

Table 1. Detection, quantitation, precision and accuracy limits for sediment analyses conducted at the Wisconsin State Lab of Hygiene. Note only a partial list of commonly detected PCB congeners is provided.

Lab Measurement	Limit of Detection	Limit of Quantitation	Precision Limit Rel. % Diff.	Accuracy Limit % Recovery
Total Volatile Solids %	0.1 *	n.a.	15	n.a.
Total Kjeldahl Nitrogen ug/g	230	n.a.	30	70 - 130
Ammonia-N ug/g	0.16	0.64	20	75 - 125
Nitrite+Nitrate-N ug/g	0.25	7.8	20	75 - 125
Total Phosphorus ug/g	9.9	29.7	20	75 - 125
Cadmium (ICP) ug/g	0.1 - 0.4	0.3 - 1.2	20	75 - 125
Chromium (ICP) ug/g	0.4 - 0.5	1.2 - 1.6	20	75 - 125
Copper (ICP) ug/g	0.5 - 0.7	1.6 - 2.4	13	75 - 125
Lead (ICP) ug/g	1 - 2	3 - 8	20	82 - 120
Manganese (ICP) ug/g	0.1 - 0.2	0.3 - 0.5	11	75 - 125
Zinc (ICP) ug/g	0.5 - 2	1.6 - 6	16	75 - 125
Mercury ug/g	0.015	0.045	10	85 - 115
Total Organic Carbon %	0.16 - 0.32	n.a.	25.9	70 - 124
PCB congener # 28/31 ng/g	0.40 - 1.4	1.3+	21 - 30	65 - 111
PCB congener # 52 ng/g	0.20 - 0.30	0.64+	19	72 - 107
PCB congener # 101 ng/g	0.25 - 0.30	0.80+	17 - 32	80 - 107
PCB congener # 77/110 ng/g	0.30 - 0.40	0.96+	16 - 34	80 - 108
PCB congener # 138/163 ng/g	0.30 - 0.40	0.96+	45	80 - 112

* Report limit
n.a. Not available
+ Recent limit

Table 2. Spearman rank correlations of chemical measurements versus year, river flow, total organic carbon (TOC) and total volatile solids (TVS) for suspended sediment samples collected at Locks and Dams 3 and 4 on the Mississippi River.

Variable	Lock and Dam 3 - Red Wing, MN					Lock and Dam 4 - Alma, WI				
	Year	Flow	TOC	TVS		Year	Flow	TOC	TVS	
Flow	0.190		-0.379 *	-0.549 *		0.225		-0.540 *	-0.833 *	
TVS	-0.221	-0.549 *	0.203		-0.180	-0.833 *	0.556 *			
TOC	0.002	-0.379 *		-0.203	0.122	-0.540 *			0.556 *	
TSS	0.241	0.454 *	-0.354 *	-0.562 *						
Sed. Rate	0.261	0.890 *	-0.371 *	-0.460 *	0.302	0.673 *	-0.303	-0.490 *		
Cd										
Cd/TOC	-0.466 *	-0.156	-0.129	0.228	-0.553 *	-0.096	-0.155	0.120		
Cd/TVS	-0.317	0.109	-0.325	0.065	-0.469 *	0.170	-0.540 *	-0.121		
Cd/TOC	-0.414 *	-0.074	0.058	0.072	-0.418 *	0.225	-0.386 *	-0.214		
Cd/Mn	-0.405 *	0.179	-0.115	0.005	-0.346	0.477 *	-0.397 *	-0.417		
Cr										
Cr/TOC	-0.211	-0.263	-0.197	0.084	-0.269	-0.315	0.444	0.394		
Cr/TOC	-0.300	-0.012	-0.610 *	0.067	-0.532 *	0.277	-0.495 *	-0.364		
Cr/TVS	-0.131	0.022	-0.244	-0.507 *	0.039	0.739 *	-0.598 *	-0.740 *		
Cr/Mn	-0.217	0.480 *	-0.304	-0.485 *	-0.076	0.914 *	-0.800 *	-0.841 *		
Cu										
Cu/TOC	-0.523 *	-0.490 *	0.355 *	0.652 *	-0.488 *	-0.252	-0.160	0.335		
Cu/TOC	-0.174	0.091	0.716 *	0.173	-0.264	0.224	-0.812 *	-0.212		
Cu/TVS	-0.426 *	0.023	0.112	-0.243	-0.107	0.428 *	-0.668 *	-0.556 *		
Cu/Mn	-0.324 *	0.444 *	-0.296	-0.195	-0.007	0.778 *	-0.654 *	-0.679 *		
Pb										
Pb/TOC	-0.461 *	-0.486 *	0.457 *	0.506 *	-0.258	-0.456 *	0.280	0.386 *		
Pb/TOC	-0.324 *	-0.127	-0.115	0.293	-0.218	0.046	-0.490 *	-0.067		
Pb/TVS	-0.415 *	-0.258	0.426 *	0.100	-0.095	0.168	-0.107	-0.307		
Pb/Mn	-0.387 *	0.178	0.097	-0.017	-0.054	0.599 *	-0.341	-0.628 *		
Mn										
Mn/TOC	0.040	-0.714 *	0.335 *	0.598 *	-0.100	-0.853 *	0.529 *	0.824 *		
Mn/TOC	0.197	-0.369 *	-0.453 *	0.344 *	-0.065	-0.648 *	0.062	0.588 *		
Mn/TVS	-0.073	-0.612 *	0.283	0.208	0.063	-0.667 *	0.404 *	0.540 *		
Hg										
Hg/TOC	-0.680 *	-0.516 *	-0.010	0.347 *	-0.642 *	-0.468 *	0.067	0.606 *		
Hg/TOC	-0.552 *	-0.105	-0.555 *	0.123	-0.776 *	0.018	0.562 *	0.058		
Hg/TVS	-0.684 *	-0.268	-0.124	-0.042	-0.708 *	0.202	-0.469 *	-0.145		
Hg/Mn	-0.625 *	0.212	-0.312	-0.018	-0.335	0.702 *	-0.527 *	-0.506 *		
Zn										
Zn/TOC	-0.215	-0.618 *	0.339 *	0.726 *	-0.440 *	-0.660 *	0.326	0.746 *		
Zn/TOC	0.013	-0.108	-0.634 *	0.363 *	-0.292	0.179	-0.826 *	-0.015		
Zn/TVS	-0.094	-0.099	0.119	-0.200	0.064	0.670 *	-0.456 *	-0.793 *		
Zn/Mn	-0.025	0.574 *	-0.183	-0.291	-0.034	0.808 *	-0.498 *	-0.707 *		
NHx										
NHx/TOC	-0.401 *	0.001	-0.014	0.031	-0.117	-0.304	0.285	0.414		
NHx/TOC	-0.430 *	0.071	-0.138	-0.060	-0.168	-0.277	0.217	0.291		
NHx/TVS	-0.437 *	0.048	-0.079	-0.116	-0.094	-0.172	0.136	0.252		
NHx/Mn	-0.487 *	0.138	-0.120	-0.087	-0.082	0.294	-0.237	-0.204		
TKN										
TKN/TOC	-0.276	0.010	0.061	0.385 *	-0.001	-0.793 *	0.598 *	0.724 *		
TKN/TOC	-0.322	0.173	-0.281	0.150	-0.391	-0.494 *	0.158	0.357		
TKN/TVS	-0.380	0.096	-0.160	-0.134	-0.155	-0.311	0.152	0.177		
TKN/Mn	-0.438	0.494 *	-0.262	-0.022	-0.284	0.427	0.611 *	-0.584 *		
TP										
TP/TOC	-0.688 *	-0.169	0.049	0.115	-0.282	-0.566 *	0.301	0.405		
TP/TVS	-0.717 *	0.013	-0.357	-0.096	-0.714 *	0.030	-0.448	-0.252		
TP/Mn	-0.714 *	0.083	-0.141	-0.528 *	-0.653 *	0.110	-0.462 *	-0.311		
PCBs										
PCBs/TOC	-0.677 *	-0.614 *	0.291	0.511 *	-0.792 *	-0.533 *	0.004	0.406 *		
PCBs/TVS	-0.613 *	-0.308	-0.227	0.308	-0.785 *	-0.314	0.300	0.206		
PCBs/Mn	-0.736 *	-0.472 *	0.213	0.236	-0.818 *	-0.292	-0.180	0.166		
PCBs/Mn	-0.778 *	-0.136	0.030	0.121	-0.728 *	0.053	-0.328	-0.081		

* Significant at $P \leq 0.05$

Table 3. Temporal changes in average suspended sediment constituents over two time periods (spring and fall) at Locks and Dams 3 and 4 on the Mississippi River. Significant differences between periods were evaluated using a Kruskal-Wallis AOV.

Season	Variable	Lock & Dam 3				Lock & Dam 4				
		1987-1995		1997-2005		1987-1995		1997-2005		
		N	Avg.	N	Avg.	N	Avg.	N	Avg.	
Spring	Flow	8	35953	9	45760	8	54840	7	71116	29.7
	TSS mg/L	8	38.4	8	41.2	8	0.09	7	0.13	44.4
	Sed. Rate cm/d	8	0.12	8	0.14	8	3.32	7	3.58	7.8
	TOC %	8	2.84	9	2.94	8	9.22	7	8.56	-7.2
	TVS %	8	7.66	9	7.52	8		7		
	Cd ug/g	8	1.18	9	0.63	8	0.79	7	0.42	-46.8
	Cr ug/g	3	27.3	8	23.9	3	31.0	6	29.4	-5.2
	Cu ug/g	8	25.2	9	21	8	21.8	7	18.1	-17.0
	Pb ug/g	8	24.6	9	17.4	8	17.1	7	16	-6.4
	Mn ug/g	8	1444	9	1504	8	1625	7	1561	-3.9
Hg ug/g	7	0.170	9	0.104	7	0.127	7	0.076	-40.2	
Zn ug/g	8	99.2	9	93.6	8	83.4	7	76.9	-7.8	
NHx-N mg/L	5	174	9	131	5	203	7	257	26.6	
TKN mg/L	4	3338	9	3108	4	3750	7	4276	14.0	
TP mg/L	4	1150	9	976	4	1625	7	1571	-3.3	
PCBs ng/g	8	81.3	9	52.8	8	23.3	7	12.8	-45.1	
Fall	Flow	9	15179	9	15341	8	27761	7	35739	28.7
	Sed. Rate cm/d	9	0.08	9	0.08	8	0.05	7	0.06	20.0
	TOC %	9	3.90	9	2.96	8	3.74	6	4.46	19.3
	TVS %	9	8.30	9	7.88	8	10.2	7	10.9	6.9
	Cd ug/g	9	1.29	9	1.65	8	0.83	6	0.36	-56.6
	Cr ug/g	3	28.2	9	38.0	3	31.0	6	32.0	3.2
	Cu ug/g	9	27.5	9	21.6	8	24.2	5	19.3	-20.2
	Pb ug/g	9	26.7	9	18.9	8	21.4	6	18.3	-14.5
	Mn ug/g	9	2206	9	1948	8	2625	6	3941	50.1
	Hg ug/g	9	0.162	9	0.125	7	0.102	7	0.092	-9.8
Zn ug/g	9	105.7	9	100.0	8	94.4	6	90.0	-4.7	
NHx-N mg/L	3	105	9	81.8	3	177	6	267	50.8	
TKN mg/L	3	3433	9	2999	3	4433	6	5603	26.4	
TP mg/L	3	1250	9	1089	3	2167	6	1945	-10.2	
PCBs ng/g	9	107	9	64.9	8	41.7	7	18	-56.8	

Bold font reflects a significantly difference ($P \leq 0.05$) between periods.

Table 4. Temporal changes in average suspended sediment total organic carbon- (OC), total volatile solids- (TVS) and manganese-normalized metal, nutrient and PCB levels over two time periods (spring and fall) at Locks and Dams 3 and 4 on the Mississippi River. Significant differences between periods were evaluated using a Kruskal-Wallis AOV.

Season Variable	Lock & Dam 3				Lock & Dam 4						
	1987-1995		1997-2005		1987-1995		1997-2005				
	N	Avg.	N	Avg.	N	Avg.	N	Avg.			
				% Change	Variable			% Change			
Spring											
Cd ug/g OC	8	42.8	9	21.4	-50.0	Cd ug/g OC	8	24	7	12.4	-48.3
Cd ug/g TVS	8	15.3	9	8.48	-44.6	Cd ug/g TVS	8	8.33	7	5.21	-37.5
Cd/Mn ug/ug	8	0.0008	9	0.00043	-46.3	Cd/Mn ug/ug	8	0.00049	7	0.0003	-38.8
Cr ug/g OC	3	1125	8	814	-27.6	Cr ug/g OC	3	1082	6	816	-24.6
Cr ug/g TVS	3	366	8	317	-13.4	Cr ug/g TVS	3	392	6	343	-12.5
Cr/Mn	3	0.021	8	0.016	-23.8	Cr/Mn	3	0.026	6	0.021	-19.2
Cu ug/g OC	8	932	9	714	-23.4	Cu ug/g OC	8	695	7	509	-26.8
Cu ug/g TVS	8	327	9	279	-14.7	Cu ug/g TVS	8	240	7	213	-11.3
Cu/Mn ug/ug	8	0.017	9	0.014	-17.6	Cu/Mn ug/ug	8	0.015	7	0.012	-20.0
Pb ug/g OC	8	834	9	587	-29.6	Pb ug/g OC	8	530	7	442	-16.6
Pb ug/g TVS	8	321	9	229	-28.7	Pb ug/g TVS	8	187	7	185	-1.1
Pb/Mn ug/ug	8	0.017	9	0.012	-29.4	Pb/Mn ug/ug	8	0.011	7	0.011	0.0
Hg ug/g OC	7	6.56	9	3.57	-45.6	Hg ug/g OC	7	4.04	7	2.13	-47.3
Hg ug/g TVS	7	2.21	9	1.40	-36.7	Hg ug/g TVS	7	1.36	7	0.90	-33.8
Hg/Mn ng/ug	7	0.114	9	0.071	-37.7	Hg/Mn ng/ug	7	0.084	7	0.052	-38.1
Zn ug/g OC	8	1294	9	1244	-3.9	Zn ug/g OC	8	917	7	907	-1.1
Zn ug/g TVS	8	3609	9	3196	-11.4	Zn ug/g TVS	8	2616	7	2170	-17.0
Zn/Mn ug/ug	8	0.070	9	0.062	-11.4	Zn/Mn ug/ug	8	0.055	7	0.054	-1.8
NHx ug/g OC	3	7734	9	4493	-41.9	NHx ug/g OC	3	7521	7	6660	-11.4
NHx ug/g TVS	5	2296	9	1773	-22.8	NHx ug/g TVS	5	2359	7	2781	17.9
NHx/Mn ug/ug	5	0.132	9	0.090	-31.8	NHx/Mn ug/ug	5	0.153	7	0.151	-1.3
TKN ug/g OC	3	137887	9	106159	-23.0	TKN ug/g OC	3	135830	7	117392	-13.6
TKN ug/g TVS	4	45313	9	41225	-9.0	TKN ug/g TVS	4	45741	7	49067	7.3
TKN/Mn ug/ug	4	2.51	9	2.08	-17.1	TKN/Mn ug/ug	4	3.06	7	2.77	-9.5
TP ug/g OC	3	49857	9	33458	-32.9	TP ug/g OC	3	61248	7	44195	-27.8
TP ug/g TVS	3	15889	9	13151	-17.2	TP ug/g TVS	3	21369	7	18447	-13.7
TP/Mn ug/ug	3	0.866	9	0.667	-23.0	TP/Mn ug/ug	3	1.401	7	1.066	-23.9
PCBs ng/g OC	8	2878	9	1795	-37.6	PCBs ng/g OC	8	723	7	340	-53.0
PCBs ng/g TVS	8	1053	9	700	-33.5	PCBs ng/g TVS	8	253	7	142	-43.9
PCBs/Mn ng/ug	8	0.056	9	0.035	-37.5	PCBs/Mn ng/ug	8	0.015	7	0.008	-46.7

Bold font reflects a significantly difference (P< 0.05) between periods.

Table 4. Continued.

Season Variable	Lock & Dam 3				%	Variable	Lock & Dam 4					
	1987-1995		1997-2005				1987-1995		1997-2005			
	N	Avg.	N	Avg.			N	Avg.	N	Avg.		
Fall	Cd ug/g OC	9	38.0	9	56.7	49.2	Cd ug/g OC	8	24.1	5	8.96	-62.8
	Cd ug/g TVS	9	15.1	9	21.5	42.4	Cd ug/g TVS	8	8.0	6	3.5	-56.5
	Cd/Mn ug/ug	9	0.00058	9	0.00083	43.1	Cd/Mn ug/ug	8	0.00032	6	0.00012	-62.5
	Cr ug/g OC	3	1000	9	1299	29.9	Cr ug/g OC	3	964	5	739	-23.3
	Cr ug/g TVS	3	332	9	490	47.6	Cr ug/g TVS	3	314	6	325	3.5
	Cr/Mn	3	0.0143	9	0.019	32.9	Cr/Mn	3	0.013	6	0.009	-30.8
	Cu ug/g OC	9	839	9	729	-13.1	Cu ug/g OC	8	747	4	447	-40.2
	Cu ug/g TVS	9	326	9	275	-15.6	Cu ug/g TVS	8	238	5	200	-16.0
	Cu/Mn ug/ug	9	0.013	9	0.011	-15.4	Cu/Mn ug/ug	8	0.009	5	0.005	-44.4
	Pb ug/g OC	9	797	8	636	-20.2	Pb ug/g OC	8	633	5	421	-33.5
Pb ug/g TVS	9	317	8	239	-24.6	Pb ug/g TVS	8	218	6	185	-15.1	
Pb/Mn ug/ug	9	0.012	8	0.010	-16.7	Pb/Mn ug/ug	8	0.009	6	0.005	-44.4	
Hg ug/g OC	8	4.93	9	4.23	-14.2	Hg ug/g OC	7	3.26	6	2.03	-37.7	
Hg ug/g TVS	8	1.96	9	1.61	-17.9	Hg ug/g TVS	7	1.03	7	0.091	-91.2	
Hg/Mn ng/ug	8	0.077	9	0.066	-14.3	Hg/Mn ng/ug	7	0.039	6	0.026	-33.3	
Zn ug/g OC	9	1273	9	1270	-0.2	Zn ug/g OC	8	945	6	918	-2.9	
Zn ug/g TVS	9	3176	9	3382	6.5	Zn ug/g TVS	8	2726	5	2064	-24.3	
Zn/Mn ug/ug	9	0.050	9	0.052	4.0	Zn/Mn ug/ug	8	0.039	6	0.024	-38.5	
NHx ug/g OC	3	3563	9	2704	-24.1	NHx ug/g OC	3	6005	5	5025	-16.3	
NHx ug/g TVS	3	1462	9	1054	-27.9	NHx ug/g TVS	3	2074	6	2845	37.2	
NHx/Mn ug/ug	3	0.061	9	0.046	-24.6	NHx/Mn ug/ug	3	0.091	6	0.062	-31.9	
TKN ug/g OC	3	115603	9	100894	-12.7	TKN ug/g OC	3	149242	5	131962	-11.6	
TKN ug/g TVS	3	47746	9	38199	-20.0	TKN ug/g TVS	3	51759	6	54305	4.9	
TKN/Mn ug/ug	3	1.997	9	1.557	-22.0	TKN/Mn ug/ug	3	2.249	6	1.438	-36.1	
TP ug/g OC	3	41887	9	36747	-12.3	TP ug/g OC	3	82080	5	45213	-44.9	
TP ug/g TVS	3	17365	9	13910	-19.9	TP ug/g TVS	3	24491	6	19166	-21.7	
TP/Mn ug/ug	3	0.727	9	0.570	-21.6	TP/Mn ug/ug	3	1.119	6	0.516	-53.9	
PCBs ng/g OC	9	3083	9	2194	-28.8	PCBs ng/g OC	8	1204	6	372	-69.1	
PCBs ng/g TVS	9	1274	9	828	-35.0	PCBs ng/g TVS	8	398	7	183	-54.0	
PCBs/Mn ng/ug	9	0.049	9	0.034	-30.6	PCBs/Mn ng/ug	8	0.017	6	0.005	-70.6	

Bold font reflects a significantly difference (P < 0.05) between periods.

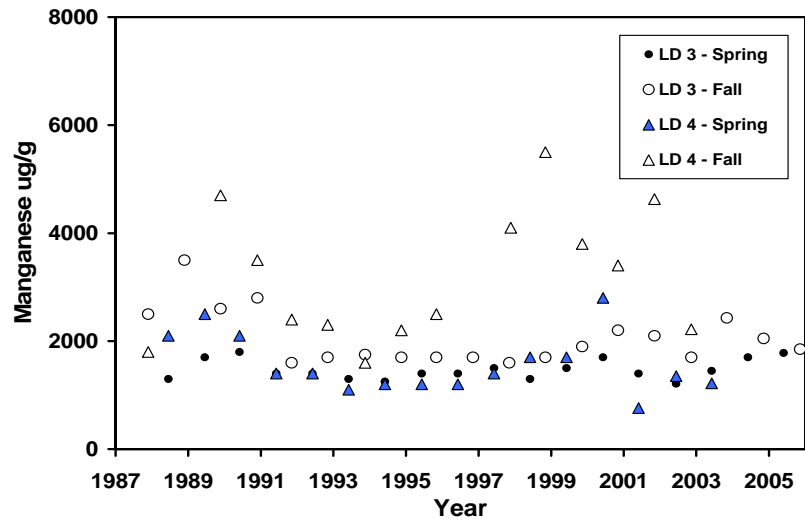
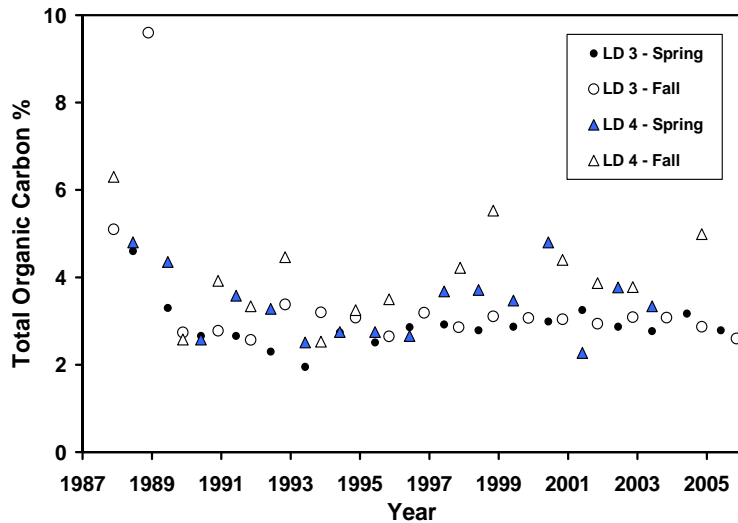
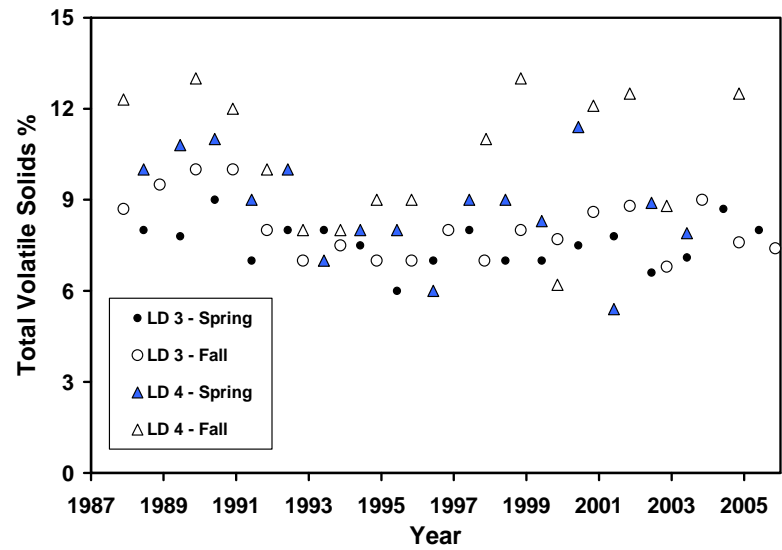
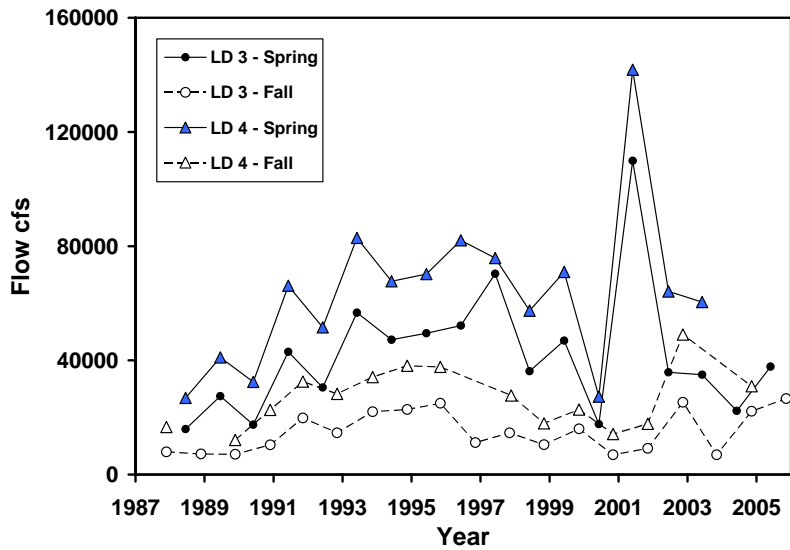


Figure 1. River flow and total volatile solids, total organic carbon and manganese levels in suspended sediment at Locks and Dams 3 and 4 on the Mississippi River from 1987 to 2005.

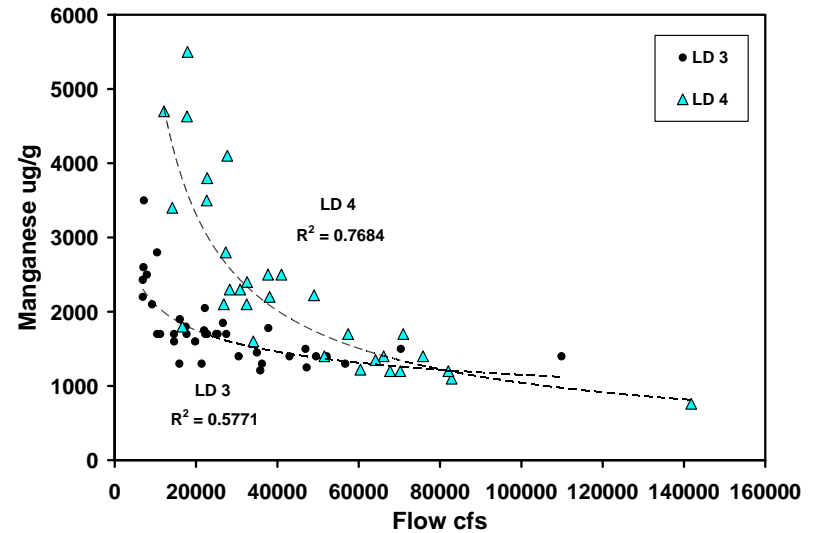
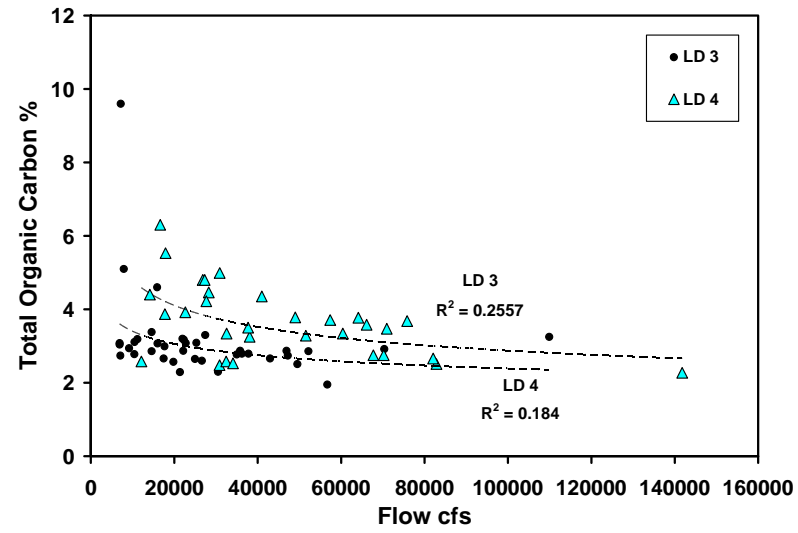
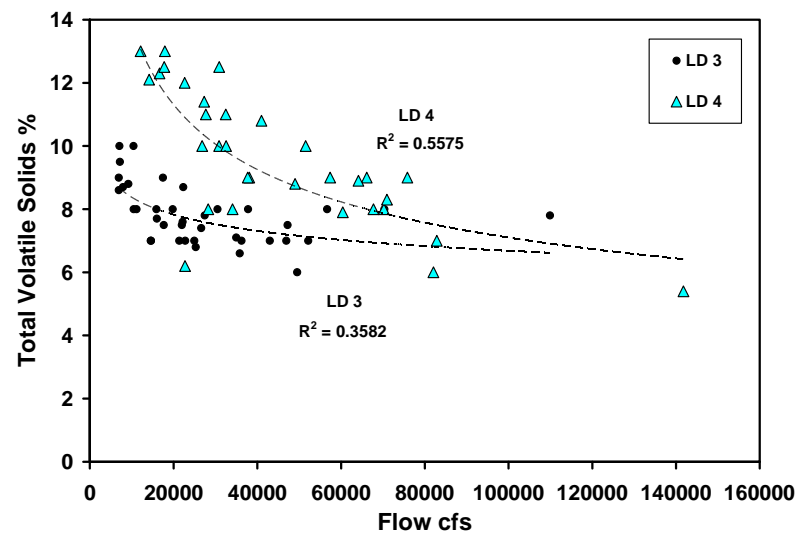
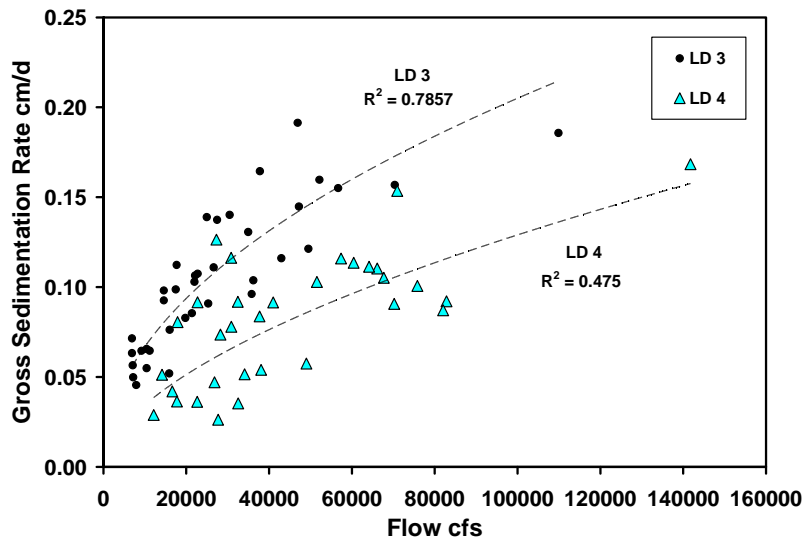


Figure 2. Regression plots of gross sedimentation rates and total volatile solids, total organic carbon and manganese levels in suspended sediment versus river flow at Locks and Dams 3 and 4 on the Mississippi River. Regression lines (dashes) and correlation coefficients (R^2) are provided where Spearman rank correlations were statistically significant ($P < 0.05$).

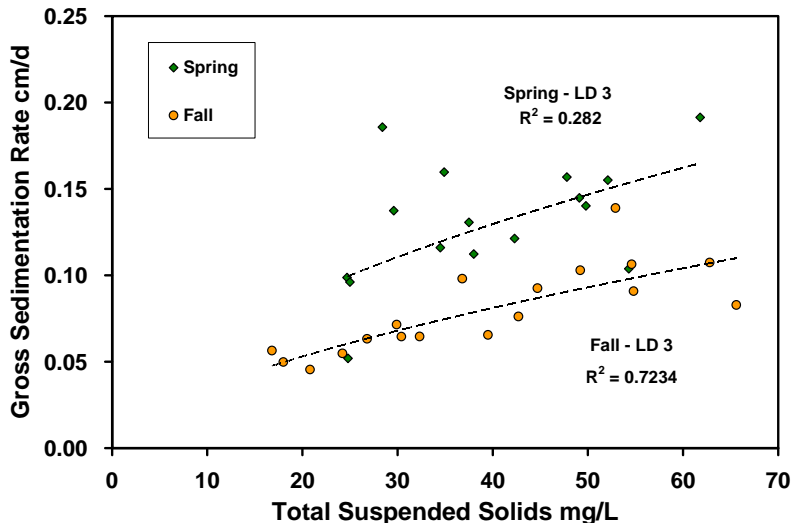
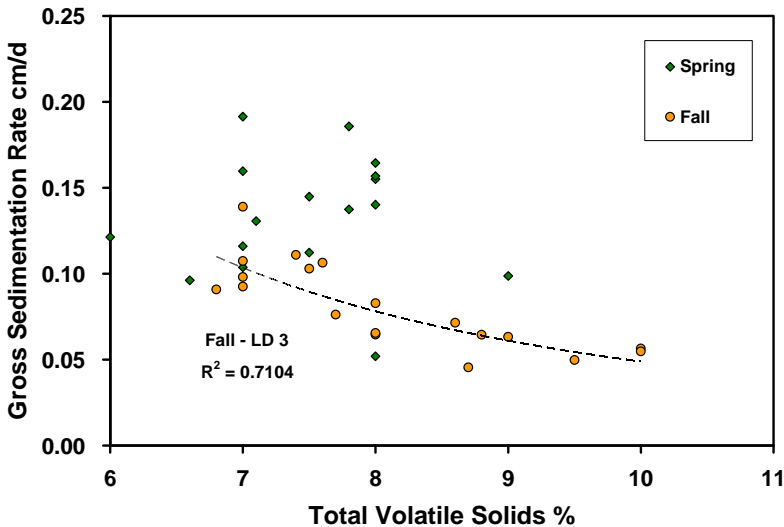
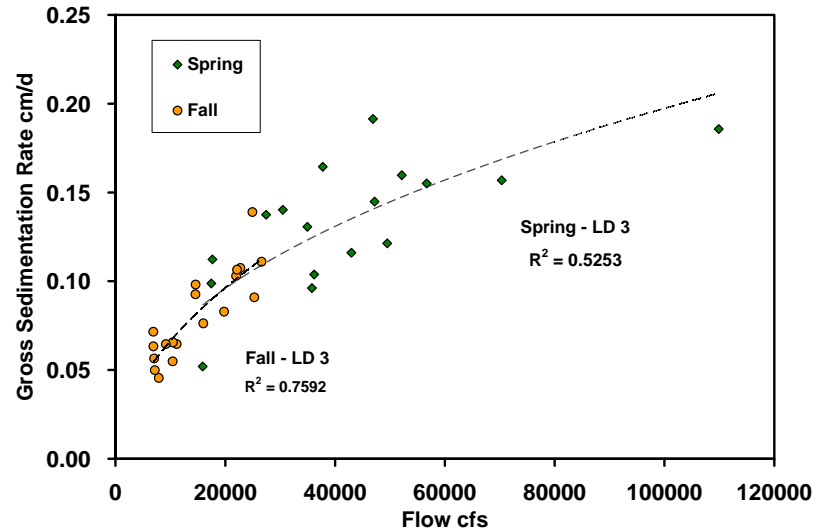
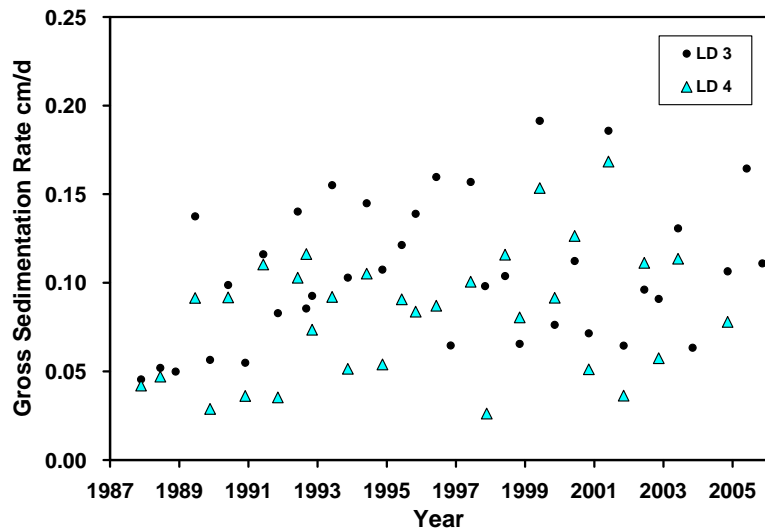


Figure 3. Gross sedimentation rates versus time and regression plots of gross sedimentation rates versus river flow, total volatile solids, and total suspended solids in suspended sediment at Locks and Dam 3 on the Mississippi River. Regression lines (dashes) and correlation coefficients (R^2) are provided where Spearman rank correlations were statistically significant ($P \leq 0.05$).

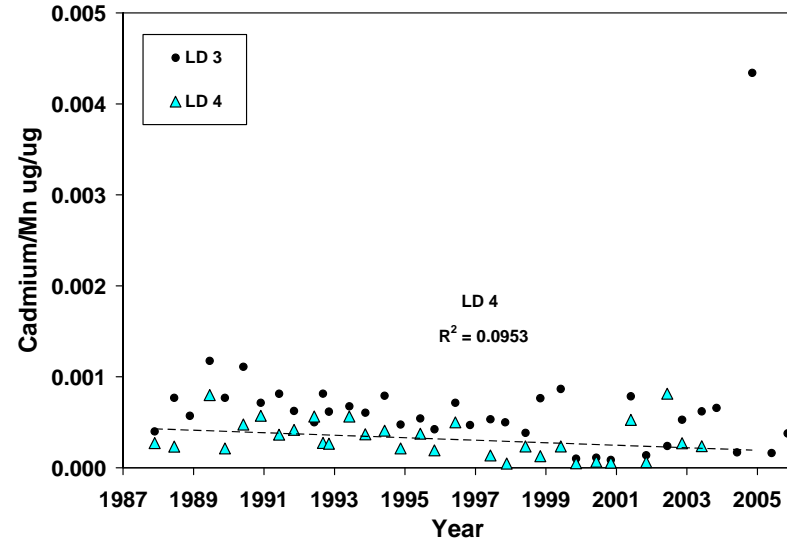
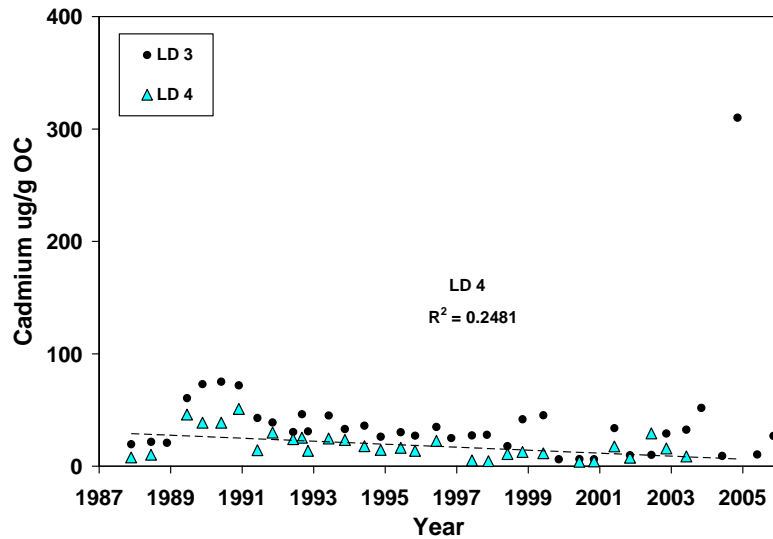
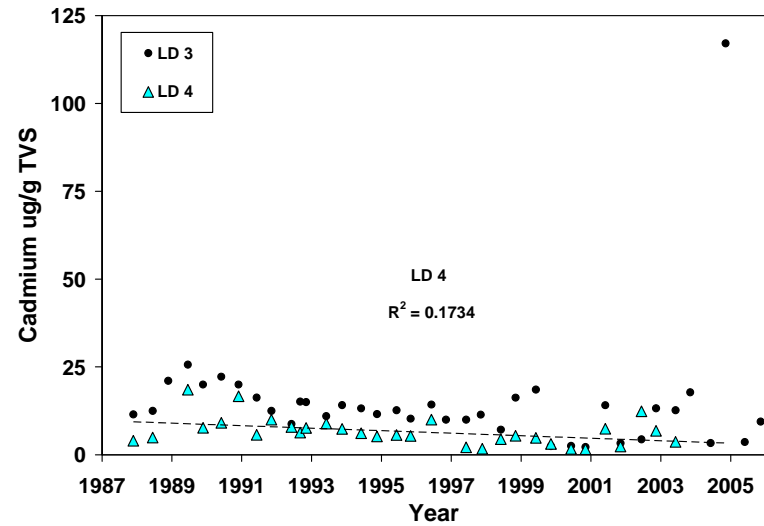
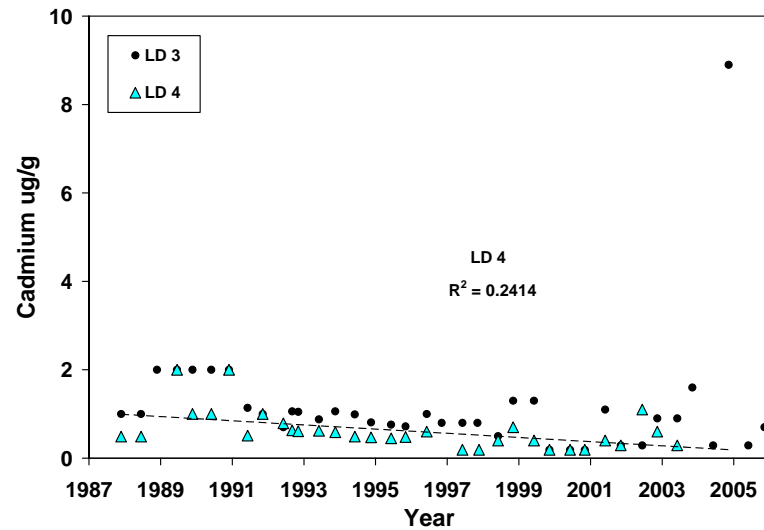


Figure 4. Temporal changes in cadmium concentrations and total volatile solids (TVS)-, total organic carbon (OC)-, and manganese-normalized cadmium concentrations in suspended sediment at Locks and Dams 3 and 4 on the Mississippi River. Regression lines (dashes) and correlation coefficients (R^2) are provided where Spearman rank correlations were statistically significant ($P \leq 0.05$).

