1. Supplementary material A: Schematic drawing of the two systems at lab scale

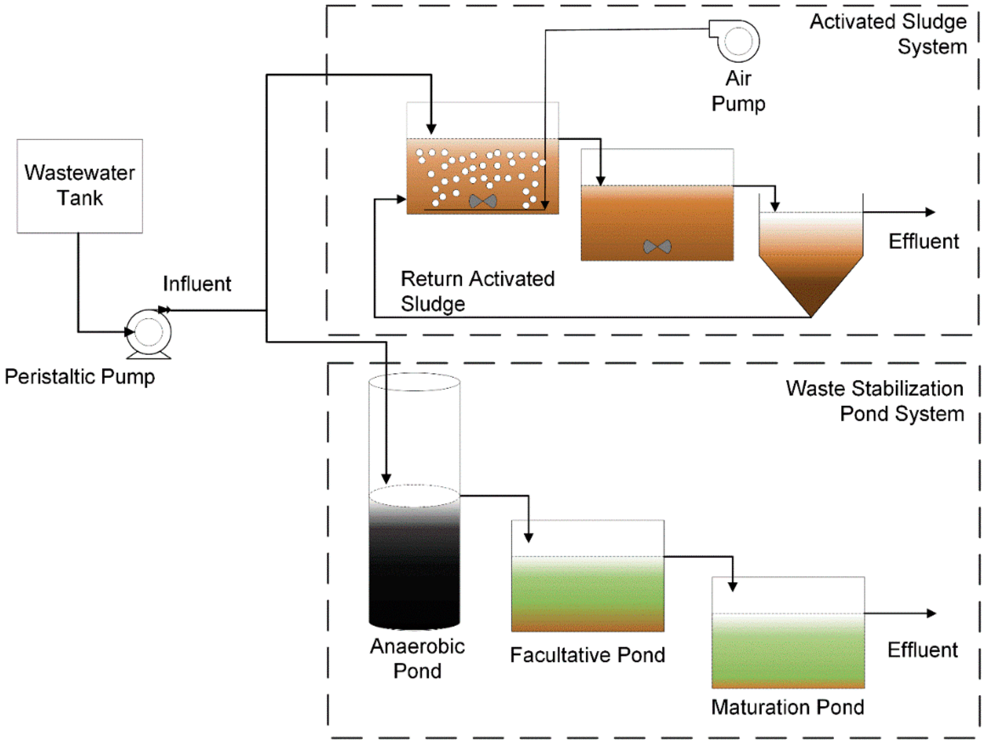

Figure A1. Schematic drawing of the two systems at lab scale. Two systems were installed in triplicate, which were located in one common room. The AS system was based on the Wuhrmann process and the conventional configuration of WSPs consisted of three compartments in series, including an anaerobic, a facultative and a maturation pond [1].

2. Supplementary material B: The microbial interaction in the two models

Table B.1. Overview of microbial competition for substrates (S) and dependencies through formed products (P) in the AS model.

Processes	Particulate COD	Soluble COD	Acetate	NH_4^+	NO_3^-	PO_4^{3-}	O_2	N_2
Hydrolysis (anaerobic/anoxic/aerobic)	S	P						
Fermentation		S	P					
Anoxic heterotrophs (HB)		S	S		S			P
Aerobic heterotrophs (HB)		S	S				S	P
Autotrophs (AB)				S	P		S	
Phosphate accumulating organisms (PAO)					S	P	S	

Table B.2. Overview of microbial competition for substrates (S) and dependencies through formed products (P) in the WSP model.

Processes	Particulate COD	Soluble COD	Acetate	NH_4^+	NO_3^-	PO_4^{3-}	O_2	N_2	CH_4	H_2
Anaerobic ponds										
Hydrolysis	S	P								
Fermenting bacteria (FB)		S	P							
Acetotrophic methanogenic bacteria (AMB)			S						P	
Hydrogenotrophic methanogenic bacteria (HMB)									P	S
Facultative and maturation ponds										
Anoxic heterotrophs (HB)		S	S		S			P		
Aerobic heterotrophs (HB)		S	S				S	P		
Autotrophs (AB)				S	P		S			
Algae growth on NH_4^+				S			P			
Algae growth on NO_3^-					S		P			

3. Supplementary material C: Initial and influent conditions

The initial and influent concentrations of the components related to COD in below table were calculated based on their typical fraction of total COD in municipal wastewater according to Henze, *et al.* [2].

Table C.1. The initial and influent concentrations of the two model.

Name	Description	Initial condition	Influent condition	Unit
X_S	Slowly biodegradable particulate COD	31.2	94.5	g COD.m^{-3}
X_I	Particulate inert COD	11.1	26.2	g COD.m^{-3}
X_{FB}	Fermenting bacteria	2.67	6.30	g COD.m^{-3}
X_{HMB}	Hydrogenotrophic methanogenic bacteria	0.45	1.05	g COD.m^{-3}
X_{AMB}	Acetotrophic methanogenic bacteria	0.45	1.05	g COD.m^{-3}
X_{PHA}	Poly-hydroxyalkanoates	0.45	1.05	g COD.m^{-3}
X_{PP}	Polyphosphate	0.01	0.01	g COD.m^{-3}
X_{PAO}	Phosphate accumulating organisms	0.45	1.05	g COD.m^{-3}
X_A	Autotrophic bacteria	0.14	1.4	g COD.m^{-3}
X_H	Heterotrophic bacteria	2.8	14	g COD.m^{-3}
X_{ALG}	Algae	5	0.01	g COD.m^{-3}
S_F	Fermentable, readily biodegradable soluble COD	17.83	37.79	g COD.m^{-3}
S_A	Fermentation products as acetate	13.37	14.70	g COD.m^{-3}
S_I	Soluble inert COD	5.35	12.60	g COD.m^{-3}
S_O	Oxygen gas	5	5	g O_2.m^{-3}
S_{NH}	Ammonium nitrogen	16.35	15.24	g N.m^{-3}
S_{NO}	Nitrite- and nitrate- nitrogen	0.06	0.08	g N.m^{-3}
S_{PO4}	Phosphate	2.06	1.91	g P.m^{-3}

4. Supplementary material D: Stoichiometric matrix and kinetic rate expression

Table D1. Stoichiometric matrix of the activated sludge model.

Component (i) →		S_F	S_A	S_I	S_O	S_{NH}	S_{NO}	S_{N2}	S_{PO4}	X_S	X_I	X_{XPHA}	X_{H-O}	X_{H-NO}	X_{XPP}	X_{PAO}	X_{AB}
Process (j) ↓		$g_{COD}.m^{-3}$	$g_{COD}.m^{-3}$	$g_{COD}.m^{-3}$	$g_{COD}.m^{-3}$	$g_N.m^{-3}$	$g_N.m^{-3}$	$g_N.m^{-3}$	$g_P.m^{-3}$	$g_{COD}.m^{-3}$	$g_{COD}.m^{-3}$	$g_{COD}.m^{-3}$	$g_{COD}.m^{-3}$	$g_{COD}.m^{-3}$	$g_{COD}.m^{-3}$	$g_{COD}.m^{-3}$	$g_{COD}.m^{-3}$
ρ_1	Aerobic hydrolysis	$1-f_{SI}$		f_{SI}		ϑ_1			ϑ_2	-1							
ρ_2	Anoxic hydrolysis	$1-f_{SI}$		f_{SI}		ϑ_1			ϑ_2	-1							
ρ_3	Anaerobic hydrolysis	$1-f_{SI}$		f_{SI}		ϑ_1			ϑ_2	-1							
ρ_4	Storage of X_{PHA}		-1						Y_{PO4}			1			$-Y_{PO4}$		
ρ_5	Fermentation	-1	1			i_{NSF}			i_{PSF}								
ρ_6	Anoxic growth of HB on S_F	$-\frac{1}{Y_H}$				$\frac{i_{NSF}}{Y_H} - i_{NXB}$	$-\frac{1-Y_H}{2.86Y_H}$	$\frac{1-Y_H}{2.86Y_H}$	$\frac{i_{PSF}}{Y_{FB}} - i_{PXB}$					1			
ρ_7	Anoxic growth of HB on S_A		$-\frac{1}{Y_H}$			$-i_{NXB}$	$-\frac{1-Y_H}{2.86Y_H}$	$\frac{1-Y_H}{2.86Y_H}$	$-i_{PXB}$					1			
ρ_8	Anoxic storage of X_{PP}						$-\frac{Y_{PHA}}{2.86}$	$\frac{Y_{PHA}}{2.86}$	-1			$-Y_{PHA}$			1		
ρ_9	Anoxic growth of X_{PAO}					$-i_{NXB}$	$-\frac{1-Y_{PAO}}{2.86Y_{PAO}}$	$\frac{1-Y_{PAO}}{2.86Y_{PAO}}$	$-i_{PXB}$			$-1/Y_{PAO}$				1	
ρ_{10}	Aerobic growth of HB on S_F	$-\frac{1}{Y_H}$			$1-\frac{1}{Y_H}$	$\frac{i_{NSF}}{Y_H} - i_{NXB}$			$\frac{i_{PSF}}{Y_{FB}} - i_{PXB}$				1				
ρ_{11}	Aerobic growth of HB on S_A		$-\frac{1}{Y_H}$		$1-\frac{1}{Y_H}$	$-i_{NXB}$			$-i_{PXB}$				1				

ρ_{12}	Growth of AB				$1-\frac{4.57}{Y_A}$	$-\frac{1}{Y_A}-i_{NXB}$	$\frac{1}{Y_A}$		$-i_{PXB}$								1
ρ_{13}	Aerobic storage of X_{PP}				$-Y_{PHA}$				-1			$-Y_{PHA}$			1		
ρ_{14}	Aerobic growth of X_{PAO}				$1-\frac{1}{Y_{PAO}}$	$-i_{NXB}$			$-i_{PXB}$			$-1/Y_{PAO}$				1	
ρ_{15}	Decay of PHA		1									-1					
ρ_{16}	Decay of HB_O					ϑ_1			ϑ_2	$1-f_{XI}$	f_{XI}		-1				
ρ_{17}	Decay of HB_NO					ϑ_1			ϑ_2	$1-f_{XI}$	f_{XI}			-1			
ρ_{18}	Decay of PP								1						-1		
ρ_{19}	Decay of PAO					ϑ_1			ϑ_2	$1-f_{XI}$	f_{XI}					-1	
ρ_{20}	Death of AB					ϑ_1			ϑ_2	$1-f_{XI}$	f_{XI}						-1
Composition matrix																	
g_{COD}/unit comp.		1	1	1	-1	0	-4.57	-1.71	0	1	1	1	1	1	0	1	1
g_N/ unit comp.		i_{NSF}	0	i_{NSI}	0	1	1	1	0	i_{NXS}	i_{NXI}	0	i_{NXB}	i_{NXB}	0	i_{NXB}	i_{NXB}
g_P/ unit comp.		i_{PSF}	0	i_{PSI}	0	0	0	0	1	i_{PXS}	i_{PXI}	0	i_{PXB}	i_{PXB}	1	i_{PXB}	i_{PXB}

$$\vartheta_1 = i_{NXB} - f_{XI} \times i_{NXI} - (f_{XI} - 1) \times i_{NXS}$$

$$\vartheta_2 = i_{PXB} - f_{XI} \times i_{PXI} - (f_{XI} - 1) \times i_{PXS}$$

Table D2. Stoichiometric matrix of the waste stabilization pond model.

AP compartment

Component (i) →		S_F	S_A	S_I	S_{NH}	S_{PO4}	S_{H2}	S_{CH4}	X_S	X_I	X_{FB}	X_{AMB}	X_{HMB}
Process (j) ↓		$g_{COD}.m^{-3}$	$g_{COD}.m^{-3}$	$g_{COD}.m^{-3}$	$g_N.m^{-3}$	$g_P.m^{-3}$	$g_N.m^{-3}$	$g_{COD}.m^{-3}$	$g_{COD}.m^{-3}$	$g_{COD}.m^{-3}$	$g_{COD}.m^{-3}$	$g_{COD}.m^{-3}$	$g_{COD}.m^{-3}$
ρ_1	Hydrolysis	$1-f_{SI}$		f_{SI}	ϑ_1	ϑ_2			-1				
ρ_2	Growth of FB	$-\frac{1}{Y_{FB}}$	$\frac{1-Y_{FB}}{9Y_{FB}}$		$\frac{i_{NSF}}{Y_{FB}} - i_{NXB}$	$\frac{i_{PSF}}{Y_{FB}} - i_{PXB}$	$\frac{1-Y_{FB}}{9Y_{FB}}$				1		
ρ_3	Growth of AMB		$-\frac{1}{Y_{AMB}}$		$-i_{NXB}$	$-i_{PXB}$		$\frac{1-Y_{AMB}}{4Y_{AMB}}$				1	
ρ_4	Growth of HMB				$-i_{NXB}$	$-i_{PXB}$	$-\frac{1}{8Y_{HMB}}$	$\frac{1-Y_{HMB}}{4Y_{HMB}}$					1
ρ_5	Decay of FB				ϑ_1	ϑ_2			$1-f_{XI}$	f_{XI}	-1		
ρ_6	Decay of AMB				ϑ_1	ϑ_2			$1-f_{XI}$	f_{XI}		-1	
ρ_7	Decay of HMB				ϑ_1	ϑ_2			$1-f_{XI}$	f_{XI}			-1

FP and MP compartments

Component (i) → / Process (j) ↓		S_F $g_{COD}.m^{-3}$	S_A $g_{COD}.m^{-3}$	S_O $g_{COD}.m^{-3}$	S_{NH} $g_N.m^{-3}$	S_{NO} $g_N.m^{-3}$	S_{N2} $g_N.m^{-3}$	S_{PO4} $g_P.m^{-3}$	X_S $g_{COD}.m^{-3}$	X_I $g_{COD}.m^{-3}$	$X_{H\text{-}O}$ $g_{COD}.m^{-3}$	$X_{H\text{-}NO}$ $g_{COD}.m^{-3}$	X_{ALG} $g_{COD}.m^{-3}$	X_{AB} $g_{COD}.m^{-3}$
ρ_8	Anoxic growth of HB on S_F	$-\frac{1}{Y_H}$			$\frac{i_{NSF}}{Y_H} - i_{NXB}$	$-\frac{1-Y_H}{2.86Y_H}$	$\frac{1-Y_H}{2.86Y_H}$	$\frac{i_{PSF}}{Y_{FB}} - i_{PXB}$				1		
ρ_9	Anoxic growth of HB on S_A		$-\frac{1}{Y_H}$		$-i_{NXB}$	$-\frac{1-Y_H}{2.86Y_H}$	$\frac{1-Y_H}{2.86Y_H}$	$-i_{PXB}$				1		
ρ_{10}	Growth of Algae on NH_4			1	$-i_{NXALG}$			$-i_{PXALG}$					1	
ρ_{11}	Growth of Algae on NO_3^-			$1 + 4.57i_{NXALG}$		$-i_{NXALG}$		$-i_{PXALG}$					1	
ρ_{12}	Algal respiration			$f_{p1} - 1$	$i_{NXALG} - f_{p1} \times i_{NXI}$			$i_{PXALG} - f_{p1} \times i_{PXI}$		f_{p1}				
ρ_{13}	Aerobic growth of HB on S_F	$-\frac{1}{Y_H}$		$1 - \frac{1}{Y_H}$	$\frac{i_{NSF}}{Y_H} - i_{NXB}$			$\frac{i_{PSF}}{Y_{FB}} - i_{PXB}$			1			
ρ_{14}	Aerobic growth of HB on S_A		$-\frac{1}{Y_H}$	$1 - \frac{1}{Y_H}$	$-i_{NXB}$			$-i_{PXB}$			1			
ρ_{15}	Growth of AB			$1 - \frac{4.57}{Y_A}$	$-\frac{1}{Y_A} - i_{NXB}$	$\frac{1}{Y_A}$		$-i_{PXB}$						1
ρ_{16}	Decay of HB_O				ϑ_1			ϑ_2	$1 - f_{XI}$	f_{XI}	-1			
ρ_{17}	Decay of HB_NO				ϑ_1			ϑ_2	$1 - f_{XI}$	f_{XI}		-1		
ρ_{18}	Death of ALG				ϑ_1			ϑ_2	$1 - f_{p1}$	f_{p1}			-1	
ρ_{19}	Death of AB				ϑ_1			ϑ_2	$1 - f_{XI}$	f_{XI}				-1
Composition matrix														
g_{COD}/unit comp.		1	1	-1	0	-4.57	-1.71	0	1	1	1	1	1	1
g_N/ unit comp.		i_{NSF}	0	0	1	1	1	0	i_{NXS}	i_{NXI}	i_{NXB}	i_{NXB}	i_{NXALG}	i_{NXB}
g_P/ unit comp.		i_{PSF}	0	0	0	0	0	1	i_{PXS}	i_{PXI}	i_{PXB}	i_{PXB}	i_{PXALG}	i_{PXB}

$$\vartheta_1 = i_{NXB} - f_{XI} \times i_{NXI} - (f_{XI} - 1) \times i_{NXS};$$

$$\vartheta_2 = i_{PXB} - f_{XI} \times i_{PXI} - (f_{XI} - 1) \times i_{PXS}$$

Chemical reactions in WSPs

Component (i) →		S_{PO4}	S_{ALK}	X_{CaOH}	X_{CaP}	X_{TSS}	S_{NH}	S_{NH3_aq}	S_{NH3_g}
Process (j) ↓		$g_P.m^{-3}$	$mol_{HCO3.}\ m^{-3}$	$g_{TSS}.m^{-3}$	$g_{TSS}.m^{-3}$	$g_{TSS}.m^{-3}$	$g_N.m^{-3}$	$g_N.m^{-3}$	$g_N.m^{-3}$
ρ_{20}	Precipitation	-1	0.048	-2.39	10	7.61			
ρ_{21}	Redissolution	1	0.048	2.39	-10	-7.61			
ρ_{22}	Ammonia balance						-1	1	
ρ_{23}	Ammonia volatilization							-1	1
Composition matrix									
g_N/ unit comp.		0	0	0	0	0	1	1	1
g_P/ unit comp.		1	0	0	0.10	0	0	0	0
g_{TSS}/unit comp.		0	0	1	1	-1	0	0	0
Charge		0.048	-1	0	0	0	0	0	0

Table D.3. Kinetic rate expression of the activated sludge model.

Process	Kinetic rate expression
Aerobic hydrolysis	$\rho_1 = f(T).K_h.\left[\frac{X_S/(X_H + X_{FB})}{K_X + (X_S/(X_H + X_{FB}))}\right].\frac{S_{O2}}{K^H_{O2} + S_{O2}}$
Anoxic hydrolysis	$\rho_2 = f(T).K_h.\eta_H\frac{K^H_{iO2}}{K^H_{iO2} + S_{O2}}.\left[\frac{X_S/(X_H + X_{FB})}{K_X + (X_S/(X_H + X_{FB}))}\right]$
Anaerobic hydrolysis	$\rho_3 = f(T).K_h.\eta_{fe}\frac{K^{Hyd}_{iO2}}{K^{Hyd}_{iO2} + S_{O2}}.\left[\frac{X_S/(X_H + X_{FB})}{K_X + (X_S/(X_H + X_{FB}))}\right]$
Storage of X_{PHA}	$\rho_4 = f(T).q_{PHA}.\frac{S_A}{K^P_A + S_A}.\frac{X_{PP}/X_{PAO}}{K^P_{PP} + X_{PP}/X_{PAO}}.X_{PAO}$
Fermentation	$\rho_5 = f(T).q_{fe}.\frac{K^H_{iO2}}{K^H_{iO2} + S_{O2}}.\frac{K^H_{NO}}{K^H_{NO} + S_{NO}}.\frac{S_F}{K^H_F + S_F}.X_H$
Anoxic growth of HB on S_F	$\rho_6 = f(T).\mu_H.\eta_H.\frac{S_F}{K^H_F + S_F}.\frac{S_F}{S_F + S_A}.\frac{K^H_{iO2}}{K^H_{iO2} + S_{O2}}.\frac{S_{NO}}{K^H_{NO} + S_{NO}}.\frac{S_{NH}}{K^H_{NH} + S_{NH}}.\frac{S_{PO4}}{K^H_P + S_{PO4}}.X_{H\_NO}$
Anoxic growth of HB on S_A	$\rho_7 = f(T).\mu_H.\eta_H.\frac{S_A}{K^H_A + S_A}.\frac{S_A}{S_F + S_A}.\frac{K^H_{iO2}}{K^H_{iO2} + S_{O2}}.\frac{S_{NO}}{K^H_{NO} + S_{NO}}.\frac{S_{NH}}{K^H_{NH} + S_{NH}}.\frac{S_{PO4}}{K^H_P + S_{PO4}}.X_{H\_NO}$
Anoxic storage of X_{PP}	$\rho_8 = f(T).\eta_P.q_{PP}.\frac{S_{NO}}{K^P_{NO} + S_{NO}}.\frac{S_{PO4}}{K^P_P + S_{PO4}}.\frac{X_{PHA}/X_{PAO}}{K^P_{PHA} + X_{PHA}/X_{PAO}}.\frac{K^P_{MAX} - X_{PP}/X_{PAO}}{K^P_{IPP} + K^P_{MAX} - X_{PP}/X_{PAO}}.\frac{K^P_{O2}}{K^P_{O2} + S_{O2}}.X_{PAO}$
Anoxic growth of X_{PAO}	$\rho_9 = f(T).\eta_P.\mu_{PAO}.\frac{S_{NO}}{K^P_{NO} + S_{NO}}.\frac{S_{NH}}{K^P_{NH} + S_{NH}}.\frac{S_{PO4}}{K^P_P + S_{PO4}}.\frac{X_{PHA}/X_{PAO}}{K^P_{PHA} + X_{PHA}/X_{PAO}}.\frac{K^P_{O2}}{K^P_{O2} + S_{O2}}.X_{PAO}$
Aerobic growth of HB on S_F	$\rho_{10} = f(T).\mu_H.\frac{S_F}{K^H_F + S_F}.\frac{S_F}{S_F + S_A}.\frac{S_{O2}}{K^H_{O2} + S_{O2}}.\frac{S_{NH}}{K^H_{NH} + S_{NH}}.\frac{S_{PO4}}{K^H_P + S_{PO4}}.X_{H\_O}$
Aerobic growth of HB on S_A	$\rho_{11} = f(T).\mu_H.\frac{S_A}{K^H_A + S_A}.\frac{S_A}{S_F + S_A}.\frac{S_{O2}}{K^H_{O2} + S_{O2}}.\frac{S_{NH}}{K^H_{NH} + S_{NH}}.\frac{S_{PO4}}{K^H_P + S_{PO4}}.X_{H\_O}$
Growth of AB	$\rho_{12} = f(T).\mu_A.\frac{S_{NH}}{K^A_{NH} + S_{NH}}.\frac{S_{O2}}{K^A_{O2} + S_{O2}}.\frac{S_{PO4}}{K^A_P + S_{PO4}}.X_A$
Aerobic storage of X_{PP}	$\rho_{13} = f(T).q_{PP}.\frac{S_{O2}}{K^P_{O2} + S_{O2}}.\frac{S_{PO4}}{K^P_P + S_{PO4}}.\frac{X_{PHA}/X_{PAO}}{K^P_{PHA} + X_{PHA}/X_{PAO}}.\frac{K^P_{MAX} - X_{PP}/X_{PAO}}{K^P_{IPP} + K^P_{MAX} - X_{PP}/X_{PAO}}.X_{PAO}$
Aerobic growth of X_{PAO}	$\rho_{14} = f(T).\mu_{PAO}.\frac{S_{O2}}{K^P_{O2} + S_{O2}}.\frac{S_{NH}}{K^P_{NH} + S_{NH}}.\frac{S_{PO4}}{K^P_P + S_{PO4}}.\frac{X_{PHA}/X_{PAO}}{K^P_{PHA} + X_{PHA}/X_{PAO}}.X_{PAO}$
Decay of PHA	$\rho_{15} = f(T).b_{PHA}.X_{PHA}$
Decay of HB_O	$\rho_{16} = f(T).b_H.X_{H\_O}$
Decay of HB_NO	$\rho_{17} = f(T).b_H.X_{H\_NO}$
Decay of PP	$\rho_{18} = f(T).b_{PP}.X_{PP}$
Decay of PAO	$\rho_{19} = f(T).b_{PAO}.X_{PAO}$
Decay of AB	$\rho_{20} = f(T).b_A.X_A$
Arrhenius equation	$f(T) = \theta^{T-20}$

Table D.4. Kinetic rate expression of the waste stabilization pond model.

