Continuous underway data series for cruise AMT10 (11th April – 7th May, 2000)

Chief Scientist

Chris Gallienne, Plymouth Marine Laboratory

Content of data series

Parameter	Column heading	Units	Comments
Latitude	LAT+VEN	Degrees +ve N	
Longitude	LON+VEE	Degrees +ve E	
Salinity	RPSAL	PSU	
Sea temperature	RTEMP	Degrees C	
Raw Turner Designs fluorometer output	TFLUOR	Nominal units	Range changes
Calibrated fluorometer output.	CPHYL	mg chl-a m^{-3}	Poor calibration
Atmospheric pressure	APRES	mbar	
Dry bulb air temperature (Masthead starboard)	SMDBT	Degrees C	
Wind speed	MWS	knots	
Wind direction	MWD	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 11/04/2000 12:01 to 07/05/2000 14:57, 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 40 samples gave a very small offset of –0.00826˚C between CTD and surface underway data with a standard deviation of 0.0303. 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. The offset between CTD channel 1 and the underway salinity was 0.0072 with a standard deviation of 0.0279. The offset between channel 2 and the underway salinity was 0.0114 with a standard deviation of 0.0280. There is fairly good agreement between the CTD and underway data.

- **Fluorometer**

The Turner Designs fluorometer operated on different range settings throughout the cruise. The points at which the range setting changed were identified during screening by looking for abrupt jumps in the signal with a magnitude of approximately 3. The data were then adjusted to a constant range for the whole cruise. For AMT10, the following corrections were applied.

Section start	Section end	Scaling factor
12/04/2000 22:47:00	14/04/2000 02:01:00	10.0
14/04/2000 02:01:00	26/04/2000 13:22:00	31.6
26/04/2000 13:22:00	27/04/2000 10:09:00	10.0
27/04/2000 10:09:00	27/04/2000 11:05:00	3.16
27/04/2000 11:05:00	28/04/2000 04:01:00	10.0
28/04/2000 04:01:00	01/05/2000 12:58:00	31.6
01/05/2000 12:58:00	03/05/2000 16:01:00	10.0
03/05/2000 16:01:00	07/05/2000 14:57:00	3.16

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
11/04/2000 12:01	17/04/2000 23:55	0.139	-0.0948	0.689	29
17/04/2000 23:56	26/04/2000 17:06	0.450	-0.563	0.533	83
26/04/2000 17:07	01/05/2000 22:17	0.137	-0.0855	0.613	44
01/05/2000 22:18	03/05/2000 22:33	0.0691	0.163	0.549	20
03/05/2000 22:34	07/05/2000 14:57	0.294	-2.49	0.831	10

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.

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. However, there was a high degree of scatter in the relationship between underway fluorometer data and chlorophyll-a measurements. 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.