OC and EC in PM_1 and $PM_{2.5}$ at two EMEP background reference monitoring stations, Diabla Góra and Zielonka, in northern Poland

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Contents

1. Mean OC and EC in Marker campaigns

Figures S1 and S2 show the day and night variation of OC (a) and EC (b) in PM_1 and $PM_{2.5}$ during the Marker campaigns at Diabla Góra nad Zielonka, respectively.

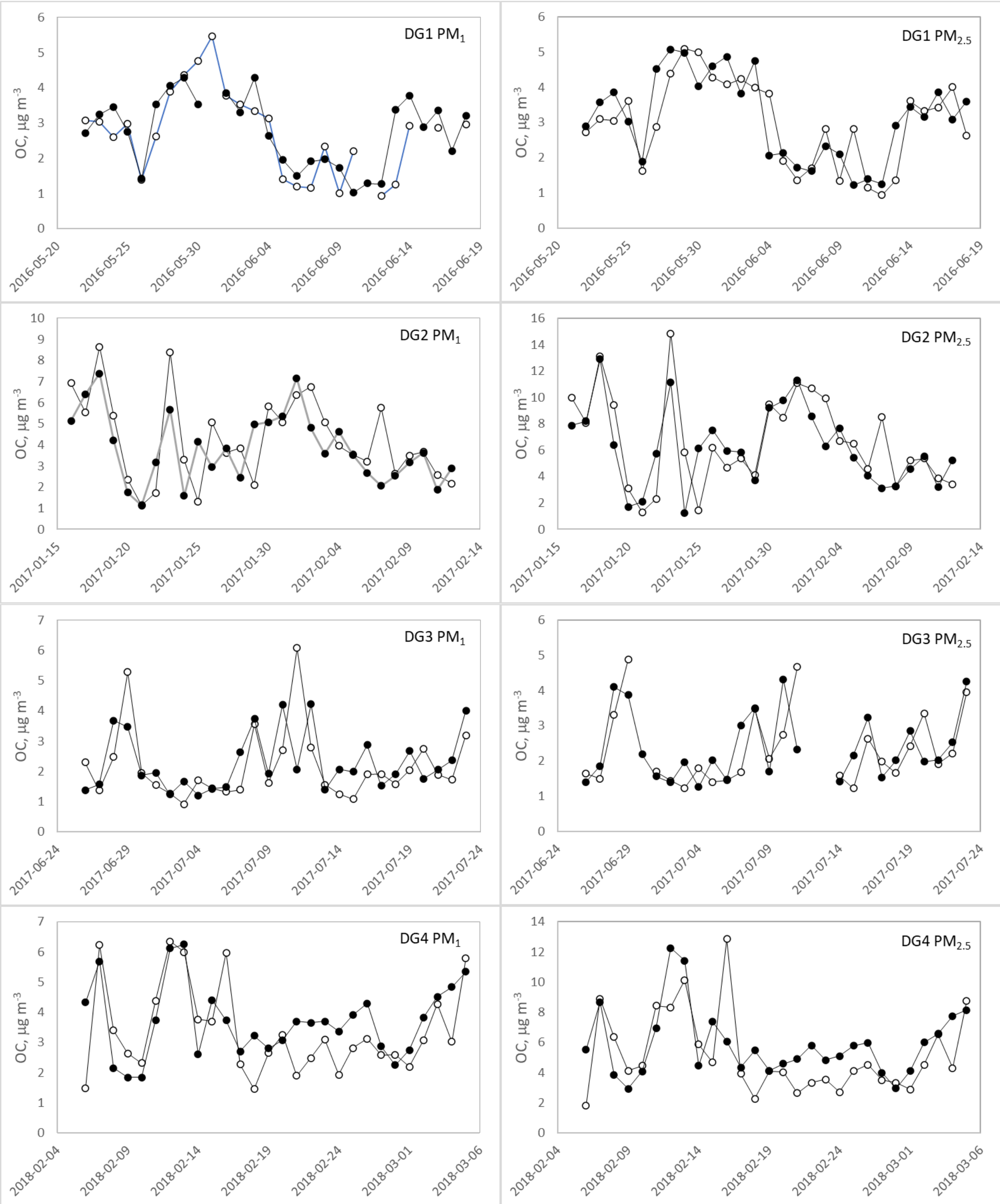

Fig. S1a PM_1 and $PM_{2.5}$ OC in Diabla Góra campaigns, for the days (white points) and nights (black points)

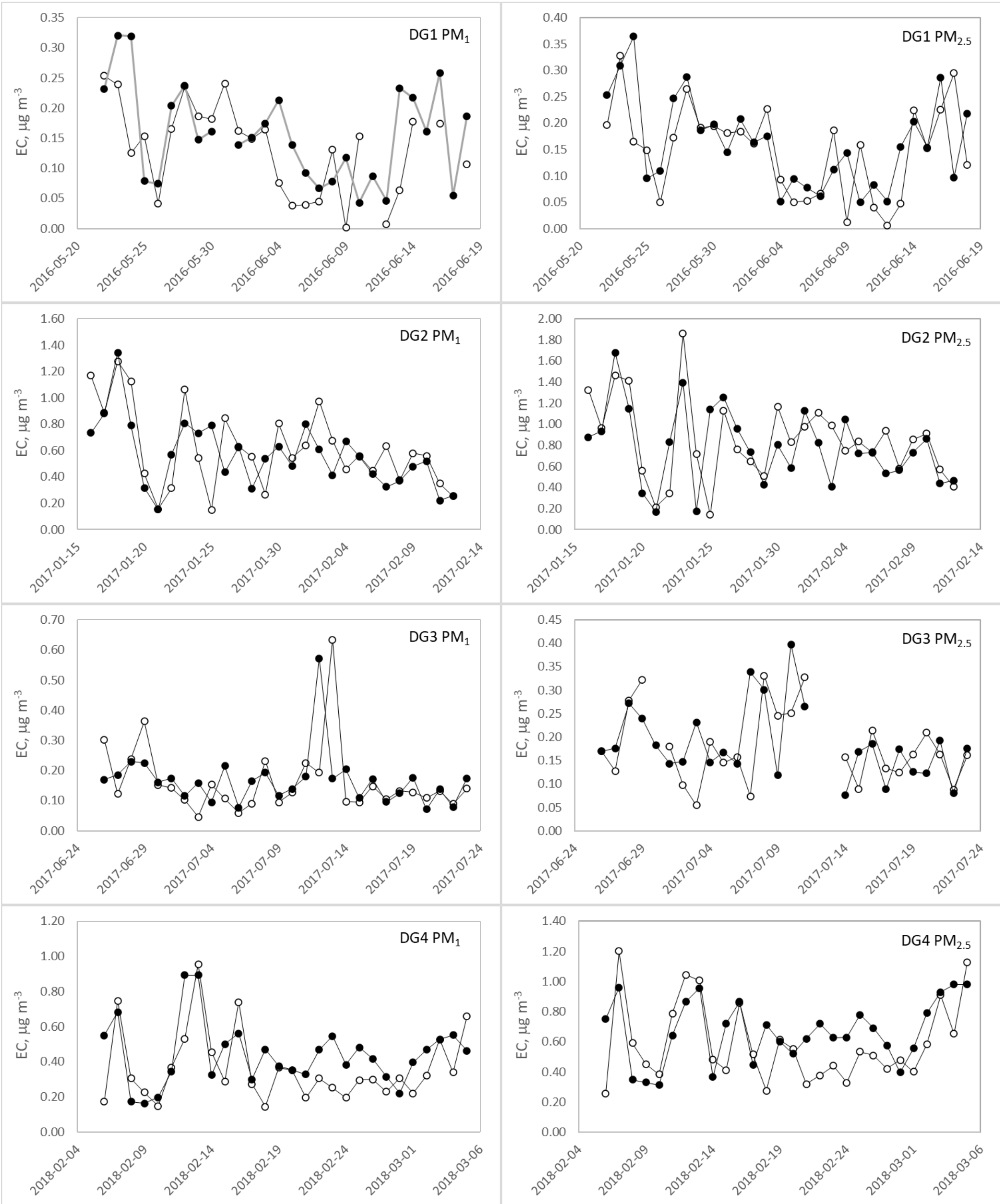

Fig. S1b PM$_1$ and PM$_{2.5}$ EC in Diabla Góra campaigns, for the days (white points) and nights (black points)

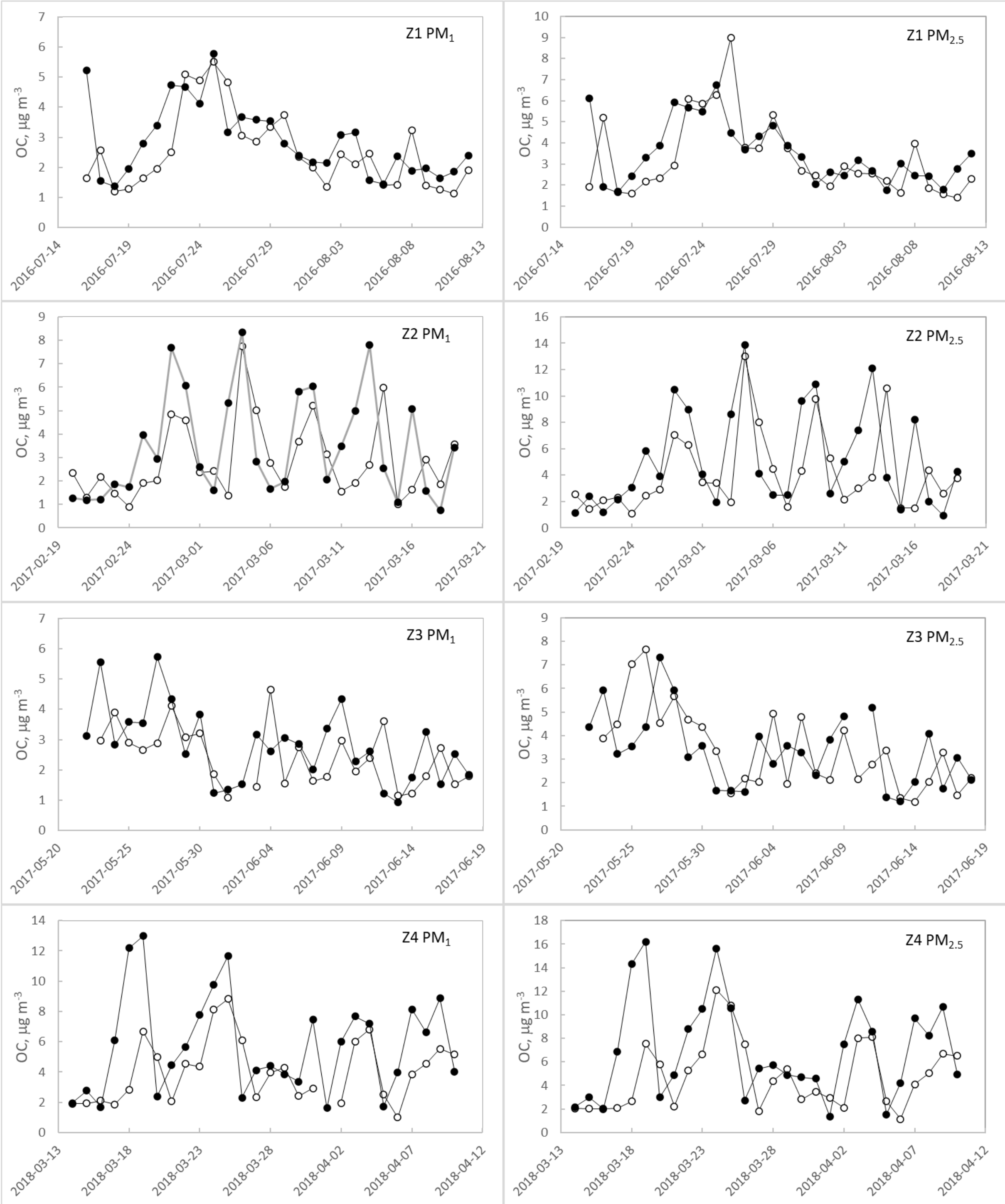

Fig. S2a PM_1 and $PM_{2.5}$ OC in Zielonka campaigns, for the days (white points) and nights (black points)

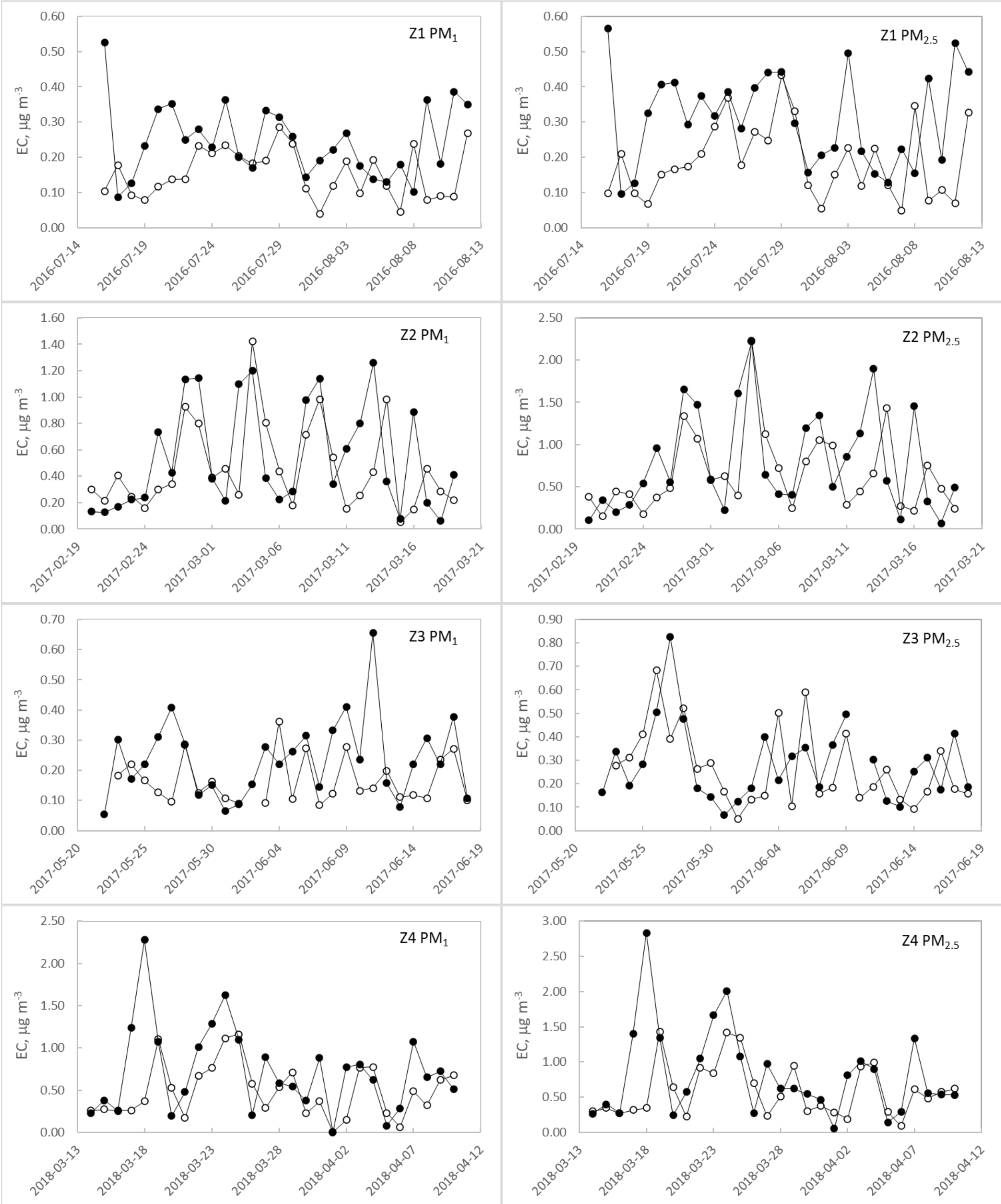

Fig. S2b PM_1 and $PM_{2.5}$ EC in Zielonka campaigns, for the days (white points) and nights (black points)

2. Details of statistical analyses presented in Tables 2, 3, and 4 in the main text

Table S1 Results of Kruskal-Wallis ANOVA on ranks analysis of differences reported in Tables 2 and 3

Table in the main text	Compared values	H statistics	Degrees of freedom	P
Table 2	OC in PM_1 on days	37.969	7	≤ 0.001
	OC in PM_1 on nights	42.453	7	≤ 0.001
	OC in $PM_{2.5}$ on days	52.557	7	≤ 0.001
	OC in $PM_{2.5}$ on nights	67.846	7	≤ 0.001
Table 3	EC in PM_1 on days	113.604	7	≤ 0.001
	EC in PM_1 on nights	104.311	7	≤ 0.001
	EC in $PM_{2.5}$ on days	129.600	7	≤ 0.001
	EC in $PM_{2.5}$ on nights	118.830	7	≤ 0.001

Table S2 Results of Mann-Whitney rank sum tests of differences reported in Tables 4 – 6

Table in the main text	superscript	Compared medians	statistics		n		P
			U	T	small	big	
Table 4	a	$PM_{2.5}$ OC winters, DG vs. Z	5204	14691	115	115	0.005
	b	$PM_{2.5}$ OC summers, DG vs. Z	4705	10700	109	112	0.003
	d	EC summers, DG vs. Z	5614	12169	114	116	0.048
	e	$PM_{2.5}$ EC summers	3815	9810	109	112	≤ 0.001
	h	PM_1 EC summers, DG vs. Z	4565	10893	112	112	≤ 0.001
	c	$PM_{2.5}$ OC (DG + Z), summers vs. winters	12497	37028	221	230	≤ 0.001
	f	$PM_{2.5}$ EC (DG + Z), summers vs. winters	4670	29201	221	230	≤ 0.001
	g	PM_1 OC (DG + Z), summers vs. winters	15556	40756	224	229	≤ 0.001
	i	PM_1 EC (DG + Z), summers vs. winters	6258	31458	224	230	≤ 0.001
	j	$PM_{2.5}$ OC in DG winters vs. summers	1639	7634	109	115	≤ 0.001
	k	$PM_{2.5}$ OC in Z winters vs. summers	4669	10997	112	115	≤ 0.001
	l	$PM_{2.5}$ EC in DG winters vs. summers	232	6257	109	116	≤ 0.001
	m	$PM_{2.5}$ EC in Z winters vs. summers	2353	8681	112	114	≤ 0.001
	n	PM_1 OC in DG winters vs. summers	3263	9561	112	116	≤ 0.001
	o	PM_1 OC in Z winters vs. summers	4534	10862	112	113	≤ 0.001
	p	PM_1 EC in DG winters vs. summers	777	7105	112	116	≤ 0.001
	q	PM_1 EC in Z winters vs. summers	2630	8958	112	114	≤ 0.001
Table 5	a	OC_f all summers vs. all winters	14214.5	61598.5	222	230	≤ 0.001
	b	EC_f all summers vs. all winters	18035	56875	220	230	≤ 0.001

Table 6	a	OC_f winters, all DG vs. all Z	3068	16711	114	116	≤ 0.001
	b	EC_f winters, all DG vs. all Z	4023	15756	114	116	≤ 0.001
	c	OC_f summers, all DG vs. all Z	3642	14670	109	113	≤ 0.001
	d	EC_f summers, all DG vs. all Z	4978	10756	107	110	0.050

3. Consistency of PMF modeling

The 3-factor PMF modeling of PM_1 and $PM_{2.5}$ yielded results assigned to SOA, biomass burning (BB), and vehicle (veh) emissions. In the 6-factor modeling, each of those sources was split into the remote and local components. Figures S3 and S4 compare the 3-f factor results with the sums of local and remote components from the 6-f factor modeling, e.g., $(SOA\ OC)_{3f}$ vs. $(SOA\ OC)_{6f,\ remote}$ + $(SOA\ OC)_{6f\ local}$. The results are well consistent for OC and barely consistent for EC. Poor EC consistency occurred probably because the EC values were much smaller than the OC values, so the model performed better on the OC than on the EC.

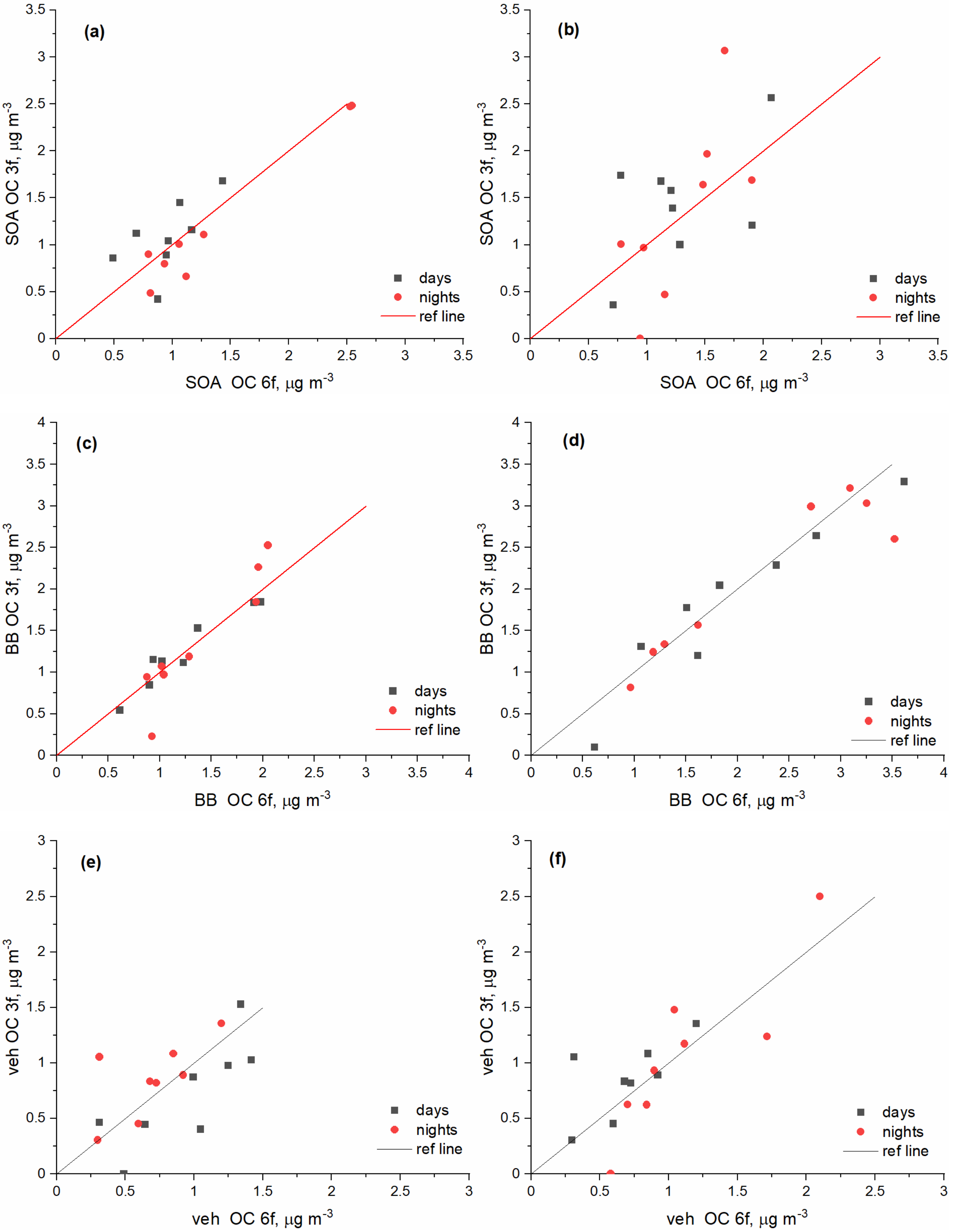

Fig. S3 Consistency of 3-factor and 6-factor PMF modeling of OC source apportionment for the Marker campaigns: SOA in PM_1 (a) and $PM_{2.5}$ (b); biomass burning in PM_1 (c) and $PM_{2.5}$ (d); and vehicle exhausts in PM_1 (e) and $PM_{2.5}$ (f). The plots show the mean values for each campaign; the reference lines are y = x. All 6-factor values are the sums of the local and remote components

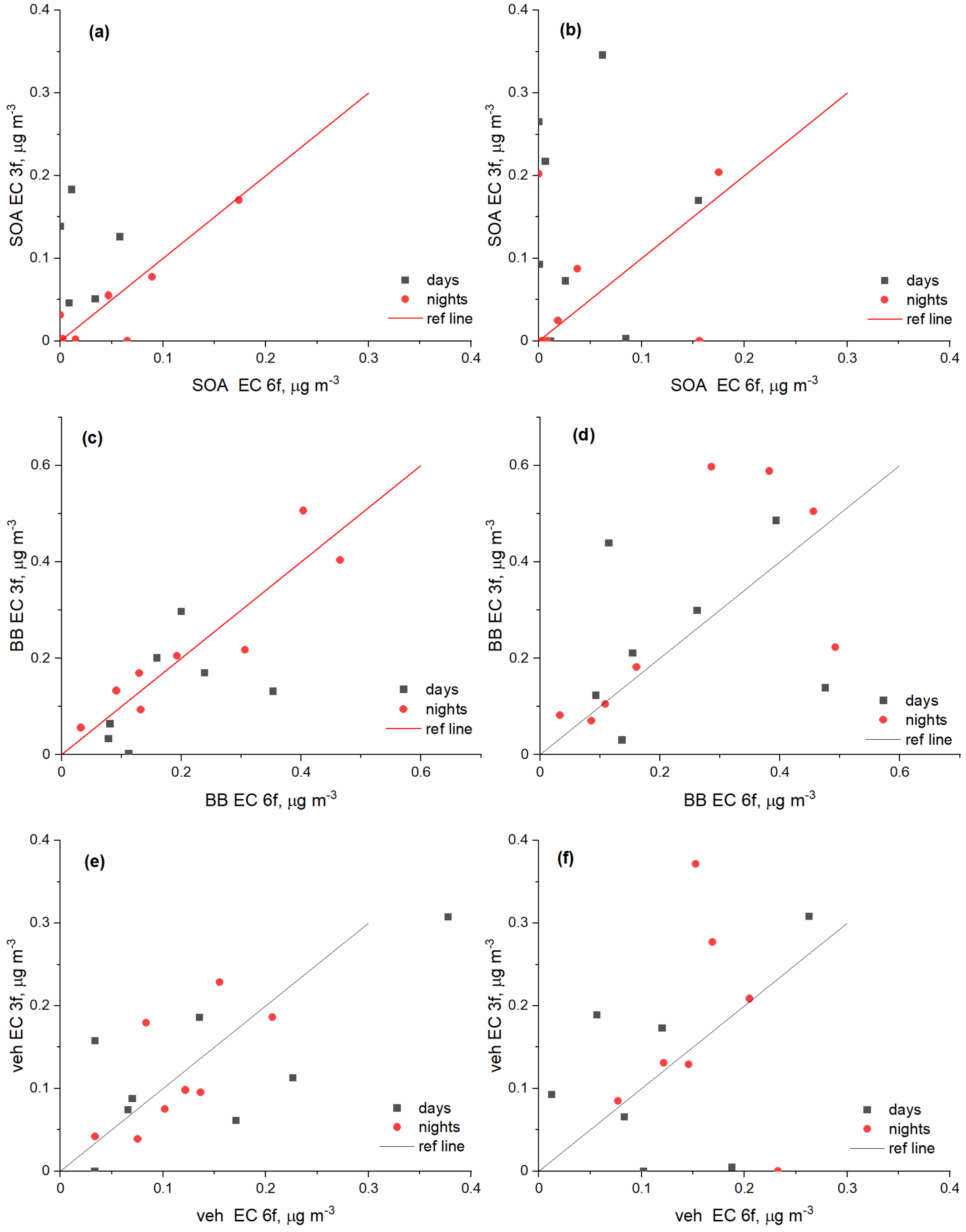

Fig. S4 Consistency of 3-factor and 6-factor PMF modeling of EC source apportionment for the Marker campaigns: SOA in PM_1 (a) and $PM_{2.5}$ (b); biomass burning in PM_1 (c) and $PM_{2.5}$ (d); and vehicle exhausts in PM_1 (e) and $PM_{2.5}$ (f). The plots show the mean values for each campaign; the reference lines are y = x. All 6-factor values are the sums of the local and remote components

4. Contributions of PM sources to OC and EC (6-factor PMF modeling)

Figures S5–S6 show the mass contributions of remote and local sources to OC and EC from the Marker campaigns, obtained using 6-factor PMF modeling. Figures S7–S10 compare winter and summer OC and EC in the campaign samples. Figures S11–S14 compare OC and EC in Diabla Góra nad Zielonka samples.

The dotted lines and numbers in the plots are the mean values from all campaigns for each category presented. For each plot panel, we evaluated the statistical significance of differences between the complete datasets from the campaign periods and locations presented, using the Mann-Whitney rank sum test ($P \leq 0.05$). Table S3 presents the test results, and asterisks in the plots indicate statistically significant differences between datasets.

The main-text section, *Analysis of source contributions/Detailed differences between campaigns*, discusses the results obtained.

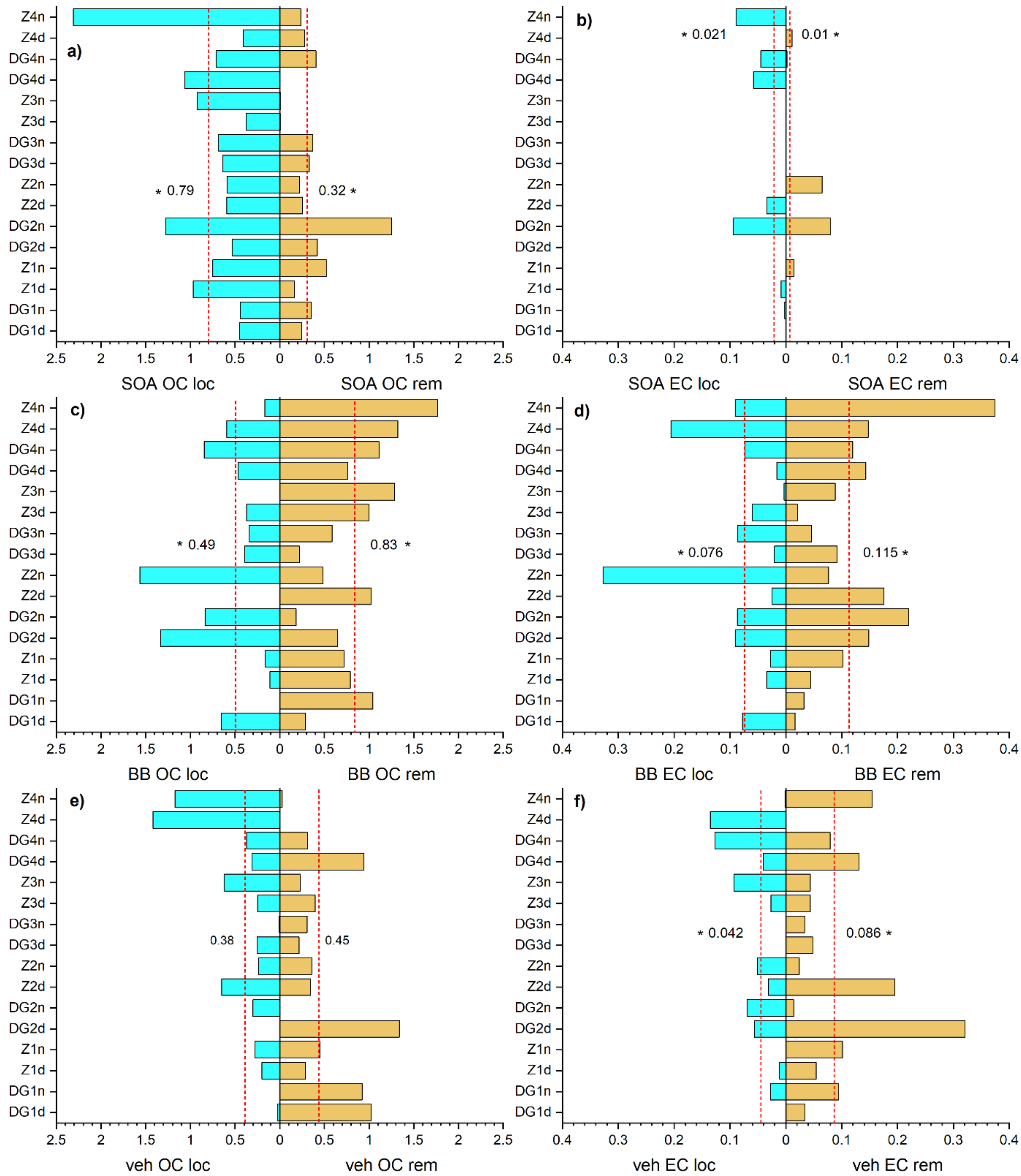

Fig. S5 PM_1 OC and EC source-apportionment for Marker campaigns obtained by 6-factor PMF modeling (µg m^{-3}): a) local and remote SOA OC, b) local and remote SOA EC, c) local and remote BB OC, d) local and remote BB EC, e) local and remote veh OC, and f) local and remote veh EC. The plots show the mean day and night values from each campaign. Annotated dashed red lines show the overall mean concentrations

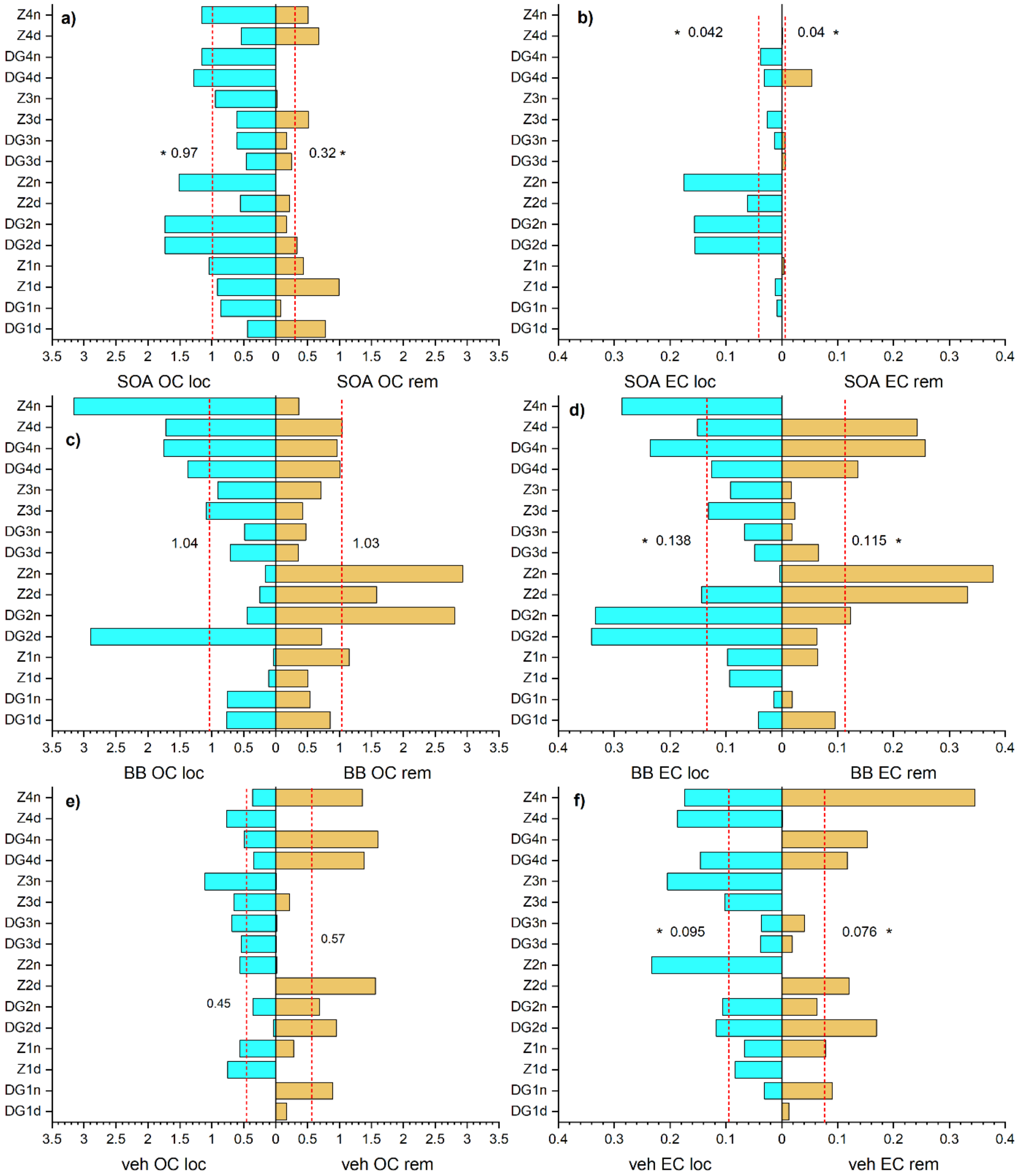

Fig. S6 $PM_{2.5}$ OC and EC source-apportionment for Marker campaigns obtained by 6-factor PMF modeling (µg m^{-3}): a) local and remote SOA OC, b) local and remote SOA EC, c) local and remote BB OC, d) local and remote BB EC, e) local and remote veh OC, and f) local and remote veh EC. The plots show the mean day and night values from each campaign. Annotated dash red lines show the overall mean concentrations

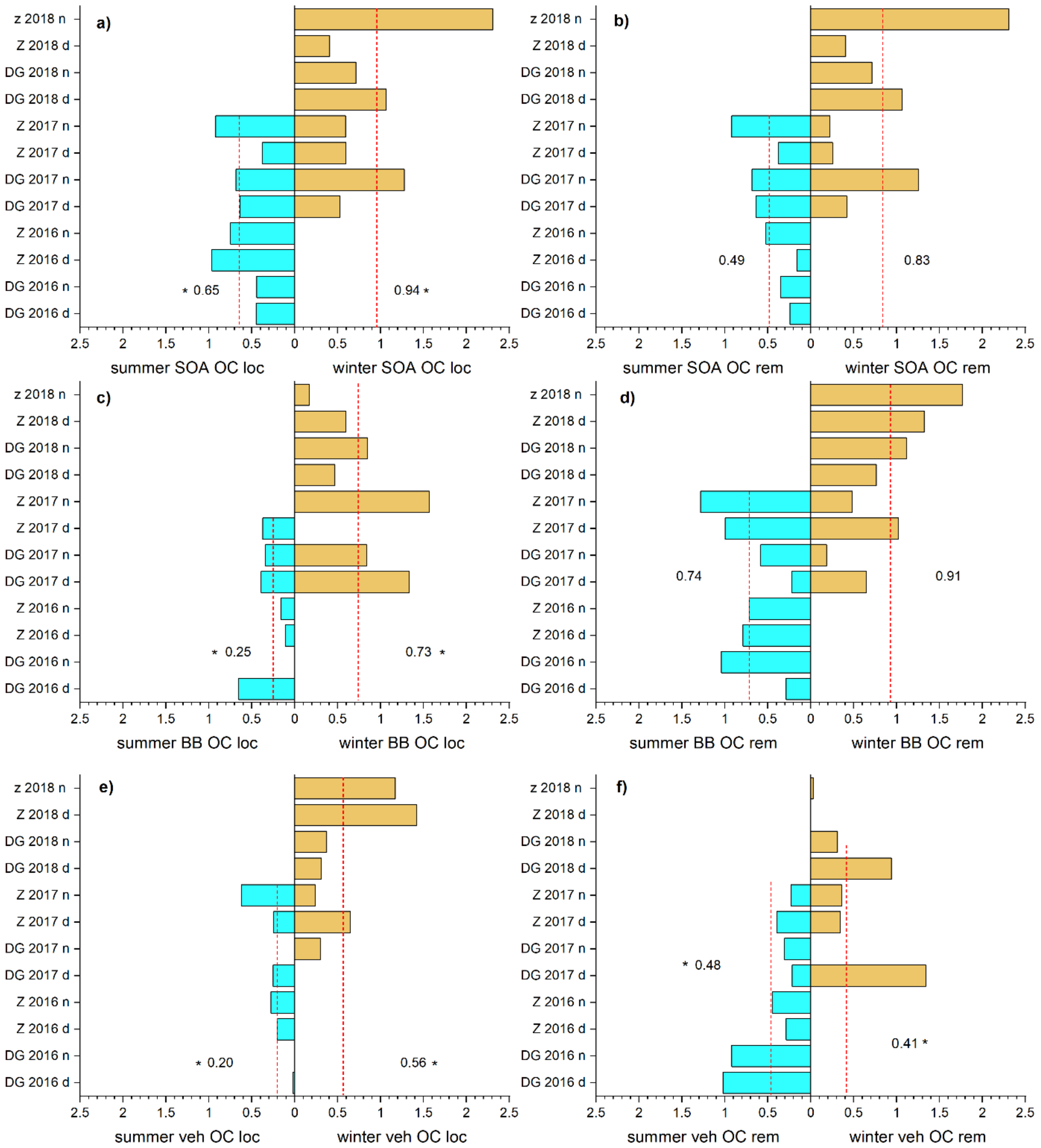

Fig. S7 Mean summer and winter PM_1 OC estimated by 6-factor PMF modeling for Marker campaigns ($\mu g\ m^{-3}$): a) SOA local, b) SOA remote, c) BB local, d) BB remote, e) veh local, and f) veh remote. Red dashed lines are the overall mean concentrations

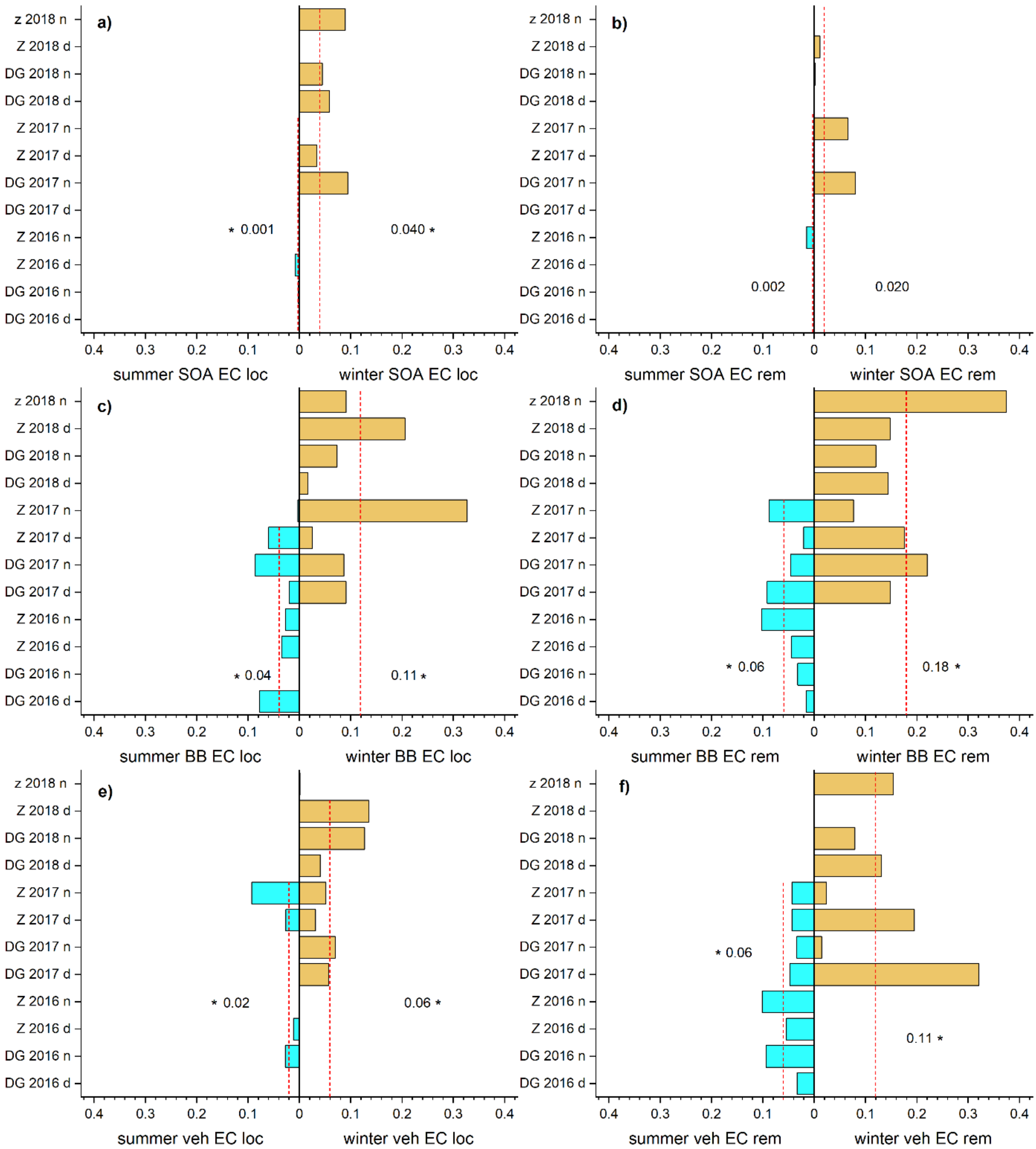

Fig S8 Mean summer and winter PM_1 EC estimated by 6-factor PMF modeling for Marker campaigns (µg m^{-3}): a) SOA local, b) SOA remote, c) BB local, d) BB remote, e) veh local, and f) veh remote. Red dashed lines are the overall mean concentrations

