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A meta-analysis on environmental drivers of marine phytoplankton C : N : P

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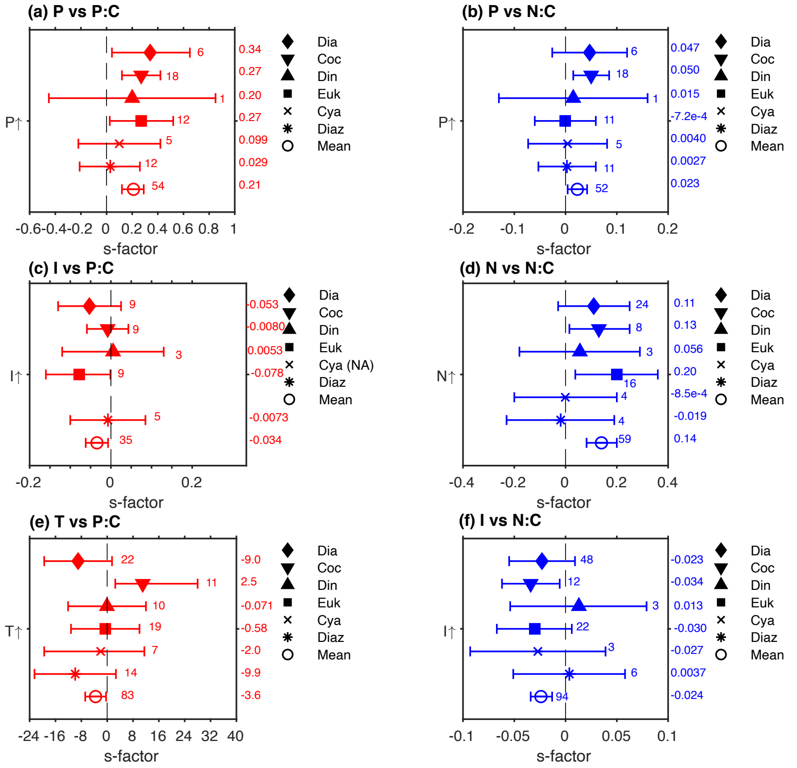

Figure S1. S-factor for each PFT for (a) P vs P:C, (b) P vs N:C, (c) I vs P:C, (d) N vs N:C, (e) T vs P:C, and (f) I vs N:C. Heterogeneity due to moderators are not statistically significant (Table S1). Number next to the point indicates the number of experimental units.

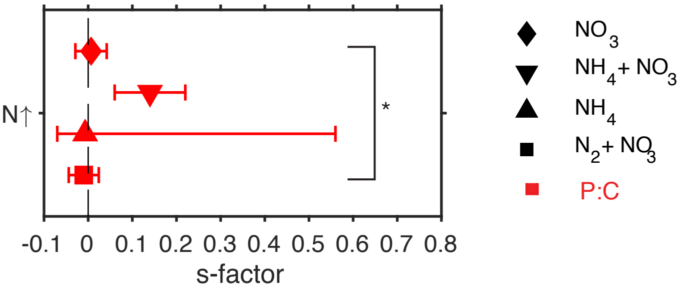

Figure S2. Effects of N types on N vs P:C experiments. The heterogeneity amongst N types is statistically significant ($P < 0.05$).

TABLE S1. Effects of categorical moderators on the responses of fourteen photosynthesis-related traits to N addition. n, number of observation; $\overline{s_X^Y}$, weighted mean stoichiometry sensitivity factor with environmental driver X and response variable Y; ci.lb, lower boundary of 95% CI; ci.ub, upper boundary of 95% CI; sig., significance of the between-moderator heterogeneity test; ns, $P > 0.05$; *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.001$. Red bold texts highlight moderators significantly affecting the responses. For iron experiments $\overline{\ln(RR)}$, the weighted mean value of the natural logarithm-transformed response ratio was used for heterogeneity test.

Environmental Driver 1: Dissolved inorganic phosphorus

		Phosphorus vs P:C				
		n	$\overline{s_X^Y}$	ci.lb	ci.ub	sig.
Plankton functional type	Diatoms	6	0.34	0.042	0.65	ns
	Coccolithophores	18	0.27	0.12	0.42	
	Dinoflagellates	1	0.20	-0.45	0.85	
	Other Eukaryotes	12	0.27	0.025	0.52	
	Cyanobacteria	5	0.099	-0.22	0.42	
	Diazotrophs	12	0.029	-0.21	0.26	
	Eukaryotes	37	0.28	0.18	0.38	*
	Prokaryotes	17	0.049	-0.13	0.23	
	Temperate/Warm					
	Cold	NA	NA	NA	NA	NA
Culture Growth Mode	Batch	22	0.24	0.11	0.38	ns
	Semi-continuous	25	0.15	-0.034	0.34	
	Chemostat	7	0.31	-0.0096	0.63	
	Turbidostat	NA	NA	NA	NA	
Growth Phase at harvest	Exponential	18	0.095	-0.0097	0.20	ns
	Stationary	25	0.18	0.041	0.32	

		Phosphorus vs N:C				
		n	$\overline{s_X^Y}$	ci.lb	ci.ub	sig.
Plankton functional type	Diatoms	6	0.047	-0.026	0.12	ns
	Coccolithophores	18	0.050	0.015	0.085	
	Dinoflagellates	1	0.015	-0.13	0.16	
	Other Eukaryotes	11	-7.2×10^{-4}	-0.060	0.059	
	Cyanobacteria	5	0.0040	-0.073	0.081	
	Diazotrophs	11	0.0027	-0.053	0.059	
	Eukaryotes	36	0.033	0.0096	0.056	ns
	Prokaryotes	16	0.0032	-0.037	0.043	
	Temperate/Warm					
	Cold	NA	NA	NA	NA	NA
Culture Growth Mode	**Batch**	20	0.017	0.0033	0.030	***
	Semi-continuous	25	0.0067	-0.011	0.025	
	Chemostat	7	0.14	0.085	0.20	
	Turbidostat	NA	NA	NA	NA	
Growth Phase at harvest	Exponential	17	0.0044	-0.0078	0.017	ns
	Stationary	24	0.0012	-0.0043	0.028	

Environmental Driver 2: Dissolved inorganic nitrogen

		Nitrogen vs P:C				
		n	$\overline{s_X^Y}$	ci.lb	ci.ub	sig.
Plankton functional type	Diatoms	8	0.0042	-0.070	0.079	ns
	Coccolithophores	8	0.0053	-0.011	0.021	
	Dinoflagellates	2	0.018	-0.12	0.16	
	Other Eukaryotes	8	0.0045	-0.073	0.082	
	Cyanobacteria	2	-0.0056	-0.11	0.099	
	Diazotrophs	4	0.0022	-0.080	0.085	
	Eukaryotes	26	0.011	-0.0030	0.025	ns
	Prokaryotes	6	-0.010	-0.044	0.023	
	Temperate/Warm					
	Cold	NA	NA	NA	NA	NA
N form	**NO_3^-**	26	0.0066	-0.029	0.042	*
	NH_4NO_3	1	0.14	0.060	0.22	
	NH_4^+	1	-0.0069	-0.070	0.56	
	N_2NO_3	4	-0.010	-0.044	0.024	
Culture Growth Mode	Batch	18	0.0064	-0.011	0.024	ns
	Semi-continuous	14	0.0085	-0.018	0.035	
	Chemostat	NA	NA	NA	NA	
	Turbidostat	NA	NA	NA	NA	
Growth Phase at harvest	Exponential	8	0.022	-0.010	0.054	ns
	Stationary	13	0.0034	-0.039	0.046	
		Nitrogen vs N:C				
		n	$\overline{s_X^Y}$	ci.lb	ci.ub	sig.
Plankton functional type	Diatoms	24	0.11	-0.029	0.25	ns
	Coccolithophores	8	0.13	0.015	0.25	
	Dinoflagellates	3	0.056	-0.18	0.29	
	Other Eukaryotes	16	0.20	0.038	0.36	
	Cyanobacteria	4	-8.5×10^{-4}	-0.20	0.20	
	Diazotrophs	4	-0.019	-0.23	0.19	
	Eukaryotes	51	0.17	0.11	0.22	*
	Prokaryotes	8	-0.017	-0.18	0.15	
	Temperate/Warm					
	Cold	NA	NA	NA	NA	NA
N form	NO_3^-	52	0.15	-0.077	0.37	ns
	NH_4NO_3	1	0.57	0.09	1.1	
	NH_4^+	2	0.096	-0.32	0.51	
	N_2NO_3	4	-0.035	-0.25	0.18	
Culture Growth Mode	Batch	28	0.14	0.052	0.22	ns
	Semi-continuous	28	0.16	0.036	0.28	
	Chemostat	NA	NA	NA	NA	

	Turbidostat	3	0.010	-0.26	0.28	
Growth Phase at harvest	Exponential	21	0.15	0.041	0.26	ns
	Stationary	24	0.18	0.024	0.33	

Environmental Driver 3: Dissolved iron

		Iron vs P:C				
		n	$\overline{\ln(RR)}$	ci.lb	ci.ub	sig.
Plankton functional type	Diatoms	23	-0.033	-0.23	0.17	ns
	Coccolithophores	NA	NA	NA	NA	
	Dinoflagellates	NA	NA	NA	NA	
	Other Eukaryotes	4	-0.0085	-0.52	0.51	
	Cyanobacteria	3	-0.089	-0.67	0.49	
	Diazotrophs	7	0.19	-0.22	0.60	
	Eukaryotes	27	-0.029	-0.21	0.15	ns
	Prokaryotes	10	0.11	-0.24	0.45	
	Temperate/Warm/Unspecified	20	0.039	-0.27	0.35	ns
	Cold	17	-0.028	-0.26	0.20	
Culture Growth Mode	Batch	14	-0.030	-0.28	0.22	ns
	Semi-continuous	23	0.033	-0.29	0.35	
	Chemostat	NA	NA	NA	NA	
	Turbidostat	NA	NA	NA	NA	
Growth Phase at harvest	Exponential	11	-0.090	-0.29	0.11	ns
	Stationary	13	-0.12	-0.39	0.15	
		Iron vs N:C				
		n	$\overline{\ln(RR)}$	ci.lb	ci.ub	sig.
Plankton functional type	Diatoms	45	0.0061	-0.084	0.096	ns
	Coccolithophores	NA	NA	NA	NA	
	Dinoflagellates	NA	NA	NA	NA	
	Other Eukaryotes	6	0.046	-0.22	0.31	
	Cyanobacteria	6	0.0033	-0.26	0.27	
	Diazotrophs	8	-0.22	-0.45	0.010	
	Eukaryotes	51	0.011	-0.073	0.095	ns
	Prokaryotes	14	-0.13	-0.31	0.054	
	Temperate/Warm/Unspecified	42	-0.018	-0.18	0.14	ns
	Cold	21	-0.022	-0.15	0.11	
Culture Growth Mode	Batch	26	-0.065	-0.18	0.054	ns
	Semi-continuous	39	0.011	-0.14	0.16	
	Chemostat	NA	NA	NA	NA	
	Turbidostat	NA	NA	NA	NA	
Growth Phase at harvest	Exponential	38	-0.035	-0.14	0.073	
	Stationary	13	-0.11	-0.32	0.096	

Environmental Driver 4: Irradiance (photon flux density)

		Irradiance vs P:C				
		n	$\overline{s_X^Y}$	ci.lb	ci.ub	sig.
Plankton functional type	Diatoms	9	-0.053	-0.13	0.025	ns
	Coccolithophores	9	-0.0080	-0.059	0.043	
	Dinoflagellates	3	0.0053	-0.12	0.13	
	Other Eukaryotes	9	-0.078	-0.16	-0.0013	
	Cyanobacteria	NA	NA	NA	NA	
	Diazotrophs	5	-0.0073	-0.10	0.085	
	Eukaryotes	30	-0.039	-0.069	-0.0088	ns
	Prokaryotes	5	-0.0076	-0.089	0.074	
	Temperate/Warm/Unspecified					
	Cold	NA	NA	NA	NA	NA
Culture Growth Mode	Batch	19	-0.052	-0.095	-0.010	ns
	Semi-continuous	8	-0.0092	-0.078	0.060	
	Chemostat	8	-0.031	-0.099	0.036	
	Turbidostat	NA	NA	NA	NA	
Growth Phase at harvest	Exponential	12	0.014	-0.025	0.054	ns
	Stationary	7	-0.0076	-0.068	0.053	
Light regime	Continuous Light	1	-0.012	-0.16	0.13	ns
	Periodic Light	34	-0.036	-0.19	0.11	

		Irradiance vs N:C				
		n	$\overline{s_X^Y}$	ci.lb	ci.ub	sig.
Plankton functional type	Diatoms	48	-0.023	-0.055	0.0092	ns
	Coccolithophores	12	-0.034	-0.062	-0.0057	
	Dinoflagellates	3	0.013	-0.054	0.079	
	Other Eukaryotes	22	-0.030	-0.067	0.0061	
	Cyanobacteria	3	-0.027	-0.093	0.039	
	Diazotrophs	6	0.0037	-0.051	0.058	
	Eukaryotes	85	-0.025	-0.036	-0.014	ns
	Prokaryotes	9	-0.0081	-0.045	0.029	
	Temperate/Warm/Unspecified	89	6.0×10^{-4}	-0.042	0.044	ns
	Cold	5	-0.025	-0.069	0.019	
Culture Growth Mode	**Batch**	46	-0.034	-0.049	-0.019	**
	Semi-continuous	27	0.0034	-0.020	0.026	
	Chemostat	12	-0.047	-0.076	-0.017	
	Turbidostat	9	-0.024	-0.058	0.010	
Growth Phase at harvest	Exponential	47	-0.014	-0.028	7.6×10^{-4}	ns
	Stationary	18	-0.0042	-0.032	0.024	
Light regime	**Continuous Light**	30	-0.0092	-0.026	0.0077	*
	Periodic Light	64	-0.031	-0.052	-0.010	

Environmental Driver 5: Temperature

		Temperature vs P:C				
		n	$\overline{s_X^Y}$	ci.lb	ci.ub	sig.
Plankton functional type	Diatoms	22	-9.0	-19.5	1.5	ns
	Coccolithophores	11	2.5	-6.0	11.1	
	Dinoflagellates	10	-0.071	-12.1	12.0	
	Other Eukaryotes	19	-0.58	-11.2	10.0	
	Cyanobacteria	7	-2.0	-15.5	11.5	
	Diazotrophs	14	-9.9	-22.5	2.7	
	Eukaryotes	62	-2.8	-6.4	0.81	ns
	Prokaryotes	21	-6.5	-14.4	1.5	
	Temperate/Warm/Unspecified	70	-3.5	-11.4	4.4	ns
	Cold	13	-3.6	-12.2	5.1	
Culture Growth Mode	**Batch**	28	-9.0	-14.1	-3.9	*
	Semi-continuous	53	-0.21	-6.7	6.3	
	Chemostat	2	-4.7	-26.3	16.9	
	Turbidostat	NA	NA	NA	NA	
Growth Phase at harvest	**Exponential**	50	-8.3	-12.2	-4.4	***
	Stationary	28	5.0	-1.2	11.2	

		Temperature vs N:C				
		n	$\overline{s_X^Y}$	ci.lb	ci.ub	sig.
Plankton functional type	Diatoms	31	-0.80	-6.0	4.4	ns
	Coccolithophores	11	-1.0	-5.5	3.4	
	Dinoflagellates	10	0.28	-6.0	6.5	
	Other Eukaryotes	19	-1.8	-7.2	3.6	
	Cyanobacteria	8	0.28	-6.2	6.7	
	Diazotrophs	17	2.8	-3.6	9.1	
	Eukaryotes	71	-0.96	-2.6	0.71	ns
	Prokaryotes	25	1.6	-2.0	5.2	
	Temperate/Warm/Unspecified	83	1.0	-3.0	5.0	ns
	Cold	13	-0.64	-5.0	3.7	
Culture Growth Mode	**Batch**	31	-1.8	-4.2	0.59	*
	Semi-continuous	63	0.71	-2.3	3.7	
	Chemostat	2	-11.5	-22.5	-0.53	
	Turbidostat	NA	NA	NA	NA	
Growth phase at harvest	**Exponential**	59	-1.6	-3.5	0.29	*
	Stationary	32	1.8	-1.2	4.8	

