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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: GU1105\_Leg1  
Experiment Type: Research Cruise  
Platform Type: Ship  
Co2 Instrument Type: Equilibrator-IR or CRDS or GC

Cruise ID: 33GG20111007  
Cruise Info: AOML\_SOOP\_CO2  
Geographical Region:

Westernmost Longitude: -85.7  
Easternmost Longitude: -72.3  
Northernmost Latitude: 39.2  
Southernmost Latitude: 24.0

Cruise Dates (YYYYMMDD)

Start\_Date: 20111008  
End\_Date: 20111026

Ports of Call:

Pascagoula, MS  
Charleston, SC  
Norfolk, VA

Vessel Name: R/V Gordon Gunter

Vessel ID: 33GG  
Vessel Owner: NOAA

**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 ( $\mu\text{atm}$ )  
Unit of Variable:  $\mu\text{atm}$

Variable Name: fCO2\_ATM\_interpolated\_uatm  
Description of Variable: Fugacity of CO2 in air corresponding to the interpolated xCO2 at SST and 100% humidity ( $\mu\text{atm}$ )  
Unit of Variable:  $\mu\text{atm}$

Variable Name: dfCO2\_uatm  
Description of Variable: Sea water fCO2 minus interpolated air fCO2 ( $\mu\text{atm}$ )  
Unit of Variable:  $\mu\text{atm}$

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 fCO<sub>2</sub> values, provides explanation when QC flag=3

Unit of Variable: None

### Method Description:

#### Equilibrator Design:

Depth of Seawater Intake: 5 meters

Location of Seawater Intake: Bow

Equilibrator Type: Spray head above dynamic pool, no 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 3 hours

Location and Height: Bow mast, ~15 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: IR

Manufacturer: LI-COR

Model: 7000

Frequency: Every 140 seconds, except during calibration

Resolution Water: ± 0.01 µatm in fCO<sub>2</sub>\_SW

Uncertainty Water: ± 2 µatm in fCO<sub>2</sub>\_SW

Resolution Air: ± 0.01 µatm in fCO<sub>2</sub>\_ATM

Uncertainty Air: ± 0.5 µatm in fCO<sub>2</sub>\_ATM

Manufacturer of Calibration Gas:

Std 1: LL100000, 0.00 ppm, owned by AOML, used every ~2.5 hours. Std 2: JA02267, 247.72 ppm, owned by AOML, used every ~2.5 hours. Std 3: FA02258, 399.25 ppm, owned by AOML, used every ~2.5 hours. Std 4: JA02689, 520.79 ppm, owned by AOML, used every ~2.5 hours.

Number of Non Zero Gas Standards: 3

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

The analyzer is calibrated every 4.5 hours with field standards that in turn were calibrated with primary standards that are directly traceable to the WMO scale. The zero gas is ultra-high purity air.

Other Comments:

Instrument is located in an air-conditioned laboratory. Ultra-High Purity air (0.0 ppm CO<sub>2</sub>) and the high standard gas are used to zero and span the LI-COR analyzer.

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 Co2 Sensing:

details of CO2 sensing (not required)

Measured Co2 Params:

xco2(dry)

Sea Surface Temperature:

Location: hull mounted, ~3 m below sea surface

Manufacturer: Furuno

Model: T2000

Accuracy Degrees Celsius: 0.2

Precision Degrees Celsius: 0.1

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: 1521

Accuracy Degrees Celsius: 0.025

Precision Degrees Celsius: 0.001

Calibration: Factory calibration

Comments: Resolution is taken as Precision.

Equilibrator Pressure:

Location: Attached to equilibrator headspace. Combined with Licor Pressure

Manufacturer: Licor

Model: None

Accuracy hPa: 1.2

Precision hPa: 0.02

Calibration: Factory calibration

Comments:

Differential pressure reading from Setra-239 attached to the equilibrator headspace was added to the pressure reading from the LICOR analyzer to yield equilibrator pressure. Manufacturer's Resolution is taken as Precision.

Atmospheric Pressure:

Location: Next to the bridge, ~15 m above the sea surface water

Manufacturer: RMYoung

Model: 61201

Accuracy:  $\pm 0.5$  hPa

Precision: 0.01 hPa

Calibration: Factory calibration

Normalized: yes

Comments: Manufacturer's Resolution is taken as Precision; Maintained by ship.

Sea Surface Salinity:

Location: In Chem lab, next to CO2 system

Manufacturer: Seabird

Model: SBE 21

Accuracy:  $\pm 0.05$  o/oo

Precision: 0.002 o/oo

Calibration: Factory calibration

Comments: Manufacturer's Resolution is taken as Precision; Maintained by ship.

**Additional Information:**

This data set presented several issues with the analyzer showing large jumps in the readings, water flow being problematic in the middle of the cruise. For these reasons, the LI-7000 Firmware 2.0 bug correction was not applied and all values that could be saved have been flagged 3. We estimate that their accuracy might be in the range of 5-10 ppm. All original data can be found at: [http://www.aoml.noaa.gov/ocd/ocdweb/gunter/gunter\\_introduction.html](http://www.aoml.noaa.gov/ocd/ocdweb/gunter/gunter_introduction.html)

**Preliminary Quality Control:**

NA

**Form Type:**

underway