Investigators: Wiley Evans (Hakai Institute), Katie Pocock (Hakai Institute), Shawn Hateley (Hakai Institute), and Jessy Barrette (Hakai Institute)

Title: Surface seawater and marine boundary layer CO_2 observations from October 2020 to September 2021 made from the Kwakshua Channel (KC) Buoy on the central coast of British Columbia

Abstract: Kwakshua Channel, located near Fitz Hugh Sound on the central coast of British Columbia, has been a site for moored, high-resolution measurements of surface seawater and marine boundary layer CO_2 content since May 2018. Measurements of in situ temperature, salinity, seawater and atmospheric CO_2 partial pressure are made using a Battelle Seaology (MApCO2) System. This data contribution consists of measurements from October 27, 2020 to September 3, 2021.

Cite as: Evans, W., K. Pocock, S. Hateley, and J. Barrette (2022). Surface seawater and marine boundary layer CO_2 observations from October 2020 to September 2021 made from the Kwakshua Channel (KC) Buoy on the central coast of British Columbia. Version 1.0. Hakai Institute. Dataset. [access date].

Type of Study: Measurements of surface ocean and marine boundary layer CO_2 from a surface buoy

Temporal Coverage: October 27, 2020 to September 3, 2021

Spatial Coverage: Surface ocean and marine boundary layer CO_2 measurements from the mouth of Kwakshua Channel; Fitz Hugh Sound; central British Columbia coast; 51.6507°N, 127.9697°W

Geographic Names: Kwakshua Channel; Fitz Hugh Sound; central British Columbia coast; Gulf of Alaska; North Pacific Ocean

Expocode: 187F20201027

Platforms: KC Buoy

Version: 1.0

Submission Date: January 13, 2022

Change log:

This is Version 1.0 of this dataset. Data collected between January and May 2021 are believed to still on the platform and will be added to this dataset in a future submission.

Sampling frequencies:
Oct 2020 - Sep 2021: 1 hour

Data processing segments:
Oct 2020 - Jan 2021
May2021 - Sep 2021

Flagging windows:
Oct 2020 - Sep 2021: 3 points on either side of measurement

Dataset Metadata note:
As part of the QC process, a trend analysis is performed on the CO2 measurements in which an average xCO2 and standard deviation is computed over a set time window around each value (i.e. number of points on each side of the measurement). These values are then compared to the measured xCO2 to determine whether the measurement should be flagged. Due to the variable nearshore environment of the deployment location, the flagging range used in the QC of this record was decreased from the default of 48 points on each side of the measurement (with a 3-hour sample frequency) to 3 points on each side of the measurement.

Filename: KC_BUOY_Oct2020_Sep2021.csv

Data dictionary / header information:

(1) Mooring Name: Name/description of mooring
(2) Latitude: Mooring latitude in decimal degrees
(3) Longitude: Mooring longitude in decimal degrees
(4) Date: UTC date (mm/dd/yyyy)
(5) Time: UTS time (hh:mm)
(6) xCO2 SW (wet): (umol/mol) Mole fraction of CO2 in air in equilibrium with the seawater at sea surface temperature and measured humidity
(7) CO2 SW QF: Flag for xCO2 sw (wet)
(8) H20 SW: (mmol/mol) Mole fraction of H2O in air from equilibrator
(9) xCO2 Air (wet): (umol/mol) Mole fraction of CO2 in air from airblock, 4 feet above the sea surface at measured humidity.
(10) CO2 Air QF: Quality Flag for xCO2 Air (wet)
(11) H20 Air: (mmol/mol) Mole fraction of H2O in air from airblock, 4 feet above the sea surface.
(12) Licor Atm Pressure: (hPa) Atmospheric pressure at the airblock, 4 feet above the sea surface.
(13) Licor Temp: (C) Temperature of the Infrared Licor 820 in degrees Celsius.
(14) MAPCO2 %O2: The percent oxygen of the surface seawater divided by the percent oxygen of the atmosphere at 4 feet above the sea surface. Disclaimer: The oxygen measurement is made in the equilibrated air and does not come to complete equilibrium therefore this measurement is qualitative and for diagnostic use only.
(15) SST: (C) Sea Surface Temperature.
(16) Salinity: Sea Surface Salinity on the practical scale.
(17) xCO2 SW (dry): (umol/mol) Mole fraction of CO2 in air in equilibrium with the seawater at sea surface temperature (dry air).

