Processed CTD data from R/V Thomas G. Thompson cruise TN277 in the Eastern North Pacific Ocean in March 2012 (POWOW project)

Website: https://www.bco-dmo.org/dataset/3745
Data Type: Cruise Results
Version: 1
Version Date: 2013-03-25

Project
» Seasonal and decadal changes in temperature drive Prochlorococcus ecotype distribution patterns (POWOW)

Contributors	Affiliation	Role
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Abstract
Processed CTD data from R/V Thomas G. Thompson cruise TN277 in the Eastern North Pacific Ocean in March 2012. CTD data were collected from 13 casts/stations during cruise TN277. Data were processed with Sea-Bird SBE Data Processing Version 7.21F.

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Coverage

Spatial Extent: **N**:31.246 **E**:-120.6975 **S**:21.7488 **W**:-158.3048
Temporal Extent: 2012-03-01 - 2012-03-10

Dataset Description

CTD data from 13 casts/stations during cruise TN277 during March 2012. Data were processed with Sea-Bird SBE Data Processing Version 7.21F using windows and filters as described below.

Methods & Sampling

Header information from Sea-Bird SBE 9 Data Files:
Software Version Seasave V 7.21b
Temperature SN = 2195; Conductivity SN = 2881
Number of Bytes Per Scan = 41; Number of Voltage Words = 4

Number of Scans Averaged by the Deck Unit = 1
SBE 11plus V 5.1g
number of scans to average = 1; pressure baud rate = 9600; NMEA baud rate = 4800
units = specified
name 0 = scan: Scan Count
name 1 = prDM: Pressure, Digiquartz [db]
name 2 = t068C: Temperature [ITS-68, deg C]
name 3 = c0S/m: Conductivity [S/m]
name 4 = sbeox0Mm/Kg: Oxygen, SBE 43 [umol/Kg]
name 5 = flECO-AFL: Fluorescence, WET Labs ECO-AFL/FL [mg/m^3]
name 6 = bat: Beam Attenuation, Chelsea/Seatech [1/m]
name 7 = nbf: Bottles Fired
name 8 = sal00: Salinity, Practical [PSU]
name 9 = sigma-é00: Density [sigma-theta, Kg/m^3]
name 10 = potemp090C: Potential Temperature [ITS-90, deg C]
name 11 = scan: Scan Count
name 12 = nbin: number of scans per bin
name 13 = flag: flag
interval = decibars: 1; bad_flag = -9.990e-29; Sensors count=13

Sensor Channel 1: Frequency 0, Temperature; Sensor ID = 55; SerialNumber: 2195
Calibration Date: 23-Feb-12
UseG_J: 1
A: 0.00000000e+000; B: 0.00000000e+000; C: 0.00000000e+000; D: 0.00000000e+000; F0_Old: 0.000
G: 4.34901434e-003
H: 6.51224577e-004
I: 2.39780771e-005
J: 2.22858686e-006
F0: 1000.000
Slope: 1.00000000; Offset: 0.0000

Sensor Channel 2: Frequency 1, Conductivity; Sensor ID = 3; SerialNumber: 2881
Calibration Date: 12-Oct-11
UseG_J: 1; Cell const and series R are applicable only for wide range sensors.
SeriesR: 0.0000; CellConst: 2000.0000
ConductivityType: 0
Coefficients equation = 0
A: 0.00000000e+000; B: 0.00000000e+000; C: 0.00000000e+000; D: 0.00000000e+000; M: 0.0
CPcor: -9.57000000e-008
Coefficients equation = 1
G: -1.03710663e+001
H: 1.42479088e+000
I: 1.06729270e-003
J: 6.08592340e-006
CPcor: -9.57000000e-008; CTcor: 3.2500e-006
WBOTC not applicable unless ConductivityType = 1.
WBOTC: 0.00000000e+000
Slope: 1.00000000; Offset: 0.00000

Sensor Channel 3: Frequency 2, Pressure, Digiquartz with TC; Sensor ID = 45; SerialNumber: 94112-0216
Calibration Date: 07-may-2008
C1: -4.562074e+004; C2: 1.820199e-001; C3: 1.580430e-002
D1: 3.615300e-002; D2: 0.000000e+000
T1: 3.024088e+001; T2: -3.472576e-004; T3: 4.427560e-006; T4: 3.763240e-009
Slope: 0.99992000; Offset: -2.70470
T5: 0.000000e+000
AD590M: 1.176000e-002; AD590B: -8.544400e+000

Sensor Channel 4: Frequency 3, Temperature, 2; Sensor ID = 55; SerialNumber: 2060
Calibration Date: 23-Feb-12
UseG_J: 1
A: 0.00000000e+000; B: 0.00000000e+000; C: 0.00000000e+000; D: 0.00000000e+000; F0_Old: 0.000
G: 4.13897250e-003

