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| **Dataset Expocode** | **BMBE20110726** |
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| **Dataset** | **Funding Info:** NOAA Climate Program Office; NOAA Ocean Acidification Program<br>**Initial Submission (yyyymmdd):** 20160511<br>**Revised Submission (yyyymmdd):** 20160511 |
| **Campaign/Cruise** | **Expocode:** BMBE20110726<br>**Campaign/Cruise Name:** BarX20110726<br>**Campaign/Cruise Info:** AOML_SOOP_CO2<br>**Platform Type:**<br>**CO2 Instrument Type:** Equilibrator-IR or CRDS or GC<br>**Survey Type:** SOOP Line<br>**Vessel Name:** Barcelona Express<br>**Vessel Owner:** Anglo Eastern Ship Management<br>**Vessel Code:** BMBE |
| **Coverage** | **Start Date (yyyymmdd):** 20110726<br>**End Date (yyyymmdd):** 20110808<br>**Westernmost Longitude:** 80 W<br>**Easternmost Longitude:** 9.2 E<br>**Northernmost Latitude:** 39.2 N<br>**Southernmost Latitude:** 26.2 N<br>**Port of Call:** Cagliari, Italy<br>**Port of Call:** Leghorn, Italy<br>**Port of Call:** Genoa, Italy<br>**Port of Call:** Barcelona, Spain<br>**Port of Call:** Valencia, Spain<br>**Port of Call:** Port Everglades, FL, USA<br>**Port of Call:** Veracruz, Mexico<br>**Port of Call:** Altamira, Mexico<br>**Port of Call:** Houston, TX, USA<br>**Port of Call:** New Orleans, LA, USA |
| **Variable** | **Name:** xCO2_EQU_ppm<br>**Unit:** ppm<br>**Description:** Mole fraction of CO2 in the equilibrator headspace (dry) at equilibrator temperature (ppm) |

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| **Variable** | **Name:** xCO2_ATM_ppm<br>**Unit:** ppm<br>**Description:** Mole fraction of CO2 measured in dry outside air (ppm) |
| **Variable** | **Name:** xCO2_ATM_interpolated_ppm<br>**Unit:** ppm<br>**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<br>**Unit:** hPa<br>**Description:** Barometric pressure in the equilibrator headspace (hPa) |
| **Variable** | **Name:** PRES_ATM@SSP_hPa<br>**Unit:** hPa<br>**Description:** Barometric pressure measured outside, corrected to sea level (hPa) |
| **Variable** | **Name:** TEMP_EQU_C<br>**Unit:** Degree C<br>**Description:** Water temperature in equilibrator (°C) |
| **Variable** | **Name:** SST_C<br>**Unit:** Degree C<br>**Description:** Sea surface temperature (°C) |
| **Variable** | **Name:** SAL_permil<br>**Unit:** ppt<br>**Description:** Sea surface salinity on Practical Salinity Scale (o/oo) |
| **Variable** | **Name:** fCO2_SW@SST_uatm<br>**Unit:** µatm<br>**Description:** Fugacity of CO2 in sea water at SST and 100% humidity (µatm) |
| **Variable** | **Name:** fCO2_ATM_interpolated_uatm<br>**Unit:** µatm<br>**Description:** Fugacity of CO2 in air corresponding to the interpolated xCO2 at SST and 100% humidity (µatm) |
| **Variable** | **Name:** dfCO2_uatm<br>**Unit:** µatm<br>**Description:** Sea water fCO2 minus interpolated air fCO2 (µatm) |
| **Variable** | **Name:** WOCE_QC_FLAG<br>**Unit:** None<br>**Description:** Quality control flag for fCO2 values (2=good, 3=questionable) |
| **Variable** | **Name:** QC_SUBFLAG<br>**Unit:** None<br>**Description:** Quality control subflag for fCO2 values, provides explanation when QC flag=3 |
| **Sea Surface Temperature** | **Location:** In ship's engine room at a side port off the piping carrying cooling water for the engines. Between the sea chest and the side port there is ~5 meters of pipe (~0.25 diameter). During the transit, the seawater warms an estimated 0.2-0.5 deg C. The reported SST is the value measured at the side port.<br>**Manufacturer:** Seabird<br>**Model:** SBE 38<br>**Accuracy:** 0.001 (°C if units not given) |

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| | **Precision:** 0.0003 (°C if units not given)<br>**Calibration:** Factory calibration<br>**Comments:** Manufacturer's Resolution is taken as Precision. |
| **Sea Surface Salinity** | **Location:** In the ship's engine room next to CO2 system.<br>**Manufacturer:** Seabird<br>**Model:** SBE 45<br>**Accuracy:** ± 0.005 o/oo<br>**Precision:** 0.0002 o/oo<br>**Calibration:** Factory calibration<br>**Comments:** Manufacturer's Resolution is taken as Precision. |
| **Atmospheric Pressure** | **Location:** On deck above bridge at ~20 m above sea surface.<br>**Normalized to Sea Level:** yes<br>**Manufacturer:** Druck<br>**Model:** RPT350<br>**Accuracy:** ± 0.08 hPa (hPa if units not given)<br>**Precision:** 0.01 hPa (hPa if units not given)<br>**Calibration:** Factory calibration<br>**Comments:** Manufacturer's Resolution is taken as Precision. |
| **Atmospheric CO2** | **Measured/Frequency:** Yes, 5 readings in a group every ~4.5 hours<br>**Intake Location:** On mast above the bridge at ~20 meters above the sea surface<br>**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).<br>**Atmospheric CO2 Accuracy:** ± 0.5 µatm in fCO2_ATM<br>**Atmospheric CO2 Precision:** ± 0.01 µatm in fCO2_ATM |
| **Aqueous CO2 Equilibrator Design** | **System Manufacturer:**<br>**Intake Depth:** 5 meters<br>**Intake Location:** Bow<br>**Equilibration Type:** Spray head above dynamic pool, with thermal jacket<br>**Equilibrator Volume (L):** 0.95 L (0.4 L water, 0.55 L headspace)<br>**Headspace Gas Flow Rate (ml/min):** 70 - 150 ml/min<br>**Equilibrator Water Flow Rate (L/min):** 1.5 - 2.0 L/min<br>**Equilibrator Vented:** Yes<br>**Equilibration Comments:** Primary equilibrator is vented through a secondary equilibrator.<br>**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<br>**Method details:** details of CO2 sensing (not required)<br>**Manufacturer:** LI-COR<br>**Model:** 840<br>**Measured CO2 Values:** xCO2(dry)<br>**Measurement Frequency:** Every 140 seconds, except during calibration<br>**Aqueous CO2 Accuracy:** ± 2 µatm in fCO2_SW<br>**Aqueous CO2 Precision:** ± 0.01 µatm in fCO2_SW<br>**Sensor Calibrations:**<br>**Calibration of Calibration Gases:** The analyzer is calibrated every ~4.5 hours using ESRL standards that are directly traceable to the WMO scale. Ultra-High |

Purity air (0.0 ppm CO2) and the high standard (when both present) are used to zero and span the LI-COR analyzer.
**Number Non-Zero Gas Standards:** 4
**Calibration Gases:**

Std 1: CA04563, 192.34 ppm, owned by ESRL, used every ~5.0 hours.
Std 2: CA06368, 328.12 ppm, owned by ESRL, used every ~5.0 hours.
Std 3: CA03910, 372.81 ppm, owned by ESRL, used every ~5.0 hours.
Std 4: CC71588, 531.98 ppm, owned by ESRL, used every ~5.0 hours.
Std 5: 0.00 ppm, owned by AOML, used every ~26.5 hours.
**Comparison to Other CO2 Analyses:**
**Comments:** Instrument is located below a walkway in the engine room.
**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:** 1521
**Accuracy:** 0.025 (°C if units not given)
**Precision:** 0.001 (°C if units not given)
**Calibration:** Factory calibration
**Comments:** Manufacturer's Resolution is taken as Precision.

**Equilibrator Pressure Sensor**

**Location:** Inside LICOR connected to ambiant air. The differential pressure reading from A Setra 239, which is attached to the equilibrator headspace, is added to the pressure reading from the LICOR analyzer.
**Manufacturer:** Licor
**Model:** 840-P
**Accuracy:** 15 (hPa if units not given)
**Precision:** 1 (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 system showed issues with the SST measurements and a large part of the data had to be discarded. After Year Day 220, the system lost SST so it was estimated based on its offset from equT earlier during the cruise. SST=equT -0.493 °C. Atm Pressures showed large variations which did not seem real. ATM Pressure has been estimated instead from the relationship between the NCEP-R2 pressures and the licor pressures based on the previous 2 cruises. Atm pressure = licor Pressure + 2.60 mbar. Original Data Location: http://www.aoml.noaa.gov/ocd/ocdweb/barcelona/barcelona_introduction.html
**Citation for this Dataset:**
**Other References for this Dataset:**