

Dataset Expocode	33WA20191118
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Dataset	Funding Info: NOAA Climate Program Office; NOAA Ocean Acidification Program Initial Submission (yyyymmdd): 20200505 Revised Submission (yyyymmdd): 20200505
Campaign/Cruise	Expocode: 33WA20191118 Campaign/Cruise Name: WS19322 Campaign/Cruise Info: SOOP_CO2, SFER Platform Type: CO2 Instrument Type: Equilibrator-IR or CRDS or GC Survey Type: Research Cruise Vessel Name: R/V F.G. Walton Smith Vessel Owner: University of Miami Vessel Code: 33WA
Coverage	Start Date (yyyymmdd): 20191118 End Date (yyyymmdd): 20191124 Westernmost Longitude: 83.5 W Easternmost Longitude: 80 W Northernmost Latitude: 28.1 N Southernmost Latitude: 24.3 N Port of Call: Miami, FL, USA
Variable	Name: xCO2_EQU_ppm Unit:

Description: Mole fraction of CO₂ in the equilibrator headspace (dry) at equilibrator temperature (ppm)

Variable

Name: xCO₂_ATM_ppm

Unit:

Description: Mole fraction of CO₂ measured in dry outside air (ppm)

Variable

Name: xCO₂_ATM_interpolated_ppm

Unit:

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:

Description: Barometric pressure in the equilibrator headspace (hPa)

Variable

Name: PRES_ATM@SSP_hPa

Unit:

Description: Barometric pressure measured outside, corrected to sea level (hPa)

Variable

Name: TEMP_EQU_C

Unit:

Description: Water temperature in equilibrator (°C)

Variable

Name: SST_C

Unit:

Description: Sea surface temperature (°C)

Variable

Name: SAL_permil

Unit:

Description: Sea surface salinity on Practical Salinity Scale (o/oo)

Variable

Name: fCO₂_SW@SST_uatm

Unit:

Description: Fugacity of CO₂ in sea water at SST and 100% humidity (µatm)

Variable

Name: fCO₂_ATM_interpolated_uatm

Unit:

Description: Fugacity of CO₂ in air corresponding to the interpolated xCO₂ at SST and 100% humidity (µatm)

Variable

Name: dfCO₂_uatm

Unit:

Description: Sea water fCO₂ minus interpolated air fCO₂ (µatm)

Variable

Name: WOCE_QC_FLAG

Unit:

Description: Quality control flag for fCO₂ values (2=good, 3=questionable)

Variable

Name: QC_SUBFLAG

Unit:

Description: Quality control subflag for fCO₂ values, provides explanation when QC flag=3

**Sea Surface
Temperature**

Location: After sea water pump in the forward, port hull

Manufacturer: Seabird, Inc.

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: Near the sea water pump in the forward, port hull.

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 mast above bridge at ~13 m above sea surface.

Normalized to Sea Level: yes

Manufacturer: R.M. Young

Model: 61302

Accuracy: ± 0.3 hPa (hPa if units not given)

Precision: 0.1 hPa (hPa if units not given)

Calibration: Factory calibration

Comments: Manufacturer's Resolution is taken as Precision.

Atmospheric CO2

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

Intake Location: On mast above the bridge at ~13 meters 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: 1.5 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 ~4.5 hours using field standards that were calibrated with primary standards at AOML that are directly traceable to the WMO 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: FF4297, 213.54 ppm, owned by RSMAS, used every ~4.5 hours.

Std 2: FF42246, 382.17 ppm, owned by RSMAS, used every ~4.5 hours.

Std 3: FF36858, 607.03 ppm, owned by RSMAS, used every ~4.5 hours.

Std 4: FF3582, 1530.42 ppm, owned by RSMAS, used every ~4.5 hours.

Std 5: LL100000, 0.00 ppm, owned by AOML, used every ~23.0 hours.

Comparison to Other CO₂ Analyses:

Comments: Instrument is located in an air-conditioned laboratory.

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. 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 operated well during the cruise; though for the first two hours of the cruise, the ship's sensors were not recorded. Missing SST values were estimated by subtracting 0.32 degrees from the Equilibrator temperature. For the following 6 days, the average difference between the SST and Equilibrator temperature is 0.32 (+/- 0.09) degree Celsius. Missing barometric pressure values were estimated by subtracting 0.48 mbar from the LICOR pressure. For the following 6 days, the average difference between the barometric and LICOR pressures is 0.48 (+/- 0.10) mbar. Missing salinity values were estimated from adjacent measured values. Original Data Location: http://www.aoml.noaa.gov/ocd/ocdweb/wsmith/wsmith_introduction.html . Full unprocessed data files from analytical instrument including flow information plus meteorological and TSG data at time of sampling can be obtained upon request.

Citation for this Dataset:

Other References for this Dataset: