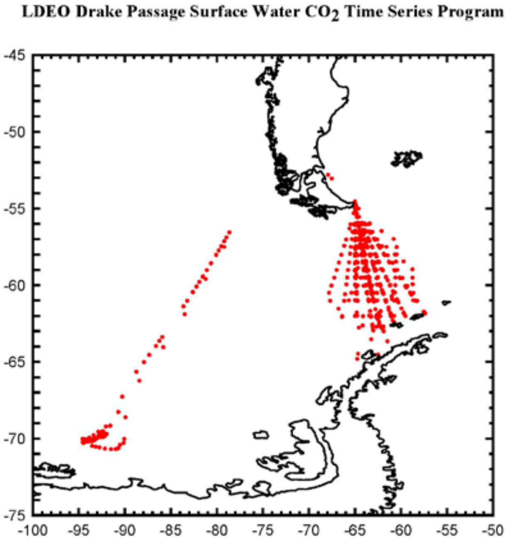
Documentation for
LDEO Drake Passage Surface Water CO_2 Time Series Program

by

Taro Takahashi, Stewart C. Sutherland, John G. Goddard and
Timothy Newberger

(February 22, 2018)

This program began in 2002 and consists primarily of 15 stations sampled approximately six times per year across the Drake Passage. Several research groups have participated in this program sampling and measurements of salinity, temperature, XBT profiling, carbonate chemistry, C-14, and nutrients.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Reported measurements are obtained by the following groups: Total CO_2 concentration, partial pressure of CO_2 (pCO_2), salinity (from Thermosalinograph), temperature and position by the LDEO Carbonate Chemistry Group; and phosphate, nitrite, nitrite + nitrate, silicate, and ammonia by the University of Delaware group. Because the time of sample corrections and measurements (i.e. the time the sample collection began, when it ended, pCO_2 equilibration time, transit time of water from the water intake to the water sampling point, ship's position and TSG measurements at water intake) are not precisely coordinated each other, we have chosen to average the three TSG and pCO_2 data measured around 9 minutes the time indicated on the data sheet for TCO_2 and nutrient samples.

The total CO_2 concentration (TCO_2) is based on the manometric standards established by the C. D. Keeling of the Scripps Institution of Oceanography (Dickson, 2001), and the pCO_2 is calibrated using WMO reference air-CO_2 gas mixtures prepared by NOAA/ESRL. Total alkalinity (TA) is calculated using an inorganic chemical equilibrium model with the observed values of temperature of equilibration, salinity, pCO_2, the concentrations of TCO_2, silicate and phosphate. The total boron concentration is estimated to be proportional to salinity (Total Boron (mol/kg) = 0.0004106 * SAL / 35). The following dissociation constants and CO_2 solubility in seawater are used for calculation: First and second dissociation constants of carbonic acid by Lueker et al. (2000); dissociation constants for boric acid by Dickson (1990); those for phosphoric acid by Dickson and Riley (1979-b) ; those for silicic acid by Sjoberg et al. (1981); and dissociation of water by Dickson and Riley (1979-a); and solubility of CO_2 in seawater by Weiss (1974). The total hydrogen ion scale is used throughout the calculation. The seawater pCO_2 at the in situ temperature (TSG) is computed using the temperature dependence (Takahashi et al., 1993):

$$(pCO_2)_{sw} @T_{in\ situ} = [(pCO_2)_{sw} @ T_{eq}] \mathrm{Exp}\{0.0433 (T_{in\ situ} - T_{eq}) - 4.35 \times 10^{-5} [(T_{in\ situ})^2 - (T_{eq})^2] \}$$

where the “sw” and “eq” indicate the in situ and equilibrator conditions respectively.

R/V Laurence M. Gould CO_2 and nutrient data.

Units and parameters are:
FILENAME = Internal reference to LDEO File.
BOTTLE_NUM = Sample number.
YEAR = Calendar year.
JDATE = Day of the year, in decimal days, including hour and minute.
Day 1.00001 = 01 Jan 0001 UTC, Day 365.99999 = 31 December 2359 UTC
LAT = Latitude - Decimal Degrees, where negative values are for south latitude.
LON = Longitude - Decimal Degrees, where negative values are for west longitude.
PCO2_MEAS = Observed pCO2 (microatmospheres). This is an average of 3 observations.
TEMP_PCO2 = Temperature at which pCO2 was measured.
SAL = Sea Surface Salinity (PSS).
TEMP = Sea Surface Temperature (Deg Celsius).
PCO2_SST = pCO2 at Sea Surface Temperature (microatmospheres)
EQ_PBARO = Barometric Pressure in equilibration vessel (millibar)
SHIPPBARO = Barometric Pressure from ship sensor (millibar)
TCO2_KG = Total Concentration of Carbon Dioxide in seawater (micromoles per kilogram seawater).
NO2, NH4, PO4, SIO3, NO3
= Total Concentration in seawater (micromoles per kilogram seawater)
TACALC = Calculated Total Alkalinity (microequivalents per kilogram seawater)

-999.9 = No Data.

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