Supplementary Section S1. Tables

Table S1. Coccospheres and detached coccolith standing stocks and associated PIC measurements in waters off the Southeast Pacific margin during the late-spring 2015 (LowpHOX 1 cruise). 'na' indicates not available data.

Station	Date	Longitude (° W)	Latitude (° S)	Depth (m)	Spheres (per L^{-1})	Liths (per L^{-1})	PIC (mmol L^{-1})	PIC:POC
T1_07	2015-11-27	-70.20983	-20.09859	2	154959	1276277	2.09	0.010
T1_05	2015-11-27	-70.20983	-20.09859	10	63397	1182411	1.30	0.008
T1_03	2015-11-27	-70.20983	-20.09859	50	6302	280312	1.34	0.013
T1_01	2015-11-27	-70.20983	-20.09859	100	2135	255866	1.22	0.017
T2_20	2015-11-27	-70.24963	-20.10028	2	387235	5400814	2.19	0.009
T2_18	2015-11-27	-70.24963	-20.10028	10	127385	1292712	3.81	0.022
T2_16	2015-11-27	-70.24963	-20.10028	50	3883	301066	1.22	0.019
T2_14	2015-11-27	-70.24963	-20.10028	100	1448	120766	0.93	0.022
T2_12	2015-11-27	-70.24963	-20.10028	200	3981	768823	0.64	0.010
T2_10	2015-11-27	-70.24963	-20.10028	300	4524	614038	0.84	0.016
T2_08	2015-11-27	-70.24963	-20.10028	400	1164	162972	0.49	0.015
T3_41	2015-11-27	-70.42027	-20.10010	2	12060	50847	0.20	0.002
T3_39	2015-11-27	-70.42027	-20.10010	10	14559	95339	na	na
T3_37	2015-11-27	-70.42027	-20.10010	50	543	61929	0.41	0.009
T3_34	2015-11-27	-70.42027	-20.10010	100	4980	148033	0.62	0.020
T3_32	2015-11-27	-70.42027	-20.10010	200	1992	388417	0.91	0.020
T3_30	2015-11-27	-70.42027	-20.10010	300	2623	586021	0.88	0.023
T3_28	2015-11-27	-70.42027	-20.10010	400	2082	410147	0.78	0.023
T3_26	2015-11-27	-70.42027	-20.10010	500	1405	161614	0.76	0.020
T3_22	2015-11-27	-70.42027	-20.10010	750	453	138526	0.58	na
T3_21	2015-11-27	-70.42027	-20.10010	1000	562	224766	0.65	na
T4_63	2015-11-28	-70.59990	-20.09992	2	1086	47262	na	na
T4_61	2015-11-28	-70.59990	-20.09992	10	4496	49707	1.34	0.010
T4_59	2015-11-28	-70.59990	-20.09992	50	11843	134452	0.45	0.008
T4_57	2015-11-28	-70.59990	-20.09992	100	na	na	0.18	0.004
T4_53	2015-11-28	-70.59990	-20.09992	200	4104	607072	0.78	0.012
T4_51	2015-11-28	-70.59990	-20.09992	300	2278	248533	0.37	0.011
T4_49	2015-11-28	-70.59990	-20.09992	400	2897	334999	0.31	0.007
T4_47	2015-11-28	-70.59990	-20.09992	500	1750	96878	0.67	0.017

T4_43	2015-11-28	-70.59990	-20.09992	750	1026	252154	0.44	0.019
T4_42	2015-11-28	-70.59990	-20.09992	1000	60	77140	0.40	0.015
T5_77	2015-11-28	-70.89187	-20.09927	100	4618	578552	0.62	0.015
T5_75	2015-11-28	-70.89187	-20.09927	200	2023	151157	0.63	0.016
T5_73	2015-11-28	-70.89187	-20.09927	300	8638	660853	0.62	0.015
T5_71	2015-11-28	-70.89187	-20.09927	400	1956	319018	0.51	0.013
T5_69	2015-11-28	-70.89187	-20.09927	500	4400	554106	0.44	0.014
T6_98	2015-11-28	-71.14552	-20.09932	100	5867	397245	0.35	0.008
T6_96	2015-11-28	-71.14552	-20.09932	200	10430	640074	0.59	0.013
T6_94	2015-11-28	-71.14552	-20.09932	300	3934	714633	0.45	0.011
T6_91	2015-11-28	-71.14552	-20.09932	500	2248	435543	0.37	0.012
L1_160	2015-12-05	-70.49990	-21.49958	5	30984	3210542	1.31	0.030
L1_159	2015-12-05	-70.49990	-21.49958	25	89463	5622314	2.18	0.009
L1_158	2015-12-05	-70.49990	-21.49958	50	9747	664783	0.58	0.012
L1_157	2015-12-05	-70.49990	-21.49958	100	1416	500906	0.62	0.015
L1_156	2015-12-05	-70.49990	-21.49958	200	1046	625360	1.03	0.019
L1_155	2015-12-05	-70.49990	-21.49958	300	4863	1496535	1.10	0.030
L1_154	2015-12-05	-70.49990	-21.49958	380	1908	951568	0.51	0.002
L2_167	2015-12-06	-70.77552	-22.99972	5	83513	4524648	1.98	0.011
L2_166	2015-12-06	-70.77552	-22.99972	25	91597	2476704	1.33	0.014
L2_165	2015-12-06	-70.77552	-22.99972	50	21853	1419750	1.19	0.015
L2_164	2015-12-06	-70.77552	-22.99972	100	1600	238858	0.38	0.007
L2_163	2015-12-06	-70.77552	-22.99972	200	4247	345533	0.43	0.014
L2_162	2015-12-06	-70.77552	-22.99972	300	8926	1307149	0.83	0.014
L2_161	2015-12-06	-70.77552	-22.99972	350	4986	1536731	0.68	0.016
L3_174	2015-12-07	-70.76965	-24.50902	5	141335	6287612	2.46	0.022
L3_173	2015-12-07	-70.76965	-24.50902	25	24623	734354	1.22	0.009
L3_172	2015-12-07	-70.76965	-24.50902	50	7284	520489	0.38	0.007
L3_171	2015-12-07	-70.76965	-24.50902	100	2278	613765	0.47	0.009
L3_170	2015-12-07	-70.76965	-24.50902	200	4801	1107714	0.98	0.028
L3_169	2015-12-07	-70.76965	-24.50902	300	1662	703433	0.66	0.014
L3_168	2015-12-07	-70.76965	-24.50902	350	1600	348625	0.21	0.008
L4_181	2015-12-07	-70.85445	-26.01713	5	5130	363312	0.31	0.002
L4_180	2015-12-07	-70.85445	-26.01713	25	5171	272097	0.36	0.002
L4_179	2015-12-07	-70.85445	-26.01713	50	4104	295030	2.44	0.042

L4_178	2015-12-07	-70.85445	-26.01713	100	2031	569704	2.72	0.048
L4_177	2015-12-07	-70.85445	-26.01713	200	3263	949249	0.95	0.020
L4_176	2015-12-07	-70.85445	-26.01713	300	1477	1263861	1.23	0.054
L4_175	2015-12-07	-70.85445	-26.01713	350	2339	1947196	0.54	0.014
L5_188	2015-12-08	-71.13293	-27.50957	5	37057	1408413	0.88	0.006
L5_187	2015-12-08	-71.13293	-27.50957	25	19452	1188880	0.99	0.012
L5_186	2015-12-08	-71.13293	-27.50957	50	7633	514820	0.58	0.009
L5_185	2015-12-08	-71.13293	-27.50957	100	1046	331619	0.42	0.005
L5_184	2015-12-08	-71.13293	-27.50957	200	1170	319251	0.38	0.015
L5_183	2015-12-08	-71.13293	-27.50957	300	1539	955433	1.15	0.041
L5_182	2015-12-08	-71.13293	-27.50957	350	369	1240671	0.97	0.018
L6_200	2015-12-09	-71.62032	-29.51215	5	33549	877359	1.19	0.011
L6_199	2015-12-09	-71.62032	-29.51215	10	18672	1597541	0.81	0.007
L6_197	2015-12-09	-71.62032	-29.51215	50	3693	98944	0.45	0.010
L6_196	2015-12-09	-71.62032	-29.51215	100	2401	500133	0.47	0.012
L6_194	2015-12-09	-71.62032	-29.51215	200	1231	548060	0.64	0.018
L6_192	2015-12-09	-71.62032	-29.51215	300	1108	405827	0.41	0.010
L6_191	2015-12-09	-71.62032	-29.51215	400	554	225717	0.68	0.028
L6_190	2015-12-09	-71.62032	-29.51215	500	1231	401962	0.77	na

5   **Table S2. Coccospheres and detached coccolith standing stocks and associated PIC measurements in waters off the Southeast Pacific margin during the mid-summer 2018 (LowpHOX 2 cruise). 'na' indicates not available data.**

Station	Date	Longitude (° W)	Latitude (° S)	Depth (m)	Spheres (per L^{-1})	Liths (per L^{-1})	PIC (mmol L^{-1})	PIC:POC
Lander2_001	2018-01-29	-71.31996	-23.38402	2	36565	2252533	1.13	na
Lander2_002	2018-01-29	-71.31996	-23.38402	10	53796	2487055	1.06	na
Lander2_003	2018-01-29	-71.31996	-23.38402	25	73356	4554280	1.49	na
Lander2_004	2018-01-29	-71.31996	-23.38402	50	18303	890500	0.46	na
Lander2_005	2018-01-29	-71.31996	-23.38402	100	3940	678182	0.37	na
Lander2_006	2018-01-29	-71.31996	-23.38402	250	na	na	0.35	na
Lander2_007	2018-01-29	-71.31996	-23.38402	500	na	na	0.28	na
Lander2_008	2018-01-29	-71.31996	-23.38402	750	na	na	0.48	na
Lander2_009	2018-01-29	-71.31996	-23.38402	1000	na	na	0.47	na
Lander2_010	2018-01-29	-71.31996	-23.38402	2000	na	na	0.38	na
Lander2_011	2018-01-29	-71.31996	-23.38402	3000	na	na	0.45	na
Lander2_012	2018-01-29	-71.31996	-23.38402	4000	na	na	0.17	na

Lander2_013	2018-01-29	-71.31996	-23.38402	5000	na	na	0.11	na
T05_001	2018-02-03	-70.89187	-20.09927	2	4925	30920	0.08	0.002
T05_002	2018-02-03	-70.89187	-20.09927	10	1231	15460	0.08	0.001
T05_003	2018-02-03	-70.89187	-20.09927	25	303354	4900844	3.05	0.009
T05_004	2018-02-03	-70.89187	-20.09927	30	516835	3503253	2.23	0.014
T05_005	2018-02-03	-70.89187	-20.09927	50	1231	143779	0.17	0.002
T05_006	2018-02-03	-70.89187	-20.09927	100	2783	1162589	0.36	0.007
T05_007	2018-02-03	-70.89187	-20.09927	250	2937	750720	0.47	0.011
T05_008	2018-02-03	-70.89187	-20.09927	500	2046	400893	0.18	0.006
T05_009	2018-02-03	-70.89187	-20.09927	750	na	na	0.30	0.010
T05_010	2018-02-03	-70.89187	-20.09927	1000	na	na	0.20	0.007
T05_011	2018-02-03	-70.89187	-20.09927	2000	616	219533	0.25	0.008
T05_012	2018-02-03	-70.89187	-20.09927	2800	na	na	0.18	0.007
T03_019	2018-02-05	-70.42027	-20.10010	2	30779	1546007	3.44	0.008
T03_020	2018-02-05	-70.42027	-20.10010	10	42064	2016251	5.32	0.011
T03_021	2018-02-05	-70.42027	-20.10010	25	45963	783310	1.76	0.008
T03_022	2018-02-05	-70.42027	-20.10010	50	410	126257	0.23	0.005
T03_023	2018-02-05	-70.42027	-20.10010	100	1133	552484	0.53	0.016
T03_024	2018-02-05	-70.42027	-20.10010	250	na	na	0.39	0.011
T03_025	2018-02-05	-70.42027	-20.10010	500	na	na	0.18	0.005
T03_026	2018-02-05	-70.42027	-20.10010	750	na	na	0.23	0.007
T03_027	2018-02-05	-70.42027	-20.10010	1000	na	na	0.28	0.011
T01_034	2018-02-06	-70.20983	-20.09859	2	16005	783310	2.30	0.006
T01_035	2018-02-06	-70.20983	-20.09859	10	6521	376676	1.83	0.006
T01_036	2018-02-06	-70.20983	-20.09859	25	1253	359948	0.75	0.006
T01_037	2018-02-06	-70.20983	-20.09859	50	1094	434600	0.57	0.006
T01_038	2018-02-06	-70.20983	-20.09859	100	528	318036	0.60	0.005
Hyd002_001	2018-02-07	-71.33462	-21.33567	2	118255	3722623	1.67	na
Hyd2_Tes_5	2018-02-07	-71.33462	-21.33567	5	75839	4545262	0.00	na
Hyd2_Tes_10	2018-02-07	-71.33462	-21.33567	10	102276	3140140	1.59	na
Hyd2_Tes_30	2018-02-07	-71.33462	-21.33567	30	164973	3975448	2.02	na
Hyd002_010	2018-02-07	-71.33462	-21.33567	50	6156	239631	0.72	na
Hyd002_015	2018-02-07	-71.33462	-21.33567	100	2257	340122	0.34	na
Hyd3_001	2018-02-08	-71.47207	-25.00338	2	31086	977850	1.37	na
Hyd3_002	2018-02-08	-71.47207	-25.00338	10	36934	1047420	1.70	na

Hyd3_004	2018-02-08	-71.47207	-25.00338	25	216189	3596013	2.87	na
Hyd3_010	2018-02-08	-71.47207	-25.00338	50	19874	706746	0.75	na
Hyd3_015	2018-02-08	-71.47207	-25.00338	100	4573	1106500	0.71	na
Hyd3_016	2018-02-08	-71.47207	-25.00338	250	na	na	0.60	na
Hyd3_017	2018-02-08	-71.47207	-25.00338	500	na	na	0.00	na
Hyd3_018	2018-02-08	-71.47207	-25.00338	750	na	na	0.49	na
Hyd3_019	2018-02-08	-71.47207	-25.00338	1000	na	na	0.45	na
Hyd4_074	2018-02-08	-71.57857	-26.48587	2	3693	81165	0.21	na
Hyd4_073	2018-02-08	-71.57857	-26.48587	10	3693	123681	0.39	na
Hyd4_070	2018-02-08	-71.57857	-26.48587	25	9110	374134	0.93	na
Hyd4_065	2018-02-08	-71.57857	-26.48587	50	179009	2059282	1.93	na
Hyd4_060	2018-02-08	-71.57857	-26.48587	100	2052	167484	0.64	na
Hyd4_059	2018-02-08	-71.57857	-26.48587	250	na	na	0.53	na
Hyd4_058	2018-02-08	-71.57857	-26.48587	500	na	na	0.68	na
Hyd4_057	2018-02-08	-71.57857	-26.48587	750	na	na	0.50	na
Hyd4_056	2018-02-08	-71.57857	-26.48587	1000	na	na	0.47	na
Lander1_097	2018-02-09	-72.08040	-28.25007	5	85359	3983546	2.67	na
Lander1_095	2018-02-09	-72.08040	-28.25007	15	97260	3262076	2.27	na
Lander1_093	2018-02-09	-72.08040	-28.25007	25	87411	2947721	2.22	na
Lander1_089	2018-02-09	-72.08040	-28.25007	45	73048	2081957	1.83	na
Lander1_083	2018-02-09	-72.08040	-28.25007	100	6771	251226	0.51	na
Lander1_082	2018-02-09	-72.08040	-28.25007	250	na	na	0.53	na
Lander1_081	2018-02-09	-72.08040	-28.25007	500	na	na	0.78	na
Lander1_080	2018-02-09	-72.08040	-28.25007	750	na	na	0.59	na
Lander1_079	2018-02-09	-72.08040	-28.25007	1000	na	na	0.69	na
Hyd6_130	2018-02-12	-72.69940	-32.50307	5	128860	3329069	2.76	na
Hyd6_129	2018-02-12	-72.69940	-32.50307	10	135118	2670728	5.86	na
Hyd6_126	2018-02-12	-72.69940	-32.50307	25	56633	1430057	2.11	na
Hyd6_121	2018-02-12	-72.69940	-32.50307	50	42167	896684	0.90	na
Hyd6_116	2018-02-12	-72.69940	-32.50307	100	7695	796194	1.09	na
Hyd6_115	2018-02-12	-72.69940	-32.50307	250	na	na	1.26	na
Hyd6_114	2018-02-12	-72.69940	-32.50307	500	na	na	0.94	na
Hyd6_113	2018-02-12	-72.69940	-32.50307	750	na	na	0.90	na
Hyd6_112	2018-02-12	-72.69940	-32.50307	1000	na	na	0.85	na
Hyd7_152	2018-02-13	-73.12212	-33.95928	5	7797	185521	2.09	na

