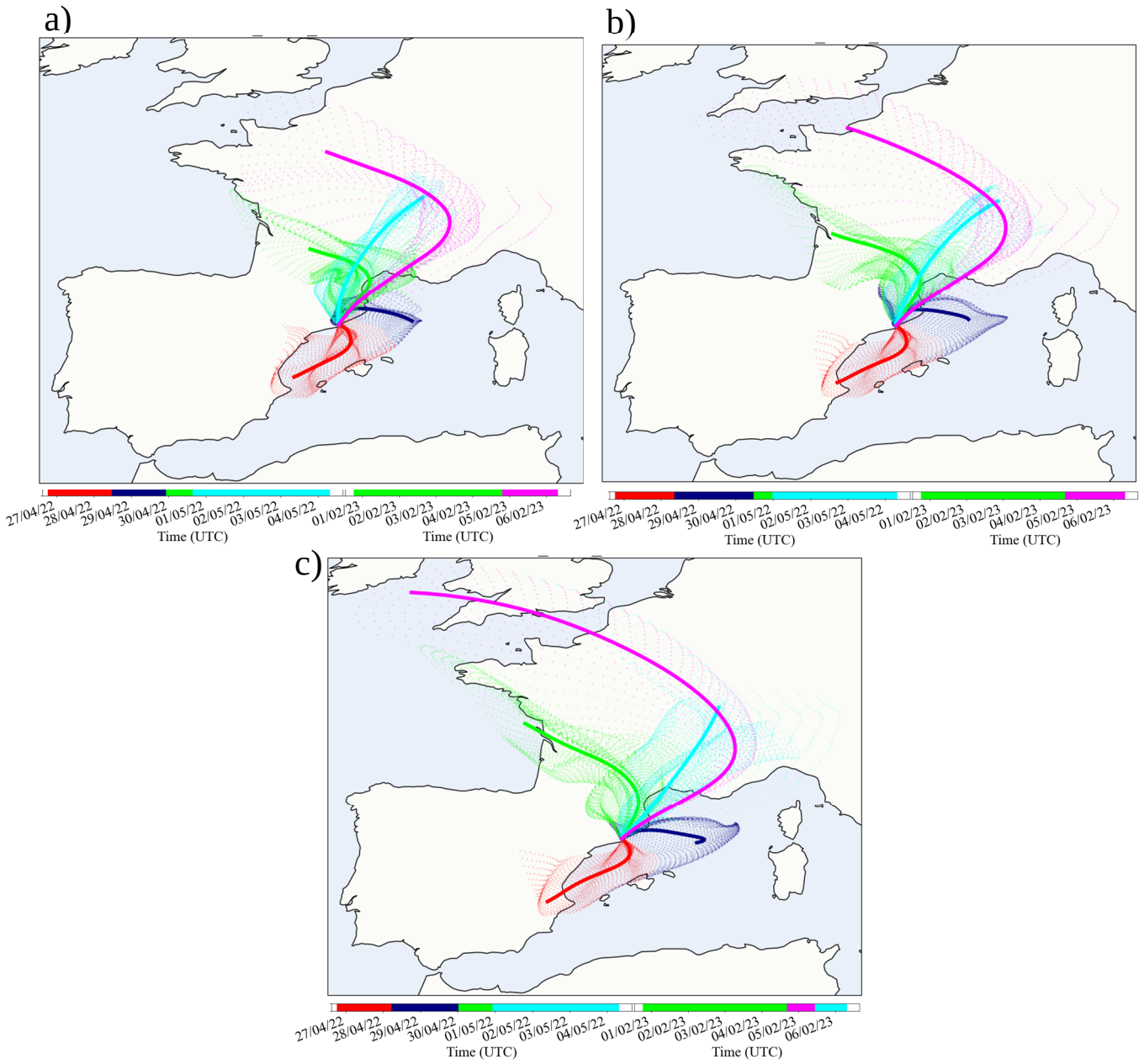

Figure S3. Mean trajectory of each 48h cluster (solid line) with all trajectory endpoinds of that cluster (dots). The color legend shows the date of the cluster each trajectory belongs to for the two sampling campaigns. The three subfigures show the cluster analysis with trajectories computed at the city site at 100 m agl (a), middle site at 200 m agl (b) and the elevated site at 400 m agl(c).

