Supporting Information on

Atmospheric Distribution and Long-Range Transport Behavior of Organochlorine Pesticides in North America

Li Shen, Frank Wania, Ying D. Lei, Camilla Teixeira, Derek C.G. Muir, Terry F. Bidleman

TABLE SI-1. Sampler Concentrations (ng PAS^{-1}) of OCPs at 40 Stations across North America in 2000/2001

no.	Station	CC	TC	TN	OXY	HEPT	HEPX	dieldrin	α-endo	β-endo	pp'-DDT	pp'-DDE	pp'-DDD	HCB	PeCB
1	**Point Petre**	1.3	1.8	0.76	1.2	0.22	1.6	2.3	18	6.5	ND[a]	4.5	ND	19	13
2	**Burnt Island**	*0.23*	*0.18*	0.68	*0.35*	*0.064*[d]	0.39[b]	1.3	3.5	ND	(0.11)[c]	0.51	Int[e]	13	5.8
3	**Alert**	*0.15*	(0.013)	(0.03)	(0.037)	ND	(0.034)	ND	1.5	ND	ND	ND	*0.031*	13	5.1
4	**Bonavista**	1.1	0.71	0.86	0.82	(0.038)	0.65	1.6	6.6	0.55	*1.9*	*0.37*	0.24	25	12
5	**Daniel Harbour**	*0.18*	*0.15*	*0.16*	(0.027)	(0.033)	*0.11*	(0.18)	2.6	ND	ND	*0.25*	*0.042*	18	7.9
6	**East Point**	0.49	0.46	*0.32*	*0.22*	ND	*0.21*	(0.081)	47	5.8	2.0	3.8	0.25	9.9	3.2
7	**Sable Island**	0.83	0.46	*0.29*	*0.22*	(0.013)	0.41	*0.29*	3.9	(0.019)	(0.040)	*0.32*	0.12	23	9.2
8	**Kejimkujik**	0.66	0.44	*0.19*	(0.089)	(0.015)	0.31	*0.31*	2.4	0.30	ND	*0.38*	*0.081*	15	7.3
9	**St. Leonard**	0.50	0.19	(0.048)	(0.17)	ND	*0.18*	(0.17)	ND	14	3.5	8.9	*0.067*	18	8.7
10	**Frelighsburg**	0.87	0.78	0.70	(0.15)	*0.082*	0.42	*0.57*	26	1.8	(0.24)	2.2	*0.058*	15	8.0
11	**Pukaskwa**	0.40	0.36	*0.13*	(0.17)	ND	0.58	*0.37*	2.3	*0.16*	(0.11)	*0.37*	0.20	16	7.7
12	**Thunder Bay**	*0.20*	0.24	*0.19*	(0.057)	(0.033)	0.45	*0.24*	4.1	*0.19*	ND	*0.16*	*0.081*	19	13
13	**Expl. Lake Area**	*0.25*	0.19	(0.018)	(0.079)	ND	0.38	(0.13)	8.2	0.71	(0.022)	*0.29*	*0.091*	17	7.5
14	**McCreary**	1.1	1.6	*0.24*	*0.29*	ND	0.51	(0.010)	30	3.4	ND	*0.28*	*0.087*	14	6.7
15	**Bratt's Lake**	0.44	0.48	*0.16*	*0.38*	(0.051)	2.2	*0.23*	7.2	0.30	ND	*0.19*	*0.091*	24	11
16	**Suffield**	0.63	0.53	(0.072)	(0.11)	ND	1.2	*0.20*	18	2.0	(0.24)	0.57	ND	23	10
17	**Kananaskis**	0.53	0.32	*0.42*	(0.076)	ND	0.30	*0.38*	8.6	1.3	*1.7*	*0.24*	0.89	14	6.3
18	**Bow Lake**	0.26	*0.057*	(0.12)	(0.12)	ND	*0.12*	(0.19)	7.7	1.1	(0.29)	*0.17*	0.18	15	6.4
19	**Rock Isle Lake**	0.23	*0.17*	(0.067)	(0.12)	ND	(0.057)	ND	11	0.68	(0.051)	0.57	ND	17	7.4
20	**Donald Station**	0.27	*0.15*	*0.21*	*0.18*	ND	*0.15*	*0.33*	4.0	1.6	4.2	*0.12*	1.3	11	5.0

