Carbonate chemistry data gridded to 4 degree latitude by 5 degree longitude by monthly boxes in the global model from 2011-2013 (Climatological Mean Distribution of pH project)

Website: https://www.bco-dmo.org/dataset/3961
Version:
Version Date: 2013-06-10

Project
» Climatological Mean Distribution of pH in Surface Waters in the Unified pH Scale and Mean Rate of changes in Selected Areas (Climatological Mean Distribution of pH)

Program
» Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES): Ocean Acidification (formerly CRI-OA) (SEES-OA)

Contributors	Affiliation	Role
Takahashi, Taro	Lamont-Doherty Earth Observatory (LDEO)	Principal Investigator
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Dataset Description

Carbonate chemistry data gridded to 4 degree latitude by 5 degree longitude by monthly grid in the reference year 2005.

For detailed information, see final report.

Associated dataset: LDEO global surface ocean carbon.

Maps of global estimated pH

Methods & Sampling

Gridded data for salinity, sea surface temperature, nitrate, phosphate, and silicate were regridded to our 4 degree latitude by 5 degree longitude grid. pCO2 were interpolated to the same grid in the manner described in the Final Report by Taro Takahashi to NSF for Grant OCE-10-38891 'Climatological Mean Distribution in the Global Ocean Surface Waters in the Unified pH Scale and Mean Rate of Their Changes in Selected Areas' (Dec. 31, 2012) pp. 34. The method will be described in detail in a paper in preparation.

Data Processing Description

Working on a 4 degree latitude by 5 degree longitude by monthly grid, Potential Alkalinity (PALK) was calculated using a series of linear equations relating PALK to salinity. Total alkalinity was obtained by removing the nitrate component of PALK using climatological data. TCO2 was calculated from Total Alkalinity, and pCO2 using an updated global pCO2 map. The other carbonate chemistry values such as pH, CO3=, calcite and aragonite saturation were calculated at the same time as TCO2.

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Data Files

File
pH_grid.csv (Comma Separated Values (.csv), 2.35 MB) MD5:94ef71f7de17d1db45f68f968bf56869 Primary data file for dataset ID 3961

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Parameters

Parameter	Description	Units
month	Calendar month, e.g. 1 = Jan, 2=Feb	
lat	Latitude; North is positive	decimal degrees
lon_360	Longitude of the center point of the box in degrees East (i.e. 75 degrees W = -75 + 360 = 285)	decimal degrees
lon	Longitude; East is positive	decimal degrees
slope	Slope of linear relation between Salinity and Potential Alkalinity	unitless
intercept	Intercept of linear relation between Salinity and Potential Alkalinity	unitless
temp_ss	Climatological Sea Surface Temperature	degrees Celsius
sal	Climatological Sea Surface Salinity (Practical Salinity Scale)	unitless
PALK	Potential Alkalinity. PALK = Total Alkalinity + Nitrate estimated from salinity: PALK = SLOPE * Salinity + INTERCEPT	microequivalents per kilogram seawater
NO3	Climatological Nitrate	micromoles per kilogram seawater
PO4	Climatological Phosphate	micromoles per kilogram seawater
SIO3	Climatological Silicate	micromoles per kilogram seawater
TALK	Total Alkalinity calculated from Potential Alkalinity: TALK = PALK - NO3	microequivalents per kilogram seawater
PCO2_SST	Partial Pressure of CO2 at sea surface temperature; adjusted to year 2005	microatmospheres
TCO2	Total CO2 calculated from TALK and pCO2	micromoles per kilogram seawater
CO3	Carbonite ion concentration	micromoles per kilogram seawater
pH	Total hydrogen ion concentration scale	unitless
HION	Total hydrogen ion concentration	10^-9 moles per kilogram seawater
OMGARAG	Degree of saturation (Omega) of Aragonite	unitless
OMGCALC	Degree of saturation (Omega) of Calcite	unitless

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Deployments

Takahashi_LDEO

Website	https://www.bco-dmo.org/deployment/59042
Platform	LDEO
Start Date	2011-01-01
End Date	2013-12-31

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Project Information

Climatological Mean Distribution of pH in Surface Waters in the Unified pH Scale and Mean Rate

of changes in Selected Areas (Climatological Mean Distribution of pH)

