Total alkalinity and dissolved inorganic carbon data measured during the pH internal consistency experiment.

Website: https://www.bco-dmo.org/dataset/905278
Data Type: experimental
Version: 1
Version Date: 2023-07-31

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

Contributors	Affiliation	Role
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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

Oligotrophic Atlantic surface seawater was collected from 39° 46.406′ N and 70° 53.065′ W on October 10, 2019.

The surface seawater was modified to five different salinities and 5 different pCO2 values for a total of 25 batches. Salinity was modified through dilution or evaporation. pCO2 was modified by bubbling CO2 gas of different pCO2 concentrations (balance air).

The water was then bottled and sealed into 250 mL borosilicate glass bottles following SOPs (Dickson et al. 2007). Each batch consisted of 44 bottles.

Data Processing Description

Total Alkalinity was measured by open cell HCl titration following SOP (Dickson et al. 2007)

Dissolved inorganic carbon was measured by coulometry following SOP (Dickson et al. 2007)

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Data Files

File
905278_v1_ta_dic.csv(Comma Separated Values (.csv), 2.41 KB) MD5:bb79044f2152c9c697f2ca4478c04c89 Primary datafile for dataset 905278.

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Related Publications

Dickson, A.G.; Sabine, C.L. and Christian, J.R. (eds) (2007) Guide to best practices for ocean CO2 measurement. Sidney, British Columbia, North Pacific Marine Science Organization, 191pp. (PICES Special Publication 3; IOCCP Report 8). DOI: https://doi.org/10.25607/OBP-1342
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

IsRelatedTo

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: Data is part of the same experiment.

IsSourceOf

Woosley, R. (2023) **Measured pH and nutrient data acquired during the pH internal consistency experiment.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-08-01 doi:10.26008/1912/bco-dmo.905357.1 [view at BCO-DMO]
Relationship Description: The "TA & DIC" dataset contains the raw values for the "measured pH and nutrients" dataset.

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Parameters

Parameter	Description	Units
Batch	Seawater batch number	unitless
Practical_Salinity	Salinity	unitless
meas_TA	measured total alkalinity	micromoles per kilogram (µmol/kg)
meas_DIC	measured dissolved inorganic carbon	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 CO_2 humans release into the atmosphere from the burning of fossil fuels and other activities. While ocean uptake of CO_2 slows its rate of increase in the atmosphere, it comes with costs for the oceans and the organisms that live there. Once in seawater, CO_2 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 CO_2 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 CO_2 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