AMT RRS James Cook Cruise JC079 AMT22 Underway Meteorology and Surface Hydrography Document

Cruise details

Dates	2012-10-10 to 2012-11-24
Principal Scientific Officer	Glen Tarran (PML)
Data supplied by	Martin Bridger (NMF-SS)

These notes refer to underway data collected during the RRS James Cook cruise (JC079) AMT22, between 10th October and 24th November 2012. The cruise departed from Southampton (UK) and finished in Punta Arenas (Chile). All time quoted in this document are UTC.

The data provided to BODC cover the period from 10/10/2012 to 20/11/2012.

The data did not fully cover the period of the cruise as the sea surface hydrography sensor suite was not turned on until clear of land at the start of the cruise (11/10/2012 08:50) and turned off prior to entering Argentinean territorial waters (20/11/2012 20:00). The vessel then arrived into Punta Arenas on schedule on 24th November 2012.

Content of data series

Parameter	Units	Parameter code	Comments
Latitude	Degrees (+ve N)	ALATGP01	-
Longitude	Degrees (+ve E)	ALONGP01	-
Ship's heading (Gyro)	degrees	HEADCM01	-
Ship's eastward velocity	cm s^{-1}	APEWGP01	-
Ship's northward velocity	cm s^{-1}	APNSGP01	-
Distance run	km	DSRNCV01	-
Bathymetric depth	m	MBANCT01	-
Atmospheric pressure	mbar	CAPHTU01	-
Air temperature	°C	CDTASS01	-
Relative humidity	%	CRELSS01	-
PAR irradiance	W m^{-2}	DWIRRXMX	-
Total irradiance	W m^{-2}	CSLRR1XS	-

Relative wind direction	Degrees	ERWDSS01	-
Relative wind speed	m s^{-1}	ERWSSS01	-
Absolute wind direction	Degrees	EWDASS01	Corrected for ship's heading and speed
Absolute wind speed	m s^{-1}	EWSBSS01	Corrected for ship's heading and speed
Salinity - calibrated	Dimensionless	PSALSG01	Calibrated against samples
Temperature (sea surface, remote housing at non-toxic seawater supply inlet) - calibrated	°C	TEMPHG01	Calibrated against samples
Temperature (TSG housing)	°C	TMESSG01	-
Fluorometer output: voltage	V	FVLTWS01	-
Chlorophyll fluorescence (calibrated)	mg chl_a m^{-3}	CPHLUT01	Calibrated against samples
Beam transmission	%	POPTDR01	-
Beam attenuation	m^{-1}	ATTNDR01	-

Instrumentation

Navigation and bathymetry (HIPLAT)

Instrument	Type
Applanix POS MV	GPS
C-Nav 3050	GPS
Kongsberg Seatex DPS116	GPS
Sperry Marine Gyrocompass	Gyro compass
Simrad EA600 Precision Echo Sounder	Echosounder

Meteorology (HIMET)

Sensor	Serial number	Last calibration date	Deployment
Gill Wind sonic (Option 3)	064537	-	Starboard
Skye Instruments SKE510	28560	2011-07-05	Starboard
Skye Instruments SKE510	28561	2011-07-11	Port
Kipp and Zonen Ltd CMB6	973134	2011-07-15	Starboard

Kipp and Zonen Ltd CMB6	973135	2011-07-15	Port
Vaisala PTB100A	U1420016	2012-03-26	Starboard
Vaisala HMP45A	E1055002	2012-07-02	Starboard

Surface hydrography (HIUWAY)

Sensor	Serial number	Last calibration date
Sea-Bird SBE38	0488	2012-06-13
Sea-Bird SBE45	0233	2012-07-25
Wetlabs C-Star	CST-1132PR	2012-07-19
Wetlabs WetStar	WS3S-351P	2012-07-24

Originator's Data Processing

Navigation and bathymetry (HPPLAT)

During the cruise there was a dual logging system in place on the RRS James Cook. Data from the various instruments were logged to the RVS Level-C system and also as NetCDF (binary) through the Ifremer Techsas data logging system. The following instruments were logged during the cruise:

