CTD Averaged Bottle Data from R/V Knorr KN197-08 in the Amazon River plume, NE coast of South America from May to June 2010 (ANACONDAS project)

Website: https://www.bco-dmo.org/dataset/3371
Version: 17 June 2011
Version Date: 2011-06-17

Project
» Amazon iNfluence on the Atlantic: CarbOn export from Nitrogen fixation by DiAtom Symbioses (ANACONDAS)

Programs
» Integrated Marine Biogeochemistry and Ecosystem Research -US (IMBER-US)
» Ocean Carbon and Biogeochemistry (OCB)
» Emerging Topics in Biogeochemical Cycles (ETBC)
» Marine Microbiology Initiative (MMI)

Contributors	Affiliation	Role
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Gegg, Stephen R.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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Dataset Description

CTD data at the locations where bottles were tripped

Methods & Sampling

SBE9+ s/n 785 Pressure calibration 08 Aug 2008
Channel 1:
SBE4c s/n 04 3089 Conductivity calibration 16 Mar 2010
SBE3T s/n 03P 4502 Temperature calibration 24 Mar 2010
SBE43 s/n 43 1642 Dissolved Oxygen calibration 12 June 2009

Channel 2:
SBE4c s/n 04 3042 Conductivity calibration 24 Mar 2010
SBE3T s/n 03P 4507 Temperature calibration 12 Mar 2010

Transmissometer WetLabs Model CSTar s/n CST - 1117DR Calibrated 30 April 2008

Fluorometer WetLabs Model FLNTU s/n FLNTURD-304 Calibrated 10 March 2008

Surface PAR Biospherical Instruments QSR-240 s/n 6294 Calibrated 13 March 2008

Aquatic PAR Biospherical Instruments s/n QSP-200L4 s/n 4550 Calibrated 13 March 2008

Channel 2 is used for most profiles as there were problems with the pump for channel 1 on some stations. Oxygen is taken from channel 1, however there are some bad values which are not yet flagged.

Sample header file:

```
* Sea-Bird SBE 9 Data File:
* FileName = C:Datactd19708001.hdr
* Software Version Seasave V 7.18d
* Temperature SN = 4502
* Conductivity SN = 3089
* Number of Bytes Per Scan = 40
* Number of Voltage Words = 5
* Number of Scans Averaged by the Deck Unit = 1
* System UpLoad Time = May 23 2010 08:09:54
* NMEA Latitude = 11 33.61 N
* NMEA Longitude = 056 47.89 W
* NMEA UTC (Time) = May 23 2010 08:09:51
* Store Lat/Lon Data = Append to Every Scan
** Ship: R/V Knorr
** Station: 001
** Operator: Victoria
** station 001 cast 01 event 01.03
# nquan = 23
# nvalues = 1994
# units = specified
# name 0 = prDM: Pressure, Digiquartz [db]
# name 1 = depSM: Depth [salt water, m]
# name 2 = t190C: Temperature, 2 [ITS-90, deg C]
# name 3 = c1S/m: Conductivity, 2 [S/m]
# name 4 = sbeox0V: Oxygen Voltage, SBE 43
# name 5 = xmiss: Beam Transmission, Chelsea/Seatech/Wetlab CStar [%]
# name 6 = bat: Beam Attenuation, Chelsea/Seatech/Wetlab CStar [1/m]
# name 7 = flECO-AFL: Fluorescence, Wetlab ECO-AFL/FL [mg/m^3]
# name 8 = upoly0: Upoly 0, FLNTU turbidity
# name 9 = spar: SPAR/Surface Irradiance
# name 10 = par: PAR/Irradiance, Biospherical/Licor
# name 11 = cpar: CPAR/Corrected Irradiance [%]
# name 12 = t090C: Temperature [ITS-90, deg C]
# name 13 = c0S/m: Conductivity [S/m]
# name 14 = depSM: Depth [salt water, m], lat = 11.5602
# name 15 = density11: Density, 2 [density, Kg/m^3]
# name 16 = sigma-t11: Density, 2 [sigma-t, Kg/m^3 ]
# name 17 = potemp190C: Potential Temperature, 2 [ITS-90, deg C]
# name 18 = sal11: Salinity, Practical, 2 [PSU]
# name 19 = svWM: Sound Velocity [Wilson, m/s]
# name 20 = sbeox0Mm/Kg: Oxygen, SBE 43 [umol/Kg], WS = 2
# name 21 = sbeox0PS: Oxygen, SBE 43 [% saturation], WS = 2
# name 22 = flag: flag
# span 0 = 5.029, 2019.162
# span 1 = 4.978, 1997.855
# span 2 = 3.4786, 28.9724
# span 3 = 3.293110, 5.786188
# span 4 = 1.2362, 2.4303
# span 5 = 93.5592, 97.7670
# span 6 = 0.0903, 0.2663
# span 7 = -0.0113, 0.4303
# span 8 = 1.0607965, 1.3869948
# span 9 = 1.5656e+01, 1.7824e+01
# span 10 = 1.0000e-12, 1.0000e-12
```

span 11 = 5.6114e-12, 6.3893e-12
span 12 = 3.4787, 28.9723
span 13 = 3.293104, 5.786650
span 14 = 5.000, 1998.000
span 15 = 1020.0771, 1037.0397
span 16 = 20.0517, 27.8118
span 17 = 3.3170, 28.9661
span 18 = 32.1813, 37.0067
span 19 = 1486.29, 1544.67
span 20 = 112.419, 249.669
span 21 = 38.99671, 96.04706
span 22 = 0.0000e+00, 0.0000e+00
interval = meters: 1
start_time = May 23 2010 08:09:51
bad_flag = -9.990e-29
datcnv_date = Jun 23 2010 19:27:22, 7.20c
datcnv_in = Z:Data aw19708001.hex Z:Data aw19708001.CON
datcnv_skipover = 0
datcnv_ox_hysteresis_correction = yes
filter_date = Jun 23 2010 19:27:59, 7.20c
filter_in = Z:Datavicprocess19708001.cnv
filter_low_pass_tc_A = 0.500
filter_low_pass_tc_B = 0.150
filter_low_pass_A_vars = depSM t190C c1S/m sbeox0V xmiss bat flECO-AFL upoly0 spar cpar t090C c0S/m
filter_low_pass_B_vars = prDM
alignctd_date = Jun 23 2010 19:28:04, 7.20c
alignctd_in = Z:Datavicprocess19708001.cnv
alignctd_adv = c1S/m 0.073, sbeox0V 2.000
celltm_date = Jun 23 2010 19:28:09, 7.20c
celltm_in = Z:Datavicprocess19708001.cnv
celltm_alpha = 0.0000, 0.0300
celltm_tau = 0.0000, 7.0000
celltm_temp_sensor_use_for_cond = , secondary
loopedit_date = Jun 23 2010 19:28:14, 7.20c
loopedit_in = Z:Datavicprocess19708001.cnv
loopedit_minVelocity = 0.250
loopedit_surfaceSoak: minDepth = 5.0, maxDepth = 20, useDeckPress = 1
loopedit_excl_bad_scans = yes
wildedit_date = Jun 23 2010 19:28:19, 7.20c
wildedit_in = Z:Datavicprocess19708001.cnv
wildedit_pass1_nstd = 2.0
wildedit_pass2_nstd = 20.0
wildedit_pass2_mindelta = 0.000e+000
wildedit_npoint = 100
wildedit_vars = prDM depSM t190C c1S/m xmiss bat flECO-AFL upoly0 spar par cpar t090C c0S/m
wildedit_excl_bad_scans = yes
wfilter_date = Jun 23 2010 19:28:23, 7.20c
wfilter_in = Z:Datavicprocess19708001.cnv
wfilter_excl_bad_scans = yes
wfilter_action xmiss = gaussian, 200, 100, 0
wfilter_action bat = gaussian, 200, 100, 0
wfilter_action flECO-AFL = gaussian, 200, 100, 0
Derive_date = Jun 23 2010 19:28:31, 7.20c
Derive_in = Z:Datavicprocess19708001.cnv Z:Data aw19708001.con
derive_time_window_docdt = seconds: 2
derive_ox_tau_correction = yes
binavg_date = Jun 23 2010 19:28:45, 7.20c
binavg_in = Z:Datavicprocess19708001.cnv
binavg_bintype = meters
binavg_binsize = 1
binavg_excl_bad_scans = no
binavg_skipover = 0
binavg_surface_bin = yes, min = 0.000, max = 0.000, value = 0.000

file_type = ascii
END

Data Processing Description

The data have not yet been processed to include hand salinity and oxygen samples.

BCO-DMO Processing Notes
- Awk written to reformat original .avg.btl.csv files contributed by Victoria Coles
- AWK: ANACONDAS_CTDbtl_2_bcodmo.awk
- Header data for bottle data generated from .avg.btl.csv files
- comma delimited reformatted to tab delimited
- I/P header rec with parameter names and units skipped
- BCO-DMO header o/p from routine modeled after original header rec
- First parameter in each original record removed. Artifact of preliminary processing
- Text Date (Jun032010) reformatted to YYYYMMDD
- Time reformatted from HH:MM:SS to HHMMSS
- Decimal places reported for each parameter provided by Victoria Coles

- Two files without Anconda.Num. Replaced with "nd"
19708032.btl.avg.csv
19708085.btl.avg.csv

BCO-DMO Processing Notes/17June2011
Data re-submitted after corrections by Victoria Coles, et al
This version of the bottle data corrects an error in a few stations
that resulted in an incorrect average depth for the surface bottles
(e.g. in 09708054.btl.avg.csv) . Other parameters were correctly
averaged. The files are also renamed to include event number, and the
standard deviation columns have been dropped.

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Data Files

File
CTD_Bottle.csv (Comma Separated Values (.csv), 824.79 KB) MD5:4169e91636a9d65566f15eeb16f41de4 Primary data file for dataset ID 3371

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Parameters

Parameter	Description	Units
BTL_DataSet	Bottle dataset id (19708001)	text
CTD	unique CTD number	integer
date_gmt	Station date (GMT)	YYYYMMDD
time_gmt	Station time (GMT)	HHMMSS
lon	Station longitude (West is negative)	decimal degrees
lat	Station latitude (South is negative)	decimal degrees
Anaconda_Num	unique sample ID	text

Depth_code	when multiple bottles are fired at the same depth they all receive the same depth code	text
Bottle	niskin #	integer
Station	Station number	integer
Cast	CTD cast at the same station	integer
Event	Event number = station_event_number at bottle trip	xx.xx
Lon_BtlTrip	Longitude at bottle trip (West is negative)	decimal degrees
Lat_BtlTrip	Latitude at bottle trip (South is negative)	decimal degrees
Yearday	year.day including time from CTD header file	ddd.xxxx
Date_BtlTrip	Date (GMT) at bottle trip	YYYYMMDD
Time_BtlTrip	Time (GMT) at bottle trip	HHMMSS
Press	Pressure at bottle trip	decibars
Avg_Press	Pressure averaged from all bottles tripped at the same nominal pressure	decibars
Depth	Depth at bottle trip	meters
Avg_Depth	Depth averaged from all bottles tripped at the same nominal pressure	meters
Temp	Temperature at bottle trip	degrees Celsius
Avg_Temp	Temperature averaged from all bottles tripped at the same nominal pressure	degrees Celsius
Pot_Temp	Potential Temperature at bottle trip	degrees Celsius
Avg_Pot_Temp	Potential Temperature averaged from all bottles tripped at the same nominal pressure	degrees Celsius
Salinity	Salinity at bottle trip	PSU
Avg_Salinity	Salinity averaged from all bottles tripped at the same nominal pressure	PSU
Density	Density at bottle trip	kgm-2
Avg_Density	Density averaged from all bottles tripped at the same nominal pressure	kgm-2
Sigma_theta	Sigma Theta at bottle trip	kgm-2
Avg_Sigma_theta	Sigma Theta averaged from all bottles tripped at the same nominal pressure	kgm-2
Oxygen	Oxygen at bottle trip	umolkg-1
Avg_Oxygen	Oxygen averaged from all bottles tripped at the same nominal pressure	umolkg-1
OxygenSat	Oxygen Saturation at bottle trip (percentage)	percentage
Avg_OxygenSat	Oxygen Saturation averaged from all bottles tripped at the same nominal pressure (percentage)	percentage
BeamTrans	Beam Transmission at bottle trip	percentage
Avg_BeamTrans	Beam Transmission averaged from all bottles tripped at the same nominal pressure	percentage
BeamAtten	Beam Attenuation at bottle trip	m-1
Avg_BeamAtten	Beam Attenuation averaged from all bottles tripped at the same nominal pressure	m-1
Fluorescence	Fluorescence at bottle trip	mgm-3

Avg_Fluorescence	Fluorescence averaged from all bottles tripped at the same nominal pressure	mgm-3
Turbidity	Turbidity at bottle trip	Nephelometric Turbidity Units (NTU)
Avg_Turbidity	Turbidity averaged from all bottles tripped at the same nominal pressure	Nephelometric Turbidity Units (NTU)
Surf_Irradiance	Surface Irradiance at bottle trip	uEm-2sec-1
Avg_Surf_Irradiance	Surface Irradiance averaged from all bottles tripped at the same nominal pressure	uEm-2sec-1
Corr_Irradiance	Corrected Surface Irradiance at bottle trip	uEm-2sec-1
Avg_Corr_Irradiance	Corrected Surface Irradiance averaged from all bottles tripped at the same nominal pressure	uEm-2sec-1
PAR	PAR at bottle trip	uEm-2sec-1
Avg_PAR	PAR averaged from all bottles tripped at the same nominal pressure	uEm-2sec-1

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Instruments

Dataset-specific Instrument Name	CTD Sea-Bird SBE 911plus
Generic Instrument Name	CTD Sea-Bird SBE 911plus
Dataset-specific Description	SBE9+ s/n 785 Pressure calibration 08 Aug 2008 Channel 1: SBE4c s/n 04 3089 Conductivity calibration 16 Mar 2010 SBE3T s/n 03P 4502 Temperature calibration 24 Mar 2010 SBE43 s/n 43 1642 Dissolved Oxygen calibration 12 June 2009 Channel 2: SBE4c s/n 04 3042 Conductivity calibration 24 Mar 2010 SBE3T s/n 03P 4507 Temperature calibration 12 Mar 2010
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

Dataset-specific Instrument Name	Fluorometer
Generic Instrument Name	Fluorometer
Dataset-specific Description	WetLabs Model FLNTU s/n FLNTURD-304 Calibrated 10 March 2008
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	Photosynthetically Available Radiation Sensor
Generic Instrument Name	Photosynthetically Available Radiation Sensor
Dataset-specific Description	Surface PAR Biospherical Instruments QSR-240 s/n 6294 Calibrated 13 March 2008 Aquatic PAR Biospherical Instruments s/n QSP-200L4 s/n 4550 Calibrated 13 March 2008
Generic Instrument Description	A PAR sensor measures photosynthetically available (or active) radiation. The sensor measures photon flux density (photons per second per square meter) within the visible wavelength range (typically 400 to 700 nanometers). PAR gives an indication of the total energy available to plants for photosynthesis. This instrument name is used when specific type, make and model are not known.

Dataset-specific Instrument Name	Wet Labs CSTAR Transmissometer
Generic Instrument Name	WET Labs {Sea-Bird WETLabs} C-Star transmissometer
Dataset-specific Description	WetLabs Model CSTar s/n CST - 1117DR Calibrated 30 April 2008
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

KN197-08

Website	https://www.bco-dmo.org/deployment/58043
Platform	R/V Knorr
Report	http://bcodata.whoi.edu/ANACONDAS/ANACONDAS1-FullCruiseReport.pdf
Start Date	2010-05-22
End Date	2010-06-24
Description	ANACONDAS: Amazon iNfluence on the Atlantic: CarbOn export from Nitrogen fixation by DiAtom SymbiosesROCA: River Ocean Continuum of the Amazon WHOI cruise planning synopsis Cruise information and original data are available from the NSF R2R data catalog. Cruise Track over Salinity Climatology (Image from Dr. Ajit Subramaniam)

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Project Information

Amazon iNfluence on the Atlantic: CarbOn export from Nitrogen fixation by DiAtom Symbioses (ANACONDAS)

Website: http://amazoncontinuum.org/

Coverage: Amazon River plume; NE coast of South America; Western Tropical North Atlantic - 15N-Equator and 60W to 45W - Region surrounding the Amazon River Plume

ANACONDAS is an IMBER endorsed project.
View list of all IMBER endorsed projects

View the ANACONDAS project GCMD DIF record

The ANACONDAS project was funded as part of the US National Science Foundation (NSF) Emerging Topics in Biogeochemical Cycles (ETBC) program (Directorate for Geosciences, NSF 07 -049, September 19, 2007) explicitly intended to support emerging areas of interdisciplinary research. The ETBC program aimed to foster transformational advances in the quantitative or mechanistic understanding of biogeochemical cycles that integrated physical-chemical-biological processes over the range of temporal and/or spatial scales in Earth's environments. The program especially sought proposals that addressed emerging topics in biogeochemical cycles, the water cycle or their coupling, across the interfaces of atmosphere, land, and oceans.

The ANACONDAS investigators hypothesize that large tropical river plumes with low N: P ratios provide an ideal niche for diatom-diazotroph assemblages (DDAs). They suggest that the ability of these organisms to fix N2 within the surface ocean is responsible for significant C export in the Amazon River plume. Their previous observations in the Amazon River plume helped reveal that blooms comprised of the endosymbiotic N2-fixing cyanobacterium Richelia and its diatom hosts (e.g. Hemiaulus) were a significant source of new production and carbon export. The previous work focused largely on the sensitivity of DDAs to external forcing from dust and riverine inputs, so the ecology of these organisms and the fate of their new production were largely unstudied. It is now known that DDAs are responsible for a significant amount of CO2 drawdown in the Amazon River plume, and floating sediment traps at 200 m measured 4x higher mass fluxes beneath the plume than outside the plume. This led the researchers to hypothesize that this greater export is due either to aggregation and sinking of DDAs themselves or to grazing of DDAs by zooplankton.

In this study the researchers will undertake a suite of field, satellite and modeling studies aimed at understanding the ecology and tracing the fate of C and N fixed by DDAs and other phytoplankton living in the plume. By examining C and silicate (Si) export from offshore surface waters, through the upper oceanic food web, the mesopelagic, and down to the deep sea floor, they will quantify the impact of the Amazon River on biological processes that control C sequestration and the implications of these regional processes on C, N and Si budgets. The study will go beyond previous research because they will quantify 1) the distribution, nutrient demands, and activity of DDAs in the context of phytoplankton species succession, 2) the sensitivity of the CO2 drawdown to the mix of phytoplankton, 3) the grazing and aggregation processes contributing to the sinking flux, 4) the composition of this flux, and 5) the proportion of this material that reaches the seafloor.

This effort truly represents a measure of C sequestration and pump efficiency. Ecological modeling will be used to place observational results from field studies and satellites into the context of the larger Atlantic basin with tropical climate variability on interannual and longer time scales.

Three cruises were carried out during the ANACONDAS project:
AN10/KN197-08 - R/V KNORR - May/June 2010 - Cruise Track over Salinity Climatology *(Image: Yager, et al, 2007)*
AN11/MV1110 - R/V MELVILLE - September/October 2011 - Cruise Track over Salinity Climatology *(Image: Yager, et al, 2007)*
AN12/AT21-04 - R/V ATLANTIS - July/2012 - Cruise Track over Salinity Climatology *(Image: Yager, et al, 2007)*

The ANACONDAS project builds on observations made by MANTRA/PIRANA in 2001 and 2003 (RV Knorr and Seward Johnson I cruises to the same region) to address specifically 1) how carbon cycling and sequestration in the western tropical North Atlantic (WTNA) is influenced by the Amazon River through its impact on pelagic ecosystem dynamics and 2) the sensitivity of this ecosystem to anthropogenic climate change. PIRANA revealed the importance of both riverine and atmospheric inputs for driving the high productivity of the WTNA through N2-fixation, and demonstrated the significance of the region to basin-wide biogeochemistry and C cycling. ANACONDAS will now focus on what drives phytoplankton community succession through the plume, light and nutrient requirements, factors limiting productivity, and the fate of production. These components are critical to understand the role of the plume in the regional C cycle, and to predict its response to climate variability and change.

The NSF-funded ANACONDAS project will also serve as a platform for additional measurements supported by the Gordon and Betty Moore Foundation's Marine Microbiology Initiative. ROCA (River-Ocean Continuum of the Amazon) brings additional focus on marine microbial community structure and activities, along with high-resolution measurements of organic matter along the river-ocean continuum.

