SOweb - Parameters, Energy Flows & Impacts

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State and environmental variables

Primary Producers

Parameter Allocation

Energy Flows and Impacts

Table 1: State and environmental forcing variables in the Steady-state Ecosystem Model

Variable	Symbol	Units
Arena		
Latitude	L	0
Area	A	km^2
Depth	Z	m
State Variables		
Detritus	D	$gC.m^{-2}$
Macronutrients (Silicate)	Si	$mmol.m^{-2}$
Micronutrients (dissolved Iron)	dFe	$\mu mol.m^{-2}$
Phytoplankton	P	$gC.m^{-2}$
Higher trophic levels	B	$gC.m^{-2}$
Environmental Forcing Variables		
Mixed layer depth	MLD	m
Incident solar radiation (insolation) at surface	I(0,t)	$W.m^{-2}$
Sea ice concentration	$\stackrel{\circ}{SIC}$	%
Sea ice thickness	SIT	m
Temperature	T	$^{\circ}C$

Table 2: Parameters used for primary production in diatoms and other phytoplankton (modelled on haptophytes) in the NPZD model of Base Production

Parameter	Symbol	Units
Light		
Attenuation PAR through sea ice	k_{si}	m^{-1}
Attenuation PAR through water	k_w	m^{-1}
Proportion incident radiation photosynthetically active	PAR	_
Growth rate		
Photosynthesis efficiency (initial slope of P-I curve)	α	
Maximum growth rate	μ_{max}	d^{-1}
Half saturation constants for nutrient uptake	,	
Silicate	K_{SiO_4}	$mmol.m^{-3}$
Dissolved Iron	K_{dFe}	$\mu mol.m^{-3}$
Stoichiometry		
Algal carbon to nitrogen ratio	$R_{c:n}$	$mol.mol^{-1}$
Algal chl-a to nitrogen ratio	$R_{chla:n}$	$g.mol^{-1}$
Algal iron to nitrogen ratio	$R_{fe:n}$	$mmol.mol^-$
Algal silica to nitrogen ratio	$R_{fe:n}$	$mol.mol^{-1}$

