Continuous underway data series for cruise AMT4
(21st April – 27th May, 1997)

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	
Sea temperature	RTEMP	Degrees C	
Bathymetric depth	DEPTH	m	
Raw Turner Designs fluorometer output	TFLUOR	Nominal units	Range changes
Calibrated fluorometer output	CPHYL	mg chl-a m^{-3}	Calibrated against fluorometric chl-a
Atmospheric pressure	APRES	mbar	None
Dry bulb air temperature (Masthead starboard)	SMDBT	Degrees C	Periods of poor quality
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

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 21/04/1997 12:07:00 to 27/05/1997 00:05:00, 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 4 gaps and 2 speed check failures. These 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 also compared with averaged surface values extracted from CTD profiles to 7 metres. The 51 samples gave a small offset of 0.007°C between CTD and surface underway data, with a standard deviation 0.0239. As the mean offset is lower than the standard deviation of the sample offsets, no correction has been applied to the temperature channel.

- **Salinity**

Surface CTD data were extracted to calibrate the underway salinity. The offset was 0.0082 PSU, with a standard deviation of 0.0036. This excluded 4 samples from the 22/04/1997 to 23/04/1997 where the offset ranged between 0.062 and 0.556 PSU. There was no obvious problem in the underway data track for this period but it appears that the underway data are anomalously low, or the CTD data are anomalously high on these dates. As BODC do not hold any salinometer data for this cruise, it is not possible to investigate the discrepancy further.

The following calibration has been applied to the salinity channel.

$$\text{Salinity}_{corrected} = \text{Salinity}_{raw} + 0.008 \text{ PSU}$$

- **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 fluorc = fluor*(31.6/range).

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

Section start	Section end	Fluorometer range
21/04/1997 12:07:00	24/04/1997 11:25:00	10.00
24/04/1997 11:25:30	30/04/1997 01:10:00	03.16
30/04/1997 01:10:30	30/04/1997 10:23:00	10.00
30/04/1997 10:23:30	30/04/1997 12:07:00	31.60
30/04/1997 12:07:30	30/04/1997 23:26:00	10.00
30/04/1997 23:26:30	14/05/1997 21:11:00	31.60
14/05/1997 21:11:30	15/05/1997 16:19:00	10.00
15/05/1997 16:19:30	20/05/1997 19:13:00	31.60
20/05/1997 19:13:30	21/05/1997 19:41:00	10.00
21/05/1997 19:41:30	22/05/1997 18:41:00	03.16
22/05/1997 18:41:30	24/05/1997 10:21:00	01.00
24/05/1997 10:21:30	27/05/1997 00:05:00	03.16

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 (mg m^{-3}) = 0.0024 *fluorometer value – 0.054

(n=294, R2=77.1%)

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.

Note that this calibration is very close to that found in AMT2.

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.