

**Spatiotemporal variability of sedimentary organic matter supply and recycling  
processes in coral reefs of Tayrona National Natural Park, Colombian Caribbean**

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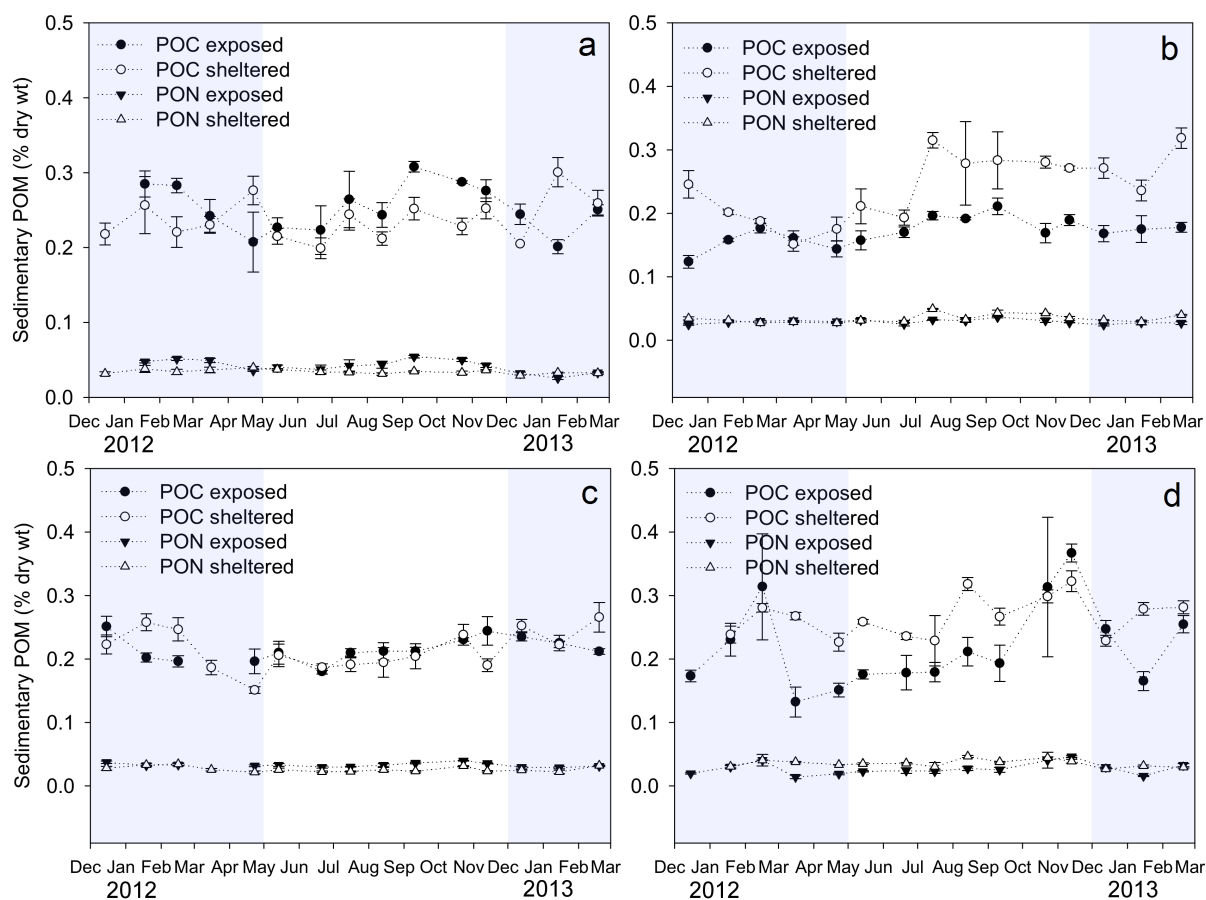
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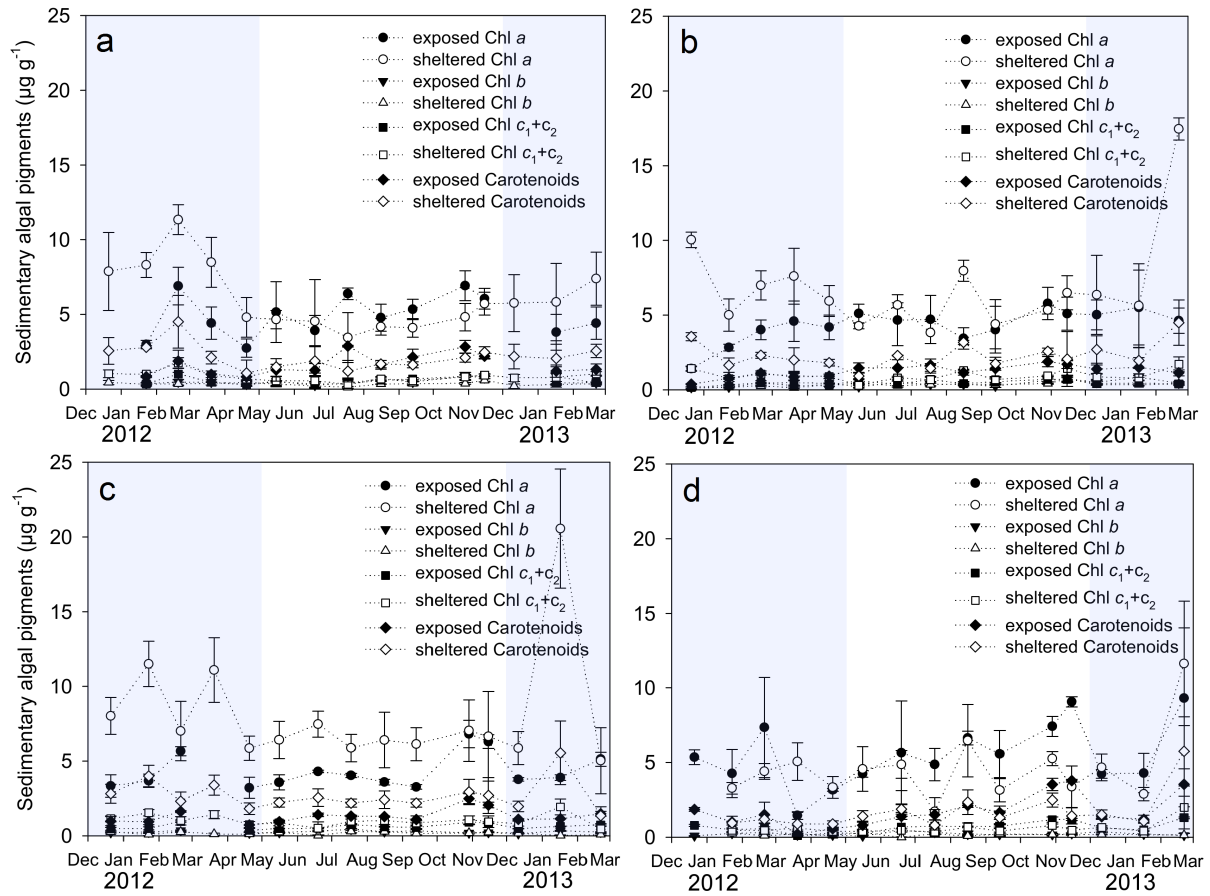
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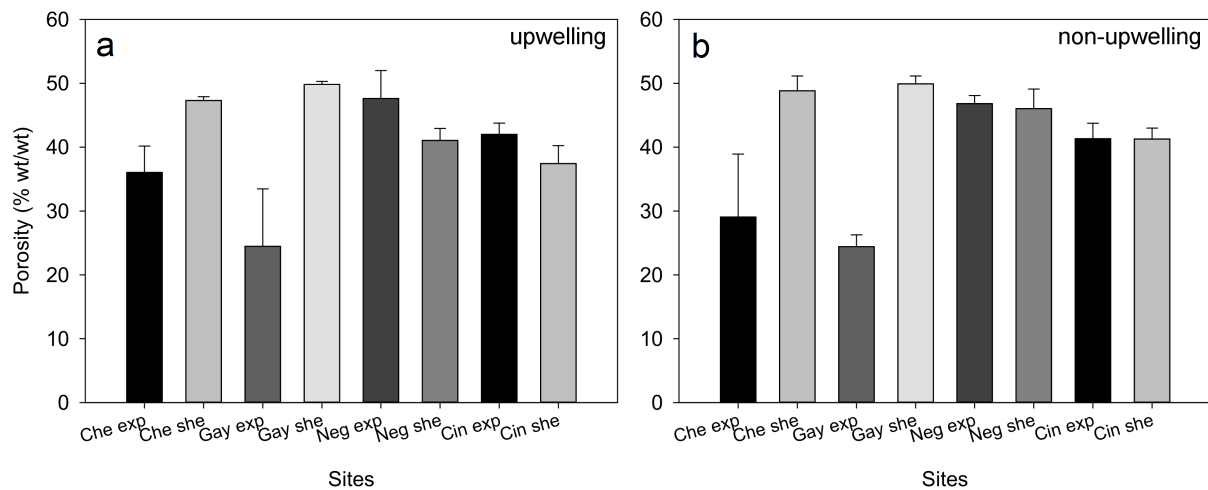
## Supplementary material



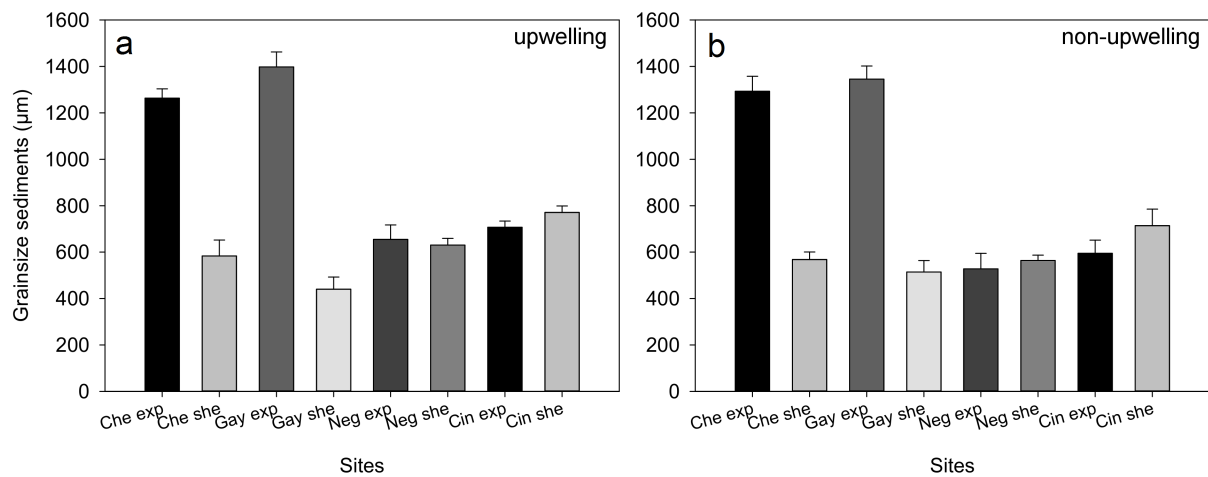
**Figure S1:** Sedimentary particulate organic matter (POM) in Tayrona National Natural Park. Displayed are contents of particulate organic carbon (POC) and nitrogen (PON) at an exposed and sheltered site in the bays (a) Chengue; (b) Gayraca; (c) Neguanje; and (d) Cinto.



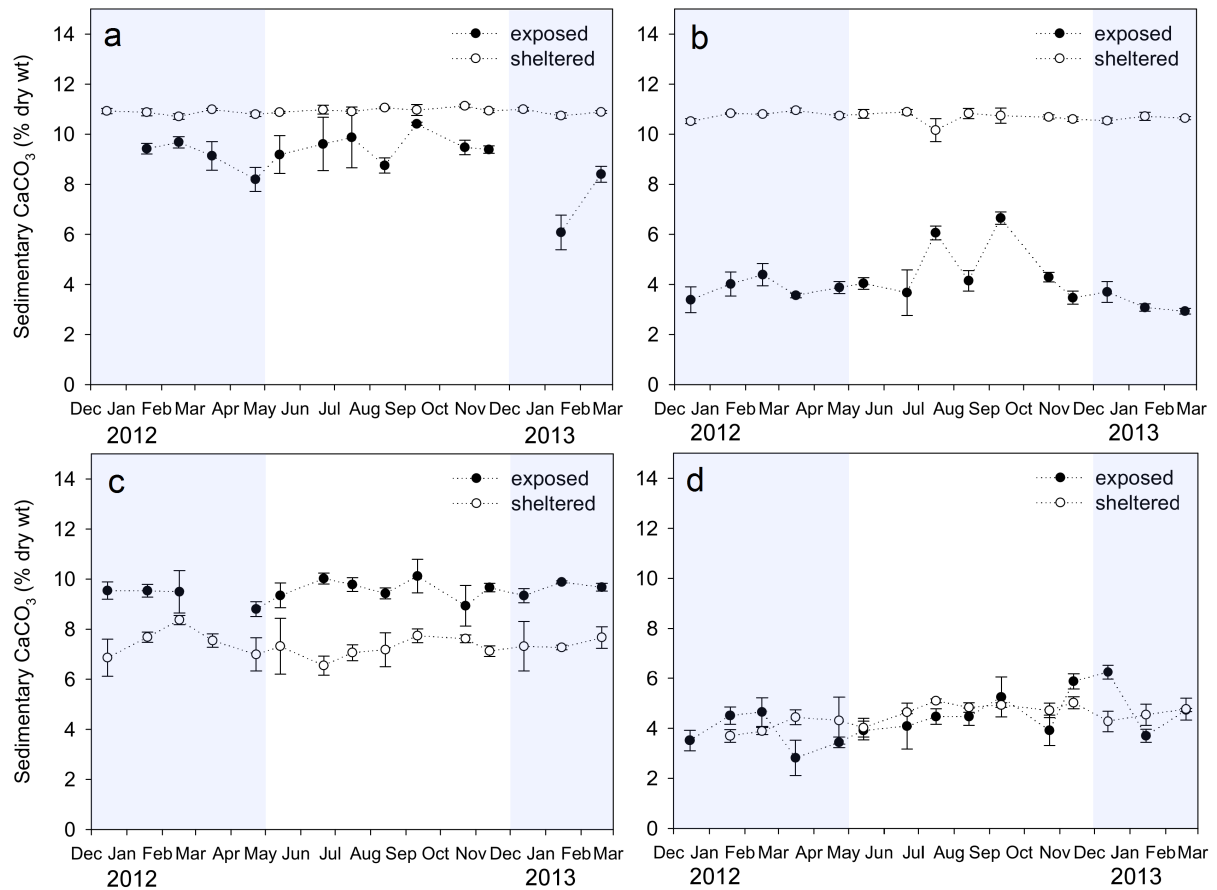
**Figure S2:** Sedimentary algal pigments in Tayrona National Natural Park. Displayed are contents of the algal pigments chlorophyll *a* (Chl *a*), chlorophyll *b* (Chl *b*), chlorophyll *c*<sub>1</sub>+*c*<sub>2</sub> (Chl *c*<sub>1</sub>+*c*<sub>2</sub>) and carotenoids at the exposed and sheltered sites of the bays (a) Chengue; (b) Gayraca; (c) Neguanje; and (d) Cinto.



