

**Table S2. Parameters for the sea ice biogeochemical model.**

Symbol	Description	Unit	Default value	Reference
$\alpha^{ia} / P_m^{ia}$	Ratio of photosynthetic parameters (photosynthetic efficiency and maximum photosynthetic rate) for IA	$(\mu\text{mol photons m}^{-2} \text{ s}^{-1})^{-1}$	0.44	Within the range of Lavoie et al. (2005)
$b_{ia}$	Temperature sensitivity coefficient for ice algal growth	$(^\circ\text{C})^{-1}$	0.0633	Lavoie et al. (2005)
$C_{ice}$	Critical ice growth/melt rate	$\text{m d}^{-1}$	0.015	Lavoie et al. (2005)
$C_{io}$	Drag coefficient at the ice-ocean interface	-	0.0054	Shirasawa and Ingram (1997)
$D$	Molecular diffusivity for nutrients at the ice-water interface	$\text{m}^2 \text{ s}^{-1}$	$0.47 \times 10^{-9}$	Rebreanu et al. (2008)
$f_{lia}$	Fraction of ice algae linear mortality that goes to $\text{NH}_4$	-	0.3	This study
$f_{seed}$	Fraction of ice algae sloughing that contributes to P2 seeding	-	0.1	Lavoie et al. (2009)
$k_n$	Half-saturation constant for nitrogen uptake	$\text{mmol N m}^{-3}$	1	Lavoie et al. (2005)
$k_s$	Half-saturation constant for silicon uptake	$\text{mmol Si m}^{-3}$	4	Lavoie et al. (2005)
$m_{lia}$	Rate constant for	$\text{d}^{-1}$	0.03	This study

	ice algae linear mortality			
$m_{qia}$	Rate constant of ice algae quadratic mortality	$d^{-1} (\text{mmol N m}^{-3} d^{-1})^{-1}$	0.00015	This study
$\mu_{ia}^{max}$	Maximum specific ice algal growth rate	$d^{-1}$	0.85	Lavoie et al. (2005)
$q_{si2n}$	Intracellular silicon-to-nitrogen ratio	mol Si: mol N	1.7	Mundy et al. (2014)
$r_{pond}$	Melt pond drainage rate	$m d^{-1}$	0.0175	Taylor and Feltham (2003)
$r_{nit}$	Nitrification rate constant in sea ice	$d^{-1}$	0.01	This study
$v_n$	Scale factor for nitrogen preference function	$\text{mmol N m}^{-3}$	0.2	Denman (2003)
$\nu$	Kinematic viscosity of seawater	$m^2 s^{-1}$	$1.85 \times 10^{-6}$	Lavoie et al. (2005)
$z_{ia}$	Thickness of the ice skeletal layer	m	0.03	This study
$z_{oc}$	Thickness of the ocean vertical grid	m	1	