

Dataset Expocode	316420120614
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Dataset	Funding Info: NOAA Initial Submission (yyyymmdd): 12/11/2015 Revised Submission (yyyymmdd): 08/28/2017
Campaign/Cruise	Expocode: 316420120614 Campaign/Cruise Name: Campaign/Cruise Info: Platform Type: CO2 Instrument Type: Survey Type: Moored Buoy Vessel Name: Vessel Owner: Vessel Code: 3164
Coverage	Start Date (yyyymmdd): 20120614 End Date (yyyymmdd): 20121114 Westernmost Longitude: 157.969 W Easternmost Longitude: 157.969 W Northernmost Latitude: 22.665 N Southernmost Latitude: 22.665 N
Variable	Name: Mooring Unit: Description: string, Buoy Mooring Name
Variable	Name: Latitude Unit: Description: float, latitude in decimal degrees
Variable	Name: Longitude Unit: Description: float, longitude in decimal degrees
Variable	Name: Date Unit: Description: string, date in MM/DD/YYYY format
Variable	Name: Time Unit: Description: string, time in hh:mm format
Variable	Name: Time Unit: Description: string, time in hh:mm format

Variable	Name: xCO2_SW_wet Unit: Description: float, units of umol/mol. Mole fraction of CO2 in air in equilibrium with the seawater at sea surface temperature and measured humidity.
Variable	Name: xCO2_SW_QF Unit: Description: integer, Flag for xCO2_SW_wet
Variable	Name: H2O_SW Unit: Description: float, units mmol/mol. Mole fraction of H2O in air from equilibrator.
Variable	Name: xCO2_Air_wet Unit: Description: float, units umol/mol. Mole fraction of CO2 in air from airblock, 4 feet above the sea surface at measured humidity.
Variable	Name: xCO2_Air_QF Unit: Description: integer, Quality Flag for xCO2 Air (wet)
Variable	Name: H2O_AIR Unit: Description: float, units mmol/mol. Mole fraction of H2O in air from airblock, 4 feet above the sea surface.
Variable	Name: Licor_Atm_Pressure Unit: Description: float, units hPa. Atmospheric pressure at the airblock, 4 feet above the sea surface.
Variable	Name: Licor_Temp Unit: Description: float, units degrees C. Temperature of the Infrared Licor 820 in degrees Celsius.
Variable	Name: Percent_O2 Unit: Description: float, 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. We have found that the oxygen does not come to complete equilibrium so any rapid changes in oxygen do not get properly captured using this system. Therefore, we tend to use the oxygen data only as a qualitative sense of the biology. It is not a quantitative measure.
Variable	Name: SST Unit: Description: float, units degrees C. Sea Surface Temperature.
Variable	Name: Salinity Unit: Description: float, units PSU. Sea Surface Salinity.
Variable	Name: xCO2_SW_dry Unit: Description: float, units umol/mol. Mole fraction of CO2 in air in equilibrium with the seawater at sea surface temperature (dry air).

Variable	Name: xCO2_Air_dry Unit: Description: float, units umol/mol. Mole fraction of CO2 in air at the airblock, 4 feet above the sea surface (dry air).
Variable	Name: fCO2_SW_sat Unit: Description: float, units 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.
Variable	Name: fCO2_Air_sat Unit: Description: float, units uatm. Fugacity of CO2 in air at the airblock, 4 feet above the sea surface (100% humidity).
Variable	Name: dfCO2 Unit: Description: float, units uatm. Difference of the fugacity of the CO2 in seawater and the fugacity of the CO2 in air (fCO2 SW - fCO2 Air).
Variable	Name: pCO2_SW_sat Unit: Description: float, units uatm. Partial Pressure of CO2 in air in equilibrium with the seawater at sea surface temperature (100% humidity)
Variable	Name: pCO2_Air_sat Unit: Description: float, units uatm. Partial Pressure of CO2 in air at the airblock, 4 feet above the sea surface (100% humidity).
Variable	Name: dpCO2 Unit: Description: float, units uatm. Difference of the partial pressure of CO2 in seawater and air (pCO2 SW - pCO2 Air)
Variable	Name: pH Unit: Description: float, units pH. pH of Seawater (total scale)
Variable	Name: pH_QF Unit: Description: integer, Quality Flag for pH
Sea Surface Temperature	Location: 1m Manufacturer: SeaBird Model: SBE16 Accuracy: < 0.01 (°C if units not given) Precision: (°C if units not given) Calibration: ~ Annually by SeaBird Comments: Temperature data are internally recorded and collected during the equilibration period. Data are not post-calibrated. Annual drift for this deployment was minimal and does not impact the fCO2 and pCO2 calculations (within the degree of accuracy of the CO2 measurement). Contact us if you would like the CTD post-calibration information.
Sea Surface Salinity	Location: 1m Manufacturer: SeaBird

Model: SBE16
Accuracy: < 0.05
Precision:
Calibration: ~ Annually by SeaBird
Comments: Conductivity data are internally recorded and collected during the equilibration period. Data are not post-calibrated. Annual drift for this deployment was minimal and does not impact the fCO₂ and pCO₂ calculations (within the degree of accuracy of the CO₂ measurement). Contact us if you would like the CTD post-calibration information.

