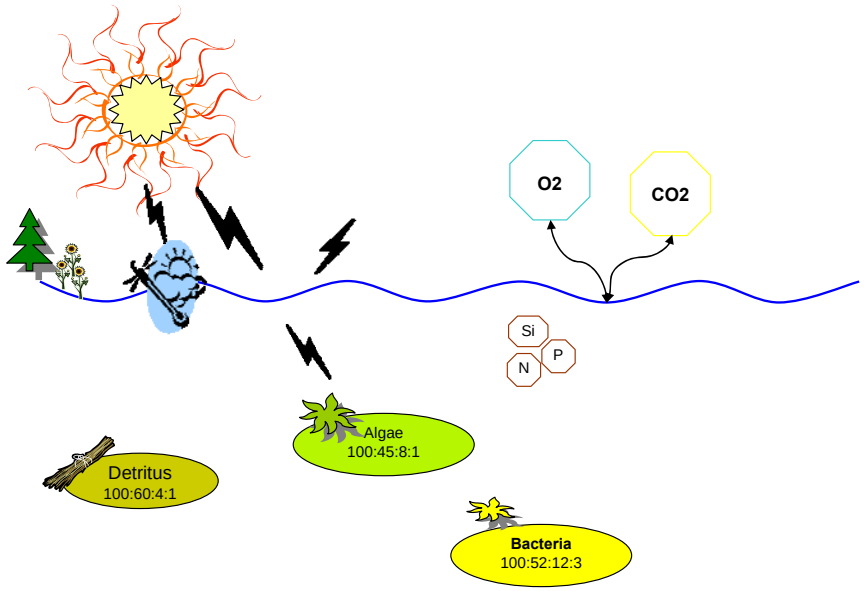
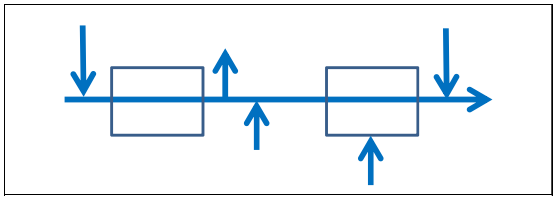
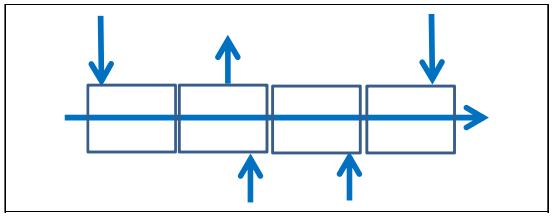
Modeling LBR Periphyton
(attached algae)
…some background



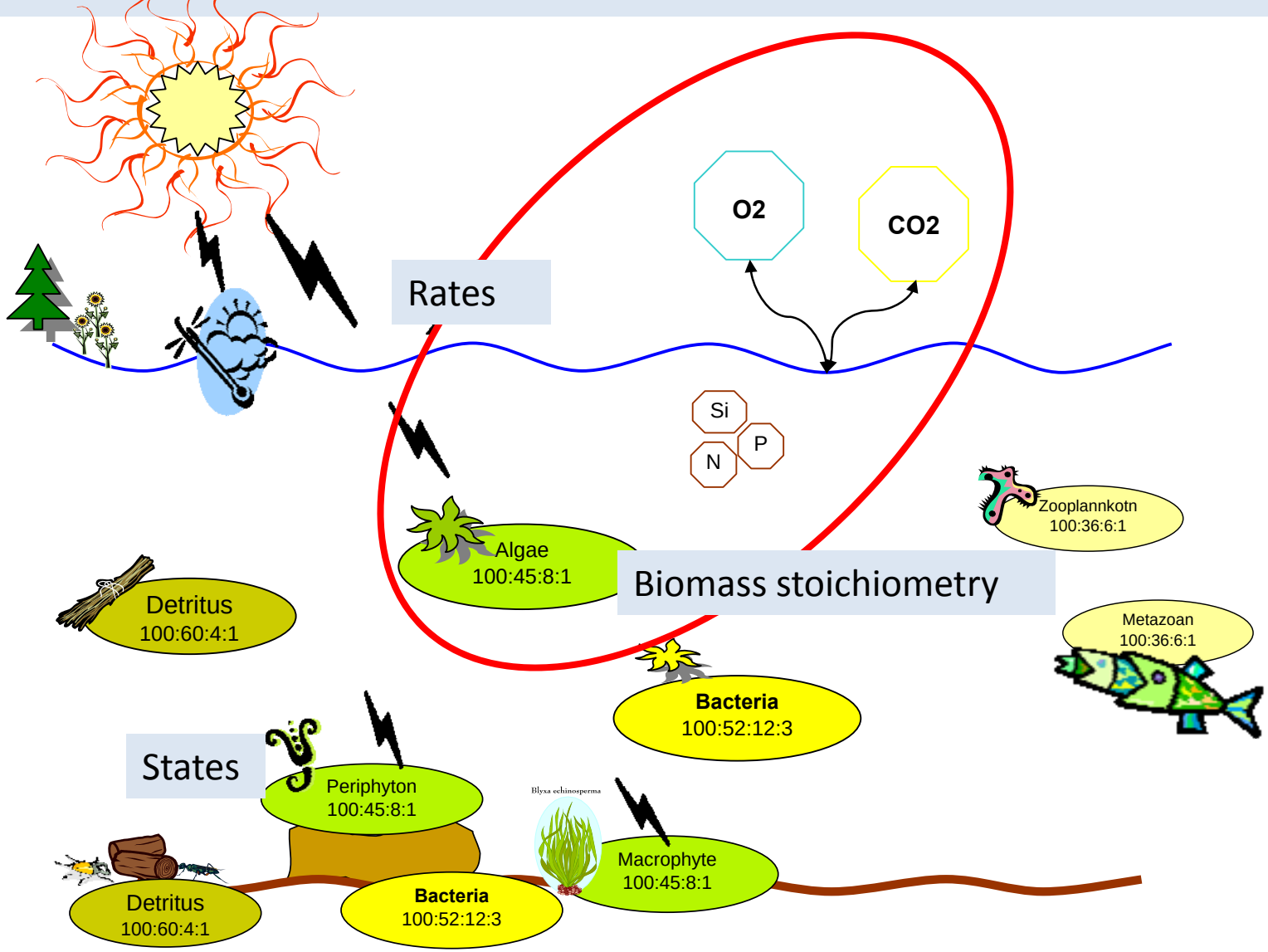




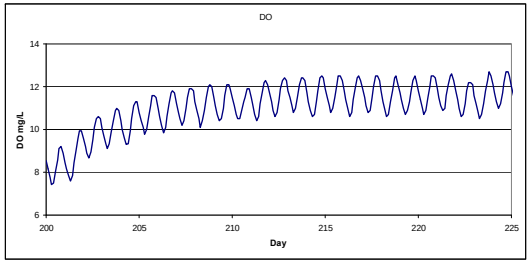
Lower Boise River
Modeling Work Group
February 21, 2013 v2

HyQual
Hydraulics
Hydrology
Water Quality

Carbon cycling ….and food web?

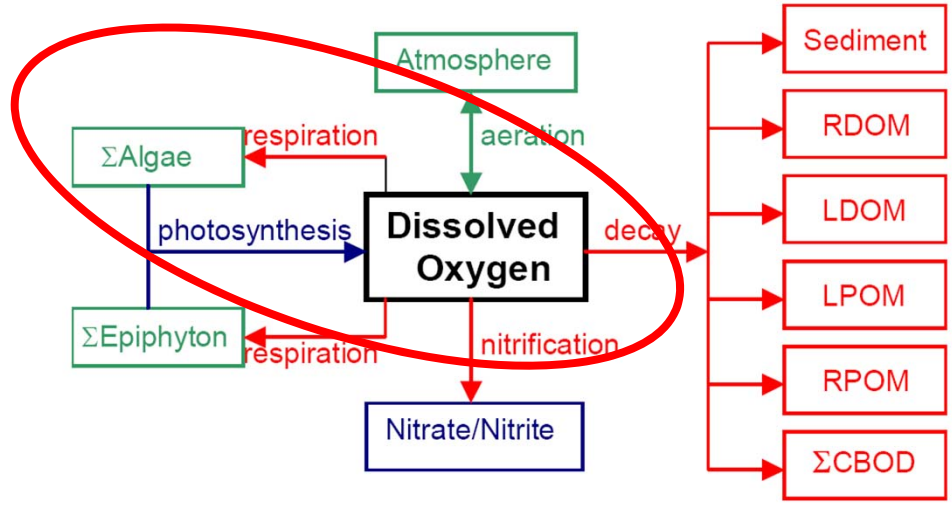


Modeling Periphyton: …setup and processes



		Parameter	Boundary Condition	Modeled
	Nutrients			
	•Stoichiometry ratios	X		
State	•Availability		X	X
	•Luxuriant uptake	X		
	•Longitudinal uptake			X
	Velocity			X
	•Average	X	X	
	•Actual			X
	Solar Input		X	
Rates	•Seasonal		X	X
	•Daily Shading			X
	•Sediment		X	
	Water Temperature			X
	•Optimum	X		
	•Growth rate	X		
State	Biomass			X
	•Chl a ratios	X		
	•Sloughing Rates	X		X
	•Mortality	X		X

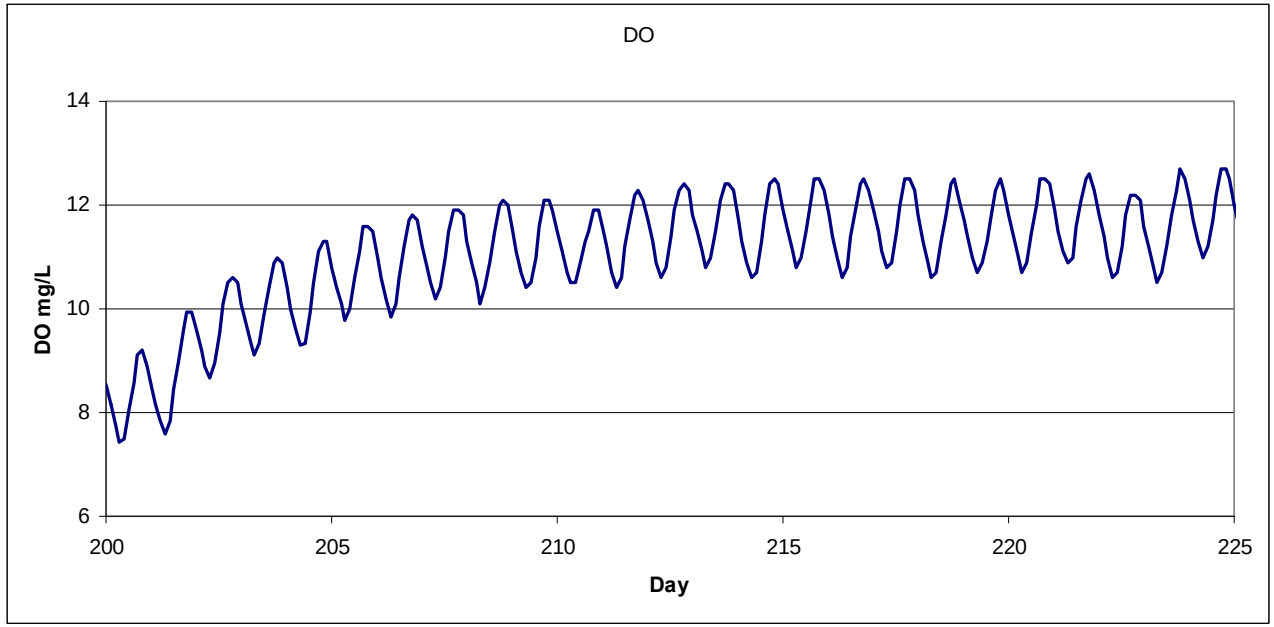
Primary Production



CE-QUAL-W2

Cole and Wells 2003

$$\frac{\partial \Phi_{DO}}{\partial t} = \Sigma(\mathrm{K}_{gro,\mathrm{Alg}} - \mathrm{K}_{res,\mathrm{Alg}})\delta_{OM}\Phi_{\mathrm{Alg}} \pm \ldots$$

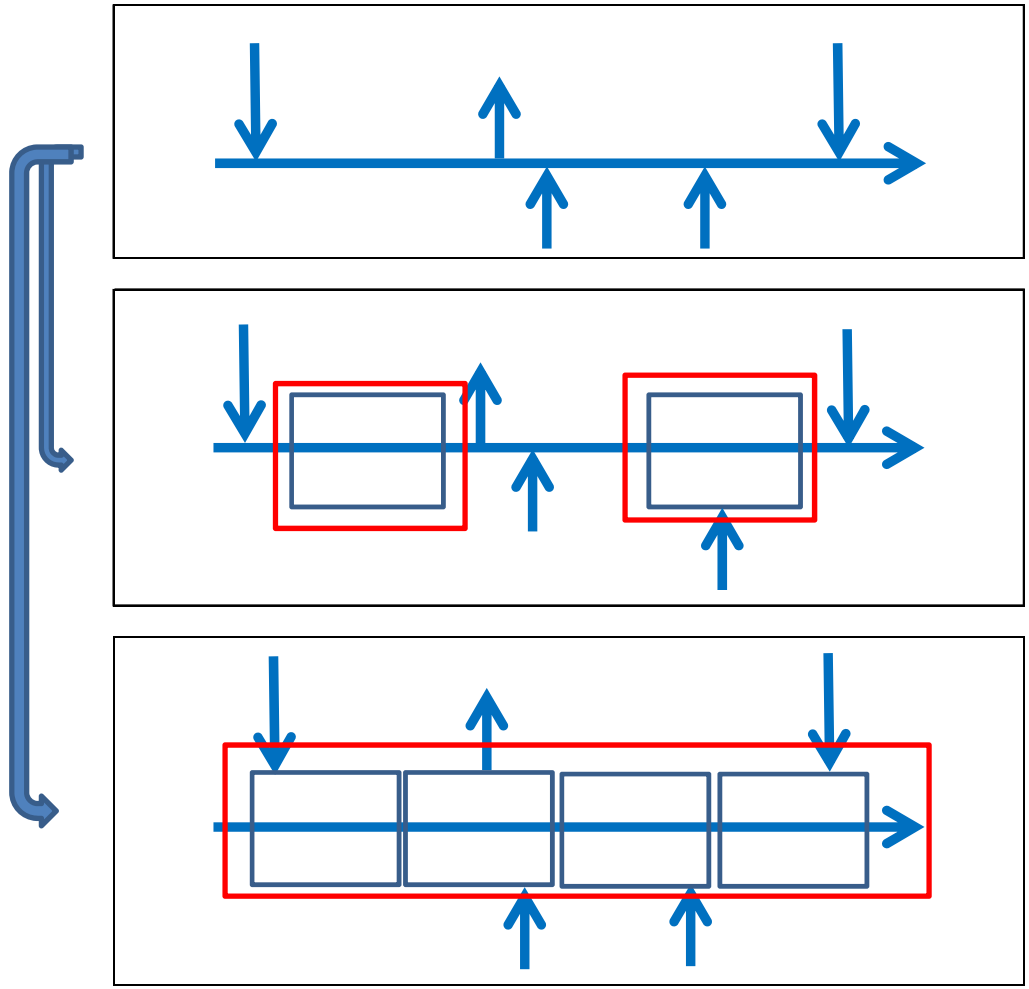


Model structure and time period

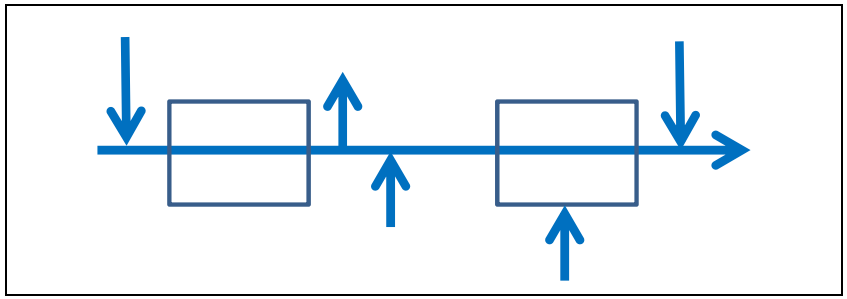
Mass Balance
(flow and TP only)

AQUATOX (multi days)

QUAL2Kw (24hrs)



AQUATOX: Periphyton Biomass Model



$$\frac{dBiomass_{Peri}}{dt} = Loading + Photosynthesis - Respiration - Excretion$$
$$- Mortality - Predation + Sed_{Peri}$$

