Nitrite (NO2) and Nitrate (NO3) concentrations from Thomas G. Thompson and R/V Kilo Moana cruises TN277, KM1301, KM1312 in the Eastern North Pacific Ocean from 2012-2013 (POWOW project)

Website: https://www.bco-dmo.org/dataset/3755
Data Type: Cruise Results
Version: 2
Version Date: 2014-07-10

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

Contributors	Affiliation	Role
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Abstract
Nitrite (NO2) and Nitrate (NO3) concentrations from Thomas G. Thompson and R/V Kilo Moana cruises TN277, KM1301, KM1312 in the Eastern North Pacific Ocean from 2012-2013 (POWOW project)

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Coverage

Spatial Extent: **N**:46.6888 **E**:-118.316 **S**:21.3428 **W**:-160.6166
Temporal Extent: 2012-03-01 - 2013-07-27

Dataset Description

Nitrite (NO2) and Nitrate (NO3) concentrations in uM from 3 POWOW cruises (TN277, KM1301, and KM1312). Samples that had a mean concentration (mean of replicated samples) below the nominal detection limit are reported as zero.

Also see related inorganic nutrient data from this project:
Ammonium (NH4) https://www.bco-dmo.org/dataset/3754
Phosphate and Silicate (PO4, SiOH4) https://www.bco-dmo.org/dataset/3756

Methods & Sampling

Water for later nutrient analysis was sampled in duplicate into HCl-cleaned HDPE bottles (VWR#414004-110) and stored at -80 degrees C until later analysis using an Astoria-Pacific A2 autoanalyzer following the

manufacturer's recommended protocols running each replicate sample in duplicate. Certified reference materials were used to verify protocols (Inorganic Ventures: QCP-NT, QCP-NUT-1, CGSI1-1). The detection limits are as follows:
The detection limit of NO2 was 0.05 uM for sample from all 3 cruises.
The detection limit of NO3 was 0.1 uM for samples from POWOW1 and POWOW2 cruises.
The detection limit of NO3 was 0.05 uM for samples from POWOW3 cruise.

Data Processing Description

BCO-DMO edits made:
- Parameter names have been changed to conform to BCO-DMO conventions.
- month_utc, day_utc, year, and time_utc were added, based on the original ISO_DateTime_UTC field.
- Rosette bottle numbers were added from the CTD cast sheets for POWOW1.
- Changed latitude of POWOW3 cast CTD028 to value on cast sheet.
- 'NaN' was replaced with 'nd' to indicate 'no data'.

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Data Files

File
NO2_NO3.csv (Comma Separated Values (.csv), 120.58 KB) MD5:4192e43bf243c527cd108a97c2970f71 Primary data file for dataset ID 3755

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Parameters

Parameter	Description	Units
cruise_name	Cruise identifier (POWOW1 = TN277 = R/V Thomas G. Thompson cruise 277; POWOW2 = KM1301 = R/V Kilo Moana cruise 1301; POWOW3 = KM1312 = R/V Kilo Moana cruise 1312).	text
cast	Consecutive CTD cast number. CTD numbers are unique and sequential across stations.	unitless
lat	Latitude at start of CTD cast. Positive = North.	decimal degrees
lon	Longitude at start of CTD cast. Positive = East.	decimal degrees
depth_w	Depth of the water (bottom depth) at sampling station.	meters
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_utc	Time (UTC) at start of sample collection, 24-hour clock.	HHMM.mm
ISO_DateTime_UTC	Date/Time (UTC) ISO8601 formatted. T indicates start of time string; Z indicates UTC.	YYYY-mm-ddTHH:MM:SS.ssZ
depth	Sample depth.	meters
bot	Rosette position of the bottle.	unitless
NO2	Nitrite (NO2) concentration, uM.	micromolar (uM)
NO3	Nitrate (NO3) concentration, uM.	micromolar (uM)

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Instruments

Dataset-specific Instrument Name	Niskin bottle
Generic Instrument Name	Niskin bottle
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Dataset-specific Instrument Name	Nutrient Autoanalyzer
Generic Instrument Name	Nutrient Autoanalyzer
Dataset-specific Description	Nutrients were analyzed using an Astoria-Pacific A2 autoanalyzer following the manufacturer's recommended protocols.
Generic Instrument Description	Nutrient Autoanalyzer is a generic term used when specific type, make and model were not specified. In general, a Nutrient Autoanalyzer is an automated flow-thru system for doing nutrient analysis (nitrate, ammonium, orthophosphate, and silicate) on seawater samples.

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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.

KM1301

Website	https://www.bco-dmo.org/deployment/505095
Platform	R/V Kilo Moana
Report	http://dmoserv3.whoi.edu/data_docs/POWOW/POWOW2-cruise_report.pdf
Start Date	2013-01-10
End Date	2013-02-08
Description	From the cruise report: The POWOW#2 cruise was the second in a series of cruises to study the influence of temperature and other environmental variables on Prochlorococcus, its viruses and other members of the microbial community. 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. Cruise information and original data are available from the NSF R2R data catalog.

KM1312

Website	https://www.bco-dmo.org/deployment/515629
Platform	R/V Kilo Moana
Report	http://dmoserv3.whoi.edu/data_docs/POWOW/POWOW3-cruise_report.pdf
Start Date	2013-07-01
End Date	2013-07-28
Description	From the cruise report: The POWOW#3 cruise was the third in a series of cruises to study the influence of temperature and other environmental variables on Prochlorococcus, its viruses and other members of the microbial community in the Northern Pacific Ocean. 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. The official title of the project is "Collaborative Research: Seasonal and decadal changes in temperature drive Prochlorococcus ecotype distribution patterns" and it is part of NSF #1031064 (Duke) and 1030518 (UTK). 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

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