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Supplement of

Diazotrophy as the main driver of the oligotrophy gradient in the western tropical South Pacific Ocean: results from a one-dimensional biogeochemical–physical coupled model

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Supplementary material

Symbol	Definition	Units	Value	Value	Value	Value	Value	Value
			HNF	BAC	PHYS	UCYN	PHYL	TRI
<i>DOP assimilation</i>								
K_{LDOP}	Half-saturation constant for LDOP	mol.L ⁻¹	-	6.62 10 ⁻⁷	6.57 10 ⁻⁷	6.57 10 ⁻⁷	5.66 10 ⁻⁶	5.66 10 ⁻⁶
<i>Intracellular contents</i>								
Q_P^{min}	minimum phosphate content	mol.cell ⁻¹	1.27 10 ⁻¹²	1.15 10 ⁻¹⁵	-	-	-	-
Q_P^{max}	maximum phosphate content	mol.cell ⁻¹	3 Q_P^{min}	3 Q_P^{min}	-	-	-	-
Q_N^{min}	minimum nitrogen content	mol.cell ⁻¹	16 Q_P^{min}	16 Q_P^{min}	-	-	-	-
Q_N^{max}	maximum nitrogen content	mol.cell ⁻¹	3 Q_N^{min}	3 Q_N^{min}	-	-	-	-
Q_C^{min}	minimum carbon content	mol.cell ⁻¹	106 Q_P^{min}	106 Q_P^{min}	-	-	-	-
Q_C^{max}	maximum carbon content	mol.cell ⁻¹	3 Q_C^{min}	3 Q_C^{min}	-	-	-	-
<i>Nutrients assimilation</i>								
$V_{NO_3}^{max}$	Maximum uptake rate for NO ₃	mol.cell ⁻¹ .s ⁻¹	$\mu \cdot Q_N^{max}$	$\mu \cdot Q_N^{max}$	-	-	-	-
$V_{NH_3}^{max}$	Maximum uptake rate for NH ₄	mol.cell ⁻¹ .s ⁻¹	$\mu \cdot Q_N^{max}$	$\mu \cdot Q_N^{max}$	-	-	-	-
$V_{PO_4}^{max}$	Maximum uptake rate for PO ₄	mol.cell ⁻¹ .s ⁻¹	$\mu \cdot Q_P^{max}$	$\mu \cdot Q_P^{max}$	-	-	-	-
V_{DON}^{max}	Maximum uptake rate for DON	mol.cell ⁻¹ .s ⁻¹	$\mu \cdot Q_N^{max}$	$\mu \cdot Q_N^{max}$	-	-	-	-
V_{DOP}^{max}	Maximum uptake rate for DOP	mol.cell ⁻¹ .s ⁻¹	$\mu \cdot Q_N^{max}$	$\mu \cdot Q_P^{max}$	-	-	-	-
			DETS-C	DETL-C	DETS-N	DETL-N	DETS-P	DETL-P
<i>Particulate matter hydrolysis and sink</i>								
ω	sinking rate	m.d ⁻¹	1.0	25.0	1.0	25.0	1.0	25.0
TT_{DET_P}	Turnover time for DET-P	d ⁻¹					0.5	0.5

Table 1. Model parameters which differ from Alekseenko et al. (2014) mentioned in Section 2.2.2, with μ = maximum growth rate

Symbol	Definition	Value	Value	Units
		TRI	UCYN	
<i>Growth and Intracellular contents</i>				
μ_{max}	maximum growth rate	$2.08 \cdot 10^{-6}$	$3.2 \cdot 10^{-5}$	s^{-1}
k_m	specific natural mortality rate	$1.16 \cdot 10^{-6}$	$1.16 \cdot 10^{-6}$	s^{-1}
Q_C^{min}	minimum cell quota of C	$2.28 \cdot 10^{-10}$	$6.84 \cdot 10^{-15}$	$mol.cell^{-1}$
Q_C^{max}	maximum cell quota of C	$6.84 \cdot 10^{-15}$	$2.05 \cdot 10^{-14}$	$mol.cell^{-1}$
Q_N^{min}	minimum cell quota of N	$3.44 \cdot 10^{-11}$	$1.03 \cdot 10^{-15}$	$mol.cell^{-1}$
Q_N^{max}	maximum cell quota of N	$1.03 \cdot 10^{-10}$	$3.09 \cdot 10^{-15}$	$mol.cell^{-1}$
Q_P^{min}	minimum cell quota of P	$3.44 \cdot 10^{-11}$	$1.03 \cdot 10^{-15}$	$mol.cell^{-1}$
Q_P^{max}	maximum cell quota of P	$1.03 \cdot 10^{-10}$	$3.09 \cdot 10^{-15}$	$mol.cell^{-1}$
Q_{CN}^{min}	minimum cell C:N ratio	5.0	5.0	$mol.mol^{-1}$
Q_{CN}^{max}	maximum cell C:N ratio	19.8	19.8	$mol.mol^{-1}$
Q_{CP}^{min}	minimum cell C:P ratio	35.33	35.33	$mol.mol^{-1}$
Q_{CP}^{max}	maximum cell C:P ratio	318.0	318.0	$mol.mol^{-1}$
<i>Nutrients assimilation</i>				
K_{NO3-}	Half-saturation constant for $NO3-$	$1.85 \cdot 10^{-6}$	$7.6 \cdot 10^{-6}$	$mol.L^{-1}$
V_{NO3-}^{max}	Maximum uptake rate for $NO3-$	$3.16 \cdot 10^{-15}$	$9.91 \cdot 10^{-20}$	$mol.cell^{-1}.s^{-1}$
K_{NH4+}	Half-saturation constant for $NH4+$	$7.0 \cdot 10^{-6}$	$1.69 \cdot 10^{-6}$	$mol.L^{-1}$
V_{NH4+}^{max}	Maximum uptake rate for $NH4+$	$3.16 \cdot 10^{-15}$	$9.91 \cdot 10^{-20}$	$mol.cell^{-1}.s^{-1}$
$K_{PO4^{3-}}$	Half-saturation constant for $PO4^{3-}$	$1.4 \cdot 10^{-6}$	$2.62 \cdot 10^{-7}$	$mol.L^{-1}$
$V_{PO4^{3-}}^{max}$	Maximum uptake rate for $PO4^{3-}$	$1.98 \cdot 10^{-16}$	$6.19 \cdot 10^{-21}$	$mol.cell^{-1}.s^{-1}$
K_{DON}	Half-saturation constant for DON	$4.32 \cdot 10^{-5}$	$1.05 \cdot 10^{-5}$	$mol.L^{-1}$
V_{DON}^{max}	Maximum uptake rate for DON	$3.16 \cdot 10^{-15}$	$9.91 \cdot 10^{-20}$	$mol.cell^{-1}.s^{-1}$
K_{DOP}	Half-saturation constant for DOP	$3.4 \cdot 10^{-6}$	$6.57 \cdot 10^{-7}$	$mol.L^{-1}$
V_{DOP}^{max}	Maximum uptake rate for DOP	$3.16 \cdot 10^{-15}$	$6.19 \cdot 10^{-21}$	$mol.cell^{-1}.s^{-1}$
<i>Diazotrophy process</i>				
$Nase_{prod}^{max}$	Maximum rate of increase of nitrogenase activity	$1.17 \cdot 10^{-21}$	$3.51 \cdot 10^{-26}$	$mol.cell^{-1}.s^{-2}$
$Nase_{decr}^{max}$	Maximum rate of decay of nitrogenase activity	$9.36 \cdot 10^{-22}$	$2.83 \cdot 10^{-26}$	$mol.cell^{-1}.s^{-2}$
K_{Nase}	Coefficient of nitrogenase degradation	$9.44 \cdot 10^{-16}$	$1.92 \cdot 10^{-20}$	$mol.cell^{-1}.s^{-1}$
$COST_{DIAZO}$	Respiration cost for nitrogen fixation	1.5	1.5	$mol.mol^{-1}$
$EXUD_{DON}$	Exudation part of N_2 fixed towards DON	0.5	0.5	-
$EXUD_{NH_4}$	Exudation part of N_2 fixed towards NH_4	0.5	0.5	-

Table 2. Model Parameters relative to diazotroph organisms TRI and UCYN

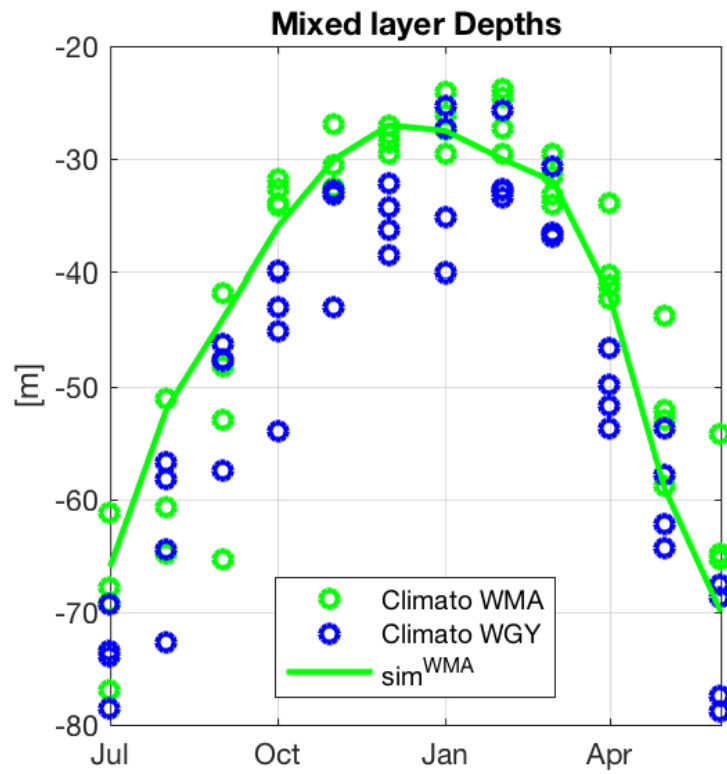


Figure SM 1 Temporal dynamics of the *in situ* mixed layer depths estimated using a climatology (de Boyer Montégut et al., 2004) at WMA (green circles) and WGY (blue circles), and simulated by the model (green line)