**Figure S3:** Porosity of Tayrona National Natural Park sediments. Displayed are porosities during (a) upwelling and (b) non-upwelling period. Abbreviations: Chengue exposed (Che exp), Chengue sheltered (Che she), Gayraca exposed (Gay exp), Gayraca sheltered (Gay she), Neguanje exposed (Neg exp), Neguanje sheltered (Neg she), Cinto exposed (Cin exp), Cinto sheltered (Cin she).



**Figure S4:** Grain-size of Tayrona National Natural Park sediments. Displayed are grain-sizes during (a) upwelling and (b) non-upwelling period. Abbreviations: Chengue exposed (Che exp), Chengue sheltered (Che she), Gayraca exposed (Gay exp), Gayraca sheltered (Gay she), Neguanje exposed (Neg exp), Neguanje sheltered (Neg she), Cinto exposed (Cin exp), Cinto sheltered (Cin she).



**Figure S5:** Carbonate content of marine sediments in Tayrona National Natural Park. Displayed are sedimentary carbonate ( $\text{CaCO}_3$ ) contents at exposed and sheltered sites in the bays (a) Chengue; (b) Gayraca; (c) Neguanje; and (d) Cinto.

**Table S1:** Mean sediment parameters ( $\pm$  SD) at the exposed and sheltered sites and a water depth of 10 m in Chengue Bay for the major upwelling (December – April), minor upwelling (July - August), major non-upwelling (September - November) and minor non-upwelling (May - June) periods. Abbreviations: particulate organic nitrogen (PON), particulate organic carbon (POC), chlorophyll *a* (Chl *a*), chlorophyll *b* (Chl *b*), chlorophyll *c*<sub>1</sub>+*c*<sub>2</sub> (Chl *c*), and sedimentary carbonate content (CaCO<sub>3</sub>).

Sediments Chengue	Major upwelling		Minor upwelling		Major non-upwelling		Minor non-upwelling	
	exposed site	sheltered site	exposed site	sheltered site	exposed site	sheltered site	exposed site	sheltered site
Sedimentary PON (mg PON g <sup>-1</sup> )	0.40 $\pm$ 0.10	0.35 $\pm$ 0.05	0.43 $\pm$ 0.10	0.32 $\pm$ 0.03	0.49 $\pm$ 0.06	0.35 $\pm$ 0.03	0.39 $\pm$ 0.07	0.36 $\pm$ 0.04
Sedimentary POC (mg POC g <sup>-1</sup> )	2.45 $\pm$ 0.45	2.49 $\pm$ 0.41	2.54 $\pm$ 0.47	2.28 $\pm$ 0.31	2.91 $\pm$ 0.20	2.44 $\pm$ 0.24	2.25 $\pm$ 0.39	2.07 $\pm$ 0.21
Sedimentary Chl <i>a</i> ( $\mu$ g chl <i>a</i> g <sup>-1</sup> )	4.05 $\pm$ 1.49	7.26 $\pm$ 2.43	5.58 $\pm$ 1.08	3.81 $\pm$ 1.18	6.10 $\pm$ 0.97	4.88 $\pm$ 0.97	4.53 $\pm$ 1.58	4.60 $\pm$ 1.81
Sedimentary Chl <i>b</i> ( $\mu$ g chl <i>b</i> g <sup>-1</sup> )	0.48 $\pm$ 0.31	0.36 $\pm$ 0.12	0.54 $\pm$ 0.29	0.23 $\pm$ 0.13	0.69 $\pm$ 0.24	0.45 $\pm$ 0.14	0.39 $\pm$ 0.28	0.27 $\pm$ 0.14
Sedimentary Chl <i>c</i> ( $\mu$ g chl <i>c</i> g <sup>-1</sup> )	0.44 $\pm$ 0.21	0.93 $\pm$ 0.29	0.48 $\pm$ 0.24	0.50 $\pm$ 0.28	0.82 $\pm$ 0.18	0.77 $\pm$ 0.19	0.41 $\pm$ 0.26	0.55 $\pm$ 0.33
Sedimentary Carotenoids ( $\mu$ g carotenoid g <sup>-1</sup> )	1.08 $\pm$ 0.33	2.28 $\pm$ 0.86	2.25 $\pm$ 0.71	1.44 $\pm$ 0.54	2.39 $\pm$ 0.49	2.06 $\pm$ 0.45	1.27 $\pm$ 0.55	1.68 $\pm$ 0.66
Sedimentary O <sub>2</sub> uptake (mmol O <sub>2</sub> m <sup>-2</sup> d <sup>-1</sup> )	10.4 $\pm$ 3.4	15.2 $\pm$ 4.9	19.9 $\pm$ 7.4	18.5 $\pm$ 5.2	16.4 $\pm$ 5.0	18.1 $\pm$ 3.5	17.4 $\pm$ 3.4	19.9 $\pm$ 3.2
Porosity (% wt/wt)	36.1 $\pm$ 4.1	47.3 $\pm$ 0.6	-	-	29.1 $\pm$ 9.9	48.8 $\pm$ 2.3	-	-
Grain-size ( $\mu$ m)	1263.1 $\pm$ 40.5	583.1 $\pm$ 69.0	-	-	1293.3 $\pm$ 64.5	567.9 $\pm$ 32.3	-	-
Sedimentary CaCO <sub>3</sub> (% dry wt)	8.5 $\pm$ 1.3	10.9 $\pm$ 0.1	9.3 $\pm$ 1.0	11.0 $\pm$ 0.1	9.8 $\pm$ 0.5	11.0 $\pm$ 0.2	9.4 $\pm$ 0.9	10.9 $\pm$ 0.1

**Table S2:** Mean sediment parameters ( $\pm$  SD) at the exposed and sheltered sites and a water depth of 10 m in Gayraca Bay for the major upwelling (December – April), minor upwelling (July - August), major non-upwelling (September - November) and minor non-upwelling (May - June) periods. Abbreviations: particulate organic nitrogen (PON), particulate organic carbon (POC), chlorophyll *a* (Chl *a*), chlorophyll *b* (Chl *b*), chlorophyll *c*<sub>1</sub>+*c*<sub>2</sub> (Chl *c*), and sedimentary carbonate content (CaCO<sub>3</sub>).

