

Dataset Expocode	MLCE20230406
Primary Contact	Name: Sullivan, Kevin Organization: NOAA/AOML CIMAS Address: 4301 Rickenbacker Causeway, Miami, FI 33149 Phone: (305) 361-4382 Email: kevin.sullivan@noaa.gov
Investigator	Name: Wanninkhof, Rik Organization: NOAA/Atlantic Oceanographic & Meteorological Laboratory Address: 4301 Rickenbacker Causeway, Miami FI, 33149 Phone: 305-361-4379 Email: Rik.Wanninkhof@noaa.gov
Investigator	Name: Pierrot, Denis Organization: NOAA/Atlantic Oceanographic & Meteorological Laboratory Address: 4301 Rickenbacker Causeway, Miami FI, 33149 Phone: 305-361-4441 Email: Denis.Pierrot@noaa.gov
Dataset	Funding Info: NOAA Climate Program Office; NOAA Ocean Acidification Program Initial Submission (yyyymmdd): 20230504 Revised Submission (yyyymmdd): 20230504
Campaign/Cruise	Expocode: MLCE20230406 Campaign/Cruise Name: EQNX_20230406 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): 20230406 End Date (yyyymmdd): 20230412 Westernmost Longitude: 85.2 W Easternmost Longitude: 68.2 W Northernmost Latitude: 26.1 N Southernmost Latitude: 11.9 N Port of Call: Fort Lauderdale, FL Port of Call: Georgetown, Grand Cayman Port of Call: Oranjestad, Aruba Port of Call: Willemstad, Curacao Port of Call: Kralendijk, Bonaire
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: fCO ₂ _SW@SST_uatm Unit: µatm Description: Fugacity of CO ₂ in sea water at SST and 100% humidity (µatm)
Variable	Name: fCO ₂ _ATM_interpolated_uatm Unit: µatm Description: Fugacity of CO ₂ in air corresponding to the interpolated xCO ₂ at SST and 100% humidity (µatm)
Variable	Name: dfCO ₂ _uatm Unit: µatm Description: Sea water fCO ₂ minus interpolated air fCO ₂ (µatm)
Variable	Name: WOCE_QC_FLAG Unit: None Description: Quality control flag for fCO ₂ values (2=good, 3=questionable)
Variable	Name: QC_SUBFLAG Unit: None Description: Quality control subflag for fCO ₂ 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 pCO ₂ 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: CA05585, 280.24 ppm, owned by ESRL, used every ~5.0 hours.
Std 2: CA05979, 382.05 ppm, owned by AOML, used every ~5.0 hours.
Std 3: CA05998, 419.51 ppm, owned by AOML, used every ~5.0 hours.
Std 4: CB08988, 455.80 ppm, owned by ESRL, used every ~5.0 hours.
Std 5: LL100000, 0.00 ppm, owned by AOML, used every ~24.0 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: The analytical system operated well during this cruise.

The scientific GPS signal was lost for the last 3 days, so no data reported.

Original Data Location: http://www.aoml.noaa.gov/ocd/ocdweb/equinox/equinox_introduction.html. Full unprocessed data files from analytical instrument including flow information plus meteorological and TSG data at time of sampling can be obtained upon request.

Citation for this Dataset:

Other References for this Dataset: