

# Carbonate chemistry and isotopes from multiple M/V OOCL Tianjin and M/V OOCL Tokyo cruises between Hong Kong and Long Beach in the Pacific Basin from 2008-2012 (NPac Cont Ship project)

**Website:** <https://www.bco-dmo.org/dataset/665195>

**Data Type:** Cruise Results

**Version:**

**Version Date:** 2016-11-21

## Project

» [North Pacific Surface Carbon, Oxygen and Isotope Measurements from Container Ships \(2008-\)](#) (NPac Cont Ship)

Contributors	Affiliation	Role
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## Coverage

**Spatial Extent:** N:49.67 E:-120 S:22.133 W:120

**Temporal Extent:** 2008-10-06 - 2012-12-11

## Dataset Description

This dataset includes dissolved inorganic carbon (DIC),  $\delta^{13}\text{C}$ -DIC, and total alkalinity (TA). Samples were collected during transects across the Pacific Ocean from Hong Kong to Long Beach, CA on commercial container ships starting in 2008.

**Related Dataset:** [O<sub>2</sub>/Ar and triple oxygen isotopes](#)

## Methods & Sampling

Samples for carbonate chemistry analysis were collected from shipboard seawater intake (10 m depth) on basin-wide transects of the North Pacific between Hong Kong and Long Beach, California onboard the M/V OOCL Tianjin and the M/V OOCL Tokyo (each individual transect has a unique Cruise ID). Sea surface temperature and salinity at the time of sample collection were determined using a Sea-Bird Electronics SBE45 thermosalinograph installed in the ship's seawater intake. To prevent biofouling that could cause respiration in the ship's seawater lines [Juraneck *et al.*, 2010], intake lines between the anticorrosive sea chest and the

sampling port were purged with bleach and freshwater between every cruise.

Samples for both dissolved inorganic carbon (DIC) and total alkalinity (TA) analysis were collected into 250 mL bottles with greased ground glass stoppers and poisoned with 100  $\mu\text{L}$  of saturated mercuric chloride solution. DIC concentrations were determined in the laboratory through a combination of manometric measurements (DIC\_SIL, *Quay and Stutsman*, 2003) and measurements with an Apollo SciTech AS-C3 IR-based DIC analyzer (DIC\_IR). Certified reference materials (Andrew Dickson, UCSD) were used for calibration and determination of sample-specific measurement error for all DIC measurements using the AS-C3 analyzer (DIC\_IR\_uncert), with mean uncertainty of  $\pm 4 \mu\text{mol kg}^{-1}$  for the entire dataset. Comparison of duplicate samples analyzed both manometrically and with the AS-C3 analyzer ( $n = 111$ ) agree to within  $1 \pm 9 \mu\text{mol kg}^{-1}$  and indicate uncertainty of  $\pm 8 \mu\text{mol kg}^{-1}$  in the manometric measurements (DIC\_SIL).  $\delta^{13}\text{C}$  of the DIC samples measured manometrically was determined following the methods detailed in *Quay and Stutsman* (2003). TA samples were measured using an automated, open-cell potentiometric titration system (*Dickson et al.*, [2007]; SOP 3b), with sample-specific measurement error quantified based on certified reference materials (Andrew Dickson, UCSD) measured with each sample batch (TA\_uncert, mean uncertainty of  $\pm 2 \mu\text{eq kg}^{-1}$  for the entire dataset).

## Data Processing Description

Data are only reported for samples that meet quality control standards (any with problems in the laboratory extraction and measurement process have been omitted in the data spreadsheet).

### BCO-DMO Processing:

- added conventional header with dataset name, PI name, version date, reference information
- renamed parameters to BCO-DMO standard
- split date/time into two columns
- reformatted date from m/d/yyyy to yyyy-mm-dd
- replaced blank cells with nd (no data)

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## Data Files

File
<b>carbonate_chemistry.csv</b> (Comma Separated Values (.csv), 99.12 KB) MD5:b4f2b5cf77b933a03f99dadcf813ac1
Primary data file for dataset ID 665195

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## Related Publications

Dickson, A.G., Sabine, C.L. and Christian, J.R. (Eds.) 2007. Guide to Best Practices for Ocean CO<sub>2</sub> Measurements. PICES Special Publication 3, 191 pp <https://isbnsearch.org/isbn/1-897176-07-4>  
*Methods*

Juranek, L. W., Hamme, R. C., Kaiser, J., Wanninkhof, R., & Quay, P. D. (2010). Evidence of O<sub>2</sub> consumption in underway seawater lines: Implications for air-sea O<sub>2</sub> and CO<sub>2</sub> fluxes. *Geophysical Research Letters*, 37(1), n/a–n/a. doi:10.1029/2009gl040423 <https://doi.org/10.1029/2009GL040423>  
*Methods*