(18) xCO2 Air (dry): (umol/mol) Mole fraction of CO2 in air at the airblock, 4 feet above the sea surface (dry air).
(19) fCO2 SW (sat): (uatm) Fugacity of CO2 in air in equilibrium with the seawater at sea surface temperature (100% humidity). Since the measurements are taken at the sea surface, warming calculations are not necessary.
(20) fCO2 Air (sat): (uatm) Fugacity of CO2 in air at the airblock, 4 feet above the sea surface (100% humidity)
(21) dfCO2: Difference of the fugacity of the CO2 in seawater and the fugacity of the CO2 in air (fCO2 SW - fCO2 Air).
(22) pCO2 SW (sat): (uatm) Partial Pressure of CO2 in air in equilibrium with the seawater at sea surface temperature (100% humidity)
(23) pCO2 Air (sat): (uatm) Partial Pressure of CO2 in air at the airblock, 4 feet above the sea surface (100% humidity).
(24) dpCO2: Difference of the partial pressure of CO2 in seawater and air (pCO2 SW - pCO2 Air).

Researcher Contact: Please direct questions regarding these data to Wiley Evans (wiley.evans@hakai.org).

Researcher institution: Hakai Institute

Core Variables:

Seawater partial pressure of carbon dioxide at sea surface temperature
Abbreviation: pCO2 SW (sat)
Unit: μatm
Observation type: Measurements from moored buoy with $MApCO_2$ system
In-situ/Manipulation/Response variable: In situ observation
Measured or calculated: Calculated from measured CO_2 mole fractions (xCO_2) and ambient atmospheric pressure.
Sampling instrument: $MApCO_2$ equilibrator
Analyzing instrument: Battelle Seaology ($MApCO_2$) System with LI-COR LI-820
Detailed sampling and analyzing information: All measurements are at sea surface temperature and atmospheric pressure. During the equilibration cycle, a closed loop of air equilibrates with seawater for 10 minutes. Once the equilibration period is complete, the pump stops and the system opens to the atmosphere allowing the pressure to equilibrate with atmospheric pressure. Measurements are recorded for 30 seconds at 2 Hz and then averaged. During the air cycle, fresh air is pumped through the detector for 1 minute. Once the pump stops, the system opens to the atmosphere allowing the pressure to equilibrate with atmospheric pressure. Measurements are recorded for 30 seconds at 2 Hz and then averaged. The gas streams for both the air cycle and equilibrator cycle are partially dried before entering the detector. The values listed as wet xCO2 generally have relative humidity levels ranging from 40 to 80 percent. The humidity levels increase over the course of a deployment. Sampling occurs every 30 minutes. The infrared detector is calibrated at the beginning of every sampling period using a zero and span gas. To calculate the dry measurements, the water mole fraction in the Licor

detector is measured using a relative humidity sensor located immediately downstream of the detector.

Replicate information: N/A

Standardization description: Measurements calibrated using onboard zero and span gas with a known concentration. Span gases used to generate this dataset were 900 ppm from October 2020 to January 2021 (Praxair, Inc.), and 975 ppm from January 2021 to Septebmber 2021 (Praxair, Inc.).

Standardization frequency: Every measurement

CRM manufacturer: Praxair, Inc. and ESRL

Poison name: N/A

Poison volume: N/A

Poison correction: N/A

Uncertainty: 2 ppm for calibrated xCO_2; ~2 µatm for pCO_2

Quality flag convention: No quality flag applied

Method reference: Sutton, A.J., Sabine, C.L., Maenner-Jones, S., Lawrence-Slavas, N., Meinig, C., Feely, R.A., Mathis, J.T., Musielewicz, S., Bott, R., Mclain, P.D., Fought, H.J., and Kozyr, A. (2014). A high-frequency atmospheric and seawater pCO_2 data set from 14 open-ocean sites using a moored autonomous system. *Earth System Science Data* **6**, 353-366.