21	**Summerland**	0.34	0.21	ND	(0.036)	(0.012)	*0.14*	*0.26*	130	23	5.0	30	0.14	19	20
22	**Saturna Island**	0.48	0.33	*0.26*	*0.21*	(0.031)	*0.18*	ND	5.9	0.73	(0.31)	0.69	*0.080*	18	7.4
23	**Cape Beale**	0.68	0.39	ND	(0.15)	ND	*0.14*	*0.40*	0.97	ND	2.3	*0.46*	0.84	10	4.0
24	**Eureka**	*0.23*	*0.065*	ND	ND	ND	*0.084*	(0.029)	2.5	ND	ND	(0.043)	(0.021)	18	9.0
25	**Devon Island**	0.28	0.20	*0.32*	(0.036)	1.4	(0.069)	*0.42*	2.4	ND	ND	1.1	0.28	15	6.3
26	**Kangiqtugaapik**	*0.18*	*0.11*	(0.10)	(0.087)	ND	(0.069)	ND	1.3	ND	ND	(0.038)	ND	20	8.6
27	**Cape Dorset**	0.61	0.25	*0.31*	*0.26*	ND	*0.27*	*0.38*	3.7	ND	0.96	*0.15*	0.52	23	11
28	**Kuujjuaq**	*0.22*	*0.10*	(0.053)	(0.11)	ND	(0.027)	ND	1.9	(0.035)	(0.093)	(0.068)	0.14	18	7.8
29	**Kuujjuarapik**	0.33	*0.15*	(0.017)	(0.017)	ND	0.23	*0.35*	2.7	0.39	*0.41*	*0.19*	0.11	15	7.0
30	**Big Creek**	1.3	1.3	0.70	*0.50*	0.33	1.4	3.5	13	2.0	*0.83*	7.1	*0.10*	14	9.7
31	**Toronto**	3.1	4.4	0.87	0.77	2.0	1.1	4.0	37	5.1	2.3	8.9	0.20	21	16
32	**Youngstown**	2.7	2.9	1.5	0.87	0.97	1.5	1.8	9.2	1.0	2.2	3.1	0.20	25	10
33	**Solomons**	6.0	8.3	2.8	0.68	2.9	1.9	4.1	15	4.1	*1.1*	2.5	0.20	16	6.1
34	**Wilmington**	5.6	8.7	3.3	*0.40*	5.4	1.2	1.9	1.7	*0.13*	(0.37)	0.87	ND	9.3	4.5
35	**Turkey Point**	2.4	2.8	0.68	(0.14)	0.92	0.95	0.92	0.60	ND	(0.062)	1.7	0.35	17	7.6
36	**Muscle Shoals**	5.0	7.9	3.1	0.97	5.8	2.3	4.8	20	4.8	6.5	6.9	1.1	18	26
37	**Chetumal**	*0.12*	*0.062*	(0.042)	ND	ND	(0.055)	*0.29*	12	1.6	38	29	1.3	14	4.0
38	**Tapachula**	0.55	0.50	ND	ND	0.14	*0.16*	*0.50*	67	4.3	68	72	3.3	24	8.5
39	**Belmopan**	1.3	1.5	*0.25*	*0.35*	0.20	(0.068)	49	0.90	ND	46	38	1.0	12	4.3
40	**Costa Rica**	0.51	0.36	*0.15*	(0.12)	ND	*0.16*	*0.53*	11	1.2	2.2	*0.38*	0.39	12	3.8

[a] ND, not detectable. [b] ten months deployment. [c] Numbers in brackets are lower than MDLs. [d] Numbers in italic are between MDLs and MQLs. [e] Int, interference

TABLE SI-2. Method Detection Limits (MDL[a]) and Method Quantification Limits (MQL[b]) in ng PAS^{-1} Calculated from the Average Blank Values (ABV[c])

Compound	resin blanks (n=19)	field blanks (n=8)	ABV	MDL	MQL
HCB	0.09 ± 0.11	0.22 ± 0.46	0.13 ± 0.27	0.94	2.8
PeCB	0.22 ± 0.23	0.17 ± 0.09	0.19 ± 0.16	0.67	1.8
α-HCH	0.07 ± 0.05	0.08 ± 0.07	0.07 ± 0.05	0.23	0.61
γ-HCH	0.09 ± 0.06		0.09 ± 0.06	0.26	0.66
cis-chlordane	0.03 ± 0.02		0.03 ± 0.02	0.09	0.26
trans-chlordane	0.04 ± 0.02	0.02	0.03 ± 0.02	0.09	0.19
trans-nonachlor	0.06		0.06	0.18[d]	0.60
oxychlordane	0.06 ± 0.06		0.06 ± 0.06	0.24	0.65
heptachlor	0.03 ± 0.02		0.03 ± 0.02	0.09	0.20
heptachlor epoxide	0.03		0.03	0.08[d]	0.30
aldrin	0.20 ± 0.16	0.10 ± 0.10	0.16 ± 0.14	0.57	1.5
dieldrin	0.09 ± 0.07		0.09 ± 0.07	0.29	0.74
endrin	0.11 ± 0.11	0.07	0.10 ± 0.11	0.43	1.2
α-endosulfan	0.04 ± 0.03	0.04	0.04 ± 0.03	0.13	0.35
β-endosulfan	0.02 ± 0.01	0.05 ± 0.	0.03 ± 0.02	0.09	0.22
p,p'-DDT	0.15 ± 0.19	0.10 ± 0.03	0.15 ± 0.19	0.70	2.0
p,p'-DDE	0.07 ± 0.04		0.07 ± 0.04	0.20	0.47
p,p'-DDD	0.02 ± 0.01	0.02	0.02 ± 0.01	0.05	0.11

[a] ABV plus three times the standard deviation. [b] ABV plus ten times the standard deviation. [c] 19 resin blanks plus 8 field blanks. [d] three times the average blank value.

TABLE SI-3. Input Parameters at 25 °C for Assessment Models TaPL3-2.10, ELPOS-1.1.0, and Chemrange-2.1

	MW	mp	P_L	S_{WL}	log K_{OW}	log K_{AW}	log K_{OA}	half-life/days			
	g mol^{-1}	°C	Pa	mol m^{-3}				Air	Water	Soil	Sediment
HCB	284.8	229.1	0.0931	0.00175	5.56	-1.67	7.23	410	931	1862	6051
PeCB	250.3	84.5	0.833	0.0100	5.01	-1.47	6.49	191	524	1049	3409
a-HCH	290.9	158	0.245	0.333	3.94	-3.53	7.46	79	484	969	3149
g-HCH	290.9	114	0.0757	0.247	3.83	-3.91	7.74	58	484	969	3149
CC	409.8	104.1	0.00488	0.00107	6.17	-2.74	8.91	2.20	5314	10629	34543
TC	409.8	101.1	0.00621	0.00113	6.31	-2.65	8.97	2.20	5314	10629	34543
HEPT	373.4	95.4	0.0502	0.00277	5.82	-2.14	7.96	0.181	3325	6650	21612
HEPX	389.2	163.8	0.0148	0.0122	5.18	-3.31	8.50	2.139	3633	7266	23614
dieldrin	380.9	178.2	0.0121	0.00909	5.45	-3.27	8.72	1.203	2558	5115	16625
endrin	380.9	156.8	0.00542	0.00942	5.29	-3.63	8.92	1.203	2558	5115	16625
aldrin	364.9	99.0	0.0655	0.00129	6.44	-1.69	8.13	0.171	2341	4682	15217
α-endosulfan	406.9	109.2	0.0063	0.00897	5.09	-3.55	8.64	1.355	2794	5587	18159
pp'-DDT	354.5	109.1	0.000444	0.000409	6.38	-3.36	9.74	3.22	1041	2082	6767
pp'-DDE	319.0	88.5	0.00336	0.0008	6.92	-2.77	9.70	2.55	431	862	2802
pp'-DDD	321.0	109.0	0.00120	0.00224	6.32	-3.67	9.99	1.49	362	725	2355

Quality Control Guidelines for Sampler Installation and Retrieval

The following steps were taken to assure that the passive air samplers had been properly installed:

1. The passive samplers were deliberately designed to prevent errors during installation and retrieval. Use is intuitive and extremely simple.
2. The installation and retrieval was performed by qualified and conscientious people. At approximately a third of the sites we performed the installation ourselves. At most of the other air monitoring sites, the operators were employees of the Meteorological Service of Canada with experience in operating considerably more complex air sampling equipment. Most others were environmental scientists. Only very few operators were laypeople.
3. A 3-page very detailed instruction sheet with numerous photographs of every individual step in the installation was send along with the samplers. A similar 2-page sheet with retrieval instructions was send prior to the end of the deployment period. These instruction could be understood and followed without a knowledge of the written text. Copies of these instruction sheets are reproduced on the next few pages.
4. Each package included a disposable camera, and the operators were asked to take photographs of the site, the installation, and the installed sampler. The picture gave us further confidence that the samplers had been installed properly.

Setting up a Passive Air Sampler for Persistent Organic Pollutants

1. Structure Holding the Sampler Housing

The sampler housing should be placed approximately 1.5 meters above the ground in an open area with unobstructed airflow. The easiest solution is to use an existing structure, such as the banister of a sampling platform (Fig. 1a) or a fence post (Fig. 1b). If that option is not feasible, a post needs to be erected. In an area with soft ground cover, a 2 meter long, perforated, galvanised steel bars with an L-profile or a fence post can be used. The bar or post is rammed into the ground using a mallet and a wooden block, and then is further stabilised with three braided steel wires, which are grounded with tent pegs (Fig. 1c).

Figure 1a

Figure 1b

Figure 1c

In areas with solid ground, such as the Arctic, a post such as shown in Fig. 2 can be used.

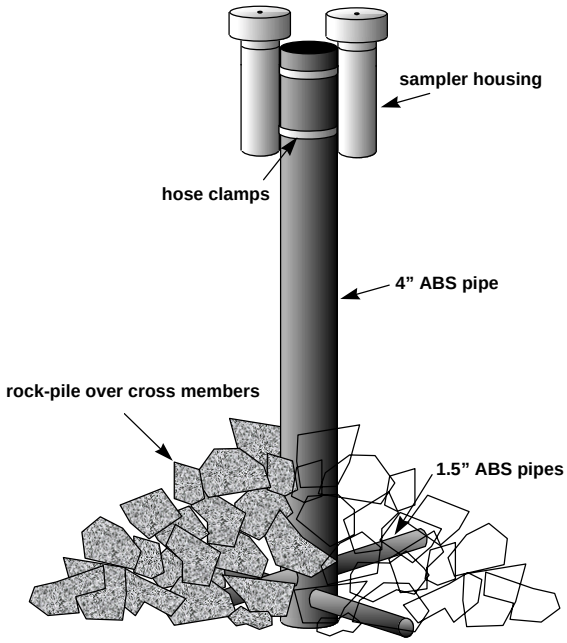

Figure 2

2. Attaching the sampler housing to the support structure

Two hose clamps are attached to the sampler housing (Fig. 3a) and can be used to fasten the housing to the support structure (Fig. 3b). If they are too short, they can be extended to various lengths with additional hose clamps of the same width. Alternatively or additionally, plastic straps can be used. The sampler housing should not be allowed to vibrate or rattle, but should be securely fastened to the support structure.

