Marine Data Voyage Report 2015/16 Voyage 3

Prepared by:

Document Status: **ISSUED**

**Document Change Description**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Issue** | **Date** | **Change Description** | **By** | **Approval** |
|  |  | First Release | LPS |  |

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# Introduction

This is the Marine Data Voyage Report for Voyage 3 2015/16 which took place between the 11th January and the 12th March 2016.

# Purpose of This Document

During most Antarctic voyages, the underway data collection system is operated to continuously record navigational, meteorological and water chemistry information. This data collection is performed as part of STS project 3313 whose objective for every voyage is as follows:

* *Science Technical Support including provision of recording scientific data during the voyage for publication from the Australian Antarctic Data Centre (AADC) to the wider scientific community.*
* *Provide meteorological, sea water, bathymetry and navigation information to ship’s crew, BOM observers and scientific personnel in real time.*
* *Provide a system for the general use of expeditioners to track the voyage progress and environmental conditions.*

This document is intended to provide a complete description of the underway data recorded on the Voyage. Marine Data Voyage Reports are structured in three parts:

1. A description of the voyage including:

* Departure and return dates.
* Purpose of the voyage.
* Particular activities and events which are relevant to the voyage data set.
* Any particular instrumentation issues that occurred on the voyage.

1. A description of the instruments installed on the ship for the voyage. Normally this section of the report will remain relatively constant over the course of an Antarctic season but there may be minor changes as instruments occasionally fail or need to be replaced for various reasons.
2. A description of the ship’s underway data collection system including the three levels of data that are collected (raw instrument strings, NetCDF files and the final database product that is supplied to the Australian Antarctic Data Centre)

# Voyage Description

## Voyage Objectives

The principal objectives of the voyage were to:

* Conduct the K-Axis Marine Science program.
* Carry out the Mawson resupply,
* Conduct minor cargo operations at Davis and then return to Hobart.

Due to the vessel grounding at Mawson on the 24th February the vessel returned to Fremantle without visiting Davis.

## Timing and locations:

The table below shows the actual voyage schedule:

|  |  |  |
| --- | --- | --- |
| **Location** | **Time (UTC)** | **Activity** |
| Hobart | 11th January 2016 | Departure from Hobart |
| K-Axis Marine Science | 21st January to 19th February | K-Axis marine science program |
| Mawson | 20th February 2016 | Arrival at Mawson |
| Mawson | 24th February 2016 | Vessel breaks mooring lines and runs aground inside Horseshoe Harbour. |
| Mawson | 26th February 2016 | Vessel refloated and departs harbour |
| Vicinity of Mawson | 27th February – 2nd March 2016 | Minor cargo operations and vessel checking |
| Fremantle | 12th March 2016 | Return to Fremantle |

Table - Voyage Schedule

## Ships Track

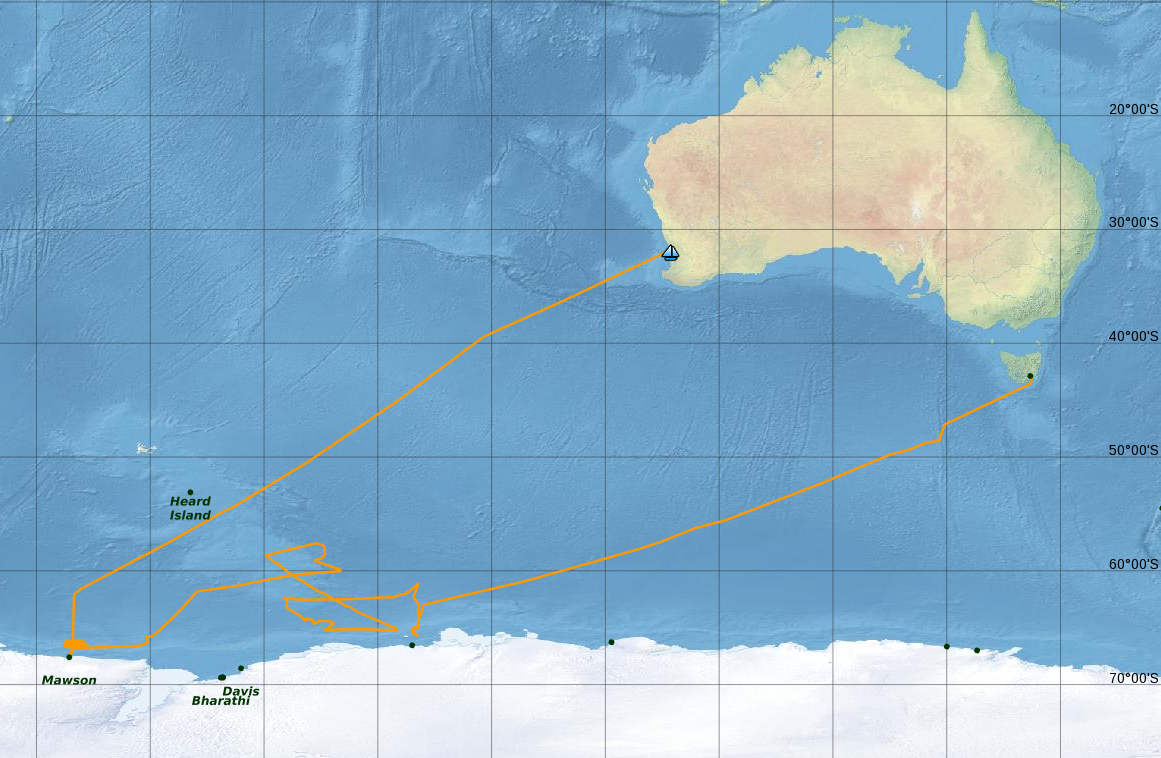


Figure - Ships Track for Voyage 3 - 2015/2016

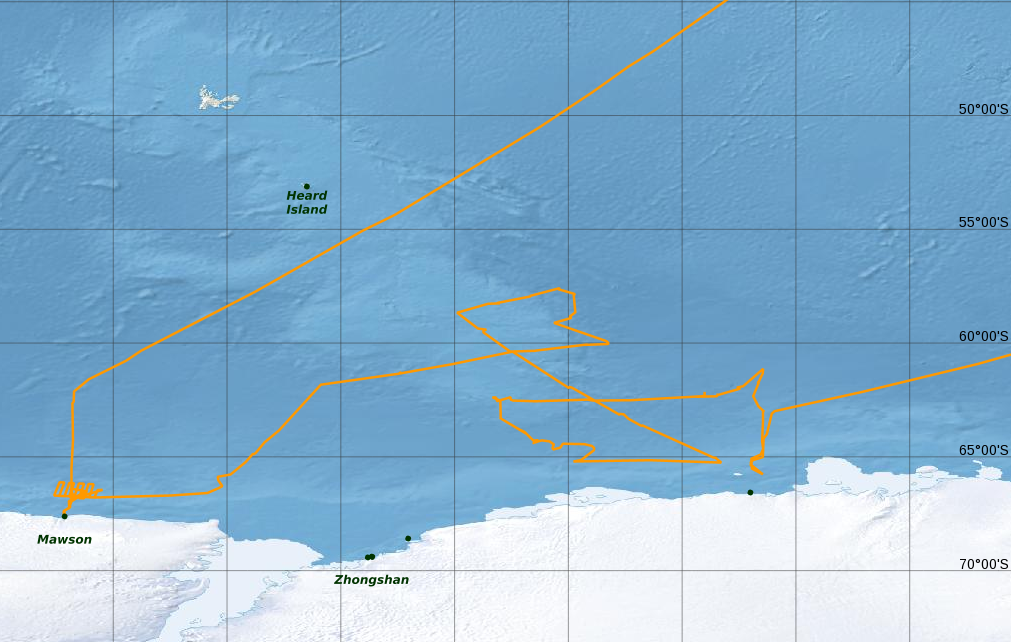


Figure - Ships Track for Voyage 3 - 2015/2016 (Marine Science legs)

## Personnel

To support the K-Axis marine science program, we had three electronics staff on board this voyage except for the return leg from Mawson to Fremantle when we were reduced to one.

# 

## Issues with Instrumentation

During this voyage the following issues were encountered that affected data quality:

### Pressure Sensor

There are occasional negative spikes in pressure data. These spikes have been removed from the data. The original data is available from the AADC if required.

### Starboard Wind Sensor

After the blizzard at Mawson on the 24th February, there were some observed problems with the starboard wind sensor (it seemed to be sticking at times) however during post voyage data inspection, it is difficult to see any clear evidence of a problem. However caution should be exercised when using this data after the 24th February. The wind sensor did completely fail after arrival back at Fremantle.

### Uncontaminated Water Flow

All uncontaminated water data should be interpreted with reference to the water flow data.

### Eppley PIR

The starboard Eppley PIR fails to track the port sensor during all of January (including the sensor temperature). The reason for this is unknown. It appears to function well during the remainder of the voyage.

### Fluorometer Data

There was a significant step change in the fluorometer data on the second day of the voyage. It was on this day that we opened the fluorometer to find that a cleaning cloth had been left in the instrument! It worked much better after this was removed.

### Meteorological Data Gap

There is a gap in the meteorological data between the 1700 and 2330 UTC on the 15th January. This was due to a UPS circuit breaker tripping in the met lab.

### Missing Biological Echo Sounder Data

The biological echo sounder was turned off after the 24th February due to concerns that the transducer may have been damaged during the grounding event at Mawson. (Turns out that it was not!) Thus there is no biological echo sounder data for the return leg to Fremantle.

## Waypoints

A number of waypoints were maintained in the ships GIS system for this voyage. These are shown in in Section 7, **Table 35 - Voyage Waypoints**.

## Technical Voyage Events

A technical Event Log is maintained by STS staff on every marine science cruise. The contents of this log are found in section 6. This is not to be confused with the scientific event log that was maintained by scientific staff during the voyage.

## Start and End of Voyage

For the purposes of underway data collection, the precise start and end times of any voyage are arbitrarily chosen after the completion of the voyage. The start time is usually chosen to be a few hours before the ship departs its final berth before heading south. The stop time is usually chosen to be a few hours after it has initially berthed after returning from the Southern Ocean.

Some data will have been collected in the days before and after a voyage as the on-board systems are tested in preparation for the voyage. This additional data may be available in the raw format but will not be included in the official voyage processed data set.

|  |  |  |  |
| --- | --- | --- | --- |
| **Departure Port:** | Hobart | **Start Time:** | 0000UTC, 11th January 2016 |
| **Return Port:** | Fremantle | **Stop Time:** | 2359 UTC, 12th March 2015 |

Table - Voyage Data Start and Finish Times

## Rectangular Mid-water Trawl (RMT) FSI CTD Data.

A total of 44 routine trawls and 38 target trawls were conducted during the cruise using the Rectangular mid water trawl system.

The RMT system is fitted with a fibre optic cable and at the start of the cruise, we had two high definition cameras with lights mounted on the frame. The lights were only switched on for operational reasons and not during sample trawls.

The data from the RMT is available in the TECHSAS NetCDF files (refer to sections 5.3.16 to 5.3.19) and the high definition video is also available from the AADC. We stopped recording video a couple weeks into the voyage when a flooded housing took out the camera system. Consequently only a limited set of video is available.

## Conductivity, Temperature and Depth (CTD) data.

A total of 42 CTD deployments were undertaken during the voyage. Data was collected and recorded using the seabird system however we also logged the raw data using TECHSAS and this data is available in NetCDF format as part of the underway data set.

All CTD data (in both seabird and NetCDF form) has been submitted to the AADC.

## MIDOC Trawl Data

A total of 40 deep ocean MIDOC trawls were conducted during the voyage. A typical trawl involved deploying the net to 1200 metres and then opening the net at prescribed intervals on the ascent. The cod end was fitted with the CSIRO MIDOC device which allow 6 different cod ends to be switched to the net at time intervals.

MIDOC data was obtained by downloading the unit after every deployment. This data has been submitted to the AADC.

The MIDOC trawl was instrumented using scanmar sensors which were logged by the TECHSAS system and are available in NetCDF format as part of the TECHSAS underway dataset. (Available from the AADC.)

## Acoustic Data

A program of acoustic observations were made throughout the science phase of the voyage using the ships 38, 120 and 200 kHz echo sounders. This observing program was overseen by Dr Martin Cox and all data has been submitted to the AADC.

## Trace Metals Data

A program of Trace metal rosette deployments were made throughout the scientific phase of the voyage. This program was overseen by Dr Christina Schallenberg and the samples will be analysed post voyage.

## UVP data

An Underwater Vision Profiler (UVP) instrument for CNRS (Centre National de la Recherche Scientifique) was fitted to the CTD for some deployments. This program was overseen by Dr Emmanuel Laurenceau-Cornec.

## Other Data Collected

CO2 measurement in surface water: This instrument is maintained by the CSIRO personnel under AAD project 3313 and instrument data is not processed by the AAD.

# Instrument Description

## Installed Instruments

During this voyage, the instruments shown in Table 3 were operational.

Calibration certificates are held by the Science Technical Support section at the Australian Antarctic Division and can be made available via queries to the Australian Antarctic Data Centre.

|  |  |  |
| --- | --- | --- |
| **Instrument** | **Serial Number** | **Notes** |
| JRC GPS-112 GPS Receiver (Forward) |  |  |
| JRC GPS-112 GPS Receiver (Aft) |  | Not functional during this voyage (is planned for removal) |
| Ashtech ADU800 GPS Receiver | 209130080033 |  |
| Sperry Mk-37 Mod D/E Gyrocompass | unknown | Owned by P&O |
| Simrad 12kHz EK60 GPT | 271 |  |
| 12kHz Transducer, EDO Corporation 323 HP | 126-89 | Serviced during dry-dock 2013 |
| Simrad 38kHz EK60 GPT | 254 |  |
| 38kHz Transducer, Simrad ES38B | 28396 | Serviced during dry-dock 2013 |
| Simrad 120kHz EK60 GPT | 260 |  |
| 120kHz Forward Transducer, Simrad ES120-7 | 29488 | Serviced during dry-dock 2013 |
| 120kHz Aft Transducer, Simrad ES120-7 | 29490 | Serviced during dry-dock 2013 |
| Simrad 200kHz EK60 GPT | 246 |  |
| 200kHz Transducer, Simrad ES200-7 | 126 | Serviced during dry-dock 2013 |
| RDI OSADCP 150kHz Acoustic Doppler Current Profiler | 1667 |  |
| ADCP Transducer, Teledyne RD Instruments 71A-1022-00 | 2133 | Serviced during dry-dock 2013 |
| Krohn IFC 020 D Electromagnetic flow meter (TSG) | R08207b |  |
| Krohn IFC 020 D Electromagnetic flow meter (Fluorometer) | R08207a |  |
| Sea-Bird SBE 21 Thermosalinograph (TSG) | 2797 | Calibrated: June 2015 |
| WetLabs RMA 2948 Wetstar Chlorophyll sensor | FLRTD-013 | Calibrated: August 2015 |
| Seabird SBE-38 Water temperature probe | 0395 | Calibrated: June 2015 |
| Aanderra Optode 3835 Oxygen sensor (owned by AAD) | 299 | Calibrated: September 2015 |
| Vaisala HMP223 Temperature and Humidity – Port | X0520018 | Calibrated: June 2015 |
| Vaisala HMP223 Temperature and Humidity – Starboard | X0520019 | Calibrated: June 2015 |
| Vaisala PTB220 Barometer | A3920002 | Calibrated: June 2015 |
| RM Young 05103 Wind Anemometer - Port | 58616 | Serviced January 2013 |
| RM Young 05103 Wind Anemometer - Starboard | 37285 | Serviced January 2013 |
| Young 50201 Precipitation Gauge | 01606 |  |
| Middleton SK01-DP2 PAR Sensor – Port | 123.1765 | Calibrated: June 2015 |
| Middleton SK01-DP2 PAR Sensor – Starboard | 123.1766 | Calibrated: June 2015 |
| Middleton EQ08 Solar Pyranometer – Port | 8409 | Calibrated: June 2015 |
| Middleton EQ08 Solar Pyranometer – Starboard | 8408 | Calibrated: June 2015 |
| Eppley PIR, Precision IR Radiometer – Port | 35091F3 | Calibrated: June 2015 |
| Eppley PIR, Precision IR Radiometer – Starboard | 35092F3 | Calibrated: June 2015 |

Table - Instruments installed and operational during this Voyage

# Underway Data Collection System Description

The Underway data system on the Aurora Australis is an autonomous system that logs and distributes data from navigation and scientific instruments in real time during a voyage. The acquisition system is the TECHSAS system which has been developed by IFREMER (French Research Institute for Exploitation of the Sea) and is in use of numerous marine research vessels around the work. To complement the TECHSAS system, AAD uses a CSIRO software package called uwyMerger (underway data merger) which takes the TECHSAS recorded data and further merges it into a synchronised voyage data set containing selected parameters from all instruments and writes it to a single master NetCDF file for the voyage

In summary, data is recorded in three ways:

* All data from received from instruments is time stamped and written to ASCII log files.
* Selected data from the instrument strings is picked by TECHSAS and written to time series NetCDF files (one per day per instrument).
* A master NetCDF file for the voyage is recorded.

During each voyage, summary 1 minute data for the parameters is automatically sent back to the AADC every 60 minutes and is normally available for download within a few hours of the data being collected on board the voyage. This data is available from the Australian Antarctic Data Centre web site.

Sometime after each voyage, the higher time resolution data is generally reprocessed at Head office (using uwyMerger) to produce a final synchronised 5 second time resolution data set. This higher resolution data is then also placed in the Australian Antarctic Data Centre and published.

Not all instruments on the Aurora are connected to the logging system and not all the data from the connected instruments (which is recorded in the raw data text files) is distributed over the network or saved to the database. While only the specific parameters recorded in the database is publicly available from the AADC data centre, both the raw instrument data and the individual instrument NetCDF files are available upon request.

For Marine Science voyages an event log is maintained to record events during the voyage related to data collection and this is included as an appendix to this document when available.

## Quality Control

Very little automatic checking of data is performed, and only gross instrument failures can be detected in some cases. Instrument readings are affected by environmental conditions and meteorological instruments can be affected by ships superstructure and exhaust heat depending on the prevailing weather conditions and the ships heading.

Only the most basic form of quality control has been performed on this data (i.e. some data may have been discarded if it is deemed to be totally worthless or misleading)

**Before using any data collected on a voyage you should perform quality checking appropriate to your own needs to ensure that the data sets that you wish to use are valid.**

## Underway Parameters published by the AADC

Table 4 lists the parameters are available from the Australian Antarctic Data Centre for download. This does not represent the complete set of data that is collected but is the set of parameters that are transmitted back from the ship in real time (hourly) and made available through the AADC Web Feature Service.

|  |  |  |
| --- | --- | --- |
| Parameter Name | Description | Units |
| TIMESTAMP\_GPS\_UTC | Time | Days since December 30, 1899 |
| LATITUDE\_DEGNORTH | Latitude | decimal degrees |
| LONGITUDE\_DEGEAST | Longitude | decimal degrees |
| TEMP\_AIR\_PORT\_DEGC | Air Temperature (port) | °C |
| TEMP\_AIR\_STRBRD\_DEGC | Air Temperature (starboard) | °C |
| REL\_HUMIDITY\_PORT\_PERCENT | Relative Humidity (port ) | relative % |
| REL\_HUMIDITY\_STRBD\_PERCENT | Relative Humidity (starboard) | relative % |
| ATM\_PRESS\_HPA | Atmospheric Pressure | hectoPascals |
| ATM\_PRESS\_THREE\_HR\_TREND\_HPA | Atmospheric Pressure (3 hour trend) | hPa/ 3 hour |
| TEMP\_SEA\_WTR\_DEGC | Seawater Temperature | °C |
| FLOW\_RATE\_TSG\_LPERMIN | Thermosalinograph Flow Rate | litres / minute |
| FLUOROMTR\_FLOW\_RATE\_LPERMIN | Fluorometer Flow Rate | litres / minute |
| FLUORESCENCE\_NOUNIT | Fluorescence | unitless |
| CHLOROPHYLL\_UGPERL | Chlorophyll Concentration | micrograms / litre |
| SALINITY\_TSG\_PSU | Thermosalinograph Salinity | PSU (PSS-78) |
| OXY\_CONCEN\_CORR\_MMOL | oxygen concentration - corrected | µmol / litre |
| OXY\_CONCEN\_UNCORR\_MMOL | oxygen concentration - uncorrected | µmol / litre |
| WTR\_TEMP\_OPTODE\_DEGC | Optode water temperature | °C |
| SALINITY\_OPTODE\_PSU | Optode salinity | PSU (PSS-78) |
| DPHASE\_OPTODE\_NOUNIT | Optode D Phase | unitless |
| BPHASE\_OPTODE\_NOUNIT | Optode Blue Phase | unitless |
| TEMP\_TSG\_DEGC | Thermosalinograph water temperature | °C |
| CONDUCTIVITY\_TSG\_MSPERCM | Thermosalinograph conductivity | milliSiemens/cm |
| SHIP\_HEADING\_GPS\_DEG | vessel heading (GPS) | decimal degrees |
| SHIP\_COURSE\_OVER\_GROUND\_DEG | vessel course over ground | decimal degrees |
| SHIP\_HEADING\_GYRO\_DEG | Vessel heading (gyro) | decimal degrees |
| SHIP\_SPD\_OVER\_GROUND\_KNOT | Vessel speed over ground | knots |
| WTR\_DEPTH\_M | Depth from 12 kHz echo-sounder | metres |
| WTR\_DEPTH\_BIOMETER\_M | Depth from 38kHz echo-sounder | metres |
| WND\_DIR\_PORT\_CORR\_DEG | Wind Direction - true (port) | decimal degrees |
| WND\_DIR\_PORT\_UNCORR\_DEG | Wind Direction - uncorrected (port) | decimal degrees |
| WND\_DIR\_STRBD\_CORR\_DEG | Wind direction - true (starboard) | decimal degrees |
| WND\_DIR\_STRBD\_UNCORR\_DEG | Wind direction - uncorrected (starboard) | decimal degrees |
| WND\_SPD\_PORT\_CORR\_KNOT | Wind Speed - true (port) | knots |
| WND\_SPD\_PORT\_UNCORR\_KNOT | Wind Speed - uncorrected (port) | knots |
| WND\_SPD\_STRBD\_CORR\_KNOT | Wind Speed - true (starboard) | knots |
| WND\_SPD\_STRBD\_UNCORR\_KNOT | Wind Speed - uncorrected (starboard) | knots |
| PITCH\_TEN\_SEC\_MIN\_DEG | Vessel Pitch (10 second minimum) | decimal degrees |
| PITCH\_TEN\_SEC\_MAX\_DEG | Vessel pitch (10 second maximum) | decimal degrees |
| PITCH\_ONE\_MIN\_MIN\_DEG | Vessel pitch (one minute minimum) | decimal degrees |
| PITCH\_ONE\_MIN\_MAX\_DEG | Vessel pitch (one minute maximum) | decimal degrees |
| ROLL\_TEN\_SEC\_MIN\_DEG | Vessel roll (10 second minimum) | decimal degrees |
| ROLL\_TEN\_SEC\_MAX\_DEG | Vessel roll (10 second maximum) | decimal degrees |
| ROLL\_ONE\_MIN\_MIN\_DEG | Vessel roll (one minute minimum) | decimal degrees |
| ROLL\_ONE\_MIN\_MAX\_DEG | vessel roll (one minute maximum) | decimal degrees |
| RAD\_PAR\_PORT\_WPERME | photosynthetically active radiation (port) | µmol s-1 m-2 |
| RAD\_PAR\_STRBRD\_WPERME | photosynthetically active radiation (starboard) | µmol s-1 m-2 |
| RAD\_SLR\_PORT\_WPERM2 | solar radiation (port) | W m-2 |
| RAD\_SLR\_STRBRD\_WPERM2 | Solar radiation (starboard) | W m-2 |
| RAD\_INFRRD\_PORT\_WPERM2 | Infrared radiation (port) | W m-2 |
| RAD\_INFRRD\_STRBRD\_WPERM2 | Infrared radiation (starboard) | W m-2 |
| TEMP\_INFRRD\_SNSOR\_PORT\_DEGC | Temperature of Infrared Sensor (port) | °C |
| TEMP\_INFRRD\_SNSOR\_STRBRD\_DEGC | Temperature of Infrared Sensor (starboard) | °C |
| RAIN\_ACCUM\_FOREMST\_MM | Accumulated rainfall | millimetres |

