

Supporting Information for

Changes in Surface Area and Concentrations of Semivolatile Organic Contaminants in Ageing Snow

DEBBIE A. BURNISTON,[†] WILLIAM J. M. STRACHAN,[†] JOHN T. HOFF,[‡] FRANK WANIA^{*,§}

[†] Aquatic Ecosystem Protection Research Division, Environment Canada, 867 Lakeshore Road, Burlington, Ontario, Canada L7R 4A6.

[‡] 15 Mohegan Crescent, London, Ontario, Canada N5V 2X7

[§] Department of Physical and Environmental Sciences, University of Toronto Scarborough, 1265 Military Trail, Toronto, Ontario, Canada M1C 1A4.

* To whom correspondence should be addressed, E-mail: frank.wania@utoronto.ca

Table of Content	Page
Table S1 Dates, meteorological conditions and specific snow surface areas for the five sampled snowfall events.	S2
Figure S1 Time course of the daily mean, maximum and minimum temperature during the ageing of snow falling during five events at Turkey Lakes in the winter of 1999/2000.	S3
Table S2 Instrument detection limit for OCPs and PCBs in picograms.	S4
Table S3 Concentration of organochlorine pesticides and chlorobenzenes in snow-melt water in pg/L SWE (mean and relative standard deviation of 3 replicates).	S5
Table S4 Concentration of total polychlorinated biphenyls in snowmelt water in ng/L SWE (mean and relative standard deviation of 3 replicates) and homologue composition.	S6
Figure S2 Concentration changes of polychlorinated biphenyl congeners during the ageing of four snowpacks as a function of the congeners' snow-air partition coefficients K_{SA} adjusted to the mean temperature during the ageing period.	S7

Table S1 Dates, meteorological conditions and specific snow surface areas for the five sampled snowfall events.

	Event 1	Event 2	Event 3	Event 4	Event 5
Day of first sampling	23/12/99	20/1/00	24/1/00	9/2/00	16/3/00
Day of second sampling	5/1/00	31/1/00	31/1/00	16/2/00	20/3/00
Length of snow ageing in days	13	11	7	7	4
Wind direction and speed during snowfall	NE, 1.1 m/s	N, 2.1 m/s	W, 1.6 m/s	NW, 3.2 m/s	N, 1.8 m/s
Temperature during snowfall in °C	-14.2 (-9.2 to -18.2)	-19.5 (-12.3 to -25.0)	-10.7 (-8.0 to -13.5)	-4.1 (-9.5 to -0.4)	-8.1 (-13.6 to -2.6)
Mean and range of daily mean wind speed during ageing	2.3 (0.7 to 4.6)	1.5 (0.6 to 2.5)	1.4 (0.6 to 2.5)	2.2 (1.0 to 3.2)	2.2 (1.8 to 3.0)
SWE of snowfall event in mm	9.6 mm	6.6 mm ^a	7.4 mm	13.9 mm	11.2 mm
Range of daily mean temperature during ageing in °C	-16.3 to -2.5	-22 to -3.6	-19.3 to -3.6	-14 to -4	-7.6 to +2.6
Overall range of temperature during ageing in °C	-21.7 to +0.7	-29.1 to +1.7	-23.1 to +1.7	-19.6 to -0.4	-14.2 to +5.0
Mean temperature during ageing in °C	-10.9	-12.8	-10.0	-9.7	-3.0
Specific surface area immediately after snowfall in cm ² /g	1223 ± 38 (n = 3)	1332 ± 203 (n = 4)	1220 ± 51 (n = 3)	1014 ± 11 (n = 3)	1115 ± 135 (n = 3)
Specific surface area after ageing in cm ² /g	685 ± 217 (n = 3)	595 ± 19 (n = 3)	776 ± 54 (n = 3)	559 ± 19 (n = 3)	520 ± 50 (n = 3)
Snowmelt water volume extracted before ageing in L	17.0 ± 0.3 (n = 3)	5.1 ± 0.1 (n = 3)	7.1 ± 0.2 (n = 3)	6.2 ± 0.3 (n = 3)	9.5 ± 0.1 (n = 3)
Snowmelt water volume extracted after ageing in L	23.4 ± 1.1 (n = 3) ^b	4.8 ± 0.1 (n = 3)	6.4 ± 0.3 (n = 3)	6.1 ± 0.4 (n = 3)	11.9 ± 1.7 ^c (n = 3)

^a sum of the precipitation falling from Jan. 18 to 20, 2000, ^b snow meltwater volume increased during ageing, likely because of blowing snow, ^c snow meltwater volume increased during ageing, likely because of rain falling onto snowpack.

