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Nitrite cycling in the primary nitrite maxima of the eastern tropical North Pacific

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Supplemental Tables and Figures

Table S1. Table of Station Summary Features – (a) Station specific water column features are listed for each station from the 2016 PPS dataset. (b) Means are presented in the second table for all stations in the PPS2016 dataset, as well as means for the 'offshore' and 'coastal' station groupings (13,14,15,16 and 6,7,8,9, respectively). (c) Table of regression coefficients for water column features versus concentrations of the nitrite maxima and depth of the nitrite maxima.

(a)

Summary of PPS Stations

Station	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0
PNM_max	0.3	0.4	0.1	0.3	0.7	0.8	1.0	1.2	1.4	0.5	0.5	0.7	0.5	0.5	0.8	0.3
PNM_depth	70.6	102.0	72.9	53.4	66.7	42.1	56.9	38.1	45.2	81.2	76.8	103.0	92.5	96.0	99.2	86.1
PNM_top	60.5	80.8	64.1	47.2	58.7	26.8	27.0	28.7	38.8	NA	66.5	92.4	78.8	80.5	94.2	81.2
PNM_sig	24.5	24.7	24.5	23.7	24.5	22.7	24.1	23.2	23.8	23.7	23.9	24.1	24.5	22.3	24.1	23.1
Temp_max	19.6	21.0	21.9	24.3	25.2	25.9	26.6	27.3	28.7	29.5	29.2	28.0	27.7	26.0	27.0	24.0
TempPNM	18.9	18.0	18.8	22.4	19.6	19.2	20.9	23.7	21.8	22.2	21.4	21.0	19.2	19.5	20.9	19.2
NH4PNM	0.3	0.0	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MLD	71.1	75.8	54.0	14.7	28.1	20.2	22.8	21.0	16.3	24.6	25.6	45.0	19.6	20.3	36.9	14.8
Chl_max	4.5	4.7	8.9	7.1	7.0	14.2	9.9	48.5	11.1	12.2	7.8	6.2	6.1	5.4	5.0	9.5
PARChl	0.7	0.8	0.6	1.2	1.3	1.5	1.7	4.1	1.5	1.9	0.4	0.3	6.8	2.9	0.7	1.6
Chl_depth	69.2	75.0	78.7	66.6	48.5	34.3	52.4	36.9	46.2	64.4	74.1	90.2	63.0	69.6	89.5	76.7
Chl_sig	24.5	24.3	24.7	24.0	23.7	23.9	23.8	23.2	23.9	22.3	23.6	23.2	23.0	23.2	23.4	24.1
Nitracline	96.6	105.0	79.7	54.2	54.3	55.9	61.2	38.7	41.8	81.9	75.0	93.6	93.2	110.0	118.0	110.0
Nitracline_top	69.7	102.0	60.2	50.2	53.7	31.1	34.0	29.8	40.0	74.2	72.6	93.2	81.5	90.2	95.0	83.8
NitPNM	1.3	1.7	8.5	5.3	9.4	14.3	20.1	19.5	12.9	7.7	15.6	8.7	7.3	4.4	7.4	2.1
NitChl	1.1	NaN	12.1	16.7	-0.1	4.5	8.6	15.2	13.1	0.9	5.2	0.0	0.4	0.2	0.9	0.0
ChlPNM	4.2	1.6	3.6	1.4	2.4	1.6	5.0	28.1	5.2	4.7	3.0	2.2	2.0	2.7	2.7	3.0
Oxycline_top	65.0	65.0	63.7	52.8	40.0	22.0	42.0	32.8	33.0	58.0	65.0	85.0	60.0	60.0	85.0	70.0
OxyPNM	227.0	151.0	173.0	219.0	101.0	31.5	63.7	149.0	56.7	85.6	65.8	74.8	63.2	120.0	86.6	164.0
pPAR1	64.8	74.8	73.2	NA	50.9	38.3	57.1	45.6	49.0	70.2	64.4	86.4	NA	84.1	84.9	83.3
PARPNM	0.7	0.2	1.0	3.8	0.2	0.7	1.0	3.1	1.8	0.3	0.7	0.1	0.5	0.3	0.3	0.8
PNM_dist_Nittop	1.0	0.4	12.7	3.2	13.0	-29.1	22.9	8.2	4.7	6.9	4.3	9.8	11.0	-87.7	16.9	-81.3
PNM_dist_Oxytop	41.4	NA	9.2	0.6	38.8	NA	28.7	5.2	22.2	53.3	48.7	56.2	54.1	-44.7	61.0	-18.0
PNM_dist_Chl	1.4	27.0	-5.8	-13.2	18.2	-32.2	4.5	1.2	-1.1	16.8	2.7	12.7	29.6	-67.1	9.7	-74.1
PNM_dist_pPAR1	5.8	27.2	-0.3	NA	15.8	-36.3	-0.2	-7.5	-3.8	11.0	12.4	16.5	NA	-81.6	14.3	-80.7
Int_Chl	159.0	146.0	182.0	161.0	192.0	217.0	214.0	295.0	195.0	247.0	155.0	178.0	204.0	184.0	156.0	186.0
Int_NO3	513.0	84.7	987.0	1350.0	1120.0	2170.0	1670.0	2510.0	2120.0	978.0	1150.0	369.0	506.0	330.0	396.0	357.0
Int_NO2	13.2	11.1	2.4	19.0	21.3	28.1	48.4	45.7	31.7	13.2	18.3	16.4	21.5	22.4	18.1	14.1
Int_NH4	36.0	2.6	7.2	3.5	3.2	2.3	0.2	3.1	1.1	1.3	0.9	0.3	0.2	0.2	0.2	0.2
ChlxNO3_ln	1.0	0.9	7.6	2.4	5.3	4.4	14.9	83.6	13.4	9.6	8.2	4.7	4.0	4.0	5.5	2.2
OxyxNO3_ln	57.0	82.6	370.0	367.0	225.0	83.8	191.0	443.0	145.0	174.0	181.0	162.0	126.0	178.0	173.0	122.0
Sig_slope	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.0
NH4_depth_manual	86.0	86.0	68.0	50.0	56.0	35.0	50.0	35.0	42.0	75.0	75.0	98.0	85.0	40.0	96.0	80.0
NH4_max_manual	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sigma_slope	-70.0	-35.0	-25.0	-42.0	-24.0	-14.0	-12.0	-12.0	-9.6	-9.7	-11.0	-12.0	-29.0	-19.0	-15.0	-42.0

(b)

PPS Station Characteristics

column	n	mean	sd	min	max	se
Station	16	8.50	4.76	1.00	16.00	1.19
PNM_max	16	0.63	0.35	0.06	1.37	0.09
PNM_depth	16	73.92	21.93	38.10	103.00	5.48
PNM_top	15	61.75	23.41	26.80	94.20	6.05
PNM_sig	16	24.16	0.41	23.20	24.70	0.10
Temp_max	16	25.74	2.93	19.60	29.50	0.73
TempPNM	16	20.42	1.60	18.00	23.70	0.40
NH4PNM	16	0.05	0.07	0.00	0.27	0.02
MLD	16	31.92	19.51	14.70	75.80	4.88
Chl_max	16	10.51	10.52	4.53	48.50	2.63
PARChl	16	1.76	1.65	0.35	6.79	0.41
Chl_depth	16	64.71	16.94	34.30	90.20	4.23
Chl_sig	16	23.68	0.61	22.30	24.70	0.15
Nitracline	16	79.32	25.76	38.70	118.00	6.44
Nitracline_top	16	66.33	24.23	29.80	102.00	6.06
NitPNM	16	9.14	5.90	1.29	20.10	1.48
NitChl	15	5.25	6.20	-0.15	16.70	1.60
ChlPNM	16	4.59	6.39	1.43	28.10	1.60
Oxycline	14	76.26	26.93	41.40	133.00	7.20
Oxycline_top	16	56.21	18.08	22.00	85.00	4.52
OxyPNM	16	114.49	59.55	31.50	227.00	14.89
pPAR1	14	66.21	16.01	38.30	86.40	4.28
PARPNM	16	0.97	1.06	0.12	3.78	0.27
PNM_dist_Nittop	16	-5.19	32.90	-87.70	22.90	8.23
PNM_dist_Oxytop	14	25.49	31.50	-44.70	61.00	8.42

Coastal Station Characteristics

column	n	mean	sd	min	max	se
Station	4	7.50	1.29	6.00	9.00	0.65
PNM_max	4	1.12	0.23	0.85	1.37	0.11
PNM_depth	4	45.58	8.09	38.10	56.90	4.05
PNM_top	4	30.32	5.71	26.80	38.80	2.86
PNM_sig	4	23.92	0.59	23.20	24.60	0.29
Temp_max	4	27.12	1.20	25.90	28.70	0.60
TempPNM	4	21.40	1.87	19.20	23.70	0.94
NH4PNM	4	0.07	0.08	0.01	0.18	0.04
MLD	4	20.08	2.74	16.30	22.80	1.37
Chl_max	4	20.93	18.47	9.91	48.50	9.24
PARChl	4	2.19	1.27	1.47	4.10	0.64
Chl_depth	4	42.45	8.37	34.30	52.40	4.19
Chl_sig	4	23.70	0.34	23.20	23.90	0.17
Nitracline	4	49.40	10.86	38.70	61.20	5.43
Nitracline_top	4	33.73	4.54	29.80	40.00	2.27
NitPNM	4	16.70	3.63	12.90	20.10	1.82
NitChl	4	10.35	4.79	4.46	15.20	2.39
ChlPNM	4	9.99	12.19	1.65	28.10	6.09
Oxycline	3	44.37	3.69	41.40	48.50	2.13
Oxycline_top	4	32.45	8.18	22.00	42.00	4.09
OxyPNM	4	75.22	51.09	31.50	149.00	25.55
pPAR1	4	47.50	7.80	38.30	57.10	3.90
PARPNM	4	1.64	1.08	0.68	3.12	0.54
PNM_dist_Nittop	4	1.68	21.98	-29.10	22.90	10.99
PNM_dist_Oxytop	3	18.71	12.11	5.24	28.70	6.99

Offshore Station Characteristics

column	n	mean	sd	min	max	se
Station	4	14.50	1.29	13.00	16.00	0.65
PNM_max	4	0.53	0.19	0.30	0.75	0.09
PNM_depth	4	93.45	5.61	86.10	99.20	2.81
PNM_top	4	83.67	7.09	78.80	94.20	3.54
PNM_sig	4	24.30	0.16	24.10	24.50	0.08
Temp_max	4	26.18	1.61	24.00	27.70	0.80
TempPNM	4	19.70	0.81	19.20	20.90	0.41
NH4PNM	4	0.00	0.00	0.00	0.00	0.00
MLD	4	22.90	9.65	14.80	36.90	4.82
Chl_max	4	6.52	2.03	5.04	9.49	1.02
PARChl	4	3.00	2.68	0.72	6.79	1.34
Chl_depth	4	74.70	11.34	63.00	89.50	5.67
Chl_sig	4	23.42	0.48	23.00	24.10	0.24
Nitracline	4	107.80	10.44	93.20	118.00	5.22
Nitracline_top	4	87.62	6.14	81.50	95.00	3.07
NitPNM	4	5.30	2.55	2.11	7.39	1.27
NitChl	4	0.37	0.41	-0.03	0.92	0.20
ChlPNM	4	2.60	0.40	2.02	2.95	0.20
Oxycline	4	84.10	9.66	70.40	93.00	4.83
Oxycline_top	4	68.75	11.81	60.00	85.00	5.91
OxyPNM	4	108.45	43.76	63.20	164.00	21.88
pPAR1	3	84.10	0.80	83.30	84.90	0.46
PARPNM	4	0.48	0.23	0.31	0.81	0.12
PNM_dist_Nittop	4	-35.27	56.95	-87.70	16.90	28.48
PNM_dist_Oxytop	4	13.10	52.55	-44.70	61.00	26.27

(c)

Pearsons R

	$NO_{2}^{-}{}_{max}$	Z_{NO2}
$NO_{2}^{-}{}_{max}$	1.000	-0.521
Z_{NO2}	-0.521	1.000
Chl_{max}	0.527	-0.577
$NH_{4}^{+}{}_{max}$	0.312	-0.494
Z_{chl}	-0.624	0.836
Z_{NH4}	-0.505	0.787
Z_{nit}	-0.549	0.974
Z_{mnit}	-0.583	0.904
Z_{oxy}	-0.575	0.868
Z_{moxy}	-0.520	0.716
Z_{PAR}	-0.593	0.931
Chl_{pnm}	0.502	-0.478
$NH_{4}^{+}{}_{pnm}$	-0.055	-0.411
$NO_{3}^{-}{}_{pnm}$	0.733	-0.623
T_{pnm}	0.552	-0.446
D_{pnm}	-0.484	0.395
PAR_{pnm}	0.253	-0.680
O_{2pnm}	-0.578	0.001
BV_{pnm}	0.664	-0.183
NH_{4}^{+}_Int	0.532	-0.516
NO_{2}^{-}_Int	0.698	-0.941
NO_{3}^{-}_Int	0.853	-0.604
Chl_Int	-0.337	-0.114

P-value

	$NO_{2}^{-}{}_{max}$	Z_{NO2}
$NO_{2}^{-}{}_{max}$	NA	0.03871
Z_{NO2}	0.03871	NA
Chl_{max}	0.03599	0.01923
$NH_{4}^{+}{}_{max}$	0.23958	0.05205
Z_{chl}	0.00985	0.00005
Z_{NH4}	0.04612	0.00030
Z_{nit}	0.02771	0.00000
Z_{mnit}	0.01773	0.00000
Z_{oxy}	0.01978	0.00001
Z_{moxy}	0.05649	0.00398
Z_{PAR}	0.02555	0.00000
Chl_{pnm}	0.04732	0.06117
$NH_{4}^{+}{}_{pnm}$	0.83873	0.11371
$NO_{3}^{-}{}_{pnm}$	0.00122	0.00994
T_{pnm}	0.02669	0.08314
D_{pnm}	0.05762	0.13024
PAR_{pnm}	0.34348	0.00372
O_{2pnm}	0.01907	0.99595
BV_{pnm}	0.00507	0.49852
NH_{4}^{+}_Int	0.03379	0.04074
NO_{2}^{-}_Int	0.00263	0.00000
NO_{3}^{-}_Int	0.00003	0.01325
Chl_Int	0.20223	0.67487

Table S2. In situ rate measurements – Data from all four cruises to the ETNP (a) Source water data for all stations and depths where experimental rates are reported. Some ammonium concentrations reported were below the 30nM detection limit for the quantitation method used (b) Rate measurements for ammonia oxidation, nitrite oxidation, nitrate reduction and nitrite uptake. Table shows standard deviation and limit of detection for experimental bottle replicates associated with each rate measurement. Replicate bottles for nitrite uptake measurements were combined in order to maximize particulate nitrogen content prior to isotope analysis, and therefore do not have an associated standard deviation. Nitrite uptake rates have been bolded when particulate nitrogen content was below the typical quantity (c) Rate means and p-values for coastal vs offshore stations. Median rates are also shown.

(a)

Cruise	Depth (m)	Station	Region	Cast	Longitude (W)	Latitude (N)	SigmaT (g kg^-1)	Salinity (ppt)	TempC (C)	Oxygen (uM)	NO2 (uM) (uM)	NO3 (uM) (uM)	NH4 (nM) (nM)	Chl (mg m^-2)	pPAR (%)	PNM_deptl (m)	PNM_max (uM
Ward	60	PS1	Offshore	17	-113.0	10.0	23.86	34.39	21.63	88.53	0.79	12.06	19.7	2.42	1%	55	1.49
Ward	55	PS1	Offshore	9	-113.0	10.0	23.57	34.29	22.42	86.46	1.08	12.2	68.5	3.17	2%	60	1.52
Ward	60	PS1	Offshore	9	-113.0	10.0	23.86	34.37	21.57	68.2	0.75	14.79	9	2.72	1%	60	1.52
Ward	65	PS1	Offshore	9	-113.0	10.0	24.25	34.47	20.42	45.27	0.44	17.55	0	2.49	1%	60	1.52
Ward	70	PS1	Offshore	9	-113.0	10.0	25.1	34.64	17.6	8.04	0.05	17.15	9	2.53	0%	60	1.52
Ward	75	PS2	Offshore	36	-105.0	15.8	24.73	34.42	18.39	63.17	0.75	14.99	5	1.47	2%	63	0.62
Ward	70	PS2	Offshore	44	-105.0	15.8	23.51	34.48	23.13	196.34	0.18	0.61	25	3.13	3%	80	0.48
Ward	80	PS2	Offshore	44	-105.0	15.8	24.84	34.3	17.57	86.22	0.48	12.66	25	1.77	1%	80	0.48
Ward	30	PS3	Coastal	75	-102.4	17.7	24.75	34.59	18.83	31.64	0.47	19.03	29	3.28	1%	21	0.65
Ward	30	PS3	Coastal	87	-102.4	17.7	24.34	34.5	20.17	65.03	0.52	19.38	25	1.93	3%	30	0.52
Ward	20	PS3	Coastal	83	-102.4	17.7	23.89	34.49	21.79	120.03	0.47	3.57	5	4.03	2%	25	1.3
Ward	25	PS3	Coastal	83	-102.4	17.7	24.36	34.56	20.26	41.66	1.3	12.14	5	3.96	1%	25	1.3
Falkor	70	F2	Offshore	5	-103.0	14.0	24.28	34.48	20.34	79	0.31	13.61	25	0.4	3%	60	0.76
Falkor	65	F9	Offshore	16	-110.0	14.0	22.7	34.07	24.8	150	0.39	7.56	20	0.65	1%	65	0.39
Falkor	50	F9	Offshore	19	-110.0	14.0	22.16	33.99	26.35	185.1	0.15	23.47	59	0.94	2%	70	0.2
HODZ	25	P1	Coastal	27	-106.2	20.3	23.4	34.58	23.75	182.18	0	0.35	38.64	2.8	6%	35	0.35
HODZ	30	P1	Coastal	27	-106.2	20.3	24.07	34.55	21.28	142.92	0.18	3.07	87.56	9.78	4%	35	0.35
HODZ	35	P1	Coastal	27	-106.2	20.3	24.39	34.56	20.14	87.82	0.35	10.84	17.27	1.67	3%	35	0.35
HODZ	45	P1	Coastal	27	-106.2	20.3	24.8	34.53	18.46	53.27	0.05	16.19	54.4	0.69	1%	35	0.35
HODZ	25	P1	Coastal	20	-106.1	20.2	23.78	34.54	22.28	169.16	0.05	0.79	90	5.94	6%	30	0.47
HODZ	30	P1	Coastal	20	-106.1	20.2	24.12	34.49	20.95	112.15	0.47	6.22	80	3.81	4%	30	0.47
HODZ	40	P1	Coastal	20	-106.1	20.2	24.72	34.53	18.78	57.68	0.22	16.35	30	0.71	2%	30	0.47
HODZ	60	P1	Coastal	20	-106.1	20.2	25.22	34.57	16.83	22.19	0.05	19.52	0	0.33	0%	30	0.47
HODZ	50	P2	Offshore	35	-107.2	16.4	21.56	33.73	27.64	183.12	0.13	2.02	362.18	1.33	17%	55	0.99
HODZ	55	P2	Offshore	35	-107.2	16.4	22.91	34.3	24.68	145.88	0.99	4.24	28.13	1.57	6%	55	0.99
HODZ	65	P2	Offshore	35	-107.2	16.4	23.7	34.43	22.31	83	0.05	20.45	0	0.78	3%	55	0.99
ETNP2016	55	3	Coastal	6	-110.2	22.6	24.04	34.43	20.83	209.9	0.15	0.4	158.26	0.24	4%	72.88	0.06
ETNP2016	75	3	Coastal	6	-110.2	22.6	24.72	34.33	18.13	158.22	0.47	5.18	24.3	0.26	1%	72.88	0.06
ETNP2016	100	3	Coastal	6	-110.2	22.6	25.46	34.38	15.02	61.14	0.05	18	25.76	0.08	0%	72.88	0.06
ETNP2016	120	3	Coastal	6	-110.2	22.6	25.82	34.49	13.83	40.51	0	24.35	15.51	0.06	0%	72.88	0.06
ETNP2016	25	6	Coastal	14	-104.4	18.7	23.39	34.41	25.12	204.1	0.08	1.21	64.92	0.33	8%	43.14	0.85
ETNP2016	40	6	Coastal	14	-104.4	18.7	24.13	34.52	20.56	57.17	0.18	18.93	33.94	0.27	1%	43.14	0.85
ETNP2016	55	6	Coastal	14	-104.4	18.7	24.95	34.61	17.78	14.74	0.12	22.27	25	0.13	1%	43.14	0.85
ETNP2016	75	6	Coastal	14	-104.4	18.7	25.46	34.75	15.28	0.89	0.1	23.91	24.93	0.14	0%	43.14	0.85
ETNP2016	35	9	Coastal	23	-99.0	15.0	22.76	34.33	23.65	129.52	0.52	0.49	212	0.39	7%	70.63	1.36
ETNP2016	40	9	Coastal	23	-99.0	15.0	23.62	34.43	21.82	57.17	0.82	17.93	46	0.42	3%	70.63	1.36
ETNP2016	50	9	Coastal	23	-99.0	15.0	24.38	34.57	19.4	20.99	0.22	20.89	37	0.25	1%	70.63	1.36
ETNP2016	60	9	Coastal	23	-99.0	15.0	24.84	34.64	17.9	8.04	0.15	22.26	44	0.16	0%	70.63	1.36
ETNP2016	10	12	Offshore	32	-106.1	16.3	21.25	33.48	28.02	192.49	0	0.52	0	0.06	20%	102.95	0.66
ETNP2016	75	12	Offshore	32	-106.1	16.3	22.39	34.13	25.96	203.21	0	0.61	0	0.1	1%	102.95	0.66
ETNP2016	85	12	Offshore	32	-106.1	16.3	22.63	34.19	25.34	209.91	0.09	0.09	11.4	0.14	0%	102.95	0.66
ETNP2016	95	12	Offshore	32	-106.1	16.3	23.34	34.35	23.37	168.82	0.22	4.92	34.8	0.21	0%	102.95	0.66
ETNP2016	100	12	Offshore	32	-106.1	16.3	23.97	34.44	21.38	103.61	0.44	7.61	17	0.17	0%	102.95	0.66
ETNP2016	62	16	Offshore	39	-111.9	19.9	23.98	34.42	21.29	206.42	0	0.63	247.5	0.22	4%	87.79	0.3
ETNP2016	72	16	Offshore	39	-111.9	19.9	24.14	34.33	20.41	184.55	0.46	2.93	381.52	0.24	2%	87.79	0.3
ETNP2016	80	16	Offshore	39	-111.9	19.9	24.32	34.25	19.49	166.06	0.21	4.87	296.45	0.23	1%	87.79	0.3

(b)