H: 6.25024768e-004
I: 2.05347545e-005
J: 2.08075011e-006
F0: 1000.000
Slope: 1.00000000; Offset: 0.0000

Sensor Channel 5: Frequency 4, Conductivity, 2; Sensor ID = 3; SerialNumber: 1824
Calibration Date: 30-Nov-11
UseG_J: 1; Cell const and series R are applicable only for wide range sensors.
SeriesR: 0.0000; CellConst: 2000.0000
ConductivityType: 0
Coefficients equation = 0
A: 0.00000000e+000; B: 0.00000000e+000; C: 0.00000000e+000; D: 0.00000000e+000; M: 0.0
CPcor: -9.57000000e-008
Coefficients equation = 1
G: -4.15188213e+000
H: 5.57831770e-001
I: -7.57079565e-004
J: 6.96537524e-005
CPcor: -9.57000000e-008; CTcor: 3.2500e-006
WBOTC not applicable unless ConductivityType = 1.
WBOTC: 0.00000000e+000
Slope: 1.00000000; Offset: 0.00000

Sensor Channel 6: A/D voltage 0, Oxygen, SBE 43; Sensor ID = 38; SerialNumber: 0518
Calibration Date: 13-Dec-11
Use2007Equation: 1
CalibrationCoefficients equation = 0
Coefficients for Owens-Millard equation.
Boc: 0.0000; Soc: 0.0000e+000
offset: 0.0000
Pcor: 0.00e+000; Tcor: 0.0000; Tau: 0.0
CalibrationCoefficients equation = 1
Coefficients for Sea-Bird equation - SBE calibration in 2007 and later.
Soc: 4.9360e-001
offset: -0.5268
A: -3.0579e-003
B: 1.0450e-004
C: -1.7256e-006
D0: 2.5826e+000; D1: 1.92634e-004; D2:-4.64803e-002
E: 3.6000e-002
Tau20: 2.0100
H1: -3.3000e-002; H2: 5.0000e+003; H3: 1.4500e+003

Sensor Channel 7: A/D voltage 1, Free

Sensor Channel 8: A/D voltage 2, Oxygen, SBE 43, 2; Sensor ID = 38; SerialNumber: 0023
Calibration Date: 10-Feb-12
Use2007Equation: 1
CalibrationCoefficients equation = 0
Coefficients for Owens-Millard equation.
Boc: 0.0000; Soc: 0.0000e+000
offset: 0.0000
Pcor: 0.00e+000; Tcor: 0.0000; Tau: 0.0
CalibrationCoefficients equation = 1
Coefficients for Sea-Bird equation - SBE calibration in 2007 and later.
Soc: 4.3418e-001
offset: -0.5182
A: -2.5112e-003
B: 1.4798e-004
C: -2.6123e-006
D0: 2.5826e+000; D1: 1.92634e-004; D2: -4.64803e-002
E: 3.6000e-002

Tau20: 1.1700
H1: -3.3000e-002; H2: 5.0000e+003; H3: 1.4500e+003

Sensor Channel 9: A/D voltage 3, Free
Sensor Channel 10: A/D voltage 4, Free
Sensor Channel 11: A/D voltage 5, Free

Sensor Channel 12: A/D voltage 6, Fluorometer, WET Labs ECO-AFL/FL; Sensor ID = 20; SerialNumber: FLRTD-063
Calibration Date: April-20-2011
ScaleFactor: 2.50000000e+001
Vblank: 0.0260

Sensor Channel 13: A/D voltage 7, Transmissometer, Chelsea/Seatech; Sensor ID = 59; SerialNumber: CST-402DR
Calibration Date: March-11-2011
M: 21.8670
B: -1.2280
PathLength: 0.250

Data Processing Description

BCO-DMO replaced values of '-9.990e-29' with 'nd' to indicate 'no data'. Parameter names were modified to conform with BCO-DMO convention. month_utc, day_utc, year, time_start, lat_start, and lon_start were taken from the CTD headers.
25 March 2013: BCO-DMO added station number (taken from cast sheets and cruise report).

