Unfiltered underway data from shipboard acquisition system 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/3365
Version: 15 September 2010
Version Date: 2010-09-15

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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Table of Contents

- Dataset Description
  - Methods & Sampling
  - Data Processing Description
- Data Files
- Parameters
- Instruments
- Deployments
- Project Information
- Program Information
- Funding

Dataset Description

Unfiltered ship underway measurements from 3m depth

Methods & Sampling

Air temp; Port WXT520 (WXTP_Ta) Format: XXX.XX degrees C, Data obtained from Vaisala WXT520 sensor mounted on the forward mast, port side, 20m above the waterline.

Barometric pressure (BPR), Primary barometric sensor reading (IMET_BPR), BPR data has been corrected for 20.1 meter mast height (.1185 millibars/m)

Decimal Latitude (Dec_Lat), Format: +/-xx.xxxx (S = "-"), Latitude value in degrees obtained from the GPS NMEA $GPRMC data sentence. The RMC sentence is obtained from the switched GPS receiver (C-Nav, GP1850, GP-90D).

Decimal Longitude (Dec_Lon), Format: +/-xxx.xxxx (W = "-"), Longitude value in degrees obtained from the GPS NMEA $GPRMC data sentence.

The RMC sentence is obtained from the switched GPS receiver (C-Nav, GP1850, GP-90D).

Depth (12 kHz) (Depth12), 12 kHz depth (meters) from sea surface obtained by Knudsen bathymetry system. See Knudsen Bathymetry information for sound speed and transducer depth corrections; normally based on 1500 m/s sound speed & corrected for 5.95 meter (19.5 ft) transducer depth.

Fluorometer (FLR)

GPS course over ground (GPS_COG), Format: XXX.X degrees This is the primary COG data. Course-over-ground (true) in degrees obtained from the GPS GPRMC data sentence. The RMC sentence is obtained from the switched GPS receiver (C-Nav, GP1850, GP-90D).

GPS speed over ground (GPS_SOG) Format: XX.X knots. This is the primary SOG data. Speed-over-ground (knots) obtained from GPS NMEA $GPRMC data sentence. The RMC sentence is obtained from the switched GPS receiver (C-Nav, GP1850, GP-90D).

IMET Humidity (IMET_HRH) Format: XX.XX (%RH), XXX.XXX (C), IMET temperature and humidity sensor. Humidity (HRH) and air temperature (Air_Temp) are obtained from this instrument. Sensor is mounted on the forward mast, 20m above the waterline.

Salinity (Salinity) Format: ss.ssss (psu) Salinity calculated from SBE45 TMP and SBE45 CND data values in accordance with UNESCO 44. (also see SBE45s)

Sea Surface Temperature (SSTMP) Format xx.xxxx (C) Sea surface temperature (degrees C) from primary sensor (SBE48). This sensor is located in the bow chamber approximately 5m BWL This value is used for related "conversion" calculations (i.e. Sound velocity).

True wind direction; Port WXT520 (WXTP_TD) - degrees Values are calculated from the Vaisala WXT520 Weather Transmitter raw data corrected for sensor alignment error and combined with the ship's gyro heading and GPS SOG and COG values. Sensor is mounted on the bow mast, port side, at a height of 20m above the waterline.

True wind speed; Stbd WXT520 (WXTS_TD) - m/sec Values are calculated from the Vaisala WXT520 Weather Transmitter raw data corrected for sensor alignment error and combined with the ship's gyro heading and GPS SOG and COG values. Sensor is mounted on the bow mast, stbd side, at a height of 20m above the waterline.

Data Processing Description

As reported:
Missing data are indicated with NaN for the filtered dataset and -999 for the unfiltered dataset.
Note: Changed to BCO-DMO standard of "nd" in both datasets

Filtering is boxcar with a filterwidth of .041666 days = 1 hour

BCO-DMO Processing Notes
Generated from original text file "underway-sail.dat" contributed by Victoria Coles

BCO-DMO Edits
- Parameter names modified to conform to BCO-DMO convention
- date reformatted to YYYYMMDD
- time reformatted to HHMMSS
- decimal data values padded to consistent decimal places as reported
- "-999" no data flag changed to "nd"
- depth values of "0" changed to "nd"

[table of contents | back to top]

Data Files

File
UW_UnFilt.csv (Comma Separated Values (.csv), 6.10 MB) MD5:32a70fe378112b118bfdec20d29d8077 Primary data file for dataset ID 3365

[table of contents | back to top]

