Series 1B: Four follow-up experiments on the combined effect of light and temperature changes on the growth rate (mu) of Thalassiosira pseudonana CCMP 1335 conducted to supplement series 1A experiments

Website: https://www.bco-dmo.org/dataset/745492
Data Type: experimental
Version: 1
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Project
» Collaborative Research: Effects of multiple stressors on Marine Phytoplankton (Stressors on Marine Phytoplankton)

Contributors	Affiliation	Role
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Abstract
This dataset reports supplemental experiments that were conducted to investigate the combined effect of light and temperature changes on the growth rate (mu) of Thalassiosira pseudonana CCMP 1335. Experiments were conducted at three temperatures and two light levels. Optical density measurements, dark-adapted Instantaneous Chlorophyll Fluorescence, and the quantum yield and cell concentrations were determined daily. Particulate organic carbon and nitrogen as well as Chl a were measured when volume allowed.

Table of Contents

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

Coverage

Temporal Extent: 2017-05-08 - 2017-07-07

Dataset Description

This dataset reports supplemental experiments that were conducted to investigate the combined effect of light and temperature changes on the growth rate (mu) of Thalassiosira pseudonana CCMP 1335. Experiments were conducted at three temperatures and two light levels. Optical density measurements, dark-adapted Instantaneous Chlorophyll Fluorescence, and the quantum yield and cell concentrations were determined daily. Particulate organic carbon and nitrogen as well as Chl a were measured when volume allowed.

Methods & Sampling

T. pseudonana was grown in artificial seawater (ASW) (Kester et al.1967), enriched as in f/2 (Guillard 1975) with 50mL autoclaved natural filtered seawater per liter added. Experiments were conducted at 13.5, 22, and

26˚C. Cultures were kept on a 12-hour light 12-hour dark cycle under light intensities ranging from 35 µmol m-2 s-1 to 350 µmol m-2 s-1. Optical density measurements (OD680 and OD720), dark-adapted Instantaneous Chlorophyll Fluorescence (F0) and the quantum yield (QY=Fv/Fm, where Fv is the maximal variable fluorescence and Fm is the maximal fluorescence intensity) and cell concentrations were determined daily at the end of the dark period. Cell counts were conducted in a hemocytometer on a microscope. Cell concentrations on day 0 were calculated based on the inoculum and the dilution. Particulate organic carbon and nitrogen as well as Chl a were measured when volume allowed. Combusted 25mm GFF were prepared for particulate organic carbon and particulate organic nitrogen (POC, PON) and measured in a CEC44OHA elemental analyzer (Control Equipment). Chl a was collected on 47mm 0.45 HAWP filters, then extracted in 90% acetone for 24hrs and measured in a fluorometer (Turner 700).

Data Processing Description

BCO-DMO Processing Notes:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- replaced blank cells with 'nd' (no data)
- combined data for all four experiments into one table (dataset)
- added columns for experiment identifier, temperature, light level and date of experiment
- reformatted integers to remove embedded commas

[table of contents | back to top]

Data Files

File
Tp-growth-S1B.csv (Comma Separated Values (.csv), 13.31 KB) MD5:bd69930d2f14953c6dc2e22c142f6b88 Primary data file for dataset ID 745492

[table of contents | back to top]