Sediments Gayraca	Major upwelling		Minor upwelling		Major non-upwelling		Minor non-upwelling	
	exposed site	sheltered site	exposed site	sheltered site	exposed site	sheltered site	exposed site	sheltered site
PON sedimentation (mg PON m <sup>-2</sup> d <sup>-1</sup> )	110.3 $\pm$ 47.4	62.9 $\pm$ 18.8	88.7 $\pm$ 48.6	76.8 $\pm$ 24.7	54.2 $\pm$ 11.5	31.8 $\pm$ 8.9	65.9 $\pm$ 34.4	49.0 $\pm$ 12.2
POC sedimentation (mg POC m <sup>-2</sup> d <sup>-1</sup> )	623.2 $\pm$ 192.5	381.9 $\pm$ 124.4	532.0 $\pm$ 95.2	514.3 $\pm$ 168.9	399.3 $\pm$ 62.8	241.5 $\pm$ 47.5	406.1 $\pm$ 189.5	338.2 $\pm$ 83.1
Chl <i>a</i> sedimentation (mg chl <i>a</i> m <sup>-2</sup> d <sup>-1</sup> )	66.4 $\pm$ 41.2	27.9 $\pm$ 21.5	27.6 $\pm$ 9.0	17.2 $\pm$ 19.9	8.5 $\pm$ 5.0	1.2 $\pm$ 0.1	12.2 $\pm$ 8.8	3.7 $\pm$ 4.2
Molar C:N of supplied organic matter	6.6 $\pm$ 2.5	7.3 $\pm$ 1.3	8.4 $\pm$ 4.0	8.0 $\pm$ 2.2	8.7 $\pm$ 1.0	8.0 $\pm$ 4.5	7.4 $\pm$ 0.7	8.1 $\pm$ 1.4
Relative proportion of Chl <i>a</i> in supplied POC (%)	0.15 $\pm$ 0.11	0.10 $\pm$ 0.08	0.07 $\pm$ 0.02	0.04 $\pm$ 0.04	0.03 $\pm$ 0.02	0.01 $\pm$ 0.00	0.04 $\pm$ 0.02	0.01 $\pm$ 0.01
Sedimentary PON (mg PON g <sup>-1</sup> )	0.28 $\pm$ 0.04	0.31 $\pm$ 0.04	0.32 $\pm$ 0.03	0.41 $\pm$ 0.10	0.32 $\pm$ 0.05	0.40 $\pm$ 0.06	0.29 $\pm$ 0.05	0.30 $\pm$ 0.04
Sedimentary POC (mg POC g <sup>-1</sup> )	1.61 $\pm$ 0.25	2.23 $\pm$ 0.57	1.94 $\pm$ 0.08	2.97 $\pm$ 0.76	1.89 $\pm$ 0.25	2.79 $\pm$ 0.40	1.64 $\pm$ 0.20	2.02 $\pm$ 0.34
Sedimentary Chl <i>a</i> ( $\mu$ g chl <i>a</i> g <sup>-1</sup> )	4.02 $\pm$ 1.59	7.72 $\pm$ 3.63	4.08 $\pm$ 1.31	5.90 $\pm$ 2.36	4.96 $\pm$ 1.34	5.41 $\pm$ 1.36	4.88 $\pm$ 1.18	4.83 $\pm$ 0.78
Sedimentary Chl <i>b</i> ( $\mu$ g chl <i>b</i> g <sup>-1</sup> )	0.43 $\pm$ 0.28	0.26 $\pm$ 0.12	0.36 $\pm$ 0.07	0.37 $\pm$ 0.07	0.54 $\pm$ 0.27	0.50 $\pm$ 0.20	0.34 $\pm$ 0.21	0.36 $\pm$ 0.11
Sedimentary Chl <i>c</i> ( $\mu$ g chl <i>c</i> g <sup>-1</sup> )	0.35 $\pm$ 0.12	1.05 $\pm$ 0.38	0.55 $\pm$ 0.19	0.98 $\pm$ 0.37	0.65 $\pm$ 0.16	1.01 $\pm$ 0.43	0.48 $\pm$ 0.20	0.50 $\pm$ 0.29
Sedimentary Carotenoids ( $\mu$ g carotenoids g <sup>-1</sup> )	1.01 $\pm$ 0.42	2.56 $\pm$ 1.15	1.40 $\pm$ 0.39	2.30 $\pm$ 0.97	1.68 $\pm$ 0.40	2.13 $\pm$ 1.02	1.46 $\pm$ 0.41	1.47 $\pm$ 0.77
Sedimentary O <sub>2</sub> uptake (mmol O <sub>2</sub> m <sup>-2</sup> d <sup>-1</sup> )	8.8 $\pm$ 5.1	19.9 $\pm$ 4.4	11.9 $\pm$ 3.1	19.4 $\pm$ 6.8	11.7 $\pm$ 4.1	21.3 $\pm$ 5.1	13.0 $\pm$ 3.0	23.1 $\pm$ 5.9
Porosity (% wt/wt)	24.5 $\pm$ 9.0	49.8 $\pm$ 0.5	-	-	24.4 $\pm$ 1.8	49.9 $\pm$ 1.2	-	-
Grain-size ( $\mu$ m)	1398.0 $\pm$ 64.4	440.1 $\pm$ 52.4	-	-	1345.5 $\pm$ 56.3	514.0 $\pm$ 49.6	-	-
Sedimentary CaCO <sub>3</sub> (% dry wt)	3.6 $\pm$ 0.6	10.7 $\pm$ 0.2	5.1 $\pm$ 1.1	10.5 $\pm$ 0.5	4.6 $\pm$ 1.4	10.7 $\pm$ 0.2	3.9 $\pm$ 0.6	10.9 $\pm$ 0.1

**Table S3:** Mean sediment parameters ( $\pm$  SD) at the exposed and sheltered sites and a water depth of 14.5 m in Neguanje Bay for the major upwelling (December – April), minor upwelling (July - August), major non-upwelling (September - November) and minor non-upwelling (May - June) periods. Abbreviations: particulate organic nitrogen (PON), particulate organic carbon (POC), chlorophyll *a* (Chl *a*), chlorophyll *b* (Chl *b*), chlorophyll *c*<sub>1</sub>+*c*<sub>2</sub> (Chl *c*), and sedimentary carbonate content (CaCO<sub>3</sub>).

Sediments Neguanje	Major upwelling		Minor upwelling		Major non-upwelling		Minor non-upwelling	
	exposed site	sheltered site	exposed site	sheltered site	exposed site	sheltered site	exposed site	sheltered site
Sedimentary PON (mg PON g <sup>-1</sup> )	0.32 $\pm$ 0.03	0.28 $\pm$ 0.06	0.31 $\pm$ 0.03	0.24 $\pm$ 0.04	0.37 $\pm$ 0.03	0.26 $\pm$ 0.04	0.31 $\pm$ 0.03	0.24 $\pm$ 0.04
Sedimentary POC (mg POC g <sup>-1</sup> )	2.17 $\pm$ 0.26	2.26 $\pm$ 0.43	2.11 $\pm$ 0.17	1.93 $\pm$ 0.28	2.29 $\pm$ 0.25	2.11 $\pm$ 0.32	1.95 $\pm$ 0.26	1.97 $\pm$ 0.23
Sedimentary Chl <i>a</i> ( $\mu$ g chl <i>a</i> g <sup>-1</sup> )	4.02 $\pm$ 0.92	8.98 $\pm$ 4.61	3.82 $\pm$ 0.29	6.14 $\pm$ 1.34	5.46 $\pm$ 1.74	6.61 $\pm$ 1.94	3.94 $\pm$ 0.51	6.94 $\pm$ 1.12
Sedimentary Chl <i>b</i> ( $\mu$ g chl <i>b</i> g <sup>-1</sup> )	0.24 $\pm$ 0.09	0.13 $\pm$ 0.09	0.35 $\pm$ 0.10	0.28 $\pm$ 0.05	0.25 $\pm$ 0.09	0.19 $\pm$ 0.07	0.26 $\pm$ 0.07	0.13 $\pm$ 0.13
Sedimentary Chl <i>c</i> ( $\mu$ g chl <i>c</i> g <sup>-1</sup> )	0.57 $\pm$ 0.19	1.14 $\pm$ 0.52	0.68 $\pm$ 0.08	0.99 $\pm$ 0.20	0.78 $\pm$ 0.19	0.96 $\pm$ 0.26	0.49 $\pm$ 0.03	0.68 $\pm$ 0.36
Sedimentary Carotenoids ( $\mu$ g carotenoid g <sup>-1</sup> )	1.12 $\pm$ 0.32	2.92 $\pm$ 1.55	1.30 $\pm$ 0.05	2.30 $\pm$ 0.43	1.88 $\pm$ 0.66	2.61 $\pm$ 0.82	1.17 $\pm$ 0.27	2.39 $\pm$ 0.46
Sedimentary O <sub>2</sub> uptake (mmol O <sub>2</sub> m <sup>-2</sup> d <sup>-1</sup> )	7.2 $\pm$ 2.7	18.4 $\pm$ 5.4	9.4 $\pm$ 3.9	19.5 $\pm$ 3.8	9.2 $\pm$ 3.0	19.6 $\pm$ 3.5	6.4 $\pm$ 2.8	14.6 $\pm$ 9.7
Porosity (% wt/wt)	47.6 $\pm$ 4.4	41.1 $\pm$ 1.9	-	-	46.8 $\pm$ 1.3	46.0 $\pm$ 3.1	-	-
Grain-size ( $\mu$ m)	654.6 $\pm$ 63.0	630.2 $\pm$ 28.8	-	-	527.6 $\pm$ 67.0	563.7 $\pm$ 23.2	-	-
Sedimentary CaCO <sub>3</sub> (% dry wt)	9.5 $\pm$ 0.5	7.5 $\pm$ 0.6	9.6 $\pm$ 0.3	7.1 $\pm$ 0.5	9.6 $\pm$ 0.7	7.5 $\pm$ 0.3	9.7 $\pm$ 0.5	6.9 $\pm$ 0.9



