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Supplement of

A three-dimensional niche comparison of *Emiliana huxleyi* and *Gephyrocapsa oceanica*: reconciling observations with projections

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1 Supplementary tables and figures

Table S1. Carbonate chemistry speciation, temperature, light conditions and measured physiological parameters for *E. huxleyi* experiments on carbonate chemistry speciation and light interaction.

| μ (d ⁻¹) | POC Rate ($\frac{\text{pg C}}{\text{cell d}}$) | PIC Rate ($\frac{\text{pg C}}{\text{cell d}}$) | POC Quota (pg C cell ⁻¹) | PIC Quota (pg C cell ⁻¹) | $f\text{CO}_2$ (μatm) | [CO ₂] ($\mu\text{mol kg}^{-1}$) | [HCO ₃ ⁻] ($\mu\text{mol kg}^{-1}$) | [CO ₃ ²⁻] ($\mu\text{mol kg}^{-1}$) | pH _T | [H ⁺] ($\frac{\text{mol}}{\text{kg}}$) | TA ($\mu\text{mol kg}^{-1}$) | DIC ($\mu\text{mol kg}^{-1}$) | Light ($\frac{\mu\text{mol}}{\text{m}^2 \text{s}}$) | Temp. (°C) |
|-----------------------------|--|--|--|--|---------------------------------------|---|---|---|-----------------|---|-----------------------------------|------------------------------------|--|---------------|
| 0.65 | 5.45 | 5.03 | 8.45 | 7.80 | 52 | 1.68 | 1102.8 | 507.1 | 8.709 | 1.95E-09 | 2362.53 | 1611.52 | 50 | 20 |
| 0.92 | 8.52 | 7.17 | 9.30 | 7.83 | 111 | 3.60 | 1417.5 | 390.8 | 8.487 | 3.26E-09 | 2383.83 | 1811.94 | 50 | 20 |
| 0.96 | 8.24 | 6.73 | 8.55 | 6.99 | 202 | 6.55 | 1661.1 | 294.5 | 8.295 | 5.07E-09 | 2388.56 | 1962.17 | 50 | 20 |
| 0.95 | 8.42 | 6.94 | 8.84 | 7.28 | 339 | 10.97 | 1882.6 | 225.9 | 8.126 | 7.49E-09 | 2438.75 | 2119.51 | 50 | 20 |
| 0.91 | 9.69 | 7.07 | 10.66 | 7.77 | 663 | 21.48 | 2066.8 | 139.1 | 7.875 | 1.33E-08 | 2411.09 | 2227.35 | 50 | 20 |
| 0.95 | 7.58 | 6.00 | 8.01 | 6.34 | 738 | 23.92 | 2102 | 129.2 | 7.835 | 1.46E-08 | 2421.75 | 2255.07 | 50 | 20 |
| 0.92 | 8.69 | 4.98 | 9.50 | 5.44 | 1292 | 41.88 | 2169.2 | 78.6 | 7.606 | 2.48E-08 | 2365.91 | 2289.62 | 50 | 20 |
| 0.89 | 8.32 | 4.97 | 9.37 | 5.59 | 1730 | 56.07 | 2213.6 | 61.1 | 7.488 | 3.25E-08 | 2367.40 | 2330.77 | 50 | 20 |
| 0.92 | 7.61 | 4.98 | 8.31 | 5.44 | 1755 | 56.86 | 2288.9 | 64.5 | 7.496 | 3.19E-08 | 2449.87 | 2410.19 | 50 | 20 |
| 0.86 | 7.01 | 3.81 | 8.12 | 4.41 | 2906 | 94.19 | 2314.4 | 39.8 | 7.282 | 5.23E-08 | 2415.35 | 2448.34 | 50 | 20 |
| 0.82 | 6.92 | 3.08 | 8.45 | 3.76 | 4044 | 131.06 | 2366.4 | 29.9 | 7.148 | 7.11E-08 | 2442.96 | 2527.35 | 50 | 20 |
| 0.20 | 1.43 | 1.04 | 7.23 | 5.25 | 31 | 1.01 | 891.3 | 549.8 | 8.837 | 1.46E-09 | 2273.35 | 1442.07 | 400 | 20 |
| 1.38 | 10.39 | 9.25 | 7.53 | 6.70 | 120 | 3.88 | 1400.7 | 353.5 | 8.449 | 3.56E-09 | 2282.44 | 1758.03 | 400 | 20 |
| 1.48 | 14.68 | 8.10 | 9.92 | 5.47 | 234 | 7.59 | 1657.7 | 253.4 | 8.231 | 5.88E-09 | 2289.17 | 1918.66 | 400 | 20 |
| 1.66 | 15.82 | 10.88 | 9.53 | 6.55 | 372 | 12.06 | 1842.2 | 196.9 | 8.075 | 8.41E-09 | 2331.44 | 2051.15 | 400 | 20 |
| 1.65 | 17.93 | 11.78 | 10.86 | 7.14 | 697 | 22.60 | 2007 | 124.7 | 7.840 | 1.45E-08 | 2318.37 | 2154.31 | 400 | 20 |
| 1.59 | 14.32 | 7.62 | 9.01 | 4.79 | 1001 | 32.44 | 2080.8 | 93.4 | 7.699 | 2.00E-08 | 2314.91 | 2206.65 | 400 | 20 |
| 1.51 | 17.31 | 10.07 | 11.46 | 6.67 | 1280 | 41.48 | 2161.4 | 78.8 | 7.608 | 2.46E-08 | 2358.80 | 2281.69 | 400 | 20 |
| 1.32 | 13.76 | 6.59 | 10.43 | 4.99 | 1359 | 44.03 | 2179.2 | 75.5 | 7.586 | 2.59E-08 | 2368.27 | 2298.73 | 400 | 20 |
| 1.28 | 15.01 | 6.51 | 11.73 | 5.09 | 2203 | 71.40 | 2233.9 | 48.9 | 7.387 | 4.10E-08 | 2357.77 | 2354.22 | 400 | 20 |
| 1.09 | 11.94 | 4.93 | 10.96 | 4.52 | 3206 | 103.88 | 2276.1 | 34.9 | 7.232 | 5.86E-08 | 2365.38 | 2414.85 | 400 | 20 |
| 0.73 | 7.87 | 2.61 | 10.78 | 3.58 | 4004 | 129.77 | 2236.8 | 27.0 | 7.128 | 7.45E-08 | 2306.96 | 2393.57 | 400 | 20 |
| 0.20 | 2.52 | 1.80 | 12.91 | 9.23 | 32 | 1.04 | 912.6 | 561.2 | 8.835 | 1.46E-09 | 2317.05 | 1474.81 | 600 | 20 |
| 0.77 | 7.56 | 8.38 | 9.80 | 10.88 | 54 | 1.74 | 1104.1 | 489.4 | 8.693 | 2.03E-09 | 2323.81 | 1595.15 | 600 | 20 |
| 1.17 | 14.85 | 9.90 | 12.65 | 8.43 | 116 | 3.77 | 1427.2 | 378.4 | 8.470 | 3.39E-09 | 2364.32 | 1809.37 | 600 | 20 |
| 1.35 | 23.50 | 11.85 | 17.39 | 8.77 | 258 | 8.36 | 1682.9 | 236.9 | 8.195 | 6.38E-09 | 2274.10 | 1928.12 | 600 | 20 |
| 1.48 | 21.15 | 16.11 | 14.28 | 10.87 | 405 | 13.11 | 1872 | 187.0 | 8.046 | 8.99E-09 | 2336.53 | 2072.08 | 600 | 20 |
| 1.53 | 24.07 | 17.16 | 15.77 | 11.25 | 779 | 25.25 | 2034.7 | 114.7 | 7.798 | 1.59E-08 | 2321.29 | 2174.65 | 600 | 20 |
| 1.48 | 17.12 | 10.69 | 11.60 | 7.25 | 1148 | 37.19 | 2099.3 | 82.9 | 7.643 | 2.28E-08 | 2307.58 | 2219.35 | 600 | 20 |
| 1.51 | 17.98 | 12.86 | 11.95 | 8.55 | 1070 | 34.68 | 2161.8 | 94.3 | 7.686 | 2.06E-08 | 2396.57 | 2290.78 | 600 | 20 |
| 1.38 | 24.65 | 8.78 | 17.83 | 6.35 | 2275 | 73.73 | 2206.3 | 46.2 | 7.367 | 4.29E-08 | 2323.78 | 2326.20 | 600 | 20 |
| 1.23 | 15.25 | 7.49 | 12.40 | 6.09 | 2603 | 84.35 | 2234 | 41.4 | 7.314 | 4.85E-08 | 2339.59 | 2359.79 | 600 | 20 |
| 1.14 | 20.22 | 6.28 | 17.72 | 5.50 | 3493 | 113.21 | 2310.5 | 33.0 | 7.201 | 6.29E-08 | 2394.97 | 2456.72 | 600 | 20 |
| 0.71 | 11.54 | 2.80 | 16.17 | 3.93 | 4617 | 149.62 | 2284.2 | 24.4 | 7.075 | 8.41E-08 | 2347.77 | 2458.25 | 600 | 20 |
| 1.62 | 14.84 | 11.86 | 9.18 | 7.34 | 660 | 21.40 | 2086.7 | 142.3 | 7.880 | 1.32E-08 | 2438.16 | 2250.41 | 600 | 20 |
| 1.61 | 16.35 | 9.26 | 10.15 | 5.75 | 1193 | 38.66 | 2176.8 | 85.8 | 7.642 | 2.28E-08 | 2390.76 | 2301.22 | 600 | 20 |
| 1.55 | 20.58 | 9.03 | 13.32 | 5.84 | 1712 | 55.48 | 2244.3 | 63.5 | 7.498 | 3.17E-08 | 2403.51 | 2363.27 | 600 | 20 |
| 1.39 | 13.42 | 6.01 | 9.66 | 4.33 | 2125 | 68.86 | 2271.6 | 52.4 | 7.410 | 3.89E-08 | 2403.62 | 2392.83 | 600 | 20 |
| 1.27 | 12.66 | 6.54 | 9.98 | 5.16 | 3201 | 103.74 | 2327.3 | 36.5 | 7.242 | 5.72E-08 | 2420.26 | 2467.56 | 600 | 20 |
| 1.01 | 11.98 | 3.45 | 11.86 | 3.41 | 4248 | 137.68 | 2372.6 | 28.6 | 7.128 | 7.45E-08 | 2445.94 | 2538.84 | 600 | 20 |
| 0.89 | 9.36 | 7.90 | 10.56 | 8.91 | 50 | 1.64 | 1080.4 | 499.0 | 8.711 | 1.94E-09 | 2324.59 | 1581.05 | 1200 | 20 |
| 1.48 | 16.28 | 12.24 | 10.98 | 8.26 | 181 | 5.87 | 1622.6 | 313.9 | 8.333 | 4.64E-09 | 2397.46 | 1942.41 | 1200 | 20 |
| 1.62 | 18.04 | 13.09 | 11.13 | 8.07 | 358 | 11.59 | 1847.4 | 206.0 | 8.094 | 8.06E-09 | 2358.09 | 2065.02 | 1200 | 20 |
| 1.44 | 21.26 | 11.35 | 14.72 | 7.86 | 1387 | 44.94 | 2156.9 | 72.4 | 7.573 | 2.68E-08 | 2338.85 | 2274.23 | 1200 | 20 |
| 0.91 | 18.23 | 4.87 | 20.03 | 5.35 | 3788 | 122.75 | 2244.1 | 28.7 | 7.153 | 7.02E-08 | 2318.47 | 2395.58 | 1200 | 20 |
| 1.26 | 16.85 | 11.55 | 13.35 | 9.15 | 122 | 3.95 | 1423.9 | 359.1 | 8.448 | 3.56E-09 | 2316.77 | 1786.90 | 1200 | 20 |
| 1.43 | 28.89 | 15.27 | 20.23 | 10.69 | 768 | 24.90 | 2039.3 | 116.8 | 7.805 | 1.57E-08 | 2330.87 | 2181.00 | 1200 | 20 |
| 1.18 | 40.19 | 13.45 | 34.18 | 11.44 | 2171 | 70.37 | 2265.5 | 51.0 | 7.399 | 3.99E-08 | 2394.25 | 2386.92 | 1200 | 20 |

Table S2. Carbonate chemistry speciation, temperature, light conditions and measured physiological parameters for *E. huxleyi* experiments on the carbonate chemistry and temperature interaction and taken from Sett et al. (2014).