Hyd7_151	2018-02-13	-73.12212	-33.95928	10	8823	185521	3.18	na
Hyd7_148	2018-02-13	-73.12212	-33.95928	25	14422	214232	1.59	na
Hyd7_143	2018-02-13	-73.12212	-33.95928	50	41243	1370793	1.47	na
Hyd7_138	2018-02-13	-73.12212	-33.95928	100	3693	1287603	1.12	na
Hyd7_137	2018-02-13	-73.12212	-33.95928	250	na	na	1.58	na
Hyd7_136	2018-02-13	-73.12212	-33.95928	500	na	na	0.69	na
Hyd7_135	2018-02-13	-73.12212	-33.95928	750	na	na	0.86	na
Hyd7_134	2018-02-13	-73.12212	-33.95928	1000	na	na	0.80	na

Table S3. Coccolith length measurements used to estimate specific PIC_{Cocco} quotas.

Species or genus	Length (μm)	Volume (μm³)	Mass (pg)	Coccoliths measured
Gephyrocapsa parvula	2.0 ± 0.1	0.4	1.0	6
Gephyrocapsa huxleyi	3.6 ± 0.3	0.9	2.5	20
Gephyrocapsa oceanica	5.2 ± 0.6	6.9	18.7	20
Helicosphaera spp.	9.0 ± 1.1	36.9	99.7	20
Oolithotus spp.	4.5 ± 0.4	6.2	16.8	20
C. leptoporus large-type	8.1 ± 0.9	41.9	113.0	20
C. leptoporus small-type	3.9 ± 0.4	4.7	12.6	11
Syracosphaera spp.	3.7 ± 0.2	0.8	2.0	2
Acanthoica spp.	4.0 ± 0.3	1.9	5.2	5
Discosphaera tubifera	1.6 ± 0.1	0.3	0.8	2
Umbellosphaera spp.	5.7 ± 0.6	2.7	7.4	7
Umbilicosphaera spp.	4.7 ± 0.6	5.1	13.9	7

10   **Supplementary Section S2. Figures**

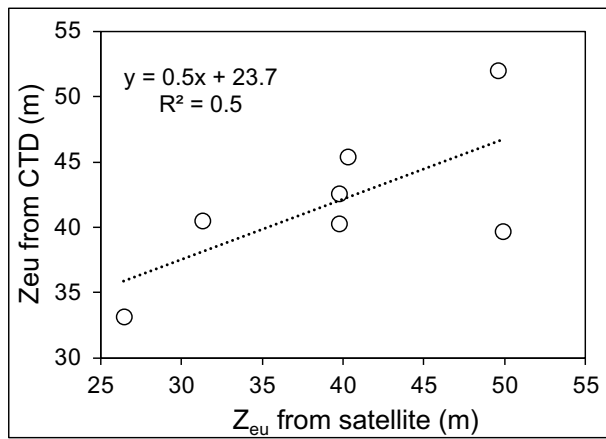



Figure S1. Comparison between euphotic depth derived from satellite observations and from PAR obtained with a sensor attached to the CTD.

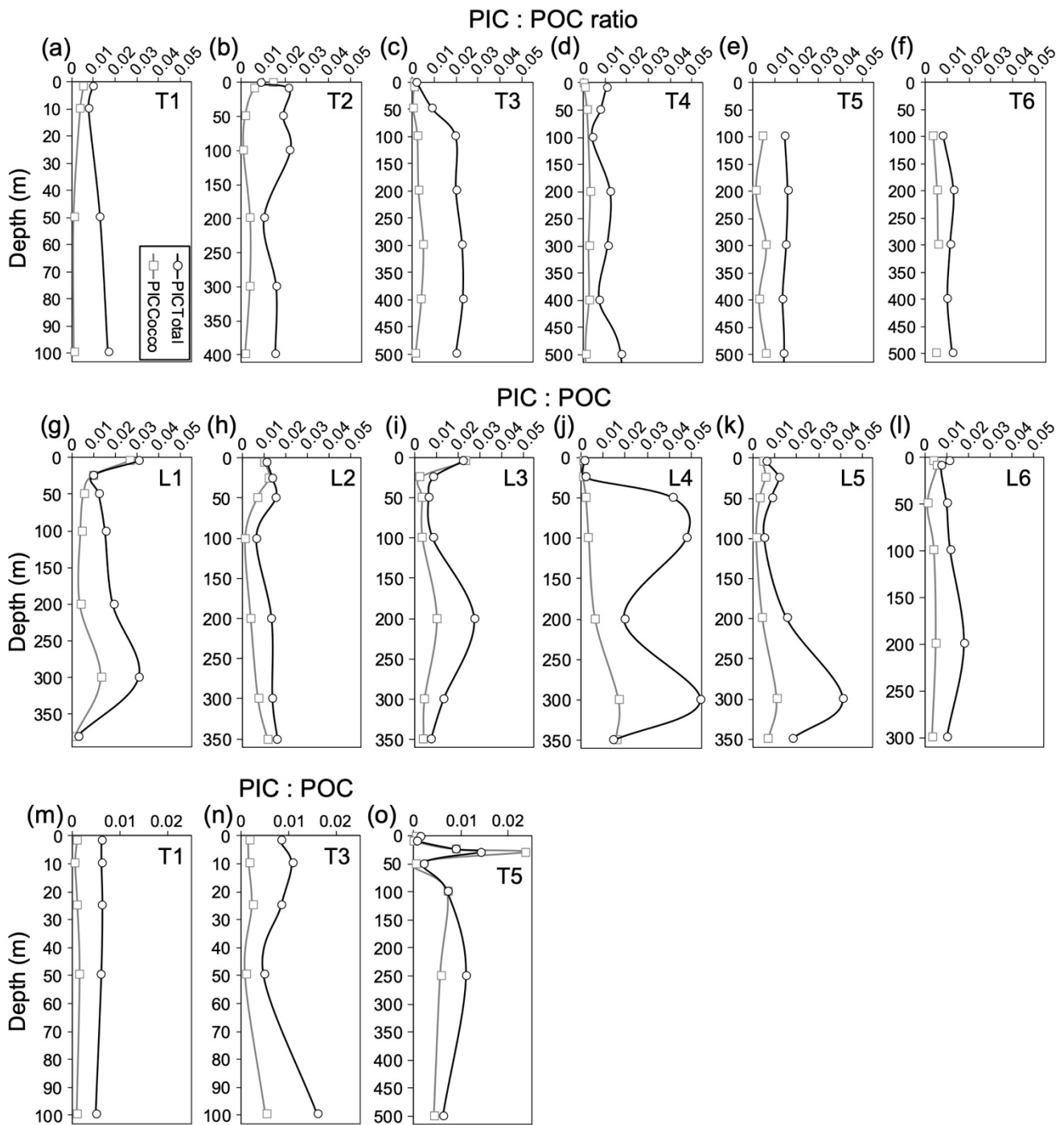
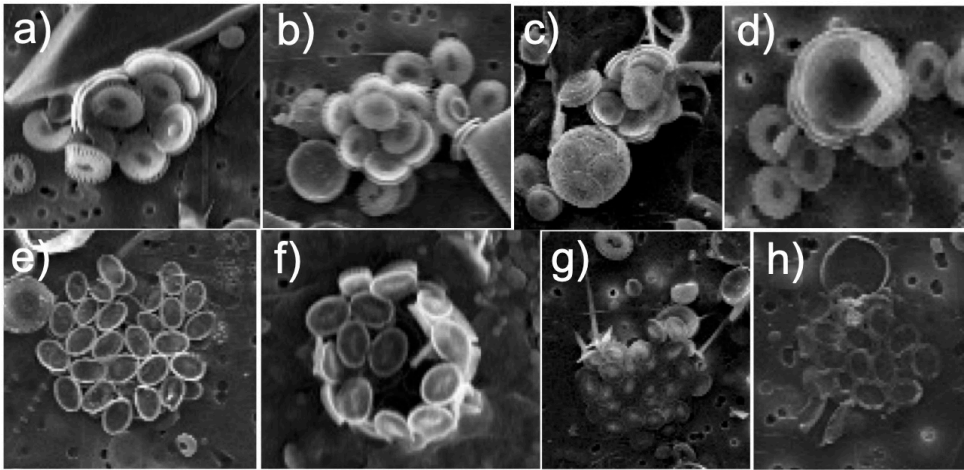



