Continuous underway data series for cruise AMT3
(20th September – 25th October, 1996)

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 with 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^{-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 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 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 21/09/1996 12:16:00 to 25/10/1996 13:20:00, 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**

Temperature and salinity readings from the thermosalinograph were compared with precision reversing thermometers mounted on the CTD frame at the 7m position. The calibration exercise was carried out by Colin Griffiths and Tony Bale (PML).

BODC do not have the calibration data, but the mean and standard deviation of the errors are presented in the AMT3 cruise report. They were -0.0004 and 0.0297 °C respectively.

The underway sea temperature channel was also compared with averaged surface values extracted from CTD profiles to 7 metres. The 30 samples gave a small offset of –0.0166°C between CTD and surface underway data, with a standard deviation 0.0306. This data set, and the reversing thermometer calibration data set, showed mean offsets that were lower than the standard deviation of the population. As a result, no correction has been applied to the original temperature data.

- **Salinity**

Salinity values from the thermosalinograph were compared with the salinity of samples taken from the thermosalinograph outlet measured on the Autolab precision salinometer. The calibration exercise was carried out by Colin Griffiths and Tony Bale (PML).

The average salinity error was -0.008 PSU, and the standard deviation was 0.011PSU.

Surface CTD data were also extracted to calibrate the underway salinity. The offset was 0.0109 PSU, with a standard deviation of 0.0052. This excluded 3 samples from the 24/10/1996 and 25/10/1996 where the offset ranged between 0.307 and 0.336 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.

The comparison with both CTD data and salinometer data gave significantly different offsets. The salinometer data are a more reliable data set to use for the calibration exercise; the low offset and relatively high standard deviation show that no correction is required for the salinity data.

- **Fluorometer**

In contrast to other AMT cruises, it appeared that there were no range changes on the fluorometer during AMT3.

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}) = 0.405 *fluorometer value – 0.651

(n=297, R2=74.7%)

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.

Due to the range of the fluorometer being set at a constant level, the sensitivity of the instrument in regions of low chlorophyll concentrations is low.

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.