| μ (d^{-1}) | POC Rate ($\frac{pg\ C}{cell\ d}$) | PIC Rate ($\frac{pg\ C}{cell\ d}$) | POC Quota ($pg\ C\ cell^{-1}$) | PIC Quota ($pg\ C\ cell^{-1}$) | fCO_2 (μatm) | $[CO_2]$ ($\mu mol\ kg^{-1}$) | $[HCO_3^-]$ ($\mu mol\ kg^{-1}$) | $[CO_3^{2-}]$ ($\mu mol\ kg^{-1}$) | pH _T | $[H^+]$ ($\frac{mol}{kg}$) | TA ($\mu mol\ kg^{-1}$) | DIC ($\mu mol\ kg^{-1}$) | Light ($\frac{\mu mol}{m^2\ s}$) | Temp. ($^{\circ}C$) |
|-----------------------|--|--|--|--|--------------------------|------------------------------------|---------------------------------------|---|-----------------|---------------------------------|------------------------------|-------------------------------|---------------------------------------|--------------------------|
| 0.42 | 3.52 | 3.12 | 8.38 | 7.43 | 84 | 3.69 | 1458.4 | 347.6 | 8.591 | 2.57E-09 | 2327.50 | 1809.70 | 150 | 10 |
| 0.52 | 5.44 | 5.33 | 10.46 | 10.25 | 129 | 5.64 | 1633.2 | 284.9 | 8.455 | 3.51E-09 | 2345.60 | 1923.80 | 150 | 10 |
| 0.58 | 8.86 | 7.02 | 15.28 | 12.10 | 193 | 8.49 | 1778.4 | 224.5 | 8.315 | 4.85E-09 | 2341.10 | 2011.40 | 150 | 10 |
| 0.61 | 8.63 | 7.29 | 14.15 | 11.95 | 263 | 11.53 | 1881.2 | 184.9 | 8.206 | 6.22E-09 | 2345.30 | 2077.60 | 150 | 10 |
| 0.64 | 7.51 | 6.72 | 11.73 | 10.50 | 356 | 15.64 | 1961.4 | 148.2 | 8.092 | 8.10E-09 | 2334.60 | 2125.20 | 150 | 10 |
| 0.65 | 7.80 | 6.38 | 12.00 | 9.82 | 474 | 20.80 | 2020 | 118.2 | 7.981 | 1.05E-08 | 2319.00 | 2159.00 | 150 | 10 |
| 0.62 | 8.62 | 6.15 | 13.90 | 9.92 | 591 | 25.95 | 2061.1 | 98.6 | 7.893 | 1.28E-08 | 2311.50 | 2185.70 | 150 | 10 |
| 0.63 | 7.34 | 6.21 | 11.65 | 9.86 | 701 | 30.75 | 2102.7 | 86.6 | 7.828 | 1.49E-08 | 2322.90 | 2220.10 | 150 | 10 |
| 0.60 | 6.62 | 5.86 | 11.03 | 9.77 | 781 | 34.26 | 2124.8 | 79.4 | 7.786 | 1.64E-08 | 2326.80 | 2238.40 | 150 | 10 |
| 0.58 | 6.63 | 5.03 | 11.43 | 8.67 | 916 | 40.18 | 2148.6 | 69.2 | 7.721 | 1.90E-08 | 2325.30 | 2258.00 | 150 | 10 |
| 0.55 | 6.54 | 4.33 | 11.89 | 7.87 | 1132 | 49.68 | 2182.7 | 57.8 | 7.636 | 2.31E-08 | 2330.70 | 2290.10 | 150 | 10 |
| 0.51 | 6.96 | 4.12 | 13.65 | 8.08 | 1521 | 66.73 | 2219.4 | 44.5 | 7.515 | 3.05E-08 | 2334.20 | 2330.60 | 150 | 10 |