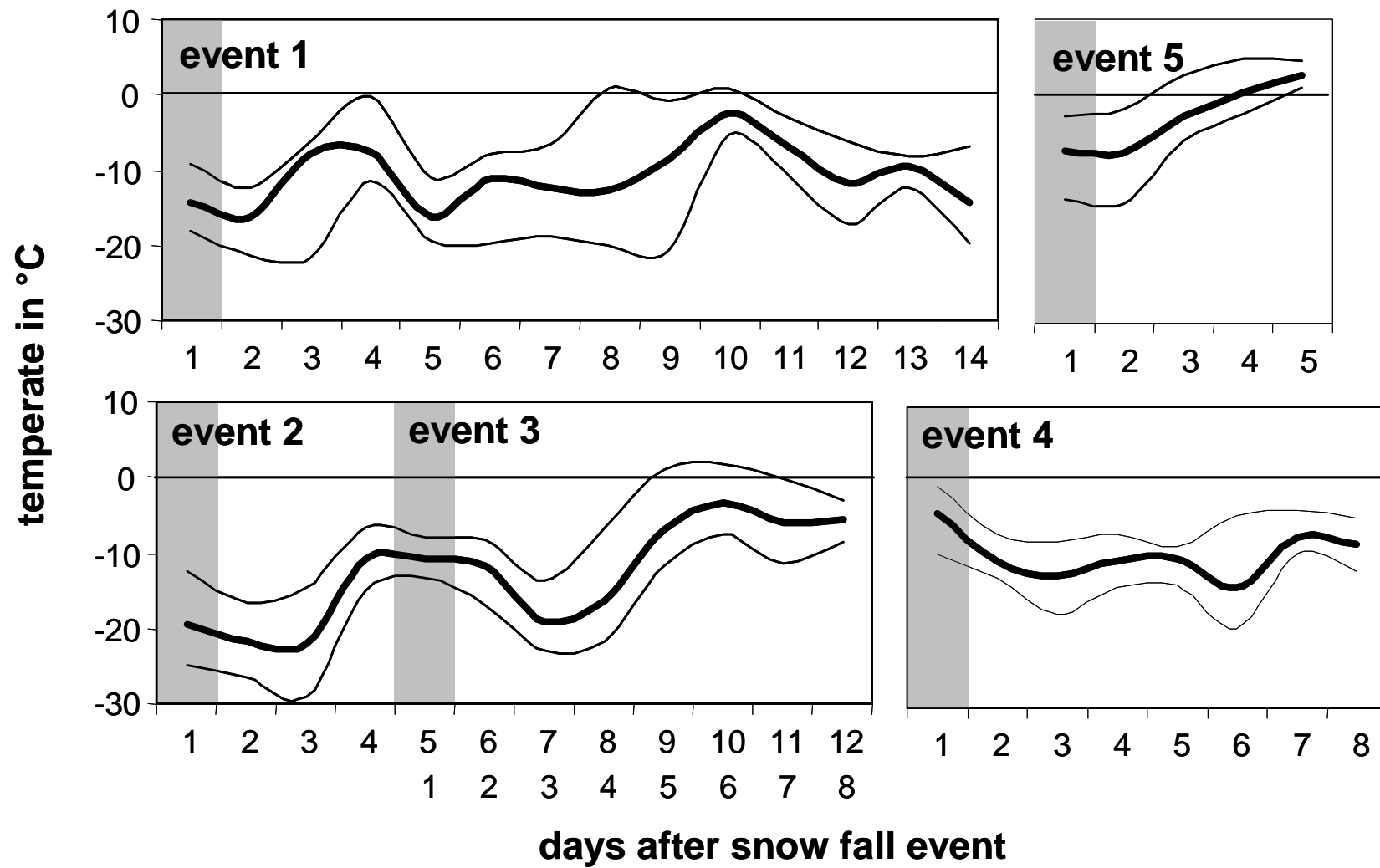


Figure S1 Time course of the daily mean, maximum and minimum temperature during the ageing of snow falling during five events at Turkey Lakes in the winter of 1999/2000.