**Table S4:** Mean sediment parameters ( $\pm$  SD) at the exposed and sheltered sites and a water depth of 10 m in Cinto Bay for the major upwelling (December – April), minor upwelling (July - August), major non-upwelling (September - November) and minor non-upwelling (May - June) periods. Abbreviations: particulate organic nitrogen (PON), particulate organic carbon (POC), chlorophyll *a* (Chl *a*), chlorophyll *b* (Chl *b*), chlorophyll *c*<sub>1</sub>+*c*<sub>2</sub> (Chl *c*), and sedimentary carbonate content (CaCO<sub>3</sub>).

Sediments Cinto	Major upwelling		Minor upwelling		Major non-upwelling		Minor non-upwelling	
	exposed site	sheltered site	exposed site	sheltered site	exposed site	sheltered site	exposed site	sheltered site
Sedimentary PON (mg PON g <sup>-1</sup> )	0.25 $\pm$ 0.10	0.33 $\pm$ 0.05	0.25 $\pm$ 0.05	0.38 $\pm$ 0.12	0.37 $\pm$ 0.15	0.40 $\pm$ 0.04	0.24 $\pm$ 0.05	0.35 $\pm$ 0.02
Sedimentary POC (mg POC g <sup>-1</sup> )	2.09 $\pm$ 0.77	2.58 $\pm$ 0.28	1.96 $\pm$ 0.35	2.74 $\pm$ 0.66	2.91 $\pm$ 1.25	2.96 $\pm$ 0.32	1.77 $\pm$ 0.31	2.47 $\pm$ 0.14
Sedimentary Chl <i>a</i> ( $\mu$ g chl <i>a</i> g <sup>-1</sup> )	4.74 $\pm$ 2.69	4.71 $\pm$ 2.74	5.75 $\pm$ 1.22	4.09 $\pm$ 3.07	7.35 $\pm$ 1.75	3.93 $\pm$ 1.30	4.95 $\pm$ 2.32	4.71 $\pm$ 1.12
Sedimentary Chl <i>b</i> ( $\mu$ g chl <i>b</i> g <sup>-1</sup> )	0.21 $\pm$ 0.15	0.17 $\pm$ 0.09	0.26 $\pm$ 0.08	0.16 $\pm$ 0.09	0.20 $\pm$ 0.06	0.18 $\pm$ 0.08	0.27 $\pm$ 0.52	0.16 $\pm$ 0.22
Sedimentary Chl <i>c</i> ( $\mu$ g chl <i>c</i> g <sup>-1</sup> )	0.52 $\pm$ 0.28	0.61 $\pm$ 0.37	0.72 $\pm$ 0.09	0.51 $\pm$ 0.27	1.04 $\pm$ 0.26	0.56 $\pm$ 0.22	0.46 $\pm$ 0.68	0.42 $\pm$ 0.10
Sedimentary Carotenoids ( $\mu$ g carotenoid g <sup>-1</sup> )	1.22 $\pm$ 0.73	1.43 $\pm$ 1.16	1.82 $\pm$ 0.41	1.58 $\pm$ 1.01	2.99 $\pm$ 1.06	1.74 $\pm$ 0.71	1.10 $\pm$ 1.15	1.64 $\pm$ 0.42
Sedimentary O <sub>2</sub> uptake (mmol O <sub>2</sub> m <sup>-2</sup> d <sup>-1</sup> )	15.5 $\pm$ 7.7	16.1 $\pm$ 7.3	16.6 $\pm$ 5.4	17.3 $\pm$ 6.9	23.1 $\pm$ 5.7	22.9 $\pm$ 2.0	12.3 $\pm$ 7.9	12.1 $\pm$ 6.8
Porosity (% wt/wt)	42.0 $\pm$ 1.8	37.4 $\pm$ 2.8	-	-	41.3 $\pm$ 2.4	41.3 $\pm$ 1.7	-	-
Grain-size ( $\mu$ m)	707.0 $\pm$ 26.9	770.9 $\pm$ 28.4	-	-	594.6 $\pm$ 56.9	713.7 $\pm$ 71.7	-	-
Sedimentary CaCO <sub>3</sub> (% dry wt)	4.2 $\pm$ 1.1	4.3 $\pm$ 0.5	4.5 $\pm$ 0.3	5.0 $\pm$ 0.2	5.0 $\pm$ 1.0	4.9 $\pm$ 0.2	4.0 $\pm$ 0.6	4.3 $\pm$ 0.4