| 0.43 | 5.53 | 3.62 | 12.86 | 8.42 | 2121 | 93.06 | 2255.1 | 32.9 | 7.378 | 4.19E-08 | 2341.00 | 2381.10 | 150 | 10 |
| 0.35 | 4.72 | 1.67 | 13.49 | 4.77 | 2859 | 125.46 | 2276.2 | 24.9 | 7.252 | 5.60E-08 | 2341.90 | 2426.50 | 150 | 10 |
| 0.30 | 4.04 | 1.78 | 13.47 | 5.93 | 4075 | 178.79 | 2300.5 | 17.8 | 7.103 | 7.89E-08 | 2348.50 | 2497.10 | 150 | 10 |
| 0.23 | 3.78 | 0.89 | 16.43 | 3.87 | 5631 | 247.09 | 2312.5 | 13.0 | 6.964 | 1.09E-07 | 2348.40 | 2572.60 | 150 | 10 |
| 0.34 | 4.41 | 2.37 | 12.84 | 6.89 | 19 | 0.70 | 810.5 | 609.6 | 9.005 | 9.88E-10 | 2334.10 | 1420.80 | 150 | 15 |
| 0.69 | 4.67 | 4.09 | 6.81 | 5.95 | 46 | 1.73 | 1132 | 478.2 | 8.755 | 1.76E-09 | 2324.41 | 1612.03 | 150 | 15 |
| 0.98 | 7.78 | 5.40 | 7.96 | 5.53 | 83 | 3.13 | 1361.6 | 383.8 | 8.579 | 2.64E-09 | 2318.52 | 1748.58 | 150 | 15 |
| 1.07 | 9.63 | 7.20 | 9.00 | 6.73 | 131 | 4.91 | 1537.7 | 311.7 | 8.436 | 3.67E-09 | 2315.27 | 1854.27 | 150 | 15 |
| 1.11 | 13.27 | 8.94 | 11.97 | 8.06 | 195 | 7.32 | 1683.6 | 250.6 | 8.302 | 4.99E-09 | 2309.83 | 1941.62 | 150 | 15 |
| 1.11 | 12.64 | 9.09 | 11.40 | 8.20 | 269 | 10.09 | 1782.1 | 203.7 | 8.187 | 6.50E-09 | 2292.54 | 1995.94 | 150 | 15 |
| 1.09 | 11.79 | 11.00 | 10.78 | 10.06 | 374 | 14.01 | 1885.6 | 164.3 | 8.069 | 8.53E-09 | 2297.63 | 2063.84 | 150 | 15 |
| 1.11 | 13.39 | 8.90 | 12.11 | 8.04 | 461 | 17.26 | 1945.7 | 141.9 | 7.992 | 1.02E-08 | 2302.03 | 2104.84 | 150 | 15 |
| 1.07 | 14.35 | 7.23 | 13.37 | 6.74 | 581 | 21.78 | 1991.8 | 117.9 | 7.901 | 1.26E-08 | 2288.81 | 2131.44 | 150 | 15 |
| 1.07 | 12.19 | 4.75 | 11.44 | 4.46 | 704 | 26.38 | 2045.9 | 102.7 | 7.830 | 1.48E-08 | 2304.77 | 2174.97 | 150 | 15 |
| 1.07 | 9.78 | 6.03 | 9.15 | 5.64 | 846 | 31.70 | 2072.9 | 87.7 | 7.756 | 1.76E-08 | 2294.83 | 2192.34 | 150 | 15 |
| 1.04 | 10.82 | 6.88 | 10.38 | 6.60 | 933 | 34.96 | 2091.3 | 80.9 | 7.717 | 1.92E-08 | 2296.32 | 2207.19 | 150 | 15 |
| 1.05 | 11.66 | 7.07 | 11.14 | 6.76 | 955 | 35.78 | 2110.5 | 80.6 | 7.711 | 1.95E-08 | 2314.29 | 2226.86 | 150 | 15 |
| 1.01 | 9.59 | 5.98 | 9.49 | 5.92 | 1110 | 41.59 | 2124.3 | 70.2 | 7.648 | 2.25E-08 | 2302.48 | 2236.06 | 150 | 15 |