ANACONDAS: Amazon iNfluence on the Atlantic: CarbOn export from Nitrogen fixation by DiAtom Symbioses
ROCA: River Ocean Continuum of the Amazon

The project is funded by NSF-OCE-0934095 and NSF-OCE-0934036: Collaborative Research: ETBC: Amazon iNfluence on the Atlantic: CarbOn export from Nitrogen fixation by DiAtom Symbioses and by the Gordon and Betty Moore Foundation through GBMF-MMI-2293: River Ocean Continuum of the Amazon.

Planned Cruise Sampling

Water Column Characterization (hydrographic sampling with CTD/Rosette):
Nutrient (NO2, NO2+NO3, PO4, SiO4) concentrations
Chlorophyll a and pigments concentrations
Inorganic carbon (discrete DIC, ALK, underway pCO2)
Organic carbon, nitrogen, phosphorus
Phytoplankton and Diazotroph Abundance (using rosette and also small nets to collect)
Carbon and Nitrogen Fixation by plankton
Kinetic and Physiological Measurements of phytoplankton
Stable Isotopic Measurements of particulate material
Microbial heterotrophy
Microbial community structure and gene expression
Organic carbon and biomarker characterization

MOCNESS tows for zooplankton
Zooplankton collection for abundance and biomass
Zooplankton grazing and POC flux measurements

Multicorer for deep sea sediment analyses
Solid phase analysis
Pore water chemistry
Isotopic composition (Pb, Th, C)

Other instrumentation over the side:
The in-water light field will be characterized with a free-falling 14 channel spectroradiometer
Two "Carbon Explorers" - autonomous Sounding Oceanographic Lagrangian Observer profilers
Sediment Trap Studies (using 48h deployments of floating Particle Interceptor Traps; PITs)
Surface water pumps - directly bring large volumes of surface water to the deck of the ship for processing.

Shipboard Instrumentation:
ADCP 75 kHz
Bathymetry System 12 kHz
Bathymetry System 3.5 kHz
Deionized Water System
Fume Hood
HiSeasNet
Multibeam
Uncontaminated Seawater System
CTD/Water Sampling: 911+ Rosette 24-position, 10-liter bottle Rosette with dual T/C sensors
Biospherical underwater PAR (1000m depth limit)
SBE43 oxygen sensor
Wet Labs C*Star transmissometer (660nm wavelength)
Wet Labs ECO-AFL fluorometer
Dissolved Oxygen Titration System (Portable modified Winkler titration system)

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Program Information

Integrated Marine Biogeochemistry and Ecosystem Research -US (IMBER-US)

Website: http://www.imber.info/

Coverage: global

The BCO-DMO database includes data from IMBER endorsed projects lead by US funded investigators. There is no dedicated US IMBER project or data management office. Those functions are provided by US-OCB and BCO-DMO respectively.

The information in this program description pertains to the Internationally coordinated IMBER research program. The projects contributing data to the BCO-DMO database are those funded by US NSF only. The full IMBER data catalog is hosted at the Global Change Master Directory (GCMD).

IMBER Data Portal: The IMBER project has chosen to create a metadata portal hosted by the NASA's Global Change Master Directory (GCMD). The GCMD IMBER data catalog provides an overview of all IMBER endorsed and related projects and links to datasets, and can be found at URL http://gcmd.nasa.gov/portals/imber/.

IMBER research will seek to identify the mechanisms by which marine life influences marine biogeochemical cycles, and how these, in turn, influence marine ecosystems. Central to the IMBER goal is the development of a predictive understanding of how marine biogeochemical cycles and ecosystems respond to complex forcings, such as large-scale climatic variations, changing physical dynamics, carbon cycle chemistry and nutrient fluxes, and the impacts of marine harvesting. Changes in marine biogeochemical cycles and ecosystems due to global change will also have consequences for the broader Earth System. An even greater challenge will be drawing together the natural and social science communities to study some of the key impacts and feedbacks between the marine and human systems.

To address the IMBER goal, four scientific themes, each including several issues, have been identified for the IMBER project: Theme 1 - Interactions between Biogeochemical Cycles and Marine Food Webs; Theme 2 - Sensitivity to Global Change: How will key marine biogeochemical cycles, ecosystems and their interactions, respond to global change?; Theme 3 - Feedback to the Earth System: What are the roles of the ocean biogeochemistry and ecosystems in regulating climate?; and Theme 4 - Responses of Society: What are the relationships between marine biogeochemical cycles, ecosystems, and the human system?

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.

Emerging Topics in Biogeochemical Cycles (ETBC)

Website: http://www.nsf.gov/pubs/2007/nsf07049/nsf07049.jsp

Coverage: global

The original call for proposals for Emerging Topics in Biogeochemical Cycles (ETBC) was issued in September 2007 by the US NSF Directorate for Geosciences (NSF 07-049).

The Geosciences Directorate (GEO) is substantially augmenting our past funding sources to explicitly support emerging areas of interdisciplinary research. We seek to foster transformational advances in our quantitative or mechanistic understanding of biogeochemical cycles that integrate physical-chemical-biological processes over the range of temporal and/or spatial scales in Earthâ€™s environments. We encourage submission of proposals that address emerging topics in biogeochemical cycles, the water cycle or their coupling, across the interfaces of atmosphere, land, and oceans. Proposals must cross the disciplinary boundaries of two or more divisions in Geosciences (e.g. ATM, EAR, OCE) or of at least one division in Geosciences and a division in another NSF directorate.

Although funding programmatic disciplines continues to provide a robust and adaptable framework to build our understanding of the geosciences and the earth as a system, there are classes of emerging and challenging problems that require integration of concepts and observations across diverse fields. Our goal is to enhance such integration. Successful proposals need to develop intellectual excitement in the participating disciplinary communities. Also encouraged are proposals that have broader educational, diversity, societal, or infrastructure impacts that capitalize on this interdisciplinary opportunity.

Marine Microbiology Initiative (MMI)

Website: https://www.moore.org/initiative-strategy-detail?initiativeId=marine-microbiology-initiative

A Gordon and Betty Moore Foundation Program.

Forging a new paradigm in marine microbial ecology:

Microbes in the ocean produce half of the oxygen on the planet and remove vast amounts of carbon dioxide, a greenhouse gas, from the atmosphere. Yet, we have known surprisingly little about these microscopic organisms. As we discover answers to some long-standing puzzles about the roles that marine microorganisms play in supporting the ocean's food webs and driving global elemental cycles, we realized that we still need to learn much more about what these organisms do and how they do it—including how they evolved and contribute to our ocean's health and productivity.

The Marine Microbiology Initiative seeks to gain a comprehensive understanding of marine microbial communities, including their diversity, functions and behaviors; their ecological roles; and their origins and evolution. Our focus has been to enable researchers to uncover the principles that govern the interactions among microbes and that govern microbially mediated nutrient flow in the sea. To address these opportunities, we support leaders in the field through investigator awards, multidisciplinary team research projects, and efforts to create resources of broad use to the research community. We also support development of new instrumentation, tools, technologies and genetic approaches.

Through the efforts of many scientists from around the world, the initiative has been catalyzing new science through advances in methods and technology, and to reduce interdisciplinary barriers slowing progress. With our support, researchers are quantifying nutrient pools in the ocean, deciphering the genetic and biochemical bases of microbial metabolism, and understanding how microbes interact with one another. The initiative has five grant portfolios:

Individual investigator awards for current and emerging leaders in the field.
Multidisciplinary projects that support collaboration across disciplines.
New instrumentation, tools and technology that enable scientists to ask new questions in ways previously not possible.
Community resource efforts that fund the creation and sharing of data and the development of tools, methods and infrastructure of widespread utility.
Projects that advance genetic tools to enable development of experimental model systems in marine microbial ecology.
We also bring together scientists to discuss timely subjects and to facilitate scientific exchange.

Our path to marine microbial ecology was a confluence of new technology that could accelerate science and an opportunity to support a field that was not well funded relative to potential impact. Around the time we began this work in 2004, the life sciences were entering a new era of DNA sequencing and genomics, expanding possibilities for scientific research – including the nascent field of marine microbial ecology. Through conversations with pioneers inside and outside the field, an opportunity was identified: to apply these new sequencing tools to advance knowledge of marine microbial communities and reveal how they support and influence ocean systems.

After many years of success, we will wind down this effort and close the initiative in 2021. We will have invested more than $250 million over 17 years to deepen understanding of the diversity, ecological activities and evolution of marine microbial communities. Thanks to the work of hundreds of scientists and others involved with the initiative, the goals have been achieved and the field has been profoundly enriched; it is now positioned to address new scientific questions using innovative technologies and methods.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0934095
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