# Underway thermosalinograh data from two R/V Kilo Moana cruises, KM1301 and KM1312, in the Eastern North Pacific Ocean in 2013 (POWOW project)

**Website**: https://www.bco-dmo.org/dataset/528459
**Version**: 17 Sept 2014
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**Project**
» Seasonal and decadal changes in temperature drive Prochlorococcus ecotype distribution patterns (POWOW)

| Contributors | Affiliation | Role |
|---|---|---|
| Johnson, Zackary I. | Duke University | Chief Scientist, Contact |
| Zinser, Erik | University of Tennessee Knoxville (UTK) | Co-Chief Scientist |
| Rauch, Shannon | Woods Hole Oceanographic Institution (WHOI BCO-DMO) | BCO-DMO Data Manager |

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## Dataset Description

Underway thermosalinograph data from two R/V Kilo Moana cruises carried out as part of the "POWOW" project, KM1301 (POWOW1) and KM1312 (POWOW2).

### Methods & Sampling

Data were collected while underway using a SeaBird SBE Micro Thermosalinograph. See the calibration files:
KM1301 (POWOW2) SBE45 Temp Calibration file (PDF)
KM1301 (POWOW2) SBE45 Cond Calibration file (PDF)
KM1312 (POWOW3) SBE45 Temp & Cond Calibration file (PDF)

### Data Processing Description

BCO-DMO obtained data files from the "km13xx-Finaldata" directory. Master fluorometer files, named "km13xx_uthsl_wfix", were prepared for serving online. The following edits were made:
- parameter names were changed to conform to BCO-DMO conventions;
- the original "code" column was removed from display;
- mon, day, time, and ISO_DateTime_UTC were added programmatically based on the original year, julian day, hour, min, sec, and msec fields.

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## Data Files

| File |
|---|
| **underway_uthsl_KM.csv** (Comma Separated Values (.csv), 559.04 MB)<br>MD5:449626c7993eb3175c6e10cfc53231fd<br>Primary data file for dataset ID 528459 |

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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 |
| yrday | Julian day (year-day). | integer (consecutive day of year) |
| mon | 2-digit month of year. | mm (1 through 12) |
| day | 2-digit day of month. | dd (1 through 31) |
| year | 4-digit year. | YYYY |
| time | Time represented as hour-minute-decimal minute. | HHMM.xx |
| hour | 2-digit hour (24-hour clock; GMT). | HH |
| min | 2-digit minutes component of time (24-hour clock; GMT). | MM |
| sec | 2-digit seconds component of time (24-hour clock; GMT) | SS |
| msec | 3-digit milliseconds component of time (24-hour clock; GMT) | ms |
| lat | Latitude; positive = north. | decimal degrees |
| lon | Longitude; positive = east. | decimal degrees |
| ISO_DateTime_UTC | Date/Time (UTC) formatted to ISO8601 standard. T indicates start of time string; Z indicates UTC. | YYYY-mm-ddTHH:MM:SS.xxZ |

| | | |
|---|---|---|
| temp | Temperature (in degrees Celsius)  measured by the SBE45. | degrees Celsius (C) |
| cond | Conductivity (in Siemens per meter) measured by the SBE45. | Siemens per meter (S/m) |
| sal | Salinity (in PSU) measured by the SBE45. | Practical Salinity Units (PSU) |
| remote_temp | remote_temp is the sensor closest to uncontaminated scientific seawater intake, 8 meters below surface. Measured in degrees Celsius. | degrees Celsius (C) |

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## Instruments

| | |
|---|---|
| **Dataset-specific Instrument Name** | SeaBird SBE45 Micro Thermosalinograph |
| **Generic Instrument Name** | Sea-Bird SBE 45 MicroTSG Thermosalinograph |
| **Dataset-specific Description** | Data were collected while underway using a SeaBird SBE Micro Thermosalinograph. See the calibration files: KM1301 (POWOW2) SBE45 Temp Calibration file (PDF) KM1301 (POWOW2) SBE45 Cond Calibration file (PDF) KM1312 (POWOW3) SBE45 Temp & Cond Calibration file (PDF) |
| **Generic Instrument Description** | A small externally powered, high-accuracy instrument, designed for shipboard determination of sea surface (pumped-water) conductivity and temperature. It is constructed of plastic and titanium to ensure long life with minimum maintenance. It may optionally be interfaced to an external SBE 38 hull temperature sensor. Sea Bird SBE 45 MicroTSG (Thermosalinograph) |

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## Deployments

**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


| 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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