| 0.94 | 11.73 | 4.11 | 12.54 | 4.40 | 1739 | 65.14 | 2171.3 | 46.8 | 7.463 | 3.44E-08 | 2291.48 | 2283.22 | 150 | 15 |
| 0.85 | 10.73 | 3.51 | 12.61 | 4.13 | 2392 | 89.60 | 2203.2 | 35.1 | 7.331 | 4.67E-08 | 2294.10 | 2327.87 | 150 | 15 |
| 0.78 | 9.97 | 2.95 | 12.81 | 3.79 | 3032 | 113.56 | 2232.7 | 28.4 | 7.234 | 5.84E-08 | 2306.94 | 2374.69 | 150 | 15 |
| 0.67 | 6.84 | 2.40 | 10.17 | 3.57 | 3678 | 137.79 | 2256.5 | 23.9 | 7.154 | 7.01E-08 | 2319.42 | 2418.18 | 150 | 15 |
| 0.60 | 5.41 | 1.90 | 9.09 | 3.19 | 4752 | 178.02 | 2262.8 | 18.6 | 7.044 | 9.03E-08 | 2312.56 | 2459.46 | 150 | 15 |
| 0.51 | 4.69 | 1.46 | 9.25 | 2.88 | 5466 | 204.77 | 2292.2 | 16.6 | 6.989 | 1.03E-07 | 2336.84 | 2513.60 | 150 | 15 |
| 0.73 | 1.82 | 2.52 | 2.49 | 3.45 | 82 | 2.65 | 1275.6 | 429.8 | 8.574 | 2.67E-09 | 2343.00 | 1708.00 | 150 | 20 |
| 0.83 | 4.32 | 5.72 | 5.20 | 6.89 | 131 | 4.24 | 1458.7 | 351.0 | 8.428 | 3.73E-09 | 2330.30 | 1813.90 | 150 | 20 |
| 1.25 | 6.08 | 7.62 | 4.86 | 6.10 | 196 | 6.36 | 1613.2 | 286.4 | 8.296 | 5.06E-09 | 2324.60 | 1906.00 | 150 | 20 |
| 1.35 | 6.00 | 7.76 | 4.44 | 5.75 | 268 | 8.68 | 1726.4 | 240.3 | 8.190 | 6.45E-09 | 2323.50 | 1975.40 | 150 | 20 |
| 1.26 | 8.99 | 10.03 | 7.13 | 7.96 | 370 | 11.99 | 1831.2 | 195.6 | 8.075 | 8.41E-09 | 2317.90 | 2038.80 | 150 | 20 |
| 1.29 | 8.48 | 9.40 | 6.57 | 7.29 | 481 | 15.59 | 1912.6 | 164.1 | 7.980 | 1.05E-08 | 2321.20 | 2092.30 | 150 | 20 |
| 1.37 | 8.84 | 9.62 | 6.45 | 7.02 | 590 | 19.11 | 1966.1 | 141.5 | 7.904 | 1.25E-08 | 2318.90 | 2126.70 | 150 | 20 |
| 1.39 | 10.59 | 10.61 | 7.62 | 7.63 | 700 | 22.68 | 2025.8 | 126.6 | 7.842 | 1.44E-08 | 2341.10 | 2175.00 | 150 | 20 |
| 1.38 | 10.40 | 8.73 | 7.54 | 6.33 | 823 | 26.69 | 2058.9 | 111.1 | 7.779 | 1.66E-08 | 2336.30 | 2196.70 | 150 | 20 |
| 1.38 | 10.62 | 10.24 | 7.70 | 7.42 | 954 | 30.93 | 2082.1 | 98.1 | 7.720 | 1.91E-08 | 2327.50 | 2211.10 | 150 | 20 |
| 1.46 | 9.91 | 7.74 | 6.79 | 5.30 | 1255 | 40.67 | 2067.2 | 73.5 | 7.597 | 2.53E-08 | 2253.20 | 2181.40 | 150 | 20 |
| 1.40 | 9.03 | 7.78 | 6.45 | 5.56 | 1136 | 36.81 | 2115.4 | 85.0 | 7.651 | 2.23E-08 | 2328.60 | 2237.20 | 150 | 20 |
| 1.37 | 9.49 | 8.13 | 6.93 | 5.93 | 1438 | 46.60 | 2155.9 | 69.8 | 7.557 | 2.78E-08 | 2331.50 | 2272.30 | 150 | 20 |
| 1.32 | 9.25 | 6.49 | 7.01 | 4.92 | 2466 | 79.93 | 2144.2 | 40.2 | 7.320 | 4.79E-08 | 2247.70 | 2264.40 | 150 | 20 |
| 1.19 | 9.97 | 4.77 | 8.38 | 4.01 | 3307 | 107.16 | 2200.1 | 31.6 | 7.204 | 6.25E-08 | 2281.90 | 2338.90 | 150 | 20 |
| 1.09 | 7.16 | 3.99 | 6.57 | 3.66 | 3945 | 127.84 | 2189.4 | 26.2 | 7.125 | 7.50E-08 | 2258.00 | 2343.50 | 150 | 20 |
| 0.96 | 7.26 | 3.62 | 7.56 | 3.77 | 4284 | 138.84 | 2253.4 | 25.6 | 7.102 | 7.91E-08 | 2320.00 | 2417.80 | 150 | 20 |
| 0.90 | 6.40 | 3.03 | 7.11 | 3.37 | 5374 | 174.16 | 2264.4 | 20.6 | 7.005 | 9.88E-08 | 2318.70 | 2459.20 | 150 | 20 |

Table S3. Optimum CO₂ concentrations, CO₂ K₂¹ concentrations and maximum rates (V_{max}) at 50-800 μmol photons m⁻² s⁻¹ from Eq. (2) fit to *G. oceanica* data at 50, 100, 200, 400, 600 and 800 μmol photons m⁻² s⁻¹ and 20°C from Zhang et al. (2015) and *G. oceanica* CO₂ data from Sett et al. (2014).

| CO ₂ | 50 PAR | 100 PAR | 200 PAR | 400 PAR | 600 PAR | 800 PAR |
|---|-----------|------------|------------|------------|------------|------------|
| CO₂ optima (μmol kg ⁻¹) | | | | | | |
| Calcification | 7.09 | 8.46 | 9.69 | 10.48 | 10.62 | 10.55 |
| Photosynthesis | 13.75 | 15.18 | 15.57 | 14.84 | 14.00 | 13.29 |
| Growth rate | 9.09 | 10.89 | 12.63 | 13.95 | 14.36 | 14.45 |
| V_{max} | | | | | | |
| Calcification (pg C cell ⁻¹ d ⁻¹) | 17.48 | 25.14 | 36.27 | 49.71 | 56.04 | 58.38 |
| Photosynthesis (pg C cell ⁻¹ d ⁻¹) | 10.12 | 15.48 | 23.25 | 31.50 | 34.30 | 34.61 |
| Growth rate (d ⁻¹) | 0.93 | 1.02 | 1.09 | 1.13 | 1.14 | 1.14 |
| K₂¹ inhib (μmol kg⁻¹) | | | | | | |
| Calcification | 28.32 | 29.14 | 28.81 | 27.51 | 26.53 | 25.86 |
| Photosynthesis | 99.45 | 72.56 | 54.41 | 42.01 | 37.02 | 34.27 |
| Growth rate | 42.20 | 51.21 | 60.33 | 67.73 | 70.42 | 71.32 |
| K₂¹ sat (μmol kg⁻¹) | | | | | | |
| Calcification | 1.38 | 2.02 | 2.82 | 3.57 | 3.84 | 3.90 |
| Photosynthesis | 1.99 | 3.00 | 4.10 | 4.80 | 4.85 | 4.70 |
| Growth rate | 1.40 | 1.66 | 1.90 | 2.07 | 2.11 | 2.11 |

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