Assessing Heavy Metals in the Sele River Estuary: An Overview of Pollution Indices in Southern Italy

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Table S1. Description of the sampling sites and heavy metals concentration (μg/L) detected in the water dissolved phase (DP) of the Sele River, southern Italy.

Location ID	Season	As	Hg	Cd	Cr	Cu	Ni	Pb	Zn
1 (river water)	July	6.84 ± 3.15	2.35 ± 1.13	1.45 ± 0.48	14.97 ± 4.97	3.02 ± 1.00	11.15 ± 3.73	14.41 ± 4.78	4.17 ± 1.37
	November	1.17 ± 0.51	0.23 ± 0.09	0.52 ± 0.18	3.95 ± 1.32	< 1.57	1.94 ± 0.63	1.64 ± 0.53	2.25 ± 0.77
	February	1.55 ± 0.73	< 0.23	< 0.50	0.91 ± 0.32	< 1.57	< 1.73	< 1.57	2.18 ± 0.71
	April	3.32 ± 1.60	0.57 ± 0.18	0.63 ± 0.21	11.12 ± 3.69	1.67 ± 0.54	5.58 ± 1.84	4.82 ± 1.62	2.69 ± 0.87
2 (sea water)	July	5.70 ± 1.87	0.72 ± 0.22	0.84 ± 0.29	3.71 ± 1.18	1.79 ± 1.27	2.81 ± 0.94	1.59 ± 0.52	5.46 ± 1.83
	November	0.69 ± 0.22	< 0.23	< 0.50	0.62 ± 0.17	< 1.57	< 1.73	< 1.57	< 2.17
	February	< 0.67	< 0.23	< 0.50	< 0.63	< 1.57	< 1.73	< 1.57	< 2.17
	April	2.41 ± 0.81	< 0.23	< 0.50	1.96 ± 0.66	1.58 ± 0.54	2.12 ± 0.69	< 1.57	2.92 ± 0.97
3 (sea water)	July	2.58 ± 0.85	0.25 ± 0.09	0.53 ± 0.18	1.54 ± 0.52	1.71 ± 0.56	1.76 ± 0.61	< 1.57	2.21 ± 0.75
	November	< 0.67	< 0.23	< 0.50	0.64 ± 0.19	< 1.57	< 1.73	< 1.57	< 2.17
	February	< 0.67	< 0.23	< 0.50	< 0.63	< 1.57	< 1.73	< 1.57	< 2.17
	April	0.74 ± 0.25	< 0.23	< 0.50	< 0.63	1.57 ± 0.52	< 1.73	< 1.57	< 2.17
4 (sea water)	July	0.68 ± 0.28	< 0.23	< 0.50	0.68 ± 0.20	< 1.57	< 1.73	< 1.57	< 2.17
	November	< 0.67	< 0.23	< 0.50	< 0.63	< 1.57	< 1.73	< 1.57	< 2.17
	February	< 0.67	< 0.23	< 0.50	< 0.63	< 1.57	< 1.73	< 1.57	< 2.17
	April	< 0.67	< 0.23	< 0.50	< 0.63	< 1.57	< 1.73	< 1.57	< 2.17
5 (sea water)	July	2.36 ± 0.79	0.92 ± 0.28	0.82 ± 0.24	6.17 ± 2.04	1.66 ± 0.53	5.81 ± 1.91	4.43 ± 1.45	2.25 ± 0.72
	November	< 0.67	< 0.23	< 0.50	1.65 ± 0.52	< 1.57	< 1.73	< 1.57	< 2.17
	February	0.52 ± 0.16	< 0.23	< 0.50	< 0.63	< 1.57	< 1.73	< 1.57	< 2.17
	April	1.39 ± 0.44	0.23 ± 0.05	0.52 ± 0.16	5.36 ± 1.74	1.59 ± 0.49	2.34 ± 0.75	1.90 ± 0.61	< 2.17
6 (sea water)	July	< 0.67	0.42 ± 1.21	0.60 ± 0.19	1.93 ± 0.61	1.57± 0.51	3.58 ± 1.15	1.68 ± 0.53	< 2.17
	November	< 0.67	< 0.23	< 0.50	0.65 ± 0.19	< 1.57	< 1.73	< 1.57	< 2.17
	February	< 0.67	< 0.23	< 0.50	< 0.63	< 1.57	< 1.73	< 1.57	< 2.17
	April	< 0.67	< 0.23	< 0.50	3.50 ± 1.13	< 1.57	1.85 ± 0.57	< 1.57	< 2.17
7 (sea water)	July	< 0.67	< 0.23	< 0.50	0.79 ± 0.23	< 1.57	1.76 ± 0.56	< 1.57	< 2.17
	November	< 0.67	< 0.23	< 0.50	< 0.63	< 1.57	< 1.73	< 1.57	< 2.17
	February	< 0.67	< 0.23	< 0.50	< 0.63	< 1.57	< 1.73	< 1.57	< 2.17

	April	< 0.67	< 0.23	< 0.50	1.01 ± 0.31	< 1.57	< 1.73	< 1.57	< 2.17
8 (sea water)	July	14.28 ± 4.73	1.87 ± 0.57	1.69 ± 0.52	12.41 ± 4.09	13.23 ± 4.42	8.73 ± 2.88	3.12 ± 1.00	3.32 ± 1.09
	November	1.15 ± 0.36	0.25 ± 0.07	0.54 ± 0.14	2.89 ± 0.93	3.74 ± 1.20	1.84 ± 0.60	< 1.57	2.19 ± 0.71
	February	6.47 ± 2.10	< 0.23	< 0.50	0.68 ± 0.18	< 1.57	< 1.73	< 1.57	< 2.17
	April	1.62 ± 0.53	0.61 ± 0.19	0.82 ± 0.23	11.54 ± 3.81	7.52 ± 2.48	3.62 ± 1.17	1.60 ± 0.51	2.35 ± 0.75
9 (sea water)	July	7.59 ± 2.49	1.45 ± 0.45	0.73 ± 0.21	5.72 ± 1.88	5.42 ± 1.78	3.79 ± 1.22	< 1.57	2.38 ± 0.71
	November	< 0.67	< 0.23	< 0.50	1.05 ± 0.33	< 1.57	< 1.73	< 1.57	< 2.17
	February	1.13 ± 0.31	< 0.23	< 0.50	0.67 ± 0.19	< 1.57	< 1.73	< 1.57	< 2.17
	April	2.91 ± 0.92	0.34 ± 0.09	0.50 ± 0.13	4.48 ± 1.41	3.56 ± 1.11	1.89 ± 0.59	< 1.57	2.18 ± 0.65
10 (sea water)	July	3.30 ± 0.97	0.42 ± 0.11	0.58 ± 0.15	2.69 ± 0.85	2.35 ± 0.73	1.80 ± 0.56	< 1.57	2.20 ± 0.72
	November	< 0.67	< 0.23	< 0.50	0.71 ± 0.21	< 1.57	< 1.73	< 1.57	< 2.17
	February	< 0.67	< 0.23	< 0.50	< 0.63	< 1.57	< 1.73	< 1.57	< 2.17
	April	1.21 ± 0.37	< 0.23	0.51 ± 0.13	1.30 ± 0.39	1.58 ± 0.48	< 1.73	< 1.57	2.17 ± 0.66

Table S2. Description of the sampling sites and heavy metals concentration (μg/L) detected in Suspended Particulate Matter (SPM) of the Sele River, southern Italy.

Location ID	Season	As	Hg	Cd	Cr	Cu	Ni	Pb	Zn
1 (river water)	July	75.23 ± 24.97	6.94 ± 2.29	2.06 ± 0.61	17.45 ± 5.73	100.69 ± 33.41	54.03 ± 17.78	86.66 ± 28.73	90.28 ± 29.95
	November	19.65 ± 6.45	2.11 ± 0.64	0.52 ± 0.15	3.20 ± 1.02	18.54 ± 6.08	10.34 ± 3.38	33.28 ± 11.01	2.19 ± 0.67
	February	4.59 ± 1.52	1.84 ± 0.51	< 0.50	1.54 ± 0.47	8.96 ± 2.85	2.85 ± 0.85	13.50 ± 4.44	< 2.17
	April	37.82 ± 12.53	2.47 ± 0.76	1.01 ± 0.30	7.43 ± 2.38	71.21 ± 23.64	24.86 ± 8.19	53.07 ± 17.67	30.24 ± 10.03
2 (sea water)	July	20.31 ± 6.65	3.07 ± 1.00	0.74 ± 0.22	9.76 ± 3.18	36.77 ± 12.16	7.02 ± 2.27	19.35 ± 6.32	29.05 ± 9.61
	November	5.24 ± 1.72	0.48 ± 0.13	< 0.50	2.07 ± 0.66	11.52 ± 3.81	5.93 ±1.85	10.47 ± 3.40	2.19 ± 0.63
	February	8.50 ± 2.77	0.40 ± 0.09	< 0.50	1.58 ± 0.47	1.88 ± 0.53	< 1.73	1.68 ± 0.53	< 2.17
	April	0.85 ± 0.23	1.05 ± 0.32	< 0.50	4.27 ± 1.33	25.50 ± 8.41	8.96 ± 2.88	22.81 ± 7.46	14.78 ± 4.81
3 (sea water)	July	7.42 ± 2.44	1.86 ± 0.60	< 0.50	4.91 ± 1.58	4.63 ± 1.44	4.21 ± 1.31	8.29 ± 2.65	10.39 ± 3.34
	November	2.54 ± 0.82	0.69 ±0.18	< 0.50	1.01 ± 0.31	17.82 ± 5.84	< 1.73	4.54 ± 1.43	< 2.17
	February	< 0.67	< 0.23	< 0.50	0.89 ± 0.25	< 1.57	< 1.73	< 1.57	< 2.17
	April	6.87 ± 2.25	0.54 ± 0.16	< 0.50	1.67 ± 0.49	9.58 ± 3.08	5.08 ± 1.58	10.32 ± 3.32	6.59 ± 2.08
4 (sea water)	July	0.75 ± 0.24	0.78 ± 0.24	0.51 ± 0.15	2.64 ± 0.77	< 1.57	< 1.73	2.21 ± 0.65	5.07 ± 1.58
	November	0.69 ± 0.19	0.63 ± 0.17	< 0.50	1.36 ± 0.35	8.96 ± 2.89	< 1.73	< 1.57	< 2.17
	February	< 0.67	< 0.23	< 0.50	0.87 ± 0.23	< 1.57	< 1.73	< 1.57	< 2.17
	April	1.29 ± 0.42	< 0.23	< 0.50	0.75 ± 0.19	4.33 ± 1.31	1.79 ± 0.52	3.86 ± 1.21	2.17 ± 0.59
5 (sea water)	July	42.08 ± 13.99	4.97 ± 1.63	1.03 ± 0.25	10.10 ± 3.29	64.91 ± 21.53	21.05 ± 6.92	53.69 ± 17.81	47.88 ± 15.86
	November	12.69 ± 4.2	1.05 ± 0.29	< 0.50	2.62 ± 0.82	25.83 ± 8.51	11.27 ± 3.64	24.78 ± 8.15	< 2.17
	February	1.96 ± 0.63	0.91 ± 0.24	< 0.50	1.87 ± 0.58	5.17 ± 1.62	2.18 ± 0.66	5.21 ± 1.65	< 2.17
	April	18.37 ± 6.08	1.56 ± 0.48	0.65 ± 0.12	5.28 ± 1.73	41.87 ± 12.95	21.29 ± 6.08	34.65 ± 11.47	20.67 ± 6.78
6 (sea water)	July	28.93 ± 9.61	3.21 ± 1.03	0.87 ± 0.21	7.41 ± 2.44	26.53 ± 8.75	10.40 ± 3.36	30.20 ± 9.94	24.89 ± 8.21
	November	5.04 ± 1.66	1.10 ± 0.32	< 0.50	1.09 ± 0.32	9.65 ± 3.10	3.25 ± 1.01	8.57 ± 2.77	< 2.17
	February	0.78 ± 0.24	0.74 ± 0.21	< 0.50	0.88 ± 0.24	1.59 ± 0.45	< 1.73	1.84 ± 0.53	< 2.17
	April	8.65 ± 2.78	0.86 ± 0.27	0.59 ± 0.21	2.17 ± 0.66	26.84 ± 8.86	12.36 ± 4.03	19.86 ± 6.52	11.56 ± 3.74
7 (sea water)	July	12.09 ± 3.97	1.23 ± 0.36	< 0.50	3.13 ± 1.01	6.21 ± 2.00	6.18 ± 1.95	9.28 ± 2.96	9.21 ± 2.96
	November	1.84 ± 0.55	0.87 ± 0.25	< 0.50	1.05 ± 0.28	4.07 ± 1.25	< 1.73	2.70 ± 0.83	< 2.17
	February	< 0.67	< 0.23	< 0.50	< 0.63	< 1.57	< 1.73	< 1.57	< 2.17

	April	2.07 ± 0.63	0.52 ± 0.12	0.54 ± 0.09	1.21 ± 0.37	8.03 ± 2.56	3.16 ± 0.94	8.95 ± 2.77	4.58 ± 1.45
	July	116.52 ± 38.52	10.03 ± 3.27	4.57 ± 1.49	33.47 ± 11.06	139.85 ± 46.51	88.74 ± 29.47	81.92 ± 27.12	107.54 ± 35.68
8	November	30.26 ± 9.86	3.11 ± 0.95	0.71 ± 0.18	8.56 ± 2.78	39.57 ± 13.08	21.06 ± 6.93	39.87 ± 13.08	2.25 ± 0.63
(sea water)	February	12.71 ± 4.18	1.07 ± 0.33	< 0.50	4.03 ± 1.26	18.61 ± 6.09	3.29 ± 1.02	13.66 ± 4.41	< 2.17
	April	56.88 ± 18.72	3.95 ± 1.24	2.10 ± 0.62	15.69 ± 5.19	92.05 ± 30.56	31.68 ± 10.44	59.40 ± 19.69	42.79 ± 14.13
	July	72.00 ± 23.78	4.20 ± 1.38	1.34 ± 0.35	14.28 ± 4.67	58.96 ± 19.53	44.52 ± 14.73	30.07 ± 9.92	48.96 ± 16.22
9	November	19.65 ± 6.43	1.08 ± 0.35	0.52 ± 0.12	3.17 ± 0.96	23.44 ± 7.70	10.37 ± 3.35	18.92 ± 6.21	< 2.17
(sea water)	February	4.21 ±1.34	0.79 ± 0.22	< 0.50	1.29 ± 0.37	6.72 ± 2.13	1.87 ± 0.51	5.21 ± 1.65	< 2.17
	April	31.52 ± 10.46	2.04 ± 0.61	0.93 ± 0.26	6.89 ± 2.15	39.57 ± 13.07	20.25 ± 6.62	28.54 ± 9.43	23.63 ± 7.76
	July	24.19 ± 7.95	2.48 ± 0.80	0.69 ± 0.19	6.08 ± 1.89	23.91 ± 7.86	19.88 ± 6.54	8.88 ± 2.85	27.30 ± 8.98
10	November	6.30 ± 2.07	0.86 ± 0.26	< 0.50	1.92 ± 0.54	11.69 ± 3.82	4.19 ±1.33	6.23 ± 1.78	< 2.17
(sea water)	February	1.04 ± 0.33	< 0.23	< 0.50	0.75 ± 0.17	2.05 ± 0.59	< 1.73	3.17 ± 0.97	< 2.17
	April	9.89 ± 3.23	1.17 ± 0.31	0.53 ± 0.17	3.45 ± 1.08	16.80 ± 5.47	10.34 ± 3.31	11.95 ± 3.84	13.92 ± 6.59

Table S3. Description of sampling sites and heavy metals concentration detected in April in the sediment samples (SED) (mg/kg dw) of Sele River, southern Italy.

Location ID	As	Hg	Cd	Cr	Cu	Ni	Pb	Zn
1 (river water)	5.96 ± 2.84	0.74 ± 0.33	0.28 ± 0.12	20.35 ± 10.16	7.32 ± 3.54	9.27 ± 4.55	10.63 ± 5.27	33.64 ± 16.72
2 (sea water)	3.21 ± 1.51	< 0.70	< 0.25	5.28 ± 2.63	2.96 ± 1.31	2.68 ± 1.30	3.42 ± 1.57	14.05 ± 6.88
3 (sea water)	1.09 ± 0.49	< 0.70	< 0.25	2.64 ± 1.27	2.47 ± 1.21	< 2.67	2.05 ± 0.96	8.64 ± 4.09
4 (sea water)	< 1.07	< 0.70	< 0.25	1.22 ± 0.56	< 2.47	< 2.67	< 1.87	6.21 ± 2.97
5 (sea water)	4.12 ± 2.03	< 0.70	< 0.25	10.37 ± 5.13	3.64 ± 1.73	3.02 ± 1.42	6.28 ± 3.12	19.93 ± 9.84
6 (sea water)	2.05 ± 0.98	< 0.70	< 0.25	4.28 ± 1.99	< 2.47	< 2.67	1.96 ± 0.89	9.47 ± 4.23
7 (sea water)	1.93 ± 0.95	< 0.70	< 0.25	5.02 ± 2.48	< 2.47	< 2.67	< 1.87	5.92 ± 2.87
8 (sea water)	12.56 ± 6.12	1.10 ± 0.51	0.25± 0.11	29.10 ± 14.45	3.18 ± 1.53	24.89 ± 12.34	34.57 ± 17.07	42.00 ± 20.82
9 (sea water)	4.47 ± 2.19	0.81 ± 0.38	< 0.25	8.95 ± 4.42	2.59 ± 1.19	2.75 ± 1.35	6.02 ± 2.67	24.27 ± 12.05
10 (sea water)	1.38 ± 0.62	< 0.70	< 0.25	5.03 ± 2.45	< 2.47	nd	2.26 ± 1.01	12.06 ± 5.91

Table S4. Comparisons of heavy metal (HMs) concentrations detected in previous studies carried out from other river catchments and transitional waters in areas close to the study.

		Heavy Metals							
Area	**References**	**As**	**Hg**	**Cd**	**Cr**	**Cu**	**Ni**	**Pb**	**Zn**
DPs (µg/L^{-1})									
Sarno River, Italy	Montuori et al., [72]	3.10 - 28.57	0.1 – 0.74	0.03 – 0.79	41.63- 1669.84	0.11 – 9.51	0.47 – 22.11	0.41 – 10.47	0.14 – 5.17
Tiber River, Italy	Montuori et al., [26]	2.05 - 92.04	0.1 – 0.90	0.06 – 5.42	1.05 – 94.61	0.34 – 821.12	0.33 – 77.92	1.08 – 186.74	0.16 – 155.38
Volturno River, Italy	De Rosa et al., [35]	0.52 – 15.07	0.10 – 2.72	0.09 – 3.00	1.00 – 15.77	0.10 – 14.00	0.10 – 11.75	0.45 – 15.22	0.11 – 6.20
This study	Di Duca et al.,	nd – 14.28	nd – 2.35	nd – 1.69	nd – 14.97	nd – 13.23	nd – 11.15	nd – 14.41	nd – 5.46
SPM (µg/L^{-1})									
Sarno River, Italy	Montuori et al., [72]	1.94 – 106.7	0.06 – 134.2	0.03 – 0.62	14.1 – 1149.7	36.3 – 809.8	3.3 – 1009.3	1.02 – 4063.5	59.4 – 3327.2
Tiber River, Italy	Montuori et al., [26]	2.01 – 243.9	0.11 – 6.37	0.05 – 4.80	1.02 – 131.6	5.21 – 1550.3	0.68 – 172.5	0.62 – 272.9	0.32 – 505.2
Volturno River, Italy	De Rosa et al., [35]	1.00 – 120.3	1.01 – 12.07	0.01 – 5.89	1.10 – 35.55	0.63 – 142.65	0.52 – 91.27	1.00 – 89.67	0.01 – 110.12
This study	Di Duca et al.,	nd – 116.52	nd – 10.03	nd – 4.57	nd – 33.47	nd – 139.85	nd – 88.74	nd – 86.66	nd – 107.54
SED (µg/kg^{-1})									
Sarno River, Italy	Montuori et al., [72]	0.24 – 69.3	0.2 – 1.02	0.39 – 2.92	23.77 – 514.40	33.64 – 580.18	1.58 – 651.70	0.47 – 1658.1	55.00 – 802.8
Tiber River, Italy	Montuori et al., [26]	2.65 – 45.2	0.05 – 1.14	0.08 – 2.22	8.52 – 189.91	16.01 – 527.81	6.22 – 494.26	3.07 – 186.67	6.18 – 413.36
Volturno River, Italy	De Rosa et al., [35]	1.00 – 14.08	0.06 – 1.45	0.10 – 0.32	2.92 – 31.10	1.67 – 8.40	0.88 – 26.49	0.65 – 36.27	7.03 – 43.06
This study	Di Duca et al.	nd – 12.56	nd – 1.10	nd – 0.98	1.22 – 29.10	nd – 7.32	nd – 24.89	nd – 34.57	5.92 – 42.00