Cruise	Depth (m)	Station	NH3.Ox1 (nM d^-1)	Stdev_4	LOD_4	NO2.Ox1 (nM d^-1)	Stdev_2	LOD_2	NO3.Red1 (nM d^-1)	Stdev_3	LOD_3	NO2.up (nM d^-1)	NetNit1	NetP1	NetN1
Ward	60	PS1	7.65	0.37	0.16	6.72	4.53	0.6	0.3	0.58	-0.23	**5.44**	0.92	-5.14	-4.22
Ward	55	PS1	13.66	3.39	0.47	4.96	3.68	1.45	5.62	1.17	n.d.	**9.49**	8.7	-3.87	4.83
Ward	60	PS1	11.65	4.28	0.69	-0.94	0.7	1.7	3.78	0.18	n.d.	**6.04**	12.59	-2.26	10.33
Ward	65	PS1	21.59	2.24	0.95	1.9	n.d.	2.77	3.48	0.71	n.d.	**3.74**	19.69	-0.26	19.43
Ward	70	PS1	20.27	1.23	1.09	18.58	1.08	1.73	1.89	0.22	n.d.	**2.01**	1.69	-0.11	1.57
Ward	75	PS2	28.78	0.46	0.16	40.32	5.43	37.18	9.14	1.26	n.d.	**8.6**	-11.54	0.54	-11
Ward	70	PS2	-1.2	0.11	0.12	-2.62	0.52	3.26	n.d.	n.d.	n.d.	**10.43**	1.43	n.d.	n.d.
Ward	80	PS2	44.09	1.68	0.74	87.4	11.58	53.86	n.d.	n.d.	n.d.	**2.32**	-43.31	n.d.	n.d.
Ward	30	PS3	90.42	1.95	0.09	60.48	2.11	0.85	5.82	0.82	n.d.	4	29.94	1.82	31.75
Ward	30	PS3	68.59	2.69	1.19	42.82	1.71	0.88	1.43	0.44	n.d.	3.82	25.77	-2.39	23.38
Ward	20	PS3	-1.32	0.35	0.21	-5.54	3.71	19.34	1.24	0.78	n.d.	2.28	4.22	-1.04	3.18
Ward	25	PS3	7.09	3.2	1.12	78.56	1.6	24.95	1.58	0.22	n.d.	1.24	-71.47	0.34	-71.14
Falkor	70	F2	57.01	34.07	n.d.	24.36	0.62	n.d.	n.d.	n.d.	n.d.	1.06	32.64	n.d.	n.d.
Falkor	65	F9	20.5	1.76	n.d.	11.1	4.98	n.d.	n.d.	n.d.	n.d.	n.d.	9.41	n.d.	n.d.
Falkor	50	F9	1.83	0.63	n.d.	5.07	12.36	n.d.	n.d.	n.d.	n.d.	n.d.	-3.24	n.d.	n.d.
HODZ	25	P1	3.63	0.06	0.04	-9.2	0	n.d.	0	0	n.d.	112.74	12.84	-112.74	-99.9
HODZ	30	P1	8.66	0.05	0.18	-15.04	5.99	n.d.	49.13	1.02	n.d.	165	23.7	-115.88	-92.18
HODZ	35	P1	50.45	2.92	0.95	-4.09	1.1	n.d.	33.23	5.96	n.d.	18.79	54.55	14.43	68.98
HODZ	45	P1	49.85	3.89	1.51	34.96	0.47	n.d.	3.54	1.6	n.d.	4.4	14.89	-0.86	14.02
HODZ	25	P1	4.42	1.24	0.26	29.94	n.d.	n.d.	0	0	n.d.	123.26	-25.52	-123.26	-148.78
HODZ	30	P1	15.73	3.08	0.7	13.03	4.8	n.d.	53.15	2.15	n.d.	49.41	2.71	3.74	6.44
HODZ	40	P1	26.18	4.41	1.22	45.73	4.18	n.d.	1.92	0.51	n.d.	10.83	-19.55	-8.91	-28.46
HODZ	60	P1	16.87	0.09	0.98	18.35	1.92	n.d.	0	0	n.d.	**0.66**	-1.48	-0.66	-2.14
HODZ	50	P2	-3.15	1.05	1	n.d.	n.d.	n.d.	-1.18	0.77	n.d.	3.99	n.d.	-5.16	n.d.
HODZ	55	P2	2.11	1.08	0.4	13.41	1.91	n.d.	2.06	0.23	n.d.	7.34	-11.31	-5.27	-16.58
HODZ	65	P2	71.2	1.32	2.06	46.63	2.71	n.d.	13.12	6.29	n.d.	6.97	24.56	6.15	30.71
ETNP2016	55	3	0.76	0.06	0.06	8.4	0.14	-0.17	n.d.	n.d.	n.d.	46.95	-7.64	n.d.	n.d.
ETNP2016	75	3	28.17	9.34	0.83	29.25	2.12	0.99	-2.3	n.d.	n.d.	8.85	-1.08	-11.15	-12.23
ETNP2016	100	3	28.72	1.49	0.92	34.83	13.7	0.94	1.5	n.d.	0.19	1.07	-6.11	0.43	-5.68
ETNP2016	120	3	10.38	1.5	1.01	14.59	0.88	1.55	0	n.d.	0	1.07	-4.21	-1.07	-5.28
ETNP2016	25	6	2.32	0.97	0.08	-8.97	27.06	n.d.	7.39	1.85	0.1	46.8	11.3	-39.41	-28.11
ETNP2016	40	6	46.83	2.92	1.1	31.88	3.02	n.d.	5.56	1.08	-0.1	**3.5**	14.95	2.07	17.01
ETNP2016	55	6	42.59	5.33	1.67	34	1.38	n.d.	3.07	1.56	-0.08	**0.69**	8.59	2.38	10.97
ETNP2016	75	6	8.36	1.89	0.81	20.98	0.56	n.d.	2.18	0.36	0.4	n.d.	-12.62	2.18	-10.45
ETNP2016	35	9	15.42	6.28	0.44	1.71	2.37	n.d.	0.12	0	0.01	6.64	13.71	-6.52	7.19
ETNP2016	40	9	73.84	1.12	1.16	5.48	0.43	n.d.	12.33	1.9	1.33	7.18	68.37	5.15	73.52
ETNP2016	50	9	59.28	16.31	1.62	20.89	0.2	n.d.	0.41	0.49	0	**3.35**	38.39	-2.94	35.45
ETNP2016	60	9	13.63	4.46	1.93	7.54	1.53	n.d.	0.04	0	0.01	**0.54**	6.09	-0.5	5.59
ETNP2016	10	12	-0.42	0.1	0.05	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
ETNP2016	75	12	2.85	0.4	0.06	25.64	6.93	n.d.	0.9	0.22	-0.01	19.04	-22.79	-18.14	-40.93
ETNP2016	85	12	0.04	0.04	-0.03	0.37	37.79	n.d.	0.04	0.01	0	17.4	-0.33	-17.36	-17.7
ETNP2016	95	12	30.19	0.09	0.26	n.d.	n.d.	n.d.	0.06	0.04	0.04	21.26	n.d.	-21.2	n.d.
ETNP2016	100	12	32.15	0.76	0.48	5.8	0.08	n.d.	0.78	0.3	0.63	11.18	26.36	-10.41	15.95
ETNP2016	62	16	0.55	0.16	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
ETNP2016	72	16	31.52	3	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
ETNP2016	80	16	53.57	3.4	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

(c)

	Median		Mean			
Rates	**Coastal**	**Offshore**	**Coastal**	**Offshore**	**t-value**	**p-value**
Ammonia Oxidation	16.3	16.97	28.0	20.3	1.093	0.281
Nitrite Oxidation	19.62	8.91	20.4	18.0	0.318	0.752
Nitrate Reduction	1.58	1.89	7.88	3.08	1.410	0.170
Nitrite Uptake	4.2	7.15	25.96	8.52	1.874	0.073
Net Nitrite Production	3.18	1.57	-8.99	-0.69	-0.667	0.510

Figure S1. Regressions with CTD data included – (a) Concentration of the nitrite maxima regressed against water column features and (b) depth of the nitrite maxima regressed against depth-related water column features.

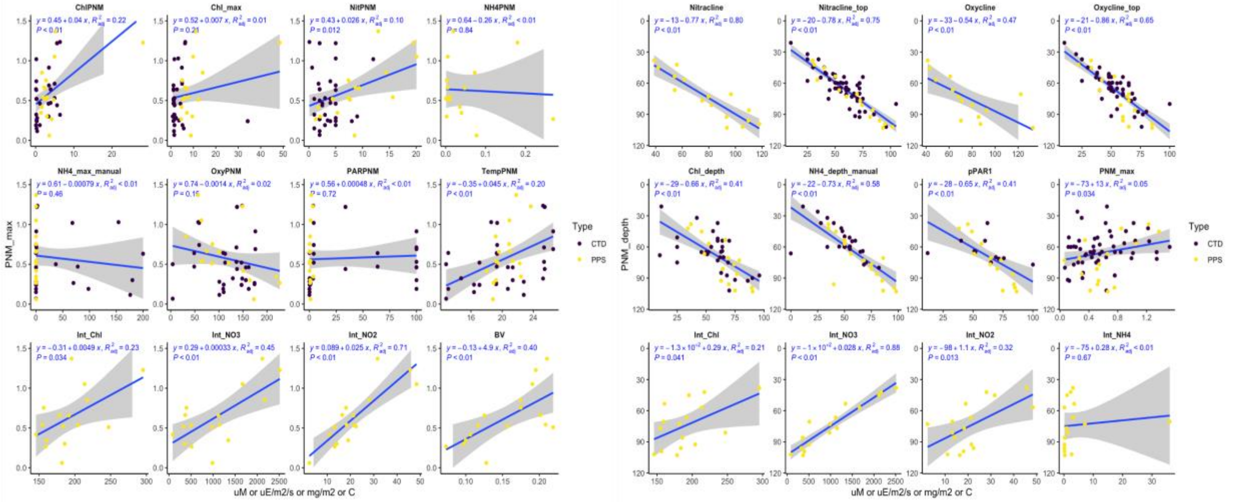
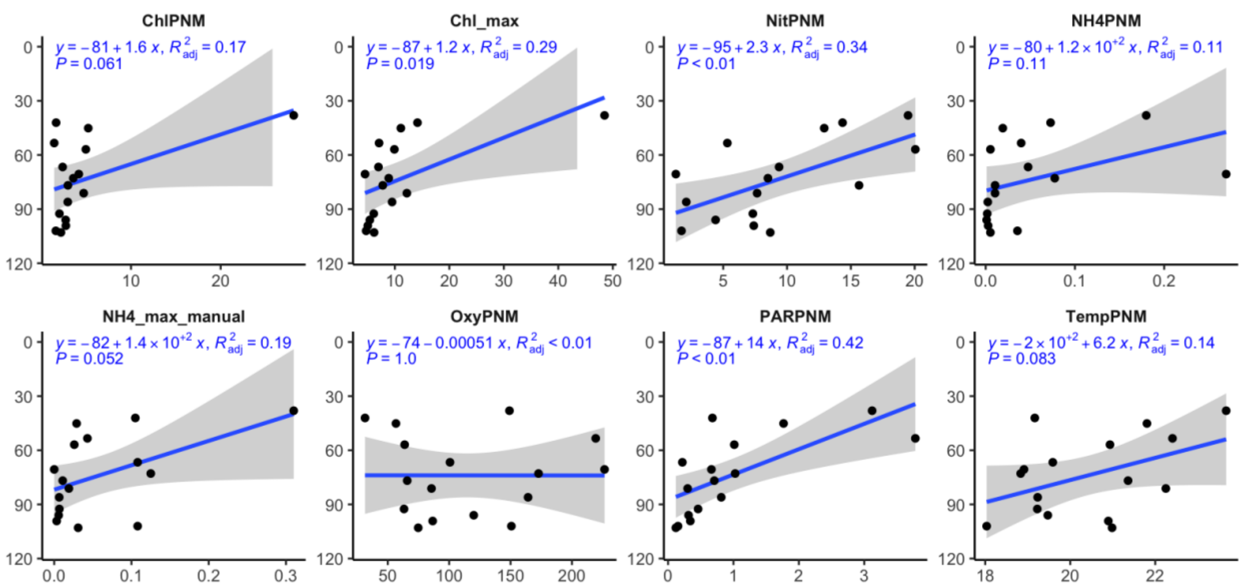


Figure S2. Regression of depth of nitrite maxima – This plot shows regressions of depth vs features of the water column that are not limited to depth-related features (eg. depth of nitrite maxima vs concentration of chlorophyll at the nitrite maxima).



Multiple Linear Regression Analysis - "Full" Variable Model

All-Station

This model analysis used all the available variables to predict nitrite concentrations in the ETNP. When trained using all the stations, multiple linear regression optimization across all stations resulted in a combination of 10 variables that were able to predict 66% of the total variance in nitrite concentration. The final optimized model included 3 primary variables (chlorophyll, ammonium and oxygen) and 7 interaction terms (Table S3). Based on relative importance calculations, the temperature-density interaction term contributed the largest amount to the total variance in nitrite explained by the model (19.8%). The top 3 variables by relative importance all involved temperature, and in sum contributed 32.3% to the total model R^2. Eight out of ten of the variables selected in this model contributed less than 6% each to total model R^2 (Table S3). The predicted vs. observed nitrite slope was less than 1, meaning small nitrite maxima (<~70 nM) were overpredicted and larger nitrite maxima tended to be underpredicted.

Regional Station Subsets – Coastal and Offshore

Taking subsets of station data to make separate coastal and offshore 'full' models allowed for better explanatory power compared to grouping all of the stations together in a single MLR model (Fig. S3). Model optimization selected different sets of variables to explain the nitrite concentrations in each model, but nitrate was critical across all three models, aligning with results from the simple linear regression analyses, where nitrate is important for explaining both depth of the nitrite maximum and the concentration of the nitrite maximum. While the maximum nitrite concentration was not predicted well by these models, the mean error for the depth of the nitrite maximum was less than 4 m for all three 'full' models. However, the predicted depth of the nitrite maximum at individual stations could be more significantly erroneous (Table S4).

For the coastal 'full' model the optimization resulted in 10 variables and was able to predict 77% of the total variance in nitrite across the coastal stations. The predicted versus observed slope was less than 1, suggesting slight overprediction of smaller nitrite maxima (<330 nM) and slight underprediction of larger nitrite maxima. The most important variable was the nitrate-oxygen interaction term, which explained 17% of the total model variance. Although nitrate was not included as a primary variable, it was involved in three out of seven of the interaction terms, and in sum these nitrate interaction terms contributed to nearly half of the total model R^2 (33.8%). The coastal 'full' model was able to predict the depth of the nitrite maxima well at the coastal stations, with an average underprediction in depth of only 2.9 m (Fig. S3, Table S4). The maximum nitrite concentrations at coastal stations were also accurately predicted by the coastal model, with an average underprediction of only 121 nM. The largest observed nitrite maximum (Station 8) was slightly overpredicted by the coastal model, while the nitrite maxim at Stations 6 and 7 were well predicted (Fig. S3, green). The inability of this model to be applied across all stations is reflected again in the poor correlation between observed and predicted nitrite concentration (R^2=0.013).

For the offshore 'full' model, 12 variables were included after the optimization process and the final model explained 79% of the overall variance in nitrite across offshore stations. The predicted vs observed slope was less than 1, again suggesting slight overprediction of smaller nitrite maxima (<~150 nM) and slight underprediction of larger sized nitrite maxima. The two most important variables in the offshore model were the oxygen-chlorophyll and density-chlorophyll interaction terms, which each explained 9.4% of the total nitrite variance (Table S3c). Chlorophyll appeared to be an important parameter in this model, being included as a primary variable and in 4 interaction terms for a total contribution of 38% to total model R^2. Predicted nitrite profiles accurately captured the concentration of the nitrite maxima at offshore stations 13 and 16, while offshore stations 14 and 15 were both slightly underpredicted. The accuracy of the offshore 'full' model applied to all stations was much more variable, with a mix of fairly accurate (stations 5 and 12), overprediction (stations 3, 4, 6, 7, 8, 10, 11) and underprediction (stations 1 and 2) (Fig. S3).

Table S3. Coefficients from 'Full' MLR model – Optimized multiple linear regression coefficients from each 'full' model and relative importance values (all-stations, coastal, offshore).

