

Supplementary Material

Simulating potential impacts of bottom trawling on the biological carbon pump: A case study in the Benguela Upwelling System

Claire Siddiqui^{1,2}, Tim Rixen^{1,3}, Niko Lahajnar³, Tarron Lamont^{4,5,6}, Anja K. van der Plas⁷

¹Leibniz Centre for Tropical Marine Research – ZMT, Bremen, Germany

²anemos Gesellschaft für Umweltmeteorologie mbH, Reppenstedt, Germany

³Institute of Geology, Universität Hamburg, Hamburg, Germany

⁴Oceans & Coasts Research Branch, Department of Environment, Forestry and Fisheries, Cape Town, South Africa

⁵Department of Oceanography, University of Cape Town, Rondebosch, South Africa

⁶Bayworld Centre for Research & Education, Cape Town, South Africa

⁷National Marine Information and Research Centre, Swakopmund, Namibia

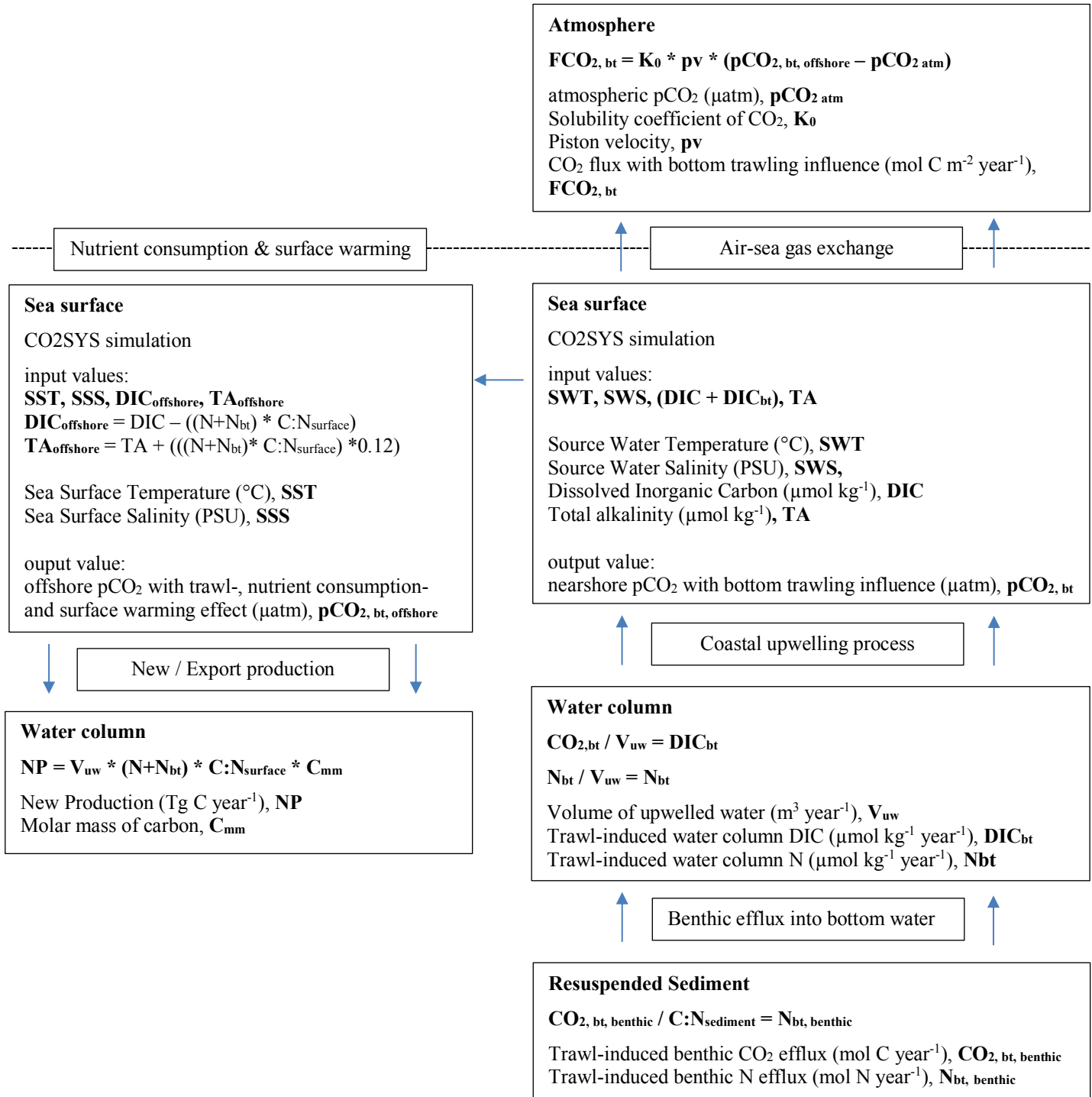
Correspondence to: Claire Siddiqui (ClaireZimmermann@gmx.de, claire.siddiqui@anemos.de)

Supplementary Table 1: Average hydrographic conditions of source water masses (DIC: Dissolved Inorganic Carbon, TA: Total Alkalinity, P: Phosphate, N: Nitrate, SWT: Source Water Temperature, SWS: Source Water Salinity) taken from (Siddiqui et al. 2023) based on water column samples during various cruises across the northern and southern Benguela Upwelling System.

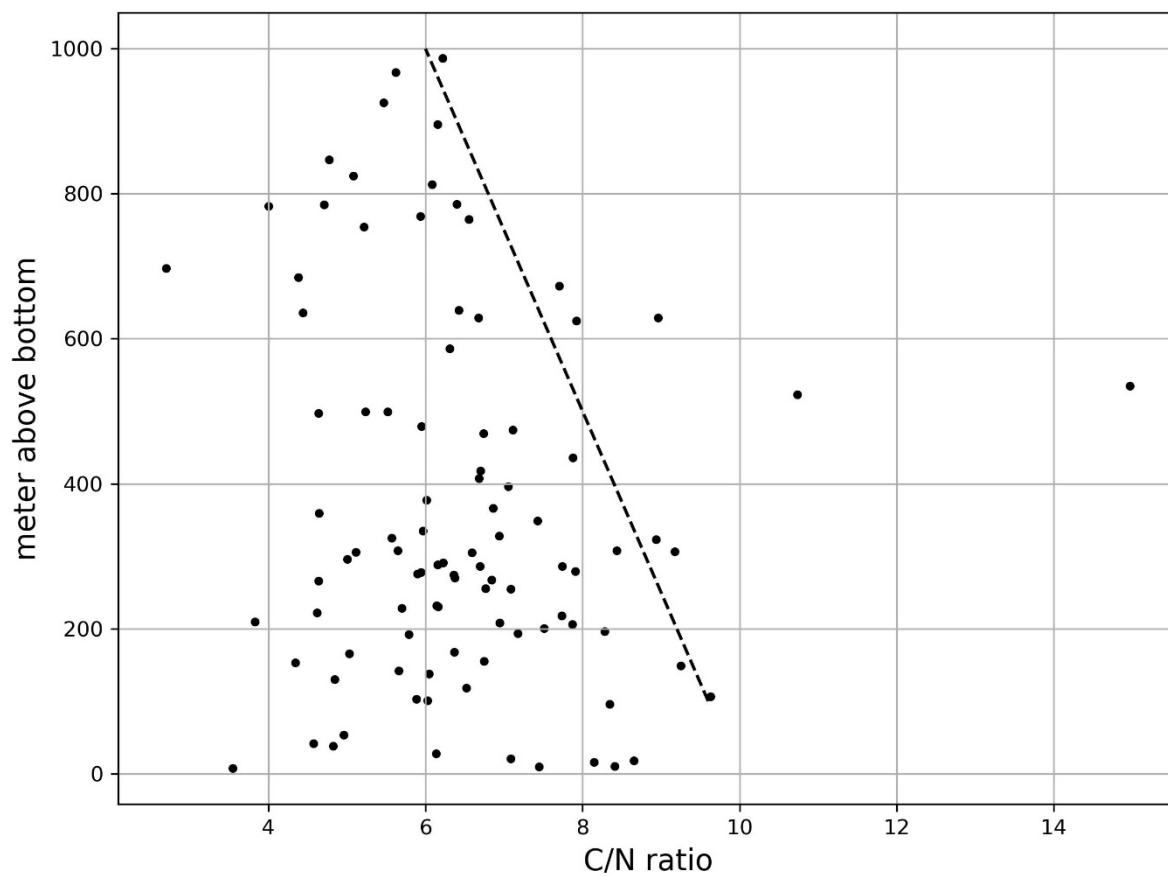
Cruise		DIC ^{*1}	TA ^{*1}	P ^{*1}	N ^{*1}	SWT ^{*2}	SWS ^{*3}
NBUS							
Afr258	2.12.2009 – 16.12.2009	2200.32 ±9.44 n=26	2301.26 ±1.9 n=48	2.07 ±0.06 n=48	27.86 ±0.8 n=48	11.8 ±0.19 n=49	35.09 ±0.02 n=49
D356	10.09.2010 – 19.10.2010	2220.40 ±5.03 n=82	2306.02 ±1.05 n=90	1.88 ±0.04 n=97	32.62 ±0.8 n=97	11.94 ±0.12 n=102	35.12 ±0.02 n=102
MSM17/3	20.01.2011 – 07.03.2011	2232.95 ±5.61 n=47	2304.76 ±1.42 n=45	2.33 ±0.12 n=45	27.12 ±0.8 n=44	11.65 ±0.21 n=48	35.09 ±0.03 n=48
M100	31.08.2013 – 21.10.2013	-	2308.20 ±2.59 n=118	1.84 ±0.04 n=130	25.99 ±0.4 n=130	11.9 ±0.1 n=134	35.07 ±0.01 n=134
M103/1	27.12.2013 – 18.01.2014	-	2302.50 ±1.45 n=41	1.90 ±0.12 n=33	22.68 ±1.1 n=32	11.37 ±0.19 n=51	35.01 ±0.03 n=51
M103/2	21.01.2014 – 11.02.2014	-	2306.57 ±2.9 n=16	2.25 ±0.05 n=49	25.03 ±1.3 n=49	11.49 ±0.19 n=53	35.05 ±0.02 n=53
M153	15.02.2019 – 31.03.2019	2314.23 ±6.9 n=95	2298.73 ±1.7 n=97	1.87 ±0.03 n=96	24.52 ±0.5 n=96	11.5 ±0.09 n=267	35.04 ±0.01 n=267
SO285	20.08.2021 – 02.11.2021	2250.51 ±2.82 n=134	2308.53 ±0.59 n=140	-	-	11.8 ±0.07 n=287	35.06 ±0.01 n=287
GLODAP	2008 - 2018	2209.40 ±5.41 n=39	2298.56 ±0.82 n=39	1.73 ±0.05 n=56	26.09 ±0.8 n=56	10.77 ±0.19 n=64	34.93 ±0.02 n=64
