Gross and integrated gross oxygen productivity from R/V Atlantis II cruise AII-119-4 in the North Atlantic in 1989 (U.S. JGOFS NABE project)

Website: https://www.bco-dmo.org/dataset/2576
Version: June 15, 1995
Version Date: 1995-06-15

Project
» U.S. JGOFS North Atlantic Bloom Experiment (NABE)

Program
» U.S. Joint Global Ocean Flux Study (U.S. JGOFS)

Contributors	Affiliation	Role
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Dataset Description

Gross and Integrated Gross Oxygen Productivity

Methods & Sampling

PI: Michael Bender and J. Kiddon
of: University of Rhode Island
dataset: Gross and Integrated Gross Oxygen Productivity
dates: April 29, 1989 to May 7, 1989
location: N: 46.8 S: 46.4 W: -20.2 E: -19
project/cruise: North Atlantic Bloom Experiment/Atlantis II 119, leg 4
ship: Atlantis II

sta=station number, each day cycles a new station number
gross_integ_prod=Integrated O-18 Gross O2 Production,
units=mmoles o2/m2/day
depth=sample depth, units=meters
gross_o2=O-18 Gross O2 Production, units=umoles O2/L/14hr

Methodology: J. Kiddon, M.L. Bender; URI O-18 Gross O2 Production

units: umoles O2/L/14 hr

North Atlantic Bloom Experiment

Atlantis II Cruise 119 Leg 4

Seawater samples were spiked with H2O enriched in O-18, such that the 18/16 oxygen mass ratio in the sample water was about twice the natural level. Gross production during a 14 hour bottle incubation generates O2 with the same enriched ratio, thereby enhancing the 18/16 ratio in the large original dissolved O2 pool. The tagged O2 mixes with the large O2 pool before being respired, thereby minimizing changes in the isotopic composition of the measured O2 pool associated with respiration. Thus, the O-18 enrichment of the dissolved O2 is taken to be a proportional measure of gross production.

Water samples were drawn before dawn, spiked with 0.2 ml of H2O(18) and incubated in 100 ml quartz bottles for 14 daylight hrs at the depth of collection. A drifting buoy was used for sample deployment. The incubated samples, as well as unincubated samples from each depth were processed to strip and collect dissolved gases. This stripping process was accomplished by introducing approximately 50 ml. of seawater into an evacuated two chamber container; the degassed water remained in a lower chamber and the stripped gases rose to an upper glass ampoule. The ampoule was flame sealed and returned to the lab where the 18/16 ratio of the dissolved O2 was measured with an isotope ratio mass spectrometer as the per mil difference relative to a laboratory standard (referred to as 'del' measurements).

The gross O2 production, denoted [O2]p, was calculated as: [O2]p = {[(del)f - (del)i]/[(del)p - (del)f]}*[O2]i (eqn 1) The parameters (del)i and (del)f are the 'del' values of the dissolved O2 measured respectively before and after incubation. (del)p is the isotopic composition of the O2 produced during the incubation, calculated knowing the volumes (V) of the H2O(18) spike and the sample, the mole fraction of O-18 in the spike (0.980) and the mole fraction of O-18 in natural seawater (0.002). That is, (del)p = {[(X)incub/(X)ref] - 1}*1000, where (X)incub is the mole fraction of O-18 in the spiked sample water, itself calculated as: (Vspike/Vbottle)*0.978 + 0.002; and (X)ref is the separately determined O-18 mole fraction in the laboratory standard. [O2]i in equation 1 is the initial O2 concentration, determined via Winkler titration by the Oceanographic Data facility. Equation 1 may be derived from a more intuitive equation which expresses the final isotopic composition (del)f as a weighted average of the isotopic compositions of the initial O2 and the O2 added during production: (del)f = {[O2]i*(del)i + [O2]p*(del)p}/{[O2]i + [O2]p}.

Integrated gross O2 production

units: mmoles O2/m2/day

Leg 4

Integrated values of productivity were calculated using the histogram method. The euphotic region (surface to the 1% light level, Knudson et al.) was divided into intervals of uniform productivity associated with O-18 gross production measurements. The summation interval was defined as the depth interval bounded by the two mid points of three adjacent sampling depths. For example, if depths 4, 12, 20 and 30 meters were sampled, the productivity measured at 20m was taken to represent the interval 16 to 25 meters. The productivity of the shallowest sample represents the interval

from the surface to the mid point with the next deepest sample, i.e., from 0 to 8 meters. The deepest sample represents the interval from the last mid point to the 1% light level.