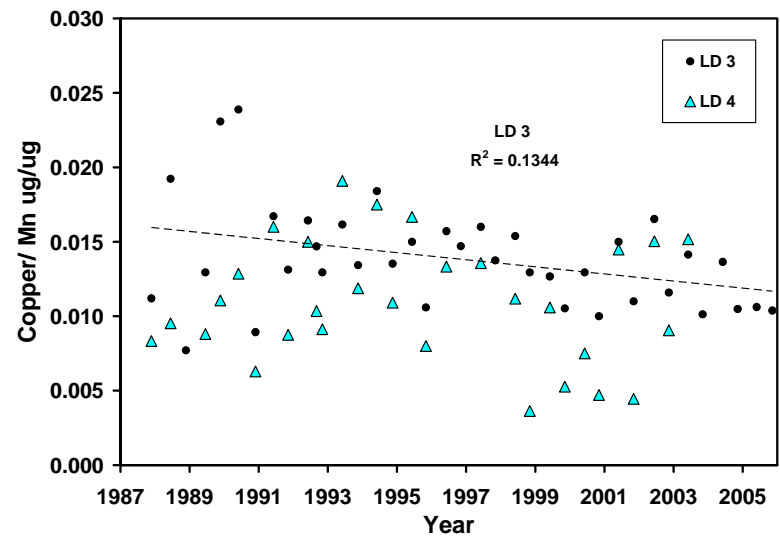
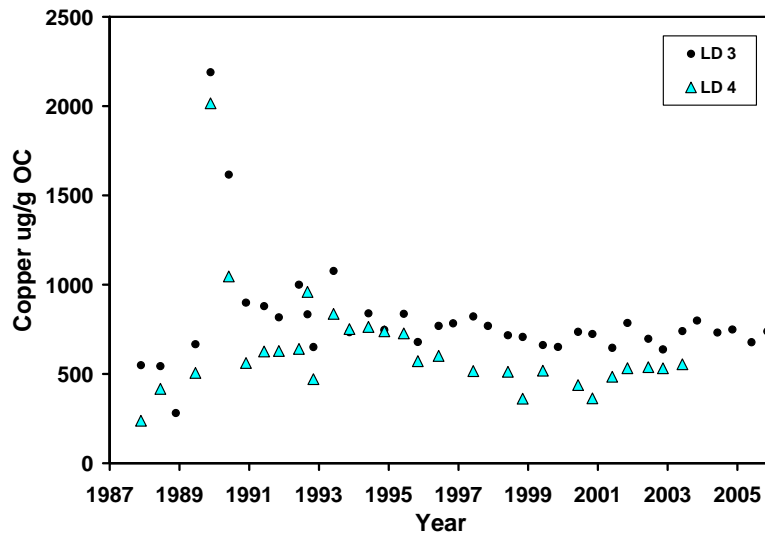
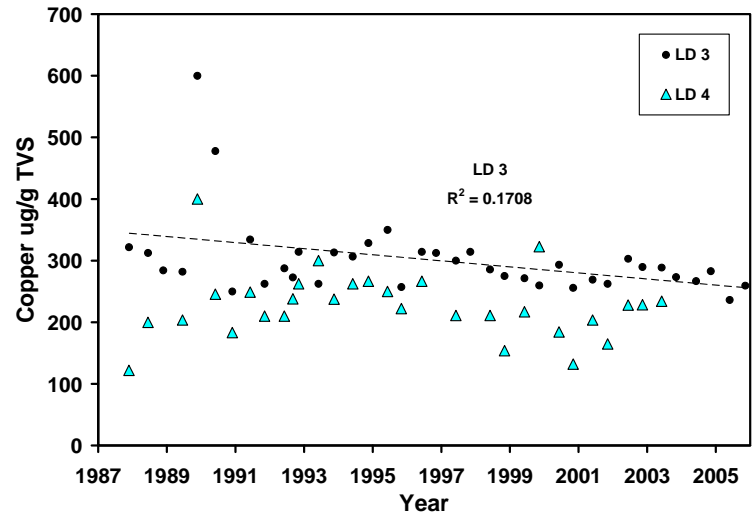
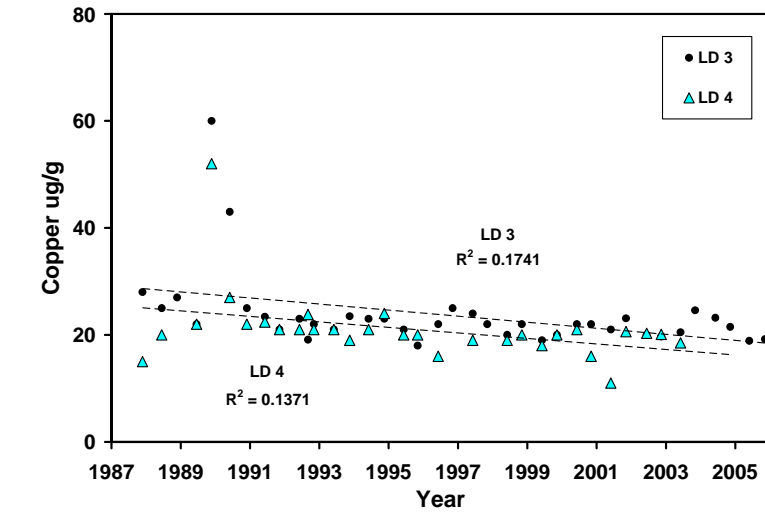


Figure 5. Temporal changes in copper concentrations and total volatile solids (TVS)-, total organic carbon (OC)-, and manganese-normalized copper concentrations in suspended sediment at Locks and Dams 3 and 4 on the Mississippi River. Regression lines (dashes) and correlation coefficients (R^2) are provided where Spearman rank correlations were statistically significant ($P \leq 0.05$).

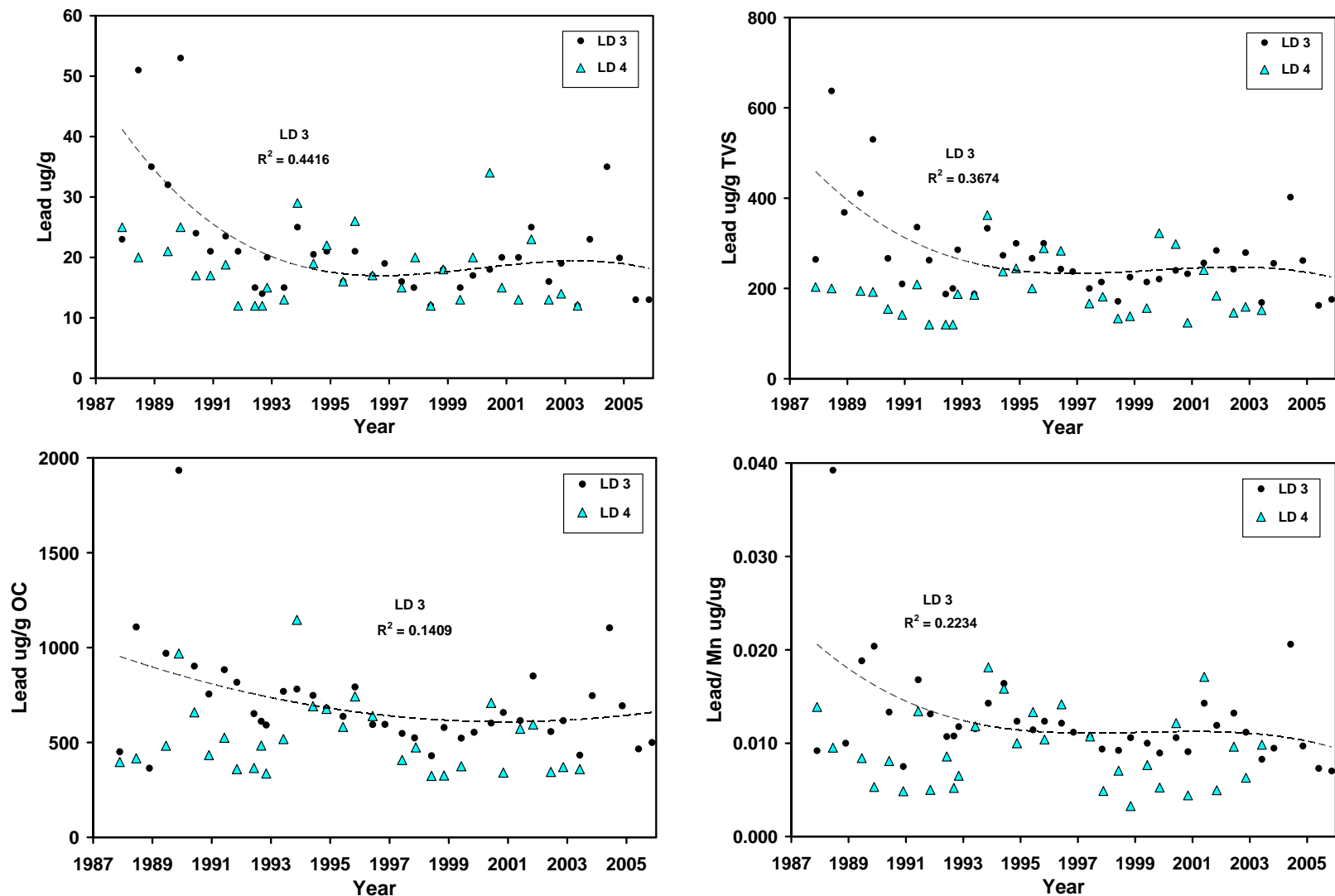


Figure 6. Temporal changes in lead concentrations and total volatile solids (TVS)-, total organic carbon (OC)-, and manganese-normalized lead concentrations in suspended sediment at Locks and Dams 3 and 4 on the Mississippi River. Regression lines (dashes) and correlations coefficients (R^2) are provided where a Spearman rank correlations were statistically significant ($P \leq 0.05$).

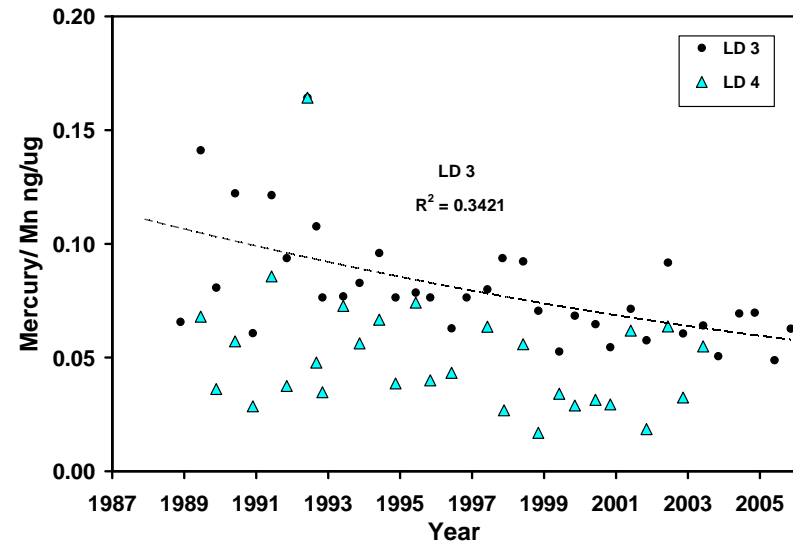
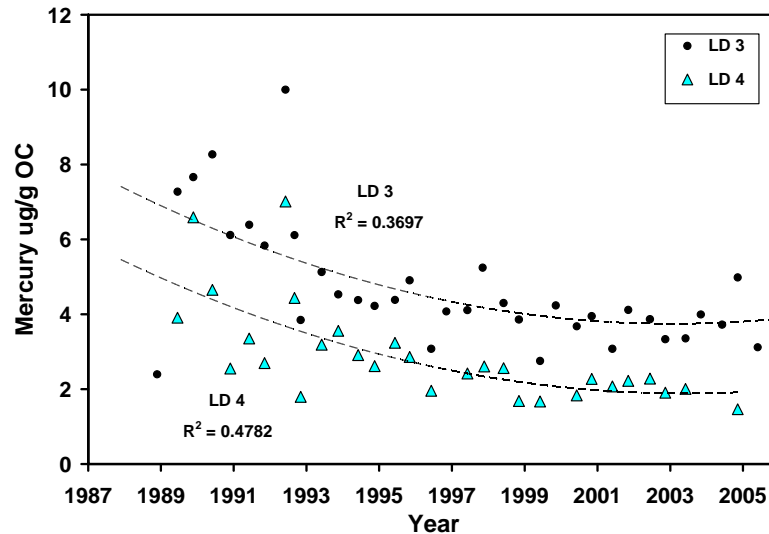
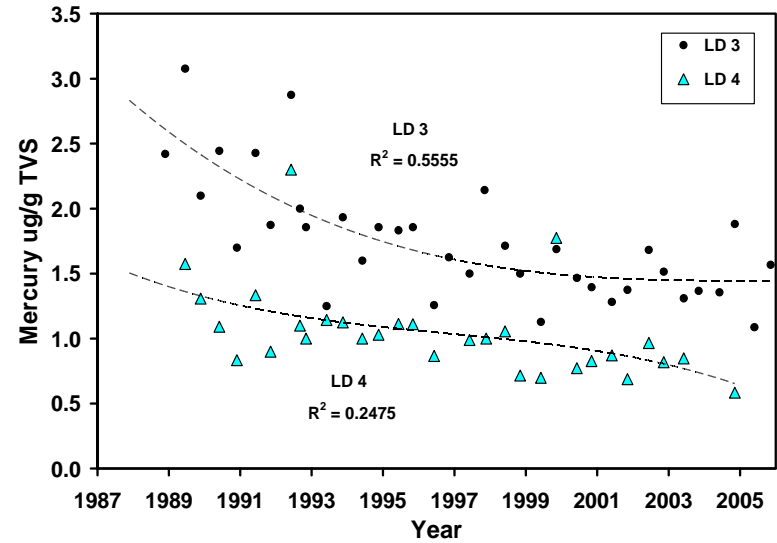
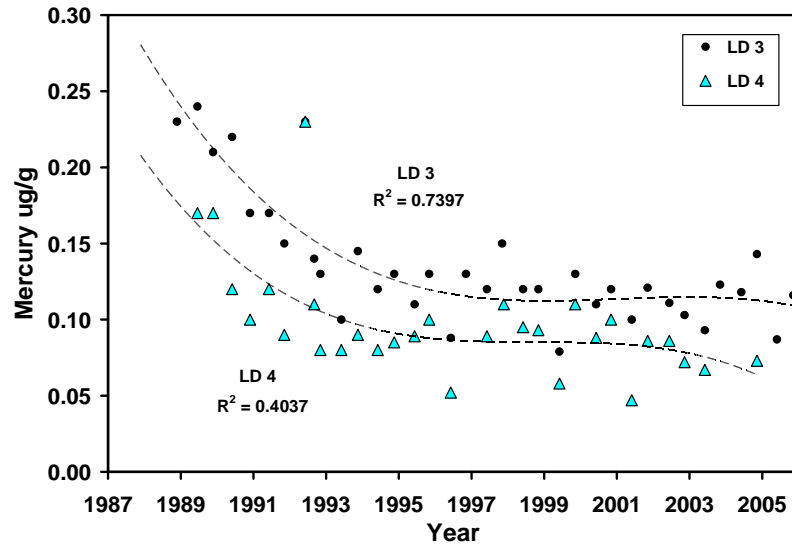


Figure 7. Temporal changes in mercury concentrations and total volatile solids (TVS)-, total organic carbon (OC)-, and manganese-normalized mercury concentrations in suspended sediment at Locks and Dams 3 and 4 on the Mississippi River. Regression lines (dashes) and correlation coefficients (R^2) are provided where a Spearman rank correlations were statistically significant ($P \leq 0.05$).

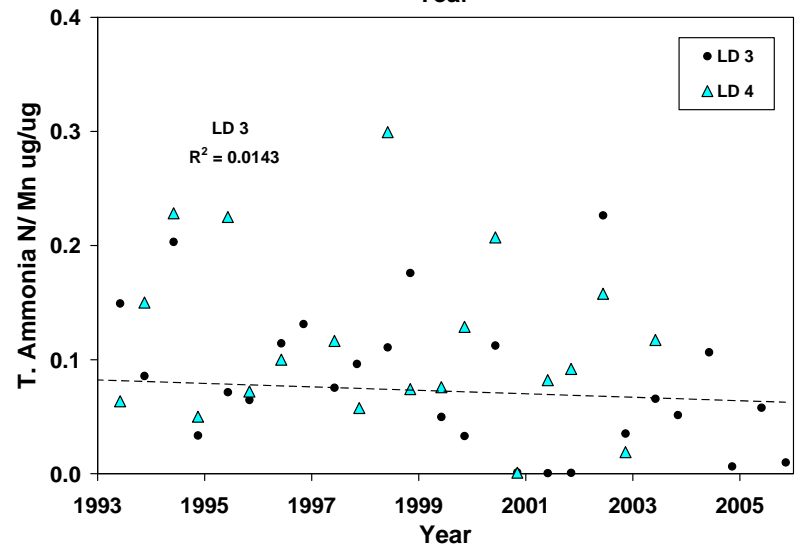
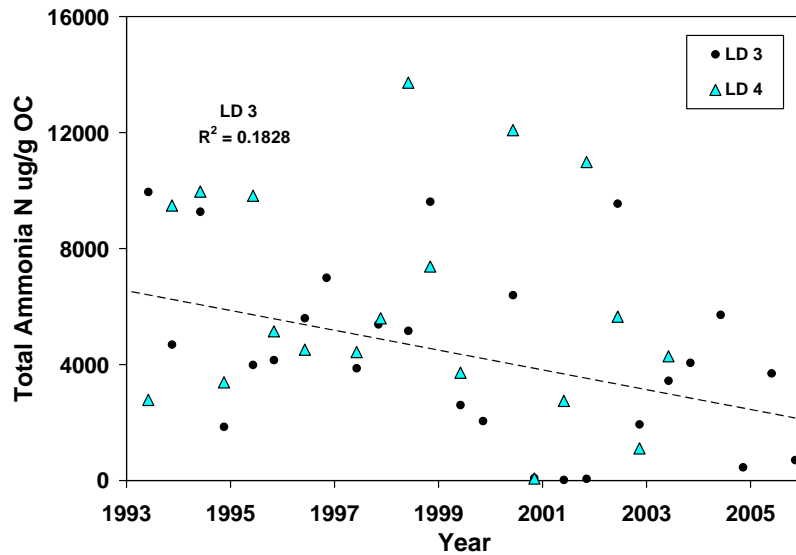
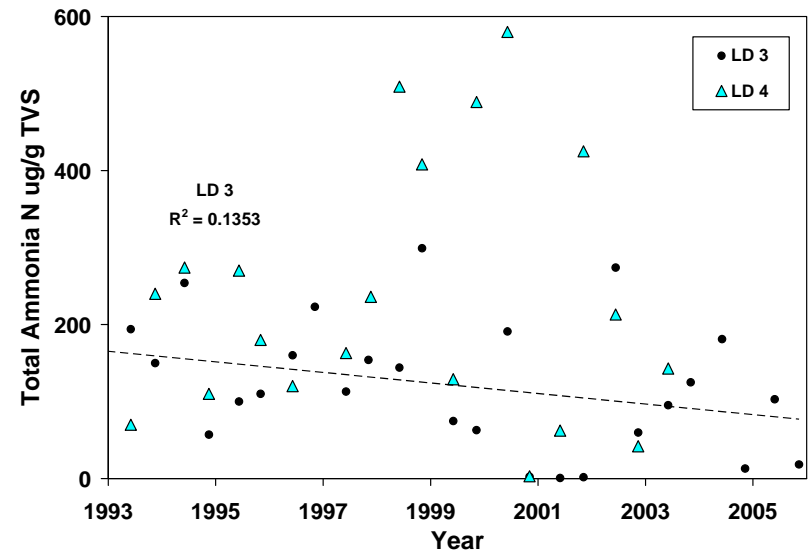
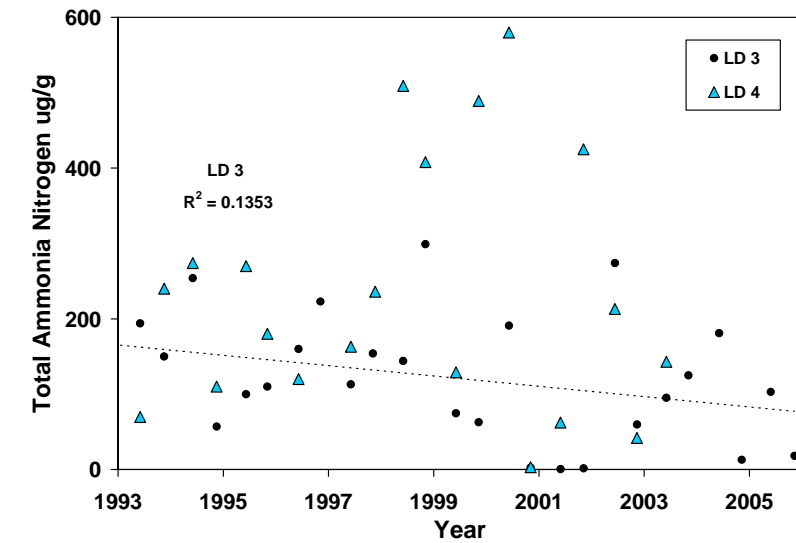


Figure 8. Temporal changes in ammonia-N concentrations and total volatile solids (TVS)-, total organic carbon (OC)-, and manganese-normalized ammonia-N concentrations in suspended sediment at Locks and Dams 3 and 4 on the Mississippi River. Regression lines (dashes) and correlation coefficients (R^2) are provided where Spearman rank correlations were statistically significant ($P \leq 0.05$).

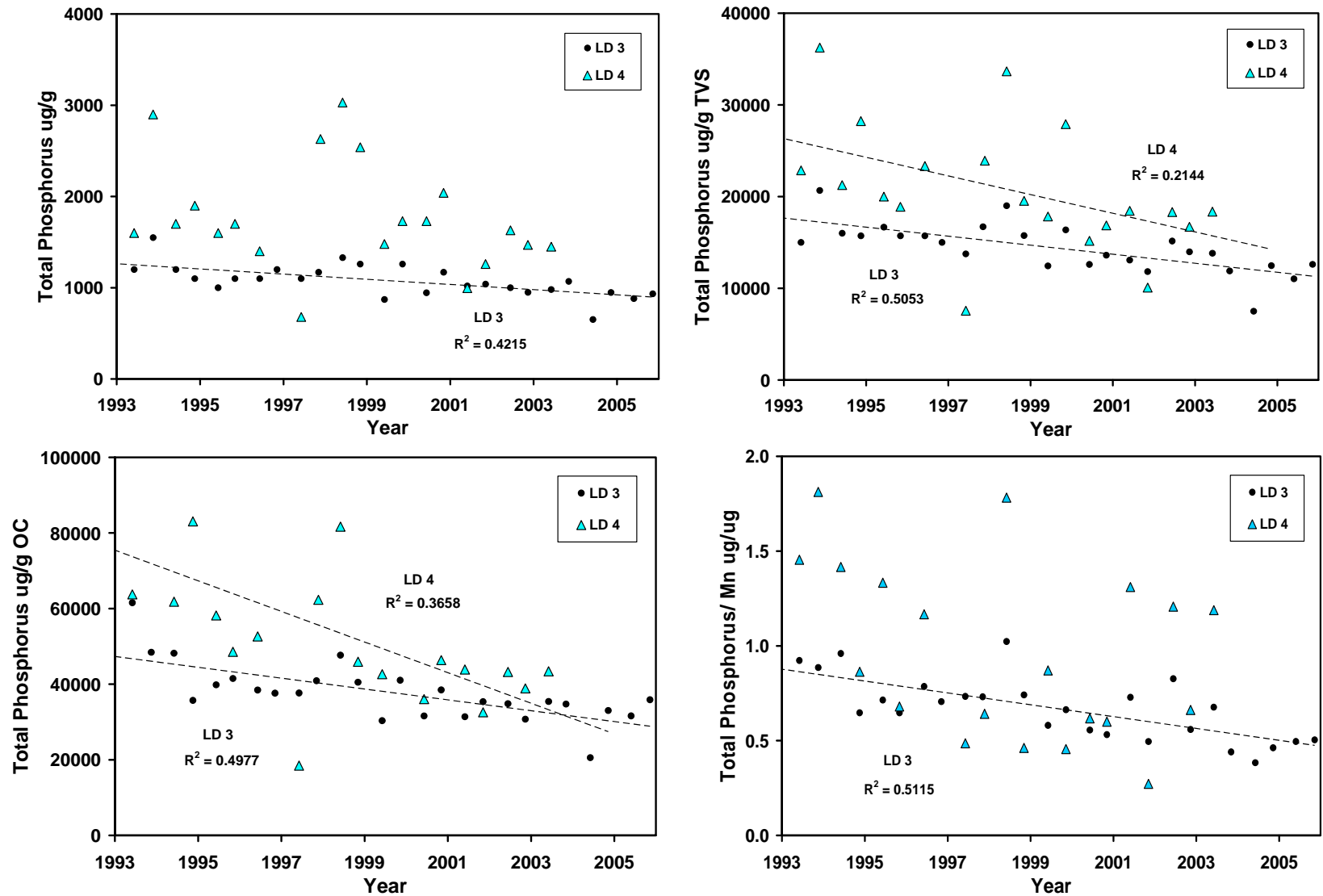


Figure 9. Temporal changes in total phosphorus concentrations and total volatile solids (TVS)-, total organic carbon (OC)-, and manganese-normalized total phosphorus concentrations in suspended sediment at Locks and Dams 3 and 4 on the Mississippi River. Regression lines (dashes) and correlation coefficients (R^2) are provided where a Spearman rank correlations were statistically significant ($P \leq 0.05$).

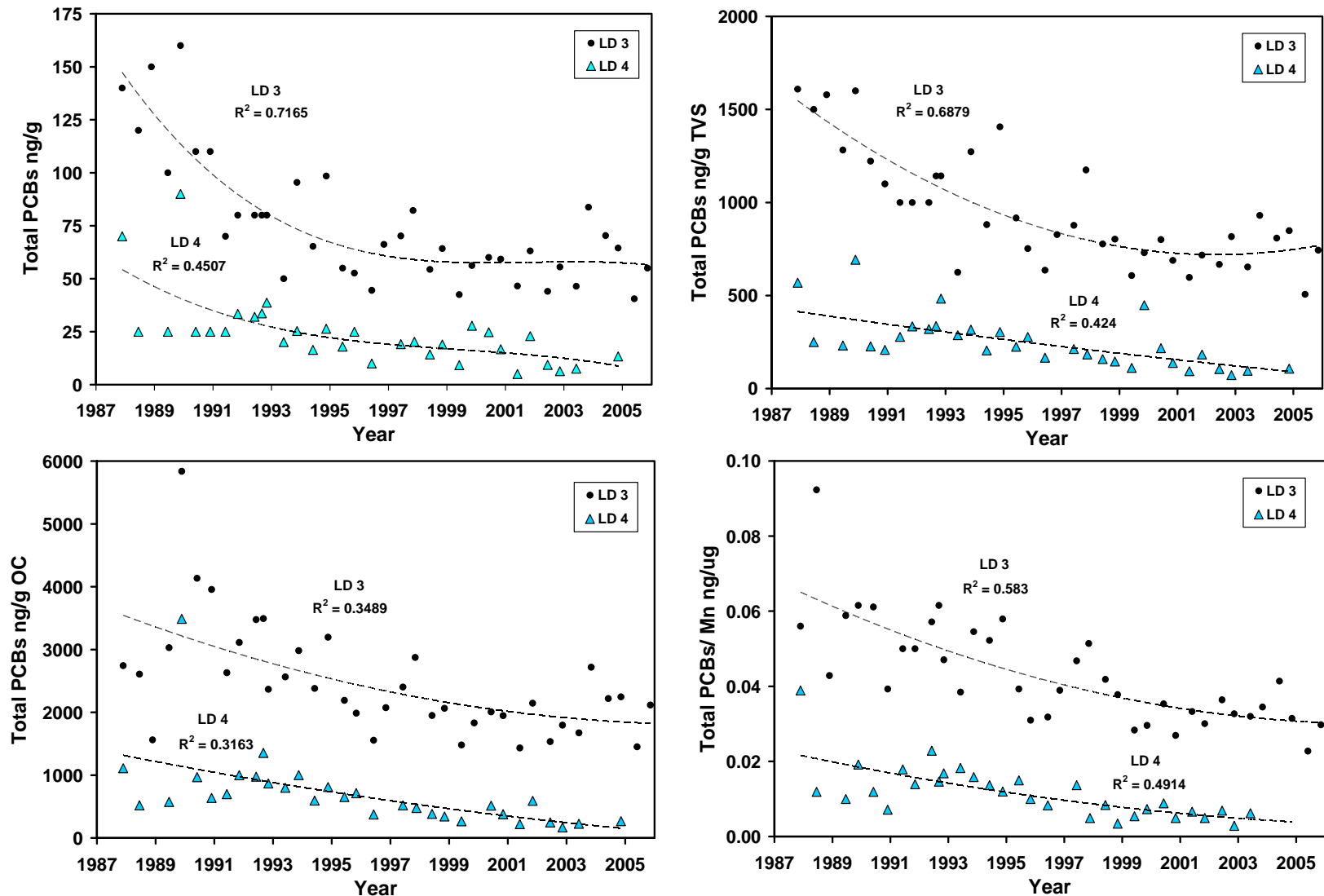


Figure 10. Temporal changes in total PCB concentrations and total volatile solids (TVS)-, total organic carbon (OC)-, and manganese-normalized total PCB concentrations in suspended sediment at Locks and Dams 3 and 4 of the Mississippi River. Regression lines (dashes) and correlations coefficients (R^2) are provided where a Spearman rank correlations were statistically significant ($P \leq 0.05$).