Table S2 Instrument detection limit for organochlorine pesticides and polychlorinated biphenyls in picograms. Method detection limits vary between samples because of different sample volume

OCPs		PCB		PCB		PCB		PCB	
α -HCH	0.20	3	0.09	46	0.02	110	0.03	177	0.01
β -HCH	0.20	4+10	0.05	47	0.04	114	0.02	178	0.02
γ -HCH	0.30	5+8	0.11	48	0.04	118	0.02	180	0.03
		6	0.03	52	0.02	119	0.01	182+187	0.03
dieldrin	0.38	7	0.04	56+60	0.04	124+135+144	0.02	183	0.02
endrin	0.10	12+13	0.02	63	0.02	128	0.03	185	0.01
heptachlor epoxide	0.06	16	0.03	66	0.03	129	0.01	189	0.04
α -chlordane	0.03	17	0.03	70	0.03	130	0.01	190	0.01
γ -chlordans	0.04	18	0.05	74	0.02	134+143	0.03	191	0.04
α -endosulfan	0.15	19	0.02	81+87	0.02	136	0.01	193	0.01
β -endosulfan	0.04	21+33+53	0.05	82	0.06	137	0.02	194	0.01
Trans-nonachlor	0.04	22	0.04	83	0.02	138+163	0.03	195	0.05
		24+27	0.02	84	0.02	141	0.01	196+203	0.07
pp'-DDE	0.02	25	0.02	85	0.03	146	0.04	197	0.05
pp'-DDT	0.05	26	0.04	89	0.01	151	0.02	198	0.03
pp'-DDD	0.03	28	0.05	91	0.02	153	0.03	199	0.02
		29	0.04	92	0.08	156+171	0.03	201	0.04
HCB	0.04	31	0.02	95	0.03	157	0.05	202	0.01
aldrin	0.04	32	0.02	97	0.02	158	0.01	205	0.02
heptachlor	0.08	40	0.02	99	0.02	167	0.01	206	0.04
methoxychlor	0.09	41+64+71	0.03	100	0.01	170	0.02	207	0.01
mirex	0.30	42	0.03	101	0.02	172	0.02	208	0.01
		43+49	0.02	103	0.04	174	0.01	209	0.02
		44	0.02	105+132	0.03	175	0.03		
		45	0.02	107+142	0.05	176	0.01		

Table S3 Concentration of organochlorine pesticides and chlorobenzenes in snowmelt water in pg/L SWE (mean and relative standard deviation of 3 replicates).

