Electronic Supplementary Material (ESI) for Environmental Science: Processes & Impacts.

Comparability of semivolatile organic compound concentrations from co-located active and passive air monitoring networks in Europe

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Electronic Supplementary Information

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Table S1 Site locations and EMEP sampling and analytical details.

Site				EMEP Sampling					EMEP Analytical	
Name	**Country**	**Lat.**	**Lon.**	**Years**	**Duration**		**Instrument**		**Method**	**Lab**
Birkenes	Norway	58.380	8.252	2003–2018	24 h	Weekly	High vol (480 m^3/d)	Glass fibre filter + 2 PUF	GC-MS	NILU (Norway)
Košetice	Czechia	49.573	15.080	1996–2018	24 h	Weekly	High vol (720 m^3/d)	Glass fibre filter + 2 PUF	GC-MS/MS	RECETOX (Czechia)
Pallas	Finland	68.000	24.246	1996–2018	7 d	Weekly	High vol (570 m3/d)	Glass fibre filter + 3 PUF	HPLC, GC-MS, GC-ECD	IVL (Sweden)
Råö	Sweden	57.394	11.914	2002–2018	7 d	Weekly	High vol (570 m^3/d)	Glass fibre filter + 3 PUF	HPLC, GC-MS, GC-ECD	IVL (Sweden)
Stórhöfði	Iceland	63.400	–20.283	1995–2018		Bi-weekly	Low vol (70 m^3/d)	PUF	GC-MS	
Zeppelin	Norway	78.880	11.883	1993–2018	48 h	Weekly	High vol (480 m^3/d)	Glass fibre filter + 2 PUF	GC-MS	NILU (Norway)

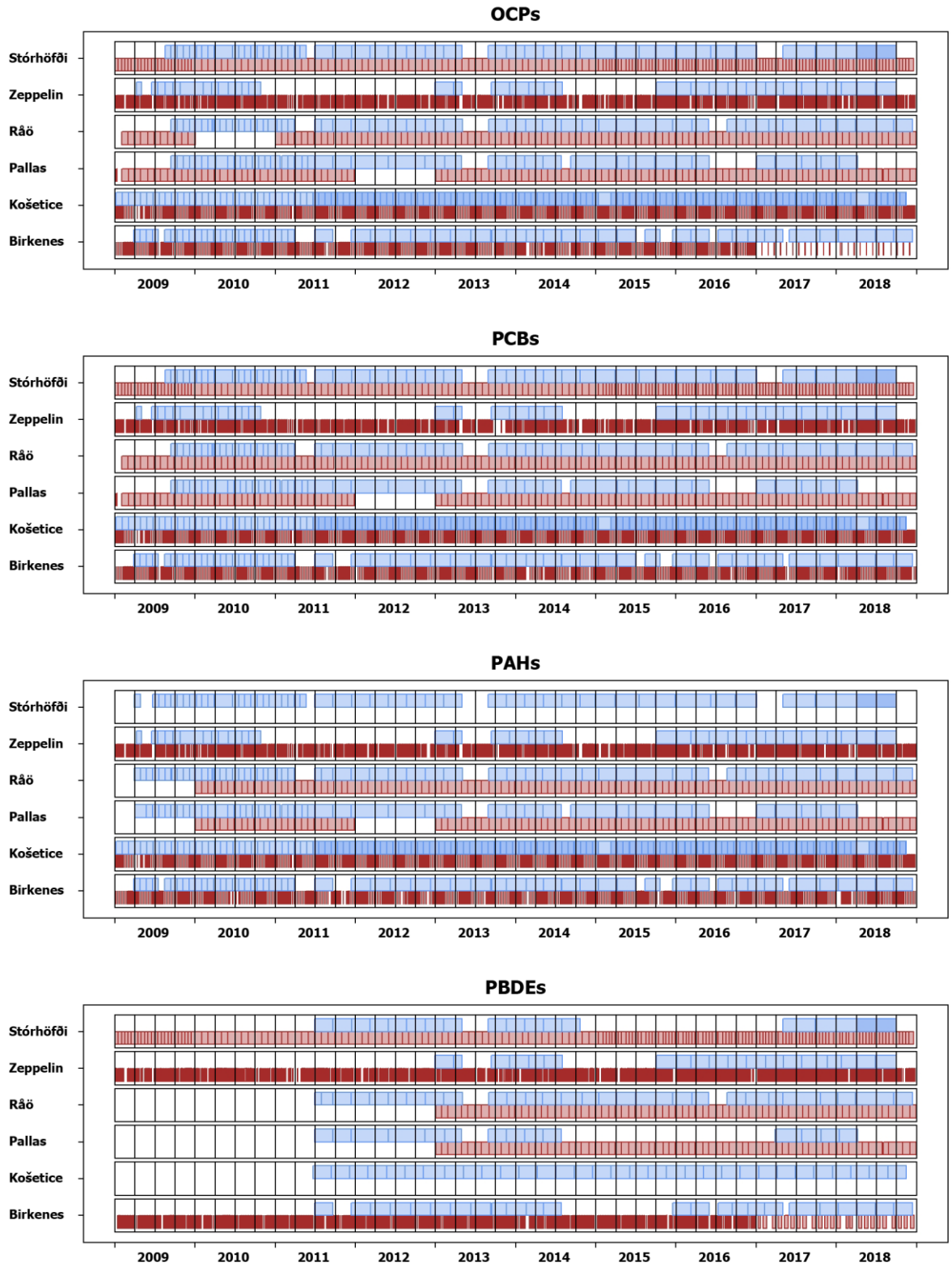

Fig. S1 Temporal sampling regime of the EMEP AAS (red) and MONET PAS (blue) for SVOCs from 2009–2018. Each year is divided into four quarters (black cells).

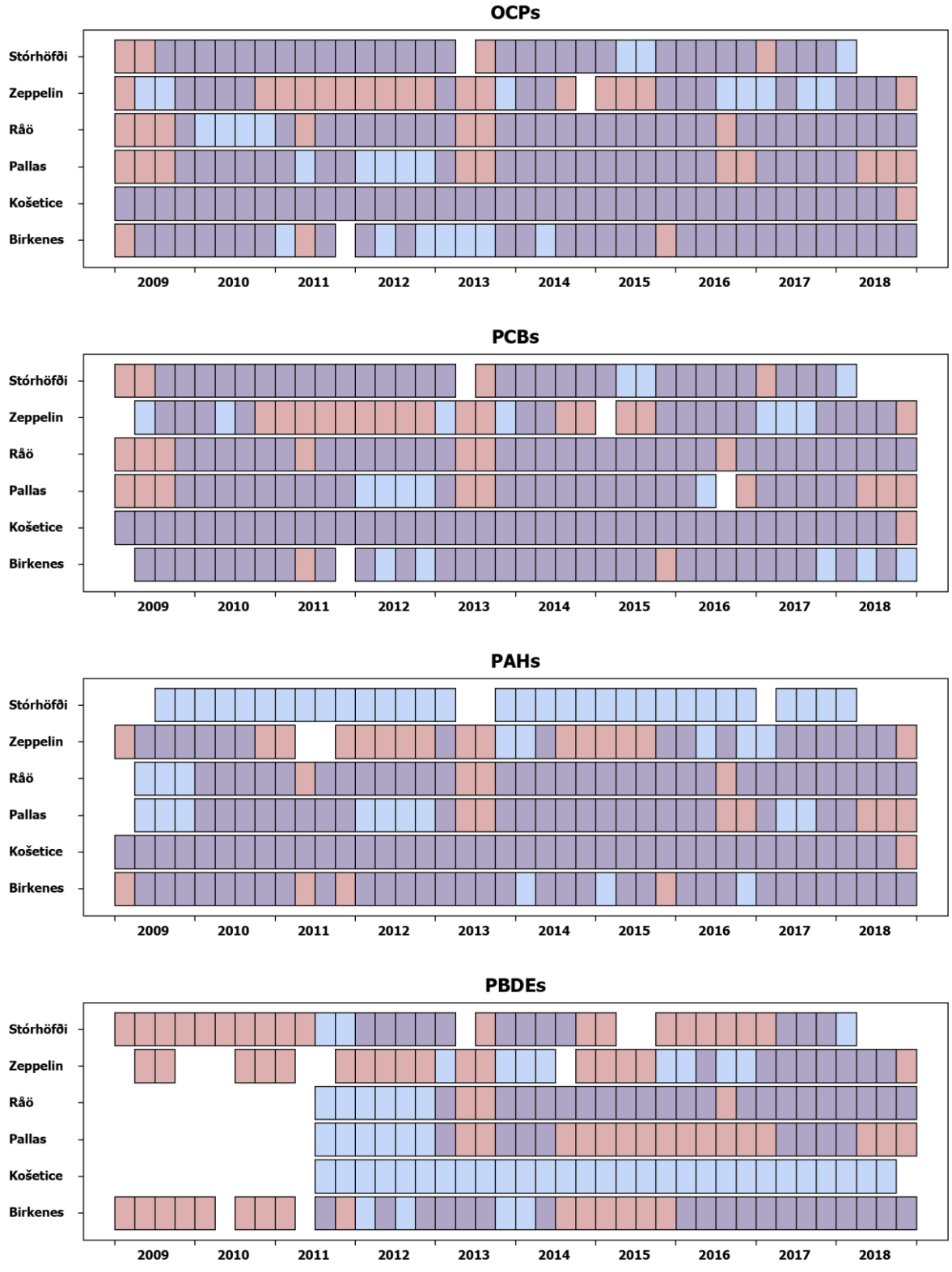

Fig. S2 Temporal sampling regime of the EMEP AAS (red) and MONET PAS (blue) for SVOCs from 2009–2018 aggregated into four quarters per year (individual cells). Purple cells indicate quarters containing sufficient samples from both EMEP and MONET for further analysis of R_S values.

Table S2 MONET-specific input parameters used for the Harner and Herkert models as described by Bohlin-Nizzetto et al., 2020.

Parameter	Symbol	Harner	Herkert
Effective gas-phase sampling rate	R_S	4 $m^3 \cdot day^{-1}$	
Particle phase R_S as fraction of gas-phase R_S	e_{part}	1	1
Fraction of organic matter in particles	f_{OC}	0.2	
Total suspended solid particles, TSP	TSP	25 $\mu g \cdot m^{-3}$	
Effective film thickness	d_{film}	0.00567 m	
Density	ρ_{PUF}	30,300 $g \cdot m^{-3}$	30,300 $g \cdot m^{-3}$
Volume of PUF disk	V_{PUF}	0.000265 m^3	0.000265 m^3
Surface area	A_S	0.0422543 m^2	0.0422543 m^2
Mass transfer rate on wind speed – exponent	α		0.5
Mass transfer dimensionless constant	γ		0.315

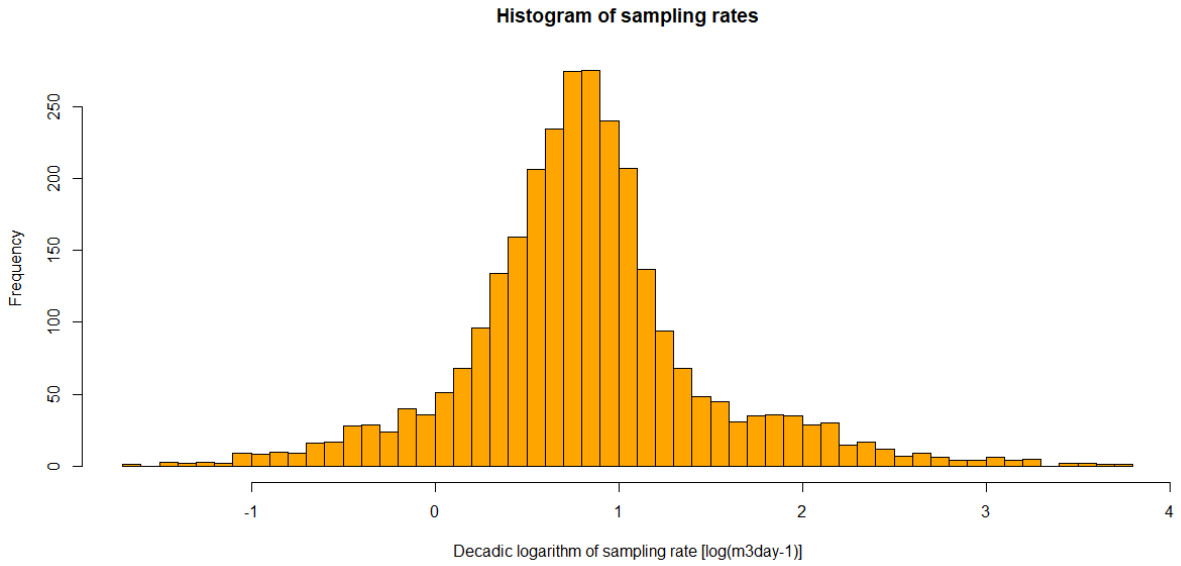

Fig. S3 Approximately normal distribution of log-transformed values of field R_S.

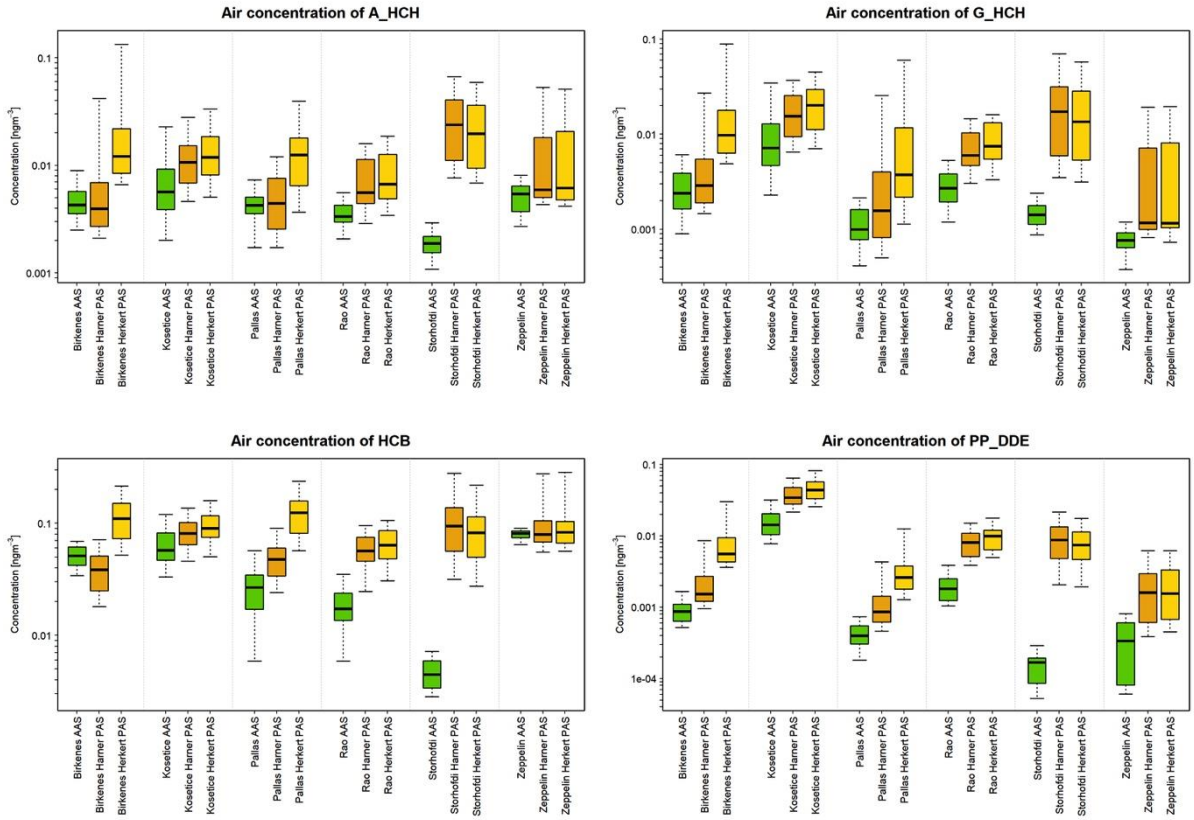

Fig. S4a Boxplots of OCP concentrations measured by EMEP AAS (green) and calculated from MONET PAS data using the Harner (orange) and Herkert (yellow) models (e_{part} = 100%) . Thick horizontal black lines represent medians, boxes span from 25th to 75th percentiles, and whiskers represent the 5th and 95th percentiles.

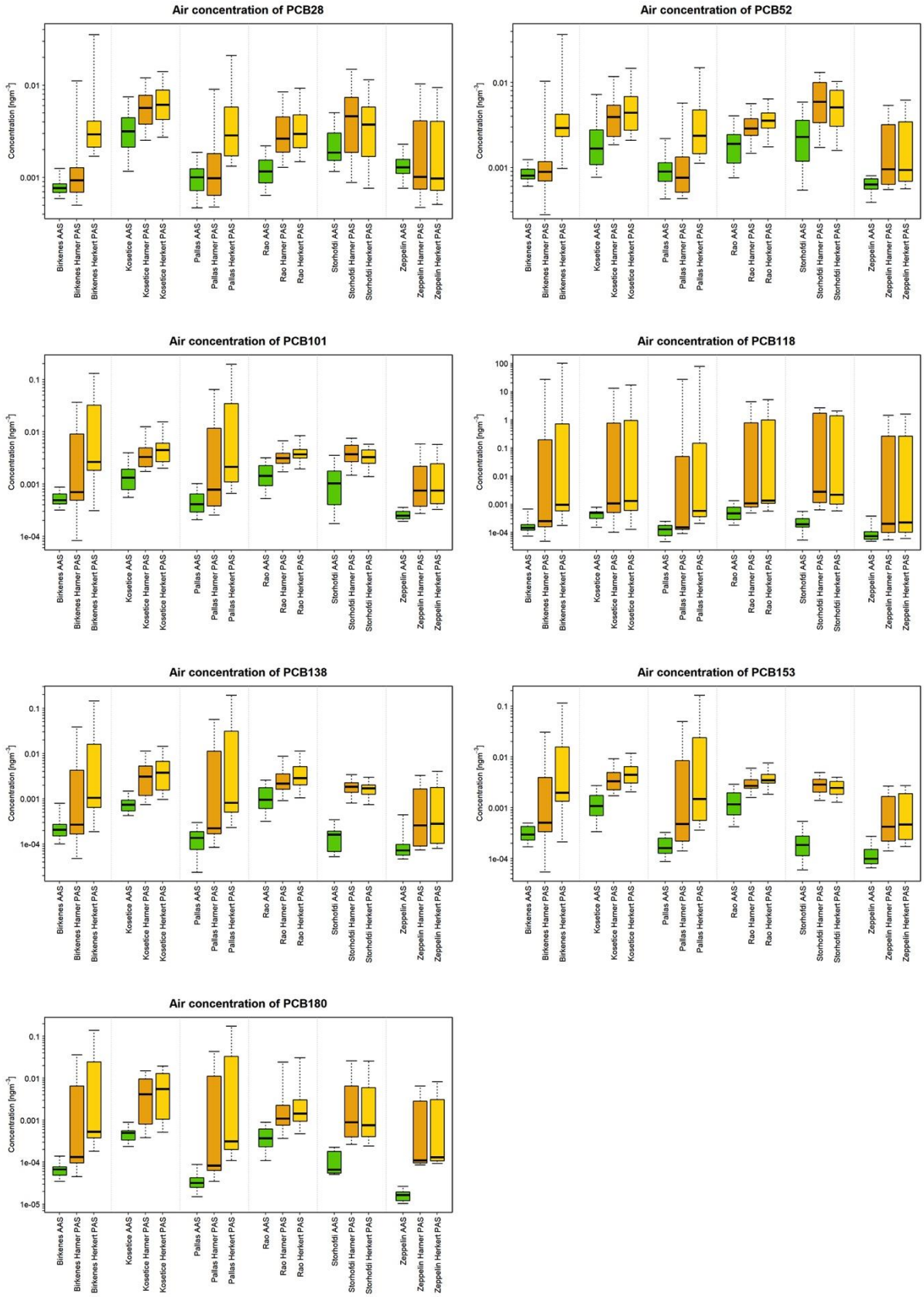

Fig. S4b Boxplots of PCB concentrations measured by EMEP AAS (green) and calculated from MONET PAS data using the Harner (orange) and Herkert (yellow) models (e_{part} = 100%) . Thick horizontal black lines represent medians, boxes span from 25th to 75th percentiles, and whiskers represent the 5th and 95th percentiles.

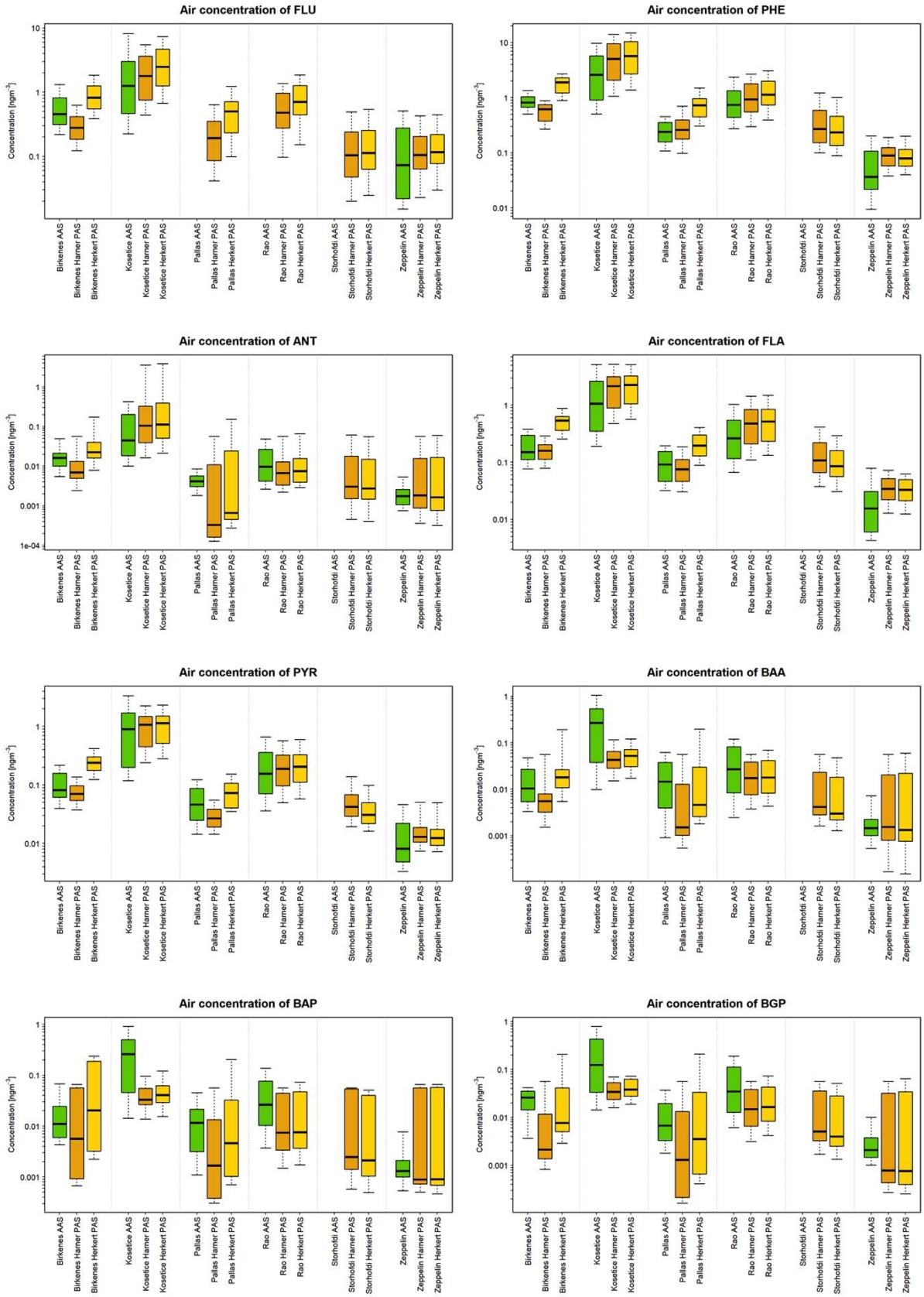

Fig. S4c Boxplots of PAH concentrations measured by EMEP AAS (green) and calculated from MONET PAS data using the Harner (orange) and Herkert (yellow) models (e_{part} = 100%) . Thick horizontal black lines represent medians, boxes span from 25th to 75th percentiles, and whiskers represent the 5th and 95th percentiles.

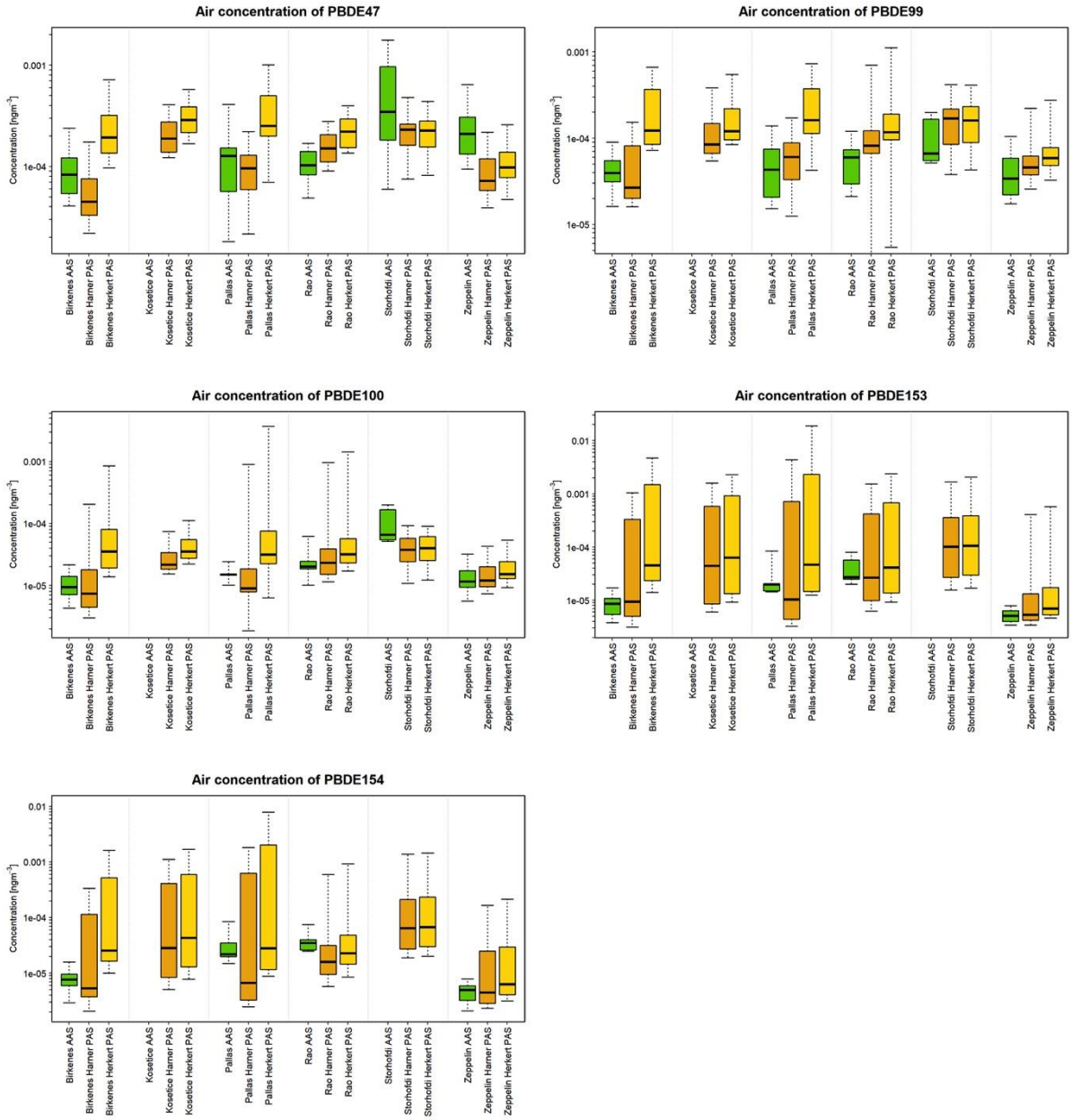

Fig. S4d Boxplots of PBDE concentrations measured by EMEP AAS (green) and calculated from MONET PAS data using the Harner (orange) and Herkert (yellow) models (e_{part} = 100%) . Thick horizontal black lines represent medians, boxes span from 25th to 75th percentiles, and whiskers represent the 5th and 95th percentiles.

Table S3 Median concentrations for all SVOCs at each site.

	Unit	Birkenes			Košetice			Pallas			Rao			Storhofdi			Zeppellin		
		Active	Harner	Herkert	Active	Harner	Herkert	Active	Harner	Herkert	Active	Harner	Herkert	Active	Harner	Herkert	Active	Harner	Herkert
α-HCH	$ng \cdot m^{-3}$	0.0043	0.0040	0.0121	0.0057	0.0107	0.0119	0.0042	0.0045	0.0125	0.0034	0.0056	0.0067	0.0019	0.0239	0.0197	0.0054	0.0059	0.0062
γ-HCH		0.0024	0.0029	0.0098	0.0072	0.0155	0.0202	0.0010	0.0016	0.0038	0.0027	0.0060	0.0075	0.0014	0.0174	0.0136	0.0008	0.0012	0.0012
HCB		0.0513	0.0385	0.1100	0.0575	0.0814	0.0902	0.0268	0.0478	0.1245	0.0172	0.0567	0.0637	0.0045	0.0948	0.0822	0.0813	0.0796	0.0833
p,p'-DDE		0.0009	0.0015	0.0056	0.0143	0.0345	0.0439	0.0004	0.0009	0.0026	0.0018	0.0081	0.0099	0.0002	0.0088	0.0074	0.0003	0.0016	0.0016
PCB 28	$ng \cdot m^{-3}$	0.0008	0.0009	0.0029	0.0032	0.0057	0.0061	0.0010	0.0010	0.0029	0.0012	0.0026	0.0030	0.0019	0.0046	0.0038	0.0013	0.0010	0.0010
PCB 52		0.0008	0.0009	0.0029	0.0017	0.0039	0.0044	0.0009	0.0008	0.0024	0.0019	0.0029	0.0036	0.0023	0.0059	0.0051	0.0006	0.0010	0.0009
PCB101		0.0005	0.0007	0.0027	0.0013	0.0033	0.0045	0.0004	0.0008	0.0021	0.0014	0.0031	0.0037	0.0010	0.0037	0.0033	0.0002	0.0008	0.0008
PCB 118		0.0001	0.0003	0.0010	0.0005	0.0011	0.0013	0.0001	0.0002	0.0006	0.0005	0.0011	0.0014	0.0002	0.0028	0.0022	0.0001	0.0002	0.0002
PCB 153		0.0003	0.0005	0.0020	0.0011	0.0033	0.0045	0.0002	0.0005	0.0015	0.0012	0.0027	0.0035	0.0002	0.0029	0.0025	0.0001	0.0004	0.0005
PCB 138		0.0002	0.0003	0.0011	0.0007	0.0031	0.0038	0.0001	0.0002	0.0008	0.0010	0.0022	0.0029	0.0002	0.0019	0.0017	0.0001	0.0003	0.0003
PCB 180		0.0001	0.0001	0.0005	0.0005	0.0042	0.0056	0.0000	0.0001	0.0003	0.0004	0.0011	0.0015	0.0001	0.0009	0.0008	0.0000	0.0001	0.0001
FLA	$ng \cdot m^{-3}$	0.1507	0.1600	0.5391	1.1176	2.1615	2.2726	0.0915	0.0752	0.1955	0.2636	0.4775	0.5179		0.1074	0.0855	0.0155	0.0343	0.0329
FLU		0.4555	0.2786	0.8186	1.3463	1.7868	2.4807		0.1920	0.5026		0.4790	0.7063		0.1043	0.1133	0.0727	0.1055	0.1164
PHE		0.8179	0.6191	1.8942	2.7018	5.0635	5.7020	0.2399	0.2600	0.7288	0.7414	0.9298	1.1389		0.2714	0.2352	0.0365	0.0888	0.0791
PYR		0.0815	0.0704	0.2390	0.9075	1.0664	1.1368	0.0471	0.0269	0.0731	0.1558	0.1894	0.2057		0.0424	0.0308	0.0081	0.0130	0.0124
BAP		0.0110	0.0057	0.0204	0.2670	0.0330	0.0410	0.0117	0.0031	0.0063	0.0266	0.0075	0.0076		0.0025	0.0021	0.0013	0.0009	0.0009
ANT		0.0162	0.0070	0.0224	0.0458	0.1054	0.1127	0.0042	0.0003	0.0007	0.0097	0.0067	0.0075		0.0031	0.0029	0.0017	0.0018	0.0016
BGP		0.0260	0.0021	0.0076	0.1305	0.0342	0.0380	0.0068	0.0013	0.0036	0.0347	0.0149	0.0166		0.0051	0.0040	0.0021	0.0008	0.0008
BAA		0.0105	0.0056	0.0182	0.2747	0.0429	0.0525	0.0146	0.0015	0.0046	0.0270	0.0174	0.0180		0.0042	0.0030	0.0015	0.0015	0.0013
PBDE 47	$pg \cdot m^{-3}$	0.0832	0.0451	0.1935		0.1890	0.2883	0.1274	0.0962	0.2525	0.1031	0.1514	0.2215	0.3476	0.2322	0.2265	0.2107	0.0723	0.0982
PBDE 99		0.0396	0.0268	0.1229		0.0849	0.1209	0.0433	0.0607	0.1622	0.0598	0.0820	0.1175	0.0666	0.1698	0.1609	0.0342	0.0461	0.0592
PBDE 100		0.0094	0.0074	0.0354		0.0217	0.0354	0.0150	0.0090	0.0316	0.0202	0.0232	0.0319	0.0658	0.0376	0.0401	0.0116	0.0121	0.0153
PBDE 153		0.0086	0.0095	0.0452		0.0446	0.0634	0.0200	0.0106	0.0512	0.0273	0.0267	0.0414		0.1017	0.1063	0.0051	0.0054	0.0070
PBDE 154		0.0077	0.0054	0.0256		0.0284	0.0432	0.0220	0.0070	0.0304	0.0350	0.0159	0.0229		0.0647	0.0676	0.0050	0.0045	0.0064

Table S4 Median R_S ($m^3 \cdot day^{-1}$) for all SVOCs at each site.

	Birkenes			Košetice			Pallas			Råö			Stórhöfði			Zeppellin		
	Field	Harner	Herkert	Field	Harner	Herkert	Field	Harner	Herkert	Field	Harner	Herkert	Field	Harner	Herkert	Field	Harner	Herkert
α-HCH	3.11	3.79	1.22	5.81	3.47	2.96	4.16	3.93	1.45	5.88	3.55	3.05	61.40	3.78	4.35	6.81	4.05	3.98
γ-HCH	5.68	3.99	1.22	6.89	3.74	3.16	5.65	4.03	1.49	10.62	3.85	3.23	44.98	3.99	4.63	15.01	4.18	4.12
HCB	2.28	3.48	1.19	4.50	3.26	2.88	6.25	3.66	1.43	9.28	3.26	2.87	85.78	3.48	4.10	3.97	3.83	3.88
p,p'-DDE	9.22	4.40	1.20	10.16	4.39	3.57	9.16	4.42	1.50	17.21	4.39	3.55	280.31	4.41	5.05	20.51	4.42	4.30
PCB 28	4.87	4.02	1.23	6.98	4.01	3.57	4.66	4.15	1.57	10.13	3.97	3.48	12.85	4.13	5.18	4.71	4.26	4.38
PCB 52	4.42	4.24	1.25	7.48	4.10	3.46	4.90	4.31	1.53	7.53	4.14	3.50	12.15	4.24	4.96	6.39	4.33	4.33
PCB101	5.04	4.35	1.17	10.35	4.32	3.53	6.89	4.37	1.48	8.25	4.33	3.47	14.45	4.36	4.90	9.45	4.40	4.25
PCB 118	6.12	4.40	1.19	6.97	4.40	3.55	5.99	4.41	1.49	9.64	4.40	3.51	28.48	4.41	4.98	5.94	4.42	4.22
PCB 153	6.04	4.40	1.15	11.96	4.39	3.42	7.54	4.41	1.44	10.26	4.39	3.41	56.75	4.41	4.81	12.65	4.42	4.12
PCB 138	5.29	4.41	1.16	13.91	4.40	3.43	29.01	4.42	1.44	8.79	4.40	3.40	57.13	4.41	4.82	12.41	4.42	4.12
PCB 180	14.09	4.42	1.12	33.49	4.42	3.34	11.93	4.42	1.40	12.76	4.42	3.29	66.11	4.42	4.69	407.16	4.42	3.98
FLA	4.37	4.39	1.36	7.00	4.39	4.07	3.13	4.41	1.74	6.97	4.39	4.01		4.41	5.70	8.54	4.42	4.97
FLU	1.75	3.69	1.29	3.95	3.43	2.34		3.87	1.52		3.43	2.37		3.68	3.09	4.86	4.05	3.62
PHE	2.89	4.23	1.37	6.67	4.19	3.62	4.06	4.31	1.69	5.05	4.19	3.54		4.26	5.03	10.85	4.36	4.69
PYR	3.40	4.40	1.38	5.20	4.40	4.10	2.04	4.41	1.74	4.21	4.40	4.03		4.41	5.72	7.07	4.42	4.96
BAP	1.17	4.42	1.30	0.96	4.42	3.88	0.54	4.42	1.63	0.61	4.42	3.85		4.42	5.45	3.54	4.42	4.62
ANT	2.80	4.37	1.41	3.96	4.36	3.89	0.34	4.39	1.71	2.66	4.34	3.59		4.37	5.12	4.66	4.40	4.73
BGP	0.46	4.42	1.27	1.13	4.42	3.77	0.48	4.42	1.58	1.07	4.42	3.72		4.42	5.29	1.24	4.42	4.53
BAA	2.00	4.42	1.36	0.89	4.42	4.04	0.44	4.42	1.68	1.38	4.42	3.95		4.42	5.62	2.10	4.42	4.82
PBDE 47	2.37	4.42	1.04		4.42	3.11	1.95	4.42	1.31	4.65	4.42	3.08	4.04	4.42	4.37	2.35	4.42	3.71
PBDE 99	4.70	4.42	1.00		4.42	2.97	2.32	4.42	1.23	5.15	4.42	2.93	5.64	4.42	4.16	5.51	4.42	3.52
PBDE 100	4.26	4.42	1.00		4.42	2.96	2.79	4.42	1.24	5.31	4.42	2.94	1.64	4.42	4.16	7.59	4.42	3.55
PBDE 153	6.96	4.42	0.95		4.42	2.84	0.93	4.42	1.19	1.71	4.42	2.81		4.42	3.99	5.64	4.42	3.39
PBDE 154	6.41	4.42	0.95		4.42	2.84	0.50	4.42	1.19	1.76	4.42	2.81		4.42	3.99	6.27	4.42	3.38

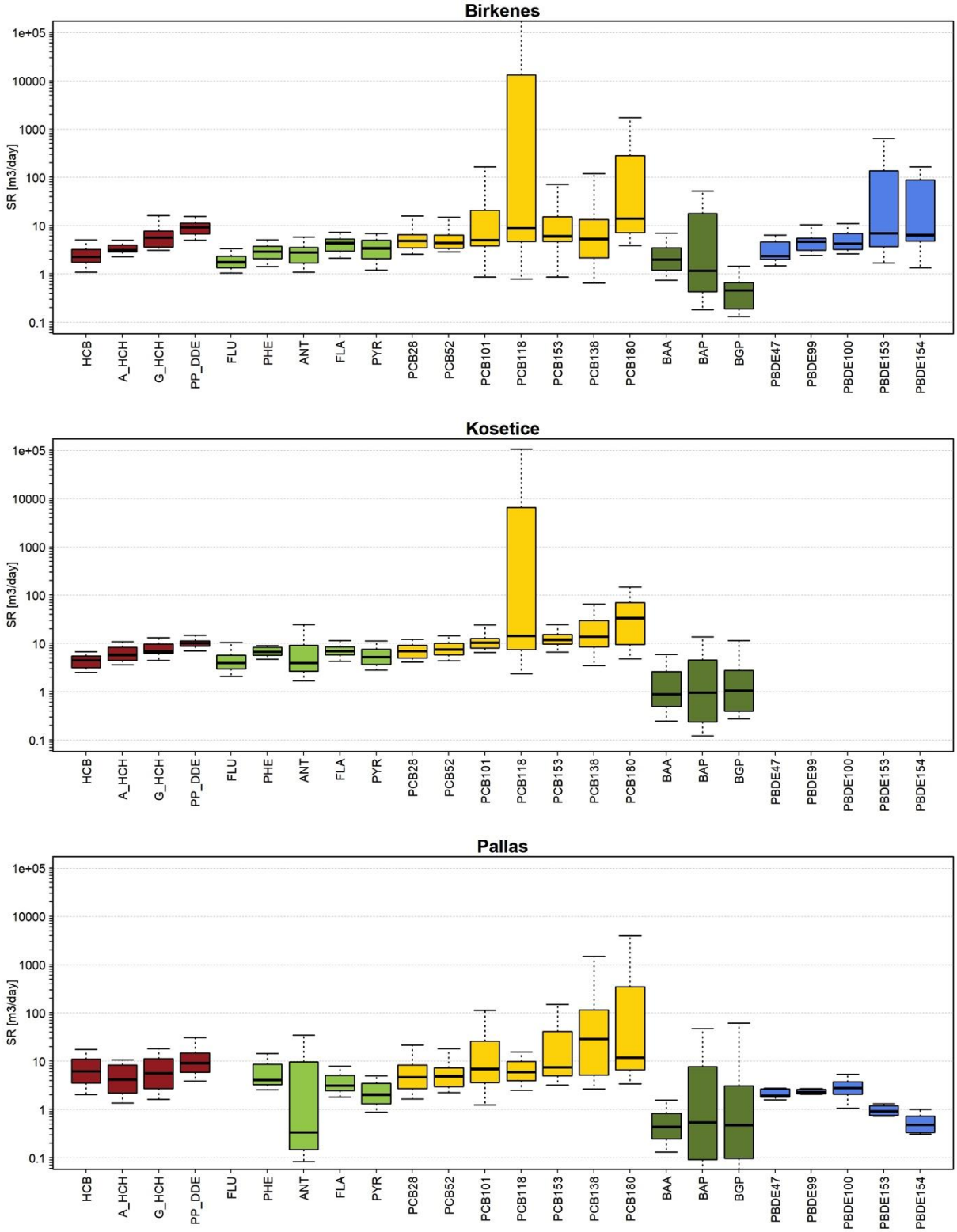

Fig. S5a Boxplots of field R_S derived from quarterly-aggregated EMEP AAS and MONET PAS SVOC data measured at six stations during the period 2009–2018 (n = 8–39). Compound groups are distinguished by colour: OCPs (red), PAHs (light and dark green represent predominantly gas-phase and particle-phase PAHs, respectively), PCBs (yellow), and PBDEs (blue). SVOC groups and individual compounds are ordered by increasing K_{OA} from left to right. Thick black lines represent medians, boxes span from 25th to 75th percentiles, and whiskers represent the 5th and 95th percentiles. Range of the plot spans from 0.1 to 1,000 $m^3 \cdot day^{-1}$ to avoid extreme values to limit plots‘ readability.

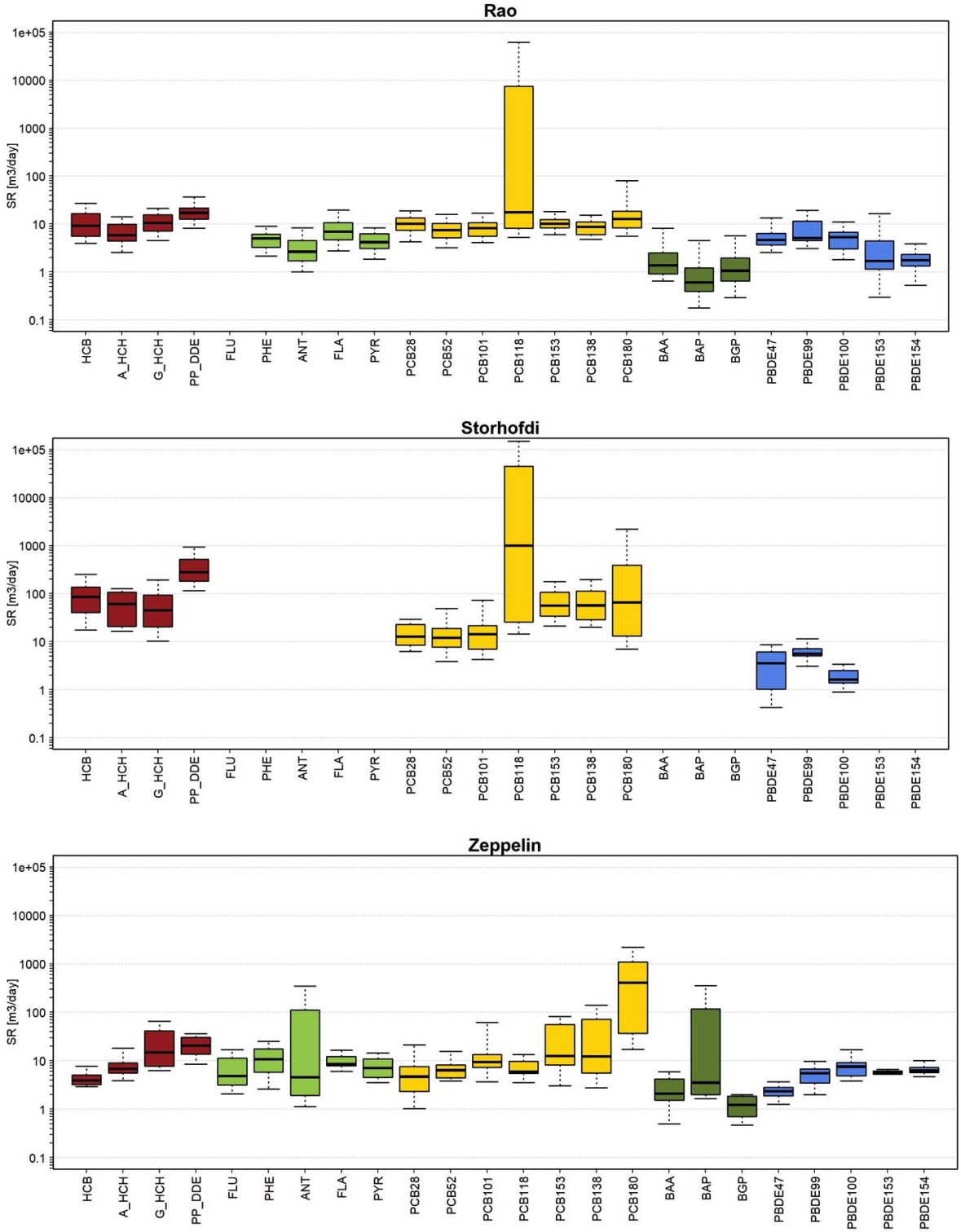

Fig. S5b Boxplots of field R_S derived from quarterly-aggregated EMEP AAS and MONET PAS SVOC data measured at six stations during the period 2009–2018 (n = 8–39). Compound groups are distinguished by colour: OCPs (red), PAHs (light and dark green represent predominantly gas-phase and particle-phase PAHs, respectively), PCBs (yellow), and PBDEs (blue). SVOC groups and individual compounds are ordered by increasing K_{OA} from left to right. Thick black lines represent medians, boxes span from 25th to 75th percentiles, and whiskers represent the 5th and 95th percentiles. Range of the plot spans from 0.1 to 1,000 $m^3 \cdot day^{-1}$ to avoid extreme values to limit plots‘ readability.

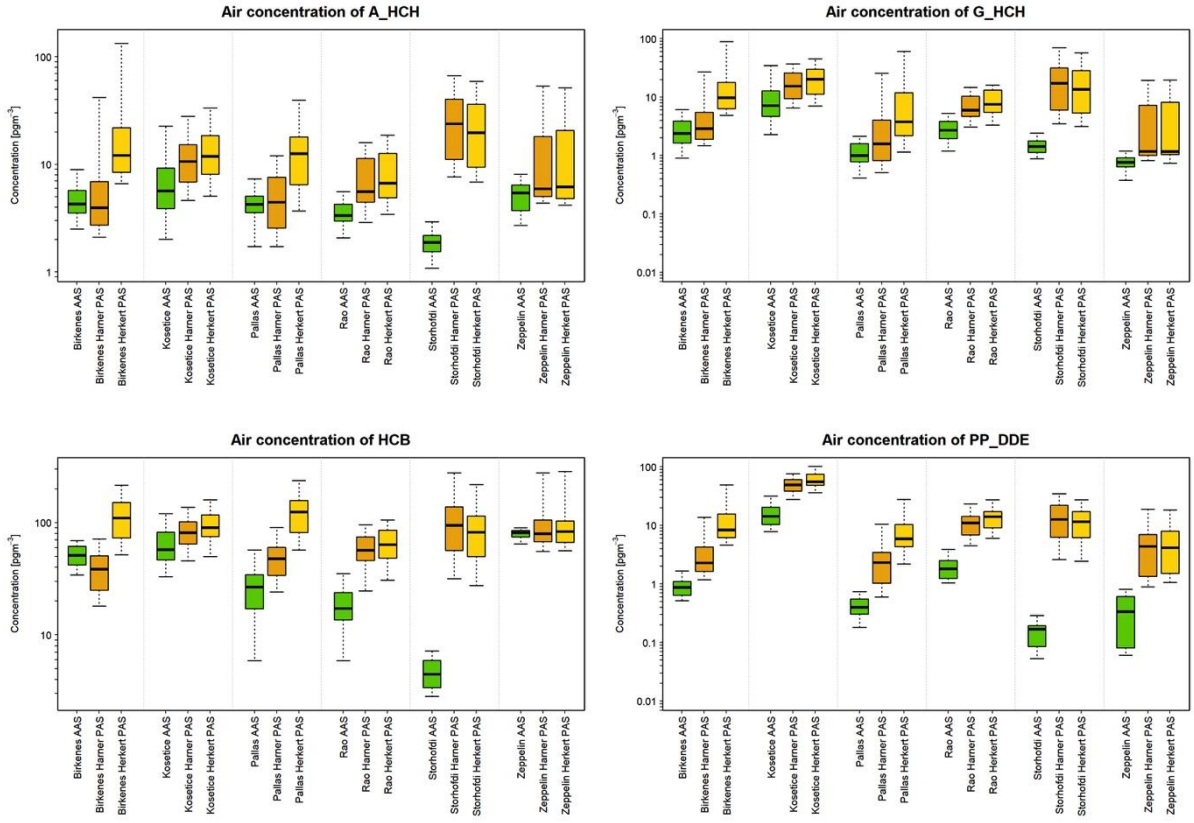

Fig. S6a Boxplots of OCP concentrations measured by EMEP AAS (green) and calculated from MONET PAS data using the Harner (orange) and Herkert (yellow) models (e_{part} = 18%) . Thick horizontal black lines represent medians, boxes span from 25th to 75th percentiles, and whiskers represent the 5th and 95th percentiles.

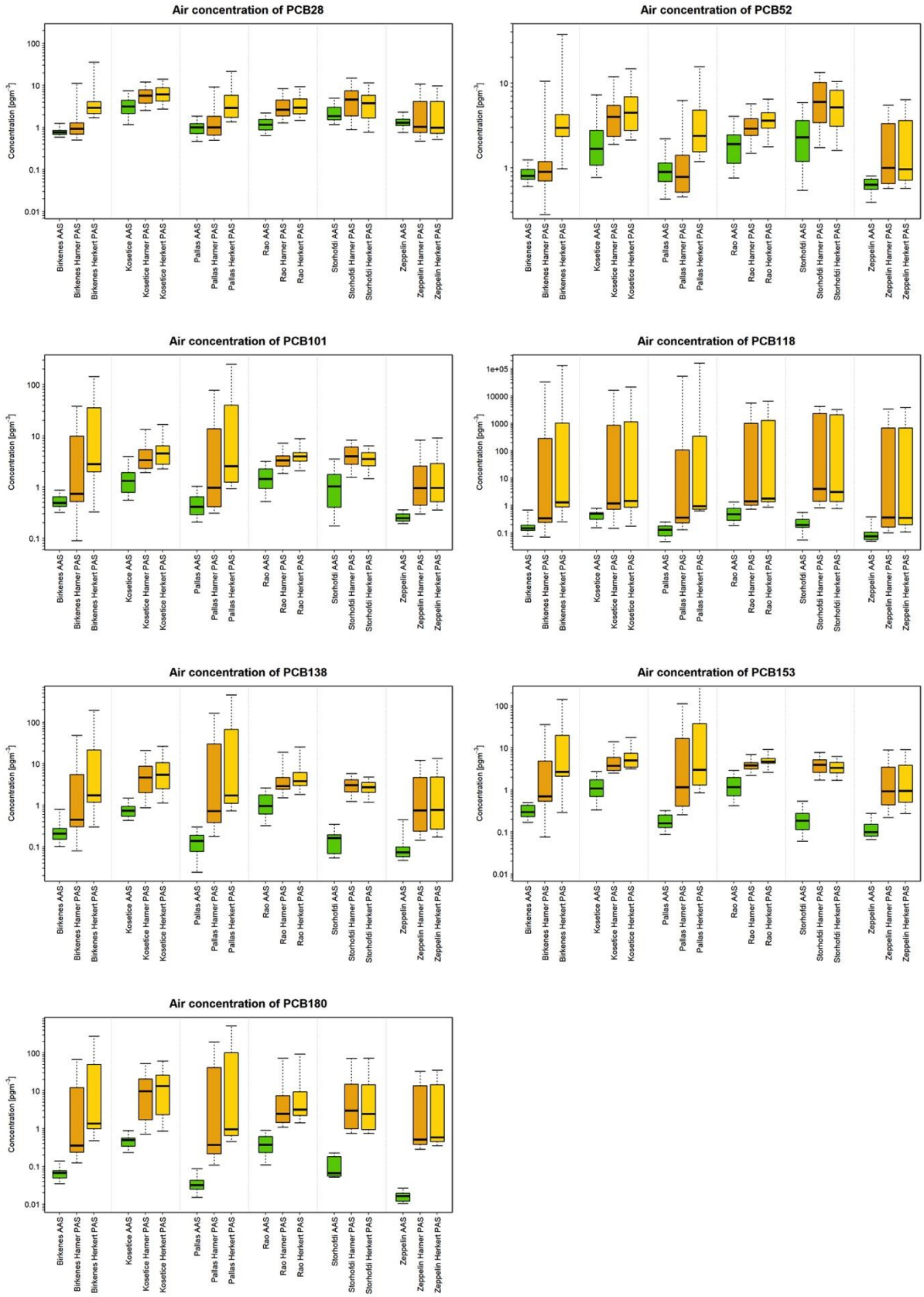

Fig. S6b Boxplots of PCB concentrations measured by EMEP AAS (green) and calculated from MONET PAS data using the Harner (orange) and Herkert (yellow) models (e_{part} = 18%) . Thick horizontal black lines represent medians, boxes span from 25th to 75th percentiles, and whiskers represent the 5th and 95th percentiles.

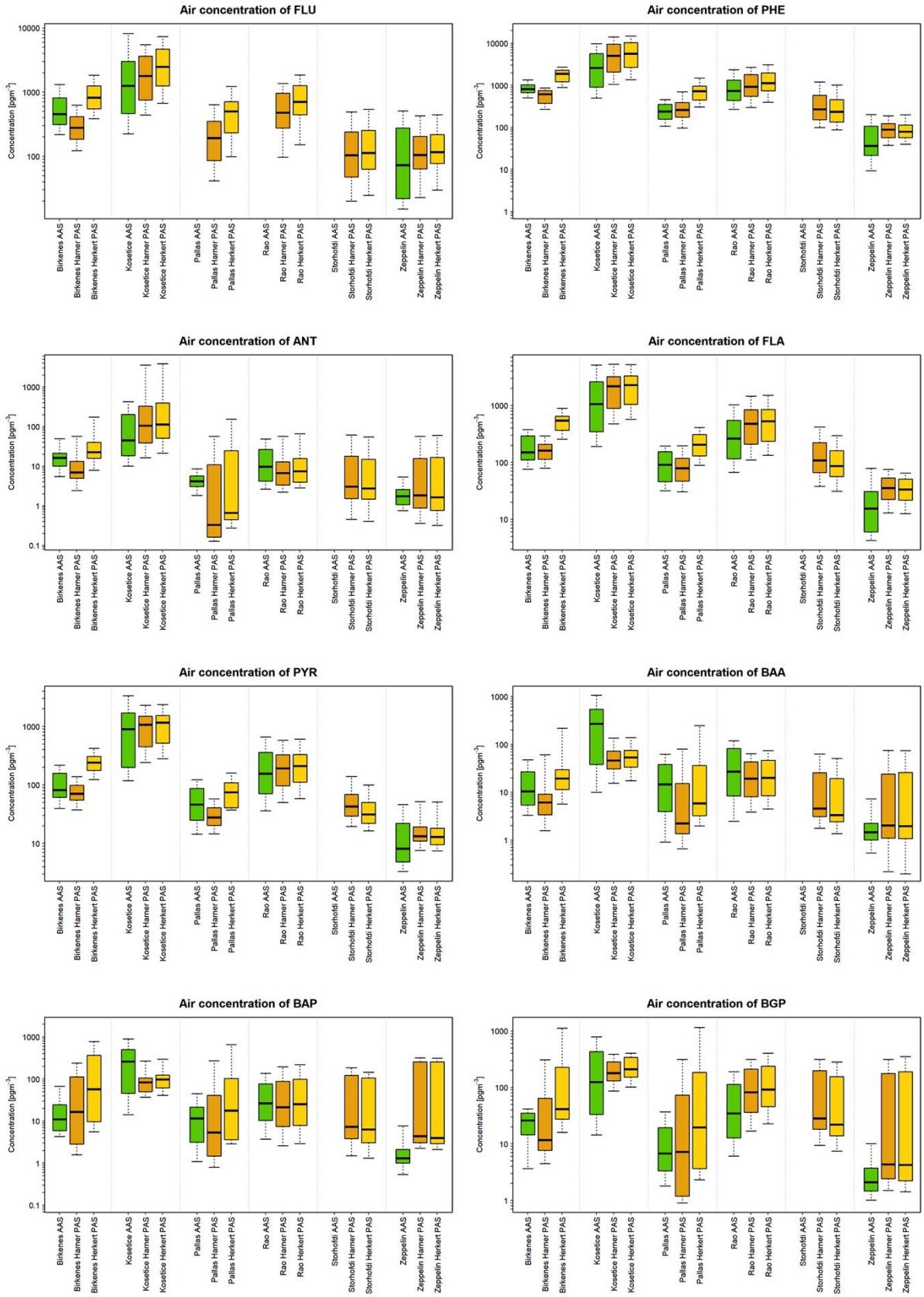

Fig. S6c Boxplots of PAH concentrations measured by EMEP AAS (green) and calculated from MONET PAS data using the Harner (orange) and Herkert (yellow) models (e_{part} = 18%) . Thick horizontal black lines represent medians, boxes span from 25th to 75th percentiles, and whiskers represent the 5th and 95th percentiles.