**Atmospheric
Pressure**

Location:
Normalized to Sea Level:
Manufacturer:
Model:
Accuracy: (hPa if units not given)
Precision: (hPa if units not given)
Calibration:
Comments:

Atmospheric CO₂

Measured/Frequency: yes, 3hr cycle
Intake Location: unused
Drying Method: unused
Atmospheric CO₂ Accuracy: 1 uatm
Atmospheric CO₂ Precision: 0.6 uatm

**Aqueous CO₂
Equilibrator Design**

System Manufacturer:
Intake Depth: 14cm - 20cm
Intake Location:
Equilibration Type: Bubble Equilibrator
Equilibrator Volume (L): N/A
Headspace Gas Flow Rate (ml/min): ~600 cc/min
Equilibrator Water Flow Rate (L/min): N/A
Equilibrator Vented: Yes
Equilibration Comments:
Drying Method:

**Aqueous CO₂
Sensor Details**

Measurement Method: Absolute, non-dispersive infrared (NDIR) gas analyzer
Method details:
Manufacturer: Licor
Model: LI-820
Measured CO₂ Values:
Measurement Frequency: 3hr cycle
Aqueous CO₂ Accuracy: 2 uatm
Aqueous CO₂ Precision: 0.7 uatm
Sensor Calibrations:
Calibration of Calibration Gases: At the beginning of each sample, the instrument self-calibrates using a zero and high standard. The zero standard is generated by cycling a small amount of air through a soda lime chamber. The high standard is from a cylinder of calibrated standard reference gas, 426.67 umol/mol, from ESRL. ESRL standards are traceable to WMO x93 scale with a stated reproducibility of 0.06 micromole/mole. For more information on estimates of accuracy and precision of the MAPCO₂ system, see Sutton et al. 2014 (reference below).
Number Non-Zero Gas Standards:

Calibration Gases:

NOAA Earth System Research & Laboratory (ESRL)

Comparison to Other CO2 Analyses:**Comments:****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, J., Kozyr, A., 2014b. A high-frequency atmospheric and seawater pCO₂ data set from 14 open ocean sites using a moored autonomous system. Earth Sys. Sci. Data, 6, doi: 10.5194/essd-6-353-2014, 353-366.

Equilibrator**Temperature Sensor****Location:****Manufacturer:****Model:**

Accuracy: (°C if units not given)

Precision: (°C if units not given)

Calibration:**Comments:****Equilibrator****Pressure Sensor****Location:****Manufacturer:****Model:**

Accuracy: (hPa if units not given)

Precision: (hPa if units not given)

Calibration:**Comments:****Other Sensor****Description:**

Manufacturer: Maxtec Oxygen Sensor

Model: Max-250

Accuracy: 2.0% Full Scale over operating temperature range. 1.0% Full Scale @ constant temperature and pressure

Precision:

Calibration: Factory calibrated before purchase. Recalibrated to sea level atmospheric air every 7 days

Comments:**Other Sensor****Description:**

Manufacturer: Sensirion Humidity Sensor

Model: SHT71

Accuracy: > 0.01%

Precision:

Calibration: Factory calibrated before purchase.

Comments:**Other Sensor****Description:**

Manufacturer: Sunburst Sensors, LLC

Model: SAMI2 pH

Accuracy:**Precision:**

Calibration: ~ Annually by Sunburst Sensors

Comments: pH data are collected and internally recorded during the CO₂ equilibration period. Data are salinity compensated with salinity collected by the Seabird SBE16, using the program Sunburst Sensors QC_PH_02. Spaulding, R., 2010. Salinity Measurement and SAMI-pH Accuracy. Tech Notes, 1.

Additional Information

Suggested QC flag from Data Provider:

Additional Comments: o All measurements are at sea surface temperature and atmospheric pressure. o 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 hertz and then averaged. o 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 hertz and then averaged. o 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. o Sampling occurs every 3 hours. The infrared detector is calibrated at the beginning of every sampling period. Averaged data and standard deviations for each measurement are transmitted back daily. o To calculate the dry measurements, the water mole fraction in the Licor detector must be known. A relative humidity sensor is located immediately downstream of the detector. o As part of the QC process, each data set is compared with the Marine Boundary Layer (MBL) data from GlobalView-CO₂. As part of the QC process, xCO₂ air measurements are compared to the following data sets when available: previous MAPCO₂ deployment if overlap on recovery/deployment, following MAPCO₂ deployment if overlap on recovery/deployment, and Marine Boundary Layer (MBL) xCO₂ air data from GlobalView-CO₂. The available comparison data sets are in good agreement with the MAPCO₂ air data and no adjustment was made. GLOBALVIEW-CO₂: Cooperative Atmospheric Data Integration Project - Carbon Dioxide. CD-ROM, NOAA ESRL, Boulder, Colorado [Also available on Internet via anonymous FTP to ftp.cmdl.noaa.gov, Path: ccg/co2/GLOBALVIEW], 2010 o During the QC process, an adjustment to the Licor pressure is also made based on each sensor's bias to barometric pressure as measured in the lab. This system has Licor pressure bias of -0.100 applied. Averaged wet xCO₂ measurements are post-calibrated using a simple linear regression between original averaged measurements and span coefficients, a method similar to the post-cal established by the underway pCO₂ community as described here: Feely, R.A., R. Wanninkhof, H.B. Milburn, C.E. Cosca, M. Stapp, and P.P. Murphy, A new automated underway system for making high precision pCO₂ measurements onboard research ships, *Analytica Chim. Acta*, 377, 185-191, 1998. Post calculation correlation between Licor temperature and coefficient is: o No data = -9.999 or -999 o These data are made freely available to the public and the scientific community in the belief that their wide dissemination will lead to greater understanding and new scientific insights. The availability of these data does not constitute publication of the data. We rely on the ethics and integrity of the user to assure that PMEL receives fair credit for our work. Please send manuscripts using this data to PMEL for review before they are submitted for publication so we can insure that the quality and limitations of the data are accurately represented.

Citation for this Dataset:

Sutton, A., C. Sabine, S. Maenner, S. Musielewicz, R. Bott, and J. Osborne. 2014. High-resolution ocean and atmosphere pCO₂ time-series measurements from mooring WHOTS_158W_23N.

Other References for this Dataset:

None