Table - List of Published Underway Parameters

## Instrument Data Description

The list of instruments included in the underway data collection system is presented in the following summary table. Detailed descriptions of each instrument are provided afterwards.

|  |  |
| --- | --- |
| **Instrument** | **Comment** |
| Ashtech ADU800 GPS | Antenna Array is mounted on the rear gantry |
| JRC GPS-112 GPS Receiver | Antenna is mounted Forward |
| Sperry Mk-37 Mod D/E Gyrocompass | Belongs to P&O |
| Vaisala HMP223 Temperature and Humidity | Mounted Port and Starboard |
| Vaisala PTB220 Barometer | Located in the Met Lab at bridge level. The intake tube is on the Monkey Deck one level above. |
| RM Young 05103 Wind Anemometers | Mounted Port and Starboard on topmast |
| Young 50201 Precipitation Gauge | Mounted on the Port Side |
| Middleton SK01-DP2 PAR Sensor | Mounted Port and Starboard |
| Middleton EQ08 Solar Pyranometer | Mounted Port and Starboard |
| Eppley PIR, Precision IR Radiometer | Mounted Port and Starboard |
| Krone IFM5020K flow meters | These meters are used to measure water flow rates to the TSG (refer to section 5.3.11) and Fluorometer instruments (refer to section 5.3.12) |
| Seabird SBE-21 Thermosalinograph (TSG) | These three instruments are located in the Ocean lab and are at the mercy of flow variations in the uncontaminated seawater system (which is why we measure the flow!). The biggest problem occurs when the sea water intakes freeze! |
| WetLabs RMA 2948 Wetstar Chlorophyll sensor (Fluorometer) |
| Aanderra Optode 3835 Oxygen sensor |
| Seabird SBE-38 Water temperature probe | Located in the shaft tunnel so as to be as close to the water intake as possible. |
| Simrad EK60 12 kHz GPT (Bathy) | These transducers are located in the hull. |
| Simrad 38 kHz, 120 kHz & 200 kHz GPT (Biological) |
| Teledyne RD Instruments OS75 150 kHz Acoustic Doppler Current Profiler (ADCP) |

Table - Summary of Installed instruments

The mounting location of any instrument transducer or antenna is shown in Section 5.7

### Ashtech ADU800 GPS

In addition to latitude and longitude, this instrument measures vessel pitch and roll. It is also the preferred source of instrument time.

The antennae are mounted on the rear gantry.

Parameters logged from this instrument into separate NetCDF files for vessel position, vessel attitude and satellite information respectively are listed in Table 6, Table 7 and Table 8

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| measureTS | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| lat | Decimal Degrees (North is positive) | Latitudinal position |
| long | Decimal Degrees (East is positive) | Longitudinal position |
| alt | metres above mean sea level | Altitude |
| gndcourse | Decimal degrees (0 to 359.9) | Course over Ground |
| gndspeed | knots | Speed over Ground |
| heading | Decimal degrees (0 to 359.9) | Vessel heading |
| prec |  | Horizontal position precision code |
| mode |  | GPS Mode used to compute fix |

Table - Ashtech ADU800 Logged Parameters (position)

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| HDOP | - | Horizontal Dilution of Precision |
| VDOP | - | Vertical Dilution of Precision |
| PDOP | - | Dilution of Precision |
| nbseen | - | number of visible satellites |
| nbused | - | number of satellites used |

Table - Ashtech ADU800 Logged Parameters (Satellite Information)

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| measureTS | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| roll | degrees (-90 to +90) | Vessel Roll |
| pitch | degrees (-90 to +90) | Vessel Pitch |
| brms | metres | RMS error |
| mrms | metres | baseline length RMS error |
| ROLL\_TEN\_SEC\_MAX\_DEG | degrees (-90 to +90) | Vessel Roll (maximum value in last 10 seconds) |
| ROLL\_TEN\_SEC\_MIN\_DEG | degrees (-90 to +90) | Vessel Roll (minimum value in last 10 seconds) |
| PITCH\_TEN\_SEC\_MAX\_DEG | degrees (-90 to +90) | Vessel Pitch (maximum value in last 10 seconds) |
| PITCH\_TEN\_SEC\_MIN\_DEG | degrees (-90 to +90) | Vessel Pitch (minimum value in last 10 seconds) |
| ROLL\_ONE\_MIN\_MAX\_DEG | degrees (-90 to +90) | Vessel Roll (maximum value in last minute) |
| ROLL\_ONE\_MIN\_MIN\_DEG | degrees (-90 to +90) | Vessel Roll (minimum value in last minute) |
| PITCH\_ONE\_MIN\_MAX\_DEG | degrees (-90 to +90) | Vessel Pitch (maximum value in last minute) |
| PITCH\_ONE\_MIN\_MIN\_DEG | degrees (-90 to +90) | Vessel Pitch (minimum value in last minute) |
| roll\_max\_15 | degrees (-90 to +90) | Vessel Roll (maximum value in last 15 minutes) |
| roll\_min\_15 | degrees (-90 to +90) | Vessel Roll (minimum value in last 15 minutes) |
| pitch\_max\_15 | degrees (-90 to +90) | Vessel Pitch (maximum value in last 15 minutes) |
| pitch\_min\_15 | degrees (-90 to +90) | Vessel Pitch (minimum value in last 15 minutes) |

Table - Ashtech ADU800 Logged Parameters (Ship’s attitude)

### JRC GPS-112 GPS Receiver

There is one JRC mounted on the vessel (Forward) and its primary function is to provide a backup source of vessel position and time.

The TECHSAS logging system will use the Ashtech AD800 as its primary source of ship’s position and time but will automatically switch to the JRC units if the Ashtech becomes unavailable. This would cause a slight positional error since the units are located on different parts of the ship. (JRC is about 50 metres forward on the Ashtech)

Parameters logged from this instrument into separate NetCDF files for vessel position and satellite information are listed in Table 9 and Table 10 respectively.

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| measureTS | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| latitude | Decimal Degrees (North is positive) | Latitudinal position |
| longitude | Decimal Degrees (East is positive) | Longitudinal position |
| alt | metres above mean sea level | Altitude |
| gndcourse | degrees (0 to 359.9) | Course over Ground |
| gndspeed | knots | Speed over Ground |
| heading | Decimal degrees (0 to 359.9) | Vessel Heading |
| prec |  | Horizontal position precision code |
| mode |  | GPS Mode used to compute fix |

Table - JRC GPS-112 GPS Receiver Logged Parameters (Position)

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| HDOP | - | Horizontal Dilution of Precision |
| VDOP | - | Vertical Dilution of Precision |
| PDOP | - | Dilution of Precision |
| nbseen | - | number of visible satellites |
| nbused | - | number of satellites used |

Table - JRC GPS-112 GPS Receiver Logged Parameters (Satellite Information)

### Sperry Mk-37 Mod D/E Gyrocompass

This is the ship’s gyrocompass. This instrument is owned and managed by the ship operator and we simply take a feed from it.

Parameters logged from this instrument into NetCDF files are listed in Table 11

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| ship\_heading | Decimal degrees (0 to 359.9) | Vessel heading |
| rate\_of\_turn | Degrees/minute | Vessel Rate Of Turn |

Table - Sperry Mk-37 Mod D/E Gyrocompass Logged Parameters

### Vaisala HMP223 Temperature and Humidity

A temperature and humidity sensor is mounted on the inboard side of the port side Whale Observers shelter and a second sensor on the inboard side of the starboard Whale Observers shelter on the Monkey Isle.

Depending on the wind direction relative to the ships heading the instruments can be affected by the ships exhaust. When differences between the two instruments are detected the upwind instrument should be used.

Parameters logged from this instrument into NetCDF files are listed in Table 12 and Table 13

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| TEMP\_AIR\_PORT\_DEGC | Temperature in degrees Celsius | Air Temperature (Port Side) |
| REL\_HUMIDITY\_PORT\_PERCENT | Relative Humidity (%) | Relative Humidity (Port Side) |

Table - Vaisala HMP223 Logged Parameters (Port Side)

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| TEMP\_AIR\_STRBRD\_DEGC | Temperature in degrees Celsius | Air Temperature (Starboard Side) |
| REL\_HUMIDITY\_STRBRD\_PERCENT | Relative Humidity (%) | Relative Humidity (Starboard Side) |

Table - Vaisala HMP223 Logged Parameters (Starboard Side)

### Vaisala PTB220 Barometer

This instrument measures atmospheric pressure and the 3 hours trend. It is mounted ~16m above sea level on the bridge deck outside the Met lab on the port side with a velocity head.

Parameters logged from this instrument into NetCDF files are listed in Table 14 - Vaisala PTB220 Barometer Logged Parameters.

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| pressure1 | hPa | Reading of transducer 1 |
| pressure2 | hPa | Reading of transducer 2 |
| pressure3 | hPa | Reading of transducer 3 |
| ATM\_PRESS\_HPA | hPa | Atmospheric pressure derived from the previous three values! |
| ATM\_PRESS\_THREE\_HR\_TREND\_HPA | hPa / 3 hours | The rate of change in pressure over the previous three hours |

Table - Vaisala PTB220 Barometer Logged Parameters

### RM Young 05103 Wind Anemometers

Two instruments are installed at the top of the radar mast, approximately 30 meters above the water line.

The instruments can be affected by the mast superstructure and radio domes, and the upwind instrument should be used.

The true wind speed and direction is calculated as a vector from the apparent wind direction and speed from the instrument and the ships speed and course and speed over ground.

Parameters logged from this instrument into NetCDF files are listed in **Table** 15 - RM Young 05103 Wind Anemometers Logged Parameters.

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| WND\_DIR\_PORT\_UNCORR\_DEG | Decimal degrees (0 to 359.9) | relative wind direction (port) |
| WND\_SPD\_PORT\_UNCORR\_KNOT | knots | relative wind speed (port) |
| WND\_DIR\_PORT\_CORR\_DEG | Decimal degrees (0 to 359.9) | true wind direction (port) |
| WND\_SPD\_PORT\_CORR\_KNOT | knots | true wind speed (port) |
| WND\_DIR\_STRBD\_UNCORR\_DEG | Decimal degrees (0 to 359.9) | relative wind direction (starboard) |
| WND\_SPD\_STRBD\_UNCORR\_KNOT | knots | relative wind speed (starboard) |
| WND\_DIR\_STRBD\_CORR\_DEG | Decimal degrees (0 to 359.9) | true wind direction (starboard) |
| WND\_SPD\_STRBD\_CORR\_KNOT | knots | true wind speed (starboard) |
| ptruewinddirgusts | Decimal degrees (0 to 359.9) | max true wind dir gusts in 10 min (port) |
| ptruewindspeedgusts | knots | max true wind speed gusts in 10 min (port) |
| struewinddirgusts | Decimal degrees (0 to 359.9) | max true wind dir gusts in 10 min (starboard) |
| struewindspeedgusts | knots | max true wind speed gusts in 10 min (starboard) |
| minwindsweep | Decimal degrees (0 to 359.9) | min wind dir sweep in 10 min |
| maxwindsweep | Decimal degrees (0 to 359.9) | max wind dir sweep in 10 min |
| wnd\_spd\_port\_flag | - | wind quality flag 1 |
| wnd\_dir\_port\_flag | - | wind quality flag 2 |
| wnd\_spd\_strbd\_flag | - | wind quality flag 3 |
| wnd\_dir\_strbd\_flag | - | wind quality flag 4 |

Table - RM Young 05103 Wind Anemometers Logged Parameters

### Young 50201 Precipitation Gauge

Rain gauge data is incorporated into the port radiation instrument. Please refer to section 5.3.8 for details of the logged data.

### Port Radiation Sensors (incorporating the Rain Gauge)

The solar radiation sensors are mounted on the top of the port side Whale Observers shelter and the starboard Whale Observers shelter on the Monkey Isle. The instruments are mounted in a gimbal tray that allows sideways movement to keep the instruments vertical as the ship rolls. The mounts do not allow forward to aft movement. These optical instruments can be affected by atmospheric conditions, snow, ice and dirt occluding the sensor and shading from the ships superstructure.

Voltages are measured from the instruments and converted to “real” units according to the manufacturer’s data sheet and supplied calibration constants which are re-established at the beginning of each season. Both raw voltages and derived quantities are logged. (The Eppley PIR data is corrected for dome temperature.)

#### Middleton SK01-DP2 PAR Sensor

Two Middleton PAR sensors are installed, on the port and starboard whale observer shelters. The PAR sensors measure photo synthetically active radiation in the 400-700nm band.

#### Middleton EQ08 Solar Pyranometer

Two Middleton solar radiation sensors are installed, on the port and starboard whale observer shelters. These sensors measure total downward solar radiation in the 300-3000nm band.

#### Eppley PIR, Precision IR Radiometer

The logged parameters are: Port and Starboard infrared radiation in the 3.5 to 50nm band and instrument temperature.

#### RM Young 50201 Precipitation Gauge

This instrument measures accumulated precipitation. It is mounted on the port side of the monkey rail. The instrument accumulates to 50mm, then resets to zero and starts to accumulate again.

#### Logged Parameters

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| rawMIPyrano | mV | raw Middleton Pyranometer voltage |
| rawEPPIR | mV | raw Eppley PIR voltage |
| rawEPPIRCaseTemp | mV | raw Eppley PIR case temperature voltage |
| rawEPPIRDomeTemp | mV | raw Eppley PIR dome temperature voltage |
| rawMIPAR | mV | raw Middleton PAR voltage |
| RAD\_SLR\_PORT\_WPERM2 | W/m2 | Middleton Pyranometer (port) |
| RAD\_INFRRD\_PORT\_WPERM2 | W/m2 | Eppley Pyranometer (port) |
| TEMP\_INFRRD\_SNSOR\_PORT\_DEGC | °C | Eppley PIR case temperature (port) |
| RAD\_PAR\_PORT\_WPERME | umol/s/m2 | Middleton PAR (port) |
| RAIN\_ACCUM\_FOREMST\_MM | mm | RM Young precipitation gauge |

Table - Port Radiation Sensors Logged Parameters

### Starboard Radiation Sensors

With a single exception (the absence of precipitation) starboard radiation data is identical in terms of the quantities measured by the Port Radiation Sensors. The parameters are named differently to reflect the difference between port and starboard.

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| rawMIPyrano | mV | raw Middleton Pyranometer voltage |
| rawEPPIR | mV | raw Eppley PIR voltage |
| rawEPPIRCaseTemp | mV | raw Eppley PIR case temperature voltage |
| rawEPPIRDomeTemp | mV | raw Eppley PIR dome temperature voltage |
| rawMIPAR | mV | raw Middleton PAR voltage |
|  | W/m2 | Middleton Pyranometer (starboard) |
| RAD\_INFRRD\_STRBRD\_WPERM2 | W/m2 | Eppley Pyranometer (starboard) |
| TEMP\_INFRRD\_SNSOR\_STRBRD\_DEGC | °C | Eppley PIR Case Temperature (starboard) |
| RAD\_PAR\_STRBRD\_WPERME | umol/s/m2 | Middleton PAR (starboard) |

Table - Starboard Radiation Sensors Logged Parameters

### Krone IFM5020K flow meters

These meters are used to measure water flow rates to the TSG (refer to section 5.3.11) and Fluorometer instruments (refer to section 5.3.12)

Due to the sampling rate of the interface for these units they can sample slightly longer than the 10 second sample rate used to record flow rates in the dataset. This causes approximately a 10% data loss in the data set at the usual 10 second interval rate, however this is not seen as significant as it extrapolates to only 1 record lost every 100 seconds and flow rates should be constant over this period.

Water flow is manually stopped when the instruments or de-bubblers are cleaned.

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| FLOW\_RATE\_TSG\_LPERMIN | litres / minute | Rate of water flow to TSG instrument |

Table – TSG Flow Sensor Logged Parameters

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| FLUOROMTR\_FLOW\_RATE\_LPERMIN | litres / minute | Rate of water flow to Fluorometer instrument |

Table – Fluorometer Flow Sensor Logged Parameters

### Seabird SBE-21 Thermosalinograph (TSG)

This instrument is used to measure the salinity and conductivity of the sea water.

(For more details on the Uncontaminated Water sampling system, refer to Section 5.6)

Before data from this instrument is used the appropriate flow rate parameter should be check to ensure that there is water flow through the uncontaminated sea water system.

Other useful checks would be to compare the TSG Water Temperature with the uncontaminated water temperature which it should match to within 1 degree. It is usually warmer as the sea water warms up slightly as it travels from the water inlet to the TSG instrument through the ships pipe work.

The sea water is stopped whenever cleaning is done and this can result in inaccurate results. (This is another good reason to have flow sensors!)

Data from the TSG is logged in two files described in the following tables. The hydrology file contains the most useful data while an auxiliary file contains the value measured by the 4 A/D channels (not normally connected to anything – but they might be one day! Consequently they are included here for completeness.)

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| SALINITY\_TSG\_PSU | PSU (PSS-78) | Water salinity |
| density | kg/m3 | water density derived from measurements |
| TEMP\_TSG\_DEGC | °C | water temperature |
| sndspeed | metres / second | water sound speed derived from measurements |
| CONDUCTIVITY\_TSG\_MSPERCM | milliSiemens/cm | conductivity of water |
| intaketemp | °C | temperature of water measured at the intake |

Table –TSG Hydrology Sensor Logged Parameters

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| ChannelA | - | ChannelA Value |
| ChannelB | - | ChannelB Value |
| ChannelC | - | ChannelC Value |
| ChannelD | - | ChannelD Value |

Table –TSG External A/D Sensor Logged Parameters

### WetLabs RMA 2948 Wetstar Chlorophyll sensor (Fluorometer)

The Fluorometer is used to measure the fluorescence of the sea water. This gives an indication of the amount of biological material in the water. The instrument is (usually) periodically cleaned which results in significant spikes in the data.

This instrument measures chlorophyll concentration which can be converted to provide a unit-less measure of fluorescence. Considerable care should be taken when interpreting this data.

(For more details on the Uncontaminated Water sampling system, refer to Section 5.6)

Before data from this instrument is used the appropriate flow rate parameter should be check to ensure that there is water flow through the uncontaminated sea water system.

Data from the Chlorophyll sensor is logged in NetCDF files described in the following tables.

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| FLUORESCENCE\_NOUNIT | unit-less | Fluorescence |
| CHLOROPHYLL\_UGPERL | micrograms / litre | Chlorophyll Concentration |
| value1 | - | Not Defined |
| value2 | - | Not Defined |

Table – WetLabs RMA 2948 Wetstar Chlorophyll Sensor Logged Parameters

#### Calculations

The Chlorophyll concentration is derived from the FLUORESCENCE\_NOUNIT value with calibration coefficients Scale Factor (SF) and Dark Counts applied according to the following equation:



The calibration coefficients are taken from the latest calibration sheets as described in **Table 3 - Instruments installed and operational during this Voyage**

### Aanderra Optode 3835 Oxygen sensor

This instrument is mounted in the same housing as the Fluorometer and measures the dissolved oxygen concentration. The salinity is obtained from the SBE-21Thermosalinograph and is used to calculate a corrected value.

(For more details on the Uncontaminated Water sampling system, refer to Section 5.6)

Before data from this instrument is used the appropriate flow rate parameter should be check to ensure that there is water flow through the uncontaminated sea water system.

The temperature and salinity can also be cross referenced to the SBE-21 TSG and SBE-38 temperature. The Optode water temperature can be higher than both the SBE-38 & SBE-21 readings due to the lower flow rates and longer piping required.

This instrument samples at 1 minute intervals. The 5 second data comes in the published data set comes from interpolation provided by the uwyMerger software.

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| OXY\_CONCEN\_CORR\_MMOL | micromoles/litre | oxygen concentration (corrected) |
| serialnb | - | serial number |
| BPot | - | Blue light plot |
| WTR\_TEMP\_OPTODE\_DEGC | °C | optode water temperature |
| DPHASE\_OPTODE\_NOUNIT | - | optode calibrated phase |
| RAmp | - | Red light amplitude |
| RawTemp | - | Temperature raw value |
| SALINITY\_OPTODE\_PSU | PSU (PSS-78) | optode salinity |
| BAmp | - | Blue light amplitude |
| OXY\_CONCEN\_UNCORR\_MMOL | micromoles/litre | optode oxygen concentration (uncorrected) |
| modelnb | - | Model Number |
| airSat | 100\*Pa/Pa | air saturation |
| RPhase | - | Red light phase |
| BPHASE\_OPTODE\_NOUNIT | - | optode blue light phase |

Table – Seabird SBE-38 Water Temperature Sensor Logged Parameters

#### Calculations

The OXY\_CONCEN\_CORR\_MMOL (oxygen concentration - corrected) is derived from the OXY\_CONCEN\_UNCORR\_MMOL (oxygen concentration - uncorrected) value with calibration coefficients applied according to the following calculations

The O2-concentration sensed by the Optode is in fact the O2-concentration in the sensing foil. Since this foil is only permeable to gas and not water, the Optode cannot sense the effect of salt dissolved in the water, hence the Optode always measures as if immersed in fresh water. Therefore the O2-concentration must be compensated for the salinity variations in the uncontaminated seawater system.

The TECHSAS driver calculates and outputs the corrected oxygen concentration using the following equations, based on information from CSIRO. The driver shall also use the real-time salinity values measured by the SBE21 Thermosalinograph in this calculation. If no salinity is available (i.e. bad data or instrument offline) an assumed constant salinity value of 34.0 PSS-78 is used by default.

Freshwater oxygen concentration:



Where: C1, C2, C3, C4, C5, C6 & C7 are calibration coefficients obtained from the current calibration sheet for the instrument. (**Refer to Table 3 - Instruments installed and operational during this Voyage**)

T is the Optode temperature measurement, and,

P is the Optode blue light phase raw value (BPhase).

Scaled temperature:



Where: T is the Optode temperature measurement.

Oxygen concentration scaling factor:



Where: STSG is the salinity measurement from the SBE21 Thermosalinograph,

TS is the scaled Optode temperature,

B0 = -6.24097 E-03,

B1 = -6.93498 E-03,

B2 = -6.90358 E-03,

B3 = -4.29155 E-03, and,

C0 = -3.11680 E-07.

Compensated oxygen concentration:



Where: f is the oxygen concentration scaling factor, and,

O2fresh is the freshwater concentration.

Pure water density, from UNESCO 1983 equation 14 (page 17):



Where: T is the Optode temperature measurement,

a0 = 999.842594,

a1 = 6.793952 E-02,

a2 = -9.095290 E-03,

a3 = 1.001685 E-04,

a4 = -1.120083 E-06, and,

a5 = 6.536332 E-09.

Seawater density, from UNESCO 1983 equation 13 (page 17):



Where: STSG is the salinity measurement from the SBE21 Thermosalinograph,

T is the Optode temperature measurement,

ρW is the pure water density,

b0 = 8.24493 E-01,

b1 = -4.0899 E-03,

b2 = 7.6438 E-05,

b3 = 8.2467 E-07,

b4 = 5.3875 E-09,

c0 = -5.72466 E-03,

c1 = 1.0227 E-04,

c2 = -1.6546 E-06, and,

d0 = 4.8314 E-04.

Corrected oxygen concentration:



Where: O2compensated is the oxygen concentration compensated for salinity, and,

ρSW is the density of seawater.

The calibration coefficients are taken from the latest calibration sheets as described in **Table 3 - Instruments installed and operational during this Voyage.**

### Seabird SBE-38 Water Temperature Sensor

This instrument is mounted ~4m below surface in the uncontaminated seas water suction inlet, port side of the shaft tunnel towards the stern of the ship and gives an accurate water temperature reading.

