Nutrients, chlorophyll-a, and light attenuation in the Delaware estuary from the R/V Hugh R. Sharp HRS110805DK, HRS111107DK, HRS120809DK, HRS121112DK, HRS1313, HRS1324 in 2011 - 2013 (PAPI: Photochemistry and Photoheterotroph Interactions project)

Website: https://www.bco-dmo.org/dataset/551239
Data Type: Cruise Results
Version: 2
Version Date: 2020-10-01

Project
» Activity and abundance of photoheterotrophs fueled by photochemically-produced substrates (PAPI: Photochemistry and Photoheterotroph Interactions)

Contributors	Affiliation	Role
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Abstract
Nutrients, chlorophyll-a, and light attenuation in the Delaware estuary from the R/V Hugh R. Sharp HRS110805DK, HRS111107DK, HRS120809DK, HRS121112DK, HRS1313, HRS1324 in 2011 - 2013 (PAPI: Photochemistry and Photoheterotroph Interactions project)

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Coverage

Spatial Extent: **N**:39.857 **E**:-1.248567 **S**:0.646267 **W**:-75.5825
Temporal Extent: 2011-08-05 - 2013-11-21

Dataset Description

Nutrients, chlorophyll-a, and light attenuation in the Delaware estuary from the R/V Hugh R. Sharp HRS110805DK, HRS111107DK, HRS120809DK, HRS121112DK, HRS1313, HRS1324 in 2011 - 2013 (PAPI: Photochemistry and Photoheterotroph Interactions project)

Acquisition Description

Nutrient concentrations were measured by standard wet chemical methods using a SEAL Analytical AA3 Continuous Segmented Flow Analyzer.

Samples for chlorophyll a concentrations were collected by filtering 100 ml of estuarine water through Whatman GF/F filters and stored at -20 oC until analysis. To estimate concentrations, the filters were placed into 90% acetone and 40% dimethyl sulfoxide *(DMSO*) and then the fluorescence in the extract was measured with a Turner Designs 10-AU fluorometer.

The attenuation coefficient was estimated by measuring photosynthetically active radiance with a Biospherical PNF-210 radiometer over a depth profile. In nearly all cases, the downcast and upcast profiles of radiance were indistinguishable and all data were used. When differences between the down and upcasts were apparent, only the downcast data were used.

Processing Description

Except for converting raw spectrometric or fluorometric readings to concentrations, the concentration data were not processed.

Radiance values at very shallow or very deep depths were excluded from the analysis to calculate the attenuation coefficient when these values were clearly not along the ln(radiance) vs. depth line.

BCO-DMO Processing:

- added conventional header with dataset name, PI name, version date, reference information
- renamed parameters to BCO-DMO standard
- reformated date from m/d/yyyy to yyyy-mm-dd
- replaced blank cells with nd; changed NA and ND to nd
- replaced blanks and / with underscores
- changed format of latititude and longitude to decimal degrees
- matched cruise names to R2R standard names
- revised 3 lat/lon positions - new version (2015-03-11) replaces 2015-01-19
- revised 2 lat positions - new version (2020-10-01)

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Parameters

Parameter	Description	Units
cruise_id	cruise identification	unitless
cruise_name	project assigned cruise name	unitless
date	local sampling date	yyyy-mm-dd
time_local	local time	HH:MM
lat	latitude; north is positive	decimal degrees
lon	longitiude; east is positive	decimal degrees
station	station	unitless
cast	cast number	unitless
light_atten	light attenuation	per meter
atten_err	light attenuation error; calculated by linear regression analysis of ln(irradiance) vs. depth	per meter
chl_a	chlorophyll-a concentration	microgram/liter
chl_a_sd	chlorophyll-a concentration standard deviation	microgram/liter
NO3	nitrate concentration	micromoles/liter
NO3_sd	nitrate concentration standard deviation	micromoles/liter
NH4	ammonium concentration	micromoles/liter
NH4_sd	ammonium concentration standard deviation	micromoles/liter
PO4	phosphate concentration	micromoles/liter
PO4_sd	phosphate concentration standard deviation	micromoles/liter
SiO4	silicate concentration	micromoles/liter
SiO4_sd	silicate concentration standard deviation	micromoles/liter
comment	sampling comments	unitless

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Instruments

Dataset-specific Instrument Name	Fluorometer
Generic Instrument Name	Fluorometer
Dataset-specific Description	Turner Designs 10-AU fluorometer
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	
Generic Instrument Name	Nutrient Autoanalyzer
Dataset-specific Description	SEAL Analytical AA3 Continuous Segmented Flow Analyzer
Generic Instrument Description	Nutrient Autoanalyzer is a generic term used when specific type, make and model were not specified. In general, a Nutrient Autoanalyzer is an automated flow-thru system for doing nutrient analysis (nitrate, ammonium, orthophosphate, and silicate) on seawater samples.

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Deployments

HRS110805DK

Website	https://www.bco-dmo.org/deployment/551245
Platform	R/V Hugh R. Sharp
Start Date	2011-08-05
End Date	2011-08-09
Description	Microbial and environmental sampling

HRS111107DK

Website	https://www.bco-dmo.org/deployment/551247
Platform	R/V Hugh R. Sharp
Start Date	2011-11-07
End Date	2011-11-11
Description	Microbial and environmental sampling

HRS120809DK

Website	https://www.bco-dmo.org/deployment/551249
Platform	R/V Hugh R. Sharp
Start Date	2012-08-08
End Date	2012-08-13
Description	Microbial and environmental sampling.

HRS121112DK

Website	https://www.bco-dmo.org/deployment/551250
Platform	R/V Hugh R. Sharp
Start Date	2012-11-12
End Date	2012-11-16
Description	Microbial and environmental sampling. Dates are for sampling, not necessarily cruise start and end dates.

HRS1313

Website	https://www.bco-dmo.org/deployment/551252
Platform	R/V Hugh R. Sharp
Start Date	2013-08-03
End Date	2013-08-07
Description	Microbial and environmental sampling.

HRS1324

Website	https://www.bco-dmo.org/deployment/551257
Platform	R/V Hugh R. Sharp
Start Date	2013-11-17
End Date	2013-11-22
Description	Microbial and environmental sampling.

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Project Information

Activity and abundance of photoheterotrophs fueled by photochemically-produced substrates (PAPI: Photochemistry and Photoheterotroph Interactions)

Coverage: Delaware Estuary

Intellectual Merit: Bacteria that use both dissolved organic material (DOM) and light, i.e. photoheterotrophs, would fundamentally change views of how energy and material are processed in the oceans. However, it is still not clear if these microbes have unique roles in the oceans because standard experiments have not been successful in consistently demonstrating positive effects of light on growth and respiration of presumed photoheterotrophs. It is known that these microbes are abundant, with one type (those containing proteorhodopsin) alone constituting 50% or more of all microbes in the oceans. But why these microbes are so abundant is unknown as the ecological advantages of photoheterotrophy remain obscure. The PIs will use a new approach and novel experiments to examine how light affects photoheterotrophs and to explore the contribution of these microbes to DOM fluxes. Their work is testing the following hypothesis: The biogeochemical role of photoheterotrophs is to use low energy-yielding DOM components such as products of photochemical reactions. The reactions involve chromophoric DOM (CDOM) which is a large and dynamic part of the carbon cycle especially in coastal oceans. They have hypothesized that the light energy gained by photoheterotrophs would enable these microbes to benefit from using photochemically-produced compounds which alone do not yield much energy. This hypothesis

is supported by lab experiments showing that proteorhodopsin-generated energy becomes important only when respiration is inhibited and cells are limited by energy. Other lab experiments demonstrated that anaplerotic fixation of CO2 by PR-containing bacteria is stimulated by light. This fixation is needed for growth on C1-C4 compounds, including many produced by photochemical reactions. The PIs are testing this hypothesis with experiments in the Delaware estuary where CDOM varies greatly spatially and seasonally. They are examining the effect of light (PAR) on the uptake and respiration of photochemically-produced low molecular weight (LMW) organic compounds and on gene expression (mRNA) of photoheterotrophs. The focus is on CO, pyruvate, acetaldehyde, and glyoxal; together these compounds constitute a large fraction of the photochemical-byproducts in seawater. Glycolate is also being examined because of its importance in phytoplankton excretion and because of its similarity to organic acids produced by photochemical reactions. Uptake of these compounds is estimated with 14C- tracers and HPLC measurements of concentrations. Rates are then compared with the abundance and mRNA levels of proteorhodopsin and pufM found in aerobic anoxygenic phototrophic bacteria as measured by QPCR assays. The PIs are also examining how light and the photochemically-produced LMW organic compounds affect bacterial respiration and growth efficiency. They are examining the relationships among anaplerotic CO2 fixation, uptake of photochemical byproducts, and photoheterotroph abundance and activity along transects of the Delaware estuary and during diel studies. The proposed work is being conducted by a team consisting of microbial oceanographers (Kirchman and Cottrell) and a marine biogeochemist (Kieber) with expertise in photoheterotrophs and photochemical reactions, respectively. Broader Impacts: This interdisciplinary project is supporting graduate students and also involves undergraduates in summer research projects. Results will be incorporated into web sites and used in courses taught by Kirchman and Kieber. The Kirchman lab is featured in lab tours open to the public and in Coast Day, an annual open house that attracts about 10,000 visitors. Kieber mentors undergraduates and coordinated a program for economically disadvantaged high school students.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1029569
NSF Division of Ocean Sciences (NSF OCE)	OCE-1030306

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