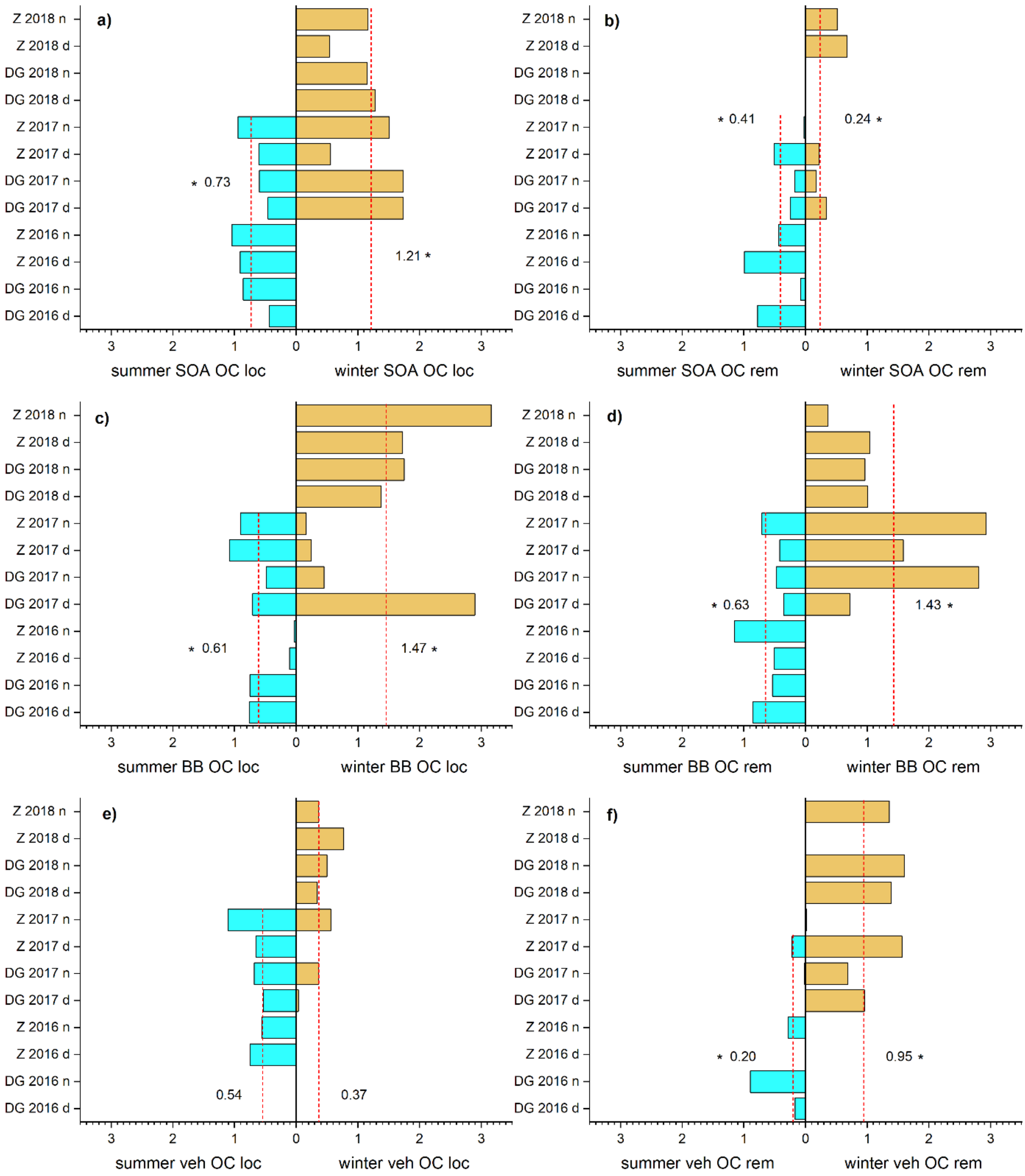

Fig. S9 Mean summer and winter $PM_{2.5}$ OC estimated by 6-factor PMF modeling for Marker campaigns ($\mu g\ m^{-3}$): a) SOA local, b) SOA remote, c) BB local, d) BB remote, e) veh local, and f) veh remote. Red dashed lines are the overall mean concentrations

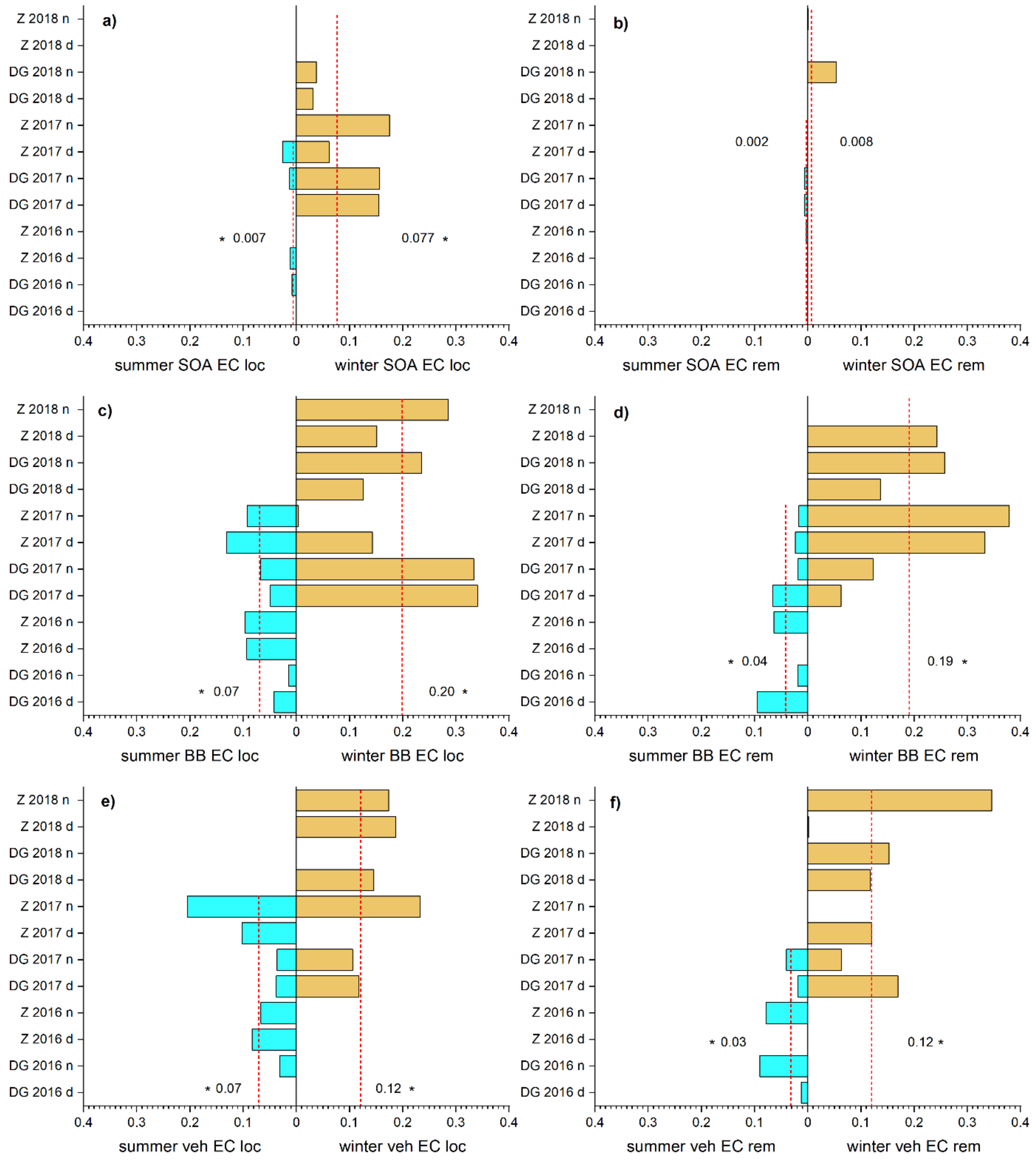

Fig S10 Mean summer and winter $PM_{2.5}$ EC estimated by 6-factor PMF modeling for Marker campaigns ($\mu g\ m^{-3}$): a) SOA local, b) SOA remote, c) BB local, d) BB remote, e) veh local, and f) veh remote. Red dashed lines are the overall mean concentrations

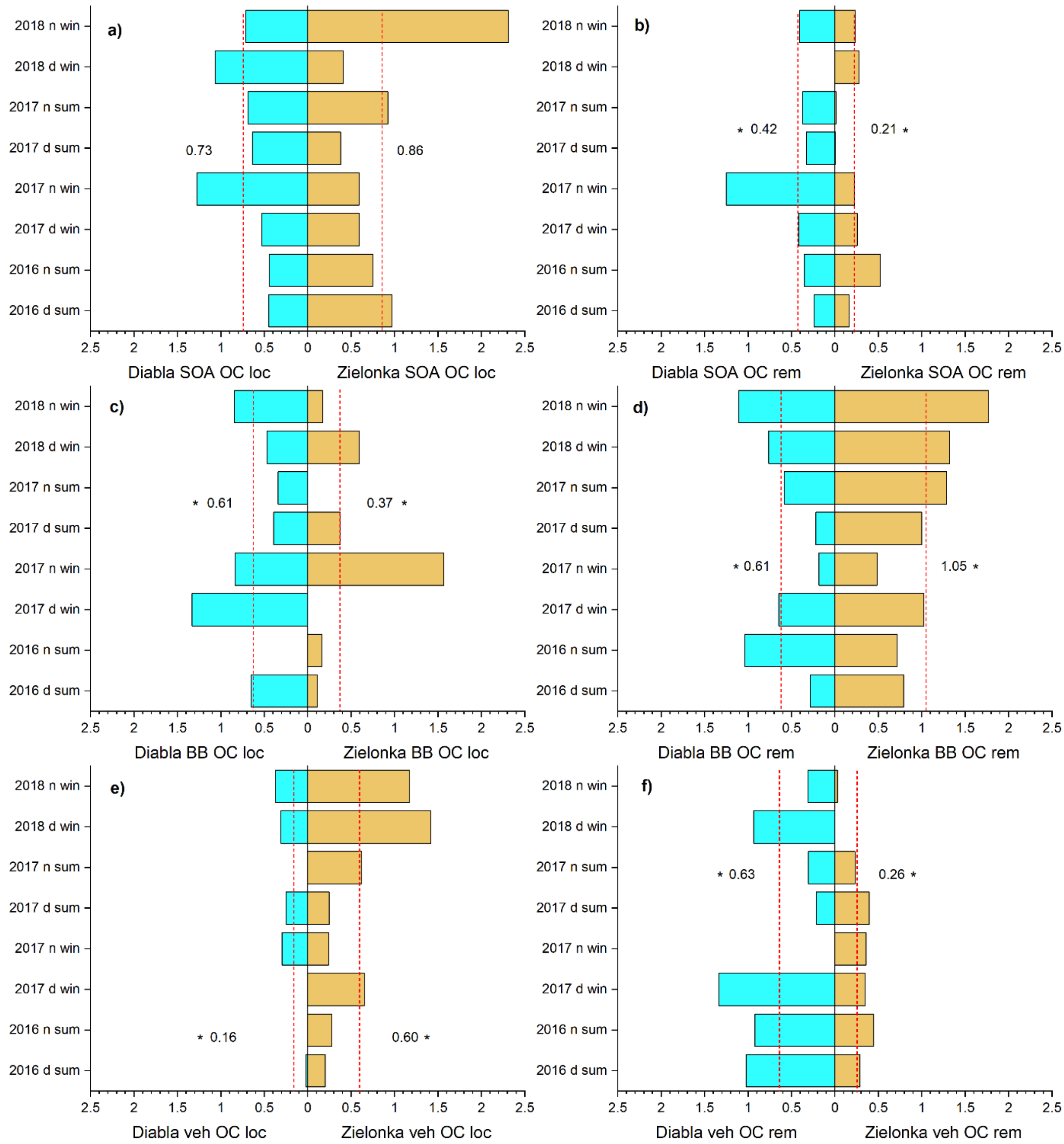

Fig. S11 Mean PM_1 OC at Diabla Góra and Zielonka estimated by 6-factor PMF modeling for Marker campaigns ($\mu g\ m^{-3}$): a) SOA local, b) SOA remote, c) BB local, d) BB remote, e) veh local, and f) veh remote. Red dashed lines are the overall mean concentrations

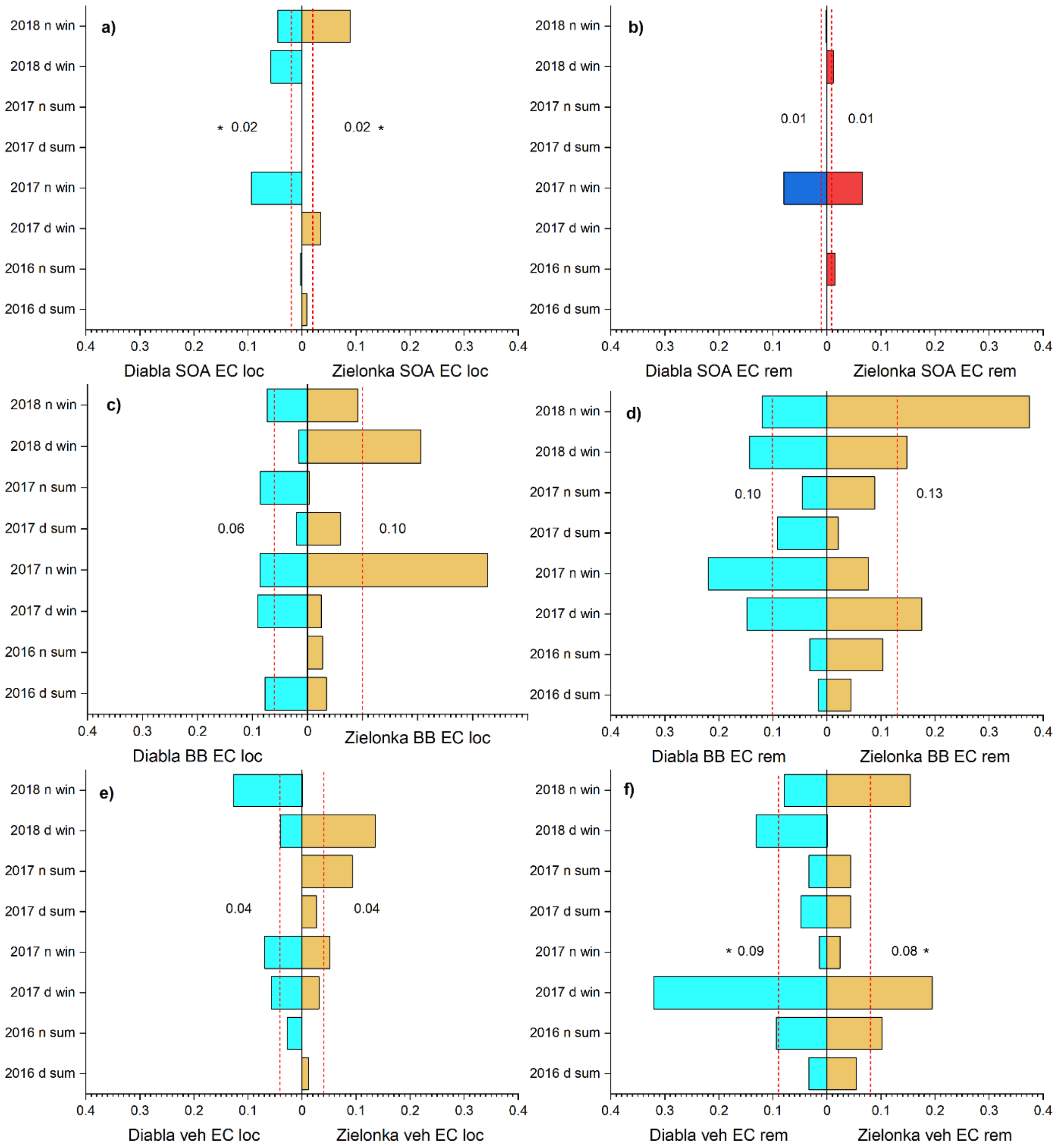

Fig. S12 Mean PM_1 EC at Diabla Góra and Zielonka estimated by 6-factor PMF modeling for Marker campaigns ($\mu g\ m^{-3}$): a) SOA local, b) SOA remote, c) BB local, d) BB remote, e) veh local, and f) veh remote. Red dashed lines are the overall mean concentrations

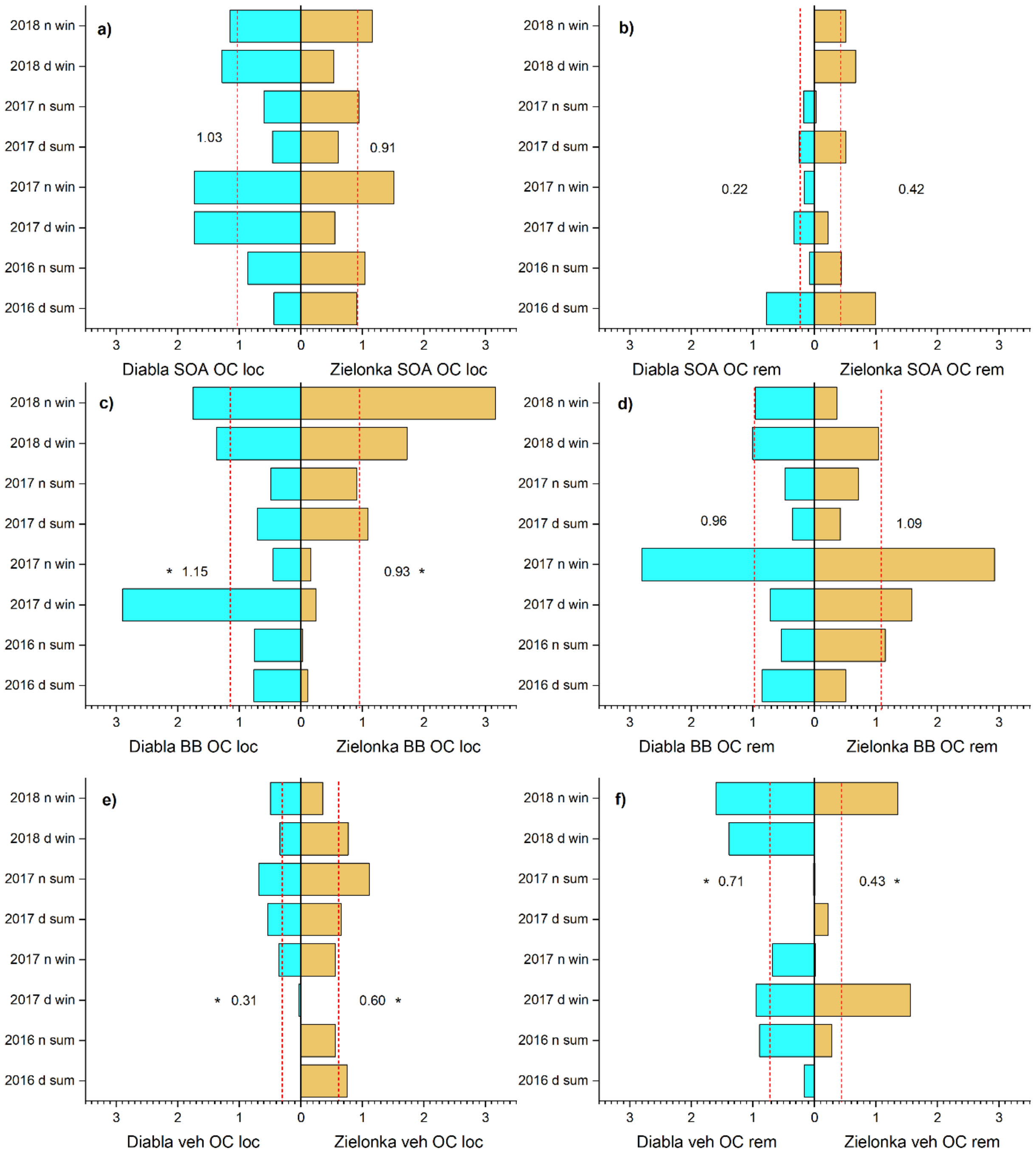

Fig. S13 Mean $PM_{2.5}$ OC at Diabla Góra and Zielonka estimated by 6-factor PMF modeling for Marker campaigns ($\mu g\ m^{-3}$): a) SOA local, b) SOA remote, c) BB local, d) BB remote, e) veh local, and f) veh remote. Red dashed lines are the overall mean concentrations

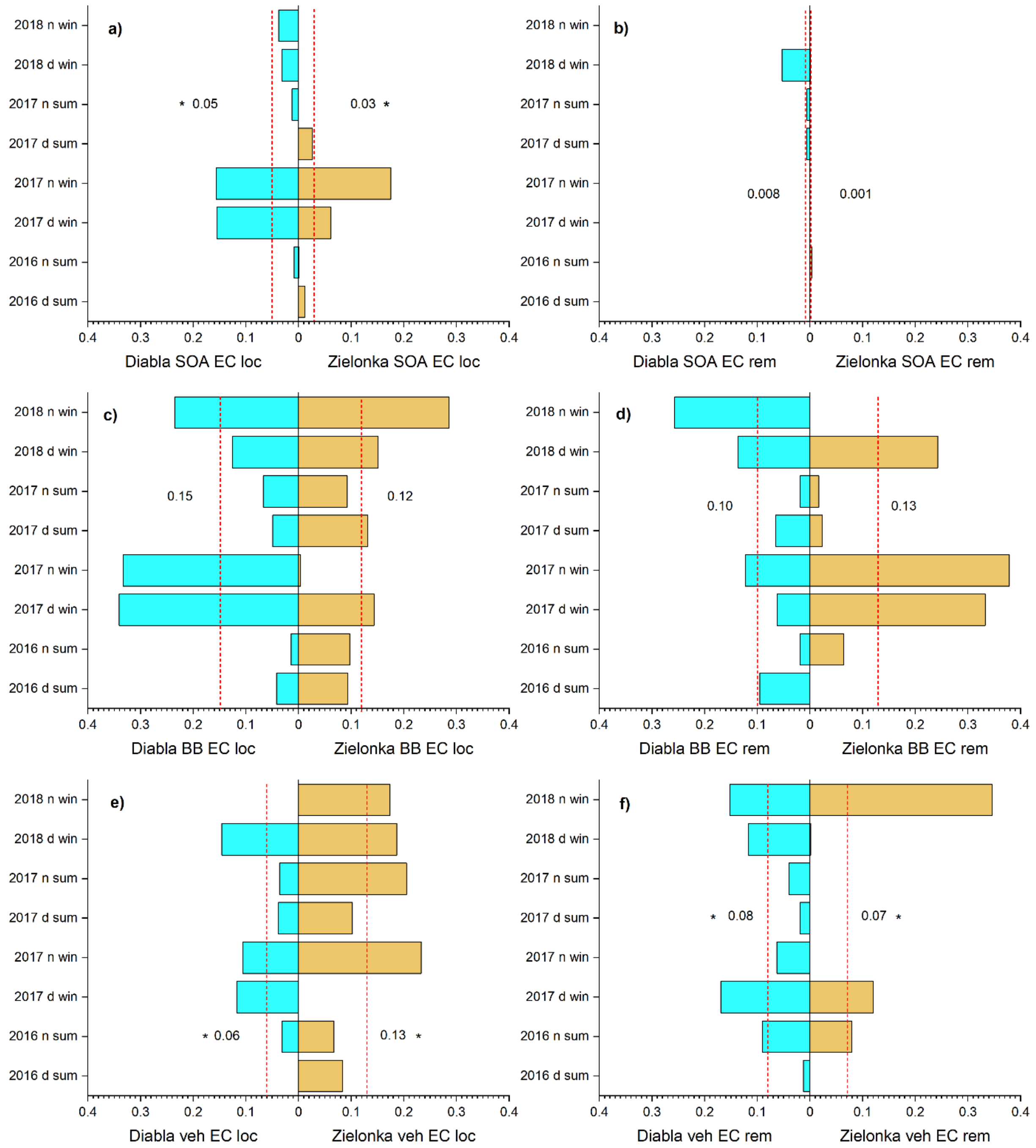

Fig. S14 Mean $PM_{2.5}$ EC at Diabla Góra and Zielonka estimated by 6-factor PMF modeling for Marker campaigns ($\mu g\ m^{-3}$): a) SOA local, b) SOA remote, c) BB local, d) BB remote, e) veh local, and f) veh remote. Red dashed lines are the overall mean concentrations

Table S3 Mann-Whitney rank sum test for the results presented in Figures S5 – S14 (P ≤ 0.05); each test evaluated a complete dataset from the corresponding sampling episodes (DG1d – Z4n).

Figure		Variable		Comparison	Means µg m^{-3}	Medians µg m^{-3}	Statistical significance	Mann-Whitney statistics U	T	n (small)	n (big)	P
S5	a	PM_1	SOA OC	Local > Remote	0.79 > 0.32	0.581 > 0.254	+	54296	220694	428	428	0.001
	b		SOA EC	Local > Remote	0.021 > 0.01	0.000049 > 0	+	62697	217001	428	439	0.001
	c		BB OC	Local < Remote	0.49 < 0.83	0.261 < 0.612	+	62745	153696	426	426	0.001
	d		BB EC	Local < Remote	0.076 < 0.115	0.0376 < 0.0766	+	67742	206391	427	428	0.001
	e		PM_1 veh OC	Local < Remote	0.38 < 0.45	0.218 < 0.278	–	83499	172330	421	427	0.073
	f		PM_1 veh EC	Local < Remote	0.042 < 0.086	0.0179 < 0.0512	+	58175	149126	426	427	0.001
S6	a	$PM_{2.5}$	SOA OC	Local > Remote	0.97 > 0.32	0.706 > 0.139	+	48334	228800	429	431	0.001
	b		SOA EC	Local > Remote	0.042 > 0.04	0.00597 > 0	+	58739	218825	430	430	0.001
	c		BB OC	Local < Remote	1.04 > 1.03	0.547 < 0.593	–	87459	179265	428	428	0.253
	d		BB EC	Local > Remote	0.138 > 0.115	0.0753 > 0.0523	+	83000	192418	428	429	0.015
	e		veh OC	Local > Remote	0.45 < 0.57	0.256 > 0.112	–	89958	185460	428	429	0.610
	f		veh EC	Local > Remote	0.095 > 0.076	0.0554 > 0.0267	+	82407	174213	428	429	0.009
S7	a	PM_1	SOA OC, local	Summer < Winter	0.65 < 0.94	0.478 < 0.677	+	17870	37571	198	230	0.001
	b		SOA OC, remote	Summer > Winter	0.49 < 0.83	0.267 > 0.251	–	22322	42023	198	230	0.726
	c		BB OC, local	Summer < Winter	0.25 < 0.73	0.143 < 0.452	+	14445	33751	196	230	0.001
	d		BB OC, remote	Summer < Winter	0.74 < 0.91	0.536 < 0.659	–	20246	39552	196	230	0.070
	e		veh OC, local	Summer < Winter	0.20 < 0.56	0.0694 < 0.303	+	13859	32387	192	229	0.001
	f		veh OC, remote	Summer > Winter	0.48 > 0.41	0.336 > 0.159	+	17851	46962	197	230	0.001
S8	a	PM_1	SOA EC, local	Summer < Winter	0.001 < 0.040	0.000119 < 0.0217	+	20667.5	44877.5	220	231	0.001
	b		SOA EC, remote	Summer - Winter	0.002 < 0.020	0 - 0	–					
	c		BB EC, local	Summer < Winter	0.04 < 0.11	0.0248 < 0.0599	+	14310	34011	198	230	0.001
	d		BB EC, remote	Summer < Winter	0.06 < 0.18	0.0404 < 0.127	+	10673	30176	197	230	0.001
	e		veh EC, local	Summer < Winter	0.02 < 0.08	0.000121 < 0.042	+	8513	22709	168	229	0.001
	f		veh EC, remote	Summer < Winter	0.06 < 0.11	0.0488 < 0.0718	+	19453.5	39154.5	198	229	0.001
S9	a	$PM_{2.5}$	SOA OC, local	Summer < Winter	0.73 < 1.21	0.617 < 0869	+	20025	40125	200	229	0.025
	b		SOA OC, remote	Summer > Winter	0.41 > 0.24	0.254 > 0.0604	+	13461	46639	200	200	0.001
	c		BB OC, local	Summer < Winter	0.61 < 1.47	0.438 < 0.805	+	16942	36643	198	230	0.001
	d		BB OC, remote	Summer < Winter	0.63 < 1.43	0.529 < 0.745	+	18327	38028	198	230	0.001
	e		veh OC, local	Summer > Winter	0.54 > 0.37	0.306 > 0.253	–	22240	43460	200	228	0.661

	f		veh OC, remote	Summer < Winter	0.20 < 0.95	0.0262 < 0.447	+	15302	35402	200	229	0.001
S10	a	$PM_{2.5}$	SOA EC, local	Summer < Winter	0.007 < 0.077	0.000409 < 0.0283	+	15494	35594	200	230	0.001
	b		SOA EC, remote	Summer = Winter	0.002 < 0.008	0 = 0						
	c		BB EC, local	Summer < Winter	0.07 < 0.20	0.0445 < 0.168	+	13962	33663	198	230	0.001
	d		BB EC, remote	Summer < Winter	0.04 < 0.19	0.0276 < 0.117	+	14793	34693	199	230	0.001
	e		veh EC, local	Summer < Winter	0.07 < 0.12	0.0421 < 0.0843	+	17948	38048	200	229	0.001
	f		veh EC, remote	Summer < Winter	0.03 < 0.12	0.0129 < 0.0705	+	14800	34700	199	229	0.001
S11	a	PM_1	SOA OC, local	Diabla < Zielonka	0.73 < 0.86	0.545 < 0.616	–	20877	45494	203	225	0.127
	b		SOA OC, remote	Diabla > Zielonka	0.42 > 0.21	0.320 > 0.168	+	17749,5	38455,5	203	225	0.001
	c		BB OC, local	Diabla > Zielonka	0.61 > 0.37	0.446 > 0.125	+	14558	35264	203	223	0.001
	d		BB OC, remote	Diabla < Zielonka	0.61 < 1.05	0.405 < 0.839	+	15647	50328	203	223	0.001
	e		veh OC, local	Diabla < Zielonka	0.16 < 0.60	0.0336 < 0.331	+	10815	54154	203	218	0.001
	f		veh OC, remote	Diabla > Zielonka	0.63 > 0.26	0.411 > 0.162	+	15689	36599	204	223	0.001
S12	a	PM_1	SOA EC, local	Diabla < Zielonka	0.02 = 0.02	0.000011 < 0.00375	+	19289	47063	203	225	0.005
	b		SOA EC, remote	Diabla = Zielonka	0.01 = 0.01	0 = 0	–	22826	43532	203	308	0.308
	c		BB EC, local	Diabla < Zielonka	0.06 < 0.10	0.0371 < 0.0380	–	21104	45277	203	225	0.175
	d		BB EC, remote	Diabla < Zielonka	0.10 < 0.13	0.0652 < 0.0937	–	20446	45732	203	224	0.072
	e		veh EC, local	Diabla > Zielonka	0.04 = 0.04	0.0206 > 0.0167	–	21169	44806	203	223	0.247
	f		veh EC, remote	Diabla > Zielonka	0.09 > 0.08	0.0551 > 0.0458	+	20019	60929	204	223	0.032
S13	a	$PM_{2.5}$	SOA OC, local	Diabla > Zielonka	1.03 > 0.91	0.756 > 0.665	–	21543	42453	204	225	0.273
	b		SOA OC, remote	Diabla < Zielonka	0.22 < 0.42	0.161 < 0.189	–	18750	37860	195	205	0.284
	c		BB OC, local	Diabla > Zielonka	1.15 > 0.93	0.810 > 0.193	+	15383	36293	204	224	0.001
	d		BB OC, remote	Diabla > Zielonka	0.96 < 1.09	0.732 > 0.528	–	20555	41465	204	224	0.073
	e		veh OC, local	Diabla < Zielonka	0.31 < 0.60	0.179 < 0.417	+	16029	50577	204	224	0.001
	f		veh OC, remote	Diabla > Zielonka	0.71 > 0.43	0.479 > 0.0249	+	12622	33737	205	224	0.001
S14	a	$PM_{2.5}$	SOA EC, local	Diabla > Zielonka	0.05 > 0.03	0.0112 > 0.000259	+	19422	40537	205	225	0.004
	b		SOA EC, remote	Diabla = Zielonka	0.22 < 0.42	0 = 0	–					
	c		BB EC, local	Diabla < Zielonka	0.15 > 0.12	0.0745 < 0.767	–	60639	4149	204	224	0.084
	d		BB EC, remote	Diabla > Zielonka	0.10 < 0.13	0.0580 > 0.0329	–	21093	42208	205	224	0.145
	e		veh EC, local	Diabla < Zielonka	0.06 < 0.13	0.0324 < 0.0901	+	15670	51364	205	224	0.001
	f		veh EC, remote	Diabla > Zielonka	0.06 < 0.07	0.0556 > 0.000645	+	13674	34789	205	223	0.001

5. Remote BB components in selected episodes

Figures 14 and 15 in the main text show the trajectories of air masses that brought high BB components in PM_1 and $PM_{2.5}$ samples collected in selected Diabla Góra and Zielonka episodes, respectively. Figures S16 and S17 below show the trajectories with low BB components. Tables S4 – S8 list the locations of remote sources of high and low BB components in those samples.

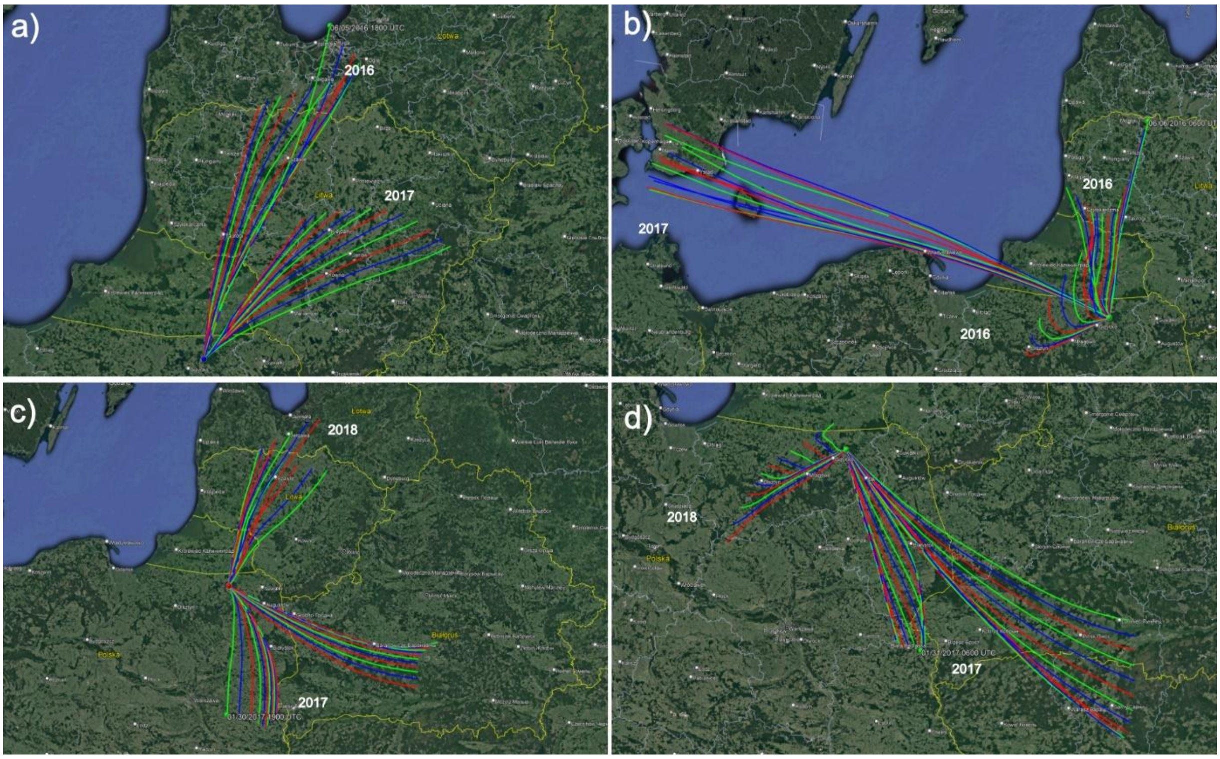

Fig. S16 Trajectories of air masses that brought low remote BB OC and EC in PM collected at selected episodes at Diabla Góra: a) summer days 6.06.2016, 22.07.2017 (PM_1, $PM_{2.5}$); b) summer nights 6.06.2016 (PM_1), 7.06.2016 ($PM_{2.5}$), 2.07.2017 (PM_1, $PM_{2.5}$); c) winter days 31.01.2017 (PM_1), 11.02.2017 ($PM_{2.5}$), 26.02.2018 (PM_1, $PM_{2.5}$); and d) winter nights 31.01.2017(PM_1), 11.02.2017, 10.02.2018 (PM_1, $PM_{2.5}$). *Created using Google Earth Pro*

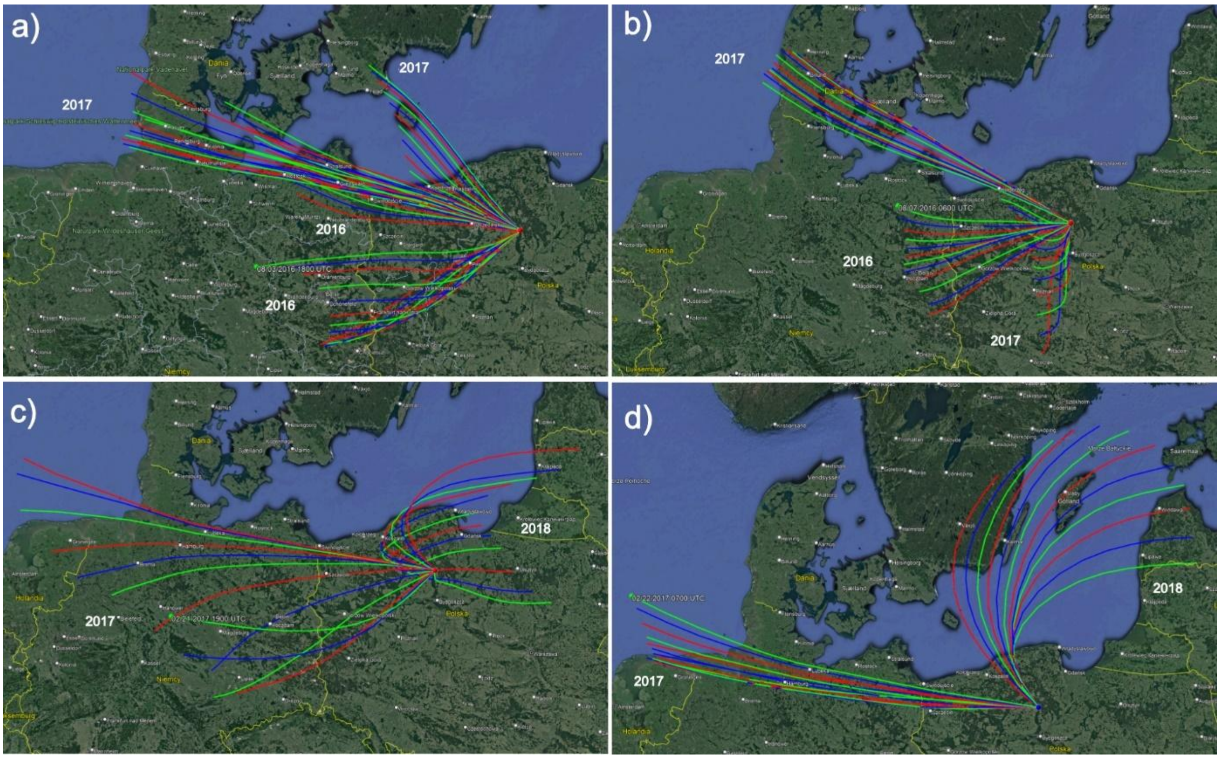

Fig. S17 Trajectories of air masses that brought low remote BB OC and EC in PM collected at selected episodes at Zielonka: a) summer days: 4.08.2016, 15.06.2017 ($PM_{2.5}$), 7.08.2016, 31.05.2017 (PM_1); b) summer nights 7.08.2016 (PM_1, $PM_{2.5}$), 31.05.2017 (PM_1), 15.06.2017 ($PM_{2.5}$); c) winter days 22.002.2017, 1.04.2018 (PM_1, $PM_{2.5}$); and d) winter nights 22.02.2017, 1.04.2018 (PM_1, $PM_{2.5}$). *Created using Google Earth Pro*

Table S4 Episode analysis of remote summer sources of BB component in PM at Diabla Góra

Summers	High BB OC and EC		Low BB OC and EC	
	inflow	**Location of sources**	**inflow**	**Location of sources**
		days		
PM_1	▪ north-northwest	▪ Kaliningrad region [7.06.2016]		
	▪ north-west	▪ Kaliningrad region , Baltic sea [2.07.2017]	▪ north-northeast	▪ Kaliningrad and Lithuania [6.06.2016]
$PM_{2.5}$	▪ south-west	▪ Poland (kujawsko-pomorskie) [16.06.2016]	▪ north-east	▪ *ibid* [22.07.2017]
	▪ west	▪ Poland (warmińsko-mazurskie and pomorskie) [27.06.2017]		
		nights		
PM_1, $PM_{2.5}$	▪ West, east (close)	▪ Kaliningrad region/Poland (warmińsko-mazurskie and podlaskie) [27.06.2017]	▪ west-northwest	▪ Kaliningrad region, Baltic sea, and Sweden (Bornholm) [2.07.2017]
PM_1	▪ south, south-west	▪ Poland (mazowieckie) [16.06.2016]	▪ north	▪ Kaliningrad region and Lithuania [6.06.2016]
$PM_{2.5}$	▪ north	▪ Kaliningrad region and Lithuania [6.06.2016]	▪ north-northwest to south-west	▪ Kaliningrad region/Poland [7.06.2016]

Table S5 Episode analysis of remote winter sources of BB component in PM at Diabla Góra

Winters	High BB OC and EC		Low BB OC and EC	
	inflow	**Location of sources**	**inflow**	**Location of sources**
		days		
PM_1, $PM_{2.5}$	▪ south-west	▪ Poland (warmińsko-mazurskie and kujawsko-pomorskie [23.01.2017]	▪ north	▪ Kaliningrad region, Lithuania [26.02.2018]
	▪ west	▪ Poland (warmińsko-mazurskie and pomorskie) [13.02.2018]		
PM_1			▪ south	▪ Poland (podlaskie, mazowieckie, lubelskie) [31.01.2017]
$PM_{2.5}$			▪ south-east	▪ Poland (podlaske), Belarus [11.02.2017]
		nights		
PM_1, $PM_{2.5}$	▪ west, north-west	▪ Kaliningrad region, Poland (warmińsko-mazurskie and pomorskie) [23.01.2017]	▪ south-east	▪ Poland (podlaskie), Belarus [11.02.2017]
	▪ east, north-east (close)	▪ Poland (warmińsko-mazurskie, podlaskie), Lithuania/ Poland (warmińsko-mazurskie) [13.02.2018]	▪ south-west	▪ Poland (warmińsko-mazurskie) [10.02.2018]
PM_1			▪ south-southeast	▪ OC: Poland (podlaskie) [31.01.2017]

Table S6 Episode analysis of remote summer sources of BB component in PM at Zielonka

Summers	High BB OC and EC		Low BB OC and EC	
	inflow	Location of sources	inflow	Location of sources
		Days		
PM_1	▪ north-west	▪ Poland (zachodniopomorskie), Baltic sea, Bornholm [15.06.2017]	▪ west, south-southwest ▪ north-westwest	▪ Poland (zachodniopomorskie), Germany (Mecklenburg), Denmark [7.08.2016] ▪ Poland (zachodniopomorskie), Germany (Mecklenburg), Denmark [31.05.2017]
$PM_{2.5}$	▪ south-east ▪ west-northwest	▪ Poland (kujawsko-pomorskie) [25.07.2016] ▪ Poland (zachodniopomorskie), Germany (Mecklenburg), Denmark [31.05.2017]	▪ south-west ▪ north-west	▪ Poland (wielkopolskie, lubuskie, zachodniopomorskie), Germany (Brandenburg) [4.08.2016] ▪ Poland (zachodniopomorskie), Baltic sea, Bornholm [15.06.2017]
		nights		
PM_1, $PM_{2.5}$	▪ west, south-east ▪ west-northwest to south-west	▪ Poland (kujawsko-pomorskie, pomorskie) [25.07.2016] ▪ Poland [kujawsko-pomorskie, pomorskie zachodniopomorskie, wielkopolskie [23.05.2017]	▪ west to south-west	▪ Poland (wielkopolskie, lubuskie, zachodniopomorskie), Germany (Brandenburg) [7.08.2016]
PM_1			▪ north-west	▪ Poland (pomorskie, zachodniopomorskie) Baltic sea, Denmark [31.05.2017]
$PM_{2.5}$			▪ north-west to south	▪ Poland (kujawsko-pomorskie, wielkopolskie, pomorskie (corner)) [15.06.2017]

Table S7. Episode analysis of remote winter sources of BB component in PM at Zielonka

Winters	High BB OC and EC		Low BB OC and EC	
	inflow	Location of sources	inflow	Location of sources
		Days		
PM_1, $PM_{2.5}$	▪ south to south-southwest ▪ south-west, south-east	▪ Poland (kujawsko-pomorskie, wielkopolskie, opolskie, lubuskie, dolnośląskie), corners of Czechia and Germany [4.03.2017] ▪ Poland (many districts), Germany (Brandenburg, Saxony-Anhalt, Lower Saxony) [29.03.2018]	▪ west, south-west ▪ east, north, north-east	▪ Poland (wielkopolskie, zachodniopomorskie, lubuskie), Germany (Brandenburg, Mesklenburg, Saxony, Saxony-Anhalt, Lower Saxony) [22.02.2017] ▪ Poland (kujawsko-pomorskie, zachodniopomorskie, warmińsko-mazurskie, mazowieckie), Baltic sea, Lithuania coast [1.04.2018]
		nights		
PM_1, $PM_{2.5}$	▪ south ▪ west-southwest	▪ Poland (kujawsko-pomorskie, wielkopolskie, opolskie, dolnośląskie), Czechia, Slovakia [4.03.2017] ▪ Poland (zachodniopomorskie), Germany (Mecklenburg, Brandenburg, Saxony-Anhalt) [29.03.2018]	▪ west ▪ north, north-northwest	▪ Poland (zachodniopomorskie), Germany (Mecklenburg, Schlezwig-Holstein), north sea [22.02.2017] ▪ Poland (pomorskie), Baltic sea, Latvia [1.04.2018]