Section S1. List of 104 studies used in meta-analysis

ID	Abbreviation	Driver(s)	Reference:
1	Bechemin99	P, N	Béchemin, C., Grzebyk, D., Hachame, F., Hummert, C. and Maestrini, S.: Effect of different nitrogen/phosphorus nutrient ratios on the toxin content in Alexandrium minutum, Aquat. Microb. Ecol., 20(2), 157–165, doi:10.3354/ame020157, 1999.
2	Berges02	T	Berges, J., Varela, D. and Harrison, P.: Effects of temperature on growth rate, cell composition and nitrogen metabolism in the marine diatom Thalassiosira pseudonana (Bacillariophyceae), Mar. Ecol. Prog. Ser., 225, 139–146, doi:10.3354/meps225139, 2002.
3	BermanFrank01	Fe	Berman-Frank, I., Cullen, J. T., Shaked, Y., Sherrell, R. M. and Falkowski, P. G.: Iron availability, cellular iron quotas, and nitrogen fixation in Trichodesmium, Limnol. Oceanogr., 46(6), 1249–1260, doi:10.4319/lo.2001.46.6.1249, 2001.
4	Bertilsson03	P	Bertilsson, S., Berglund, O., Karl, D. M. and Chisholm, S. W.: Elemental composition of marine Prochlorococcus and Synechococcus: Implications for the ecological stoichiometry of the sea, Limnol. Oceanogr., 48(5), 1721–1731, doi:10.4319/lo.2003.48.5.1721, 2003.
5	Bi17	T	Bi, R., Ismar, S., Sommer, U. and Zhao, M.: Environmental dependence of the correlations between stoichiometric and fatty acid-based indicators of phytoplankton nutritional quality, Limnol. Oceanogr., 62(1), 334–347, doi:10.1002/lno.10429, 2017.
6	Bi18	P, N, T	Bi, R., Ismar, S. M. H., Sommer, U. and Zhao, M.: Simultaneous shifts in elemental stoichiometry and fatty acids of Emiliania huxleyi in response to environmental changes, Biogeosciences, 15(4), 1029–1045, doi:10.5194/bg-15-1029-2018, 2018.
7	Bittar13	I	Bittar, T. B., Lin, Y., Sassano, L. R., Wheeler, B. J., Brown, S. L., Cochlan, W. P. and Johnson, Z. I.: Carbon allocation under light and nitrogen resource gradients in two model marine phytoplankton 1, edited by M. Posewitz, J. Phycol., 49(3), 523–535, doi:10.1111/jpy.12060, 2013.
8	BlancoAmeijeiras18	Fe	Blanco-Ameijeiras, S., Moisset, S. A. M., Trimborn, S., Campbell, D. A., Heiden, J. P. and Hassler, C. S.: Elemental Stoichiometry and Photophysiology Regulation of Synechococcus sp. PCC7002 Under Increasing Severity of Chronic Iron Limitation, Plant Cell Physiol., 59(9), 1803–1816, doi:10.1093/pcp/pcy097, 2018.
9	Borchard12	T	Borchard, C. and Engel, A.: Organic matter exudation by Emiliania huxleyi under simulated future ocean conditions, Biogeosciences, 9(8), 3405–3423, doi:10.5194/bg-9-3405-2012, 2012.
10	Boyd16	T	Boyd, P. W., Dillingham, P. W., Mcgraw, C. M., Armstrong, E. A., Cornwall, C. E., Feng, Y. Y., Hurd, C. L., Gault-Ringold, M., Roleda, M. Y., Timmins-Schiffman, E. and Nunn, B. L.: Physiological responses of a Southern Ocean diatom to complex future ocean conditions, Nat. Clim. Chang., 6(2), 207–213, doi:10.1038/nclimate2811, 2016.

