Solar irradiance in Delaware Estuary from the R/V Hugh R. Sharp HRS111107DK, HRS120809DK, HRS121112DK, HRS1313, HRS1324 in 2011 - 2013 (PAPI: Photochemistry and Photoheterotroph Interactions project)

Website: https://www.bco-dmo.org/dataset/551609
Data Type: Cruise Results
Version: 1
Version Date: 2015-01-15

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

Contributors	Affiliation	Role
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Abstract
This data set is a compilation of solar irradiance data that were collected during the PAPI cruises 1 through 6 in the Delaware Estuary from Aug. 2009 to Nov. 2013. Data were obtained to support photobiological and photochemical experiments. (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: 2011-11-10 - 2013-11-18

Dataset Description

This data set is a compilation of solar irradiance data that were collected during the PAPI cruises 1 through 6 in the Delaware Estuary from Aug. 2009 to Nov. 2013. Data were obtained to support photobiological and photochemical experiments.

Methods & Sampling

Data were collected with a deck mounted NIST-calibrated Optronics OL754 spectroradiometer with a cosine

collector. Solar irradiance data were collected at 1 nm intervals from 290 to 600 nm. The Optronic's quartz sensor was mounted on top of one of the laboratory vans near the aft end in an unshaded section of the ship's deck. The controller, monochromator and other part were contained within a temperature controlled van.

Data Processing Description

No data processing was done with the data set.

BCO-DMO Processing:
- added conventional header with dataset name, PI name, version date
- renamed parameters to BCO-DMO standard
- reformated date from m/d/yyyy to yyyy-mm-dd
- replaced blank cells with nd
- replaced blanks within cells with underscores
- reformatted time, weather, and wavelength data from rows to columns

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Data Files

File
PAPI_irrad.csv (Comma Separated Values (.csv), 4.16 MB) MD5:19b2941b4a07b204f0b9fdd8442ca6d6 Primary data file for dataset ID 551609

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Parameters

Parameter	Description	Units
cruise_name	cruise name assigned by project	unitless
date_local	local date	yyyy-mm-dd
wavelength	wavelength	nanometer
run	wavelength run number	unitless
time_start	start time	HH:MM:SS
ISO_DateTime_Local	local date and time in ISO 8601:2004(E) format	yyyy-mm-ddTHH:MM:SS
solar_irradiance	solar irradiance	Watts/meter^2/nanometer
weather	description of weather	unitless

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Instruments

Dataset-specific Instrument Name	Spectroradiometer
Generic Instrument Name	Spectroradiometer
Dataset-specific Description	deck mounted NIST-calibrated Optronics OL754 spectroradiometer with a cosine collector
Generic Instrument Description	A Spectroradiometer or Spectraradiometer is an instrument that measures the intensity and nature of electromagnetic radiation. An ocean color radiometer makes the measurements in a manner optimized for the determination of ocean chlorophyll concentration.

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Deployments

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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