Supplementary Information

Human Intakes of Atmospheric Brominated Flame Retardants in Different Weather Types: Levels and Mechanisms

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Supplementary Table 1. The meteorological information of three different weather types in sampling period

Weather type	Date (mm/dd/yy)	Temperature	TSP ($\mu g/m^3$)	AQI
Clear days in summer	08/19/2017	30 ℃ / 20 ℃	80.43	56
	08/21/2017	28 ℃ / 20 ℃	61.88	46
	08/22/2017	29 ℃ / 17 ℃	71.40	50
	08/23/2017	23 ℃ / 16 ℃	64.98	48
	08/27/2017	28 ℃ / 15 ℃	66.92	61
Clear days in winter	12/17/2017	-12 ℃ / -19 ℃	118.26	80
	12/18/2017	-13 ℃ / -24 ℃	85.36	89
	12/19/2017	-13 ℃ / -23 ℃	131.46	84
	12/25/2017	-11 ℃ / -23 ℃	92.17	89
	12/26/2017	-18 ℃ / -24 ℃	62.84	48
Haze days in winter	12/27/2017	-14 ℃ / -24 ℃	106.84	70
	12/30/2017	-12℃ / -17 ℃	185.97	206
	12/31/2017	-12 ℃ / -20 ℃	276.88	162
	01/01/2018	-12 ℃ / -23 ℃	270.31	312
	01/05/2018	-10 ℃ / -21 ℃	111.78	109

Supplementary Table 2. Information and the permeability coefficient of PBDEs and NBFRs congeners

Compounds	*A*	*B*	*H* (pa m^3/mol)	*MW* (g/mol)	K_{OW}	$K_{p\text{-}cw}$(cm/h)	$k_{p\text{-}g}$(m/h)	$k_{p\text{-}d}$(m/h)
BDE-17	-5.29	4286	1.02	407	5.88	0.029	0.53	0.37
BDE-28	-4.84	4286	1.02	407	5.88	0.029	0.53	0.37
BDE-47	-5.64	4722	0.41	486	6.77	0.038	1.38	0.64
BDE-66	-5.42	4722	0.41	486	6.77	0.038	1.38	0.64
BDE-99	-6.21	5157	0.16	565	7.66	0.054	2.92	0.85
BDE-138	-6.78	5592	0.065	644	8.55	0.081	4.48	0.95
BDE-183	-7.44	6027	0.026	722	9.44	0.13	5.40	0.98
BDE-209	-9.50	7333	0.0016	959	12.1	0.57	5.97	1.00
PBT	-2.52	3614	6.05	487	6.99	0.054	0.15	0.13
PBEB	-2.61	3752	8.02	501	7.48	0.10	0.16	0.14
HBBZ	-3.87	4250	2.18	551	7.33	0.038	0.31	0.25
DPTE	-2.52	4046	0.048	531	6.34	0.010	2.72	0.83
EHTBB	-1.87	4235	0.37	550	8.75	0.38	2.98	0.86
BTBPE	-3.06	5584	0.00074	688	9.15	0.12	5.98	1.00
BEHTBP	-2.47	5765	0.030	706	12.0	8.79	5.59	0.99
DBDPE	-8.83	8363	0.0065	971	13.6	5.91	5.89	1.00

Supplementary Table 3. Concentrations of 8 PBDEs and 8 NBFRs in atmosphere under three different weather types in Harbin , China (unit: pg/m^3)

