Supporting Information for

Seasonal Air Concentration Variability, Gas/Particle Partitioning, Precipitation Scavenging, and Air-Water Equilibrium of Organophosphate Esters in Southern Canada

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Content

Table S1 List of materials, chemicals, and suppliers.

Chemicals	Abbreviation	Supplier
Internal Standards		
Triethyl Phosphate-d_{15}	d_{15}-TEP	Wellington Lab (Canada)
Tri-n-propyl Phosphate-d_{21}	d_{21}-TPrP	Wellington Lab (Canada)
Triphenyl Phosphate-d_{15}	d_{15}-TPhP	Wellington Lab (Canada)
Tris(2-chloroethyl) phosphate-d_{12}	d_{12}-TCEP	Wellington Lab (Canada)
Tris(2-butoxy-[$^{13}C_2$]-ethyl) phosphate	$^{13}C_2$-TBEP	Wellington Lab (Canada)
Tris(1,3-dichloro-2-propyl) phosphate-d_{15}	d_{15}-TDCPP	Wellington Lab (Canada)
Tributyl Phosphate-d_{27}	d_{27}-TBP	Cambridge Iso. Lab. (U.S.)
Injection Standard		
Triamyl Phosphate	TAP	TCI America (U.S.)
Native Standards		
Tri-ethyl phosphate	TEP	Wellington Lab (Canada)
Tri-propyl phosphate	TPrP	Wellington Lab (Canada)
Tri-n-butyl phosphate	TBP	Wellington Lab (Canada)
Tris(2-chloroethyl) phosphate	TCEP	Wellington Lab (Canada)
Tris(1-chloro-2-propyl) phosphate	TCPP	Wellington Lab (Canada)
Tris(1,3-dichloro-2-propyl) phosphate	TDCPP	Wellington Lab (Canada)
Tris (phenyl)phosphate	TPhP	Wellington Lab (Canada)
Tris (2-butoxyethyl) phosphate	TBEP	Wellington Lab (Canada)
2-ethylhexyl-diphenyl phosphate	EHDPP	Wellington Lab (Canada)
Tris (2-ethylhexyl) phosphate	TEHP	Wellington Lab (Canada)
Tri-o-tolyl phosphate	ToTP	Wellington Lab (Canada)
Tri-m-tolyl phosphate	TmTP	Wellington Lab (Canada)
Tri-p-tolyl phosphate	TpTP	Wellington Lab (Canada)
Tris(2-isopropylphenyl) phosphate	T2IPP	Wellington Lab (Canada)
Tris(3,5-dimethylphenyl) phosphate	T35DMPP	Wellington Lab (Canada)
Tris(2,3-dibromopropyl) phosphate	TDBPP	Wellington Lab (Canada)
Others		
Hexane		Millipore Sigma
Acetone		Millipore Sigma
Dichloromethane	DCM	Millipore Sigma
Sodium sulfates	Na_2SO_4	EMD Chemicals Inc.
XAD-2 resin (20-60 mesh)		Supelpak™
PUF and filters		Tisch Environmental, Inc..

Table S2 Transitions and collision energies (CEs) of GC-MS/MS for GC-MS/MS detection.

Chemicals	Precursor ion	Product ion	CE (eV)
Spiking Standards			
Labeled OPEs			
d_{15}-TEP	167.7	103.0	15
	167.1	83.0	45
d_{21}-TPrP	151.1	102.9	5
	199.2	103.0	5
d_{15}-TPhP	341.1	223.2	35
	341.1	176.0	60
d_{12}-TCEP	261.0	196.1	5
	263.0	131.0	10
$^{13}C_2$-TBEP	201.1	103.0	5
	303.2	103.0	5
d_{15}-TDCPP	394.0	163.9	10
	396.0	163.8	10
d_{27}-TBP	167.1	103.0	5
	231.2	103.0	5
Injection Standards			
TAP	168.8	99.0	5
	238.8	99.1	10
Native Standards			
OPEs			
TEP	155.1	99.0	50
	99.0	80.9	20
TPrP	141.9	98.9	5
	183.1	99.0	5
TBP	99.0	81.0	20
	155.0	99.0	5
TCEP	249.0	187.0	5
	249.0	125.0	10
TCPP	201.0	125.0	5
	201.0	99.0	25
TDCPP	191.0	75.0	10
	380.9	158.9	10
TPhP	326.1	169.2	35
	326.1	214.9	35
TBEP	199.0	101.1	5
	299.0	199.0	5
EHDPP	251.0	77.0	35
	250.0	170.0	5
TEHP	99.0	81.0	25
	113.0	95.0	20
ToTP	368.1	181.2	5
	368.1	165.0	60
TmTP	368.1	165.0	60
	368.1	243.0	35
TpTP	368.1	243.0	35
	368.1	197.3	35
T2IPP	118.0	91.0	35
	118.0	77.0	35
T35DMPP	410.2	193.1	35
	410.2	104.0	35
TDBPP	219.0	99.0	5
	217.9	137.0	5

Table S3 Recovery of surrogate standards in passive air samples (PAS), gas phase active air samples (AAS_G), particle samples (GFF), precipitation samples (PCPN), and passive water samples (PWS)

	Recovery Rates (%)		
Chemicals	**AAS**	**PCPN**	**PWS**
d_{15}-TEP	77.7 ± 20.7	88.7 ± 16.8	98.3 ± 9.3
d_{21}-TPrP	118.8 ± 39.2	112.5 ± 36.7	117.1 ±11.1
d_{27}-TBP	142.5 ± 39.9	142.1 ± 65.1	140.1 ±15.3
d_{12}-TCEP	114.6 ± 69.7	91.9 ± 46.6	154.3 ± 18.3
d_{15}-TDCPP	133.5 ± 47.5	120.9 ± 56.6	170.6 ± 35.0
d_{15}-TPhP	153.9 ± 55.2	119.6 ± 49.7	122.4 ± 17.7
$^{13}C_2$-TBEP	172.9 ± 45.3	222.5 ± 136.8	232.4 ± 68.6

Table S4 Basic properties of the nine reliably detected OPEs in our study at 25 ℃

	MW (g/mol)	**log K_{OW}**	**log K_{OA}**	**log K_{AW}**	**ΔH_{AW} (kJ/mol)**	**ΔH_{OW} (kJ/mol)**	**ΔH_{OA} (kJ/mol)**
TEP	182.2	0.66	6.02	-5.71	84.4	28.4	-56.1
TPrP	224.2	2.07	7.17	-5.41	99.7	29.6	-70.1
TBP	266.3	3.65	8.28	-4.88	113.3	29.4	-84.0
TCEP	285.5	1.34	8.53	-7.58	91.0	19.8	-71.3
TCPP	327.6	2.54	8.14	-5.99	99.71	31.9	-105.0
TDCPP	430.9	3.51	11.2	-8.17	119.8	20.9	-98.9
TPhP	326.3	4.68	11.69	-7.47	109.3	0.6	-108.7
TBEP	398.5	3.11	12.25	-9.88	175.1	59.5	-115.3
EHDPP	362.4	6.16	11.63	-5.72	118.7	10.3	-108.8

Molecular weight (MW) data were obtained from PubChem and other data in this table could be obtained using the UFZ-LSER database(UFZ-LSER database v 3.2.1 [Internet], 2024).

Table S5 Details on active air sampling (AAS) and concentration levels of OPEs in the gas phase (pg m^{-3}).

	Start date	End date	Sampling Volume (m^3)	Temperature (°C)	TEP	TPrP	TBP	TCEP	TCPP	TDCPP	TPhP	EHDPP	TBEP
Saturna Island (coordinates: 48.7753, -123.1283)													
1	2019-12-18	2019-12-19	377	6.1	40.6	N.D.	2.5	13.8	9.8	N.D.	4.1	0.2	N.D.
2	2020-01-17	2020-01-18	382	2.2	10.2	N.D.	0.7	8.5	5.9	N.D.	4.9	1.1	N.D.
3	2020-02-14	2020-02-15	599	4.9	14.8	N.D.	1.2	5.9	10.9	N.D.	2.5	0.2	N.D.
4	2020-03-15	2020-03-16	581	3.8	9.5	N.D.	1.1	9.1	1.4	N.D.	1.0	0.4	N.D.
5	2020-04-15	2020-04-16	Pump Died	12.5									
6	2020-05-11	2020-05-12	476	15.4	28.3	N.D.	5.3	80.4	133.5	N.D.	4.2	1.4	N.D.
7	2020-06-11	2020-06-12	459	13.7	39.6	N.D.	3.9	58.4	71.0	N.D.	16.7	2.9	N.D.
8	2020-07-08	2020-07-09	409	14.0	32.4	N.D.	3.8	106.5	188.7	N.D.	8.3	N.D.	N.D.
9	2020-08-06	2020-08-07	455	18.3	18.2	N.D.	2.7	51.3	77.9	N.D.	8.1	2.0	N.D.
10	2020-09-04	2020-09-05	611	14.6	21.0	N.D.	5.8	88.4	128.3	N.D.	24.7	1.0	N.D.
11	2020-10-03	2020-10-04	437	13.3	22.1	N.D.	5.0	76.1	133.8	N.D.	6.5	N.D.	N.D.
12	2020-11-01	2020-11-02	444	9.2	23.5	N.D.	2.7	53.8	80.2	N.D.	5.0	N.D.	N.D.
Tadoussac (coordinates: 48.1431, -69.6931)													
1	2020-12-18	2020-12-19	362	-10.0	3.1	N.D.	N.D.	4.2	8.5	N.D.	N.D.	N.D.	37.2
2	2021-01-16	2021-01-17	487	-2.0	4.8	N.D.	0.1	2.2	8.4	N.D.	1.2	N.D.	N.D.
3	2021-02-14	2021-02-15	479	-11.8	4.0	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	9.7
4	2021-03-13	2021-03-14	533	-11.8	0.2	N.D.	0.3	49.4	16.7	N.D.	N.D.	3.3	N.D.

	Start date	End date	Sampling Volume (m^3)	Temperature (°C)	TEP	TPrP	TBP	TCEP	TCPP	TDCPP	TPhP	EHDPP	TBEP
5	2021-04-14	2021-04-15	515	4.3	6.4	N.D.	0.7	1.6	1.8	N.D.	6.9	2.6	N.D.
6	2021-05-15	2021-05-16	452	6.8	44.2	N.D.	3.1	1.4	1.0	N.D.	14.2	6.5	N.D.
7	2021-06-13	2021-06-14	496	11.0	50.7	N.D.	6.1	3.1	4.8	N.D.	60.7	2.4	15.4
8	2021-07-12	2021-07-13	545	15.8	26.1	N.D.	88.6	20.3	52.4	1.6	51.6	4.5	N.D.
9	2021-08-10	2021-08-11	537	18.0	66.6	N.D.	177.4	24.5	62.7	3.2	50.6	N.D.	N.D.
10	2021-09-08	2021-09-09	450	14.0	94.8	N.D.	29.4	23.6	40.3	5.7	35.4	N.D.	12.5
11	2021-10-07	2021-10-08	526	11.0	103.0	N.D.	52.6	11.5	26.8	1.5	36.2	0.0	N.D.
12	2021-11-05	2021-11-06	460	3.8	14.0	N.D.	3.2	0.3	1.0	N.D.	3.1	6.3	37.2
Toronto (coordinates: 43.7837, -79.1902)													
1	2020-06-17	2020-06-24	407	25.2		85.1	150.9	485.4	2936.0	12.4	82.2	7.9	N.D.
2	2020-06-24	2020-07-01	412	25.2		52.0	59.9	113.9	653.3	7.6	11.5	5.8	N.D.
3	2020-07-01	2020-07-08	368	29.2		84.8	39.7	105.4	778.8	15.8	45.0	37.6	N.D.
4	2020-07-08	2020-07-15	394	27.0		61.8	41.9	133.9	684.6	6.8	15.7	4.6	N.D.
5	2020-07-15	2020-07-22	399	26.3		58.5	53.2	152.9	664.8	4.5	222.0	3.4	N.D.
6	2020-07-22	2020-07-29	392	27.0		56.6	72.3	74.6	651.7	22.0	24.9	8.2	N.D.
7	2020-07-29	2020-08-05	416	24.9		21.8	14.1	65.1	264.0	20.3	108.0	2.3	N.D.
8	2020-08-05	2020-08-12	410	25.4		55.1	67.5	40.3	516.5	10.3	9.9	5.2	N.D.
9	2020-08-12	2020-08-19	485	24.5		39.3	26.5	51.0	340.6	4.0	46.3	0.8	N.D.
10	2020-08-19	2020-08-26	397	26.5		42.6	46.6	45.9	600.7	2.5	19.6	2.5	N.D.

	Start date	End date	Sampling Volume (m^3)	Temperature (°C)	TEP	TPrP	TBP	TCEP	TCPP	TDCPP	TPhP	EHDPP	TBEP
11	2020-08-26	2020-09-02	430	23.4		26.3	26.6	58.2	303.0	318.9	34.2	7.1	N.D.
12	2020-09-02	2020-09-09	459	20.8		23.1	22.6	25.6	176.9	1.3	2.9	N.D.	N.D.
13	2020-09-09	2020-09-16	475	19.1		19.1	16.6	47.6	163.2	2.3	46.6	N.D.	N.D.
14	2020-09-16	2020-09-23	493	17.4		17.3	10.8	95.3	107.1	N.D.	N.D.	3.4	N.D.
15	2020-09-23	2020-09-30	455	21.1		34.5	35.6	74.5	528.0	131.9	32.2	6.8	N.D.
16	2020-09-30	2020-10-07	593	15.0		19.6	21.6	20.0	98.5	1.0	3.6	N.D.	N.D.
17	2020-10-07	2020-10-14	524	14.7		19.8	14.1	39.0	151.8	181.5	13.0	10.1	N.D.
18	2020-10-14	2020-10-21	548	12.6		21.6	5.9	9.4	48.7	272.1	5.7	5.1	N.D.
19	2020-10-21	2020-10-28	638	10.8		21.5	6.4	30.7	68.9	2.0	12.5	N.D.	N.D.
20	2020-10-28	2020-11-04	606	7.2		16.9	3.5	7.2	22.9	0.7	0.3	N.D.	N.D.
21	2020-11-04	2020-11-11	590	14.7		36.8	36.8	35.4	635.0	11.2	14.4	N.D.	N.D.
22	2020-11-11	2020-11-18	605	7.2		12.7	2.6	1.9	18.1	1.6	1.1	N.D.	N.D.
23	2020-11-18	2020-11-25	595	6.8		13.0	1.9	N.D.	10.5	N.D.	2.5	N.D.	N.D.
24	2020-11-25	2020-12-02	615	6.6		20.5	6.9	9.4	37.0	1.3	5.2	6.4	N.D.
25	2020-12-02	2020-12-09	635	2.5		1.7	2.5	N.D.	4.1	1.8	2.1	N.D.	N.D.
26	2020-12-09	2020-12-16	627	3.3		1.9	3.7	0.8	10.6	3.3	0.6	N.D.	N.D.
27	2020-12-16	2020-12-23	386	1.9		2.4	1.3	N.D.	2.4	0.2	27.7	N.D.	N.D.
28	2020-12-23	2020-12-30	379	2.2		1.6	2.7	N.D.	5.4	N.D.	N.D.	N.D.	N.D.
29	2020-12-30	2021-01-06	636	2.8		1.9	1.9	1.5	10.3	0.5	0.8	N.D.	N.D.

	Start date	End date	Sampling Volume (m^3)	Temperature (°C)	TEP	TPrP	TBP	TCEP	TCPP	TDCPP	TPhP	EHDPP	TBEP
30	2021-01-06	2021-01-13	643	1.5		1.8	1.1	0.2	3.7	N.D.	1.4	N.D.	N.D.
31	2021-01-13	2021-01-20	634	3.1		2.3	4.0	1.3	12.0	1.2	3.8	N.D.	N.D.
32	2021-01-20	2021-01-27	646	0.4		1.2	1.0	5.2	4.4	1.8	4.8	13.3	N.D.
33	2021-01-27	2021-02-03	425	-2.7		1.1	1.4	15.5	19.0	0.1	6.4	12.2	N.D.
34	2021-02-03	2021-02-10	677	-1.9		1.4	0.8	4.8	4.4	N.D.	4.3	12.1	N.D.
35	2021-02-10	2021-02-17	699	-3.9		1.6	0.0	N.D.	N.D.	0.5	8.6	N.D.	N.D.
36	2021-02-17	2021-02-24	399	0.1		2.8	0.4	N.D.	2.0	1.7	0.1	7.0	N.D.
37	2021-02-24	2021-03-03	633	2.4		1.3	5.5	1.9	27.6	2.5	18.1	34.4	N.D.
38	2021-03-03	2021-03-10	707	2.4		2.8	1.4	8.3	13.7	N.D.	5.1	17.4	N.D.
39	2021-03-10	2021-03-17	673	5.1		1.5	0.8	N.D.	4.8	0.5	63.6	0.2	N.D.
40	2021-03-17	2021-03-24	580	8.0		3.8	9.6	2.9	75.5	1.1	0.8	0.7	N.D.
41	2021-03-24	2021-03-31	634	9.4		1.3	4.8	12.5	67.1	0.2	3.2	N.D.	N.D.
42	2021-03-31	2021-04-07	632	9.3		2.1	1.8	N.D.	9.4	0.2	0.3	4.4	N.D.
43	2021-04-07	2021-04-14	603	12.9		1.0	8.4	49.2	197.6	5.2	42.7	5.2	N.D.
44	2021-04-14	2021-04-21	623	10.8		1.8	1.8	N.D.	19.6	1.7	0.5	3.3	N.D.
45	2021-04-21	2021-04-28	604	12.9		1.9	7.3	1.1	27.1	3.3	5.5	1.8	N.D.
46	2021-04-28	2021-05-05	622	11.5		2.0	5.6	17.4	70.2	2.0	0.9	6.3	N.D.
47	2021-05-05	2021-05-12	599	12.6		1.5	1.8	4.5	27.9	1.2	18.3	8.5	N.D.
48	2021-05-12	2021-05-19	541	19.7		7.3	21.0	24.1	860.3	2.4	11.1	22.7	N.D.

	Start date	End date	Sampling Volume (m^3)	Temperature (°C)	TEP	TPrP	TBP	TCEP	TCPP	TDCPP	TPhP	EHDPP	TBEP
MDL (pg m^{-3})					5.6	0.1	2.7	8.8	9.2	1.0	4.5	4.7	0.01

The TEP concentrations for samples from Toronto may have interferences in quantification, therefore, these data are not included in this table.
Blank corrected instrument-generated data were substituted for levels below the MDLs to avoid bias.

Table S6 Regressions of the natural logarithm of partial pressure of OPEs in air against reciprocal temperature (in K) using data from PASs deployed during different seasons in Southwestern BC.

	R^2					Slopes					$\Delta H_{SA\text{-}app}$, kJ mol^{-1}				
	TBP	TCEP	TCPP	TPhP	EHDPP	TBP	TCEP	TCPP	TPhP	EHDPP	TBP	TCEP	TCPP	TPhP	EHDPP
L1	0.90	0.96	0.88	0.89	0.81	-2100 ± 700	-7000 ± 1400	-6500 ± 2300	-8900 ± 3100	-18800 ± 9100	17.0 ± 5.8	58.3 ± 11.8	54.1 ± 19.5	**74.3 ± 25.7**	**156.4 ± 76.1**
L3	0.63	0.70	0.65	0.07	0.15	-7900 ± 4200	-5500 ± 2600	-10200 ± 5300			**65.8 ± 35.3**	45.8 ± 21.3	**84.6 ± 44.0**		
L4	0.00	0.16	0.03	0.81	0.15				11800 ± 4000					-98.1 ± 33.3	
L5	0.01	0.04	0.54	0.61	0.55			-11500 ± 7400	-3600 ± 2000	-18000±11500			**95.2 ± 61.6**	29.8 ± 16.9	**149.5 ± 95.3**
L13	0.71	0.88	0.77	0.39	0.00	-6200 ± 3900	-1100 ± 400	-4800 ± 2600			51.2 ± 32.5	9.5 ± 3.5	39.9 ± 21.8		
L31	0.43	0.11	0.95	0.69	0.75	-8700 ± 10000		6800 ± 1600	44900 ± 30400	8400 ± 4900			-56.9 ± 13.0	-373.1 ± 252.4	-70.2 ± 41.1
L34	0.53	0.82	0.00	0.71	0.49	-2900 ± 2700	-2900 ± 1400		-3300 ± 2100		23.9 ± 22.6	23.9 ±11.3		27.7 ± 17.6	
L39	0.94	0.99	0.80	0.00	0.34	-7400 ± 1900	-8300 ± 600	-9900 ± 5000			61.6 ± 15.7	**69.3 ± 5.2**	82.0 ± 41.3		
L43	0.37	0.30	0.54	0.24	0.19			-11900 ± 4900					**98.8 ± 40.7**		
L44	0.84	0.99	1.00	0.73	0.01	-7100 ± 3100	-6200 ± 500	-8300 ± 100	-5400 ± 3200		**59.3 ± 25.6**	51.6 ± 4.3	69.4 ± 0.5	44.6 ± 27.0	
L45	0.78	0.15	0.56	0.55	0.21	-6800 ± 3600		-5900 ± 5200	-6800 ± 6100		**56.9 ± 29.8**		48.7 ± 43.3		
											Theoretical ΔH_{SA}, kJ mol^{-1}				
											84-113	71-91	100-105	109	109-119

* ΔH_{AO} is equal to $-\Delta H_{OA}$ taken from Table S4. The slope and apparent ΔH_{AS} only calculated for OPEs with R^2 values greater than 0.5.
$\Delta H_{SA\text{-}app}$ values in bold indicate values that are in the range of the predictions.

Table S7 Regressions of the natural logarithm of partial pressure of OPEs in gas phase against reciprocal temperature (in K) using data from one-year of active air sampling in Tadoussac, Saturna Island, and Toronto.

	R^2	*p*	n**	Slope	Apparent ΔH_{AS} (kJ mol^{-1})	Theoretical ΔH_{AS}* (kJ mol^{-1})
Saturna Island						
TEP	0.32	7.0E-02	11	-4200 ± 2000	35 ± 17	56-84
TBP	0.69	1.1E-02	8	-9300 ± 2600	77 ± 21	84-113
TCEP	0.75	2.4E-03	9	-12100 ± 2600	101 ± 22	71-91
TCPP	0.74	3.0E-03	9	-21200 ± 4800	176 ± 40	100-105
TPhP	0.16	3.2E-01	8	-4100 ± 3800		
EHDPP	0.80	2.9E-01	3	-12500 ± 6200	104 ± 51	109-119
Tadoussac						
TEP	0.77	1.7 E-04	12	-11500 ± 2000	96 ± 17	56-84
TBP	0.78	7.1E-04	10	-19900 ± 3700	165 ± 31	84-113
TCEP	0.02	6.7E-01	11	-1800 ± 4100		
TCPP	0.11	3.1E-01	11	-3900 ± 3700		
TDCPP	0.10	6.9E-01	4	-5500 ±11900		
TPhP	0.88	2.0E-04	9	-16400 ± 2300	137 ± 19	109
TBEP	0.03	8.2E-01	4	600 ± 2200		
EHDPP	0.04	7.1E-01	6	-700 ± 1700		
Toronto						
TPrP	0.70	1.2E-13	48	-10800 ± 1000	90 ± 9	70-100
TBP	0.82	2.0E-18	47	-11800 ± 800	98 ± 7	84-113
TCPP	0.84	9.9E-20	47	-15600 ± 1000	130 ± 8	100-105
TDCPP	0.36	2.4E-05	42	-9700 ± 2000	80 ± 17	99-120
TCEP	0.64	7.9E-10	39	-12200 ± 1500	102 ± 12	71-91
TPhP	0.33	3.0E-05	46	-8400 ± 1800	70 ± 15	109
EHDPP	0.00	6.9E-01	31	600 ± 1600		

*Theoretical ΔH_{AS} are between ΔH_{AW} and ΔH_{AO}, taken from Table S4. ΔH_{AO} is equal to $-\Delta H_{OA}$. The apparent ΔH_{AS} only calculated for OPEs with R^2 values greater than 0.3.**n is the number of samples

Table S8 Comparison of OPE concentrations in PAS and AAS (pg/m^3) on Saturna Island and in Tadoussac.

	Start date	End date	TBP	TCEP	TCPP	TPhP
Saturna Island						
AAS 7	2020-06-11	2020-06-12	3.9	58.4	71.0	16.7
AAS 8	2020-07-08	2020-07-09	3.8	106.5	188.7	8.3
AAS 9	2020-08-06	2020-08-07	2.7	51.3	77.9	8.1
AAS 10	2020-09-04	2020-09-05	5.8	88.4	128.3	24.7
AAS 11	2020-10-03	2020-10-04	5.0	76.1	133.8	6.5
AAS 12	2020-11-01	2020-11-02	2.7	53.8	80.2	5.0
Average AAS level			4.0	72.4	113.3	11.6
PAS (site L43) level	2020-05-28	2020-10-11	36.2	17.5	67.6	26.3
Tadoussac						
AAS 1	2020-12-18	2020-12-19	N.D.	4.2	8.5	N.D.
AAS 2	2021-01-16	2021-01-17	0.1	2.2	8.4	1.2
AAS 3	2021-02-14	2021-02-15	N.D.	N.D.	N.D.	N.D.
AAS 4	2021-03-13	2021-03-14	0.3	49.4	16.7	N.D.
AAS 5	2021-04-14	2021-04-15	0.7	1.6	1.8	6.9
AAS 6	2021-05-15	2021-05-16	3.1	1.4	1.0	14.2
AAS 7	2021-06-13	2021-06-14	6.1	3.1	4.8	60.7
AAS 8	2021-07-12	2021-07-13	88.6	20.3	52.4	51.6
AAS 9	2021-08-10	2021-08-11	177.4	24.5	62.7	50.6
AAS 10	2021-09-08	2021-09-09	29.4	23.6	40.3	35.4
Average AAS level			30.8	13.5	19.7	22.7
PAS (site S57 level)	2019-11-29	2020-08-24	< MDL	6.9	12.2	23.5
PAS/AAS ratio for Saturna Island			9.1	0.2	0.6	2.3
PAS/AAS ratio for Tadoussac			N/A	0.5	0.6	1.0

Table S9 Details on active air sampling (AAS) and concentrations of five OPEs in particle phase (pg per cubic meter sampling air) and fractions of OPEs in the particle phase (Φ)

	Concentration in particle phase (pg m^{-3})					Fraction of an OPE in particle phase (Φ, %)*					Temperature (°C)	$PM_{2.5}$ concentration (µg m^{-3})#
Sample	**TBP**	**TCEP**	**TCPP**	**TPhP**	**EHDPP**	**TBP**	**TCEP**	**TCPP**	**TPhP**	**EHDPP**		
Saturna Island (coordinates: 48.7753, -123.1283)												
1	10.9	22.8	30.3	N.D.	N.D.	81	62	87			6.1	
2	4.1	41.4	43.7	N.D.	N.D.	85	83	88			2.2	
3	6.1	13.0	38.1	N.D.	N.D.	84	69	78			4.9	
4	3.5	4.7	17.2	N.D.	N.D.	72	52	92			3.8	
5											12.5	
6	13.9	70.2	263.3	N.D.	N.D.	72	47	66			15.4	
7	8.3	79.1	176.0	N.D.	N.D.	68	58	71			13.7	
8	11.9	114.9	351.0	N.D.	N.D.	76	52	65			14.0	
9	3.3	52.0	97.4	N.D.	N.D.	55	50	56			18.3	
10	1.0	42.6	48.4	N.D.	N.D.	15	33	27			14.6	
11	6.0	65.5	189.0	N.D.	N.D.	55	46	59			13.3	
12	5.0	42.4	90.3	N.D.	N.D.	66	44	53			9.2	
Mean	6.7	49.9	122.3			66	54	67			10.7	
SD	4.0	31.7	109.3			20	14	19				
log K_{OA} at average temperature	9.0	9.1	8.8									
Tadoussac (coordinates: 48.1431, -69.6931)												

	Concentration in particle phase (pg m^{-3})					Fraction of an OPE in particle phase (Φ, %)[*]					Temperature (°C)	$PM_{2.5}$ concentration (μg m^{-3})[#]
1	1.4	2.2	6.9	14.5	16.3	100	35	45	100	100	-10.0	2.3
2	1.3	1.0	2.0	1.4	0.3	95	31	19	55	100	-2.0	5.0
3	0.7	0.5	1.4	1.1	0.5	100	100	100	100	100	-11.8	2.4
4	0.3	0.4	0.8	N.D.	N.D.	56	1	4	100	0	-11.8	2.4
5	2.5	1.5	3.8	0.5	0.3	78	49	68	6	11	4.3	5.4
6	6.7	2.7	6.8	N.D.	N.D.	68	67	87	0	0	6.8	5.5
7	3.2	1.4	2.7	N.D.	0.9	34	30	36	0	28	11.0	5.0
8	1.8	0.8	1.4	N.D.	1.0	2	4	3	0	18	15.8	4.2
9	1.0	0.7	1.6	2.4	0.6	1	3	3	5	100	18.0	14.1
10	7.4	2.2	6.0	0.9	0.5	20	9	13	3	16	14.0	2.9
11	1.1	0.7	1.0	4.2	0.4	2	6	4	10	100	11.0	6.8
12	5.9	0.6	2.3	N.D.	0.4	65	71	70	0	6	3.8	1.8
Mean	2.8	1.2	3.1	2.1	1.8	52	34	38	32	48	4.1	4.8
SD	2.5	0.8	2.3	4.1	4.6	39	32	36	44	46		
log K_{OA} at average temperature	9.4	9.4	9.1	13.1	13.0							
Toronto (coordinates: 43.7837, -79.1902)												
1	0.1	3.2	21.3	2.9	20.5	0	1	1	3	72	25.2	9.6
2	0.3	25.0	14.6	0.9	8.4	1	18	2	7	59	25.2	6.2
3	0.8	106.6	40.7	1.6	10.7	2	50	5	3	22	29.2	7.1
4	1.6	42.2	36.1	2.3	14.2	4	24	5	13	75	27.0	6.6

	Concentration in particle phase (pg m⁻³)					Fraction of an OPE in particle phase (Φ, %)*					Temperature (°C)	$PM_{2.5}$ concentration (μg m^{-3})#
5	0.1	15.0	15.5	4.9	13.0	0	9	2	2	79	26.3	6.7
6	4.3	3.7	26.9	1.8	9.8	6	5	4	7	54	27.0	6.7
7	0.4	4.6	14.3	1.0	0.8	3	7	5	1	24	24.9	5.2
8	1.0	N.D.	14.6	10.6	19.6	2	2	3	52	79	25.4	6.9
9	0.8	8.7	27.5	1.5	12.5	3	15	7	3	94	24.5	6.2
10	2.5	6.0	46.4	2.1	15.3	5	12	7	10	86	26.5	8.3
11	1.4	7.6	52.6	4.1	12.2	5	12	15	11	63	23.4	4.1
12	5.9	25.2	141.4	3.4	6.8	21	50	44	54	93	20.8	3.9
13	2.9	7.9	63.3	4.7	7.8	15	14	28	9	77	19.1	3.9
14	1.5	5.5	48.6	5.8	7.3	13	5	31	72	68	17.4	3.7
15	1.0	2.9	42.2	7.2	20.2	3	4	7	18	75	21.1	11.0
16	4.0	4.2	56.3	7.2	17.1	16	17	36	67	88	15.0	4.3
17	3.6	16.9	110.2	8.5	12.8	20	30	42	40	56	14.7	4.8
18	8.0	14.1	103.6	17.3	6.8	58	60	68	75	57	12.6	3.9
19	9.1	24.2	144.1	8.5	21.9	59	44	68	40	90	10.8	5.3
20	10.9	13.0	124.2	15.0	9.1	76	64	84	98	79	7.2	5.7
21	1.1	4.6	50.6	20.0	27.5	3	11	7	58	92	14.7	18.7
22	14.9	7.5	86.6	15.6	7.9	85	80	83	93	77	7.2	5.3
23	13.6	23.5	146.7	12.9	12.9	88	84	93	84	85	6.8	5.3
24	15.8	15.6	121.9	27.8	10.8	70	78	77	84	63	6.6	7.0

	Concentration in particle phase (pg m^{-3})					Fraction of an OPE in particle phase (Φ, %)*					Temperature (°C)	$PM_{2.5}$ concentration (μg m^{-3})#
25	15.8	5.8	106.5	22.5	7.6	86	57	96	92	76	2.5	6.0
26	18.6	21.5	121.5	18.9	16.0	83	96	92	97	87	3.3	10.3
27	16.4	13.3	115.7	13.1	6.4	92	75	98	32	73	1.9	10.4
28	14.6	8.2	57.6	7.0	3.2	84	65	91	76	57	2.2	4.2
29	10.8	20.9	98.8	13.0	7.3	85	93	91	94	76	2.8	7.9
30	17.3	5.4	79.5	16.8	24.1	94	97	96	92	91	1.5	9.2
31	27.4	20.4	123.7	20.4	14.2	87	94	91	84	86	3.1	13.4
32	15.4	13.2	109.2	21.3	5.3	94	72	96	82	29	0.4	5.8
33	5.8	14.3	83.3	4.7	3.2	81	48	81	42	20	-2.7	4.0
34	17.1	7.9	71.3	24.8	31.4	96	62	94	85	72	-1.9	7.0
35	12.5	11.8	78.3	16.4	5.2	90	73	94	66	69	-3.9	5.6
36	27.1	18.4	126.2	25.0	8.3	99	81	98	100	54	0.1	9.2
37	15.1	20.1	126.6	12.8	15.6	73	91	82	41	31	2.4	7.9
38	9.0	16.3	100.8	19.1	14.4	87	66	88	79	45	2.4	6.9
39	16.4	25.8	150.7	14.7	10.2	96	85	97	19	98	5.1	6.3
40	19.4	45.2	222.9	43.3	19.9	67	94	75	98	96	8.0	10.6
41	10.1	28.8	167.2	18.3	10.0	68	70	71	85	81	9.4	5.9
42	13.1	24.7	166.3	16.3	10.6	88	85	95	98	71	9.3	7.3
43	0.9	13.0	33.5	1.5	2.5	10	21	14	3	32	12.9	6.8
44	8.1	6.3	122.7	9.8	10.6	82	59	86	95	76	10.8	5.9

	Concentration in particle phase (pg m^{-3})					Fraction of an OPE in particle phase (Φ, %)*					Temperature (°C)	$PM_{2.5}$ concentration (μg m^{-3})#
45	31.8	24.2	159.7	9.2	11.7	81	96	85	63	87	12.9	7.1
46	8.0	33.1	167.3	4.8	6.8	59	66	70	84	52	11.5	6.7
47	5.3	5.8	125.0	4.8	5.5	74	56	82	21	39	12.6	3.3
48	1.1	4.3	46.9	15.2	28.7	5	15	5	58	56	19.7	9.8
Mean	9.2	16.6	89.8	11.7	12.2	50	50	56	54	68	12.2	7.0
SD	8.0	16.5	50.5	8.7	6.8	38	32	38	35	21		
log K_{OA} at average temperature	8.9	9.1	8.7	12.5	12.4							
log K_{PA} at 15 °C(m^3 g^{-1})**	1.2	2.0	1.6	4.8	4.7							
MDL (pg m^{-3})	0.6	0.7	1.1	0.001	0.001							

½ MDLs were used for not detected samples when the mean and standard deviation (SD) were calculated for the concentrations of OPEs in particle phase. Values of 0 were assigned to samples for which blank-correction yielded negative concentrations.

* ½ MDLs were used for data lower than MDLs. For TPhP and EHDPP in Tadoussac, more than 50% Φ data points were calculated using ½ MDLs, which may have high uncertainties; thus, they were not considered reliable.

** K_{PA} is the average partitioning ratio between aerosol and air (m^3 air g^{-1} aerosol), which could be calculated using the UFZ-LSER database (UFZ-LSER database v 3.2.1 [Internet], 2024).

$PM_{2.5}$ concentration at Tadoussac and Toronto were obtained from the national air pollution surveillance program (NAPS) stations 53201 and 60410, respectively.

Table S10 Regressions of the natural logarithm of partitioning ratio between aerosol and air (K_{PA}, m^3 g^{-1}) against reciprocal temperature (in K) using data from one-year of active air sampling in Tadoussac, Saturna Island, and Toronto.

	R^2	p	n*	Slope	Apparent ΔH_{AS} (kJ mol^{-1})	ΔH_{AO} (kJ mol^{-1})**
Saturna Island* **						
TBP	0.38	5.6E-02	10	9700 ± 4300	80.4 ± 36.0	84.0
TCEP	0.61	7.6E-03	10	7600 ± 2200	63.3 ± 17.9	71.3
TCPP	0.57	1.2E-02	10	10600 ± 3300	88.2 ± 27.3	105.0
Tadoussac						
TBP	0.53	1.6E-02	10	18400 ± 6100	152.7 ± 50.5	84.0
TCEP	0.44	3.7E-02	10	11600 ± 4700	96.5 ± 38.7	71.3
TCPP	0.14	2.6E-01	11			
TPhP	0.80	3.9E-02	5	14100 ± 4000	117.4 ± 33.4	108.7
EHDPP	0.52	2.4E-01	4	-5100 ± 3500	-42.2 ± 28.9	
Toronto						
TBP	0.78	1.7E-16	47	21300 ± 1700	177.3 ± 13.9	84.0
TCEP	0.55	9.8E-08	37	13400 ± 2000	111.8 ± 16.8	71.3
TCPP	0.79	1.2E-16	47	19500 ± 1500	162.2 ± 12.6	105.0
TPhP	0.49	7.4E-08	46	14000 ± 2200	116.4 ± 15.4	108.7
EHDPP	0.02	4.0E-01	32			

* n is the number of samples.
** ΔH_{AO} is equal to $-\Delta H_{OA}$ taken from Table S4. The apparent ΔH_{AS} only calculated for OPEs with R^2 values greater than 0.3 and p value lower than 0.1.
*** The concentrations of $PM_{2.5}$ near the sampling site on Saturna Island are not available; thus, a constant $PM_{2.5}$ concentration was used for linear regressions.
To avoid high uncertainties, only samples reliably detected were used for the linear regressions.

Table S11 OPE concentrations in precipitation and wet deposition flux in Tadoussac and on Saturna Island.

		mm	Concentration, ng/L								Wet deposition flux, ng/m^2/day							
		Precipitation	**TEP**	**TBP**	**TCEP**	**TCPP**	**TDCPP**	**TPhP**	**TBEP**	**EHDPP**	**TEP**	**TBP**	**TCEP**	**TCPP**	**TDCPP**	**TPhP**	**TBEP**	**EHDPP**
Saturna Island																		
2019-12-18	2020-01-17	106.2	4.4	5.9	117.1	126.8	28.0	3.8	81.2	7.3	15.7	20.8	414.5	448.9	99.1	13.4	287.5	25.8
2020-01-17	2020-02-14	189.3	Sample lost															
2020-02-14	2020-03-15	92.5	2.1	1.4	1.1	2.8	7.0	0.6	1.2	0.3	6.3	4.3	3.4	8.5	21.6	1.7	3.8	0.9
2020-03-15	2020-04-15	45.9	4.6	4.2	10.7	23.1	11.0	1.0	11.2	0.4	6.9	6.3	15.8	34.1	16.3	1.4	16.6	0.6
2020-04-15	2020-05-11	38.7	2.3	2.7	4.0	11.9	17.8	0.8	8.1	0.5	3.4	4.0	5.9	17.6	26.5	1.1	12.0	0.8
2020-05-11	2020-06-11	46.9	1.7	2.4	4.6	9.0	17.8	0.6	5.1	0.3	2.6	3.6	6.9	13.6	26.9	1.0	7.7	0.5
2020-06-11	2020-07-08	32.4	1.5	4.1	9.6	34.8	24.4	0.7	19.3	0.7	1.8	5.0	11.5	41.8	29.3	0.8	23.2	0.8
2020-07-08	2020-08-06	21.2	7.2	11.5	8.5	26.4	18.9	1.1	5.8	1.6	5.3	8.4	6.2	19.3	13.8	0.8	4.2	1.1
2020-08-06	2020-09-04	25.0	1.4	5.8	7.6	23.6	41.4	0.5	4.1	0.6	1.2	5.0	6.6	20.3	35.7	0.5	3.5	0.5
2020-09-04	2020-10-03	58.1	2.3	2.4	3.9	9.2	19.4	0.6	9.5	0.6	4.7	4.9	7.8	18.3	39.0	1.2	19.1	1.2
2020-10-03	2020-11-01	89.7	3.7	2.1	4.2	11.5	38.6	1.3	1.5	0.5	11.4	6.4	12.9	35.6	119.5	4.0	4.6	1.6
2020-11-01	2020-12-01	130.7	1.7	1.2	0.8	3.4	5.5	0.5	3.5	0.2	7.5	5.2	3.7	14.8	24.0	2.4	15.2	1.0
Mean		73.1	3.0	4.0	15.6	25.7	20.9	1.0	13.7	1.2	6.1	6.7	45.0	61.2	41.1	2.6	36.1	3.2
Tadoussac																		
2020-12-18	2021-01-16	49.5	1.2	0.8	6.0	15.4	16.5	0.8	4.4	2.7	2.1	1.3	10.3	26.3	28.2	1.4	7.6	4.6
2021-01-16	2021-02-14	46.0	1.2	0.4	2.7	3.0	55.7	0.7	3.3	0.3	1.9	0.7	4.2	4.8	88.3	1.2	5.2	0.5
2021-02-14	2021-03-13	34.6	1.2	0.8	2.7	5.3	11.9	1.1	2.2	0.4	1.6	1.1	3.4	6.8	15.2	1.4	2.8	0.6
2021-03-13	2021-04-14	48.0	0.6	0.4	1.3	4.5	12.5	0.5	2.4	0.3	0.9	0.5	2.0	6.7	18.8	0.8	3.5	0.4
2021-04-14	2021-2015	67.3	2.2	0.3	1.4	4.7	26.1	0.5	1.8	0.2	4.7	0.7	3.0	10.2	56.7	1.0	3.9	0.4
2021-05-15	2021-06-13	18.9	1.8	0.8	2.8	5.9	259.8	0.7	4.1	0.3	1.2	0.5	1.8	3.9	169.3	0.5	2.6	0.2
2021-06-13	2021-07-12	82.9	0.6	0.5	1.0	2.9	6.2	0.4	1.8	0.2	1.8	1.5	2.9	8.1	17.8	1.1	5.1	0.6

2021-07-12	2021-08-10	44.2	0.3	0.5	1.1	3.6	6.7	0.7	0.0	0.3	0.5	0.8	1.7	5.6	10.1	1.1	0.0	0.4
2021-08-10	2021-09-08	17.7	1.6	0.6	1.0	2.8	4.3	0.4	1.6	0.3	1.0	0.4	0.6	1.7	2.6	0.3	1.0	0.2
2021-09-08	2021-10-07	92.4	1.0	0.4	0.9	1.4	3.5	0.7	1.8	0.4	3.0	1.3	2.7	4.5	11.1	2.4	5.8	1.4
2021-10-07	2021-11-05	95.2	1.1	1.0	7.7	6.2	4.0	0.6	7.5	0.2	3.5	3.3	25.3	20.5	13.1	2.0	24.7	0.7
Mean		54.2	1.2	0.6	2.6	5.1	37.0	0.6	2.8	0.5	2.0	1.1	5.3	9.0	39.2	1.2	5.6	0.9
MDL			1.1E-04	1.0E-01	2.8E-04	1.3E-01	1.3E-03	5.9E-04	1.5E-03	4.1E-05								

Table S12 Comparison of measured scavenging ratios and equilibrium scavenging ratios

	Temperature (°C)	Measured scavenging ratio, MSR								Ratio between MSR and estimated scavenging ratio ESR*							
		TEP	TBP	TCEP	TCPP	TDCPP	TPhP	TBEP	EHDPP	TEP	TBP	TCEP	TCPP	TDCPP	TPhP	TBEP	EHDPP
Saturna Island																	
2019-12-18	6.05	1.1E+05	4.4E+05	3.2E+06	3.2E+06		9.0E+05		4.0E+07		9.2E-01	1.9E-02	1.3E+00				
2020-01-17	2.15																
2020-02-14	4.90	1.4E+05	1.9E+05	5.9E+04	5.6E+04		2.2E+05		1.2E+06		3.9E-01	3.5E-04	1.2E-02				
2020-03-15	3.75	4.8E+05	9.2E+05	7.7E+05	1.2E+06		8.9E+05		1.2E+06		1.1E+00	2.5E-03	5.8E-01				
2020-04-15	12.50																
2020-05-11	15.35	6.1E+04	1.2E+05	3.0E+04	2.3E+04		1.5E+05		2.4E+05		5.1E-01	4.4E-04	1.5E-02				
2020-06-11	13.70	3.7E+04	3.4E+05	7.0E+04	1.4E+05		3.9E+04		2.3E+05		1.2E+00	1.0E-03	8.6E-02				
2020-07-08	14.00	2.2E+05	7.3E+05	3.9E+04	4.9E+04		1.4E+05		1.2E+06		2.8E+00	5.2E-04	2.6E-02				
2020-08-06	18.30	7.5E+04	9.6E+05	7.4E+04	1.3E+05		6.6E+04		2.8E+05		4.7E+00	1.7E-03	1.1E-01				
2020-09-04	14.60	1.1E+05	3.6E+05	3.0E+04	5.2E+04		2.5E+04		6.0E+05		9.8E-01	3.1E-04	1.6E-02				
2020-10-03	13.25	1.7E+05	1.9E+05	2.9E+04	3.6E+04		1.9E+05		4.0E+05		5.7E-01	3.2E-04	1.5E-02				
2020-11-01	9.15	7.2E+04	1.5E+05	8.8E+03	2.0E+04		1.1E+05		1.7E+05		3.3E-01	5.3E-05	3.9E-03				
Tadoussac																	
2020-12-18	-10.00	1.1E+05	5.4E+05	9.3E+05	1.0E+06	8.2E+06	5.6E+04	1.2E+05	1.7E+05		2.7E+00	2.9E-04	6.6E-03		2.8E-01		8.3E-01
2021-01-16	-2.00	2.5E+05	3.0E+05	8.4E+05	2.9E+05	2.8E+10	2.8E+05	4.4E+08	1.2E+06		5.9E-01	8.4E-04	5.4E-03		2.6E-04		6.1E+00
2021-02-14	-11.75	2.4E+05	1.2E+06	5.0E+06	3.7E+06	5.9E+09	1.0E+06	2.2E+05	8.2E+05		6.1E+00	2.5E+01	1.9E+01		5.1E+00		4.1E+00
2021-03-13	-11.75	1.9E+06	6.3E+05	2.7E+04	2.6E+05	6.3E+09		3.1E+08	7.9E+04		3.1E-02	4.1E-06	7.1E-04		0.0E+00		1.8E-04
2021-04-14	4.25	3.4E+05	9.7E+04	4.6E+05	8.5E+05	1.3E+10	6.2E+04	2.4E+08	6.1E+04		1.5E-01	1.5E-03	1.1E-01		8.4E-05		3.6E-03
2021-05-15	6.75	4.1E+04	7.7E+04	6.8E+05	7.5E+05	1.3E+11	5.2E+04	5.4E+08	5.3E+04		1.3E-01	4.9E-03	3.4E-01		1.0E-04		4.4E-03
2021-06-13	11.00	1.2E+04	5.7E+04	2.3E+05	3.8E+05	3.1E+09	6.3E+03	1.2E+05	6.5E+04		1.1E-01	1.4E-03	7.5E-02		2.5E-05		1.6E-02
2021-07-12	15.75	1.3E+04	5.8E+03	5.2E+04	6.8E+04	4.2E+06	1.4E+04	0.0E+00	4.8E+04		1.8E-02	4.4E-04	1.8E-02		1.1E-04		2.4E-02
2021-08-10	18.00	2.3E+04	3.5E+03	3.9E+04	4.4E+04	6.5E+05	8.3E+03	2.1E+08	5.0E+05		1.5E-02	4.4E-04	1.7E-02		1.0E-04		2.5E+00
2021-09-08	14.00	1.0E+04	1.1E+04	3.3E+04	3.1E+04	6.1E+05	2.0E+04	1.5E+05	9.3E+05		2.9E-02	2.4E-04	7.0E-03		1.3E-04		3.3E-01
2021-10-07	11.00	1.0E+04	1.9E+04	6.3E+05	2.2E+05	2.6E+06	1.5E+04	1.0E+09	6.3E+05		2.7E-02	2.9E-03	2.9E-02		6.6E-05		3.1E+00

* We obtained the estimated scavenging ratios (ESRs) assuming equilibrium between OPE in the atmospheric gas phase and water droplets (Oh et al., 2023), and that all OPEs are sorbed to the same particles, which are scavenged with a scavenging ratio W_P of 200,000 (Kim et al., 2006). Therefore, they should be equal to $(1-\Phi)K_{WA} + \Phi W_P$, where K_{WA} is the temperature-adjusted partitioning ratio between water and air ($K_{WA} = K_{AW}^{-1}$, Table S4).

Table S13 Details on passive water sampler (PWS) networks and concentration levels of OPEs

						ng L^{-1}						
	Start Date	**End Date**	**days**	**Latitude**	**Longitude**	**TBP**	**TCEP**	**TCPP**	**TDCPP**	**TPhP**	**EHDPP**	**TEHP**
Southwestern BC												
V1_Top	2021-06-21	2021-07-26	35	49.2916	-122.8863	4.8E+00	N.D.	N.D.	2.8E+01	N.D.	6.2E-03	N.D.
V1_Mid	2021-06-21	2021-07-26	35	49.2916	-122.8863	N.D.	1.5E+02	N.D.	N.D.	N.D.	4.7E-03	4.4E-03
V1_Bot	2021-06-21	2021-07-26	35	49.2916	-122.8863	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
V2_1_Top	2021-06-29	2021-07-20	21	49.3204	-122.9102	1.3E+01	N.D.	N.D.	N.D.	N.D.	1.7E-02	N.D.
V2_1_Bot	2021-06-29	2021-07-26	27	49.3204	-122.9102	9.1E+00	N.D.	N.D.	N.D.	N.D.	1.9E-02	N.D.
V2_Top	2021-07-20	2021-08-09	20	49.3204	-122.9102	1.3E+01	N.D.	N.D.	N.D.	N.D.	8.9E-03	1.9E-02
V2_Bot	2021-07-20	2021-08-09	20	49.3204	-122.9102	1.7E+01	N.D.	5.4E+00	1.9E+01	N.D.	N.D.	2.1E-02
V3_1	2021-05-14	2021-06-03	20	49.3400	-123.2335	N.D.	N.D.	N.D.	N.D.	N.D.	1.3E-02	N.D.
V3_2	2021-05-14	2021-06-03	20	49.3400	-123.2335	5.5E+00	N.D.	N.D.	N.D.	N.D.	2.0E-02	N.D.
V3_3	2021-05-14	2021-06-03	20	49.3400	-123.2335	8.1E+00	N.D.	N.D.	N.D.	N.D.	2.1E-02	N.D.
V4_Top	2021-07-09	2021-07-30	21	49.1803	-123.1848	1.7E-01	N.D.	N.D.	N.D.	N.D.	1.3E-02	5.5E-03
V4_Mid	2021-07-09	2021-07-30	21	49.1803	-123.1848	3.6E+00	N.D.	N.D.	N.D.	N.D.	2.0E-02	1.1E-02
V4_Bot	2021-07-09	2021-07-30	21	49.1803	-123.1848	N.D.	N.D.	N.D.	N.D.	N.D.	1.5E-02	4.0E-03
V4_1_Top	2021-07-30	2021-08-20	21	49.1803	-123.1848	1.8E+00	N.D.	N.D.	N.D.	N.D.	1.7E-02	7.3E-03
V4_1_Mid	2021-07-30	2021-08-20	21	49.1803	-123.1848	2.3E+00	N.D.	N.D.	N.D.	N.D.	1.8E-02	7.1E-03
V4_1_Bot	2021-07-30	2021-08-20	21	49.1803	-123.1848	3.9E+00	N.D.	N.D.	N.D.	N.D.	1.5E-02	5.7E-03
V5_1_Top	2021-06-03	2021-06-24	21	49.0807	-123.1302	1.6E+01	N.D.	N.D.	3.1E+01	N.D.	1.4E-02	2.1E-04
V5_1_Mid	2021-06-03	2021-06-24	21	49.0807	-123.1302	2.1E+01	N.D.	5.0E+00	N.D.	N.D.	1.2E-02	3.5E-04
V5_1_Bot	2021-06-03	2021-06-24	21	49.0807	-123.1302	1.3E+01	N.D.	N.D.	2.3E+01	N.D.	1.2E-02	N.D.
V5_Top	2021-06-24	2021-07-15	21	49.0807	-123.1302	1.0E+01	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
V5_Mid	2021-06-24	2021-07-15	21	49.0807	-123.1302	3.9E+00	N.D.	N.D.	N.D.	N.D.	4.6E-03	3.9E-04
V5_Bot	2021-06-24	2021-07-15	21	49.0807	-123.1302	N.D.	N.D.	N.D.	1.4E+01	N.D.	N.D.	N.D.
V6_Top	2021-08-10	2021-09-01	22	48.4382	-123.3816	N.D.	N.D.	N.D.	N.D.	4.4E-01	2.9E-02	9.0E-02
V6_Mid	2021-08-10	2021-09-01	22	48.4382	-123.3816	N.D.	N.D.	N.D.	3.0E+01	N.D.	2.5E-02	6.7E-02
V6_Bot	2021-08-10	2021-09-01	22	48.4382	-123.3816	N.D.	N.D.	N.D.	N.D.	2.8E-01	2.8E-02	6.1E-02
V7_Top	2021-08-10	2021-09-01	22	48.4275	-123.3714	N.D.	N.D.	1.1E+00	1.8E+01	N.D.	3.8E-02	2.1E-02

	Start Date	End Date	days	Latitude	Longitude	ng L^{-1}						
						TBP	**TCEP**	**TCPP**	**TDCPP**	**TPhP**	**EHDPP**	**TEHP**
V7_Bot	2021-08-10	2021-09-01	22	48.4275	-123.3714	N.D.	N.D.	N.D.	N.D.	N.D.	2.8E-02	1.6E-02
V8_Top	2021-08-10	2021-09-01	22	48.4231	-123.3712	N.D.	N.D.	2.0E+01	N.D.	4.7E-01	5.6E-02	1.4E-02
V8_Mid	2021-08-10	2021-09-21	22	48.4231	-123.3712	N.D.	N.D.	2.1E+00	1.3E+01	2.8E-01	4.4E-02	2.8E-02
V8_Bot	2021-08-10	2021-09-01	22	48.4231	-123.3712	N.D.	N.D.	N.D.	N.D.	N.D.	3.8E-02	1.3E-02
V9_Top	2021-08-10	2021-09-01	22	48.4236	-123.3850	N.D.	N.D.	1.8E+01	N.D.	3.7E-01	3.2E-02	1.1E-02
V9_Mid	2021-08-10	2021-09-01	22	48.4236	-123.3850	N.D.	N.D.	5.3E+00	1.9E+01	N.D.	3.0E-02	1.2E-02
V9_Bot	2021-08-10	2021-09-01	22	48.4236	-123.3850	N.D.	1.5E+02	N.D.	N.D.	N.D.	4.0E-02	2.1E-02
V10_Top	2021-08-10	2021-09-01	22	48.4386	-123.4337	1.3E+01	N.D.	1.1E+02	N.D.	N.D.	9.6E-03	N.D.
V10_Mid	2021-08-10	2021-09-01	22	48.4386	-123.4337	9.2E+00	N.D.	6.9E+01	1.8E+01	N.D.	1.1E-02	N.D.
V10_Bot	2021-08-10	2021-09-01	22	48.4386	-123.4337	N.D.	N.D.	6.3E+01	N.D.	N.D.	9.3E-03	N.D.
Southern Quebec												
W1	2021-07-28	2021-08-24	27	45.5348	-73.5277	2.5E+00	N.D.	N.D.	N.D.	N.D.	6.1E-03	7.4E-03
W2	2021-07-28	2021-08-24	27	45.5658	-73.5091	4.0E+00	1.2E+02	1.5E+01	N.D.	N.D.	4.8E-03	2.0E-03
W3	2021-07-28	2021-08-24	27	45.7348	-73.4171	1.3E+00	N.D.	N.D.	2.7E+01	N.D.	N.D.	4.0E-03
W4	2021-07-28	2021-08-24	27	45.7906	-73.3447	5.8E+00	3.5E+02	1.5E+01	4.2E+01	N.D.	1.0E-02	1.8E-03
W5	2021-07-28	2021-08-25	28	46.0413	-73.1649	5.7E+00	N.D.	4.5E-01	4.5E+01	N.D.	4.4E-02	1.0E-02
W6	2021-07-29	2021-08-25	27	46.2436	-72.7453	5.4E+00	N.D.	4.3E+00	3.9E+01	N.D.	1.0E-02	3.8E-03
W7	2021-07-29	2021-08-25	27	46.3789	-72.4470	8.1E-01	N.D.	4.7E+00	N.D.	N.D.	9.9E-03	4.8E-03
W8	2021-07-30	2021-08-27	28	46.8321	-71.1717	6.0E+00	N.D.	N.D.	N.D.	N.D.	N.D.	9.9E-03
W9	2021-07-30	2021-08-27	28	46.8442	-71.1712	2.2E+00	N.D.	1.1E+01	N.D.	N.D.	8.4E-03	5.8E-03
W10_1	2021-04-29	2021-05-31	32	48.5078	-68.5178	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
W10_2	2021-04-29	2021-06-25	57	48.5078	-68.5178	N.D.	N.D.	1.7E+00	N.D.	N.D.	N.D.	2.5E-03
W10_3	2021-04-29	2021-07-08	70	48.5078	-68.5178	2.6E+00	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
MDL						6.0E-04	4.9E-03	4.7E-04	1.3E-02	7.5E-03	5.7E-04	1.1E-02

Note: N.D. denotes not detected. The site codes, 'V' and 'W' refer to locations in Southwestern BC and Southern Quebec, respectively. The numeric sequence following the letter represents the site and the number of replicated deployments. 'Top', 'Mid', and 'Bot' indicate sampling at the water surface, in the middle, and at the bottom, respectively. Site-specific sampling rates were calculated using the equation from by Booij and Smedes et al.(Booij et al., 2003; Booij and Smedes, 2010).

Table S14 Water and air fugacity ratio ($f_{W/A}$) of OPEs

Sites	**Water/ air fugacity ratio ($f_{W/A}$)**				
	TBP	**TCEP**	**TCPP**	**TPhP**	**EHDPP**
V1	1.58E-02				1.63E-06
V2	1.14E-01				2.90E-05
V3					9.46E-07
V4	2.23E-04				7.28E-06
V5	4.96E-02				9.23E-06
V6				3.45E-05	1.00E-04
V7			1.88E-03		5.32E-05
V8			3.49E-02	3.23E-05	7.94E-05
V9			3.23E-02	2.55E-05	4.54E-05
V10	3.19E-01		1.26E-01		3.33E-05
W1	2.53E-03				4.48E-06
W2	4.08E-03	8.50E-04	3.18E-03		3.55E-06
W3	5.47E-03				
W4	2.41E-02	1.33E-02	1.23E-02		2.58E-05
W5	1.43E-02		1.76E-04		5.02E-05
W6	1.29E-02		2.47E-03		2.82E-05
W7	3.35E-03		1.27E-02		3.53E-06
W8	2.13E-02				
W9	7.92E-03		6.64E-03		9.51E-06
W10					

Blank cells mean that data are unavailable. Average concentrations in water were used for replicates in fugacity calculations. Air concentrations for calculating fugacity were derived from PAS in the proximity to the PWS sites in similar season.

Table S15 Long-range transport potential (LRTP) assessment for five OPEs

Chemical name	Input parameters						LRTP metrics Φ (%)		
	Molar Mass	log K_{AW}	log K_{OW}	Half-life in air (h)	Half-life in water (h)	Half-life in soil (h)	Φ1	Φ2	Φ3
TBP	266.3	-4.88	3.65	4.88	73.0	146.1	0.14	0.01	2.14E-6
TCEP	285.5	-7.58	1.34	17.5	932.9	1865.8	0.29	0.17	1.49E-3
TCPP	327.6	-5.99	2.54	17.5	932.9	1865.8	0.45	0.10	4.62E-4
TPhP	326.3	-7.47	4.68	35.5	431.8	863.6	1.71	1.50	0.056
EHDPP	362.4	-5.72	6.16	9.66	301.0	601.9	1.47	0.49	0.054

The partition ratios for OPEs were obtained using the poly-parameter linear free energy relationships (ppLFERs) in the UFZ-LSER database (UFZ-LSER database v 3.2.1 [Internet], 2024). The environmental degradation half-lives were obtained from EAS-E Suite.(Anon, n.d.)

