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**Dataset Information:**

Funding\_Info: NOAA Climate Program Office; NOAA Ocean Acidification Program  
Initial\_Submission: 20160130  
Revised\_Submission: 20160130

**Cruise Information:**

Experiment Name: WS1215  
Experiment Type: Research Cruise  
Platform Type: Ship  
Co2 Instrument Type: Equilibrator-IR or CRDS or GC

Cruise ID: 33WA20120917  
Cruise Info: USWTR-APT; SOOP\_CO2

**Geographical Region:**

Westernmost Longitude: -80.5  
Easternmost Longitude: -80.0  
Northernmost Latitude: 30.5  
Southernmost Latitude: 25.7

**Cruise Dates (YYYYMMDD)**

Start\_Date: 20120917  
End\_Date: 20120925

**Ports of Call:**

Miami, FL

Vessel Name: F.G. Walton Smith  
Vessel ID: 33WA  
Vessel Owner: University of Miami

## Variables Information:

Variable Name: xCO2\_EQU\_ppm

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

Unit of Variable: ppm

Variable Name: xCO2\_ATM\_ppm

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

Unit of Variable: ppm

Variable Name: xCO2\_ATM\_interpolated\_ppm

Description of Variable: 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)

Unit of Variable: ppm

Variable Name: PRES\_EQU\_hPa

Description of Variable: Barometric pressure in the equilibrator headspace (hectopascals)

Unit of Variable: hPa

Variable Name: PRES\_ATM@SSP\_hPa

Description of Variable: Barometric pressure measured outside, corrected to sea level (hectopascals)

Unit of Variable: hPa

Variable Name: TEMP\_EQU\_C

Description of Variable: Water temperature in equilibrator (degrees Celsius)

Unit of Variable: Degree C

Variable Name: SST\_C

Description of Variable: Sea surface temperature (degrees Celsius)

Unit of Variable: Degree C

Variable Name: SAL\_permil

Description of Variable: Sea surface salinity on Practical Salinity Scale (permil)

Unit of Variable: ppt

Variable Name: fCO2\_SW@SST\_uatm

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

Unit of Variable:  $\mu$ atm

Variable Name: fCO2\_ATM\_interpolated\_uatm

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

Unit of Variable:  $\mu$ atm

Variable Name: dfCO2\_uatm

Description of Variable: Sea water fCO2 minus interpolated air fCO2 (microatmospheres)

Unit of Variable:  $\mu$ atm

Variable Name: WOCE\_QC\_FLAG

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

Unit of Variable: None

Variable Name: QC\_SUBFLAG

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

Unit of Variable: None

## Method Description:

### Equilibrator Design:

Depth of Seawater Intake: 1.5 meters

Location of Seawater Intake: Bow

Equilibrator Type: Sprayhead above dynamic pool, with thermal jacket

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

Water Flow Rate: 1.5 - 2.0 L/min

Headspace Gas Flow Rate: 70 - 150 ml/min

Vented: Yes

Drying Method for CO<sub>2</sub> in Water:

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

Additional Information: Primary equilibrator is vented through a secondary equilibrator

### CO<sub>2</sub> in Marine Air:

Measurement: Yes, 5 readings in a group every 4 hours

Location and Height: Mast above the bridge, ~13 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).

### CO<sub>2</sub> Sensor:

Measurement Method: Infrared absorption of dry sample gas

Manufacturer: LI-COR

Model: 840

Frequency: Every 140 seconds, except during calibration

Resolution Water: 0.01 microatmosphere

Uncertainty Water: ± 2 microatmospheres

Resolution Air: 0.01 ppm

Uncertainty Air: ± 0.8 ppm

Manufacturer of Calibration Gas:

Airgas, Inc. - Std 1: 202.52 ppm / Std 2: 391.28 ppm / Std 3: 628.67 ppm / Std 4: 1479.07 ppm

Number of Non Zero Gas Standards: 4

### CO<sub>2</sub> Sensor Calibration:

The analyzer is calibrated every 4 hours with field standards that in turn were calibrated with primary standards that are directly traceable to the WMO scale.

### Other Comments:

Instrument is located in an air-conditioned laboratory.

### Method References:

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.

### Details Co<sub>2</sub> Sensing:

details of CO<sub>2</sub> sensing (not required)

### Measured Co<sub>2</sub> Params:

xco<sub>2</sub>(dry)

### Sea Surface Temperature:

Location: After sea water pump  
Manufacturer: Seabird  
Model: SBE-38  
Accuracy Degrees Celsius: 0.001  
Precision Degrees Celsius: 0.00025  
Calibration: Factory calibration  
Comments: Manufacturer's Resolution is taken as Precision; Maintained by ship.

Equilibrator Temperature:

Location: Inserted into equilibrator ~5 cm below water level  
Manufacturer: Hart  
Model: 1523  
Accuracy Degrees Celsius: 0.015  
Precision Degrees Celsius: 0.001  
Calibration: Factory calibration  
Comments: Manufacturer's Resolution is taken as Precision.

Equilibrator Pressure:

Location: Attached to equilibrator headspace  
Manufacturer: Setra  
Model: 239  
Accuracy hPa: 0.052  
Precision hPa: 0.01  
Calibration: Factory calibration  
Comments:  
Differential pressure reading from Setra-239 attached to the equilibrator headspace was added to the pressure reading of the analyzer to yield the equilibrator pressure. Manufacturer's Resolution is taken as Precision.

Atmospheric Pressure:

Location: On mast above the bridge at ~13 m above the sea surface water  
Manufacturer: R.M. Young  
Model: 61302  
Accuracy:  $\pm 0.3$  hPa  
Precision: 0.1 hPa  
Calibration: Factory calibration  
Normalized: yes  
Comments: Manufacturer's Resolution is taken as Precision; Maintained by ship.

Sea Surface Salinity:

Location: In dry lab  
Manufacturer: Seabird  
Model: SBE 45  
Accuracy:  $\pm 0.005$  permil  
Precision: 0.0002 permil  
Calibration: Factory calibration  
Comments: Manufacturer's Resolution is taken as Precision; Maintained by ship.

**Additional Information:**

The pressure transducer in the LICOR analyzer operated well, though the atmospheric pressure recorded by the ship had a resolution of 1 mbar. A simple linear regression was done between the measured LICOR and atmospheric pressures and was used to estimate atmospheric pressure values with 0.1 mbar resolution. During a 6.5 hour interval with the ship close to the Fort Pierce Inlet, there was no water flow through the TSG

(SBE45). The missing salinity data were assigned a value of 34 psu.

**Preliminary Quality Control:**

NA

**Form Type:**

underway