Quay, P., & Stutsman, J. (2003). Surface layer carbon budget for the subtropical N. Pacific: constraints at station ALOHA. *Deep Sea Research Part I: Oceanographic Research Papers*, 50(9), 1045–1061. doi:10.1016/s0967-0637(03)00116-x [https://doi.org/10.1016/S0967-0637\(03\)00116-X](https://doi.org/10.1016/S0967-0637(03)00116-X)  
*Methods*

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## Parameters

Parameter	Description	Units
cruise_id	cruise identification	unitless
station	station number	unitless
date	date; UTC	yyyy-mm-dd
time	time; UTC	HH:MM
sal	sea surface salinity	PSU
temp	sea surface temperature	degrees Celsius
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
yrday_utc	UTC day and decimal time. e.g. 326.5 for the 326th day of the year or November 22 at 1200 hours (noon)	days
ISO_DateTime_UTC	UTC time formatted as ISO 8601:2004 standard YYYY-mm-ddTHH:MM:SS[.xx]Z	year-month-day-hour-minute-second
DIC_Sil	dissolved inorganic carbon measured manometrically	micromolar/kilogram (umol/kg)
del13C_DIC	Carbon 13 to Carbon 12 ratio of DIC: $1000 * [(13C/12C)_{sample} - (13C/12C)_{standard}] / (13C/12C)_{standard}$	per mil
TAlk	total alkalinity	micro-microequivalents/kilogram (ueq/kg)
TAlk_uncert	sample batch specific measurement uncertainty	micro-microequivalents/kilogram (ueq/kg)
DIC_IR	dissolved inorganic carbon measured with an Apollo SciTech AS-C3 analyzer	micromolar/kilogram (umol/kg)
DIC_IR_uncert	sample batch specific measurement uncertainty	micromolar/kilogram (umol/kg)

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## Instruments

<b>Dataset-specific Instrument Name</b>	automated, open-cell potentiometric titration system
<b>Generic Instrument Name</b>	Automatic titrator
<b>Dataset-specific Description</b>	To measure total alkalinity
<b>Generic Instrument Description</b>	Instruments that incrementally add quantified aliquots of a reagent to a sample until the end-point of a chemical reaction is reached.

<b>Dataset-specific Instrument Name</b>	Apollo SciTech AS-C3 IR-based DIC analyzer
<b>Generic Instrument Name</b>	CO2 Analyzer
<b>Dataset-specific Description</b>	To measure dissolved inorganic carbon (DIC) and total alkalinity.
<b>Generic Instrument Description</b>	Measures atmospheric carbon dioxide (CO2) concentration.

<b>Dataset-specific Instrument Name</b>	Finnigan MAT 251
<b>Generic Instrument Name</b>	Mass Spectrometer
<b>Dataset-specific Description</b>	To measure del13C-DIC
<b>Generic Instrument Description</b>	General term for instruments used to measure the mass-to-charge ratio of ions; generally used to find the composition of a sample by generating a mass spectrum representing the masses of sample components.

<b>Dataset-specific Instrument Name</b>	
<b>Generic Instrument Name</b>	Sea-Bird SBE 45 MicroTSG Thermosalinograph
<b>Generic Instrument Description</b>	A small externally powered, high-accuracy instrument, designed for shipboard determination of sea surface (pumped-water) conductivity and temperature. It is constructed of plastic and titanium to ensure long life with minimum maintenance. It may optionally be interfaced to an external SBE 38 hull temperature sensor. Sea Bird SBE 45 MicroTSG (Thermosalinograph)

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## Deployments

### TJ1

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/626889">https://www.bco-dmo.org/deployment/626889</a>
<b>Platform</b>	OOCL Tianjin
<b>Start Date</b>	2008-10-06
<b>End Date</b>	2008-10-17
<b>Description</b>	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

### TJ2

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/626891">https://www.bco-dmo.org/deployment/626891</a>
<b>Platform</b>	OOCL Tianjin
<b>Start Date</b>	2008-11-13
<b>End Date</b>	2008-11-21
<b>Description</b>	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

### TJ3

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/626893">https://www.bco-dmo.org/deployment/626893</a>
<b>Platform</b>	OOCL Tianjin
<b>Start Date</b>	2008-11-27
<b>End Date</b>	2008-12-11
<b>Description</b>	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

#### TJ4

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/626896">https://www.bco-dmo.org/deployment/626896</a>
<b>Platform</b>	OOCL Tianjin
<b>Start Date</b>	2009-01-20
<b>End Date</b>	2009-01-30
<b>Description</b>	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

#### TJ5

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/626897">https://www.bco-dmo.org/deployment/626897</a>
<b>Platform</b>	OOCL Tianjin
<b>Start Date</b>	2009-04-01
<b>End Date</b>	2009-04-10
<b>Description</b>	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

#### TJ6

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/626898">https://www.bco-dmo.org/deployment/626898</a>
<b>Platform</b>	OOCL Tianjin
<b>Start Date</b>	2009-09-24
<b>End Date</b>	2009-09-27
<b>Description</b>	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

#### TJ7

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/626900">https://www.bco-dmo.org/deployment/626900</a>
<b>Platform</b>	OOCL Tianjin
<b>Start Date</b>	2009-10-28
<b>End Date</b>	2009-11-07
<b>Description</b>	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

#### TJ9

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/626904">https://www.bco-dmo.org/deployment/626904</a>
<b>Platform</b>	OOCL Tianjin
<b>Start Date</b>	2010-02-13
<b>End Date</b>	2012-02-21
<b>Description</b>	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

#### Tianjin\_1

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/626918">https://www.bco-dmo.org/deployment/626918</a>
<b>Platform</b>	OOCL Tianjin
<b>Start Date</b>	2012-04-30
<b>End Date</b>	2012-05-13
<b>Description</b>	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

#### Tianjin\_2

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/626920">https://www.bco-dmo.org/deployment/626920</a>
<b>Platform</b>	OOCL Tianjin
<b>Start Date</b>	2012-07-24
<b>End Date</b>	2012-08-06
<b>Description</b>	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

#### Tianjin\_3

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/626922">https://www.bco-dmo.org/deployment/626922</a>
<b>Platform</b>	OOCL Tianjin
<b>Start Date</b>	2012-11-28
<b>End Date</b>	2012-12-11
<b>Description</b>	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

#### Tokyo\_0

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/626906">https://www.bco-dmo.org/deployment/626906</a>
<b>Platform</b>	OOCL Tokyo
<b>Start Date</b>	2011-02-23
<b>End Date</b>	2011-03-07
<b>Description</b>	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

#### Tokyo\_1

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/626908">https://www.bco-dmo.org/deployment/626908</a>
<b>Platform</b>	OOCL Tokyo
<b>Start Date</b>	2011-05-16
<b>End Date</b>	2011-05-29
<b>Description</b>	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

#### Tokyo\_2

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/626910">https://www.bco-dmo.org/deployment/626910</a>
<b>Platform</b>	OOCL Tokyo
<b>Start Date</b>	2011-06-27
<b>End Date</b>	2011-07-10
<b>Description</b>	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

#### Tokyo\_3

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/626912">https://www.bco-dmo.org/deployment/626912</a>
<b>Platform</b>	OOCL Tokyo
<b>Start Date</b>	2011-09-20
<b>End Date</b>	2011-10-02
<b>Description</b>	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

#### Tokyo\_4

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/626914">https://www.bco-dmo.org/deployment/626914</a>
<b>Platform</b>	OOCL Tokyo
<b>Start Date</b>	2012-01-25
<b>End Date</b>	2012-02-06
<b>Description</b>	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

#### TJ8

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/626902">https://www.bco-dmo.org/deployment/626902</a>
<b>Platform</b>	OOCL Tianjin
<b>Start Date</b>	2009-12-03
<b>End Date</b>	2009-12-12
<b>Description</b>	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

## Project Information

### North Pacific Surface Carbon, Oxygen and Isotope Measurements from Container Ships (2008-) (NPac Cont Ship)

**Coverage:** Transects across the North Pacific from Hong Kong to Long Beach, California, USA; ~25-50N, 115E-120W

This project is an ongoing time-series beginning in 2008 of measurements relevant to ocean carbon cycling and productivity on basin-wide container ship transects across the North Pacific from Hong Kong to Long Beach, California, with transects made throughout the seasonal cycle beginning in October 2008. The goal of this project is to improve our understanding of the rates and mechanisms of ocean carbon uptake from the atmosphere throughout the seasonal cycle and across spatial gradients across the basin. Sampling includes both discrete samples and continuous underway measurements. Tracers sampled in this program include triple oxygen isotopes ( $\delta^{17}O$  and  $\delta^{18}O$ ), a tracer of gross primary production, oxygen/argon dissolved gas ratios, a tracer of net community production or carbon export, and carbonate system parameters ( $pCO_2$ , total alkalinity, DIC, and  $^{13}C$ -DIC) as tracers of ocean carbon uptake and carbon cycling.

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## Funding

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-0628663</a>
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1259055</a>
NOAA Oceanic and Atmospheric Research (OAR) Climate Program Office (NOAA OAR Climate Program)	<a href="#">A10OAR4310088</a>

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