The maximum LRTP metrics Φ1 were calculated using an emissions-fractions based LRTP screen tool (Breivik et al., 2022) under the scenario with 100% emissions to air. Φ1, Φ1 and Φ3 represent the fraction reach a remote region, transferred to surface media in the remote region and accumulated in the remote region, respectively.

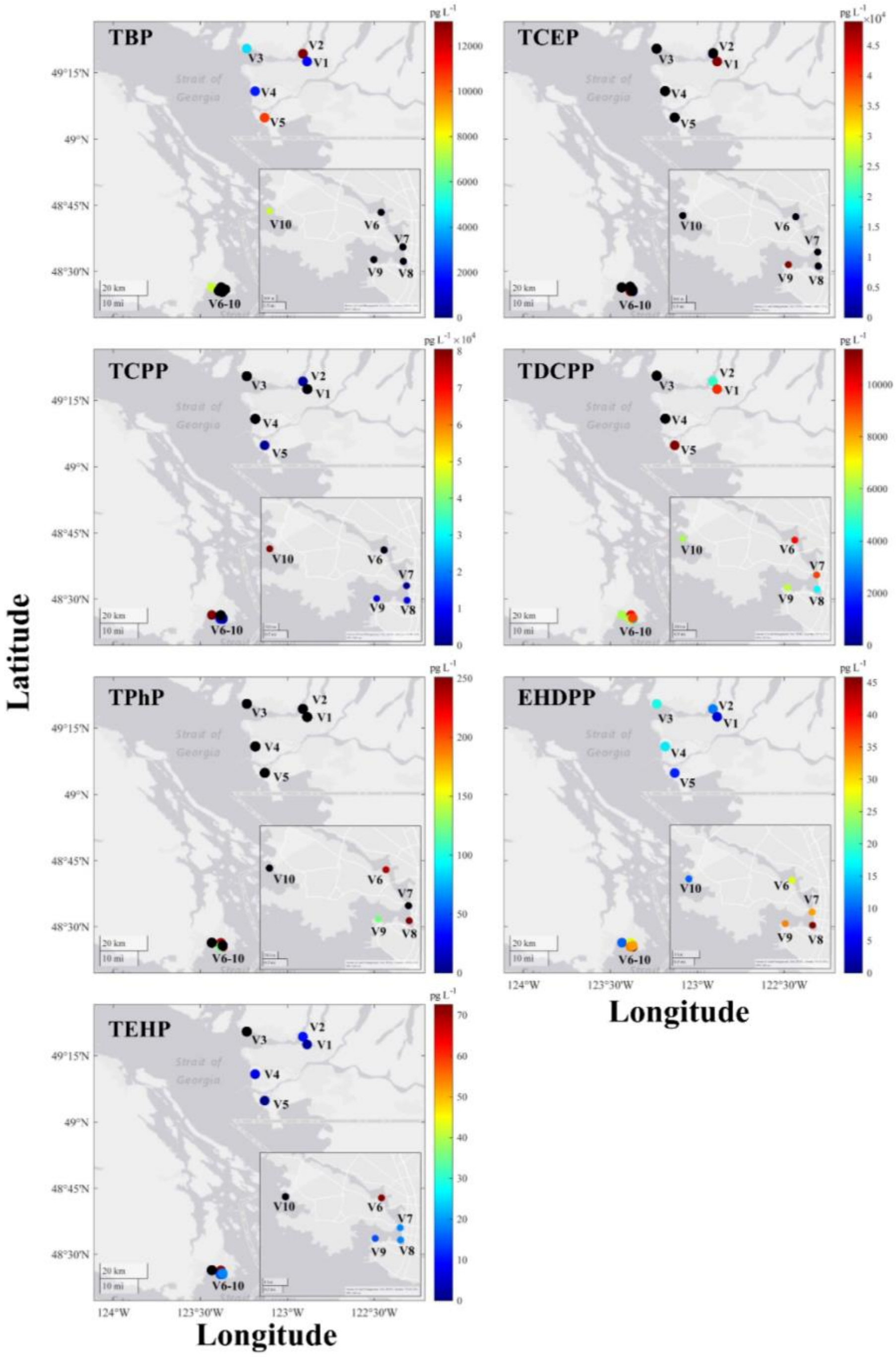

Figure S1 Spatial patterns of OPEs in the water in Southwestern British Columbia (BC). The small inserted maps at the bottom right of each panel show the sampling sites located within Victoria. The concentration levels of the duplicated samples from the same site were averaged. Dark dots indicate that at these sites, OPEs were not detected. The maps were created using the basemap of MATLAB, copyrighted to Bureau of Land Management, Esri, HERE, Garmin, USGS, EPA, NPS, and NRCan.

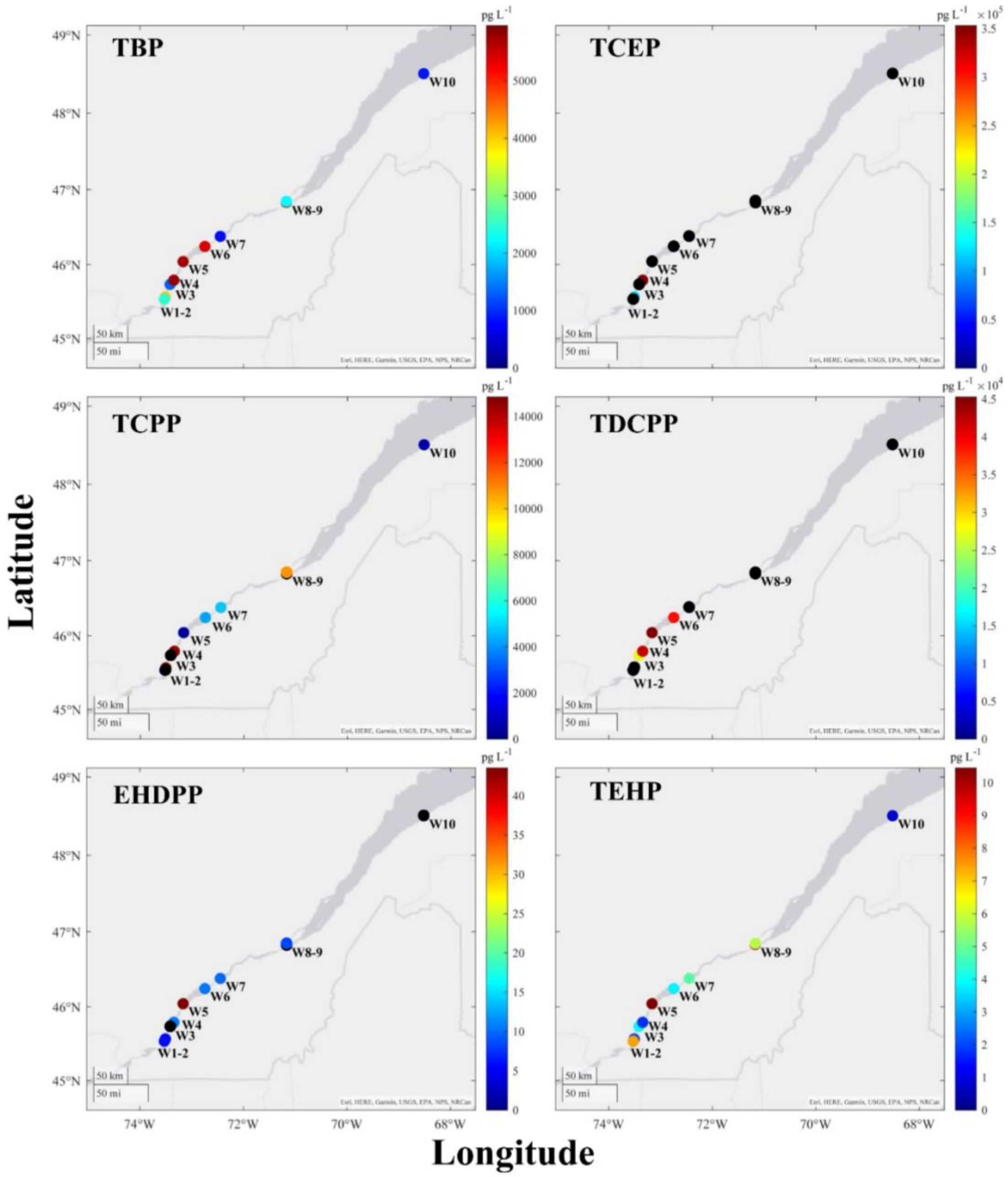

Figure S2 Spatial patterns of OPEs in the water in Southwestern Quebec (QC). The concentration levels of the duplicated samples from the same site were averaged. Dark dots indicate that at these sites, OPEs were not detected. The maps were created using the basemap of MATLAB, copyrighted to Bureau of Land Management, Esri, HERE, Garmin, USGS, EPA, NPS, and NRCan.

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