SUPPORTING INFORMATION FOR:

Atmospheric Deposition of Current-Use and Historic-Use Pesticides in Snow at National Parks in the Western United States

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SI Table 1. Sample information including site location, mean winter (November 2002 to March 2003) air temperatures at the site, snow-water equivalent (SWE), particulate matter concentration, and regional cropland intensity. Regional cropland intensity is cropland area as a percentage of total land area within a 150-km radius of the park.

Park & Site Names	Latitude, ºN	Longitude, ºW	Elevation, masl[1]	Mean Winter Air Temp., °C	SWE, m	Particulate Matter, mg/L	Cropland Intensity
Sequoia							
Emerald Lake[2]	36.60	118.67	2908	-3.0	0.95	2.4, 2	11
Pear Lake	36.60	118.66	2950	-3.7	0.93	6.2	11
Rocky							
Lake Irene[2]	40.41	105.82	3243	-8.5	0.76	8.6, 2.4	8.1
Lone Pine Lake	40.22	105.73	2975	-7.1	0.40	19	8.1
Mills Lake	40.29	105.64	3056	-7.1	0.91	45	8.1
Rainier[3]							
Alta Vista	46.79	126.73	1730	-2.9	1.2	0.12	3.1
Alta Vista	46.79	126.73	1730	-2.9	1.3	0.51	3.1
Glacier							
Lower Snyder Lake	48.63	113.79	1600	-3.5	0.36	7.3	11
Aster Park	48.46	113.38	1922	-6.3	0.73	8.9	11
Denali							
Kahiltna Base Camp	62.97	151.17	2153	-21	1.2	0.13	0
McLeod Lake	63.38	151.07	609	-11	0.042	50	0
Wonder Lake	63.48	150.88	610	-11	0.048	56	0
Noatak							
Burial Lake	68.43	159.18	427	-22	0.60	1.4	0
Gates of the Arctic							
Matcharak Lake	67.75	156.21	488	-22	0.13	24	0

[1]Meters above sea level. [2]Sites at which field replicates were collected; particulate matter is provided for each replicate. [3]Two samples were collected at Alta Vista; the first one listed was collected on March 4, 2005 (before a snow event) whereas the second one listed was collected on March 17, 2005 (after the snow event).

SI Table 2. Concentrations in seasonal snowpack samples (collected March-April 2003) for the most frequently-detected current-use and historic-use pesticides.

	Concentration, ng/L (%RSD)[1]							
	Current-Use Pesticides				Historic-Use Pesticides			
Park Name	Dacthal	Total Chlorpyrifos[4]	Total Endosulfan[5]	γ-HCH[6]	Dieldrin	α-HCH[7]	Total Chlordane[8]	HCB[9]
Sequoia								
Emerald Lake[2]	5.3 (14)	2.8 (3.2)	1.5 (5.9)	0.062 (2.1)	0.30 (14)	0.080 (14)	0.050 (4.4)	0.016 (31)
Pear Lake	3.2	1.3	1.2	0.064	4.8	0.081	0.13	0.072
Rocky								
Lake Irene[2]	0.95 (10)	0.033 (3.1)	0.92 (1.3)	0.080 (16)	0.26 (8.2)	0.077 (11)	0.029 (9.4)	0.0065 (3.9)
Lone Pine Lake	1.1	--	0.96	0.066	0.22	0.079	0.017	--
Mills Lake	1.1	--	1.3	0.12	0.34	0.14	0.011	--
Rainier[3]								
Alta Vista	--	0.048	0.14	<0.012	<0.048	0.063	0.016	--
Alta Vista	0.030	0.056	0.17	0.048	<0.048	0.094	0.014	--
Glacier								
Lower Snyder Lake	0.75	0.085	0.82	0.11	0.23	0.086	0.018	0.018
Aster Park	0.61	0.53	0.80	0.21	0.33	0.17	0.020	0.015
Denali								
Kahiltna Base Camp	0.022	0.026	0.14	<0.012	0.056	<0.018	0.0098	0.0032
McLeod Lake	0.016	0.024	0.044	<0.012	<0.0020	<0.018	0.015	0.012
Wonder Lake	--	0.010	<0.0040	<0.012	<0.0020	<0.018	0.0018	--
Noatak								
Burial Lake	0.0065	0.024	0.19	0.072	0.054	0.20	0.016	0.0038
Gates of the Arctic								
Matcharak Lake	0.0039	0.030	0.051	<0.012	0.035	<0.018	0.059	0.0072

[1]RSD is relative standard deviation. Nondetects are depicted as having concentrations less than (<) their estimated method detection limits. Cases in which lab-blank concentrations exceeded 33% of sample concentrations are marked with '--'. [2]Sites at which field replicates were collected. [3]Two samples were collected at Alta Vista; the first one listed was collected on March 4, 2005 (before a snow event) whereas the second one listed was collected on March 17, 2005 (after the snow event). [4]Total chlorpyrifos is the sum of chlorpyrifos and chlorpyrifos oxon, [5]Total endosulfan is the sum of endosulfan I, endosulfan II, and endosulfan sulfate. [6]γ-HCH is γ-hexachlorocyclohexane. [7]α-HCH is α-hexachlorocyclohexane. [8]Total chlordane is the sum of trans-chlordane, cis-nonachlor, and trans-nonachlor. [9]HCB is hexachlorobenzene.

SI Table 3. Depositions in seasonal snowpack samples (collected March-April 2003) for the most frequently-detected current-use and historic-use pesticides.

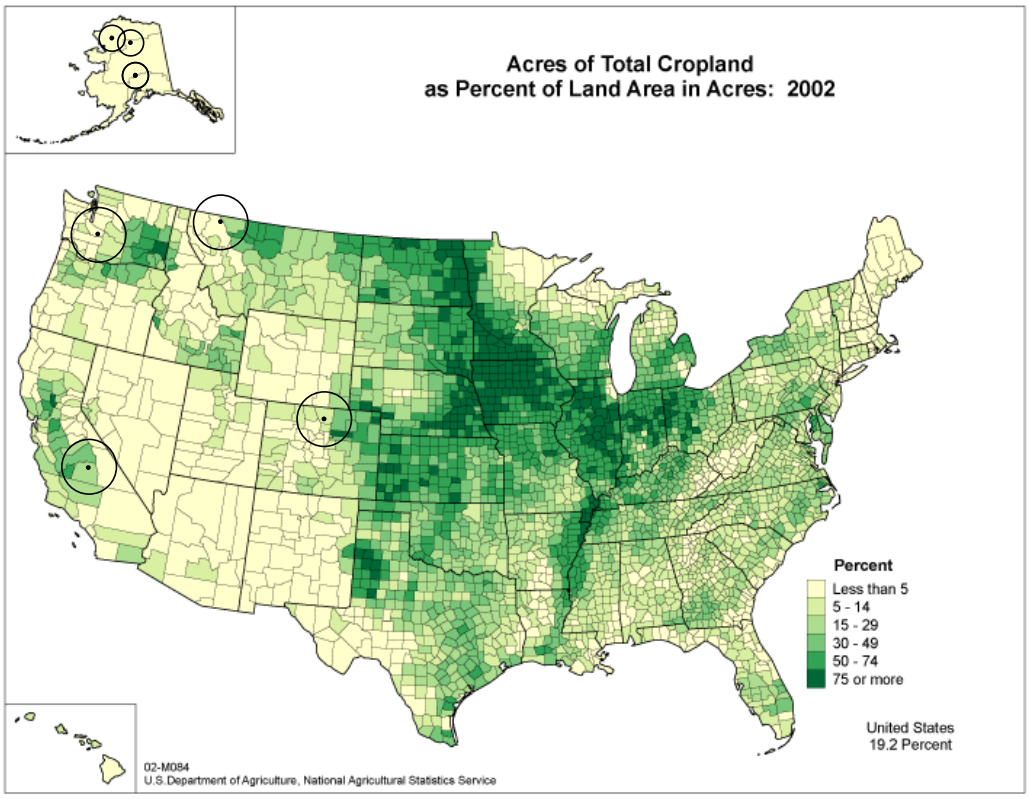
	Deposition, ng/m^2 (%RSD)[1]							
	Current-Use Pesticides				Historic-Use Pesticides			
Park Name	Dacthal	Total Chlorpyrifos[4]	Total Endosulfan[5]	γ-HCH[6]	Dieldrin	α-HCH[7]	Total Chlordane[8]	HCB[9]
Sequoia								
Emerald Lake[2]	5100 (14)	2600 (3.1)	1400 (5.9)	59 (2.1)	280 (14)	76 (14)	47 (4.4)	15 (31)
Pear Lake	3000	1200	1100	60	4400	75	120	67
Rocky								
Lake Irene[2]	720 (10)	25 (3.1)	690 (1.3)	61 (16)	200 (8.2)	58 (11)	22 (9.4)	4.9 (31)
Lone Pine Lake	420	--	380	27	86	32	6.8	--
Mills Lake	1000	--	1200	110	310	130	10	--
Rainier[3]								
Alta Vista	--	59	170	<14	<58	77	19	--
Alta Vista	37	70	210	60	<60	120	18	--
Glacier								
Lower Snyder Lake	270	30	290	39	83	31	6.6	6.6
Aster Park	440	39	580	150	240	120	15	11
Denali								
Kahiltna Base Camp	27	32	170	<14	64	<22	12	3.8
McLeod Lake	0.67	1.0	1.8	<0.52	<0.082	<0.76	0.63	0.51
Wonder Lake	--	0.48	<0.19	<0.58	<0.095	<0.88	0.065	--
Noatak								
Burial Lake	3.9	14	110	43	31	120	9.6	2.3
Gates of the Arctic								
Matcharak Lake	0.49	3.8	6.5	<1.6	6.7	<2.3	0.76	0.92

[1]RSD is relative standard deviation. Nondetects are depicted as having deposition values less than (<) their estimated method detection limits multiplied by SWE. Cases in which lab-blank concentrations exceeded 33% of sample concentrations are marked with '--'. [2]Sites at which field replicates were collected. [3]Two samples were collected at Alta Vista; the first one listed was collected on March 4, 2005 (before a snow event) whereas the second one listed was collected on March 17, 2005 (after the snow event). [4]Total chlorpyrifos is the sum of chlorpyrifos and chlorpyrifos oxon. [5]Total endosulfan is the sum of endosulfan I, endosulfan II, and endosulfan sulfate. [6]γ-HCH is γ-hexachlorocyclohexane. [7]α-HCH is α-hexachlorocyclohexane. [8]Total chlordane is the sum of trans-chlordane, cis-nonachlor, and trans-nonachlor. [9]HCB is hexachlorobenzene.

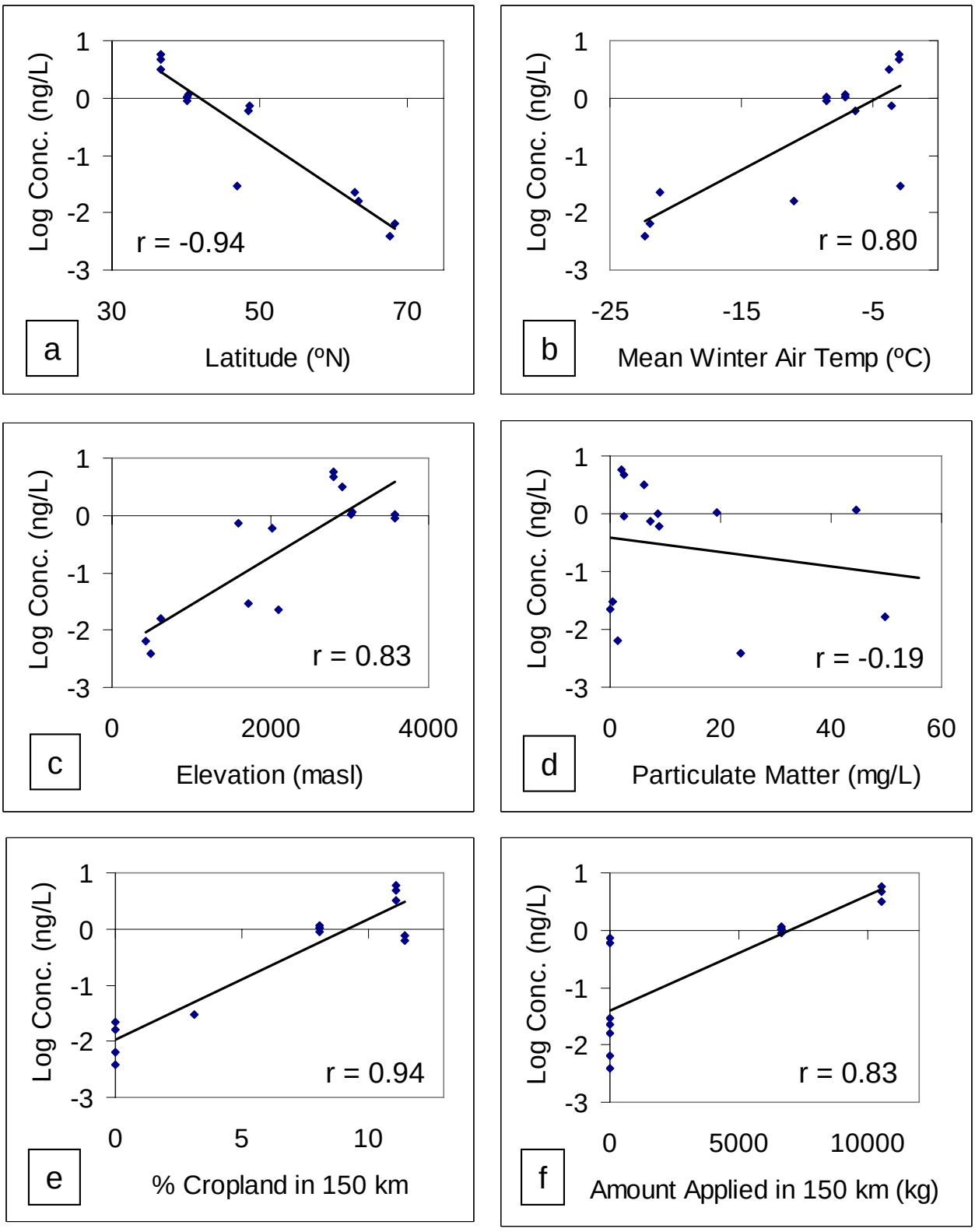
SI Table 4. Sub-cooled liquid vapor pressures, half-lives in air, and half-lives in soil for the four most-frequently detected current-use pesticides and the four most-frequently detected historic-use pesticides.

	Vapor Pressure, Pa, 25ºC	Half-Life in Air, days	Half-Life in Soil, days
Current-Use Pesticides			
Dacthal	0.0066[a]	24[c]	100[a]
Chlorpyrifos	0.0034[b]	1[b]	7[b]
Endosulfan I	0.008[b]	1[b]	50[b]
γ-HCH	0.027[b]	43[d]	730[b]
Historic-Use Pesticides			
Dieldrin	0.016[b]	2[b]	730[b]
α-HCH	0.1[b]	59[d]	70[e]
trans-Chlordanes	0.0032[b]	2[b]	730[b]
HCB	0.2447[b]	306[d]	2190[b]

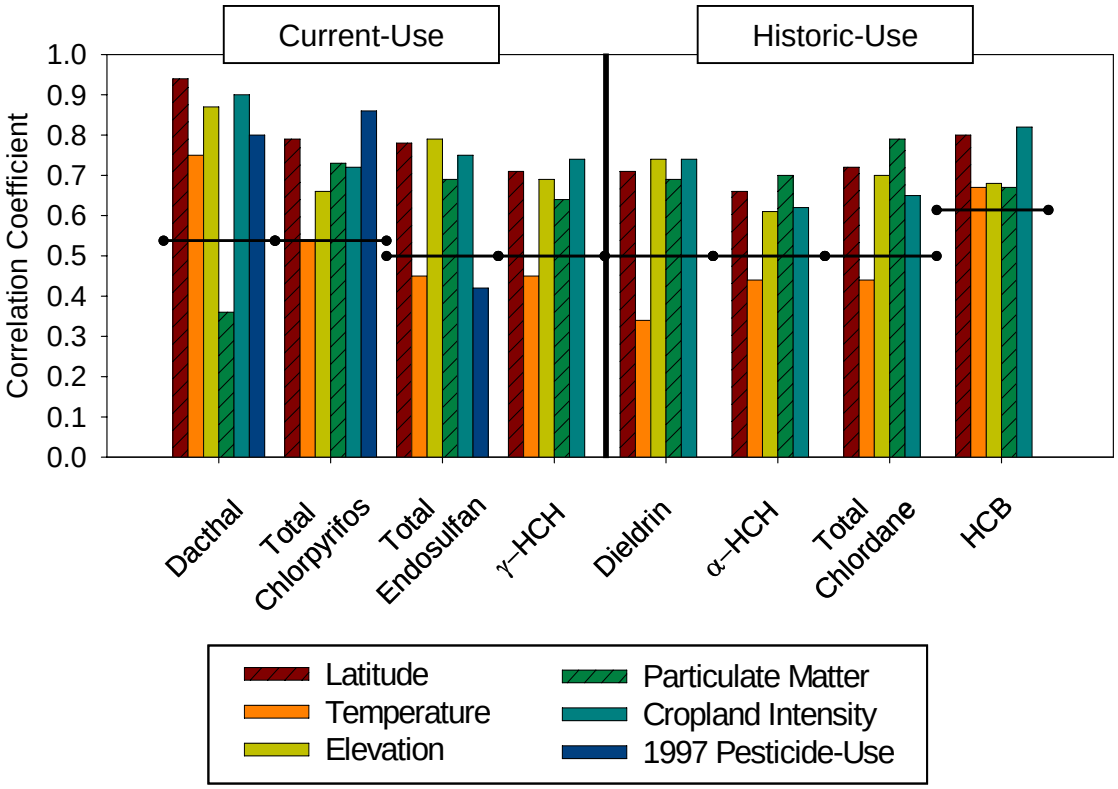
[a](*1*), [b](*2*), [c](*3*), [d](*4*), [e](*5*)



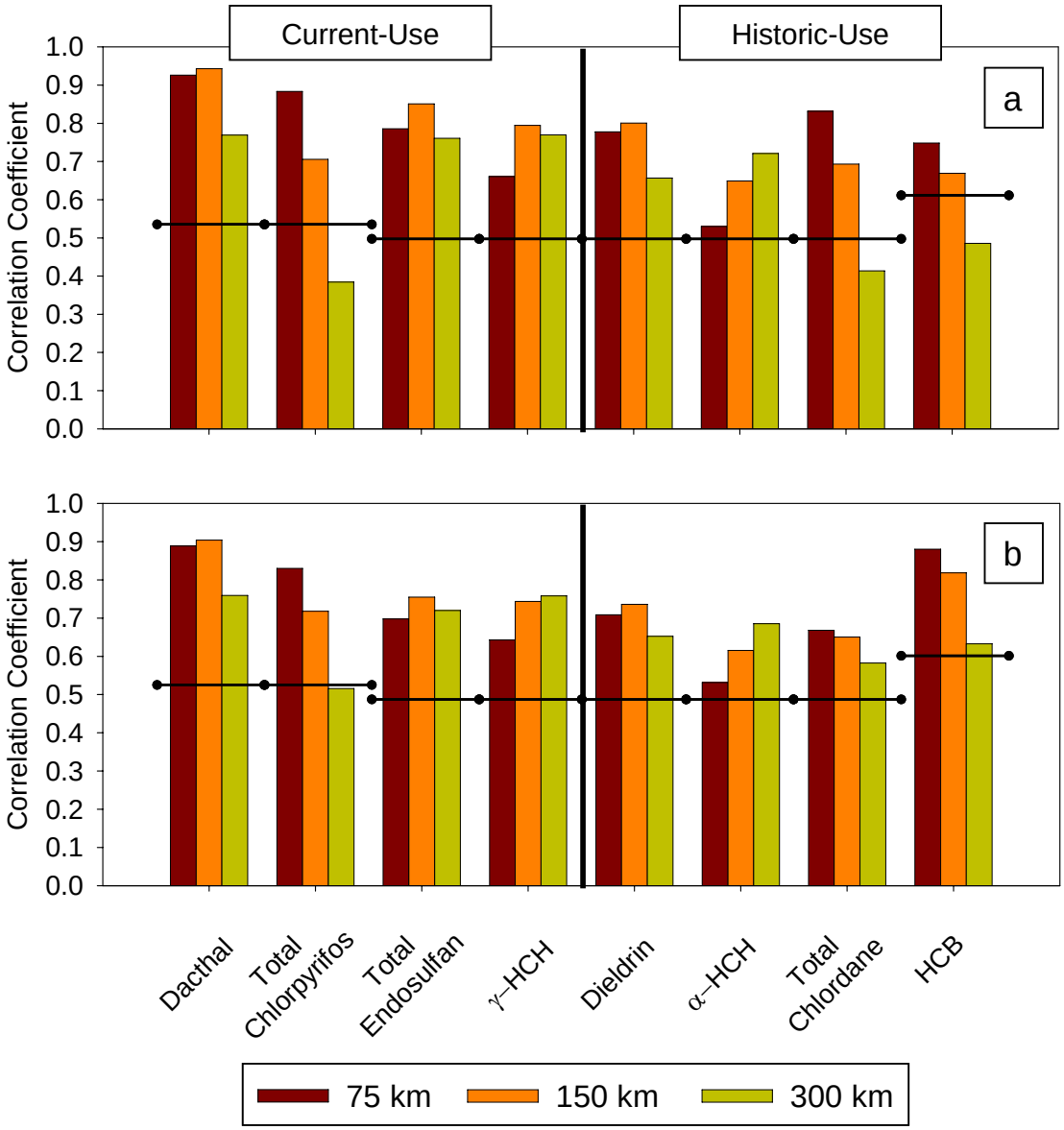
SI Figure 1. 2002 cropland map (U.S. National Agriculture Statistics Service) (*6*) with 150-km radius circles shown centered at each of the parks in this study.



SI Figure 2. Correlation coefficients (r) and plots for the log concentration of dacthal versus (a) latitude, (b) mean winter air temperature, (c) site elevation, (d) particulate matter concentration in snow samples, (e) cropland area as a percentage of total land area within a 150-km radius of the park, and (f) the quantity of dacthal applied within a 150-km radius of the park.



SI Figure 3. Correlation coefficients for log pesticide deposition with latitude, mean winter air temperature, elevation, particulate matter concentration, regional cropland intensity within 150 km, and the quantity of specific current-use pesticides applied within 150 km of each park in 1997. Correlation coefficients for 1997 pesticide use are only provided for pesticides that were used within 150 km of the parks in 1997 (i.e. dacthal, chlorpyrifos, and endosulfan). Diagonal lines through bars indicate negative correlation while solid bars indicate positive correlation. Horizontal lines indicate statistical significance at $p<0.05$.



SI Figure 4. Correlation coefficients for (a) log pesticide concentration and (b) log pesticide deposition with regional cropland intensity where regional cropland intensity is cropland area as a percentage of total land area in 75, 150, and 300-km radii of the park. Horizontal lines indicate statistical significance at $p<0.05$.

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