Seawater chlorophyll-a from R/V Endeavor cruise EN589 in the Northwest Atlantic Ocean from September to October 2016 (Refractory DOC Recycling project)

Website: https://www.bco-dmo.org/dataset/710245
Data Type: Cruise Results
Version: 1
Version Date: 2019-01-02

Project
» Collaborative Research: Coupled Ocean-Atmosphere Recycling of Refractory Dissolved Organic Carbon in Seawater (Refractory DOC Recycling)

Program
» United States Surface Ocean Lower Atmosphere Study (U.S. SOLAS)

Contributors	Affiliation	Role
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Coverage

Spatial Extent: **N**:41.41893 **E**:-63.28855 **S**:34.99955 **W**:-70.83515
Temporal Extent: 2016-09-16 - 2016-10-15

Dataset Description

Seawater samples collected from CTD casts and analyzed for Chl a.

Methods & Sampling

Chlorophyll a Methods: Seawater samples were collected from CTD casts in pre-cleaned opaque brown polyethylene bottles and then analyzed from chlorophyll a (Chl-a) after extraction into 90% acetone:10% high purity water according to the method outlined in Welschmeyer, 1994. Briefly, after a seawater sample was collected from the CTD, a known volume of that seawater was filtered through a 25 mm diameter GF/F glass fiber filter under subdued lighting and at ~100 mm Hg pressure differential. Samples were filtered within 30 min of sample collection. The filter-funnel walls were then rinsed with previously filtered seawater. The filter was then folded with a flat-tipped forcep and placed in a borosilicate test tube that was tightly capped. The test tube was wrapped in Al foil and frozen. Once several samples were processed and stored this way, they

were removed from the freezer and 4 mL of 90% (v/v) acetone (Burdick and Jackson, spectrophotometric grade) diluted with high-purity laboratory water (Milli-Q water from a Barnstead water system. The samples were vigorously shaken, wrapped in Al foil, and the Chl-a extracted overnight in the freezer (ca. 12 hr) in the dark. Chl-a in the acetone extracts was quantified by fluorescence under subdued lighting using a Turner Designs model AU-10 fluorometer. Samples were removed from the freezer and warmed to room temperature in the dark prior to analysis.

Chlorophyll a Concentration Calculation: To obtain chlorophyll a concentrations, blank-corrected fluorescence values obtained from the AU-10 were converted to ug Chl- a/L by using the standard curve equation obtained from calibration with an authentic Chl-a standard diluted in 90% acetone prior to the cruise. Secondary solid standards were analyzed daily during the cruise to ensure that the calibration of the AU-10 remained constant. Concentrations were corrected based on the filtered and extract volumes, as well as dilution factors, when needed.

Relevant Reference:

Welschmeyer, N.A. 1994. Fluorometric analysis of chlorophyll a in the presence of chlorophyll b and pheopigments. Limnol. Oceanogr. 39: 1985-1992. 10.4319/lo.1994.39.8.1985

Data Processing Description

BCO-DMO Processing:
Added conventional header with dataset name, PI name, version date.
Modified parameter names to conform with BCO-DMO naming conventions.
Re-formatted date from dd-MM-YY to yyyymmdd.
Re-formatted the latitude longitude pairs from degrees decimal minutes to decimal degrees.

2019-01-02: revised the station positions and changed cast ID 16267U1804 to 16267U1604. Version 2 (2019-01-02) replaces version 1 (2017-07-19).

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Data Files

File	
EN589_chla_v20190102.csv	(Comma Separated Values (.csv), 9.29 KB) MD5:dcf5ad628a6a4efb1c779008b763442c
Primary data file for dataset ID 710245	

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Parameters

Parameter	Description	Units
Sample_Date	Date when the sample was collected.	yyyymmdd
Latitude	Latitude coordinate where the sample was collected, South is negative.	decimal degrees
Longitude	Longitude coordinate where the sample was collected, West is negative.	decimal degrees
Cast_ID	Identifier for the specific cast which collected the data.	unitless
CTD_Sample_Depth	Depth at which the sample was collected.	meters (m)
Vol_Filtered	Total amount of water filtered.	milliliters (mL)
Vol_Extracted	Total amount extracted after filtering.	milliliters (mL)
Dilution_Factor	Factor by which the sample was diluted	unitless
AU10_signal	Raw signal collected from the Turner Designs model AU-10 fluorometer	unitless
Chl_a_extract	Chlorophyll a concentration of the extracted water.	micrograms per Liter (ug/L)
Chl_a_sample	Chlorophyll a concentration of the sample.	micrograms per Liter (ug/L)
chl_a_avg	Average chlorophyll a concentrations from the sample.	micrograms per Liter (ug/L)
chl_a_stdev	Standard deviation of the chlorophyll a concentrations from the sample.	micrograms per Liter (ug/L)

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Instruments

Dataset-specific Instrument Name	Seawater samples were collected from CTD casts.
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Seawater samples were collected from CTD casts in pre-cleaned opaque brown polyethylene bottles and then analyzed from chlorophyll a (Chl-a) after extraction into 90% acetone:10% high purity water according to the method outlined in Welschmeyer, 1994.
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	Turner Designs model AU-10 fluorometer
Generic Instrument Name	Turner Designs Fluorometer 10-AU
Dataset-specific Description	Chl-a in the acetone extracts was quantified by fluorescence under subdued lighting using a Turner Designs model AU-10 fluorometer.
Generic Instrument Description	The Turner Designs 10-AU Field Fluorometer is used to measure Chlorophyll fluorescence. The 10AU Fluorometer can be set up for continuous-flow monitoring or discrete sample analyses. A variety of compounds can be measured using application-specific optical filters available from the manufacturer (read more from Turner Designs, turnerdesigns.com, Sunnyvale, CA, USA).

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Deployments

EN589

Website	https://www.bco-dmo.org/deployment/710271
Platform	R/V Endeavor
Report	http://dmoserv3.bco-dmo.org/data_docs/Refractory_DOC_Recycling/EN589_Post_Cruise_Report_10.20.16.pdf
Start Date	2016-09-16
End Date	2016-10-15
Description	The main purpose of this cruise was to study the organic matter put into the atmosphere as particles (also called aerosols) that are generated from bursting bubbles at the sea surface. To do this, the investigators deployed an aerosol generator to reproduce a model surface ocean using the ship's clean flow-through seawater system. The ship occupied four hydrographic stations: two biologically productive stations and two stations in the Sargasso Sea. To support the aerosol generator work, over fifty CTD casts were conducted to collect seawater and to characterize the physical, chemical, and biological properties of the water column. Cruise description excerpted from EN589 post-cruise report: EN589_Post_Cruise_Report_10.20.16.pdf. Related documents: EN589_Cruise_Plan.pdf

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Project Information

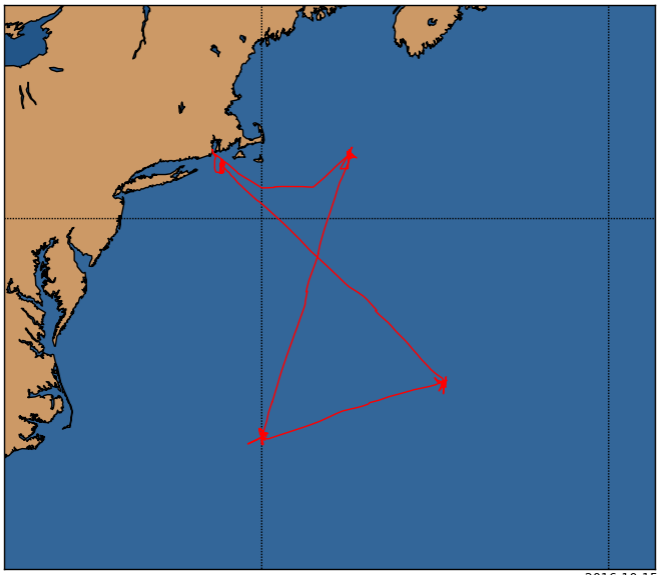
Collaborative Research: Coupled Ocean-Atmosphere Recycling of Refractory Dissolved Organic Carbon in Seawater (Refractory DOC Recycling)

Coverage: Northwest Atlantic Ocean

The oceans hold a massive quantity of organic carbon that is greater than all terrestrial organic carbon biomass combined. Nearly all marine organic carbon is dissolved and more than 95% is refractory, and cycled through the oceans several times before complete removal. Refractory dissolved organic carbon (RDOC) concentrations are uniform with depth in the water column and represent the "background" carbon present throughout the oceans. However, very little is known regarding RDOC production and removal processes. One potential removal pathway is through adsorption of RDOC onto surfaces of rising bubbles produced by breaking waves and ejection via bubble bursting into the atmosphere. Building on prior research, the investigators will evaluate the importance of ocean- atmosphere processing in recycling marine RDOC during a research cruise in the northwestern Atlantic Ocean. Results of the research will provide important insights regarding the coupled ocean-atmosphere loss of RDOC, thereby improving understanding of and ability to predict the role of RDOC in oceanic and atmospheric biogeochemistry, the global carbon cycle, and Earth's climate. The research will involve three early career faculty, and will provide training for undergraduate and graduate researchers.

Recent results based on a limited set of observations indicate that the organic matter (OM) associated with primary marine aerosol (PMA) produced by bursting bubbles from breaking waves at the sea surface is comprised partly to wholly of RDOC rather than OM of recent biological origin as has been widely assumed. The injection of RDOC into the atmosphere in association with PMA and its subsequent photochemical oxidation is a potentially important and hitherto unrecognized sink for RDOC in the oceans of sufficient magnitude to close the marine carbon budget and help resolve a long-standing conundrum regarding removal mechanisms for marine RDOC. This project will involve a shipboard investigation and modeling study to (1) quantify the relative contributions of marine refractory dissolved organic carbon (RDOC) to primary marine aerosol organic matter (PMA OM) produced from near-surface seawater in biologically productive and oligotrophic regions and from North Atlantic Deep Water, and to (2) determine the importance of atmospheric photochemical processing as a recycling pathway for RDOC. To test these hypotheses, a high-capacity aerosol generator will be deployed at four hydrographic stations in the NW Atlantic Ocean to characterize (1) the natural abundance of 14C in PMA and in surface and deep seawater; (2) the surface tension and physical properties of bubble plumes; (3) size-resolved production fluxes, chemical composition, organic carbon enrichments, spectral absorbance, and photochemical evolution of PMA; and (4) the carbon content, optical properties, and physical properties of seawater. The importance of RDOC recycling via PMA production and photochemical evolution will be interpreted with model calculations.

EN589 Cruise Track



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Program Information

United States Surface Ocean Lower Atmosphere Study (U.S. SOLAS)

Website: http://www.us-solas.org/

Coverage: Global

The Surface Ocean Lower Atmosphere Study (SOLAS) program is designed to enable researchers from different disciplines to interact and investigate the multitude of processes and interactions between the coupled ocean and atmosphere.

Oceanographers and atmospheric scientists are working together to improve understanding of the fate, transport, and feedbacks of climate relevant compounds, and also weather and hazards that are affected by processes at the surface ocean.

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Physical, chemical, and biological research near the ocean-atmosphere interface must be performed in synergy to extend our current knowledge to adequately understand and forecast changes on short and long time frames and over local and global spatial scales.

The findings obtained from SOLAS are used to improve knowledge at process scale that will lead to better quantification of fluxes of climate relevant compounds such as CO2, sulfur and nitrogen compounds, hydrocarbons and halocarbons, as well as dust, energy and momentum. This activity facilitates a fundamental understanding to assist the societal needs for climate change, environmental health, weather prediction, and national security.

The US SOLAS program is a component of the International SOLAS program where collaborations are forged with investigators around the world to examine SOLAS issues ubiquitous to the world's oceans and atmosphere.

Â» International SOLAS Web site

Science Implementation Strategy Reports

US-SOLAS (4 MB PDF file)
Other SOLAS reports are available for download from the US SOLAS Web site

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1536608
NSF Division of Ocean Sciences (NSF OCE)	OCE-1536605
NSF Division of Ocean Sciences (NSF OCE)	OCE-1536674
NSF Division of Ocean Sciences (NSF OCE)	OCE-1536597

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