Process	Kinetic rate expression
AP compartment	
Hydrolysis	$\rho_1 = f(T).K_h.\left[\frac{X_S/(X_H + X_{FB})}{K_X + (X_S/(X_H + X_{FB}))}\right].(X_H + \eta_{hy}.X_{FB})$
Growth of FB	$\rho_2 = f(T).\mu_{FB}.\frac{S_F}{K_F^{FB} + S_F}.\frac{K_{O2}^{FB}}{K_{O2}^{FB} + S_A}.\frac{K_{NO}^{FB}}{K_{NO}^{FB} + S_{NO}}.\frac{S_{NH}}{K_{NH}^{FB} + S_{NH}}.\frac{S_{PO4}}{K_P^{FB} + S_{PO4}}.X_{FB}$
Growth of AMB	$\rho_3 = f(T).\mu_{AMB}.\frac{S_A}{K_A^{AMB} + S_A}.\frac{K_{O2}^{AMB}}{K_{O2}^{AMB} + S_{O2}}.\frac{K_{NO}^{AMB}}{K_{NO}^{AMB} + S_{NO}}.\frac{S_{NH}}{K_{NH}^{AMB} + S_{NH}}.\frac{S_{PO4}}{K_P^{AMB} + S_{PO4}}.X_{AMB}$
Growth of HMB	$\rho_4 = f(T).\mu_{HMB}.\frac{S_{H2}}{K_{H2}^{HMB} + S_{H2}}.\frac{K_{O2}^{HMB}}{K_{O2}^{HMB} + S_{O2}}.\frac{S_{NH}}{K_{NH}^{HMB} + S_{NH}}.\frac{S_{PO4}}{K_P^{HMB} + S_{PO4}}.X_{HMB}$
Decay of FB	$\rho_5 = f(T).b_{FB}.X_{FB}$
Decay of AMB	$\rho_6 = f(T).b_{AMB}.X_{AMB}$
Decay of HMB	$\rho_7 = f(T).b_{HMB}.X_{HMB}$
FP and MP compartments	
Anoxic growth of HB on S_F	$\rho_8 = f(T).\mu_H.\eta_H.\frac{S_F}{K_F^H + S_F}.\frac{S_F}{S_F + S_A}.\frac{K_{O2}^H}{K_{O2}^H + S_{O2}}.\frac{S_{NO}}{K_{NO}^H + S_{NO}}.\frac{S_{NH}}{K_{NH}^H + S_{NH}}.\frac{S_{PO4}}{K_P^H + S_{PO4}}.X_{H\_NO}$
Anoxic growth of HB on S_A	$\rho_9 = f(T).\mu_H.\eta_H.\frac{S_A}{K_A^H + S_A}.\frac{S_A}{S_F + S_A}.\frac{K_{O2}^H}{K_{O2}^H + S_{O2}}.\frac{S_{NO}}{K_{NO}^H + S_{NO}}.\frac{S_{NH}}{K_{NH}^H + S_{NH}}.\frac{S_{PO4}}{K_P^H + S_{PO4}}.X_{H\_NO}$
Growth of ALG on NH_4	$\rho_{10} = f(T).f(L).\mu_{ALG}.\frac{S_{NH}}{K_{NH}^{ALG} + S_{NH}}.\frac{S_{PO4}}{K_P^{ALG} + S_{PO4}}.X_{ALG}$
Growth of ALG on NO_3^-	$\rho_{11} = f(T).f(L).\mu_{ALG}.\frac{S_{NO}}{K_{NO}^{ALG} + S_{NO}}.\frac{S_{PO4}}{K_P^{ALG} + S_{PO4}}.\frac{K_{NH}^{ALG}}{K_{NH}^{ALG} + S_{NH}}.X_{ALG}$
Algal respiration	$\rho_{12} = f(T).b_{ALG}^{res}.\frac{S_{O2}}{K_{O2}^{ALG} + S_{O2}}.X_{ALG}$
Aerobic growth of HB on S_F	$\rho_{13} = f(T).\mu_H.\frac{S_F}{K_F^H + S_F}.\frac{S_F}{S_F + S_A}.\frac{S_{O2}}{K_{O2}^H + S_{O2}}.\frac{S_{NH}}{K_{NH}^H + S_{NH}}.\frac{S_{PO4}}{K_P^H + S_{PO4}}.X_{H\_O}$
Aerobic growth of HB on S_A	$\rho_{14} = f(T).\mu_H.\frac{S_A}{K_A^H + S_A}.\frac{S_A}{S_F + S_A}.\frac{S_{O2}}{K_{O2}^H + S_{O2}}.\frac{S_{NH}}{K_{NH}^H + S_{NH}}.\frac{S_{PO4}}{K_P^H + S_{PO4}}.X_{H\_O}$
Growth of AB	$\rho_{15} = f(T).\mu_A.\frac{S_{NH}}{K_{NH}^A + S_{NH}}.\frac{S_{O2}}{K_{O2}^A + S_{O2}}.\frac{S_{PO4}}{K_P^A + S_{PO4}}.X_A$
Decay of HB_O	$\rho_{16} = f(T).b_H.X_{H\_O}$
Decay of HB_NO	$\rho_{17} = f(T).b_H.X_{H\_NO}$
Death of ALG	$\rho_{18} = f(T).b_{ALG}.X_{ALG}$
Decay of AB	$\rho_{19} = f(T).b_A.X_A$
Precipitation	$\rho_{20} = k_{PRE}.S_{PO4}.X_{FeOH}$
Redissolution	$\rho_{21} = k_{RED}.X_{FeP}.S_{ALK}/(K_{ALK} + S_{ALK})$
Ammonia balance	$\rho_{22} = \frac{1}{1 + 10^{pK-pH}}$
Ammonia volatilization	$\rho_{23} = K_l[NH_3]$
Arrhenius equation	$f(T) = \theta^{T-20}$

Table D.5. Parameter values in the two models.

Para.	Description	Value	Unit	Reference
Algae (X_{ALG})				
μ_{ALG}	Maximum growth rate of algae	2	d^{-1}	Reichert, *et al.* [3]
K_{NH}^{ALG}	Ammonium half saturation coefficient for algae	0.01	g $N.m^{-3}$	Chao, *et al.* [4]
K_{NO}^{ALG}	Nitrate half saturation coefficient for algae	0.01	g $N.m^{-3}$	Chao, Jia, Shields, Wang and Cooper [4]
K_{P}^{ALG}	Phosphorous half saturation coefficient for algae	0.02	g $P.m^{-3}$	Reichert, Borchardt, Henze, Rauch, Shanahan, Somlyody and Vanrolleghem [3]
K_{O2}^{ALG}	Oxygen half saturation coefficient for algae	0.2	g $O_2.m^{-3}$	Reichert, Borchardt, Henze, Rauch, Shanahan, Somlyody and Vanrolleghem [3]
b_{ALG}	Decay rate of algae	0.03	d^{-1}	Reichert, Borchardt, Henze, Rauch, Shanahan, Somlyody and Vanrolleghem [3]
b_{ALG}^{res}	Respiration rate of algae	0.05	d^{-1}	Reichert, Borchardt, Henze, Rauch, Shanahan, Somlyody and Vanrolleghem [3]
Autotrophic bacteria (X_A)				
Y_A	Yield of autotrophic bacteria	0.24	g $COD.g^{-1}$ N	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
μ_A	Maximum growth rate of autotrophs	2	d^{-1}	Sah, *et al.* [5]
K_{O2}^{A}	Oxygen half saturation coefficient for autotrophs	0.5	g $O_2.m^{-3}$	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
K_{NH}^{A}	Ammonium half saturation coefficient for autotrophs	0.2	g $N.m^{-3}$	Sah, Rousseau, Hooijmans and Lens [5]
K_{P}^{A}	Phosphorous half saturation coefficient for autotrophs	0.01	g $P.m^{-3}$	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
b_A	Specific biomass decay rate of autotrophs	0.015	d^{-1}	Sah, Rousseau, Hooijmans and Lens [5]
Heterotrophic bacteria (X_H)				
Y_H	Yield of heterotrophic bacteria	0.63	g $COD.g^{-1}$ COD	Henze, Gujer, Mino, Matsuo, Wentzel,

				Marais and Van Loosdrecht [2]
μ_H	Maximum growth rate of heterotrophs	6	d^{-1}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
K_A^H	Fermentation products (acetate) half saturation coefficient for heterotrophs	4	g COD. m^{-3}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
K_{O2}^H	Oxygen half saturation coefficient for heterotrophs	0.2	g $O_2.m^{-3}$	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
K_{NH}^H	Ammonium half saturation coefficient for heterotrophs	0.05	g $N.m^{-3}$	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
K_F^H	Fermentable substrate half saturation coefficient for heterotrophs	3	g COD. m^{-3}	Sah, Rousseau, Hooijmans and Lens [5]
K_{NO}^H	Nitrate half saturation coefficient for heterotrophs	0.5	g $N.m^{-3}$	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
K_{iO2}^H	Inhibition coefficient of oxygen for heterotrophs	0.35	g $O_2.m^{-3}$	Alpkvist, *et al.* [6]
K_P^H	Phosphorous half saturation coefficient of heterotrophs	0.01	g $P.m^{-3}$	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
η_H	Correction factor for anoxic growth of heterotrophs	0.8	-	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
b_H	Decay rate of heterotrophs	0.4	d^{-1}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
Fermenting bacteria (X_{FB})				
Y_{FB}	Yield of FB	0.053	g COD.g^{-1} COD	Langergraber, *et al.* [7]
μ_{FB}	Maximum growth rate of FB	6	d^{-1}	Sah, Rousseau, Hooijmans and Lens [5]
K_F^{FB}	Fermentable substrate half saturation coefficient for FB	28	g COD. m^{-3}	Langergraber, Rousseau, Garcia and Mena [7]
K_{O2}^{FB}	Inhibition coefficient of oxygen for FB	0.2	g $O_2.m^{-3}$	Langergraber, Rousseau, Garcia and Mena [7]

K_{NO}^{FB}	Inhibition coefficient of S_{NO} for FB	0.5	g N.m^{-3}	Langergraber, Rousseau, Garcia and Mena [7]
K_{NH}^{FB}	Saturation coefficient of S_{NH} for FB	0.01	g N.m^{-3}	Langergraber, Rousseau, Garcia and Mena [7]
K_{P}^{FB}	Phosphorous half saturation coefficient for FB	0.01	g P.m^{-3}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
b_{FB}	Decay rate of FB	0.02	d^{-1}	Langergraber, Rousseau, Garcia and Mena [7]
Hydrogenotrophic methanogenic bacteria (X_{HMB})				
Y_{HMB}	Yield of HMB	0.02	g COD.g^{-1} COD	Kalyuzhnyi and Fedorovich [8]
μ_{HMB}	Maximum growth rate of HMB	1	d^{-1}	Kalyuzhnyi and Fedorovich [8]
K_{H2}^{HMB}	Hydrogen gas half saturation coefficient for HMB	0.00013	g COD. m^{-3}	Kalyuzhnyi and Fedorovich [8]
K_{O2}^{HMB}	Oxygen half saturation coefficient for HMB	0.215	g O_2.m^{-3}	Kalyuzhnyi and Fedorovich [8]
K_{NH}^{HMB}	Nitrogen half saturation coefficient for HMB	0.01	g N.m^{-3}	Assumption
K_{P}^{HMB}	Phosphorous half saturation coefficient for HMB	0.01	g P.m^{-3}	Assumption
b_{HMB}	Specific biomass decay rate of HMB	0.04	d^{-1}	Kalyuzhnyi and Fedorovich [8]
Acetotrophic methanogenic bacteria (X_{AMB})				
Y_{AMB}	Yield of AMB	0.032	g COD.g^{-1} COD	Langergraber, Rousseau, Garcia and Mena [7]
μ_{AMB}	Maximum growth rate of AMB	0.085	d^{-1}	Langergraber, Rousseau, Garcia and Mena [7]
K_{A}^{AMB}	Saturation coefficient of S_A for AMB	56	g COD. m^{-3}	Langergraber, Rousseau, Garcia and Mena [7]
K_{O2}^{AMB}	Inhibition coefficient of oxygen for AMB	0.0002	g O_2.m^{-3}	Langergraber, Rousseau, Garcia and Mena [7]
K_{NO}^{AMB}	Inhibition coefficient of S_{NO} for AMB	0.0005	g N.m^{-3}	Langergraber, Rousseau, Garcia and Mena [7]
K_{NH}^{AMB}	Saturation coefficient of S_{NH} for AMB	0.01	g N.m^{-3}	Langergraber, Rousseau, Garcia and Mena [7]
K_{P}^{AMB}	Saturation coefficient of S_{PO4} for AMB	0.01	g P.m^{-3}	Langergraber, Rousseau, Garcia and Mena [7]

b_{AMB}	Decay rate of AMB	0.008	d^{-1}	Langergraber, Rousseau, Garcia and Mena [7]
Precipitation and redissolution				
k_{PRE}	Rate constant for P precipitation	1	$m^3.g^{-1}.d^{-1}$	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
k_{RED}	Rate constant for redissolution	0.6	d^{-1}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
K_{ALK}	Saturation coefficient for alkalinity	0.5	mole HCO_3^{-1}. m^{-3}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
Nitrogen and Phosphorus content				
i_{NXB}	Fraction of nitrogen in bacteria	0.07	g N. g^{-1} COD_{BM}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
i_{NXALG}	Fraction of nitrogen in algae	0.063	g N. g^{-1} COD_{ALG}	Peng, *et al.* [9]
i_{NXS}	Fraction of nitrogen in X_S	0.04	g N. g^{-1} COD_{XS}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
i_{NXI}	Fraction of nitrogen in X_I	0.03	g N. g^{-1} COD_{XI}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
i_{NSI}	Fraction of nitrogen in S_I	0.01	g N. g^{-1} COD_{SI}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
i_{NSF}	Fraction of nitrogen in S_F	0.03	g N. g^{-1} COD_{SF}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
i_{PXB}	Fraction of phosphorus in bacteria	0.02	g P. g^{-1} COD_{BM}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
i_{PXALG}	Fraction of phosphorus in algae	0.01	g P. g^{-1} COD_{ALG}	Reichert, Borchardt, Henze, Rauch, Shanahan, Somlyody and Vanrolleghem [3]
i_{PXS}	Fraction of phosphorus in X_S	0.01	g P. g^{-1} COD_{XS}	Henze, Gujer, Mino, Matsuo, Wentzel,

				Marais and Van Loosdrecht [2]
i_{PXI}	Fraction of phosphorus in X_I	0.01	g P. g^{-1} COD_{XI}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
i_{PSI}	Fraction of phosphorus in S_I	0.00	g P. g^{-1} COD_{SI}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
i_{PSF}	Fraction of phosphorus in S_F	0.01	g P. g^{-1} COD_{SF}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
Phosphorous accumulating organisms (PAO)				
Y_{PAO}	Yield coefficient (biomass/PHA)	0.63	g COD.g^{-1} COD	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
Y_{PO4}	PP requirement (S_{PO4} release) for PHA storage	0.40	g P.g^{-1} COD	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
Y_{PHA}	PHA requirement for PP storage	0.20	g COD.g^{-1} COD	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
μ_{PAO}	Maximum growth rate of PAO	1.00	d^{-1}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
q_{PHA}	Storage of X_{PHA} (base X_{PP}) rate constant	3.00	g X_{PHA}. g^{-1} X_{PAO} d^{-1}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
q_{PP}	Storage of X_{PP} rate constant	1.50	g X_{PP}. g^{-1} X_{PAO} d^{-1}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
K_{PP}^{P}	Poly-phosphate saturation coefficient	0.01	g X_{PP}. g^{-1} X_{PAO}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
K_{PS}^{P}	Phosphorous in storage of PP saturation coefficient	0.20	g P.m^{-3}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
K_{MAX}^{P}	Maximum ratio of X_{PP}/X_{PAO}	0.34	g X_{PP}. g^{-1} X_{PAO}	Henze, Gujer, Mino, Matsuo, Wentzel,

				Marais and Van Loosdrecht [2]
K_{IPP}^{P}	Inhibition coefficient for PP storage	0.02	g X_{PP}. g^{-1} X_{PAO}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
K_{PHA}^{P}	PHA saturation coefficient	0.01	g X_{PHA}. g^{-1} X_{PAO}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
K_{NH}^{P}	Ammonium half saturation coefficient for PAO	0.05	g $N.m^{-3}$	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
K_{O2}^{P}	Oxygen half saturation coefficient for PAO	0.20	g $O_2.m^{-3}$	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
K_{NO}^{P}	Nitrate half saturation coefficient for PAO	0.50	g $N.m^{-3}$	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
K_{P}^{P}	Phosphate (nutrient) half saturation coefficient for PAO	0.01	g $P.m^{-3}$	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
K_{A}^{P}	Acetate half saturation coefficient for PAO	4.00	g $COD.m^{-3}$	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
η_{P}	Correction factor for μ_{PAO} under anoxic conditions	0.60	-	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
b_{PAO}	Specific biomass decay rate of PAO	0.20	d^{-1}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
b_{PP}	Specific biomass decay rate of X_{PP}	0.20	d^{-1}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
b_{PHA}	Specific biomass decay rate of X_{PHA}	0.20	d^{-1}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
Hydrolysis				
K_{X}	Saturation coefficient for hydrolysis	0.10	g $COD_{SF}.g^{-1}$ COD_{BM}	Henze, Gujer, Mino, Matsuo, Wentzel,

