

<b>Dataset Expocode</b>	<b>33RR20160519</b>
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<b>Dataset</b>	<b>Funding Info:</b> NOAA Climate Program Office <b>Initial Submission (yyyymmdd):</b> 20160727 <b>Revised Submission (yyyymmdd):</b> 20160727
<b>Campaign/Cruise</b>	<b>Expocode:</b> 33RR20160519 <b>Campaign/Cruise Name:</b> RR1606 <b>Campaign/Cruise Info:</b> AOML_SOOP_CO2; RR1606, FLEAT1 <b>Platform Type:</b> <b>CO2 Instrument Type:</b> Equilibrator-IR or CRDS or GC <b>Survey Type:</b> Research Cruise <b>Vessel Name:</b> Roger Revelle <b>Vessel Owner:</b> U.S. Navy; operated by Scripps Institute of Oceanography <b>Vessel Code:</b> 33RR
<b>Coverage</b>	<b>Start Date (yyyymmdd):</b> 20160519 <b>End Date (yyyymmdd):</b> 20160528 <b>Westernmost Longitude:</b> 133.7 E <b>Easternmost Longitude:</b> 135.6 E <b>Northernmost Latitude:</b> 9.0 N <b>Southernmost Latitude:</b> 7.2 N <b>Port of Call:</b> Malakal, Palau, Micronesia
<b>Variable</b>	<b>Name:</b> xCO2_EQU_ppm <b>Unit:</b> ppm <b>Description:</b> Mole fraction of CO2 in the equilibrator headspace (dry) at equilibrator temperature (ppm)
<b>Variable</b>	<b>Name:</b> xCO2_ATM_ppm <b>Unit:</b> ppm <b>Description:</b> Mole fraction of CO2 measured in dry outside air (ppm)
<b>Variable</b>	<b>Name:</b> xCO2_ATM_interpolated_ppm <b>Unit:</b> ppm <b>Description:</b> Mole fraction of CO2 in outside air associated with each water analysis. These values are interpolated between the bracketing averaged good xCO2_ATM analyses (ppm)
<b>Variable</b>	<b>Name:</b> PRES_EQU_hPa

**Unit:** hPa  
**Description:** Barometric pressure in the equilibrator headspace (hPa)

**Variable**      **Name:** PRES\_ATM@SSP\_hPa  
**Unit:** hPa  
**Description:** Barometric pressure measured outside, corrected to sea level (hPa)

**Variable**      **Name:** TEMP\_EQU\_C  
**Unit:** Degree C  
**Description:** Water temperature in equilibrator (°C)

**Variable**      **Name:** SST\_C  
**Unit:** Degree C  
**Description:** Sea surface temperature (°C)

**Variable**      **Name:** SAL\_permil  
**Unit:** ppt  
**Description:** Sea surface salinity on Practical Salinity Scale (o/oo)

**Variable**      **Name:** fCO2\_SW@SST\_uatm  
**Unit:** µatm  
**Description:** Fugacity of CO2 in sea water at SST and 100% humidity (µatm)

**Variable**      **Name:** fCO2\_ATM\_interpolated\_uatm  
**Unit:** µatm  
**Description:** Fugacity of CO2 in air corresponding to the interpolated xCO2 at SST and 100% humidity (µatm)

**Variable**      **Name:** dfCO2\_uatm  
**Unit:** µatm  
**Description:** Sea water fCO2 minus interpolated air fCO2 (µatm)

**Variable**      **Name:** WOCE\_QC\_FLAG  
**Unit:** None  
**Description:** Quality control flag for fCO2 values (2=good, 3=questionable)

**Variable**      **Name:** QC\_SUBFLAG  
**Unit:** None  
**Description:** Quality control subflag for fCO2 values, provides explanation when QC flag=3

**Sea Surface Temperature**      **Location:** Hydro Lab, near CO2 system  
**Manufacturer:** Seabird  
**Model:** 45  
**Accuracy:** 0.002 (°C if units not given)  
**Precision:** 0.0002 (°C if units not given)  
**Calibration:** Factory calibration  
**Comments:** Manufacturer's Typical Stability is taken as Precision; Maintained by ship. A regression fit between the average temperature measured in the Hydro Lab and the CTD surface temperature during a prior cruise was done to estimate the SST. See additional comments below.

**Sea Surface Salinity**      **Location:** In Hydro lab, near CO2 system  
**Manufacturer:** Seabird  
**Model:** SBE 45  
**Accuracy:** ± 0.005 o/oo  
**Precision:** 0.0002 o/oo  
**Calibration:** Factory calibration

**Comments:** Manufacturer's Resolution is taken as Precision; Maintained by ship.

## Atmospheric Pressure

**Location:** On MET mast, ~17 m above the sea surface water

**Normalized to Sea Level:** yes

**Manufacturer:** RMYoung

**Model:** 61302V

**Accuracy:**  $\pm 0.3$  hPa (hPa if units not given)

**Precision:** 0.01 hPa (hPa if units not given)

**Calibration:** Factory calibration

**Comments:** Manufacturer's Resolution is taken as Precision; Maintained by ship.

## Atmospheric CO2

**Measured/Frequency:** Yes, 5 readings in a group every 4.5 hours

**Intake Location:** Bow mast, ~18 meters above sea surface

**Drying Method:** Gas stream passes through a thermoelectric condenser (~5 °C) and then through a Perma Pure (Nafion) dryer before reaching the analyzer (90% dry).

**Atmospheric CO2 Accuracy:**  $\pm 0.5$   $\mu$ atm in fCO2\_ATM

**Atmospheric CO2 Precision:**  $\pm 0.01$   $\mu$ atm in fCO2\_ATM

## Aqueous CO2 Equilibrator Design

**System Manufacturer:**

**Intake Depth:** 5 meters

**Intake Location:** Bow, or engine room sea chest (mid ship)

**Equilibration Type:** Spray head above dynamic pool with thermal jacket

**Equilibrator Volume (L):** 0.95 L (0.4 L water, 0.55 L headspace)

**Headspace Gas Flow Rate (ml/min):** 70 - 150 ml/min

**Equilibrator Water Flow Rate (L/min):** 1.3 - 2.5 L/min

**Equilibrator Vented:** Yes

**Equilibration Comments:** Primary equilibrator is vented through a secondary equilibrator.

**Drying Method:** Gas stream passes through a thermoelectric condenser (~5 °C) and then through a Perma Pure (Nafion) dryer before reaching the analyzer (90% dry).

## Aqueous CO2 Sensor Details

**Measurement Method:** IR

**Method details:** details of CO2 sensing (not required)

**Manufacturer:** LI-COR

**Model:** 6262

**Measured CO2 Values:** xco2(dry)

**Measurement Frequency:** Every 140 seconds, except during calibration

**Aqueous CO2 Accuracy:**  $\pm 2$   $\mu$ atm in fCO2\_SW

**Aqueous CO2 Precision:**  $\pm 0.01$   $\mu$ atm in fCO2\_SW

**Sensor Calibrations:**

**Calibration of Calibration Gases:** The analyzer is calibrated every 4.5 hours with field standards that in turn were calibrated with primary standards that are directly traceable to the WMO scale. The zero gas is ultra-high purity air.

**Number Non-Zero Gas Standards:** 4

**Calibration Gases:**

Std 1: JA02280, 233.46 ppm, owned by AOML, used every ~4.5 hours.

Std 2: JA02264, 326.18 ppm, owned by AOML, used every ~4.5 hours.

Std 3: JA02285, 406.06 ppm, owned by AOML, used every ~4.5 hours.

Std 4: JA02646, 463.00 ppm, owned by AOML, used every ~4.5 hours.

Std 5: 0.00 ppm, owned by AOML, used every ~23.5 hours.

**Comparison to Other CO2 Analyses:**

**Comments:****Method Reference:**

Pierrot, D., C. Neil, K. Sullivan, R. Castle, R. Wanninkhof, H. Lueger, T. Johannessen, A. Olsen, R. A. Feely, and C. E. Cosca (2009), Recommendations for autonomous underway pCO<sub>2</sub> measuring systems and data reduction routines, Deep-Sea Res II, 56, 512-522.

**Equilibrator  
Temperature Sensor**

**Location:** Inserted into equilibrator ~5 cm below water level

**Manufacturer:** Hart

**Model:** 1523

**Accuracy:** 0.015 (°C if units not given)

**Precision:** 0.001 (°C if units not given)

**Calibration:** Factory calibration

**Comments:** Resolution is taken as Precision.

**Equilibrator  
Pressure Sensor**

**Location:** Attached to equilibrator headspace. The differential pressure reading from Setra 239, which is attached to the equilibrator headspace, is added to the pressure reading from the LICOR analyzer, which is measured by an external Setra 270 connected to the exit of the analyzer.

**Manufacturer:** Setra

**Model:** 270

**Accuracy:** 0.15 (hPa if units not given)

**Precision:** 0.015 (hPa if units not given)

**Calibration:** Factory calibration

**Comments:** Manufacturer's Resolution is taken as Precision.

**Additional  
Information**

**Suggested QC flag from Data Provider:** NA

**Additional Comments:** The analytical system performed well throughout this cruise. Values for the ship's sensors were appended to the CO<sub>2</sub> data record in real-time. Missing real-time values were taken from the MET files logged by the ship. During a prior cruise (RR1604, I09N) the temperature data from the CTD casts and shipboard sensors were used to estimate SSTemperature. A regression fit between the average temperature measured in the Hydro Lab (HLT, average of equilibrator and TSG temperatures) and the CTD temperature (average over top 8 db) was done for all 117 casts. After eliminating eleven outlying data, the resulting second degree polynomial equation was used to estimate the SST.  $SST(estimated) = 0.001424 * HLT^2 + 0.950053 * HLT + 0.048227$  ; standard deviation of the differences between the CTD temperatures and the SST(estimated) was +/- 0.061 degree Celcius. The temperatures measured during this cruise fall within the range covered by the regression equation. The same temperature sensors in the hydro lab were used on both cruises.

**Citation for this Dataset:**

**Other References for this Dataset:**