

Supplementary materials

Tables

Supplementary Table 1. Eco-group classification and taxonomic framework of the 41 planktonic foraminifera (PF) species used in the diversity analyses. The lumped taxonomy follows the morpho-taxonomic concepts of Schiebel and Hemleben (2017), expanded by Morard et al. (2019) and revised by Brummer and Kucera (2022), as implemented in the FORCIS database (Chaabane et al., 2023). For lumped analytical units, the included morphospecies are explicitly indicated in the table. Eco-groups are defined based on symbiont status following Morard et al. (2019) and Takagi et al. (2019).

Species	All species	Major species	Photosymbiont -barren*	Photoymbiont-bearing*	Facultative
<i>Beella digitata</i>	x				
<i>Berggrenia pumilio</i>	x				
<i>Bolivina variabilis</i>	x				
<i>Dentigloborotalia anfracta</i>	x				
<i>Globigerina bulloides</i>	x	x	x		
<i>Globigerina falconensis</i>	x			x	
<i>Globigerinella adamsi</i>	x				
<i>Globigerinella calida</i>	x	x		x	
<i>Globigerinella siphonifera</i>	x	x		x	
<i>Globigerinita glutinata</i>	x	x			x
<i>Globigerinita minuta</i>	x				
<i>Globigerinita uvula</i>	x	x			x
<i>Globigerinoides conglobatus</i>	x	x		x	
<i>Globigerinoides ruber</i> (<i>G. ruber albus</i> + <i>G. elongatus</i> (excl. <i>G. ruber ruber</i>))	x	x		x	
<i>Globigerinoides ruber ruber</i> (treated as distinct morphospecies)	x	x		x	
<i>Globigerinoides tenellus</i>	x			x	
<i>Globoquadrina conglomerata</i>	x	x			
<i>Globorotalia cavernula</i>	x				
<i>Globorotalia crassaformis</i>	x	x			
<i>Globorotalia hirsuta</i>	x	x	x		
<i>Globorotalia inflata</i>	x	x			x
<i>Globorotalia menardii</i>	x	x			x
<i>Globorotalia scitula</i>	x	x	x		
<i>Globorotalia theyeri</i>	x				
<i>Globorotalia truncatulinoides</i> (Left- and right-coiling morphotypes)	x	x	x		

<i>Globorotalia tumida</i>	x				
<i>Globorotalia unguolata</i>	x				
<i>Globorotaloides hexagona</i>	x	x	x		
<i>Globoturborotalita rubescens</i>	x	x		x	
<i>Hastigerina pelagica</i>	x	x	x		
<i>Hastigerinella digitata</i>	x	x	x		
<i>Neogloboquadrina dutertrei</i>	x	x			x
<i>Neogloboquadrina incompta</i>	x	x	x		
<i>Neogloboquadrina pachyderma</i>	x	x	x		
<i>Orbulina universa</i>	x	x		x	
<i>Pulleniatina obliquiloculata</i>	x				x
<i>Sphaeroidinella dehiscens</i>	x			x	
<i>Tenuitellita iota</i>	x				
<i>Trilobatus sacculifer</i> (With and without sac-like final chamber morphotypes)	x	x		x	
<i>Turborotalita humilis</i>	x	x		x	
<i>Turborotalita quinqueloba</i>	x	x	x		

* Based on Morard et al., 2019 and Takagi et al., 2019

Supplementary Table 2. Selected sensitivity tests for each species and diversity model simulations with performance metrics. The model parameters highlighted in green are the ones used to produce the final predictive maps. The first three green rows are the model parameters used to generate maps for *G. bulloides* and the last green rows are the model parameters used to generate maps for diversity. The rows highlighted in yellow represent viable options with different gridding schemes based on R-value but were less favorable by other metrics or produced unrealistic past distribution maps (Appendix 4) and were therefore ranked below the *G. bulloides* row in green. The rows in blue indicate the model parameters that produced the highest R-values for the SSP 2-4.5 scenario using both the ESM and GRNN for the other five species.

*Model runs excluding the 200 samples collected in 2016 and 2017 that were set to 2014 for the analysis.

Model	SSP	Species	Environmental parameters	Coverage	Parameter average	Gridding (lat × lon × time)	Shallow limit (m)	Deep limit (m)	w	d	Spread	n	R	Adjusted R ²	Bias	RMSD	MAE
ESM	2-4.5	<i>G. bulloides</i>	<i>chl</i>	Global	Annual	5°×5°×5	0	100	1,00E+15	0.03	-	2016	0.433	0.19	0.26	0.15	0.29
ESM	2-4.5	<i>G. bulloides</i>	<i>RSDO</i>	Global	Annual	5°×5°×5	0	100	1,00E+15	0.03	-	2003	0.470	0.22	0.15	0.07	0.21
ESM	2-4.5	<i>G. bulloides</i>	<i>t20d</i>	Global	Annual	5°×5°×5	0	100	1,00E+15	0.03	-	2011	0.409	0.17	0.09	0.05	0.16
ESM	2-4.5	<i>G. bulloides</i>	<i>thetao</i>	Global	Annual	5°×5°×5	0	100	1,00E+15	0.03	-	1972	0.312	0.10	0.11	0.06	0.18
ESM	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO</i>	Global	Annual	5°×5°×5	0	100	1,00E+15	0.03	-	2003	0.522	0.27	0.13	0.06	0.19
ESM	2-4.5	<i>G. bulloides</i>	<i>RSDO, t20d</i>	Global	Annual	5°×5°×5	0	100	1,00E+15	0.03	-	1976	0.612	0.37	0.08	0.03	0.14
ESM	2-4.5	<i>G. bulloides</i>	<i>t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	1,00E+15	0.03	-	1936	0.564	0.32	0.07	0.04	0.13

