

Dataset Expocode	33RO20170528
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Dataset	Funding Info: NOAA Climate Program Office Initial Submission (yyyymmdd): 20171017 Revised Submission (yyyymmdd): 20171017
Campaign/Cruise	Expocode: 33RO20170528 Campaign/Cruise Name: RB1703 Campaign/Cruise Info: AOML_SOOP_CO2 , TAO (95W, 110W) Platform Type: CO2 Instrument Type: Equilibrator-IR Survey Type: Research Cruise Vessel Name: R/V Ronald H. Brown Vessel Owner: NOAA Vessel Code: 33RO
Coverage	Start Date (yyyymmdd): 20170528 End Date (yyyymmdd): 20170625 Westernmost Longitude: 111.1 W Easternmost Longitude: 78.1 W Northernmost Latitude: 8.1 N Southernmost Latitude: 18.3 S Port of Call: Arica, Chile Port of Call: Panama City, Panama
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: Bow thruster room, before sea water pump, ~5 m below water line. Manufacturer: Seabird Model: SBE-38 Accuracy: 0.001 (°C if units not given) Precision: 0.0003 (°C if units not given) Calibration: Factory calibration Comments: Manufacturer's Resolution is taken as Precision; Maintained by ship.
Sea Surface Salinity	Location: The AOML SBE45 was attached to CO2 underway 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

Atmospheric Pressure

Location: On bulkhead exterior on the port side of the radio room aft of the bridge at ~14 m above the sea surface.
Normalized to Sea Level: yes
Manufacturer: Vaisala
Model: PTB330
Accuracy: ± 0.2 hPa (hPa if units not given)
Precision: ± 0.08 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 3.5 hours
Intake Location: Bow tower ~10 m above the 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
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): 1.5 - 2.0 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: ± 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 3.5 hours using field standards that were calibrated with primary standards that are directly traceable to the WMO X2007 scale. Ultra-High Purity air (0.0 ppm CO2) and the high standard are used to zero and span the LI-COR analyzer.
Number Non-Zero Gas Standards: 4
Calibration Gases:

Std 1: CA04957, 282.55 ppm, owned by ESRL, used every ~5.0 hours.
Std 2: CC105863, 380.22 ppm, owned by ESRL, used every ~5.0 hours.
Std 3: CB09696, 453.04 ppm, owned by ESRL, used every ~5.0 hours.
Std 4: CB09032, 539.38 ppm, owned by ESRL, used every ~5.0 hours.
Std 5: 0.00 ppm, owned by AOML, used every ~19.5 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: 1521

Accuracy: 0.025 (°C if units not given)

Precision: 0.01 (°C if units not given)

Calibration: Factory calibration

Comments: Resolution is taken as Precision.

**Equilibrator
Pressure Sensor**

Location: Attached to equilibrator headspace. Differential pressure reading from Setra 239 attached to the equilibrator headspace is added to the pressure reading from the LICOR, 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 during this cruise; the analytical system was stopped and restarted for exclusive economic zones. For the first 24 hrs of CO₂ data (YD 148.5-149.5), the Std1 (282ppm) did not have adequate flow. Fortunately, all of the EQU and ATM analyses had concentrations above Std2 (330ppm), so the unknowns were bracketed with std gas analyses. The system was not running for the next 12 hrs; and when the system was restarted all stds had good flow. Around YearDay 167.8, the seawater flow went from a stable 1.4 L/min to a stable 0.7 L/min; no other changes in the system performance were apparent. The ship's SBE38 SSTemperature sensor was replaced prior to this cruise and behaved much better than on previous cruises this year. Starting around 08:00 utc on 9 June (YD ~160.3) the SBE38 and hydro lab temperature sensors displayed increased noise. The noise in hydro lab temperatures decreased significantly after 24 hrs. The noise in the SBE38 temperatures continued for an additional 22 hrs and the offset between the SBE38 temperature and the hydro lab temperatures increased. At 05:15 utc on 11 June, the characteristics of the SBE38 temperature readings abruptly returned to their pattern prior to 9 June. For the 22 hr interval when the SBE38 alone was noisy (Yrday 161.32 to 162.22), the SST was estimated using the relationships determined for earlier cruises (RB1606 Legs1 and 2, GO-SHIP P18). The relationship determined for adjusting SSS during RB1606 was also applied on this data set. The ship sensors for measuring SST were not operating well during RB1606, so SST was estimated from good data further from the bow. The temperature and salinity data from the CTD casts from Legs 1 and 2 of P18 cruise (RB1606) were used to estimate SSTemperature and to adjust the SSSalinity used in the fCO₂ processing. A regression fit between the average temperature measured from the seawater supply in the Hydro Lab (HLT) and the CTD surface temperature was done for all casts. After eliminating twelve outlying data, the resulting linear equation was used to estimate the SST.

SST(estimated) = $1.01399 * HLT - 0.48039$; standard deviation of the differences between the CTD temperatures and the SST(estimated) is +/- 0.054 degree Celsius. A regression fit between the salinity measured in the Hydro Lab (HLS) and the CTD surface salinity was done for all casts. After eliminating nine outlying data, the resulting linear equation was used to adjust the SSS. $SSS(\text{adjusted}) = 0.998584 * HLS + 0.064605$; standard deviation of the differences between the CTD salinities and the SSS(adjusted) is +/- 0.0090 . For more information, see Supplemental ReadMe file for RB1606 (ExpoCode 33RO20161119). Original Data Location: http://www.aoml.noaa.gov/ocd/ocdweb/brown/brown_introduction.html
Full unprocessed data file from analytical instrument including flow information and ship's meteorological and TSG data at time of sampling can be obtained upon request.

Citation for this Dataset:

Other References for this Dataset: