

Contact Person:

Name: Woosley, Ryan
Organization: RSMAS/University of Miami
Address: 4600 Rickenbacker Causeway, Miami, FL 33149
Phone: (305) 421-4708
Email: rwoosley@rsmas.miami.edu

Investigator(s):

Name: Millero, Frank
Organization: RSMAS/University of Miami
Address: 4600 Rickenbacker Causeway, Miami FL, 33149
Phone: 305-421-4707
Email: FMillero@rsmas.miami.edu

Name: Wanninkhof, Rik
Organization: NOAA/Atlantic Oceanographic & Meteorological Laboratory
Address: 4301 Rickenbacker Causeway, Miami FL, 33149
Phone: 305-361-4379
Email: Rik.Wanninkhof@noaa.gov

Dataset Information:

Funding_Info: NOAA Climate Program Office; NOAA Ocean Acidification Program
Initial_Submission: 20160130
Revised_Submission: 20160130

Cruise Information:

Experiment Name: WS15012
Experiment Type: Research Cruise
Platform Type: Ship
Co2 Instrument Type: Equilibrator-IR or CRDS or GC

Cruise ID: 33WA20150112
Cruise Info: 27N Survey, SOOP_CO2

Geographical Region:

Westernmost Longitude: -80.2
Easternmost Longitude: -79.1
Northernmost Latitude: 27.1
Southernmost Latitude: 25.7

Cruise Dates (YYYYMMDD)

Start_Date: 20150112
End_Date: 20150114

Ports of Call:

Miami, FL, USA

Vessel Name: R/V 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 (hPa)

Unit of Variable: hPa

Variable Name: PRES_ATM@SSP_hPa

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

Unit of Variable: hPa

Variable Name: TEMP_EQU_C

Description of Variable: Water temperature in equilibrator (°C)

Unit of Variable: Degree C

Variable Name: SST_C

Description of Variable: Sea surface temperature (°C)

Unit of Variable: Degree C

Variable Name: SAL_permil

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

Unit of Variable: ppt

Variable Name: fCO2_SW@SST_uatm

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

Unit of Variable: µatm

Variable Name: fCO2_ATM_interpolated_uatm

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

Unit of Variable: µatm

Variable Name: dfCO2_uatm

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

Unit of Variable: µatm

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: Spray head 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 CO₂ 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.

CO₂ in Marine Air:

Measurement: Yes, 5 readings in a group every 4.5 hours

Location and Height: 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).

CO₂ Sensor:

Measurement Method: IR

Manufacturer: LI-COR

Model: 6262

Frequency: Every 140 seconds, except during calibration

Resolution Water: $\pm 0.01 \mu\text{atm}$ in fCO₂_SW

Uncertainty Water: $\pm 2 \mu\text{atm}$ in fCO₂_SW

Resolution Air: $\pm 0.01 \mu\text{atm}$ in fCO₂_ATM

Uncertainty Air: $\pm 0.5 \mu\text{atm}$ in fCO₂_ATM

Manufacturer of Calibration Gas:

Std 1: 202.52 ppm, owned by RSMAS, used every ~4.5 hours. Std 2: 391.28 ppm, owned by RSMAS, used every ~4.5 hours. Std 3: 628.68 ppm, owned by RSMAS, used every ~4.5 hours. Std 4: 1537.18 ppm, owned by RSMAS, used every ~4.5 hours. Std 5: 0.00 ppm, owned by AOML, used every ~NaN hours.

Number of Non Zero Gas Standards: 4

CO₂ Sensor Calibration:

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 CO₂) and the high standard are used to zero and span the LI-COR analyzer.

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 pCO₂ measuring systems and data reduction routines, Deep-Sea Res II, 56, 512-522.

Details Co₂ Sensing:

details of CO₂ sensing (not required)

Measured Co2 Params:

xco2(dry)

Sea Surface Temperature:

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

Manufacturer: Seabird, Inc.

Model: SBE 38

Accuracy Degrees Celsius: 0.001

Precision Degrees Celsius: 0.0003

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: Resolution is taken as Precision.

Equilibrator Pressure:

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 hPa: 0.15

Precision hPa: 0.015

Calibration: Factory calibration

Comments:

Manufacturer's Resolution is taken as Precision.

Atmospheric Pressure:

Location: On mast above bridge at ~13 m above sea surface.

Manufacturer: R.M. Young

Model: 61302

Accuracy: ± 0.3 hPa

Precision: 0.1 hPa

Calibration: Factory calibration

Normalized: yes

Comments: Manufacturer's Resolution is taken as Precision.

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

Additional Information:

The analytical system performed well. The salinity and SST sensors were not logged for the last 28 analyses. The SST was estimated by subtracting 0.26 degrees from the equilibrator temperature, and the salinity was assigned a value of 36 psu. Original Data Location: http://www.aoml.noaa.gov/ocd/ocdweb/wsmith/wsmith_introduction.html

Preliminary Quality Control:

NA

Form Type:

underway