Two decibar-averaged CTD profiles from the Hawaii Ocean Time-Series cruises from 1988-2016 (HOT project)

Website: https://www.bco-dmo.org/dataset/3937
Data Type: Cruise Results
Version: 1
Version Date: 2018-04-06

Project
» [Current] Hawaii Ocean Time-series (HOT): 2023-2028; [Previous] Hawaii Ocean Time-series (HOT): Sustaining ocean ecosystem and climate observations in the North Pacific Subtropical Gyre (HOT)

Programs
» Ocean Carbon and Biogeochemistry (OCB)
» U.S. Joint Global Ocean Flux Study (U.S. JGOFS)
» Ocean Time-series Sites (Ocean Time-series)

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Abstract
HOT CTD data are collected using a SeaBird CTD 9-11 (9-11 Plus with dual sensors as of HOT-54) at the maximum sampling rate of 24 samples per second (24 Hz). They are screened for errors and processed to 2-dbar averages. The majority of the sampling effort, approximately 60-72 h per standard HOT cruise, is spent at Station ALOHA. High vertical resolution environmental data are collected with a Sea-Bird CTD having external temperature (T), conductivity (C), dissolved oxygen (DO) and fluorescence (F) sensors and an internal pressure (P) sensor. A Sea-Bird 24-place carousel and an aluminum rosette that is capable of supporting 24 12-L PVC bottles are used to obtain water samples from desired depths. The CTD and rosette are deployed on a 3-conductor cable allowing for real-time display of data and for tripping the bottles at specific depths of interest.

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Coverage

Spatial Extent: **N**:23.4375 **E**:-157.4567 **S**:21.2283 **W**:-158.8575
Temporal Extent: 1988-10-30 - 2016-11-28

Dataset Description

HOT CTD data are collected using a SeaBird CTD 9-11 (9-11 Plus with dual sensors as of HOT-54) at the maximum sampling rate of 24 samples per second (24 Hz). They are screened for errors and processed to 2-dbar averages. Details of the CTD processing for each year can be found in HOT Data Reports #1-8 (see the file Readme.first for information on how to obtain these Data Reports).

CTD data are written to files using formats specified by the WOCE Hydrographic Programme Office. These formats are based on NODC formats, and are detailed in the WHP Office Report WHPO 90-1, available from Steve Diggs, WHPO Data Manager, Scripps Institution of Oceanography, 9500 Gilman Drive, La Jolla, CA 92093-0214.

The files contain pressure, temperature and salinity profiles for all casts. Some casts also have dissolved oxygen, light transmission, and fluorescence. The data format consists of a self-documenting header followed by the data. The data records are written so that they can be read with a simple FORTRAN read statement. Details of this format are given in the file Readme.format.

The first year's temperatures are reported in IPTS-68. Subsequent temperatures are reported in ITS-90 units. Since temperature sensor calibrations were done in IPTS-68 units, and the UNESCO routines require IPTS-68 temperature, all intermediate processing was done in IPTS-68. As a final step, temperature and potential temperature were converted to ITS-90 using t_90 = 0.99976 t_68.

Since November 2001 CTD fluorescence data have been regularly calibrated against Chlorophyll bottle data and reported in the CTD files as Chloropigments (CHLPIG) in microgram/liter (uG/L). Bottle Fluorometric Chlorophyll-a plus Pheopigments above 175 dbar are matched against the upcast CTD Fluorometry to calibrate the downcast Fluorescence reported in the CTD files. All CTD files for prior cruises were calibrated and updated to reflect this change.

Starting HOT-177 (2006), the Transmissometer data that used to be included in the CTD files have been replaced by continuous Nitrate measured using Satlantic's InSitu Underwater Spectrometer (ISUS V2). Satlantic's ISUS V2 is a chemical free sensor that uses UV absorption technology to provide accurate nitrate concentration measurements in real-time These data are not included since they were uncalibrated and of questionable quality.

Methods & Sampling

HOT CTD yearly reports

Data Processing Description

Please see HOT's "CTD Data Format Document" for detailed description of original HOT data formatting, original parameter names and Quality Word definitions.

