Article

Estimation of Global Water Quality in Four Municipal Wastewater Treatment Plants over Time Based on Statistical Methods

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Supplementary information

Table S1. Descriptive statistics for AL- influent (i) and - effluent (e) parameters.

Parameter	Unit	Mean	Median	SD*	SE**	Variance	Skewness	Kurtosis	Range	Min	Max
pHi	-	7.5	7.5	0.1	0.0	0.3	-0.3	-1.1	0.4	7.3	7.7
ECi	mS/cm	2.7	2.7	0.2	0.0	0.5	0.8	0.8	1.0	2.3	3.3
TSSi	mg/L	319.7	302.9	85.4	17.8	170.7	2.2	7.2	426.5	201.5	628.0
CODi	mg/L	910.4	881.4	239.3	49.9	478.6	-0.3	0.8	1049.3	291.3	1340.6
TNi	mg/L	72.4	71.9	8.6	1.8	17.3	0.1	1.5	42.7	50.9	93.6
TPi	mg/L	9.3	8.6	1.8	0.4	3.6	1.4	1.8	7.3	6.8	14.0
BODi	mg/L	579.8	547.7	154.1	32.1	308.3	-0.6	2.2	727.1	133.9	861.0
DOCi	mg/L	35.7	33.9	25.0	5.2	50.1	0.8	0.3	91.5	8.7	100.2
pHe	-	7.8	7.8	0.2	0.0	0.4	0.0	-1.2	0.6	7.5	8.1
ECe	mS/cm	2.5	2.5	0.5	0.1	1.0	3.7	15.7	2.7	2.1	4.7
TSSe	mg/L	5.5	5.4	1.4	0.3	2.8	0.6	1.1	6.0	2.7	8.7
CODe	mg/L	25.6	25.6	3.4	0.7	6.8	0.1	-0.4	13.7	19.2	32.9
TNe	mg/L	11.5	11.8	3.3	0.7	6.6	-0.4	2.6	16.9	2.4	19.3
TPe	mg/L	2.4	2.2	1.5	0.3	3.0	0.9	-0.1	4.8	0.7	5.5
BODe	mg/L	9.2	9.0	2.6	0.5	5.2	0.7	-0.1	8.9	5.8	14.7
DOCe	mg/L	13.2	10.6	6.0	1.2	12.0	1.7	2.7	22.5	7.3	29.8

*SD: Std. Deviation   **SE: Std. Error

Table S2. Descriptive statistics for MO- influent (i) and- effluent (e) parameters.

Parameter	Unit	Mean	Median	SD*	SE**	Variance	Skewness	Kurtosis	Range	Min	Max
pHi	-	6.9	6.9	0.2	0.0	0.4	-0.3	-0.7	0.6	6.6	7.2
ECi	mS/cm	5.2	5.3	0.5	0.1	1.0	-0.1	-0.2	2.1	4.2	6.3
TSSi	mg/L	475.9	467.4	97.5	20.3	194.9	0.1	-1.0	329.6	327.4	657.0
CODi	mg/L	1204.1	1199.9	205.2	42.8	410.3	0.0	-1.3	646.5	866.9	1513.4
TNi	mg/L	61.8	63.7	8.1	1.7	16.1	0.2	-0.8	29.4	49.7	79.1
TPi	mg/L	7.9	7.7	1.0	0.2	2.0	0.5	-0.4	3.5	6.4	9.9
BODi	mg/L	792.8	857.7	148.2	30.9	296.4	-0.4	-1.3	476.5	518.7	995.2
DOCi	mg/L	70.6	66.0	54.6	11.4	109.2	1.5	2.4	214.5	19.9	234.4
pHe	-	8.0	8.0	0.2	0.0	0.4	-0.1	0.3	0.8	7.6	8.4
ECe	mS/cm	4.3	4.4	0.5	0.1	1.1	-0.1	-1.4	1.6	3.4	5.0
TSSe	mg/L	3.9	4.0	1.0	0.2	1.9	0.4	0.5	3.9	2.3	6.2
CODe	mg/L	37.2	33.9	7.0	1.5	14.0	0.6	-1.2	20.6	29.2	49.7
TNe	mg/L	8.7	8.7	2.2	0.5	4.5	-0.1	-0.8	7.4	5.1	12.5
TPe	mg/L	1.5	1.4	0.3	0.1	0.7	1.0	0.2	1.2	1.2	2.4
BODe	mg/L	4.2	3.7	2.0	0.4	3.9	2.7	9.2	9.1	2.6	11.6
DOCe	mg/L	19.3	19.2	3.5	0.7	7.0	0.0	-1.1	11.3	13.7	24.9

Table S3. Descriptive statistics for LZ- influent (i) and - effluent (e) parameters.

Parameter	Unit	Mean	Median	SD*	SE**	Variance	Skewness	Kurtosis	Range	Min	Max
pHi	-	7.7	7.7	0.2	0.0	0.3	-0.9	0.9	0.7	7.3	7.9
ECi	mS/cm	6.3	6.2	0.8	0.2	1.7	0.0	0.0	3.3	4.5	7.8
TSSi	mg/L	322.4	303.5	114.8	23.9	229.6	1.0	0.5	430.7	180.1	610.8
CODi	mg/L	275.1	287.9	83.6	17.4	167.2	0.1	0.6	359.5	122.6	482.1
TNi	mg/L	42.6	42.3	10.7	2.2	21.5	0.4	-0.3	41.1	25.6	66.7
TPi	mg/L	6.9	6.1	2.7	0.6	5.4	1.3	2.2	11.1	3.6	14.7
BODi	mg/L	141.9	152.0	37.6	7.8	75.2	-0.2	-0.8	141.9	74.9	216.8
DOCi	mg/L	18.2	18.0	7.7	1.6	15.3	-0.1	-1.0	26.6	5.4	32.0
pHe	-	7.7	7.7	0.2	0.0	0.3	-1.2	1.6	0.7	7.2	7.9
ECe	mS/cm	5.9	5.9	0.8	0.2	1.6	0.5	1.9	3.8	4.3	8.1
TSSe	mg/L	5.2	4.9	1.4	0.3	2.8	1.3	2.9	6.1	3.4	9.5
CODe	mg/L	18.9	18.8	2.9	0.6	5.7	0.3	0.0	11.9	13.8	25.7
TNe	mg/L	2.2	1.8	1.0	0.2	2.1	1.0	-0.2	3.3	1.1	4.4
TPe	mg/L	0.9	0.8	0.2	0.1	0.5	0.9	-0.4	0.8	0.6	1.4
BODe	mg/L	5.4	5.8	0.9	0.2	1.9	-0.3	-1.5	2.8	4.0	6.8
DOCe	mg/L	11.7	12.2	3.7	0.8	7.4	0.0	-0.8	12.5	5.4	17.9

Table S4. Descriptive statistics for SP- influent (i) and - effluent (e) parameters.

Parameter	Unit	Mean	Median	SD*	SE**	Variance	Skewness	Kurtosis	Range	Min	Max
pHi	-	7.8	7.8	0.2	0.0	0.3	-0.5	-0.8	0.6	7.5	8.0
ECi	mS/cm	4.9	4.7	0.5	0.1	1.0	0.8	-0.3	1.9	4.2	6.0
TSSi	mg/L	183.7	186.5	30.2	6.3	60.4	-0.2	-1.4	90.4	138.6	229.0
CODi	mg/L	263.8	256.9	40.6	8.5	81.1	0.1	-0.2	166.8	174.7	341.4
TNi	mg/L	52.1	52.0	7.9	1.6	15.8	1.6	5.5	38.9	40.2	79.1
TPi	mg/L	5.6	5.5	0.7	0.2	1.4	0.2	-0.5	2.9	4.3	7.1
BODi	mg/L	145.2	133.9	42.8	8.9	85.6	2.4	7.5	205.9	94.7	300.5
DOCi	mg/L	23.5	21.9	3.8	0.8	7.7	1.2	0.1	12.5	18.7	31.1
pHe	-	7.8	7.9	0.2	0.0	0.4	-0.8	-0.6	0.6	7.5	8.1
ECe	mS/cm	4.4	4.3	0.5	0.1	1.0	1.1	0.8	2.0	3.7	5.7
TSSe	mg/L	2.3	2.2	0.5	0.1	1.0	0.1	-1.1	1.7	1.5	3.2
CODe	mg/L	18.5	18.8	1.8	0.4	3.6	-0.4	-1.2	5.8	15.3	21.0
TNe	mg/L	2.9	3.0	0.6	0.1	1.2	-0.7	-0.3	2.2	1.5	3.8
TPe	mg/L	1.6	1.6	0.4	0.1	0.8	-0.4	-0.3	1.6	0.7	2.2
BODe	mg/L	5.9	5.8	0.4	0.1	0.7	0.5	2.9	1.8	5.1	6.9
DOCe	mg/L	8.8	8.3	2.2	0.5	4.4	0.9	0.8	8.9	5.8	14.7

Table S5. Pearson correlation matrix of different variables of AL- WWTP.