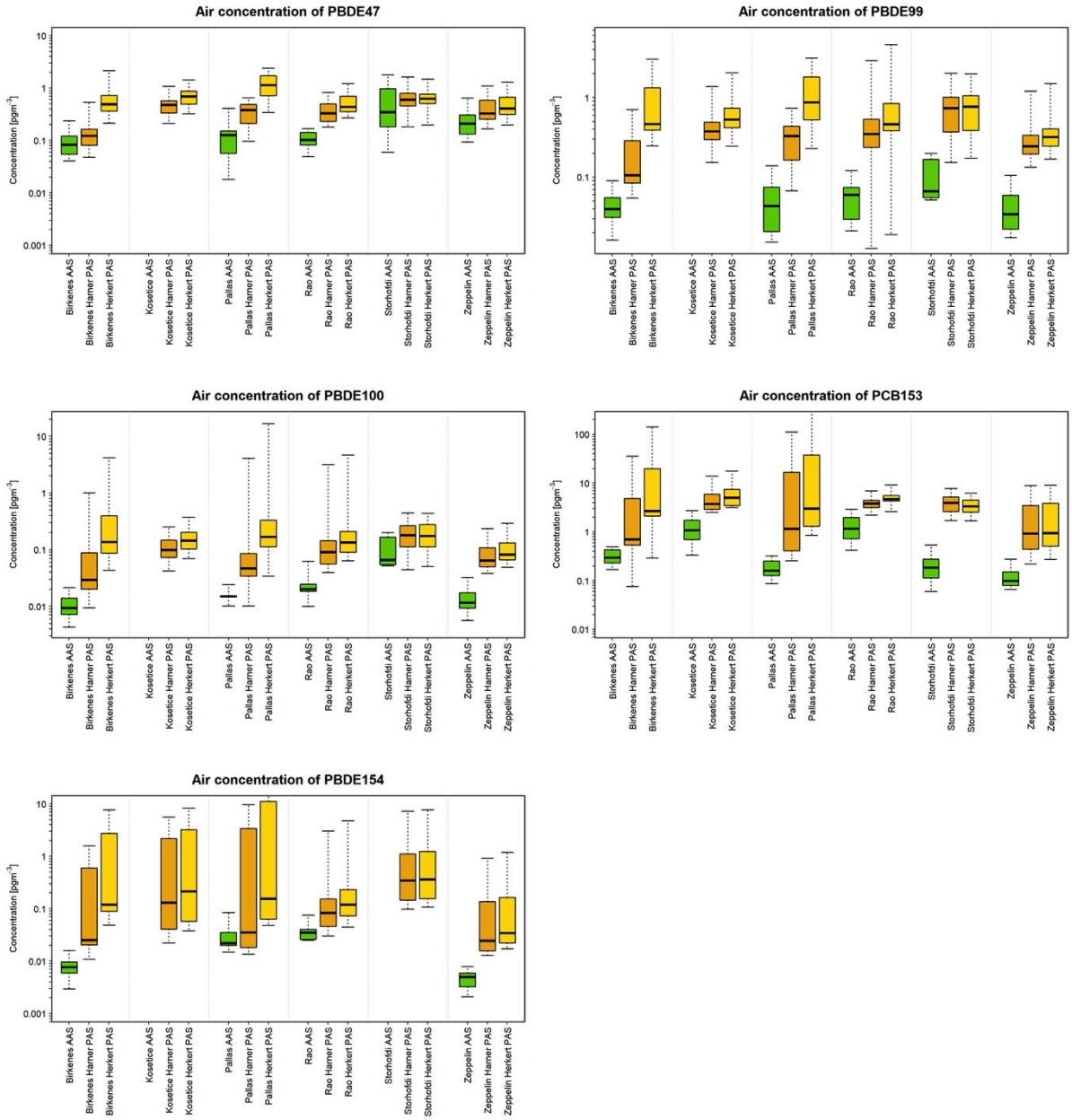

Fig. S6d Boxplots of PBDE concentrations measured by EMEP AAS (green) and calculated from MONET PAS data using the Harner (orange) and Herkert (yellow) models (e_{part} = 18%) . Thick horizontal black lines represent medians, boxes span from 25th to 75th percentiles, and whiskers represent the 5th and 95th percentiles.

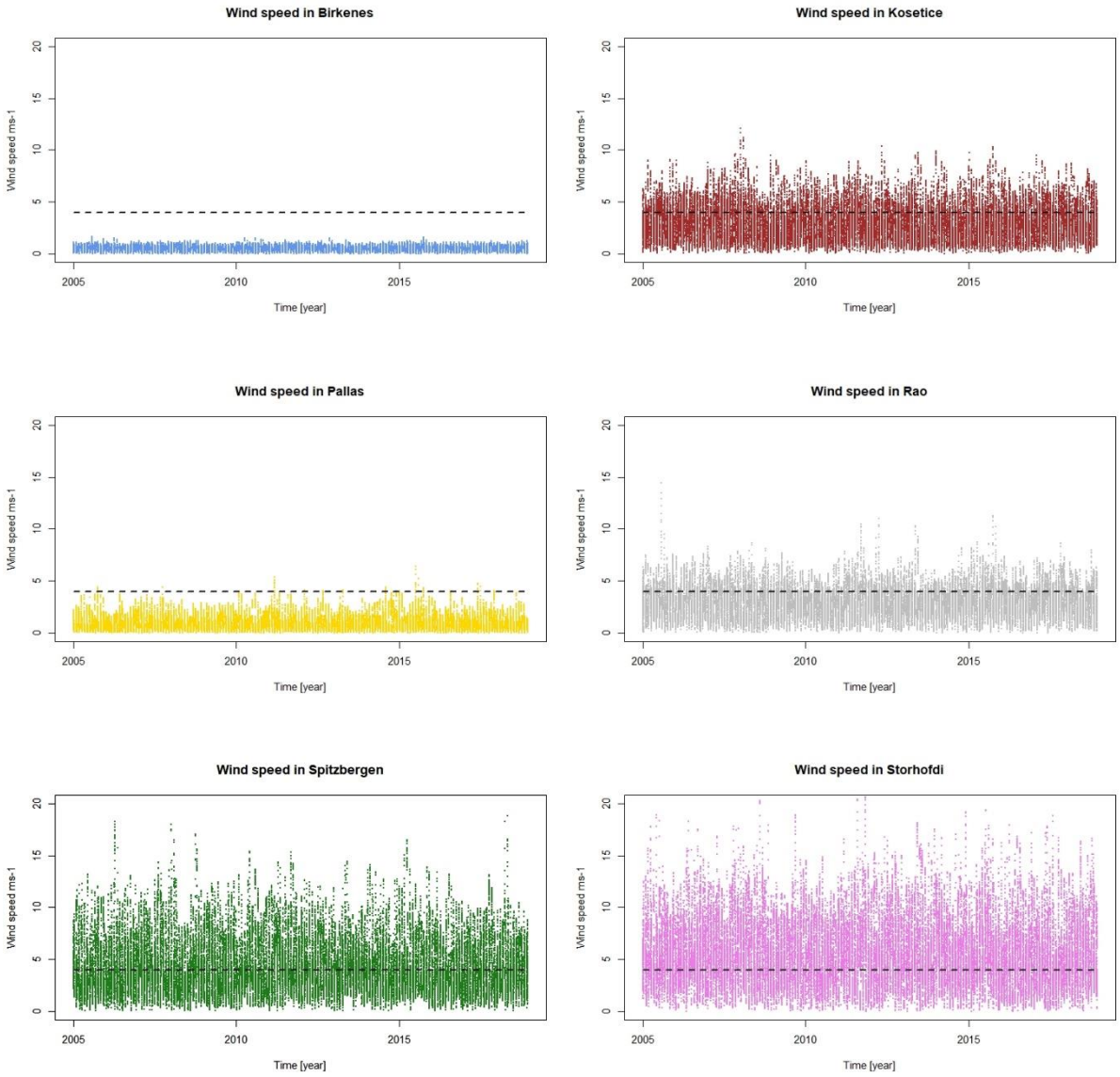

Fig. S7 Hourly wind speeds modelled at each site using the MERRA-2 model. The black dashed line at 4 $m \cdot s^{-1}$ represents the upper threshold for laminar flow within passive air samplers as identified by Tuduri et al., 2006.