weather types	Compounds	Particle			Gas			Particle + Gas		
		Range	GM	Median	Range	GM	Median	Range	GM	Median
Clear days in summer	BDE-17	0.14-0.93	0.27	0.21	0.87-4.69	2.86	3.21	1.01-5.62	3.17	3.52
	BDE-28	0.07-0.26	0.12	0.10	0.48-2.70	1.19	1.40	0.74-2.8	1.38	1.47
	BDE-47	0.11-0.20	0.15	0.18	0.20-1.23	0.60	0.77	0.31-1.43	0.76	0.89
	BDE-66	0.24-1.22	0.69	1.00	0.06-0.41	0.18	0.25	0.3-1.37	0.91	1.25
	BDE-99	0.05-0.21	0.12	0.17	0.04-0.25	0.14	0.15	0.1-0.42	0.27	0.32
	BDE-138	0.03-0.14	0.09	0.11	0.01-0.07	0.03	0.03	0.05-0.18	0.12	0.15
	BDE-183	0.18-0.66	0.27	0.24	0.03-0.09	0.06	0.05	0.24-0.69	0.34	0.31
	BDE-209	25.7-90.0	38.43	30.20	0.42-1.61	0.91	1.26	27.1-90.5	39.7	31.8
	Σ8PBDEs	27.2-92.7	40.46	31.27	3.42-10.7	6.47	7.26	34.7-101	47.9	37.9
	PBT	0.24-1.17	0.43	0.38	42.6-134	71.3	64.3	42.9-135	71.8	65.5
	PBEB	0.02-0.05	0.03	0.03	0.12-0.43	0.26	0.29	0.14-0.45	0.30	0.31
	HBBZ	0.01-0.19	0.05	0.05	0.49-0.94	0.69	0.65	0.53-0.98	0.77	0.84
	DPTE	3.54-18.7	6.54	5.76	3.56-22.2	6.58	5.26	7.13-29.4	14.5	12.5
	EHTBB	0.55-2.11	1.15	1.47	0.30-0.73	0.46	0.43	0.88-2.54	1.67	1.77

	BTBPE	0.08-0.46	0.21	0.21	0-0.06	0.02	0.01	0.14-0.49	0.25	0.24
	BEHTBP	0.47-2.90	0.90	0.73	0.03-1.38	0.23	0.33	0.51-2.9	1.26	1.57
	DBDPE	5.78-7.75	6.47	6.10	0.26-18.3	2.87	4.95	5.78-25.4	9.31	6.36
	Σ8NBFRs	11.4-31.7	16.6	15.4	52.2-158	84.3	71.0	65.7-174	104	87.2
	Σ16BFRs	41.3-109	58.3	45.0	57.5-166	91.1	79.2	100.38-211	158	185
Clear days in winter	BDE-17	0.10-0.37	0.20	0.19	0.08-0.44	0.20	0.13	0.33-0.72	0.41	0.40
	BDE-28	0.61-0.92	0.84	0.91	0.06-0.17	0.10	0.11	0.73-1.08	0.95	0.98
	BDE-47	0.18-0.79	0.39	0.32	0.05-0.16	0.08	0.06	0.24-0.84	0.50	0.47
	BDE-66	0.32-0.53	0.42	0.42	0.15-0.31	0.20	0.17	0.58-0.68	0.63	0.63
	BDE-99	0.16-0.94	0.36	0.36	0.12-0.22	0.16	0.15	0.31-1.05	0.55	0.58
	BDE-138	0.11-0.61	0.27	0.31	0.08-0.27	0.13	0.11	0.18-0.68	0.42	0.58
	BDE-183	0.26-0.47	0.38	0.41	0.10-0.14	0.11	0.10	0.36-0.61	0.49	0.51
	BDE209	13.0-48.1	26.2	31.6	0.97-2.04	1.43	1.30	14.3-49.1	27.9	33.6
	Σ8PBDEs	16.2-50.1	29.7	35.8	1.87-3.12	2.51	2.71	18.5-51.9	32.5	38.9
	PBT	0.38-0.78	0.52	0.47	0.25-0.75	0.47	0.50	0.72-1.42	1.01	0.88
	PBEB	0.05-0.13	0.09	0.11	0.04-0.13	0.08	0.08	0.09-0.25	0.16	0.19
	HBBZ	0.08-0.13	0.10	0.09	0.04-0.09	0.07	0.08	0.12-0.21	0.17	0.17
	DPTE	1.63-3.32	2.30	2.49	0.41-1.36	0.91	1.12	2.04-4.17	3.26	3.85
	EHTBB	1.46-5.26	2.58	2.85	0.04-0.35	0.12	0.16	1.65-5.29	2.76	3.02
	BTBPE	0.17-0.56	0.27	0.24	0.05-0.30	0.11	0.09	0.26-0.86	0.40	0.33

	BEHTBP	0.85-2.16	1.38	1.42	0.13-0.47	0.23	0.19	0.99-2.44	1.65	1.56
	DBDPE	10.5-22.0	16.9	18.9	12.5-21.3	17.0	19.1	29.1-43.2	34.46	32.6
	Σ8NBFRs	19.4-28.3	255.0	27.1	14.7-24.0	19.2	21.0	38.8-51.3	44.6	42.8
	Σ16BFRs	43.5-73.9	56.6	55.2	16.8-26.5	21.7	23.7	62.4-96.5	79.2	81.7
Haze days in winter	BDE-17	0.28-1.49	0.63	0.46	0.12-0.36	0.24	0.25	0.4-1.73	0.89	0.74
	BDE-28	0.98-3.49	1.84	1.74	0.13-0.21	0.16	0.14	1.11-3.7	2.01	1.94
	BDE-47	0.54-8.13	1.42	1.11	0.07-0.17	0.10	0.10	0.61-8.25	1.55	1.21
	BDE-66	0.63-3.03	0.99	0.65	0.07-0.30	0.11	0.08	0.7-3.17	1.14	0.95
	BDE-99	0.33-6.28	0.85	0.46	0.10-0.20	0.15	0.14	0.43-6.41	1.05	0.62
	BDE-138	0.23-0.59	0.34	0.31	0.05-0.14	0.09	0.09	0.3-0.7	0.42	0.37
	BDE-183	0.33-1.91	0.90	1.26	0.08-0.11	0.10	0.10	0.44-2.02	1.02	1.34
	BDE-209	71.5-163	127	149	1.14-5.28	1.80	1.33	73.0-169	129	150
	Σ8PBDEs	75.1-180	135	154	2.04-6.45	2.84	2.38	77.3-182	138	156
	PBT	0.38-0.87	0.58	0.57	0.32-0.88	0.57	0.59	0.7-1.75	1.14	1.16
	PBEB	0.08-0.25	0.15	0.13	0.04-0.09	0.07	0.07	0.15-0.34	0.22	0.20
	HBBZ	0.12-0.28	0.20	0.20	0.04-0.11	0.07	0.07	0.23-0.37	0.28	0.26
	DPTE	1.99-5.64	3.78	4.10	0.47-2.56	1.06	1.01	4.51-7.43	5.17	4.71
	EHTBB	0.78-8.25	3.20	4.09	0.51-1.30	0.98	1.13	2.08-9.37	4.52	5.26
	BTBPE	0.33-1.97	0.66	0.65	0.06-0.14	0.11	0.11	0.44-2.04	0.80	0.76
	BEHTBP	2.02-5.66	3.04	2.79	0.01-0.22	0.09	0.16	2.17-5.88	3.19	2.88

DBDPE	11.3-25.7	16.27	18.09	8.96-23.3	13.5	13.61	20.3-41.4	30.3	30.9
Σ8NBFRs	20.1-39.9	29.18	32.34	13.7-27.6	16.9	16.12	35.1-67.5	46.5	46.2
Σ16BFRs	95.2-220	165	187	16.0-30.0	20.1	18.6	114-250	185	203

Supplementary Table 4. Correlation coefficients of PBDEs and NBFRs congeners with the concentration of TSP