Full MLR Coefficients - All Stations

Variable	Coefficient	Percent Importance
(Intercept)	-10.798	
Temperature:SigmaT	0.0175	19.8
Ammonium:Temperature	0.0245	6.7
Oxygen:Temperature	-0.0052	5.8
SigmaT:Chlorophyll	0.9121	5.7
Chlorophyll	-28.526	5.5
Nitrate:Temperature	0.0063	5.1
Temperature:Chlorophyll	0.3126	4.9
Ammonium	-0.6865	4.5
Oxygen	0.3892	4.4
Oxygen:SigmaT	-0.0118	4.1

Full MLR Coefficients - Coastal

Variable	Coefficient	Percent Importance
(Intercept)	-38.861	
Nitrate:Oxygen	0.0078	17.7
Oxygen:pPAR	-0.0043	10.4
pPAR	0.9702	10
Nitrate:Chlorophyll	0.0450	9.3
Nitrate:Ammonium	0.2290	6.8
Ammonium:pPAR	0.0147	6.8
Oxygen:Chlorophyll	-0.0018	4.8
Ammonium	-0.5882	4.3
SigmaT	1.5081	4.1
pPAR:Chlorophyll	0.0371	2.7

Full MLR Coefficients - Offshore

Variable	Coefficient	Percent Importance
(Intercept)	-2.5289	
Oxygen:Chlorophyll	-0.0027	9.4
SigmaT:Chlorophyll	0.5121	9.4
Nitrate:Temperature	0.1299	9.1
Chlorophyll	-13.565	8.6
Nitrate	-12.572	7.3
Nitrate:SigmaT	0.4168	6.9
Ammonium:Oxygen	-0.0002	5.4
Nitrate:Ammonium	0.0141	5.4
Temperature:Chlorophyll	0.0898	5.3
Ammonium:Chlorophyll	-0.0029	5.3
Ammonium:pPAR	-0.0003	3.2
Ammonium:SigmaT	-0.0009	0.9

Figure S3. Nitrite profile predictions from three 'full' model multiple linear regression analyses trained using all station (blue), trained on coastal subset of station (green) and trained using an offshore subset of stations (dark blue). Subsets of stations using in the coastal and offshore model are outlined in green and dark blue, respectively. Observed nitrite concentrations are plotted in magenta. Offshore model: Station 8 and 9 are beyond the x-axis. All-station model: Station 8 is beyond the x-axis.

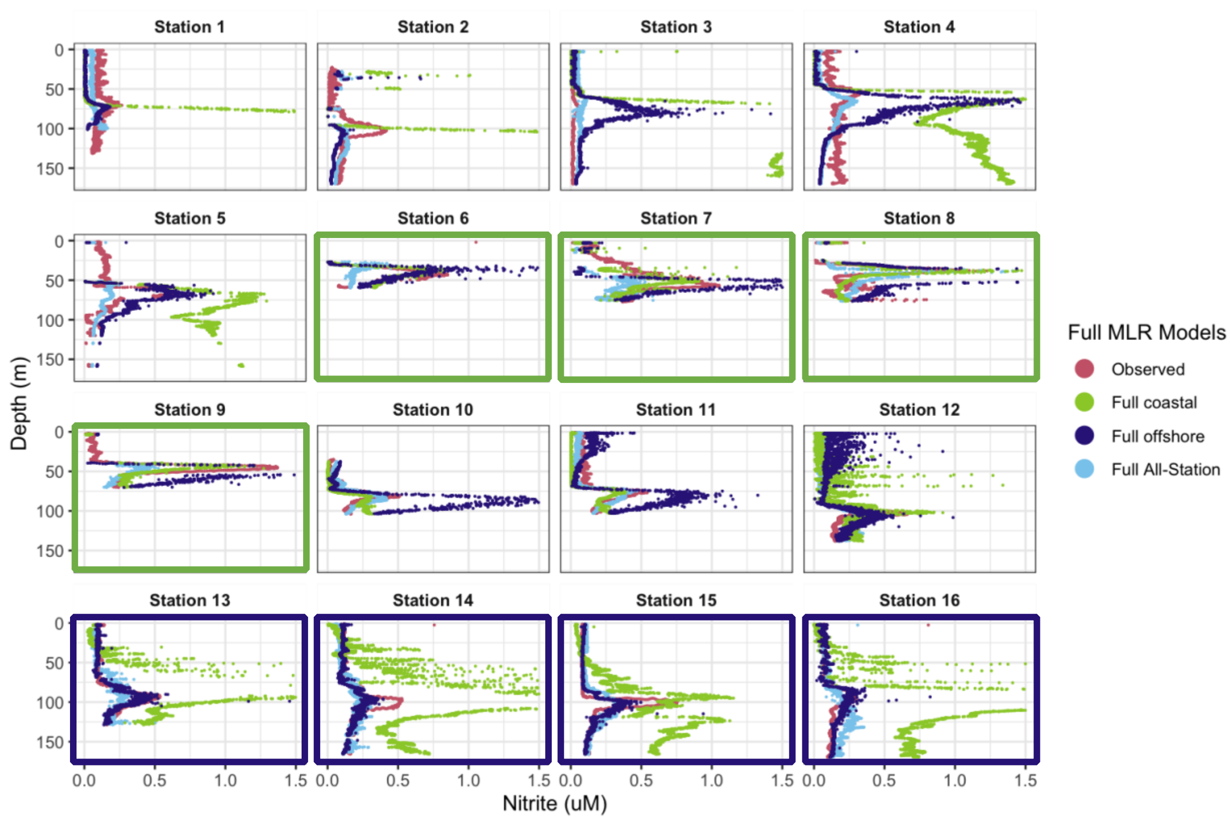


Table S4. Error values for 'Full' MLR – Observed nitrite maxima and corresponding depth are listed for each station during the 2016 cruise (PPS data). The depth error and nitrite maxima size errors are listed for each of the three models. Negative error values are underestimates of the observed feature, and positive errors are overestimates of the observed nitrite maximum. The stations used for training the coastal and offshore models are boxed (coastal – 6,7,8,9 and offshore – 13,14,15,16). Summary of the observed nitrite maxima across the region (means and standard errors), and summaries for the errors in each model are listed at the bottom of the table. In the offshore model, nitrite maxima size error at Station 8 is an extreme outlier, thus a summary excluding this station is also provided for the offshore model. Summaries (mean and standard error) of the errors for only the subset of training stations for each model are also included.

Full Variable MLR

			All-Station Errors		Coastal Errors		Offshore Errors	
Station	Nitrite Maxima (uM)	Depth of Nitrite Maxima (m)	Depth (m)	Size (uM)	Depth (m)	Size (uM)	Depth (m)	Size (uM)
1	0.27	70.61	29.01	-0.1	NA	NA	2.2	-0.08
2	0.42	102	4.96	-0.27	30.96	2.58	4.96	-0.3
3	0.06	72.88	-9.29	0.05	7.12	3.14	5.8	1.54
4	0.35	53.4	11.66	-0.04	6.6	2.06	13.15	1.96
5	0.66	66.67	-10.27	-0.41	1.33	0.64	0.44	0.26
6	0.85	42.1	-8.19	-0.25	-6.06	-0.01	-7.85	4.05
7	1.05	56.89	-8.81	-0.45	-6.89	-0.05	-4.52	2.95
8	1.23	38.08	-1.16	15.28	0.18	0.64	-1.16	13670
9	1.37	45.15	1.09	-0.84	1.09	-0.1	2.85	4.93
10	0.51	81.18	4.97	-0.09	3.82	-0.17	5.82	2.85
11	0.54	76.84	-1.87	-0.07	-0.62	-0.15	6.16	0.56
12	0.66	103	2.25	-0.21	0.05	0.34	4.05	-0.01
13	0.53	92.53	-0.53	-0.22	-4.53	3.21	-1.53	0.09
14	0.52	96.01	6.99	-0.21	-2.01	1.58	0.66	-0.12
15	0.75	99.2	4.09	-0.38	-4.22	0.4	0.8	-0.24
16	0.3	86.06	34.94	0.05	8.94	2.8	-1.06	0.07
Mean	**0.63**	**73.91**	**3.74**	**0.74**	**2.38**	**1.13**	**1.92**	**855.53**
Std Error	*0.1*	*5.5*	*3.2*	*1.0*	*2.3*	*0.3*	*1.2*	*854.3*
								1.23
								0.44
					Coastal Stations Only		Offshore Stations Only	
					-2.92	**0.12**	**-0.28**	**-0.05**
					2.07	0.17	0.59	0.08

Multiple Linear Regression Analysis - "Core" Variable Model

Coastal station subset

The coastal 'core' model was able to explain 83% of the variance in coastal nitrite concentration (Table 2a). The top 3 variables (oxygen-nitrate, nitrate, and pPAR) explained over half of the total model variance (44.1%). Nitrate was the dominant variable, with the combined contribution of all 3 nitrate variables explaining 41.9% of model variance. The total contribution of the chlorophyll related variables was 17.5%. The slope of the predicted vs observed values was 0.71, less than 1, indicating a tendency to overpredict the size of smaller nitrite maxima (< ~350 nM) and underpredict larger sized nitrite maxima.

Offshore station subset

The offshore 'core variable' model was able to explain 98% of the total variance in nitrite at all offshore stations (Table 2b). The relative importance calculation of each variable shows that nitrate, chlorophyll and oxygen together explain more than a third of the total model variance (32.3%). These 3 single variables were also relatively similar in their individual contributions to total model variance (10.2%, 11.1%, 11%) (Table 2). However, nitrate was involved in both interaction terms, which were the top 2 most important variables. The combined contribution of all nitrate effects was 38.8%, almost half of the total model R^2 and similar to the coastal 'core' model. The total contribution of chlorophyll related variables is 34.6%, higher than that seen in the coastal 'core' model. The slope of predicted vs observed nitrite was less than 1, indicating a tendency to overpredict the size of smaller nitrite maxima and underpredict larger sized nitrite maxima with a cross-over point between over- and underprediction occurring at ~150 nM nitrite.

Coefficient Comparison

The nitrate variables were involved in explaining similar amounts of the nitrite variance in both models (coastal and offshore, 40.8% and 38.8%). Nitrate as a single variable also explained a similar portion of the total model variance in both the coastal and offshore models (12.2%, 10.2% respectively). The coefficients for nitrate variables have the same sign in both models, with nitrate having a negative coefficient and the two nitrate interaction terms having positive coefficients. Overall, the negative nitrate coefficients act to decrease predicted nitrite below the nitrite maxima where nitrate increases towards ~25 μM. The slightly more negative coefficient in the coastal model is counteracted by the slightly higher concentrations of nitrate seen at coastal nitrite maxima. The oxygen and pPAR coefficients for both models are also negative, and act to decrease predicted nitrite at the depths above the nitrite maximum. The interaction terms containing nitrate in both models have positive coefficient values, adding nitrite to depths near the PNM where nitrate, oxygen and chlorophyll are all present together. In both 'core' models, the interaction term between nitrate and chlorophyll is an important variable (>10% R^2 in both).

The chlorophyll variables are the only coefficients that differ in sign between the two models, with the coastal chlorophyll coefficient being negative and the offshore chlorophyll coefficient being positive. The quadratic term for chlorophyll has a negative sign for both models, meaning the presence of a chlorophyll maximum decreases nitrite predictions strongly just above the nitrite maximum (perhaps driven by nitrite uptake) and shifts the nitrite peak towards the downslope of the chlorophyll maximum. The single chlorophyll term in the coastal model is also negative and reduces nitrite predictions in direct proportion to the size of the chlorophyll peak. In contrast, the positive single chlorophyll term in the offshore model means that, opposing the quadratic term, this variable adds nitrite at depths across the chlorophyll maximum. Additionally, the single chlorophyll term in the offshore model is much larger in absolute magnitude than the coastal term, which likely explains the poor performance of the offshore core model at coastal stations where chlorophyll concentrations are often larger (Fig. 7).

Table S5. Error values for 'Core' MLR – Observed nitrite maxima and corresponding depth are listed for each station during the 2016 cruise (PPS data). The depth error and nitrite maxima size errors are listed for each of the two core models. Negative error values are underestimates of the observed feature, and positive errors are overestimates of the observed nitrite maximum. The stations used for training the coastal and offshore models are boxed (coastal – 6,7,8,9 and offshore – 13,14,15,16). Summary of the observed nitrite maxima across the region (means and standard errors), and summaries for the errors in each model are listed at the bottom of the table. Summaries (mean and standard error) of the errors for only the subset of training stations for each model are also included.

Core Variable MLR

Station	Nitrite Maxima (uM)	Depth of Nitrite Maxima (m)	Coastal Errors Depth (m)	Coastal Errors Size (uM)	Offshore Errors Depth (m)	Offshore Errors Size (uM)
1	0.27	70.61	23.41	0.29	17.42	-0.09
2	0.42	102	4.96	0.1	4.96	-0.11
3	0.06	72.88	5.8	0.57	12.12	0.25
4	0.35	53.4	6.77	0.36	18.6	-0.03
5	0.66	66.67	0.44	-0.14	-1.67	-0.28
6	0.85	42.1	-5.11	-0.34	-4.1	-0.05
7	1.05	56.89	-4.52	-0.47	6.11	-0.6
8	1.23	38.08	1.65	0.81	13.92	-0.92
9	1.37	45.15	1.09	-0.83	7.85	-0.97
10	0.51	81.18	2.27	0.01	6.82	-0.06
11	0.54	76.84	-1.87	-0.03	-2.73	-0.14
12	0.66	103	-0.61	-0.15	-2.95	-0.17
13	0.53	92.53	-4.98	0.05	-5.53	0.18
14	0.52	96.01	0.59	-0.02	-0.01	-0.19
15	0.75	99.2	0.04	-0.25	2.8	-0.35
16	0.3	86.06	7.34	0.23	13.94	0.04
Mean	**0.63**	**73.91**	**2.33**	**0.01**	**5.47**	**-0.22**
Std Error	*0.1*	*5.5*	*1.7*	*0.1*	*2.0*	*0.1*
			Coastal Stations Only		Offshore Stations Only	
			-1.72	**-0.21**	**2.80**	**-0.08**
			1.79	0.35	4.10	0.12

Figure S4. Rates vs nitrite concentration – None of the four rate measurements (ammonia oxidation, nitrite oxidation, nitrate reduction or nitrite uptake) or net nitrite calculations (NetNit, NetPhy, $NetNO_2$) correlate with observed nitrite concentrations at the depth of measurement.

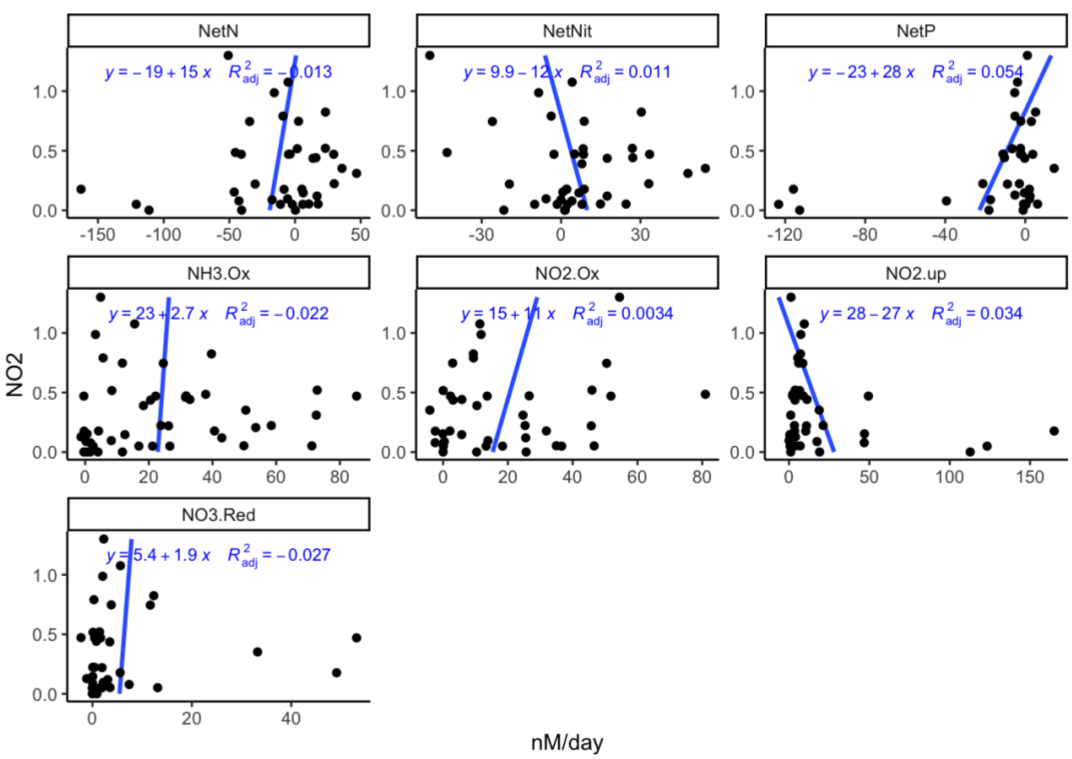


Figure S5. Maximum Rates vs PNM size – The maximum measured rate at each station was regressed against the size of the PNM for that station, and no correlations were seen. Because only 3-4 depths were sampled for rate measurements per station, there is a possibility that we missed the depth of the real maximum rate and/or the real nitrite maxima.

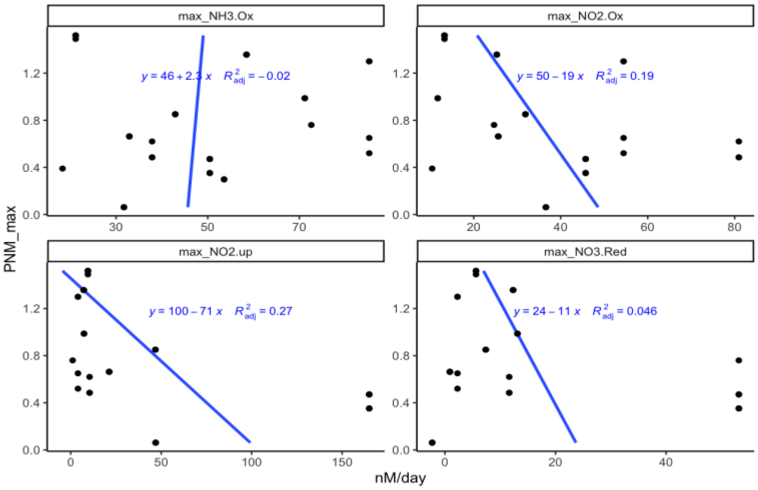


Figure S6. Residence Time – residence time can be calculated from net influx or outflux to the system assuming steady-state. We calculated residence time using net production of nitrite (a), production from ammonia oxidation (b) and using net consumption (c). Mean residence times are 30.8, 43.4, 20.3 days, respectively. Potential formation time is calculated using the NetNO2 production rates and observed nitrite concentrations (d). Mean formation time is 4.4 days.

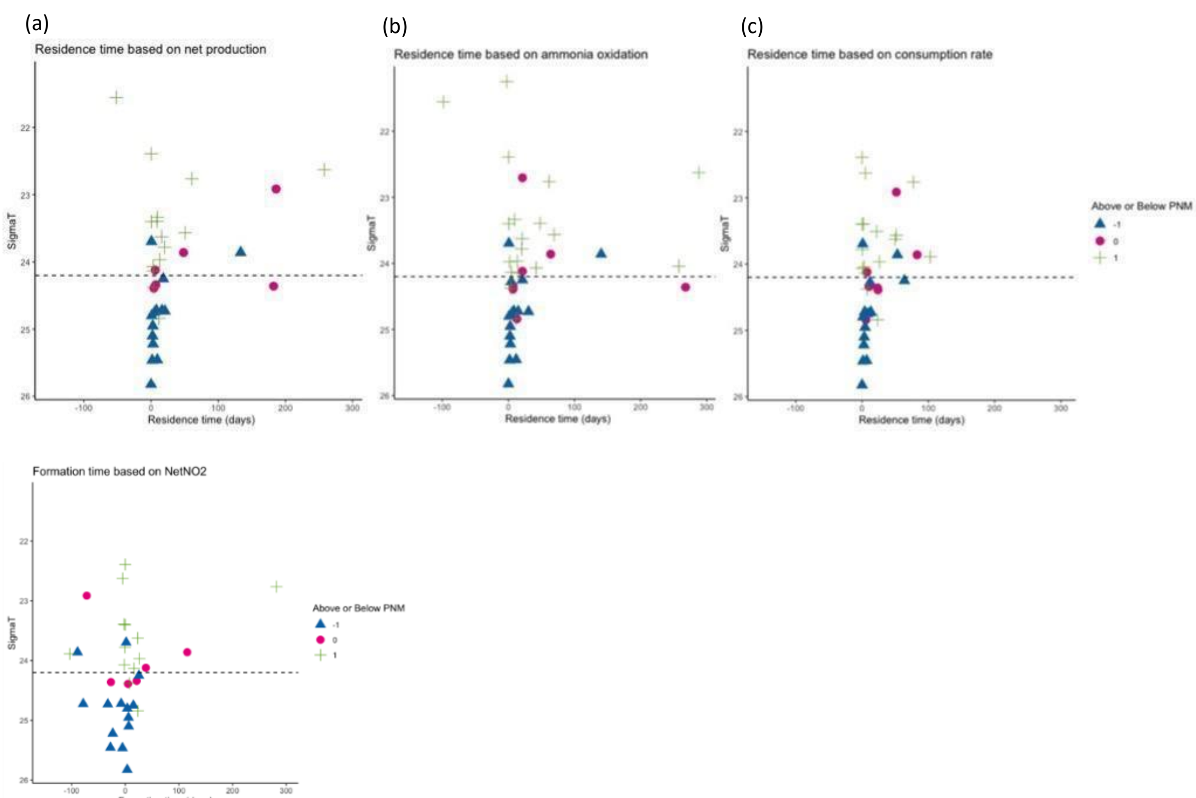


Figure S7. DIN concentration versus microbial rates did now show a linear substrate dependence. However, most of the highest ammonia oxidation and nitrite uptake rates fell in the lower range of substrate concentrations. At low DIN there is still high variability in the magnitude of the resulting rate, suggesting DIN-limitation is not the only controlling factor.

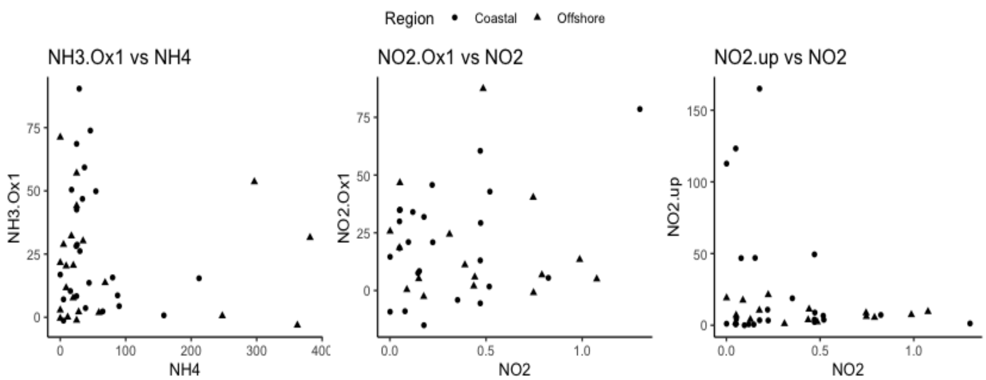


Figure S8. The surface current plot for April 07-11 2016 (5 day average from OSCAR; Earth & Space Research, below) showed fastest movement of surface waters near the southern coastal stations (6,7,8,9), which is similar to the averaged March surface currents by Fiedler and Lavín (2017).

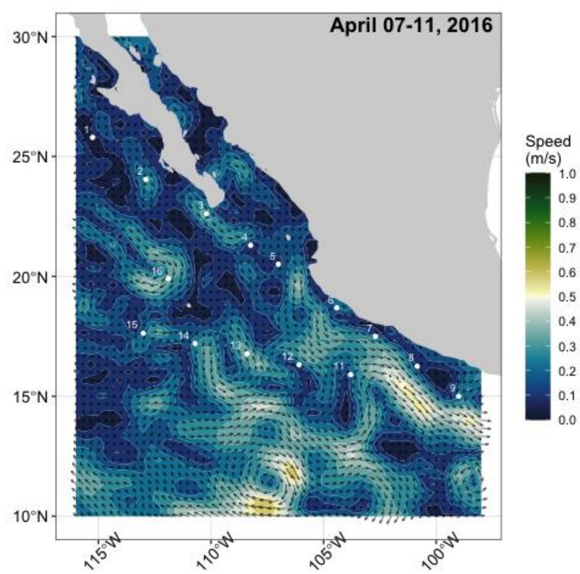


Figure S9. Density profiles for the 2016 PPS dataset across 16 station in the ETNP. Linear fits were applied through the SigmaT data centered at the depth of the nitrite maxima and spanning 16 m total.