Bacterial cell counts and Dissolved Organic Carbon (DOC) measurements from R/V Atlantis AT32, AT34, AT38, and AT39-06 in the western North Atlantic Ocean (35°N to 57°N; 45°W) in Nov. 2015, May 2016, Sep 2017, Mar/Apr 2018

Website: https://www.bco-dmo.org/dataset/824623
Data Type: Cruise Results, experimental
Version: 1
Version Date: 2020-09-16

Project
» Tracking the temporal and spatial variability of dissolved organic matter, its diagenetic state and bioavailability during various bloom states in the North Atlantic (DOM_SeasonalDynamics)

Program
» North Atlantic Aerosols and Marine Ecosystems Study (NAAMES)

Contributors	Affiliation	Role
Carlson, Craig A.	University of California-Santa Barbara (UCSB-MSI)	Principal Investigator
Copley, Nancy	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset includes analyses from Niskin bottle samples collected on R/V Atlantis cruises AT32, AT34, AT38 and AT39-6 as part of the NASA NAAMES campaign (2015-2018). Reported are bacterial abundances and Dissolved Organic Carbon (DOC) measurements pre- and post-experiment. Remineralization experiments were used to examine the ability of natural assemblages of bacteria to utilize in situ DOM as well as different algal-derived substrates.

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Coverage

Spatial Extent: **N**:56.341 **E**:-37.514 **S**:39.187 **W**:-46.148
Temporal Extent: 2016-05-11 - 2018-03-20

Dataset Description

This dataset includes analyses from Niskin bottle samples collected on R/V Atlantis cruises AT32, AT34, AT38 and AT39-6 as part of the NASA NAAMES campaign (2015-2018). Reported are bacterial abundances and Dissolved Organic Carbon (DOC) measurements pre- and post-experiment. Remineralization experiments were used to examine the ability of natural assemblages of bacteria to utilize in situ DOM as well as different algal-derived substrates.

Methods & Sampling

Bioassays were conducted at each station using water collected within 10 m depth horizon. Water was gently gravity-filtered serially through 142 mm PC filtration cartridges loaded with either a 1.2- or a 0.2-µm mixed cellulose ester membrane filter. The 1.2 µm filtrate was retained as a bacterioplankton inoculum with diluted large phytoplankton and nanoflagellate grazers while the 0.2 µm fraction was retained as particle-free DOM substrate. When possible, the filtration rig was directly attached to Niskin bottles with platinum-cured silicon tubing and the filtrate was collected into PC carboys. Otherwise, unfiltered water from the Niskin was first drawn into a PC carboy and then filtered into another PC carboy. Each bioassay was initiated by combining the 1.2 µm filtrate with the 0.2 µm filtrate in a 30:70 ratio. A pair of incubation bottles were then rinsed with this water and subsequently filled. Ammendments were added if applicable. 8 pre-combusted (4 hours at 450°C) 40 mL EPA borosilicate glass incubation vials were also rinsed and filled with initial incubation water. Bioassays were maintained in Fisherbrand Isotemp BOD refrigerated incubators. They were kept in darkness for up to 81 days at temperatures as near in situ as logistically possible (±1.5°C). Incubation bottles were sampled over the duration of each campaign, while vials were sacrificially sampled for organic carbon during and beyond the duration of each campaign. Bacterioplankton carbon (BC, µmol C / L) refers to the carbon content of a population at any given time. BC at the initial and stationary growth conditions of each bioassay were estimated by applying empirical carbon conversion factors (CCFs, fg C / cell) to POC estimates. The dissolved organic carbon (DOC) fraction in a bioassay, was estimated by subtracting bacterioplankton cell carbon (µmol C / L) from TOC measurements.

Data Processing Description

BCO-DMO Processing:
- added conventional header with dataset name, PI name, version date
- replaced blank cells and -999 with 'nd' (no data)
- concatenated tables from 3 cruises (AT34, AT38, AT39-05)

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Data Files

File
bact_counts_DOC.csv (Comma Separated Values (.csv), 55.24 KB) MD5:27cfd1773588d8c9c2cb016d8481fd07
Primary data file for dataset ID 824623

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Supplemental Files

File
Bacterial abundance using DAPI DNA binding stain and Epifluorescence microscopy filename: Bacterial_Abundance_using_DAPI_DNA_binding_stain_and_EFM.pdf (Portable Document Format (.pdf), 367.91 KB) MD5:bcc7f60bea95a080fe056e1bb095536e C. Carlson [version date: 2017-08-29]
Protocol: Bacterial Carbon Concentration in Bioassay Experiments (NAAMES campaign) filename: Protocol_Bacterial_Carbon_Bioassay_2020-09-17.pdf (Portable Document Format (.pdf), 410.67 KB) MD5:6a1687e8f0201448589dc854936c91f7 Protocol for determination of Bacterial Carbon Concentration in Bioassay Experiments (NAAMES campaign)
Protocols for Dissolved Organic Carbon and Total Dissolved Nitrogen Analysis filename: DOC_TDN_method_Carlson.pdf (Portable Document Format (.pdf), 258.09 KB) MD5:46973edce747f7f77099db51ac36acfa Version date: 2017-10-10. UCSB - CRAIG CARLSON. v

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Related Publications

Carlson, C. A., Hansell, D. A., Nelson, N. B., Siegel, D. A., Smethie, W. M., Khatiwala, S., Meyers, M. M., Halewood, E. (2010). Dissolved organic carbon export and subsequent remineralization in the mesopelagic and bathypelagic realms of the North Atlantic basin. Deep Sea Research Part II: Topical Studies in Oceanography, 57(16), 1433–1445. doi:10.1016/j.dsr2.2010.02.013
Methods

James, A. K., Passow, U., Brzezinski, M. A., Parsons, R. J., Trapani, J. N., & Carlson, C. A. (2017). Elevated pCO2 enhances bacterioplankton removal of organic carbon. PLOS ONE, 12(3), e0173145. doi:10.1371/journal.pone.0173145
Methods

Porter, K. G., & Feig, Y. S. (1980). The use of DAPI for identifying and counting aquatic microflora. Limnology and Oceanography, 25(5), 943–948. doi:10.4319/lo.1980.25.5.0943
Methods

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Parameters

Parameter	Description	Units
Cruise	Cruise identifier	unitless
Station	Station identifier	unitless
Depth	Depth from which incubation water was collected	meters
Treatment	Indicates the type of amendment or mixture used (when applicable)	unitless
Bottle	ID for incubation bottle	unitless
Hours	Time since experiment initiation	hours
Stationary_Sampling	Time at which sampling for POC took place	hours
Cells	Bacterial abundance measure by epifluorescent microscopy (Porter & Feig; 1980)	cells /Liter
Cells_sd	Bacterial abundance standard deviation	cells /Liter
DOC	Dissolved organic carbon concentration measured by high temperature combustion/oxidation (HTCO) (Carlson et al; 2010)	micromol carbon/liter (umol C / L)
DOC_sd	Dissolved organic carbon concentration standard deviation	micromol carbon/liter (umol C / L)
Initial_BC	Bacterial carbon concentration at the start of the experiment measured by high temperature combustion/oxidation (HTCO) with glass fiber filtrate type GF/75 (Advantec) (?James et al; 2017)	micromol carbon/liter (umol C / L)
Stationary_BC	Bacterial carbon concentration at the stationary sampling time measured by high temperature combustion/oxidation (HTCO) with glass fiber filtrate type GF/75 (Advantec) (?James et al; 2017)	micromol carbon/liter (umol C / L)

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Instruments

Dataset-specific Instrument Name	Olympus BX51 Epiflourescence Microscope
Generic Instrument Name	Fluorescence Microscope
Dataset-specific Description	For bacterial abundance estimates
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of fluorescence and phosphorescence instead of, or in addition to, reflection and absorption of visible light. Includes conventional and inverted instruments.

Dataset-specific Instrument Name	
Generic Instrument Name	Niskin bottle
Dataset-specific Description	For water sample collection
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Dataset-specific Instrument Name	
Generic Instrument Name	Shimadzu TOC-V Analyzer
Dataset-specific Description	Used to measure dissolved organic carbon (DOC) and total dissolved nitrogen (TDN). Shimadzu TOC-V analyzers (Shimadzu Scientific Instruments, Columbia, MD, USA) were slightly modified from the manufacturer's model system. The condensation coil was removed and the head space of an internal water trap was reduced to minimize system dead space. The combustion tube contained 0.5 cm Pt pillows placed on top of Pt alumina beads to improve peak shape and to reduce alteration of the combustion matrix throughout the analytical run. CO2-free carrier gas was delivered to the TOC-V systems via commercial ultra high purity gas cylinders or a Whatmans gas generator. A magnesium perchlorate trap was added to the existing water and halide traps to ensure removal of water vapor from the gas line prior to entering a nondispersive infrared detector. The resulting peak area was integrated with Shimadzu chromatographic software.
Generic Instrument Description	A Shimadzu TOC-V Analyzer measures DOC by high temperature combustion method.

Dataset-specific Instrument Name	Fisherbrand Isotemp BOD refrigerated incubators
Generic Instrument Name	Shipboard Incubator
Dataset-specific Description	Used for bioassays.
Generic Instrument Description	A device mounted on a ship that holds water samples under conditions of controlled temperature or controlled temperature and illumination.

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Deployments

AT34

Website	https://www.bco-dmo.org/deployment/716567
Platform	R/V Atlantis
Start Date	2016-05-11
End Date	2016-06-05
Description	Part of the 'North Atlantic Aerosols and Marine Ecosystems Study' (NAAMES) project

AT38

Website	https://www.bco-dmo.org/deployment/822600
Platform	R/V Atlantis
Start Date	2017-08-30
End Date	2017-09-22
Description	North Atlantic Aerosols and Marine Ecosystems Study (NAAMES) cruise

AT39-06

Website	https://www.bco-dmo.org/deployment/824382
Platform	R/V Atlantis
Start Date	2018-03-20
End Date	2018-04-13
Description	Cruise for project "Project: North American Aerosols and Marine Ecosystems Study (NAAMES)".

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Project Information

Tracking the temporal and spatial variability of dissolved organic matter, its diagenetic state and bioavailability during various bloom states in the North Atlantic (DOM_SeasonalDynamics)

Coverage: North Atlantic Ocean (35°N to 57°N; 45°W)

Tracking the temporal and spatial variability of dissolved organic matter, its diagenetic state and bioavailability during various bloom states in the North Atlantic
Craig Carlson
ID: 1537943

The North Atlantic phytoplankton bloom is among the most conspicuous biological events annually recorded. This bloom represents a hot spot of biological activity during which a significant amount of dissolved organic matter is produced through bloom-associated food web processes. While recent work has shed some light on the spatial distribution of dissolved organic matter during the North Atlantic bloom, temporal resolution of dissolved organic matter variability in the context of the North Atlantic bloom is lacking. This project aims to understand the temporal and spatial dynamics of dissolved organic matter, its compositional variability, as well as the mechanisms that control its accumulation, persistence and export in the North Atlantic. This project will leverage a large, recently funded, NASA field-program called the North Atlantic Aerosols and Marine Ecosystem Study (NAAMES) designed to evaluate the fundamental controls of the north Atlantic phytoplankton bloom initiation, its magnitude and interannual variability. Results from this research will provide a mechanistic understanding of carbon cycling in the context of the North Atlantic phytoplankton bloom. The research will be carried out at the University of California ? Santa Barbara, a Hispanic-serving institution, and will involve

educational opportunities for students from elementary through graduate school.

Recent work examining the spatial distribution of dissolved organic matter in the North Atlantic coupled to measurements of water mass ventilation rates has estimated that a significant amount of carbon is vertically exported out of the surface ocean to deep waters as dissolved organic matter. However, an overarching gap in dissolved organic matter knowledge is the lack of valuable temporal resolution necessary to investigate the mechanisms that control dissolved organic matter production, accumulation, or its change in quality and bioavailability as a result of changing bloom phases and phytoplankton cycles. This research will examine the temporal and spatial variability of dissolved organic matter dynamics along a repeated meridional transect during four distinct phases associated with the North Atlantic spring phytoplankton bloom including 1) pre-bloom, mixing phase, 2) nutrient-replete, increasing biomass phase, 3) nutrient-stressed decreasing biomass phase, and 4) post bloom stratified phase. This will be accomplished by coupling continuous water column and surface layer ecosystem properties from autonomous in situ sensors, and satellite observations with four 26-day coordinated ship and airborne field campaigns.

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Program Information

North Atlantic Aerosols and Marine Ecosystems Study (NAAMES)

Website: http://naames.larc.nasa.gov/

Coverage: North Atlantic Ocean

The North Atlantic Aerosols and Marine Ecosystems Study (NAAMES) is an interdisciplinary investigation resolving key processes controlling marine ecosystems and aerosols that are essential to our understanding of Earth system function and future change. NAAMES is funded by the NASA Earth Venture Suborbital Program and is the first EV-S mission focused on studying the coupled ocean ecosystem and atmosphere.

Plankton ecosystems of the global ocean profoundly affect climate and life on Earth. NASA's ocean color satellite record tells us that these invaluable ecosystems are highly responsive to climate variability, with changes in ocean production impacting food production, uptake of atmospheric carbon dioxide, and emission of climate-regulating aerosols. Intergovernmental Panel on Climate Change (IPCC) simulations suggest that surface ocean temperatures will warm by +1.3 to +2.8 degrees C globally over the 21st century, with major consequences on physical properties of the surface ocean where plankton populations thrive. **The pressing question is, how will these changes alter plankton production, species composition, and aerosol emissions?** Today, even the sign of these potential changes remains unresolved. Our ability to predict Earth System consequences of a warming ocean and develop realistic mitigation and adaption strategies depends on resolving conflicting hypotheses regarding the factors controlling plankton ecosystems and biogenic aerosol emissions.

NAAMES consists of four, combined ship and aircraft field campaigns that are each aligned to a specific event in the annual plankton lifecycle. Ship-based measurements provide detailed characterization of plankton stocks, rate processes, and community composition. Ship measurements also characterize sea water volatile organic compounds, their processing by ocean ecosystems, and the concentrations and properties of gases and particles in the overlying atmosphere. These diverse data are extended over broader spatial scales through parallel airborne remote sensing measurements and in situ aerosol sampling that target ocean properties as well as the aerosols and clouds above. The airborne data crucially link local-scale processes and properties to the much larger scale continuous satellite record. Integrating the NAAMES observations with state-of-the-art climate and ecosystems models enables the creation of a process-based foundation for resolving plankton dynamics in other ocean regions, accurately interpreting historical satellite records, and improving predictions of future change and their societal impacts.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1537943

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