Compounds	Gas phase	Particle phase	Gas phase + Particle phase
BDE-17	-0.436	0.803**	-0.23
BDE-28	-0.39	0.877**	0.625*
BDE-47	-0.387	0.759**	0.708**
BDE-66	-0.456	0.666**	0.604*
BDE-99	-0.037	0.726**	0.728**
BDE-138	0.059	0.532*	0.511
BDE-183	0.357	0.835**	0.849**
BDE-209	0.651**	0.768**	0.775**
PBT	-0.436	0.327	-0.435
PBEB	-0.437	0.806**	0.012
HBBZ	-0.474	0.754**	-0.328
DPTE	-0.261	-0.153	-0.269
EHTBB	0.427	0.576*	0.612*
BTBPE	0.315	0.791**	0.819**
BEHTBP	-0.224	0.814**	0.817**
DBDPE	0.331	0.515*	0.507
total	-0.376	0.816**	0.540*

*Statistically significant correlation at $P < 0.05$ level

**Statistically significant correlation at $P < 0.01$ level

Supplementary Table 5. The percentages (%) of log K_{PM} falling into ADRs of log K_{PE} and log K_{PS} in three different weather types

weather type		log K_{PE}	log K_{PS}
Clear days in summer	Overestimated	24.7	3.90
	Underestimated	9.09	19.5
	In ADRs	66.2	76.6
Clear days in winter	Overestimated	75.0	0.00
	Underestimated	0.00	3.75
	In ADRs	25.0	96.3
Haze days in winter	Overestimated	64.6	1.27
	Underestimated	0.00	6.33
	In ADRs	35.4	92.41

Supplementary Table 6. Inhalation intakes of gaseous BFRs (DIg) and particulate BFRs (DIp) in the atmosphere [pg/(kg·day)]

	DIg				DIp				DIg+DIp
	Clear days in summer	**Clear days in winter**	**Haze days in winter**	**total**	**Clear days in summer**	**Clear days in winter**	**Haze days in winter**	**total**	
BDE-17	0.53	3.67 × 10-2	4.36 × 10-2	0.61	6.61 × 10-2	4.95 × 10-2	0.16	0.27	0.88
BDE-28	0.22	1.86 × 10-2	2.95 × 10-2	0.27	3.02 × 10-2	0.21	0.45	0.69	0.96
BDE-47	0.11	1.57 × 10-2	1.91 × 10-2	0.14	3.74 × 10-2	9.58 × 10-2	0.35	0.48	0.63
BDE-66	3.38 × 10-2	3.66 × 10-2	2.10 × 10-2	0.09	0.17	0.10	0.24	0.52	0.61
BDE-99	2.61 × 10-2	2.91 × 10-2	2.68 × 10-2	0.08	2.89 × 10-2	8.85 × 10-2	0.21	0.33	0.41
BDE-138	5.48 × 10-3	2.34 × 10-2	1.61 × 10-2	0.04	2.23 × 10-2	6.70 × 10-2	8.48 × 10-2	0.17	0.22
BDE-183	1.04 × 10-2	2.12 × 10-2	1.79 × 10-2	0.05	6.63 × 10-2	9.24 × 10-2	0.22	0.38	0.43
BDE-209	0.17	0.26	0.33	0.76	9.46	6.46	31.1	47.1	47.8
Σ8PBDEs	1.10	0.45	0.51	2.05	9.88	7.16	32.9	49.9	52.0
PBT	13.16	8.76 × 10-2	0.10	13.4	0.11	0.13	0.14	0.38	13.7
PBEB	4.88 × 10-2	1.39 × 10-2	1.27 × 10-2	0.08	7.24 × 10-3	2.23 × 10-2	3.61 × 10-2	0.07	0.14
HBBZ	0.13	1.30 × 10-2	1.28 × 10-2	0.15	1.34 × 10-2	2.43 × 10-2	4.96 × 10-2	0.09	0.24
DPTE	1.22	0.17	0.20	1.58	1.61	0.57	0.93	3.11	4.69
EHTBB	8.44 × 10-2	2.24 × 10-2	0.18	0.29	0.28	0.63	0.79	1.71	1.99
BTBPE	3.07 × 10-3	2.09 × 10-2	2.02 × 10-2	0.04	5.17 × 10-2	6.74 × 10-2	0.16	0.28	0.33
BEHTBP	4.23 × 10-2	4.16 × 10-2	1.74 × 10-2	0.10	0.22	0.34	0.75	1.31	1.41
DBDPE	0.53	3.14	2.50	6.16	1.59	4.16	4.01	9.76	15.9
Σ8NBFRs	15.2	3.51	3.04	21.75	3.89	5.94	6.86	16.7	38.5
Σ16BFRs	16.3	3.95	3.55	23.81	13.8	13.1	39.7	66.6	90.4

Supplementary Table 7. Dermal intakes of gaseous BFRs (DDg) and particulate BFRs (DDp) in the atmosphere [pg/(kg·day)]

	DDg				DDp				DDg+DDp
	Clear days in summer	**Clear days in winter**	**Haze days in winter**	**total**	**Clear days in summer**	**Clear days in winter**	**Haze days in winter**	**total**	
BDE-17	3.73 × 10-2	2.59 × 10-3	3.08 × 10-3	0.04	2.43 × 10-3	1.82 × 10-3	5.71 × 10-3	0.01	0.05
BDE-28	1.55 × 10-2	1.32 × 10-3	2.08 × 10-3	0.02	1.11 × 10-3	7.59 × 10-3	1.66 × 10-2	0.03	0.04
BDE-47	2.02 × 10-2	2.89 × 10-3	3.50 × 10-3	0.03	2.40 × 10-3	6.15	2.24 × 10-2	0.03	0.06
BDE-66	6.22 × 10-3	6.74 × 10-3	3.86 × 10-3	0.02	1.09 × 10-2	6.59	1.56 × 10-2	0.03	0.05
BDE-99	1.02 × 10-2	1.13 × 10-2	1.04 × 10-2	0.03	2.46 × 10-3	7.52 × 10-3	1.78 × 10-2	0.03	0.06
BDE-138	3.27 × 10-3	1.40 × 10-2	9.60 × 10-3	0.03	2.11 × 10-3	6.34 × 10-3	8.03 × 10-3	0.02	0.04
BDE-183	7.45 × 10-3	1.52 × 10-2	1.29 × 10-2	0.04	6.51 × 10-3	9.07 × 10-3	2.17 × 10-2	0.04	0.07
BDE-209	0.13	0.21	0.26	0.61	0.95	0.65	3.11	4.70	5.31
Σ8PBDEs	0.23	0.26	0.31	0.81	0.97	0.69	3.22	4.88	5.69
PBT	0.26	1.76 × 10-3	2.11 × 10-3	0.27	1.43 × 10-3	1.72 × 10-3	1.91 × 10-3	0.01	0.27
PBEB	1.06 × 10-3	3.01 × 10-4	2.75 × 10-4	0.00	1.04 × 10-4	3.19 × 10-4	5.18 × 10-4	0.00	0.00
HBBZ	5.27 × 10-3	5.42 × 10-4	5.32 × 10-4	0.01	3.31 × 10-4	6.02 × 10-4	1.23 × 10-3	0.00	0.01
DPTE	0.44	6.10 × 10-2	7.10 × 10-2	0.57	0.13	4.72 × 10-2	7.74 × 10-2	0.26	0.83
EHTBB	3.35 × 10-2	8.91 × 10-3	7.19 × 10-2	0.11	2.43 × 10-2	5.43 × 10-2	6.73 × 10-2	0.15	0.26
BTBPE	2.44 × 10-3	1.67 × 10-2	1.61 × 10-2	0.04	5.17 × 10-3	6.74 × 10-3	1.63 × 10-2	0.03	0.06
BEHTBP	3.16 × 10-2	3.10 × 10-2	1.30 × 10-2	0.08	2.19 × 10-2	3.35 × 10-2	7.40 × 10-2	0.13	0.20
DBDPE	0.42	2.47	1.96	4.84	0.16	0.41	0.40	0.97	5.81
Σ8NBFRs	1.19	2.59	2.14	5.92	0.35	0.56	0.64	1.54	7.46
Σ16BFRs	1.43	2.85	2.45	6.72	1.32	1.25	3.86	6.43	13.2