1) Applanix POS MV DGPS (logged to RVS format as posmvpos)
2) C-Nav 300 DGPS (logged to RVS format as gps_cnav)
3) Kongsberg Seatex DPS116 DGPS (logged to RVS format as dps116)
4) Chernikeef EM speed log (logged to RVS format as log_chf)
5) Ship's Gyrocompass (logged to RVS format as gyro_s)
6) Simrad EA600 Precision Echo Sounder (logged to RVS format as ea600m)

Processing was carried out using the RVS software suite. The following routines were run on the navigation and bathymetry data channels to produce files named after the routine that generated them:
RELMOV - Relmov is the relative motion file for this cruise. This was generated using the ships gyro and ships Chernikeef Log data to extract a movement in a given direction. This was then used by bestnav when and where necessary to calculate fixes if GPS fixes were not available.
BESTNAV - Bestnav uses all 3 GPS Systems logged and creates a best suite stream by providing an as complete account of the ships track as possible. This is done by reading all 3 GPS streams with posmvpos being primary, gps_cnav as secondary and dps116 as tertiary. The system looks for gaps of a certain length in the primary and when it finds those gaps it requests that the next gps down fill in the gaps. If no GPS data is available it asks RELMOV to fill in until data is available again. Then the system calculates back over itself to ensure that the extrapolated positions are correct using the GPS data available around the gap.
BESTDRF - Bestdrf is a product of bestnav. When run bestnav uses the relmov data which contains a predicted vn and ve based upon direction and speed through the water. The Bestdrf file is the accurate drift velocity of what actually occurred based on the GPS changes between each record.
PRODEP - Prodep is an automated process that accessed the bestnav position fix data and then uses a pre programmed Carter tables of corrections and corrects the echo sounder data for that given time.

The data from the BESTNAV and PRODEP routines were taken for transfer into the underway dataset.

Filename	Data type	Start Calendar	Start	Finish Calendar	Finish	Data

		Day	Time	Day	Time	Interval
bestnav	RVS Level-C processed	2012-10-10	08:00:00	2012-11-20	20:00:40	10 seconds
prodep	RVS Level-C processed	2012-10-10	09:05:15	2012-11-20	20:00:05	variable

Meteorology (HPMET)

During the cruise there was a dual logging system in place on the RRS James Cook. Data from the various instruments were logged to the RVS Level-C system file surfmet, and also as NetCDF (binary) through the Ifremer Techsas data logging system. The following instruments were logged during the cruise:
1) Gill Wind sonic (Option 3)
2) Skye Instruments SKE510 (port and starboard)
3) Kipp and Zonen Ltd CMB6 (port and starboard)
4) Vaisala PTB100A
5) Vaisala HMP45A

Processing was carried out using the RVS software suite only on the wind channels. The RVS processing routine PRO_WIND was run on the navigation data in the bestnav and the relative wind data in the surfmet files. This program was designed to remove the relative variables from the wind data logged by surfmet. By removing any fixed offsets in the system and removing the affect of ship motion the data in the pro_wind file is a true representation of wind data at the ship's position.

Filename	Data type	Start Calendar Day	Start Time	Finish Calendar Day	Finish Time	Interval
pro_wind	RVS Level-C processed	2012-10-10	08:00:00	2012-11-20	20:00:30	10 seconds
surfmet	RVS Level-C raw	2012-10-10	07:59:58	2012-11-20	20:00:54	1 sec

Sea surface hydrography (HPUWAY)

During the cruise there was a dual logging system in place on the RRS James Cook. Data from the various instruments are logged to the RVS Level-C system and also as NetCDF (binary) through the Ifremer Techsas data logging system. The following instruments were logged during the cruise:
1) Wetlabs C-star 25 cm pathlength transmissometer (logged to RVS format in surfmet)
2) Wetlabs WetStar fluorometer (logged to RVS format in surfmet)
3) Seabird SBE38 Temperature sensor (logged to RVS format in sbe45)
4) Seabird SBE45 MicroTSG (logged to RVS format in sbe45)

Filename	Data type	Start Calendar Day	Start Time	Finish Calendar Day	Finish Time	Interval
sbe45	RVS Level-C raw	2012-10-10	07:59:58	2012-11-20	20:00:54	1 sec
surfmet	RVS Level-C raw	2012-10-10	07:59:58	2012-11-20	20:00:54	1 sec

BODC Data Processing

Navigation and bathymetry (HPPLAT)

The RVS Level-C files were chosen for transfer to the BODC underway file.

