

* =mandatory field)

- **Investigator:***
 - **Name*:** Dr. Adrienne Sutton
 - **Organization:** NOAA/PMEL
 - **Address:**
NOAA/PMEL
7600 Sand Point Way NE
Seattle Washington, 98115 USA
Phone: 206-526-6879
 - **Email:** adrienne.sutton@noaa.gov
 - **Dataset_Info:***
 - **Dataset_ID*:** [GraysRf_81W_31N_Jun2008_May2009](#)
 - **Submission_Dates:***
 - **Initial_Submission:** [20120522](#) (YYYYMMDD)
 - **Revised_Submission:** (YYYYMMDD)
 - **Cruise_Info:***
 - **Experiment:**
 - **Experiment_Name*:**
 - **Cruise:(-)**
 - **Cruise_ID:** (EXPOCODE)
 - **Section:** (Leg)
 - **Geographical_Coverage:***
 - **Geographical_Region:**
 - **Bounds:**
 - **Westernmost_Longitude:**
Enter decimal fractions of degrees:
or Degrees, Minutes, Seconds:
 - **Easternmost_Longitude:**
Enter decimal fractions of degrees: [- 80.87](#)(+ = E, - = W)
or Degrees, Minutes, Seconds:
 - **Northernmost_Latitude:**
Enter decimal fractions of degrees:[+31.40](#) (+ = E, - = W)
 - **Southernmost_Latitude:**
Enter decimal fractions of degrees:
 - **Temporal_Coverage:**
 - **Start_Date:** [20080616](#) (YYYYMMDD)
 - **End_Date:** [20090518](#) (YYYYMMDD)
 - **Vessel:*** [Mooring platform](#)
 - **Vessel_Name:**
 - **Vessel_ID:**
 - **Country:**
 - **Vessel_Owner:**
- **Variables_Info:***
 - **Variable:**
 - **Variable_Name and Description*:**
- [xCO₂ SW \(wet\) \(umol/mol\) - Mole fraction of CO₂ in air in equilibrium with the seawater at sea surface temperature and measured humidity.](#)
- [CO₂ SW QF – Quality Flag for xCO₂ SW \(wet\).](#)
- [H₂O SW \(mmol/mol\) - Mole fraction of H₂O in air from equilibrator.](#)
- [xCO₂ Air \(wet\) \(umol/mol\) - Mole fraction of CO₂ in air from airblock, 4 feet above the sea surface at measured humidity.](#)
- [CO₂ Air QF – Quality Flag for xCO₂ Air \(wet\)](#)
- [H₂O Air \(mmol/mol\) - Mole fraction of H₂O in air from airblock, 4 feet above the sea surface.](#)

- Licor Atm Pressure (hPa) – Atmospheric pressure at the airblock, 4 feet above the sea surface
- Licor Temp (C) – Temperature of the Infrared Licor 820 in degrees Celsius
- % O₂ - The percent oxygen of the surface seawater divided by the percent oxygen of the atmosphere at 4 feet above the sea surface. Disclaimer: The oxygen measurement is made in the equilibrated air. We have found that the oxygen does not come to complete equilibrium so any rapid changes in oxygen do not get properly captured using this system. Therefore, we tend to use the oxygen data only as a qualitative sense of the biology. It is not a quantitative measure.
- SST (C) - Sea Surface Temperature measured by CTD (MicroCAT C-T Recorder). Temperature data is internally recorded and collected during the equilibration period. Data not post-calibrated. Annual drift for this deployment was minimal and does not impact the fCO₂ calculation (within the degree of accuracy of the CO₂ measurement). Contact us if you would like the CTD post-calibration information.
- Salinity - Sea Surface Salinity measured by CTD (MicroCAT C-T Recorder). Conductivity data is internally recorded and collected during the equilibration period. Data not post-calibrated. Annual drift for this deployment was minimal and does not impact the fCO₂ calculation (within the degree of accuracy of the CO₂ measurement). Contact us if you would like the CTD post-calibration information.
- xCO₂ SW (dry) (umol/mol) – Mole fraction of CO₂ in air in equilibrium with the seawater at sea surface temperature (dry air).
- xCO₂ Air (dry) (umol/mol) – Mole fraction of CO₂ in air at the airblock, 4 feet above the sea surface (dry air).
- fCO₂ SW (sat) uatm – Fugacity of CO₂ in air in equilibrium with the seawater at sea surface temperature (100% humidity). Since the measurements are taken at the sea surface, warming calculations are not necessary.
- fCO₂ Air (sat) uatm – Fugacity of CO₂ in air at the airblock, 4 feet above the sea surface (100% humidity).
- dfCO₂ – Difference of the fugacity of the CO₂ in seawater and the fugacity of the CO₂ in air (fCO₂ SW - fCO₂ Air).

