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Metadata for the WAGES instrumentation deployed
on the RRS *James Clark Ross* between
May 2010 and September 2013

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2015

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# *DOCUMENT DATA SHEET*

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*ABSTRACT*

The RRS *James Clark Ross* makes meteorological measurements around Antarctica during the austral summer, in the Arctic during the boreal summer and in the Atlantic during passages between the two poles. In May 2010, as part of the WAGES project the ships existing systems were complemented by the AutoFlux system (Yelland et al., 2009) to measure the transfers of momentum, heat and CO2 between the atmosphere and the ocean. Similarly, a commercial directional wave radar "WAVEX" made by the Norwegian firm MIROS was installed. This report describes the metadata for the WAGES instrumentation deployed on the RRS *James Clark Ross* between May 2010 and September 2013. Sensor serial numbers, dates of sensor changes and problems with sensors are contained in the associated tables.

*KEYWORDS*

*ISSUING ORGANISATION*

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# Metadata for the WAGES instrumentation deployed on the RRS *James Clark Ross* between May 2010 and September 2013

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## 1. Introduction

WAGES aims to improve our understanding of the air-sea fluxes of $CO_2$, sea-spray aerosol, sensible heat, latent heat and momentum. To achieve this it is necessary to obtain direct measurements of the fluxes themselves, along with the various physical parameters which drive the fluxes such as: the mean air-sea differences in $CO_2$ concentration (for the $CO_2$ flux); temperature (sensible heat flux) and humidity (latent heat flux); wind speed (all fluxes); sea state and whitecap fraction ($CO_2$ and aerosol fluxes in particular). To obtain a sufficiently large data set the fluxes and underlying parameters were measured continuously using instrumentation deployed on the *RRS James Clark Ross* from May 2010 to September 2013. WAGES was a collaborative project with Professor Ian Brooks' group at the University of Leeds.

The ship's existing systems were complemented by the AutoFlux system (Yelland et al., 2009) to measure the transfers of momentum, heat and $CO_2$ between the atmosphere and the ocean. A commercial directional wave radar "WAVEX" made by the Norwegian firm MIROS was installed in September 2010. After installation of the WAGES systems, two NOCS staff took part in an initial shake-down cruise. Details of the setup and operation of all the systems and sensors can be found in the cruise report (Yelland and Pascal, in prep). In 2006, the Plymouth Marine Laboratory installed an underway system to obtain $CO_2$ concentrations in the surface water and atmosphere.

The *James Clark Ross* spends the majority of time undertaking science around Antarctica. The ship heads north during the Antarctic winter and undertakes scientific cruises into the Arctic. Every year the ship spends August in refit. In September cargo bound for Antarctica is loaded onto the ship in Immingham. NOCS staff visited the ship when it was in port in the UK or Europe.

Data are stored on the NOCS UNIX system. All raw data were periodically archived to "RODIN" the NOCS data catalogue. Mean meteorological and wave data were routinely sent to BODC.

In addition to the continuous measurements WAGES also involved 6 intensive observation periods (IOPs) during which WAGES staff sailed on the *JCR* in order to deploy a novel spar buoy to obtain wave breaking information. The IOPs were usually piggy-backed on cruises which involved significant on-station work and included between 2 and 8 days dedicated ship time for WAGES activity: these cruises have the identifiers JR254A, JR254B etc and their dates are given in Appendix G.

This report details the metadata associated with the continuous measurements made during whole of the WAGES measurement campaign. The sensors used, dates sensors were changed etc. are documented in Section 2. Underway salinity samples were collected and used to calibrate the sea surface salinity measurements (Section 3). Section 4 describes orientation and alignments of the main flux sensors and recommends which relative wind directions can be used (160-300$^o$). Section 5 discusses issues with the various air temperature and humidity sensors and makes recommendations about which sensor should be used during which period, and what corrections need to be applied.

Any times given in this report are GMT. Jday is sometimes used instead of, or as well as data: 1200 GMT on the 1$^{st}$ of January is jday 1.5.

## 2. Instrumentation

In this section, each of the sensors is described in turn along with their tables of metadata. Table F gathers all the data streams together so that the performance of the system as a whole can be seen. In this table, port calls are highlighted in red and problems with sensors are highlighted in grey. Days of similar situations are grouped together, e.g. if the psychrometer water bottle was frozen for 3 days and no other problems had occurred then these days are grouped together. Dates when staff visited

the ship (port calls or manned cruises) to change instrumentation and download data are shown in Appendix G.

The sensor sampling frequencies are summarised in Table E. Yearly time series plots of various parameters are given in Appendix E. Note that the data used here have only had basic QC applied, if any.

## 2.1 Fast response instrumentation

A Gill R3A Ultrasonic anemometer (Table A.1) and two open path Licor 7500 $CO_2/H_2O$ Gas Analysers (Tables A.2 and A.3) were located on the foremast (Figure 1, 2 and 3). An enclosed path Licor 7200 $CO_2/H_2O$ Gas Analyser (LicorN – Table A.4) replaced the Licor 1 sensor on the 27th November 2011. Note: Sonic 038 was not used during WAGES, but the calibration is included in Appendix D.

Licor1 was mounted forward of the foremast platform and Licor2 was mounted to starboard of the platform. The Licor 7200 head was located at the base of the sonic. The Licors were routinely shrouded, with the crew moving the shroud from one sensor to the other (see Table F). A washing system to clean the Licor lenses was installed, but proved ineffective and hard to maintain so it was removed.

A SYSTRON DONNER MotionPak used 3 accelerometers and 3 rate gyros to record ship motion and was located close to the anemometer. The MotionPak was mounted to the same plate as the R3 sonic. The center of the Motionpak was located 0.65 m below, and 0.095 m aft, of the center of the R3 measurement volume. There was no port-starboard offset between the two sensors.

All systems logged data at 20Hz. Details of the sensor changes can be found in Table A.1. Motionpak calibrations are given in Appendix A and B. Licor calibrations and sonic calibrations are contained in Appendix C and D respectively.

On the 28th September 2010 the sea-spray aerosol flux sensor "CLASP" was installed, in collaboration with Ian Brooks of Leeds University, UK. The sensor was mounted so that the intake was 0.95 m below, and 0.15m m to port of, the base of the R3 anemometer (Figure 2). Details are given in Table A.5.

The height of the foremast platform above the waterline was calculated using records of the ship's draught and these are listed in Appendix F. The average draught was 5.6 m, standard deviation 0.2 m (minimum draught 4.9 m, maximum draught 6.1 m). **These translate to a height above waterline of the R3 measurement volume of 16.5 m on average (s.d. 0.2 m, minimum 16.0 m, maximum 17.2 m).**

A Vaisala PTB220 fast response pressure sensor was installed on the wheelhouse top for a few days. It was located on the rail 1m above the deck in the port forward corner of the monkey Island. It sampled at 10Hz between 26th April 2012 and 1st May 2012.

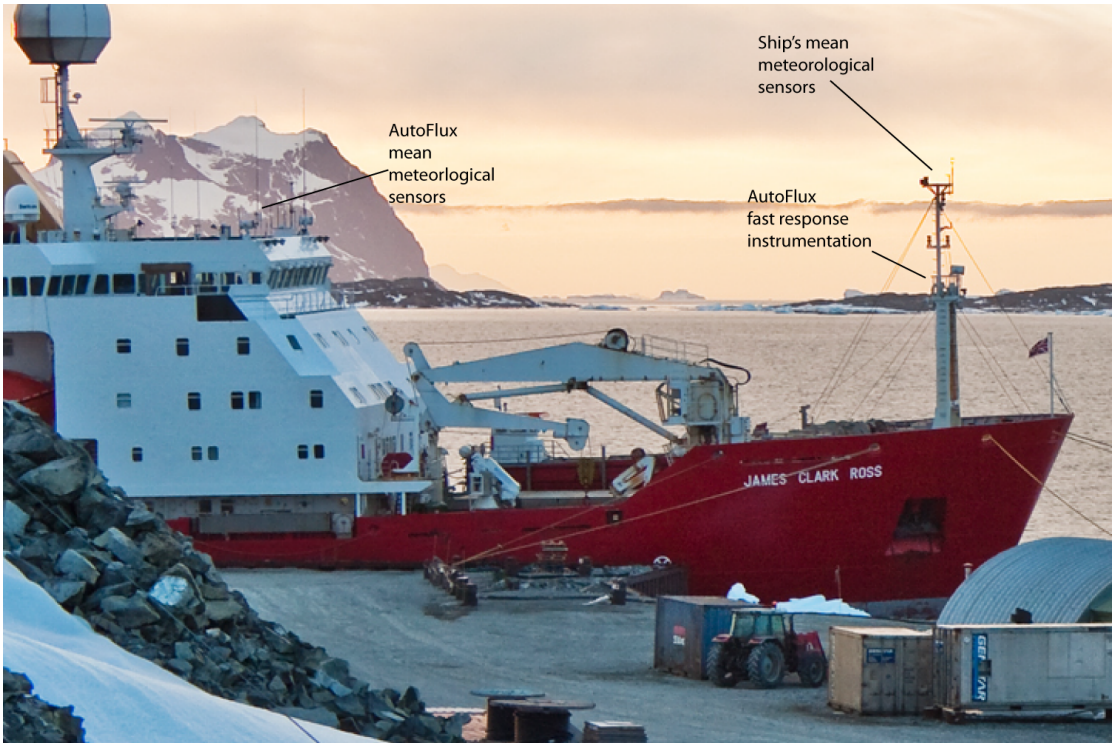


Figure 1. The locations of the instrumentation on the RRS *James Clark Ross*. The AutoFlux radiation, psychrometer (wet and dry bulb air temperature) and the Vaisala (air temperature and humidity) sensors are located on the bridge top. The ship's radiation, wind speed and Rotronic (air temperature and humidity) are located on the foremast extension.

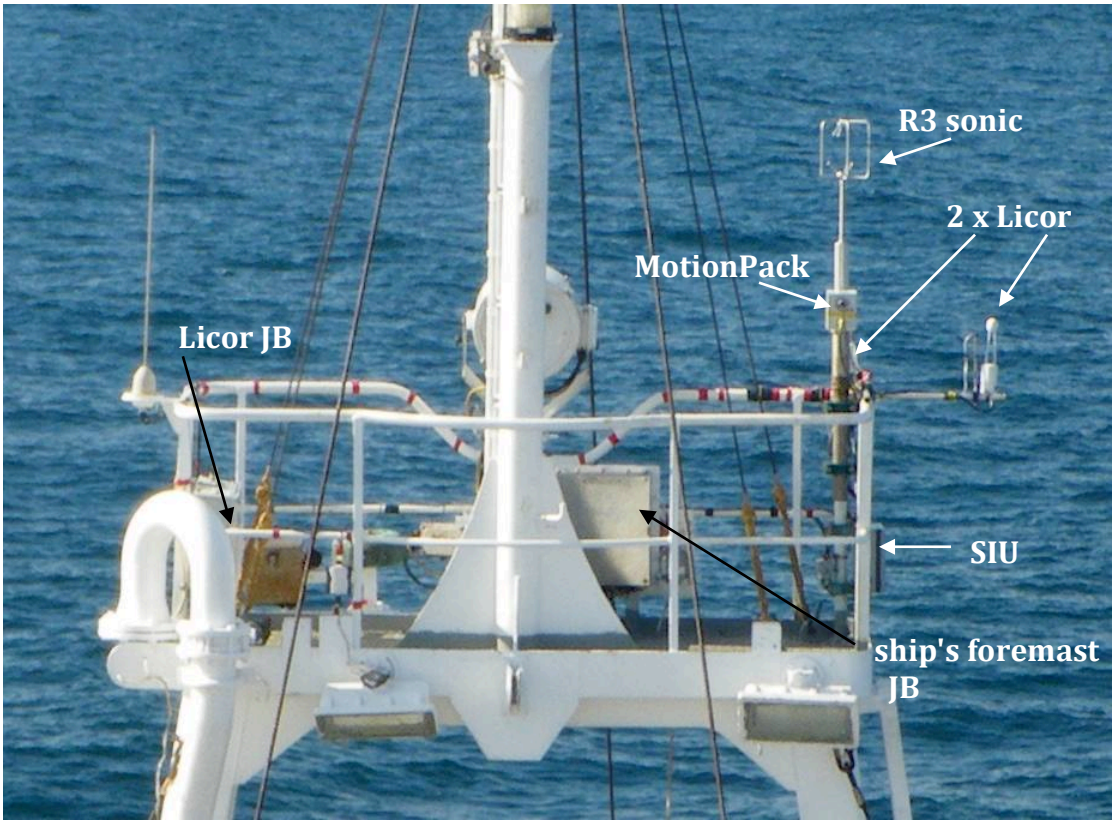


Figure 2. Photo of the fast-response sensors on the foremast platform, taken from the wheelhouse top on the passage from Frederikshavn to Portsmouth, 29th August 2010. The location of the sensor electronics ("Licor JB") and the ship's foremast junction box are also shown.

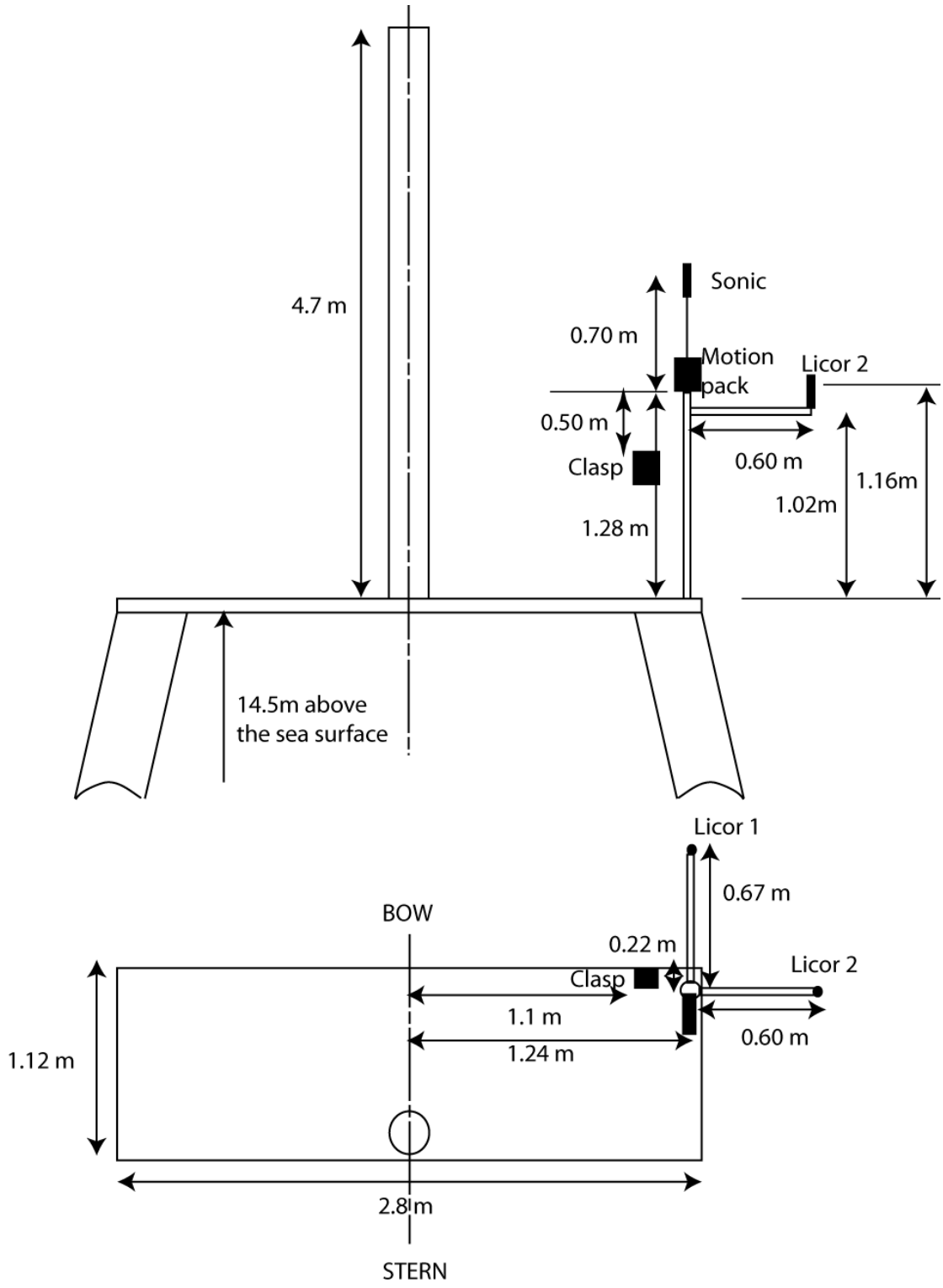


Figure 3. Layout of the foremast instrumentation. The top panel shows the view from the bridge looking forwards. The platform is 14.5 m above the sea surface (for a ship's draught of 5.6 m).

## 2.2 WAGES Mean meteorological sensors

The WAGES mean meteorological sensors were installed after the first mobilisation cruise, during the refit in late August 2010. The on-board automated processing merged air temperature and humidity from ship sensor 1 (Section 2.3) on to the other data streams from the start of the WAGES campaign in May 2010 until the 3rd April 2012, after which data from the ship's sensor 2 were

merged on instead. However, the automated (inertial dissipation and bulk) flux processing always used data from the psychrometer from the date on which it was installed (27th August 2010, jday 239) until the end of the campaign. Prior to the end of August 2010 data from the ship sensor 1 were used in the automated flux processing.

Wet and dry bulb air temperatures were measured using a NOCS aspirated psychrometer, mounted above the bridge (Figure 4, Table B.1). The wet bulb water reservoir occasionally ran dry or froze and was refilled when necessary by the crew (Table F). Relative humidity was calculated from the psychrometer and pressure data in near real time. In addition to the psychrometer, a Vaisala HMP45A or HMP155 sensor was also used to measure air temperature and relative humidity (Table B.2): the Vaisala sensor was mounted close to the psychrometer. The psychrometer and Vaisala sensors were located at heights of 18.7 m and 18.5 m above the sea surface respectively (for a ship's draught of 5.6 m). They were both located on the port side, about 1.5 m aft of the forwards edge of the bridge.


Figure 4. Photo of the mean meteorological sensors on the bridge top, looking towards the port beam. Photo taken in Immingham, UK on the 3rd October 2011.

Problems with the air temperature from the psychrometer were identified. A comparison of the psychrometer data with the air temperature from the ship's second pair of sensors (Section 2.3) showed that during the day the psychrometer dry bulb read up to 4 deg high (at night it was more like 0.8 deg high) compared to the ship's sensors. At a 10 m/s wind speed this changes the calculated U10n by up to 1 m/s, since calculated stability swaps from being stable to unstable. Instead of the standard large "hat" a small "hat" was placed on the psychrometer, because the large one had a tendency to blow off during high winds The small hat may not provide sufficient protection against solar radiation, particularly in the sunny low latitudes. Section 5 contains more information about this problem, and includes recommendations about when to use which sensor and what corrections need to be applied.

Two radiation sensors were located above the bridge at a height of 20.5 m above the sea surface. An Eppley Precision Infrared (PIR) Pyrgyometer (Table B.3) was used to measure the downwelling long wave radiation (3.5 to 50 μm). Short wave radiation was measured using a Kipp and Zonen CM11 (310-2800nm) sensor (table B.4).

All the mean meteorological data stream were logged every 10 seconds. Instrument sampling rates are found in Table E.

## 2.3 BAS sensors

Atmospheric pressure was measured by two Vaisala PTB201B1A2B sensors (serial numbers: V145002 and V145003) located in the UIC at a height of 8 m above sea level (for a ship's draught of 5.6 m). No height correction to sea level was applied to the measurements. No other metadata data are available.

A "bird table" platform mounted on top of the foremast extension carried a WindMaster sonic anemometer (0.6 m to port of the ship's centreline), two Rontronic air temperature and humidity sensors (Table B.9), and two each of shortwave radiation (Kipp and Zonen SP Lite) and photosynthetically active radiation (Kipp and Zonen ParLite) sensors. The ship's anemometer was at a height of 20.8 m above the water and the air temperature and humidity sensors are at a height of 20.4 m. Unfortunately, no serial numbers are available for the period 2011 to 2013.

Sea surface temperature (SST) was measured using a PRT 100 sensor at the water inlet (depth about 5 m). Salinity was calculated using an underway SBE45 Micro thermosalinograph (TSG) system (Table B.5) which was located in the prep lab. The TSG flow rate can be used to quality control the sea surface temperature (SST) and salinity. The flow meter is reported to have stopped working between 7th May 2011 (J127) and 23rd May 2011 (J143), but the SST and salinity measurements are OK during this period. Note that when the ship was in shallow water, in ice or in port the TSG pump was turned off (Table F). In addition, when the ship is steaming in rough weather the pump can also cut out, so SST needs careful QC. Bottle samples were taken once or twice a week by the ship's Deck Engineers throughout most of the measurement campaign. The bottle samples were analysed using a Salinometer either during manned cruises or back at NOCS. Section 3 contains a comparison between the underway TSG salinities and those from the bottle samples.

The quality of the fluorometer data was not checked, but is known to be bad at times. Please check data against MODIS EO chorophyll values before use. Sampling rates for the BAS systems are included in Table E.

## 2.4 Navigation Systems

The navigation data was acquired from the ship's systems at 1 Hz. Position, speed and course relative to the earth and ship's heading was acquired using a Kongsberg Seapath 200 system. The heading from the ship's gyro and the ship's speed relative to the water (EM log) was logged in the 'NAVN' data stream, but was not included in the AutoFlux data.

## 2.5 Digital camera systems

In 2010 a Mobotix M24 digital camera was located on the port side of the ship's bridge (Figure 5) to measure the whitecap fraction generated by breaking waves. The camera faced forwards and was set at a sampling frequency of 15 seconds on the 21st September 2011. Various sampling frequencies were used before this date and are in included in Table B.6 for completeness. The camera used a 32mm lens and the exposure time was set to a maximum of 1/90 second to minimise blurring of the images. The brightness and backlight correction are set to the factory settings (0 and 4 respectively). Sharpness (4) and noise suppression (low) were also set to the factory defaults. The exposure is set to use the full image. Image size was set at 3Mp (10% compression). In the data archive this camera is indicated as 'mx'.

On the 3rd October 2012 an additional Mobotix M24 camera was installed to the right of the existing camera (named 'mxb' in the data archive). The settings of the new camera matched the existing camera (3Mp image size and an image sampling frequency of 15 seconds). Image area of the new camera was adjusted to match the existing camera as closely as possible. Analysis of the 'mx' images showed that some images were contaminated by reflections from the windows. To reduce these reflections, each camera was surrounded by card on 3rd October 2012 to reduce reflections from the windows (Figure 5).

The existing camera (mx) was deployed with a polarizing lens filter for the whole WAGES campaign. The additional camera (mxb) had no lens filter to compare the effect using the polarizing lens filter on whitecap fraction measurements.

For the duration of the manned cruise JR254F in 2013 two Nikon Coolpix 8800 compact cameras were located alongside the IP cameras. The compact camera settings were the same as those deployed during the SOLAS cruises on RRS *Discovery* in 2006 and 2007, and will be used for a comparison of the whitecap measurement systems. Both compact cameras were set at 30 second sampling and ISO 400. A polarizing filter was added to the camera on the right hand side on the 12th May 2012. The left hand camera had no filter for the duration of the cruise. Initially the cameras were set at 3Mp resolution, which was changed to 5Mp on the 12th May 2012. An example of the EXIF metadata associated with each image from the Nikon cameras is shown in Appendix I. A time series of how the shutter speed, aperture and ISO settings varied are shown in Appendix H. No metadata was imbedded in the images from the IP cameras.

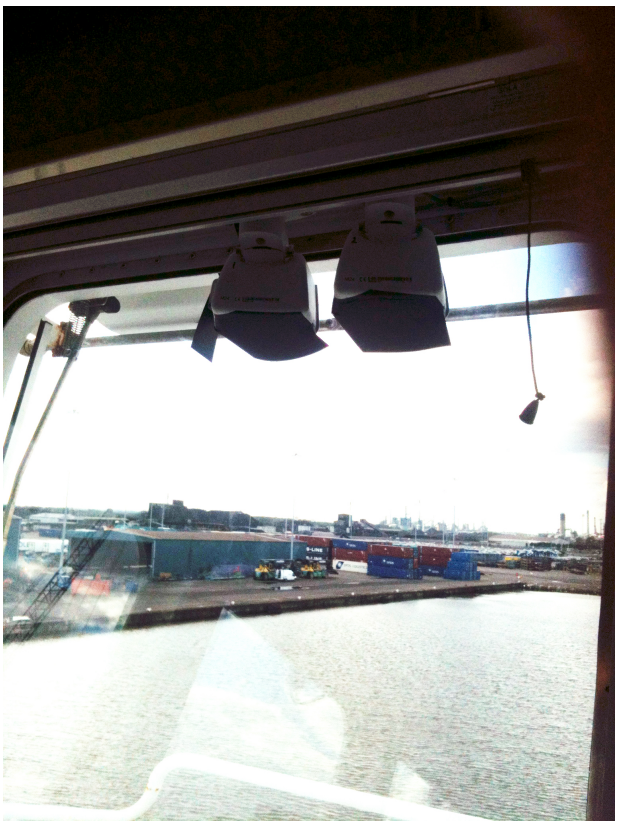

Figure 5. The IP camera system located on the port side of the bridge.

The effect of IP camera 'target brightness' and 'brightness' settings on whitecap measurement was investigated during a later cruise on the RV *Knorr*. Two cameras were located side by side as in the WAGES campaign. On the 11th November 2013, the mx3 camera had it's 'target brightness' setting changed (between 15% and 35%) whilst the mx2 camera had a constant target brightness of 25%. Meanwhile on the 12th November 2013, the 'brightness' setting was changed on the mx3 camera (values of 0, -1 and -2) whilst it remained constant on the mx2 camera ('brightness' set to -3). The manufacturer's definitions of target brightness and brightness are given below. The analysis suggested that there was a measured whitecap (Wc) dependence on both 'target brightness' and 'brightness', e.g. as the target brightness increased the Wc fraction increased. Similarly as the brightness setting was increased from -3 to 0 the Wc fraction increased. However, in both cases the variability in the measurements increased and more analysis needs to be undertaken to determine if this result is correct.

*Target Brightness*: This parameter of exposure control (default is 40%) specifies the average brightness of the image pixels considered for exposure control that the camera tries to reach; it is thus the target value for the finished image's brightness. In order to reach this value, the camera first

tries to change the exposure time within the limits set by the minimum and maximum exposure time and adjusts the hardware amplification within the internally defined limits.

*Brightness*: Changing the brightness parameter will adjust the entire image area. Configure the Exposure Windows first. This is usually sufficient to achieve good image exposure control. If setting the exposure windows alone does not produce satisfying results, you may want to use the brightness parameter for fine tuning. Selecting high values for this parameter that are too high may lead to overexposure of bright image areas.

## 2.6 Wave systems

During September 2010 a WAVEX directional wave radar was installed as part of the WAGES project (Figure 6). The X-band scanner was installed on the port side of the ships's mast at a height of 22 m above the sea surface (based on a ship's draught of 5.6m). The antenna was temporarily removed during the Portsmouth refit (23rd June 2011) for structural alterations to the platform, but was replaced with the bow mark facing the stern (i.e. 180 degrees out). This was corrected on during the September 2011 port call in Immingham. Note that data obtained when the antenna was wrongly oriented are unusable.

The WAVEX software was set up to sample for a 2 minute period out of every 5 minutes. Spectra and mean parameters were recorded every 5 minutes and raw data were recorded twice per hour. The WAVEX software allows up to eight mean parameters to be output over a serial link, which were recorded by the AutoFlux acquisition system. These are detailed in Table B.7 and any problems/upgrades are noted in Table B.8. Note that when the serial link is down, the WAVEX system was still working and the data are available (post-cruise) but summary data were not being transmitted to the AutoFlux system in real time.

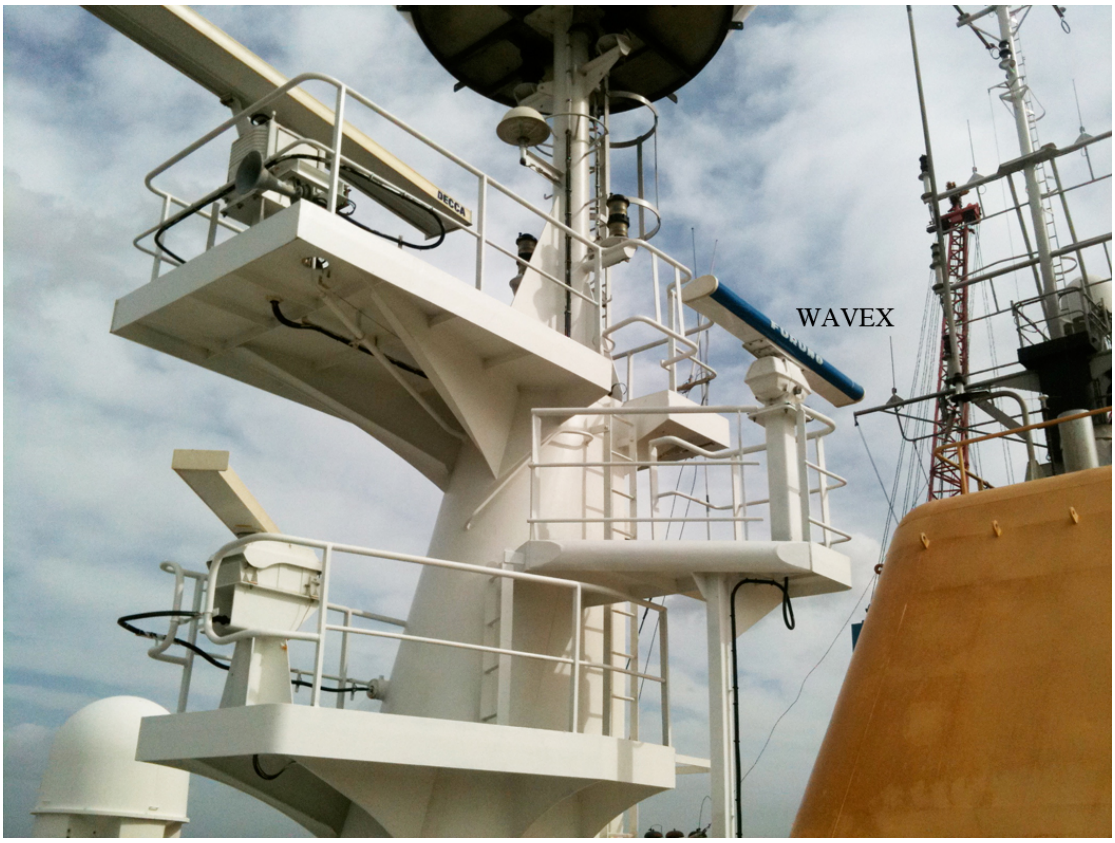


Figure 6 The WAVEX wave radar antenna located above the bridge top. Photo taken in Immingham, UK on the 3rd October 2011.

## 2.7 PML $CO_2$ system

The PML underway $pCO_2$ system on board uses a non-dispersive infrared (NDIR) detector to measure the atmospheric $pCO_2$ and seawater $pCO_2$, using a vented dual-chamber spray-head equilibrator for the latter. The system was calibrated using three standard gases (nominally 250 ppm $CO_2$ in air; 450 ppm $CO_2$ in air and high-purity $N_2$ = zero ppm $CO_2$) which were run in turn every 6 equilibrator cycles and one atmospheric cycle, i.e. one standard is run, then 6 equilibrator cycles, one atmospheric cycle then the next standard. Total repeat time for this sequence is 30 mins. Absolute calibrations for these gases were determined against NOAA certified standards prior to deployment.

## 2.8 Visual observations

As part of their routine duties, the ship's navigation officers made underway visual observations of weather and ice conditions. These data are available from ICOADS.

# 3. Thermosalinograph (TSG) calibration

During the shake-down cruise JR254A that took place immediately after mobilisation of the JCR, bottle samples were taken from the non-toxic supply to the TSG and were later analysed using a Salinometer. This showed that the TSG salinity data were biased very high, by about 1 PSU (TSG accuracy should be nearer 0.01 PSU). This unit (S/N 0072) was removed on the 17th June and replaced by unit S/N 0016. Further instrument changes are given in Table B.5.

From Autumn 2010 the JCR Deck Engineers took regular (usually every 3 or 4 days) bottle samples for later analysis so that any drift in the TSG salinity data could be detected.

Figure 7 shows a comparison of 10-minute averages of TSG salinities (after rejecting any psu outside the range 0.01 and 40) compared to bottle samples analysed with the salinometer. The blue lines indicate dates when the instrument was replaced.

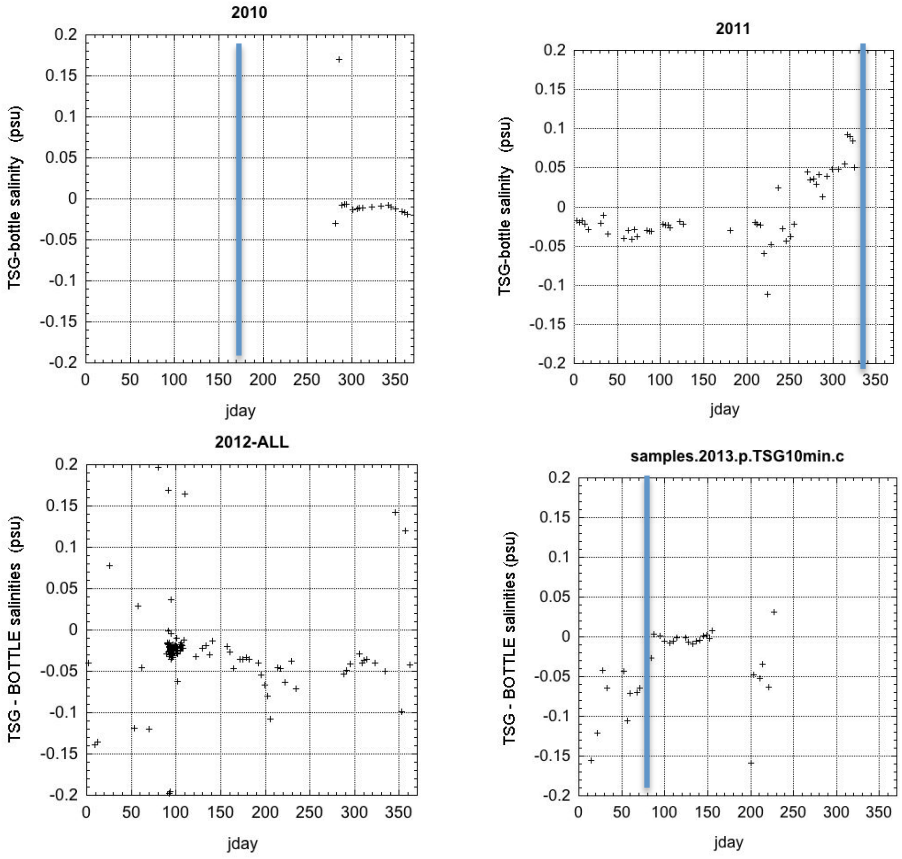


Figure 7. Time series of (TSG-Bottle) salinity difference. Blue lines indicate when the TSG unit was swapped out.

No dependence on SST, salinity or flow was seen. In 2011 the TSG deteriorated slowly and became rather noisy. The salinometer data should be accurate to about 0.001 psu (assuming the bottle sample was OK), so it was probably the TSG data which were noisy. In 2012 the data were sparse and very noisy for the first 100 days despite the installation of a new unit towards the end of 2011, but this was probably due to poor technique in obtaining and storing the bottle samples, since the data from jday 100 onwards look very good (and it is unlikely that the TSG would spontaneously "recover" from a fouling problem for example). Similarly, the data obtain in 2013 between days 200 and 250 may have been due to poor bottle samples since the analyst noted that the samples had salt crystals round the bottle cap: the ship was also in and out of sea ice during this time.

## 4. Alignments of the R3 sonic and the MotionPak relative to each other and to the ship.

The MotionPak was mounted on the same base plate as the R3 sonic. The center of the MotionPak was located 0.65 m below, and 0.095 m aft of, the center of the R3 measurement volume. There was no port-starboard offset between the two sensors.

The AutoFlux automated calculation of the inertial dissipation estimate of the fluxes assumes that the R3 is aligned perfectly with the ship. Any offset will affect the true wind speed calculation since the measured wind velocity will be offset from the ship velocity. For a ship speed of less than 2 m/s, a 5° yaw offset (rotation in the horizontal plane) would cause a bias of less than 0.01 m/s in the calculated true wind speed. Similarly, when the ship is on passage to/from port, a ship speed of 6 m/s and a 5° offset would result in a bias of less than 0.025 m/s. The automated processing was set up assuming that the R3 was oriented to port by 9 degrees (see below). This assumed offset remained constant in the processing throughout the WAGES project.

In contrast, small offsets do need to be taken into account very accurately during the calculation of the turbulent air-sea fluxes using the eddy correlation (EC) method (Brooks, 2008). The anemometer data need to be aligned as closely as possible with the MotionPak (MP) data, by rotating the frames of reference to allow for any physical misalignments between the two sensors. Once the anemometer data have been corrected for ship motion as measured by the MotionPak, the corrected data then need to be rotated a second time in to the ship frame of reference to allow for any significant yaw offset before correcting the data again for mean ship speed as measured by the ship's navigation system. Here we look first at the yaw offset. Then we will briefly discuss the measurement of instrument tilts in the fore/aft and port/starboard directions.

To aid the EC flux processing, metadata from the various tables in this report has been brought together in Table I. This table shows: port call dates; changes to, and problems with, the fast response sensors; periods when the Licors were shrouded; and any other problems relevant to the calculation of fluxes. Table H summarises the yaw orientation of the R3 and MotionPak relative to the ship and their yaw relative to each other.

### 4.1 Yaw Offsets

The R3 sonic and MotionPak (MP) sensors were changed on a number of occasions (Table A.1) so that the anemometer could be sent for calibration. When these sensors are replaced it is important to determine their alignment relative to the ship. It is difficult to align sensors on a ship since there are no straight structures which can be used as a reference. The most difficult aspect to quantify is the yaw offset, i.e. rotation about the vertical axis. Figure 8 shows a comparison of the relative wind direction as measured by the R3 with that from the ship's sonic. Only data within 5 degrees of bow-on are used and each point represents the average difference in a 10-day period. The data span the period from installation in May 2010 to de-mobilisation in August 2013. Jday is 1.5 at noon GMT on the 1st January. Note that the ship's sonic was replaced during the refit in late summer of 2010 but it is believed that no changes were made to that sensor in the following 3 years (unless it was changed or removed in July 2011, jday 202, when the ship's air temperature and humidity sensors were changed), i.e. the orientation of the ship's sonic (and its measured relative wind direction) should be unchanged from September 2010 onwards to July 2013 when it was temporarily removed. The relative wind direction from the R3 has been corrected assuming a constant yaw offset of 9 degrees to port.

To minimise variability in the yaw offset, the R3 and the MP were joined together as one unit using a mounting plate. This allowed the two to be aligned closely in the horizontal plane, and the yaw offset between the two could be quantified using the method of Brooks (2008). The various

combinations of R3 and MP sensors were examined in the lab (Prytherch et al. 2010) and the results are summarised in Table G. The MP was located in a fixed position on the horizontal mounting plate, and the sonic attached to the plate using slotted screw holes. The yaw offsets were determined for the sonic rotated as far as the slots allowed in either direction, with an anticlockwise rotation (as viewed from above) corresponding to the anemometer being rotated hard to port when on the ship. This allowed the relative offset between the R3 and MP to be known.

When the R3/MP pair were installed on the ship, the sonic was again rotated hard to port. The pair were then mounted so that the MP was aligned as closely as possible to the fore-aft axis of the ship. This was checked by eye, by someone standing in the bridge at the same distance from the ship's center line as the MotionPak. The MotionPak is mounted in a rectangular housing whose straight sides allow a check on its orientation by a second person using the parallax method. The head of the sonic anemometer has three struts, one directly "aft" of the sensor volume and two more located at 60° either side of the aft strut. The yaw offset of the R3 relative to the ship was estimated using the parallax method: a person on the bridge moves port/starboard until the "aft" strut appears to be in alignment with the central support. The R3 (and MotionPak) was mounted 1.24 m to starboard of the centerline. If the aft strut appears in alignment at a distance of 6.15 m to starboard, then the yaw angle is given by

tan(yaw) = (6.15-1.24)/31

yaw = 9 degrees to port

where 31 m is the fore-aft distance between the R3 and the person on the bridge. Repeated measurements by different observers on the bridge suggested that this method had an error of about 0.5 degree. The accuracy of the parallax method could also be checked against the lab values: again the parallax method usually agreed with the lab values to about 0.5 degrees (worst case 1.1). Table H summarises the R3 and MotionPak yaw angles relative to the ship (from the parallax method) and their relative yaw angles as measured in the lab.

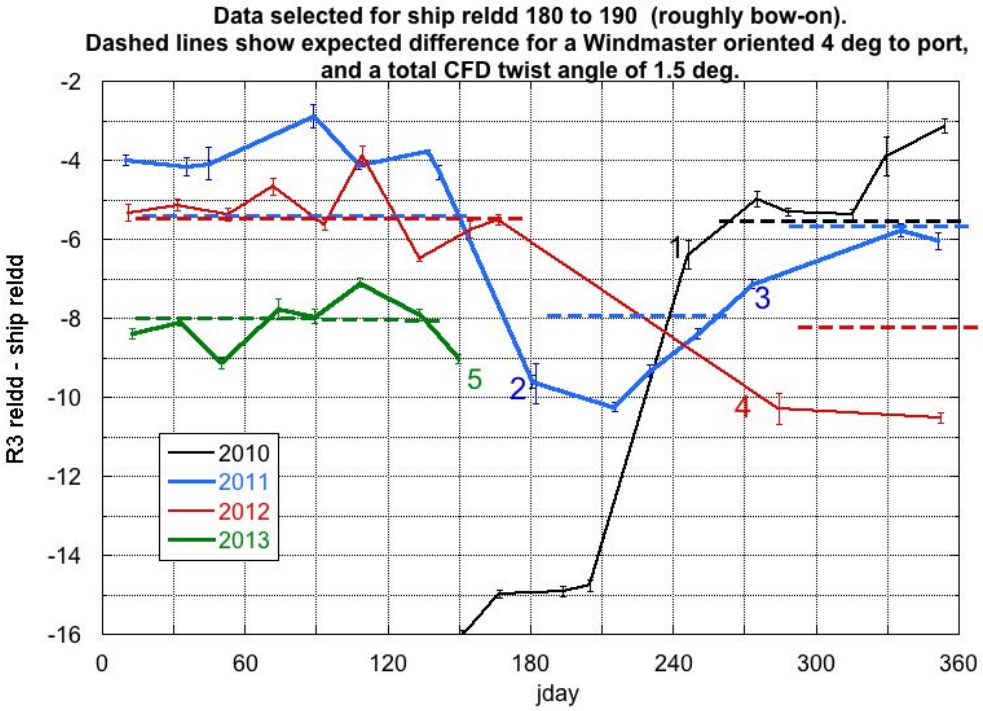


Figure 8. Relative wind direction from the R3 sonic minus relative wind direction from the ship's anemometer. Data were selected for winds within 5 degrees of bow-on. Dashed lines indicate the expected differences if (a) the ship's sonic was oriented 4 degrees to port (and was not replaced or moved during the period between roughly day 250 2010 and 150 2013) and (b) there was a horizontal "twist" of a bow-on flow (as predicted by the CFD model) of -1.4 degree at the R3 site and +0.1 at the ship's sonic.

Wind directions from the R3 were automatically corrected for an assumed yaw angle of 9 degrees to port. Only three estimates of yaw angle for the ship's sonic were made: the first (10.3 degrees to port) was made during the mobilisation cruise in July 2010; the second (4 degrees to port)

was made after the refit in 2010, i.e. around day 250 2010; and the third in January 2013 when it was estimated to be 2 degrees to port. So if the R3 was actually oriented at 9 degrees (as assumed by the correction applied automatically) and the ship sonic was 2 degrees, then the difference (R3 - ship) relative directions should be -2 degrees. The differences shown in Figure 8 are significantly larger than this, which suggests that the second estimate (4 degrees to port) was the correct one for the period following the refit around day 250 2010. This reduces the discrepancy in Figure 8 to about -2 degrees most of the time: the difference in measured wind directions for bow-on winds is predicted by the CFD model (Moat and Yelland, 2015) to be -1.5 degrees due to the horizontal "twist" of the flow around the superstructure, i.e. the in-situ estimates are in good agreement with the model if the ship sonic was oriented 4 degrees to port from day 250 2010 to day 150 2013.

## 4.2 Summary of yaw offsets:

Dates when the R3/MP pair were replaced, and best estimates of the R3 yaw angle relative to the ship are given below. The best estimate is obtained assuming the lab estimates of R3 and MP relative offsets are correct (Table G), and that the parallax measurements made on the ship were more accurate for the R3 than for the MotionPak (Table H). Figures in brackets include a -1.5 degree horizontal deflection of a now-on flow as shown by the CFD model (Moat and Yelland, 2015).

**Period 0:** beginning **jday 142 2010 (22nd May):** Mobilisation of JCR. Best estimate is that the **R3 was oriented 9 degrees** to port, and MotionPak 1 degree to port. The offset between R3 and ship relative directions should be -10.3 (-11.8) from the estimate of the offset of the ship sonic (just before "1" on Figure 8), whereas the measured offset was about -15 degrees.

**Period 1:** beginning **jday 243 2010 (31st August, marked as "1" on Figure 8):** Best estimate is that **the R3 was oriented 9 degrees to port,** and MotionPak 1 degree to port. Offset between R3 and ship relative directions should be about -4 (-5.5) degrees, assuming the ship sonic was oriented 4 degrees to port.

**Period 2**: beginning **jday 171 2011 (20th June, marked as "2" on Figure 8):** Best estimate is that the **R3 was oriented 6.6 degrees to port**, and MotionPak 1.6 degrees to **starboard**. Offset between R3 and ship relative directions should be about -6.4 (-7.9) degrees, assuming the ship sonic was oriented 4 degrees to port.

**Period** 3: beginning **jday 264 2011 (21st September, marked as "3" on Figure 8):** Best estimate is that the **R3 was oriented 9 degrees to port,** and MotionPak 1 degree to port. Offset between R3 and ship relative directions should be about -4 (-5.5) degrees, assuming the ship sonic was oriented 4 degrees to port.

**Period 4:** beginning **jday 278 2012 (5th October, marked as "4" on Figure 8):** Best estimate is that the **R3 was oriented 6.3 degrees to port**, and MotionPak 1 degree to **starboard**. Offset between R3 and ship relative directions should be about -6.7 (-8.2) degrees, assuming the ship sonic was oriented 4 degrees to port. It was during this period (January 2013) that the yaw offset of the ship's sonic was (possibly erroneously) estimated to be 2 degrees to port.

**Period 5:** beginning **jday 189 2013 (8th July, marked as "5" on Figure 8):** The instruments (both WAGES and ship's) had all been removed at the start of June 2013 since the foremast was going to be shot-blasted and re-painted later that month. When the instruments were put back it was found that the attachment point for the R3 and MotionPak had been twisted towards starboard by the blasting. Best estimate is that the **R3 was oriented 2.2 degrees to port**, and MotionPak 5.1 degrees to **starboard**. The offset between R3 and ship relative directions is not known since the ship anemometer was replaced but the yaw angle was not measured. (Data from this period are not included in Figure 8).

It can be seen from the above that the parallax measurements would indicate that the R3 was oriented roughly 9 degrees to port during periods 1 and 3 (day 243 2010 to day 171 2011, and 264 2011 to 278 2012). Assuming the ship sonic was oriented about 4 degrees to port, this suggests an expected R3-ship difference of -4 degrees, in reasonable agreement with the actual difference of roughly -5 degrees shown in Figure 8 for these periods. Similarly, parallax measurements for periods 2 and 4 (171 2011 to 264 2011, and 278 2012 to about day 155 2013) indicate that the R3 was oriented about 6.5 degrees to port, which would suggest a difference of -6.5 degrees in Figure 8 whereas the actual difference was roughly -9 degrees. Allowing for the additional -1.5 degree offset predicted by the CFD model for a bow-on flow, the agreement is very good since the specified RMS accuracies of wind direction from the R3 and ship's sonic are 1 degree and 2 degrees respectively.

Since the R3 and MotionPak orientations were measured repeatedly, were consistent, and also usually agreed with the lab measurement to within about 0.5 degrees (biggest discrepancy was 1.1 degree, Table H) we can assume that those measurements were usually good to 1 degree or better.

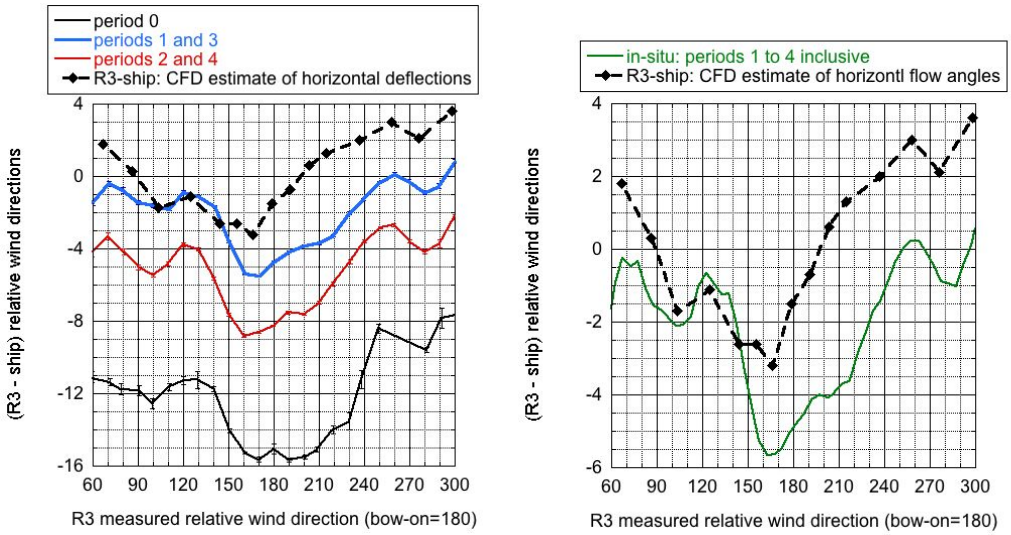


Figure 9. Difference (R3-ship) in measured relative wind directions. a) left: split into three distinct periods. b) periods 1 to 4 inclusive, after correcting the R3 data for the 2.5 degree offset from the nominal "9 degrees to port" orientation during periods 2 and4. The difference predicted by the CFD modeling is also shown (dashed line) after allowing for the modeled "twist" of the flow. Note change of y-axis scaling.

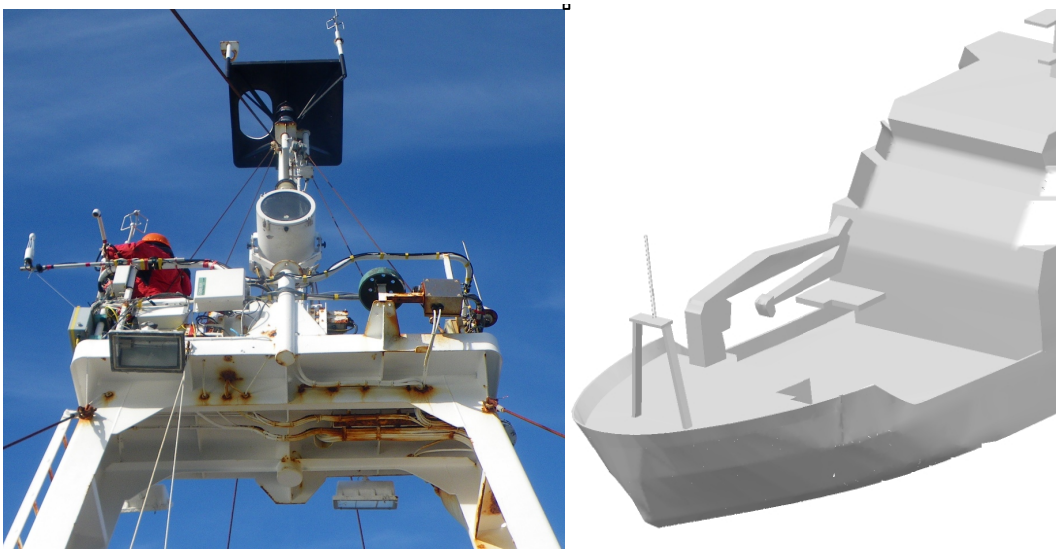

Figure 10. (a) Left - photograph of the foremast platform from below. The R3 can be seen on the left (starboard in ship frame) above the person in orange. The large searchlight is on the centerline of the platform, projecting forwards. The ship's anemometer is located 0.61m to port of the ship's centerline, on the "bird table" at the top of the mast extension. (b) Right - part of the ship geometry used in the CFD modeling of the air flow over the JCR.

Figure 9 shows the difference (R3-ship) relative wind directions, plotted against wind direction from the R3. The left hand plot shows the in-situ data, split into the different periods: period 0 when the R3 was at its nominal orientation of 9 degrees but the ship sonic was angled more than 10 degrees to port; periods 1 and 3 when the R3 orientation was roughly 9 degrees to port and the ship's sonic was 4 degrees to port; and periods 2 and 4 when the R3 orientation was about 6.5 degrees to port and the ship's sonic was still 4 degrees to port. Period 5 is not shown. The right hand plot shows data after correcting the R3 sonic for its offset from the nominal 9 degrees to port orientation. It can be seen that for bow-on flows, the difference between the CFD prediction of -1.5 degrees and the

measured difference of -5.0 degrees are in complete agreement if the ship's sonic was oriented 4 degrees to port. It also shows that the CFD estimates for winds to starboard of the bow follow the trend in the in-situ estimates very closely, even reproducing the dip for wind directions of about 280 degrees. This gives good confidence in the CFD estimates of the mean flow. For winds over the port side the agreement is less good, due to the simplifications of the CFD model geometry, since the model could not include small-scale local obstructions: Figure 10a shows a view of the foremast taken from below: various boxes housing sensor electronics and a large searchlight can be seen. Figure 10b shows the model geometry which does not include sensors electronics, or the searchlight, or the "bird table" platform on top of the foremast extension. Since the agreement for starboard side wind directions is very good, this suggests that the flow distortion for starboard winds is caused by the large-scale obstruction of the ship's hull and superstructure only.

## 4.3 Fore/aft and port/starboard alignments.

Tables C and D show the tilts of the various foremast sensors as measured using a hand-held electronic inclinometer during port calls. The inclinometer has an accuracy of about 0.1 degree but an offset of 0.1 can be caused if the feet of the inclinometer are not correctly placed. Much larger errors are introduced by changes in the trim of the ship: since the measurements were taken in port the trim of the ship could change while the measurements were being made due to stores and fuel etc. being loaded. To check on any changes in the trim of the ship measurements of the tilt angles of one instrument, e.g. the R3, were taken at the start and again at the end. Differences in this repeat measurement should show if the trim has changed (see table D for 21st September 2011 for an example of repeat measurement). Photographs of the foremast taken at sea show that the R3 was probably leaning about 1.5 degrees to port, but no verification could be made of any fore/aft tilt.

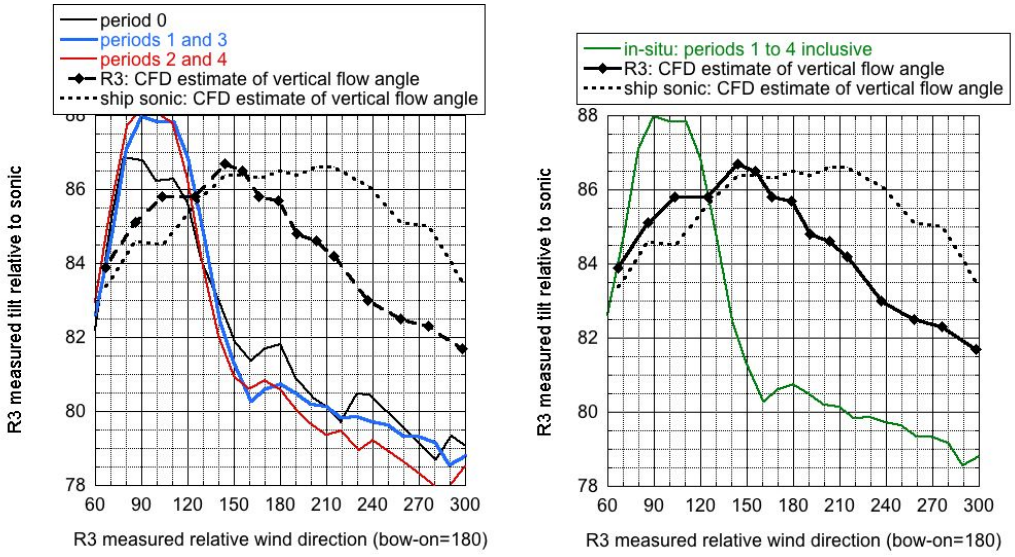


Figure 11. Measured "tilt" angles from the R3 (solid lines) and the vertical deflection of the airflow from CFD modeling (dashed for R3, dotted for ship sonic).

Figure 11 shows the tilt as measured by the R3 sonic anemometer. This tilt is a combination of the actual tilt of the instrument relative to the ship, the mean pitch/heel angle of the ship while at sea, and the deflection of the mean airflow from the horizontal by the presence of the ship disturbing the air flow to the sensor. The ship's sonic only output speed and direction relative to the sensor, so no tilt estimate was available. Also shown are the estimates of mean airflow deflection from the horizontal from CFD modeling of the flow around the ship (Moat and Yelland 2015). The CFD "tilt" for the R3 increases by about 4 degrees as the wind direction moves from bow-on round to the starboard beam. A similar trend is seen in the in-situ data and, to a lesser extent, the CFD prediction for the ship's sonic. For winds on the beam, data from the MotionPak show that the ship had a mean heel (starboard side-up) of up to 2 degrees, and visual estimates suggest that the R3 leans to port by about 1.5 degrees: in combination these explain the difference between the CFD and R3 tilts for winds from the starboard beam. However, the offset between the model and measured tilts is larger for bow-on flows. The fore/aft tilts measured using an inclinometer while the ship is in port were 1 degree or less, and the fore-aft trim of the ship only changes by about 1 degree at most, meaning that a difference of 3 degrees in tilt for bow-on winds is unexplained. Since (i) the ship's sonic was

replaced at the end of period 0, but period 0 gives similar results to the later periods, (ii) the R3 anemometers were regularly recalibrated and replaced, and the same results are obtained for periods 1 and 3 (R3 serial number 391) as for periods 2 and 4 (R3 serial number 227), then biases in the anemometer data are unlikely to be the cause of the discrepancy. Instead, the underestimate of the modeled flow angle is most probably due to the lack of small-scale obstructions in the model.

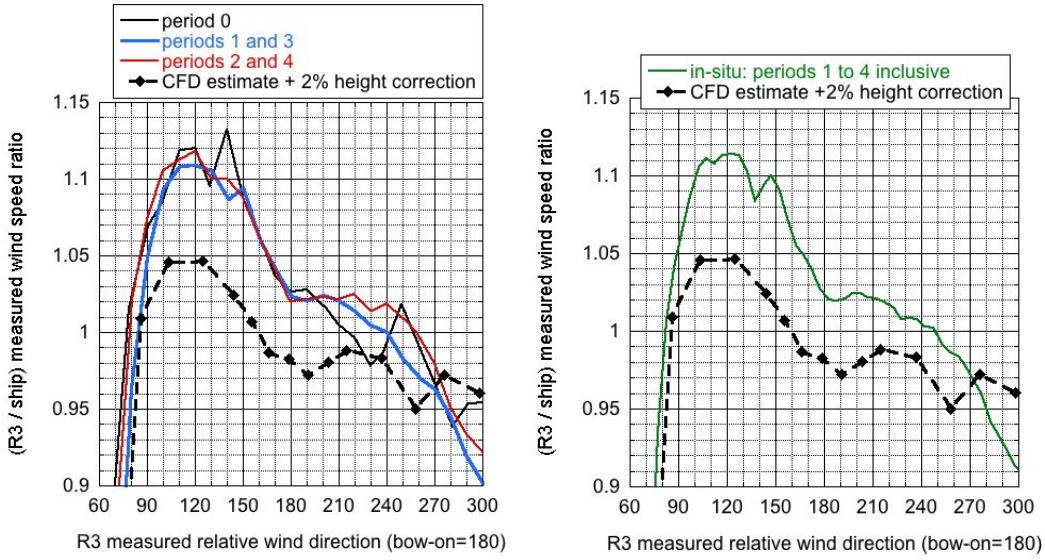


Figure 12. Ratio of measured wind speeds (R3 / ship sonic) (solid lines) and the ratio predicted from the CFD model with a correction for the difference in height of the two sensors (dashed).

Figure 12 shows the ratio of the measured relative wind speed (R3/ship sonic) along with the expected ratio using the results from the CFD model. The RMS wind speed errors for the R3 and ship's sonics are 1.0 and 1.5% respectively. The results from the model have been adjusted to allow for the different heights of the two anemometers, i.e. undisturbed flow to the ship sonic should be about 2% faster than that to the R3. However, it can be seen that the in-situ measurements from the R3 are 3% faster than those from the ship's sonic for bow-on winds, i.e. there is a discrepancy between the in-situ data and the model results of about 5% for this wind direction. The magnitude of the discrepancy decreases to zero as the wind direction moves on to the starboard beam. The relative wind speed used here from the R3 is calculated using all three axes whereas the ship's sonic is configured to output horizontal wind speed only, so the wind speed from the ship's sensor will be underestimated slightly when the anemometer is not vertical relative to the mean wind. However, this underestimate would be very small, less than 1% for flow angles of 8 degree or less. Since (a) data from all periods show a similar discrepancy, despite various changes to the anemometers, (b) the ship's sonic was very well exposed for all wind directions forward of the beam, and the flow to it was not obstructed by small scale obstacles, (c) the R3 anemometer was regularly re-calibrated and replaced, it is assumed that the discrepancy between the model and the in-situ results must be due to small scale local obstructions to the flow to the R3 anemometer which were not included in the CFD model. **The conclusion is therefore that the CFD estimate of the acceleration of the flow to the R3 is underestimated, by up to 5% for bow-on winds directions, with the underestimate decreasing to zero as the wind directions moves round to the starboard beam**. There is evidence (not shown) that this acceleration of the flow is greater when the ship is steaming than when it is on station: this is currently being investigated further.

For wind directions of more than 20 degrees to port of bow-on, the presence of the foremast extension, the large searchlight and other obstructions mean that the CFD model results can not be used to provide a useful estimate of the distortion of the air flow to the R3 anemometer. It is recommended that data are selected for relative wind directions between 160 and 300 degrees when calculating fluxes, and that data obtained when the wind direction was further to port (less than 160 degrees) should not be used.

## 5. Selection of the best temperature sensor

As briefly described in Section 2.2, the ship was instrumented with a NOC aspirated psychrometer and a Vaisala air temperature and humidity senor, both located above the bridge. The

ship also carries a pair of Rontronic air temperature and humidity sensors on the "bird table" on top of the foremast extension (Section 2.3). The NOC psychrometer should produce the best air temperature and humidity data but the siting of the sensor caused significant problems. As mentioned in Section 2.2, a comparison of the data between the various sensors showed that the psychrometer data occasionally showed a clear daytime bias of up to 4 degrees relative to data from the ship sensors and also to the sonic temperature measurement. It was thought that this is due to (a) the small "hat" providing insufficient shading from solar radiation and/or (b) heating from the deck beneath. Since the psychrometer and Vaisala were located on the port side, air flowing from starboard passed across the monkey island before reaching the sensor and would be heated by the warm deck in sunny conditions. Figure 13 shows a time series of air temperatures for a few days in 2010. It can be seen that both the psychrometer and Vaisala air temperatures air biased high when solar radiation is high, particularly so when the wind is from starboard. This suggests that heating by the deck was the major cause of the bias.

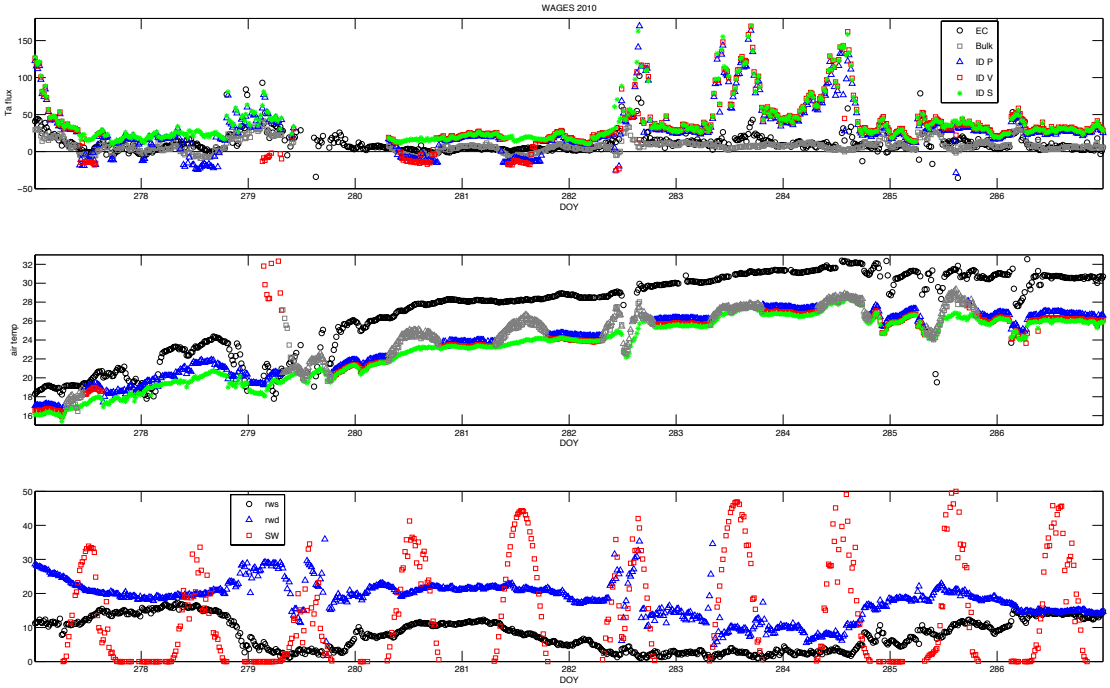


Figure 13. An example time series from 2010. The middle panel shows air temperature measurements, with the psychrometer (blue) and vaisala (red) showing a clear diurnal bias relative to the ship (green) and sonic (black, measuring 'sonic' temperature). Measurements flagged as biased by diurnal heating and so replaced by (corrected) ship measurements are coloured grey. The top panel shows sensible heat flux estimated from the various sensors using eddy covariance (EC), inertial dissipation (ID) or bulk methods (Smith, 1988, using air temperature from the psychrometer). Bottom panel shows relative wind speeds, directions (/10) and short wave insolation (/20).

In terms of instrument accuracy (neglecting external sources of bias such as the heating problem), the preferred temperature and humidity measurement would be from the psychrometer. If this instrument was not functioning (e.g. the water reservoir had dried out of frozen) then the next choice was the Vaisala and finally the ships temperature sensor. Unfortunately the Vaisala was found to be erratic when compared to the other two sensors and was not used in the automated inertial dissipation flux processing.

In practice the preferred air temperature and humidity instrument should be selected based on the following criteria. If the psychrometer temperature was missing or judged to be bad, then the ship's sensor 2 should be used. To avoid the diurnal heating bias the psychrometer data were deemed bad if:

1) the latitude was **less** than 66 degrees (North or South) **and** the short wave radiation is greater than **10** W/m$^2$ **then if** the relative wind speed was less than 12 m/s **or** the relative wind direction was from astern of the beam (relative wind direction < 90 or > 270 degrees, when a flow over the bow is defined as 180 degrees). **USE** the **corrected** ship's sensor

2) the latitude was **greater** than 66 degrees (North or South) **and** the short wave radiation is greater than **50** W/m$^2$ **then if** the relative wind speed was less than 12 m/s **or** the relative wind direction was from astern of the beam (relative wind direction < 90 or > 270 degrees, when a flow over the bow is defined as 180 degrees). **USE** the **corrected** ship's sensor

3) Additionally, periods when the psychrometer relative humidity was greater than 98% (or less than 0%) were removed since the water reservoir was likely to be dry or frozen, or the wick had stopped wicking water from the reservoir to the wet bulb.

The ship's sensors were left in place for long periods and their accuracy was not known. During WAGES, the ship's temperature sensor was changed to a new sensor on the 21st July 2011 (jday 202) and again prior to the ACCACIA Arctic campaign in 2013 (around jday 180). To allow for the different calibrations of the new sensors, separate corrections were determined for each. Data from the ship's sensor were compared to data from the psychrometer **excluding the periods known to be bad (as detailed above).** The two sensors were at different heights (psychrometer 18.7 m, ship's sensor 20 m) and an estimated correction for this was first applied using the dry adiabatic lapse rate. Outliers (differences greater than 4 deg, maybe 1% of the values) were removed prior to determining the offset:

ship_temp_corrected = ship_temp + adjustment

| Period (inclusive) | adjustment to ship temperature 2 (degrees) |
|---|---|
| 2010, day 147 - 2010, day 239 | NO psychrometer or Vaisala installed |
| 2010, day 239 – 2011, day 201 | 0.95 |
| 2011, day 202 – 2013, day 179 | -0.06 |
| 2013, day 180 – end WAGES | -0.1 |

For completeness, a similar procedure was followed for ship's air temperature from sensor 1. This sensor needed and adjustment of -0.1 degrees throughout the campaign except for the periods when it was either not working (jday 147 in 2010 to jday 201 in 2011) or the data were bad (from roughly day 100 in 2013 onwards).

Visual inspection of the time series of the fluxes identified additional periods when air temperature and humidity data from the ship's sensor2 should be used rather than the psychrometer (Table J). Similarly, the ship's temperature sensor should not be used 2011 between jday 081 to jday 095 and again 2011 between jday 196 and jday 202.

## 6. Summary

This report describes the metadata for the WAGES instrumentation deployed on the RRS *James Clark Ross* between May 2010 and August 2013. Sensor serial numbers, dates of sensor changes and problems with sensors are contained in the associated tables.

## Acknowledgemnts

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Yelland, M. J., Pascal, R. W., Taylor, P. K. and Moat, B. I., 2009: AutoFlux: an autonomous system for the direct measurement of the air-sea fluxes of CO2, heat and momentum. *Journal of Operational Oceanography*, **2**(1), 15-23.

Yelland and Pascal, 2011: RRS James Clark Ross Cruises 254A, Southampton, UK, National Oceanography Centre Southampton. (National Oceanography Centre Southampton Cruise Report *in prep*).

## TABLES A Fast response sensors: Instrument serial numbers and sensor changes

### A.1 Sonic anemometer and MotionPak

| year | sensor | location | Old serial number | New serial number | jday | month | day | Motion Pack | comment |
|---|---|---|---|---|---|---|---|---|---|
| 2010 | sonic | foremast | - | 227 | 142 | May | 22 | 682 | Mobilisation: Vigo Spain |
| 2010 | sonic | foremast | 227 | 391 | 236 | August | 24 | 791 | Mobilisation: Frederikshaven |
| 2011 | sonic | foremast | 391 | removed | 144 | May | 24 | 791 | Sensors removed in Portland before refit in Portsmouth. SIU swapped (see SIU pulldown) |
| 2011 | sonic | foremast | | 227 | 173 | June | 22 | 682 | Refit in Portsmouth |
| 2011 | sonic | foremast | 227 | 391 | 263 | September | 20 | 682 | Immingham |
| 2012 | sonic | foremast | removed | removed | 249 | September | 5 | 791 (installed December 26th 2011) | Removed for refit |
| 2012 | sonic | foremast | - | 227 | 277 | October | 3 | 791 | Immingham |
| 2013 | sonic | foremast | 227 | removed | 158 | June | 7 | 791 | Removed for refit Ascension |
| 2013 | sonic | foremast | - | 227 | 190 | July | 9 | 791 | Immingham |
| 2013 | sonic | foremast | 227 | Removed | 268 | September | 25 | 791 | System removed Immingham |

### A.2 Licor 1 (Forward of the foremast)

| year | sensor | location | Old serial number | New serial number | jday | month | day | Sensor calibration | comment |
|---|---|---|---|---|---|---|---|---|---|
| 2010 | licor1 | forward | - | 1114 | 142 | May | 22 | Appendix C | Mobilisation: Vigo Spain |
| 2010 | licor1 | forward | 1114 | 1114 | 236 | August | 24 | | Mobilisation: Frederikshaven |
| 2011 | licor1 | forward | 1114 | removed | 144 | May | 24 | | Sensors removed in Portland before refit in Portsmouth |
| 2011 | licor1 | forward | - | 0614 | 171 | June | 20 | Appendix C | During refit in Portsmouth |
| 2011 | licor1 | forward | 0614 | 1113 | 264 | September | 21 | Appendix C | Immingham |
| 2011 | licor1 | forward | 1113 | removed | 329 | November | 25 | Appendix C | Removed Falkland Islands to make space for Licor 7200 |

## A.3 Licor 2 (starboard of the foremast)

| year | sensor | location | Old serial number | New serial number | jday | month | day | Sensor calibration | comment |
|---|---|---|---|---|---|---|---|---|---|
| 2010 | licor2 | starboard | - | 1113 | 142 | May | 22 | Appendix C | Mobilisation: Vigo Spain |
| 2010 | licor2 | starboard | 1113 | 1113 | 236 | August | 24 | | Mobiisation: Frederikshaven |
| 2011 | licor2 | starboard | 1113 | removed | 144 | May | 24 | | sensors removed in Portland before refit in Portsmouth |
| 2011 | licor2 | starboard | - | 0825 | 171 | June | 20 | Appendix C | During refit in Portsmouth |
| 2011 | licor2 | starboard | 0825 | 1114 | 264 | September | 21 | Appendix C | Immingham |
| 2012 | licor2 | starboard | Removed | removed | 249 | September | 5 | Appendix C | Removed for refit |
| 2012 | licor2 | starboard | - | 0614 | 277 | October | 3 | Appendix C | Immingham |
| 2013 | licor2 | starboard | 0614 | 0614 | 120 | April | 30 | Appendix C | Sensor cleaned |
| 2013 | licor2 | starboard | 0614 | 0825 | 190 | July | 9 | Appendix C | Immingham |
| 2013 | licor2 | starboard | 0825 | Removed | 268 | September | 25 | Appendix C | System removed Immingham |

## A.4 LicorN (Li-7200)

| year | sensor | location | Old serial number | New serial number | jday | month | day | Sensor calibration | comment |
|---|---|---|---|---|---|---|---|---|---|
| 2011 | licorN | below sonic | - | Head: 0274<br>Interface: 0538 | 331 | November | 27 | Appendix C | Installed |
| 2012 | licorN | below sonic | Head: 0274<br>Interface: 0538 | Head: 0309<br>Interface: 0593 | 85 | March | 25 | Appendix C | |
| 2012 | licorN | below sonic | Head removed | Head removed | 249 | September | 5 | Appendix C | Head removed for refit |
| 2012 | licorN | below sonic | - | Head: 0309<br>Interface: 0593 | 277 | October | 3 | Appendix C | |
| 2013 | licorN | below sonic | Head: 0309<br>Interface: 0593 | Head: 0274<br>Interface: ? | 120 | April | 30 | Appendix C | |
| 2013 | licorN | below sonic | Head: 0274<br>Interface: ? | Head: 0387<br>Interface: 0831 | 190 | July | 9 | Appendix C | Immingham |
| 2013 | licorN | below sonic | Head: 0387<br>Interface: 0831 | removed | 268 | September | 25 | Appendix C | System removed |

## A.5 CLASP

| year | sensor | location | Old serial number | New serial number | jday | month | day | Sensor calibration | comment |
|---|---|---|---|---|---|---|---|---|---|
| 2010 | clasp | foremast | installed | H | 270 | September | 27 | | |
| 2010 | clasp | foremast | H | I | 346 | December | 12 | | |
| 2011 | clasp | foremast | I | K | 077 | March | 18 | | |
| 2011 | clasp | foremast | K | removed | 144 | May | 24 | | sensors removed in Portland before refit in Portsmouth |
| 2011 | clasp | foremast | - | G | 171 | June | 20 | | During refit in Portsmouth |
| 2011 | clasp | foremast | G | L | 264 | September | 21 | | Immingham |
| 2011 | clasp | foremast | L | I | 330 | November | 26 | - | Stanley, Falkland Islands |
| 2012 | clasp | foremast | I | F | 085 | March | 25 | - | |
| 2012 | clasp | foremast | F | I | 117 | April | 26 | - | |
| 2012 | clasp | foremast | Removed | Removed | 249 | September | 5 | - | Removed for refit |
| 2012 | clasp | foremast | I | L | 277 | October | 3 | - | |
| 2013 | clasp | foremast | L | G | 2 | January | 2 | - | |
| 2013 | clasp | foremast | G | F | 120 | April | 4 | - | |
| 2013 | clasp | foremast | F | O | 145 | May | 25 | - | |
| 2013 | clasp | foremast | O | Removed | 158 | June | 7 | - | Clasp removed from system |

# TABLES B Mean met systems: Instrument serial numbers and sensor changes

## B.1 Psychrometer

| year | sensor | location | Old serial number | New serial number | jday | month | day | New sensor calibration | comment |
|---|---|---|---|---|---|---|---|---|---|
| 2010 | psychrometer | bridge top | - | 1028 | 236 | August | 24 | DRY: -1.225153e+1, 3.910999e-2, 5.411647E-7, 4.485326E-10, 0 WET: -1.037088e+1 ,3.914122E-2, 1.250447e-6, 2.783538e-10, 0 | Mobilisation: Frederikshavn |
| 2011 | psychrometer | bridge top | 1028 | removed | 144 | May | 24 | - | Sensors removed in Portland before refit in Portsmouth |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2011 | psychrometer | bridge top | - | 1028 | 174 | June | 23 | DRY: -1.266876e+1, 4.072815e-2, -1.396824E-6, 1.182991E-9, 0 WET: -1.097948e+1 ,4.159742E-2, -1.909793e-6, 1.552030e-9, 0 | Refit in Portsmouth |
| 2012 | psychrometer | bridge top | 1028 unchanged | 1028 unchanged | 278 | October | 4 | DRY: -1.266876e+1, 4.072815e-2, -1.396824E-6, 1.182991E-9, 0 WET: -1.097948e+1 ,4.159742E-2, -1.909793e-6, 1.552030e-9, 0 | Immingham: replaced fan and wick |
| 2013 | psychrometer | bridge top | Removed | Removed | 158 | June | 7 | | Removed for refit in Acension |
| 2013 | psychrometer | bridge top | - | 1028 | 190 | July | 9 | DRY: -1.266876e+1, 4.072815e-2, -1.396824E-6, 1.182991E-9, 0 WET: -1.097948e+1 ,4.159742E-2, -1.909793e-6, 1.552030e-9, 0 | Immingham |
| 2013 | psychrometer | bridge top | 1028 | Removed | 268 | September | 25 | DRY: -1.266876e+1, 4.072815e-2, -1.396824E-6, 1.182991E-9, 0 WET: -1.097948e+1 ,4.159742E-2, -1.909793e-6, 1.552030e-9, 0 | System removed in Immingham |

## B.2 Vaisala air temperature and Humidity

| year | sensor | location | Old serial number | New serial number | jday | month | day | New sensor calibration | comment |
|---|---|---|---|---|---|---|---|---|---|
| 2010 | vaisala | bridge top | - | 4440006 | 236 | August | 24 | AIR:-40,0.1,0,0,0 RH:0,0.1,0,0,0 | Mobilisation: Frederikshavn |
| 2011 | vaisala | bridge top | 4440006 | removed | 144 | May | 24 | - | Sensors removed in Portland before refit in Portsmouth |
| 2011 | vaisala | bridge top | - | F4340001 | 174 | June | 23 | AIR:-40,0.1,0,0,0 RH:0,0.1,0,0,0 | New style sensor (HMP155). Refit in Portsmouth |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2011 | vaisala | bridge top | F4340001 | BROWN | 264 | September | 21 | AIR:-40,0.1,0,0,0 RH:0,0.1,0,0,0 | Immingham |
| 2011 | vaisala | bridge top | BROWN | F4340001 | 342 | December | 8 | AIR:-40,0.1,0,0,0 RH:0,0.1,0,0,0 | Rothera |
| 2013 | vaisala | bridge top | F4340001 | 45200031 | 117 | April | 26 | AIR:-40,0.1,0,0,0 RH:0,0.1,0,0,0 | Immingham |
| 2013 | vaisala | bridge top | 45200031 | 0710006 | 121 | May | 1 | AIR:-40,0.1,0,0,0 RH:0,0.1,0,0,0 | |
| 2013 | vaisala | bridge top | 0710006 | removed | 268 | September | 25 | AIR:-40,0.1,0,0,0 RH:0,0.1,0,0,0 | System removed in Immingham |

## B.3 Long wave sensors

| year | sensor | location | Old serial number | New serial number | jday | month | day | New sensor calibration | comment |
|---|---|---|---|---|---|---|---|---|---|
| 2010 | LW | bridge top | - | 31171 | 236 | August | 24 | E1:0,1,0,0,0 Td1:0,1,0,0,0 Ts1:0,1,0,0,0 | Mobilisation: Frederikshavn |
| 2011 | LW | bridge top | - | 31171 | 173 | June | 22 | E1:0,1,0,0,0 Td1:0,1,0,0,0 Ts1:0,1,0,0,0 | refit in Portsmouth |
| 2013 | LW | bridge top | 31171 | removed | 268 | September | 25 | - | System removed in Immingham |

## B.4 Short wave sensors

| year | sensor | location | Old Serial number | New serial number | jday | month | day | New sensor calibration | comment |
|---|---|---|---|---|---|---|---|---|---|
| 2010 | TIR | bridge top | | 902837 | 236 | August | 24 | 0,0.22173,0,0,0 | Mobilisation: Frederikshavn |
| 2011 | TIR | bridge top | 902837 | removed | 144 | May | 24 | | sensors removed in Portland before refit in Portsmouth |
| 2011 | TIR | bridge top | - | 902837 | 173 | June | 22 | 0,0.22173,0,0,0 | refit in Portsmouth |
| 2013 | TIR | bridge top | 902837 | removed | 268 | September | 25 | - | System removed in Immingham |

## B.5 MicroTSG

| year | sensor | location | Old serial number | New serial number | jday | month | day | New sensor calibration | comment |
|---|---|---|---|---|---|---|---|---|---|
| 2010 | TSG | cross alley | | SN072 | 144 | May | 24 | | AutoFLux installed |
| 2010 | TSG | cross alley | SN072 | SN016 | 168 | june | 17 | | TSG reading 1 PSU high.TSG replaced |
| 2011 | TSG | cross alley | SN016 | SN130 | 329 | November | 25 | | SN00130 was calibrated June 2010 |
| 2013 | TSG | cross alley | SN130 | SN018 | 078 | March | 19 | | |

## B.6 Bridge Camera systems (mx and mxb)

| year | sensor | location | jday | month | day | comment |
|---|---|---|---|---|---|---|
| 2010 | Camera (mx) | bridge | 158 | June | 7 | camera installed.sampling every 5 minutes |
| 2010 | Camera (mx) | bridge | 349 | December | 15 | 1 minute sampling |
| 2011 | Camera (mx) | bridge | 264 | September | 21 | sampling changed from every minute to every 15 seconds. |
| 2012 | Camera (mxb) | bridge | 277 | October | 3 | Second camera (mxb) installed. Sampling set to the same as the mx camera (every 15 seconds). |
| 2013 | Camera (mxb) | bridge | 158 | June | 7 | Camera (mxb) removed. |
| 2013 | Camera (mx) | bridge | 228 | August | 16 | Camera (mx) removed. |

## B.7 WAVEX serial output parameters

| WAVEX | comment |
|---|---|
| Hm0 | Hs = Hm0 = significant wave height |
| Tm01 | Tm02=(m0/m2)**0.5=zero-upcrossing. Tm01 = Te =period of peak energy |
| Tp1 | Tp1 = Primary wave peak period |
| Dp1-t | Dp1-t = primary wave peak direction |
| m4 (4dec. p.) | $SPRI_t$ = total energy directional spread |
| m1 (4dec. p.) | Tp2 = secondary wave peak period |
| m2 (4dec. p.) | Dp2-t = secondary wave peak direction |
| Dpt-t | Dpt-t = total energy peak direction |

## B.8 WAVEX system

| year | sensor | location | jday | month | day | comment |
|---|---|---|---|---|---|---|
| 2010 | wavex | main mast | 257 | September | 14 | Version 4.2 |
| 2011 | wavex | main mast | 174 | June | 23 | Antenna removed and platform altered. NOTE: Antenna was put back with the bow mark facing the stern. |
| 2011 | wavex | main mast | 263 | September | 20 | Antenna orientation corrected |
| 2012 | wavex | main mast | 264 | September | 20 | New PC installed with Oil spill detection software. Software upgraded to version 5.1<br>*** the time stamp on the files was fast by one hour compared to GMT. This was changed back to GMT on 3rd May 2013 *** |
| 2013 | Wavex | Main mast | 268 | September | 25 | Software upgraded to version 5.3 |

## B.9 BAS Air temperature and Humidity sensors

| year | sensor | location | Old serial number | New serial number | jday | month | day | New sensor calibration | comment |
|---|---|---|---|---|---|---|---|---|---|
| 2010 | Rotronic1 | Bird table | 43124014<br>model: MP103A | - | 144 | May | 24 | | Sensor failed. No air temp or humidity. |
| 2011 | Rotronic1 | Bird table | 43124014<br>model: MP103A | 0119462370<br>model: HC2-S3 | 202 | July | 21 | | |
| 2010-2013 | Gill Windmaster | Bird table | no info | no info | | | | | replaced late summer 2010. Moved July 2013. |

## Table C Instrument tilts by instrument

### C.1 LICOR1 forward

numbers/names in brackets indicate more than one measurement made during a port call.

| year | JDAY | day | month | fore/aft (degrees) | port/starboard (degrees) | measurement point |
|---|---|---|---|---|---|---|
| 2010 | 146 | 26 | May | leaning aft 2.0 | leaning to port 2.0 | instrument |
| 2010 | 243 | 31 | August | leaning aft 2.0 | leaning to port 6.0 | instrument |
| 2011 | 171 | 20 | June | leaning forwards 5.8 | leaning to port 17.4 | instrument |
| 2011 | 263 | 20 | September | leaning aft 1.9 | leaning to port 17.8 | instrument |
| 2011 | 264 | 21 | September | leaning forwards 3.8 | leaning to port 17.2 | instrument |

### C.2 LICOR2 starboard

numbers/names in brackets indicate more than one measurement made during a port call.

| year | JDAY | day | month | fore/aft (degrees) | port/starboard (degrees) | measurement point |
|---|---|---|---|---|---|---|
| 2010 | 146 | 26 | May | leaning 0.0 | leaning 0.0 | instrument |
| 2010 | 243 | 31 | August | leaning aft 4.0 | leaning to stbd 3.0 | instrument |
| 2011 | 171 | 20 | June | leaning forwards 4.6 | leaning to stbd 3.0 | instrument |
| 2011 | 263 | 20 | September | leaning aft 5.6 | leaning to stbd 2.1 | instrument |
| 2011 | 264 | 21 | September | leaning forward 6.8 | leaning to stbd 4.3 | instrument |
| 2011 | 358 | 24 | December | leaning forwards 7.0 | leaning to stb 5.0 | instrument |
| 2013 | 121 | 1 | May | leaning aft 0.4 | leaning to stb 3.0 | instrument |
| 2013 | 189 | 8 | July | leaning forward 1.5 | leaning to stb 3.5 | instrument |

### C.3 LicorN

numbers/names in brackets indicate more than one measurement made during a port call.

| year | JDAY | day | month | fore/aft (degrees) | port/starboard (degrees) | measurement point |
|---|---|---|---|---|---|---|
| 2011 | 358(1) | 24 | December | leaning forwards 1.0 | leaning to stbd 2.7 | instrument |
| 2011 | 358(1) | 24 | December | leaning forwards 1.0 | leaning to stbd 5.0 | instrument |
| 2013 | 004 | 4 | January | leaning forwards 2.4 | leaning to stbd 2.5 | instrument |
| 2013 | 121 | 1 | May | leaning aft 1.4 | leaning to stbd 1.8 | instrument |
| 2013 | 189 | 8 | July | leaning forwards 0.9 | leaning to stbd 1.1 | instrument |

### C.4 R3 sonic

numbers/names in brackets indicate more than one measurement made during a port call.

| year | JDAY | day | month | fore/aft (degrees) | port/starboard (degrees) | yaw (degrees) | measurement point | F/A R3-motion pack | P/S R3-motion pack |
|---|---|---|---|---|---|---|---|---|---|
| 2010 | 145 | 25 | May | leaning aft 1.0 | leaning to stbd 1.0 | | instrument | 0.0 | 0.0 |
| 2010 | 146 | 26 | May | leaning forward 0.3 | leaning to stbd 0.2 | | instrument | 0.3 | 0.2 |
| 2010 | 158 | 07 | June | leaning forward 0.4 | leaning to stbd 0.1 | port 9,1 | instrument | 0.3 | 0.1 |
| 2010 | 160 | 09 | June | leaning aft 0.8 | leaning to stbd 1.1 | | junction box | | |
| 2010 | 160 | 09 | June | leaning aft 0.2 | leaning to stbd 2.4 | | instrument | -0.2 | 0.1 |
| 2010 | 160 | 09 | June | leaning aft 0.8 | leaning to stbd 1.1 | | junction box | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2010 | 243(1) | 31 | August | leaning aft 0.4 | leaning to port 0.4 | | junction box | | |
| 2010 | 243(1) | 31 | August | leaning aft 0.7 | leaning to port 0.4 | | instrument | 0.0 | 0.2 |
| 2010 | 243(1) | 31 | August | leaning aft 0.4 | leaning to port 0.4 | | junction box | | |
| 2010 | 243(2) | 31 | August | leaning aft 0.3 | leaning to stbd 0.3 | | junction box | | |
| 2010 | 243(2) | 31 | August | leaning aft 0.2 | leaning to stbd 0.2 | port 9,5 | instrument | 0.0 | -0.1 |
| 2010 | 243(2) | 31 | August | leaning aft 0.3 | leaning to stbd 0.3 | | junction box | | |
| 2011 | 171 | 20 | June | leaning aft 0.4 | leaning to stbd 2.1 | | pole | | |
| 2011 | 171 | 20 | June | leaning aft 0.1 | leaning to port 1.8 | port 6.6 | instrument | -0.5 | 0.0 |
| 2011 | 171 | 20 | June | leaning aft 0.4 | leaning to stbd 1.4 | | pole | | |
| 2011 | 263 | 20 | September | leaning aft 0.6 | leaning to port 0.3 | | pole | | |
| 2011 | 263 | 20 | September | leaning aft 0.6 | leaning to port 0.3 | | instrument | -0.3 | -1.4 |
| 2011 | 263 | 20 | September | leaning aft 0.5 | leaning to port 0.3 | | pole | | |
| 2011 | 264 | 21 | September | leaning aft 0.4 | leaning to port 1.6 | | pole | | |
| 2011 | 264 | 21 | September | leaning aft 0.6 | leaning to port 1.4 | port 8.8 | instrument | -0.3 | 0 |
| 2011 | 264 | 21 | September | leaning aft 0.6 | leaning to port 1.5 | | pole | | |
| 011 | 358(1) | 24 | December | leaning aft 0.5 | leaning to port 0.2 | | Silver JB top | | |
| 2011 | 358(1) | 24 | December | leaning aft 0.2 | leaning to port 0.8 | | instrument | | |
| 2011 | 358(1) | 24 | December | leaning aft 0.5 | leaning to port 0.1 | | Silver JB top | | |
| 2011 | 358(2) | 24 | December | leaning aft 0.8 | leaning to stbd 0.2 | | Silver JB top | | |
| 2011 | 358(2) | 24 | December | leaning aft 0.7 | leaning to port 1.0 | port 9.5 | instrument | 0.2 | 0.1 |
| 2011 | 358(2) | 24 | December | leaning aft 0.9 | leaning to stbd 0.2 | | Silver JB top | | |
| 2012 | 278 | 4 | October | - | - | stb 6.7 | | | |
| 2013 | 004(1) | 4 | January | leaning aft 1.0 | leaning to port 1.8 | port 7.0 | | 0.2 | 0.1 |
| 2013 | 004(2) | 4 | January | leaning aft 0.8 | leaning to port 1.8 | port 6.3 | | 0.0 | 0.1 |
| 2013 | 121 | 1 | May | leaning aft 0.0 | leaning to port 1.8 | | | -0.3 | 0.5 |
| 2013 | 189 | 8 | July | leaning aft 0.0(1)<br>leaning fwd 0.3(2) | leaning to port 2.0<br>leaning to port 2.5 | stb2.3<br>stb 1.6 | - | - | - |
| 2013 | 269 | 26 | September | - | - | stb 2.5 | - | - | - |

## C.5 Motion pack

numbers/names in brackets indicate more than one measurement made during a port call.

| year | JDAY | day | month | fore/aft (degrees) | port/starboard (degrees) | yaw (degrees) | measurement point |
|---|---|---|---|---|---|---|---|
| 2010 | 145 | 25 | May | leaning aft 1.0 | leaning to stbd 1.0 | | instrument |
| 2010 | 146 | 26 | May | leaning 0.0 | leaning 0.0 | | instrument |
| 2010 | 158 | 07 | June | leaning forwards 0.1 | leaning 0.0 | port 2 | instrument |
| 2010 | 160 | 09 | June | leaning aft 0.4 | leaning to stbd 2.3 | | instrument |
| 2011 | 171 | 20 | June | leaning aft 0.6 | leaning to port 1.8 | stb 1.7 | instrument |
| 2011 | 243(1) | 31 | August | leaning aft 0.7 | leaning to port 0.2 | | instrument |
| 2011 | 243(2) | 31 | August | leaning aft 0.2 | leaning to stbd 0.3 | port 1.0 | instrument |
| 2011 | 263 | 20 | September | leaning aft 0.9 | leaning to port 1.7 | | instrument |
| 2011 | 264 | 21 | September | leaning aft 0.9 | leaning to port 1.4 | | instrument |
| 2011 | 358(1) | 24 | December | leaning aft 0.6 | leaning to port 1.0 | port 1.0 | instrument |
| 2011 | 358(2) | 24 | December | leaning aft 0.5 | leaning to port 0.9 | port 1.0 | instrument |
| 2012 | 278 | 4 | October | - | - | port 1.0 | instrument |
| 2013 | 004(1) | 4 | January | leaning aft 0.8 | leaning to port 1.7 | 1.1 stb | instrument |
| 2013 | 004(2) | 4 | January | leaning aft 0.8 | leaning to port 1.7 | 0.7 stb | instrument |
| 2013 | 121 | 1 | May | leaning forward 0.3 | leaning to port 1.3 | - | instrument |
| 2013 | 189 | 8 | July | 0.0 | leaning to port 1.7 | port 5.5<br>port 5.1 | Instrument |
| 2013 | 269 | 26 | September | - | - | port 4.8 | instrument |

## Table D Instrument tilts by visit

Numbers/names in brackets indicate more than one measurement made during a port call. Junction box or pole where measured at the start and end of the measurement period to check if the ship had moved significantly.

D.1 2010

### 25th May 2010

| measurement position | fore/aft | port/starboard | Comment |
|---|---|---|---|
| junction box | - | - | not measured |
| R3 | 1.0 aft | 0.2 stb | |
| Yaw R3 | - | | not measured |
| MP top | 1.0 aft | 1.0 stb | |
| Yaw MP | - | - | not measured |
| Licor 1 | - | - | not measured |
| Licor 2 | - | - | not measured |
| Licor N | - | - | not installed |
| junction box | - | - | not measured |

### 26th May 2010

| measurement position | fore/aft | port/starboard | Comment |
|---|---|---|---|
| junction box | - | - | not measured |
| R3 | 0.3 fwd | 0.2 stb | |
| Yaw R3 | - | - | not measured |
| MP top | 0.0 aft | 0.0 stb | |
| Yaw MP | - | - | not measured |
| Licor 1 | 2.0 aft | 2.0 port | |
| Licor 2 | 0.0 | 0.0 | not measured |
| Licor N | - | - | not installed |
| junction box | - | - | not measured |

### 7th June 2010

| measurement position | fore/aft | port/starboard | Comment |
|---|---|---|---|
| junction box | | | not measured |
| R3 | 0.4 fwd | 0.1 stb | |
| Yaw R3 | - | 9.1 port | |
| MP top | 0.1 aft | 0.0 | |
| Yaw MP | - | 2.0 port | |
| Licor 1 | - | - | not measured |
| Licor 2 | - | - | not measured |
| Licor N | - | - | not installed |
| junction box | - | - | not measured |

### 9th June 2010

| measurement position | fore/aft | port/starboard | Comment |
|---|---|---|---|
| junction box | 0.8 aft | 1.1 stb | |
| R3 | 0.2 aft | 2.4 stb | |
| Yaw R3 | - | - | not measured |
| MP top | 0.4 aft | 2.3 stb | |
| Yaw MP | - | - | not measured |
| Licor 1 | - | - | not measured |
| Licor 2 | - | - | not measured |
| Licor N | - | - | not installed |

| | | | |
|---|---|---|---|
| junction box | 0.8 aft | 1.1 stb | |

## 31st August 2010

| measurement position | fore/aft | port/starboard | Comment |
|---|---|---|---|
| junction box | 0.4 aft(1)<br>0.3 aft(2) | 0.4 port(1)<br>0.3 stb(2) | |
| R3 | 0.7 aft(1)<br>0.2 aft(2) | 0.4 port(1)<br>0.2 stb(2) | |
| Yaw R3 | - | 9.5 port | |
| MP top | - | - | not measured |
| Yaw MP | - | - | not measured |
| Licor 1 | 2.0 aft | 6.0 port | |
| Licor 2 | 4.0 aft | 3.0 stb | |
| Licor N | - | - | not installed |
| junction box | 0.4 aft(1)<br>0.3 aft(2) | 0.4 port(1)<br>0.3 stb(2) | |

# D.2 2011

## 20th June 2011

| measurement position | fore/aft | port/starboard | Comment |
|---|---|---|---|
| pole | 0.4 aft | 2.1 stb | |
| R3 | 0.1 aft | 1.8 port | |
| Yaw R3 | - | 6.55 port | |
| MP top | 0.6 aft | 1.8 port | |
| Yaw MP | - | - | Not measured |
| Licor 1 | 5.8 fwd | 17.4 port | |
| Licor 2 | 4.6 fwd | 3.0 stb | |
| Licor N | - | - | not installed |
| pole | 0.4 aft | 1.4 stb | |

## 31st August 2011

| measurement position | fore/aft | port/starboard | Comment |
|---|---|---|---|
| pole | - | - | Not measured |
| R3 | - | - | Not measured |
| Yaw R3 | - | - | Not measured |
| MP top | 0.7 aft(1)<br>0.2 aft(2) | 0.2 port(1)<br>0.3 stb(2) | |
| Yaw MP | - | 1.0 port | |
| Licor 1 | - | - | Not measured |
| Licor 2 | - | - | Not measured |
| Licor N | - | - | not installed |
| pole | - | - | Not measured |

## 20th September 2011

| measurement position | fore/aft | port/starboard | Comment |
|---|---|---|---|
| pole | 0.6 aft | 0.3 port | |
| R3 | 0.6 aft | 0.3 port | |
| Yaw R3 | - | - | Not measured |
| MP top | 0.9 aft | 1.7 port | |
| Yaw MP | - | - | Not measured |
| Licor 1 | 1.9 aft | 17.8 port | |
| Licor 2 | 5.6 aft | 2.1 stb | |
| Licor N | - | - | not installed |

| | | | |
|---|---|---|---|
| pole | 0.5 aft | 0.3 port | |

### 21st September 2011

| measurement position | fore/aft | port/starboard | Comment |
|---|---|---|---|
| pole | 0.4 aft | 1.6 port | |
| R3 | 0.6 aft | 1.4 port | |
| Yaw R3 | - | 8.8 port | |
| MP top | 0.9 aft | 1.4 port | |
| Yaw MP | - | 1.0 port | |
| Licor 1 | 3.8 fwd | 17.2 port | |
| Licor 2 | 6.8 fwd | 4.3 stb | |
| Licor N | - | - | not installed |
| pole | 0.6 aft | 1.5 port | |

### 24th December 2011

| measurement position | fore/aft | port/starboard | Comment |
|---|---|---|---|
| junction box | 0.5 aft(1)<br>0.8 aft(2) | 0.2 port(1)<br>0.2 stb(2) | |
| R3 | 0.2 aft(1)<br>0.7 aft(2) | 0.8 port(1)<br>1.0 port(2) | |
| Yaw R3 | - | 9.5 port | |
| MP top | 0.6 aft(1)<br>0.5 aft(2) | 1.0 port(1)<br>0.9 aft(2) | |
| Yaw MP | - | 1.0 port(1)<br>1.0 port(2) | |
| Licor 1 | - | - | removed |
| Licor 2 | 7.0 fwd | 5.0 stb | |
| Licor N | 1.0 fwd(1) 1.0 fwd(2) | 2.7 stb(1)<br>5.0 stb(2) | |
| junction box | 0.5 aft(1)<br>0.9 aft(2) | 0.1 port(1)<br>0.2 stb(2) | |

## D.3 2012

### 4th October 2012

| measurement position | fore/aft | port/<br>starboard | Comment |
|---|---|---|---|
| junction box | - | - | Not measured |
| R3 | - | - | Not measured |
| Yaw R3 | - | 6.7 stb | |
| MP top | - | - | Not measured |
| Yaw MP | - | 1.0 port | |
| Licor 1 | - | - | removed |
| Licor 2 | - | - | Not measured |
| Licor N | - | - | Not measured |
| junction box | - | - | Not measured |