BCO-DMO Processing Description

- Transferred the data from the University of Hawaii ftp site to the BCO-DMO servers.
- Reformatted the data into csv and appended cruise summary information.
- Updated the version date in the served data to the date the data was updated.
- Created EXPOCODE field with by taking the Ship value and replacing the "/" (forward slash) with a "_" (underscore). For example, Ship = 32MW001/1 would have a EXPOCODE = 32MW001_1.
- Created field (HOT_summary_file_name) which contains the name of the summary file.
- Created Year, Month, Day fields which were extracted from the Date field.
- Converted latitude and longitude values to decimal degrees (negative west and south).
- Created cruise_name field which is extracted from the Ship field. This is composed as the last three values before the "/" in the Ship field value. For example, a value of Ship = 32MW001/1 would have a cruise_name = 001.

-Created the ISO_DateTime field which is an ISO8601 representation of the date time provided in the data.

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Data Files

File
ctd.csv(Comma Separated Values (.csv), 736.45 MB) MD5:7a7588f82ba562aa61ca974f21948492 Primary data file for dataset ID 3937

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Parameters

Parameter	Description	Units
cruise_name	cruise identifier	unitless
station	station identifier	unitless
cast	CTD cast number	unitless
depth_max	Depth meassured by shipboard echo sounder in meters. The nominal depth for Station 1 = 1500m and for Station 2 = 4750m.	meters (m)
timecode	The code for when the time was taken. At the beginning (BE); bottom (BO); and completion (EN) of the cast.	unitless
HOT_summary_file_name	Filename from which the cruise summary information was obtained	unitless
parameters	A list of the parameters measured from the water samples collected during the cast. The identification numbers are listed here. 1 = Salinity; 2 = Oxygen; 3 = Silicate; 4 = Nitrate; 5 = Nitrite; 6 = Phosphate; 7 = Freon 11; 8 = Freon 12; 9 = Tritium; 10= Helium; 11= Carbon 14; 12= Carbon 13; 13= Krypton 85; 14= Argon; 15= Argon 39; 16= Neon; 17= Radium; 18= Radium 226; 19= o18/o16 ratio; 20= Stronitum 90; 21= Cesium 137	unitless
num_bottles	The number of bottles used during the cast.	unitless
section	The WHP section designator.	unitless
lon	longitude with west being negative	decimal degrees
comments	cast comments	unitless
Date	The date of the cast in MMDDYY.	untiless
Day	Day of the month value as extracted from the Date field	unitless
EXPOCODE	This code allows for the identification of cast. It consists of a 4 character NODC country-ship code; a maximum of 8 character cruise number followed by a "_" and leg number.	unitless
lat	latitude with south being negative	decimal degrees
nav_code	navigation system code	unitless
pres_max	The deepest pressure sampled.	decibars (db)
depth_hgt	Bottom depth less the maximum pressure sampled.	meters (m)
Month	Month of the year value as extracted from the Date field	unitless

timeutc	time in UTC	unitless
Year	Four digit year as extracted from the Date field	unitless
Ship	This code allows for the identification of cast. It consists of a 4 character NODC country-ship code; a maximum of 8 character cruise number followed by a "/" and leg number.	unitless
CTDTMP	Temperature (Degrees Celsius International Temperature Scale of 1988)	Degrees Celsius
NUMBER	Number of observations averaged at this pressure level	count
CTDPRS	Pressure (Decibars)	Decibars (db)
CTDOXY	Oxygen (micromoles per kilogram)	micromoles per kilogram (umol/kg)
XMISS	Transmission (% transmission)	percent transmission (%)
QUALT1	Quality (defined by investigator); The quality word is the left-to-right concatenation of required quality bytes for the variables measured. They are defined as follows: 1 = Not calibrated with water samples; 2 = Acceptable measurement; 3 = Questionable measurement; 4 = Bad measurement; 5 = Not reported; 6 = Interpolated value; 7 = Not assigned for CTD data; 8 = Not assigned for CTD data; 9 = Not sampled	unitless
CTDSAL	Salinity (1978 International Practical Salinity Scale)	PSU
CHLPIG	Chloropigments (microgram/liter)	microgram per liter (ug/L)
NITRATE	Nitrate (micromoles per kilogram) after HOT-176	micromoles per kilogram (umol/kg)
FLUOR	fluorescence	mVOLTS
ISO_DateTime	time in ISO-8601 format following the convention YYYY-mm-ddTHH:MM:SS[.xx]Z (UTC time)	unitless

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Instruments

Dataset-specific Instrument Name	SeaBird CTD 9-11
Generic Instrument Name	CTD Sea-Bird 911
Dataset-specific Description	HOT CTD data are collected using a SeaBird CTD 9-11 (9-11 Plus with dual sensors as of HOT-54) at the maximum sampling rate of 24 samples per second (24 Hz).
Generic Instrument Description	The Sea-Bird SBE 911 is a type of CTD instrument package. The SBE 911 includes the SBE 9 Underwater Unit and the SBE 11 Deck Unit (for real-time readout using conductive wire) for deployment from a 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, fluorescence, light (PAR), light transmission, etc.). More information from Sea-Bird Electronics.

Dataset-specific Instrument Name	SeaBird CTD 9-11 Plus
Generic Instrument Name	CTD Sea-Bird SBE 911plus
Dataset-specific Description	HOT CTD data are collected using a SeaBird CTD 9-11 (9-11 Plus with dual sensors as of HOT-54) at the maximum sampling rate of 24 samples per second (24 Hz).
Generic Instrument Description	The Sea-Bird SBE 911 plus is a type of CTD instrument package for continuous measurement of conductivity, temperature and pressure. The SBE 911 plus includes the SBE 9plus Underwater Unit and the SBE 11plus Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 plus and SBE 11 plus is called a SBE 911 plus. The SBE 9 plus uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 plus and SBE 4). The SBE 9 plus CTD can be configured with up to eight auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). more information from Sea-Bird Electronics

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Deployments

HOT_cruises

Website	https://www.bco-dmo.org/deployment/58879
Platform	Unknown Platform
Report	http://hahana.soest.hawaii.edu/hot/
Start Date	1988-10-31
Description	Since October 1988, the Hawaii Ocean Time-series (HOT) program has investigated temporal dynamics in biology, physics, and chemistry at Stn. ALOHA (22°45' N, 158°W), a deep ocean field site in the oligotrophic North Pacific Subtropical Gyre (NPSG). HOT conducts near monthly ship-based sampling and makes continuous observations from moored instruments to document and study NPSG climate and ecosystem variability over semi-diurnal to decadal time scales.

Project Information

[Current] Hawaii Ocean Time-series (HOT): 2023-2028; [Previous] Hawaii Ocean Time-series (HOT): Sustaining ocean ecosystem and climate observations in the North Pacific Subtropical Gyre (HOT)

Website: https://hahana.soest.hawaii.edu/hot/

Coverage: North Pacific Subtropical Gyre; 22 deg 45 min N, 158 deg W

Hawai'i Ocean Time-Series Project Summary
This continuing award for the HOT research program sustains the open-ocean climatology of biological, chemical, and physical observations into a 4th decade.

Intellectual Merit
The scientific mission of HOT continues to be monitoring of temporal dynamics in the cycling of carbon and associated bioelements, and observations of the variability of hydrological and ecological properties, heat fluxes, and circulation of the North Pacific Subtropical Gyre (NPSG). The proposed research will rely on shipboard observations and experiments conducted on 10 separate 5-day expeditions per annum along with near-continuous moored platform measurements of air-sea interactions, ocean mixing, and physical characteristics of the deep sea. The HOT program maintains the high-quality suite of biogeochemical and physical measurements required for continued assessment of dynamics in ocean carbon and nutrient pools and fluxes, plankton community structure, ecosystem productivity, and inherent optical properties of the water column. Continuity of these observations improves the value of the dataset for deciphering how low-frequency natural and anthropogenic climate signals influence ecosystem structure in the NPSG as well as providing up-to-date measurements to place current signals in the longer-term context. Such efforts will continue to aid on-going modeling efforts required for predicting how future habitat perturbations may influence ecosystem dynamics in the NPSG. All HOT program data are publicly available and are frequently used by researchers and policy makers around the world. HOT data provide reference baselines for essential ocean variables, allow for characterization of natural patterns of ocean system variability and associated links to regional climate indices, and support calibration/validation of autonomous in situ and remote (satellite, airborne) sensors.

