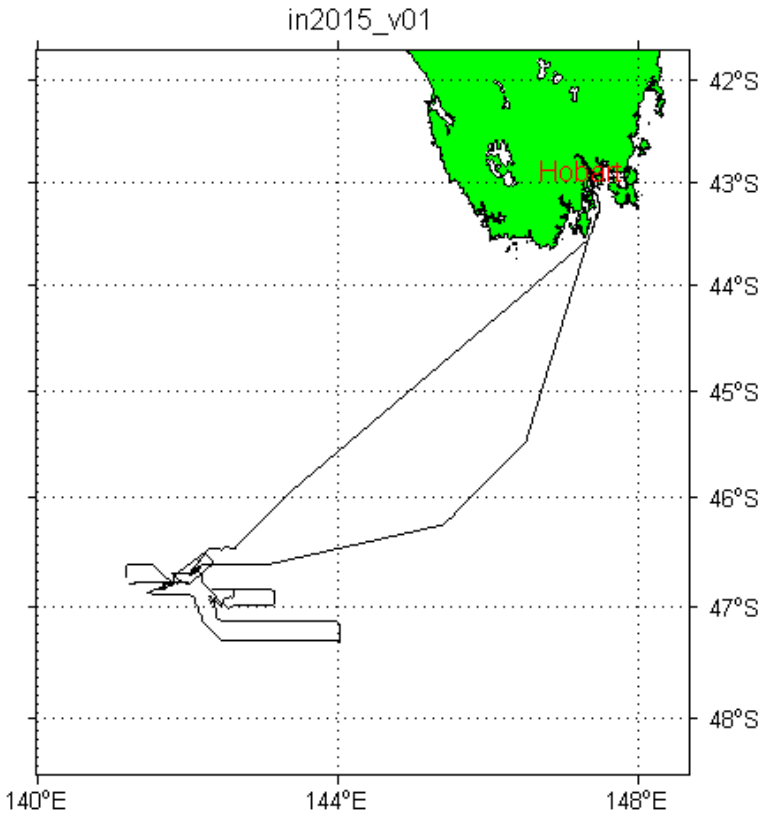
RV *Investigator*

Underway Data Processing Summary Report

Voyage #:	IN2015_v01
Voyage title:	IMOS Southern Ocean time series automated moorings for climate and carbon cycle studies southwest of Tasmania
Depart:	Hobart, 22:10 Saturday, 20 March 2015 UTC
Return:	Hobart, 22:00 Monday, 29 March 2015 UTC
Data Dates:	20-Mar-2015 22:20:05 to 29-Mar-2015 21:26:00 UTC
Chief Scientist:	Dr. Tom Trull, CSIRO Oceans and Atmospheres Tom.Trull@csiro.au office: 03 6232 5069 mobile: 04 4779 5735 Dr. Eric Schulz, Co-Chief Scientist Bureau of Meteorology E.Schulz@bom.gov.au office: 03 9669 4618
Data processed by:	Anoosh Sarraf CSIRO Oceans and Atmosphere Flagship, Hobart, Tasmania.

1.1 Table of Contents

1.2



1.3 Underway Data

Navigation data is acquired using the Seapath 330 plus position and reference unit, which is also differentially corrected by data from the FUGRO marine cstar 3610 receiver.

The Meteorological data consists of two port/starboard relative humidity and temperature sensors, vane type wind sensor, licor light sensor and a barometer.

Thermosalinograph data is acquired with a Seabird SBE21 TSG and remote temperature by SBE38. Data from a flow meter is also recorded.

Digital depth data is recorded from a Simrad EK60 sounder.

Data from the Integrated Marine Observing System sensors (IMOS) are also included. The sensors are port and starboard radiometers and pyranometers, ultrasonic wind speed and direction; optical rain and rain rate.

See Electronics report for this voyage for instruments used and their serial numbers.

Navigation, meteorological, thermosalinograph, IMOS and depth data are preliminary quality controlled by combining all data from hourly recorded files to 5 second values in a netCDF formatted file. The combined data is referred to as “underway data”.

A combined file was made on 25-Aug-2015 by running the Java application UWYMerger with data time range of 20-Mar-2015 22:20:05 to 29-Mar-2015 21:26:00 UTC.

It should be noted that the merged data file contains additional underway instrument sensor data that are not quality controlled or processed and is provided for completeness only. This includes data from the air sampling instruments (i.e. two Ozon sensors, Absorption Photometer, Picarro and sampling inlet bearing), Pco2, Drop keel position, gyro, doppler log and ISAR SST radiometer.

1.4 Completeness and Data Quality

Navigation data (latitude and longitude, speed over ground, ship heading and course over ground); meteorological data (port and starboard air temperature, port and starboard humidity, port and starboard relative and true wind direction and speed, maximum wind gust, PAR port and starboard light, atmospheric pressure and rain) and IMOS data (port and starboard radiometers and pyranometers, ultrasonic relative wind direction and speed, optical rain and rain rate), thermosalinograph (salinity and water temperature) data were evaluated and quality controlled.

1.5 Processing Comments

The atmospheric pressure values (atmPressure) showed unusual characteristics. Sudden increases and decreases in pressure values were noted. These were investigated and a direct correlation with changing of wind direction was noted. It is believed that due to the position of the intake of the atmospheric pressure sensor on the ship's super structure the values from this sensor are influenced by the prevailing wind and this affect (Bernoulli effect) becomes noticeable during notable wind direction changes. For this reason all pressure values have been marked as suspect.

A number of discrepancies between the port and starboard air temperature sensors were noted (max differences of about 6.7 degrees), otherwise both sensors gave very close reading with the mean absolute difference of about 0.12 degrees. These discrepancies occurred usually during periods of rapid temperature change. This phenomenon has probably come about due to the rapid warming of the ships metal structure and air due to the ship becoming stationary or cooling of the air temperature due to the ship speeding off from stationary or due to the evaporation of rain water around the sensor housing. Furthermore, they also seem to relate to when the ship is stationary with little wind or during/following periods of rainfall or as the result of a change in the ship speed that could be the result of hot exhaust gases being blown over the sensors depending on the wind direction.

A similar discrepancy (max differences of about 29.14%) between the port and starboard humidity sensors was observed with the mean absolute difference of about 0.63%. The recorded values are within instrument tolerance.

The courseOG values when the ship is stationary are not true values as the ship is not travelling a course however this is a feature of the current acquisition system. The QC flags have been set as good however this feature should be noted if the values during the stationary periods are to be used.

It was noted that values recorded by the Port and starboard PAR sensor had a mean absolute difference of about 29.5 (uE/m^2/s) respectively and in particular the starboard PAR values were mostly smaller than the port side sensor.

Similarly the values recorded by the port and starboard Radiometer and Pyranometer had a mean absolute difference of 2.55 and 12.84 W/m^2 respectively and in particular the starboard Pyranometer and Radiometer values were mostly smaller than the port side sensor.

The optical rain gauge sensor (which provides 'opticalRainRate', 'opticalRain') was not installed during this voyage. Therefore the values (zeros) for 'opticalRainRate', 'opticalRain' have been set to NaNs and their QG flags set to {'bad', 'none', 'operatorFlagged'}.

Due to a fault in the sensor interface application software the siphoning rain gauge values were incorrect. Therefore the values from the rain sensor have been set to NaNs and their QG flag set to {'bad', 'none', 'Software error'}. In the event that the erroneous values are required for examination, they could be obtained from the underway netCDF file using the parameter name rawRain.

Functionality to derive the ultrasonic true wind speed and direction was not implemented in the TECHSAS acquisition system for this voyage and therefore the two parameters are not available in the underway data.

The relative wind direction values for the ultrasonic wind sensor showed unusual characteristics.

This was investigated and it appears that when the wind, more or less, is on the stern of the ship the ultrasonic wind direction values exhibit wild variations (i.e. large spikes) which are not manifested by the two vane type wind sensors. It is our belief that this characteristic is most likely caused due to the interaction of the ships superstructure/foremast/ship motion and the wind in relation to the ultrasonic wind sensor on Investigator.