<i>mean</i>		2237.97	2303.9	1.97	26.49	11.58	35.05
<i>std. error</i>		18.48	1.35	0.08	1.04	0.13	0.02
SBUS							
Afr258	2.12.2009 – 16.12.2009	2165.47 ±9.78 n=34	2299.53 ±1.81 n=34	1.89 ±0.11 n=35	21.42 ±0.8 n=35	10.45 ±0.18 n=39	34.87 ±0.02 n=39
M103/1	27.12.2013 – 18.01.2014	-	2302.14 ±1.79 n=20	1.67 ±0.11 n=20	21.35 ±1.1 n=20	10.42 ±0.25 n=20	34.84 ±0.03 n=20
M153	15.02.2019 – 31.03.2019	2246.17 ±6.2 n=102	2283.94 ±2.6 n=101	1.6 ±0.05 n=79	20.57 ±0.7 n=79	10.5 ±0.06 n=265	34.83 ±0.01 n=265
SO285	20.08.2021 – 02.11.2021	2203.06 ±4.03 n=150	2303 ±0.51 n=154	-	-	10.09 ±0.07 n=391	34.8 ±0.01 n=391
GLODAP	2008 - 2018	2160.73 ±4.38 n=52	2298.84 ±0.79 n=51	1.48 ±0.05 n=63	20.89 ±0.9 n=63	10.19 ±0.15 n=105	34.83 ±0.02 n=105
<i>mean</i>		2193.86	2297.49	1.66	21.06	10.33	34.83
<i>std. error</i>		22.91	3.89	0.09	0.20	0.09	0.01

Units in ^{*1} μmol kg⁻¹, ^{*2} °C, ^{*3} PSU

Supplementary Figure 1: Schematic of the box model used to outline impacts of bottom trawling within the northern and southern Benguela Upwelling System.



Supplementary Figure 2: Carbon (C) to nitrate (N) ratios of suspended organic matter (SPM) collected from regions with water depths of 200-1000 m during cruises M153, SO283 and SO285 to the Benguela Upwelling System.



Siddiqui, Claire, Tim Rixen, Niko Lahajnar, Anja K. Van der Plas, Deon C. Louw, Tarron Lamont, and Keshnee Pillay. 2023. 'Regional and global impact of CO₂ uptake in the Benguela Upwelling System through preformed nutrients', *Nature Communications*, 14: 2582.