

Contact Person:

Name: Pierrot, Denis
Organization: NOAA/Atlantic Oceanographic & Meteorological Laboratory
Address: 4301 Rickenbacker Causeway, Miami Fl, 33149
Phone: 305-361-4441
Email: Denis.Pierrot@noaa.gov

Investigator(s):

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

Name: Pierrot, Denis
Organization: NOAA/Atlantic Oceanographic & Meteorological Laboratory
Address: 4301 Rickenbacker Causeway, Miami Fl, 33149
Phone: 305-361-4441
Email: Denis.Pierrot@noaa.gov

Dataset Information:

Funding_Info: NOAA Climate Program Office
Initial_Submission: 20150703
Revised_Submission: 20160130

Cruise Information:

Experiment Name: Reykj-1309
Experiment Type: SOOP Line
Platform Type: Ship
Co2 Instrument Type: Equilibrator-IR or CRDS or GC

Cruise ID: 64RJ20130906
Cruise Info: AOML_SOOP_CO2

Geographical Region:
Westernmost Longitude: -70.3
Easternmost Longitude: -22.0
Northernmost Latitude: 64.2
Southernmost Latitude: 43.1

Cruise Dates (YYYYMMDD)
Start_Date: 20130906
End_Date: 20130917

Ports of Call:
Portland, ME
Argentia, NL, Canada
St Anthony, NL, Canada
Reykjavik, Iceland

Vessel Name: M/V Reykjafoss
Vessel ID: 64RJ
Vessel Owner: Buss Reederei - Leer, Germany

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: 5 meters

Location of Seawater Intake: Sea chest under the engine room, at the stern of the ship

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 a post above the bridge at ~25 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: CA05998, 209.10 ppm, owned by AOML, used every ~4.5 hours. Std 2: JA02264, 317.86 ppm, owned by AOML, used every ~4.5 hours. Std 3: FA02294, 379.55 ppm, owned by AOML, used every ~4.5 hours. Std 4: CA07923, 428.07 ppm, owned by ESRL, used every ~4.5 hours. Std 5: 0.00 ppm, owned by AOML, used every ~12.0 hours.

Number of Non Zero Gas Standards: 4

CO₂ Sensor Calibration:

The analyzer is calibrated every ~4.5 hours using standards that are directly traceable to the WMO scale and using other field standards that in turn 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 alcove of the ship's engine room. The space is not air-conditioned but the

temperature is somewhat controlled by air vents.

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: In ship's engine room at a side port off the piping carrying cooling water for the engines, which is the source of the analytical seawater. The reported SST is the value measured at the side port.

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: The usual temperature probe was not available, so the temperature in the TSG (SBE45) attached to the side of the wet box was used as the temperature in the equilibrator.

Manufacturer: Seabird

Model: 45, internal temperature

Accuracy Degrees Celsius: 0.002

Precision Degrees Celsius: 0.0001

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 a post above bridge at ~25 m above sea surface.

Manufacturer: Druck

Model: RPT350

Accuracy: ± 0.08 hPa

Precision: 0.01 hPa

Calibration: Factory calibration

Normalized: yes

Comments: Manufacturer's Resolution is taken as Precision.

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 the SOOP group at AOML.

Additional Information:

EQU Temp sensor was not powered, so the TSG internal temperature was used as the EQU temperature.

Usually these two temperatures match each other. No time offset between the SST and EQU temperatures was detected. There were a lot of issues with Standard measurements and a lot of them were not used to correct the xCO₂ data. STD1 was very unstable (offset +/- 5 ppm) and was flagged 4 when offset $\sim < -5$. No STD2 (~ 300 ppm). STD3 became depleted starting on YDay ~ 259 ; the last 2-3 STD3 measurements were flagged 4. A lot of points were corrected using only 2 standards and therefore were flagged 3. Original Data Location: http://www.aoml.noaa.gov/ocd/gcc/reykjafoss_introduction.php

Preliminary Quality Control:

NA

Form Type:

underway