## D.4 2013

### 4th January 2013

| measurement position | fore/aft | port/<br>starboard | Comment |
|---|---|---|---|
| junction box | - | | Not measured |
| R3 | 1.0 aft(1)<br>0.8 aft(2) | 1.8 port(1)<br>1.8 port(2) | |

| | | | |
|---|---|---|---|
| Yaw R3 | - | 7.0 port(1)<br>6.3 port(2) | |
| MP top | 0.8 aft(1)<br>0.8 aft(2) | 1.7 port(1)<br>1.7 port(2) | |
| Yaw MP | - | 1.1 stb(1)<br>0.7 stb(2) | |
| Licor 1 | - | - | removed |
| Licor 2 | - | - | Not measured |
| Licor N | 2.4 fwd | 2.5 stb | |
| junction box | - | - | Not measured |

## 1st May 2013

| measurement position | fore/aft | port/<br>starboard | Comment |
|---|---|---|---|
| junction box | - | - | Not measured |
| R3 | 0.0 | 1.8 port | |
| Yaw R3 | - | - | Not measured |
| MP top | 0.3 fwd | 1.3 port | |
| Yaw MP | - | - | Not measured |
| Licor 1 | - | - | removed |
| Licor 2 | 0.4 aft | 3.0 stb | |
| Licor N | 1.4 aft | 1.8 stb | |
| junction box | - | - | Not measured |

## 8th July 2013

| measurement position | fore/aft | port/<br>starboard | Comment |
|---|---|---|---|
| junction box | - | - | Not measured |
| R3 | 0.0 (1), 0.3 fwd(2) | 2.0 port (1), 2.5 port(2) | |
| Yaw R3 | - | 2.3 stb(1), 1.6 stb(2) | Not measured |
| MP top | 0.3 fwd | 1.3 port | |
| Yaw MP | - | 5.5 port(1), 5.1 port(2) | Not measured |
| Licor 1 | - | - | removed |
| Licor 2 | 1.5 fwd | 3.5 stb | |
| Licor N | 0.9 fwd | 1.1 stb | |
| junction box | - | - | Not measured |

## 26th September 2013

| measurement position | fore/aft | port/<br>starboard | Comment |
|---|---|---|---|
| junction box | | | Not measured |
| R3 | | | |
| Yaw R3 | | 2.5 stb | Not measured |
| MP top | | | |
| Yaw MP | | 4.8 port | Not measured |
| Licor 1 | | - | removed |
| Licor 2 | | | |
| Licor N | | | |
| junction box | | | Not measured |

## Table E Sensor sampling frequencies

| system | time period | comment |
|---|---|---|
| Thermosalinograph TSG | 5 seconds | |
| underway $CO_2$ system | Contact PML | |
| Navigation | 1 second | |
| AUTOFLUX mean met | 10 seconds | SW, LW, air temp, humidity |
| BAS ship's wind speed | 2 second | Gill WindMaster sonic |
| BAS ship's mean meteorology | 10 seconds | |
| R3A sonic | 20 Hz | |
| Licors | 20 Hz | |
| WAVEX | 2 minutes out of every 5 minutes | |

**Table F Sensor problems (red = port call, yellow = manned cruise, grey = sensor problem, n/i=not installed)**

F.1 2010

| year | jday | psychrometer | Vaisala | Licor 1 forward | Licor2 starboard | Clasp | Wavex | Sonic | Ship;s RH/T | navigation | CO2 | TSG | camers | Other sensors |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2010 Vigo | 145 to 147 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | | | No data | | | |
| 2010 | 148 to 152 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | | | | | | |
| 2010 | 153 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | no data | | | | | |
| 2010 | 154 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | | | | | | |
| 2010 | 155 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | no data | | No data | | | |
| 2010 | 156 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | | | No data | | | |
| 2010 arrive Immingham | 157 to 164 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | no data | | No data | tsg turned off | | |
| 2010 | 165 to 169 | n/i | n/i | unshrouded | shrouded | n/i | n/i | | | | No data | | | |
| 2010 Longyearbyen | 170 | n/i | n/i | unshrouded | shrouded | n/i | n/i | | | | No data | tsg off | | |
| 2010 | 171 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | | | No data | | | |
| 2010 | 172 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | | | No data | tsg off. in ice | | |
| 2010 | 173 to 181 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | | | No data | | | |
| 2010 | 182 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | | | No data | tsg off | | |
| 2010 arrive Longyearbyen | 183 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | | | No data | tsg off | | |
| 2010 depart Longyearbyen | 184 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | | | No data | | | |
| 2010 | 185 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | | | No data | | | |

| | to 188 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **year** | **jday** | **psychrometer** | **Vaisala** | **Licor 1 forward** | **Licor2 starboard** | **Clasp** | **Wavex** | **Sonic** | **Ship;s RH/T** | **navigation** | **CO2** | **TSG** | **camers** | **Other sensors** |
| 2010 | 189 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | | | No data | tsg off. in ice | | |
| 2010 | 190 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | | | No data | tsg off. in ice | | |
| 2010 | 191 to 198 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | | | No data | | | |
| 2010 | 199 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | no data | no data | No data | no data | | |
| 2010 | 200 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | no data | no data | No data | no data | | |
| 2010 | 201 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | | | No data | | | |
| 2010 arrive Longyearbyen | 202 to 203 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | | | No data | tsg turned off | | |
| 2010 | 204 to 208 | n/i | n/i | shrouded | unshrouded | n/i | n/i | | | | No data | | | |
| 2010 | 209 | n/i | n/i | shrouded | unshrouded | n/i | n/i | | | | No data | tsg off | | |
| 2010 arrive Peterhead | 210 | n/i | n/i | unshrouded | unshrouded | n/i | n/i | | no ship1 air/RH | | No data | tsg off | | |
| 2010 depart Peterhead | 211 | n/i | n/i | no data | no data | n/i | n/i | no data | no ship1 air/RH | | No data | tsg off | No images | |
| 2010 | 212 | n/i | n/i | no data | no data | n/i | n/i | no data | no ship1 air/RH | | No data | tsg off | No images | |
| 2010 arrive Frederikshavn | 213 to 240 | n/i | n/i | no data | no data | n/i | n/i | no data | no ship1 air/RH | | No data | tsg off | No images | |
| 2010 | 241 to 242 | | | unshrouded | unshrouded | n/i | | | no ship1 air/RH | | No data | | No images | |
| 2010 arrive Portsmouth | 243 to 244 | | | shrouded | shrouded | n/i | | | no ship1 air/RH | | No data | tsg off | No images | |
| 2010 | 245 to 246 | | | shrouded | shrouded | n/i | | | no ship1 air/RH | | No data | | | |

| year | jday | psychrometer | Vaisala | Licor 1 forward | Licor2 starboard | Clasp | Wavex | Sonic | Ship;s RH/T | navigation | CO2 | TSG | camers | Other sensors |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2010 Immingham | 247 to 270 | | | shrouded | shrouded | n/i | | | no ship1 air/RH | | No data | tsg off | | |
| 2010 depart Immingham | 271 | | | shrouded | shrouded | mixed | | | no ship1 air/RH | | No data | | | |
| 2010 | 272 | | | shrouded | shrouded | mixed | | | no ship1 air/RH | | No data | | | |
| 2010 arrive Falmouth | 273 to 274 | | | shrouded | shrouded | | | | no ship1 air/RH | | No data | water off | | |
| 2010 depart Falmouth | 275 | | | unshrouded | unshrouded | | | | no ship1 air/RH | | No data | | | |
| 2010 | 276 to 293 | | | unshrouded | unshrouded | | | | no ship1 air/RH | | | | | |
| 2010 | 294 | | | unshrouded | unshrouded | mixed | | | no ship1 air/RH | | | | | |
| 2010 | 295 | | | unshrouded | unshrouded | no data | | no data | no ship1 air/RH | | | | | |
| 2010 | 296 | | | no data | no data | no data | | no data | no ship1 air/RH | | | | | |
| 2010 arrive FI | 297 to 299 | | | no data | no data | no data | | no data | no ship1 air/RH | | No data | water off | | |
| 2010 depart FI | 300 | | | no data | no data | no data | | no data | no ship1 air/RH | | No data | | | |
| 2010 | 301 | | | unshrouded | unshrouded | no data | | no data | no ship1 air/RH | | | | | |
| 2010 arrive SG | 302 to 304 | | | unshrouded | unshrouded | no data | | no data | no ship1 air/RH | | No data | water off | | |
| 2010 depart SG | 305 | | | unshrouded | unshrouded | no data | | | no ship1 air/RH | | No data | | | |
| 2010 | 306 to 307 | | | unshrouded | unshrouded | no data | | | no ship1 air/RH | | | | | |
| 2010 | 308 | | | shrouded | shrouded | no data | | | no ship1 | | No data | water off | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| arrive FI | to 310 | | | | | | | | air/RH | | | | | |
| **year** | **jday** | **psychrometer** | **Vaisala** | **Licor 1 forward** | **Licor2 starboard** | **Clasp** | **Wavex** | **Sonic** | **Ship;s RH/T** | **navigation** | **CO2** | **TSG** | **camers** | **Other sensors** |
| 2010 depart FI | 311 | | | shrouded | shrouded | | | | no ship1 air/RH | | | | | |
| 2010 | 312 | | | shrouded | shrouded | | | | no ship1 air/RH | | | | | |
| 2010 | 313 | frozen | | shrouded | shrouded | mixed | | | no ship1 air/RH | | | water off.in ice | | |
| 2010 | 314 | frozen | | unshrouded | unshrouded | | | | no ship1 air/RH | | No data | water off.in ice | | |
| 2010 | 315 to 319 | | | unshrouded | unshrouded | | | | no ship1 air/RH | | No data | water off.in ice | | |
| 2010 | 320 | | | shrouded | shrouded | | | | no ship1 air/RH | | No data | water off.in ice | | |
| 2010 | 321 | frozen | | shrouded | shrouded | | | | no ship1 air/RH | | | | | |
| 2010 | 322 | frozen | | shrouded | shrouded | | | | no ship1 air/RH | | | | | |
| 2010 | 323 | frozen | | shrouded | shrouded | mixed | | | no ship1 air/RH | | | water off.in ice | | |
| 2010 | 324 | frozen | | shrouded | shrouded | | | | no ship1 air/RH | | No data | water off.in ice | | |
| 2010 | 325 | frozen | | unshrouded | unshrouded | mixed | | | no ship1 air/RH | | No data | water off.in ice | | |
| 2010 | 326 to 329 | frozen | | unshrouded | unshrouded | | | | no ship1 air/RH | | No data | water off.in ice | | |
| 2010 | 330 | frozen | | unshrouded | unshrouded | mixed | | | no ship1 air/RH | | No data | water off.in ice | | |
| 2010 | 331 | frozen | | unshrouded | unshrouded | | | | no ship1 air/RH | | No data | water off.in ice | | |
| 2010 | 332 | frozen | | unshrouded | unshrouded | | | | no ship1 air/RH | | | | | |
| 2010 | 333 | frozen | | unshrouded | unshrouded | mixed | | | no ship1 air/RH | | | water off.in ice | | |
| 2010 | 334 | frozen | | unshrouded | unshrouded | | | | no ship1 | | No data | water off.in ice | | |

| | | | | | | | | | air/RH | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **year** | **jday** | **psychrometer** | **Vaisala** | **Licor 1 forward** | **Licor2 starboard** | **Clasp** | **Wavex** | **Sonic** | **Ship;s RH/T** | **navigation** | **CO2** | **TSG** | **camers** | **Other sensors** |
| 2010 | 335 | frozen | | unshrouded | unshrouded | | | | no ship1 air/RH | | No data | water off.in ice | | |
| 2010 arrive Rothera | 336 | frozen | | unshrouded | unshrouded | mixed | | | no ship1 air/RH | | No data | water off.in ice | | |
| 2010 Rothera | 337 | | | unshrouded | unshrouded | bad | | | no ship1 air/RH | | No data | water off.in ice | | |
| 2010 Rothera | 338 | frozen | | unshrouded | unshrouded | | bad | | no ship1 air/RH | | No data | water off.in ice | | |
| 2010 Depart Rothera | 339 | frozen | | unshrouded | unshrouded | | | no data | no ship1 air/RH | | No data | water off.in ice | | |
| 2010 | 340 | frozen | | unshrouded | unshrouded | bad | | | no ship1 air/RH | | | water off.in ice | | |
| 2010 | 341 | frozen | | unshrouded | unshrouded | bad | | | no ship1 air/RH | | | water off.in ice | | |
| 2010 | 342 | frozen | | unshrouded | unshrouded | bad | | | no ship1 air/RH | | No data | | | |
| 2010 | 343 | frozen | | unshrouded | unshrouded | bad | | | no ship1 air/RH | | No data | | | |
| 2010 arrive FI | 344 to 347 | | | unshrouded | unshrouded | bad | | | no ship1 air/RH | | No data | water off | | |
| 2010 depart FI | 348 | | | unshrouded | unshrouded | | | | no ship1 air/RH | | No data | | | |
| 2010 manned cruise | 349 | | | unshrouded | unshrouded | | | | no ship1 air/RH | | | | | |
| 2010 manned cruise | 350 | | | unshrouded | unshrouded | | | | no ship1 air/RH | | No data | water off | | |
| 2010 arrive FI | 351 to 354 | | | unshrouded | unshrouded | | | | no ship1 air/RH | | | water off | | |
| 2010 depart FI | 355 | | | unshrouded | unshrouded | | | | missing data | missing data | | | | |
| 2010 | 356 to 358 | | | unshrouded | unshrouded | | | | no ship1 air/RH | | | | | |
| 2010 | 359 | | | unshrouded | unshrouded | mixed | | | no ship1 | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | air/RH | | | | | |
| **year** | **jday** | **psychrometer** | **Vaisala** | **Licor 1 forward** | **Licor2 starboard** | **Clasp** | **Wavex** | **Sonic** | **Ship;s RH/T** | **navigation** | **CO2** | **TSG** | **camers** | **Other sensors** |
| 2010 | 360 to 362 | | | unshrouded | unshrouded | bad | | | no ship1 air/RH | | | | | |
| 2010 | 363 | frozen | | unshrouded | unshrouded | bad | | | no ship1 air/RH | | | | | |
| 2010 | 364 | frozen | | unshrouded | unshrouded | bad | | | no ship1 air/RH | missing data | | | | |
| 2010 | 365 | | | unshrouded | unshrouded | bad | | | missing data | missing data | No data | | | |

F.2 2011

| **year** | **jday** | **psychrometer** | **Vaisala** | **Licor 1 forward** | **Licor2 starboard** | **Clasp** | **Wavex** | **Sonic** | **Ship;s RH/T** | **navigation** | **CO2** | **TSG** | **camers** | **Other sensors** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2011 depart Stromness | 001 | | | unshrouded | unshrouded | bad | no data | | no ship1 air/RH | | No data | water off | | |
| | 002 | | bad data | unshrouded | unshrouded | bad | no data | | no ship1 air/RH | | | | | |
| 2011 | 003 to 006 | dried out | bad data | unshrouded | unshrouded | bad | | | no ship1 air/RH | | | | | |
| 2011 | 007 | | bad data | unshrouded | unshrouded | | | | no ship1 air/RH | | | | | |
| 2011 | 008 | | bad data | unshrouded | unshrouded | | off | | no ship1 air/RH | | | water off (pump tripped) | | |
| 2011 | 009 | | bad data | unshrouded | unshrouded | mixed | off | | no ship1 air/RH | | | | | |
| 2011 | 010 | | bad data | unshrouded | unshrouded | | off | | no ship1 air/RH | | | | | |
| 2011 | 011 | | bad data | unshrouded | unshrouded | mixed | off | | no ship1 air/RH | | | | | |
| 2011 | 012 | | bad data | unshrouded | unshrouded | | off | | no ship1 air/RH | | | | | |
| 2011 | 013 | | bad data | unshrouded | unshrouded | mixed | | | no ship1 | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | air/RH | | | | | |
| 2011 | 014 | | bad data | unshrouded | unshrouded | | | | no ship1 air/RH | | | tsg off | | |
| 2011 KEP | 015 | | bad data | unshrouded | unshrouded | | | | no ship1 air/RH | | | water off | | |
| 2011 | 016 | | bad data | unshrouded | unshrouded | | | | no ship1 air/RH | | | | | |
| 2011 | 017 | | bad data | unshrouded | unshrouded | | | | no ship1 air/RH | | | water off (pump tripped) | No images | |
| 2011 | 018 | | bad data | unshrouded | unshrouded | | | | no ship1 air/RH | | | water off | No images | |
| 2011 FI | 019 to 027 | | bad data | unshrouded | unshrouded | mixed | no data | | no ship1 air/RH | | No data | water off | No images | |
| 2011 depart FI | 028 | | bad data | unshrouded | unshrouded | | | | no ship1 air/RH | | | | No images | |
| 2011 | 029 | | bad data | unshrouded | unshrouded | | | | no ship1 air/RH | | | | No images | |
| 2011 | 030 | | bad data | unshrouded | unshrouded | | mixed | | no ship1 air/RH | | | | No images | |
| 2011 | 031 | | bad data | unshrouded | unshrouded | bad | | | no ship1 air/RH | | | | No images | |
| 2011 | 032 | | bad data | unshrouded | unshrouded | bad | no data | | no ship1 air/RH | | | | No images | |
| 2011 | 033 to 036 | | bad data | unshrouded | unshrouded | bad | | | no ship1 air/RH | | | | No images | |
| 2011 | 037 | frozen | bad data | unshrouded | unshrouded | bad | | | no ship1 air/RH | | | | No images | |
| 2011 | 038 | frozen | bad data | unshrouded | unshrouded | bad | | | no ship1 air/RH | | | | No images | |
| 2011 | 039 | frozen | bad data | unshrouded | unshrouded | bad | | | no ship1 air/RH | | | tsg off.ice | No images | |
| 2011 | 040 | frozen | bad data | unshrouded | unshrouded | mixed | | | no ship1 air/RH | | | tsg off. ice | No images | |
| 2011 | 041 | frozen | bad data | unshrouded | unshrouded | | | | no ship1 air/RH | | | | No images | |
| 2011 | 042 | frozen | bad data | unshrouded | unshrouded | | no data | | no ship1 | | No data | tsg off.ice | No images | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | to 045 | | | | | | | | air/RH | | | | | |
| 2011 | 046 | frozen | bad data | unshrouded | unshrouded | | no data | frozen | no ship1 air/RH | | No data | tsg off.ice | No images | |
| 2011 | 047 | frozen | bad data | unshrouded | unshrouded | mixed | no data | SIU resistor blown. sync fault | no ship1 air/RH | | No data | tsg off.ice | No images | |
| 2011 | 048 | frozen | bad data | unshrouded | unshrouded | mixed | no data | SIU resistor blown. sync fault | no ship1 air/RH | | No data | tsg off.ice | No images | |
| 2011 | 049 | frozen | bad data | unshrouded | unshrouded | mixed | no data | SIU resistor blown. sync fault | no ship1 air/RH | | | | No images | |
| 2011 | 050 | frozen | bad data | unshrouded | unshrouded | | no data | SIU resistor blown. sync fault | no ship1 air/RH | | | | No images | |
| 2011 | 051 | frozen | bad data | unshrouded | unshrouded | | no data | SIU resistor blown. sync fault | no ship1 air/RH | | | tsg off.ice | No images | |
| 2011 | 052 to 056 | frozen | bad data | unshrouded | unshrouded | mixed | no data | SIU resistor blown. sync fault | no ship1 air/RH | | No data | tsg off.ice | No images | |
| 2011 | 057 | frozen | bad data | unshrouded | unshrouded | | no data | SIU resistor blown. sync fault | no ship1 air/RH | | | tsg off.ice | No images | |
| 2011 | 058 | frozen | no data | no data | no data | no data | no data | no data | no ship1 air/RH | | No data | tsg off.ice | | no SW |
| 2011 | 059 | frozen | bad data | unshrouded | unshrouded | | no data | SIU resistor blown. sync fault | no ship1 air/RH | | No data | tsg off.ice | | |
| 2011 | 060 | frozen | bad data | unshrouded | unshrouded | mixed | no data | SIU resistor blown. sync fault | no ship1 air/RH | | | | | |
| 2011 | 061 | frozen | bad data | unshrouded | unshrouded | mixed | no data | SIU resistor blown. sync fault | no ship1 air/RH | | | | | |
| 2011 | 062 to 066 | frozen | bad data | unshrouded | unshrouded | mixed | | SIU resistor blown. sync fault | no ship1 air/RH | | | | | |
| 2011 | 067 to 068 | frozen | bad data | unshrouded | unshrouded | | | SIU resistor blown. sync fault | no ship1 air/RH | | | tsg off.in ice | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2011 | 069 | frozen | bad data | unshrouded | unshrouded | mixed | | SIU resistor blown. sync fault | no ship1 air/RH | | | | | |
| 2011 | 070 to 071 | | bad data | unshrouded | unshrouded | mixed | | SIU resistor blown. sync fault | no ship1 air/RH | | | | | |
| 2011 | 072 | | bad data | unshrouded | unshrouded | | | SIU resistor blown. sync fault | no ship1 air/RH | | | | | |
| 2011 | 073 | | bad data | unshrouded | unshrouded | mixed | | SIU resistor blown. sync fault | no ship1 air/RH | | | | | |
| 2011 FI | 074 to 077 | | bad data | unshrouded | unshrouded | mixed | | SIU resistor blown. sync fault | no ship1 air/RH | | No data | tsg off | | |
| 2011 depart FI | 078 | | bad data | unshrouded | unshrouded | mixed | | SIU resistor blown | no ship1 air/RH | | | | | |
| 2011 manned | 079 to 083 | | no humidity | unshrouded | unshrouded | mixed | | SIU resistor blown | no ship1 air/RH | | | | | |
| 2011 manned | 084 | | no humidity | unshrouded | unshrouded | mixed | | SIU resistor blown | no ship1 or ship2 air/RH | | | | | |
| 2011 manned | 085 to 087 | frozen | bad data | unshrouded | unshrouded | | | SIU resistor blown | no ship1 or ship2 air/RH | | | | | |
| 2011 manned | 088 | frozen | no data | unshrouded | unshrouded | mixed | | SIU resistor blown | no ship1 or ship2 air/RH | | | | | |
| 2011 manned | 089 | frozen | no data | unshrouded | unshrouded | | | SIU resistor blown | no ship1 or ship2 air/RH | | | | | |
| 2011 manned | 090 | frozen | no data | unshrouded | unshrouded | mixed | | SIU resistor blown | no ship1 or ship2 air/RH | | | tsg off.tripped | | |
| 2011 manned | 091 | frozen | bad data | unshrouded | unshrouded | | | SIU resistor blown | no ship1 or ship2 air/RH | | | | | |
| 2011 manned | 092 to 094 | | bad data | unshrouded | unshrouded | mixed | | SIU resistor blown | no ship1 or ship2 air/RH | | No data | tsg off | | |
| 2011 manned | 095 | | bad data | unshrouded | unshrouded | | | SIU resistor blown | no ship1 or ship2 air/RH | | No data | tsg off | | |
| 2011 arrive Punta | 096 to 098 | | bad data | unshrouded | unshrouded | | off | SIU resistor blown | no ship1 air/RH | | No data | tsg off | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2011 depart Punta | 099 | | bad data | shrouded | unshrouded | mixed | off | SIU resistor blown | no ship1 air/RH | | No data | tsg off | | |
| 2011 | 100 to 103 | frozen | bad data | shrouded | unshrouded | mixed | | SIU resistor blown | no ship1 air/RH | | | | | |
| 2011 | 104 to 105 | | bad data | shrouded | unshrouded | mixed | | SIU resistor blown | no ship1 air/RH | | | | | |
| 2011 | 106 to 107 | | bad data | shrouded | unshrouded | bad | | SIU resistor blown | no ship1 air/RH | | | | | |
| 2011 | 108 | frozen | bad data | shrouded | unshrouded | bad | | SIU resistor blown | no ship1 air/RH | | | | | |
| 2011 | 109 | frozen | bad data | shrouded | unshrouded | bad | | SIU resistor blown | no ship1 air/RH | | | | | |
| 2011 | 110 to 112 | | no data | shrouded | unshrouded | mixed | | SIU resistor blown | no ship1 air/RH | | | | | |
| 2011 | 113 | | no data | shrouded | unshrouded | mixed | | SIU resistor blown | no ship1 air/RH | | | tsg tripped | | |
| 2011 | 114 to 115 | | no data | shrouded | unshrouded | mixed | off | SIU resistor blown | no ship1 air/RH | | | | | |
| 2011 FI | 116 to 119 | dried out | no data | unshrouded | shrouded | bad | off | SIU resistor blown | no ship1 air/RH | | No data | tsg off | | |
| 2011 depart FI | 120 | no data | no data | unshrouded | shrouded | no data | | SIU resistor blown | no ship1 air/RH | | | | | no LW |
| 2011 | 121 | no data | no data | unshrouded | shrouded | no data | | SIU resistor blown | no ship1 air/RH | | | | | no LW |
| 2011 | 122 | | no data | unshrouded | shrouded | | | SIU resistor blown | no ship1 air/RH | | | | | no LW |
| 2011 | 123 | dried out | no data | unshrouded | shrouded | mixed | | SIU resistor blown | no ship1 air/RH | | | | | no LW |
| 2011 | 124 | dried out | no data | unshrouded | shrouded | mixed | | SIU resistor blown | no ship1 air/RH | | | | | no LW |
| 2011 | 125 | | no data | unshrouded | shrouded | mixed | | SIU resistor blown | no ship1 air/RH | | | | | no LW |
| 2011 | 126 | | no data | unshrouded | shrouded | mixed | | SIU resistor blown | no ship1 air/RH | | No data | | | no LW |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2011 | 127 | | no data | unshrouded | shrouded | mixed | | SIU resistor blown | no ship1 air/RH | | No data | flow meter failed | | no LW |
| 2011 | 128 to 130 | | no data | unshrouded | shrouded | mixed | | SIU resistor blown | no ship1 air/RH | | | flow meter failed | | no LW |
| 2011 | 131 | | no data | unshrouded | shrouded | mixed | no data | SIU resistor blown | no ship1 air/RH | | | flow meter failed | | no LW |
| 2011 | 132 | dried out | no data | unshrouded | shrouded | mixed | no data | SIU resistor blown | no ship1 air/RH | | | flow meter failed | | no LW |
| 2011 | 133 to 134 | | no data | unshrouded | shrouded | bad | | SIU resistor blown | no ship1 air/RH | | | flow meter failed | | no LW |
| 2011 | 135 | dried out | no data | unshrouded | shrouded | bad | | SIU resistor blown | no ship1 air/RH | | | flow meter failed | | no LW |
| 2011 | 136 | dried out | no data | unshrouded | shrouded | | mixed | SIU resistor blown | no ship1 air/RH | | | flow meter failed | | no LW |
| 2011 | 137 | dried out | no data | unshrouded | shrouded | mixed | | SIU resistor blown | no ship1 air/RH | | | flow meter failed | | no LW |
| 2011 | 138 | | no data | unshrouded | shrouded | bad | | SIU resistor blown | no ship1 air/RH | | | flow meter failed | | no LW |
| 2011 | 139 | suspect humidity | no data | unshrouded | shrouded | mixed | no data | SIU resistor blown | no ship1 air/RH | | No data | flow meter failed | | no LW |
| 2011 | 140 | suspect humidity | no data | unshrouded | shrouded | mixed | | SIU resistor blown | no ship1 air/RH | | No data | flow meter failed | | no LW |
| 2011 | 141 | suspect humidity | no data | unshrouded | shrouded | mixed | | SIU resistor blown | no ship1 air/RH | | No data | flow meter failed | | no LW |
| 2011 | 142 | suspect humidity | no data | unshrouded | shrouded | mixed | | SIU resistor blown | no ship1 air/RH | | No data | flow meter failed | | no LW |
| 2011 | 143 | suspect humidity | no data | unshrouded | shrouded | mixed | | SIU resistor blown | no ship1 air/RH | | | flow meter failed | | no LW |
| 2011 Portland,UK | 144 to 150 | removed | removed | unshrouded | shrouded | | off | SIU resistor blown | no ship1 air/RH | | No data | tsg off | | system OFF |
| 2011 depart Portland,UK | 151 | removed | removed | unshrouded | shrouded | | off | | no ship1 air/RH | | No data | tsg off | | system OFF |
| 2011 Portsmouth | 152 to 178 | removed | removed | unshrouded | shrouded | | off | | no ship1 air/RH | | No data | tsg off | | system OFF |
| 2011 | 179 | | | shrouded | shrouded | | Antenna | | no ship1 | | No data | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| depart Portsmouth | | | | | | | backwards | | air/RH | | | | | |
| 2011 | 180 | | | shrouded | shrouded | | Antenna backwards | | no ship1 air/RH | | No data | | | |
| 2011 | 181 | | | shrouded | shrouded | | Antenna backwards | | no ship1 air/RH | | No data | | | |
| 2011 | 182 | | | shrouded | shrouded | | Antenna backwards | | no ship1 air/RH | | No data | | | |
| 2011 | 183 | | | shrouded | shrouded | | Antenna backwards | | no ship1 air/RH | | No data | | | |
| 2011 | 184 | | | shrouded | shrouded | | Antenna backwards | | no ship1 air/RH | | No data | tsg off | | |
| 2011 arrive Glasgow | 185 to 206 | | | shrouded | shrouded | | Antenna backwards | | no ship1 air/RH | | No data | tsg off | | |
| 2011 Glasgow | 206 | dried out | no temp | shrouded | shrouded | | Antenna backwards | | | | No data | tsg off | | |
| 2011 depart Glasgow | 207 | dried out | no temp | shrouded | shrouded | | Antenna backwards | | | | No data | | | |
| 2011 | 208 to 212 | | no temp | shrouded | shrouded | | Antenna backwards | | | | No data | | | |
| 2011 Ny Alesund | 213 | | no temp | unshrouded | unshrouded | | Antenna backwards | | | | No data | tsg off | | |
| 2011 Longyearbyen | 214 | | no temp | unshrouded | unshrouded | | Antenna backwards | | | | No data | tsg off | | |
| 2011 | 215 to 231 | | no temp | unshrouded | unshrouded | | Antenna backwards | | | | No data | | | |
| 2011 Longyearbyen | 232 | | no temp | unshrouded | unshrouded | | Antenna backwards | | | | No data | | | |
| 2011 | 233 | | no temp | unshrouded | unshrouded | | Antenna backwards | | | | No data | | | |
| 2011 | 234 | | no temp | unshrouded | unshrouded | | Antenna backwards | | | | No data | | | no SW or LW |
| 2011 | 235 | | no temp | unshrouded | unshrouded | | Antenna backwards | | | | No data | | | |
| 2011 | 236 | | no temp | unshrouded | unshrouded | | Antenna backwards | | | | No data | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2011 Longyearbyen | 237 to 238 | | no temp | unshrouded | unshrouded | | Antenna backwards | | | | No data | tsg off | | |
| 2011 depart Longyearbyen | 239 | | no temp | unshrouded | unshrouded | | Antenna backwards | | | | No data | | | |
| 2011 | 240 to 243 | | no temp | unshrouded | unshrouded | | Antenna backwards | | | | No data | | | |
| 2011 | 244 to 247 | dried out | no temp | unshrouded | unshrouded | | Antenna backwards | | | | No data | | | |
| 2011 arrive Longyearbyen | 248 | dried out | no temp | unshrouded | unshrouded | | Antenna backwards | | | | No data | | | |
| 2011 depart Longyearbyen | 249 | dried out | no temp | unshrouded | unshrouded | | Antenna backwards | | | | No data | | | |
| 2011 | 250 | dried out | no temp | unshrouded | unshrouded | | Antenna backwards | | | | No data | | | |
| 2011 | 251 to 256 | | no temp | unshrouded | unshrouded | | Antenna backwards | | | | No data | | | |
| 2011 Immingham | 257 to 266 | | | unshrouded | unshrouded | | Antenna backwards | | | | No data | tsg off | | |
| 2011 depart Immingham | 267 | | | unshrouded | unshrouded | | | | | | No data | tsg off | | |