AQUATOX

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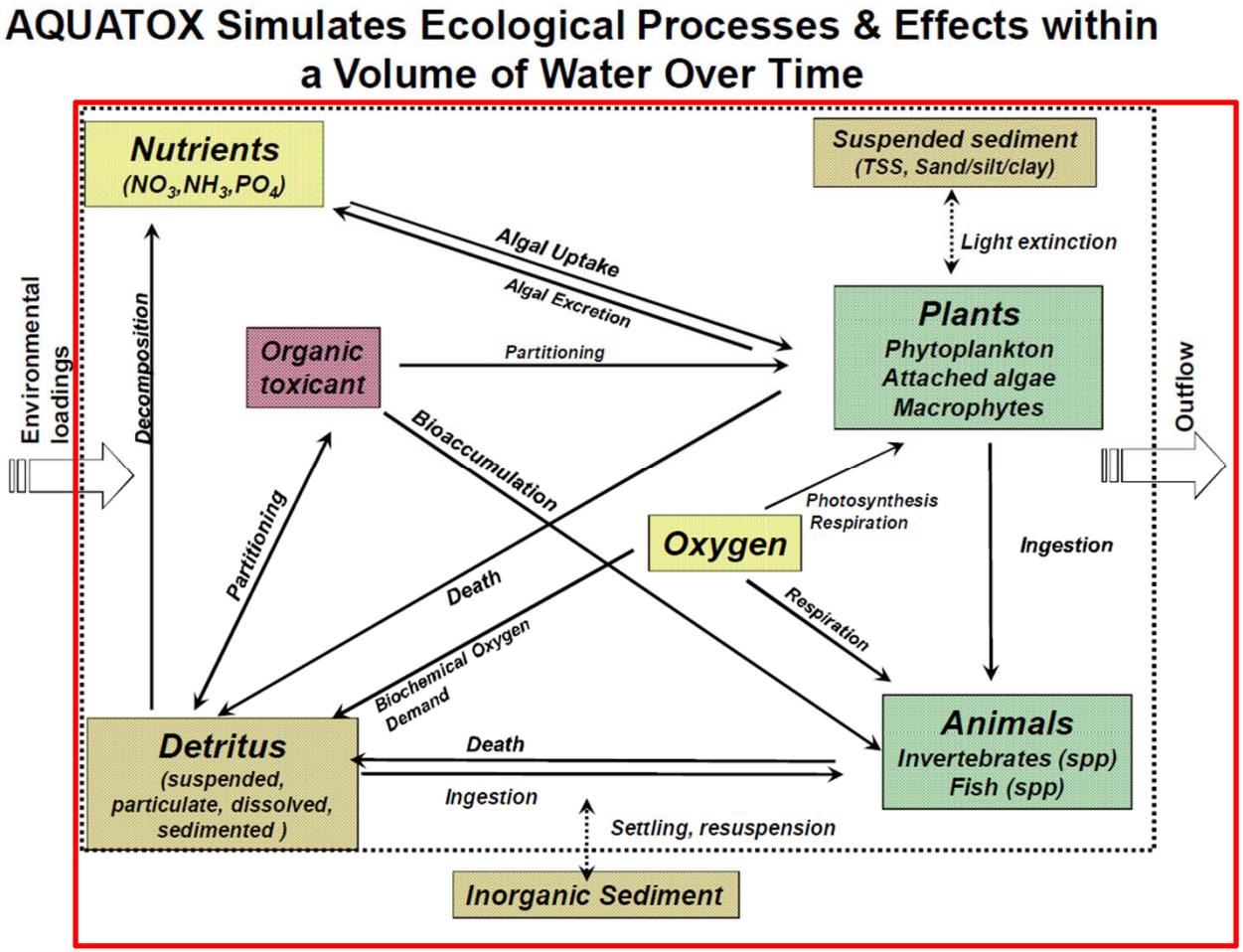
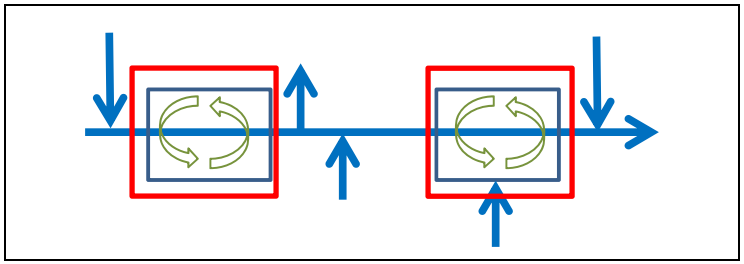
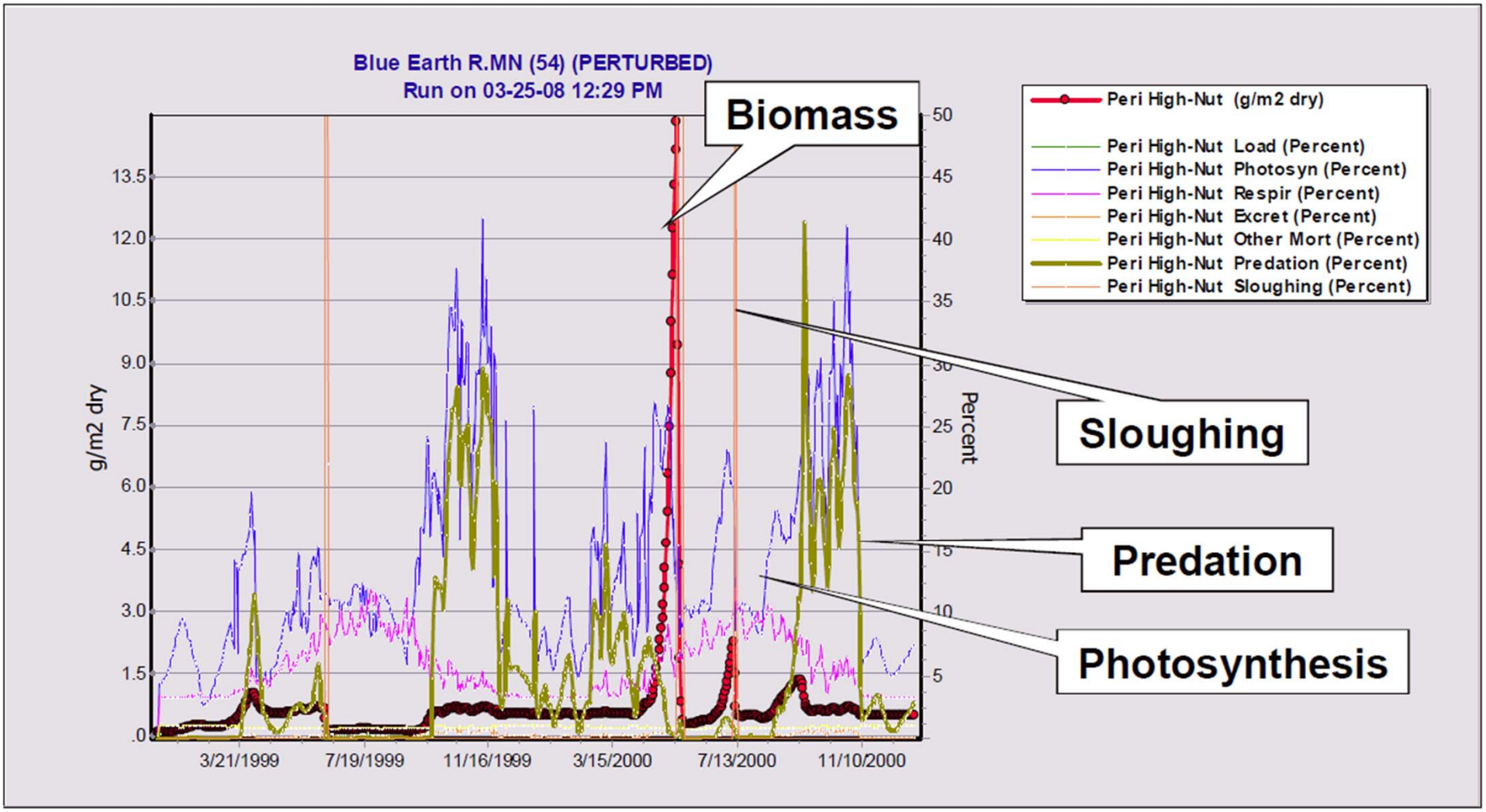
Modeling water quality with AQUATOX

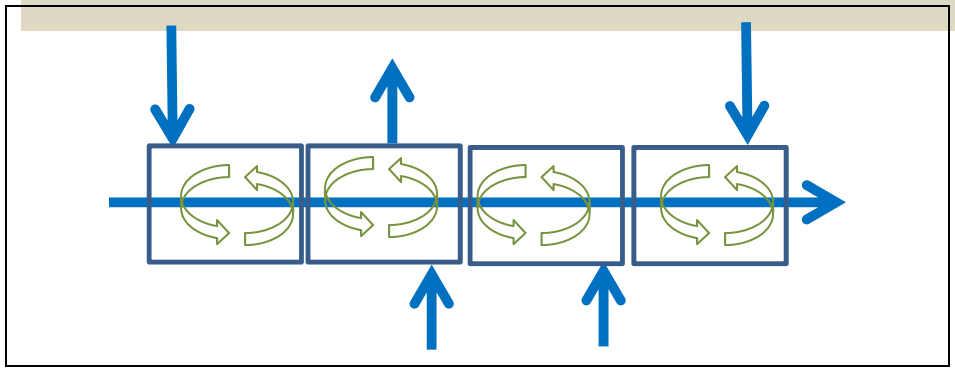




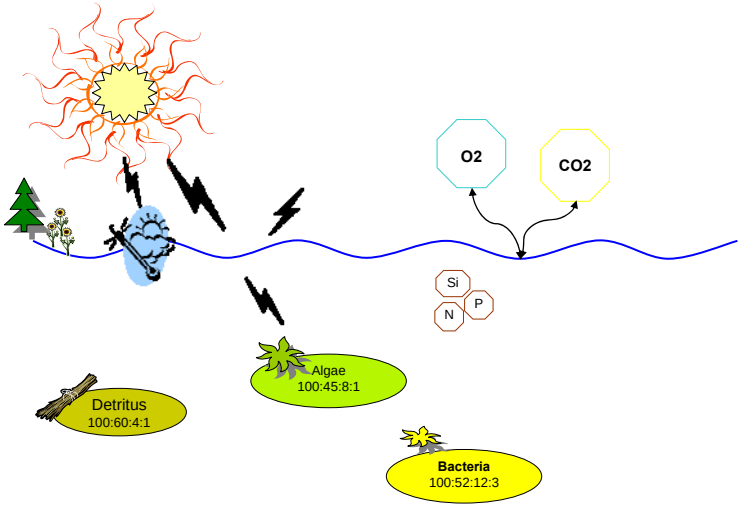
Example of Modeling periphyton



QUAL2Kw



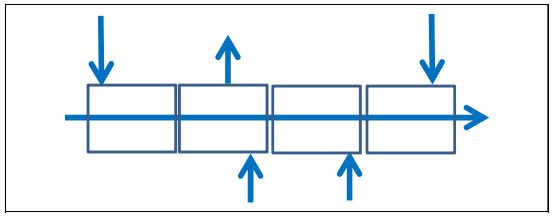
QUAL2Kw: A modeling framework for simulating river and stream water quality,
Pelletier and Chapra 2008



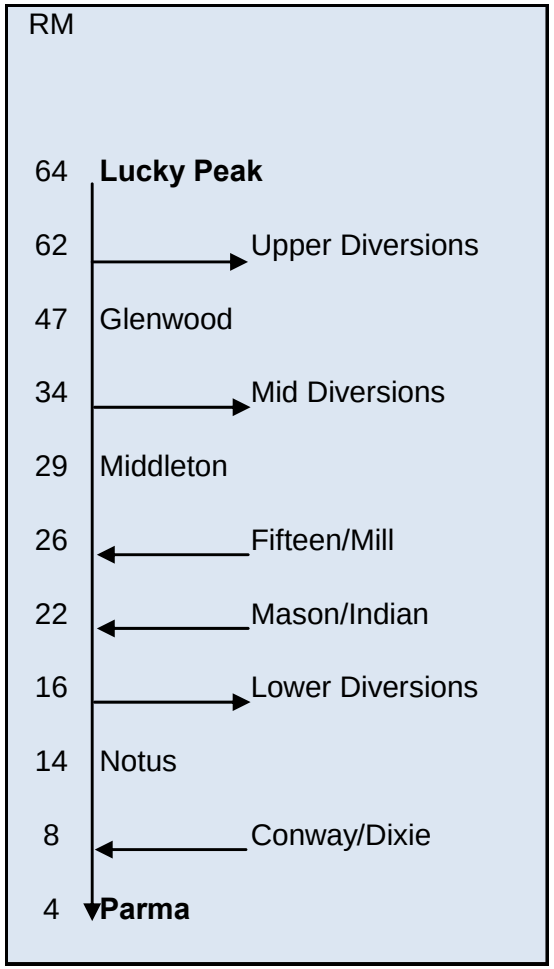
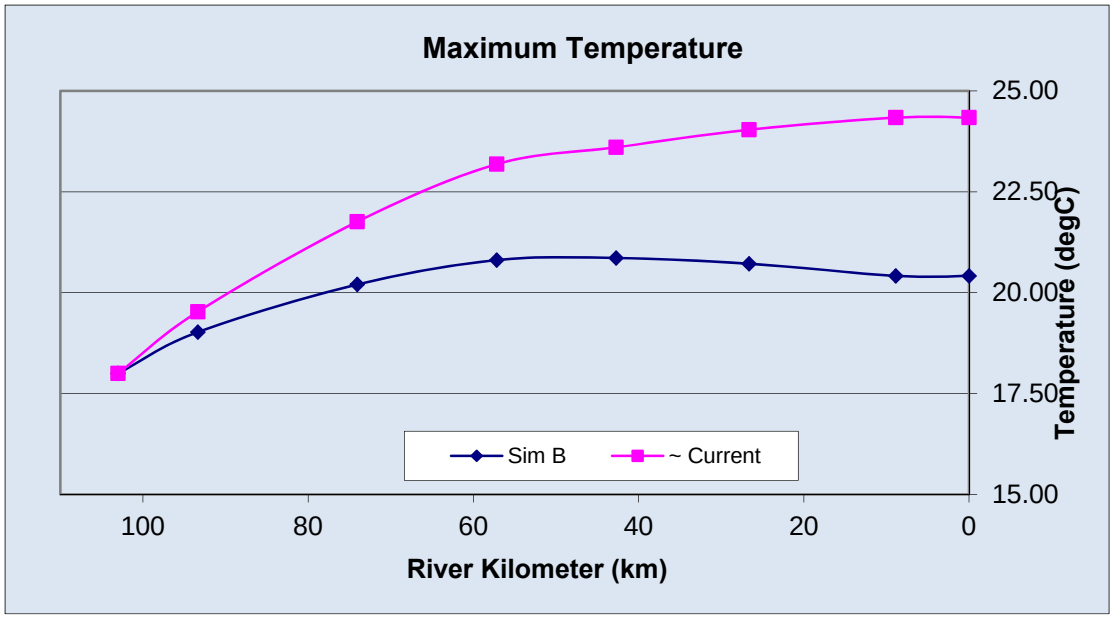
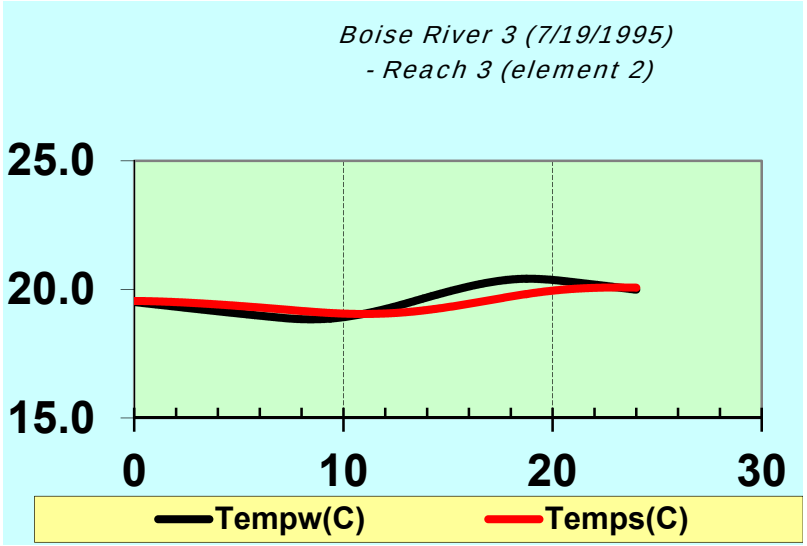
Biomass stoichiometry

$$100\ \mathrm{gD} : 40\ \mathrm{gC} : 7200\ \mathrm{mgN} : 1000\ \mathrm{mgP} : 1000\ \mathrm{mgA}$$

QUAL-2K …rates



Oxygen:			
Reaeration model	User specified		
User reaeration coefficient α	3.93		α
User reaeration coefficient β	0.5		β
User reaeration coefficient γ	1.5		γ
Temp correction	1.024		θ_a
Reaeration wind effect	None		
O2 for carbon oxidation	2.69	gO_2/gC	r_{oc}
O2 for NH4 nitrification	4.57	gO_2/gN	r_{on}
Oxygen inhib model CBOD oxidation	Exponential		
Oxygen inhib parameter CBOD oxidation	0.60	L/mgO2	K_{socf}
Oxygen inhib model nitrification	Exponential		
Oxygen inhib parameter nitrification	0.60	L/mgO2	K_{sona}
Oxygen enhance model denitrification	Exponential		
Oxygen enhance parameter denitrification	0.60	L/mgO2	K_{sodn}
Oxygen inhib model phyto resp	Exponential		
Oxygen inhib parameter phyto resp	0.60	L/mgO2	K_{sop}
Oxygen enhance model bot alg resp	Exponential		
Oxygen enhance parameter bot alg resp	0.60	L/mgO2	K_{sob}

Slow CBOD:			
Hydrolysis rate	0.1	/d	k_{hc}
Temp correction	1.07		θ_{hc}
Oxidation rate	0	/d	k_{dcs}
Temp correction	1.047		θ_{dcs}
Fast CBOD:			
Oxidation rate	0.23	/d	k_{dc}
Temp correction	1.047		θ_{dc}

Example: Lower Boise River Model