

Physiology of phytoplankton collected in coastal waters at Palmer LTER near Palmer Station, Antarctica, 2012 and 2013 (Phytoplankton Seasonal Dynamics project)

Website: <https://www.bco-dmo.org/dataset/662036>

Data Type: Other Field Results

Version:

Version Date: 2016-10-19

Project

» [The seasonal dynamics of CO₂, primary production, and DMS in the Western Antarctic Peninsula: Measurements of pools and processes using mass spectrometry](#) (Phytoplankton Seasonal Dynamics)

Contributors	Affiliation	Role
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Methods & Sampling

References:

Detailed description of methods are given in the published peer-reviewed papers listed below:

Goldman, J., Kranz, S., Young, J.N., Tortell, P.D., Bender, M., Morel, F.M.M. (2015) Gross and net production during the spring bloom along the Western Antarctic Peninsula *New Phytologist* 205 (1): 182-191. DOI: 10.1111/nph.13125.

Kranz, S., Young, J.N., Goldman, J., Tortell, P.D., Bender, M., Morel, F.M.M. (2015) Low temperature reduces the energetic requirement for the CO₂ concentrating mechanism in diatoms. *New Phytologist* 205 (1): 192-201. DOI: 10.1111/nph.12976

Tortell, P.D., Asher, E.C., Dacey, J.W.H. Kranz, S., Young, J.N., Goldman, J. Ducklow, H., Grzymiski, J. Stanley, R., Morel, F.M.M. (2014) Metabolic balance of coastal Antarctic waters revealed by autonomous high frequency pCO₂ and dO₂ /Ar measurements *Geophysical Research Letters* DOI: 10.1002/2014GL061266

Young, J.N., Goldman, J., Kranz, S., Tortell, P.D., Morel, F.M.M. (2015) Slow carboxylation of Rubisco constrains the rate of carbon fixation during Antarctic phytoplankton blooms. *New Phytologist* 205 (1): 172-181. DOI: 10.1111/nph.13021

Data Processing Description

BCO-DMO Processing:

- added conventional header with dataset name, PI name, version date, reference information
- column names reformatted to comply with BCO-DMO standards
- added lat and lon for mapping purposes
- replaced n.d. with nd (no data) and blank cells with ND
- reformatted date from Month d, yyyy to yyyy-mm-dd

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Data Files

File
phyto_physiology.csv (Comma Separated Values (.csv), 8.51 KB) MD5:fb32d91b74751498d42084a15f191f4e
Primary data file for dataset ID 662036

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Parameters

Parameter	Description	Units
date_plot	sampling date (UTC), formatted to allow sequential plotting of time variable	year-month-day
temp	As measured by CTD at 10 m depth	degrees celsius
sal	Salinity	parts per thousand
pCO2	CO2 partial pressure. Calculated from TA; pH; temperature salinity; phosphate and silicate using CO2Sys	ppm
CO2_aq	CO2 aqueous. Calculated from TA; pH; temperature; salinity; phosphate and silicate using CO2Sys	micromole/kilogram
TA_meas	Total alkalinity. Measured in 0.2micron filtered and poisoned seawater by potentiometric titration with average precision of +/- 7 micromole/kg	micromole/kilogram
TA_sd	Total alkalinity standard deviation	micromole/kilogram
DIC_cal	Dissolved Inorganic Carbon. Calculated from TA; pH; temperature; salinity; phosphate and silicate using CO2Sys	micromole/kilogram
pH	calibrated potentiometry (until mid-Dec) and spectrophotometrically (rest) and adjusted for temperature	total scale
NO3_NO2_diss_avg	Dissolved nitrate and nitrite	micromolar
NO3_NO2_diss_stdev	Dissolved nitrate and nitrite standard deviation	micromolar
SiO4_diss_avg	Dissolved silicate	micromolar
SiO4_diss_stdev	Dissolved silicate standard deviation	micromolar
PO4_diss_avg	Dissolved phosphate	micromolar
PO4_diss_stdev	Dissolved phosphate standard deviation	micromolar
Chl_a_avg	Chlorophyll a concentrations; as measured with turner fluorometer	micrograms/liter
Chl_a_stdev	Chlorophyll a standard deviation	micrograms/liter
NPP_14C_avg	Net Primary Production as measured by 14C bottle incubations (24 h)	C (micromoles)/liter/day

