

Table S2. Process kinetics for carbon oxidation, nitrification, and denitrification.

w	Process	Process Rates ρ_w
1	Aerobic growth of heterotrophs	$\mu_H \left(\frac{S_S}{K_S + S_S} \right) \left(\frac{S_O}{K_{OH} + S_O} \right) \left(\frac{S_{NH}}{K_{NH} + S_{NH}} \right) X_{BH}$
2	Anoxic growth of heterotrophs on S_{NO3}	$\eta_{NO3} \mu_H \left(\frac{S_S}{K_S + S_S} \right) \left(\frac{K_{OH}}{K_{OH} + S_O} \right) \left(\frac{S_{NO3}}{K_{NO} + S_{NO3}} \right) \left(\frac{S_{NH}}{K_{NH} + S_{NH}} \right) X_{BH}$
3	Anoxic growth of heterotrophs on S_{NO2}	$\eta_{NO2} \mu_H \left(\frac{S_S}{K_S + S_S} \right) \left(\frac{K_{OH}}{K_{OH} + S_O} \right) \left(\frac{S_{NO2}}{K_{NO} + S_{NO2}} \right) \left(\frac{S_{NH}}{K_{NH} + S_{NH}} \right) X_{BH}$
4	Aerobic growth of ammonia oxidizing bacteria	$\mu_{NS} \left(\frac{S_{NH}}{K_{NH} + S_{NH}} \right) \left(\frac{S_O}{K_{OA} + S_O} \right) X_{NS}$
5	Aerobic growth of nitrite oxidizing bacteria	$\mu_{NB} \left(\frac{S_{NO2}}{K_{NO} + S_{NO2}} \right) \left(\frac{S_O}{K_{OA} + S_O} \right) X_{NB}$
6	Decay of heterotrophs	$b_H X_{BH}$
7	Decay of ammonia oxidizing bacteria	$b_{NS} X_{NS}$
8	Decay of nitrite oxidizing bacteria	$b_{NB} X_{NB}$
9	Ammonification of soluble organic nitrogen	$k_a S_{ND} X_{BH}$
10	'Hydrolysis' of entrapped organics	$k_h \frac{X_S}{K_X X_{BH} + X_S} \left(\frac{S_O}{K_{OH} + S_O} + \eta_h \frac{K_{OH}}{K_{OH} + S_O} \left[\frac{S_{NO2} + S_{NO3}}{K_{NO} + S_{NO2} + S_{NO3}} \right] \right) X_{BH}$
11	'Hydrolysis' of entrapped organic nitrogen	$\rho_T (X_{ND} / X_S)$