| Year | Jday | psychrometer | Vaisala | Licor1 | Licor 2 | Licor N | wavex | Sonic | Ships RH/T | navigation | Co2 | TSG | Camera | other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2011 | 268 | | | unshrouded | unshrouded | not installed | | | | | no data | | | |
| 2011 | 272 | | | unshrouded | unshrouded | not installed | | | | | no data | | | |
| 2011 | 273 | | | unshrouded | unshrouded | not installed | | | | | no data | | | motion pack flooded |
| 2011 | 280 | | | unshrouded | unshrouded | not installed | | | | | no data | | | motion pack flooded |
| 2011 | 281 | | | unshrouded | unshrouded | not installed | | | | | | | | motion pack flooded |
| 2011 Arrive FI | 293 | | | unshrouded | unshrouded | not installed | | | | | no data | tsg off | | motion pack flooded |
| 2011 depart FI | 297 | | | unshrouded | unshrouded | not installed | | | no tir1 or tir2 | no data | no data | tsg off | | motion pack flooded |
| 2011 | 298 | | | unshrouded | unshrouded | not installed | | | no tir1 or tir2 | no data | | | | motion pack flooded |
| 2011 | 299 | | | unshrouded | unshrouded | not installed | | | | | | | | motion pack flooded |
| 2011 arrive SG | 300 | | | unshrouded | unshrouded | not installed | | | | | | | | motion pack flooded |
| 2011 depart SG | 301 | | | unshrouded | unshrouded | not installed | | | | | | | | motion pack flooded |
| 2011 SG | 302 | | | unshrouded | unshrouded | not installed | | | | | | | | motion pack flooded |
| 2011 SG | 303 | no data | no data | unshrouded | unshrouded | not installed | | | no data | | no data | tsg off | | motion pack flooded |
| 2011 depart SG | 304 | | | unshrouded | unshrouded | not installed | | | | | no data | | | motion pack flooded |
| 2011 | 305 | | | unshrouded | unshrouded | not installed | | | | | no data | | | motion pack flooded |
| **Year** | **Jday** | **psychrometer** | **Vaisala** | **Licor1** | **Licor 2** | **Licor N** | **wavex** | **Sonic** | **Ships RH/T** | **navigation** | **Co2** | **TSG** | **Camera** | **other** |
| 2011 SG | 309 | | | unshrouded | unshrouded | not installed | | | | | no data | | | motion pack flooded |
| 2011 | 312 | | | unshrouded | unshrouded | not installed | | | | | no data | | | motion pack flooded |
| 2011 arrive Signy | 320 | | | unshrouded | unshrouded | not installed | | | | | | | | motion pack flooded |
| 2011 depart | 323 | | | unshrouded | unshrouded | not installed | | | | | | | | motion pack flooded |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Signy | | | | | | | | | | | | | | |
| 2011 | 324 | | | unshrouded | unshrouded | not installed | serial link down | | | | | tsg tripped | | motion pack flooded |
| 2011 | 325 | | | unshrouded | unshrouded | not installed | serial link down | | | | | | | motion pack flooded |
| 2011 arrive FI | 326 | | | unshrouded | unshrouded | not installed | serial link down | | | | | tsg off | | motion pack flooded |
| 2011 FI | 327 | | | unshrouded | unshrouded | not installed | serial link down | | | | no data | tsg off | | motion pack flooded |
| 2011 FI | 328 | | | unshrouded | unshrouded | not installed | serial link down | | no tir1 or tir2 | | no data | tsg off | | motion pack flooded |
| 2011 FI | 329 | | | unshrouded | Unused: testing LI-7200 | not installed | serial link down | | | | no data | tsg off | | motion pack flooded |
| 2011 depart FI | 330 | | | removed | Unused: testing LI-7200 | not installed | serial link down | | | | no data | tsg on | | motion pack flooded |
| 2011 | 331 | | | removed | Unused: testing LI-7200 | unshrouded | serial link down | | | | | | | |
| 2011 | 341 | no data | no data | removed | Unused: testing LI-7200 | unshrouded | serial link down | | no data | | | tsg off | | |
| 2011 arrive Rothera | 342 | no data | no data | removed | Unused: testing LI-7200 | unshrouded | serial link down | | no data | | no data | tsg off | | |
| 2011 Rothera | 343 | | | removed | unshrouded | unshrouded | serial link down | | | | no data | tsg off | | |
| 2011 depart Rothera | 345 | | | removed | unshrouded | unshrouded | serial link down | | | | no data | tsg off | | |
| **Year** | **Jday** | **psychrometer** | **Vaisala** | **Licor1** | **Licor 2** | **Licor N** | **wavex** | **Sonic** | **Ships RH/T** | **navigation** | **Co2** | **TSG** | **Camera** | **other** |
| 2011 | 346 | | | removed | unshrouded | unshrouded | serial link down | | | | no data | tsg on | | |
| 2011 | 347 | | | removed | unshrouded | unshrouded | serial link down | | | | no data | tsg off | | |
| 2011 | 348 | | | removed | unshrouded | unshrouded | serial link down | | | | | tsg on | | |
| 2011 | 349 | | | removed | unshrouded | unshrouded | serial link down | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2011 | 351 | | | removed | unshrouded | unshrouded | serial link down | | | | | | | |
| 2011 | 352 | | | removed | shrouded | shrouded | serial link down | | | | | | | |
| 2011 | 356 | | | removed | shrouded | shrouded | serial link down | | | | | | | |
| 2011 | 357 | | | removed | shrouded | shrouded | | | | | | tsg tripped | | |
| 2011 arrive FI | 358 | | | removed | shrouded | shrouded | | | | no data | | tsg off | | |
| 2011 FI | 359 | | | removed | shrouded | shrouded | | | | no data | no data | tsg off | | |
| 2011 FI | 360 | | | removed | unshrouded | unshrouded | | | | | no data | tsg off | | |
| 2011 FI | 361 | | | removed | unshrouded | unshrouded | | | | | no data | tsg off | | |
| 2011 depart FI | 362 | | | removed | unshrouded | unshrouded | | | | | | tsg on | | |
| 2011 | 363 | | | removed | unshrouded | unshrouded | | | | | | | | |
| 2011 | 365 | | | removed | unshrouded | unshrouded | | | | | | | | |

## F.3 2012

| Year | Jday | psychrometer | Vaisala | Licor1 | Licor 2 | Licor N | wavex | Sonic | Ships RH/T | navigation | Co2 | TSG | Camera | other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2012 | 001 | | no air temp | removed | unshrouded | unshrouded | | | | | | | | |
| 2012 | 006 | frozen | no air temp | removed | unshrouded | unshrouded | | | | | | | | |
| 2012 | 007 | | no air temp | removed | unshrouded | unshrouded | no serial link | | | | | | | |
| 2012 | 009 | | no air temp | removed | unshrouded | unshrouded | | | | | | ice | | |
| 2012 | 010 | | no air temp | removed | unshrouded | unshrouded | | | | | | | | |
| 2012 | 011 | | no air temp | removed | unshrouded | no data | | no data | | | | | | |
| 2012 | 012 | | no air temp | removed | unshrouded | unshrouded | | | | | | | | |
| 2012 | 014 | | no air temp | removed | unshrouded | no data | | | | | | | | |
| 2012 arrive FI | 016 | dried out | no air temp | removed | unshrouded | no data | no data | | | | | tsg off | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2012 FI | 017 | | no air temp | removed | unshrouded | no data | no data | | | | no data | tsg off | | |
| 2012 FI | 018 | dired out | no air temp | removed | unshrouded | no data | no data | | | | no data | tsg off | | |
| 2012 FI | 019 | dired out | no air temp | removed | unshrouded | no data | no data | | | | no data | tsg off | | |
| 2012 depart FI | 020 | | no air temp | removed | unshrouded | no data | no data | | | | | tsg on | | |
| 2012 | 021 | | no air temp | removed | unshrouded | no data | | | | | | | | |
| 2012 | 024 | | no air temp | removed | unshrouded | no data | | | | | | tsg off | | |
| 2012 | 025 | | no air temp | removed | unshrouded | no data | | | | | | | | |
| 2012 | 027 | frozen | no air temp | removed | unshrouded | no data | | | | | | | | |
| 2012 | 029 | | no air temp | removed | unshrouded | no data | | | | | | | | |
| 2012 | 030 | | no air temp | removed | unshrouded | no data | no serial link | | | | | | | |
| 2012 arrive FI | 033 | | no air temp | removed | unshrouded | no data | no serial link | | | | | tsg off | | |
| 2012 FI | 034 | | no air temp | removed | unshrouded | no data | no serial link | | | | no data | tsg off | | |
| 2012 FI | 037 | dried out | no air temp | removed | unshrouded | no data | no data | | | | no data | tsg off | | |
| 2012 depart FI | 038 | dried out | no air temp | removed | unshrouded | no data | no data | | | | | | | |
| 2012 | 039 | | no air temp | removed | unshrouded | no data | | | | | | | | |
| **Year** | **Jday** | **psychrometer** | **Vaisala** | **Licor1** | **Licor 2** | **Licor N** | **wavex** | **Sonic** | **Ships RH/T** | **navigation** | **Co2** | **TSG** | **Camera** | **other** |
| 2012 | 042 | | no air temp | removed | unshrouded | no data | | | no ship1 air/RH | | | | | |
| 2012 | 047 | | no air temp | removed | unshrouded | no data | | | no ship1 air/RH | | | tsg off | | |
| 2012 | 048 | frozen | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | | no data | tsg off | | |
| 2012 | 049 | frozen | no air temp | removed | unshrouded | no data | | no data | no ship1 air/RH | no data | no data | in ice | | |
| 2012 | 050 | frozen | no air temp | removed | unshrouded | no data | no serial link | no data | no ship1 air/RH | no data | no data | in ice | | |
| 2012 | 051 | frozen | no air temp | removed | unshrouded | no data | no serial link | no data | no ship1 air/RH | no data | | | | |
| 2012 | 052 | frozen | no air temp | removed | unshrouded | no data | | | no ship1 | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | air/RH | | | | | |
| 2012 | 055 | frozen | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | | | in ice | | |
| 2012 | 056 | frozen | no air temp | removed | unshrouded | no data | | | no ship1 air/RH | | | | | |
| 2012 | 057 | frozen | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | | | tsg off | | |
| 2012 | 058 | frozen | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | | | | | |
| 2012 | 059 | frozen | no air temp | removed | unshrouded | no data | | | no ship1 air/RH | | | in ice | | |
| 2012 | 060 | frozen | no air temp | removed | unshrouded | no data | | | no ship1 air/RH | | | | | |
| 2012 | 062 | frozen | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | | | tsg off | | |
| 2012 | 063 | frozen | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | | no data | tsg off | | |
| 2012 | 064 | frozen | no air temp | removed | unshrouded | no data | no serial link | no data | no ship1 air/RH | | | tsg off | | |
| 2012 | 065 | frozen | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | | no data | tsg off | | |
| 2012 | 067 | frozen | no air temp | removed | unshrouded | no data | | | no ship1 air/RH | | | tsg off | | |
| 2012 | 068 | frozen | no air temp | removed | unshrouded | no data | | | no ship1 air/RH | | no data | tsg off | | |
| **Year** | **Jday** | **psychrometer** | **Vaisala** | **Licor1** | **Licor 2** | **Licor N** | **wavex** | **Sonic** | **Ships RH/T** | **navigation** | **Co2** | **TSG** | **Camera** | **other** |
| 2012 | 069 | frozen | no air temp | removed | unshrouded | no data | | | no ship1 air/RH | | | | | |
| 2012 | 070 | frozen | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | | | | | |
| 2012 | 071 | frozen | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | | | tripped | | |
| 2012 | 072 | frozen | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | | | | | |
| 2012 | 073 | frozen | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | | | | | |
| 2012 | 074 | | no air temp | removed | unshrouded | no data | | | no ship1 air/RH | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2012 | 077 | dried out | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | | | tripped | | |
| 2012 arrive Signy | 078 | dried out | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | | | tsg off | | |
| 2012 depart Signy | 079 | dried out | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | | | | | |
| 2012 | 080 | dried out | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | | | | | |
| 2012 arrive FI | 081 | dried out | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | | | tsg off | | |
| 2012 FI | 082 | dried out | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | no data | no data | tsg off | | no ship wind |
| 2012 FI | 083 | dried out | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | no data | no data | tsg off | | no ship wind |
| 2012 FI | 084 | dried out | no air temp | removed | unshrouded | no data | no serial link | | no ship1 air/RH | | no data | tsg off | | no ship wind |
| 2012 FI | 085 | dried out | no air temp | removed | unshrouded | no data | no data | | no ship1 air/RH | | no data | tsg off | | no ship wind |
| 2012 FI | 086 | | no air temp | removed | unshrouded | no data | no data | | no ship1 air/RH | | no data | tsg off | | |
| 2012 depart FI | 087 | | no air temp | removed | unshrouded | no data | no data | no data | no ship1 air/RH | | | tsg on | | no ship wind |
| 2012 | 088 | | no air temp | removed | unshrouded | unshrouded | | | no ship1 air/RH | | | olm PC dead. used bridge obs for sst. | | |
| **Year** | **Jday** | **psychrometer** | **Vaisala** | **Licor1** | **Licor 2** | **Licor N** | **wavex** | **Sonic** | **Ships RH/T** | **navigation** | **Co2** | **TSG** | **Camera** | **other** |
| 2012 | 089 | | no air temp | removed | unshrouded | unshrouded | | | no ship1 air/RH | | | olm PC dead. used bridge obs for sst. | | |
| 2012 | 093 | frozen | no air temp | removed | unshrouded | unshrouded | | | no ship1 air/RH | | | | | |
| 2012 | 096 | frozen | no air temp | removed | unshrouded | unshrouded | | frozen | no ship1 air/RH | | | | | |
| 2012 | 097 | frozen | no air temp | removed | unshrouded | unshrouded | | frozen | no ship1 air/RH | | | | | |
| 2012 | 098 | frozen | no air temp | removed | unshrouded | unshrouded | | | no ship1 air/RH | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2012 | 099 | | no air temp | removed | unshrouded | unshrouded | | | no ship1 air/RH | | no data | | | |
| 2012 | 100 | | no air temp | removed | unshrouded | unshrouded | | | no ship1 air/RH | | | | no images | |
| 2012 | 101 | frozen | no air temp | removed | unshrouded | unshrouded | | | no ship1 air/RH | | | tripped | no images | |
| 2012 | 102 | frozen | no air temp | removed | unshrouded | unshrouded | | | no ship1 air/RH | | | | no images | |
| 2012 | 103 | | no air temp | removed | unshrouded | unshrouded | | | no ship1 air/RH | | | | no images | |
| 2012 | 110 | | no air temp | removed | unshrouded | unshrouded | | | no ship1 air/RH | | | | | |
| 2012 KEP | 111 | | no air temp | removed | unshrouded | unshrouded | | | no ship1 air/RH | | | pump tripping. used bridge obs for sst. | | |
| 2012 | 112 | | no air temp | removed | unshrouded | unshrouded | | | no ship1 air/RH | | | pump tripping. used bridge obs for sst. | | |
| 2012 | 113 | frozen | no air temp | removed | unshrouded | unshrouded | | | no ship1 air/RH | | | pump tripping. used bridge obs for sst. | | |
| 2012 | 114 | frozen | no air temp | removed | unshrouded | unshrouded | | | no ship1 air/RH | | | pump tripping. used bridge obs for sst. | | |
| 2012 arrive FI | 115 | | | removed | unshrouded | unshrouded | | | no ship1 air/RH | | | tsg off | | |
| **Year** | **Jday** | **psychrometer** | **Vaisala** | **Licor1** | **Licor 2** | **Licor N** | **wavex** | **Sonic** | **Ships RH/T** | **navigation** | **Co2** | **TSG** | **Camera** | **other** |
| 2012 FI | 116 | | | removed | unshrouded | unshrouded | no data | no data | no ship1 air/RH | no data | no data | tsg off | | |
| 2012 FI | 117 | | | removed | unshrouded | unshrouded | no data | no data | no ship1 air/RH | no data | no data | tsg off | | |
| 2012 depart FI | 118 | | | removed | unshrouded | unshrouded | no data | no data | no ship1 air/RH | | no data | tsg on | | |
| 2012 | 119 | | | removed | unshrouded | unshrouded | no data | no data | no ship1 air/RH | | | | | |
| 2012 | 120 | | | removed | unshrouded | unshrouded | no data | no data | no ship1 air/RH | | | | | |
| 2012 | 121 | | | removed | unshrouded | unshrouded | no data | | no ship1 air/RH | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2012 | 122 | | | removed | unshrouded | unshrouded | no data | | no ship1 air/RH | | | | | |
| 2012 | 123 | | | removed | unshrouded | unshrouded | no data | | no ship1 air/RH | | | | | |
| 2012 | 124 | | | removed | unshrouded | unshrouded | no data | | no ship1 air/RH | | no data | | | |
| 2012 | 125 | | | removed | unshrouded | unshrouded | | | no ship1 air/RH | | no data | | | |
| 2012 | 126 | | | removed | unshrouded | unshrouded | | | no ship1 air/RH | | | | | |
| 2012 | 131 | | | removed | unshrouded | unshrouded | | | | | | | | |
| 2012 | 135 | | | removed | unshrouded | unshrouded | | | | | no data | | | |
| 2012 | 136 | | | removed | unshrouded | unshrouded | | | | | | | | |
| 2012 arrive Immingham | 145 | | | removed | unshrouded | unshrouded | no data | | | | | tsg off | | |
| 2012 Immingham | 146 | no data | no data | removed | shrouded | shrouded | no data | no data | | | no data | tsg off | | |
| 2012 Immingham | 147 | no data | no data | removed | shrouded | shrouded | no data | | | | no data | tsg off | | |
| 2012 Immingham | 148 | no data | no data | removed | shrouded | shrouded | no data | | | | no data | tsg off | | |
| **Year** | **Jday** | **psychrometer** | **Vaisala** | **Licor1** | **Licor 2** | **Licor N** | **wavex** | **Sonic** | **Ships RH/T** | **navigation** | **Co2** | **TSG** | **Camera** | **other** |
| 2012 Immingham | 149 | | | removed | shrouded | shrouded | no data | | | | no data | tsg off | | |
| 2012 depart Immingham | 153 | dried out | | removed | shrouded | shrouded | no data | | | | no data | tsg on | | |
| 2012 | 154 | dried out | | removed | shrouded | shrouded | | | | | | | | |
| 2012 | 160 | | | removed | shrouded | shrouded | | | | | | | | |
| 2012 | 166 | frozen | | removed | shrouded | shrouded | | | | | | ice | | |
| 2012 | 167 | | | removed | shrouded | shrouded | no data | | | | | ice | | |
| 2012 | 168 | | | removed | shrouded | shrouded | no data | | | | | ice | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2012 | 169 | | | removed | shrouded | shrouded | no data | no data | | | | ice | | |
| 2012 | 170 | no data | | removed | shrouded | shrouded | no data | no data | | | | ice | | |
| 2012 | 171 | | | removed | shrouded | shrouded | | | | | | ice | | |
| 2012 arrive Ny Alesund | 172 | | | removed | shrouded | shrouded | no data | | | | | tsg off | | |
| 2012 depart Ny Alesund | 173 | | | removed | shrouded | shrouded | | | | | | tsg on | | |
| 2012 | 174 | | | removed | shrouded | shrouded | | | | | | | | |
| 2012 | 177 | | | removed | unshrouded | unshrouded | | | | | | | | |
| 2012 | 181 | no data | no data | removed | unshrouded | unshrouded | no data | | | | | | | |
| 2012 arrive Reykjavik | 184 | no data | no data | removed | unshrouded | unshrouded | no data | | | | | tsg off | | |
| 2012 Reykjavik | 185 | | | removed | unshrouded | unshrouded | no data | | | | no data | tsg off | | |
| 2012 depart Reykjavik | 189 | | | removed | unshrouded | unshrouded | no data | | | | no data | tsg on | | |
| 2012 | 190 | | | removed | unshrouded | unshrouded | no data | | | | no data | | | |
| 2012 | 191 | | | removed | unshrouded | unshrouded | | | | | no data | | | |
| 2012 | 204 | | | removed | unshrouded | foremast link down | | foremast link down | | | no data | | | |
| **Year** | **Jday** | **psychrometer** | **Vaisala** | **Licor1** | **Licor 2** | **Licor N** | **wavex** | **Sonic** | **Ships RH/T** | **navigation** | **Co2** | **TSG** | **Camera** | **other** |
| 2012 | 205 | | | removed | unshrouded | foremast link down | | foremast link down | | | no data | tsg off | | |
| 2012 arrive Reykjavik | 206 | | | removed | unshrouded | foremast link down | no data | foremast link down | | | no data | tsg off | | |
| 2012 depart Reykjavik | 209 | | | removed | unshrouded | foremast link down | no data | foremast link down | | | no data | tsg on | | |
| 2012 | 210 | | | removed | unshrouded | foremast link down | | foremast link down | | | no data | | | |
| 2012 Siglufjordur | 219 | | | removed | unshrouded | foremast link down | no data | foremast link down | | | no data | tsg off | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2012 | 220 | | | removed | unshrouded | foremast link down | | foremast link down | | | no data | | | |
| 2012 | 230 | | | removed | unshrouded | foremast link down | no data | foremast link down | | | no data | ice | | |
| 2012 | 231 | | | removed | unshrouded | foremast link down | no data | foremast link down | | | no data | ice | | |
| 2012 | 232 | | | removed | unshrouded | foremast link down | | foremast link down | | | no data | | | |
| 2012 | 233 | | | removed | unshrouded | foremast link down | no data | foremast link down | | | no data | | | |
| 2012 | 234 | | | removed | unshrouded | foremast link down | no data | foremast link down | | | no data | | | |
| 2012 | 235 | | | removed | unshrouded | foremast link down | no data | foremast link down | | | no data | ice | | |
| 2012 | 236 | | | removed | unshrouded | foremast link down | no data | foremast link down | | | no data | ice | | |
| 2012 | 237 | | | removed | unshrouded | foremast link down | | foremast link down | | | no data | ice | | |
| 2012 | 238 | | | removed | unshrouded | foremast link down | | foremast link down | | | no data | | | |
| 2012 Longyearbyen | 239 | | | removed | unshrouded | foremast link down | | foremast link down | | | no data | tsg off | | |
| 2012 | 240 | | | removed | unshrouded | foremast link down | | foremast link down | | | no data | tsg off | | |
| **Year** | **Jday** | **psychrometer** | **Vaisala** | **Licor1** | **Licor 2** | **Licor N** | **wavex** | **Sonic** | **Ships RH/T** | **navigation** | **Co2** | **TSG** | **Camera** | **other** |
| 2012 refit | 245 | | | removed | unshrouded | foremast link down | off | foremast link down | | | no data | tsg off | | |
| 2012 refit | 246 | | | removed | unshrouded | foremast link down | off | foremast link down | | | no data | tsg off | | |
| 2012 refit | 247 | | | removed | removed | removed | off | removed | | | no data | tsg off | | |
| 2012 immingham ship visit | 276 | | | removed | unshrouded | unshrouded | off | | | | no data | tsg off | | |
| 2012 immingham ship visit | 277 | | | removed | unshrouded | unshrouded | off | | | | no data | tsg off | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2012 immingham ship visit | 278 | | | removed | unshrouded | unshrouded | | | | | no data | tsg off | | |
| 2012 immingham ship visit | 279 | | | removed | unshrouded | unshrouded | off | | | | no data | tsg off | | |
| 2012 | 280 | | | removed | unshrouded | unshrouded | off | | | | no data | tsg off | | |
| 2012 arrive portsmouth UK | 285 | | | removed | unshrouded | unshrouded | NOTE1 | | | | no data | tsg off | | |
| 2012 depart portsmouth UK | 286 | | | removed | unshrouded | unshrouded | NOTE1 | | | | no data | tsg on | | |
| 2012 | 287 | | | removed | unshrouded | unshrouded | NOTE1 | | | | no data | | | |
| 2012 | 305 | | | removed | unshrouded | unshrouded | NOTE1 | | | | | | | |
| 2012 arrive FI | 313 | | | removed | unshrouded | unshrouded | NOTE1 | | | | | tsg off | | |
| 2012 FI | 314 | | | removed | unshrouded | unshrouded | NOTE1 | | | | no data | tsg off | | |
| 2012 FI | 318 | no data | no data | removed | unshrouded | unshrouded | NOTE1 | no data | | | no data | tsg off | | |
| 2012 depart FI | 319 | no data | no data | removed | unshrouded | unshrouded | NOTE1 | no data | | no data | no data | tsg on | | |
| **Year** | **Jday** | **psychrometer** | **Vaisala** | **Licor1** | **Licor 2** | **Licor N** | **wavex** | **Sonic** | **Ships RH/T** | **navigation** | **Co2** | **TSG** | **Camera** | **other** |
| 2012 | 320 | no data | no data | removed | unshrouded | unshrouded | NOTE1 | no data | | | | tripped | | |
| 2012 | 321 | no data | no data | removed | unshrouded | unshrouded | NOTE1 | no data | | | | | | |
| 2012 | 322 | no data | no data | removed | unshrouded | unshrouded | NOTE1 | no data | | | | | | |
| 2012 off Bird Island | 323 | no data | no data | removed | unshrouded | unshrouded | NOTE1 | no data | | | | | | |
| 2012 off Bird Island | 324 | no data | no data | removed | unshrouded | unshrouded | NOTE1 | no data | | | | | | |
| 2012 arrive KEP | 325 | | | removed | unshrouded | unshrouded | NOTE1 | | | | | tsg off | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2012 depart KEP | 326 | | | removed | unshrouded | unshrouded | NOTE1 | | | | | tsg on | | |
| 2012 | 327 | | | removed | unshrouded | unshrouded | NOTE1 | | | | | | | |
| 2012 | 328 | | | removed | unshrouded | unshrouded | NOTE1 | | | | | | | |
| 2012 | 329 | | | removed | unshrouded | unshrouded | NOTE1 | | | | | ice | | |
| 2012 arrive Signy | 330 | frozen | | removed | unshrouded | unshrouded | NOTE1 | | | | no data | tsg off | | |
| 2012 Signy | 331 | frozen | | removed | unshrouded | unshrouded | NOTE1 | | | | no data | tsg off | | |
| 2012 Signy | 332 | frozen | | removed | unshrouded | unshrouded | NOTE1 | | | | no data | tsg off | | |
| 2012 depart Signy | 333 | frozen | | removed | unshrouded | unshrouded | NOTE1 | | | | | tsg on | | |
| 2012 | 334 | frozen | | removed | unshrouded | unshrouded | NOTE1 | | | | | tripped | | |
| 2012 | 335 | | | removed | unshrouded | unshrouded | NOTE1 | | | | | | | |
| 2012 | 339 | | | removed | unshrouded | unshrouded | NOTE1 | | | | | tripped | | |
| 2012 | 340 | | | removed | unshrouded | unshrouded | NOTE1 | | | | | | | |
| 2012 | 343 | frozen | | removed | unshrouded | unshrouded | NOTE1 | | | | | | | |
| 2012 | 344 | frozen | | removed | unshrouded | unshrouded | NOTE1 | | | | | | | |
| 2012 | 345 | | | removed | unshrouded | unshrouded | NOTE1 | | | | | | | |
| 2012 arrive FI | 346 | | | removed | unshrouded | unshrouded | NOTE1 | | | | | tsg off | | |
| **Year** | **Jday** | **psychrometer** | **Vaisala** | **Licor1** | **Licor 2** | **Licor N** | **wavex** | **Sonic** | **Ships RH/T** | **navigation** | **Co2** | **TSG** | **Camera** | **other** |
| 2012 FI | 347 | | | removed | unshrouded | unshrouded | NOTE1 | | | | no data | tsg off | | |
| 2012 FI | 348 | no data | no data | removed | unshrouded | unshrouded | NOTE1 | | | | no data | off | | |
| 2012 FI | 349 | no data | no data | removed | unshrouded | unshrouded | NOTE1 | no data | | no data | no data | tsg off | no images | |
| 2012 FI | 350 | no data | no data | removed | unshrouded | unshrouded | NOTE1 | no data | | no data | no data | tsg off | no images | |
| 2012 depart FI | 351 | no data | no data | removed | unshrouded | unshrouded | NOTE1 | no data | | no data | no data | tsg on | no images | |
| 2012 | 352 | | | removed | unshrouded | unshrouded | NOTE1 | no data | | | | | no images | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2012 | 353 | frozen | | removed | unshrouded | unshrouded | NOTE1 | | | | | | no images | |
| 2012 | 354 | frozen | | removed | unshrouded | unshrouded | | | | | | | no images | |
| 2012 | 355 | frozen | | removed | unshrouded | unshrouded | NOTE1 | | | | | tsg off | no images | |
| 2012 | 356 | frozen | | removed | unshrouded | unshrouded | NOTE1 | | | | no data | tsg off | no images | |
| 2012 | 357 | | | removed | unshrouded | unshrouded | NOTE1 | | | | no data | tsg off | no images | |
| 2012 | 360 | | | removed | unshrouded | unshrouded | NOTE1 | | | | | tsg on | no images | |
| 2012 | 361 | | | removed | unshrouded | unshrouded | NOTE1 | | | | | | no images | |
| 2012 | 362 | | | removed | unshrouded | unshrouded | NOTE1 | | | | | ice | no images | |
| 2012 | 363 | no data | no data | removed | unshrouded | unshrouded | NOTE1 | no data | | no data | no data | | no images | |
| 2012 | 364 | no data | no data | removed | unshrouded | unshrouded | NOTE1 | no data | | no data | no data | | no images | |
| 2012 | 365 | no data | no data | removed | unshrouded | unshrouded | NOTE1 | no data | | no data | no data | | no images | |

