Alongtrack data from ship's Data Acquisition System (DAS) from R/V Thomas G. Thompson cruise TN277 in the Eastern North Pacific Ocean in 2012 (POWOW project)

Website: https://www.bco-dmo.org/dataset/3758
Data Type: Cruise Results
Version: 2
Version Date: 2021-06-16

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

Contributors	Affiliation	Role
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Abstract
Alongtrack data from ship's Data Acquisition System (DAS) from R/V Thomas G. Thompson cruise TN277 in the Eastern North Pacific Ocean in 2012. Data were collected along the cruise track from the ship's IMET sensors, thermosalinograph, Knudesn, and GPS.

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Coverage

Spatial Extent: **N**:32.70665 **E**:-117.225355 **S**:21.247275 **W**:-158.342478
Temporal Extent: 2012-03-01 - 2012-03-11

Dataset Description

Data collected along the cruise track from the ship's IMET sensors, thermosalinograph, Knudesn, and GPS. Unprocessed ADCP, gravity, and multibeam underway data are also available from BCO-DMO upon request by emailing info@bco-dmo.org. These are raw data that cannot be served online in their current format.

Methods & Sampling

The DAS system collects data at an operator selected interval; this interval is usually set at 1 sample every 5 seconds. The data are collected from IMET sensors, SBE-21 Thermosalinagraph, EM302 or Knudsen, C-Nav GPS and Winch systems. The data are time, date and position tagged. A new file is started each day at GMT 0:00 and ends at 23:59:55 (depending on the data storage interval). Filename extensions are Julian Day. (From University of Washington vessel information)

Thermosalinograph calibration data for DAS data follows:
Conductivity calibration coefficients:
m = 4.6
a = 0.00000523250085
b = 0.49686504
c = -4.21206317
d = -0.0000877310216

Temperature calibration coefficients:
f = 2610.082
a = 0.00364763429
b = 0.000596620785
c = 0.0000159326489
d = 0.00000120111676

External Temperature calibration coefficients:
f = 2676.423
a = 0.00368121106
b = 0.00058938925
c = 0.0000151014632
d = 0.00000122956892

PAR sensor calibration coefficient:
dry = 1.63E-17

Data Processing Description

BCO-DMO made the following modifications:
- Parameter names were changed to conform to BCO-DMO conventions.
- Blanks were replaced with 'nd'.
- + signs preceding latitude values were removed.
- lat and lon values that were obviously erroneous were replaced with 'nd' (e.g. negative latitude values, longitude values of -500).
- humidity and sea surface temperature columns were removed because all values were nd (humidity) and -9.999, or -2 (sea surface temp).
- Values containing unreadable characters were replaced with 'nd'.

* Data Version 2 (2021-06-09) replaces version 1 (2012-10-24). There was an unsupported characters in the dataset source files which are assumed to be a corrupt value after trying to read them in over 900 different encoding types. The "bad" characters were changed to "nd" the default missing data identifier.

Below are the line changes between versions 1 and 2. The lines starting with plus sign are the new lines in version 2, the lines starting with a minus are the version 1 lines.

--- dataset_3758_v1.tsv
+++ dataset_3758_v2.tsv
@@ -54464,7 +54464,7 @@
-064 03 04 2012 0757.92 04-03-2012 25.831145 -145.675022 21.468 4.9915 35.400 5247.1 0.076 4.696 0001.0 0000.8 1ù—37 1017.9 11.2 106.3 22.5 014.3 10.9 107.5 1526.0 074.5 074.2 08.7 12.5 02 000.0 -008.9 00095.5 2012-03-04T07:57:55Z
+064 03 04 2012 0757.92 04-03-2012 25.831145 -145.675022 21.468 4.9915 35.400 5247.1 0.076 4.696 0001.0 0000.8 nd 1017.9 11.2 106.3 22.5 014.3 10.9 107.5 1526.0 074.5 074.2 08.7 12.5 02 000.0 -008.9 00095.5 2012-03-04T07:57:55Z
@@ -65557,7 +65557,7 @@
-064 03 04 2012 2325.58 04-03-2012 26.571587 -142.663568 20.504 4.8893 35.378 4759.5 0.072 4.689 1270.0 0885.4 ñ7.85 1015.3 07.6 124.9 18.4 018.7 08.5 131.0 1523.4 076.2 075.6 05.7 12.4 02 000.0 -009.2 00120.3 2012-03-04T23:25:35Z
+064 03 04 2012 2325.58 04-03-2012 26.571587 -142.663568 20.504 4.8893 35.378 4759.5 0.072 4.689 1270.0 0885.4 nd 1015.3 07.6 124.9 18.4 018.7 08.5 131.0 1523.4 076.2 075.6 05.7 12.4 02 000.0 -009.2 00120.3 2012-03-04T23:25:35Z
@@ -71913,7 +71913,7 @@
-065 03 05 2012 0815.25 05-03-2012 26.146975 -140.810162 20.923 4.9380 35.422 4720.9 0.074 4.691

0001.0 1þ5 18.9 1017.7 11.3 134.4 23.6 011.6 11.8 132.2 1524.5 110.5 110.1 09.1 12.9 02 000.0 -009.2 00091.0 2012-03-05T08:15:15Z
+065 03 05 2012 0815.25 05-03-2012 26.146975 -140.810162 20.923 4.9380 35.422 4720.9 0.074 4.691 0001.0 nd 18.9 1017.7 11.3 134.4 23.6 011.6 11.8 132.2 1524.5 110.5 110.1 09.1 12.9 02 000.0 -009.2 00091.0 2012-03-05T08:15:15Z
@@ -87281,7 +87281,7 @@
-066 03 06 2012 0542.58 06-03-2012 24.848662 -136.652917 20.132 4.8288 35.195 5032.6 0.076 4.696 0001.0 à-0.7 17.9 1019.7 13.8 076.6 25.3 343.0 14.6 081.7 1522.1 110.6 111.0 08.0 12.5 02 000.0 -009.9 00112.8 2012-03-06T05:42:35Z
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@@ -105902,7 +105902,7 @@
-067 03 07 2012 0734.33 07-03-2012 23.781255 -132.425820 19.106 4.6547 34.614 nd 0.073 4.703 0001.0 H1.4 17.0 1018.4 21.8 058.8 28.7 003.1 20.4 061.3 1518.6 055.8 057.1 06.4 06.9 02 000.0 -010.4 00074.7 2012-03-07T07:34:20Z
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@@ -149559,7 +149559,7 @@
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+069 03 09 2012 2012.42 09-03-2012 30.263440 -122.986535 14.635 4.0720 33.315 3947.6 0.078 4.626 1131.0 0798.2 nd 1021.9 11.4 000.7 11.7 359.7 11.5 000.4 1503.6 000.2 113.9 00.1 00.1 02 -061.0 1742.5 01723.5 2012-03-09T20:12:25Z
@@ -167691,7 +167691,7 @@
-070 03 10 2012 2123.42 10-03-2012 31.680522 -119.604473 14.455 4.0676 33.430 3666.6 0.095 4.470 1187.0 0915.5 ð12.26 1015.3 19.4 306.0 17.3 268.8 19.8 307.4 1503.2 062.3 067.6 08.3 08.8 02 000.0 -010.5 00087.1 2012-03-10T21:23:25Z
+070 03 10 2012 2123.42 10-03-2012 31.680522 -119.604473 14.455 4.0676 33.430 3666.6 0.095 4.470 1187.0 0915.5 nd 1015.3 19.4 306.0 17.3 268.8 19.8 307.4 1503.2 062.3 067.6 08.3 08.8 02 000.0 -010.5 00087.1 2012-03-10T21:23:25Z

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Data Files

File
alongtrack_TN277.csv (Comma Separated Values (.csv), 38.99 MB) MD5:56b0feffbf9c1a8236d09f32dfc5bcc6 Primary data file for dataset ID 3758

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Parameters

Parameter	Description	Units
yrday	Yearday (GMT).	unitless
month_gmt	Month of year (GMT).	mm (01 to 12)
day_gmt	Day of month (GMT).	dd (01 to 31)
year	4-digit year. in YYYY format	unitless
time_gmt	Nav computer GMT time.	HH:MM:SS
date_gmt	Nav computer GMT date. format: dd-mm-YYYY	unitless
lat	Nav computer latitude; positive = north.	decimal degrees
lon	Nav computer longitude; positive = east.	decimal degrees
temp	Thermosalinograph temperature.	degrees Celsius
cond	Thermosalinograph conductivity.	Seimens/meter
sal	Thermosalinograph salinity.	PSU
depth_w	Water depth.	meters
chl_raw	Thermosalinograph chlorophyll.	volts
light_trans_v	Thermosalinograph light transmission.	volts
PAR	PAR in microEinsteins per square meter per second.	uE/m^2/sec
radiation_s	IMET short wave radiation.	watts/square meter
temp_air	IMET air temperature.	degrees Celsius
press_bar	IMET barometric pressure	millibars
wind_speed	True wind speed.	knots
wind_dir	True wind direction.	degrees
wind_speed_r	Relative wind speed.	knots
wind_dir_r	Relative wind direction.	degrees
wind_speed_avg	Average true wind speed.	knots
wind_dir_avg	Average true wind direction.	degrees
sound_vel	Sound velocity.	meters/second
head	Gyro compass heading	degrees true
cog	Nav computer course over ground.	degrees true
speedlog	Doppler speed log.	knots
sog	Nav computer speed over ground.	knots
winch_no	Winch ID number: 0 = Hydro Winch 1; 1 = Trawl Winch; 2 = Hydro Winch 2.	unitless
wire_out	Number of meters of wire out.	meters
wire_rate	Wire rate.	meters/minute
wire_tension	Wire tension in pounds.	lbs
ISO_DateTime_UTC	Date/Time (UTC) ISO8601 formatted. T indicates start of time string; Z indicates UTC.	yyyy-MM-dd'T'HH:mm:ss'Z'

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Instruments

Dataset-specific Instrument Name	Fluorometer
Generic Instrument Name	Fluorometer
Dataset-specific Description	See the WetLabs ECO Fluorometer chacterization sheet (PDF) from TN277 (POWOW1) cruise.
Generic Instrument Description	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

Dataset-specific Instrument Name	Thermosalinograph
Generic Instrument Name	Thermosalinograph
Dataset-specific Description	SBE 21 SeaCAT Thermosalinograph measured conductivity and temperature. Refer to the following (PDFs) from the TN277 (POWOW1) cruise:Temperature calibration dataTemperature calibration reportConductivity calibration dataConductivity calibration report
Generic Instrument Description	A thermosalinograph (TSG) is used to obtain a continuous record of sea surface temperature and salinity. On many research vessels the TSG is integrated into the ship's underway seawater sampling system and reported with the underway or alongtrack data.

Dataset-specific Instrument Name	Wet Labs CSTAR Transmissometer
Generic Instrument Name	WET Labs {Sea-Bird WETLabs} C-Star transmissometer
Dataset-specific Description	See the WetLabs C-Star calibration sheet (PDF) from the TN277 (POWOW1) cruise.
Generic Instrument Description	The C-Star transmissometer has a novel monolithic housing with a highly intgrated opto-electronic design to provide a low cost, compact solution for underwater measurements of beam transmittance. The C-Star is capable of free space measurements or flow-through sampling when used with a pump and optical flow tubes. The sensor can be used in profiling, moored, or underway applications. Available with a 6000 m depth rating. More information on Sea-Bird website: https://www.seabird.com/c-star-transmissometer/product?id=60762467717

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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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