	Event 1 fresh snow	Event 1 aged snow	Event 2 fresh snow	Event 2 aged snow	Event 3 fresh snow	Event 3 aged snow	Event 4 fresh snow	Event 4 aged snow	Event 5 fresh snow	Event 5 aged snow
α -HCH	979 (23%)	133 (17%)	122 (9%)	54 (6%)	135 (8%)	54 (17%)	58 (22%)	61 (29%)	73 (13%)	638 (65%)
γ -HCH	435 (19%)	118 (15%)	126 (16%)	67 (17%)	108 (15%)	65 (21%)	177 (37%)	118 (21%)	113 (8.5%)	302 (54%)
Dieldrin	198 (16%)	116 (10%)	208 (58%)	102 (18%)	117 (18%)	77 (17%)	222 (42%)	139 (19%)	84 (5.1%)	161 (42%)
endosulfan-I	181 (24%)	76 (7.7%)	73 (28%)	52 (11%)	59 (45%)	32 (75%)	31 (71%)	64 (7%)	56 (8.3%)	122 (41%)
endosulfan-II	11 (23%)	10 (18%)	19 (17%)	23 (18%)	6.1 (86%)	8.4 (25%)	22 (19%)	35 (14%)	22 (39%)	22 (14%)
heptachlor epox.	60 (23%)	21 (20%)	29 (16%)	17 (23%)	32 (20%)	22 (19%)	30 (16%)	26 (61%)	25 (12%)	42 (61%)
cis-chlordane	22 (60%)	16 (16%)	22 (25%)	16 (17%)	7.1 (141%)	8.1 (34%)	20 (124%)	13 (43%)	7.3 (73%)	19 (53%)
trans-chlordane	26 (73%)	9.2 (2%)	19 (54%)	14 (41%)	19 (71%)	14 (24%)	15 (16%)	32 (46%)	35 (15%)	54 (34%)
trans-nonachlor	18 (7%)	16 (35%)	25 (43%)	10 (18%)	21 (35%)	15 (26%)	20 (11%)	12 (17%)	14 (71%)	17 (45%)
oxychlordane		10 (73%)		15 (71%)		11 (80%)				50 (56%)
methoxychlor				41 (100%)		42 (35%)			11 (14%)	
pp'-DDE	8 (71%)	11 (16%)	8.0 (74%)	4.7 (141%)	4.0 (141%)	7.5 (43%)	2.9 (141%)	14 (40%)	8.7 (79%)	17 (11%)
pp'-DDT	36 (19%)	23 (6.3%)	40 (35%)	21 (28%)	21 (88%)	10 (24%)	23 (46%)	42 (36%)	29 (49%)	57 (6%)
pp'-DDD		2.8 (20%)		6.8 (141%)		17 (8%)	23 (22%)	36 (100%)	2.8 (85%)	4.6 (71%)
op'-DDE	5.2 (27%)	3.2 (77%)			4.1 (141%)	8.5 (29%)		4.1 (141%)	4.5 (89%)	6.0 (71%)
op'-DDT	12 (33%)	9.3 (37%)	10 (71%)	2.3 (141%)		8.3 (16%)		6.1 (75%)		12 (71%)
op'-DDD		163 (8.6%)		16 (72%)	20 (71%)			11 (72%)	20 (79%)	324 (61%)
135-TCB				7.4 (141%)				8.4 (141%)		
124-TCB	38 (25%)	28 (19%)	179 (19%)	149 (7%)	116 (26%)	85 (27%)	73 (2%)	62 (24%)	33 (76%)	32 (31%)
123-TCB			10 (71%)	16 (141%)		12 (79%)			13 (141%)	4.7 (141%)
1234-TECB	4.2 (53%)	3 (49%)	12 (12%)	4.6 (141%)	3.7 (141%)	1.9 (141%)	3.9 (74%)	5.3 (72%)	642 (71%)	2.7 (17%)
PeCB	19 (49%)	10 (25%)	26 (19%)	16 (31%)	19 (20%)	11 (9%)	12 (13%)	14 (6%)	16 (72%)	20 (20%)
HCB	11 (9%)	8 (14%)	16 (6%)	12 (10%)	24 (70%)	6.4 (5%)	12 (23%)	10 (8%)	12 (46%)	15 (9%)

Table S4 Concentration of total polychlorinated biphenyls in snowmelt water in ng/L SWE (mean and relative standard deviation of 3 replicates) and homologue composition.

	Event 1 fresh snow	Event 1 aged snow	Event 2 fresh snow	Event 2 aged snow	Event 3 fresh snow	Event 3 aged snow	Event 4 fresh snow	Event 4 aged snow	Event 5 fresh snow	Event 5 aged snow
Sum PCBs 1994+	4.7 (43%)	1.8 (27%)	4.0 (36%)	2.1 (13%)	3.0 (41%)	3.3 (22%)	2.1 (24%)	2.1 (24%)	1.3 (21%)	5.0 (42%)
DichloroCBs	3.7 %	2.4 %	4.6 %	5.8 %	7.9 %	5.9 %	5.7 %	6.2 %	4.8 %	2.9 %
TrichloroCBs	18 %	13 %	14 %	15 %	17 %	36 %	20 %	20 %	19 %	18 %
TetrachloroCBs	39 %	36 %	39 %	33 %	38 %	34 %	38 %	37 %	37 %	34 %
PentachloroCBs	26 %	29 %	25 %	29 %	21 %	17 %	23 %	23 %	24 %	27 %
HexachloroCBs	11 %	14 %	13 %	14 %	12 %	6.1 %	12 %	9.5 %	8.7 %	13 %
HeptachloroCBs	1.7 %	2.8 %	1.4 %	1.3 %	3.1 %	0.42 %	1.0 %	1.4 %	3.1 %	1.6 %
OctachloroCBs	0.29 %	0.55 %	0.70 %	0.55 %	0.68 %	0.21 %	0.56 %	0.38 %	0.19 %	0.10 %