Parameters

Parameter	Description	Units
time	Time (GMT)	HHMMSS
yrday_gmt	Day of year (GMT)	decimal days
lon	Decimal Longitude (Dec_Lon); Format: +/-xxx.xxxx (W = "-"); Longitude value in degrees obtained from the GPS NMEA $GPRMC data sentence.The RMC sentence is obtained from the switched GPS receiver (C-Nav; GP1850; GP-90D).	decimal degrees
lat	Decimal Latitude (Dec_Lat); Format: +/-xx.xxxx (S = "-"); Latitude value in degrees obtained from the GPS NMEA $GPRMC data sentence. The RMC sentence is obtained from the switched GPS receiver (C-Nav; GP1850; GP-90D).	decimal degrees
depth_w	Depth (12 kHz) (Depth12); 12 kHz water depth (meters) from sea surface obtained by Knudsen bathymetry system. See Knudsen Bathymetry information for sound speed and transducer depth corrections; normally based on 1500 m/s sound speed & corrected for 5.95 meter (19.5 ft) transducer depth.	meters
Air_Temperature	Air temp; Port WXT520 (WXTP_Ta) Format: XXX.XX degrees C; Data obtained from Vaisala WXT520 sensor mounted on the forward mast; port side; 20m above the waterline.	degrees Celsius
Barometric_Pressure	Barometric pressure (BPR); Primary barometric sensor reading (IMET_BPR); BPR data has been corrected for 20.1 meter mast height (.1185 millibars/m)	millibars
Fluorescence	Fluorometer (FLR)	mgm-3
Course_over_ground	GPS course over ground (GPS_COG); Format: XXX.X degrees This is the primary COG data. Course-over-ground (true) in degrees obtained from the GPS GPRMC data sentence. The RMC sentence is obtained from the switched GPS receiver (C-Nav; GP1850; GP-90D).	degrees

Speed_over_ground	GPS speed over ground (GPS_SOG) Format: XX.X knots. This is the primary SOG data. Speed-over-ground (knots) obtained from GPS NMEA $GPRMC data sentence. The RMC sentence is obtained from the switched GPS receiver (C-Nav; GP1850; GP-90D).	knots
Relative_Humidity	IMET Humidity (IMET_HRH) Format: XX.XX (%RH); XXX.XXX (C); IMET temperature and humidity sensor. Humidity (HRH) and air temperature (Air_Temp) are obtained from this instrument. Sensor is mounted on the forward mast; 20m above the waterline.	percentage
Salinity	Salinity (Salinity) Format: ss.ssss (psu) Salinity calculated from SBE45 TMP and SBE45 CND data values in accordance with UNESCO 44. (also see SBE45s)	psu
Water_Temperature	Sea Surface Temperature (SSTMP) Format xx.xxxx (C) Sea surface temperature (degrees C) from primary sensor (SBE48). This sensor is located in the bow chamber approximately 5m BWL This value is used for related "conversion" calculations (i.e. Sound velocity).	degrees Celsius
Short_Wave_Radiation	Short Wave Radiation	W/m^2
Sound_Velocity	Sound Velocity	m/sec
True_Wind_Direction	True wind direction; Port WXT520 (WXTP_TD) - degrees Values are calculated from the Vaisala WXT520 Weather Transmitter raw data corrected for sensor alignment error and combined with the ship's gyro heading and GPS SOG and COG values. Sensor is mounted on the bow mast; port side; at a height of 20m above the waterline.	degrees
True_Wind_Speed	True wind speed; Port WXT520 (WXTP_TD) - m/sec Values are calculated from the Vaisala WXT520 Weather Transmitter raw data corrected for sensor alignment error and combined with the ship's gyro heading and GPS SOG and COG values. Sensor is mounted on the bow mast; port side; at a height of 20m above the waterline.	m/sec
date	Date (GMT)	YYYYMMDD

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Global Positioning System Receiver
Generic Instrument Name	Global Positioning System Receiver
Dataset-specific Description	C-Nav; GP1850; GP-90D
Generic Instrument Description	The Global Positioning System (GPS) is a U.S. space-based radionavigation system that provides reliable positioning, navigation, and timing services to civilian users on a continuous worldwide basis. The U.S. Air Force develops, maintains, and operates the space and control segments of the NAVSTAR GPS transmitter system. Ships use a variety of receivers (e.g. Trimble and Ashtech) to interpret the GPS signal and determine accurate latitude and longitude.

Dataset-specific Instrument Name	Improved Meteorological Recorder
Generic Instrument Name	Improved Meteorological Recorder
Generic Instrument Description	An IMET Recorder is an instrument package that can be mounted on a ship or buoy to record mean weather data including air and sea-surface temperature, incoming short and long-wave radiation, precipitation, humidity, wind velocity and barometric pressure. Each sensor in the system communicates digitally and returns calibrated values to a central data recorder.

[table of contents | back to top]

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 Symbioses ROCA: River Ocean Continuum of the Amazon Cruise information and original data are available from the NSF R2R data catalog: https://www.rvdata.us/search/cruise/KN197-08 Cruise Track over Salinity Climatology (Image from Dr. Ajit Subramaniam)

[table of contents | back to top]

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)

[table of contents | back to top]

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.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0934095
Gordon and Betty Moore Foundation: Marine Microbiology Initiative (MMI)	GBMF2293

[table of contents | back to top]