ALWWTP	pHi	ECi	TSSi	CODi	TNi	TPi	BODi	DOCi	pHe	ECe	TSSe	CODe	TNe	TPe	BODe	DOCe	WWQIi	WWQIe
pHi	1.0																	
ECi	0.0	1.0																
TSSi	-0.2	-0.1	1.0															
CODi	-0.4**	-0.1	0.8*	1.0														
TNi	-0.3**	0.0	0.6*	0.9*	1.0													
TPi	-0.3	-0.2	0.2	0.5*	0.6*	1.0												
BODi	-0.5*	0.0	0.7*	0.9*	0.9*	0.5*	1.0											
DOCi	0.0	0.2	-0.2	-0.1	-0.2	-0.1	-0.1	1.0										
pHe	0.0	-0.1	0.4**	0.4**	0.4**	0.3**	0.4**	-0.7*	1.0									
ECe	0.2	0.3	-0.4**	-0.6*	-0.6*	-0.2	-0.6*	0.3	-0.5**	1.0								
TSSe	-0.3**	0.2	0.5**	0.5*	0.3	0.3	0.4**	-0.2	0.2	-0.3**	1.0							
CODe	-0.5**	0.0	0.3	0.5*	0.3	0.1	0.5*	0.1	0.0	-0.4**	0.2	1.0						
TNe	-0.5*	0.0	0.5*	0.7*	0.7*	0.3**	0.7*	0.0	0.0	-0.6*	0.6*	0.5*	1.0					
TPe	0.1	-0.2	-0.1	-0.2	-0.2	-0.1	-0.3**	0.0	-0.2	0.4**	-0.3	-0.1	-0.1	1.0				
BODe	-0.3	0.0	-0.2	-0.2	-0.4	-0.2	-0.1	0.1	-0.1	-0.2	0.2	0.5*	0.1	-0.2	1.0			
DOCe	-0.1	-0.1	-0.3	-0.2	-0.3**	0.3	-0.2	0.4**	-0.5*	0.5*	-0.1	0.1	-0.1	0.2	0.2	1.0		
WWQIi	0.1	0.1	0.2	0.2	0.3**	0.2	0.2	0.3	0.1	-0.2	0.2	-0.1	0.3	0.0	0.0	-0.1	1.0	
WWQIe	0.1	-0.1	0.5*	0.5*	0.4**	0.3	0.5*	-0.1	0.3	-0.6*	0.3	0.3	0.5*	0.0	0.1	-0.2	0.2	1.0

* Correlation is significant at 0.01 level. ** Correlation is significant at 0.05 level

Table S6. Pearson correlation matrix of different variables of MO- WWTP.

MOWWTP	pHi	ECi	TSSi	CODi	TNi	TPi	BODi	DOCi	pHe	ECe	TSSe	CODe	TNe	TPe	BODe	DOCe	WWQIi	WWQIe
pHi	1.0																	
ECi	0.1	1.0																
TSSi	-0.5*	-0.2	1.0															
CODi	-0.5*	-0.3	0.9*	1.0														
TNi	-0.2	-0.3	0.8*	0.7*	1.0													
TPi	-0.2	-0.6*	0.7*	0.6*	0.7*	1.0												
BODi	-0.5*	-0.3	0.8*	1.0*	0.7*	0.5*	1.0											
DOCi	-0.3	0.4**	0.4**	0.5*	0.3	0.1	0.5*	1.0										
pHe	0.3	-0.2	0.1	0.3**	0.1	0.1	0.4**	0.4	1.0									
ECe	0.4**	0.9*	-0.3	-0.4**	-0.4**	-0.6*	-0.4**	0.2	0.0	1.0								
TSSe	-0.1	0.0	-0.2	-0.4**	-0.3	0.1	-0.4**	-0.5*	-0.5*	0.0	1.0							
CODe	0.1	0.4**	0.1	0.0	0.1	0.1	0.1	0.2	0.0	0.4**	0.2	1.0						
TNe	0.1	0.1	0.1	-0.1	0.2	0.1	-0.2	-0.4	-0.6	0.1	0.4	0.4	1.0					
TPe	0.3**	-0.4**	-0.1	-0.2	-0.1	0.2	-0.2	-0.4**	0.1	-0.2	0.4**	0.1	0.1	1.0				
BODe	0.0	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.1	-0.2	0.5*	0.1	-0.2	1.0			
DOCe	0.5*	0.2	-0.2	-0.2	-0.3	-0.2	-0.3	0.1	0.3	0.3	0.1	0.0	0.0	0.1	-0.2	1.0		
WWQIi	0.0	-0.1	-0.2	0.0	-0.1	0.1	-0.1	0.0	0.0	-0.2	0.1	-0.1	0.0	-0.1	0.1	0.3	1.0	
WWQIe	0.1	0.0	-0.1	-0.1	-0.2	0.2	-0.2	0.0	-0.1	0.1	0.2	0.1	0.0	0.1	0.3	0.1	0.2	1.0

Table S7. Pearson correlation matrix of different variables of LZ- WWTP.