## F.4 2013

| Year | Jday | psychrometer | Vaisala | Licor1 | Licor 2 | Licor N | wavex | Sonic | Ships RH/T | navigation | Co2 | TSG | Camera | other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2013 | 001 | frozen | | removed | unshrouded | unshrouded | no data | | | | | | | |
| 2013 arrive FI | 002 | | | removed | unshrouded | unshrouded | no data | | | | | tsg off | | |
| 2013 FI | 003 | | | removed | unshrouded | unshrouded | no data | | | | no data | tsg off | | |
| 2013 FI | 004 | no data | no data | removed | unshrouded | unshrouded | no data | | | no data | no data | tsg off | | |
| 2013 FI | 008 | no data | no data | removed | unshrouded | unshrouded | no data | | | no data | no data | tsg off | | |
| 2013 | 009 | no data | no data | removed | unshrouded | unshrouded | no data | | | no data | | | | |
| 2013 | 011 | no data | no data | removed | unshrouded | unshrouded | no data | | | no data | | ice | | |
| 2013 | 012 | | | removed | unshrouded | unshrouded | | | | | no data | | | |
| 2013 | 016 | | | removed | unshrouded | unshrouded | | | | | no data | ice | | |
| 2013 | 017 | | | removed | unshrouded | unshrouded | | | | | no data | | | |
| 2013 | 018 | frozen | | removed | unshrouded | unshrouded | no data | | | | no data | ice | | |
| 2013 | 019 | frozen | | removed | unshrouded | unshrouded | | | | | no data | | | |
| 2013 | 020 | | | removed | unshrouded | unshrouded | | | | | no data | | | |

| 2013 | 022 | no data | no data | removed | unshrouded | unshrouded | | | | no data | no data | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2013 KEP | 026 | | | removed | unshrouded | unshrouded | | | | | no data | tsg off | | |
| 2013 | 027 | | | removed | unshrouded | unshrouded | | | | | no data | | | |
| 2013 | 034 | frozen | | removed | unshrouded | unshrouded | | | | | no data | | | |
| 2013 | 036 | | | removed | unshrouded | unshrouded | | | | | no data | | | |
| 2013 | 039 | no data | no data | removed | unshrouded | unshrouded | | | | no data | no data | | | |
| 2013 | 040 | no data | no data | removed | unshrouded | unshrouded | no data | | | no data | no data | | | |
| 2013 | 041 | | | removed | unshrouded | unshrouded | | | | | no data | | | |
| 2013 arrive FI | 043 | no data | no data | removed | unshrouded | unshrouded | | | | | no data | tsg off | | |
| 2013 FI | 044 | no data | no data | removed | unshrouded | unshrouded | | | | | no data | tsg off | | |
| 2013 FI | 045 | no data | no data | removed | unshrouded | unshrouded | no data | | | | no data | tsg off | | |
| **Year** | **Jday** | **psychrometer** | **Vaisala** | **Licor1** | **Licor 2** | **Licor N** | **wavex** | **Sonic** | **Ships RH/T** | **navigation** | **Co2** | **TSG** | **Camera** | **other** |
| 2013 FI | 046 | no data | no data | removed | unshrouded | unshrouded | no data | | | | no data | tsg off | | |
| 2013 FI | 047 | no data | no data | removed | unshrouded | unshrouded | no data | | | no data | no data | tsg off | | |
| 2013 FI | 048 | no data | no data | removed | unshrouded | unshrouded | no data | | | no data | no data | tsg off | | |
| 2013 FI | 049 | no data | no data | removed | unshrouded | unshrouded | no data | | | | no data | tsg off | | |
| 2013 depart FI | 050 | no data | no data | removed | unshrouded | unshrouded | no data | | | | no data | | | |
| 2013 | 051 | no data | no data | removed | unshrouded | unshrouded | | | | | no data | | | |
| 2013 | 057 | no data | no data | removed | unshrouded | unshrouded | | | | | | | | |
| 2013 | 058 | frozen | | removed | unshrouded | unshrouded | | | | | | | | |
| 2013 | 059 | frozen | | removed | unshrouded | unshrouded | | | | | | ice | | |
| 2013 | 060 | no data | | removed | unshrouded | unshrouded | | | | | no data | ice | | |
| 2013 | 061 | no data | | removed | unshrouded | unshrouded | no data | | | | no data | ice | | |
| 2013 | 062 | frozen | | removed | unshrouded | unshrouded | no data | | | | no data | ice | | |
| 2013 | 063 | frozen | | removed | shrouded | shrouded | no data | | | | no data | ice | | |
| 2013 | 064 | frozen | | removed | shrouded | shrouded | no data | | | | no data | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2013 | 065 | frozen | | removed | shrouded | shrouded | no data | | | | | | | |
| 2013 | 066 | frozen | | removed | shrouded | shrouded | | | | | | | | |
| 2013 arrive FI | 072 | | | removed | shrouded | shrouded | no data | | | | | tsg off | | |
| 2013 FI | 075 | dried out | | removed | shrouded | shrouded | no data | | | | no data | tsg off | | no LW |
| 2013 FI | 076 | no data | no data | removed | shrouded | shrouded | no data | | | | no data | tsg off | | no LW |
| 2013 depart FI | 077 | no data | no data | removed | unshrouded | unshrouded | no data | | | | | | | no LW |
| 2013 | 078 | dried out | no data | removed | unshrouded | unshrouded | | | | | | | | no LW |
| 2013 | 079 | dried out | | removed | unshrouded | unshrouded | | | | | | | | no LW |
| 2013 | 080 | dried out | | removed | unshrouded | unshrouded | | | | | | | | no LW |
| 2013 | 081 | dried out | | removed | unshrouded | unshrouded | | | | | | | | no LW |
| 2013 | 082 | | | removed | unshrouded | unshrouded | | | | | | | | no LW |
| **Year** | **Jday** | **psychrometer** | **Vaisala** | **Licor1** | **Licor 2** | **Licor N** | **wavex** | **Sonic** | **Ships RH/T** | **navigation** | **Co2** | **TSG** | **Camera** | **other** |
| 2013 | 084 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 085 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 086 | frozen | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 090 | frozen | | removed | unshrouded | unshrouded | | | no data 1 | | | ice | | no LW |
| 2013 | 094 | frozen | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 arrive KEP | 102 | | | removed | unshrouded | unshrouded | no data | | no data 1 | | | tsg off | | no LW |
| 2013 depart KEP | 103 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 104 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 112 | | | removed | unshrouded | pump faulty - UPDATE | | | no data 1 | | | | | no LW |
| 2013 | 114 | no data | no data | removed | unshrouded | pump faulty - UPDATE | | | no data 1 | no data | | | | no LW |
| 2013 | 115 | no data | no data | removed | unshrouded | unshrouded | | | no data 1 | no data | | | | no LW |
| 2013 | 116 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 arrive FI | 117 | | | removed | unshrouded | unshrouded | no data | | no data 1 | | | tsg off | | no LW |
| 2013 | 118 | no data | no data | removed | unshrouded | unshrouded | no data | | no data 1 | no data | no data | tsg off | | no LW |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FI | | | | | | | | | | | | | | |
| 2013 depart FI | 122 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 123 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 124 | no data | no data | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 125 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 KEP | 126 | | | removed | unshrouded | unshrouded | | | no data 1 | | | tsg off | | no LW |
| 2013 | 127 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 128 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 arrive KEP | 129 | | | removed | unshrouded | unshrouded | | | no data 1 | | | tsg off | | no LW |
| 2013 depart KEP | 130 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| **Year** | **Jday** | **psychrometer** | **Vaisala** | **Licor1** | **Licor 2** | **Licor N** | **wavex** | **Sonic** | **Ships RH/T** | **navigation** | **Co2** | **TSG** | **Camera** | **other** |
| 2013 | 131 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 137 | | | removed | unshrouded | unshrouded | | | no data 1 | | no data | | | no LW |
| 2013 | 138 | dried out | | removed | unshrouded | unshrouded | | | no data 1 | | no data | | | no LW |
| 2013 | 140 | | | removed | unshrouded | unshrouded | | | no data 1 | | no data | | | no LW |
| 2013 | 143 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 147 | | | removed | unshrouded | removed | | | no data 1 | | | | | no LW |
| 2013 | 148 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 149 | dried out | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 152 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 153 | dried out | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 154 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 155 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 156 | dried out | | removed | removed | removed | | removed | no data 1 | | | | | no LW |
| 2013 | 157 | dried out | no data | removed | removed | removed | no data | removed | no data 1 | no data | | | | no LW |
| 2013 Ascension | 158 | no data | no data | removed | removed | removed | no data | removed | no data 1 | no data | | tsg off | | no LW |
| 2013 | 159 | no data | no data | removed | removed | removed | no data | removed | no data 1 | no data | | | | no LW |
| 2013 Las | 167 | no data | no data | removed | removed | removed | no data | removed | no data 1 | no data | | | | no LW |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Palmas | | | | | | | | | | | | | | |
| 2013 depart Las Palmas | 180 | no data | no data | removed | removed | removed | no data | removed | no data 1 | no data | no data | | | no LW |
| 2013 | 181 | no data | no data | removed | removed | removed | no data | removed | no data 1 | no data | no data | | | no LW |
| 2013 Immingham | 189 | no data | no data | removed | removed | removed | no data | removed | no data 1 | no data | no data | | | no LW |
| 2013 Immingham | 190 | no data | no data | removed | removed | removed | no data | removed | no data 1 | no data | no data | | | no LW |
| 2013 Immingham | 191 | no data | no data | removed | unshrouded | unshrouded | no data | | no data 1 | | no data | | | no LW |
| 2013 Immingham | 192 | no data | no data | removed | unshrouded | unshrouded | no data | | no data 1 | | no data | | | no LW |
| **Year** | **Jday** | **psychrometer** | **Vaisala** | **Licor1** | **Licor 2** | **Licor N** | **wavex** | **Sonic** | **Ships RH/T** | **navigation** | **Co2** | **TSG** | **Camera** | **other** |
| 2013 Immingham | 193 | no data | no data | removed | unshrouded | unshrouded | no data | | no data 1 | | no data | tsg off | | no LW |
| 2013 depart Immingham | 194 | no data | no data | removed | unshrouded | unshrouded | no data | | no data 1 | | no data | | | no LW |
| 2013 | 195 | no data | no data | removed | unshrouded | unshrouded | no data | | no data 1 | no data | no data | | | no LW |
| 2013 | 196 | no data | no data | removed | unshrouded | unshrouded | | | no data 1 | no data | | | | no LW |
| 2013 | 197 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 204 | frozen | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 205 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 206 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 207 | | | removed | unshrouded | unshrouded | | | no data 1 | | | ice | | no LW |
| 2013 | 208 | frozen | | removed | unshrouded | unshrouded | | | no data 1 | | | ice | | no LW |
| 2013 | 211 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 Longyearbyen | 212 | | | removed | unshrouded | unshrouded | | | no data 1 | | | tsg off | | no LW |
| 2013 | 213 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2013 | 214 | | | removed | unshrouded | unshrouded | | | no data 1 | | | ice | | no LW |
| 2013 | 215 | frozen | | removed | unshrouded | unshrouded | | | no data 1 | | | ice | | no LW |
| 2013 | 217 | | | removed | unshrouded | unshrouded | | | no data 1 | | | ice | | no LW |
| 2013 | 218 | | | removed | unshrouded | unshrouded | | | no data 1 | | | ice | | no LW |
| 2013 | 219 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 Longyerbyden | 222 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 | 223 | | | removed | unshrouded | unshrouded | | | no data 1 | | | | | no LW |
| 2013 Dundee | 228 | | | removed | unshrouded | unshrouded | | | no data 1 | | | tsg off | | no LW |
| 2013 | 229 | | | removed | unshrouded | unshrouded | no data | | no data 1 | | no data | | | no LW |
| 2013 Frederikshaven | 234 | | | removed | unshrouded | unshrouded | no data | | no data 1 | | no data | | | no LW |
| **Year** | **Jday** | **psychrometer** | **Vaisala** | **Licor1** | **Licor 2** | **Licor N** | **wavex** | **Sonic** | **Ships RH/T** | **navigation** | **Co2** | **TSG** | **Camera** | **other** |
| 2013 Frederikshaven | 265 | | | removed | unshrouded | unshrouded | no data | | no data 1 | | no data | | | no LW |
| 2013 | 266 | | | removed | unshrouded | unshrouded | no data | | no data 1 | | no data | | | no LW |
| 2013 Immingham | 268 | system removed | system removed | System removed | system removed | system removed | System removed | system removed | - | | - | | | System removed |

## Table G. Anemometer and motion instrument offsets determined in the lab.

MotionPak and Sonic mounted together on a metal plate with the Sonic aligned approximately forward facing, and the MotionPak box in line behind it with the box wiring emerging from the rear. The Sonic is twisted hard to anticlockwise against its mounting bolts when viewed from above. The MotionPak was mounted to the same plate as the R3 sonic. The center of the Motionpak was located 0.65 m below, and 0.095 m aft, of the center of the R3 measurement volume. There was no port-starboard offset between the two sensors. The offsets given are the rotational offsets of the Sonic with respect to the MotionPak frame of reference. A positive fore-aft offset means the Sonic is leaning forwards. A positive port-starboard offset means the Sonic is leaning to starboard when viewed from behind. A positive yaw angle corresponds to a rotation of the Sonic clockwise when viewed from above. Uncertainties shown are the standard deviation of the measurements made.

| MotionPak sn | Sonic sn | Fore-aft tilt offset (°) | Port-star' tilt offset (°) | Yaw offset (°) | Date of experiment |
|---|---|---|---|---|---|
| 682 | 227 | 0.20 ± 0.07 | 0.20 ± 0.03 | -8.21 ± 0.14 | Sep' 2010 |
| 682 | 38 | 0.06 ± 0.02 | 0.20 ± 0.03 | -7.48 ± 0.24 | June 2011 |
| 682 | 391 | 0.21 ± 0.05 | 0.49 ± 0.03 | -8.01 ± 0.13 | June 2011 |
| 791 | 227 | 0.38 ± 0.09 | -0.30 ± 0.05 | -7.32 ± 0.24 | Sep' 2012 |
| 791 | 38 | 0.25 ± 0.06 | -0.61 ± 0.02 | -7.68 ± 0.24 | July 2011 |
| 791 | 391 | 0.42 ± 0.02 | -0.43 ± 0.01 | -7.93 ± 0.22 | July 2011 |
| | | | | | |