Net O2 Production

units: umoles O2/L/24 hr

Leg 4

Net O2 production was determined as the difference in the measured dissolved O2 concentrations of sea water, measured before and after a 24 hour light/dark incubation by Winkler titrations. High precision in the Winkler determinations, +/- 0.1% umole O2/L, was achieved both by using an automated titrator (Radiometer, model ABU93) and by averaging four replicate measurements for each water sample.

Eight replicate water samples were drawn into quartz bottles from a Go-Flo flask containing water collected from the euphotic region before dawn (sample volumes about 100 ml, known to 0.01ml). Winkler titrations were performed on four of the replicates immediately, and the results averaged to establish the initial O2 concentration. The remaining four samples were incubated for 14 daylight hours at the depth of collection (attached to a drifting buoy), and further incubated for 10 night hours in a darkened, ship board incubator, maintained at constant temperature by flowing surface water. Winkler titrations were then performed on the incubated samples and the results averaged. Net production was calculated as the difference between the final and initial O2 concentrations.

Integrated net O2 production

units: mmoles O2/m2/day

Leg 4

Integrated values of net O2 productivity were calculated using the histogram method. The summation intervals were defined as described above for the integrated gross production, e.g., with boundaries set midway between sampled depths. Productivity was integrated over the euphotic region, to the 1% light level (Knudson et al.). In cases where data was sparse (stations 19 and 20 and, in general, for depths near the 1% light level), the net productivity was augmented using computed values of respiration rates and extrapolated gross O2 productivities: net prod = gross prod - 24 * resp rate.

Reference:
Knudson, C. W.S. Chamberlin and J. Marra (1989)
Primary production and irradiance data for U.S. JGOFS (Leg 4) Atlantis II (Cruise 112.4) Technical report LDGO-89.4. Lamont-Doherty Geological Observatory, Palisades, N.Y.

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Data Files

File
ox18.csv(Comma Separated Values (.csv), 2.03 KB) MD5:3af8367a934fb56de68d68d28e99f52d Primary data file for dataset ID 2576

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Parameters

Parameter	Description	Units
year	year, reported as YYYY	YYYY
date	date, reported as MMDD	MMDD
sta	station number, from event log	dimensionless
lat	latitude, minus = south	decimal degrees
lon	longitude, minus = west	decimal degrees
gross_integ_prod	integrated O-18 gross O2 production to the 1% light level	millimoles O2/m2/day
depth	sample depth	meters
gross_o2	O-18 gross O2 production	micromoles O2/liter/14hours

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Instruments

Dataset-specific Instrument Name	Drifter Buoy
Generic Instrument Name	Drifter Buoy
Dataset-specific Description	Used to obtain samples.
Generic Instrument Description	Drifting buoys are free drifting platforms with a float or buoy that keep the drifter at the surface and underwater sails or socks that catch the current. These instruments sit at the surface of the ocean and are transported via near-surface ocean currents. They are not fixed to the ocean bottom, therefore they "drift" with the currents. For this reason, these instruments are referred to as drifters, or drifting buoys. The surface float contains sensors that measure different parameters, such as sea surface temperature, barometric pressure, salinity, wave height, etc. Data collected from these sensors are transmitted to satellites passing overhead, which are then relayed to land-based data centers. definition sources: https://mmisw.org/ont/ioos/platform/drifting_buoy and https://www.aoml.noaa.gov/phod/gdp/faq.php#drifter1

Dataset-specific Instrument Name	GO-FLO Bottle
Generic Instrument Name	GO-FLO Bottle
Dataset-specific Description	samples were drawn from GO-FLO bottles, fixed and then redeployed on a drifter buoy for incubation
Generic Instrument Description	GO-FLO bottle cast used to collect water samples for pigment, nutrient, plankton, etc. The GO-FLO sampling bottle is specially designed to avoid sample contamination at the surface, internal spring contamination, loss of sample on deck (internal seals), and exchange of water from different depths.