11	Brauer13	T	Brauer, V. S., Stomp, M., Rosso, C., van Beusekom, S. A., Emmerich, B., Stal, L. J. and Huisman, J.: Low temperature delays timing and enhances the cost of nitrogen fixation in the unicellular cyanobacterium Cyanothece, ISME J., 7(11), 2105–2115, doi:10.1038/ismej.2013.103, 2013.
12	Bucciarelli10	Fe	Bucciarelli, E., Pondaven, P. and Sarthou, G.: Effects of an iron-light co-limitation on the elemental composition (Si, C, N) of the marine diatoms Thalassiosira oceanica and Ditylum brightwellii, Biogeosciences, 7(2), 657–669, doi:10.5194/bg-7-657-2010, 2010.
13	Claquin02	I	Claquin, P., Martin-Jezequel, V., Kromkamp, J. C., Veldhuis, M. J. W. and Kraay, G. W.: Uncoupling of silicon compared with carbon and nitrogen metabolisms and the role of the cell cycle in continuous cultures of Thalassiosira pseudonana (bacillariophyceae) under light, nitrogen, and phosphorus control, J. Phycol., 38(5), 922–930, doi:10.1046/j.1529-8817.2002.t01-1-01220.x, 2002.
14	Cunningham17	Fe	Cunningham, B. R. and John, S. G.: The effect of iron limitation on cyanobacteria major nutrient and trace element stoichiometry, Limnol. Oceanogr., 62(2), 846–858, doi:10.1002/lno.10484, 2017.
15	DeLaRocha00	Fe	De La Rocha, C., Hutchins, D., Brzezinski, M. and Zhang, Y.: Effects of iron and zinc deficiency on elemental composition and silica production by diatoms, Mar. Ecol. Prog. Ser., 195, 71–79, doi:10.3354/meps195071, 2000.
16	Feng08	I, T	Feng, Y., Warner, M. E., Zhang, Y., Sun, J., Fu, F. X., Rose, J. M. and Hutchins, D. A.: Interactive effects of increased pCO2, temperature and irradiance on the marine coccolithophore Emiliania huxleyi (Prymnesiophyceae), Eur. J. Phycol., 43(1), 87–98, doi:10.1080/09670260701664674, 2008.
17	Feng18	P, N, I, T	Feng, Y., Roleda, M. Y., Armstrong, E., Law, C. S., Boyd, P. W. and Hurd, C. L.: Environmental controls on the elemental composition of a Southern Hemisphere strain of the coccolithophore Emiliania huxleyi, Biogeosciences, 15(2), 581–595, doi:10.5194/bg-15-581-2018, 2018.
18	Finkel06	I	Finkel, Z. V., Quigg, A., Raven, J. A., Reinfelder, J. R., Schofield, O. E. and Falkowski, P. G.: Irradiance and the elemental stoichiometry of marine phytoplankton, Limnol. Oceanogr., 51(6), 2690–2701, doi:10.4319/lo.2006.51.6.2690, 2006.
19	Fu05	P	Fu, F.-X., Zhang, Y., Bell, P. R. F. F. and Hutchins, D. A.: Phosphate Uptake And Growth Kinetics Of Trichodesmium (Cyanobacteria) Isolates From The North Atlantic Ocean And The Great Barrier Reef, Australia, J. Phycol., 41(1), 62–73, doi:10.1111/j.1529-8817.2005.04063.x, 2005.
20	Fu06	P	Fu, F.-X., Zhang, Y., Feng, Y. and Hutchins, D. A.: Phosphate and ATP uptake and growth kinetics in axenic cultures of the cyanobacterium Synechococcus CCMP 1334, Eur. J. Phycol., 41(1), 15–28, doi:10.1080/09670260500505037, 2006.