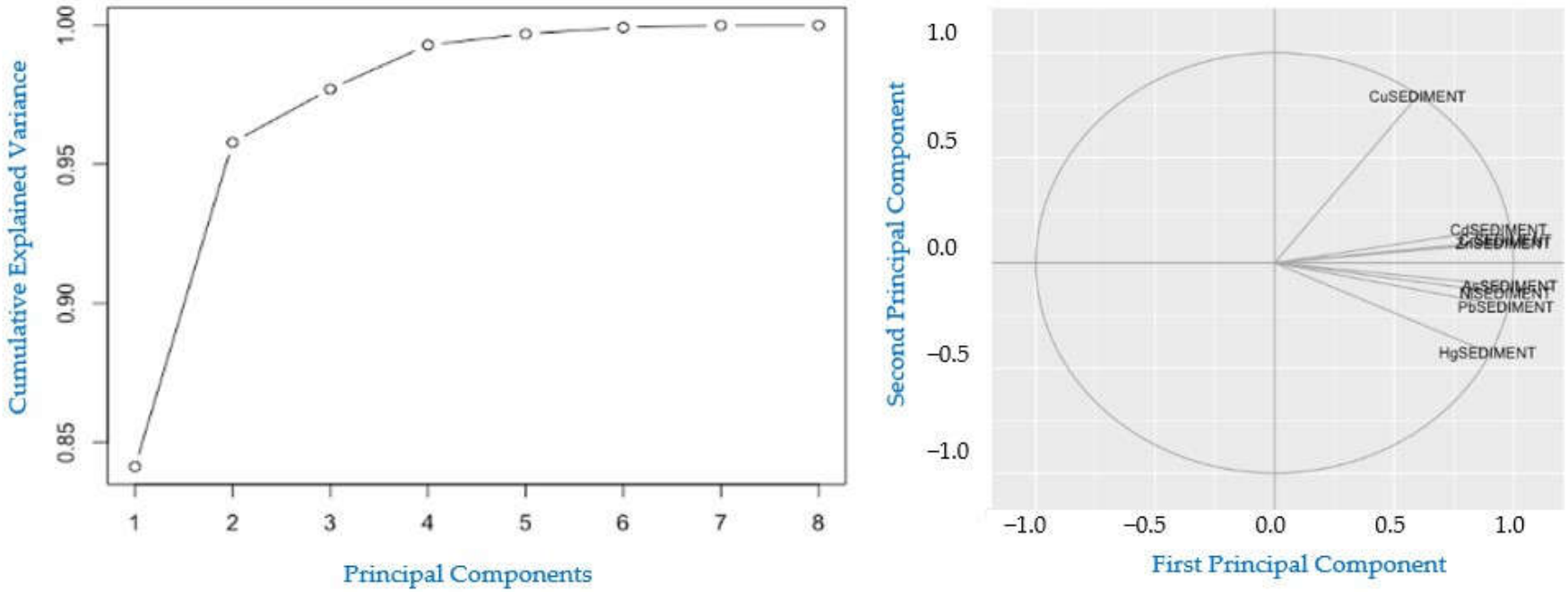

Figure S1. PCA of the sediment data: Eigen values Plot (on the left) and PCA of the sediment data: Loading plot for the first and second principal component (on the right).

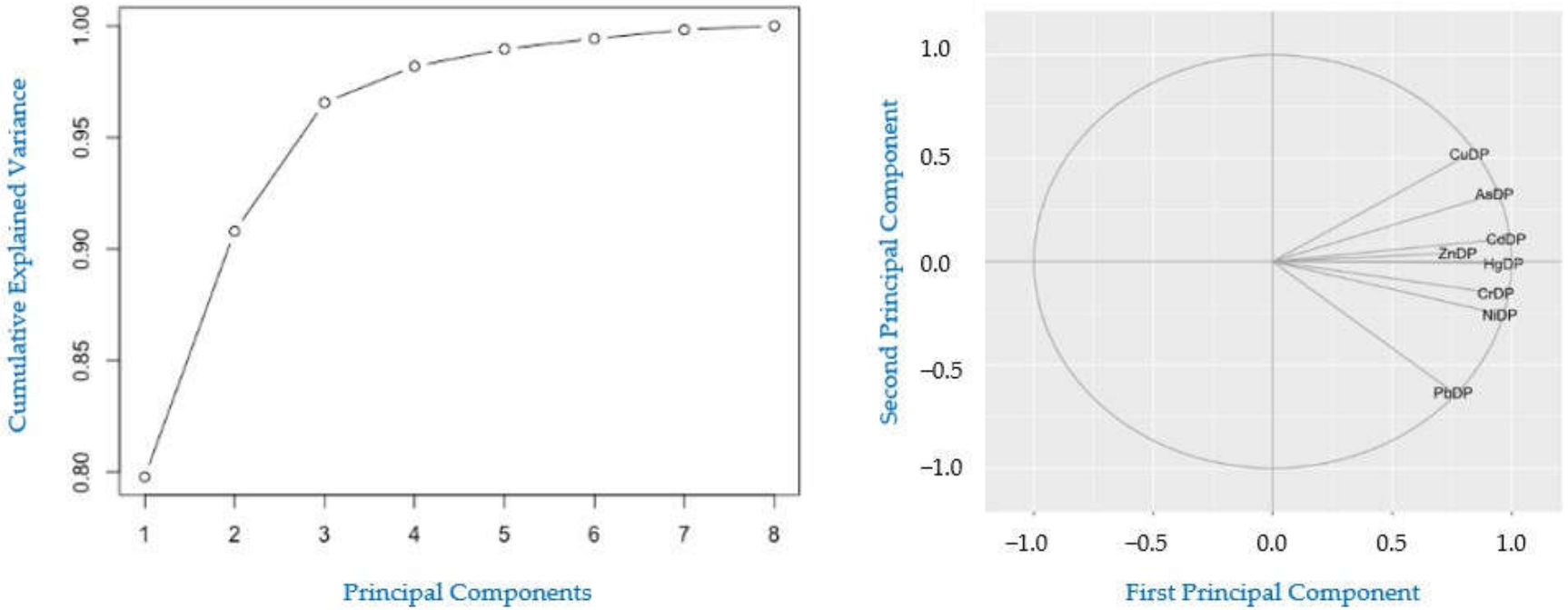

Figure S2. PCA of the dissolved phase (DP) data: Eigen values Plot (on the left) and PCA of the sediment data: Loading plot for the first and second principal component (on the right).

