

Dataset Expocode	33RR20160626
Primary Contact	Name: Sullivan, Kevin Organization: NOAA/AOML CIMAS Address: 4301 Rickenbacker Causeway, Miami, FI 33149 Phone: (305) 361-4382 Email: kevin.sullivan@noaa.gov
Investigator	Name: Wanninkhof, Rik Organization: NOAA/Atlantic Oceanographic & Meteorological Laboratory Address: 4301 Rickenbacker Causeway, Miami FI, 33149 Phone: 305-361-4379 Email: Rik.Wanninkhof@noaa.gov
Investigator	Name: Pierrot, Denis Organization: NOAA/Atlantic Oceanographic & Meteorological Laboratory Address: 4301 Rickenbacker Causeway, Miami FI, 33149 Phone: 305-361-4441 Email: Denis.Pierrot@noaa.gov
Dataset	Funding Info: NOAA Climate Program Office Initial Submission (yyyymmdd): 20161215 Revised Submission (yyyymmdd): 20161215
Campaign/Cruise	Expocode: 33RR20160626 Campaign/Cruise Name: RR1608 Campaign/Cruise Info: AOML_SOOP_CO2; FLEAT3 Platform Type: CO2 Instrument Type: Equilibrator-IR or CRDS or GC Survey Type: Research Cruise Vessel Name: Roger Revelle Vessel Owner: U.S. Navy; operated by Scripps Institute of Oceanography Vessel Code: 33RR
Coverage	Start Date (yyyymmdd): 20160626 End Date (yyyymmdd): 20160628 Westernmost Longitude: 134.7 E Easternmost Longitude: 144.6 E Northernmost Latitude: 13.4 N Southernmost Latitude: 7.3 N Port of Call: Malakal Harbor, Palau Port of Call: Apra Harbor, Guam
Variable	Name: xCO2_EQU_ppm Unit: ppm Description: Mole fraction of CO2 in the equilibrator headspace (dry) at equilibrator temperature (ppm)
Variable	Name: xCO2_ATM_ppm Unit: ppm Description: Mole fraction of CO2 measured in dry outside air (ppm)
Variable	Name: xCO2_ATM_interpolated_ppm Unit: ppm Description: 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)

Variable	Name: 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 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 temperatures measured in the Hydro Lab and the CTD surface temperatures during a prior GO-SHIP cruise was done to estimate 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.
Location: On MET mast, ~17 m above the sea surface water
Normalized to Sea Level: yes
Manufacturer: RMYoung
Model: 61302V
Accuracy: ± 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 Pressure

Atmospheric CO2

Measured/Frequency: Yes, 5 readings in a group every ~4.5 hours
Intake Location: Bow mast, ~14 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: ± 0.5 μ atm in fCO₂_ATM
Atmospheric CO2 Precision: ± 0.01 μ 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, no 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. Depending on weather conditions, the inlet of the scientific seawater system was switched between the bow and engine room.
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: ± 2 μ atm in fCO₂_SW
Aqueous CO2 Precision: ± 0.01 μ 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 pCO₂ 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 fine during this cruise. Values for the ship's sensors were taken from the MET files logged by the ship. The HydroLabTSG Temp, oxygen Temp, and equilibrator Temp all tracked each other nicely. The average difference between the HydroLabTSG Temp and Equ Temp is 0.004 (+/-0.027) degC, n=11441 for RR1607 and RR1608. For the 1287 analyses during RR1608 without Equ Temp, the values were estimated by subtracting 0.004 degC from the HydroLabTSG temperatures. 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. Original Data Location: http://www.aoml.noaa.gov/ocd/ocdweb/revelle/revelle_2016.html

Citation for this Dataset:

Other References for this Dataset: