

Dataset Expocode	MLCE20170130
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Dataset	Funding Info: NOAA Climate Program Office; NOAA Ocean Acidification Program Initial Submission (yyyymmdd): 20170404 Revised Submission (yyyymmdd): 20170404
Campaign/Cruise	Expocode: MLCE20170130 Campaign/Cruise Name: EQNX_20170130 Campaign/Cruise Info: AOML_SOOP_CO2 Platform Type: CO2 Instrument Type: Equilibrator-IR or CRDS or GC Survey Type: SOOP Line Vessel Name: M/V Equinox Vessel Owner: Royal Caribbean International Vessel Code: MLCE
Coverage	Start Date (yyyymmdd): 20170130 End Date (yyyymmdd): 20170210 Westernmost Longitude: 87.1 W Easternmost Longitude: 75.6 W Northernmost Latitude: 26.1 N Southernmost Latitude: 9.3 N Port of Call: Fort Lauderdale, FL Port of Call: Georgetown, Grand Cayman Port of Call: Cartagena, Columbia Port of Call: Colon, Panama Port of Call: Puerto Limon, Costa Rica Port of Call: Cozumel, Mexico
Variable	Name: xCO2_EQU_ppm Unit: ppm Description: Mole fraction of CO2 in the equilibrator headspace (dry) at equilibrator temperature (ppm)
Variable	Name: xCO2_ATM_ppm Unit: ppm Description: Mole fraction of CO2 measured in dry outside air (ppm)
Variable	Name: xCO2_ATM_interpolated_ppm

Unit: ppm
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: hPa
Description: Barometric pressure in the equilibrator headspace (hPa)

Variable **Name:** PRES_ATM@SSP_hPa
Unit: hPa
Description: Barometric pressure measured outside, corrected to sea level (hPa)

Variable **Name:** TEMP_EQU_C
Unit: Degree C
Description: Water temperature in equilibrator (°C)

Variable **Name:** SST_C
Unit: Degree C
Description: Sea surface temperature (°C)

Variable **Name:** SAL_permil
Unit: ppt
Description: Sea surface salinity on Practical Salinity Scale (o/oo)

Variable **Name:** fCO₂_SW@SST_uatm
Unit: µatm
Description: Fugacity of CO₂ in sea water at SST and 100% humidity (µatm)

Variable **Name:** fCO₂_ATM_interpolated_uatm
Unit: µatm
Description: Fugacity of CO₂ in air corresponding to the interpolated xCO₂ at SST and 100% humidity (µatm)

Variable **Name:** dfCO₂_uatm
Unit: µatm
Description: Sea water fCO₂ minus interpolated air fCO₂ (µatm)

Variable **Name:** WOCE_QC_FLAG
Unit: None
Description: Quality control flag for fCO₂ values (2=good, 3=questionable)

Variable **Name:** QC_SUBFLAG
Unit: None
Description: Quality control subflag for fCO₂ values, provides explanation when QC flag=3

Sea Surface Temperature **Location:** In Bow Thruster room, about 1m after the intake which is directly through the ship's hull, before the SW pump.
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 University of Miami's MTG group.

Sea Surface Salinity **Location:** Next to the pCO₂ System.
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; Maintained by University of Miami's MTG group.

Atmospheric Pressure

Location: At the base of the radar mast, 48 meter above sea level.
Normalized to Sea Level: no
Manufacturer: Vaisala
Model: WXT520
Accuracy: ± 0.5 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; Maintained by University of Miami's MTG group.

Atmospheric CO2

Measured/Frequency: Yes, 5 readings in a group every 5 hours.
Intake Location: At forward-most, grated opening in the starboard hull on the mooring deck, which is 12 meters above sea level.
Drying Method: Gas stream passes through a thermoelectric condenser ($\sim 5^\circ\text{C}$) and then through a Perma Pure (Nafion) dryer before reaching the analyzer (90% dry).
Atmospheric CO2 Accuracy: ± 0.5 μatm in fCO2_ATM
Atmospheric CO2 Precision: ± 0.01 μatm in fCO2_ATM

Aqueous CO2 Equilibrator Design

System Manufacturer:
Intake Depth: 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 ($\sim 5^\circ\text{C}$) 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 μatm in fCO2_SW
Aqueous CO2 Precision: ± 0.01 μatm in fCO2_SW
Sensor Calibrations:
Calibration of Calibration Gases: The analyzer is calibrated every 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.
Number Non-Zero Gas Standards: 4
Calibration Gases:

Std 1: CA05585, 280.18 ppm, owned by ESRL, used every ~5.0 hours.
Std 2: CA06368, 328.12 ppm, owned by ESRL, used every ~5.0 hours.
Std 3: CA05979, 381.89 ppm, owned by AOML, used every ~5.0 hours.
Std 4: CB08988, 455.60 ppm, owned by ESRL, used every ~5.0 hours.
Std 5: 0.00 ppm, owned by AOML, used every ~26.5 hours.

Comparison to Other CO2 Analyses:

Comments:

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. The differential pressure reading from Setra 239, which is attached to the equilibrator headspace, is added to the pressure reading from the LICOR analyzer, 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: From YrDay 36.36 to 38.22, the equilibrator temperature was ~1.5 deg C higher than the SBE45 and SBE38 temperatures, and the XCO₂ for water analyses was much higher. Before and after that interval, the equilibrator temperature was only ~0.2 deg C higher. No reason could be found to explain the increase in temperature, so the water analyses were deleted. From YrDay 30.96 to 31.53, the condensor temperature was much higher than normal, the LICOR temperature was lower than normal, and the LICOR response was higher than the surrounding data. No reason could be found and the results were inconsistent with the surrounding data, so these data were deleted. The atmospheric pressure sensor was not being logged for about a third of the cruise. The missing atmospheric pressure values were estimated by subtracting 6.45 mbar from the LICOR pressure. The average difference between the LICOR and atmospheric pressures was 6.45 (+/-0.42) mbar, n=1646. Original Data Location: http://www.aoml.noaa.gov/ocd/ocdweb/equinox/equinox_introduction.html

Citation for this Dataset:

Other References for this Dataset: