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| Dataset Expocode | BHAF20160807 |
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| Dataset | Funding Info: NOAA Climate Program Office; NOAA Ocean Acidification Program Initial Submission (yyyymmdd): 20160825 Revised Submission (yyyymmdd): 20160825 |
| Campaign/Cruise | Expocode: BHAF20160807 Campaign/Cruise Name: ALoS_20160807 Campaign/Cruise Info: AOML_SOOP_CO2 Platform Type: CO2 Instrument Type: Equilibrator-IR or CRDS or GC Survey Type: SOOP Line Vessel Name: Allure of the Seas Vessel Owner: Royal Caribbean International Vessel Code: BHAF |
| Coverage | Start Date (yyyymmdd): 20160807 End Date (yyyymmdd): 20160814 Westernmost Longitude: 80.1 W Easternmost Longitude: 63 W Northernmost Latitude: 26.1 N Southernmost Latitude: 18.0 N Port of Call: Fort Lauderdale, FL Port of Call: Philipsburg, St. Maarten Port of Call: San Juan, Puerto Rico Port of Call: Labadee, Haiti |
| 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)

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| 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: Near 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: none
Normalized to Sea Level:
Manufacturer: none
Model: none
Accuracy: (hPa if units not given)
Precision: (hPa if units not given)
Calibration:
Comments:

Atmospheric CO2

Measured/Frequency: No
Intake Location: none
Drying Method: none
Atmospheric CO2 Accuracy: ± 0.5 μ atm in fCO₂_ATM
Atmospheric CO2 Precision: ± 0.01 μ atm 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 (~5 °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 μ atm in fCO₂_SW
Aqueous CO2 Precision: ± 0.01 μ atm 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: CA04890, 282.59 ppm, owned by ESRL, used every ~4.5 hours.
Std 2: CC115007, 381.53 ppm, owned by ESRL, used every ~4.5 hours.
Std 3: CA06380, 448.34 ppm, owned by ESRL, used every ~4.5 hours.
Std 4: CB09022, 537.41 ppm, owned by ESRL, used every ~4.5 hours.

Std 5: 0.00 ppm, owned by AOML, used every ~27.0 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 sea water pumping system operated for only the first couple hours during the first three days but operated well during the last twenty hours of the steam to the first port of call. During the last steam between ports of call the seawater flow was constantly variable, which decreased the data coverage and quality. There were a couple instances of low or no equilibrator gas flow that also reduced the data coverage. Original Data Location: http://www.aoml.noaa.gov/ocd/ocdweb/allure/allure_introduction.html

Citation for this Dataset:

Other References for this Dataset: