Time series composite CTD profiles from R/V Hermano Ginés cruises in the Cariaco Basin from 1995 through 2017 (CARIACO Ocean Time-Series Program)

Website: https://www.bco-dmo.org/dataset/3092
Data Type: Cruise Results
Version: 1
Version Date: 2019-06-04

Project
» CARIACO Ocean Time-Series Program (CARIACO)

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

The CARIACO Ocean Time-Series Program (formerly known as CArbon Retention In A Colored Ocean) started on November 1995 (CAR-001) and ended on January 2017 (CAR-232). Monthly cruises were conducted to the CARIACO station (10.50° N, 64.67° W) onboard the R/V Hermano Ginés of the Fundación La Salle de Ciencias Naturales de Venezuela. During each cruise, a minimum of four hydrocasts were performed to collect a suite of core monthly observations. We conducted separate shallow and deep casts to obtain a better vertical resolution of in-situ Niskin-bottles samples for chemical observations, and for productivity, phytoplankton, and pigment observations. One CTD composite profile was created for each cruise by stitching together the sections of the different cruise's CTD profiles at the depth interval where water samples were obtained. CTD's Salinity, Oxygen, and Fluorescence where calibrated with in-situ measurements. The composite CTD profiles dataset is a complement of the hydrographic time series data obtained with the Niskin Bottle Samples (https://www.bco-dmo.org/dataset/3093). The following sections describe the methods used in collecting the core observations at the CARIACO station.

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Coverage

Spatial Extent: **N**:10.683 **E**:-64.367 **S**:10.492 **W**:-64.735
Temporal Extent: 1995-11-08 - 2013-03-13

Dataset Description

The CARIACO Ocean Time-Series Program (formerly known as CArbon Retention In A Colored Ocean) started on November 1995 (CAR-001) and ended on January 2017 (CAR-232). Monthly cruises were conducted to the CARIACO station (10.50° N, 64.67° W) onboard the R/V Hermano Ginés of the Fundación La Salle de Ciencias Naturales de Venezuela. During each cruise, a minimum of four hydrocasts were performed to collect a suite of core monthly observations. We conducted separate shallow and deep casts to obtain a better vertical resolution of in-situ Niskin-bottles samples for chemical observations, and for productivity, phytoplankton, and pigment observations. One CTD composite profile was created for each cruise by stitching together the sections of the different cruise's CTD profiles at the depth interval where water samples were obtained. CTD's Salinity, Oxygen, and Fluorescence where calibrated with in-situ measurements. The composite CTD profiles dataset is a complement of the hydrographic time series data obtained with the Niskin Bottle Samples (https://www.bco-dmo.org/dataset/3093). The following sections describe the methods used in collecting the core observations at the CARIACO station.

Methodology published at CARIACO site (http://imars.usf.edu/publications/methods-cariaco)

CARIACO Field Program general description (http://www.imars.usf.edu/cariaco)

Additional funding support provided by:
Fondo Nacional de Ciencia, Tecnología e Investigación, FONACIT (2000001702 and 2011000353), Venezuela.
Ley Orgánica de Ciencia, Tecnología e Innovación, LOCTI (Estación de Investigaciones Marinas, 23914), Venezuela.
Inter-American Institute for Global Change Research, IAI (IAI-CRN3094).

Methods & Sampling

Hydrocasts: CTD and Rosette Sample
During each cruise, a minimum of four hydrocasts were performed to collect a suite of core monthly observations. Additional hydrocasts were performed for specific process studies. We conducted separate shallow and deep casts to obtain better vertical resolution for chemical observations, and for productivity and pigment observations. Water was collected with a SeaBird rosette equipped with 12 (8 liter) teflon-coated Niskin bottles (bottle springs were also teflon-coated) at 20 depths between the surface and 1310 m. The rosette housed the CTD, which collected continuous profiles of temperature and salinity. The CTD also had a SBE-43 oxygen probe, a Wetlabs ECO fluorometer outfitted for chlorophyll-a estimates, and a C-Star transmissometer (660 nm, Wetlabs). Beam attenuation measurements were added to the time series on its 11th cruise (November 1986) originally using a SeaTech transmissometer. The rosette was controlled with a SeaBird deck unit via conducting cable, but alternatively it had been actuated automatically based on pressure recordings via an Autofire Module (SBE AFM) when breaks in cable conductivity had occurred.

Between November 1995 and September 1996, three separate SBE-19 CTDs were used in repeated casts until a reliable salinity profile was obtained below the oxycline. The SBE-19 model CTDs frequently failed to provide reliable conductivity values below the oxycline in the Cariaco Basin. Starting in September 1996, the SBE-19 CTDs were replaced by SBE-25 CTDs, which provided extremely accurate and reliable data in anoxic waters.

All CTDs were calibrated at the Sea-Bird factory once per year. The accuracy of the pressure sensor was 3.5 m and had a resolution of 0.7 m. The temperatures accuracy was 0.002°C with a resolution of 0.0003°C. The conductivity accuracy was 0.003 mmho/cm with a resolution of 0.0004 mmho/cm.

Discrete Salinity
Continuous salinity profiles were calculated from the CTD measurements. Discrete salinity samples were analyzed using a Guildline Portasal 8410 salinometer standardized with IAPSO Standard Seawater, with a precision of better than ± 0.003 and a resolution of 0.0003 mS/cm at 15° C and 35 psu, the accuracy was ±0.003 at the same set point temperature as standardization and within -2° and +4°C of ambient. These salinity values were used to check, and when necessary calibrate, the CTD salinity profiles.

Discrete Oxygen
Continuous dissolved oxygen (O2) profiles were obtained with a SBE-43 Dissolved Oxygen Sensor coupled to the SBE-25 CTD. Discrete oxygen samples were collected in duplicate using glass-stoppered bottles and analyzed by Winkler titration (Strickland and Parsons, 1972, as modified by Aminot, 1983). The analytical precision for discrete oxygen analysis was ±3 mM, based on analysis of duplicate samples, with a detection limit of 5 mM. The in-situ oxygen values were used to check, and when necessary calibrate, the CTD oxygen profiles.

Discrete Chlorophyll
Continuous fluorescence profiles were obtained with a Sea Tech Fluorometer coupled to the SBE-25 CTD. Discrete chlorophyll samples were immediately filtered through 25 mm Whatman GF/F filters in triplicate and frozen. The chlorophyll-a determination followed Holm-Hansen et al. (1965), and the calculations were done as indicated in Lorenzen (1966). Among the modifications are the use of methanol instead of acetone as an extraction solvent due to its greater efficiency (Holm-Hansen and Riemann, 1978) and the use of a sonic dismembrator (Wright et al., 1997). The method applies to all ranges of chlorophyll-a concentration found in seawater. The method detection limit is 0.01 µg L-1 for natural waters (for a 0.5 L sample). Fluorescence profiles were calibrated with in-situ chlorophyll-a and it is presented in its native units of RFU (fluor_CTD) and also in micrograms/m^3 (fluor_chla).

Data Processing Description

BCO-DMO Processing Notes:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- added latitude and longitude information from additional LatLon.csv file.
- reformatted the date from yyyymmdd to ISO convention yyyy-mm-dd
- additional information about the previous versions can be found at OCB DMO processing notes.

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Data Files

File
ctd.csv (Comma Separated Values (.csv), 35.46 MB) MD5:2368954a1e5c7aa0d9fef2f482a52ca3 Primary data file for dataset ID 3092