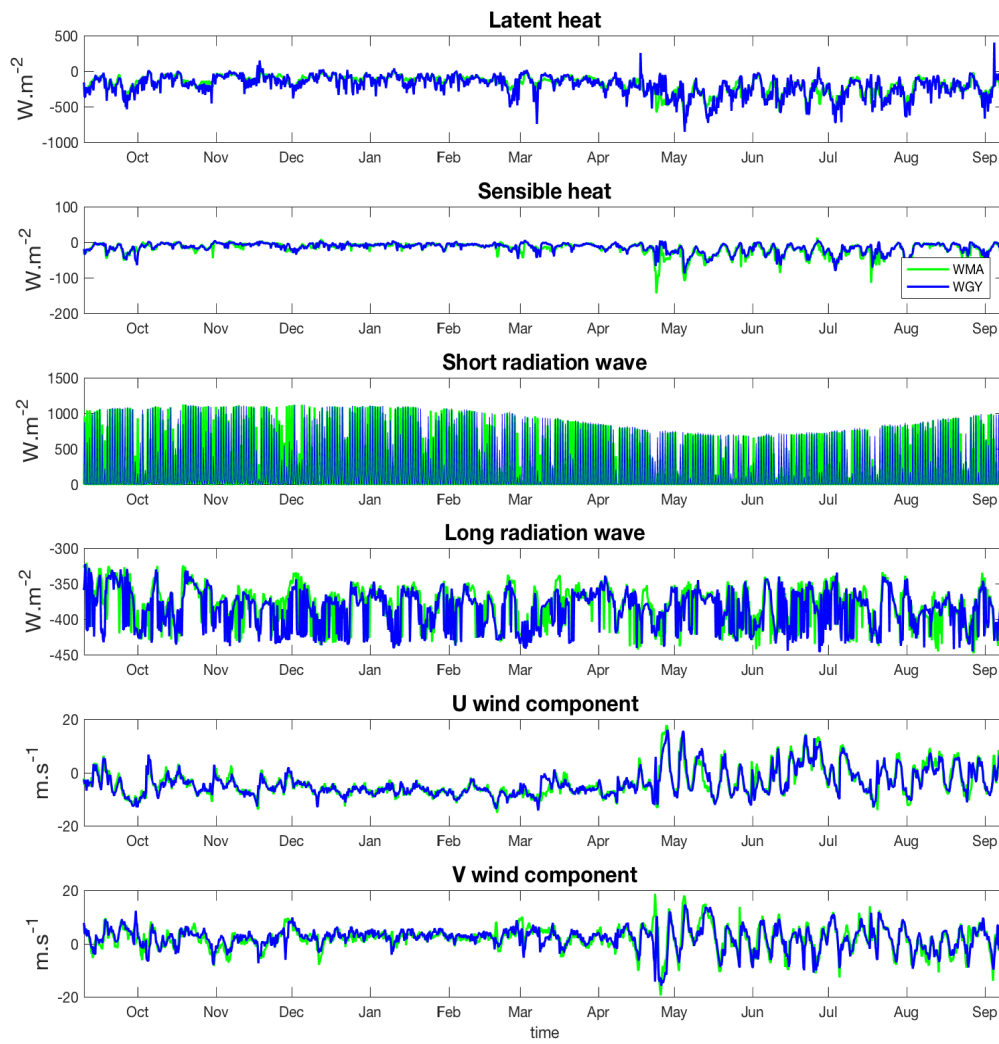


Figure SM 2 Atmospheric forcings provided by the Weather Research Forecast model and extracted at the WMA (green) and WGY (blue) locations from September 2014 to September 2015

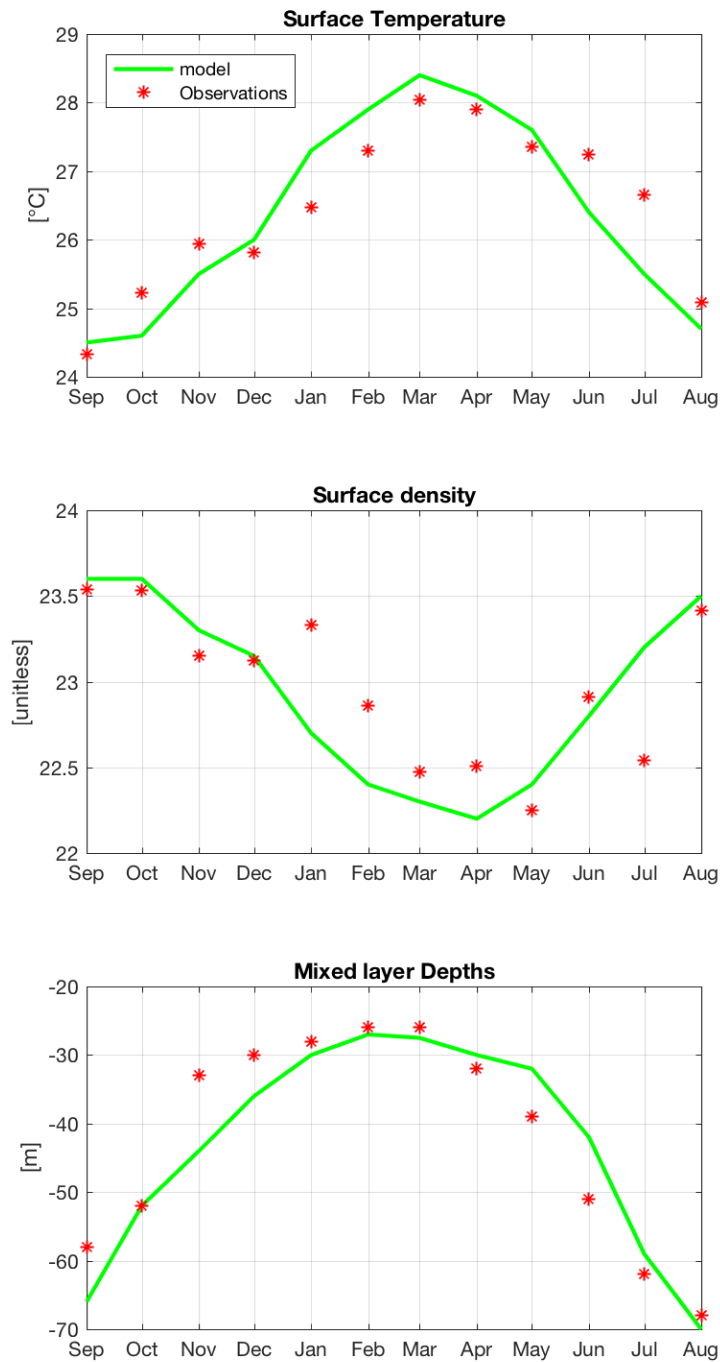


Figure SM 3 Evolution of monthly averaged (a) sea surface temperature (SST), (b) surface density and (c) mixed layer depths (MLD) from September 2014 to August 2015 predicted by the model (green line) and calculated with climatologies (WOA13 for SST and Surface density, and de Boyer Montegut et al., 2004 for MLD)