

Dataset Expocode	MLCE20250111
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Dataset	Funding Info: NOAA Climate Program Office; NOAA Ocean Acidification Program Initial Submission (yyyymmdd): 20250203 Revised Submission (yyyymmdd):
Campaign/Cruise	Expocode: MLCE20250111 Campaign/Cruise Name: EQNX_20250111 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): 20250111 End Date (yyyymmdd): 20250118 Westernmost Longitude: 85.2 W Easternmost Longitude: 70.6 W Northernmost Latitude: 28.5 N Southernmost Latitude: 18.5 N Port of Call: Port Canaveral, FL
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: RM Young

Model: 61202V

Accuracy: ± 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; 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 X2007 scale. The zero gas is ultra-high purity air.

Number Non-Zero Gas Standards: 4

Calibration Gases:

Std 1: CA07347, 246.72 ppm, owned by ESRL-X2019, used every ~ 5.0 hours. Std

2: CA06769, 368.10 ppm, owned by ESRL-X2019, used every ~ 5.0 hours. Std 3:

CA05998, 419.51 ppm, owned by AOML-X2019, used every ~ 5.0 hours. Std 4:

CC749968, 498.60 ppm, owned by AOML-X2019, used every ~5.0 hours. Std 5: LL100000, 0.00 ppm, owned by AOML, used every ~25.0 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: About half of SST values are missing due to sensor communication issues. Between Year Day 13 and 16, and end of year day 17, SST was generated from an offset with equ T calculated on year day 12 to be: equ T - SST = -0.017 ± 0.049. Others were interpolated. Those values are flagged 3 but should be good to within ± 0.05 °C. An offset of 0.46 minutes between SST and equ T was applied to minimize Delta T.

Citation for this Dataset:

Other References for this Dataset: