

<b>Dataset Expocode</b>	<b>33WA20170515</b>
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<b>Dataset</b>	<b>Funding Info:</b> NOAA Climate Program Office; NOAA Ocean Acidification Program <b>Initial Submission (yyyymmdd):</b> 20180515 <b>Revised Submission (yyyymmdd):</b> 20180515
<b>Campaign/Cruise</b>	<b>Expocode:</b> 33WA20170515 <b>Campaign/Cruise Name:</b> WS17135 <b>Campaign/Cruise Info:</b> SOOP_CO2 <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> R/V F.G. Walton Smith <b>Vessel Owner:</b> University of Miami <b>Vessel Code:</b> 33WA
<b>Coverage</b>	<b>Start Date (yyyymmdd):</b> 20170515 <b>End Date (yyyymmdd):</b> 20170613 <b>Westernmost Longitude:</b> 85.3 W <b>Easternmost Longitude:</b> 74 W <b>Northernmost Latitude:</b> 25.8 N <b>Southernmost Latitude:</b> 19.7 N <b>Port of Call:</b> Miami, FL, USA <b>Port of Call:</b> Havana, Cuba <b>Port of Call:</b> Cienfuegos, Cuba
<b>Variable</b>	<b>Name:</b> xCO2_EQU_ppm <b>Unit:</b> <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> <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>

**Description:** Mole fraction of CO<sub>2</sub> in outside air associated with each water analysis. These values are interpolated between the bracketing averaged good xCO<sub>2</sub>\_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:** fCO<sub>2</sub>\_SW@SST\_uatm

**Unit:**

**Description:** Fugacity of CO<sub>2</sub> in sea water at SST and 100% humidity (µatm)

**Variable**

**Name:** fCO<sub>2</sub>\_ATM\_interpolated\_uatm

**Unit:**

**Description:** Fugacity of CO<sub>2</sub> in air corresponding to the interpolated xCO<sub>2</sub> at SST and 100% humidity (µatm)

**Variable**

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

**Unit:**

**Description:** Sea water fCO<sub>2</sub> minus interpolated air fCO<sub>2</sub> (µatm)

**Variable**

**Name:** WOCE\_QC\_FLAG

**Unit:**

**Description:** Quality control flag for fCO<sub>2</sub> values (2=good, 3=questionable)

**Variable**

**Name:** QC\_SUBFLAG

**Unit:**

**Description:** Quality control subflag for fCO<sub>2</sub> 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:**  $\pm 0.3$  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:**  $\pm 0.5$   $\mu$ atm in fCO<sub>2</sub>\_ATM  
**Atmospheric CO2 Precision:**  $\pm 0.01$   $\mu$ atm in fCO<sub>2</sub>\_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 CO<sub>2</sub> sensing (not required)  
**Manufacturer:** LI-COR  
**Model:** 6262  
**Measured CO2 Values:** xco<sub>2</sub>(dry)  
**Measurement Frequency:** Every 140 seconds, except during calibration  
**Aqueous CO2 Accuracy:**  $\pm 2$   $\mu$ atm in fCO<sub>2</sub>\_SW  
**Aqueous CO2 Precision:**  $\pm 0.01$   $\mu$ atm in fCO<sub>2</sub>\_SW  
**Sensor Calibrations:**  
**Calibration of Calibration Gases:** The analyzer is calibrated every ~4.5 hours using field standards that were calibrated with primary standards that are directly traceable to the WMO scale. Ultra-High Purity air (0.0 ppm CO<sub>2</sub>) and the high standard are used to zero and span the LI-COR analyzer.  
**Number Non-Zero Gas Standards:** 4  
**Calibration Gases:**

Std 1: 201.11 ppm, owned by RSMAS, used every ~4.5 hours.  
Std 2: 382.17 ppm, owned by RSMAS, used every ~4.5 hours.  
Std 3: 668.13 ppm, owned by RSMAS, used every ~4.5 hours.  
Std 4: 1530.4 ppm, owned by RSMAS, used every ~4.5 hours.

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

**Comparison to Other CO<sub>2</sub> 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 pCO<sub>2</sub> measuring systems and data reduction routines, Deep-Sea Res II, 56, 512-522.

**Equilibrator**

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

**Temperature Sensor**

**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**

**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.

**Pressure Sensor**

**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:** No data for the ship sensors were recorded from YrDay 135.093 to 135.132. For this interval, The SST (SBE-38) was estimated by subtracting 0.272 (+/-0.058) degree Celsius from EQU-T; the Barom-pressure was estimated by adding 1.66 (+/- 0.24) mbar to Licor-P; the SSS was assigned a value of 36. Analyses during this interval were flagged 3. Standard 4 was shut off erroneously around YrDay 161, so the other 3 standards were used for processing for the end of the cruise. Starting at ~04:30 on 1 June (YrDay 152.2), the raw millivolts output of the LICOR analyzer steadily decreased, which was likely due to the scrubber chemicals not removing all of the CO<sub>2</sub> from the reference cell. Since the response of both the standard and unknown analyses changed, the calculated fCO<sub>2</sub> values were consistent with other measurements when crossovers from other ships/systems could be found. However, the estimated uncertainty of the fCO<sub>2</sub> values increased to 5-10 uatm. These analyses were flagged 3. The analytical system continued to run while the ship was in the Cuban ports: Havana, YrDay 136.53 - 137.77; Cienfuegos, YrDay 149.54 - 150.86; Havana, YrDay 162.63 - 163.73. The atmospheric analyses were retained, but most of the water analyses dockside are not submitted. Original Data Location: [http://www.aoml.noaa.gov/ocd/ocdweb/wsmith/wsmith\\_introduction.html](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:**