Figure S2. Profiles of PIC:POC ratios built with PIC_{Total} and PIC_{Cocco} data across the inshore-offshore (profiles a-f) and latitudinal legs (profiles g-l) sampled during late-spring 2015, as well across the inshore-offshore leg (profiles m-o) sampled during mid-summer 2018.

20   **Figure S3. Zoom of scanning electron microscopy images showing layers of coccoliths detached from *G. huxleyi* (a-c), as well as, collapsed coccospheres with distinct brightness (d-h).**

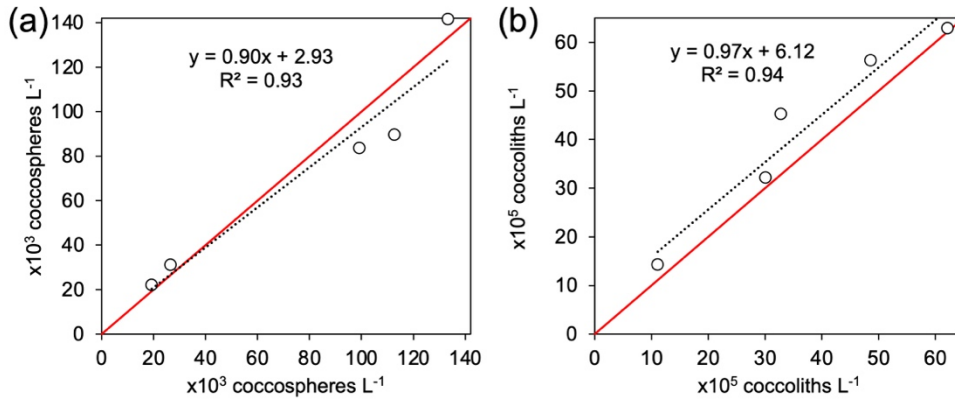



Figure S4. Linear relationship for coccospheres (a) and detached coccoliths counts (b) obtained through cross-polarized light
25   microscopy and SEM examination methods. The red line indicates 1:1 ratio, whereas the dotted curve depicts the empirical trend.

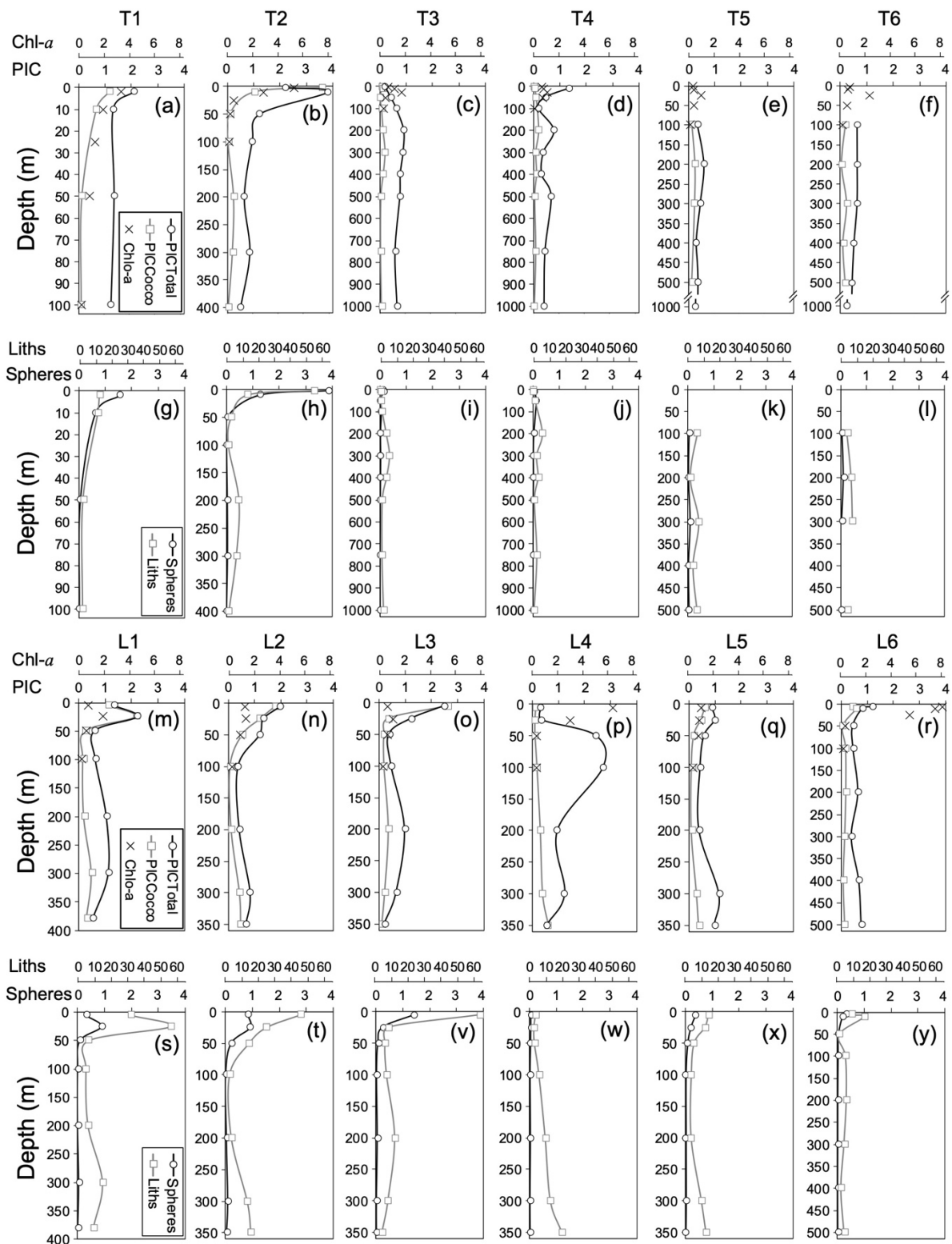
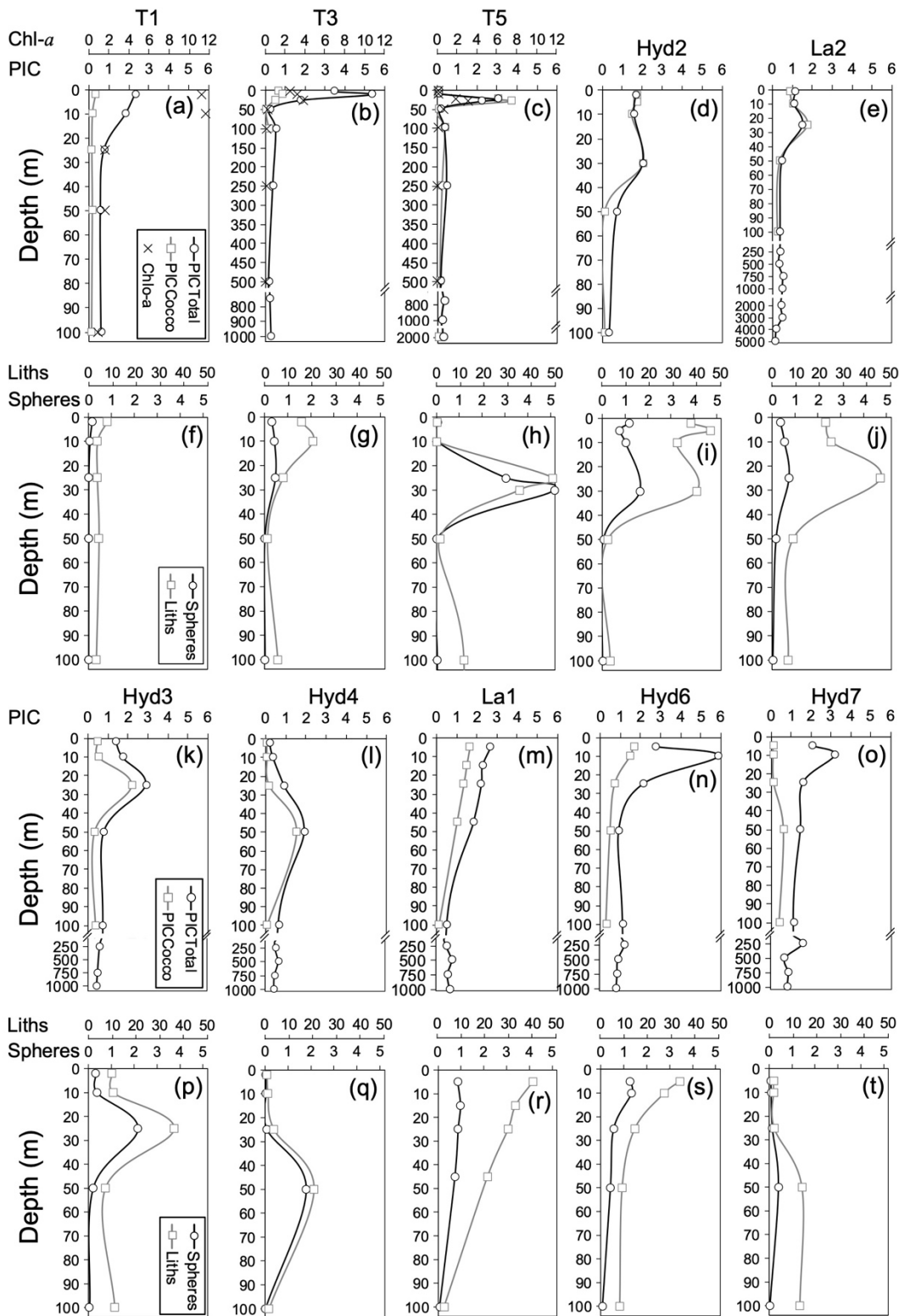
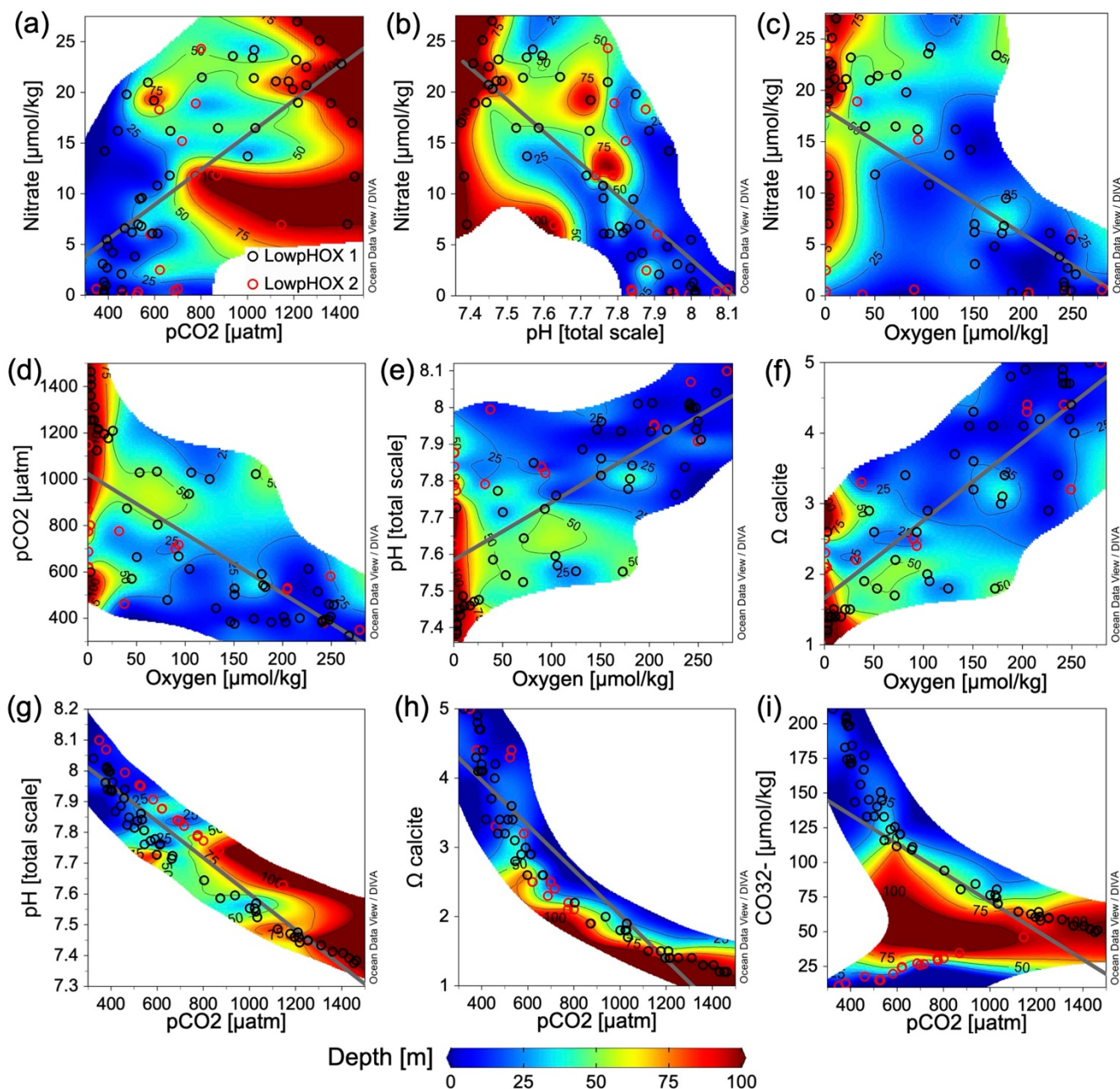



Figure S5. PIC$_{Total}$, PIC$_{Cocco}$, Chl-a, coccospheres, and detached-coccolith profiles across the inshore-offshore (profiles a-l) and latitudinal legs (profiles m-y) sampled during the late-spring 2015. Note each variables axes span the same range.

