

Supplementary material

ForamEcoGENIE 2.0: Incorporating symbiosis and spine traits into a global planktic foraminifer model

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Table S1 Collected studies in plankton net tow data compilation

Literature	Source	Region
Kuroyanagi and Kawahata, 2004	https://doi.org/10.1016/j.marmicro.2004.06.001	Japan Seas
Sousa et al., 2014	https://doi.org/10.1016/j.csr.2013.11.027	SE Brazilian margin
Bahr et al., 2013	https://doi.org/10.1016/j.epsl.2013.09.036	Caribbean
Schmuker & Schiebel, 2002	https://doi.org/10.1016/S0377-8398(02)00082-8	Caribbean
Ortiz, Mix & Collier (1995)	https://doi.org/10.1029/95PA02088	California Current
Bé et al. (1985)	https://doi.org/10.1016/0377-8398(85)90002-7	Panama Basin
Ufkes et al. (1998)	https://doi.org/10.1016/S0377-8398(97)00032-7	ES Atlantic
Bergami et al., (2009)	https://doi.org/10.1016/j.marmicro.2009.06.007	Ross Sea
Schiebel and Hemleben (2000)	https://doi.org/10.1016/S0967-0645(00)00008-4	eastern North Atlantic (BIOTRANS)
Schiebel et al., 2002	https://doi.org/10.1016/S0967-0645(02)00141-8	Azores Front
Schiebel et al., 2004	https://doi.org/10.1016/j.marmicro.2004.02.001	Arabian Sea
Rebotim et al., 2017	https://doi.org/10.5194/bg-14-827-2017	eastern North Atlantic
Meilland et al., 2020	https://doi.org/10.5194/bg-17-1437-2020	Barents Sea
Lessa et al., 2020	https://doi.org/10.5194/bg-17-4313-2020	subtropical South Atlantic
Taylor et al., 2018	https://doi.org/10.1016/j.quascirev.2018.05.006	North Pacific
Rippert et al., 2016	https://doi.org/10.1016/j.marmicro.2016.08.004	western Pacific warm pool
Tolderlund and Bé, 1971	https://doi.org/10.2307/1485143	western North Atlantic
Meilland, 2015	PhD thesis	Southern Ocean

Table S2 Collected studies in sediment trap data compilation

Literature	Source	Region
Zaric et al., 2005	https://doi.org/10.1016/j.marmicro.2005.01.002	global
Chapman et al., 2010	https://doi.org/10.1029/2008PA001708	NE Atlantic
Mohtadi et al., 2009	https://doi.org/10.1029/2008PA001636	Java sea

Table S3 Model parameter value and units adapted from EcoGENIE (Ward et al., 2018)

Parameter	Description	Value	Unit	Equation
Cell Quota				
Q_c	Cell carbon content	$1.45E-11 \times V^{0.88}$	mmol C cell ⁻¹	
Q_{min}^P	Minimum P/C quota ratio	3.3E-3	mmol P (mmol C) ⁻¹	2
Q_{max}^P	Maximum P/C quota ratio	1.1E-2	mmol P (mmol C) ⁻¹	2
Q_{min}^{Fe}	Minimum Fe/C quota ratio	1.0E-6	mmol Fe (mmol C) ⁻¹	2
Q_{max}^{Fe}	Maximum Fe/C quota ratio	4.0E-6	mmol Fe (mmol C) ⁻¹	2
Nutrient uptake				
V_{PO4}^m	Maximum PO ₄ uptake rate	$4.4E-2 \times V^{0.06}$	mmol P (mmol C) ⁻¹ d ⁻¹	12
V_{Fe}^m	Maximum Fe uptake rate	$1.4E-4 \times V^{-0.09}$	mmol Fe (mmol C) ⁻¹ d ⁻¹	12
α_{PO4}	Affinity to PO ₄	$1.1 \times V^{-0.35}$	m ³ (mmol C) ⁻¹ d ⁻¹	12
α_{Fe}	Affinity to Fe	$0.175 \times V^{-0.36}$	m ³ (mmol C) ⁻¹ d ⁻¹	12
Temperature				
A	Temperature dependency	0.05		5
T_{ref}	Reference temperature	20	°	5
Loss terms				
γ_{basal}	Respiration loss		mmol C (mmol P) ⁻¹ d ⁻¹	4
m_{basal}	Mortality loss		d ⁻¹	6
Photosynthesis				
P_a	Maximum photosynthesis	3.08		13
P_b	rate definition	5		13
P_c	($P_{a,b,c}$)	-3.08		13
Q_{chl}^m	maximum Chl <i>a</i> /P ratio	48	mg Chl <i>a</i> (mmol P) ⁻¹	16
α	initial P-I curve slope	3.83E-7	mmol C (mg Chl <i>a</i>) ⁻¹ (μEin m ⁻²) ⁻¹	16
Grazing				
K	Half-saturation concentration	5.0	mmol C m ⁻³	7
σ	Prey range	0.5		10
V	Optimal predator:prey size ratio	10		10
\wedge	Grazing refuge strength	-1	(mmol C m ⁻³) ⁻¹	7
G_m	Maximum grazing rate	$21.9 \times V^{-0.16}$	d ⁻¹	7
Carbon flux				

β_{\max}	maximum DOM fraction	0.8		22
β_{\min}	minimum DOM fraction	0.4		22
β_s	Plankton size at which DOM/POM = 1	100	μm	22

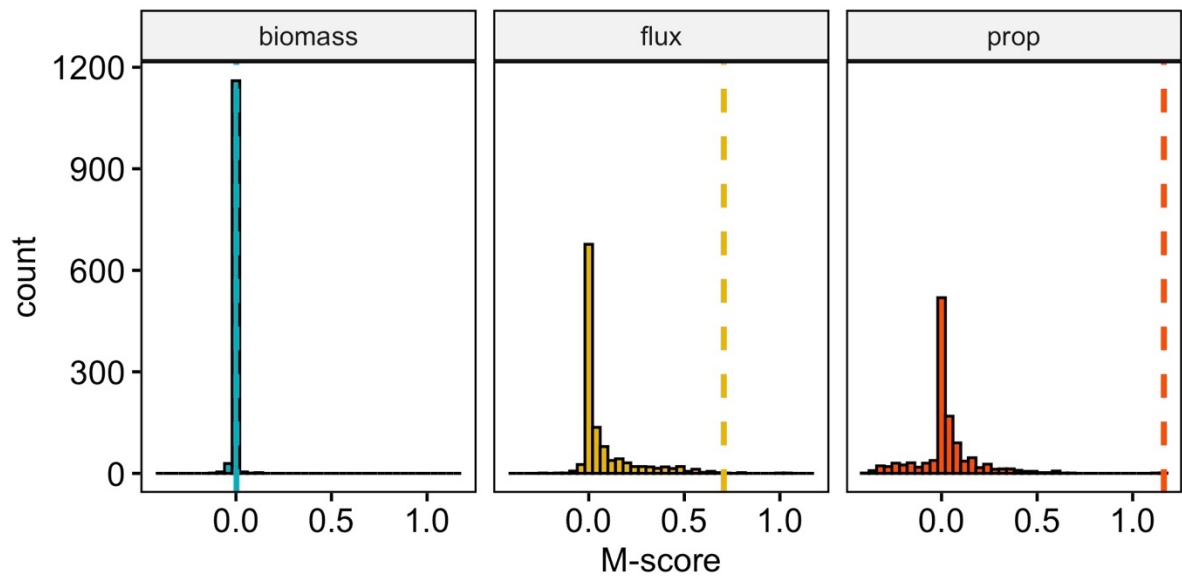


Figure S1 Variable-based M-score distribution histogram of global sensitivity analysis. Dashed line is the M-score of the run with best fit with observational data.

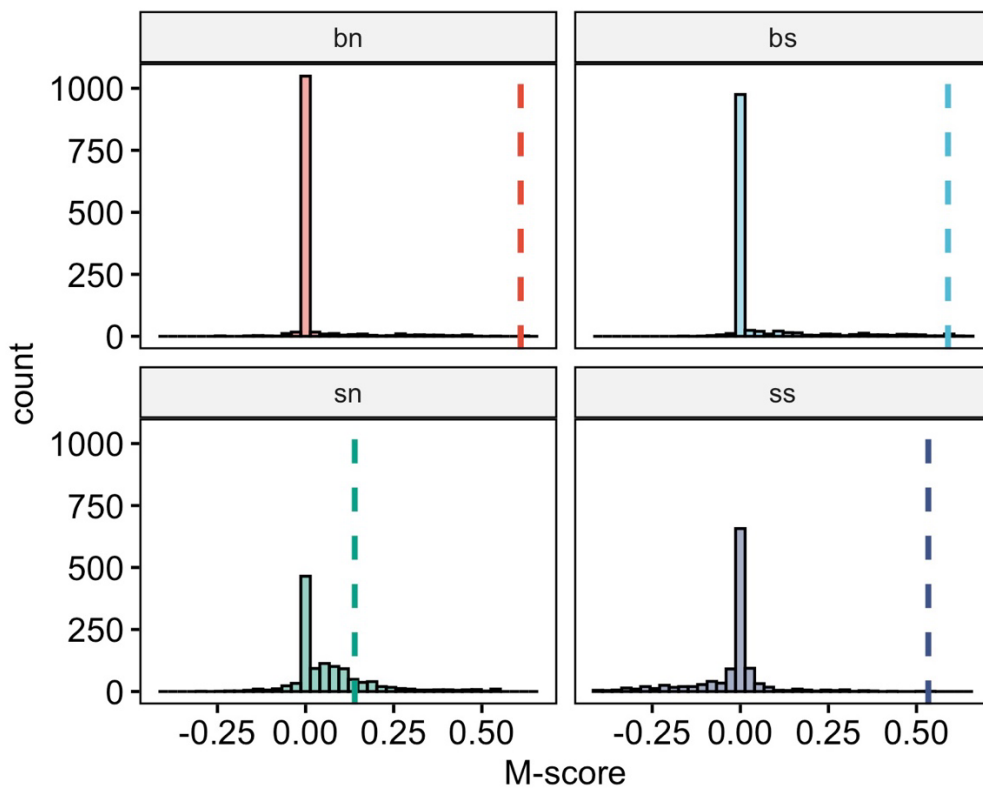


Figure S2 Foraminiferal group-based M-score distribution histogram of global sensitivity analysis. Dashed line is the M-score of best run. bn, symbiont-barren non-spinose; bs, symbiont-barren spinose; sn, symbiont-facultative non-spinose; ss, symbiont-bearing spinose