

## Continuous underway data series for cruise AMT1 (21<sup>st</sup> Sept – 24<sup>th</sup> October, 1995)

### Chief Scientist

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### Content of data series

Parameter	Column heading	Units	Comments
Latitude	LAT+VEN	Degrees +ve N	None
Longitude	LON+VEE	Degrees +ve E	None
Distance along track	Not there	km	None
Salinity	RPSAL	PSU	
Sea temperature	RTEMP	Degrees C	
Bathymetric depth	J	m	Record starts 06/10/1995 ~18:45
Raw Turner Designs fluorometer output	TFLUOR	mV	Range changes
Calibrated fluorometer output	CPHYL	mg chl-a m <sup>-3</sup>	Calibrated against fluorometric chl-a
Atmospheric pressure	APRES	mbar	
Dry bulb air temperature (Masthead starboard)	SMDBT	Degrees C	
Wind speed	Speed	knots	
Wind direction	Direction	Degrees	
Photosynthetically available radiation	IRRAD	W m <sup>-2</sup>	
Solar radiation	SOLR	W m <sup>-2</sup>	Noisy data
Ship's velocity North-South	VN	Knots +ve N	
Ship's velocity East-West	VE	Knots +ve E	

### 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 EA-500 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 ship also had a scientific meteorological package including the following:

- Wind vane and anemometer
- A photosynthetically available radiation (350 – 700 nm) sensor
- A total irradiance sensor,
- A dry bulb thermometer

### **Data acquisition and on-board data processing**

Raw data were logged as ADC counts on the ship's computers. They were converted into engineering units using initial manufacturers' calibrations. Conductivity and two temperature channels were produced from the thermosalinograph counts using laboratory calibrations on board ship.

The data from the fluorometer was logged into the JCR Ocean Logger system using the internal A/D converter and range output. The fluorometer had an autoranging capability which showed problems in the initial stages of the cruise: the fluorometer was switching ranges every 5 to 10 minutes. In addition to the frequent shifting, it was observed by the on-board scientists that there was a considerable offset between ranges. As a result, it was decided to fix the range of the fluorometer at a level suitable for the anticipated levels in the Mauritian upwelling area. This produced a clean signal with no level shifts.

The data were submitted to BODC in RVS internal format for post-cruise processing and data banking.

### **BODC post-cruise processing and screening**

#### **Reformatting**

Underway data files were merged into a single binary merge file using time as the primary linking key. The time span of the file was from 19/09/1995 14:29:30 to 25/10/1995 10:06:00, with a sampling interval of 30 seconds.

Salinity was computed from housing temperature and conductivity using the UNESCO 1978 Practical Salinity Scale (Fofonoff and Millard, 1982).

#### **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.

## **Data processing, correction and calibration**

- **Navigation**

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. The program identified 5 gaps which were corrected using linear interpolation. The longest gap of 3 hours 43 minutes started on 20/09/1995 at 13.05.

The bathymetric depth data were generally good but no data were logged before 06/10/1995 at ~ 19:00.

- **Meteorology**

Relative wind speed and direction were logged from the meteorological package during the cruise. The ship's speed and heading channels were used with the relative wind data to produce absolute wind speed and direction.

- **Temperature**

The underway sea temperature channel was compared with averaged surface values extracted from CTD profiles to 7 metres. The 20 samples gave a small offset of  $-0.0266^{\circ}\text{C}$  between CTD and surface underway data with a standard deviation 0.0610. However, the calibration sample data were derived from averaging several data points; some of these showed a high degree of variability in the underway or CTD data at the time of the calibration point (having a standard deviation of  $0.02^{\circ}\text{C}$  or greater). When these samples were removed from the data set, the mean offset was  $-0.00513^{\circ}\text{C}$ , with a standard deviation of 0.0282. Due to the low offset and relatively high standard deviation of the calibration samples, no correction was required for the original temperature channel.

- **Salinity**

Surface CTD data were also extracted to calibrate the underway salinity. The offset was  $-0.00063$  PSU, with a standard deviation of 0.009511. The underway salinity data, therefore, required no correction.

- **Fluorometer**

As the data logged from the fluorometer did not contain corrections for range changes, the exact time and scale of each range change was noted during the screening process at BODC. The data were then adjusted to the same range throughout the cruise, using the correction  $\text{fluorc} = \text{fluor} * (\text{highest range} / \text{range})$ . The highest range was 31.6.

The range used for each section of the cruise is given below.

Start date/time	End date/time	Fluorometer range
19/09/1995 14:29:30	25/09/1995 05:09:30	10.00
25/09/1995 05:10:00	25/09/1995 17:11:00	31.60
25/09/1995 17:11:30	26/09/1995 14:55:30	10.00
26/09/1995 14:56:00	26/09/1995 15:55:00	31.60
26/09/1995 15:55:30	06/10/1995 20:45:30	03.16
06/10/1995 20:46:00	22/10/1995 00:10:00	10.00
22/10/1995 00:10:30	24/10/1995 07:34:30	03.16
24/10/1995 07:35:00	24/10/1995 19:30:00	01.00
24/10/1995 19:30:30	25/10/1995 10:06:00	10.00

After corrections were made for the range changes, the data were compared with fluorometric chlorophyll-a concentrations measured on samples taken from the non-toxic supply. The resulting relationship was used to calibrate the underway fluorometer.

Calibrated chlorophyll-a ( $\text{mg m}^{-3}$ ) =  $0.00614 \times \text{fluorometer voltage} - 0.0266$

( $n=274$ ,  $R^2=60.3\%$ )

The effect of quenching was assessed by adding PAR into a multiple regression. There was no improvement in the fit, so no correction for quenching was made.

### Comments on data quality:

Users should be cautious when using ship-borne wind measurements. Although the relative wind data have been corrected for ship's heading and speed, they are still sensitive to shielding effects. Users can consult the ship's E-W and N-S speed alongside the wind speed and direction.

### Reference

Fofonoff N.P. and Millard Jr., R.C. 1982. Algorithms for Computation of Fundamental Properties of Seawater. *UNESCO Technical Papers in Marine Science* 44.