NPP_14C_stdev	NPP 14C standard deviation	C (micromoles)/liter/day
GPP_14C_avg	Gross Primary Production as measured by 14C bottle incubations (2 h)	C (micromoles)/liter/day
GPP_14C_stdev	GPP 14C standard deviation	C (micromoles)/liter/day
GPP_18O_avg	Gross Primary Production as measured by production of 18O2 from H218O water (~6h)	O2 micromoles/liter/day
GPP_18O_stdev	GPP 18O standard deviation	O2 micromoles/liter/day
NPP_O2_Ar_avg	Net Primary Production as measured by change in O2 with respect to Argon in bottle incubations (~6h)	O2 micromoles/liter/day
NPP_O2_Ar_stdev	NPP O2/Ar standard deviation	O2 micromoles/liter/day
POC	Particulate Organic Carbon as measured on Elemental Combustion Analyzer	micromoles/liter
PON	Particulate Nitrogen as measured on Elemental Combustion Analyzer	micromoles/liter
C_N	Carbon to nitrogen ratio of particulate matter; calculated from POC and PON	mol:mol
POC_d13C	Isotopic ratio of 13C to 12C in POC normalised to PDB standard	per mil
Protein	Total protein from particulate matter as measured by BCA Assay	microgram/liter
Rubisco	Percent of the carboxylating enzyme Ribulose 1;5 bisphosphate carboxylase oxygenase (Rubisco) as measured by quantitative immunoblotting	% total protein (mg:mg)
Fuco	pigment concentration of fucoxanthin; as measured by HPLC	micrograms/liter
HexFuc19	pigment concentration of 19'Hexanoyloxyfucoxanthin; as measured by HPLC	micrograms/liter
Allox	pigment concentration of alloxanthin; as measured by HPLC	micrograms/liter
diatom	Calculated from pigments using equation $0.9*(Fuco-0.05*19'HexFuc)$	cells/milliliter
Phaeo	Calculated from pigments using equation $1.25*19'HexFuc$	cells/milliliter
Cryptophyte	Calculated from pigments using equation $0.7*Allox$	cells/milliliter
eCA	Activity of external carbonic anhydrase (eCA) using the depletion of 18O of aqueous 13C18O2 caused by hydration and dehydration steps of CO2 and bicarbonate. Shown as the ratio of catalyzed CO2/bicarbonate conversion rate compared to the uncatalyzed rate and normalised to chlorophyll. Units are Fold Activity compared to uncatalyzed rate; normalised to chlorophyll concentrations.	milligrams Chl-a/liter (mg/L)
fHCO3_avg	Proportion of bicarbonate of the total inorganic carbon taken up by the cells to support photosynthesis. Measured using the disequilibrium technique	dimensionless
fHCO3_stdev	fHCO3 standard deviation	dimensionless
K1_2_CO2_avg	Michaelis-Menten half-saturation constant for the CO2 concentration that results in half maximum rate of carbon fixation rate of the natural phytoplankton community concentrated onto a 2micron filter	micromolar
K1_2_CO2_stdev	K1/2(CO2) standard deviation	micromolar

lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
year	sampling year	year
julian_day	day of year	days

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	CTD Sea-Bird SBE SEACAT 19plus
Dataset-specific Description	Depth profiles of temperature and salinity measurements
Generic Instrument Description	Self contained self powered CTD profiler. Measures conductivity, temperature and pressure in both profiling (samples at 4 scans/sec) and moored (sample rates of once every 5 seconds to once every 9 hours) mode. Available in plastic or titanium housing with depth ranges of 600m and 7000m respectively. Minature submersible pump provides water to conductivity cell.

Dataset-specific Instrument Name	
Generic Instrument Name	Membrane Inlet Mass Spectrometer
Dataset-specific Description	To measure dissolved gases
Generic Instrument Description	Membrane-introduction mass spectrometry (MIMS) is a method of introducing analytes into the mass spectrometer's vacuum chamber via a semipermeable membrane.

Dataset-specific Instrument Name	unfiltered seawater pump
Generic Instrument Name	Pump
Dataset-specific Description	Used to obtain seawater samples
Generic Instrument Description	A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action. Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps

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Deployments

Morel PAL-LTER

Website	https://www.bco-dmo.org/deployment/662020
Platform	Palmer LTER
Start Date	2012-10-24
End Date	2013-03-27

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Project Information

The seasonal dynamics of CO₂, primary production, and DMS in the Western Antarctic Peninsula: Measurements of pools and processes using mass spectrometry (Phytoplankton Seasonal Dynamics)

Coverage: Western Antarctic Peninsula, Palmer Station, LTER-PALMER sites A and B

Description from NSF award abstract:

The Southern Ocean plays a key role in marine biogeochemistry and global climate. Along the Western Antarctic Peninsula (WAP), winter air temperatures have increased by more than 5 °C over the past five decades, and sea ice duration and extent have decreased substantially, leading to dramatic ecological perturbations. The sensitivity of primary production and climate-active gas cycling to on-going changes in the physical and chemical environment of the WAP is the key to understanding potential biogeochemical climate feedbacks in this region. The objective of this project is to characterize and understand the seasonal dynamics of primary production and climate-active gases carbon dioxide (CO₂) and dimethylsulfide (DMS) in the WAP. The project will examine (1) the relationships among seasonal changes in pCO₂, temperature and light with respect to gross primary production, net primary production, and net community production; (2) the extent to which changes in surface water pCO₂ and temperature drive ecological shifts in the dominant phytoplankton species assemblage composition, and alter key processes in the DMS cycle. The research will employ membrane inlet mass spectrometry to monitor dissolved gases in ambient seawater at the Palmer Station LTER site and conduct physiological/biochemical assays with tracer compounds. The research will provide unprecedented information on the temporal evolution of primary production and dissolved gas concentrations in the WAP in relation to surface hydrography and sea ice cover. Field studies will be supported by laboratory experiments with model species subjected to detailed studies of carbon metabolism. This project will contribute significantly to the understanding of seasonal biogeochemical dynamics in a region that is particularly sensitive to ongoing climate perturbations and important for the global air-sea exchange of CO₂.

Related publications:

Young, J.N., Goldman, J., Kranz, S., Tortell, P.D., Morel, F.M.M. (2015) Slow carboxylation of Rubisco constrains the rate of carbon fixation during Antarctic phytoplankton blooms. *New Phytologist* 205 (1): 172-181. DOI: [10.1111/nph.13021](https://doi.org/10.1111/nph.13021)

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Funding

Funding Source	Award
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	PLR-1043593

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