Parameters

Parameter	Description	Units
expt	experiment identifier	unitless
temp	experimental temperature	degrees Celsius
light_level	experimental light level	unitless
date_expt	date of experiment formatted as yyyy-mm-dd	unitless
light	irradiance	micromoles/square meter/second (umol m-2 s-1)
day	sampling day where day 0 equals inoculation	day
avg_OD680	optical density at 680 nm; averaged from 7 measurements taken automatically in 10 minute intervals	instrument units
avg_OD720	optical density at 720 nm; averaged from 7 measurements taken automatically in 10 minute intervals	instrument units
F0	instantaneous chlorophyll fluorescence (F0)	instrument units
cell_counts	cell concentrations obtained microscopically	cells/milliliter
QY	the quantum yield: QY=Fv/Fm; where Fv is the maximal variable fluorescence and Fm is the maximal fluorescence intensity	dimensionless
Chla_repl_1	total chlorophyll a measured fluorometrically for replicate #1	microgram/liter
Chla_repl_2	total chlorophyll a measured fluorometrically for replicate #2	microgram/liter
POC_repl_1	Particulate organic carbon for replicate #1	microgram/liter
POC_repl_2	Particulate organic carbon for replicate #2	microgram/liter
PON_repl_1	Particulate orgainic nitrogen for replicate #1	microgram/liter
PON_repl_2	Particulate orgainic nitrogen for replicate #2	microgram/liter

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Multicultivator MC-1000 OD (Qubit Systems)
Generic Instrument Name	Cell Cultivator
Dataset-specific Description	Used for incubations and optical density measurements.
Generic Instrument Description	An instrument used for the purpose of culturing small cells such as algae or bacteria. May provide temperature and light control and bubbled gas introduction.

Dataset-specific Instrument Name	Z985 Cuvette Aquapen (Qubit Systems)
Generic Instrument Name	Fluorometer
Dataset-specific Description	Used to measure instantaneous chlorophyll fluorescence (F0) and quantum Yield (QY=Fv/Fm, where Fv is the maximal variable fluorescence and Fm is the maximal fluorescence intensity). A 20-minute dark adaptation time was used. AquaPen settings: f = 30, F=71, A = 50.
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.

[table of contents | back to top]

Project Information

Collaborative Research: Effects of multiple stressors on Marine Phytoplankton (Stressors on Marine Phytoplankton)

The overarching goal of this project is to develop a framework for understanding the response of phytoplankton to multiple environmental stresses. Marine phytoplankton, which are tiny algae, produce as much oxygen as terrestrial plants and provide food, directly or indirectly, to all marine animals. Their productivity is thus important both for global elemental cycles of oxygen and carbon, as well as for the productivity of the ocean. Globally the productivity of marine phytoplankton appears to be changing, but while we have some understanding of the response of phytoplankton to shifts in one environmental parameter at a time, like temperature, there is very little knowledge of their response to simultaneous changes in several parameters. Increased atmospheric carbon dioxide concentrations result in both ocean acidification and increased surface water temperatures. The latter in turn leads to greater ocean stratification and associated changes in light exposure and nutrient availability for the plankton. Recently it has become apparent that the response of phytoplankton to simultaneous changes in these growth parameters is not additive. For example, the effect of ocean acidification may be severe at one temperature-light combination and negligible at another. The researchers of this project will carry out experiments that will provide a theoretical understanding of the relevant interactions so that the impact of climate change on marine phytoplankton can be predicted in an informed way. This project will engage high schools students through training of a teacher and the development of a teaching unit. Undergraduate and graduate students will work directly on the research. A cartoon journalist will create a cartoon story on the research results to translate the findings to a broader general public audience.

Each phytoplankton species has the capability to acclimatize to changes in temperature, light, pCO2, and nutrient availability - at least within a finite range. However, the response of phytoplankton to multiple

simultaneous stressors is frequently complex, because the effects on physiological responses are interactive. To date, no datasets exist for even a single species that could fully test the assumptions and implications of existing models of phytoplankton acclimation to multiple environmental stressors. The investigators will combine modeling analysis with laboratory experiments to investigate the combined influences of changes in pCO2, temperature, light, and nitrate availability on phytoplankton growth using cultures of open ocean and coastal diatom strains (Thalassiosira pseudonana) and an open ocean cyanobacteria species (Synechococcus sp.). The planned experiments represent ideal case studies of the complex and interactive effects of environmental conditions on organisms, and results will provide the basis for predictive modeling of the response of phytoplankton taxa to multiple environmental stresses.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1538602

[table of contents | back to top]