Continuous underway data series for cruise AMT7 (13th September – 25th October, 1998)

Chief Scientist

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Content of data series

Parameter	Column heading	Units	Comments
Latitude	LAT+VEN	Degrees +ve N	
Longitude	LON+VEE	Degrees +ve E	
Salinity	RPSAL	PSU	Caution
Sea temperature	RTEMP	Degrees C	
Bathymetric depth	DEPTH	m	
Raw Turner Designs fluorometer output	TFLUOR	V	
Calibrated fluorometer output	CPHYL	mg chl-a m^{-3}	Calibrated using fluorometric chlorophyll-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^{-2}	
Solar radiation	SOLR	W m^{-2}	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

It is assumed that the position of the irradiance sensor was the same as for AMT5 and suffered from the same problem of shading by the foremast.

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.

The data from the fluorometer was logged into the JCR Ocean Logger system using the internal A/D converter and range output.

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 13/09/1998 16:00:00 to 25/10/1998 19:55:00, with a sampling interval of 1 minute.

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 3 gaps which were filled using linear interpolation.*

- **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 up to 7 metres. The 28 samples gave a small offset of 0.0101˚C between CTD and surface underway data with a standard deviation of 0.0228. As the offset was smaller than the standard deviation, no correction has been applied to the underway data.

- **Salinity**

It was not possible to calibrate the underway salinity channel as there are no available salinity sample data. The CTD salinity channel has itself not been calibrated. However, comparison of the two data sets can be made in order to test the consistency between the two channels. There were a number of occasions where the underway salinity was significantly different from the CTD salinity. Dates and times of these occasions are shown in the table below.

Date/time (GMT)	Mean tsg salinity (PSU)	N° values	Std.dev of values	Mean CTD salinity to 7m (PSU)	N° values	Std.dev of values	Offset CTD– tsg (PSU)
22/09/1998 09:44	36.15	8	0.003	36.314	43	0	0.164
23/09/1998 09:17	36.578	8	0.005	36.675	41	0	0.097
25/09/1998 16:01	36.124	6	0.004	36.963	39	0.002	0.839
29/09/1998 10:14	36.13	6	0.005	36.365	26	0	0.235
16/10/1998 13:10	34.829	7	0.003	35.051	23	0	0.222

The salinity data were screened again, and it appeared that there may have been a problem with the conductivity sensor for some parts of the cruise. The following sections of the salinity record were flagged as suspect:

18/09/1998 10:45 – 26/09/1998 03:10
29/09/1998 08:14 – 30/09/1998 08:12

If the high offset values are excluded from the dataset, the remaining values (N=22) show a mean offset of 0.0044 PSU with a standard deviation of 0.011 PSU.

- **Fluorometer**

The data from the Turner Designs fluorometer suggested that the instrument was operated on the same range setting throughout the cruise.

The fluorometer voltage channel was compared with data obtained from fluorometric assays on acetone extracts from discrete underway samples throughout the cruise. This exercise showed a very inconsistent relationship between the two data sets. It is likely that the response of the instrument was affected by the very different oceanographic regimes encountered throughout the whole cruise. The data were examined carefully and split into different sections where the best relationships could be identified. Calibrations were then applied to different sections of the cruise. The relationship was of the form

Chlorophyll concentration (mg m^{-3}) = fluorometer signal * coeffA + coeffB.

The effect of varying PAR was considered but no quenching effect could be identified.

Section start	Section end	coeffA	coeffB	R^2	No.samples
13/09/1998 16:00	16/09/1998 13:00	0.228	-0.196	69.2	13
16/09/1998 13:01	25/09/1998 15:47	0.350	-0.376	91.7	42
25/09/1998 15:48	29/09/1998 03:00	0.336	-0.337	90.4	34
29/09/1998 03:01	05/10/1998 15:00	0.493	-0.523	92.3	66
05/10/1998 15:01	10/10/1998 20:23	0.212	-0.265	70.7	57
10/10/1998 20:24	13/10/1998 17:40	0.227	-0.226	62.8	34
13/10/1998 17:41	15/10/1998 19:00	0.168	-0.191	89.8	23
15/10/1998 19:01	16/10/1998 23:29	0.145	-0.285	87.5	10
16/10/1998 23:30	25/10/1998 19:55	0.247	-0.166	55.6	39

Note that the data from the start of the cruise until 15/09/1998 01:00 showed a poor relationship with chlorophyll-a. The calibration equation obtained from the section 15/09/1998 14:00 to 16/09/1998 12:00 has been applied to the first section but users should not regard the first section as reliable data.

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.

As described in the section on salinity calibration, there appeared to be a problem with the conductivity sensor during the cruise. The periods where this problem could be identified in the salinity channel were flagged as suspect. There may be other suspect sections that have not been identified. The salinity data should, therefore, be used with caution.

Due to the changing nature of the relationship between fluorometer output and chlorophyll-a concentrations, the data were split into different sections for the purposes of the calibration exercise. It is believed that this is the best way to produce an accurate representation of chlorophyll-a concentration throughout the cruise, but people who need accurate concentrations should use the extracted chlorophyll-a dataset directly. Please consult Alison Fairclough (ajfa@bodc.ac.uk) for more details.

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.