30   **Figure S6. PIC$_{Total}$, PIC$_{Cocco}$, Chl-a, coccospheres, and detached-coccolith profiles across the inshore-offshore (profiles a-c and f-h) and latitudinal legs (profiles d-e and i-t) sampled during the mid-summer 2018. Note each variables axes span the same range.**

    Figure S7. Variation in nitrate vs pCO$_2$ (a), pH (b) and oxygen (c), along with variation in oxygen vs pCO$_2$ (d), pH (e), and Ω calcite
35   **(f), plus pCO$_2$ vs pH (g), Ω calcite (h), and carbonate ion (i) recorded within 100-m depth during late-spring 2015 (open black dots) and mid-summer 2018 (open red dots). Gray line depicts the least-square model fit curve.**

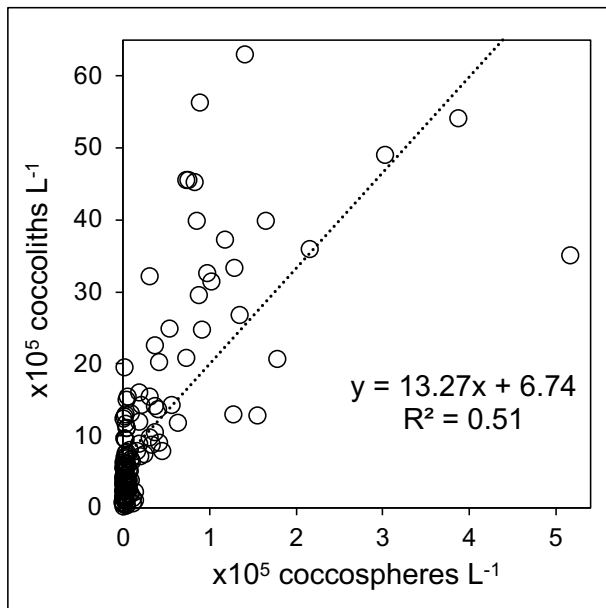



Figure S8. Linear relationship between coccospheres vs detached coccoliths recorded during late-spring 2015 and mid-summer 2018.

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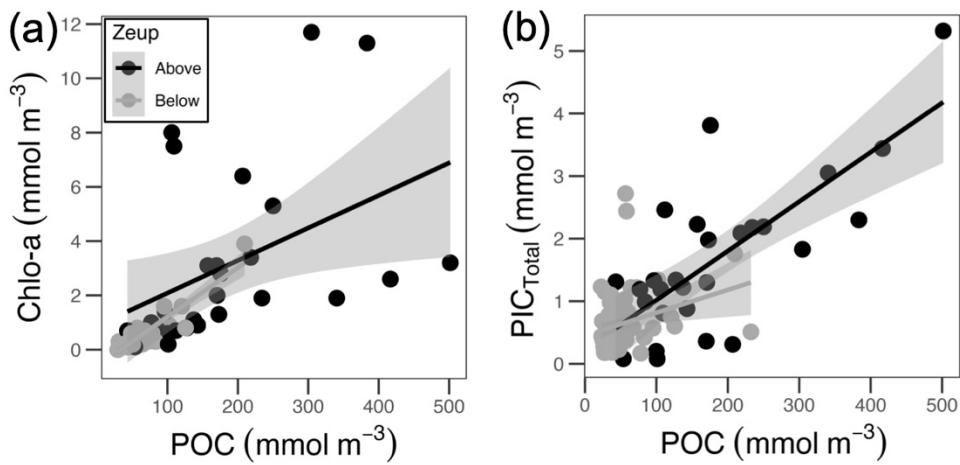
Figure S9. Chl-*a* versus POC and PIC_Total versus POC data variation.

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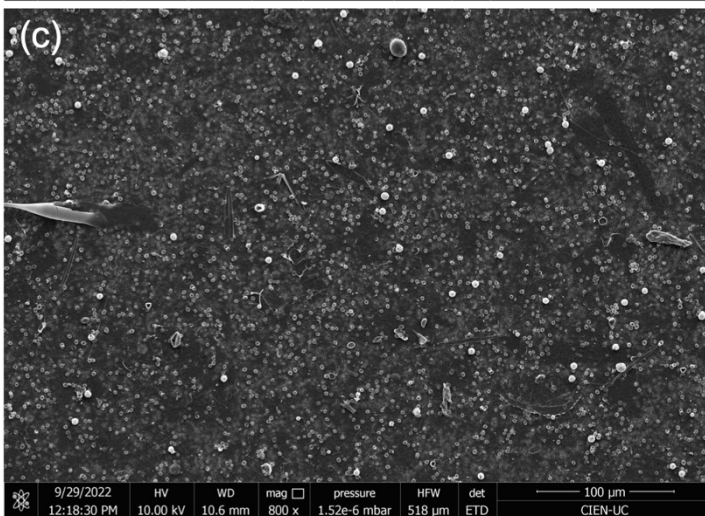
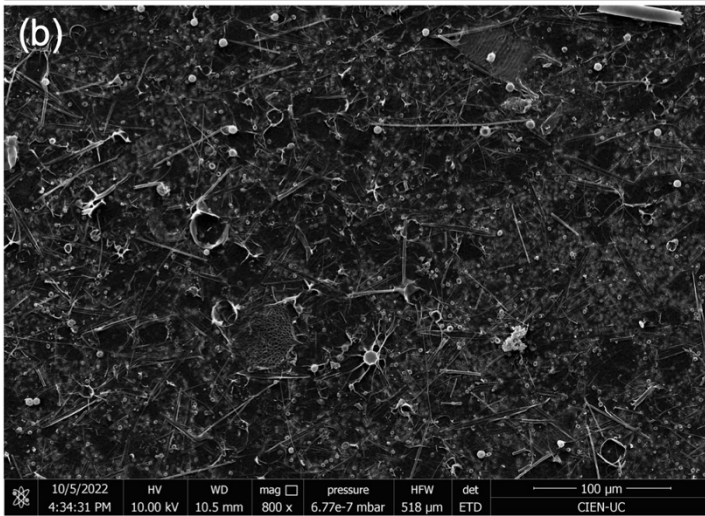
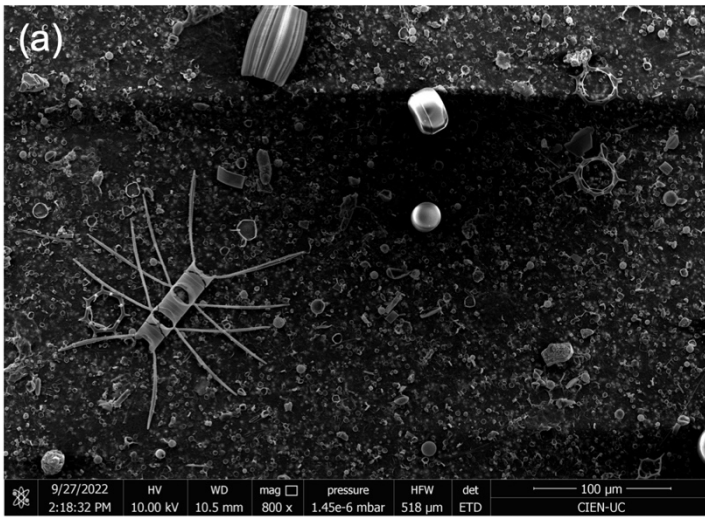
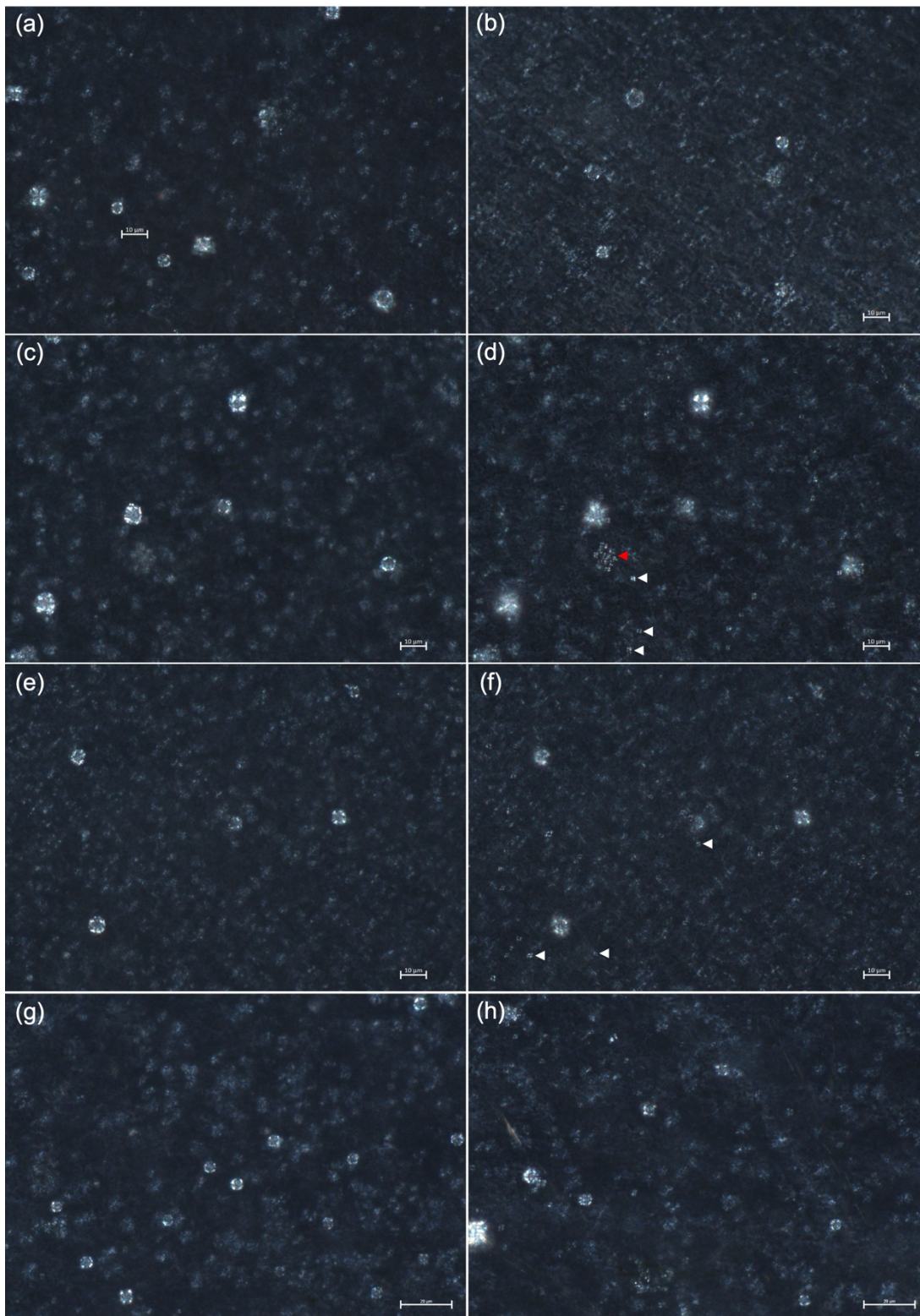