In this project, researchers at the Lamont-Doherty Earth Observatory of Columbia University will obtain the global distribution of surface ocean pH in a single unified scale based on the observations for pCO2, total alkalinity and total CO2 ion concentration (DIC) in surface waters. They will utilize three decades of their own pCO2 and DIC data, which are based on David Keeling's (and successor Pieter Tans at ERL/NOAA) WMO manometric CO2 standard, and the well-calibrated alkalinity data from the WOCE program (Dickson et al., 2003) and the time-series stations including BATS, HOT and ESTOC. These data will allow establishment of a global ocean pH and carbonate concentration baseline anchored firmly to the international CO2 standards common to the atmospheric and oceanic CO2 measurements. The pCO2 and DIC data obtained in different years will be corrected to a reference year 2000, and a climatological distribution of monthly mean pH in the total hydrogen ion scale and carbonate ion concentrations will be computed using the dissociation constants for carbonic and boric acids of Lueker et al. (2000) and Dickson (1990). This will serve as a world ocean baseline distribution for the characterization of future ocean acidification. In some data-rich areas of the North Atlantic, North Pacific and Southern Ocean, the rate of change will be demonstrated.

Because of calibration problems associated with direct pH measurements, an observation-based global ocean pH distribution map is not possible; presently the information is based on ocean GCM studies without land interactions. The research team's ongoing analysis of the alkalinity data shows, however, that its distribution differs from the open oceans in the broad regions of land interactions such as in the Bay of Bengal, Arabian Sea, Gulf of Alaska and Bering Sea. This suggests that the model results are biased by the omission of rivers and land interactions. The results of our proposed investigation will be used for the validation of global biogeochemical ocean models and will help to place the global ocean acidification study on a much firmer base.

Broader Impacts: Baseline information is needed for accurate characterization of global environmental changes. The purpose of this study is to provide a global surface ocean baseline for pH and carbonate ion concentration in waters computed in a uniform pH scale using an extensive pCO2, alkalinity and DIC database obtained for past several decades. This should serve as a reference level, against which the future and past changes may be referenced.

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Program Information

Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES): Ocean Acidification (formerly CRI-OA) (SEES-OA)

Website: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503477

Coverage: global

NSF Climate Research Investment (CRI) activities that were initiated in 2010 are now included under Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES). SEES is a portfolio of activities that highlights NSF's unique role in helping society address the challenge(s) of achieving sustainability. Detailed information about the SEES program is available from NSF (https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504707).

In recognition of the need for basic research concerning the nature, extent and impact of ocean acidification on oceanic environments in the past, present and future, the goal of the SEES: OA program is to understand (a) the chemistry and physical chemistry of ocean acidification; (b) how ocean acidification interacts with processes at the organismal level; and (c) how the earth system history informs our understanding of the effects of ocean acidification on the present day and future ocean.

Solicitations issued under this program:
NSF 10-530, FY 2010-FY2011

NSF 12-500, FY 2012
NSF 12-600, FY 2013
NSF 13-586, FY 2014
NSF 13-586 was the final solicitation that will be released for this program.

PI Meetings:
1st U.S. Ocean Acidification PI Meeting(March 22-24, 2011, Woods Hole, MA)
2nd U.S. Ocean Acidification PI Meeting(Sept. 18-20, 2013, Washington, DC)
3rd U.S. Ocean Acidification PI Meeting (June 9-11, 2015, Woods Hole, MA – Tentative)

NSF media releases for the Ocean Acidification Program:

Press Release 10-186 NSF Awards Grants to Study Effects of Ocean Acidification

Discovery Blue Mussels "Hang On" Along Rocky Shores: For How Long?

Discovery nsf.gov - National Science Foundation (NSF) Discoveries - Trouble in Paradise: Ocean Acidification This Way Comes - US National Science Foundation (NSF)

Press Release 12-179 nsf.gov - National Science Foundation (NSF) News - Ocean Acidification: Finding New Answers Through National Science Foundation Research Grants - US National Science Foundation (NSF)

Press Release 13-102 World Oceans Month Brings Mixed News for Oysters

Press Release 13-108 nsf.gov - National Science Foundation (NSF) News - Natural Underwater Springs Show How Coral Reefs Respond to Ocean Acidification - US National Science Foundation (NSF)

Press Release 13-148 Ocean acidification: Making new discoveries through National Science Foundation research grants

Press Release 13-148 - Video nsf.gov - News - Video - NSF Ocean Sciences Division Director David Conover answers questions about ocean acidification. - US National Science Foundation (NSF)

Press Release 14-010 nsf.gov - National Science Foundation (NSF) News - Palau's coral reefs surprisingly resistant to ocean acidification - US National Science Foundation (NSF)

Press Release 14-116 nsf.gov - National Science Foundation (NSF) News - Ocean Acidification: NSF awards $11.4 million in new grants to study effects on marine ecosystems - US National Science Foundation (NSF)

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1038891

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