Broader Impacts
The long-term, continuous HOT data are critical to assess variability on seasonal to decadal time-scales and thus are essential to determine the emergence of anthropogenic signals in the oligotrophic North Pacific. Further sustaining HOT measurements will strengthen our capacity to test hypotheses about poorly understood interactions between ocean dynamics, climate, and biogeochemistry and increase the value of HOT data for understanding the response of ocean ecosystems to both natural and anthropogenic climate perturbations. Over the next 5 years, we will continue to promote the value of HOT research through high quality, high visibility peer-reviewed journal and book articles, newspaper and newsletter articles, and community outreach. With partners BCO-DMO and OceanSITES we will also continue to strive for a FAIR data model (see data management plan) as metadata standards and conventions evolve in the community. We will continue working with an Earthcube Research Coordination Network for Marine Ecological Time Series (METS) to support efforts that bring together different cross-sections of METS data producers, data users, data scientists, and data managers in large- and small-group formats to foster the necessary dialog to develop FAIR data solutions across multiple time-series. In addition, HOT is a community resource that helps support the research of numerous ocean scientists who rely on the program’s infrastructure (ship time, staff, laboratories, equipment) to conduct their research, education, and outreach activities. Moreover, HOT PIs maintain a strong commitment to mentoring and training of undergraduate and graduate students, and will continue these activities as well as facilitates access to the sea by a number of ancillary students and scientists.

NSF Award Abstract:

Long-term observations of ocean physics, biology, and chemistry across decades provide a powerful lens for understanding the response of the oceans to environmental change. This award will continue the Hawaii Ocean Time-series (HOT) research program, which began in 1988, for an additional five years. Continuity of these observations will improve the value of the dataset for deciphering how natural and human-influenced climate

signals affect ecosystem structure in the Pacific Ocean. All HOT program data are publicly available and are frequently used by researchers and policy makers around the world. HOT also serves as (1) a testbed for the development of new sensors and methodologies, (2) a calibration/validation site, (3) an invaluable training ground that attracts students and researchers from around the globe, and (4) a forum for international collaboration and capacity building.

The proposed research will rely on shipboard observations and experiments conducted on ten separate five-day expeditions per year along with near-continuous moored platform measurements of air-sea interactions, ocean mixing, and physical characteristics of the deep sea. Observations include biogeochemical and physical measurements required for continued assessment of dynamics in ocean carbon and nutrient pools and fluxes, plankton community structure, ecosystem productivity, and inherent optical properties of the water column. The major program goals and objectives over the next 5 years remain as in prior years and include: (1) sustain high quality, time-resolved oceanographic measurements on the interactions between ocean-climate and ecosystem variability in the North Pacific Subtropical Gyre (NPSG), (2) quantify time-varying (seasonal to decadal) changes in reservoirs and fluxes of carbon and associated bioelements (nitrogen, phosphorus, and silicon), (3) constrain processes controlling air-sea carbon exchange, rates of carbon transformation through the planktonic food web, and fluxes of carbon into the ocean?s interior, (4) extend to 40 years a climatology of hydrographic and biogeochemical dynamics from which to gauge anomalous or extreme changes to the NPSG habitat, forming a multi-decadal baseline from which to decipher natural and anthropogenic influences on the NPSG ecosystem, (5) continue to provide scientific and logistical support to ancillary programs that benefit from the temporal context, interdisciplinary science, and regular access to the open sea afforded by HOT program occupation of Station ALOHA, including projects implementing, testing, and validating new methodologies and transformative ocean sampling technologies, and (6) provide unique training and educational opportunities for the next generation of ocean scientists.

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Program Information

Ocean Carbon and Biogeochemistry (OCB)

Website: http://us-ocb.org/

Coverage: Global

The Ocean Carbon and Biogeochemistry (OCB) program focuses on the ocean's role as a component of the global Earth system, bringing together research in geochemistry, ocean physics, and ecology that inform on and advance our understanding of ocean biogeochemistry. The overall program goals are to promote, plan, and coordinate collaborative, multidisciplinary research opportunities within the U.S. research community and with international partners. Important OCB-related activities currently include: the Ocean Carbon and Climate Change (OCCC) and the North American Carbon Program (NACP); U.S. contributions to IMBER, SOLAS, CARBOOCEAN; and numerous U.S. single-investigator and medium-size research projects funded by U.S. federal agencies including NASA, NOAA, and NSF.

The scientific mission of OCB is to study the evolving role of the ocean in the global carbon cycle, in the face of environmental variability and change through studies of marine biogeochemical cycles and associated ecosystems.

The overarching OCB science themes include improved understanding and prediction of: 1) oceanic uptake and release of atmospheric CO2 and other greenhouse gases and 2) environmental sensitivities of biogeochemical cycles, marine ecosystems, and interactions between the two.

The OCB Research Priorities (updated January 2012) include: ocean acidification; terrestrial/coastal carbon fluxes and exchanges; climate sensitivities of and change in ecosystem structure and associated impacts on biogeochemical cycles; mesopelagic ecological and biogeochemical interactions; benthic-pelagic feedbacks on biogeochemical cycles; ocean carbon uptake and storage; and expanding low-oxygen conditions in the coastal and open oceans.

U.S. Joint Global Ocean Flux Study (U.S. JGOFS)

Website: http://usjgofs.whoi.edu/

Coverage: Global

The United States Joint Global Ocean Flux Study was a national component of international JGOFS and an integral part of global climate change research.

The U.S. launched the Joint Global Ocean Flux Study (JGOFS) in the late 1980s to study the ocean carbon cycle. An ambitious goal was set to understand the controls on the concentrations and fluxes of carbon and associated nutrients in the ocean. A new field of ocean biogeochemistry emerged with an emphasis on quality measurements of carbon system parameters and interdisciplinary field studies of the biological, chemical and physical process which control the ocean carbon cycle. As we studied ocean biogeochemistry, we learned that our simple views of carbon uptake and transport were severely limited, and a new "wave" of ocean science was born. U.S. JGOFS has been supported primarily by the U.S. National Science Foundation in collaboration with the National Oceanic and Atmospheric Administration, the National Aeronautics and Space Administration, the Department of Energy and the Office of Naval Research. U.S. JGOFS, ended in 2005 with the conclusion of the Synthesis and Modeling Project (SMP).

Ocean Time-series Sites (Ocean Time-series)

Coverage: Bermuda, Cariaco Basin, Hawaii

Program description text taken from Chapter 1: Introduction from the **Global Intercomparability in a Changing Ocean: An International Time-Series Methods Workshop** report published following the workshop held November 28-30, 2012 at the Bermuda Institute of Ocean Sciences. The full report is available from the workshop Web site hosted by US OCB: http://www.whoi.edu/website/TS-workshop/home

Decades of research have demonstrated that the ocean varies across a range of time scales, with anthropogenic forcing contributing an added layer of complexity. In a growing effort to distinguish between natural and human-induced earth system variability, sustained ocean time-series measurements have taken on a renewed importance. Shipboard biogeochemical time-series represent one of the most valuable tools scientists have to characterize and quantify ocean carbon fluxes and biogeochemical processes and their links to changing climate (Karl, 2010; Chavez et al., 2011; Church et al., 2013). They provide the oceanographic community with the long, temporally resolved datasets needed to characterize ocean climate, biogeochemistry, and ecosystem change.

The temporal scale of shifts in marine ecosystem variations in response to climate change are on the order of several decades. The long-term, consistent and comprehensive monitoring programs conducted by time-series sites are essential to understand large-scale atmosphere-ocean interactions that occur on interannual to decadal time scales. Ocean time-series represent one of the most valuable tools scientists have to characterize and quantify ocean carbon fluxes and biogeochemical processes and their links to changing climate.

Launched in the late 1980s, the US JGOFS (Joint Global Ocean Flux Study; http://usjgofs.whoi.edu) research program initiated two time-series measurement programs at Hawaii and Bermuda (HOT and BATS, respectively) to measure key oceanographic measurements in oligotrophic waters. Begun in 1995 as part of the US JGOFS Synthesis and Modeling Project, the CARIACO Ocean Time-Series (formerly known as the CArbon Retention In A Colored Ocean) Program has studied the relationship between surface primary production, physical forcing variables like the wind, and the settling flux of particulate carbon in the Cariaco Basin.

The objective of these time-series effort is to provide well-sampled seasonal resolution of biogeochemical variability at a limited number of ocean observatories, provide support and background measurements for process-oriented research, as well as test and validate observations for biogeochemical models. Since their creation, the BATS, CARIACO and HOT time-series site data have been available for use by a large community of researchers.

Data from those three US funded, ship-based, time-series sites can be accessed at each site directly or by selecting the site name from the Projects section below.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0926766
NSF Division of Ocean Sciences (NSF OCE)	OCE-1260164
NSF Division of Ocean Sciences (NSF OCE)	OCE-1756517
NSF Division of Ocean Sciences (NSF OCE)	OCE-2241005

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