Researcher name: Wiley Evans

Researcher institution: Hakai Institute

Atmospheric partial pressure of carbon dioxide

Abbreviation: ATM pCO2 wet

Unit: µatm

Observation type: Measurements from air intake on M/V Columbia foredeck

In-situ/Manipulation/Response variable: In situ observation

Measured or calculated: Calculated from measured CO_2 mole fractions (xCO_2) and ambient atmospheric pressure.

Sampling instrument: Air intake

Analyzing instrument: Battelle Seaology ($MApCO_2$) with LI-COR LI-820

Detailed sampling and analyzing information: All measurements are at sea surface temperature and atmospheric pressure. During the equilibration cycle, a closed loop of air equilibrates with seawater for 10 minutes. Once the equilibration period is complete, the pump stops and the system opens to the atmosphere allowing the pressure to equilibrate with atmospheric pressure. Measurements are recorded for 30 seconds at 2 Hz and then averaged. During the air cycle, fresh air is pumped through the detector for 1 minute. Once the pump stops, the system opens to the atmosphere allowing the pressure to equilibrate with atmospheric pressure. Measurements are recorded for 30 seconds at 2 Hz and then averaged. The gas streams for both the air cycle and equilibrator cycle are partially dried before entering the detector. The values listed as wet xCO2 generally have relative humidity levels ranging from 40 to 80 percent. The humidity levels increase over the course of a deployment. Sampling occurs every 30 minutes. The infrared detector is calibrated at the beginning of every sampling period using a zero and span gas. To calculate the dry measurements, the water mole fraction in the Licor detector is measured using a relative humidity sensor located immediately downstream of the detector.

Replicate information: N/A

Standardization description: Measurements calibrated using onboard zero and span gas with a known concentration. Span gases used to generate this dataset were 900 ppm from October 2020 to January 2021 (Praxair, Inc.), and 975 ppm from January 2021 to Septebmber 2021 (Praxair, Inc.).
Standardization frequency: Every measurement
CRM manufacturer: Praxair, Inc. and ESRL
Poison name: N/A
Poison volume: N/A
Poison correction: N/A
Uncertainty: 2 ppm for calibrated xCO_2; ~2 µatm for pCO_2
Quality flag convention: No quality flag applied
Method reference: Sutton, A.J., Sabine, C.L., Maenner-Jones, S., Lawrence-Slavas, N., Meinig, C., Feely, R.A., Mathis, J.T., Musielewicz, S., Bott, R., Mclain, P.D., Fought, H.J., and Kozyr, A. (2014). A high-frequency atmospheric and seawater pCO_2 data set from 14 open-ocean sites using a moored autonomous system. *Earth System Science Data* 6**,** 353-366.
Researcher name: Wiley Evans
Researcher institution: Hakai Institute

Sea surface temperature
Abbreviation: Intake T
Unit: °C, ITS-90 scale
Observation type: Measurements from surface buoy (1 m depth)
In-situ/Manipulation/Response variable: In situ observation
Measured or calculated: Measured
Sampling instrument: N/A
Analyzing instrument: SBE16plusV2
Detailed sampling and analyzing information: Data captured using a Campbell Scientific data logger onboard the surface buoy
Replicate information: N/A
Standardization description: N/A
Standardization frequency: N/A
CRM manufacturer: N/A
Poison name: N/A
Poison volume: N/A
Poison correction: N/A
Uncertainty: 0.005°C
Quality flag convention: No quality flag applied
Method reference:
Researcher name: Wiley Evans
Researcher institution: Hakai Institute

Seawater Salinity
Abbreviation: TSG Salinity
Unit: 1978 Practical Salinity Scale
Observation type: Measurements from surface buoy (1 m depth)
In-situ/Manipulation/Response variable: In situ observation

Measured or calculated: Calculated from conductivity and temperature measurements
Sampling instrument: N/A
Analyzing instrument: SBE16plusV2
Detailed sampling and analyzing information: Data captured using a Campbell Scientific data logger onboard the surface buoy
Replicate information: N/A
Standardization description: N/A
Standardization frequency: N/A
CRM manufacturer: N/A
Poison name: N/A
Poison volume: N/A
Poison correction: N/A
Uncertainty: 0.0005 S/m
Quality flag convention: No quality flag applied
Method reference:
Researcher name: Wiley Evans
Researcher institution: Hakai Institute