The bestnav and prodep data were transferred. A description of the channels present in the files, units, whether they were transferred, BODC parameter code and units, and if a unit conversion was applied during the transfer are detailed in the table below:

bestnav	Channels	Description	Units	BODC Parameter Code	Units	Conversion Factor
	lat	Latitude	Degrees +ve N	ALATGP01	Degrees +ve N	*1
	lon	Longitude	Degrees +ve E	ALONGP01	Degrees +ve E	*1
	vn	Northwards velocity	knots	APNSGP01	cm s^{-1}	*51.44
	ve	Eastwards velocity	knots	APEWGP01	cm s^{-1}	*51.44
	cmg	Course made good	Degrees True	APDAGP01	Degrees True	*1
	smg	Speed made good	knots	APSAGP01	m s^{-1}	*0.514
	dist_run	Distance run	Nautical mile	DSRNCV01	km	*1.852
	heading	Ship's heading	Degrees True	HEADCM01	Degrees True	*1
prodep	**Channels**	**Description**	**Units**	**BODC Parameter Code**	**Units**	**Conversion Factor**
	uncdepth	Raw depth from echosounder	m	MBANZZ01 - To be dropped after screening	m	*1
	cordepth	Depth corrected from Carter's tables	m	MBANCT01	m	*1
	cartarea	Carter's table area from position	-	not for transfer	-	-

The navigation channels were checked using BODC Matlab routine 'navcheck' and 15 gaps were identified. Each period was less than 10 minutes in duration and using the BODC Matlab routine 'navint' the gaps were filled by interpolation. There were no speed check failures.

Meteorology (HPMET) and Sea surface hydrography (HPUWAY)

The RVS Level-C files were chosen for transfer to the BODC underway file.

The surfmet and sbe45 data were transferred. A description of the channels present in the files, units, whether they were transferred, BODC parameter code and units, and if a unit conversion was applied during the transfer are detailed in the table below:

surfmet	Channels	Description	Units	BODC Parameter Code	Units	Conversion Factor
	temp_h	TSG housing temperature	-	not for transfer - loaded from sbe45 file with salinity	-	-
	temp_r	Remote temperature at non-toxic inlet	-	not for transfer - loaded from sbe45 file with salinity	-	-
	cond	TSG conductivity	-	not for transfer - loaded from sbe45 file with salinity	-	-
	fluo	Raw fluorometer voltage	V	FVLTWS01	V	*1
	trans	Raw transmissometer voltage	V	TVLTDR01	V	*1
	press	Atmospheric pressure at measurement height - no sea level correction	1 hPa	CAPHTU01	1 mbar	*1
	ppar	Raw port PAR sensor voltage	10^{-2}mV	DVLTRPSD	V	$*10^{-5}$
	spar	Raw starboard PAR sensor voltage	10^{-2}mV	DVLTRSSD	V	$*10^{-5}$
	speed	Relative wind speed	m s^{-1}	ERWSSS01	m s^{-1}	*1
	direct	Relative wind direction	Degrees	ERWDSS01	Degrees	*1
	airtemp	Air temperature	Degrees Celsius	CDTASS01	Degrees Celsius	*1
	humid	Air humidity	Percent	CRELSS01	Percent	*1
	ptir	Raw port TIR sensor voltage	10^{-2}mV	CVLTRP01	V	$*10^{-5}$
	stir	Raw starboard TIR sensor voltage	10^{-2}mV	CVLTRS01	V	$*10^{-5}$
sbe45	**Channels**	**Description**	**Units**	**BODC Parameter Code**	**Units**	**Conversion Factor**
	temp_h	TSG housing temperature	Degrees Celsius	TMESSG01	Degrees Celsius	*1
	cond	TSG conductivity	S m^{-1}	CNDCSG01	S m^{-1}	*1

	salin	Salinity	PSU	PSALSU01	dimensionless	*1
	sndspeed	Velocity of sound in water	m s^{-1}	SVELSG01	m s^{-1}	*1
	temp_r	Remote temperature at non-toxic inlet	Degrees Celsius	TEMPHU01	Degrees Celsius	*1

Wind channels - calculation of absolute values

The BODC Matlab procedure 'wincor' was run using relative wind speed and direction, the ship's north-south and east-west velocities with the vane set to 0 degrees at the bow to generate absolute wind speed (EWSASS01) and direction (EWDASS01).

Irradiance channels (PAR and TIR) - conversion from voltages using manufacturer's calibrations

The manufacturer's calibrations from the sheets supplied by NMF-SS have been applied through the BODC Calibration database.

BODC ICALRF 6767 DWIRRSSD = DVLTRSSD * 93896.714 from calibration coefficient 10.65 µV / W m^{-2}

BODC ICALRF 6772 DWIRRPSD = DVLTRPSD * 96911.968 from calibration coefficient 10.11 µV / W m^{-2}

BODC ICALRF 6770 CSLRRS01 = CVLTRS01 * 91742.119 from calibration coefficient 10.90 µV / W m^{-2}

BODC ICALRF 6771 CSLRRP01 = CVLTRP01 * 84459.459 from calibration coefficient 11.84 µV / W m^{-2}

The port and starboard channels for PAR and TIR were each merged based on the maximum value from the paired channels to give one definitive channel.

BODC ICALRF 6135 DWIRRXMX = max(DWIRRPSD, DWIRRSSD)

BODC ICALRF 6258 CSLRR1XS = max(CSLRRS01, CSLRRP01)

Transmissometer - conversion from voltage using manufacturer's calibrations

The manufacturer's calibrations from the sheets supplied by NMF-SS have been applied through the BODC Calibration database.

BODC ICALRF 6774 POPTDR01 = 100 * (TVLTDR01 -0.060) / (4.665 - 0.060) = 21.7155 * TVLTDR01 - 1.3029

BODC ICALRF 6724 ATTNDR01 = -(1/0.25) * ln (POPTDR01 * 0.01)

Sample Calibrations

Temperature

The hull temperature sensor data were calibrated against the CTD temperature sensors during the cruise. The data from the hull sensor at the CTD start time were compared with the temperature from the externally mounted CTD temperature at 5 decibars. The temperature offsets (CTD - Hull) were plotted against date/time and CTD sensor temperature then outliers identified. The relationships in the offset between sensors were then compared to the date/time and the CTD sensor temperature in separate linear

regressions. There was no significant relationship with CTD sensor temperature (R^2 = -0.015; n = 52; F = 0.262; p = 0.611) or offset with date/time (R^2 = -0.02; n = 52; F = 0.0019; p = 0.965). The mean offset was calculated to correct the temperature channel.

Applying the offset between the externally mounted CTD temperature sensor and the hull mounted temperature sensor, the calibrated temperature channel data were generated through the BODC BUDS calibration routine.

BODC ICALRF 6778 TEMPHG01 = TEMPHU01 + 0.0033

Salinity

The SBE45 salinity data were calibrated against bench salinometer data from samples collected from the underway system during the cruise. The data from the SBE45 TSG at the discrete sampling times were compared with the bench salinometer measurements. The salinity offsets (bench - TSG) were plotted against date/time and bench salinity then outliers were identified. The relationships in the offset between TSG and bench salinometer were then compared to bench salinity. There was a significant relationship of offset with bench salinity (R^2 = 0.210; n = 118; F = 30.83; p < 0.0001).