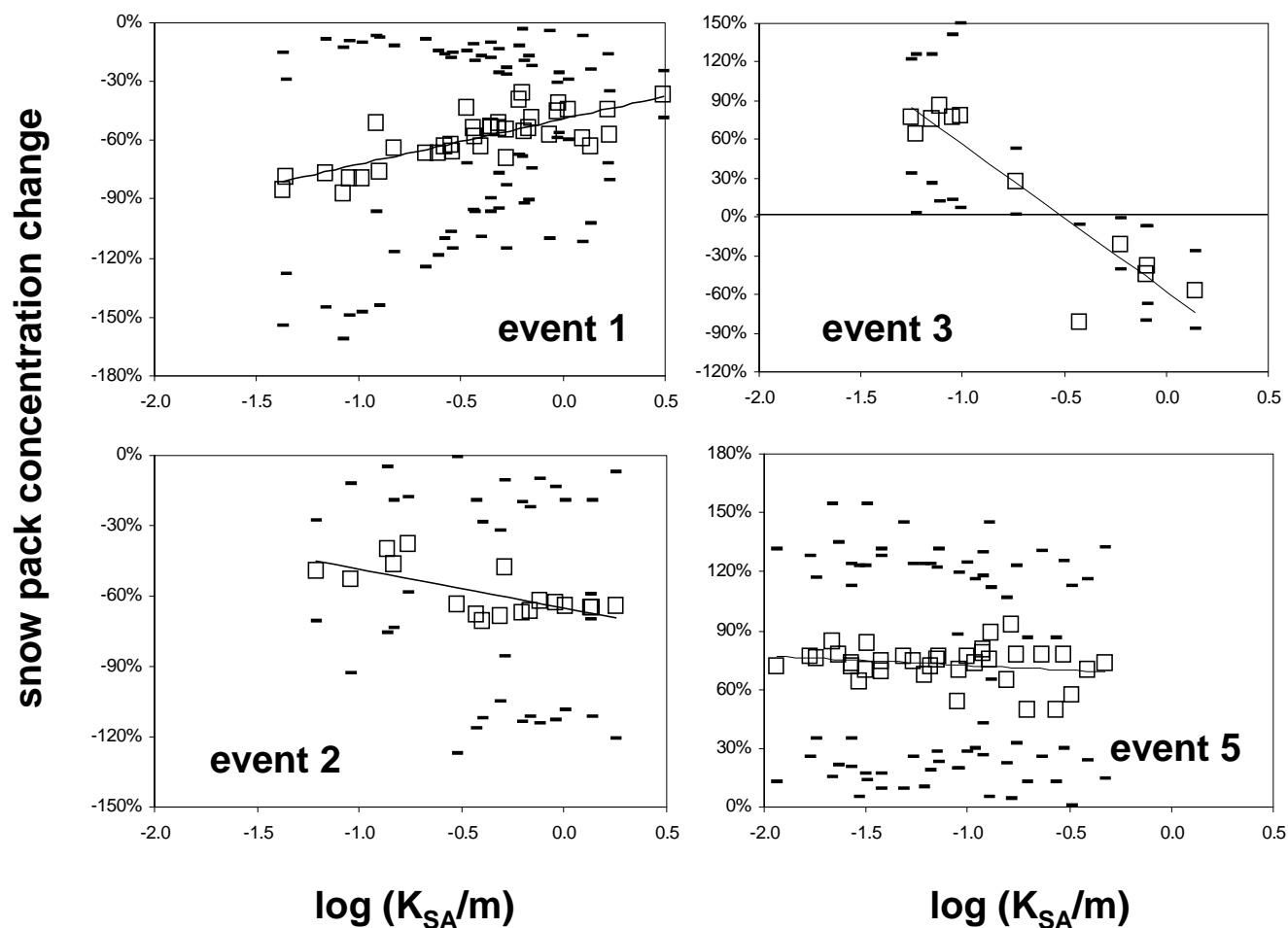


Figure S2 Concentration changes of polychlorinated biphenyl congeners during the ageing of four snowpacks as a function of the congeners' snow-air partition coefficients K_{SA} adjusted to the mean temperature during the ageing period. Concentrations of PCBs during event 4 did not change significantly and are not displayed. Negative values indicate loss of chemical during ageing, positive values indicate a concentration increase. The square marks the mean, and the bars the mean plus/minus one standard deviation, calculated by error propagation from the standard deviation of the snow concentrations.