data summary

Southern Surveyor Voyage ss2010_v07

CSIRO

MARINE NATIONAL FACILITY

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# *ss2010_v07*

## *Title*

Integrated Marine Observing System (IMOS) Facility 3. Southern Ocean Time Series (SOTS) moorings for climate and carbon cycle studies southwest of Tasmania (47ºS, 140ºE)

## *Principal Investigators*

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## *Ports*

Original schedule:

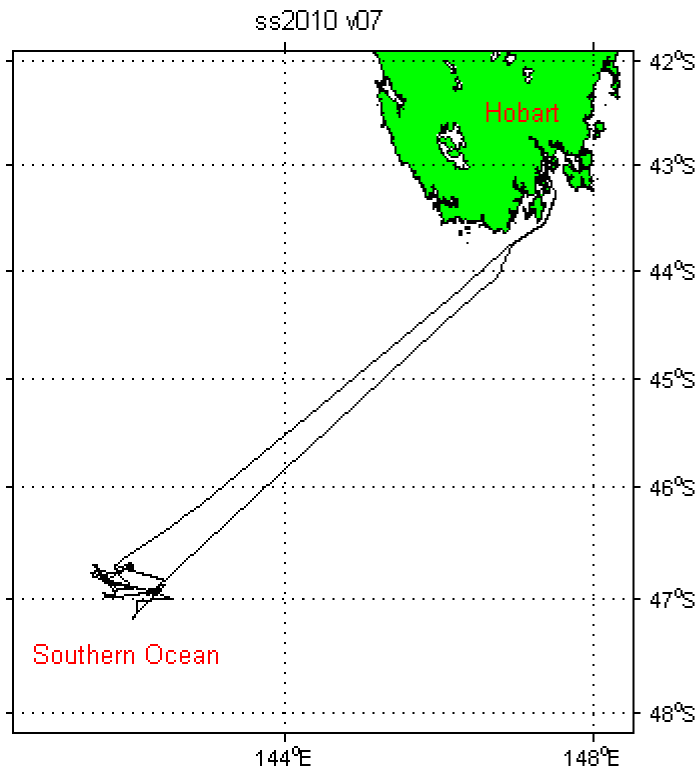
Depart Hobart 0800 Tuesday 7 September 2010

Arrive Hobart no later than 1000hrs Wednesday 15 September, 2010

## *Date*

06-Sep-2010 21:51 to 14-Sep-2010 21:52 (UTC)

## ***Voyage Track***



## *Underway Data*

Navigation data is acquired using the Seapath 200 position and reference unit, which is also differentially corrected by data from the FUGRO DGPS receiver.

The Meteorological data consists of 2 relative humidity and temperature sensors; a barometer, wind sensor, and licor light sensor.

Thermosalinograph data is acquired with a Seabird TSG and remote temperature by SBE 3T. Data from a flow meter is also recorded.

Digital depth data is recorded from a Simrad EK60 sounder. Echograms are also recorded using SonarData's Echolog software. Digital depth data can be re-picked using SonarData's Echoview software.

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

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

Navigation, meteorological, thermosalinograph, IMOS and depth data are 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 using TECHSAS1 on 6 Mar 2011 by running a Java application, written by Lindsay Pender of CMAR, UwyMerger version 1.3 however during the processing of the data set it discovered that TSG data was not recorded by TECHSAS1 therefore a new underway file from TECHSAS2 was generated on 18-Mar-2011 with dates range 06-Sep-2010 21:51 to 14-Sep-2010 21:52 (UTC) .

### 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, wind direction and speed, maximum wind gust, light, atmospheric pressure, uncorrected wind direction, rain and speed) and IMOS data (port and starboard radiometers, port and starboard pyranometers, derived wind direction and speed, uncorrected wind direction and speed, rain and rain rate), thermosalinograph (salinity and water temperature) data and depth data were evaluated and quality controlled.

### Processing Comments

A number of discrepancies between the port and starboard air temperature sensors were noted (max differences of about 1.99 degree). These occurred usually during periods of rapid temperature increase or decrease. Investigation of these indicated that they have usually occurred when the ship was stationary with little wind or during/following periods of rainfall. This phenomenon has probably come about due to the rapid warming of air due to the ship becoming stationary or cooling of the air temperature due to the evaporation of the rain water around the sensor housing. It is unclear as to why there should be a notable temperature differential between the port and starboard temperature sensors.

A similar discrepancy (max differences of about 14.26%) between the port and starboard humidity sensor was observed. It should also be noted that the starboard humidity sensor appears to consistently give a higher humidity reading (mean absolute difference of about 1.61%). The recorded values appear to be within instrument tolerance.

A number of rapid temperature changes were noted (e.g. around 3-5 degrees during a short period of time) for both port and starboard temperature sensors.
These rapid temperature changes were most likely due to the warming up effect of the ship's metal structures and/or the engine exhaust blowing over the sensors, when the wind is blowing on the stern of the ship or the ship is stationary with little wind or being hit by a cold/warm front. The sensor values for the ship speed, uncorrected wind direction, wind speed and port/starboard temperature were closely examined for correlation and the following two conditions were indentified as usually prevalent during the periods of rapid temperature changes (in particular temperature rise):

1) The ship stationary with no or low wind speed in the region of 5 knots blowing on the stern (i.e. uncorrected wind direction around 135 to 225 degrees).
2) The ship cruising at about 8-10 knots with wind speed in the region of 10-40 knots blowing on the stern (i.e. uncorrected wind direction around 135 to 225 degrees).

Periods of rapid changes are suspect for reasons highlighted above, otherwise the data is good.

The wind speed had a number downward spikes. These were investigated and the cause was attributed to anomalous raw wind direction data. The wind speed is derived from uncorrected wind speed and wind direction plus a few other parameters. Examination of the underlying data revealed possible anomalous wind direction data which coincided with the downward spikes in the derived wind speed. Most of the obvious anomalies during this period were manually set to NaN with their QG flags set to {'bad','none','operatorFlagged'}. However due to the number of spikes throughout the data it was not possible to ascertain if they were all caused due to the problem with the wind direction or not. Therefore due to this uncertainty it was decided to keep the rest of the data and its QCflag left in its initial {'noQC','none','preliminary'} state, otherwise the data is of good quality. Similarly 'uncorrWindDirQC', 'uncorrWindSpeedQC','windDirQC' have been left in their original {'noQC','none','preliminary'} state.

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.

The speedOG data appeared to contain unusually noisy and fluctuating values. This was investigated and attributed to the intermittent lack of DGPS (Differential GPS). A peak speedOG of 16.78knots and occasional fluctuation in the region of 10 knots in 5 seconds was noted; given the capabilities of the Southern Surveyor, such values are improbable. This variability in the speedOG data is most likely due to the inaccuracies with the standard GPS and the rolling of the ship. The speedOG data was QCed as good (as there was no actual fault as such). However, where the data values are highly fluctuating, it is recommended that they are used with reference to the Doppler velocity log that records the ships speed through water. The Doppler velocity log name is 'shipsLog' in the netCDF underway file (ss2010_v07uwy.nc). It should be noted that Doppler velocity is not QCed as part of the underway processing and there can be obvious anomalous spikes in this data. However as this data is less noisy than the recorded speedOG it could provide a point of reference when using the speedOG data.

The readings from the foremast IMOSRain sensor (which is an optical type) when available, was notably higher than the readings from the foremast funnel/siphoning type rain sensor. This was initially considered to be unusual because the optical IMOSRain sensor reading was expected to be similar to those from the foremast funnel/siphoning sensor. However, further investigation of this issue across a number of voyages indicated a very close correlation between periods of strong winds or rough sea/swells and the times that the optical IMOSRain sensor recordings indicated significantly higher rain level than the foremast funnel/siphoning rain sensor. It is suspected that the higher IMOSRain sensor recordings are due to water spray from the breaking of waves against the bow of the ship and wind-carried spray from the rough seas which are more likely to interrupt the optical sensor beam path and less likely to enter the funnel at the top of the funnel/siphoning sensor. The foremast rain sensors are virtually co-located.

It was noted that IMOS starboard Radiometer recordings were mostly about 3 ($W/m^2$) greater than the port Radiometer recordings throughout the voyage.

