

# DIC and del13C-DIC from nine M/S Columbus Waikato cruises between New Zealand and Long Beach, CA in the Pacific Basin from 2004-2006

**Website:** <https://www.bco-dmo.org/dataset/700907>

**Data Type:** Cruise Results

**Version:** 1

**Version Date:** 2017-05-24

## Project

» [Time-Series Measurements of the 13C/12C of Dissolved Inorganic Carbon](#) (13C/12C DIC Time-Series)

Contributors	Affiliation	Role
<a href="#">Quay, Paul</a>	University of Washington (UW)	Principal Investigator, Contact
<a href="#">Juranek, Laurie</a>	Oregon State University (OSU-CEOAS)	Co-Principal Investigator
<a href="#">Rauch, Shannon</a>	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

## Abstract

Carbonate chemistry and isotopes from nine M/S Columbus Waikato cruises between New Zealand and Long Beach, CA in the Pacific Basin from 2004-2006. This dataset includes dissolved inorganic carbon (DIC), and del13C-DIC.

---

## Table of Contents

- [Coverage](#)
  - [Dataset Description](#)
    - [Methods & Sampling](#)
    - [Data Processing Description](#)
  - [Data Files](#)
  - [Related Publications](#)
  - [Parameters](#)
  - [Instruments](#)
  - [Deployments](#)
  - [Project Information](#)
  - [Funding](#)
- 

## Coverage

**Spatial Extent:** N:46.4 E:179.7 S:-39.11 W:-179.93

**Temporal Extent:** 2004-03-03 - 2005-10-08

---

## Dataset Description

Carbonate chemistry and isotopes from nine M/S Columbus Waikato cruises between New Zealand and Long Beach, CA in the Pacific Basin from 2004-2006. This dataset includes dissolved inorganic carbon (DIC), and del13C-DIC.

## Methods & Sampling

**Shipboard Sample Collection Methods:** Samples were collected in pre-washed and baked 250 ml ground glass stoppered bottles that were poisoned with 100 ul of a saturated HgCl<sub>2</sub> solution. The stored sealed samples were returned to the Stable Isotope Laboratory at the University of Washington for extraction and measurement.

**Laboratory Methods:** CO<sub>2</sub> was extracted from the DIC seawater samples using a modification of the helium stripping technique described in Quay and Stutsman (2003). The  $\delta^{13}\text{C}$  is measured on a Thermo Finnigan MAT 253 mass spectrometer.

## 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). Blank cells have been replaced with nd (no data).

BCO-DMO Data Processing:

- re-formatted time to HHMM;
- modified parameter names to conform with BCO-DMO naming conventions (replaced hyphens with underscores);
- added ISO\_DateTime\_UTC using original date and time fields.

[ [table of contents](#) | [back to top](#) ]

---

## Data Files

File
<b>Waikato_carbon.csv</b> (Comma Separated Values (.csv), 34.21 KB) MD5:f744da5125126171be08cb08b165e4a1
Primary data file for dataset ID 700907

[ [table of contents](#) | [back to top](#) ]

---

## Related Publications

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*

[ [table of contents](#) | [back to top](#) ]

---

## Parameters

Parameter	Description	Units
SIL_cruise_id	UW Stable Isotope Lab cruise identification	unitless
PMEL_cruise_id	NOAA Pacific Marine Environmental Lab cruise identification	unitless
ISO_DateTime_UTC	Date and time (UTC) formatted to ISO8601 standard (yyyy-mm-ddTHH:MM:SSxx)	unitless
date	Year, month, and day (UTC) in yyyy-mm-dd format	unitless
time	Time (UTC) in HHMM format	unitless
lat	Latitude; north is positive	decimal degrees
lon	Longitude; east is positive	decimal degrees
DIC	Dissolved inorganic carbon measured manometrically	micromoles/kilogram (umol/kg)
d13C_DIC	Carbon 13 to Carbon 12 ratio of DIC: $1000 * [(13C/12C)_{sample} - (13C/12C)_{standard}] / (13C/12C)_{standard}$	per mil

[ [table of contents](#) | [back to top](#) ]

---

## Instruments

<b>Dataset-specific Instrument Name</b>	Thermo Finnigan MAT 253 mass spectrometer
<b>Generic Instrument Name</b>	Isotope-ratio Mass Spectrometer
<b>Dataset-specific Description</b>	del13C was measured on a Thermo Finnigan MAT 253 mass spectrometer.
<b>Generic Instrument Description</b>	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).