(For more details on the Uncontaminated Water sampling system, refer to Section 5.6)

Before data from this instrument is used the appropriate flow rate parameter should be check to ensure that there is water flow through the uncontaminated sea water system.

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| TEMP\_SEA\_WTR\_DEGC | °C | Sea water temperature |

Table – Seabird SBE-38 Water Temperature Sensor Logged Parameters

### Seabird 911+ CTD

The data from the seabird CTD is primarily logged by the seabird software but each scan of the processed data is output via a serial port and recorded by the TECHSAS system so that the CTD status can be broadcast around the vessel. This means that it is also logged in TECHSAS as NetCDF files. The format is this file is given in the following table.

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| scancount | Unit-less | Number of the scan |
| primCond | S/m | Primary Conductivity |
| primTemp | °C | Primary Temperature |
| pressure | ***Good Question!***  (see note below) | Pressure |
| secCond | S/m | Secondary Conductivity |
| secTemp | °C | Secondary Temperature |
| oxygen | µmol/l | Oxygen |
| par | Unit-less | Photosynthetically active radiation |
| altitude1 | metres | Altimeter 1 |
| altitude2 | metres | Altimeter 2 |
| transmis | Unit-less | transmissivity |
| fluo | Unit-less | fluorometer |
| rate | metres/second | Rate of ascent |
| salinity | PSU | Salinity |

Table – Seabird 911+ CTD Logged Parameters

***Note that there has been some confusion with regard to the pressure units put out by the CTD over the last few years up to and including 2015/16. The seabird unit puts out pressure in deci-bars and TECHSAS has been wrongly interpreting this data as bars and so multiplying these numbers by 10 before storing the data. This bug has now been fixed but the bottom line is that all Seabird 911 CTD pressure data recorded in NetCDF format up to and including 2015/16 is probably in “centi-bars” and needs to be divided by 10 to restore it to deci-bars. The data recorded by the Seabird system (which most people prefer to use) is unaffected by this fault.***

### Rectangular Midwater Trawl - Attitude Sensor

The attitude sensor measures the attitude of the RMT. This data is logged in TECHSAS as NetCDF files. The format is this file is given in the following table.

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| fault | integer | Fault code |
| pitch | degrees | pitch |
| roll | degrees | roll |
| yaw | degrees | yaw |
| accel\_z |  | Acceleration – Z- Axis |
| pressure | bars (really) |  |
| depth | metres |  |

Table – RMT Attitude Logged Parameters

### Rectangular Midwater Trawl – Power Supply Unit

The RMT PSU returns various status information including voltages and currents. It is used to monitor the RMT system performance.

This data is logged in TECHSAS as NetCDF files. The format is this file is given in the following table.

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| volts | Volts | Volts at submerged end |
| amp | Amperes | Current at submerged end |
| watts | Watts | Power at submerged end |
| hs\_temp | °C | Power supply temperature |
| v36 | integer |  |
| v24 | integer |  |

Table – RMT Power Supply Unit Logged Parameters

### RMT Flow Meter

The Flow meter measures water flow.

This data is logged in TECHSAS as NetCDF files. The format is this file is given in the following table.

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| flow\_speed | metres/second | Water flow speed |
| hertz | Hz | Frequency from counter |
| edge\_events | integer | Edge event count |
| time | seconds | Elapsed time in seconds |

Table – RMT Flow Meter Logged Parameters

### Teledyne RDI CTD NV

A Teledyne RDI CTD is mounted on the Rectangular Midwater trawl for all deployments to provide accurate CTD data.

This data is logged in TECHSAS as NetCDF files. The format is this file is given in the following table.

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| conductivity | mS/cm | Seawater conductivity |
| temp | °C | °C |
| pressure | deci-bars | Seawater pressure |
| salinity | PSU | Salinity |
| soundvel | metres/second | Speed Of Sound |
| Aux1 | Volts | Space Channel |
| chlorophyll | µg/litre | Chlorophyll concentration |
| battvoltage | Volts | Battery Voltage |
| Aux4 | Volts | Spare channel |

Table – Teledyne RDI CTD NV Logged Parameters

### Scanmar Net Sensors

Scanmar net sensors are used on a variety of nets to record and transmit acoustically information about the equipment. This data is collected by the TECHSAS system by decoding the NMEA data stream from the scan mate system in the Aft Control room so that it can be recorded and disseminated around the vessel

. This means that it is also logged in TECHSAS as NetCDF files. The format is this file is given in the following table.

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| trawl\_door\_spread | Unit-less | Trawl Door Spread |
| trawl\_depth | S/m | Depth of the trawl |
| trawl\_temperature | °C | Water temperature |
| trawl\_fish\_density | Unit-less | A number from 0 to 9 |
| trawl\_opening | metres | Opening of the trawl net |
| trawl\_clearance | metres | Clearance of the trawl net |
| trawl\_height | metres | Height of the trawl net |
| trawl\_speed\_x | knots | Speed through the water (x component) |
| trawl\_speed\_y | knots | Speed through the water (y component) |

Table –Scanmar Logged Parameters

## TECHSAS Virtual Instruments

TECHSAS has the capability of maintaining “virtual instruments” which can act as a convenient collection point for several streams of data from other “real” instruments.

### Ships Navigation

Ship navigational information comes from a variety of sources and it is useful to have a “one stop shop” for this data in some applications (especially where the data may have to come from alternative sources (i.e. if a GPS fails and another one has to take over)

The parameters stored in the daily NetCDF files are shown in Table 31 – Ships Navigation Virtual Instrument Logged Parameters

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| surfspeed | knots | Vessel speed over the surface |
| SHIP\_SPD\_OVER\_GROUND\_KNOT | knots | Speed over Ground |
| driftspeed | knots | Estimated drift speed of the vessel |
| TIMESTAMP\_GPS\_UTC | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| surfcourse | degrees (0 to 359.9) | Vessel course over the surface |
| draught | metres | Distance from the water surface to the bottom of the keel |
| SHIP\_COURSE\_OVER\_GROUND\_DEG | degrees (0 to 359.9) | vessel course over ground |
| driftcourse | degrees (0 to 359.9) | Estimated drift course of the vessel |
| depth | metres | Depth of water under the keel |
| LATITUDE | Decimal Degrees (North is positive) | Latitudinal position |
| roll | degrees (-90 to +90) | Vessel Roll |
| alt | metres above mean sea level | Altitude |
| heave | metres | Not recorded |
| SHIP\_HEADING\_GYRO\_DEG | knots | Vessel Heading (from gyro) |
| LONGITUDE | Decimal Degrees (East is positive) | Longitudinal position |
| pitch | degrees (-90 to +90) | Vessel pitch |

Table – Ships Navigation Virtual Instrument Logged Parameters

## Acoustic Instruments

The acoustic instruments record the bottom depth and profile, biological activity in the water column and currents at various depths. Primary depth calculated from the Simrad 12 kHz sounder interface is processed by the underway logging system. This season the Simrad 38 kHz acoustic sounder is being tested as a second source of depth information for waters less than 1600m in depth.

A Teledyne RD Instruments OS75 150kHz Acoustic Doppler Current Profiler (ADCP) is used to measure water currents under the vessel.

All data from these instruments is recorded on computer hard disk and transferred to the AADC at the end of the voyage.

The Bio acoustic sounders were calibrated in the river Derwent off White Rock, Tasmania during September 2014 by a team from the CSIRO. The Bathy 12 kHz sounder is not calibrated and uses the default configuration values as supplied by Simrad.

### Simrad EK60 12 kHz GPT (Bathy)

The Simrad 12kHz GPT acoustic sounder is used to measure the backscatter coefficient (Sv) and other data to a depth of 5000m. The Simrad ER60 software interface also calculates the depth and this value is send to the underway data system for display and recording. The raw data for this instrument is transferred to the AADC at the end of the voyage.

A dedicated computer runs the Simrad ER60 and Echolog software to record the raw data generated by this instrument. Further processing can be performed with the Echoview software package.

The depth calculation is affected by any sea ice or turbulence under the hull that may be present during ice breaking or rough weather. The operation of the ships thrusters which are used to maintain a stationary position also affects the reliability of the depth calculation. It is a common occurrence during ice breaking or thrusters operations that the bottom depth cannot be determined by the software and a random value (usually very deep) or zero is recorded. The algorithm used to calculate depth for the 12 kHz sensor is poor in shallow waters as the instrument configuration is set to allow deep water measurement and any readings less than 200m might be suspect. Better bathymetry can be obtained by post-processing the raw acoustic data that was collected on the acoustics computer system. This is usually not done on a voyage.

If accurate values are required the raw data must be manually reprocessed and the depth recalculated. The depth parameters transferred to the AADC are not quality checked. Please check with the AADC for further information regarding the status of collected depth information for specific voyages.

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| WTR\_DEPTH\_M | metres | Water Depth |

Table –12kHz Depth Sounder Logged Parameters

### Simrad 38 kHz, 120 kHz & 200 kHz GPT (Bio)

These three sounders are used to profile the backscatter coefficient (Sv) and other data in the water column. The higher the frequency of the transducer the more resolution can be obtained, but the beam absorption is higher so less depth can be sampled. The backscatter (or visibility) of objects varies with the frequency. The raw data from these instruments are transferred to the AADC at the completion of the voyage.

A similar setup to the Simrad 12 kHz sounder with a dedicated computer running the Simrad ER60 and Echolog software is used to record the raw data generated by this instrument. Further processing can be performed with the Echoview software package.

The 38 kHz depth data estimation from the Simrad ER60 software is been displayed and recorded as part of the voyage data

As the 38kHz sounder is set for a maximum depth of 1600m the instrument and ER60 software depth algorithms perform better in shallow water and should give better results than the 12kHz sounder for water less than 200 metres in depth. Water depths greater than 1600 metres cannot be measured with this instrument.

|  |  |  |
| --- | --- | --- |
| **Name** | **Unit** | **Description** |
| time | Days since 1899-12-30T00:00:00 UTC | The timestamp for each data point in the NetCDF file |
| WTR\_DEPTH\_BIOMETER\_M | metres | Water Depth |

Table –38kHz Depth Sensor Logged Parameters

### Teledyne RD Instruments OS75 150 kHz Acoustic Doppler Current Profiler (ADCP)

The Teledyne RD Instruments OS75 150kHz Acoustic Doppler Current Profiler (ADCP) determines currents at different depths. It uses the pitch and roll information from the Ashtech GPS unit to compensate for the ships movement when calculating current profiles.

No data from the ADCP is fed into the TECHSAS system.

The raw data is transferred to the AADC at the completion of the voyage.

## Uncontaminated Seawater Flow

The Uncontaminated seawater (UCS) system supplies UCS to most laboratories, the aquarium, TSG, Fluorometer and Optode in the Ocean Lab etc. The system consists of the following stages:

* Uncontaminated saltwater is pumped from an intake that is located in the propeller shaft tunnel approximately 4m below the waterline & 10m forward of the stern gland on the port side of the vessel.
* Pumped by a Grundfos CRN15 – 96485668 Vertical, non-self-priming, multistage, in-line, centrifugal pump (approximately 300 l/minute, 7 bar) …
* Through a 36.3mm ID Stainless Steel main pipe run.

Most water goes to the oceanographic lab where it goes to the TSG, Fluorometer and Optode instruments.

* The water temperature is measured by a Seabird Electronics SBE38 temperature sensor that is located approximately 150mm inboard from the intake. The temperature rise from the intake to the ocean lab is approximately 0.6C.
* The pressure at the pressure relieving overboard discharge valve us approximately 6.5 bar,
* Note that other side branches take the water to the other labs prior to the Oceanographic (OG) lab (except for Lab 1 which is fed from OG lab.)
* Small ice fragments can partially block the water intake which can result in reduced or erratic flows. This is especially prevalent during ice breaking.

## Instrument and Transducer Locations

The SBE 21 TSG, Krone flow meters, Fluorometer and Aanderra O2 sensors are located in the Ocean Laboratory.

The external meteorological sensor positions are shown on the drawing on the following page.

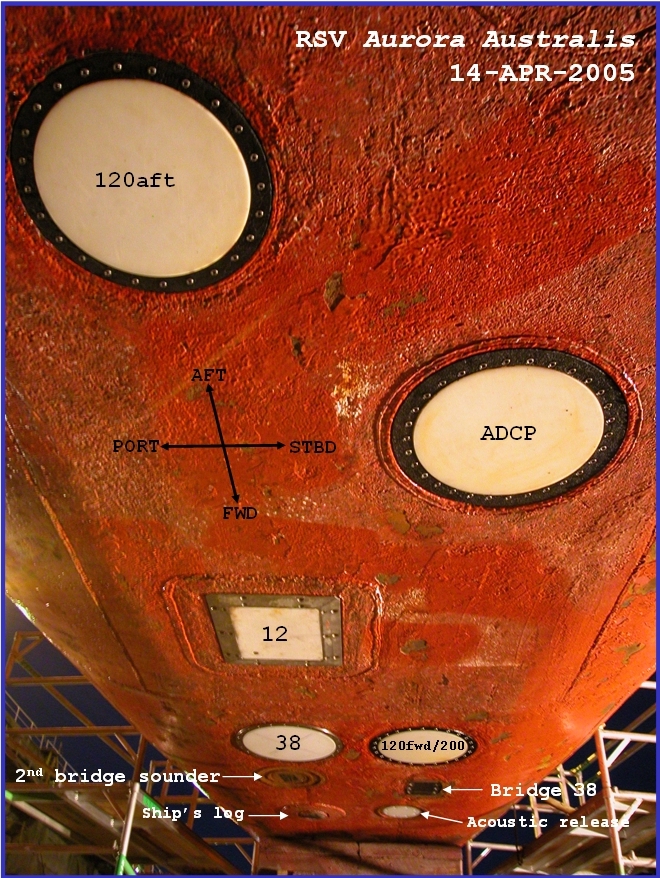
The square 12 kHz transducer sea chest is positioned between ribs 101 and 102 and to the port side of the keel, with the starboard edge of the sea chest touching the keel centreline.

The circular 38 kHz transducer sea chest is positioned between ribs 103 and 104 and to the port side of the keel, with the starboard side of the sea chest approximately 10cm from the keel centreline.

The circular 120fwd/200 transducer sea chest is positioned between ribs 103 and 104 and to the starboard side of the keel, with the port side of the sea chest approximately 10cm from the keel centreline.

The circular 120aft transducer sea chest is positioned across rib 98 and to the port side of the keel, with the starboard side of the sea chest approximately 10cm from the keel centreline.

The 200 kHz transducer is mounted in the same sea chest as the 120fwd channel.

 **Figure 3 - Location of Acoustic Transducers**



# Event Log

During the voyage, STS personnel maintain a Voyage Event Log which records deployments and technical issues encountered throughout the voyage. This is not to be confused with the Scientific Event Log which was maintained by scientists on board during the voyage and seeks to achieve other objectives.

