



Supplement of

Variable particle size distributions reduce the sensitivity of global export flux to climate change

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Figure S1: PRiSM-calculated particle flux profiles with varying surface β values. Larger β values correspond with smaller particles.



Figure S2: Annual means of all nine monthly time series of global export considered here, computed from all possible permutations of three net primary productivity (NPP) and three e-ratio (export/NPP) algorithms (described in Section 2.2.2). Units are molC m^{-2} yr⁻¹. NPP algorithm key: VGPM = the Vertically Generalized Production Model (VGPM) (Behrenfeld & Falkowski, 1997); VGPME = the Eppley-VGPM model (Carr et al., 2006); CbPM = the Carbon-based Production Model (Behrenfeld et al., 2005). E-ratio algorithm key: L2000 = Laws et al. (2000); D2005 = Dunne et al. (2005); L2011 = Laws et al. (2011).



Figure S3: All nine monthly β versus time-mean normalized export $(\frac{d\beta_{sat}}{dE_{n,sat}})$, unitless) maps considered here. Title colors correspond to the NPP and e-ratio export combinations in Fig. 4a.



Figure S4: Example β and time-mean normalized export (E_n) time series at the randomly chosen grid points within each ocean region shown in the map. The first letter of each ocean region name denotes the location of the chosen grid point. All E_n time series shown here are derived from combining VGPM NPP and D2005 e-ratio. $\frac{d\beta_{sat}}{dE_{n,sat}}$ values are calculated over the entire SeaWiFS period (September 1997 – December 2010), but we show only a random subset of these years for visual clarity.



Figure S5: Example β and time-mean normalized export (E_n) time series at the randomly chosen grid point within the SAZ (Subantarctic Zone) denoted in the map in Fig. S4. The NPP and e-ratio algorithms used to derive the E_n time series are denoted above each subplot. $\frac{d\beta_{sat}}{dE_{n,sat}}$ values are calculated over the entire SeaWiFS period (September 1997 – December 2010), but we show only a random subset of these years for visual clarity.

Particle			
parameters	Definition	Units	Value
$D_{L}(z'=0)$	Largest particle diameter at surface	um	2000
$D_{\rm S}(z'=0)$	Smallest particle diameter at surface	um	20
c _w	Coefficient in the relationship between particle sinking velocity and	$m^{(1-\eta)} day^{-1}$	2.2e5
	particle size		
η	Exponent in the relationship between particle sinking velocity and	Unitless	1.17
	particle size		
c _r	Degradation rate of sinking particles	day ⁻¹	1/29
ζ	Exponent in the relationship between particle mass and particle size	Unitless	1.62
5			
Biogeochemical			

Diogeoenenneai			
parameters	Definition	Units	Value
τ	Nutrient restoring timescale	days	30
κ	DOP to PO ₄ first-order decay rate	year ⁻¹	0.5
σ	Fraction of production routed directly to DOP in the euphotic zone	Unitless	0.1
Z_S	Nominal mixing depth	m	115

Table S1: PRiSM parameter values (reproduced from T	Table 1 in DeVries	et al., 2014 - see	DeVries et al.,	2014 for the
equations in which the parameters are	e used)				

Parameter	Definition	Units	Value
To	Reference temperature	°C	25
μ_{max}	Maximum growth rate at reference temperature	year-1	365.25
K _p	Half-saturation coefficient for PO ₄ uptake	mmol m ⁻³	0.1
KI	Saturating light level	W m ⁻²	40
\mathbf{k}_{T}	Temperature sensitivity of growth	Unitless	0.03
m_1	Linear mortality rate	year-1	36.525
m_2	Quadratic mortality rate	year-1 mmol-1 m ³	3652.5

Table S2: Prognostic production scheme parameter values, with minor differences from those used in Weber and Deutsch (2012). These parameter values were re-derived by matching model surface PO_4 values with World Ocean Atlas observations on a 2-degree horizontal grid, in contrast with the 4-degree grid used in Weber and Deutsch (2012).

Export algorithms	AAZ region	SAZ region	STA region	STP region	ETA region	ETP region	NA region	NP region
VGPM NPP								
+ e-ratio from:								
Laws 2000	0.1139	0.3207	0.2308	0.0504	0.0656	0.0656	0.0478	0.0000
Dunne 2005	0.1508	0.2328	0.1677	0.0300	0.0729	0.0729	0.0697	0.0026
Laws 2011	0.0927	0.0454	0.0975	0.0208	0.0445	0.0445	0.1169	0.1855
VGPM-Eppley NPP								
+ e-ratio from:								
Laws 2000	0.1507	0.0420	0.1419	0.0663	0.1213	0.1213	0.1184	0.1197
Dunne 2005	0.1349	0.0212	0.0993	0.0435	0.1516	0.1516	0.1294	0.2379
Laws 2011	0.0622	0.0036	0.0636	0.0292	0.1080	0.1080	0.1308	0.1211
CbPM NPP								
+ e-ratio from:								
Laws 2000	0.0478	0.2014	0.0900	0.2688	0.1667	0.1667	0.1263	0.0107
Dunne 2005	0.1215	0.1141	0.0640	0.2695	0.1047	0.1047	0.1322	0.0978
Laws 2011	0.1255	0.0188	0.0451	0.2216	0.1648	0.1648	0.1286	0.2247
Sum	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table S3: Regional weights for export map calculation (reproduced from Table S2 in Weber et al., 2016)