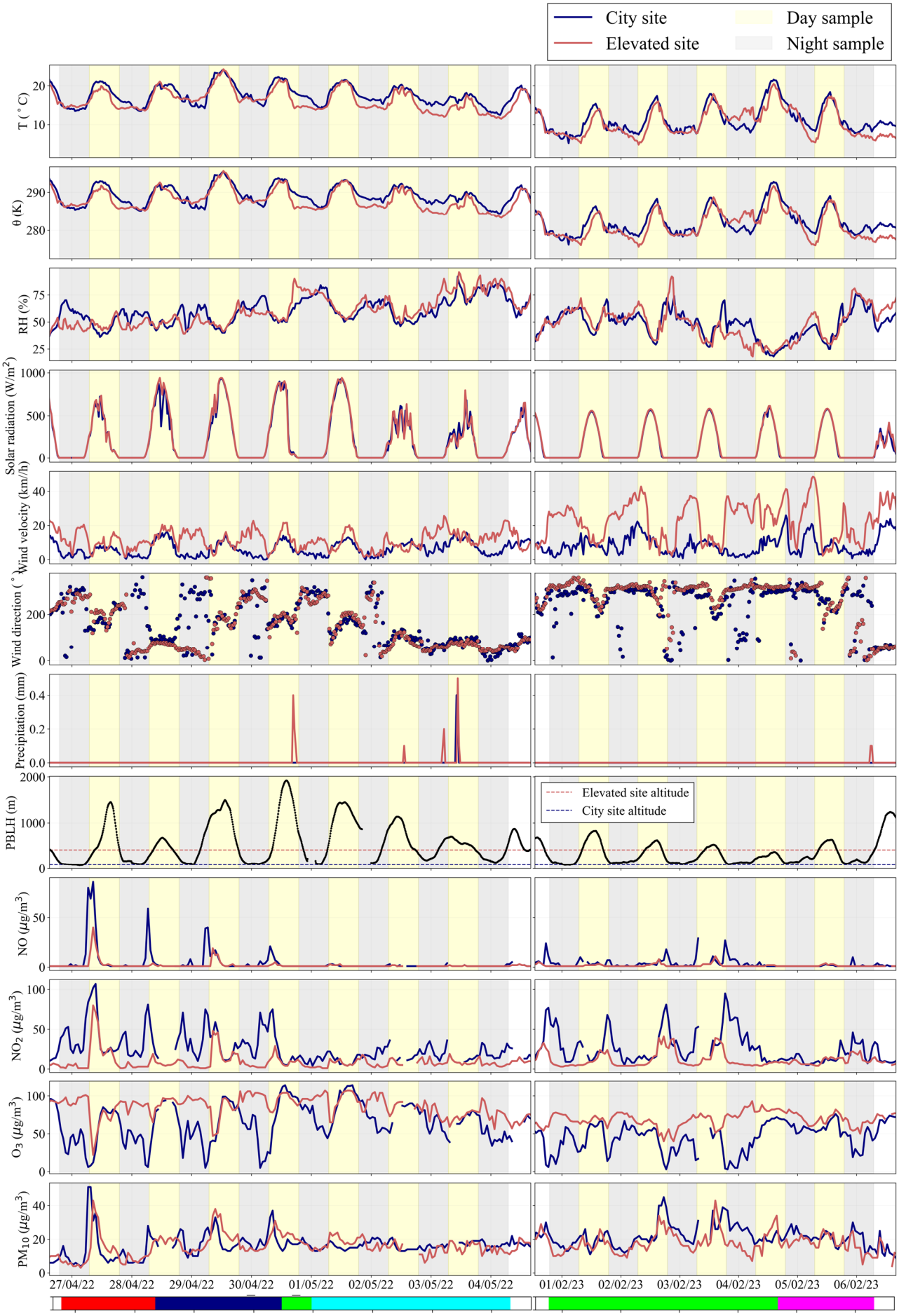

Figure S4. Meteorological and air quality variables during all sampling campaings with the air trajectory cluster for each period in the x axis.

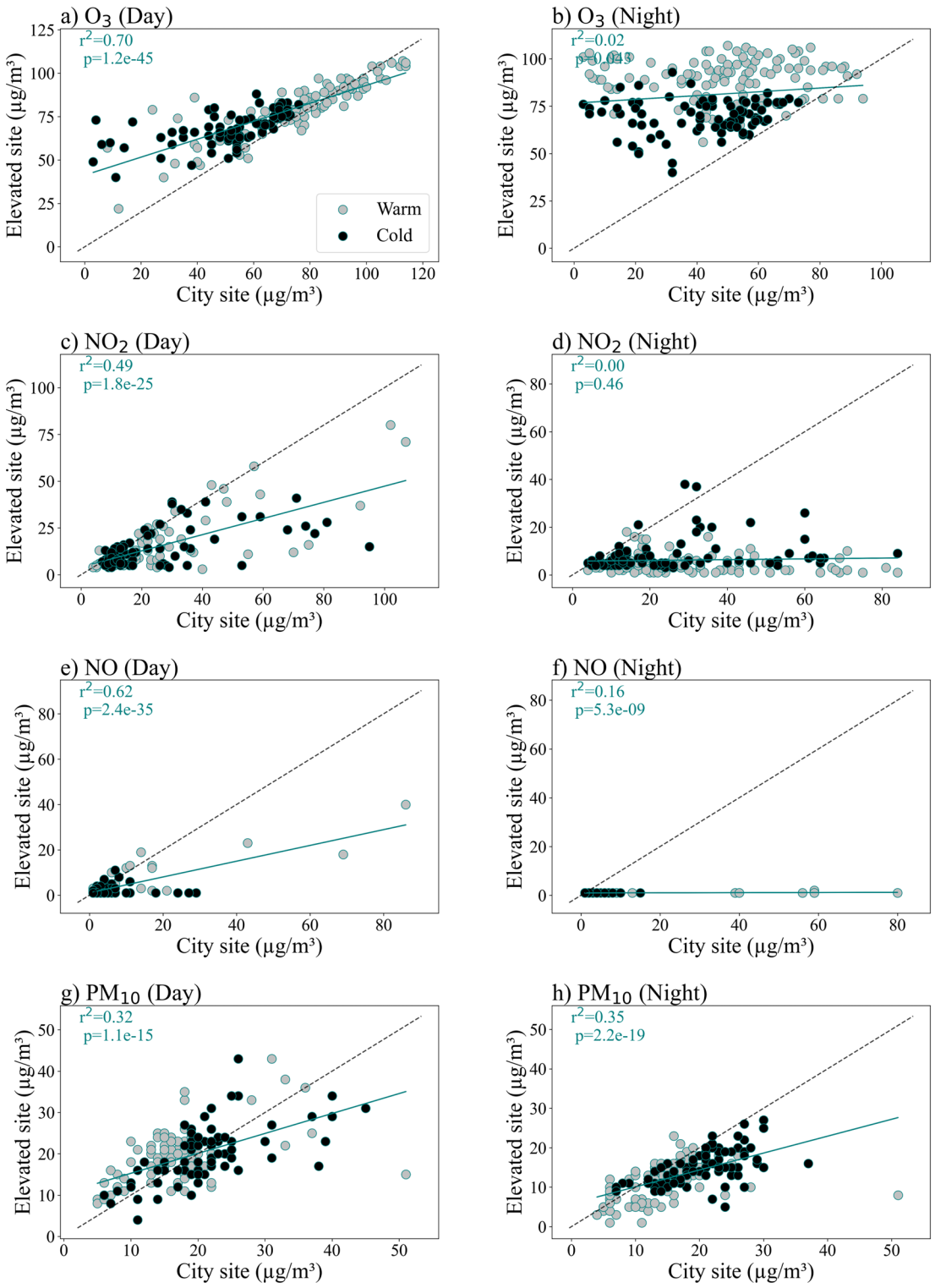

Figure S5. Correlation of air quality automatic data at both background sites during day and night periods.