|  |  |  |
| --- | --- | --- |
| **id** | **time** | **message** |
| 413 | 2016-01-11 06:00:00 | Departed Hobart at 5pm local time.  Lloyd Symons |
| 415 | 2016-01-12 23:28:33 | Fluorometer readings were identified as suspect. Upon inspection a foreign object (small cleaning rag) was discovered and removed. The Fluorometer face was cleaned at the same time.  Lloyd Symons |
| 414 | 2016-01-13 00:50:00 | Trial MIDOC deployment at approximately S47 53; E139 34  MIDOC Start Time: 00:50:00; 2016-01-13 First interval: 105 minutes. Remaining Intervals are 30 minutes. We didn't quite get to 1000 metres due to winch issues but we managed to get to 789m by the time that the first cod end fired. All other cod ends were within 25 m of the target depth.  Lloyd Symons |
| 416 | 2016-01-15 23:10:00 | A power failure/disruption in the Met Lab took out the wind and pressure data between 1650UTC - 2310UTC. The problem was eventually resolved by cycling power on the Met Lab Perle Terminal Server and then rerunning the "init\_barometer" script on the TECHSAS server to kick start the barometer transmissions.  Lloyd Symons |
| 417 | 2016-01-16 03:36:00 | Fluorometer cleaned at 0330UTC.  Lloyd Symons |
| 418 | 2016-01-17 19:17:53 | CPR Tow Summary  Tow #1  Start 12/1/16 02:45 UTC 45 20.021 S 143 44.962 E  End 13/1/16 00:10 UTC 48 07.643 S 139 27.596 E  Tow #2  Start 07:34 13/1/16 48 26.980 S 139 28.126 E  End 15/1/16 09:53 51 51.743 S 129 56.016 E  Tow #3  Start 15/1/16 10:03; 51 52.290 S 129 55.355 E  End 17/1/16 06:52 55 43.399 S 119 50.276 E  91 at top of tunnel. Cassette # 2  Tow #4  Start 17/1/16 06:59 55 43.581 S 119 48.973 E  Cassette #3 course 250  End 19/1/16 07:57 59 16.884 S 108 46.157 E  Tow #5  Start 19/1/16 08:05 59 17.550 S 108 43.870 E  End 20/1/16 21:51 62 25.492 S 96 35.007 E Ongoing  Received from Rob King |
| 419 | 2016-01-18 00:30:07 | Just played with the 12 kHz echo sounder to see if we can pick up the bottom correctly. It has been picking up the bottom at about 2250m for quite a few days now which is clearly wrong. In the end; I altered the echogram backscatter to PR (no TVG) (was SV -20LogTVG). That didn't work so I doubled the pulse length. Now it seems to be working. We are now picking up the bottom correctly at about 4500m.  Lloyd Symons |
| 420 | 2016-01-18 12:51:14 | For the second time today; an earth leakage fault has taken out the met lab rack. This means gaps in wind and pressure data. Firstly we unplugged the ships camera system from this circuit but then it tripped again. Now we have unplugged the METLAB DIP and screen. Note: You have to power cycle the Perle terminal server in the Met Lab rack to get the wind data flowing again. And then you need to reinitialise the barometer by running the ""init\_barometer"" script on the TECHSAS server desktop (bottom left)  Lloyd Symons |
| 421 | 2016-01-19 16:00:00 | The ships track ran almost directly over a large sea mount at S57 48; E107 06 A temporary spike in chlorophyll was picked up for a few hours as we passed over.  Lloyd Symons |
| 422 | 2016-01-20 02:20:02 | We put an argo float in at 0336UTC. I need to get the details from Stuart  Lloyd Symons |
| 423 | 2016-01-21 02:56:56 | CTD - K00 Test Deployment to 300m 62deg 41.82' S 95deg 21.85' E |
| 424 | 2016-01-22 04:30:00 | RMT Test deployment to 200m. K-Axis Marine Science Log event 96 LAT LONG Net Open signal sent at approximately 26m. Observed on camera the shackles were still caught on the net release. The winch operator gave a sharp upward tug and the cable was successfully freed and deployed to 200m. The net stayed open and was brought back up to 10m before being closed and recovered. At 10m depth; the image was clearer without lights; and the net closing could be confirmed.  Brian McGlashan |
| 425 | 2016-01-23 00:30:00 | CTD - K00 Deployment in approx. 3200m Station KX03 Event K03 64deg 00.059 S 93deg 33.086' E  Brian McGlashan |
| 426 | 2016-01-23 06:12:20 | CTD - K00 Deployment in approx. 3175m Station KX04 Event K04 63deg 28.232S 93deg 32.673E  Brian McGlashan |
| 427 | 2016-01-23 10:42:36 | Completed RMT oblique tow. |
| 428 | 2016-01-23 18:00:06 | Completed RMT oblique tow. |
| 429 | 2016-01-23 22:11:25 | CTD Deployment in approx. 3960m Station KX06 Event K06 62deg 16.953S 93deg 09.533E  Brian McGlashan |
| 430 | 2016-01-24 04:20:23 | RMT Target Trawl to 150m Video on 2 cameras. No lights used. 61degE52.1 93degE19.3 Flow Meter final reading 106364 Brian McGlashan |
| 431 | 2016-01-24 05:38:28 | CTD Deployment to 300m Station KX07 Event K07 61deg 42.55 S 93deg 22.050' E Brian McGlashan |
| 432 | 2016-01-24 14:22:48 | MIDOC - KX08 Deployed 2016-01-24 10:52z Retrieved 2016-01-24 14:52z  Data downloaded to laptop. Scanmar TS0024 failed to send info. Others very intermittent. Check charge level.  Tom Luttrell |
| 433 | 2016-01-24 16:38:27 | CTD - K08 wp 0212 Deployed to 300m 61deg 09.124'S 093deg 32.997'E Tom Luttrell |
| 434 | 2016-01-24 19:03:23 | RMTR - R04 In water 18:43:12z; 61deg 8.058 S; 93deg 33.723 E Open 18:43:33z; 61deg 8.050 S; 93deg 33.725 E; 10m; down at 0.8m/s; up at 0.3m/s Closed 19:01:00; 61deg 7.649 S; 93deg 33.877 E; 10m; RMT screens failed to switch. RMT Control GUI latitude showing West instead of East.  Tom Luttrell. |
| 435 | 2016-01-25 04:54:23 | MIDOC K09 In water 00:30UTC 61deg 58.2 S; 92deg 33.6 E on completion Cable length were mismatched by 550m on completion of trawl. Scanmar Depth data was unreliable throughout the trawl.  Brian McGlashan |
| 436 | 2016-01-25 06:19:19 | CTD Event - K09 Station - KX09 to 300m 61deg 58.2 S; 92deg 33.6 E Brian McGlashan |
| 437 | 2016-01-25 07:45:33 | RMT Target Trawl to 150m Video on 2 cameras. No lights used. 61degS58.85 92degE33.6  Brian McGlashan |
| 438 | 2016-01-25 09:55:38 | RMT - T06 Target to 140m Open 09:32:43; 62deg 1.131 S; 92deg 26.543 E Close 09:47:49; 62deg 1.341 S; 92deg 27.206 E 2x Video recorded. Lights used momentarily to determine if net opened.  Tom Luttrell |
| 439 | 2016-01-25 15:19:00 | MIDOC03 - KX10 Deployed 2016-01-25 11:39z Retrieved 2016-01-24 15:49z Scanmar data settled down once Robbie got the net straight using winch pressure readings rather than wire length. Data downloaded to laptop and transferred to K:\MIDOC\2016-01-25\data\ Scanmar sensors recharged. MIDOC recharged.  Tom Luttrell |
| 440 | 2016-01-25 21:39:11 | CTD - K10 wp 0302 Deployed in approx. 4040m 62deg 17.400'S 091deg 31.99200'E |
| 441 | 2016-01-26 00:37:30 | RMT - Regular Oblique to 200m Lost RMT Net Control GUI prior to opening - Returned in tiime to open atl 26.6m Net closed at 9m Video on 2 cameras. No lights used. 62degS18.224 91degE31.2  Brian McGlashan |
| 442 | 2016-01-26 15:22:54 | MIDOC04 - KX11 Deployed 2016-01-26 08:10z Retrieved 2016-01-26 12:20z Incorrect Scanmar trawl speed sensor mounted.  Tom Luttrell. |
| 443 | 2016-01-26 15:23:59 | CTD - K11 wp0303 Deployed in approx. 4165m 62deg 23.673'S 089deg 39.365'E  Tom Luttrell |
| 444 | 2016-01-26 18:11:53 | RMTR - R06 Oblique to 200m Open 18:24:35; 62deg 23.520 S 89deg 39.536 E pause at 115m (winch problems). Close 18:53:59; 62deg 22.940 S 89deg 37.855 E No video recorded. Lights used momentarily to determine if net opened. No Scanmar trawl speed data received. Instrument DIP not working. Used load cell DIP instead.  Tom Luttrell |
| 445 | 2016-01-26 18:57:52 | RMTT - T06 Target Trawl to 40m; then to 25m at 0.3m/s. No video recorded (too dark; lights not able to be used). Open 19:40:38; 62deg 23.568 S 89deg 39.729 E Close 19:48:44; 62deg 23.762 S 89deg 40.196 E RMT net control GUI crashed when net closed. LINE RESISTANCE DROPPED TO 38K OHM AND ALARMED. Cleaned sea connector; resistance = 127k Ohm.  Tom Luttrell |
| 446 | 2016-01-27 01:04:00 | CTD - Event K12 Station KX12 wp0304 Deployed in approx. 3500m 62deg 28.237'S 087deg 47.772'E  Brian McGlashan |
| 447 | 2016-01-27 14:04:37 | MIDOC05 - KX13 wp0305 Deployed 2016 /01/27 09:40z Retrieved 2016 /01/27 13:50z Tom Luttrell |
| 448 | 2016-01-27 14:57:34 | CTD - K13 wp0305 Deployed in approx. 3939m 62deg 30.861'S 086deg 06.820'E  Tom Luttrell |
| 449 | 2016-01-27 22:07:30 | RMTR - R09 Oblique to 200m 62deg 29S 86deg54 E |
| 450 | 2016-01-27 22:09:46 | Cleaned Fluorometer face in Oceanography Lab  Brian McGlashan |
| 451 | 2016-01-28 03:03:47 | RMT Target Trawl 25m Event T07 Station KX13 - 14 62deg 31.2'S 084deg 64.2'E  Brian McGlashan |
| 452 | 2016-01-28 03:29:47 | CTD in approx. 2600m Event CTD14 Station KX14 62deg 31.2'S 084deg 64.2'E  Brian McGlashan |
| 453 | 2016-01-28 09:07:23 | RMT Target Trawl 30-40m Event T08 Open 09:21:06 62deg 31.614'S 083deg 33.989'E Close 09:40:12 62deg 32.138'S 083deg 33.973'E  Tom Luttrell |
| 454 | 2016-01-28 17:24:04 | MIDOC06 - KX15 wp0307 Deployed 2016/01/28 12:14z Retrieved 2016/01/28 16:24z" No Scanmar data. Had to wiggle Scanmar acoustic receive cable to get data. Inspected (ok) and cleaned connector. Scanmar trawl speed sensor unresponsive then gave negative data. Could have flipped on net.  Tom Luttrell |
| 455 | 2016-01-28 18:43:32 | Lost power to Met rack again. Put isolation transformer in line with Met power supply. Removed comms PC from essential power. Restarted Perle serial server. Ran init\_optode.py Ran init\_barometer.py  Tom Luttrell. |
| 456 | 2016-01-28 18:56:52 | CTD - K15 wp0307 Deployed in approx. 2000m 62deg 31.321'S 082deg 01.483'E  Tom Luttrell |
| 457 | 2016-01-29 00:54:47 | RMT - Regular Event - R11 Station - KX15 Oblique to 200m Line Insulation prior to deployment 161K Back on deck on completion 31.9K Net closed at 10m Video only from 1 camera. 62degS31.32 81degE59.57  Brian McGlashan |
| 458 | 2016-01-29 05:54:44 | 1 Whale Buoy Recovered, 1 Whale Buoy Deployed  Brian McGlashan |
| 459 | 2016-01-29 10:01:53 | MIDOC07 - KX16 wp0401 Deployed 2016/01/29 10:12z Retrieved 2016/01/29 14:22z Hydrophone cable replaced. Intermittent reception problem persisted. PC board visually checked; no faults found. Re-seated inter-board connectors.  Tom Luttrell |
| 460 | 2016-01-29 15:34:03 | CTD - K16 wp0401 Deployed in approx. 3000m 63deg 16.213'S 082deg 01.147'E Chief engineer had to disconnect charger before running out the gantry.  Tom Luttrell |
| 461 | 2016-01-29 20:49:04 | RMT - Regular Event - R12 Station - KX16 Oblique to 200m Scanmar working. Cable resistance. Before 111K After 31K  Brian McGlashan |
| 462 | 2016-01-30 03:35:20 | MIDOC8 Station KX17 63deg 45.566'S 082deg 48.729'E Nets failed to open - mechanical fault - repaired now  Brian McGlashan |
| 463 | 2016-01-30 06:26:58 | CTD017 Station - KX17 63deg 57.109'S 083deg 08.476'E  Brian McGlashan |
| 464 | 2016-01-30 11:08:08 | RMT - Regular Event - R13 Station - KX17 Oblique to 200m Lost contact with BeagleBone on the way up. Cable failed on lift from water. HV supply short to chassis. Rewired aft control room power supply to use one HV return as HV supply. Disconnected and isolated both HV supply lines.  Tom Luttrell |
| 465 | 2016-01-30 14:42:14 | MIDOC9 Station KX17 63deg 48.327'S 082deg 53.769'E 200 - 0m net didn't open. Re-shot with net open.  Tom Luttrell |
| 466 | 2016-01-30 19:12:28 | MIDOC10 Station KX17 63deg 56.3'S 083deg 7.331'E Net shot open 0 - 200 - 0m (~40 minutes) as last shot did not open  Tom Luttrell |
| 467 | 2016-01-30 21:38:08 | MIDOC11 Station KX18 64deg 10.77'S 083deg 21.719'E  Brian McGlashan |
| 468 | 2016-01-31 13:44:32 | MIDOC12 deployed Station KX19 64deg 18.52'S 84deg11.00 'E MIDOC initiated at 1342UTC Net 6 failed to open (200 to 0m). Re-shot  Lloyd Symons and Tom Luttrell |
| 469 | 2016-01-31 18:55:20 | MIDOC13 deployed Station KX19 64deg 26.63'S 84deg 21.82 'E 0 - 200 - 0m re-shoot of MIDOC12 because net failed to open. Shot at 18:54z; resurface at 19:36z  Tom Luttrell |
| 470 | 2016-01-31 21:55:01 | CTD019 Station - KX19 64deg 38.26'S 084deg 19.47'E  Brian McGlashan |
| 471 | 2016-02-01 05:30:33 | RMT - Regular Station - KX19 Oblique to 200m 64deg 24.595'S 84deg 46.13 'E  Brian McGlashan |
| 472 | 2016-02-01 06:06:23 | RMT - Target Trawl to 23m 64deg 25.278'S 84deg 47.154 'E  Brian McGlashan |
| 473 | 2016-02-01 19:35:38 | MIDOC14 - KX20 wp0405 |
| 474 | 2016-02-01 19:36:10 | CTD - K30 wp0405A Deployed in approximately 3200m |
| 475 | 2016-02-01 22:32:30 | RMT - Regular Event - R16 Station - KX20 Oblique to 200m 65deg 10.32'S 85deg 19.78 'E  Brian McGlashan |
| 476 | 2016-02-01 22:55:14 | RMT - Target Event - T10 To 30m 65deg 09.96 'S 85deg 46.14 'E  Brian McGlashan |
| 477 | 2016-02-02 13:13:20 | MIDOC15 - KX21 Start 2016-02-02 12:06z Finish 2016-02-02 16:06z Tom Luttrell |
| 478 | 2016-02-02 17:14:33 | CTD - K21 Deployed in approximately 1200m 65deg 09.391'S 091deg 37.110'E  Tom Luttrell |
| 479 | 2016-02-02 21:03:10 | RMT Event - R17 Station - KX21 Oblique to 200m depth. Net failed to open - Mechanical Failure Repairs carried out on deck and successfully completed on second attempt. 65deg 06.62'S 091deg 33.53'E  Brian McGlashan |
| 480 | 2016-02-02 21:50:00 | RMTR - R18 KX21 - KX22 Start 2016/02/02 21:50z 65deg 02.5 S; 91deg 22.4 E End 2016/02/02 22:14z 65deg 02.4 S; 91deg 31.4 E  Tom Luttrell |
| 481 | 2016-02-02 23:04:00 | CTD - KX22 Start 2016/02/02 23:04z 65deg 00.2 S; 91deg 23.1 E |
| 482 | 2016-02-03 05:17:00 | MIDOC 16 - KX23 Start 2016/02/03 05:17z 65deg 29.0 S; 91deg 10.8 E |
| 483 | 2016-02-03 09:52:00 | CTD 23 Start 2016/02/03 09:52z 64deg 18.96 S; 89deg 47.86 E |
| 484 | 2016-02-03 14:26:40 | RMTR - R19 Oblique to 200m Open 14:12:50 64deg 19.071 S 89deg 50.431 E Close 14:33:31 64deg 19.648 S 89deg 51.553 E |
| 485 | 2016-02-03 15:00:37 | RMTT - T15 Target trawl to 20m / 5 minutes Open 14:48 64.34 S 89.88 E Close 14:53:27 64deg 20.201 S 89deg 52.690 E |
| 486 | 2016-02-03 17:41:58 | RMTT - T16 Target trawl to 25m Open 17:35:56 63deg 59.203 S 89deg 7.421 E Close 17:38:56 63deg 59.297 S 89deg 7.655 E |
| 487 | 2016-02-03 20:06:56 | MIDOC17 Deployed 2016/02/03 20:02z 63deg 45.881 S 88deg 35.462 E |
| 488 | 2016-02-04 02:22:22 | CTD 24 wp0601 |
| 489 | 2016-02-04 02:00:00 | RMTR to 200m |
| 490 | 2016-02-04 21:41:54 | CTD25 - to 300m wp0603 |
| 491 | 2016-02-04 22:47:56 | RMTR - 22 Oblique to 200m |
| 492 | 2016-02-04 23:26:00 | RMTT - T17 Target trawl to 30m 62deg 25.9 S 86deg 2.5 E |
| 494 | 2016-02-04 21:21:00 | CTD 26 wp0604 |
| 493 | 2016-02-05 01:50:00 | CTD 27 wp0604 |
| 495 | 2016-02-05 11:15:00 | RMTR - R23 |
| 496 | 2016-02-05 15:16:00 | MIDOC - MIDOC20 |
| 497 | 2016-02-05 21:26:45 | CTD28 - to approx. 2500m wp0605 |
| 498 | 2016-02-05 07:20:44 | Ethanol - Water Mix Changed in RMT Mechanical Flow Meter.  Brian McGlashan |
| 499 | 2016-02-06 13:27:32 | RMTR - R25 Oblique to 200m |
| 500 | 2016-02-06 14:00:53 | RMTT - T18 140m target trawl |
| 501 | 2016-02-06 15:34:19 | RMTT - T19 220m target trawl. FOTS tested to 365m (accidentally). |
| 502 | 2016-02-06 18:30:00 | RMTT - T20 Target trawl to 220m. HV cable resistance dropped to 80kR at depth; recovered to 160kR. Removing pressure housing HV coupling made no difference. |
| 503 | 2016-02-07 01:00:00 | MIDOC 22 - Station KX30 wp00607 |
| 504 | 2016-02-07 07:10:00 | CTD30 |
| 505 | 2016-02-07 09:14:00 | RMTR - R26 |
| 506 | 2016-02-07 13:13:00 | MIDOC23 Replaced Scanmar PC after trawl. |
| 507 | 2016-02-07 17:43:42 | CTD31 |
| 508 | 2016-02-07 21:00:00 | RMT R 27 Station KX31 |
| 509 | 2016-02-08 02:00:00 | MIDOC 24 Station KX 32 |
| 510 | 2016-02-08 07:00:00 | CTD 32 Station KX32 |
| 511 | 2016-02-08 09:43:19 | RMTT - T21 |
| 512 | 2016-02-08 10:19:00 | RMTR - R28 |
| 513 | 2016-02-08 13:55:00 | MIDOC - MIDOC25 Updated Scanmar trawl sounder #2 channel parameters. |
| 514 | 2016-02-08 19:00:25 | CTD - K33 |
| 515 | 2016-02-08 21:47:00 | RMT R29 - K33 |
| 516 | 2016-02-09 00:56:00 | MIDOC 26 - KX34 wp0702 |
| 517 | 2016-02-09 06:20:00 | CTD 34 - KX34 wp00703 |
| 521 | 2016-02-09 10:05:00 | RMTR - R30 KX34 |
| 522 | 2016-02-09 12:25:00 | MIDOC27 - KX35 |
| 523 | 2016-02-09 17:45:00 | CTD35 - KX35 |
| 524 | 2016-02-09 19:02:00 | RMTR - R31 KX35 |
| 525 | 2016-02-09 23:00:00 | RMT T22 - KX36 |
| 526 | 2016-02-10 01:18:00 | MIDOC 28 - KX38 |
| 527 | 2016-02-10 06:47:00 | CTD 36 - KX38 |
| 528 | 2016-02-10 07:23:00 | RMTT T23 - KX36 |
| 529 | 2016-02-10 07:57:00 | RMTR R32 - KX36 |
| 530 | 2016-02-10 10:10:00 | MIDOC29 - KX37 |
| 531 | 2016-02-10 15:36:48 | CTD K37 - KX37 wp0802 |
| 532 | 2016-02-10 16:17:17 | RMTR R33 KX37 Net failed to open. |
| 533 | 2016-02-10 16:46:05 | RMTR R34 KX37 |
| 534 | 2016-02-10 23:37:00 | MIDOC 30 - KX38 |
| 535 | 2016-02-11 07:21:29 | CTD 38 - KX38 |
| 536 | 2016-02-11 10:19:00 | RMTT - T24 KX38 |
| 537 | 2016-02-11 10:34:00 | RMTR - R35 KX38 1.1M to 120K Ohm |
| 538 | 2016-02-11 12:37:00 | MIDOC31 KX39 wp0803 |
| 539 | 2016-02-11 18:05:23 | CTD39 - KX39 wp0901 |
| 540 | 2016-02-11 23:54:00 | RMT R36 - KX39 Prior to deployment; insulation reading 1.2MOhm min. observed 170kOhm Rubber Tape may have improved insulation. Level has remained at 171kOhm despite RMT being back on deck... suspect seawater is not able to drain as quickly. |
| 541 | 2016-02-12 05:11:02 | RMT Insulation dropped from 800kOhm prior to deployment to 140kOhm. Suspect cable retaining water due to rubber tape. Removed tape to avoid frozen water causing further damage. |
| 542 | 2016-02-12 07:26:00 | MIDOC32 - KX40 |
| 543 | 2016-02-12 12:41:00 | RMTT - T26 KX40 |
| 544 | 2016-02-12 14:27:15 | RMTR - R37 KX40 |
| 545 | 2016-02-12 15:20:17 | CTD40 - KX40 wp0902 Waypoint was incorrect in Viasge. Was: 60deg 7.74 S 83deg 34.57 E Changed to: 60deg 19.002 S 83deg 35.360 E Voyage route needs updating. |
| 546 | 2016-02-12 21:45:00 | CTD41 - KX41 wp0903 |
| 547 | 2016-02-13 05:33:00 | MIDOC33 - KX42 Retrieved and re-deployed due to twisted line. |
| 548 | 2016-02-13 06:23:00 | MIDOC34 - KX42 |
| 549 | 2016-02-13 10:54:00 | CTD42 - K42 KX42 wp0904 |
| 550 | 2016-02-13 15:04:00 | RMTR - R38 KX42 850K to 160K |
| 551 | 2016-02-13 21:25:00 | MIDOC35 KX43 |
| 552 | 2016-02-14 01:58:00 | CTD43 KX43 wp0905 |
| 553 | 2016-02-14 06:39:00 | RMTT T27 KX43 |
| 554 | 2016-02-14 07:10:00 | RMTT T28 KX43 |
| 555 | 2016-02-14 07:29:00 | RMTT T29 KX43 |
| 556 | 2016-02-14 08:26:00 | RMTR R39 KX43 |
| 557 | 2016-02-14 15:12:00 | MIDOC36 KX44 |
| 558 | 2016-02-14 20:04:04 | CTD44 K44 wp0906 |
| 559 | 2016-02-15 01:28:00 | RMTR R40 KX44 |
| 560 | 2016-02-15 04:46:00 | MIDOC37 KX45 |
| 561 | 2016-02-15 09:45:05 | CTD45 KX45 wp1001 |
| 562 | 2016-02-15 10:15:00 | RMTR R41 KX45 Net failed to open. |
| 563 | 2016-02-15 10:46:00 | RMTR R42 KX45 |
| 564 | 2016-02-15 14:50:00 | RMTT T30 |
| 565 | 2016-02-15 16:47:50 | MIDOC38 KX46 |
| 568 | 2016-02-15 22:14:00 | RMTR R43 KX46 |
| 569 | 2016-02-16 01:34:00 | MIDOC39 KX47 |
| 570 | 2016-02-16 06:48:00 | CTD47 KX47 WP1003 |
| 571 | 2016-02-16 07:51:00 | RMTR R44 KX47 |
| 567 | 2016-02-16 12:31:00 | MIDOC40 KX48 |
| 573 | 2016-02-18 06:25:00 | RMT T31 |
| 574 | 2016-02-18 08:47:00 | RMT T32 |
| 575 | 2016-02-18 16:31:00 | RMT T33 |
| 576 | 2016-02-18 17:51:00 | RMT T34 |
| 577 | 2016-02-18 18:24:00 | RMT T35 |
| 578 | 2016-02-18 19:11:00 | RMT T36 |
| 579 | 2016-02-18 23:56:00 | RMT T37 |
| 572 | 2016-02-19 04:22:00 | RMT Target T38 |
| 580 | 2016-02-22 03:39:29 | Had another power failure in the Met lab possibly due to the 60+ knot blizzard currently going on causing blizz static via the physics instruments on the Monkey deck. We reset the breaker and it quickly tripped again. So I have pulled out every cable to these experiments and restarted the rack.  Lloyd Symons |
| 581 | 2016-02-24 03:55:00 | Ship got loose from mooring lines and ran aground at West Arm; Horseshoe harbour |
| 582 | 2016-02-26 00:00:00 | Ship was floated off the rocks and exited the harbour at 1:42pm Mawson time |
| 583 | 2016-03-05 07:34:48 | Just checking oceanographic lab to find that the TSG was running dry. I upped the flow rate. Also cleaned the fluorometer. Lloyd Symons |
| 584 | 2016-03-06 10:30:00 | Found the fluorometer running dry so I adjusted flows once more. TSG data appears less spikey as a result  Lloyd Symons |
| 585 | 2016-03-07 04:14:29 | Just found the fluorometer bubbler running dry and the TSG bubbler working perfectly (the reverse of yesterday’s situation) so I increased the flow rate into the fluoro slightly and it started to fill. This system seems extraordinarily touchy... Especially given that there are no scientists on board trying to take water from the system via other means. Lloyd Symons |
| 586 | 2016-03-12 05:30:22 | As we are approaching Fremantle; I have shut down the sea water instruments so that the engineers can shut down the sea water intakes.  Lloyd Symons |

