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Dataset Information:

Cruise Information:

Experiment Name: I09N
Experiment Type: Research Cruise
Platform Type: Ship
Co2 Instrument Type: Equilibrator-IR or CRDS or GC
Cruise ID: 33RR20160321
Cruise Info: AOML_SOOP_CO2; RR1604, I09N L.Barbero (AOML) chief scientist
Geographical Region:
Westernmost Longitude: 84.7
Easternmost Longitude: 115.6
Northernmost Latitude: 17.9
Southernmost Latitude: -32.0
Cruise Dates (YYYYMMDD)
Start_Date: 20160321
End_Date: 20160427
Ports of Call:
Fremantle, Australia
Phuket, Thailand
Vessel Name: Roger Revelle
Vessel ID: 33RR
Vessel Owner: U.S. Navy; operated by Scripps Institute of Oceanography

Variables Information:

Variable Name: xCO2_EQU_ppm

Description of Variable: Mole fraction of CO_2 in the equilibrator headspace (dry) at equilibrator temperature (ppm)
Unit of Variable: ppm
Variable Name: xCO2_ATM_ppm
Description of Variable: Mole fraction of CO_2 measured in dry outside air (ppm)
Unit of Variable: ppm
Variable Name: xCO2_ATM_interpolated_ppm
Description of Variable: Mole fraction of CO_2 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 CO_2 in sea water at SST and 100% humidity (µatm)
Unit of Variable: µatm
Variable Name: fCO2_ATM_interpolated_uatm
Description of Variable: Fugacity of CO_2 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: Bow, or engine room sea chest (mid 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: 1.3 - 2.5 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: Bow mast, ~18 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).

CO2 Sensor:

Measurement Method: IR

Manufacturer: LI-COR

Model: 6262

Frequency: Every 140 seconds, except during calibration

Resolution Water: ± 0.01 µatm in fCO2_SW

Uncertainty Water: ± 2 µatm in fCO2_SW

Resolution Air: ± 0.01 µatm in fCO2_ATM

Uncertainty Air: ± 0.5 µatm in fCO2_ATM

Manufacturer of Calibration Gas:

Std 1: JA02280, 233.46 ppm, owned by AOML, used every ~4.5 hours. Std 2: JA02264, 326.18 ppm, owned by AOML, used every ~4.5 hours. Std 3: JA02285, 406.06 ppm, owned by AOML, used every ~4.5 hours. Std 4: JA02646, 463.00 ppm, owned by AOML, used every ~4.5 hours. Std 5: 0.00 ppm, owned by AOML, used every ~23.5 hours.

Number of Non Zero Gas Standards: 4

CO2 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 the air-conditioned Hydro Laboratory. Ultra-High Purity air (0.0 ppm CO2) 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 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: Hydro Lab, near CO2 system

Manufacturer: Seabird

Model: 45

Accuracy Degrees Celsius: 0.002

Precision Degrees Celsius: 0.0002

Calibration: Factory calibration

Comments: Manufacturer's Typical Stability is taken as Precision; Maintained by ship. A regression fit between the average temperature measured in the Hydro Lab and the CTD surface temperature was done for all casts to estimate the SST. See additional comments below and supplemental ReadMe file.

Equilibrator Temperature:

Location: Inserted into equilibrator ~5 cm below water level

Manufacturer: Hart

Model: 1523

Accuracy Degrees Celsius: 0.015

Precision Degrees Celsius: 0.001

Calibration: Factory calibration

Comments: Resolution is taken as Precision.

Equilibrator Pressure:

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 hPa: 0.15
Precision hPa: 0.015
Calibration: Factory calibration
Comments:
Manufacturer's Resolution is taken as Precision.
Atmospheric Pressure:
Location: On MET mast, ~17 m above the sea surface water
Manufacturer: RMYoung
Model: 61302V
Accuracy: ± 0.3 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 Hydro lab, near CO2 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 ship. A regression fit between the average salinity measured in the Hydro Lab and the CTD surface salinity was done for all casts to adjust the SSS. See additional comments below and supplemental ReadMe file.

Additional Information:

The analytical system performed well throughout this cruise. Values for the ship's sensors were appended to the CO2 data record in real-time. Missing real-time values were taken from the MET files logged by the ship. The temperature and salinity data from the CTD casts were used to estimate SSTemperature and to adjust the SSSalinity used in the fCO2 processing. A regression fit between the average temperature measured in the Hydro Lab (HLT) and the CTD surface temperature was done for all casts. After eliminating eleven outlying data, the resulting second degree polynomial equation was used to estimate the SST. $SST(estimated) = 0.001424*HLT^2 + 0.950053*HLT + 0.048227$; standard deviation of the differences between the CTD temperatures and the SST(estimated) is +/- 0.061 degree Celcius. A regression fit between the average salinity measured in the Hydro Lab (HLS) and the CTD surface salinity was done for all casts. After eliminating six outlying data, the resulting linear equation was used to adjust the SSS. $SSS(adjusted) = 1.003444*HLS - 0.099042$; standard deviation of the differences between the CTD salinities and the SSS(adjusted) is +/- 0.0243 psu. See supplemental ReadMe file.

Preliminary Quality Control:

NA

Form Type:

underwayy