Polybrominated diphenyl ethers and alternative flame retardants in air and precipitation samples from the northern Lake Lake Victoria region, East Africa.

SUPPORTING INFORMATION

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Figure S1a. Picture of the Ugandan part of the Lake Victoria area showing Entebbe, the location of the sampling site. A more detailed description of the sampling site is given elsewhere.[1]

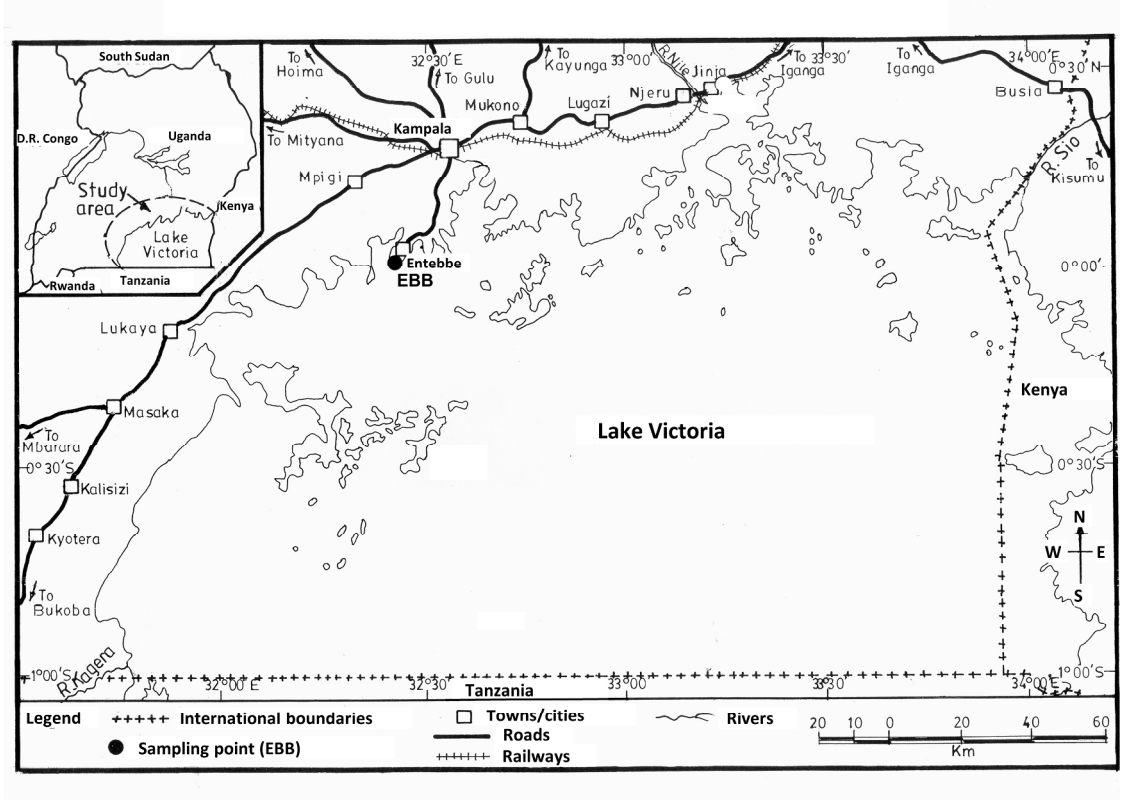


Figure S1b. Picture of sampling site at Entebbe showing the Meteorological Instruments of Canada (MIC) type precipitation sampler used.

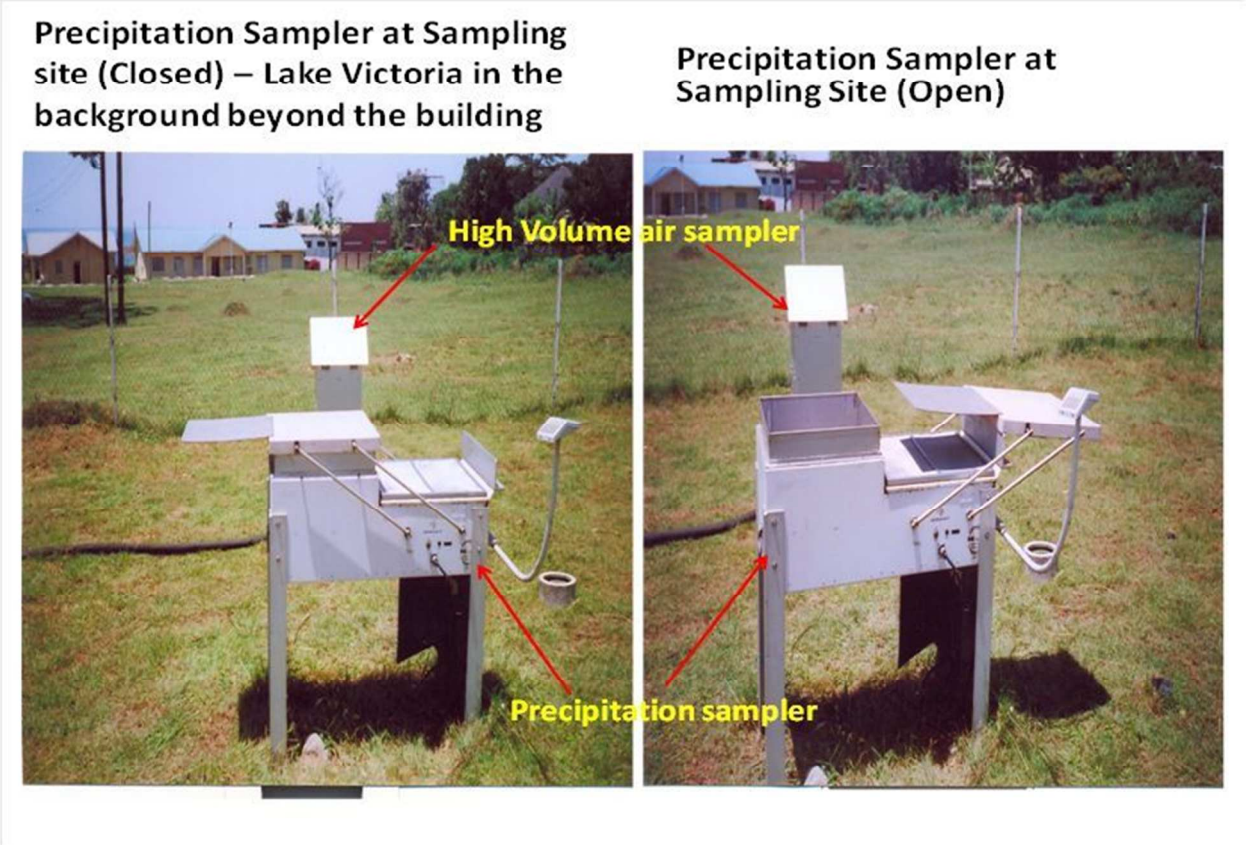


Table S1. Deployment periods and corresponding total rainfall received for the precipitation samples.

Sample Code	Date of Deployment	Date of Removal	Number of days Sampled	Total rain (mm) received over the sampling period - rain guage data
ER 1	28-Oct-08	28-Nov-08	31	101.1
ER 2	28-Nov-08	9-Jan-09	42	58.9
ER 3	9-Jan-09	10-Feb-09	32	173.1
ER 4	10-Feb-09	11-Mar-09	29	90.1
ER 5	11-Mar-09	12-Apr-09	32	244.5
ER 6	12-Apr-09	13-May-09	31	163.3
ER 7	20-May-09	21-Jun-09	32	21.4
ER 8	21-Jun-09	22-Jul-09	31	76.4
ER 9	22-Jul-09	21-Aug-09	30	64.7
ER 10	21-Aug-09	22-Sep-09	32	85.5
ER 12	26-Mar-10	27-Apr-10	31	264.3

Table S2a. Method detection limits, instrument detection limits and recoveries of the monitored alternative FRs in the air and precipitation samples

Compound	Abbreviation	IDL pg	MDL (Air samples) pg m^{-3}	MDL (Precipitation Flux) pg m^{-2} $sample^{-1}$	Average Recovery for Air Samples %	Ions monitored
1,3,5-tribromobenzene	135-TBB	0.04	-[2]	-[2]	100	79, 81, 315.6
1,3-Diiodobenzene	13-DiIB	0.02	-[2]	0.02	143	128.8, 125.9, 81
1,3,5-tribromo-2-methoxy-4-methylbenzene	MeOMe-TBB	0.12	-[2]	-[2]	94	79, 81, 277.6
Allyl 2,4,6-tribromophenyl ether	TBP-AE	0.04	-[2]	-[2]	103	290.8' 79, 81
Pentachlorothiophenol[2]	MET-690B	0.02	-[2]	-[2]		280.8, 245.60
2-bromoallyl 2,4,6-tribromophenyl ether	TBP-BAE	0.04	-[2]	-[2]	103	79, 81, 159.8
2,3,5,6-tetrabromo-p-xylene	TBX	0.04	-[2]	0.02		79, 81
1,2,3,4,5-pentabromobenzene	PBB	0.05	-[2]	0.09	142	473.4, 79, 81
Pentabromotoluene[2]	PBT	0.06	-[2]	0.05		487.6, 485.6, 80.9
Pentabromoethylbenzene	PBEB	0.06	-[2]	0.02	118	79, 80.9, 499.6
2,3-dibromopropyl 2,4,6-tribromophenyl ether	TBP-DBPE	0.15	-[2]	0.15	93	290.80, 80.9, 159.8
Hexabromobenzene	HBB	0.09	-[2]	0.10	149	551.5, 471.6, 79
1-bromomethyl-2,3,4,5,6-pentabromobenzene[2]	PeBBmB	0.41	-[2]	0.02		79, 80.9, 487.6
Pentabromobenzyl acrylate	PBB-Acr	0.31	2.007	0.11	99	71.1, 485.5, 79
2-ethyl-1-hexyl 2,3,4,5-tetrabromobenzoate	EH-TBB	0.06	-[2]	0.11	103	468.80, 356.60
Hexachlorocyclopentadienyl-dibromocyclooctane	DBHCTD	0.06	-[2]	-[2]	114	539.7, 236.8, 80.9
1,2-bis(2,4,6-tribromophenoxy)ethane	BTBPE	0.06	-[2]	0.44	103	80.9, 79, 250.7
Bis(2-ethyl-1-hexyl)-tetrabromophthalate	BEH-TEBP	0.69	-[2]	0.37	97	512.7, 383.7, 79
Syn-Dechlorane Plus	S-DP	0.05	-[2]	0.98	76	583.8, 547.7, 236.7
Anti-Dechlorane Plus	A-DP	0.05	-[2]	0.29	112	583.7, 509.8, 236.8
Decabromodiphenyl ethane	DBDPE	5.90	-[2]	-[2]	43	79, 81
gamma-Hexabromocyclodecane[3]	HBCDD	0.30	-[2]	-[2]	89	79, 81, 403

[1]Nomenclature from Bergman et al. [2]
[2] "-" for the MDLs indicates that blanks were zero and therefore the MDL=IDL
[2] Recoveries were not determined
[3] It has been reported elsewhere that the β and γ isomers of HBCDD residues in the samples were most likely thermally isomerized to the α isomer and/or degraded in the GC injection port.[3] Therefore our results, while quantified based on a γ-HBCDD standard, are reported as total HBCDD

Table S2b. Method detection limits, recoveries ions monitored in the SIM program for the monitored PBDEs in the air and precipitation samples

PBDE	IDL (pg)	MDL (Air samples) pg m^{-3}	MDL (Precipitation Flux) pg m^{-2} $sample^{-1}$	Average Recovery for Air Samples[1] %	Ions monitored in the SIM program
BDE-17	0.05	-[2]	-[2]	114	79, 81, 327
BDE-28	0.10	0.37	0.03	135	79, 81, 327
BDE-49	0.05	-[2]	0.31	36	79, 81, 325
BDE-71	0.05	-[2]	-[2]	149	79, 81, 325
BDE-47	0.05	2.08	4.05	126	79, 81, 325
BDE-66	0.10	-[2]	0.30	112	79, 81, 325
BDE-100	0.08	0.32	0.52	94	79, 81, 403
BDE-99	0.07	1.73	3.35	112	79, 81, 403
BDE-85	0.12	-[2]	0.15	104	79, 81, 403
BDE-154	0.10	-[2]	0.39	100	79, 81, 403
BDE-153	0.12	-[2]	0.35	104	79, 81, 403
BDE-138	0.12	-[2]	0.58	110	79, 81, 484
BDE-183	0.11	-[2]	0.49	145	79, 81, 484
BDE-209	1.57	0.71	42.63	107	79, 81, 485
13C12 BDE-209	0.86	-[2]	-[2]	109	487, 493, 495
BDE-190	0.07	-[2]	2.03	83	79, 81
BDE-202	0.06	-[2]	1.80	65	79, 81
BDE-201	0.07	0.48	0.69	60	79, 81
BDE-204	0.03	-[2]	0.64	59	79, 81
BDE-197	0.06	0.76	2.11	66	79, 81
BDE-203	0.13	1.18	2.17	72	79, 81
BDE-196	0.11	0.24	2.33	66	79, 81
BDE-205	0.06	-[2]	2.19	112	79, 81
BDE-194	0.12	-[2]	0.49	78	79, 81
BDE-195	0.07	-[2]	0.63	80	79, 81

BDE-208	0.10	4.00	2.26	59	79, 81
BDE-207	0.13	6.41	4.97	64	79, 81
BDE-206	0.11	2.46	5.59	73	79, 81

[1] For precipitation samples, recoveries were determined for BDE 71 and ^{13}C12 BDE-209
[2] "-" for the MDLs indicates that blanks were zero and therefore the MDL=IDL

Figure S2. The geometric mean concentrations (pg m^{-3}) of the flame retardants in the air samples.

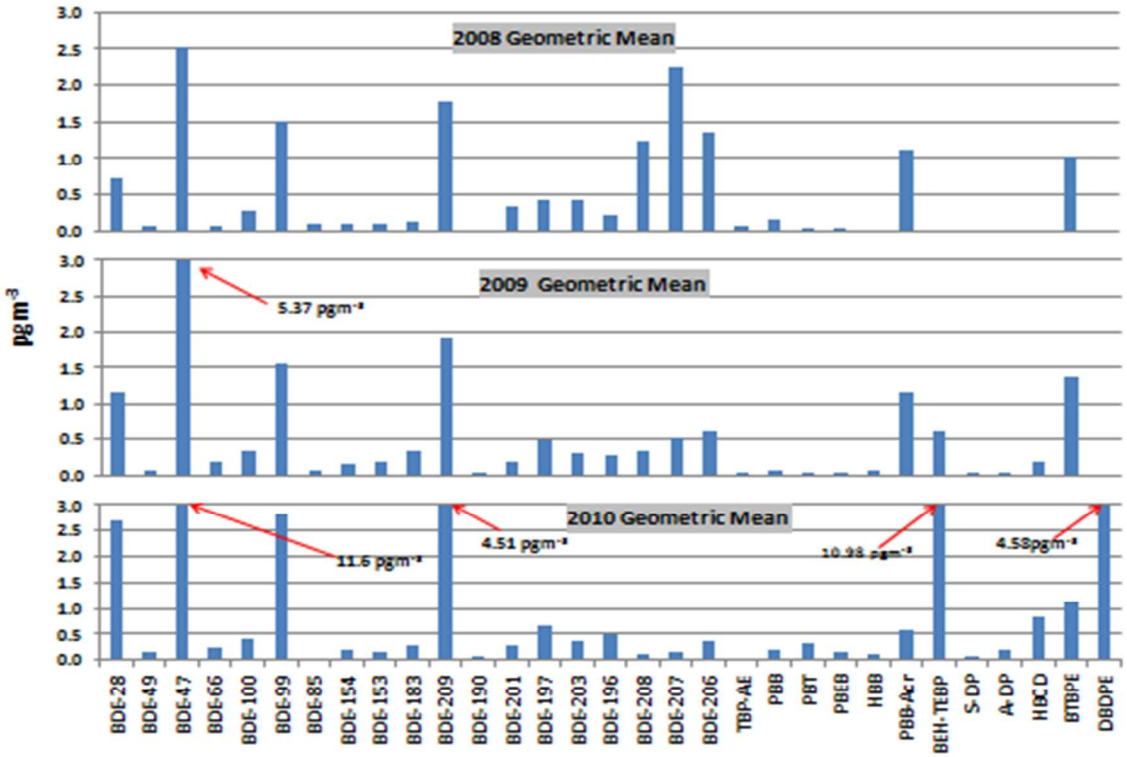


Table S3a. Descriptive statistics for the 2008-2010 combined air sample dataset (N=56; Concentrations in pg m^{-3}).

Flame Retardant	Mean	Standard error	Geometric Mean	Median	Min	Max	FD[a] (%)
BDE-28	2.90	1.08	1.38	1.35	< 0.36	61.2	95
BDE-49	0.83	0.41	0.08	0.03	< 0.05	21.7	32
BDE-47	9.84	1.41	6.01	6.98	< 2.08	49.5	84
BDE-66	0.99	0.30	0.16	0.05	<0.10	9.28	38
BDE-100	0.55	0.10	0.35	0.34	<0.32	3.85	52
BDE-99	4.38	1.46	1.87	0.87	<1.73	77.0	46
BDE-85	0.11	0.03	0.07	0.06	<0.12	1.41	13
BDE-154	0.29	0.05	0.14	0.05	<0.10	1.71	48
BDE-153	0.37	0.07	0.15	0.06	<0.12	2.26	39
BDE-183	0.83	0.15	0.28	0.33	<0.11	4.46	59
BDE-209	8.27	3.23	2.46	1.93	<1.57	168	61
BDE-190	0.08	0.01	0.05	0.03	<0.05	0.37	29
BDE-201	0.70	0.16	0.23	0.27	<0.05	5.29	77
BDE-197	1.11	0.18	0.53	0.63	<0.04	6.61	93
BDE-203	0.58	0.07	0.33	0.38	<0.09	2.42	80
BDE-196	0.49	0.06	0.30	0.39	<0.07	1.69	88
BDE-208	1.10	0.21	0.31	0.53	<0.07	9.68	61
BDE-207	1.90	0.36	0.47	0.77	<0.09	16.3	61
BDE-206	1.54	0.26	0.58	0.90	<0.07	11.8	77
Σtetra BDEs[b]	11.7	1.60	6.93	7.78	1.12	49.6	
Σpenta BDEs[c]	4.93	1.49	2.32	1.52	1.03	77.0	
Σhexa BDEs[d]	0.66	0.11	0.34	0.25	0.11	3.97	
ΣBDEs 47,99,209	22.5	5.10	12.0	11.7	2.69	234	
ΣBDEs 153,154,183	1.49	0.24	0.73	0.76	0.17	7.53	
Sum PBDEs[e]	29.2	5.96	16.7	16.9	3.27	252	
TBP-AE	0.12	0.05	0.03	0.02	<0.04	2.80	21
PBB	0.31	0.06	0.11	0.10	<0.05	2.30	54
PBT	0.54	0.40	0.08	0.03	<0.06	22.2	45
PBEB	0.11	0.03	0.05	0.03	<0.06	1.83	30
HBB	0.14	0.04	0.06	0.05	<0.09	1.47	13
PBB-Acr	2.41	0.33	0.94	1.26	<0.31	8.65	61
EH-TBB	0.05	0.02	0.03	0.03	<0.06	1.19	5
BEH-TEBP	7.38	1.66	1.35	0.35	<0.69	64.2	36
S-DP	0.26	0.11	0.04	0.03	<0.05	4.39	11
A-DP	0.16	0.04	0.05	0.03	<0.05	1.37	29
HBCDD	0.61	0.14	0.28	0.15	<0.30	6.19	29
BTBPE	4.62	1.68	1.24	1.26	<0.06	90.5	91
DBDPE	7.23	3.82	3.37	2.95	<5.90	216	5

[a]Frequecy (%) of Detection (concentration ≥MDL or IDL where MDL =zero); [b]Sum of BDEs 49, 47 and 99; [c]Sum of BDEs 99 and 100; dsum of BDEs 153 and 154; [e]Sum of BDEs 28, 47, 49, 66, 99, 100, 153, 154, 183 and 209

Table S3b. Descriptive statistics for 2008 air sample dataset (N=9; Concentrations in pg m^{-3}).

Flame Retardant	Arithmetic Mean	Standard Error	Geometric Mean	Median	Min	Max	Detection Frequency (%)
BDE-28	0.86	0.23	0.73	0.63	0.45	2.66	100
BDE-49	2.43	2.41	0.05	< 0.05	< 0.05	21.7	11
BDE-47	4.79	1.96	2.52	< 2.08	< 2.08	15.5	44
BDE-66	<0.10		<0.10	<0.10	<0.10	0.43	11
BDE-100	0.62	0.41	<0.32	<0.32	<0.32	3.85	22
BDE-99	3.38	1.97	<1.73	<1.73	<1.73	18.5	22
BDE-85	0.21	0.15	<0.12	<0.12	<0.12	1.41	11
BDE-154	0.23	0.15	<0.10	<0.10	<0.10	1.42	33
BDE-153	0.19	0.13	<0.12	<0.12	<0.12	1.25	11
BDE-183	0.21	0.08	0.12	<0.11	<0.11	0.64	44
BDE-209	2.15	0.42	1.79	1.74	<1.57	3.96	67
BDE-190	<0.12		<0.12	<0.12	<0.12	<0.12	
BDE-201	0.92	0.40	0.34	0.66	<0.05	3.74	78
BDE-197	0.92	0.38	0.42	0.62	<0.04	3.63	89
BDE-203	0.74	0.24	0.43	0.60	<0.09	2.42	78
BDE-196	0.37	0.14	0.20	0.27	<0.07	1.36	78
BDE-208	1.71	0.38	1.22	1.98	0.23	3.57	100
BDE-207	3.17	0.65	2.25	3.51	0.23	6.45	100
BDE-206	2.19	0.46	1.37	2.31	<0.07	3.81	89
TBP-AE	0.40	0.30	0.06	<0.04	<0.04	2.80	33
PBB	0.28	0.09	0.14	0.23	<0.05	0.79	67
PBT	<0.06		<0.06	<0.06	<0.06	0.11	33
PBEB	<0.06		<0.06	<0.06	<0.06	0.30	11
HBB	<0.09		<0.09	<0.09	<0.09		
PBB-Acr	2.65	0.93	1.11	1.27	<0.31	7.51	67
EH-TBB	<0.06		<0.06	<0.06	<0.06		
BEH-TEBP	<0.07		<0.07	<0.07	<0.07		
S-DP	<0.05		<0.05	<0.05	<0.05		
A-DP	<0.05		<0.05	<0.05	<0.05		
HBCDD	<0.30		<0.30	<0.30	<0.30		
BTBPE	2.10	0.71	1.04	1.12	<0.06	6.18	89
DBDPE	<5.90		<5.90	<5.90	<5.90		

Table S3c. Descriptive statistics for 2009 air sample dataset (N=30; Concentrations in pg m^{-3}).

Flame Retardant	Arithmetic Mean	Standard Error	Geometric Mean	Median	Min	Max	Detection Frequency (%)
BDE-28	1.54	0.20	1.15	1.29	< 0.36	5.05	90
BDE-49	0.45	0.24	0.06	< 0.05	< 0.05	6.78	23
BDE-47	8.11	1.66	5.37	6.09	< 2.08	49.5	87
BDE-66	1.10	0.40	0.17	<0.10	<0.10	8.01	37
BDE-100	0.48	0.08	0.35	0.39	<0.32	1.91	53
BDE-99	2.10	0.33	<1.73	<1.73	<1.73	8.58	43
BDE-85	<0.12		<0.12	<0.12	<0.12	0.48	20
BDE-154	0.30	0.07	0.14	<0.10	<0.10	1.71	47
BDE-153	0.48	0.12	0.18	<0.12	<0.12	2.26	47
BDE-183	1.17	0.26	0.35	0.26	<0.11	4.46	60
BDE-209	2.94	0.62	1.93	1.84	<1.57	16.5	60
BDE-190	0.07	0.02	<0.05	<0.05	<0.05	0.37	23
BDE-201	0.57	0.19	0.19	0.26	<0.05	5.29	70
BDE-197	0.91	0.23	0.50	0.41	<0.04	6.20	97
BDE-203	0.53	0.10	0.29	0.38	<0.09	1.74	77
BDE-196	0.42	0.07	0.26	0.27	<0.07	1.25	83
BDE-208	1.24	0.35	0.34	0.54	<0.07	9.68	63
BDE-207	2.11	0.60	0.52	1.21	<0.09	16.3	63
BDE-206	1.69	0.43	0.60	0.90	<0.07	11.8	77
TBP-AE	0.08	0.03	<0.04	<0.04	<0.04	0.71	20
PBB	0.14	0.03	0.07	<0.05	<0.05	0.57	47
PBT	<0.06		<0.06	<0.06	<0.06	0.20	23
PBEB	<0.06		<0.06	<0.06	<0.06	0.12	10
HBB	<0.09		<0.09	<0.09	<0.09	1.19	7
PBB-Acr	3.04	0.50	1.17	4.25	<0.31	8.65	60
EH-TBB	<0.06		<0.06	<0.06	<0.06	0.16	7
BEH-TEBP	3.39	1.62	<0.69	<0.69	<0.69	33.21	17
S-DP	0.21	0.13	<0.05	<0.05	<0.05	3.49	10
A-DP	0.10	0.05	<0.05	<0.05	<0.05	1.14	10
HBCDD	<0.30		<0.30	<0.30	<0.30	2.32	13
BTBPE	6.17	3.06	1.37	1.11	<0.06	90.55	93
DBDPE	<5.90		<5.90	<5.90	<5.90		

Table S3d. Descriptive statistics for 2010 air sample dataset (N=17; Concentrations in pg m^{-3}).

Flame Retardant	Arithmetic Mean	Standard Error	Geometric Mean	Median	Min	Max	Detection Frequency (%)
BDE-28	6.37	3.48	2.70	1.59	0.76	61.2	100
BDE-49	0.65	0.23	0.17	0.21	< 0.05	3.54	59
BDE-47	15.6	3.09	11.6	9.75	4.55	43.4	100
BDE-66	1.28	0.67	0.23	0.21	<0.10	9.28	53
BDE-100	0.64	0.20	0.41	0.42	<0.32	3.61	65
BDE-99	8.92	4.58	2.84	1.86	<1.73	77.0	65
BDE-85	<0.12		<0.12	<0.12	<0.12		
BDE-154	0.31	0.08	0.18	0.29	<0.10	1.28	59
BDE-153	0.27	0.07	0.15	<0.12	<0.12	0.84	41
BDE-183	0.55	0.14	0.29	0.41	<0.11	1.82	65
BDE-209	20.9	10.1	4.51	3.49	<1.57	168	59
BDE-190	0.12	0.03	0.07	0.07	<0.05	0.37	53
BDE-201	0.81	0.34	0.28	0.27	<0.05	5.29	82
BDE-197	1.55	0.40	0.66	1.27	<0.04	6.61	82
BDE-203	0.58	0.13	0.36	0.28	<0.09	1.74	88
BDE-196	0.67	0.11	0.48	0.59	<0.07	1.69	94
BDE-208	0.53	0.21	0.13	<0.07	<0.07	2.57	35
BDE-207	0.87	0.34	0.17	<0.09	<0.09	4.17	35
BDE-206	0.93	0.25	0.34	0.45	<0.07	3.14	71
TBP-AE	<0.04		<0.04	<0.04	<0.04	0.13	18
PBB	0.64	0.17	0.21	0.64	<0.05	2.30	59
PBT	1.66	1.29	0.33	0.34	<0.06	22.19	88
PBEB	0.26	0.10	0.14	0.17	<0.06	1.83	76
HBB	0.28	0.11	0.10	0.05	<0.09	1.47	29
PBB-Acr	1.18	0.32	0.59	0.54	<0.31	4.70	59
EH-TBB	0.10	0.07	0.04	<0.06	<0.06	1.19	6
BEH-TEBP	18.2	3.51	11.0	17.0	<0.69	64.2	88
S-DP	0.46	0.29	0.05	<0.05	<0.05	4.39	18
A-DP	0.33	0.08	0.18	0.29	<0.05	1.37	76
HBCDD	1.47	0.38	0.82	1.15	<0.30	6.19	71
BTBPE	3.21	1.04	1.14	1.53	<0.06	15.20	88
DBDPE	17.05	12.50	4.58	2.95	<5.90	216.13	18

Figure S3. Profiles of BDEs 183, 154 and 153 compared with the profile of pyrene previously measured in the same set of samples.[1]

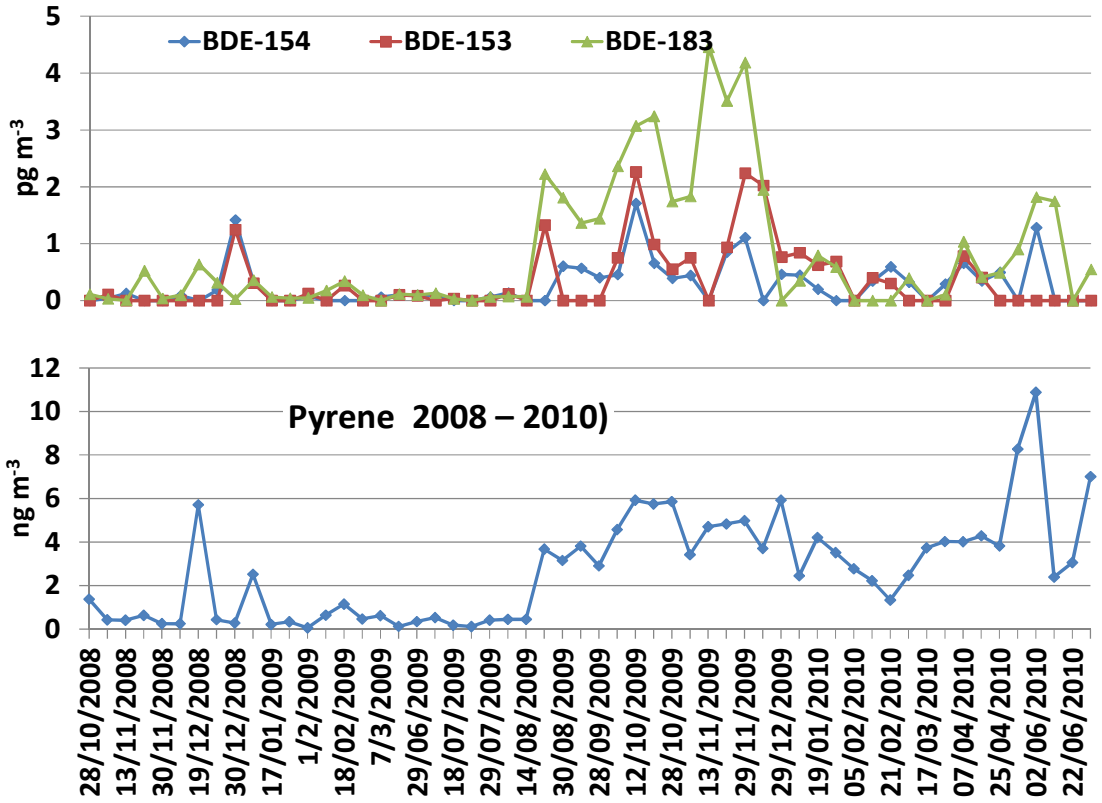


Table S4. Pearson correlation matrix for the profiles of the common PBDEs and BTBPE with each other and with 9 US EPA priority PAHs [1] for the same air samples.

	BDE_28	BDE-47	BDE-100	BDE-99	BDE-154	BDE-153	BDE-183	BDE209
BDE_28	1							
BDE-47	0.541	1						
BDE-100	-0.029	0.368	1					
BDE-99	**0.943**	0.579	0.206	1				
BDE-154	-0.055	0.230	0.554	0.034	1			
BDE-153	-0.037	0.154	0.304	0.019	0.592	1		
BDE-183	-0.018	0.194	0.046	-0.033	0.496	0.598	1	
BDE209	0.269	0.593	0.523	0.391	-0.015	-0.147	-0.048	1
Pyrene	0.115	0.479	0.106	0.152	0.438	0.319	0.571	0.270
Fluoranthene	-0.047	0.387	0.081	-0.026	0.421	0.307	0.536	0.203
Indeno(1,2,3-cd)pyrene	0.129	0.323	-0.055	0.217	0.193	0.104	0.341	0.204
Benzo(ghi)perylene	0.034	0.295	0.002	0.068	0.348	0.343	0.667	0.089
Phenanthrene	0.172	0.378	-0.01	0.225	0.246	0.112	0.329	0.292
Benzo(b&j)fluoranthene	0.128	0.448	0.078	0.224	0.387	0.306	0.526	0.199
Benzo(k)fluoranthene	0.071	0.429	0.093	0.153	0.366	0.296	0.465	0.290
Benzo(e)pyrene	-0.035	0.145	0.082	0.011	0.378	0.413	0.603	0.003
Benz(a)anthracene	0.149	0.523	0.167	0.206	0.393	0.303	0.544	0.362
	Bonferroni adjusted probabilities significant at 95% confidence level							

Table S5. Loading matrix extracted for the PBDEs in air samples from Entebbe. The highest loadings for key PBDEs and PAHs are indicated in bold text.

Compound	Loadings Component 1	Loadings Component 2	Loadings Component 3
BDE-28	**0.152**	0.065	0.270
BDE-49	0.077	0.053	0.283
BDE-47	**0.182**	0.011	**0.325**
BDE-66	0.031	0.099	**0.222**
BDE-100	0.086	-0.131	**0.360**
BDE-99	0.129	-0.052	**0.355**
BDE-85	0.014	-0.139	**0.328**
BDE-154	**0.129**	**-0.173**	0.110
BDE-153	**0.112**	**-0.165**	0.083
BDE-183	**0.19**	-0.048	-0.015
BDE-209	**0.126**	**0.147**	**0.258**
BDE-190	**0.133**	-0.072	0.125
BDE-201	0.007	**0.323**	-0.070
BDE-197	0.088	**0.300**	-0.013
BDE-203	0.050	**0.330**	0.099
BDE-196	0.165	**0.269**	0.051
BDE-208	-0.145	**0.338**	0.036
BDE-207	-0.141	**0.355**	0.018
BDE-206	-0.097	**0.371**	0.032
NAP	**0.155**	0.057	-0.031
ACY	**0.183**	0.040	-0.121
ACE	**0.141**	0.078	0.112
FLU	**0.163**	0.125	-0.066
PHE	**0.227**	0.148	-0.111
ANT	**0.184**	0.075	-0.163
FTH	**0.223**	-0.006	-0.191
PYR	**0.249**	-0.017	-0.074
BaA	**0.249**	-0.013	-0.081
CRY	**0.254**	0.017	-0.048
BbjF	**0.241**	-0.080	-0.062
BkF	**0.237**	-0.034	-0.095
BaPY	**0.23**	0.004	-0.090
IPY	**0.239**	0.037	-0.126
DahA	0.141	0.195	0.130
BghiP	**0.233**	-0.055	-0.175

Figure S4a. Component 1 vs 2 factor scores plot for PBDE and PAH combined data for air samples

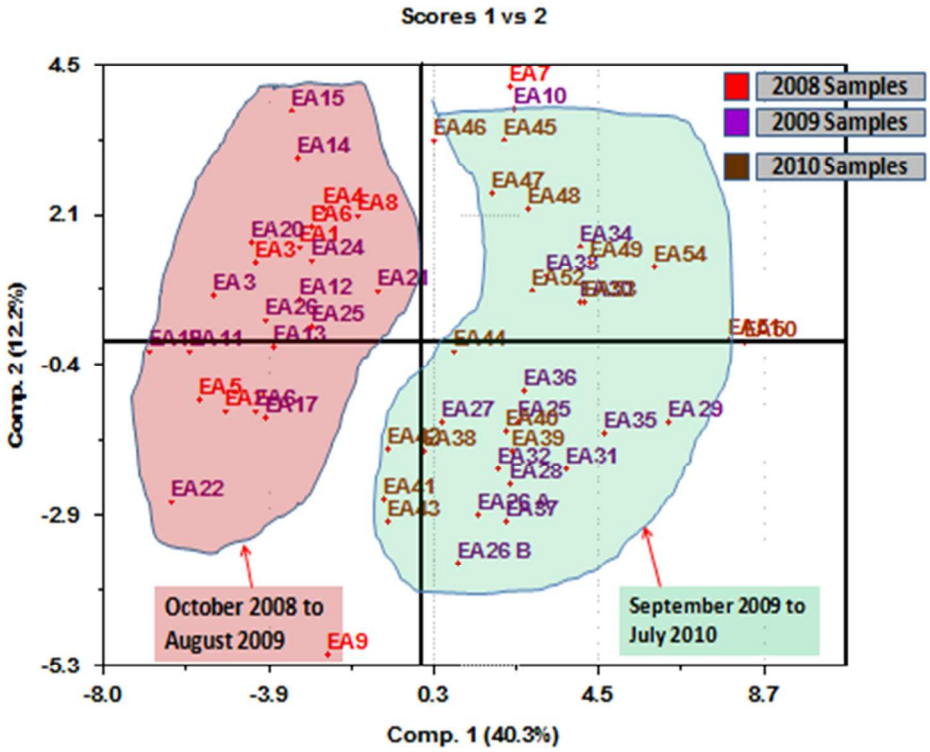
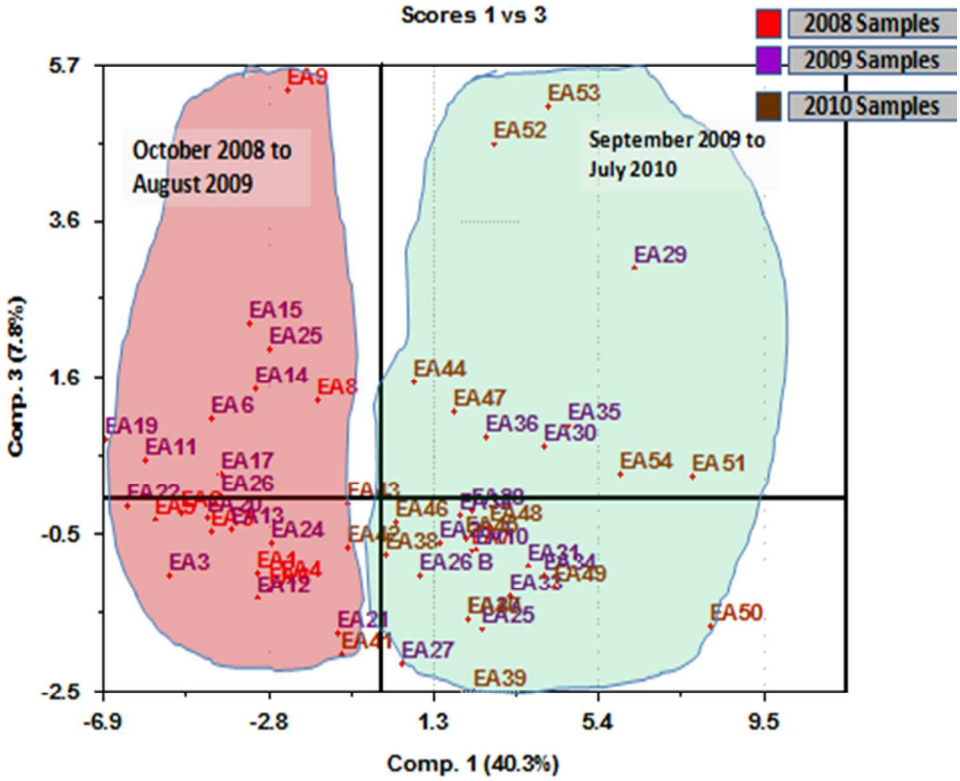


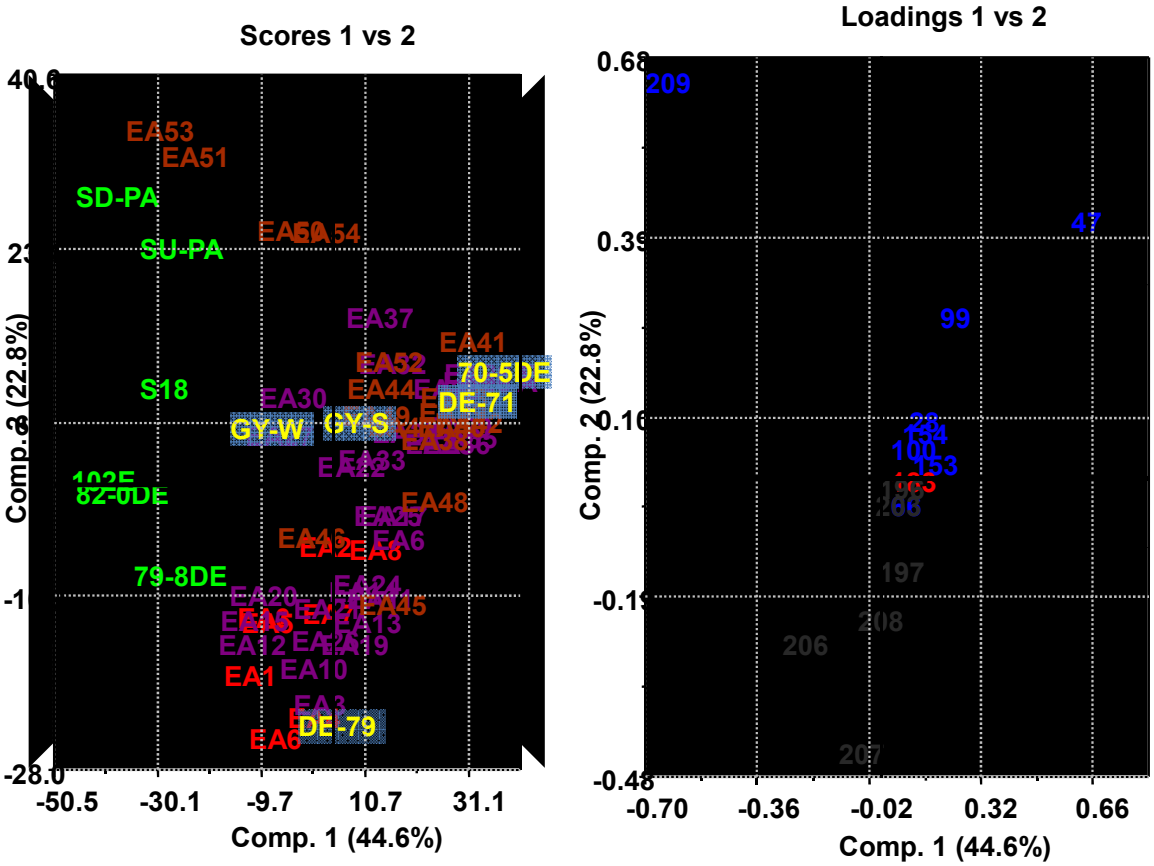
Figure S4b. Component 1 vs 3 factor scores plot for PBDE and PAH combined data for air samples



PCA of PBDE Entebbe air data and data reported elsewhere.

PCA was also done to compare the Entebbe air data with concentration profiles reported elsewhere for technical PBDE mixtures,[4] emissions from a municipal waste incineration plant and two e-waste recycling sites in China.[5, 6] The PBDE congeners that were considered in this PCA are BDEs 28, 48, 99, 153, 154, 183, 196, 197, 203, 206, 207, 208 and 209. Two significant components were extracted and their scores and loading plots are given in Figure S4c. Component 1 (explaining 44.6% of the variance in the dataset) had high loading of BDEs 47 and 99 with low loadings for BDEs 183, 153,154, 100 and 28. The highly brominated PBDEs had very low to negative loadings on this component. Volatilization and atmospheric transfer could be described by this loading distribution where the high PBDE congeners are adsorbed onto particulate matter with BDE-209 as the dominant congener while the lighter PBDEs are more prevalent in the gas phase. In addition, the high loading of BDE 47 and 99 is also explained by relatively high abundance in emissions from old flame retarded products and dispersal by air mass movements. Component 2 (explaining 22.8% of the variance in the dataset) had high positive factor scores for the profiles reported for municipal waste combustion (SD-PA and SU-PA) and moderate factor scores for profiles observed at e-waste sites (S18, GY-W and GY-S) and those reported for technical penta-BDE mixture (DE-71 and 70-5DE). These corresponded to high positive loadings of BDEs 209, 99 and 47. The nona-BDEs had high negative loadings on this component while the hexa-, hepta- and octa-BDEs had median loadings on this component. The octa-BDE technical mixtures had high negative scores on this component. These observations suggest influence of e-waste combustion and handling in the profiles observed in the Entebbe air samples, in addition to photolysis and atmospheric transfer.

Figure S4c. Component 1 vs 2 factor scores and loadings plots for common and higher PBDEs in the air samples from this study and other reports from studies elsewhere.[4-6]



SD-PA and **SU-PA** represent flue gas "Shut Down" and "Start Up" profiles measured during the transient operation stage of a boiler at a U.S. municipal waste combustion plant.[7] The transient operation stage was preferred for reference here in order to represent low temperature open burning that is common in the East African region, especially in Uganda. **S18** represents the profile of PBDEs measured at a waste recycling site (S18 at Tianjin, North China.[5] The profiles of the deca- (**102E** and **82-0DE**), octa- (**DE-79** and **79-8DE**) and penta- (**DE-71** and **70-5DE**) PBDE technical mixtures were those reported by La Guardia et al.[4] **GY-W** and **GY-S** are winter and summer PBDE profiles at an e-waste recycling site at Giuyu, Guangdong, China.[8]

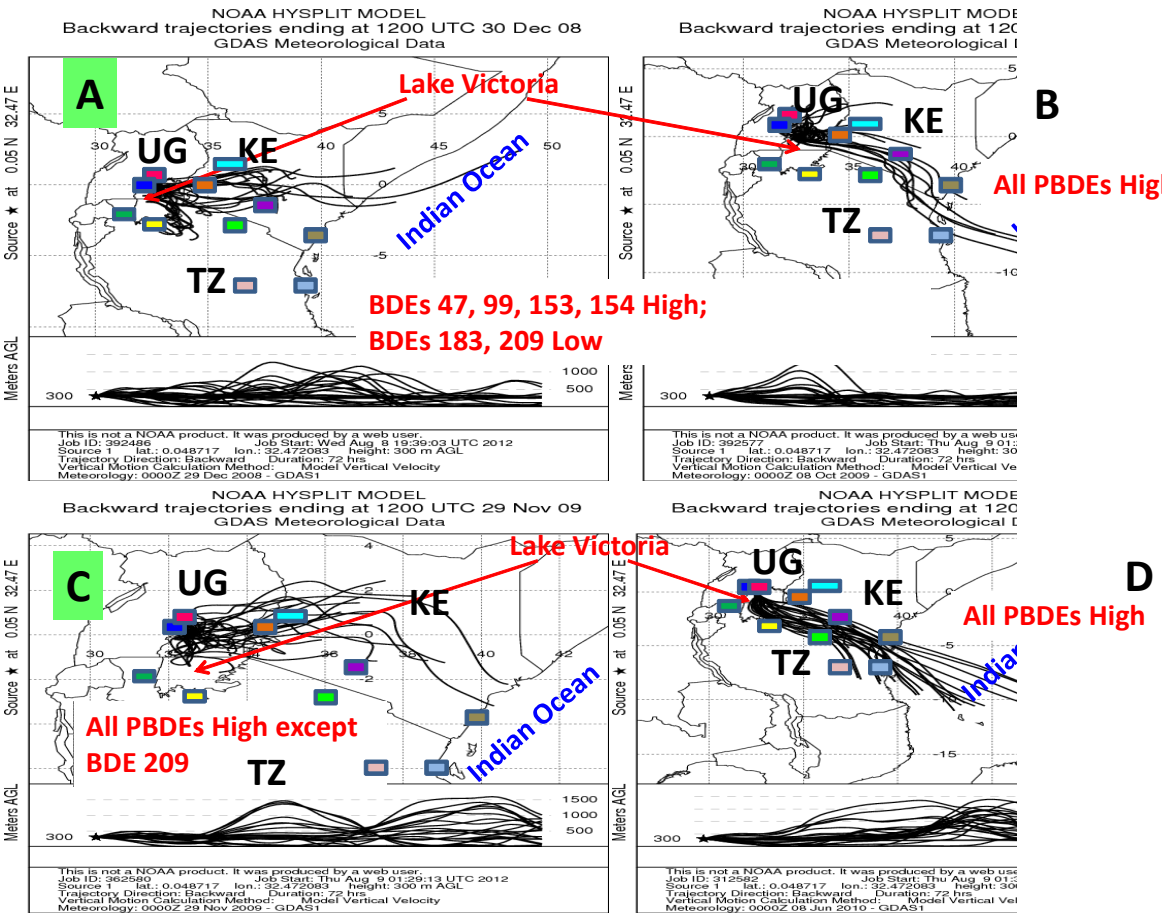
Table S6. Pearson correlation matrix of profiles of AFRs and common PBDEs in 2010 air samples.

	BDE-47	BDE-100	BDE-99	BDE-153	BDE-183	BDE-209	BTBPE	TBP-AE	PBB	PBT	PBEB	HBB	BEH-TEBP	S-DP	A_DP
BDE-47	1.000														
BDE-100	0.534	1.000													
BDE-99	0.709	0.073	1.000												
BDE-153	-0.095	0.115	-0.283	1.000											
BDE-183	-0.354	-0.062	-0.289	0.139	1.000										
BDE209	0.466	-0.089	0.541	0.397	0.003	1.000									
BTBPE	0.754	0.890	0.340	-0.025	-0.346	0.108	1.000								
TBP- AE	-0.343	-0.166	-0.171	-0.002	0.588	-0.040	-0.215	1.000							
PBB	-0.426	-0.143	-0.289	0.069	0.343	0.113	-0.261	0.278	1.000						
PBT	0.538	-0.168	0.940	-0.219	-0.198	0.571	0.059	-0.115	-0.207	1.000					
PBEB	0.551	-0.184	0.865	-0.141	-0.177	0.635	0.024	-0.185	-0.173	0.966	1.000				
HBB	-0.304	-0.118	-0.226	-0.265	0.353	-0.107	-0.265	0.004	0.619	-0.129	-0.036	1.000			
BEH-TEBP	0.233	-0.050	0.201	0.020	-0.285	0.207	0.024	-0.392	0.088	0.214	0.278	0.364	1.000		
S-DP	-0.134	-0.095	-0.160	0.103	-0.172	-0.184	-0.138	-0.162	0.133	-0.099	-0.102	-0.203	0.052	1.000	
A_DP	-0.142	-0.155	-0.213	0.277	-0.157	-0.028	-0.189	-0.079	0.144	-0.127	-0.081	-0.202	0.313	**0.838**	1.000

Table S7. Selected physical-chemical data for BTBPE, PBT and PBEB which showed significant correlation with penta-BDEs (BDE-99 and 100) in the 2010 air samples. (This data was extracted from the extended dataset modeled with EPA's EPI Suite Software)

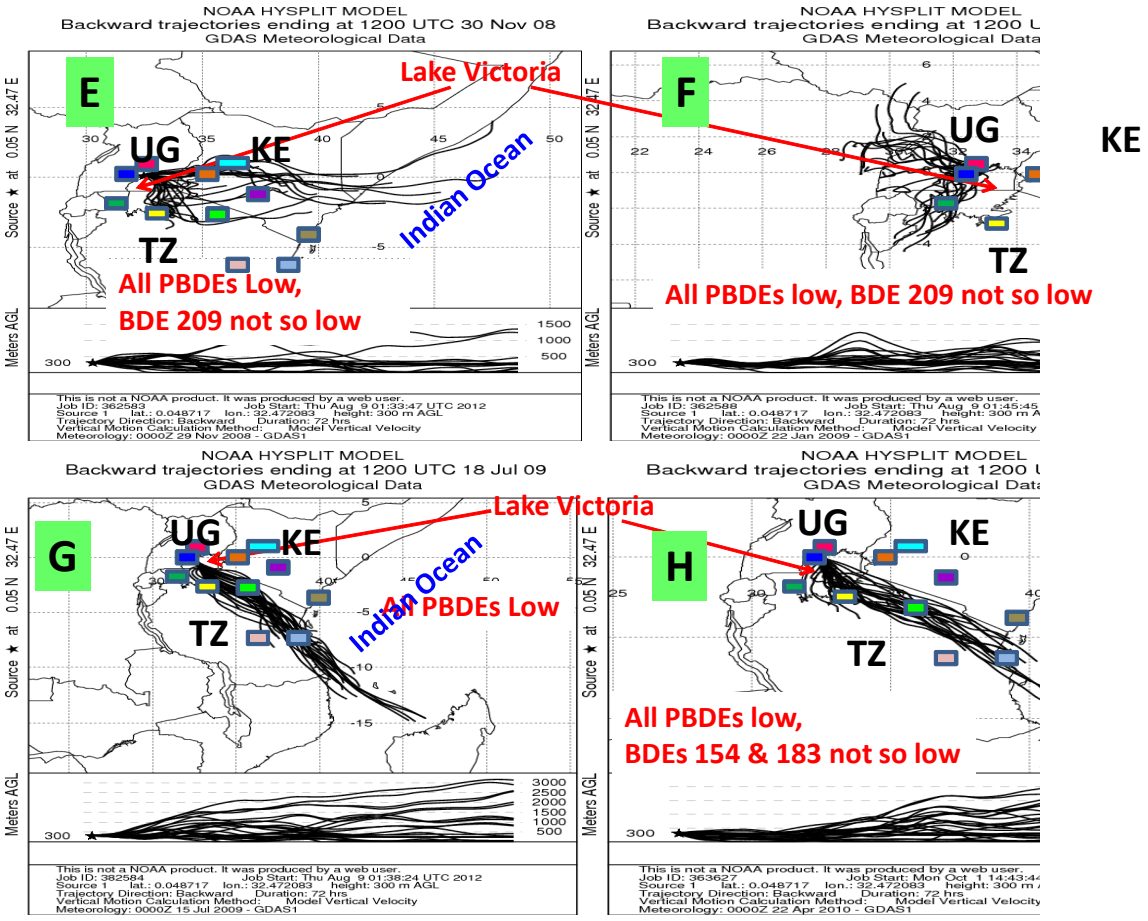
Compound			BDE-99	BTBPE	PBT	PBEB
MW			565	688	487	501
Log K_{ow} (Octanol-Water)			6.84	9.15	6.99	7.48
Henry's Law Constant (Bond Method, 25°C) (atm-m3/mole)			1.18×10^{-6}	7.32×10^{-9}	5.27×10^{-5}	7.92×10^{-5}
Vapour pressure (mm Hg at 25°C)			3.5×10^{-7}	2.38×10^{-10}	1.46×10^{-7}	4.65×10^{-6}
Log K_{oa} (Octanol-air), 25°C			11.3	15.7	9.60	9.97
Sorption to aerosols (25°C)	KP (particle/gas partition coefficient (m3/ug)	Mackay Model	0.064	0.93	1.86×10^{-4}	3.52×10^{-4}
		Octanol/air (K_{oa}) model	0.050	1.16×10^{3}	9.82×10^{-4}	2.29×10^{-3}
	Fraction absorbed to airborne particulates	Junge-Pankow model	0.699	0.971	6.67×10^{-3}	1.25×10^{-2}
		Mackay model	0.837	0.987	1.47×10^{-2}	2.74×10^{-2}
		Octanol/air (K_{oa}) Model	0.8	1	7.28×10^{-2}	0.155
Soil Adsorption Coefficient) Log K_{oc} (MCI Method)			4.336	4.653	3.448	3.729

Figure S5. Back air trajectories (72 hrs, Ensembled matrix) associated with selected air samples showing elevated PBDE levels.



UG = Uganda, **KE** = Kenya, **TZ** = Tanzania; **A,B,C** and **D** are trajectory models computed for air samples collected on December 30, 2008, October 12, 2009, November 29, 2009 and June 11, 2010 respectively. **Kampala city**, the capital city of Uganda, on the North Shore of Lake Victoria and North East of the Sampling site; **Entebbe Municipality** – Location of the sampling site, an urban area which also hosts the Entebbe International Airport (EBB); **Bukoba**, a town on the western shoreline of Lake Victoria in Tanzania; Mwanza town located on the southern shoreline of Lake Victoria, Tanzania; **Kisumu** town located on the eastern shoreline of Lake Victoria in Kenya; **Eldoret** town located about 116 km north-east of Kisumu; **Nairobi**, capital city of Kenya and largest business centre in the East African region; **Arusha** town, a tourist destination and capital of the East African Community; Mombasa, a major Kenyan port city on the Indian ocean coast; **Dar es Salaam**, a major port city and business capital of Tanzania; **Dodoma**, the Capital city of Tanzania.

Figure S6. Back air trajectories (72 hrs, Ensembled matrix) associated with selected air samples showing low PBDE levels.



UG = Uganda, **KE** = Kenya, **TZ** = Tanzania; **E,F,G** and **H** are trajectory models computed for air samples collected on November 30, 2008, January 25, 2009, July 18, 2009, April 25, 2010 respectively. **Kampala** city, the capital city of Uganda, on the North Shore of Lake Victoria and North East of the Sampling site; **Entebbe Municipality** – Location of the sampling site, an urban area which also hosts the Entebbe International Airport (EBB); **Bukoba**, a town on the western shoreline of Lake Victoria in Tanzania; Mwanza town located on the southern shoreline of Lake Victoria, Tanzania; **Kisumu** town located on the eastern shoreline of Lake Victoria in Kenya; **Eldoret** town located about 116 km north-east of Kisumu; **Nairobi**, capital city of Kenya and largest business centre in the East African region; **Arusha** town, a tourist destination and capital of the East African Community; **Mombasa,** a major Kenyan port city on the Indian ocean coast; **Dar es Salaam**, a major port city and business capital of Tanzania; **Dodoma**, the Capital city of Tanzania.

Table S8a. Summary descriptive statistics for PBDE and AFR fluxes ***(ng m^{-2} sample^{-1})*** from precipitation samples.

	Mean	Standard Error	Minimum	Maximum	FD %
BDE-28	0.19	0.03	0.03	0.35	100
BDE-49	0.08	0.06	< 0.31*	0.62	45
BDE-47	3.40	0.77	1.58	10.12	100
BDE-66	0.19	0.04	0.04	0.52	100
BDE-100	0.57	0.08	0.31	1.35	100
BDE-99	6.23	0.94	2.50	13.67	100
BDE-85	0.10	0.03	<0.15*	0.27	64
BDE-154	0.32	0.02	0.20	0.43	100
BDE-153	1.02	0.27	0.27	3.40	100
BDE-183	0.29	0.05	0.10	0.53	100
BDE-209	7.82	3.39	1.61	41.2	100
BDE-190	0.07	0.04	< 2.03*	0.39	27
BDE-201	0.16	0.03	< 0.69*	0.29	73
BDE-197	0.29	0.04	< 2.11*	0.48	91
BDE-203	0.42	0.15	< 2.17*	1.24	45
BDE-196	0.08	0.03	< 2.33*	0.24	45
BDE-208	0.59	0.14	< 2.26*	1.40	73
BDE-207	0.85	0.16	< 4.97*	2.05	91
BDE-206	0.30	0.11	< 5.59*	0.89	45
BTBPE	0.37	0.06	0.14	0.79	100
HBCD	1.77	0.34	0.58	4.56	100
PBB-Acr	0.18	0.07	< 0.02*	0.71	64
S-DP	0.30	0.07	0.07	0.85	100
A-DP	0.82	0.14	0.21	1.74	100

FD% = Frequency of Detection; * value x 10^{-3} (ng m^{-2} sample^{-1})

Table S8b. Summary descriptive statistics for PBDE and AFR fluxes ***(pg m^{-2} day^{-1})*** from precipitation samples.

Compound	Mean	Standard Error	Median	Minimum	Maximum	Frequency of Detection %
BDE-28	5.95	1.03	5.9	0.98	12.16	100
BDE-49	2.61	1.92	< 0.31	< 0.31	21.49	45
BDE-47	107.52	24.74	80.2	50.83	316.34	100
BDE-66	5.91	1.37	4	1.39	16.22	100
BDE-100	17.96	2.71	16.68	9.62	42.21	100
BDE-99	196.74	30.79	186.88	78.11	427.07	100
BDE-85	3.14	0.95	2.26	<0.15	9.24	64
BDE-154	10.01	0.88	11.49	6.19	13.74	100
BDE-153	32.61	9.26	23.89	8.76	117.3	100
BDE-183	9.05	1.54	6.96	3.09	18.32	100
BDE-209	253.33	117.99	127.44	51.88	1420.95	100
BDE-190	2.28	1.35	< 2.03	< 2.03	12.55	27
BDE-201	5.1	1.14	6.05	< 0.69	9.48	73
BDE-197	9.09	1.31	9.35	< 2.11	15.52	91
BDE-203	13.51	4.9	< 2.17	< 2.17	39.88	45
BDE-196	2.63	0.97	< 2.33	< 2.33	7.66	45
BDE-208	18.6	4.61	18.64	< 2.26	43.71	73
BDE-207	27.36	5.43	26.25	< 4.97	70.85	91
BDE-206	9.72	3.58	< 5.59	< 5.59	30.53	45
BTBPE	11.6	1.95	10.3	4.62	27.09	100
HBCD	55.17	10.56	46.46	18.57	142.45	100
PBB-Acr	5.15	1.7	4.08	< 0.02	16.87	64
S-DP	9.26	2.19	6.49	2.16	27.3	100
A-DP	25.8	4.68	20.22	6.61	56.26	100

Figure S7. Proportion (%) of selected common PBDEs in the precipitation samples

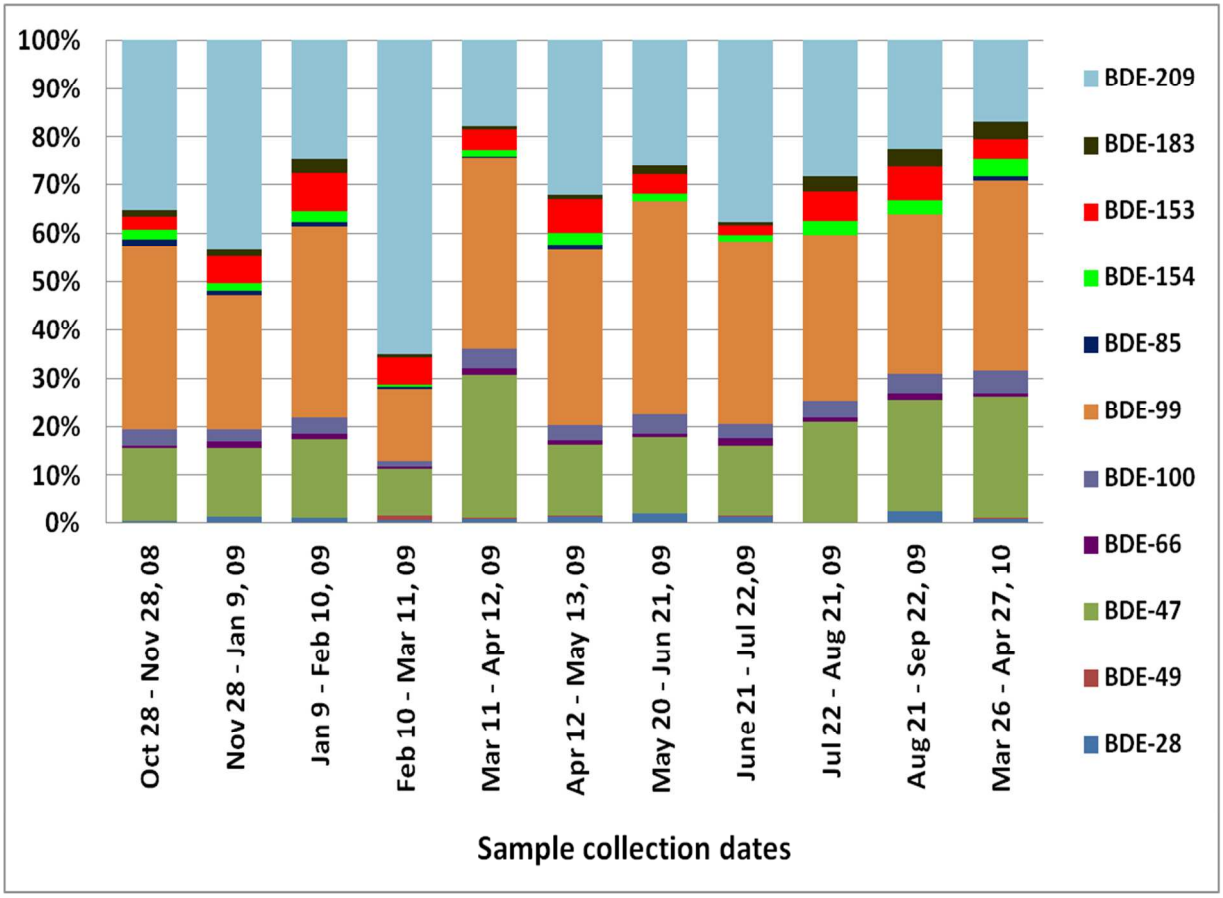


Figure S8. Profiles of fluxes (ng m^{-2} $sample^{-1}$) BTBPE, HBCD, S-DP and A-DP in the precipitation samples along with the profile of total rainfall (mm) received at the sampling site during the sampling period for each sample. The sampling periods for individual samples are given in Table S1.

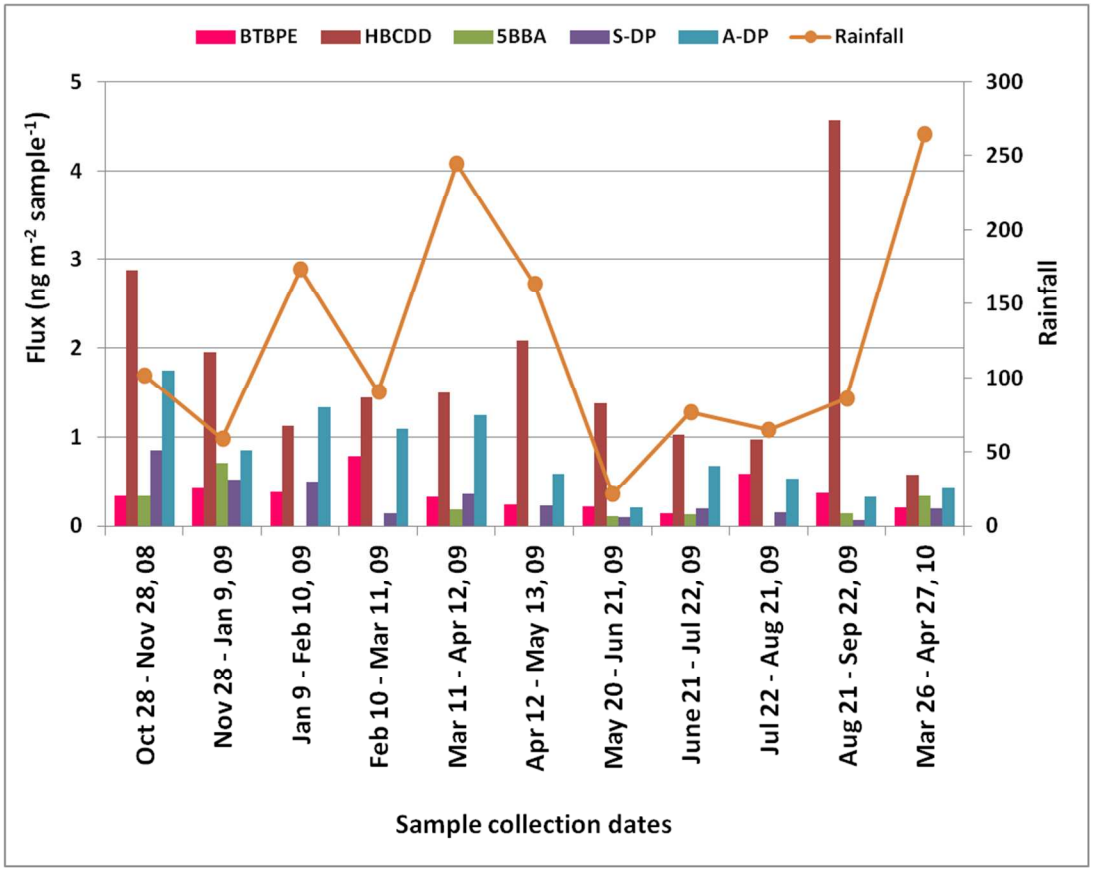


Table S9. Pearson correlation of PBDEs and total rainfall[1] profiles for precipitation samples.

	BDE-28	BDE-49	BDE-47	BDE-66	BDE-100	BDE-99	BDE-85	BDE-154	BDE-153	BDE183	BDE209	BDE 190	BDE 201	BDE 197	BDE 203	BDE 196	BDE 208	BDE 207	BDE 206	Rainfall
BDE-28	1																			
BDE-49	0.579	1										Bonferroni adjusted probabilities p≤0.005 at 95%confidence								
BDE-47	0.533	0.529	1																	
BDE-66	0.668	0.46	**0.907**	1																
BDE-100	0.514	0.33	**0.959**	**0.892**	1															
BDE-99	0.653	0.497	**0.932**	**0.919**	**0.957**	1														
BDE-85	0.245	0.561	0.177	0.152	0.068	0.22	1													
BDE-154	0.162	0.451	0.643	0.554	0.602	0.603	0.413	1												
BDE-153	0.624	**0.918**	0.599	0.548	0.434	0.593	0.661	0.607	1											
BDE-183	0.038	0.482	0.128	0.046	-0.029	0.043	0.262	0.436	0.598	1										
BDE-209	0.598	**0.973**	0.417	0.413	0.222	0.427	0.613	0.358	**0.911**	0.472	1									
BDE 190	-0.089	-0.166	-0.184	-0.174	-0.079	-0.042	0.383	0.433	0.062	0.108	-0.169	1								
BDE 201	-0.221	0.343	0.243	0.075	0.164	0.22	**0.764**	0.565	0.476	0.307	0.34	0.383	1							
BDE 197	0.063	0.349	0.112	-0.047	0.042	0.09	0.22	-0.189	0.147	-0.424	0.346	-0.359	0.251	1						
BDE 203	0.077	0.418	0.308	0.178	0.258	0.368	**0.735**	0.351	0.472	0.059	0.389	0.363	**0.797**	0.382	1					
BDE 196	-0.614	-0.213	0.059	-0.194	0.092	-0.029	0.086	0.216	-0.228	-0.325	-0.291	0.163	0.581	0.488	0.423	1				
BDE 208	0.248	0.408	0.2	0.289	0.146	0.337	0.429	0.132	0.522	0.531	0.508	-0.065	0.401	-0.13	0.393	-0.306	1			
BDE 207	0.332	**0.758**	0.325	0.29	0.233	0.461	0.676	0.449	**0.779**	0.447	**0.796**	0.159	0.643	0.287	0.681	0.009	**0.726**	1		
BDE 206	0.549	0.662	0.597	0.602	0.551	0.642	0.381	0.645	0.589	-0.058	0.588	0.166	0.211	0.304	0.353	0.052	-0.084	0.474	1	
Rainfall	-0.15	0.005	0.433	0.299	0.459	0.332	0.143	0.682	0.051	0.075	-0.163	0.408	0.298	-0.317	0.264	0.323	-0.246	-0.053	0.398	1

[1] Sum of daily rain gauge measurements for the entire sampling period for each XAD column (rain sampler) deployed.

Table S10. Pearson correlation matrix for the fluxes of BTBPE, HBCD, S-DP and A-DP in the precipitation samples along with the profile of total rainfall (mm) received at the sampling site during the sampling period for each sample

	BDE-28	BDE-49	BDE-47	BDE-66	BDE-100	BDE-99	BDE-85	BDE-154	BDE-153	HBCD	BDE-183	BDE-209	BTBPE	5BBA	S-DP	A-DP	Rainfall
BDE-28	1																
BDE-49	0.579	1															
BDE-47	0.533	0.529	1														
BDE-66	0.668	0.46	0.907	1													
BDE-100	0.514	0.33	0.959	0.892	1												
BDE-99	0.653	0.497	0.932	0.919	0.957	1											
BDE-85	0.245	0.561	0.177	0.152	0.068	0.22	1										
BDE-154	0.162	0.451	0.643	0.554	0.602	0.603	0.413	1									
BDE-153	0.624	0.918	0.599	0.548	0.434	0.593	0.661	0.607	1								
HBCD	-0.025	-0.142	-0.229	-0.235	-0.312	-0.362	-0.003	-0.501	-0.165	1							
BDE-183	0.038	0.482	0.128	0.046	-0.029	0.043	0.262	0.436	0.598	-0.249	1						
BDE-209	0.598	0.973	0.417	0.413	0.222	0.427	0.613	0.358	0.911	-0.139	0.472	1					
BTBPE	0.131	0.699	0.282	0.175	0.052	0.151	0.457	0.318	0.751	0.024	0.713	0.73	1				
5BBA	-0.129	-0.279	-0.128	-0.039	-0.138	-0.221	0.114	-0.321	-0.312	0.129	-0.306	-0.213	-0.173	1			
S-DP	-0.343	-0.239	-0.067	-0.045	-0.035	-0.022	0.421	-0.114	-0.17	0.108	-0.192	-0.178	-0.056	0.481	1		
A-DP	-0.06	0.221	0.336	0.324	0.295	0.372	0.557	0.229	0.285	0.019	0.077	0.234	0.264	0.115	0.832	1	
Rainfall	-0.15	0.005	0.433	0.299	0.459	0.332	0.143	0.682	0.051	-0.26	0.075	-0.163	-0.246	-0.013	0.117	0.225	1

Bonferroni Adjusted probability significant at 95% confidence

Figure S9a. Wind roses for precipitation samples ER1-ER4

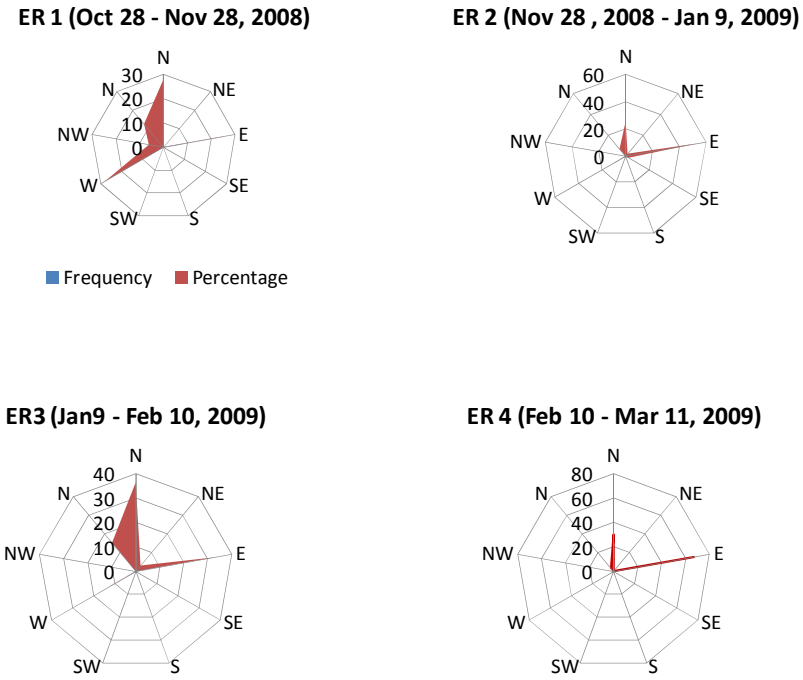


Figure S9b. Wind roses for precipitation samples ER5-ER8

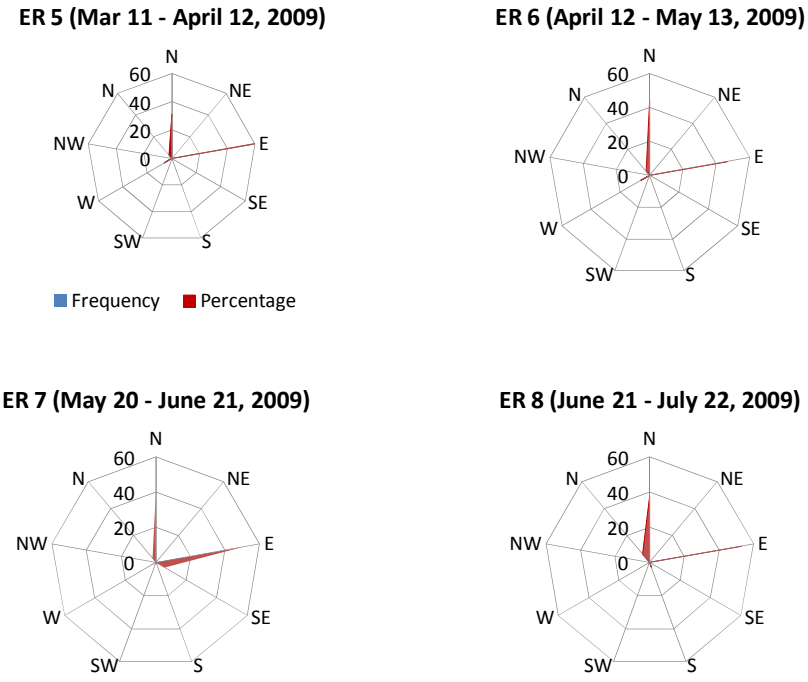
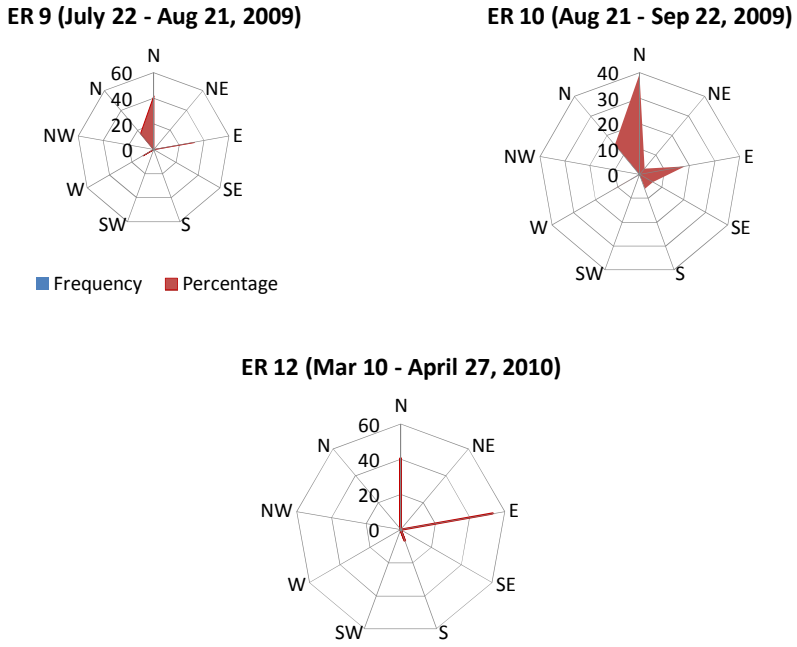


Figure S9c. Wind roses for precipitation samples ER9-ER11



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