- **Method_Description:***

- **Equilibrator_Design:**

- Equilibrator_Type: (show pick list) Bubble Equilibrator
 - Equilibrator_Volume: (L) N/A
 - Water_Flow_Rate: (L/min) N/A
 - Headspace_Gas_Flow_Rate: (L/min) ~600 cc/min
 - Vented: (show pick list) Yes

- Measurement_Method: Absolute, non-dispersive infrared (NDIR) gas analyzer

- Manufacturer_of_Calibration_Gas: NOAA Earth System Research Laboratory (ESRL)

- **CO₂_Sensors:**

- **CO₂_Sensor:**

- Manufacturer: Licor
 - Model: Environmental_Control: LI-820
 - Resolution: 0.01 ppm
 - Uncertainty: < 2.5% of reading with 14 cm bench (stated)
<1.5 ppm determined in lab
 - CO₂_Sensor_Calibration: (For each calibration gas, document traceability to an internationally recognized scale, including date and place of last calibration. Include uncertainty of assigned value.)

At the beginning of each sample, the instrument self-calibrates using a zero and high standard. The zero standard is generated by cycling a small amount of air through a soda lime chamber. The high standard is from a cylinder of calibrated standard reference gas, 528.11 umol/mol from ESRL. ESRL

standards are traceable to WMO x93 scale with a stated reproducibility of 0.06 micromole/mole.

- **Other_Sensors:**
 - Manufacturer: Oxygen Sensor
Maxtec
 - Model: Max-250
 - Resolution: 0.01 %
 - Uncertainty: $\pm 2.0\%$ Full Scale over operating temperature range
 $\pm 1.0\%$ Full Scale @ constant temperature and pressure
 - Calibration: (For each sensor of pressure, temperature, and salinity, document traceability to an internationally recognized scale, including date and place of last calibration.)
Factory calibrated before purchase. Recalibrated to sea level atmospheric air every 7 days.
- **Other_Sensors:**
 - Manufacturer: Humidity Sensor
Sensirion
 - Model: SHT71
 - Resolution: 0.01 %
 - Uncertainty: Measurement range: 0-100% RH
Absolute RH accuracy: $\pm 3\%$ RH (20-80% RH)
Repeatability RH: $\pm 0.1\%$ RH
 - Calibration: (For each sensor of pressure, temperature, and salinity, document traceability to an internationally recognized scale, including date and place of last calibration.)
Factory calibrated before purchase.
- Method_References: (Publication(s) describing method)

Sabine, C. (2005): High-resolution ocean and atmosphere pCO₂ time-series measurements. The State of the Ocean and the Ocean Observing System for Climate, Annual Report, Fiscal Year 2004, NOAA/OGP/Office of Climate Observation, Section 3.32a, 246–253.

- Additional Information

- All measurements are at sea surface temperature and atmospheric pressure.
- During the equilibration cycle, a closed loop of air equilibrates with seawater for 10 minutes. Once the equilibration period is complete, the pump stops and the system opens to the atmosphere allowing the pressure to equilibrate with atmospheric pressure. Measurements are recorded for 30 seconds at 2 hertz and then averaged.
- During the air cycle, fresh air is pumped through the detector for 1 minute. Once the pump stops, the system opens to the atmosphere allowing the pressure to equilibrate with atmospheric pressure. Measurements are recorded for 30 seconds at 2 hertz and then averaged.
- The gas streams for both the air cycle and equilibrator cycle are partially dried before entering the detector. The values listed as wet xCO₂ generally have relative humidity levels ranging from 40 to 80 percent. The humidity levels increase over the course of a deployment.
- Sampling occurs every 3 hours. The infrared detector is calibrated at the beginning of every sampling period. Averaged data and standard deviations for each measurement are transmitted back daily.
- To calculate the dry measurements, the water mole fraction in the Licor detector must be known. A relative humidity sensor is located immediately downstream of the detector.

- As part of the QC process, each data set is compared with the Marine Boundary Layer (MBL) data from GlobalView-CO₂. The data from this deployment were 8.8± 8.5 umol/mol on average of the MBL data and therefore no correction was applied.

GLOBALVIEW-CO₂: Cooperative Atmospheric Data Integration Project - Carbon Dioxide. CD-ROM, NOAA ESRL, Boulder, Colorado [Also available on Internet via anonymous FTP to ftp.cmdl.noaa.gov, Path: ccg/co2/GLOBALVIEW], 2010

-During the QC process, an adjustment to the Licor pressure is typically made based on each sensor's bias to barometric pressure as measured in the lab. We have not yet run this test on this system.

- No data = -9.999 or -999

- Data_set_References: (Publication(s) describing data set) None
- Citation: (How to cite this data set) Sabine, C., A. Sutton, W.-J. Cai, S. Noakes, S. Musielewicz, S. Maenner, and R. Bott. 2012. High-resolution ocean and atmosphere pCO₂ time-series measurements from Gray's Reef mooring.
- Data_Set_Link:
- URL*: <http://www.pmel.noaa.gov/co2/story/Grays+Reef>
- Label*: **PMEL CO2 Group – Gray's Reef mooring**

- Link_Note: (Optional instructions or remarks)(m s t)

Quality Flags definitions:

- 2 = Acceptable measurement;
- 3 = Questionable measurement;
- 4 = Bad measurement
- 5 = Not reported;
- 9 = Sample not drawn for this measurement from this bottle.

Quality Flag Log for this dataset.

Date	Measurement	Value (Dry)	Flag	Comments
7/20/2008 0:17	xCO ₂ _SW	426.8665889	3	CO ₂ data submitted was adjusted by - 5 ppm b/c zero calibration was off as predicted by change in Licor temperature
7/20/2008 0:17	xCO ₂ _Air	390.9834599	3	CO ₂ data submitted was adjusted by - 5 ppm b/c zero calibration was off as predicted by change in Licor temperature
8/13/2008 21:17	xCO ₂ _SW	481.9924298	3	likely bad CO ₂ sw measurement due to equilibrator pressure problem
8/13/2008 22:17	xCO ₂ _SW	499.2527804	3	likely bad CO ₂ sw measurement due to equilibrator pressure problem
8/13/2008 23:17	xCO ₂ _SW	485.5603156	3	likely bad CO ₂ sw measurement due to equilibrator pressure problem
8/21/2008 12:17	xCO ₂ _SW	528.8222984	4	bad CO ₂ sw measurement due to equilibrator pressure problem
8/23/2008 0:17	xCO ₂ _SW	517.8253645	4	bad CO ₂ sw measurement due to equilibrator pressure problem
9/5/2008 18:17	xCO ₂ _SW	518.5528239	4	bad CO ₂ sw measurement due to equilibrator pressure problem
9/5/2008 21:17	xCO ₂ _SW	529.4003064	4	bad CO ₂ sw measurement due to equilibrator pressure problem