Figure S6. Photos taken from the city site to the city harbour during the sampling campaign.

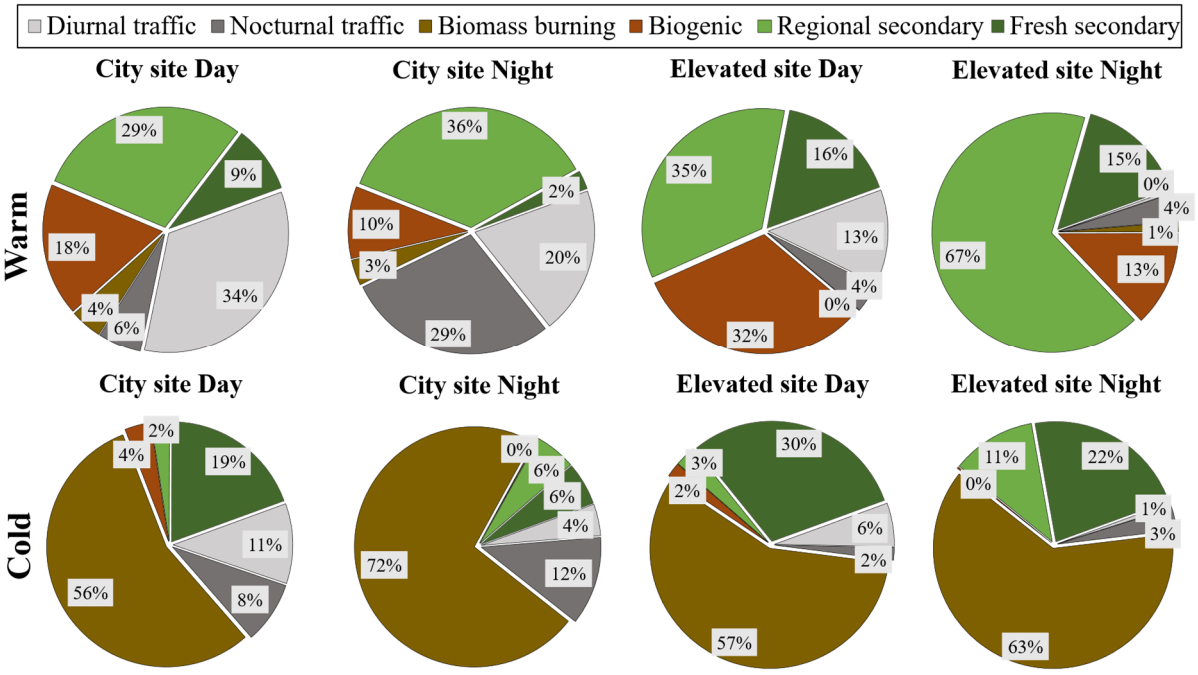

Figure S7. Pie charts the MCR-ALS scores separated by season, site and period of the day.

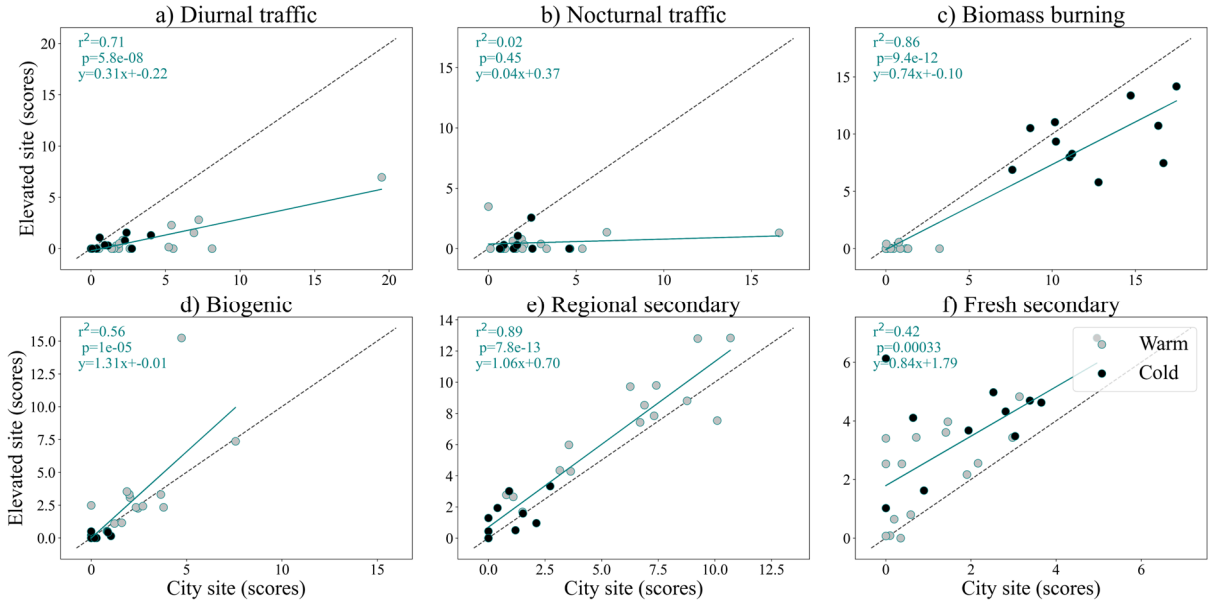

Figure S8. Correlation between MCR-ALS scores at both sites for the 6 components.

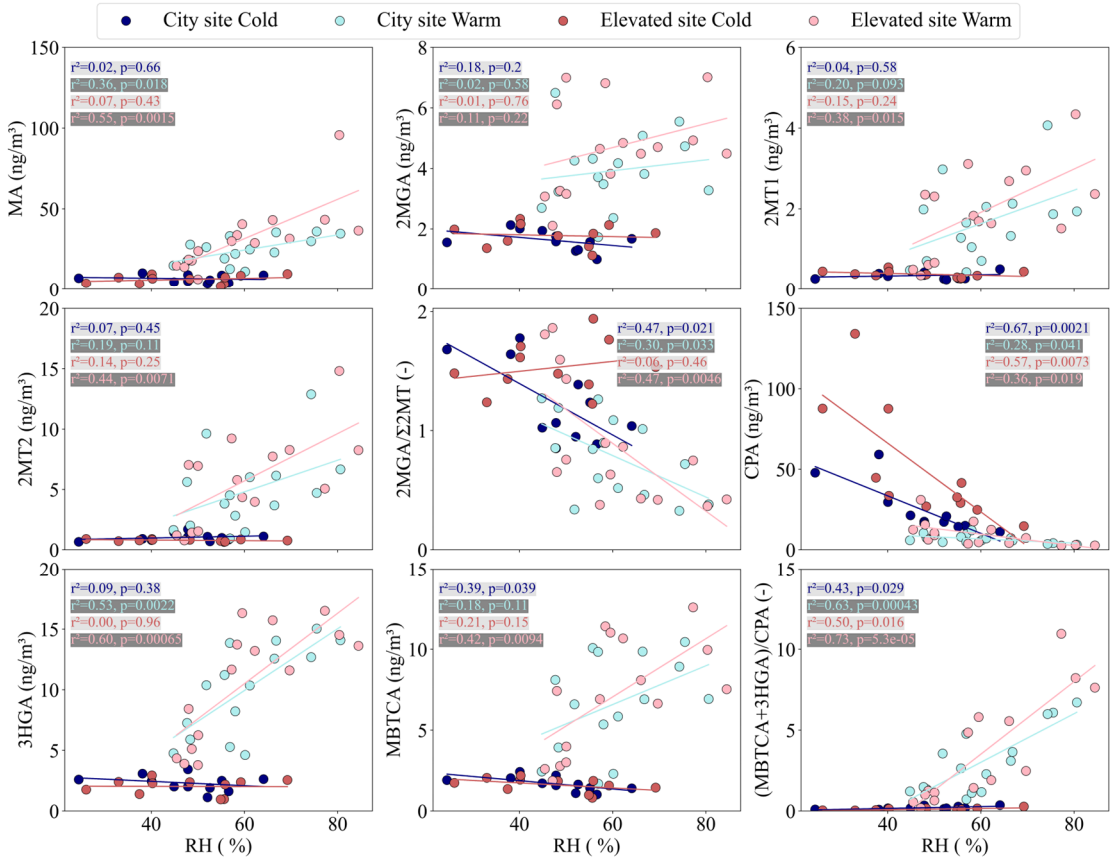

Figure S9. Concentration of Biogenic SOA compounds and ratios between them against Relative Humidity (RH) at the different sites and campaings. Abbreviations are defined in Table 1.

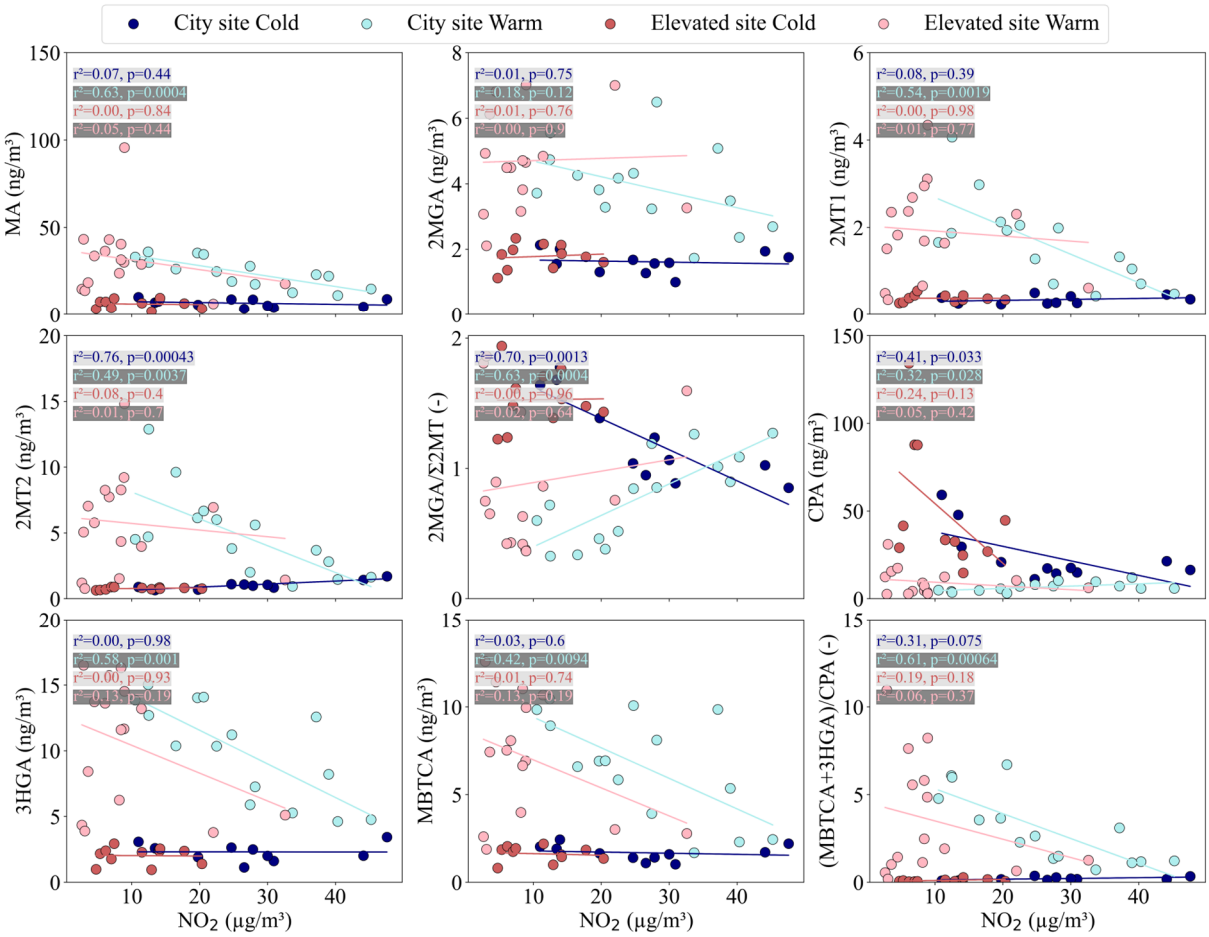

Figure S10. Concentration of Biogenic SOA compounds and ratios between them against NO_2 at the different sites and campaings. Abbreviations are defined in Table 1.

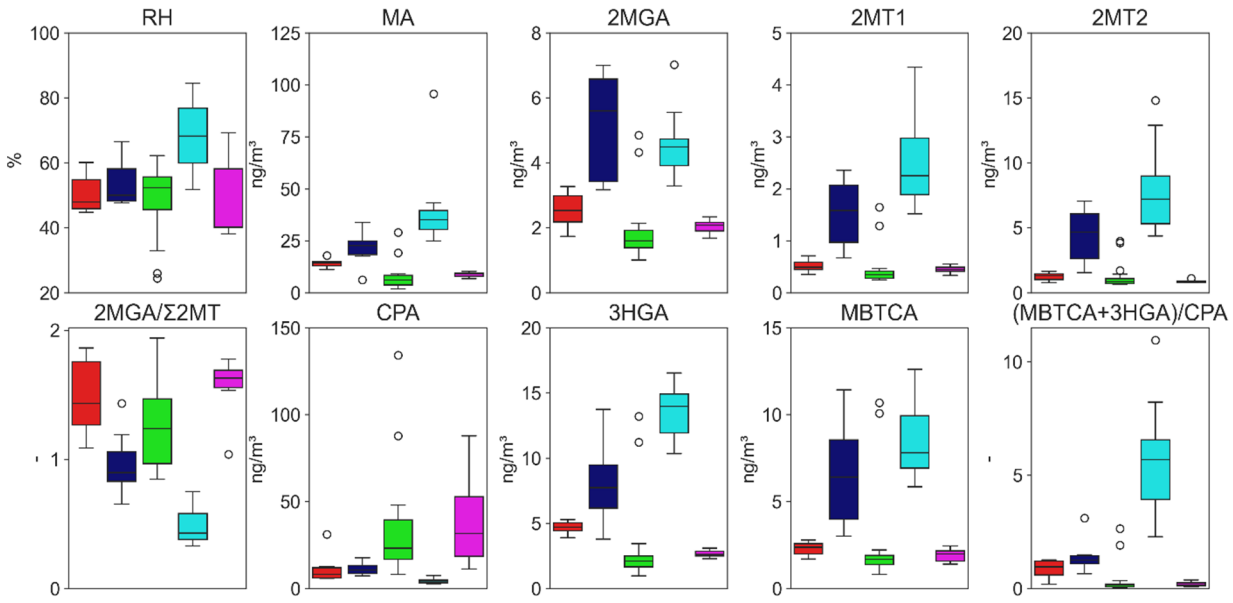

Figure S11. Concentration of Biogenic SOA compounds and ratios between them under different air mass origins. Colours of boxes correspond to the backward trajectory clusters of Figure S3 b; red: northward Mediterranean, blue: southward Mediterranean, green: southward Atlantic, light blue: southward continental, pink: Atlantic-continental. Abbreviations are defined in Table 1.

Table S1.. Average concentrations and standard deviations of day and night samples during warm and cold campaigns at both sites. Abbreviations are defined in Table 1..

	Warm								**Cold**							
	City site				**Elevated site**				**City site**				**Elevated site**			
	Day		**Night**		**Day**		**Night**		**Day**		**Night**		**Day**		**Night**	
	Avg	**sd**	**Avg**	**sd**	**Avg**	**sd**	**Avg**	**sd**	**Avg**	**sd**	**Avg**	**sd**	**Avg**	**sd**	**Avg**	**sd**
	pg/m^3															
PHE	**33**	16	**41**	17	**24**	13	**8**	4	**82**	17	**92**	19	**87**	17	**70**	13
ANT	**3**	2	**5**	4	**2**	2	**ND**	**ND**	**12**	2	**15**	2	**13**	2	**12**	4
FL	**48**	18	**128**	189	**34**	13	**19**	6	**169**	36	**216**	41	**180**	35	**148**	32
PYR	**67**	34	**96**	43	**44**	22	**20**	5	**199**	47	**266**	50	**199**	39	**177**	36
BAA	**17**	10	**28**	32	**12**	9	**5**	2	**80**	19	**105**	18	**71**	14	**68**	23
C+T	**50**	24	**64**	47	**35**	22	**16**	7	**198**	37	**262**	52	**177**	34	**168**	49
BBJKFL	**94**	60	**94**	74	**52**	24	**24**	9	**310**	46	**502**	81	**299**	54	**319**	107
BEP	**58**	33	**57**	34	**33**	17	**13**	5	**165**	24	**262**	42	**147**	32	**170**	54
BAP	**24**	14	**36**	35	**17**	9	**7**	2	**138**	27	**218**	43	**135**	31	**147**	50
PYL	**4**	2	**7**	5	**3**	2	**1**	0.3	**29**	8	**41**	11	**23**	6	**28**	14
DBAJANT	**6**	6	**8**	9	**4**	2	**2**	1	**46**	11	**74**	17	**47**	12	**47**	16
IP	**74**	49	**62**	33	**43**	16	**20**	6	**161**	27	**248**	48	**146**	31	**159**	56
DBAH+ACANT	**9**	7	**10**	10	**5**	3	**2**	1	**23**	1	**40**	7	**23**	5	**26**	7
BGHIP	**138**	103	**117**	57	**71**	38	**23**	7	**229**	64	**323**	68	**187**	30	**190**	63
ANTHAN	**23**	10	**24**	12	**18**	5	**10**	4	**49**	14	**71**	12	**44**	8	**48**	17
COR	**50**	40	**36**	23	**24**	22	**ND**	**ND**	**69**	28	**84**	23	**51**	10	**47**	18
3mPHE	**9**	5	**18**	22	**7**	4	**5**	4	**16**	3	**19**	4	**14**	3	**12**	2
2mPHE	**9**	5	**19**	23	**7**	5	**5**	5	**47**	10	**48**	13	**23**	4	**18**	2
2mANT	**2**	1	**4**	6	**1**	1	**1**	1	**5**	1	**7**	1	**4**	1	**5**	2
9mPHE	**8**	4	**15**	19	**5**	3	**3**	3	**10**	2	**14**	3	**10**	3	**10**	2
1mPHE	**5**	3	**11**	13	**4**	2	**3**	3	**18**	4	**25**	4	**21**	6	**18**	5
17dmPHE	**5**	3	**10**	11	**4**	3	**3**	3	**22**	5	**31**	3	**24**	6	**21**	5
1+3mFL	**19**	31	**13**	12	**6**	3	**3**	1	**47**	8	**67**	14	**46**	11	**43**	12
RET	**46**	86	**27**	12	**12**	10	**13**	4	**247**	93	**495**	58	**351**	64	**357**	98
4mPYR	**27**	49	**14**	9	**8**	5	**3**	1	**27**	7	**37**	7	**23**	5	**22**	5
1mPYR	**15**	27	**8**	5	**4**	3	**2**	0.4	**21**	5	**31**	6	**18**	3	**18**	4
3mC	**31**	16	**36**	20	**20**	12	**8**	2	**57**	8	**97**	23	**42**	9	**49**	11
6mC	**8**	4	**9**	5	**5**	3	**2**	0.4	**10**	3	**16**	4	**7**	1	**7**	2
9FLO	**28**	18	**31**	22	**16**	12	**14**	7	**106**	14	**128**	15	**119**	31	**130**	21
ANQ	**182**	72	**219**	216	**129**	48	**218**	192	**454**	38	**479**	51	**421**	42	**460**	132
2mANQ	**158**	63	**120**	33	**102**	62	**50**	9	**112**	13	**115**	15	**90**	10	**94**	25
23dmANQ	**36**	39	**16**	5	**15**	17	**5**	2	**8**	1	**14**	3	**8**	2	**11**	4
BAF	**71**	100	**40**	20	**28**	17	**15**	5	**64**	11	**83**	14	**58**	7	**62**	20
9nANT	**4**	3	**11**	6	**2**	1	**2**	2	**10**	5	**20**	8	**7**	4	**9**	6
2nFLU	**4**	2	**3**	1	**3**	2	**1**	0.5	**1**	0.3	**ND**	**ND**	**2**	1	**1**	1
norHOP	**181**	116	**126**	64	**85**	63	**21**	8	**83**	38	**67**	26	**48**	13	**25**	6
HOP	**176**	115	**126**	67	**83**	65	**18**	7	**73**	34	**61**	26	**39**	12	**20**	7
	ng/m^3															
GAL	**1.7**	0.7	**2.0**	0.6	**1.4**	0.4	**1.3**	0.7	**8.7**	1.1	**15.5**	5.2	**9.0**	1.7	**12.8**	4.7
MANNO	**1.5**	0.4	**2.2**	0.6	**1.3**	0.4	**1.3**	0.6	**7.3**	1.0	**14.3**	4.8	**8.0**	1.7	**10.3**	4.4
LEV	**15.3**	2.9	**21.5**	3.5	**14.4**	4.4	**13.3**	7.2	**116.9**	18.8	**202.4**	75.1	**123.2**	21.7	**148.4**	67.5
OXA	**4.7**	1.5	**5.8**	2.3	**4.7**	2.3	**6.7**	3.4	**2.3**	1.5	**5.1**	1.9	**1.8**	1.3	**4.7**	1.7
MALA	**2.4**	1.4	**2.5**	1.5	**3.4**	2.2	**4.3**	1.9	**0.6**	0.5	**0.6**	0.5	**0.3**	0.3	**0.9**	0.4
SA	**16.9**	3.8	**14.7**	3.3	**16.9**	8.1	**15.2**	6.9	**9.9**	1.5	**10.7**	3.2	**8.9**	2.3	**10.3**	4.3
GLU	**4.2**	1.3	**3.2**	1.1	**3.7**	1.5	**3.6**	1.8	**1.7**	0.2	**1.7**	0.3	**1.7**	0.4	**1.9**	0.6
ADIA	**1.2**	0.3	**0.9**	0.2	**1.0**	0.3	**0.8**	0.3	**0.5**	0.1	**0.5**	0.1	**0.5**	0.2	**0.6**	0.1
PIMA	**0.5**	0.1	**0.4**	0.1	**0.3**	0.0	**0.3**	0.1	**0.2**	0.1	**0.2**	0.1	**0.2**	0.1	**0.2**	0.1
SUBA	**0.9**	0.2	**0.9**	0.4	**0.7**	0.2	**0.6**	0.2	**0.3**	0.1	**0.4**	0.2	**0.3**	0.1	**0.4**	0.1
AZA	**6.0**	2.1	**6.6**	2.4	**4.1**	1.7	**3.3**	1.2	**2.9**	0.6	**4.1**	2.7	**2.9**	0.5	**2.7**	1.1
MA	**24.2**	6.9	**25.0**	9.9	**34.8**	28.9	**29.5**	12.1	**5.5**	1.8	**7.7**	2.4	**4.4**	2.1	**7.6**	2.4
TARA	**4.8**	1.9	**6.0**	2.1	**5.7**	2.8	**7.7**	2.8	**0.6**	0.4	**1.2**	0.6	**0.5**	0.3	**1.3**	0.5
PHA	**2.6**	0.7	**1.8**	0.8	**2.4**	0.7	**1.5**	0.5	**2.2**	0.4	**1.6**	0.5	**1.7**	0.5	**1.1**	0.5
OLEA	**2.4**	1.5	**3.3**	4.3	**2.9**	2.1	**1.0**	0.4	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**
2MGA	**4.3**	1.3	**3.6**	1.1	**4.8**	1.6	**4.6**	1.5	**1.7**	0.3	**1.6**	0.4	**1.8**	0.3	**1.8**	0.5
2MT1	**1.9**	1.3	**1.4**	0.7	**2.1**	1.3	**1.8**	1.0	**0.4**	0.1	**0.3**	0.1	**0.4**	0.1	**0.4**	0.1
2MT2	**5.7**	4.1	**4.1**	2.2	**6.0**	4.8	**5.5**	3.0	**1.0**	0.3	**1.0**	0.4	**0.8**	0.1	**0.8**	0.1
CPA	**6.4**	2.3	**6.9**	2.9	**7.1**	3.6	**11.7**	9.7	**26.8**	12.8	**22.9**	18.1	**45.1**	24.7	**55.4**	46.3
3HGA	**9.4**	3.5	**10.5**	4.1	**10.1**	5.0	**11.0**	4.9	**2.0**	0.6	**2.5**	0.7	**1.8**	0.6	**2.2**	0.7
MBTCA	**7.1**	3.0	**6.2**	3.1	**6.9**	3.7	**7.3**	3.7	**1.7**	0.5	**1.6**	0.4	**1.6**	0.5	**1.6**	0.5
MANNI	**30.6**	8.4	**25.8**	3.1	**60.2**	22.5	**29.4**	8.0	**3.1**	0.5	**2.6**	0.6	**3.0**	0.7	**2.7**	0.7
SOR	**1.2**	0.4	**1.0**	0.2	**1.6**	0.6	**0.9**	0.4	**0.3**	0.1	**0.3**	0.1	**0.3**	0.1	**0.3**	0.2
MERY	**6.6**	3.3	**3.8**	0.8	**6.2**	2.7	**3.6**	1.2	**6.3**	0.9	**8.2**	2.1	**7.0**	1.5	**6.4**	2.9
AGLU	**40.8**	20.7	**25.1**	6.9	**82.4**	91.7	**29.6**	8.5	**5.4**	1.0	**4.6**	1.3	**5.0**	0.9	**4.1**	1.4
BGLU	**47.9**	24.0	**30.3**	8.6	**105.1**	120.8	**37.1**	11.8	**5.4**	0.9	**4.9**	1.3	**5.0**	1.2	**4.3**	1.5

