

<b>Dataset Expocode</b>	<b>316420160716</b>
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<b>Dataset</b>	<b>Funding Info:</b> NOAA <b>Initial Submission (yyyymmdd):</b> 01/14/2021 <b>Revised Submission (yyyymmdd):</b>
<b>Campaign/Cruise</b>	<b>Expocode:</b> 316420160716 <b>Campaign/Cruise Name:</b> <b>Campaign/Cruise Info:</b> <b>Platform Type:</b> <b>CO2 Instrument Type:</b> <b>Survey Type:</b> Moored Buoy <b>Vessel Name:</b> <b>Vessel Owner:</b> <b>Vessel Code:</b> TAO1
<b>Coverage</b>	<b>Start Date (yyyymmdd):</b> 20160716 <b>End Date (yyyymmdd):</b> 20180731 <b>Westernmost Longitude:</b> 164.842 E <b>Easternmost Longitude:</b> 164.842 E <b>Northernmost Latitude:</b> 8.023 S <b>Southernmost Latitude:</b> 8.023 S
<b>Variable</b>	<b>Name:</b> Date Time <b>Unit:</b> <b>Description:</b> Date and Time (UTC)
<b>Variable</b>	<b>Name:</b> xCO2 SW (wet) <b>Unit:</b> <b>Description:</b> (umol/mol) Mole fraction of CO2 in air in equilibrium with the seawater at sea surface temperature and measured humidity.
<b>Variable</b>	<b>Name:</b> CO2 SW QF <b>Unit:</b> <b>Description:</b> Flag for xCO2 sw (wet)
<b>Variable</b>	<b>Name:</b> H2O SW <b>Unit:</b> <b>Description:</b> (mmol/mol) Mole fraction of H2O in air from equilibrator.
<b>Variable</b>	<b>Name:</b> xCO2 Air (wet) <b>Unit:</b> <b>Description:</b> umol/mol) Mole fraction of CO2 in air from airblock, 4 feet above the sea surface at measured humidity.
<b>Variable</b>	<b>Name:</b> CO2 Air QF

**Unit:**  
**Description:** Quality Flag for xCO<sub>2</sub> Air (wet)

**Variable**

**Name:** H<sub>2</sub>O Air

**Unit:**

**Description:** (mmol/mol) Mole fraction of H<sub>2</sub>O in air from airblock, 4 feet above the sea surface.

**Variable**

**Name:** Licor Atm Pressure

**Unit:**

**Description:** (hPa) Atmospheric pressure at the airblock, 4 feet above the sea surface.

**Variable**

**Name:** Licor Temp

**Unit:**

**Description:** (C) Temperature of the Infrared Licor 820 in degrees Celsius.

**Variable**

**Name:** MAPCO<sub>2</sub> %O<sub>2</sub>

**Unit:**

**Description:** 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:** (C) Sea Surface Temperature.

**Variable**

**Name:** Salinity

**Unit:**

**Description:** (PSU) Sea Surface Salinity.

**Variable**

**Name:** xCO<sub>2</sub> SW (dry)

**Unit:**

**Description:** (umol/mol) Mole fraction of CO<sub>2</sub> in air in equilibrium with the seawater at sea surface temperature (dry air).

**Variable**

**Name:** xCO<sub>2</sub> Air (dry)

**Unit:**

**Description:** (umol/mol) Mole fraction of CO<sub>2</sub> in air at the airblock, 4 feet above the sea surface (dry air).

**Variable**

**Name:** fCO<sub>2</sub> SW (sat)

**Unit:**

**Description:** (uatm) Fugacity of CO<sub>2</sub> 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:** fCO<sub>2</sub> Air (sat)

**Unit:**

**Description:** (uatm) Fugacity of CO<sub>2</sub> in air at the airblock, 4 feet above the sea surface (100% humidity).

**Variable**

**Name:** dfCO<sub>2</sub>

**Unit:**

**Description:** Difference of the fugacity of the CO<sub>2</sub> in seawater and the fugacity of the CO<sub>2</sub> in air (fCO<sub>2</sub> SW - fCO<sub>2</sub> Air).

**Variable**

**Name:** pCO<sub>2</sub> SW (wet)

**Unit:**

**Description:** (uatm) Partial Pressure of CO<sub>2</sub> in air in equilibrium with the seawater at sea surface temperature (100% humidity)

**Variable**

**Name:** pCO<sub>2</sub> Air (wet)

**Unit:**

**Description:** (uatm) Partial Pressure of CO<sub>2</sub> in air at the airblock, 4 feet above the sea surface (100% humidity).