9/19/2008 21:17	xCO2_SW	558.0518224	4	bad CO2 sw measurement due to equilibrator pressure problem
9/21/2008 21:17	xCO2_SW	548.7192677	4	bad CO2 sw measurement due to equilibrator pressure problem
10/1/2008 15:17	xCO2_SW	423.4827062	3	CO2 data submitted was adjusted by - 9 ppm b/c span calibration was off as predicted by change in Licor temperature
10/1/2008 15:17	xCO2_Air	403.9335485	3	CO2 data submitted was adjusted by - 9 ppm b/c span calibration was off as predicted by change in Licor temperature
10/4/2008 12:17	xCO2_Air	406.2181147	4	bad CO2 air measurement b/c high st dev
10/12/2008 12:17	xCO2_SW	413.0462752	3	CO2 data submitted was adjusted by - 5 ppm b/c span calibration was off as predicted by change in Licor temperature
10/12/2008 12:17	xCO2_Air	383.5092597	3	CO2 data submitted was adjusted by - 5 ppm b/c span calibration was off as predicted by change in Licor temperature
10/12/2008 21:17	xCO2_SW	419.1158227	3	CO2 data submitted was adjusted by - 4 ppm b/c span calibration was off as predicted by change in Licor temperature
10/12/2008 21:17	xCO2_Air	385.6879829	3	CO2 data submitted was adjusted by - 4 ppm b/c span calibration was off as predicted by change in Licor temperature
10/24/2008 12:17	xCO2_SW	404.0146009	4	bad CO2 sw measurement due to equilibrator pressure problem
10/24/2008 15:17	xCO2_SW	429.1268684	4	bad CO2 sw measurement due to equilibrator pressure problem
10/24/2008 18:17	xCO2_SW	423.8517592	4	bad CO2 sw measurement due to equilibrator pressure problem
11/17/2008 15:17	xCO2_SW	328.665187	3	CO2 data submitted was adjusted by - 4 ppm b/c span calibration was off as predicted by change in Licor temperature
11/17/2008 15:17	xCO2_Air	397.7650392	3	CO2 data submitted was adjusted by - 4 ppm b/c span calibration was off as predicted by change in Licor temperature
12/12/2008 6:17	xCO2_SW	368.7924586	4	bad CO2 sw measurement due to equilibrator pressure problem
1/7/2009 21:17	xCO2_SW	388.0551956	4	bad CO2 sw measurement due to equilibrator pressure problem
1/29/2009 15:17	xCO2_SW	347.3984686	3	CO2 data submitted was adjusted by - 4 ppm b/c span calibration was off as predicted by change in Licor temperature
1/29/2009 15:17	xCO2_Air	404.0591941	3	CO2 data submitted was adjusted by - 4 ppm b/c span calibration was off as predicted by change in Licor temperature
4/7/2009 0:17	xCO2_SW	449.5374247	4	bad CO2 sw measurement due to equilibrator pressure problem
4/7/2009 3:17	xCO2_SW	447.1940634	4	bad CO2 sw measurement due to equilibrator pressure problem
4/24/2009 15:17	xCO2_SW	484.9786924	3	CO2 data submitted was adjusted by - 8 ppm b/c span calibration was off as predicted by change in Licor temperature
4/24/2009 15:17	xCO2_Air	423.370639	3	CO2 data submitted was adjusted by - 8 ppm b/c span calibration was off as predicted by change in Licor temperature
5/2/2009 9:17	xCO2_SW	597.6988018	3	CO2 sw likely high but no signs of bad data in diagnostics
5/2/2009 12:17	xCO2_SW	677.9239858	3	CO2 sw likely high but no signs of bad data in diagnostics
5/2/2009 15:17	xCO2_SW	709.2478451	3	CO2 sw likely high but no signs of bad data in diagnostics
5/2/2009 18:17	xCO2_SW	650.0750323	3	CO2 sw likely high but no signs of bad data in diagnostics
5/2/2009 21:17	xCO2_SW	569.7898621	3	CO2 sw likely high but no signs of bad data in diagnostics
5/3/2009 0:17	xCO2_SW	599.9434745	3	CO2 sw likely high but no signs of bad data in diagnostics
5/3/2009 3:17	xCO2_SW	512.8128414	3	CO2 sw likely high but no signs of bad data in diagnostics
5/3/2009 6:17	xCO2_SW	576.5076007	3	CO2 sw likely high but no signs of bad data in diagnostics
5/3/2009 9:17	xCO2_SW	664.4684963	3	CO2 sw likely high but no signs of bad data in diagnostics
5/3/2009 12:17	xCO2_SW	714.631742	3	CO2 sw likely high but no signs of bad data in diagnostics
5/3/2009 15:17	xCO2_SW	727.0879781	3	CO2 sw likely high but no signs of bad data in diagnostics
5/3/2009 18:17	xCO2_SW	589.3519106	3	CO2 sw likely high but no signs of bad data in diagnostics
5/3/2009 21:17	xCO2_SW	699.3837006	3	CO2 sw likely high but no signs of bad data in diagnostics