ESM	2-4.5	<i>G. bulloides</i>	<i>RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	1,00E+15	0.03	-	1917	0.620	0.38	0.05	0.03	0.11
ESM	2-4.5	<i>G. bulloides</i>	<i>chl, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	1,00E+15	0.03	-	1936	0.620	0.38	0.06	0.03	0.12
ESM	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	1,00E+15	0.03	-	1966	0.647	0.42	0.04	0.03	0.11
ESM	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	1,00E+10	0.03	-	1966	0.634	0.40	0.04	0.03	0.11
ESM	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	1,00E+20	0.01	-	1733	0.553	0.30	0.01	0.03	0.10
ESM	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	1,00E+30	0.05	-	1993	0.645	0.42	0.05	0.03	0.11
GRNN	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	-	-	0.001	-	0.553	0.30	-0.14	0.19	0.22
GRNN	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	-	-	0.005	-	0.595	0.35	-0.15	0.20	0.23
GRNN	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	-	-	0.01	-	0.551	0.30	-0.07	0.18	0.25
ESM	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Summer (Mar-Aug)	5°×5°×5	0	100	1,00E+15	0.03	-	1878	0.441	0.19	-0.09	0.19	0.23
ESM	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Winter (Sep-Feb)	5°×5°×5	0	100	1,00E+15	0.03	-	1608	0.596	0.35	-0.09	0.14	0.20
ESM	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	2°×2°×5	0	100	1,00E+15	0.03	-	11143	0.655	0.43	0.00	0.02	0.09
ESM	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×10°×5	0	100	1,00E+15	0.03	-	962	0.670	0.45	-0.12	0.16	0.23

ESM	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	NH	Annual	5°×5°×5	0	100	1,00E+15	0.03	-	203	0.603	0.35	-0.03	0.08	0.16
ESM	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	NH	Annual	2°×2°×5	0	100	1,00E+15	0.03	-	959	0.337	0.11	-0.03	0.17	0.28
ESM	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	50	1,00E+15	0.03	-	1839	0.402	0.16	0.12	0.08	0.22
ESM	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	150	1,00E+15	0.03	-	1908	0.592	0.35	0.01	0.03	0.11
ESM	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	50	150	1,00E+15	0.03	-	1407	0.501	0.25	0.01	0.04	0.11
ESM	1-2.6	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global*	Annual	5°×5°×5	0	100	1,00E+15	0.03	-	1965	0.625	0.39	0.05	0.03	0.11
ESM	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global*	Annual	5°×5°×5	0	100	1,00E+15	0.03	-	1966	0.628	0.39	0.05	0.03	0.11
ESM	3-7.0	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global*	Annual	5°×5°×5	0	100	1,00E+15	0.03	-	1971	0.629	0.40	0.05	0.03	0.11
GRNN	1-2.6	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global*	Annual	5°×5°×5	0	100	-	-	0.005	-	0.581	0.34	-0.14	0.20	0.24
GRNN	2-4.5	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global*	Annual	5°×5°×5	0	100	-	-	0.005	-	0.586	0.34	-0.15	0.20	0.23
GRNN	3-7.0	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global*	Annual	5°×5°×5	0	100	-	-	0.005	-	0.588	0.35	-0.15	0.20	0.23
ESM	1-2.6	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	1,00E+15	0.03	-	1965	0.644	0.41	0.04	0.03	0.11

ESM	3-7.0	<i>G. bulloides</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	1,00E+15	0.03	-	1971	0.648	0.42	0.04	0.03	0.11
ESM	2-4.5	<i>G. ruber</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	1,00E+25	0.04	-	1985	0.815	0.66	0.03	0.02	0.10
GRNN	2-4.5	<i>G. ruber</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	-	-	0.005	-	0.631	0.40	-0.11	0.14	0.24
ESM	2-4.5	<i>N. dutertrei</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	1,00E+25	0.02	-	1943	0.806	0.65	0.11	0.03	0.12
GRNN	2-4.5	<i>N. dutertrei</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	-	-	0.001	-	0.656	0.43	-0.03	0.16	0.21
ESM	2-4.5	<i>T. sacculifer</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	1,00E+30	0.03	-	1972	0.832	0.69	0.09	0.02	0.11
GRNN	2-4.5	<i>T. sacculifer</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	-	-	0.001	-	0.646	0.42	-0.14	0.18	0.26
ESM	2-4.5	<i>N. incompta</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	1,00E+30	0.01	-	1830	0.831	0.69	0.05	0.01	0.06
GRNN	2-4.5	<i>N. incompta</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	-	-	0.0007	-	0.785	0.62	-0.01	0.03	0.07
ESM	2-4.5	<i>N. pachyderma</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	1,00E+30	0.02	-	1943	0.797	0.64	0.05	0.02	0.06
GRNN	2-4.5	<i>N. pachyderma</i>	<i>chl, RSDO, t20d, thetao</i>	Global	Annual	5°×5°×5	0	100	-	-	0.001	-	0.742	0.55	-0.07	0.11	0.13