The depth data was re-picked using Sonar Data's Echoview software. Due to interference from the ships thrusters or incorrect settings on the EK60 system there are a number of periods that no echogram and depth data is available, the most notable periods are listed below:
07-Sep-2010 06:42 to 07-Sep-2010 07:27
08-Sep-2010 16:56 to 08-Sep-2010 19:23
09-Sep-2010 03:11 to 09-Sep-2010 03:51
09-Sep-2010 20:20 to 10-Sep-2010 07:19
11-Sep-2010 08:11 to 11-Sep-2010 10:51
12-Sep-2010 04:58 to 12-Sep-2010 05:34
12-Sep-2010 09:30 to 12-Sep-2010 11:44
12-Sep-2010 16:51 to 12-Sep-2010 19:23

During the processing of recent voyages TSG/CTD calibration runs, the examination of the overlapped salinity plots have shown a notable discrepancy in the TSG salinity relative to the CTD salinity. The investigation of this anomaly has not been conclusive so far. However examination of TSG data has revealed that if the TSG conductivity is advanced by about 32 seconds relative to the TSG sensor temperature, when calculating the derived salinity, a significant improvement in TSG salinity relative to the CTD salinity is obtained. Whilst this issue is being investigated further, a conductivity lag correction factor is introduced as part of TSG calibration and utilised for the calculation and processing of TSG salinity. This lag factor is henceforth documented in this processing report.

There was no CTD hydrology conducted on this voyage. Therefore it was not be possible to derive a TSG calibration based on calibrated CTD data. A TSG salinity scaling factor of 1.000135078665575 was obtain using uncalibrated TSG/CTD run in ss2010_v07003Ctd.nc.

However due to lack of calibration for the CTD it was decided to use the TSG scaling factor from previous voyage that used calibrated CTD data. Therefore the salinity scaling factor of `1.000332555125775` from voyage ss2010_t02 was used. This scaling factor was applied to the TSG salinity data and the thermosalingraph salinity QC was set to {'good' ,'manually adjusted','no error'}.

## Final Underway Data

The navigation, meteorological, thermosalinograph, IMOS and depth data will be entered into the CMAR divisional data warehouse. All data timestamps are in UTC.

| Filename | Parameters | Resolution |
|---|---|---|
| ss2010_v07uwy10.csv | latitude, latitudeQC, longitude, longitudeQC, speedOG, speedOGQC, courseOG, courseOGQC, shipHeading, shipHeadingQC, uncorrWindDir, uncorrWindDirQC, uncorrWindSpeed, uncorrWindSpeedQC, waterDepth, waterDepthQC, portAirTemp, portAirTempQC, stbdAirTemp, stbdAirTempQC, portHumidity, portHumidityQC, stbdHumidity, stbdHumidityQC, windSpeed, windSpeedQC, maxWindGust, maxWindGustQC, windDir, windDirQC, PAR, PARQC, atmPressure, atmPressureQC, waterTemp, waterTempQC, salinity, salinityQC, IMOSStbdRadiometer, IMOSStbdRadiometerQC, IMOStbdPyranometer, IMOSStbdPyranometerQC, IMOSRainRate, IMOSRainRateQC, IMOSRain, IMOSRainQC, IMOSWindSpeed, IMOSWindSpeedQC, IMOSWindDir,IMOSWindDirQC, IMOSPortRadiometer, MOSPortRadiometerQC, IMOSPortPyranometer, IMOSPortPyranometerQC, IMOSUncorrWindSpeed,MOSUncorrWindSpeedQC, IMOSUncorrWindDir,IMOSUncorrWindDirQC rain, rainQC | 10 seconds |
| ss2010_v07uwy5min.csv | Ditto 10 second data | 5 minutes |
| ss2010_v07pdr10.csv | latitude, latitudeQC, longitude, longitudeQC, waterDepth, waterDepthQC | 10 seconds |

## *References*

Subversion repository version of DPG Matlab generic tools 1488
Pender, L., 2000. Data Quality Control flags.
http://www.marine.csiro.au/datacentre/ext_docs/DataQualityControlFlags. Pdf

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