

<b>Dataset Expocode</b>	<b>BMBE20130903</b>
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<b>Dataset</b>	<b>Funding Info:</b> NOAA Climate Program Office; NOAA Ocean Acidification Program <b>Initial Submission (yyyymmdd):</b> 20160713 <b>Revised Submission (yyyymmdd):</b> 20160713
<b>Campaign/Cruise</b>	<b>Expocode:</b> BMBE20130903 <b>Campaign/Cruise Name:</b> BarX20130903 <b>Campaign/Cruise Info:</b> AOML_SOOP_CO2 <b>Platform Type:</b> <b>CO2 Instrument Type:</b> Equilibrator-IR or CRDS or GC <b>Survey Type:</b> SOOP Line <b>Vessel Name:</b> Barcelona Express <b>Vessel Owner:</b> Anglo Eastern Ship Management <b>Vessel Code:</b> BMBE
<b>Coverage</b>	<b>Start Date (yyyymmdd):</b> 20130903 <b>End Date (yyyymmdd):</b> 20131008 <b>Westernmost Longitude:</b> 80 W <b>Easternmost Longitude:</b> 14.8 E <b>Northernmost Latitude:</b> 44.3 N <b>Southernmost Latitude:</b> 25.6 N <b>Port of Call:</b> Cagliari, Italy <b>Port of Call:</b> Leghorn, Italy <b>Port of Call:</b> Genoa, Italy <b>Port of Call:</b> Barcelona, Spain <b>Port of Call:</b> Valencia, Spain <b>Port of Call:</b> Port Everglades, FL, USA
<b>Variable</b>	<b>Name:</b> xCO2_EQU_ppm <b>Unit:</b> ppm <b>Description:</b> Mole fraction of CO2 in the equilibrator headspace (dry) at equilibrator temperature (ppm)
<b>Variable</b>	<b>Name:</b> xCO2_ATM_ppm <b>Unit:</b> ppm <b>Description:</b> Mole fraction of CO2 measured in dry outside air (ppm)
<b>Variable</b>	<b>Name:</b> xCO2_ATM_interpolated_ppm

**Unit:** ppm  
**Description:** Mole fraction of CO<sub>2</sub> in outside air associated with each water analysis. These values are interpolated between the bracketing averaged good xCO<sub>2</sub>\_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<sub>2</sub>\_SW@SST\_uatm  
**Unit:** µatm  
**Description:** Fugacity of CO<sub>2</sub> in sea water at SST and 100% humidity (µatm)

**Variable**      **Name:** fCO<sub>2</sub>\_ATM\_interpolated\_uatm  
**Unit:** µatm  
**Description:** Fugacity of CO<sub>2</sub> in air corresponding to the interpolated xCO<sub>2</sub> at SST and 100% humidity (µatm)

**Variable**      **Name:** dfCO<sub>2</sub>\_uatm  
**Unit:** µatm  
**Description:** Sea water fCO<sub>2</sub> minus interpolated air fCO<sub>2</sub> (µatm)

**Variable**      **Name:** WOCE\_QC\_FLAG  
**Unit:** None  
**Description:** Quality control flag for fCO<sub>2</sub> values (2=good, 3=questionable)

**Variable**      **Name:** QC\_SUBFLAG  
**Unit:** None  
**Description:** Quality control subflag for fCO<sub>2</sub> 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.  
**Manufacturer:** Seabird  
**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.

**Sea Surface Salinity**      **Location:** In the ship's engine room next to CO<sub>2</sub> system.

**Manufacturer:** Seabird  
**Model:** SBE 45  
**Accuracy:**  $\pm 0.005$  o/oo  
**Precision:** 0.0002 o/oo  
**Calibration:** Factory calibration  
**Comments:** Manufacturer's Resolution is taken as Precision.

**Atmospheric Pressure**

**Location:** On deck above bridge at ~20 m above sea surface.  
**Normalized to Sea Level:** yes  
**Manufacturer:** Druck  
**Model:** RPT350  
**Accuracy:**  $\pm 0.08$  hPa (hPa if units not given)  
**Precision:** 0.01 hPa (hPa if units not given)  
**Calibration:** Factory calibration  
**Comments:** Manufacturer's Resolution is taken as Precision.

**Atmospheric CO2**

**Measured/Frequency:** Yes, 5 readings in a group every ~4.5 hours  
**Intake Location:** On mast above the bridge at ~20 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).  
**Atmospheric CO2 Accuracy:**  $\pm 0.5$   $\mu$ atm in fCO<sub>2</sub>\_ATM  
**Atmospheric CO2 Precision:**  $\pm 0.01$   $\mu$ atm in fCO<sub>2</sub>\_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 CO<sub>2</sub> sensing (not required)  
**Manufacturer:** LI-COR  
**Model:** 840A  
**Measured CO2 Values:** xCO<sub>2</sub>(dry)  
**Measurement Frequency:** Every 140 seconds, except during calibration  
**Aqueous CO2 Accuracy:**  $\pm 2$   $\mu$ atm in fCO<sub>2</sub>\_SW  
**Aqueous CO2 Precision:**  $\pm 0.01$   $\mu$ atm in fCO<sub>2</sub>\_SW  
**Sensor Calibrations:**  
**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 CO<sub>2</sub>) 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: CA05585, 280.18 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.

**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 pCO<sub>2</sub> 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 ambient 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:** ATM pressure showed large daily fluctuations between 1000 and 1050 mbar and was not useable. It was instead estimated from licor P using relationship determined during a previous cruise (BMBE20130716)  
 $\text{atmP} = \text{licorP} - 4.585 (+/- 0.174) \text{ mbar}$  Otherwise, no real issues to report for this cruise. Original Data Location: [http://www.aoml.noaa.gov/o cd/o cdweb/barcelona/barcelona\\_introduction.html](http://www.aoml.noaa.gov/o cd/o cdweb/barcelona/barcelona_introduction.html)

**Citation for this Dataset:**

**Other References for this Dataset:**