[ [table of contents](#) | [back to top](#) ]

---

## Deployments

CW2004\_02

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/701003">https://www.bco-dmo.org/deployment/701003</a>
<b>Platform</b>	M/S Columbus Waikato
<b>Report</b>	<a href="http://dmoserv3.who.edu/data_docs/DIC_Time-Series/cw2004_02_Readme.pdf">http://dmoserv3.who.edu/data_docs/DIC_Time-Series/cw2004_02_Readme.pdf</a>
<b>Start Date</b>	2004-03-03
<b>End Date</b>	2004-03-18
<b>Description</b>	In 2004, PMEL installed an underway pCO <sub>2</sub> system on the container ship Columbus Waikato to monitor atmospheric and surface water CO <sub>2</sub> concentrations as the ship traversed the Pacific Ocean from the western united states to New Zealand. In the time period between Feb 2004 and Feb 2006, 13 data sets were along this ship track. In March, 2006, the ship changed it's route to as well as it's name. The ship is now the Cap Victor. More information: Columbus Waikato/Cap Victor Master Readme File (Both the readme file and cruise report were obtained from <a href="https://www.pmel.noaa.gov/co2/uwpc2/waikato_data.html">https://www.pmel.noaa.gov/co2/uwpc2/waikato_data.html</a> and converted to PDF)

#### CW2004\_06

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/701004">https://www.bco-dmo.org/deployment/701004</a>
<b>Platform</b>	M/S Columbus Waikato
<b>Report</b>	<a href="http://dmoserv3.who.edu/data_docs/DIC_Time-Series/cw2004_06_Readme.pdf">http://dmoserv3.who.edu/data_docs/DIC_Time-Series/cw2004_06_Readme.pdf</a>
<b>Start Date</b>	2004-06-10
<b>End Date</b>	2004-06-23
<b>Description</b>	In 2004, PMEL installed an underway pCO <sub>2</sub> system on the container ship Columbus Waikato to monitor atmospheric and surface water CO <sub>2</sub> concentrations as the ship traversed the Pacific Ocean from the western united states to New Zealand. In the time period between Feb 2004 and Feb 2006, 13 data sets were along this ship track. In March, 2006, the ship changed it's route to as well as it's name. The ship is now the Cap Victor. More information: Columbus Waikato/Cap Victor Master Readme File (Both the readme file and cruise report were obtained from <a href="https://www.pmel.noaa.gov/co2/uwpc2/waikato_data.html">https://www.pmel.noaa.gov/co2/uwpc2/waikato_data.html</a> and converted to PDF)

#### CW2004\_09

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/701007">https://www.bco-dmo.org/deployment/701007</a>
<b>Platform</b>	M/S Columbus Waikato
<b>Report</b>	<a href="http://dmoserv3.who.edu/data_docs/DIC_Time-Series/cw2004_09_Readme.pdf">http://dmoserv3.who.edu/data_docs/DIC_Time-Series/cw2004_09_Readme.pdf</a>
<b>Start Date</b>	2004-09-20
<b>End Date</b>	2004-10-04
<b>Description</b>	In 2004, PMEL installed an underway pCO <sub>2</sub> system on the container ship Columbus Waikato to monitor atmospheric and surface water CO <sub>2</sub> concentrations as the ship traversed the Pacific Ocean from the western united states to New Zealand. In the time period between Feb 2004 and Feb 2006, 13 data sets were along this ship track. In March, 2006, the ship changed it's route to as well as it's name. The ship is now the Cap Victor. More information: Columbus Waikato/Cap Victor Master Readme File (Both the readme file and cruise report were obtained from <a href="https://www.pmel.noaa.gov/co2/uwpc2/waikato_data.html">https://www.pmel.noaa.gov/co2/uwpc2/waikato_data.html</a> and converted to PDF)

#### CW2005\_02

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/701012">https://www.bco-dmo.org/deployment/701012</a>
<b>Platform</b>	M/S Columbus Waikato
<b>Report</b>	<a href="http://dmoserv3.who.edu/data_docs/DIC_Time-Series/cw2005_02_Readme.pdf">http://dmoserv3.who.edu/data_docs/DIC_Time-Series/cw2005_02_Readme.pdf</a>
<b>Start Date</b>	2005-02-16
<b>End Date</b>	2005-02-28
<b>Description</b>	In 2004, PMEL installed an underway pCO <sub>2</sub> system on the container ship Columbus Waikato to monitor atmospheric and surface water CO <sub>2</sub> concentrations as the ship traversed the Pacific Ocean from the western united states to New Zealand. In the time period between Feb 2004 and Feb 2006, 13 data sets were along this ship track. In March, 2006, the ship changed it's route to as well as it's name. The ship is now the Cap Victor. More information: Columbus Waikato/Cap Victor Master Readme File (Both the readme file and cruise report were obtained from <a href="https://www.pmel.noaa.gov/co2/uwpc02/waikato_data.html">https://www.pmel.noaa.gov/co2/uwpc02/waikato_data.html</a> and converted to PDF)

#### CW2005\_04

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/701081">https://www.bco-dmo.org/deployment/701081</a>
<b>Platform</b>	M/S Columbus Waikato
<b>Report</b>	<a href="http://dmoserv3.who.edu/data_docs/DIC_Time-Series/cw2005_04_Readme.pdf">http://dmoserv3.who.edu/data_docs/DIC_Time-Series/cw2005_04_Readme.pdf</a>
<b>Start Date</b>	2005-04-06
<b>End Date</b>	2005-04-17
<b>Description</b>	In 2004, PMEL installed an underway pCO <sub>2</sub> system on the container ship Columbus Waikato to monitor atmospheric and surface water CO <sub>2</sub> concentrations as the ship traversed the Pacific Ocean from the western united states to New Zealand. In the time period between Feb 2004 and Feb 2006, 13 data sets were along this ship track. In March, 2006, the ship changed it's route to as well as it's name. The ship is now the Cap Victor. More information: Columbus Waikato/Cap Victor Master Readme File (Both the readme file and cruise report were obtained from <a href="https://www.pmel.noaa.gov/co2/uwpc02/waikato_data.html">https://www.pmel.noaa.gov/co2/uwpc02/waikato_data.html</a> and converted to PDF)

#### CW2005\_07

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/701295">https://www.bco-dmo.org/deployment/701295</a>
<b>Platform</b>	M/S Columbus Waikato
<b>Report</b>	<a href="http://dmoserv3.who.edu/data_docs/DIC_Time-Series/cw2005_07_Readme.pdf">http://dmoserv3.who.edu/data_docs/DIC_Time-Series/cw2005_07_Readme.pdf</a>
<b>Start Date</b>	2005-07-02
<b>End Date</b>	2005-07-15
<b>Description</b>	In 2004, PMEL installed an underway pCO <sub>2</sub> system on the container ship Columbus Waikato to monitor atmospheric and surface water CO <sub>2</sub> concentrations as the ship traversed the Pacific Ocean from the western united states to New Zealand. In the time period between Feb 2004 and Feb 2006, 13 data sets were along this ship track. In March, 2006, the ship changed it's route to as well as it's name. The ship is now the Cap Victor. More information: Columbus Waikato/Cap Victor Master Readme File (Both the readme file and cruise report were obtained from <a href="https://www.pmel.noaa.gov/co2/uwpc02/waikato_data.html">https://www.pmel.noaa.gov/co2/uwpc02/waikato_data.html</a> and converted to PDF)

