Measured pH and nutrient data acquired during the pH internal consistency experiment.

Website: https://www.bco-dmo.org/dataset/905357
Data Type: experimental
Version: 1
Version Date: 2023-08-01

Project
» Improving Accuracy and Precision of Marine Inorganic Carbon Measurements (Inorganic Carbon Meaurements)

Contributors	Affiliation	Role
Woosley, Ryan	Massachusetts Institute of Technology (MIT)	Principal Investigator, Contact
Soenen, Karen	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract

These data include the measured pHt, total alkalinity, dissolved inorganic carbon, raw pHt absorbance, and calculated pHt of 25 batches of seawater as a function of temperature, salinity, and pCO2. These data were used to evaluate the internal consistency of 120 different possible combinations of CO2 system constants. The marine inorganic carbon system can be calculated with two measured parameters due to thermodynamic relationships. However, there are many different parameterizations for the required constants and the most accurate or best is not known. These data were used to evaluate the constants and make recommendations for which constants to use, and how to perform CO2 system calculations.

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Coverage

Spatial Extent: **Lat**:39.773433 **Lon**:-70.884417
Temporal Extent: 2019-10-10

Methods & Sampling

This table is a summary table of the pH internal consistency experiment, averaging raw values from related datasets.

Measured total alkalinity and measured DIC are averages from the related dataset "pH internal Consistency Experiment: TA & DIC".

The measured pHt are average pHt for each temperature. Values were extrapolated to zero indicator added as described in Woosley 2021 and Woosley and Moon 2023. Raw measurements can be found in the related datatset "pH internal Consistency Experiment: Raw pH Data".

Data Processing Description

Reactive phosphate and silicate for each batch was determined spectrophotometrically using the methods of Strickland and Parsons (1972) modified according to the protocols of NOAA NCEI (Intergovernmental Oceanographic Commission,1994, see related publications). Measurements were made in triplicate and averaged.

The pCO2 of each batch was monitored from the outflow gas during bottling using a LiCor 865. The value is the average (at room temperature) during bottling. Standard Operating Procedures were NOT followed and the accuracy of the values is unknown. They are provided for reference only and not intended for use in calculations.

BCO-DMO Processing Description

* Adjusted headers to comply with database requirements

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Data Files

File
905357_v1_measuredph.csv(Comma Separated Values (.csv), 18.30 KB) MD5:4ac14585e23ec70b171225bb18302995 Primary datafile for dataset 905357

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Related Publications

Intergovernmental Oceanographic Commission (1994) Protocols for the Joint Global Ocean Flux Study (JGOFS) Core Measurements. Paris, France, UNESCO-IOC, 170pp. (Intergovernmental Oceanographic Commission Manuals and Guides: 29), (JGOFS Report; 19). DOI: https://doi.org/10.25607/OBP-1409
Methods

Strickland, J. D. H. and Parsons, T. R. (1972). A Practical Hand Book of Seawater Analysis. Fisheries Research Board of Canada Bulletin 157, 2nd Edition, 310 p.
Methods

Woosley, R. J., & Moon, J.-Y. (2023). Re-evaluation of carbonic acid dissociation constants across conditions and the implications for ocean acidification. Marine Chemistry, 250, 104247. https://doi.org/10.1016/j.marchem.2023.104247
Results

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Related Datasets

IsDerivedFrom

Woosley, R. (2023) **Raw pH data acquired during the pH internal consistency experiment.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-07-28 doi:10.26008/1912/bco-dmo.905235.1 [view at BCO-DMO]
Relationship Description: Summary table with averages based on the raw data.

Woosley, R. (2023) **Total alkalinity and dissolved inorganic carbon data measured during the pH**

internal consistency experiment. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-07-31 doi:10.26008/1912/bco-dmo.905278.1 [view at BCO-DMO]
Relationship Description: The "Measured pH and nutrients" dataset contains average values of the TA and DIC variables.

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Parameters

Parameter	Description	Units
Batch	Seawater batch number	unitless
Practical_Salinity	Salinity	unitless
Temp	Temperature	degrees Celsius (˚C)
meas_pHt	measured pH on the total scale	unitless
pHt_std_err	standard error of pHt	unitless
meas_TA	measured total alkalinity	micromoles per kilogram (µmol/kg)
TA_std	standard deviation of total alkalinity	micromoles per kilogram (µmol/kg)
meas_DIC	measured dissolved inorganic carbon	micromoles per kilogram (µmol/kg)
DIC_std	standard deviation of Dissolved inorganic carbon	micromoles per kilogram (µmol/kg)
equilibrator_pCO2	aproximate batch pCO2	microatmospheres (µatm)
PO4	reactive phosporus	micromoles per kilogram (µmol/kg)
PO4_stdev	standard deviation of reactive phosphorus	micromoles per kilogram (µmol/kg)
Si	reactive silicate	micromoles per kilogram (µmol/kg)
Si_stdev	standard deviatin of reactive silicate	micromoles per kilogram (µmol/kg)

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Project Information

Improving Accuracy and Precision of Marine Inorganic Carbon Measurements (Inorganic Carbon Meaurements)

Coverage: Lab studies

NSF Award Abstract:
The oceans absorb about one third of the CO2 humans release into the atmosphere from the burning of fossil fuels and other activities. While ocean uptake of CO2 slows its rate of increase in the atmosphere, it comes with costs for the oceans and the organisms that live there. Once in seawater, CO2 reacts with water to produce bicarbonate and hydrogen ions. The increase in hydrogen ions lowers the pH in a process called ocean acidification. Not all areas of the ocean are affected equally. The solubility of CO2 is greater in the cold waters of the Arctic making them more prone to ocean acidification. However, due to the low temperatures and low salinities in the Arctic, the uncertainties in pH values are much larger there than for the other oceans. This project evaluates pH at low temperatures and salinities, and develops best practice recommendations to improve the ability to compare measurements among laboratory groups and studies and reduce overall uncertainty in the measurements. The project provides training for an undergraduate student and promotes awareness of ocean acidification through public outreach.

Having highly accurate and precise measurements are important for monitoring changes to pH and CO2 uptake through time and the effects on marine life. In order to improve pH measurements for polar waters, several different experiments will be conducted. The temperature dependence of pH will be determined from 30˚C to near freezing for low salinity waters. The results will be compared to current chemical models to quantify offsets and biases. Recommendations will be made for the best physical chemical model to use for low temperature and salinity seawater. Moreover, pH is measured spectrophotometrically using an indicator dye. Preparation and calibration of the indictor is important to standardize studies across space and time and ensure comparability. Indicator quality is essential for detecting ocean acidification, but its stability is currently unknown. If the dye degrades after production, biases or artifacts in pH measurements may result as the dye ages. Experiments will be undertaken using batches of dyes from weeks to over 10 years old to resolve its degradation characteristics. The experiments will establish how long a batch of dye remains valid once it is prepared without biasing the measurements. This is particularly important for long term studies such as extended research expeditions and autonomous systems where a batch of dye may be used over a year. Together, by both investigating the validity of chemical models for seawater pH at low temperature and salinity and examining the stability of the pH indicator dye, methodological uncertainties can be reduced to permit better monitoring of changes in global ocean pH.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1923312

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