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Supplemental Files

File
CARIACO Parameter Table filename: CARIACO_OCB_ParameterTable.pdf (Portable Document Format (.pdf), 50.82 KB) MD5:e117100da9c8fbe504eacb8731b8b4a3 Historical CARIACO Parameter Table
Change History filename: Change_history.pdf (Portable Document Format (.pdf), 65.32 KB) MD5:4630a9221a206bd254a089047f46b26b Historical log of the changes made to the dataset.
Cruise Data Acquisition Report filename: Cruise_data_aquisition_report.xlsx (Octet Stream, 58.33 KB) MD5:c724109309a10df4ad0652338f6c116c Detailed log for each cruise. This includes information about eddies, intrusions, other anomalies, sensors used, and malfunctions.
CTD Profile Quality Notes filename: CTD_Profile_quality_notes.pdf (Portable Document Format (.pdf), 63.63 KB) MD5:8b98a8e7bfa2e5dfbc8f6a0e20d5e2aa Historical CTD Processing Quality Notes
OCB DMO Processing Notes filename: OCB_DMO_Processing_Notes.pdf (Portable Document Format (.pdf), 67.51 KB) MD5:b35491a3b6d0a1890095bcaaeed9ff99 Historical OCB DMO Processing Notes

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Related Publications

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Methods

Breland, J. A., & Byrne, R. H. (1993). Spectrophotometric procedures for determination of sea water alkalinity using bromocresol green. Deep Sea Research Part I: Oceanographic Research Papers, 40(3), 629–641. doi:10.1016/0967-0637(93)90149-w https://doi.org/10.1016/0967-0637(93)90149-W
Methods

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Methods

Carpenter, E. J., & Lively, J. S. (1980). Review of estimates of algal growth using 14 C tracer techniques. In Primary productivity in the sea (pp. 161-178). Springer, Boston, MA.
Methods

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Methods

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Related Research

Holm-Hansen, O., & Riemann, B. (1978). Chlorophyll a Determination: Improvements in Methodology. Oikos, 30(3), 438. doi:10.2307/3543338
Methods

Holm-Hansen, O., Lorenzen, C. J., Holmes, R. W., & Strickland, J. D. H. (1965). Fluorometric Determination of Chlorophyll. ICES Journal of Marine Science, 30(1), 3–15. doi:10.1093/icesjms/30.1.3
Methods

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Methods

Koroleff, F. (1968). Determination of total phosphorus in natural waters by means of persulfate oxidation.
Methods

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Methods

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Methods

Muller-Karger, F. (1984). Lower trophic level studies in the marginal sea-ice zone (Doctoral dissertation).
Methods

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Methods

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Methods

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Methods

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Methods

Strickland, J. D. H. and Parsons, T. R. (1972). A Practical Hand Book of Seawater Analysis. Fisheries Research Board of Canada Bulletin 157, 2nd Edition, 310 p.
Methods

Van Heukelem, L., & Thomas, C. S. (2001). Computer-assisted high-performance liquid chromatography method development with applications to the isolation and analysis of phytoplankton pigments. Journal of Chromatography A, 910(1), 31–49. doi:10.1016/s0378-4347(00)00603-4
Methods

Wright, S. W. (1997). Evaluation of methods and solvents for pigment extraction. Phytoplankton pigments in oceanography, 261-282.
Methods

Yao, W., Liu, X., & Byrne, R. H. (2007). Impurities in indicators used for spectrophotometric seawater pH measurements: Assessment and remedies. Marine Chemistry, 107(2), 167–172. doi:10.1016/j.marchem.2007.06.012
Methods

Yentsch, C. S., & Menzel, D. W. (1963). A method for the determination of phytoplankton chlorophyll and phaeophytin by fluorescence. Deep Sea Research and Oceanographic Abstracts, 10(3), 221–231. doi:10.1016/0011-7471(63)90358-9

Methods

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Parameters

Parameter	Description	Units
cruise_no	number of CARIACO cruise	integer
Cruise_ID1	cruise ID for OCB	alphanumeric
Cruise_ID2	cruise ID for the CARIACO project	alphanumeric
Year	year of sampling	unitless
Month	month of sampling	unitless
Day	day of sampling	unitless
Date	date of sampling (local time)	unitless
press	pressure from CTD	decibars
depth	depth from CTD	meters
temp	temperature from CTD ITS-90	degrees Celsius
sal	salinity from CTD PSS-78 (PSU)	PSU
potemp	potential temperature ITS-90	degrees Celsius
sigma_t	density sigma-t	kilograms/meter^3
sigma_0	sigma theta (potential density)	kilograms/meter^3
O2_ml_L	oxygen dissolved from SBE 43 CTD	milliliters/liter
beam_cp	particulate beam attenuation	1/meter
beam_att	beam attenuation coefficient	1/meter
fluor_CTD	CTD relative fluorescence	RFU
fluor_chla	fluorescence rescaled units are numerically equivalent to chlorophyll-a concentrations	micrograms/meter^3
Latitude	latitude with positive values indicating North	decimal degrees
Longitude	longitude with positive values indicating East	decimal degrees

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Instruments

Dataset-specific Instrument Name	SBE-25
Generic Instrument Name	CTD Sea-Bird 25
Dataset-specific Description	SBE-25
Generic Instrument Description	The Sea-Bird SBE 25 SEALOGGER CTD is battery powered and is typically used to record data in memory, eliminating the need for a large vessel, electrical sea cable, and on-board computer. All SBE 25s can also operate in real-time, transmitting data via an opto-isolated RS-232 serial port. Temperature and conductivity are measured by the SBE 3F Temperature sensor and SBE 4 Conductivity sensor (same as those used on the premium SBE 9plus CTD). The SBE 25 also includes the SBE 5P (plastic) or 5T (titanium) Submersible Pump and TC Duct. The pump-controlled, TC-ducted flow configuration significantly reduces salinity spiking caused by ship heave, and in calm waters allows slower descent rates for improved resolution of water column features. Pressure is measured by the modular SBE 29 Temperature Compensated Strain-Gauge Pressure sensor (available in eight depth ranges to suit the operating depth requirement). The SBE 25's modular design makes it easy to configure in the field for a wide range of auxiliary sensors, including optional dissolved oxygen (SBE 43), pH (SBE 18 or SBE 27), fluorescence, transmissivity, PAR, and optical backscatter sensors. More information from Sea-Bird Electronics: http:www.seabird.com.

Dataset-specific Instrument Name	SBE-19
Generic Instrument Name	CTD Sea-Bird SEACAT 19
Dataset-specific Description	SBE-19
Generic Instrument Description	The Sea-Bird SBE 19 SEACAT Recorder measures conductivity, temperature, and pressure (depth). The SEACAT is self-powered and self-contained and can be deployed in profiling or moored mode. The SBE 19 SEACAT was replaced in 2001 by the 19plus. more information from Sea-Bird Electronics

Dataset-specific Instrument Name	Sea Tech Fluorometer
Generic Instrument Name	Sea Tech Fluorometer
Generic Instrument Description	The Sea Tech chlorophyll-a fluorometer has internally selectable settings to adjust for different ranges of chlorophyll concentration, and is designed to measure chlorophyll-a fluorescence in situ. The instrument is stable with time and temperature and uses specially selected optical filters enabling accurate measurements of chlorophyll a. It can be deployed in moored or profiling mode. This instrument designation is used when specific make and model are not known. The Sea Tech Fluorometer was manufactured by Sea Tech, Inc. (Corvalis, OR, USA).

Dataset-specific Instrument Name	SBE 43 Dissolved Oxygen Sensor
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	Wet Labs CSTAR Transmissometer
Generic Instrument Name	WET Labs {Sea-Bird WETLabs} C-Star transmissometer
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

HG93_CARIACO

Website	https://www.bco-dmo.org/deployment/57845
Platform	B/O Hermano Gines
Start Date	1995-11-08
Description	Monthly oceanographic cruises to the CARIACO station (10.5 degrees N, 64.67 degrees W) have been conducted since November 1995 to examine the hydrography, primary production, and settling flux of particulate material. The research vessel is the 75-foot B/O (Barco Oceanografico) Hermano Gines of the Fundaciòn La Salle de Ciencias Naturales (FLASA) located on Margarita Island, Venezuela. Water is collected using a rosette ensemble equipped with twelve 8-liter bottles and a CTD (conductivity-temperature-depth meter); the CTD also has an oxygen sensor, a fluorometer for chlorophyll-a estimates, and a transmissometer. Data are read out real-time on a computer screen on board the ship as the rosette ensemble is lowered to approximately 1,380 m, the bottom of the Cariaco Basin. Water samples are analyzed for various parameters including phytoplankton biomass, dissolved and particulate nutrient and carbon concentration, primary productivity rates and total bacterial production.

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Project Information

CARIACO Ocean Time-Series Program (CARIACO)

Website: http://www.imars.usf.edu/CAR/index.html

Coverage: CARIACO basin

Since 1995, 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. This depression, located on the continental shelf of Venezuela (Map), shows marked seasonal and interannual variation in hydrographic properties and primary production (carbon fixation rates by photosynthesis of planktonic algae).

This peculiar basin is anoxic below ~250 m, due its restricted circulation and high primary production (Muller-Karger et al., 2001). CARIACO observations show annual primary production rates exceed 500 gC/m^2y, of which over 15-20% can be accounted for by events lasting one month or less. Such events are observed in other locations where time series observations are collected, and suggest that prior estimates of regional production based on limited sampling may have been underestimated. The annual primary production rates in the Cariaco Basin are comparable to rates estimated using time series observations for Monterey Bay (460 gC/m^2y; Chavez, 1996), and higher than previous rates estimated for Georges Bank, the New York Shelf, and the Oregon Shelf (380, 300, and 190 gC/m^2y, respectively; Walsh, 1988).

The Cariaco Basin has long been the center of attention of scientists trying to explain paleoclimate. Due to its high rates of sedimentation (30 to >100 cm/ky; Peterson et al., 2000) and excellent preservation, the varved sediments of the Cariaco Basin offer the opportunity to study high resolution paleoclimate and better understand the role of the tropics in global climate change (Black et al., 1999; Peterson et al., 2000; Haug et al., 2001; Black et al., 2004; Hughen et al., 2004).

Now, the CARIACO program provides a link between the sediment record and processes near the surface of the ocean. Sediment traps maintained by the CARIACO program show that over 5% of autochtonous material reaches 275 m depth, and that nearly 2% reaches 1,400 m. The significance of this flux is that it represents a sink for carbon and that it helps explain the record of ancient climate stored at the bottom of the Cariaco Basin.

Acknowledgements: This work was supported by the National Science Foundation (NSF), the National Aeronautics and Space Administration (NASA), and Venezuela's Fondo Nacional de Ciencia, Tecnología e Innovación (FONACIT). For more information please see this Acknowledgements link.

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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 CO_2 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
Fondo Nacional de Ciencia, Tecnología e Innovación of Venezuela (FONACIT)	unknown CARIACO FONACIT
NSF Division of Ocean Sciences (NSF OCE)	OCE-9401537
NSF Division of Ocean Sciences (NSF OCE)	OCE-9729697
NSF Division of Ocean Sciences (NSF OCE)	OCE-0326268
NSF Division of Ocean Sciences (NSF OCE)	OCE-9216626
NSF Division of Ocean Sciences (NSF OCE)	OCE-9711318
National Aeronautics & Space Administration (NASA)	NAS5-97128
NSF Division of Ocean Sciences (NSF OCE)	OCE-9415790
NSF Division of Ocean Sciences (NSF OCE)	OCE-9729284
National Aeronautics & Space Administration (NASA)	NAG5-6448
NSF Division of Ocean Sciences (NSF OCE)	OCE-0963028
NSF Division of Ocean Sciences (NSF OCE)	OCE-0752139
Fondo Nacional de Ciencia, Tecnología e Innovación of Venezuela (FONACIT)	96280221
NSF Division of Ocean Sciences (NSF OCE)	unknown CARIACO NSF OCE
NSF Division of Ocean Sciences (NSF OCE)	OCE-0326313
National Aeronautics & Space Administration (NASA)	NNX14AP62A

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