When attaching the housing to the support it should be kept in mind that the lid has a greater diameter than the main body of the sampler housing, which thus needs to "stick out" sufficiently to allow the lid to be attached (Fig. 3c).

Fig. 3a

Fig. 3b

Fig. 3c

3. Installing the Sorbent Container in the Sampler Housing

The actual samplers containing the sorbent are in white teflon tubes, plugged on either end with a teflon-tape coated rubber plug. These tubes should only be opened when the sampler housings have been set up. **It is important that the sorbent container is not touched with bare hands or otherwise subjected to contamination**. It is possible to deploy the sampler without touching it at all. Nevertheless, latex gloves should be worn during step 3.

Step A: Cut open the protective plastic bag (Figure 4) and remove the plug that is closer to the coloured labelling tape. A wire loop on the top of the sorbent container will be visible.

Figure 4

Step B: Attach the hook at the inside of the housing lid to the wire loop at the top of the sampling container (Fig. 4a) and pull the latter out of the teflon tube (Fig. 4b).

Figure 4a

Figure 4b

Step C: Put the lid on the sampler housing (Fig. 5a), making sure that the sorbent container is centered within the housing (Fig. 5b). If it is not centered, it may be because the sorbent container was placed wrongly between the spacing rods (Fig. 5c).

Figure 5a

Figure 5b

Figure 5c

Step D: Replug the teflon tube, write the sampling location onto its label and reseal them in the plastic bag. Store the teflon tubes in a safe, clean place until retrieval. They will be used to ship the sorbent containers to the laboratory for analysis. Note the date and time of installment, and take a few picture of the sampler.

Retrieval and Shipment Instruction

After exposure in the field, the inside sorbent container needs to be retrieved out of the sampling shelter, transferred to the white Teflon tube, and shipped to the laboratory for analysis. Follow these steps:

1. Wear laboratory gloves to avoid contamination.
2. Open the white Teflon tube and avoid touching the inside of tube and lid (Fig. 1).

Fig. 1

3. Open the lid of the sampler housing, revealing the sorbent container (Fig. 2a and Fig. 2b).

Fig. 2a

Fig. 2b

4. Transfer the sorbent container to the Teflon tube **without touching it** (Fig. 3).

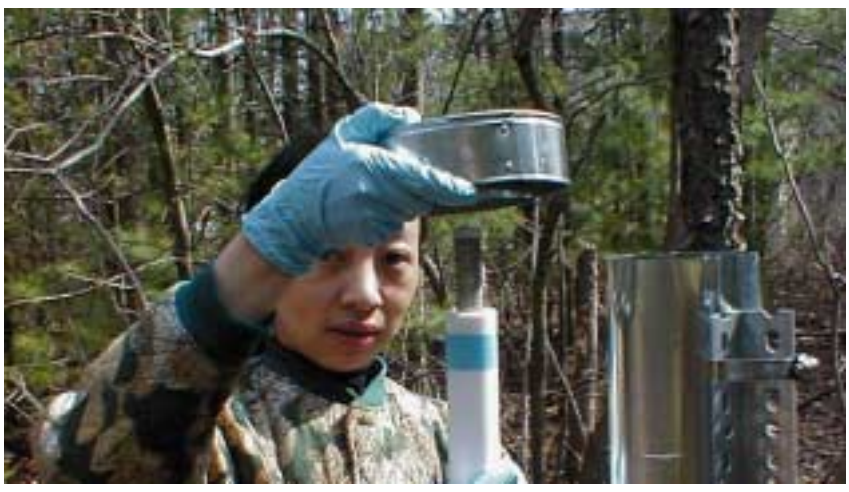

Fig. 3

5. Detach the hook at the top of the sampling container from the wire loop at the inside of the housing and put the sorbent container into the Teflon tube.
6. Replug the Teflon tube tightly and label it with the sampling location and date and time of retrieval (Fig. 4)

Fig. 4

7. Place the Teflon tube into the padded envelope enclosed and ship it to the laboratory for analysis.