21	Fu07	T	Fu, F.-X. X., Warner, M. E., Zhang, Y. H., Feng, Y. Y., Hutchins, D. A., Fu, F.-X. X., Warner, M. E., Zhang, Y. H., Feng, Y. Y. and Hutchins, D. A.: Effects of increased temperature and CO2on photosynthesis, growth, and elemental ratios in marine Synechococcus and Prochlorococcus (Cyanobacteria), J. Phycol., 43(3), 485–496, doi:10.1111/j.1529-8817.2007.00355.x, 2007.
22	Fu08a	T	Fu, F. X., Zhang, Y., Warner, M. E., Feng, Y., Sun, J. and Hutchins, D. A.: A comparison of future increased CO2and temperature effects on sympatric Heterosigma akashiwo and Prorocentrum minimum, Harmful Algae, 7(1), 76–90, doi:10.1016/j.hal.2007.05.006, 2008a.
23	Fu08b	Fe	Fu, F. X., Mulholland, M. R., Garcia, N. S., Beck, A., Bernhardt, P. W., Warner, M. E., Sañudo-Wilhelmy, S. A. and Hutchins, D. A.: Interactions between changing pCO2, N2fixation, and Fe limitation in the marine unicellular cyanobacterium Crocosphaera, Limnol. Oceanogr., 53(6), 2472–2484, doi:10.4319/lo.2008.53.6.2472, 2008b.
24	Fu14	T	Fu, F., Yu, E., Garcia, N., Gale, J., Luo, Y., Webb, E. and Hutchins, D.: Differing responses of marine N2 fixers to warming and consequences for future diazotroph community structure, Aquat. Microb. Ecol., 72(1), 33–46, doi:10.3354/ame01683, 2014.
25	Garcia11	I	Garcia, N. S., Fu, F.-X., Breene, C. L., Bernhardt, P. W., Mulholland, M. R., Sohm, J. A. and Hutchins, D. A.: Interactive effects of irradiance and CO2 on CO2 fixation and N2 fixation in the diazotroph Trichodesmium erythraeum (Cyanobacteria), J. Phycol., 47(6), 1292–1303, doi:10.1111/j.1529-8817.2011.01078.x, 2011.
26	Giovagnetti12	I	Giovagnetti, V., Cataldo, M. L., Conversano, F. and Brunet, C.: Growth and photophysiological responses of two picoplanktonic Minutocellus species, strains RCC967 and RCC703 (Bacillariophyceae), Eur. J. Phycol., 47(4), 408–420, doi:10.1080/09670262.2012.733030, 2012.
27	Greene91	Fe	Greene, R. M., Geider, R. J. and Falkowski, P. G.: Effect of iron limitation on photosynthesis in a marine diatom, Limnol. Oceanogr., 36(8), 1772–1782, doi:10.4319/lo.1991.36.8.1772, 1991.
28	Heiden16	I	Heiden, J. P., Bischof, K. and Trimborn, S.: Light Intensity Modulates the Response of Two Antarctic Diatom Species to Ocean Acidification, Front. Mar. Sci., 3, 260, doi:10.3389/fmars.2016.00260, 2016.
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Section S2. Description of files uploaded in the Zenodo repository (http://doi.org/10.5281/zenodo.3723121)

Bibliography

1. AppendixS1.pdf : list of 104 papers used in the main meta-analysis.

Excel spreadsheets:

2. New_data_190211a.xlsx: C:N and C:P dataset
3. res_all_190211a_P.csv: Effect sizes calculated for each P experiment
4. res_all_190211a_N.csv: Effect sizes calculated for each N experiment
5. res_all_190211a_Fe.csv: Effect sizes calculated for each Fe experiment
6. res_all_190211a_I.csv: Effect sizes calculated for each I experiment
7. res_all_190211a_I.csv: Effect sizes calculated for each T experiment
8. META_BIiblio_articles1st_k4899.xlsx : list of 4899 in the first round of data collection/screening (see Fig. 1 in the main text)
9. META_Biblio_articles2nd_k948.xlsx : list of 948 papers in the second round of data collection/screening (see Fig. 1 in the main text)
10. META_Biblio_articles3rd_k196.xlsx : list of 196 papers in the third round of data collection/screening (see Fig. 1 in the main text)

R scripts:

11. analysis_190211a_test_P.R: script to conduct meta-analysis on P experiments
12. analysis_190211a_test_N.R: script to conduct meta-analysis on N experiments
13. analysis_190211a_test_F.R: script to conduct meta-analysis on Fe experiments
14. analysis_190211a_test_I.R: script to conduct meta-analysis on I experiments
15. analysis_190211a_test_T.R: script to conduct meta-analysis on T experiments
16. functions_eff_logrr.R: function file to calculate ln(RR) (used in "analysis_190211a_test_X.R")
17. functions_scalc.R function file to calculate s-factor (used in "analysis_190211a_test_X.R")