LZWWTP	pHi	ECi	TSSi	CODi	TNi	TPi	BODi	DOCi	pHe	ECe	TSSe	CODe	TNe	TPe	BODe	DOCe	WWQIi	WWQIe
pHi	1.0																	
ECi	0.5*	1.0																
TSSi	0.1	0.1	1.0															
CODi	-0.3	-0.3	0.2	1.0														
TNi	-0.2	-0.5*	0.1	0.8*	1.0													
TPi	-0.6*	-0.6*	0.2	0.9*	0.7*	1.0												
BODi	-0.3	-0.4**	0.2	0.8*	0.7*	0.8*	1.0											
DOCi	-0.3	-0.3	0.5*	0.3	0.4**	0.3**	0.0	1.0										
pHe	0.9*	0.3	0.0	-0.3	-0.1	-0.6*	-0.2	-0.3	1.0									
ECe	0.4**	0.8*	0.2	-0.4**	-0.5*	-0.5*	-0.2	-0.5	0.3	1.0								
TSSe	-0.2	-0.2	-0.2	-0.3**	-0.2	-0.1	-0.3	0.0	-0.3	0.1	1.0							
CODe	-0.4**	-0.5*	0.2	0.5*	0.6*	0.6*	0.3**	0.7*	-0.5*	-0.5*	0.4**	1.0						
TNe	-0.5*	-0.5**	-0.2	0.1	0.2	0.4**	0.0	0.4**	-0.6*	-0.5*	0.5*	0.7*	1.0					
TPe	-0.5*	-0.6*	0.1	0.6*	0.7*	0.7*	0.4**	0.5*	-0.5*	-0.6*	0.3	0.8*	0.5*	1.0				
BODe	0.1	-0.3	0.0	0.1	0.3	0.1	0.2	0.1	0.0	0.0	0.6	0.5*	0.2	0.3	1.0			
DOCe	0.3	0.2	0.2	0.4	0.3**	0.0	0.2	0.1	0.4	-0.1	-0.6*	-0.1	-0.3	-0.1	-0.5	1.0		
WWQIi	-0.1	-0.2	0.1	0.3	0.4	0.3	0.3	0.3	0.0	-0.2	0.0	0.3	0.2	0.4	0.2	0.0	1.0	
WWQIe	-0.2**	-0.4	0.1	0.2**	0.3	0.3**	0.4	-0.2	-0.1	-0.1	0.1	0.1	0.1	0.3	0.3	-0.2	0.1	1.0

Table S8. Pearson correlation matrix of different variables of SP- WWTP.

SPWWTP	pHi	ECi	TSSi	CODi	TNi	TPi	BODi	DOCi	pHe	ECe	TSSe	CODe	TNe	TPe	BODe	DOCe	WWQIi	WWQIe
pHi	1.0																	
ECi	0.2	1.0																
TSSi	0.3	0.5*	1.0															
CODi	0.0	0.1	0.6*	1.0														
TNi	0.2	0.1	0.4**	0.5*	1.0													
TPi	-0.2	0.0	0.2	0.6*	0.7*	1.0												
BODi	-0.1	-0.1	0.2	0.5*	0.2	0.4**	1.0											
DOCi	0.1	-0.4**	-0.3	0.0	-0.4	-0.3**	-0.1	1.0										
pHe	0.8*	-0.1	0.0	-0.1	0.0	-0.3	0.0	0.3**	1.0									
ECe	0.2	0.9*	0.6*	0.1	0.1	0.0	0.0	-0.4**	-0.1	1.0								
TSSe	-0.2	-0.1	0.1	0.3	-0.2	0.0	0.0	0.1	-0.1	-0.1	1.0							
CODe	-0.5*	-0.1	-0.1	0.2	0.0	0.3	0.2	0.1	-0.4**	0.1	0.5*	1.0						
TNe	-0.5	-0.4**	-0.3	0.0	-0.2	0.1	-0.2	0.4**	-0.3	-0.3	0.5*	0.7*	1.0					
TPe	-0.2	-0.3**	-0.2	0.1	0.0	0.3	0.3	-0.2	0.0	-0.3**	0.2	0.4**	0.2	1.0				
BODe	0.0	0.3	0.4**	0.3**	0.0	-0.1	-0.1	-0.1	-0.2	0.3**	0.1	-0.1	-0.2	-0.3	1.0			
DOCe	0.0	0.0	0.1	0.1	-0.2	-0.1	-0.1	0.4**	0.2	-0.1	0.1	0.0	0.2	-0.1	0.0	1.0		
WWQIi	0.0	-0.2	-0.2	-0.1	0.0	0.0	0.3**	0.1	0.1	-0.1	-0.3	0.2	0.0	0.2	-0.1	-0.3	1.0	
WWQIe	0.0	-0.1	-0.2	0.0	-0.5**	-0.1	0.2	0.4	0.2	-0.1	0.3**	0.3	0.2	0.3	-0.5*	0.2	-0.2	1.0

* Correlation is significant at 0.01 level. ** Correlation is significant at 0.05 level

1