Table 3: Allocation of Parameters Part 1

$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Parameter	Symbol	Units	Category
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	J_{max} parameter		d^{-1}	Primary Production
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			1 1 1777 2	
Benthic inputs $\begin{array}{c} be \\ Carbon \ mass \ of \ higher \ trophic \ level \\ B \\ \beta \\ c \\ Phytoplankton \ competition \ coefficients \\ Circumpolar \ Deep \ Water \\ C \\ d \\ Detrital \ concentration \\ Realised \ depth \ adjustment \ for \ incident \ angle \ of \ light \\ E \\ C \\ d \\ D \\ D \\ D \\ State \ variable \\ Primary \ production \\ State \ variable \\ Primary \ production \\ Primary \ produc$			$d^{(-1)}/Wm^{-2}$	
$ \begin{array}{c} \text{Carbon mass of higher trophic level} & B \\ \beta \\ c \\ c$		-	d^{-1}	
$ \begin{array}{c} \beta \\ c \\ r \\ c \\ d \\ Detrital \ concentration \\ Realised \ depth \ adjustment \ for \ incident \ angle \ of \ light \\ E \\ \epsilon \\ \epsilon \\ \epsilon \\ \theta \\ D \\ D \\ D \\ State \ variable \\ Primary \ production \\ State \ variable \\ Primary \ production \\ Primary \ p$				
$ \begin{array}{c} c \\ r \\ r \\ c \\$	Carbon mass of higher trophic level			State variable
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$,		
Circumpolar Deep Water $ \begin{array}{c} cdw \\ C \\ d \\ Detrital \ concentration \\ Realised \ depth \ adjustment \ for \ incident \ angle \ of \ light \\ Realised \ depth \ adjustment \ for \ incident \ angle \ of \ light \\ Realised \ depth \ adjustment \ for \ incident \ angle \ of \ light \\ \hline \delta \\ \Delta \\ e \\ E \\ \epsilon \\ \hline \epsilon \\ \hline \rho \\ f \\ F \\ g \\ SU \\ Nutrient \ uptake \ by \ phytoplankton \\ Total \ grazing \ rate \ by \ zooplankton \\ Total \ rate \ rat$	Phytoplankton competition coefficients			Drimary production
$ \begin{array}{c} C\\ d\\ Detrital \ concentration\\ Realised \ depth \ adjustment \ for \ incident \ angle \ of \ light\\ Realised \ depth \ adjustment \ for \ incident \ angle \ of \ light\\ Realised \ depth \ adjustment \ for \ incident \ angle \ of \ light\\ \delta\\ \Delta\\ e\\ E\\ E\\ \epsilon\\ \epsilon\\ \epsilon\\ r\\ \eta\\ f\\ F\\ g\\ N\\ Nutrient \ uptake \ by \ phytoplankton\\ Total \ grazing \ rate \ by \ zooplankton\\ Total \ grazing \ rate \ by \ zooplankton\\ G\\ \gamma\\ \Gamma\\ h\\ h\\ H\\ i\\ I\\ N\\ M\\ m^{-2}\\ Environment\\ \end{array} $				
$ \begin{array}{c} d \\ D \\ Realised \ depth \ adjustment \ for \ incident \ angle \ of \ light \\ Realised \ depth \ adjustment \ for \ incident \ angle \ of \ light \\ Realised \ depth \ adjustment \ for \ incident \ angle \ of \ light \\ & \delta \\ & \Delta \\ & e \\ & E \\ & \epsilon \\ & \epsilon \\ & \epsilon \\ & \eta \\ & f \\ & F \\ & g \\ & S \\ & \theta \\ & \epsilon \\ & \theta \\ & $	Circumpolar Deep water			Subscript
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$				
Realised depth adjustment for incident angle of light $ \begin{array}{c} ID \\ \delta \\ \Delta \\ e \\ E \\ \epsilon \\ \\ \gamma \\ f \\ F \\ \\ S \\ Nutrient uptake by phytoplankton \\ Total grazing rate by zooplankton \\ Total grazing rate by zooplankton \\ Incident solar radiation at surface \\ I & W.m^{-2} \\ \end{array} \begin{array}{c} Primary production \\ Primary primary primary production \\ Primary primary primary primary primary primary primary$	Detrital concentration			State variable
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$				
$\begin{array}{c} e \\ E \\ \epsilon \\ \epsilon \\ \epsilon \\ \eta \\ f \\ F \\ g \\ Nutrient uptake by phytoplankton \\ Total grazing rate by zooplankton \\ Total grazing rate by zooplankton \\ G \\ \Gamma \\ h \\ h \\ H \\ i \\ Incident solar radiation at surface \\ \begin{array}{c} e \\ E \\ F \\ g \\ SN \\ F \\ \Gamma \\ h \\ H \\ i \\ W.m^{-2} \\ \end{array} \text{Primary production}$	and the same of th			, T
$\begin{array}{c} E \\ \epsilon \\ \varepsilon \\ \eta \\ f \\ F \\ g \\ gN \\ \\ \Gamma \\ C \\$		Δ		
$\begin{array}{c} \epsilon \\ \varepsilon \\ \eta \\ f \\ F \\ g \\ Nutrient uptake by phytoplankton \\ Total grazing rate by zooplankton \\ Total grazing rate by zooplankton \\ G \\ \Gamma \\ h \\ H \\ i \\ Incident solar radiation at surface \\ \end{array} \qquad \begin{array}{c} \epsilon \\ \varepsilon \\ \eta \\ gN \\ G \\ \Gamma \\ h \\ H \\ i \\ W.m^{-2} \end{array} \qquad \text{Primary production}$		e		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		E		
$ \begin{array}{c} \eta \\ f \\ F \\ g \\ Nutrient uptake by phytoplankton \\ Total grazing rate by zooplankton \\ G \\ \Gamma \\ \Gamma \\ h \\ H \\ i \\ Incident solar radiation at surface \\ \end{array} \begin{array}{c} \eta \\ f \\ gN \\ G \\ \Gamma \\ h \\ H \\ i \\ W.m^{-2} \end{array} \text{Primary production} $		ϵ		
Nutrient uptake by phytoplankton $\begin{array}{c} f \\ F \\ g \\ Nutrient uptake by phytoplankton \\ Total grazing rate by zooplankton \\ G \\ \Gamma \\ \Gamma \\ h \\ H \\ i \\ Incident solar radiation at surface \\ \end{array} \qquad \begin{array}{c} Primary production \\ P \\ Primary production \\ G \\ \Gamma \\ h \\ H \\ i \\ I \\ W.m^{-2} \\ \end{array}$		arepsilon		
Nutrient uptake by phytoplankton $ gN $		•		
Nutrient uptake by phytoplankton $ gN \\ Total \ grazing \ rate \ by \ zooplankton \\ G \\ \Gamma \\ \Gamma \\ h \\ H \\ i \\ Incident \ solar \ radiation \ at \ surface $ Primary production $ G \\ \Gamma \\ h \\ H \\ i \\ W.m^{-2} \\ Environment $				
Nutrient uptake by phytoplankton G Primary production G Γ		F'		
Total grazing rate by zooplankton G Γ Γ h H i Incident solar radiation at surface $I W.m^{-2}$ Environment	27	_		D
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		-		Primary production
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Total grazing rate by zooplankton			
$\begin{array}{cccccccccccccccccccccccccccccccccccc$				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$				
Incident solar radiation at surface				
Incident solar radiation at surface $I W.m^{-2}$ Environment				
	Incident solar radiation at surface		$W m^{-2}$	Environment
4		ι	,,.,,,	211,11011110110

Table 4: Allocation of Parameters Part 2

Parameter	Symbol	Units	Category
	$J \ J$		
Phytoplankton growth rate			Primary Production
Phytoplankton - maximum growth rate	J_{max}	_1	Primary production
Light attenuation	K = K	m^{-1}	Primary production
Phytoplankton nutrient uptake - half saturation	$rac{\kappa}{l}$		Primary production
	$L \ \lambda \ \Lambda$		
	m		
Mortality rate	M		
Mixed layer depth	MLD	m	Environment
Mortality rate of phytoplankton	μ	t^{-1}	Primary production
Nutrient concentration	n		State variable
Nutrient concentration	$N \ u$		State variable
	0		
	O		
	ω		
	Ω		
	p		Q
Phytoplankton concentration (carbon) Proportion incident radiation photosynthetically active	$P \\ PAR$		State variable Primary production
r roportion incident radiation photosynthetically active	π		rimary production
	Π		
	ϕ		
	Φ		
	q		
	Q		
	$r \ R$		
	ρ		
5	s		
Sea ice	si		Subscript
Nutrient Source	S		Nutrients
Sea ice thickness	SIT	m	Environment

Table 5: Allocation of Parameters Part 3

Parameter	Symbol	Units	Category
Time	t		Subscript
Terrestrial inputs	ti		Subscript
Temperature	T	$^{\circ}C$	Environment
	θ		
	Θ		
	ϑ		
	au		
	u		
	U		
	v		
	Υ		
	v		
	V		
	w		
	W		
	x		
	X		
	ξ		
	ξ Ξ		
	χ		
	y		
	$\overset{\circ}{Y}$		
Depth	z	m	Environment
-	Z		
	ζ		
	Ž		

Table 6: Energy Flows

Consumed	nFeM	nFeD	nFeSI	nSiM	nSiD	nSiSI	nCaM	nCaD	nCaSI	pDi	pSm	z
Consumed												
Time Terrestrial inputs Temperature	$\begin{array}{c} t \\ ti \\ T \\ \theta \\ \Theta \\ \vartheta \\ \tau \\ u \\ U \\ v \\ \Upsilon \\ v \\ V \\ w \\ W \\ X \\ \xi \\ \Xi \\ \chi \end{array}$	$^{\circ}C$	Subscript Subscript Environment									
Depth	$egin{array}{c} y \ Y \ z \ Z \ \zeta \end{array}$	m	Environment									