Table - Voyage Event Log (Technical)

# Waypoints

A number of waypoints were maintained in the ships scientific GIS system (known as Visage) for planning purposes. Note that these waypoints do not record the actual location of deployments but were used for planning purposes. The ships track data contained in the underway data is the best record of where deployments were actually conducted.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ID | Label | Latitude | Longitude | Comment |
| 576 | W-GRIBB | S62° 22.80' | E81° 47.81' | whale\_recorders |
| 577 | W-DAVIS | S66° 34.47' | E77° 38.97' | whale\_recorders |
| 675 | wp0101 | S42° 54.50' | E147° 22.03' | k-axis |
| 676 | wp0102 | S62° 41.34' | E99° 14.33' | k-axis |
| 677 | wp0103 | S63° 59.66' | E93° 35.47' | k-axis |
| 678 | wp0104 | S64° 51.00' | E93° 33.00' | k-axis |
| 679 | wp0201 | S64° 49.80' | E93° 32.40' | k-axis |
| 680 | wp0202 | S64° 48.60' | E93° 33.60' | k-axis |
| 681 | wp0203 | S64° 46.80' | E93° 33.60' | k-axis |
| 682 | wp0204 | S64° 43.80' | E93° 34.20' | k-axis |
| 683 | wp0205 | S64° 17.40' | E93° 33.60' | k-axis |
| 684 | wp0206 | S64° 0.00' | E93° 33.60' | k-axis |
| 685 | wp0207 | S63° 30.00' | E93° 33.60' | k-axis |
| 686 | wp0208 | S63° 0.00' | E93° 34.20' | k-axis |
| 687 | wp0209 | S62° 16.80' | E93° 9.00' | k-axis |
| 688 | wp0210 | S61° 57.73' | E93° 15.65' | k-axis |
| 689 | wp0211 | S61° 42.38' | E93° 22.51' | k-axis |
| 690 | wp0301 | S61° 57.91' | E92° 33.67' | k-axis |
| 691 | wp0302 | S62° 17.40' | E91° 31.20' | k-axis |
| 692 | wp0303 | S62° 23.56' | E89° 40.42' | k-axis |
| 693 | wp0304 | S62° 28.09' | E87° 47.77' | k-axis |
| 694 | wp0305 | S62° 30.67' | E86° 7.42' | k-axis |
| 695 | wp0306 | S62° 32.00' | E83° 51.57' | k-axis |
| 696 | wp0307 | S62° 31.25' | E82° 0.97' | k-axis |
| 697 | wp0401 | S63° 15.56' | E82° 0.69' | k-axis |
| 698 | wp0402 | S63° 56.74' | E83° 7.88' | k-axis |
| 699 | wp0403 | S64° 24.75' | E83° 32.70' | k-axis |
| 700 | wp0404 | S64° 39.93' | E84° 18.67' | k-axis |
| 701 | wp0405 | S65° 10.03' | E84° 18.72' | k-axis |
| 702 | wp0406 | S65° 31.43' | E84° 28.87' | k-axis |
| 703 | wp0407 | S65° 42.81' | E84° 26.96' | k-axis |
| 704 | wp0408 | S65° 46.09' | E84° 31.67' | k-axis |
| 705 | wp0409 | S65° 48.65' | E84° 33.01' | k-axis |
| 706 | wp0501 | S64° 55.19' | E88° 40.19' | k-axis |
| 707 | wp0601 | S63° 35.39' | E88° 13.05' | k-axis |
| 708 | wp0602 | S63° 6.58' | E87° 15.40' | k-axis |
| 709 | wp0603 | S62° 30.67' | E86° 7.42' | k-axis |
| 710 | wp0604 | S61° 55.39' | E85° 4.42' | k-axis |
| 711 | wp0605 | S61° 12.10' | E83° 51.77' | k-axis |
| 712 | wp0606 | S60° 21.70' | E82° 32.90' | k-axis |
| 713 | wp0607 | S59° 21.76' | E81° 6.20' | k-axis |
| 714 | wp0608 | S58° 39.47' | E80° 9.13' | k-axis |
| 715 | wp0701 | S58° 14.34' | E82° 0.04' | k-axis |
| 716 | wp0702 | S57° 54.59' | E83° 20.06' | k-axis |
| 717 | wp0703 | S57° 34.73' | E84° 35.33' | k-axis |
| 718 | wp0704 | S57° 20.70' | E85° 25.76' | k-axis |
| 719 | wp0801 | S57° 41.13' | E85° 33.70' | k-axis |
| 720 | wp0802 | S58° 49.64' | E86° 1.57' | k-axis |
| 721 | wp0803 | S59° 26.98' | E86° 17.65' | k-axis |
| 722 | wp0901 | S59° 40.78' | E85° 24.96' | k-axis |
| 723 | wp0902 | S60° 7.74' | E83° 34.57' | k-axis |
| 724 | wp0903 | S60° 21.71' | E82° 32.91' | k-axis |
| 725 | wp0904 | S60° 54.02' | E79° 55.41' | k-axis |
| 726 | wp0905 | S61° 19.03' | E77° 34.92' | k-axis |
| 727 | wp0906 | S61° 50.03' | E74° 5.77' | k-axis |
| 728 | wp1001 | S62° 41.00' | E73° 21.20' | k-axis |
| 729 | wp1002 | S63° 57.74' | E72° 7.76' | k-axis |
| 730 | wp1003 | S64° 52.61' | E71° 10.19' | k-axis |
| 731 | wp1004 | S65° 57.38' | E69° 56.69' | k-axis |
| 732 | wp1005 | S66° 37.59' | E69° 7.22' | k-axis |
| 733 | wp1006 | S66° 54.22' | E68° 45.53' | k-axis |
| 734 | wp1101 | S66° 51.70' | E66° 13.61' | k-axis |
| 735 | wp1102 | S66° 47.15' | E63° 56.93' | k-axis |
| 736 | wp1201 | S67° 36.22' | E62° 52.37' | k-axis |

Table - Voyage Waypoints