**Variable**

**Name:** dpCO<sub>2</sub>

**Unit:**

**Description:** Difference of the partial pressure of CO<sub>2</sub> in seawater and air (pCO<sub>2</sub> SW - pCO<sub>2</sub> Air)

**Variable**

**Name:** pH SW

**Unit:**

**Description:** pH of Seawater (total scale)

**Variable**

**Name:** pH QF

**Unit:**

**Description:** Quality Flag for pH

**Sea Surface  
Temperature**

**Location:** 1m

**Manufacturer:** SeaBird

**Model:** SBE 37

**Accuracy:** < 0.01 (°C if units not given)

**Precision:** (°C if units not given)

**Calibration:** ~ Annually by SeaBird

**Comments:** Sea Surface Temperature collected by NOAA/NDBC/TAO provide internally recorded SST data at 10 minute resolution. NOAA/NDBC/TAO advises to check the TAO site for the most accurate data available.

**Sea Surface Salinity**

**Location:** 1m

**Manufacturer:** SeaBird

**Model:** SBE 37

**Accuracy:** < 0.05

**Precision:**

**Calibration:** ~ Annually by SeaBird

**Comments:** Sea Surface Salinity collected by NOAA/NDBC/TAO provide internally recorded SSS data at 1 hour resolution. NOAA/NDBC/TAO advises to check the TAO site for the most accurate data available.

**Atmospheric  
Pressure**

**Location:** 1m height

**Normalized to Sea Level:**

**Manufacturer:** LICOR

**Model:** LICOR 820

**Accuracy:** 2 hPa (hPa if units not given)

**Precision:** 1 hPa (hPa if units not given)

**Calibration:** Compared annually with Paros 765 Pressure Standard

**Comments:**

**Atmospheric CO<sub>2</sub>**

**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, 460.54 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:**

**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 xCO<sub>2</sub> 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-CO<sub>2</sub>. o As part of the QC process, xCO<sub>2</sub> air measurements are compared to the following data sets when available: previous MAPCO<sub>2</sub> deployment at same site if overlap on recovery/deployment, following MAPCO<sub>2</sub> deployment at same site if overlap on recovery/deployment, and Marine Boundary Layer (MBL) xCO<sub>2</sub> air data from GlobalView-CO<sub>2</sub>. This MAPCO<sub>2</sub> deployment is offset from the available comparison data sets, and an adjustment of 5.192 umol mol<sup>-1</sup> was applied to the data set. Dlugokencky, E.J., K.W. Thoning, P.M. Lang, and P.P. Tans (2019), NOAA Greenhouse Gas Reference from Atmospheric Carbon Dioxide Dry Air Mole Fractions from the NOAA ESRL Carbon Cycle Cooperative Global Air Sampling Network. Data Path: [ftp://aftp.cmdl.noaa.gov/data/trace\\_gases/co2/flask/surface/](ftp://aftp.cmdl.noaa.gov/data/trace_gases/co2/flask/surface/). o MBL Data were last

downloaded from ESRL on 08/24/2020 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 +0.000 applied. Averaged wet xCO<sub>2</sub> 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 pCO<sub>2</sub> 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 pCO<sub>2</sub> measurements onboard research ships, *Analytica Chim. Acta*, 377, 185-191, 1998. o Post calculation correlation between Licor temperature and coefficient is: Licor coef = -0.001241 \* Temp + 0.8579 r<sup>2</sup> = 0.73 From 02/27/2018 12:00 onward, a 2.912 ppm adjustment was made to xCO<sub>2</sub> (wet) via the MBL correction. 2.912 was determined from the difference between 02/21/2018 21:18 and 02/27/2018 12:18 xCO<sub>2</sub> Air (dry) values. The difference between the wet and dry adjustment is minor. These data were marked flag 3. Data between 02/22/2018 00:00 and 02/27/2018 12:00 were marked flag 4 as these data were much lower than the other offset data. o No data = -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., S. Maenner, S. Musielewicz, R. Battisti, R. Bott, and J. Osborne. 2016. High-resolution ocean and atmosphere pCO<sub>2</sub> time-series measurements from mooring TAO165E\_8S.

**Other References for this Dataset:**

None