Processing description from Sea-Bird SBE 9 Data Files:
datcnv_skipover = 0
datcnv_ox_hysteresis_correction = yes
datcnv_ox_tau_correction = yes
wildedit_pass1_nstd = 2.0
wildedit_pass2_nstd = 20.0
wildedit_pass2_mindelta = 0.000e+000
wildedit_npoint = 100
wildedit_vars = prDM t068C c0S/m sbeox0Mm/Kg flECO-AFL bat sal00 sigma-é00 potemp090C
wildedit_excl_bad_scans = yes
wfilter_excl_bad_scans = yes
wfilter_action prDM = gaussian, 5, 1, 0
wfilter_action t068C = median, 21
wfilter_action c0S/m = median, 21
wfilter_action sbeox0Mm/Kg = gaussian, 5, 1, 0
wfilter_action flECO-AFL = gaussian, 5, 1, 0
wfilter_action bat = gaussian, 5, 1, 0
wfilter_action sal00 = gaussian, 5, 1, 0
wfilter_action sigma-é00 = gaussian, 5, 1, 0
wfilter_action potemp090C = median, 21
loopedit_minVelocity = 0.250
loopedit_surfaceSoak: minDepth = 0.0, maxDepth = 20, useDeckPress = 1
loopedit_excl_bad_scans = yes
binavg_bintype = decibars
binavg_binsize = 1
binavg_excl_bad_scans = yes
binavg_skipover = 0
binavg_surface_bin = no, min = 0.000, max = 0.000, value = 0.000
file_type = ascii

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Data Files

File
CTD_TN277.csv(Comma Separated Values (.csv), 1.16 MB) MD5:f2da2cd6835c827671dbb63d219e8840 Primary data file for dataset ID 3745

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Parameters

Parameter	Description	Units
cast	CTD cast number.	unitless
month_utc	2-digit month of year, UTC.	mm (01 to 12)
day_utc	2-digit day of month, UTC.	dd (01 to 31)
year	4-digit year. in YYYY format	unitless
time_start	Time (UTC) at start of CTD cast, 24-hour clock.	HHMM.mm
lat_start	Latitude at start of CTD cast. Positive = North.	decimal degrees
lon_start	Longitude at start of CTD cast. Positive = East.	decimal degrees
press	Pressure, Digiquartz.	decibars
temp	Temperature, ITS-68, in degrees Celsius.	degrees C
cond	Conductivity, in Siemens per meter.	S/m
O2_umol_kg	Oxygen measured by SBE 43 sensor in micromoles per kilogram.	umol/kg
fluor	Fluorescence measured by WET Labs ECO-AFL/FL in milligrams per cubic meter.	mg/m^3
beam_c	Beam attenuation measured by the Chelsea/Seatech transmissometer.	1/m

sal	Salinity in practical salinity units.	PSU
sigma_0	Sigma theta density in kilograms per cubic meter.	kg/m^3
potemp	Potential temperature, ITS-90, in degrees Celsius.	degrees C
nbin	Number of scans per bin.	unitless
ISO_DateTime_UTC	Date/Time (UTC) ISO8601 formatted. T indicates start of time string; Z indicates UTC.	YYYY-mm-ddTHH:MM:SS.ssZ
station	Station number.	unitless

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Instruments

Dataset-specific Instrument Name	CTD Sea-Bird 9
Generic Instrument Name	CTD Sea-Bird 9
Generic Instrument Description	The Sea-Bird SBE 9 is a type of CTD instrument package. The SBE 9 is the Underwater Unit and is most often combined with the SBE 11 Deck Unit (for real-time readout using conductive wire) when deployed from a research vessel. The combination of the SBE 9 and SBE 11 is called a SBE 911. The SBE 9 uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 and SBE 4). The SBE 9 CTD can be configured with auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorometer, altimeter, etc.). Note that in most cases, it is more accurate to specify SBE 911 than SBE 9 since it is likely a SBE 11 deck unit was used. more information from Sea-Bird Electronics

Dataset-specific Instrument Name	SBE-43 DO
Generic Instrument Name	Sea-Bird SBE 43 Dissolved Oxygen Sensor
Generic Instrument Description	The Sea-Bird SBE 43 dissolved oxygen sensor is a redesign of the Clark polarographic membrane type of dissolved oxygen sensors. more information from Sea-Bird Electronics

Dataset-specific Instrument Name	Transmissometer
Generic Instrument Name	Transmissometer
Generic Instrument Description	A transmissometer measures the beam attenuation coefficient of the lightsource over the instrument's path-length. This instrument designation is used when specific manufacturer, make and model are not known.

Dataset-specific Instrument Name	ECO AFL/FL
Generic Instrument Name	Wet Labs ECO-AFL/FL Fluorometer
Generic Instrument Description	The Environmental Characterization Optics (ECO) series of single channel fluorometers delivers both high resolution and wide ranges across the entire line of parameters using 14 bit digital processing. The ECO series excels in biological monitoring and dye trace studies. The potted optics block results in long term stability of the instrument and the optional anti-biofouling technology delivers truly long term field measurements. more information from Wet Labs

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Deployments

TN277

Website	https://www.bco-dmo.org/deployment/58867
Platform	R/V Thomas G. Thompson
Report	http://dmoserv3.whoi.edu/data_docs/POWOW/POWOW1-cruise_report.pdf
Start Date	2012-02-29
End Date	2012-03-11
Description	The POWOW#1 cruise was a trip of opportunity to sample along temperature gradients and test out new protocols. The primary goal of this cruise was to measure the abundance, diversity and activity of Prochlorococcus and associated bacterial and viral communities across temperature (and other environmental) gradients to understand how climate change may impact ocean ecology and biogeochemistry. There are many additional scientific and broader impact goals including characterizing oxidative stress and investigating nitrogen uptake/utilization molecular diversity. Cruise information and original data are available from the NSF R2R data catalog.

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Project Information

Seasonal and decadal changes in temperature drive Prochlorococcus ecotype distribution patterns (POWOW)

Website: http://oceanography.ml.duke.edu/johnson/research/powow/

Coverage: Eastern North Pacific Ocean

Project also known as '*Prochlorococcus* Of Warming Ocean Waters' (POWOW).

The two numerically-dominant ecotypes of the marine cyanobacterium *Prochlorococcus* partition the surface ocean niche latitudinally, with ecotype eMIT9312 dominant in the 30 degree N to 30 degree S region and eMED4 dominant at higher latitudes. These ecotypes may account for 25-50% of primary production in open ocean ecosystems, but this percentage is dependent on which ecotype dominates. The relative abundance of the two ecotypes follows a log-linear relationship with temperature, with the transition from eMIT9312 to eMED4 occurring at approx. 18 degrees C. From these descriptive data, it has been hypothesized that temperature is the primary driver of relative abundance. Their contribution to net primary production, however, appears to be independent of temperature, suggesting temperature regulates ecotype dominance through photosynthesis-independent mechanisms.

To test these hypotheses, the PIs are undertaking a series of field and lab studies to investigate the effect of temperature change on the distribution of these ecotypes. Two cruises in the North Pacific will trace the transitions from eMIT9312- to eMED4-dominated regions, with one cruise during the winter and the other during summer. They have hypothesized that the ratio of ecotype abundance will move latitudinally with the seasonal shift in temperature gradient: migration of the 18 degrees C isotherm northward in the summer will be matched by a similar migration of the 1:1 ecotype transition point. Multiple crossings of the 18 degrees C isotherm are proposed, and the summer cruise will also follow the isotherm to the Western US coast to gain insight on physical and geochemical influences. Environmental variables such as nutrient concentrations, light/mixing depths, and virus /grazing based mortality, which may impinge on the relationship between temperature and ecotype ratio, will be assessed through a series of multivariate analyses of the collected suite of physical, chemical and biological data. Seasonal comparisons will be complemented with on-deck incubations and lab competition assays (using existing and new isolates) that will establish, for the first time, how fitness coefficients of these ecotypes relate to temperature. As latitudinal shifts in temperature gradient and migration of ecotypes during seasonal warming likely share common features with high latitude warming as a consequence of climate change, the investigator's analyses will contribute important biological parameters (e.g., abundances, production rates, temperature change coefficients) for modeling biological and biogeochemical responses to climate change. This research will be integrated with that of committed collaborators, generating data sufficient for ecosystem-scale characterizations of the contributions of temperature (relative to other forcing factors) in constraining the range and seasonal migration of these numerically dominant marine phototrophs.

Publications produced as result of this research:

Rowe, J.M., DeBruyn, J.M., Poorvin, L., LeCleir, G.R., Johnson, Z.I., Zinser, E.R., and Wilhelm, S.W. 2012. Viral and bacterial abundance and production in the Western Pacific Ocean and the relation to other oceanic realms. FEMS Microbiology Ecology, 72, p. 359. DOI: 10.1111/j.1574-6941.2011.01223.x

Morris, J.J., Lenski, R.E. and E.R. Zinser. 2012. The Black Queen Hypothesis: Evolution of Dependencies through Adaptive Gene Loss. mBio, 3, p. e00036-12. DOI: 10.1128/mBio.00036-12

Morris, J.J., Johnson, Z.I., Szul, M.J., Keller, M., and Zinser, E.R. 2011. Dependence of the cyanobacterium *Prochlorococcus* on hydrogen peroxide scavenging microbes for growth at the ocean's surface. PLoS One, 6(2), p. 16805. DOI:10.1371/journal.pone.0016805

Ringuet, S., Sassano, L., and Johnson, Z.I. 2011. A suite of microplate reader-based colorimetric methods to quantify ammonium, nitrate, orthophosphate and silicate concentrations for aquatic nutrient monitoring. Journal of Environmental Monitoring. DOI:10.1039/C0EM00290A

Ritchie, A.E. and Johnson, Z.I. 2012. Abundance and genetic diversity of aerobic anoxygenic phototrophic bacteria of coastal regions of the Pacific Ocean. Applied and Environmental Microbiology, 78, p. 2858. DOI: 10.1128/AEM.06268-11

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1031064
NSF Division of Ocean Sciences (NSF OCE)	OCE-1030518

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