

Auxiliary information

EnKF assimilated controlling biogeochemical parameters in the GENIE-1 model.

Parameter name	Mean and range ^a of priors associated with the assimilations ^b : PA_8 / PAC_8 / PAC_10	8-parameter assimilation ^c 'PA_8'	8-parameter assimilation ^{d,e} 'PAC_8'	10-parameter assimilation ^d 'PAC_10'	Parameter description and units (see <i>Ridgwell et al.</i> [2006a])
$u_0^{\text{PO}_4}$	1.65 (0.3-3.0) / = = / = =	1.91	1.96 (\pm 0.34)	1.97	maximum PO ₄ uptake rate ($\mu\text{mol kg}^{-1} \text{ yr}^{-1}$)
K^{PO_4}	0.2 (0.1-0.3) / = = / = =	0.21	0.22 (\pm 0.065)	0.22	PO ₄ half-saturation concentration ($\mu\text{mol kg}^{-1}$)
r^{POC}	0.05 (0.02-0.08) / = = / = =	0.055	0.065 (\pm 0.011)	0.068	partitioning of POC export into fraction #2
l^{POC}	600 (200-1000) / = = / = =	556	550 (\pm 59)	562	<i>e</i> -folding depth of POC fraction #1 (m)
l_2^{POC}	fixed (n/a) / = = / 11000 (200-20000)	∞	∞	11766	<i>e</i> -folding depth of POC fraction #2 (m)
$r_0^{\text{CaCO}_3:\text{POC}}$	0.036 (0.015-0.088) / 0.046 (0.015-0.15) / = =	0.022	0.044 (+0.038 / -0.024) ^f	0.038	CaCO ₃ :POC export 'rain ratio' scalar ^g
η	1.5 (1-2) / 0.75 (0-1.50) / = =	1.28	0.81 (\pm 0.28)	0.91	calcification rate power
r^{CaCO_3}	0.4 (0.2-0.6) / = = / = =	0.489	0.468 (\pm 0.07)	0.627	partitioning of CaCO ₃ export into fraction #2
l^{CaCO_3}	600 (200-1000) / = = / = =	1055	1083 (\pm 244)	952	<i>e</i> -folding depth of CaCO ₃ fraction #1 (m)
$l_2^{\text{CaCO}_3}$	fixed (n/a) / = = / 11000 (2000-20000)	∞	∞	10088	<i>e</i> -folding depth of CaCO ₃ fraction #2 (m)

^a the parameter value range (listed in parentheses) is quoted as 1 standard deviation either side of the mean

^b in the format, we use the symbol '=' to indicate values of prior mean and range identical to the previously listed experiment (i.e., immediately to the left of the '/')

^c parameter values from the ocean-only geochemical data assimilation of *Ridgwell et al.* [2006a]

^d parameter values from the present study – with the assimilation of sedimentary carbonate content in addition to PO₄ and ALK

^e parameter values also quoted is 1 standard deviation of the calibrated parameter value

^f the \pm standard deviation values differ because EnKF calibration of this particular parameter was carried out in log space

^g Note that the rain ratio scalar parameter is not the same as the actual CaCO₃:POC export rain ratio because it is multiplied by $(\Omega - 1)^\eta$ where Ω is the surface ocean saturation state (with respect to calcite), as described in *Ridgwell et al.* [2006a]. Pre-industrial mean ocean surface Ω is ~5.2 in the GENIE-1 model, so that the global CaCO₃:POC export rain ratio can be estimated using the 8-parameter assimilation ^d as being equal to $(5.2 - 1)^{0.81} \times 0.044 = 0.14$.