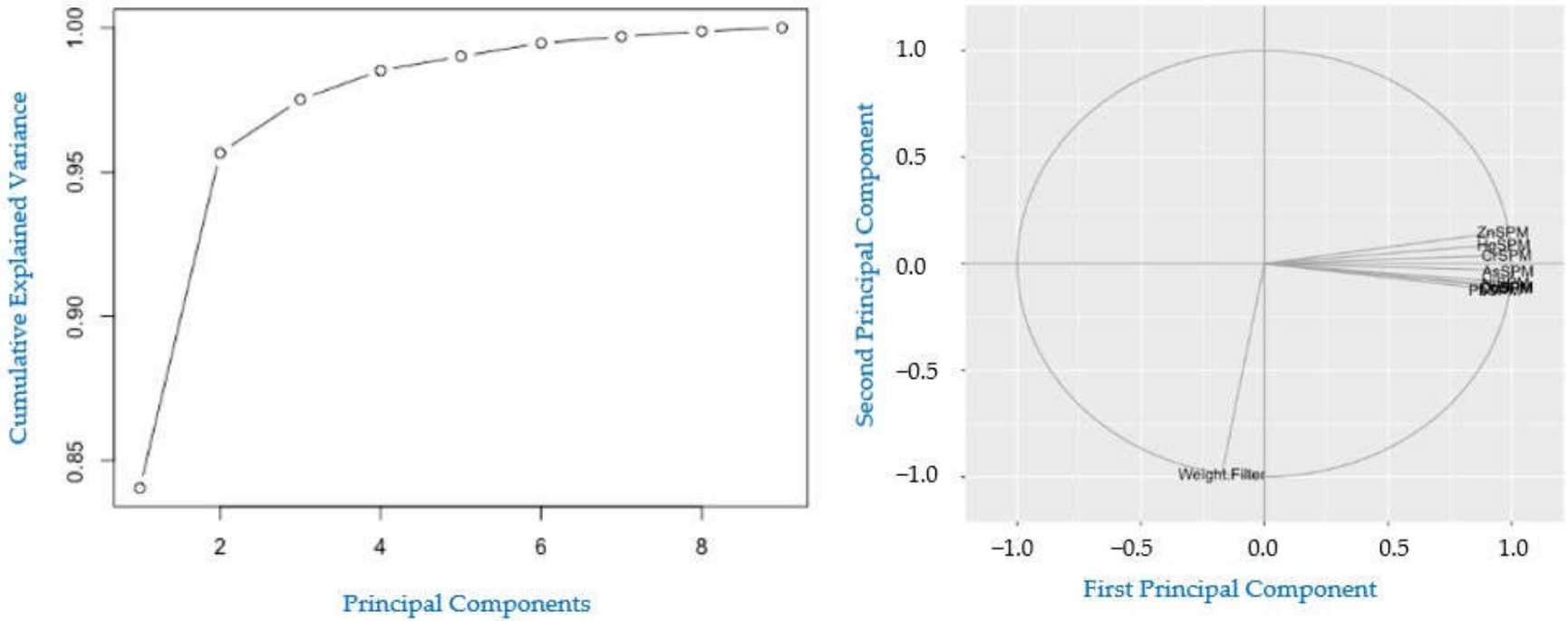

Figure S3. PCA of the suspended particulate matter (SPM) data: Eigen values Plot (on the left) and PCA of the SPM data: Loading plot for the first and second principal component (on the right).