Figure S10. Scanning electron microscopy showing diverse coccolithophore and diatom assemblages in 2015 station T1 at 2 m depth (a) as well the dominance of coccospheres and detached-coccoliths of *G. huxleyi* during post-bloom of diatoms in 2015 station L2 at 5 m depth (b) and under low biomass conditions in 2015 station L3 at 5 m depth (c). Each 800x frame corresponds to 0.2 mm².

50 **Figure S11. Cross-polarized light microscopy showing coccospheres and detached coccoliths of *G. huxleyi* dominating during mid-summer 2018. Images corresponding to: (a) Station Hyd3 at 25 m depth, (b) Station Hyd4 at 50 m depth, (c and d) Station Hyd6 at 10 m depth different focus, (e and f) Station Lander1 (La1) at 15 m depth with distinct focus, (g) Station T5 at 30 m depth, and (h) Station T5 at 30 m depth. Note the white arrows in (d) and (f) indicate some detached coccoliths, and red arrow in (d) a layer of coccoliths included in detached-coccoliths counts. All images taken at 630x magnification.**

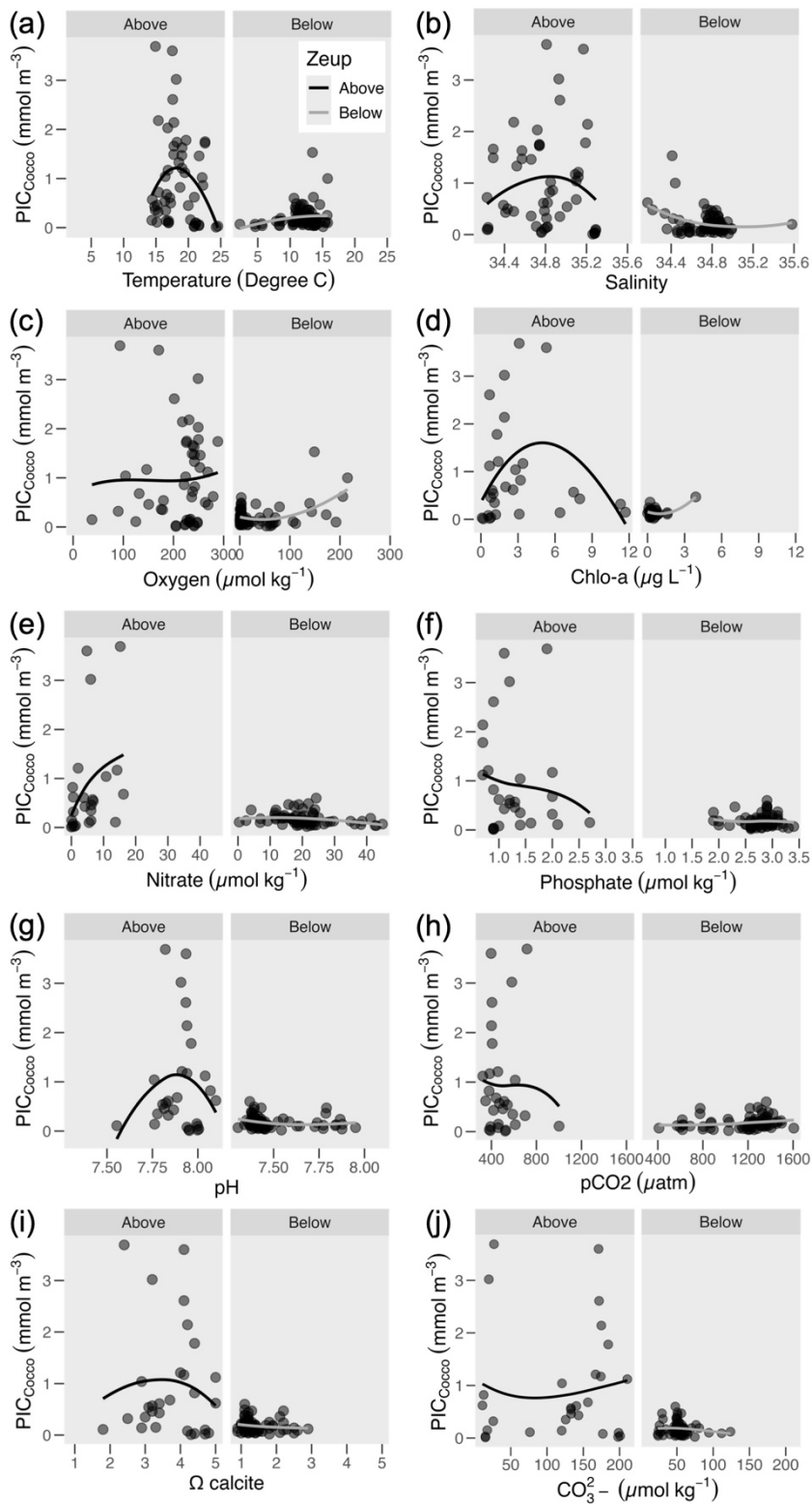



Figure S12. Above and below euphotic depth variation in PIC$_{Cocco}$ across environmental conditions during late-spring 2015 and mid-summer 2018. Temperature (a), Salinity (b), oxygen (c), Chl-*a* (d), nitrate (e), phosphate (f), pH (g), *p*CO₂ (h), Ω calcite (i), and carbonate ion (j) are shown.

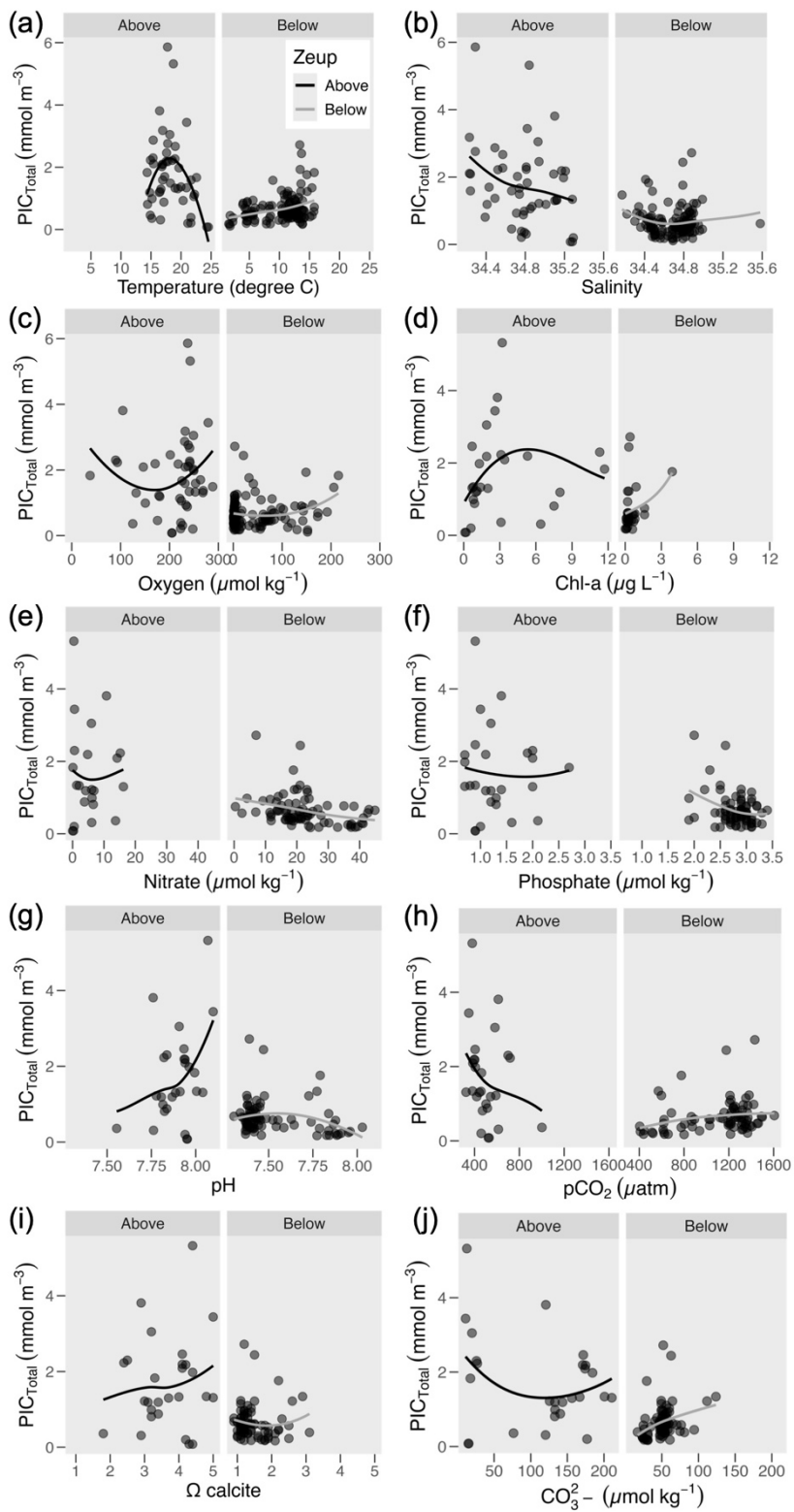



Figure S13. Above and below euphotic depth variation in PIC_{Total} across environmental conditions during late-spring 2015 and mid-summer 2018. Temperature (a), Salinity (b), oxygen (c), Chl-*a* (d), nitrate (e), phosphate (f), pH (g), pCO_2 (h), Ω calcite (i), and carbonate ion (j) are shown.

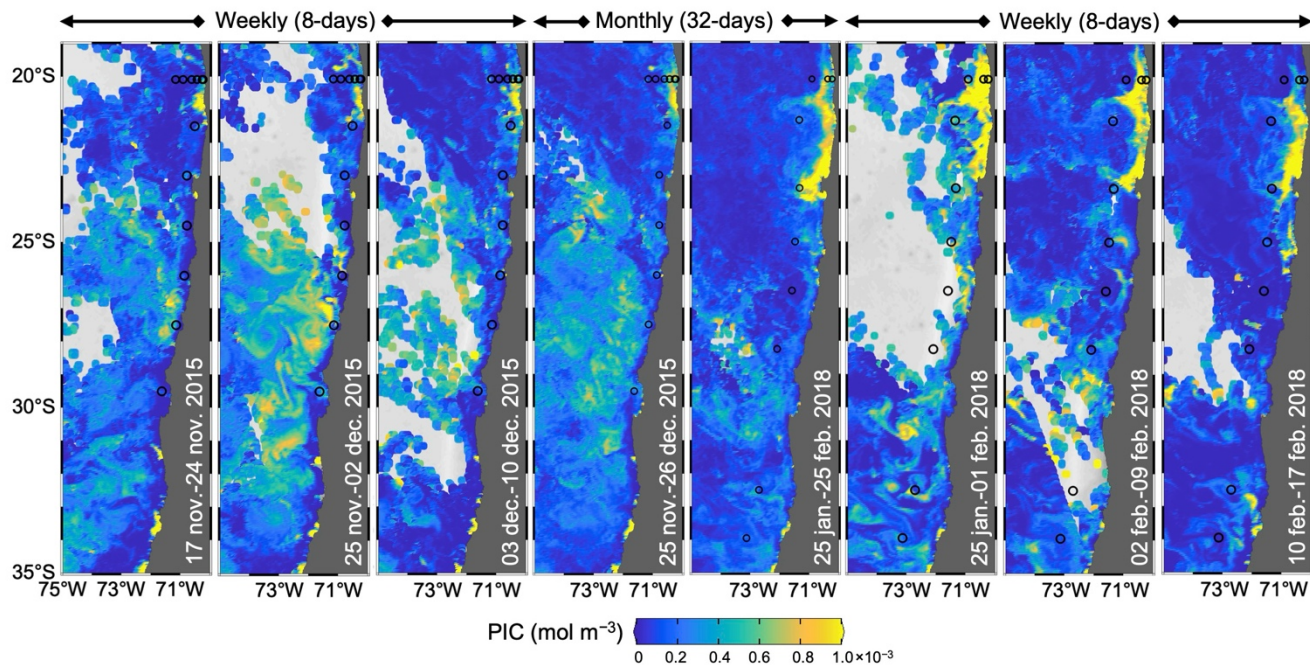



Figure S14. Weekly and monthly satellite-PIC climatologies during the LowpHOX 1 (27-28 nov./05-09 dec. 2015; open circles) and LowpHOX 2 sampling (30 ene./03-09 feb./12-13 feb. 2018; open circles).