The statistical characteristics of the ultrasonic wind direction in relation to the port side vane type wind direction was utilised in order to implement a QCing mechanism to handle the spiky portions of the ultrasonic wind direction data. The noisy portions of Ultrasonic Wind Direction data have therefore been:

1. NaNed when the difference between the unltrasonic wind direction and port vane type wind direction values is greater than four times the mean difference between the two sensors and its QC flag set to {'bad', 'none', 'operatorFlagged'}.

2. Left untouched when their difference is greater than twice the mean difference sensors and its QC flag set to {'suspect', 'none', 'operatorFlagged'}

There were a few sections of salinity data that was highly noisy. According to the voyage instrumentation report, this was due to the presence of air bubbles caused as the result of cavitations in the water intake line. The following approximately denote the major periods that the noisy data occurred:

22-Mar-2015 18:21:40 to 19:44:55

24-Mar-2015 12:23:25 to 27-Mar-2015 09:25:55

27-Mar-2015 17:35:35 to 19:42:55

This spiky salinity data was filtered and the bad data NaNed and the QC flag set to {'bad' , 'none', 'operatorFlagged'}, {'bad', 'none', 'anomalousSpike'} Or {'bad', 'none', 'range'}. The salinity data during the noisy intervals that was not NaNed has been left in the data set as they appear to be of better quality however due to their noisy characteristics they have been flagged as suspect by setting its QC flag to {'suspect', 'none', 'operatorFlagged'}.

There were no TSG/CTD calibration performed during this voyage, therefore it was not possible to undertake a final calibration of the TSG salinity data against the calibrated CTD data. However given that the TSG unit had been lab calibrated just prior to the voyage on 11/03/2015, and the salinity data was calculated using the latest calibration coefficients, therefore the data has been accepted as calibrated and good and its QC flag set accordingly.

It should be noted that the underway netCDF file contains the raw UNQCed data. Therefore even though the QCed variable may have been NaNed or otherwise adjusted, the raw data variable is always available in the netCDF underway file. This is useful if the end user wishes to apply a different QCing methodology.

Finally, the Depth data is no longer processed as part of the underway data set. The non QCed data is available in the underway data. The QCed depth data could be obtained from processed GSM dataset (centre beam) for this voyage.

1.6 Final Underway Data

The navigation, meteorological and thermosalinograph data will be entered into the O&A divisional data warehouse. All data timestamps are in UTC.

Filename	Parameters	Resolution
IN2015_v01uwy10.csv	latitude, latitudeQC, longitude, longitudeQC, speedOG, speedOGQC, courseOG, courseOGQC, shipHeading, shipHeadingQC, portAirTemp, portAirTempQC, stbdAirTemp, stbdAirTempQC, portHumidity, portHumidityQC, 'stbdHumidity, stbdHumidityQC, atmPressure, atmPressureQC, rain, rainQC, , portPAR, portPARQC, stbdPAR, stbdPARQC,portRelWindDir, portRelWindDirQC, portTrueWindDir, portTrueWindDirQC, portRelWindSpeed, portRelWindSpeedQC, portTrueWindSpeed, portTrueWindSpeedQC, stbdRelWindDir, stbdRelWindDirQC, stbdTrueWindDir, stbdTrueWindDirQC, stbdRelWindSpeed, stbdRelWindSpeedQC, stbdTrueWindSpeed, stbdTrueWindSpeedQC, maxWindGust, maxWindGustQC, stbdRadiometer, stbdRadiometerQC, portRadiometer,	10 seconds

	portRadiometerQC, stbdPyranometer, stbdPyranometerQC, portPyranometer, portPyranometerQC,ultraRelWindSpeed, ultraRelWindSpeedQC, ultraRelWindDir, ultraRelWindDirQC, opticalRain' , opticalRainQC, opticalRainRate, opticalRainRate, salinity, salinityQC, waterTemp, waterTempQC,	
IN2015_v01uwy5min.csv	Ditto 10 second data	5 minutes

1.7 References

Subversion repository version of DPG Matlab generic tools 3974

Pender, L., 2000. Data Quality Control flags.
http://www.marine.csiro.au/datacentre/ext_docs/DataQualityControlFlags.pdf