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

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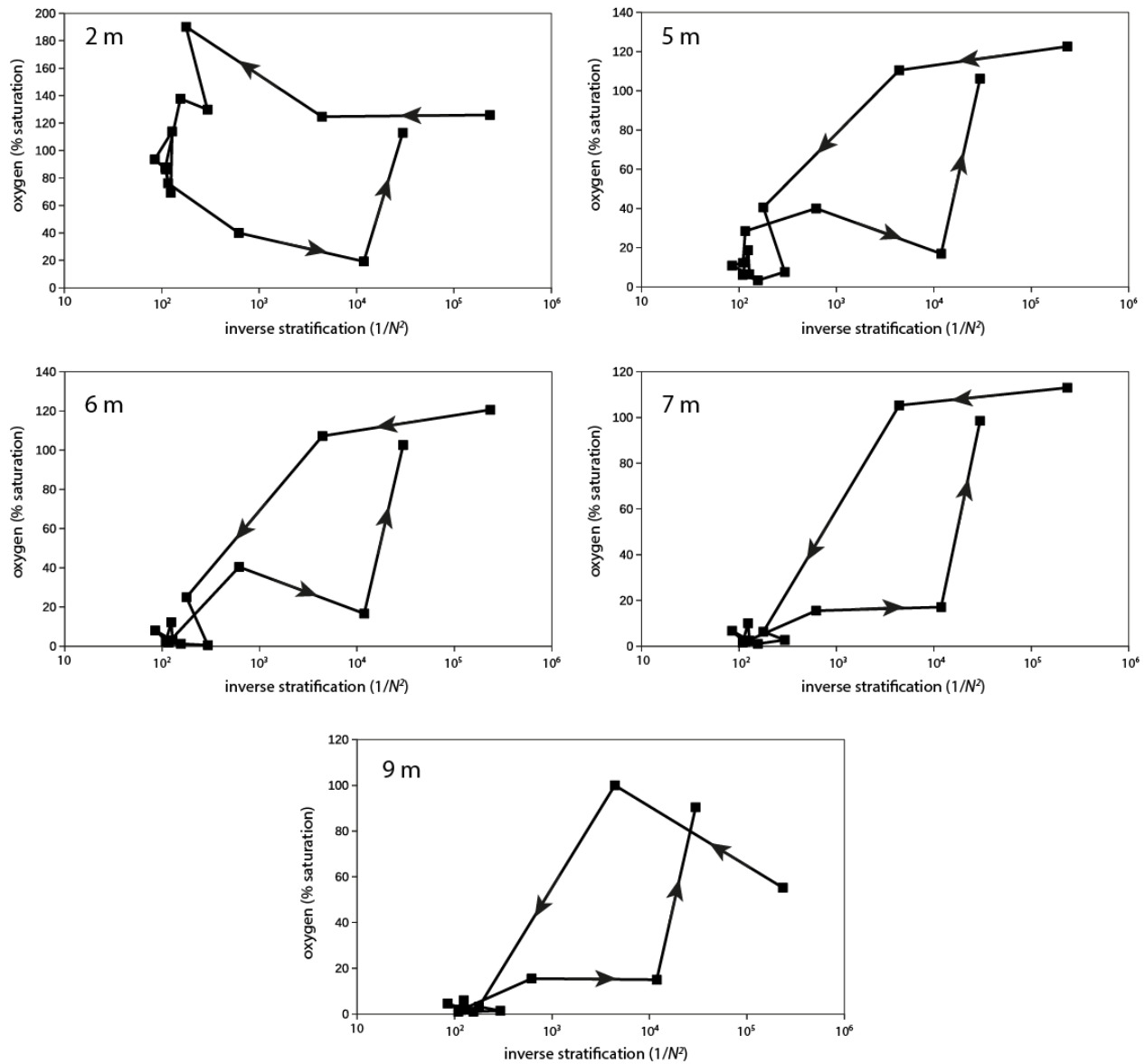
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**Supplementary Figure 1. Hysteresis loops for different depths in Lake Vechten.** The graphs plot the oxygen saturation level against the inverse of the stratification strength ( $1/N^2$ , where  $N^2$  is the squared buoyancy frequency). The inverse 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 <sup>-1</sup>	1
$g_{\max, PB}$	Maximum specific growth rate of PB	0.07 hr <sup>-1</sup>	2
$g_{\max, SB}$	Maximum specific growth rate of SB	0.1 hr <sup>-1</sup>	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 <sup>7</sup> cells μM <sup>-1</sup>	11
$y_{PB}^{SR}$	Yield of PB on reduced sulfur	1.25×10 <sup>7</sup> cells μM <sup>-1</sup>	9
$y_{CB}^P$	Yield of CB on phosphorus	1.67×10 <sup>8</sup> cells μM <sup>-1</sup>	12
$y_{PB}^P$	Yield of PB on phosphorus	1.67×10 <sup>8</sup> cells μM <sup>-1</sup>	-
$y_{SB}^P$	Yield of SB on phosphorus	1.67×10 <sup>8</sup> cells μM <sup>-1</sup>	-
$p_{CB}$	Production of oxygen per cyanobacterial cell	6×10 <sup>-9</sup> μM cell <sup>-1</sup>	13
$m_{CB}$	Mortality rate of CB	0.020 hr <sup>-1</sup>	-
$m_{PB}$	Mortality rate of PB	0.028 hr <sup>-1</sup>	-
$m_{SB}$	Mortality rate of SB	0.040 hr <sup>-1</sup>	-
$\alpha_S$	Diffusivity of sulfur	0.001 hr <sup>-1</sup>	-
$\alpha_O$	Diffusivity of oxygen	10 <sup>-6</sup> – 10 <sup>-2</sup> hr <sup>-1</sup>	-
$\alpha_P$	Diffusivity of phosphorus*	0.01 hr <sup>-1</sup>	-
$S_{R,b}$	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 <sup>-5</sup> μM <sup>-1</sup> hr <sup>-1</sup>	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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