Dataset-specific Instrument Name	Isotope-ratio Mass Spectrometer
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	An isotope ratio mass spectrometer was used to measure the 18/16 ratio of the dissolved O2.
Generic Instrument Description	The Isotope-ratio Mass Spectrometer is a particular type of mass spectrometer used to measure the relative abundance of isotopes in a given sample (e.g. VG Prism II Isotope Ratio Mass-Spectrometer).

Dataset-specific Instrument Name	Quartz Bottle
Generic Instrument Name	Light-Dark Bottle
Dataset-specific Description	100 ml quartz bottles were used to store samples which spiked with 0.2 ml of H2O(18) for 14 daylight hrs at the depth of collection.
Generic Instrument Description	The light/dark bottle is a way of measuring primary production by comparing before and after concentrations of dissolved oxygen. Bottles containing seawater samples with phytoplankton are incubated for a predetermined period of time under light and dark conditions. Incubation is preferably carried out in situ, at the depth from which the samples were collected. Alternatively, the light and dark bottles are incubated in a water trough on deck, and neutral density filters are used to approximate the light conditions at the collection depth.Rates of net and gross photosynthesis and respiration can be determined from measurements of dissolved oxygen concentration in the sample bottles.

Dataset-specific Instrument Name	Winkler Oxygen Titrator
Generic Instrument Name	Winkler Oxygen Titrator
Generic Instrument Description	A Winkler Oxygen Titration system is used for determining concentration of dissolved oxygen in seawater.

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Deployments

AII-119-4

Website	https://www.bco-dmo.org/deployment/57737
Platform	R/V Atlantis II
Start Date	1989-04-17
End Date	1989-05-11
Description	early bloom cruise; 17 locations; 60N 21W to 46N 18W

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Project Information

U.S. JGOFS North Atlantic Bloom Experiment (NABE)

Website: http://usjgofs.whoi.edu/research/nabe.html

Coverage: North Atlantic

One of the first major activities of JGOFS was a multinational pilot project, North Atlantic Bloom Experiment (NABE), carried out along longitude 20° West in 1989 through 1991. The United States participated in 1989 only, with the April deployment of two sediment trap arrays at 48° and 34° North. Three process-oriented

cruises where conducted, April through July 1989, from R/V *Atlantis II* and R/V *Endeavor* focusing on sites at 46° and 59° North. Coordination of the NABE process-study cruises was supported by NSF-OCE award # 8814229. Ancillary sea surface mapping and AXBT profiling data were collected from NASA's P3 aircraft for a series of one day flights, April through June 1989.

A detailed description of NABE and the initial synthesis of the complete program data collection efforts appear in: Topical Studies in Oceanography, JGOFS: The North Atlantic Bloom Experiment (1993), Deep-Sea Research II, Volume 40 No. 1/2.

The U.S. JGOFS Data management office compiled a preliminary NABE data report of U.S. activities: Slagle, R. and G. Heimerdinger, 1991. U.S. Joint Global Ocean Flux Study, North Atlantic Bloom Experiment, Process Study Data Report P-1, April-July 1989. NODC/U.S. JGOFS Data Management Office, Woods Hole Oceanographic Institution, 315 pp. (out of print).

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Program Information

U.S. Joint Global Ocean Flux Study (U.S. JGOFS)

Website: http://usjgofs.whoi.edu/

Coverage: Global

The United States Joint Global Ocean Flux Study was a national component of international JGOFS and an integral part of global climate change research.

The U.S. launched the Joint Global Ocean Flux Study (JGOFS) in the late 1980s to study the ocean carbon cycle. An ambitious goal was set to understand the controls on the concentrations and fluxes of carbon and associated nutrients in the ocean. A new field of ocean biogeochemistry emerged with an emphasis on quality measurements of carbon system parameters and interdisciplinary field studies of the biological, chemical and physical process which control the ocean carbon cycle. As we studied ocean biogeochemistry, we learned that our simple views of carbon uptake and transport were severely limited, and a new "wave" of ocean science was born. U.S. JGOFS has been supported primarily by the U.S. National Science Foundation in collaboration with the National Oceanic and Atmospheric Administration, the National Aeronautics and Space Administration, the Department of Energy and the Office of Naval Research. U.S. JGOFS, ended in 2005 with the conclusion of the Synthesis and Modeling Project (SMP).

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Funding

Funding Source	Award
National Science Foundation (NSF)	unknown NABE NSF

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