

Dataset Expocode 09AR20141022

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Dataset **Funding Info:** Data collection was funded by the Integrated Marine Observing System (IMOS) - IMOS is supported by the Australian Government through the National Collaborative.
Initial Submission (yyyymmdd): 20160201
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Campaign/Cruise **Expocode:** 09AR20141022
Campaign/Cruise Name: Integrated Marine Observing System (IMOS)
Campaign/Cruise Info: AA1415V01
Platform Type:
CO2 Instrument Type: Equilibrator-IR or CRDS or GC
Survey Type: Ship Of Opportunity Program(SOOP)
Vessel Name: Aurora Australis
Vessel Owner: P&O Maritime Services
Vessel Code: 09AR

Coverage **Start Date (yyyymmdd):** 20141022
End Date (yyyymmdd): 20141123
Westernmost Longitude: 74.75 E
Easternmost Longitude: 147.47 E
Northernmost Latitude: 42.87 S
Southernmost Latitude: 68.57 S
Port of Call: Hobart, Australia
Port of Call: Davis Station, Antarctica.

Variable **Name:** Group/ship
Unit:
Description: CSIRO/ ship name.

Variable **Name:** CruiseID
Unit:
Description: Cruise designation.

Variable **Name:** JD_GMT
Unit: ddd.hhhh
Description: UTC

Variable **Name:** Date
Unit: yyyymmdd
Description: Observation date UTC

Variable **Name:** Time
Unit: HH:MM:SS

Description: Observation time UTC

Variable

Name: Lat

Unit: degree

Description: Latitude (decimal degrees).

Variable

Name: Long

Unit: degree

Description: Longitude (decimal degrees).

Variable

Name: xCO2EQ_PPM

Unit: ppm

Description: Mole fraction of CO2 (dry) in the equilibrator head space at equilibrator temperature

Variable

Name: xCO2ATM_PPM

Unit: ppm

Description: Mole fraction of CO2 (dry) in air

Variable

Name: xCO2ATM_PPM_INTERPOLATED

Unit: ppm

Description: mole fraction CO2 (dry) in air, interpolated

Variable

Name: Press_Equil

Unit: hPa

Description: pressure in equilibrator

Variable

Name: Press_ATM

Unit: hPa

Description: barometric pressure at sea level

Variable

Name: TEQ

Unit: degree celsius

Description: equilibrator seawater temperature

Variable

Name: SST

Unit: degree celcius

Description: Sea surface temperature

Variable

Name: SAL

Unit:

Description: sea surface salinity

Variable

Name: fCO2SW_UATM

Unit:

Description: fugacity of carbon dioxide at surface water salinity and temperature and 100% humidity

Variable

Name: fCO2ATM_UATM_INTERPOLATED

Unit: microatmosphere

Description: Fugacity of CO2 in the atmosphere from xCO2ATM_PPM at sea surface salinity and temperature and 100% humidity

Variable

Name: DfCO2_UATM

Unit: microatmosphere

Description: Sea water fCO2 minus interpolated air fCO2

Variable

Name: LICOR_flow

Unit: millilitre per minute

Description: gas flow to LICOR NDIR

Variable	Name: H2O_flow Unit: litre per minute Description: seawater flow to equilibrator
Variable	Name: WindSpd_True Unit: knot Description: wind speed, true
Variable	Name: WindDirn_True Unit: degree Description: wind direction, True , 0 degree is N, 90 is E
Variable	Name: Type Unit: Description: Measurement type (EQU=equilibrator; ATM=air)
Variable	Name: WOCE_QC_FLAG Unit: Description: WOCE quality control flag (2=good, 3=questionable).
Variable	Name: SUBFLAG Unit: Description: Quality control sublag for questionable data as defined in Pierrot et al 2009
Sea Surface Temperature	Location: Approximately 150mm inboard from the intake. Manufacturer: Sea-Bird Electronics Model: SBE-38 sn: 0395. Accuracy: 0.005 (°C if units not given) Precision: 0.001 (°C if units not given) Calibration: CSIRO NATA calibration facility, Hobart, September 2014. Comments: Sensor maintain by the Australian Antarctic Division.
Sea Surface Salinity	Location: Next and inline with water supply to the fCO2 system. Manufacturer: Sea-Bird Electronics Model: SBE-45 sn: 0368 Accuracy: ± 0.01 Precision: .003 Calibration: Pre-season calibration made on the 26 May 2014, at CSIRO Hobart. Comments:
Atmospheric Pressure	Location: Mounted ~16m above sea level on the bridge deck outside the Meteorological lab on the port side with a velocity head. Normalized to Sea Level: yes Manufacturer: Vaisala Model: PTB220 sn: A3920002. Accuracy: 0.15 (hPa if units not given) Precision: 0.01 (hPa if units not given) Calibration: September 2014. Sensor maintain by the Australian Antarctic Division. Comments:
Atmospheric CO2	Measured/Frequency: A set of 5 records every 3-4 hours Intake Location: Mounted ~16m above sea level on the bridge deck outside the Met lab on the port side. Drying Method: Thermoelectric condenser (2-5 °C), and Perma Pure (Nafion dryers). Dried to <2 H2O mmol/mol Atmospheric CO2 Accuracy: ± 0.2 ppm at 350 ppm

Atmospheric CO2 Precision: 0.01 ppm

Aqueous CO2 Equilibrator Design

System Manufacturer: General Oceanics 8050 with LICOR 7000 NDIR

Intake Depth: 4 m.

Intake Location: The intake is located in the propeller shaft tunnel approximately 4m below the waterline and 10m forward of the stern gland on the port side of the vessel.

Equilibration Type: Weiss style shower equilibrator with water jacket, General Oceanics.

Equilibrator Volume (L): 1.2 L

Headspace Gas Flow Rate (ml/min): 70 - 150 ml/min

Equilibrator Water Flow Rate (L/min): 2.3 L/min

Equilibrator Vented: Yes

Equilibration Comments: Equilibrator with water jacket and vented through a smaller equilibrator.

Drying Method: Thermoelectric condenser (2-5 °C), and Perma Pure (Nafion dryers). Dried to <2 H2O mmol/mol.

Aqueous CO2 Sensor Details

Measurement Method: CO2 mole fraction in dry air (non-dispersive infrared gas analyser), stopped flow.

Method details: see Pierrot et al., 2009

Manufacturer: LI-COR

Model: LI-7000 sn: IRG4-0910

Measured CO2 Values: xCO2(dry)

Measurement Frequency: Every 80 sec, except during calibration routines

Aqueous CO2 Accuracy: 2 ppm

Aqueous CO2 Precision: 0.01 ppm

Sensor Calibrations: The LI-COR analyser is calibrated using four reference standards measured every 3-4 hours. The instrument zero and span are set daily using the low and high reference standards.

Calibration of Calibration Gases: CO2-in-air reference gases were manufactured and calibrated by CSIRO, Melbourne

Number Non-Zero Gas Standards: 3

Calibration Gases:

Std 1 CA06898: 0 ppm 04 Jun 2008, Std 2 CA01610: 299.41 ppm 17 Aug 2004, Std 3 CA01669: 353.00 ppm 17 Aug 2004, Std 4 CA01673: 402.15 ppm 23 Aug 2004. Reference standards were calibrated on WMO-X2007 mole fraction scale for CO2-in-air at CSIRO Ocean and Atmosphere, Melbourne. Uncertainty = ± 0.05 ppm.

Comparison to Other CO2 Analyses:

Comments:

Method Reference:

Pierrot D., C. Neill, K. Sullivan, R. Castle, R. Wanninkhof, H. Luger, T. Johannessen, A. Olsen, R. A. Feely, C. E. Cosca (2009). Recommendations for autonomous underway pCO2 measuring systems and data-reduction routines. Deep-Sea Research II, 56, 512-522.

Equilibrator Temperature Sensor

Location: Probe 60 mm below water line inside the equilibrator.

Manufacturer: Fluke Hart Scientific.

Model: 1521 sn: A66752 paired with probe 5610-9 sn: B072714.

Accuracy: 0.025 (°C if units not given)

Precision: 0.001 (°C if units not given)

Calibration: The meter and paired probe were calibrated as a system on the 30 Aug 2013 in a NATA facility at CSIRO, Hobart.

Comments:**Equilibrator
Pressure Sensor****Location:** Attached to equilibrator headspace.**Manufacturer:** Setra**Model:** 239 sn: 2223344.**Accuracy:** 0.052 (hPa if units not given)**Precision:** 0.01 (hPa if units not given)**Calibration:** Factory calibration.**Comments:** The equilibrator pressure is the differential pressure reading from the Setra-239 attached to the equilibrator headspace added to a pressure reading made using a GE Druck RPT350 sensor located at the outlet of the LI-COR 6252 analyser when the analyser is vented to laboratory air for a measurement.**Additional
Information****Suggested QC flag from Data Provider:** NA**Additional Comments:** The salinity values used on this cruise, correspond to a thermosalinograph installed next in-line with the water supply of the fCO₂ system. This thermosalinograph (Sea Bird Electronics SBE-45) was maintained and calibrated by CSIRO. There is no wind speed and direction data collected on this cruise. All data prior to 22/10/2014 12:58 was excluded. This is the starting point of the cruise outside the Derwent River. The seawater flow to the fCO₂ system was stopped for a few minutes to clean the water filter during the times listed below. These times periods include the time required by the equilibrator to stabilise after the filter is replaced back into the system. This data was flagged as "bad" and excluded for calculations. 25/10/2014 07:04 to 07:20, 29/10/2014 09:09 to 09:22, 07/11/2014 02:16 to 03:19, 08/11/2014 06:55 to 07:10, 11/11/2014 02:46 to 03:01, and 17/11/2014 03:24 to 03:51. While the ship was in heavy ice, there was insufficient seawater flowing to the fCO₂ system and/or the salinity becomes unreliable. For this reason the time periods listed below are flagged as 'bad' and excluded for calculations. 01/11/2014 06:06 to 06/11/2014 13:52, and 12/11/2014 06:24 to 15/11/2014 05:30. All data after 22/11/2014 22:33 was excluded. This is the end point of the cruise outside the Derwent River. EQU Observations: 31749, QCed: 70% good 30% bad (including pre/post-cruise logging and insufficient seawater flow to the fCO₂ system in heavy ice). ATM Observations: 995, QCed: 55% good 45% bad.**Citation for this Dataset:**Tilbrook, B., C. Neill and J. Akl. 2014. Integrated Marine Observing System (IMOS) sea surface and atmospheric fCO₂ measurements in the Southern Ocean onboard R/V Aurora Australis in Oct - Nov 2014.**Other References for this Dataset:**