#### CW2005\_08

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/701428">https://www.bco-dmo.org/deployment/701428</a>
<b>Platform</b>	M/S Columbus Waikato
<b>Report</b>	<a href="http://dmoserv3.whoi.edu/data_docs/DIC_Time-Series/cw2005_08_Readme.pdf">http://dmoserv3.whoi.edu/data_docs/DIC_Time-Series/cw2005_08_Readme.pdf</a>
<b>Start Date</b>	2005-08-17
<b>End Date</b>	2005-08-31
<b>Description</b>	In 2004, PMEL installed an underway pCO <sub>2</sub> system on the container ship Columbus Waikato to monitor atmospheric and surface water CO <sub>2</sub> concentrations as the ship traversed the Pacific Ocean from the western united states to New Zealand. In the time period between Feb 2004 and Feb 2006, 13 data sets were along this ship track. In March, 2006, the ship changed it's route to as well as it's name. The ship is now the Cap Victor. More information: Columbus Waikato/Cap Victor Master Readme File (Both the readme file and cruise report were obtained from <a href="https://www.pmel.noaa.gov/co2/uwpc02/waikato_data.html">https://www.pmel.noaa.gov/co2/uwpc02/waikato_data.html</a> and converted to PDF)

#### CW2005\_09

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/701483">https://www.bco-dmo.org/deployment/701483</a>
<b>Platform</b>	M/S Columbus Waikato
<b>Report</b>	<a href="http://dmoserv3.whoi.edu/data_docs/DIC_Time-Series/cw2005_09_Readme.pdf">http://dmoserv3.whoi.edu/data_docs/DIC_Time-Series/cw2005_09_Readme.pdf</a>
<b>Start Date</b>	2005-09-23
<b>End Date</b>	2005-10-08
<b>Description</b>	In 2004, PMEL installed an underway pCO <sub>2</sub> system on the container ship Columbus Waikato to monitor atmospheric and surface water CO <sub>2</sub> concentrations as the ship traversed the Pacific Ocean from the western united states to New Zealand. In the time period between Feb 2004 and Feb 2006, 13 data sets were along this ship track. In March, 2006, the ship changed it's route to as well as it's name. The ship is now the Cap Victor. More information: Columbus Waikato/Cap Victor Master Readme File (Both the readme file and cruise report were obtained from <a href="https://www.pmel.noaa.gov/co2/uwpc02/waikato_data.html">https://www.pmel.noaa.gov/co2/uwpc02/waikato_data.html</a> and converted to PDF)

#### PWZ04C

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/701530">https://www.bco-dmo.org/deployment/701530</a>
<b>Platform</b>	M/S Columbus Waikato
<b>Start Date</b>	2004-08-01
<b>End Date</b>	2004-08-12
<b>Description</b>	In 2004, PMEL installed an underway pCO <sub>2</sub> system on the container ship Columbus Waikato to monitor atmospheric and surface water CO <sub>2</sub> concentrations as the ship traversed the Pacific Ocean from the western united states to New Zealand. In the time period between Feb 2004 and Feb 2006, 13 data sets were along this ship track. In March, 2006, the ship changed it's route to as well as it's name. The ship is now the Cap Victor. More information: Columbus Waikato/Cap Victor Master Readme File (Obtained from <a href="https://www.pmel.noaa.gov/co2/uwpc02/waikato_data.html">https://www.pmel.noaa.gov/co2/uwpc02/waikato_data.html</a> and converted to PDF) Note that PMEL did not collect data on this cruise, however, data were collected as part of the project "Time-Series Measurements of the 13C/12C of Dissolved Inorganic Carbon".

[ [table of contents](#) | [back to top](#) ]

