

Supplementary Information

Identification and Apportionment of Potential Pollution Sources using Multivariate Statistical Techniques and APCS-MLR Model to Assess Surface Water Quality in Imjin River Watershed, South Korea

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Table S1. Factors and calculations of the APCS-MLR model.

Factor	Description	Formula
C_j	This represents the source contributions to pollutant's concentration.	
$(r_0)_j$	This represents the constant term of multiple regressions for pollutant j .	
j	This represents the average contribution of the j pollutant from sources not determined by PCA/FA.	$C_j = (r_0)_j + \sum_{k=1}^n r_{jk} \times APCS_k$
r_{jk}	This represents the coefficient of multiple regression of the source k for pollutant j .	
$APCS_k$	This represents the scaled value of the rotated factor k for the considered sample.	
$r_{jk} \times APCS_k$	This represents the contribution of source k to C_j .	

Table S2. Mean and standard deviation (SD) of water quality parameters at different monthly in the Imjin River Watershed, South Korea.

Monthly	WT	pH	EC	DO	BOD	COD	SS	TN	NH ₃ -N	NO ₃ -N	TP	PO ₄ -P	
Jan	Mean	1.5	7.8	699	14.0	2.5	5.6	7.4	6.67 ^{VI}	1.78	3.80	0.08	0.02
	SD	1.5	0.2	637	0.8	1.9	3.6	12.0	4.00	1.90	1.91	0.06	0.03
Feb	Mean	3.5	7.8	792	13.3	3.0 ^{III}	6.1	18.5	7.01 ^{VI}	2.19	3.36	0.09	0.02
	SD	2.1	0.3	636	2.3	2.2	3.3	46.1	4.28	2.43	1.68	0.11	0.04
Mar	Mean	11.4	7.9	627	11.5	3.5	6.8	19.8	5.33 ^{VI}	1.13	2.76	0.09	0.01
	SD	4.7	0.3	521	1.6	2.9	3.6	39.3	3.23	1.43	1.25	0.07	0.01
Apr	Mean	14.4	7.9	742	11.0	4.3 ^{III}	7.7	21.2	5.08 ^{VI}	0.75	2.98	0.10	0.01
	SD	2.7	0.3	605	1.1	2.9	3.5	36.6	2.87	0.86	1.49	0.06	0.01
May	Mean	19.9	7.9	625	9.4	3.7 ^{III}	7.9 ^{IV}	35.1 ^{IV}	4.26 ^{VI}	0.45	2.63	0.15 ^{III}	0.02
	SD	2.7	0.3	595	1.2	2.7	3.8	47.6	2.15	0.61	1.37	0.14	0.02
Jun	Mean	25.1	8.1	684	9.3	3.7	8.0	24.8	3.52 ^{VI}	0.29	2.08	0.13 ^{III}	0.02
	SD	2.4	0.5	621	1.9	2.9	4.2	26.8	1.97	0.44	1.30	0.13	0.04
Jul	Mean	25.2	7.9	513	9.1	2.6	6.7	24.8	3.22 ^{VI}	0.21	2.11	0.13 ^{III}	0.03
	SD	2.9	0.4	550	1.6	2.5	4.3	24.9	1.66	0.33	1.14	0.12	0.04
Aug	Mean	27.3	7.9	382	9.1	2.8	6.8	37.3 ^{IV}	3.55 ^{VI}	0.17	2.23	0.14 ^{III}	0.03
	SD	2.8	0.5	336	1.5	2.7	5.7	124.8	1.91	0.34	1.30	0.15	0.04
Sep	Mean	22.5	7.8	351	9.5	1.3	4.2	14.2	3.71 ^{VI}	0.10	2.70	0.08	0.03
	SD	2.0	0.4	317	1.4	1.0	2.1	34.6	2.01	0.12	1.40	0.06	0.03
Oct	Mean	16.4	7.9	564	10.6	1.5	4.7	13.6	4.58 ^{VI}	0.19	3.16	0.06	0.01
	SD	3.0	0.3	448	1.3	1.2	2.4	33.1	2.61	0.22	1.71	0.06	0.01
Nov	Mean	9.8	7.9	577	11.9	1.7	4.8	7.8	5.09 ^{VI}	0.39	3.37	0.07	0.01
	SD	2.8	0.3	438	1.4	1.8	2.6	12.7	2.93	0.50	1.76	0.08	0.02
Dec	Mean	4.9	7.8	570	13.8	1.4	4.2	3.5	5.71 ^{VI}	0.57	3.89	0.04	0.01
	SD	1.8	0.3	408	1.0	1.3	2.4	3.7	3.41	0.59	2.12	0.04	0.01

Environmental standard for water quality River of the Ministry of Environment in the South Korea.

Water quality levels: Very good (Ia), Good (Ib), Slightly average (II), Fair (III), Slightly poor (IV), Poor (V) and Very poor (VI).

Water quality parameter unit: WT (°C), EC (μS/cm) and other parameters (mg/L).

Table S3. Summary of all acronyms in this study

No.	Original word	Abbreviation
1	Absolute principal component score-multiple linear regression	APCS-MLR
2	African swine fever	ASF
3	Ammonium nitrogen	NH ₃ -N
4	Biological oxygen demand	BOD
5	Chemical oxygen demand	COD
6	Cluster analysis	CA
7	Dissolved oxygen	DO
8	Dry season	DS
9	Electrical conductivity	EC
10	Hierarchical cluster analysis	HCA
11	High pollution	HP
12	Imjin River Watershed	IRW
13	Keiser-Meyer-Olkin test	KMO test
14	Lower pollution	LP
15	Military Demarcation Line	MDL
16	Multiple linear regression	MLR
17	Multivariate statistical techniques	MST
18	Nitrate nitrogen	NO ₃ -N
19	one-way analysis of variance	one-way ANOVA
20	Phosphates phosphorous	PO ₄ -P
21	Potential of hydrogen	pH
22	Principal components	PCs
23	Principal component analysis and factor analysis	PCA/FA
24	Quality assurance and quality control	QA/QC
25	Suspended solids	SS
26	Total nitrogen	TN
27	Total phosphorus	TP
28	Total Pollution Load Management System	TPLMS
29	Unidentified source	UIS
30	Variance factors	VFs
31	Water temperature	WT
32	Wet season	WS