Applying the equation from the bench salinometer regression, the calibrated salinity channel data were generated through the BODC BUDS calibration routine.

BODC ICALRF 6779 PSALSG01 = 0.9968 * PSALSU01 + 0.1205

Fluorescence

The fluorometer voltage data were calibrated against extracted chlorophyll-a data from samples collected from the underway system during the cruise. Samples of seawater collected and extracted chlorophyll-a measurements made following Welschmeyer (1994). Each sample of 250 ml was filtered through a 47 mm 0.2 µm polycarbonate filter. The filters were then placed in a vial with 10 ml 90% acetone and left in a freezer for 24 hours. The samples were then analysed on a pre-calibrated Turner Designs Trilogy fluorometer with a non-acidified chl module (CHL NA #046) fitted. The bench fluorometer calibration was checked against dilutions of pure chlorophyll stock during the cruise and no modifications to the calibration were necessary. The raw voltage data from the fluorometer at the discrete sampling times were compared with the extracted chlorophyll-a measurements. The offsets (extracted chl-a - voltage) were plotted against date/time and extracted chlorophyll-a and outliers identified. There was a significant relationship between the offset and extracted chl-a concentration (R^2 = 0.994; n = 143; F = 23255.1; p < 0.0001).

Applying the equation from the extracted chlorophyll-a regression, the calibrated fluorescence channel data were generated through the BODC BUDS calibration routine.

BODC ICALRF 6777 CPHLUT01 = 7.1500 * FVLTWS01 - 0.2561

On 14/05/2014 a further correction was applied to the fluorometer calibration. A cross calibration between fluorometers used to measure the discrete chl-a values across AMT20-23 highlighted that there was potentially an issue with the standard used to calibrate the fluormeter unit at the start of the cruise. The further correction applied was:
0.7886 * chl-a - 0.0012

References

Welschmeyer N.A., 1994. Fluorometric analysis of chlorophyll-a in the presence of chlorophyll-b and phaeopigments. Limnology and Oceanography, 39:1985-1992.

Data quality report

Navigation and bathymetry (HQPLAT)

The navigation data have been through BODC quality control screening. The 15 gaps of less than ten minutes have been filled by interpolation. Overall the data for the cruise duration appear good.

The bathymetric data have been through BODC quality control screening. There are periods of noise that hide the real bathymetry in the channel. Where possible some periods have been flagged to remove the noise. Users should use caution when interpreting the bathymetric depth channel.

Meteorology (HQMET)

The meteorology data have been through BODC quality control screening. Some intermittent flagging of data have been made. Overall the data for the cruise duration appear good.

Wind channels: The relative wind speed and direction channels show natural variation and fluctuation but there were no values or trends that stood out as unrealistic. There were 'steps' in the channel but this is related to the vessel coming on to or leaving station. No additional flags were added. The absolute wind speed and direction channels were screened and a few spikes flagged suspect.

Irradiance channels: The data in the channels did not require further flagging as it is unclear whether the variation is due to changing cloud cover etc.

Sea surface hydrography (HQUWAY)

The underway log sheets were used as a guide to the times when the non-toxic flow was switched off, dropped low or was adjusted during the cruise. Where there was noise in the channel at these times the data were flagged suspect. If there was no noise or spiking the data remain unflagged.

The sample calibrations applied to the TSG salinity, hull sensor temperature and fluorometer channels appear reasonable and did not produce suspect data in the calibrated channels. The calibrated fluorometer data exhibit large amounts of variability towards the end of the cruise in the southern Atlantic Ocean. The calibration in this area is not as closely matched to the sample data for this reason and users should keep this in mind when using the sample calibrated fluorometer data.

Attenuance and transmittance: There are some periods of noise within the transmissometer data, which may be the result of bubbles accumulating at the lens. There are other periods when there are steps in the data. Users should therefore apply caution when interpreting the transmissometer data.

Problem report

Navigation and bathymetry

Not applicable.

Meteorology

Not applicable.

Sea surface hydrography

Not applicable.