Oxic-anoxic regime shifts mediated by feedbacks between biogeochemical processes and microbial community dynamics

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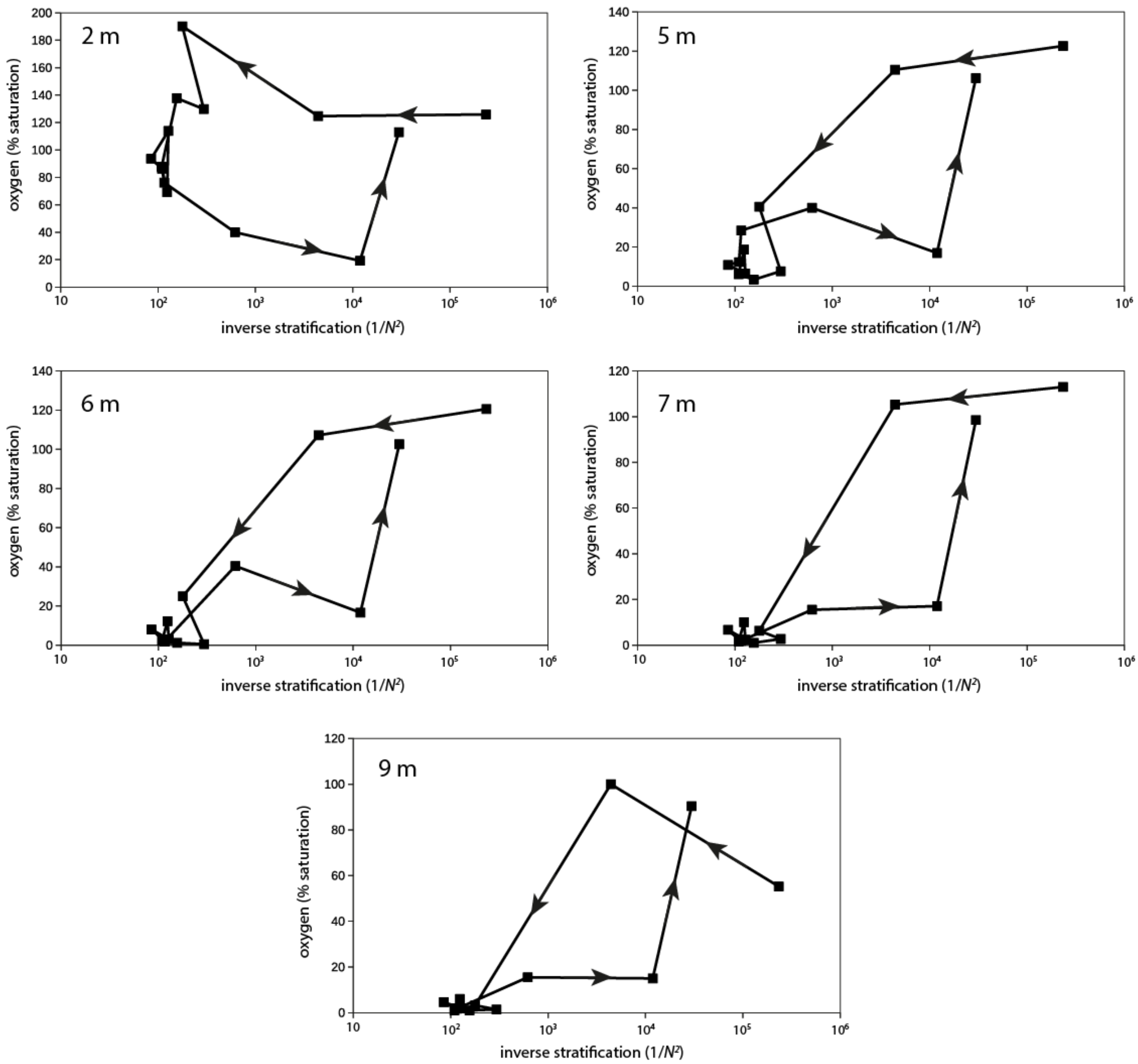
Supplementary Figure 1. Hysteresis loops for different depths in Lake Vechten. The graphs plot the oxygen saturation level against the inverse of the stratification strength ($1/N^2$, where N^2 is the squared buoyancy frequency). The inverse of the stratification strength provides a simple proxy of oxygen diffusivity across the thermocline (see Methods). A hysteresis loop is found irrespective of whether oxygen saturation is measured at a depth of **a**, 2 m; **b**, 5 m; **c**, 6 m; **d**, 7 m; **e**, 9 m. Data points are from March 2013 to March 2014; arrows indicate the direction of time.



Supplementary Table 1. Parameter values of the model.

Parameter	Meaning	Value	Reference
$g_{\max,CB}$	Maximum specific growth rate of CB	0.05 hr^{-1}	1
$g_{\max,PB}$	Maximum specific growth rate of PB	0.07 hr^{-1}	2
$g_{\max,SB}$	Maximum specific growth rate of SB	0.1 hr^{-1}	3,4
$K_{PB,SR}$	Half-saturation constant of PB on reduced sulfur	10 μM	5
$K_{SB,SO}$	Half-saturation constant of SB on oxidized sulfur	5 μM	6
$K_{CB,P}$	Half-saturation constant of CB on phosphorus	0.2 μM	7
$K_{PB,P}$	Half-saturation constant of PB on phosphorus	0.5 μM	8
$K_{SB,P}$	Half-saturation constant of SB on phosphorus	0.5 μM	-
$H_{CB,SR}$	Half-inhibition constant of CB on reduced sulfur	300 μM	9
$H_{PB,O}$	Half-inhibition constant of PB on oxygen	100 μM	10
$H_{SB,O}$	Half-inhibition constant of SB on oxygen	100 μM	10
y_{SB}^{SO}	Yield of SB on oxidized sulfur	3.33×10^{7} cells μM^{-1}	11
y_{PB}^{SR}	Yield of PB on reduced sulfur	1.25×10^{7} cells μM^{-1}	9
y_{CB}^{P}	Yield of CB on phosphorus	1.67×10^{8} cells μM^{-1}	12
y_{PB}^{P}	Yield of PB on phosphorus	1.67×10^{8} cells μM^{-1}	-
y_{SB}^{P}	Yield of SB on phosphorus	1.67×10^{8} cells μM^{-1}	-
p_{CB}	Production of oxygen per cyanobacterial cell	6×10^{-9} μM $cell^{-1}$	13
m_{CB}	Mortality rate of CB	0.020 hr^{-1}	-
m_{PB}	Mortality rate of PB	0.028 hr^{-1}	-
m_{SB}	Mortality rate of SB	0.040 hr^{-1}	-
α_S	Diffusivity of sulfur	0.001 hr^{-1}	-
α_O	Diffusivity of oxygen	$10^{-6} - 10^{-2}$ hr^{-1}	-
α_P	Diffusivity of phosphorus*	0.01 hr^{-1}	-
$S_{R,b}$	Background concentration of reduced sulfur	300 μM	14
$S_{O,b}$	Background concentration of oxidized sulfur	300 μM	14
O_b	Background concentration of oxygen	300 μM	15
P_b	Background concentration of phosphorus	2 − 10 μM	16
c	Oxidation rate of reduced sulfur	4×10^{-5} μM^{-1} hr^{-1}	17,18

CB = cyanobacteria; PB = phototrophic sulfur bacteria; SB = sulfate-reducing bacteria
**We assumed a higher diffusive influx for phosphorus than for sulfur and oxygen, because the phosphorus influx also includes phosphorus release from the sediment and remineralization from dead biomass.*

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