				Marais and Van Loosdrecht [2]
K_h	Hydrolysis rate	3	d^{-1}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
η_{NO}^{HYD}	Anoxic hydrolysis reduction factor	0.60	-	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
η_{fe}^{HYD}	Anaerobic hydrolysis reduction factor	0.40	-	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
K_{O2}^{HYD}	Saturation/inhibition coefficient for oxygen	0.2	g O_2.m^{-3}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
K_{NO}^{HYD}	Inhibition coefficient for nitrate	0.50	g N.m^{-3}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]
Other parameters				
T_w	Temperature of the pond	29	^oC	Sah, Rousseau, Hooijmans and Lens [5]
Θ_{Tw}	Temperature coefficient	1.07	-	von Sperling [10]
K	Reaeration coefficient	0.3	m.d^{-1}	Sah, Rousseau, Hooijmans and Lens [5]
S_{O_S}	Saturation concentration of oxygen	7.75	g O_2.m^{-3}	Sah, Rousseau, Hooijmans and Lens [5]
I_o	Irradiance at surface	900	μE.m^{-2}.s^{-1}	Kayombo, *et al.* [11]
I_z	Irradiance at depth z	Variable	μE.m^{-2}.s^{-1}	Heaven, *et al.* [12]
k_z	Light extinction coefficient	13	-	Sah, Rousseau, Hooijmans and Lens [5]
z	Depth	Variable	M	Sah, Rousseau, Hooijmans and Lens [5]
IK	Saturation constant for the light limitation	198	μE.m^{-2}.s^{-1}	Kayombo, Mbwette, Mayo, Katima and Jorgensen [11]
f_{p1}	Fraction of X_I formed during decay of algae	0.1	g COD_{XI}.g^{-1} COD_{ALG}	Peng, Wang, Song and Yuan [9]
f_{p2}	Fraction of X_I formed during decay of bacteria	0.1	g COD_{XI}. g^{-1} COD_{BM}	Henze, Gujer, Mino, Matsuo, Wentzel,

				Marais and Van Loosdrecht [2]
f_{SI}	Fraction of S_I formed during hydrolysis	0	g COD_{SI}. g^{-1} COD_{XS}	Henze, Gujer, Mino, Matsuo, Wentzel, Marais and Van Loosdrecht [2]

5. Supplementary material E: Uncertainty range and scale factor of the parameters in both models

Table E.1. Uncertainty range of the parameters in both models

Name	Description	Distribution	Mean	Min	Max	Unit
A	Surface area of FP1	lognormal	130000	123500	136500	m^2
b_A	Decay rate of autotrophs	lognormal	0.000625	0.000313	0.000938	h^{-1}
b_{ALG}	Decay rate of algae	lognormal	0.00125	0.000625	0.001875	h^{-1}
$b_{ALG\ res}$	Respiration rate of algae	lognormal	0.0125	0.00625	0.01875	h^{-1}
b_{AMB}	Decay rate of AMB	lognormal	0.0003333	0.000167	0.0005	h^{-1}
b_{FB}	Decay rate of FB	lognormal	0.0008333	0.000417	0.00125	h^{-1}
b_H	Decay rate of heterotrophs	lognormal	0.0166667	0.008333	0.025	h^{-1}
b_{HMB}	Decay rate of HMB	lognormal	0.0016667	0.000833	0.0025	h^{-1}
b_{PAO}	Decay rate of PAO	lognormal	0.0083333	0.004167	0.0125	h^{-1}
b_{PHA}	Decay rate of X_{PHA}	lognormal	0.0083333	0.004167	0.0125	h^{-1}
b_{PP}	Decay rate of X_{PP}	lognormal	0.0083333	0.004167	0.0125	h^{-1}
θ_{Tw}	Temperature coefficient	lognormal	1.07	1.0165	1.1235	-
f_{p1}	Fraction of X_I formed during decay of algae	lognormal	0.1	0.095	0.105	g COD_{XI}. g^{-1} COD_{ALG}
f_{p2}	Fraction of X_I formed during decay of bacteria	lognormal	0.1	0.095	0.105	g COD_{XI}. g^{-1} COD_{BM}
f_{SI}	Fraction of S_I formed during hydrolysis	lognormal	0	0	0.005	g COD_{SI}. g^{-1} COD_{XS}
I_K	Saturation coefficient for light	lognormal	198	99	297	$\mu E.m^{-2}.s^{-1}$
i_{NSF}	Fraction of nitrogen in S_F	lognormal	0.03	0.024	0.036	g N. g^{-1} COD_{SF}
i_{NSI}	Fraction of nitrogen in S_I	lognormal	0.01	0.008	0.012	g N. g^{-1} COD_{SI}
i_{NXALG}	Fraction of nitrogen in algae	lognormal	0.063	0.0504	0.0756	g N. g^{-1} COD_{ALG}
i_{NXB}	Fraction of nitrogen in bacteria	lognormal	0.07	0.056	0.084	g N. g^{-1} COD_{BM}
i_{NXI}	Fraction of nitrogen in X_I	lognormal	0.03	0.024	0.036	g N. g^{-1} COD_{XI}
i_{NXS}	Fraction of nitrogen in X_S	lognormal	0.04	0.032	0.048	g N. g^{-1} COD_{XS}
I_o	Irradiance at surface	lognormal	1500	1425	1575	$\mu E.m^{-2}.s^{-1}$
i_{PSF}	Fraction of phosphorus in S_F	lognormal	0.01	0.005	0.015	g P. g^{-1} COD_{SF}
i_{PSI}	Fraction of phosphorus in S_I	lognormal	1.00E-06	5E-07	1.5E-06	g P. g^{-1} COD_{SI}
i_{PXALG}	Fraction of phosphorus in algae	lognormal	0.01	0.005	0.015	g P. g^{-1} COD_{ALG}
i_{PXB}	Fraction of phosphorus in bacteria	lognormal	0.02	0.016	0.024	g P. g^{-1} COD_{BM}
i_{PXI}	Fraction of phosphorus in X_I	lognormal	0.01	0.005	0.015	g P. g^{-1} COD_{XI}
i_{PXS}	Fraction of phosphorus in X_S	lognormal	0.01	0.005	0.015	g P. g^{-1} COD_{XS}
K_A^{AMB}	Saturation coefficient of S_A for AMB	lognormal	56	28	84	g COD. m^{-3}
K_F^P	Acetate half saturation coefficient for heterotrophs	lognormal	4	2	6	g COD. m^{-3}
K_A^P	Acetate half saturation coefficient for PAO	lognormal	4	2	6	g COD.m^{-3}
K_{ALK}	Saturation coefficient for alkalinity	lognormal	0.5	0.25	0.75	mole HCO_3^{-1}. m^{-3}
K_F^{FB}	Fermentable substrate half saturation coefficient for FB	lognormal	28	14	42	g COD. m^{-3}

K_F^H	Fermentable substrate half saturation coefficient for heterotrophs	lognormal	3	1.5	4.5	g COD. m^{-3}
K_h	Hydrolysis rate	lognormal	0.125	0.0625	0.1875	h^{-1}
K_{H2}^{HMB}	Hydrogen gas half saturation coefficient for HMB	lognormal	0.00013	0.000065	0.000195	g COD. m^{-3}
K_{iO2}^H	Inhibition coefficient of oxygen for heterotrophs	lognormal	0.35	0.175	0.525	g O_2.m^{-3}
K_{IPP}^P	Inhibition coefficient for PP storage	lognormal	0.02	0.01	0.03	g X_{PP}. g^{-1} X_{PAO}
K_{MAX}^P	Maximum ratio of X_{PP}/X_{PAO}	lognormal	0.34	0.17	0.51	g X_{PP}. g^{-1} X_{PAO}
K_{NH}^A	Ammonium half saturation coefficient for autotrophs	lognormal	0.2	0.1	0.3	g N.m^{-3}
K_{NH}^{ALG}	Ammonium half saturation coefficient for algae	lognormal	0.01	0.005	0.015	g N.m^{-3}
K_{NH}^{AMB}	Saturation coefficient of S_{NH} for AMB	lognormal	0.01	0.005	0.015	g N.m^{-3}
K_{NH}^{FB}	Saturation coefficient of S_{NH} for FB	lognormal	0.01	0.005	0.015	g N.m^{-3}
K_{NH}^H	Ammonium half saturation coefficient for heterotrophs	lognormal	0.05	0.025	0.075	g N.m^{-3}
K_{NH}^{HMB}	Nitrogen half saturation coefficient for HMB	lognormal	0.01	0.005	0.015	g N.m^{-3}
K_{NH}^P	Ammonium half saturation coefficient for PAO	lognormal	0.05	0.025	0.075	g N.m^{-3}
K_{NO}^{ALG}	Nitrate half saturation coefficient for algae	lognormal	0.01	0.005	0.015	g N.m^{-3}
K_{NO}^{AMB}	Inhibition coefficient of S_{NO} for AMB	lognormal	0.0005	0.00025	0.00075	g N.m^{-3}
K_{NO}^{FB}	Inhibition coefficient of S_{NO} for FB	lognormal	0.5	0.25	0.75	g N.m^{-3}
K_{NO}^H	Nitrate half saturation coefficient for heterotrophs	lognormal	0.5	0.25	0.75	g N.m^{-3}
K_{NO}^P	Nitrate half saturation coefficient for PAO	lognormal	0.5	0.25	0.75	g N.m^{-3}
K_{O2}^A	Oxygen half saturation coefficient for autotrophs	lognormal	0.5	0.4	0.6	g O_2.m^{-3}
K_{O2}^{ALG}	Oxygen half saturation coefficient for algae	lognormal	0.2	0.1	0.3	g O_2.m^{-3}
K_{O2}^{AMB}	Inhibition coefficient of oxygen for AMB	lognormal	0.0002	0.0001	0.0003	g O_2.m^{-3}
K_{O2}^{FB}	Inhibition coefficient of oxygen for FB	lognormal	0.2	0.1	0.3	g O_2.m^{-3}
K_{O2}^H	Oxygen half saturation coefficient for heterotrophs	lognormal	0.2	0.1	0.3	g O_2.m^{-3}
K_{O2}^{HMB}	Oxygen half saturation coefficient for HMB	lognormal	0.215	0.1075	0.3225	g O_2.m^{-3}
K_{O2}^P	Oxygen half saturation coefficient for PAO	lognormal	0.2	0.1	0.3	g O_2.m^{-3}
K_P^A	Phosphorous half saturation coefficient for autotrophs	lognormal	0.01	0.005	0.015	g P.m^{-3}

K_P^{ALG}	Phosphorous half saturation coefficient for algae	lognormal	0.02	0.01	0.03	g P.m^{-3}
K_P^{AMB}	Saturation coefficient of S_{PO4} for AMB	lognormal	0.01	0.005	0.015	g P.m^{-3}
K_P^{FB}	Phosphorous half saturation coefficient for FB	lognormal	0.01	0.005	0.015	g P.m^{-3}
K_P^{H}	Phosphorous half saturation coefficient of heterotrophs	lognormal	0.01	0.005	0.015	g P.m^{-3}
K_P^{HMB}	Phosphorous half saturation coefficient for HMB	lognormal	0.01	0.005	0.015	g P.m^{-3}
K_P^{P}	Phosphate saturation coefficient for PAO	lognormal	0.01	0.005	0.015	g P.m^{-3}
K_{PHA}^{P}	PHA saturation coefficient	lognormal	0.01	0.005	0.015	g X_{PHA}. g^{-1} X_{PAO}
K_{PO4}^{P}	Phosphate (nutrient) half saturation coefficient for PAO	lognormal	0.01	0.005	0.015	g X_{PP}. g^{-1} X_{PAO}
K_{PP}^{P}	Poly-phosphate saturation coefficient	lognormal	0.01	0.005	0.015	g P.m^{-3}
k_{PRE}	Rate constant for P precipitation	lognormal	0.0416667	0.020833	0.0625	m^3.g^{-1} $Fe(OH)_3$.h^{-1}
K_{PS}^{P}	Phosphorous in storage of PP saturation coefficient	lognormal	0.2	0.1	0.3	g P.m^{-3}
K_R	Reaeration coefficient	lognormal	0.00375	0.001875	0.005625	m.h^{-1}
k_{RED}	Rate constant for redissolution	lognormal	0.025	0.0125	0.0375	h^{-1}
K_X	Saturation coefficient for hydrolysis	lognormal	0.1	0.05	0.15	g COD_{SF}. g^{-1} COD_{BM}
k_z	Light extinction coefficient	lognormal	13	10.4	15.6	-
K_z	Vertical eddy diffusivity	lognormal	0.05	0.025	0.075	m^2.d^{-1}
μ_A	Maximum growth rate of autotrophs	lognormal	0.0833333	0.066667	0.1	h^{-1}
μ_{ALG}	Maximum growth rate of algae	lognormal	0.0833333	0.041667	0.125	h^{-1}
μ_{AMB}	Maximum growth rate of AMB	lognormal	0.00354167	0.002833	0.00425	h^{-1}
μ_{FB}	Maximum growth rate of FB	lognormal	0.25	0.2	0.3	h^{-1}
μ_H	Maximum growth rate of heterotrophs	lognormal	0.25	0.2	0.3	h^{-1}
μ_{HMB}	Maximum growth rate of HMB	lognormal	0.0416667	0.033333	0.05	h^{-1}
μ_{PAO}	Maximum growth rate of PAO	lognormal	0.0416667	0.033333	0.05	h^{-1}
η_H	Correction factor for anoxic growth of heterotrophs	lognormal	0.8	0.64	0.96	-
η_{hy}	Correction factor for hydrolysis by fermenting bacteria	lognormal	0.1	0.08	0.12	-
η_P	Correction factor for under anoxic conditions	lognormal	0.6	0.48	0.72	-
pH	pH	lognormal	7.8	3.9	11.7	-
q_{PHA}	Storage of X_{PHA} (base X_{PP}) rate constant	lognormal	0.125	0.0625	0.1875	g X_{PHA}. g^{-1} X_{PAO} h^{-1}
q_{PP}	Storage of X_{PP} rate constant	lognormal	0.0625	0.03125	0.09375	g X_{PP}. g^{-1} X_{PAO} h^{-1}

ρ_a	Air density	lognormal	1.2	0.96	1.44	kg.m^{-3}
ρ_{ALG}	Algal density	lognormal	200000	160000	240000	g.m^{-3}
ρ_W	Water density	lognormal	1000	800	1200	kg.m^{-3}
ρ_X	Bacteria density	lognormal	200000	160000	240000	g.m^{-3}
Sed_{F1}	Sediment layers in FP1	lognormal	1.2	0.6	1.8	m
Y_A	Yield of autotrophic bacteria	lognormal	0.24	0.12	0.36	g COD.g^{-1} N
Y_{AMB}	Yield of AMB	lognormal	0.032	0.0256	0.0384	g COD.g^{-1} COD
Y_{FB}	Yield of FB	lognormal	0.053	0.05035	0.05565	g COD.g^{-1} COD
Y_H	Yield of heterotrophic bacteria	lognormal	0.63	0.5985	0.6615	g COD.g^{-1} COD
Y_{HMB}	Yield of HMB	lognormal	0.02	0.019	0.021	g COD.g^{-1} COD
Y_{PAO}	Yield coefficient (biomass/PHA)	lognormal	0.63	0.5985	0.6615	g COD.g^{-1} COD
Y_{PHA}	PHA requirement for PP storage	lognormal	0.2	0.19	0.21	g COD.g^{-1} COD
Y_{PO4}	PP requirement (S_{PO4} release) for PHA storage	lognormal	0.4	0.38	0.42	g P.g^{-1} COD

Table E.2. Scale factor of the state variables of the AS model. According to Brun, *et al.* [13], the scales were chosen to be equal to the mean concentration in the different compartments. .

Name	Description	Aerated compartment	Anoxic compartment	Unit
S_A	Fermentation products as acetate	1	1	g COD.m^{-3}
S_F	Fermentable, readily biodegradable soluble COD	5	1	g COD.m^{-3}
S_{NH}	Ammonium nitrogen	20	15	g N.m^{-3}
S_{NO}	Nitrite- and nitrate nitrogen	20	15	g N.m^{-3}
S_{PO4}	Phosphate concentration	5	2.5	g P.m^{-3}
X_S	Slowly biodegradable particulate COD	40	10	g COD.m^{-3}

Table E.3. Scale factor of the state variables of the WSP model. According to Brun, Reichert and Kunsch [13], the scales were chosen to be equal to the mean concentration in the different compartments. .

Name	Description	AP compartment	FP compartment	MP compartment	Unit
S_A	Fermentation products as acetate	30	10	1	g COD.m^{-3}
S_F	Fermentable, readily biodegradable soluble COD	18	10	5	g COD.m^{-3}
S_{NH}	Ammonium nitrogen	50	42	25	g N.m^{-3}
S_{NO}	Nitrite- and nitrate nitrogen	1	1	8	g N.m^{-3}
S_{PO4}	Phosphate concentration	8	6.5	6	g P.m^{-3}
X_S	Slowly biodegradable particulate COD	30	15	5	g COD.m^{-3}

6. Supplementary material F: The list of parameters in the Figures 1-4

Table F.1. List of parameters in the Figure 1

Para.	Description	Value	Unit
b_A	Specific biomass decay rate of autotrophs	0.015	d^{-1}
b_H	Decay rate of heterotrophs	0.4	d^{-1}
b_{PAO}	Specific biomass decay rate of PAO	0.20	d^{-1}
b_{PHA}	Specific biomass decay rate of X_{PHA}	0.20	d^{-1}
b_{PP}	Specific biomass decay rate of X_{PP}	0.20	d^{-1}
K_A^P	Acetate half saturation coefficient for PAO	4.00	g $COD.m^{-3}$
K_{IPP}^P	Inhibition coefficient for PP storage	0.02	g X_{PP}. g^{-1} X_{PAO}
K_{NH}^A	Ammonium half saturation coefficient for autotrophs	0.2	g $N.m^{-3}$
K_{O2}^A	Oxygen half saturation coefficient for autotrophs	0.5	g $O_2.m^{-3}$
K_P^A	Phosphorous half saturation coefficient for autotrophs	0.01	g $P.m^{-3}$
K_{O2}^P	Oxygen half saturation coefficient for PAO	0.20	g $O_2.m^{-3}$
K_{PHA}^P	PHA saturation coefficient	0.01	g X_{PHA}. g^{-1} X_{PAO}
K_P^P	Phosphate (nutrient) half saturation coefficient for PAO	0.01	g $P.m^{-3}$
K_{PP}^P	Poly-phosphate saturation coefficient	0.01	g X_{PP}. g^{-1} X_{PAO}
Y_A	Yield of autotrophic bacteria	0.24	g $COD.g^{-1}$ N
Y_H	Yield of heterotrophic bacteria	0.63	g $COD.g^{-1}$ COD
Y_{PAO}	Yield coefficient (biomass/PHA)	0.63	g $COD.g^{-1}$ COD
Y_{PHA}	PHA requirement for PP storage	0.20	g $COD.g^{-1}$ COD
η_H	Correction factor for anoxic growth of heterotrophs	0.8	-
η_P	Correction factor for μ_{PAO} under anoxic conditions	0.60	-
μ_A	Maximum growth rate of autotrophs	2	d^{-1}

Table F.2. List of parameters in the Figure 2

Para.	Description	Value	Unit
b_A	Specific biomass decay rate of autotrophs	0.015	d^{-1}
b_H	Decay rate of heterotrophs	0.4	d^{-1}
b_{PP}	Specific biomass decay rate of X_{PP}	0.20	d^{-1}
K_A^P	Acetate half saturation coefficient for PAO	4.00	g $COD.m^{-3}$
K_h	Hydrolysis rate	3	d^{-1}
K_{IPP}^P	Inhibition coefficient for PP storage	0.02	g X_{PP}. g^{-1} X_{PAO}
K_{O2}^H	Oxygen half saturation coefficient for heterotrophs	0.2	g $O_2.m^{-3}$
K_P^A	Phosphorous half saturation coefficient for autotrophs	0.01	g $P.m^{-3}$
K_P^H	Phosphorous half saturation coefficient of heterotrophs	0.01	g $P.m^{-3}$
K_{PHA}^P	PHA saturation coefficient	0.01	g X_{PHA}. g^{-1} X_{PAO}
K_P^P	Phosphate (nutrient) half saturation coefficient for PAO	0.01	g $P.m^{-3}$
K_{PS}^P	Phosphorous in storage of PP saturation coefficient	0.20	g $P.m^{-3}$
q_{PP}	Storage of X_{PP} rate constant	1.50	g X_{PP}. g^{-1} X_{PAO} d^{-1}
Y_A	Yield of autotrophic bacteria	0.24	g $COD.g^{-1}$ N
Y_H	Yield of heterotrophic bacteria	0.63	g $COD.g^{-1}$ COD
Y_{PAO}	Yield coefficient (biomass/PHA)	0.63	g $COD.g^{-1}$ COD
Y_{PHA}	PHA requirement for PP storage	0.20	g $COD.g^{-1}$ COD
Y_{PO4}	PP requirement (S_{PO4} release) for PHA storage	0.40	g $P.g^{-1}$ COD
η_{Hy}	Correction factor for anoxic growth of heterotrophs	0.8	-

μ_A	Maximum growth rate of autotrophs	2	d^{-1}
μ_H	Maximum growth rate of heterotrophs	6	d^{-1}

Table F.3. List of parameters in the Figure 3

Para.	Description	Value	Unit
b_A	Specific biomass decay rate of autotrophs	0.015	d^{-1}
b_{ALG}	Decay rate of algae	0.03	d^{-1}
b_{AMB}	Decay rate of AMB	0.008	d^{-1}
b_{FB}	Decay rate of FB	0.02	d^{-1}
b_{HMB}	Specific biomass decay rate of HMB	0.04	d^{-1}
b_{PAO}	Specific biomass decay rate of PAO	0.20	d^{-1}
b_{PHA}	Specific biomass decay rate of X_{PHA}	0.20	d^{-1}
b_{PP}	Specific biomass decay rate of X_{PP}	0.20	d^{-1}
f_{p2}	Fraction of X_I formed during decay of bacteria	0.1	$g\ COD_{XI}.\ g^{-1}\ COD_{BM}$
K_{H2}^{HMB}	Hydrogen gas half saturation coefficient for HMB	0.00013	$g\ COD.\ m^{-3}$
K_{NH}^{ALG}	Ammonium half saturation coefficient for algae	0.01	$g\ N.m^{-3}$
K_{NO}^{ALG}	Nitrate half saturation coefficient for algae	0.01	$g\ N.m^{-3}$
K_{O2}^{AMB}	Inhibition coefficient of oxygen for AMB	0.0002	$g\ O_2.m^{-3}$
K_{O2}^{H}	Oxygen half saturation coefficient for heterotrophs	0.2	$g\ O_2.m^{-3}$
k_{PRE}	Rate constant for P precipitation	1	$m^3.g^{-1}.d^{-1}$
Y_{HMB}	Yield of HMB	0.02	$g\ COD.g^{-1}\ COD$
I_k	Saturation constant for the light limitation	198	$\mu E.m^{-2}.s^{-1}$
k_z	Light extinction coefficient	13	-
Q_{in}	Flow of the influent	3.4	$L.day^{-1}$

Table F.4. List of parameters in the Figure 4

Para.	Description	Value	Unit
b_A	Specific biomass decay rate of autotrophs	0.015	d^{-1}
b_{ALG}	Decay rate of algae	0.03	d^{-1}
b_{AMB}	Decay rate of AMB	0.008	d^{-1}
b_{FB}	Decay rate of FB	0.02	d^{-1}
b_{HMB}	Specific biomass decay rate of HMB	0.04	d^{-1}
i_{NSF}	Fraction of nitrogen in S_F	0.03	$g\ N.\ g^{-1}\ COD_{SF}$
i_{NXB}	Fraction of nitrogen in bacteria	0.07	$g\ N.\ g^{-1}\ COD_{BM}$
i_{PSF}	Fraction of phosphorus in S_F	0.01	$g\ P.\ g^{-1}\ COD_{SF}$
i_{PSI}	Fraction of phosphorus in S_I	0.00	$g\ P.\ g^{-1}\ COD_{SI}$
i_{PXALG}	Fraction of phosphorus in algae	0.01	$g\ P.\ g^{-1}\ COD_{ALG}$
i_{PXB}	Fraction of phosphorus in bacteria	0.02	$g\ P.\ g^{-1}\ COD_{BM}$
i_{PXS}	Fraction of phosphorus in X_S	0.01	$g\ P.\ g^{-1}\ COD_{XS}$
K_{NO}^{ALG}	Nitrate half saturation coefficient for algae	0.01	$g\ N.m^{-3}$
K_{P}^{ALG}	Phosphorous half saturation coefficient for algae	0.02	$g\ P.m^{-3}$
Y_{HMB}	Yield of HMB	0.02	$g\ COD.g^{-1}\ COD$
Q_{in}	Flow of the influent	3.4	$L.day^{-1}$

7. Supplementary material G: 20 parameters contributing the most on the variability of model outputs and model uncertainty

Table G1. Importance rankings (δ^{msqr}) of the top 20 parameters in the AS systems.

Rank	Parameters	δ^{msqr}	Rank	Parameters	δ^{msqr}
1	q_{PP}	1.77	11	n_P	0.27
2	Y_{PAO}	1.75	12	K_h	0.25
3	μ_A	1.09	13	b_H	0.23
4	Y_H	0.65	14	K_X	0.22
5	b_{PAO}	0.55	15	b_{PP}	0.21
6	Y_{PHA}	0.48	16	K_{O2}^{P}	0.20
7	μ_H	0.43	17	b_{PHA}	0.19
8	K_{PHA}^{P}	0.37	18	n_{hy}	0.17
9	Y_A	0.33	19	q_{PHA}	0.14
10	K_F^H	0.32	20	b_A	0.13

Table G2. Importance ranking (δ^{msqr}) of the top 20 parameters in the WSP systems.

Rank	Parameters	δ^{msqr}	Rank	Parameters	δ^{msqr}
1	μ_{ALG}	5.57	11	Y_A	0.85
2	I_K	3.23	12	pH	0.90
3	θ_{Tw}	2.81	13	μ_{AMB}	0.35
4	k_z	2.18	14	n_H	0.27
5	T_w	2.94	15	K_{O2}^{H}	0.30
6	Q_{in}	2.21	16	i_{NXS}	0.21
7	Y_{FB}	0.98	17	μ_{FB}	0.22
8	Y_H	1.26	18	K_A^H	0.13
9	f_{p2}	1.08	19	b_{ALG}	0.16
10	Y_{HMB}	0.91	20	b_A	0.13

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