Table S2. Concentrations of most of the studied compounds compared with data in the literature in the same region. Abbreviations are defined in Table1. .

	City site 2022	Elevated site 2022	City site 2023	Elevated site 2023	Vic 2021	Vic 2021	Vic 2022	Mollerussa 2021	Mollerussa 2021	Vallès 2022	Sierra Nevada Station	BCN 02/08/2019	BCN 16/11/2019	BCN 20/11/2019	BCN 18/12/2019	BCN 22/12/2019	Manlleu 02/08/2019	Manlleu 16/11/2019	Manlleu 20/11/2019	Manlleu 18/12/2019	Manlleu 22/12/2019	Bellver 02/08/2019	Bellver 16/11/2019	Bellver 20/11/2019	Bellver 18/12/2019	Bellver 22/12/2019	La pobla 2013	La pobla 2012	BCN 2012	BCN 2013
Samples	n=15	n=15	n=11	n=11	n=6	n=9	n=7	n=10	n=15	n=8	n=57	n=1	n=1	n=1	n=1	n=1	n=1	n=1	n=1	n=1	n=1	n=1	n=1	n=1	n=1	n=1	n=2	n=2	n=2	n=12
Site	Urban	Sub-urban	Urban	Sub-urban	Sub-urban	Sub-urban	Sub-urban	Rural	Rural	Industrial	High-altitude	Urban	Urban	Urban	Urban	Urban	Sub-urban	Sub-urban	Sub-urban	Sub-urban	Sub-urban	Rural	Rural	Rural	Rural	Rural	Rural	Rural	Urban	Urban
Season	Spring	Spring	Winter	Winter	Winter	Summer	Winter	Spring	Summer	Winter	Summer	Summer	Autum	Autum	Autum	Winter	Summer	Autum	Autum	Autum	Winter	Summer	Autum	Autum	Autum	Winter	Summer	Winter	Spring	Winter
Fraction	PM_{10}	PM_{10}	PM_{10}	PM_{10}	TSP	TSP	TSP	TSP	TSP	TSP	PM_{10}	PM_{10}	PM_{10}	PM_{10}	PM_{10}	PM_{10}	PM_{10}	PM_{10}	PM_{10}	PM_{10}	PM_{10}	PM_{10}	PM_{10}	PM_{10}	PM_{10}	PM_{10}	TSP	TSP	TSP	TSP
Reference	Present work				Jaén et al. 2024						Jaén et al. 2023	Jaén et al. 2021															van Drooge and Grimalt 2015			
	pg/m³																													
BAA	8	85	103	0	439	9	314	49	14	674	7	42	72	252	216	45	16	161	1459	1484	41	7	385	376	585	50	20	1790	120	330
C+T	29	207	247	0	621	22	608	174	49	1127	28	61	152	358	410	84	57	282	1938	3002	73	18	594	490	1008	86	40	2020	220	570
BBJKFL	37	351	433	0	1060	140	1255	588	158	3449	21	110	303	912	777	101	71	797	7783	8199	86	33	2458	1961	4856	193	140	3610	300	810
BEP	19	179	232	0	1017	62	749	291	55	1595	9	145	188	534	404	112	60	336	3015	3527	48	25	954	772	1416	129	170	1500	370	650
BAP	10	168	217	0	596	19	522	87	39	1540	-	59	114	403	335	38	44	249	3355	3240	35	13	969	817	1600	80	120	1490	220	480
DBAJANT	3	62	65	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	460	90	170
IP	29	177	222	0	402	48	456	236	139	1161	10	51	148	348	311	54	44	411	2331	2493	68	25	999	654	1131	143	130	1580	220	530
BGHIP	33	220	263	0	683	182	797	341	215	2174	15	113	271	650	727	102	49	520	3862	4091	93	30	1165	916	1601	182	210	1250	430	690
COR	6	64	69	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90	650	240	370
3mPHE	11	17	14	0	224	39	117	14	18	101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2mPHE	14	27	20	0	310	46	159	16	23	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9mPHE	9	13	12	0	150	17	71	10	14	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1mPHE	9	31	26	0	221	15	119	10	13	164	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17dmPHE	9	33	28	0	259	16	133	14	18	315	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1+3mFL	3	61	59	0	177	5	158	14	8	235	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RET	19	410	487	0	866	52	861	41	89	4242	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	3240	10	130
4mPYR	4	29	28	0	62	4	97	9	7	154	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1mPYR	2	23	23	0	57	5	75	8	6	135	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9FLO	30	173	162	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	220	50	120
ANQ	542	484	660	0	2689	372	318	240	474	678	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	380	100	160
2mANQ	70	106	128	0	520	152	152	139	168	299	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BAF	24	64	88	0	171	13	88	74	19	209	-	28	45	65	69	23	8	41	164	377	14	4	75	75	114	13	10	710	100	270
norHOP	36	62	36	0	359	18	249	38	48	419	31	91	173	527	460	137	21	28	175	181	9	8	25	48	65	11	460	300	1090	1140
HOP	29	53	34	0	298	10	217	30	52	377	27	232	230	533	556	124	38	30	179	150	10	12	31	51	56	12	410	260	1070	1090
	ng/m³																													
GAL	3	11	21	0	12	1	23	1	1	75	0.3	0.2	6	6	11	1	0.3	29	93	161	2	1	46	49	79	6	2	190	1	15
MANNO	2	10	18	0	10	BLD	17	1	1	68	0.2	0.4	8	8	12	1	1	29	99	343	97	7	85	98	118	18	1	252	2	13
LEV	26	150	271	0	128	2	207	12	4	535	2	6	74	92	136	17	6	401	1385	4979	97	37	829	963	1168	290	9	1600	18	156
MANNI	40	4	4	0	22	41	8	22	47	31	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	169	10	28	3
SOR	2	1	0.7	0.0	4	21	1	2	4	2	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SA	24	12	18	0	21	30	10	10	20	22	9	5	3	5	10	3	7	3	7	10	3	15	13	13	16	16	74	68	24	47
GLU	6	2	3	0	1	4	2	1	4	3	3	1	1	1	4	1	1	1	2	4	1	2	3	3	6	3	9	22	6	9
MA	43	7	10	0	2	12	4	2	11	36	8	8	1	3	2	2	39	5	7	3	1	47	3	3	2	2	99	27	20	35
PHA	2	2	2	0	1	2	3	10	2	2	1	2	1	4	9	16	3	2	11	11	1	2	4	4	8	2	20	33	22	19
AZA	6	3	5	0	BLD	14	2	7	3	3	2	6	4	14	9	3	6	5	14	15	2	7	11	12	24	6	21	77	18	19
2MGA	7	2	2	0	1	19	1	5	20	2	15	24	0.3	1	2	1	26	1	2	1	0.3	52	1	2	2	1	98	6	36	9
2MT1	3	0	0.6	0.0	1	14	1	4	16	1	16	4	0.3	1	2	0.2	3	1	2	1	0.1	20	3	2	8	1	121	2	27	2
2MT2	8	1	1	0	2	38	1	9	45	2	42	12	1	2	7	1	16	2	3	2	0.1	102	4	3	8	2	381	8	111	14
CPA	31	88	134	0	19	25	8	7	10	3	8	1	1	2	3	2	1	2	1	1	0.5	1	3	3	4	3	135	48	63	26
3HGA	17	2	3	0	1	4	2	1	5	2	4	5	1	2	0.4	1	12	1	3	2	0.3	25	1	2	1	1	48	8	6	8
MBTCA	13	2	2	0	1	2	1	BLD	3	BLD	3	5	1	0.5	0.1	1	14	1	2	1	0.1	14	0.1	0.5	0.2	0.2	45.4	7.1	7.9	3.3
AGL	44	6	6	0	25	1	18	37	29	156	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	258.5	46.4	105.6	49
BGL	56	7	6	0	23	BLD	20	40	33	193	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	296.2	58.9	106.3	57.8