Continuous underway data series for cruise AMT13 (11th September – 13th October, 2003)

BODC document history

Version 1.0 created 2004
Version 1.1 created 8-March-2005: includes minor corrections of Version 1.0 plus information about calibration updates to salinity and fluorometer channels (gmon, BODC)

Introduction

These notes refer to the ship's underway data collected during the James Clark Ross AMT13 cruise JR91.

Chief Scientist

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Content of data series

Parameter	Column heading	Units	Comments
Latitude (Trimble navigation)	ALATTR01	Degrees +ve N	Selected as best quality navigation channel
Longitude (Trimble navigation)	ALONTR01	Degrees +ve E	Selected as best quality navigation channel
Ship's heading (Glonass compass)	HEADCM01	Degrees true	
Ship's N-S velocity over the ground	APNSTR01	cm s^{-1}	Computed from ship's heading and Trimble navigation
Ship's E-W velocity over the ground	APEWTR01	cm s^{-1}	Computed from ship's heading and Trimble navigation
Bathymetric depth (uncorrected for density effects)	MBANUA01	m	
Salinity (calibrated)	PSALSG01	PSU	Calibrated against CTD data
Sea temperature (calibrated)	TEMPSG01	Degrees C	Calibrated against CTD data
Fluorescence chlorophyll (uncalibrated)	CPHLUMTF	Nominal mg chl m^{-3}	uncalibrated
Fluorescence chlorophyll (calibrated against extracted samples)	CPHLUT01	mg chl m^{-3}	new calibration applied 8 March 2005
Atmospheric pressure	CAPHSLMS	mbar	Mean of two sensors
Dry bulb air temperature	CDTASSMS	Degrees C	Mean of two sensors
Relative humidity	CRELSSMS	%	Mean of two sensors
Relative wind speed	ERWSSS01	m s^{-1}	
Relative wind direction	ERWDSS01	Degrees	
Absolute wind speed	EWSBSS01	m s^{-1}	
Absolute wind direction	EWDASS01	Degrees true	(Blowing from)
Downwelling surface scalar PAR irradiance	IRRDSSMS	μEinstein m^{-2} s^{-1}	Mean of two sensors
Solar radiation (300 – 3000 nm)	CSLRR1MS	W m^{-2}	Mean of two sensors

Note: each data channel has a flag column 'f': rows containing an N indicate that no data were available for that time interval. An M flag indicates suspect data from BODC's quality control procedures.

Additional channels available on request

The channels listed above are a subset of the channels that have been processed from AMT13. The following additional channels can also be listed if required:

Latitude, Longitude, Course and speed over ground from the Glonass satellite navigation system
Distance travelled (km)
Pitch angle (degrees)
Roll angle (degrees)
Dry bulb temperature from sensors 1 and 2 (°C)
Relative humidity from sensors 1 and 2 (%)
PAR irradiance from sensors 1 and 2 ($\mu E\ m^{-2}\ s^{-1}$)
Solar radiation from sensors 1 and 2 ($W\ m^{-2}$)
Atmospheric pressure from sensors 1 and 2 (mbar)
Conductivity (Siemens m^{-1})
Temperature of thermosalinograph conductivity measurement (°C)
Temperature from fluorometer sensor (°C)
Flow rate through thermosalinograph and fluorometer ($l\ m^{-1}$)
Uncalibrated temperature channel
Uncalibrated salinity channel
Computed sound velocity

The following data have been received from BAS but not included in the BODC data set. Please contact BODC if you would like to access to these data.

- Shipboard three-component magnetometer (STCM) – use Bartington sensors mounted in housings on the deck of the ship. X, Y and Z component values are measured.
- EA500 bathymetric echo sounder (SIMRAD fisheries research) operating at 12 kHz
- Doppler Log and EM Log measuring the speed of the vessel relative to the water.
- Winch Log measuring wireout distance, rate, angle and tension.

Instrumentation and data processing by originator

Underway instruments and methodology

Navigation was recorded using a 3D-GPS Trimble Surveyor system using Marine Star differential corrections. Bathymetry was measured using a Simrad EM-120 multi-beam swath bathymetry echo sounder.

The ship was equipped with a pumped "non-toxic" seawater supply system. Water was pumped through a Sea-Bird Electronics (SBE) thermosalinograph system, and a fluorometer.

The fluorometer was a linear response Turner Designs model 10 instrument in flow-through mode. This was placed in line with the SBE thermosalinograph and a flow meter.

The following information about the instruments was obtained from BAS:

Sensor	Quantity	Make	Model	Range
Temperature/ Humidity	2	Rotronic AG	MP103A-CG030-W4W	Temp-40 +60 Humidity:0 to 100%RH
PAR	2	Kipp & Zonen	ParLite 0348900	(400-700nm)
TIR/ Pyranometer	2	Kipp & Zonen	SP Lite 0339-900	1500 W/m^2 (0.4 - 1.1mm)
Barometer	2	Vaisala	Pressure Transmitter PTB210B1A2B	500 – 1100 hPa abs.
Flow	1	Litremetre	PMDQRCIL Transmitter 45SNVCE	0.04 – 6.3 litres/ Minute
Thermo-salinograph	1	Sea-Bird	SBE45	Temperature –5 – 35 deg C Conductivity 0 - 7 s/m Salinity psu Sound velocity m/s
Sea temperature	1	Rosemount		-200 – 800 deg C
Fluorometer	1	Turners Instruments	10AU-005-CE	Chlorophyll ug/l

Where two sensors are used, they are physically mounted in close proximity to each other.

The meteorological instruments were all located high up on the ship's foremast (at approximately 22m above sea level).

Data acquisition and on-board data processing

Raw data were logged every second and written to the ship's main data logging system (SCS)

The data were submitted to BODC in ASCII output from the BAS SCS system for post-cruise processing and data banking.

BODC post-cruise processing and screening

Reformatting

Data from the full-resolution SCS files were transferred to BODC's NetCDF format (QXF) under the BODC Underway Data System (BUDS). This transfer involved reducing the data to 60 second intervals using averaging. Directional data were reduced by averaging using a unit circle.

Screening

Each data channel was inspected on a graphics workstation and any spikes or periods of dubious data were flagged. The power of the workstation software was used to carry out comparative screening checks between channels by overlaying data channels. A map of the cruise track was simultaneously displayed in order to take account of the oceanographic context.

There were small but significant differences between the values recorded by each of the two sensors for air temperature, relative humidity, PAR and solar radiation:

- PAR sensor one (channel IRRDSS01) showed values closer to 0 at night than sensor 2, although they became negative from the 11th October to the end of the cruise.

- Solar radiation sensor 1 (channel CSLRR101) showed negative values at night but sensor 2 (CSLRR102) showed values of 0.1 -0.2 W m^{-2} and slightly high maximum values.
- Air temperature sensor 1 tended to have slightly higher values by 0.5 deg. C than sensor 2 and relative humidity sensor 1 tended to have values higher by ca. 5% compared with sensor 2.
- The values between the two atmospheric pressure sensor show no significant difference

None of the records looked suspect however and the differences observed were possibly due to the calibrations applied to the instruments. Because of their relatively small magnitude, a merged channel was generated for each of the 5 parameters by averaging the values from each pair of sensors.

Data processing, correction and calibration

- **Navigation**

Navigational data were available from three different systems on the JCR. These were screened in order to select the best quality data for the primary navigation channels. The data from the Trimble GPS system were consistently good and showed no spikes.

A program was run which located any null values in the latitude and longitude channels and checked to ensure that the ship's speed did not exceed 15 knots. There were 12 speed check failures in the Trimble navigation data. These points were screened again to look for improbable spikes. The cause of the speed check failure in each case was an incorrect period of constant latitude followed by a jump to the correct latitude after a few minutes. These periods were flagged as null. The gaps were then filled using linear interpolation.

- **Meteorology**

Relative wind speed and direction were logged from the meteorological package during the cruise. The anemometer was positioned with 0 degrees at the ship's bow. The ship's speed relative to the ground was calculated at BODC using the ship's navigational information and the ship's heading. The speed and heading were then used to correct the wind data for the effect of the ship's movement. Absolute wind speed and direction channels were created.

Air temperature, relative humidity, atmospheric pressure, PAR and solar radiation were measured using two different sensors mounted in close proximity to each other. All channels apart from relative humidity have been averaged to produce a combined channel from both sensors as there is no independent way of identifying which sensor was more accurate. Humidity channels will be averaged within the next few weeks. Individual sensor data are available on request.

- **Salinity**

Salinity data from the thermosalinograph have been compared with surface CTD data averaged over a depth of 6m. The underway data were averaged over the period of CTD deployments and standard deviations were used to check the quality of the data. Data points with standard deviations greater than 0.005 PSU were discarded. The 63 remaining paired values showed that the TSG salinity was consistently underestimating salinity and, after the exclusion of 1 outlier which showed an unusually large difference (0.1 PSU), the following correction was derived.

PSALSG01(PSU) = PSALSU01 + 0.031 (BODC calibration 4130, SD=0.015 PSU, n=62)

- **Temperature**

Temperature data from the thermosalinograph have been compared with surface CTD data to a depth of 6m. The underway data were averaged over the period of CTD deployments and standard deviations were used to check the quality of the data. The 59 samples showed the following relationship, which has been used to produce a calibrated temperature channel (TEMPSG01).

TEMPSG01(°C) = 1.0019 * TEMPSU01 – 0.0487 (BODC calibration 3003, R^2 = 0.9999)

- **Chlorophyll**

The calibration first applied to the fluorometer data was revised on 8-March-2005. The initial calibration (BODC calibration 3616) was strongly skewed and had many negative values. Users should therefore ensure that the data they are using contains the most up-to-date calibration.
The fluorometer channel was re-calibrated by comparing the uncalibrated fluorometer output with chlorophyll concentration values extracted from samples collected from the ship's non-toxic water supply (N=20). The calibration dataset was also complemented with extracted chlorophyll values from samples collected with the CTD rosette water sampler in the upper 10 m. Samples collected on strong gradients were excluded.

The relationship between extracted and fluorometer values was strong (R2=0.86) and apparently unskewed however, the dataset had to be split into two sections in order to avoid overestimating chlorophyll concentration at the beginning of the cruise.

Section 1: from the start till 19/09/2003 00:59, the following equation was derived by linear regression of extracted concentration versus uncalibrated fluorometer values (CPHLUMTF) using all available samples from the non-toxic (n=2) and from surface rosette sampling (n=11):

CPHLUT01 = 1.14 (±0.09) * CPHLUMTF – 0.11 (±0.02) R2=0.93, BODC ref 4127

Section 2 : from 19/09/2003 01:00, the following equation was derived by linear regression as above but using samples from the ship's non-toxic only (n=17 - the 33 CTD rosette values were later used to crosscheck the accuracy of the calibration):

CPHLUT01 = 2.76 (±0.26) * CPHLUMTF – 0.27 (±0.05) R2=0.88, BODC ref 4128

Residuals (extracted chlorophyll from the non-toxic minus calibrated fluorometer values) range between -0.19 and 0.15 mg chl m-3 for extracted chlorophyll concentrations ranging from 0.02 to 0.65 mg Chla m-3 (excludes 1 apparently excessively large extracted value on 09/10/2003 20:30). Comparison with measurements made on the samples collected close to the surface with the CTD-rosette sampler also showed good agreement between extracted samples measurements and the newly calibrated fluorescence values with residuals ranging from -0.05 to 0.27 mg m-3 (excluding 1 station with sharp surface gradients) and 84% of the 63 paired samples showing a difference of <0.05 mg m-3.

The distribution of residuals against incident PAR and time showed no evidence of quenching effect, diurnal variations or drift with time. The new calibrations were applied to the data on 08-MAR-2005.