## Project Information

**Time-Series Measurements of the 13C/12C of Dissolved Inorganic Carbon (13C/12C DIC Time-Series)**

#### *NSF Award Abstract:*

The  $^{13}\text{C}/^{12}\text{C}$  isotopic ratio of dissolved inorganic carbon (DIC) has been shown to be a very useful tracer of anthropogenic  $\text{CO}_2$  uptake in the ocean (Quay et al., 1992; Heimann and Maier-Reimer, 1996; Sonnerup et al., 2000; Quay et al., 2003). Seasonal changes in the  $\delta^{13}\text{C}$  of DIC, coupled with corresponding changes in DIC concentration and  $\text{pCO}_2$ , have been used to close the surface ocean's carbon budget (Zhang and Quay, 1997; Gruber et al., 1998, Quay and Stutsman, in press). Time-series measurements of  $\delta^{13}\text{C}$ , DIC and  $\text{pCO}_2$ , therefore, allow one to separate biological from physical causes for interannual variations in the rate of oceanic  $\text{CO}_2$  uptake as Gruber et al. (2002) recently demonstrated at BATS. Despite these advantages, there are only two sites in the subtropical N. Atlantic (BATS) and N. Pacific (HOT) oceans where such records exist. This lack of ocean time series records has severely limited our ability to understand the causes of interannual variations in the ocean uptake of anthropogenic  $\text{CO}_2$  (Quay, 2002). In stark contrast, continuous records of atmospheric  $\text{CO}_2$  and  $\delta^{13}\text{C}$  are being measured at over 100 sites.

In this project, researchers at the University of Washington will initiate monthly  $\delta^{13}\text{C}$  measurements at a third time-series site (ESTOC) in the eastern subtropical N. Atlantic. The  $\delta^{13}\text{C}$  record at ESTOC, which will complement on-going measurements of DIC,  $\text{pCO}_2$  and alkalinity at the site, offers a very useful comparison to the BATS  $\delta^{13}\text{C}$  record. Gruber et al. (2002) concluded that interannual variations in  $\text{CO}_2$  uptake at Bermuda correlated strongly with sea surface temperature (SST) and the North Atlantic Oscillation (NAO) index of atmospheric circulation. They used their  $\delta^{13}\text{C}$  record at BATS to conclude that interannual variations in the rate of net community production (NCP) correlated with NAO. The researchers of this project intend to use the proposed  $\delta^{13}\text{C}$  measurements at ESTOC to calculate NCP and determine whether interannual variations in the eastern subtropical N. Atlantic correlate with variations at Bermuda.

The research team will also continue its program of  $\delta^{13}\text{C}$  measurements at HOT. Our decade-long  $\delta^{13}\text{C}$  record at HOT shows that the  $\delta^{13}\text{C}$  decrease rate in the surface ocean has doubled since 1995. The DIC increase rate has tripled since 1995. However, this apparent acceleration of anthropogenic  $\text{CO}_2$  uptake and  $\delta^{13}\text{C}$  decrease occurred during a period (post 1998) when salinity is the highest ever measured at HOT and summertime SST has decreased significantly. These dramatic changes at HOT correlate with a shift in the Pacific Decadal Oscillation (PDO) climate index in 1998 from positive (since the late 1970s) to negative. This correlation suggests that changes in physical forcing (e.g., thermocline depth, mixed layer depth, gyre circulation rates) in the N. Pacific may have changed the subtropical ocean's carbon budget. If so, the situation at HOT may be similar to that found by Gruber et al. (2002) at Bermuda. The team intends to use  $\delta^{13}\text{C}$  measurements at HOT to determine whether the accelerated DIC increase is a result of changes in the NCP rate at HOT.

The proposed research addresses a major societal issue, that is, how natural variability affects the ocean's uptake of anthropogenically produced  $\text{CO}_2$ . The largest single human-controlled factor in future climate change is the production of  $\text{CO}_2$  from fossil fuel combustion and deforestation. The research is expected to yield an ocean  $\delta^{13}\text{C}$  data set that will be made available to the broad scientific community and serve as a useful validation test for models predicting future atmospheric  $\text{CO}_2$  concentrations. The proposed research addresses one of the specific goals of the US Carbon Cycle Science Plan (1999), that is, to better quantify and understand the uptake of anthropogenic  $\text{CO}_2$  in the oceans. The proposed work enhances infrastructure for research and education in two ways. It establishes collaboration with scientists at the Universidad de Las Palmas in the Grand Canary Islands studying the ocean's carbon cycle. It tests equipment that could be broadly used by the oceanographic community to remotely collect seawater samples for carbon analysis.

[ [table of contents](#) | [back to top](#) ]

---

## Funding

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-0327006</a>
National Oceanic and Atmospheric Administration (NOAA)	<a href="#">NA17RJ1232</a>

[ [table of contents](#) | [back to top](#) ]