## Table H. R3 and MP orientations relative to the ship

Columns 5 and 6 show best estimate (parallax method)of R3 and MP yaw offsets relative to the ship. Colum 7 shows the difference between columns 5 and 6. The final column shows the measurements of the offset between the R3 and motionpak made in the lab (from Table G). The latter are negative when the R3 is pointing to port of the motionpak (see Prytherch et al, 2010). If the parallax measurements are good, then the differences in column 7 should be close to the values in the final column. Years in bold indicate that the R3/motionpak pair have been replaced or moved just prior to the parallax measurements. **The final two columns give our best estimate of the instrument yaw angles relative to the ship as described in Section 4.2.**

| Year | Jday | Sonic S/N | Motion Pack S/N | Sonic Yaw (degrees) | Motion Pack Yaw | Difference (degrees) | Laboratory measurement | **R3 best. yaw** | **MP best yaw** |
|---|---|---|---|---|---|---|---|---|---|
| 2010 | 158 | 227 | 682 | 9.1 port | 2.0 port | 7.1 port | -8.21±0.14 | **9.0 port** | **1.0 port** |
| **2010** | 243 | 391 | 791 | 9.5 port | 1.0 port | 8.5 port | -7.93±0.22 | **9.0 port** | **1.0 port** |
| | | | | | | | | | |
| **2011** | 171 | 227 | 682 | 6.6 port | 1.6 stb | 8.2 port | -8.21±0.14 | **6.6 port** | **1.6 stb** |
| **2011** | 264 | 391 | 682 | 8.8 port | 1.0 port | 7.8 port | -8.01±0.13 | **9.0 port** | **1.0 port** |
| 2011 | 358 | 391 | 682 | 9.5 port | 1.0 port | 8.5 port | -8.01±0.13 | " | " |
| | | | | | | | | | |
| **2012** | 278 | 227 | 791 | 6.7 port | 1.0 stb | 7.7 port | -7.32±0.24 | **6.3 port** | **1.0 stb** |
| | | | | | | | | | |
| 2013 | 004 | 227 | 791 | 7.0 port<br>6.3 port | 1.1 stb<br>0.7 stb | 8.1 port<br>7.0 port | -7.32±0.24<br>-7.32±0.24 | " | " |
| **2013** | 189 | 227 | 791 | 2.3 port<br>1.6 port | 5.5 stb<br>5.1 stb | 7.8 port<br>6.7 port | -7.32±0.24<br>-7.32±0.24 | **2.2 port** | **5.1 stb** |
| 2013 | 269 | 227 | 791 | 2.5 port | 4.8 stb | 7.3 port | -7.32±0.24 | " | " |

## Table I. The metadata relevant to the calculation of the EC fluxes

From left to right: year; jday (bold type indicates a ship visit); R3 (and MP) serial number and best estimate of yaw orientations (degrees to port or to starboard); Licor1 and Licor 2 serial numbers and periods when shrouded (grey); other relevant problems. NOTE: this is an outline only (not comprehensive) and should be used in conjunction with information in other Tables and Appendices.

| year | jday | R3 | Licor1 | Licor2 | Licor N | CLASP | other |
|---|---|---|---|---|---|---|---|
| 2010 | 145 | S/N 227 (682) yaw (9 p, 1 p) | 1114 | 1113 | | none | MOBILISED |
| | 160 | | | | Not installed | | No wavex psy/vaisala |
| | 170 | | | | Not installed | | No wavex psy/vaisala |
| | 203 | | | | Not installed | | No wavex psy/vaisala |
| | 209 | | | | Not installed | | No wavex psy/vaisala |
| refit | **210** | | refit | refit | Not installed | | No wavex psy/vaisala |
| refit | **247** | 391 (791) yaw (9 p, 1 p) | refit | refit | Not installed | | |
| | 243 | | | | Not installed | | |
| | 248 | | | | Not installed | | |
| | 249 | | | | Not installed | | |
| | 268 | | | | Not installed | | |
| | **270** | | | | | H | |
| | 273 | | | | Not installed | | |
| | 274 | | | | | | |
| | 308 | | | | Not installed | | |
| | 313 | | | | Not installed | | |
| | 320 | | | | Not installed | | |
| | 324 | | | | Not installed | | |
| | 346 | | | | | I | |
| 2011 | 047 | SIU resister blown, sync fault | | | | | |
| | 077 | | | | | K | |
| | 099 | SIU resister blown, sync fault | | | Not installed | | |
| | 115 | SIU resister blown, sync fault | | | Not installed | | |
| | 116 | SIU resister blown, sync fault | | | Not installed | | |
| | **144** | SIU resister blown, sync fault removed | removed | removed | Not installed | removed | |
| | **147** | | | | Not installed | | |
| | 148 | | | | Not installed | | |
| | **171** | | | | Not installed | | |
| | **173** | 227 (682) yaw (6.6 p, 1.6 s) | 0614 | 0825 | Not installed | G | WAVEX scanner backwards |
| | **174** | | | | Not installed | | |
| | 212 | | | | Not installed | | |
| | **262** | 391 (682) yaw (9 p, 1 p) | 1113 | 1114 | Not installed | L | |

| year | jday | R3 | Licor1 | Licor2 | Licor N | CLASP | other |
|---|---|---|---|---|---|---|---|
| | **265** | | | | Not installed | | WAVEX scanner corrected |
| | 273 | motionpak FLOODED | | | | | |
| | 329 | motionpak FLOODED | | unused? | Not installed | | |
| | 330 | motionpak FLOODED | removed to install licor N | unused ? | head 0274, int 0538 | I | |
| | 342 | motionpak FLOODED | removed | unused? | | | |
| | 352 | (MP 791 installed) yaw (9 p, 1 p) | removed | | | | |
| | 359 | | removed | | | | |
| | | | | | | | |
| 2012 | 14 | | removed | | No data | | |
| | 85 | | | | | F | |
| | 87 | | removed | | head 0309, int 0593 | | |
| | 117 | | | | | I | |
| | **146** | | removed | | | | |
| | **148** | | removed | | | | |
| | 176 | | removed | | | | |
| | 204 | Foremast link down | removed | Foremast link down | Foremast link down | | |
| | 246 | Foremast link down | removed | Foremast link down | Foremast link down | | |
| | **247** | Removed refit | removed | Removed refit | Removed refit | removed | |
| | **250** | Removed refit | removed | Removed refit | Removed refit | | |
| | 275 | Removed refit | removed | Removed refit | Removed refit | | |
| | **276** | 227 (791) yaw (6.3 p, 1.0 s) | removed | 0614 | head 0309, int 0593 | L | |
| | **279** | | removed | | | | |
| | | | | | | | |
| 2013 | **003** | | removed | | | G | |
| | **008** | | removed | | | | |
| | 063 | | removed | | | | |
| | 076 | | removed | | | | |
| | 112 | | removed | | Faulty pump | | |
| | 114 | | removed | | Faulty pump | | |
| | 120 | | | | head 0274, int ? | F | |
| | 145 | | | | | O | |
| | 156 | Removed refit | removed | Removed refit | Removed refit | | |
| | **189** | Removed refit | removed | Removed refit | | | |
| | **190** | 227 (791) yaw (2.2 p, 5.1 s) | removed | 0825 | head 0387, int 0831 | | |
| | **192** | | removed | | | | |
| | 268 | SYSTEM REMOVED | | | | | |

## Table J. Periods when data from the ship's air temperature and humidity should be used.

Visual inspection of time series of fluxes and mean temperatures/humidities identified the following additional periods when ship's sensors should be used rather than the psychrometer (but note that the ship's temperature sensor should not be used 2011 between jday 081 to jday 095 and again 2011 between jday 196 and jday 202). Compare with Table F.

| year | DOY (inclusive) | Notes (which psychrometer channel was bad) |
|---|---|---|
| 2010 | 320 - 342 | hum |
| 2011 | 133 - 142 | temp |
| | 0 – 6 | hum |
| | 22 – 25 | hum |
| | 36 – 78 | hum |
| | 85 – 91 | hum (NOTE: ship's air temperatures bad between jday 81 to 95) |
| | 141 - 143 | hum |
| | 204 – 207 | hum |
| | 222 – 228 | hum |
| | 244 - 250 | hum |
| 2012 | 133 – 137 | temp (and SW > 1) |
| | 155 – 156 | temp (and SW > 1) |
| | 161 – 163 | temp (and SW > 1) |
| | 198 | temp (and SW > 1) |
| | 290 | temp (and SW > 1) |
| | 306 | temp (and SW > 1) |
| | 309 – 312 | temp (and SW > 1) |
| | 328 | temp (and SW > 1) |
| | 332 | temp |
| | 337 | temp |
| | 339 | temp |
| | 342 | temp |
| | 353 | temp |
| | 355 | temp |
| | 361 – 363 | temp |
| | 14 – 21 | hum |
| | 26 – 28 | hum |
| | 35 – 39 | hum |
| | 48 – 73 | hum |
| | 76 – 85 | hum |
| | 93 – 102 | hum |
| | 113 – 114 | hum |
| | 153 – 159 | hum |
| | 363 - 365 | hum |
| 2013 | 12 – 19 | temp |
| | 25 – 28 | temp |
| | 33 – 35 | temp |
| | 41 – 42 | temp |
| | 65 – 68 | temp |
| | 72 - 73 | temp |
| | 95 – 96 | temp |
| | 198 | temp |
| | 222 - 226 | temp |
| | 1 | hum |
| | 18 – 19 | hum |
| | 34 – 35 | hum |
| | 57 – 71 | hum |
| | 75 – 81 | hum |
| | 86 – 101 | hum |
| | 137 - 139 | hum |
| | 148 – 157 | hum |
| | 202 – 210 | hum |
| | 214 - 218 | hum |

## Appendix A Motion pack 0791

MotionPak Factory Details: 10/7/2006

| Accels | X axis | Yaxis | Z axis | Spec |
|---|---|---|---|---|
| Scale factor | 1.276 | 1.279 | 1.309 | 1.300 ±10% |
| 0g bias | 0.86 | -4.34 | 0.80 | ±12 |
| RSS align | 0.81 | 0.85 | 0.27 | <1.00 |
| Pen Align (°) | 0.09 | -0.80 | -0.20 | |
| Hin Align (°) | 0.81 | 0.28 | -0.18 | |

| Rates | X axis | Yaxis | Z axis | Spec |
|---|---|---|---|---|
| S/F (mV/°/S) | 49.898 | 49.995 | 50.112 | 50.000 ±1% |
| Bias | 0.04 | -0.18 | 0.03 | ±1.8 |
| RSS align | 0.36 | 0.55 | 0.14 | <1.00 |
| Align1 (°) | -0.32 | 0.54 | 0.02 | |
| Align2 (°) | 0.14 | 0.05 | 0.13 | |

## Appendix B Motion pack 0682

MotionPak Factory Details: 8/8/2003

| Accels | X axis | Yaxis | Z axis | Spec |
|---|---|---|---|---|
| Scale factor | 1.270 | 1.296 | 1.299 | 1.300 ±10% |
| 0g bias | 3.66 | 4.05 | 3.35 | ±12 |
| RSS align | 0.03 | 0.03 | 0.03 | <1.00 |
| Pen Align (°) | 0.01 | 0.01 | -0.03 | |
| Hin Align (°) | -0.03 | 0.03 | 0.01 | |

| Rates | X axis | Yaxis | Z axis | Spec |
|---|---|---|---|---|
| S/F (mV/°/S) | 49.823 | 50.190 | 50.113 | 50.000 ±1% |
| Bias | 0.00 | 0.11 | -0.14 | ±1.8 |
| RSS align | 0.52 | 0.12 | 0.22 | <1.00 |
| Align1 (°) | -0.50 | 0.05 | -0.19 | |
| Align2 (°) | 0.12 | 0.11 | 0.11 | |

## Appendix C Licor 7500 and 7200 calibrations

*C.1 75H-0614*

Calibration history for 75H-0614 in February 2010 is missing.

| | 75H-0614 | | |
|---|---|---|---|
| | 23-Jun-03 | 28-Jul-05 | 11-Jun-08 |
| CO2 | | | |
| A | 1.46722E+02 | 1.48959E+02 | 1.617720E+02 |
| B | 9.17028E+03 | 6.81639E+03 | -3.318770E+04 |
| C | 4.28852E+07 | 4.58741E+07 | 8.473450E+07 |
| D | -1.32324E+10 | -1.40085E+10 | -2.883290E+10 |
| E | 1.79769E+12 | 1.87077E+12 | 3.806110E+12 |
| XS | 1.50000E-03 | 1.20000E-03 | 1.800000E-03 |
| Z | 6.00000E-04 | 4.00000E-04 | 4.000000E-04 |
| H2O | | | |
| A | 4.66765E+03 | 4.65536E+03 | 4.896680E+03 |
| B | 4.15604E+06 | 4.26315E+06 | 3.984990E+06 |
| C | -1.39683E+08 | -2.20559E+08 | -1.314120E+08 |
| XS | -5.00000E-04 | -1.00000E-03 | -8.000000E-04 |
| Z | 1.67000E-02 | 1.27000E-02 | 9.300000E-03 |
| Pressure | | | |
| A0 | | | 1.058800E+01 |
| A1 | | | 2.603600E+01 |
| Zero/Span | | | |
| CO2 zero | 9.24600E-01 | 9.25100E-01 | 9.251000E-01 |
| CO2 span | 1.00160E+00 | 1.00110E+00 | 9.982000E-01 |
| H2O zero | 7.19500E-01 | 7.27600E-01 | 7.323000E-01 |
| H2O Span | 9.91300E-01 | 9.95000E-01 | 9.978000E-01 |

| CO2 abs/kPa | mmol/m3/kPa | mmol/m3/kPa | Diff | % |
|---|---|---|---|---|
| **8.38E-04** | 0.150373 | 0.149376 | **0.000996** | **0.67** |
| H2O | | | | |
| **6.27E-04** | 4.540513 | 4.604442 | **-0.063929** | **-1.39** |

## LI-7500 $CO_2/H_2O$ Analyzer

**Calibration Certificate**

**Serial Number** 75H-0614

**Date:** 17.07.2012 **Technician** M.R.

### $CO_2$ Calibration Values

**A** = 1.56303E2
**B** = -1.04641E4
**C** = 6.63574E7
**D** = -2.24436E10
**E** = 3.05483E12
**XS** = 0.0033
**Z** = -1.00000E-4

### $H_2O$ Calibration Values

**A** = 5.61401E3
**B** = 4.01761E6
**C** = -3.09217E8
**XS** = -0.0017
**Z** = 1.80000E-3

### Pressure Calibration*

**A0** = 10.586
**A1** = 26.036

* Ver 3.0.1 and above

### Zero/Span set on 18.07.2012

CO2 Zero = 0.9235
CO2 Span = 1.0021 (at 607 ppm)
H2O Zero = 0.7893
H2O Span = 0.9878 (at 15 C)
ZS5
ZS6

*C.2 75H-0825*

| | 75H-0825 | | |
|---|---|---|---|
| | 25-Jan-05 | 5-Jun-08 | 15-Jun-09 |
| CO2 | | | |
| A | 1.30869E+02 | 1.46146E+02 | 1.397630E+02 |
| B | 1.44519E+04 | -2.16892E+04 | -3.741580E+03 |
| C | 2.60842E+07 | 5.88330E+07 | 4.463380E+07 |
| D | -6.73129E+09 | -1.79119E+10 | -1.343830E+10 |
| E | 8.43984E+11 | 2.16918E+12 | 1.688310E+12 |
| XS | 1.60000E-03 | 1.30000E-03 | 3.000000E-03 |
| Z | 2.80000E-03 | 2.60000E-03 | 2.900000E-03 |
| H2O | | | |
| A | 4.50452E+03 | 4.51498E+03 | 4.669280E+03 |
| B | 3.32272E+06 | 3.74952E+06 | 3.704450E+06 |
| C | 9.89638E+07 | -1.29123E+08 | -7.034610E+07 |
| XS | -4.00000E-04 | -1.10000E-03 | -4.000000E-04 |
| Z | 2.40000E-02 | 1.42000E-02 | 1.730000E-02 |
| Pressure | | | |
| A0 | | 1.04790E+01 | 1.060600E+01 |
| A1 | | 2.60360E+01 | 2.603600E+01 |
| Zero/Span | | | |
| CO2 zero | 9.83700E-01 | 9.83600E-01 | 9.819000E-01 |
| CO2 span | 1.00000E+00 | 1.00000E+00 | 9.983000E-01 |
| H2O zero | 7.27300E-01 | 7.47900E-01 | 7.456000E-01 |
| H2O Span | 9.87500E-01 | 9.91800E-01 | 9.934000E-01 |

| CO2 | | | | |
|---|---|---|---|---|
| abs/kPa | mmol/m3/kPa | mmol/m3/kPa | Diff | % |
| **8.38E-04** | 0.133836 | 0.134741 | **-0.000905** | **-0.67** |
| H2O | | | | |
| **6.27E-04** | 4.273110 | 4.366626 | **-0.093516** | **-2.14** |

## LI-7500 $CO_2/H_2O$ Analyzer

**Calibration Certificate**

**Serial Number** 75H-0825

**Date:** 07.06.2011 **Technician** M.R.

### $CO_2$ Calibration Values

**A** = 1.41081E2
**B** = -1.09947E4
**C** = 5.18820E7
**D** = -1.61701E10
**E** = 2.01271E12
**XS** = 0.0019
**Z** = 2.10000E-3

### $H_2O$ Calibration Values

**A** = 4.66167E3
**B** = 3.39417E6
**C** = 9.20810E7
**XS** = -0.0006
**Z** = 1.37000E-2

### Pressure Calibration*

**A0** = 10.467
**A1** = 26.036
* Ver 3.0.1 and above

### Zero/Span set on 08.06.2011

CO2 Zero = 0.9834
CO2 Span = 1.0000 (at 603 ppm)
H2O Zero = 0 7519
H2O Span = 0.9915 (at 13 C)
ZS5
ZS6

---

## LI-7500 $CO_2/H_2O$ Analyzer

**Calibration Certificate**

**Serial Number** 75H-0825

**Date:** 10 July 2012 **Technician** P.M.

### $CO_2$ Calibration Values

**A** = 1.40276E2
**B** = -7.99206E3
**C** = 4.81990E7
**D** = -1.46387E10
**E** = 1.81500E12
**XS** = 0.0018
**Z** = 2.00000E-3

### $H_2O$ Calibration Values

**A** = 4.69984E3
**B** = 3.41295E6
**C** = -5.66547E7
**XS** = -0.0014
**Z** = 1.48000E-2

### Pressure Calibration*

**A0** = 10.579
**A1** = 26.036
* Ver 3.0.1 and above

### Zero/Span set on 11 July 2012

CO2 Zero = 0.9841
CO2 Span = 1.0018 (at 607 ppm)
H2O Zero = 0.7488
H2O Span = 0.9974 (at 14 C)
ZS5
ZS6

*C.3 75H-1113*

| | 75H-1113 | |
|---|---|---|
| | 31-Jul-06 | 6-Apr-09 |
| CO2 | | |
| A | 1.48438E+02 | 1.50466E+02 |
| B | -5.26643E+03 | -6.67083E+03 |
| C | 5.30750E+07 | 5.67693E+07 |
| D | -1.66528E+10 | -1.84491E+10 |
| E | 2.14891E+12 | 2.45252E+12 |
| XS | 1.70000E-03 | 2.40000E-03 |
| Z | -2.00000E-04 | 0.00000E+00 |
| H2O | | |
| A | 5.07357E+03 | 5.26040E+03 |
| B | 3.80152E+06 | 3.66483E+06 |
| C | -1.15045E+08 | -6.51934E+07 |
| XS | -1.80000E-03 | -1.20000E-03 |
| Z | 2.11000E-02 | 1.70000E-02 |
| Pressure | | |
| A0 | 1.05560E+01 | 1.04310E+01 |
| A1 | 2.60360E+01 | 2.60360E+01 |
| Zero/Span | | |
| CO2 zero | 9.08000E-01 | 9.07900E-01 |
| CO2 span | 1.00000E+00 | 1.00470E+00 |
| H2O zero | 9.16000E-01 | 9.28500E-01 |
| H2O Span | 9.96000E-01 | 1.00410E+00 |

| CO2 abs/kPa | mmol/m3/kPa | mmol/m3/kPa | Diff | % |
|---|---|---|---|---|
| **8.38E-04** | 0.144505 | 0.146630 | **-0.002125** | **-1.45** |
| H2O | | | | |
| **6.27E-04** | 4.647258 | 4.722952 | **-0.075694** | **-1.60** |

## LI-7500 $CO_2/H_2O$ Analyzer

**Calibration Certificate**

**Serial Number** 75H-1113

**Date:** 01.03.2010 **Technician** M.R.

**$CO_2$ Calibration Values**

**A** = 1.51634E2
**B** = -9.91626E3
**C** = 6.04768E7
**D** = -2.00055E10
**E** = 2.67387E12
**XS** = 0.0036
**Z** = -1.00000E-4

**$H_2O$ Calibration Values**

**A** = 5.23507E3
**B** = 3.73367E6
**C** = -9.88616E7
**XS** = -0.0013
**Z** = 1.69000E-2

**Pressure Calibration***

**A0** = 10.577
**A1** = 26.036
* Ver 3.0.1 and above

**Zero/Span set on 02.03.2010**

CO2 Zero = 0.9083
CO2 Span = 1.0064 (at 493 ppm)
H2O Zero = 0.9291
H2O Span = 1.0042 (at 15 C)

---

## LI-7500 $CO_2/H_2O$ Analyzer

**Calibration Certificate**

**Serial Number** 75H-1113

**Date:** 11 July 2011 **Technician** P.H.

**$CO_2$ Calibration Values**

**A** = 1.51232E2
**B** = -1.25860E4
**C** = 6.33523E7
**D** = -2.11261E10
**E** = 2.79848E12
**XS** = 0.0025
**Z** = -4.00000E-4

**$H_2O$ Calibration Values**

**A** = 5.32692E3
**B** = 3.23433E6
**C** = 2.02504E8
**XS** = -0.0013
**Z** = 1.61000E-2

**Pressure Calibration***

**A0** = 10.478
**A1** = 26.036
* Ver 3.0.1 and above

**Zero/Span set on 12 July 2011**

CO2 Zero = 0.9087
CO2 Span = 0.9989 (at 998 ppm)
H2O Zero = 0.9307
H2O Span = 1.0044 (at 14 C)
ZS5
ZS6

*C.4 75H-1114*

| | 75H-1114 | |
|---|---|---|
| | 31-Jul-06 | 9-Jun-09 |
| CO2 | | |
| A | 1.55021E+02 | 1.57928E+02 |
| B | -5.35142E+03 | -1.08867E+04 |
| C | 5.93488E+07 | 6.71827E+07 |
| D | -1.93517E+10 | -2.29411E+10 |
| E | 2.58283E+12 | 3.14962E+12 |
| XS | 1.90000E-03 | 4.00000E-03 |
| Z | -1.50000E-03 | -9.00000E-04 |
| H2O | | |
| A | 5.07675E+03 | 5.29671E+03 |
| B | 4.00700E+06 | 3.68981E+06 |
| C | -1.68006E+08 | -3.93517E+07 |
| XS | -1.80000E-03 | -1.20000E-03 |
| Z | 2.13000E-02 | 1.73000E-02 |
| Pressure | | |
| A0 | 1.05560E+01 | 1.06070E+01 |
| A1 | 2.60360E+01 | 2.60360E+01 |
| Zero/Span | | |
| CO2 zero | 8.82200E-01 | 8.80600E-01 |
| CO2 span | 1.00100E+00 | 1.00000E+00 |
| H2O zero | 9.40600E-01 | 9.51400E-01 |
| H2O Span | 9.95300E-01 | 1.00130E+00 |

| CO2 | | | | |
|---|---|---|---|---|
| abs/kPa | mmol/m3/kPa | mmol/m3/kPa | Diff | % |
| **8.38E-04** | 0.152495 | 0.154117 | **-0.001622** | **-1.05** |
| H2O | | | | |
| **6.27E-04** | 4.716978 | 4.761909 | **-0.044931** | **-0.94** |

## LI-7500 $CO_2/H_2O$ Analyzer

**Calibration Certificate**

**Serial Number** 75H-1114

**Date:** 23.02.2010 **Technician** M.R.

**$CO_2$ Calibration Values**

**A** = 1.59191E2
**B** = -1.47952E4
**C** = 7.18782E7
**D** = -2.50122E10
**E** = 3.44128E12
**XS** = 0.0028
**Z** = -1.10000E-3

**$H_2O$ Calibration Values**

**A** = 5.25016E3
**B** = 3.81294E6
**C** = -1.00460E8
**XS** = -0.0012
**Z** = 1.69000E-2

**Pressure Calibration***

**A0** = 10.554
**A1** = 26.036
* Ver 3.0.1 and above

**Zero/Span set on 24.02.2010**

CO2 Zero = 0.8806
CO2 Span = 1.0061 (at 493 ppm)
H2O Zero = 0.9528
H2O Span = 1.0053 (at 15 C)

---

## LI-7500 $CO_2/H_2O$ Analyzer

**Calibration Certificate**

**Serial Number** 75H-1114

**Date:** 11 July 2011 **Technician** P.H.

**$CO_2$ Calibration Values**

**A** = 1.59057E2
**B** = -1.81435E4
**C** = 7.55250E7
**D** = -2.64452E10
**E** = 3.62427E12
**XS** = 0.0028
**Z** = -1.30000E-3

**$H_2O$ Calibration Values**

**A** = 5.34812E3
**B** = 3.34581E6
**C** = 1.94364E8
**XS** = -0.0011
**Z** = 1.67000E-2

**Pressure Calibration***

**A0** = 10.508
**A1** = 26.036
* Ver 3.0.1 and above

**Zero/Span set on 12 July 2011**

CO2 Zero = 0.8813
CO2 Span = 1.0000 (at 998 ppm)
H2O Zero = 0.9535
H2O Span = 1.0042 (at 14 C)
ZS5
ZS6

*C.5 72H-0274*

---

## LI-7200 $CO_2/H_2O$ Analyzer

**Calibration Certificate**

**Serial Number** 72H-0274

**Date:** 22.08.2012 **Technician** M.R.

### $CO_2$ Calibration Values

**A** = 1.80848E2
**B** = -1.57756E4
**C** = 8.25746E7
**D** = -3.14050E10
**E** = 4.50266E12
**XS** = -0.0033
**Z** = -2.20000E-4

### $H_2O$ Calibration Values

**A** = 6.24486E3
**B** = 5.35652E6
**C** = -9.72319E8
**XS** = -0.0038
**Z** = 5.80000E-4

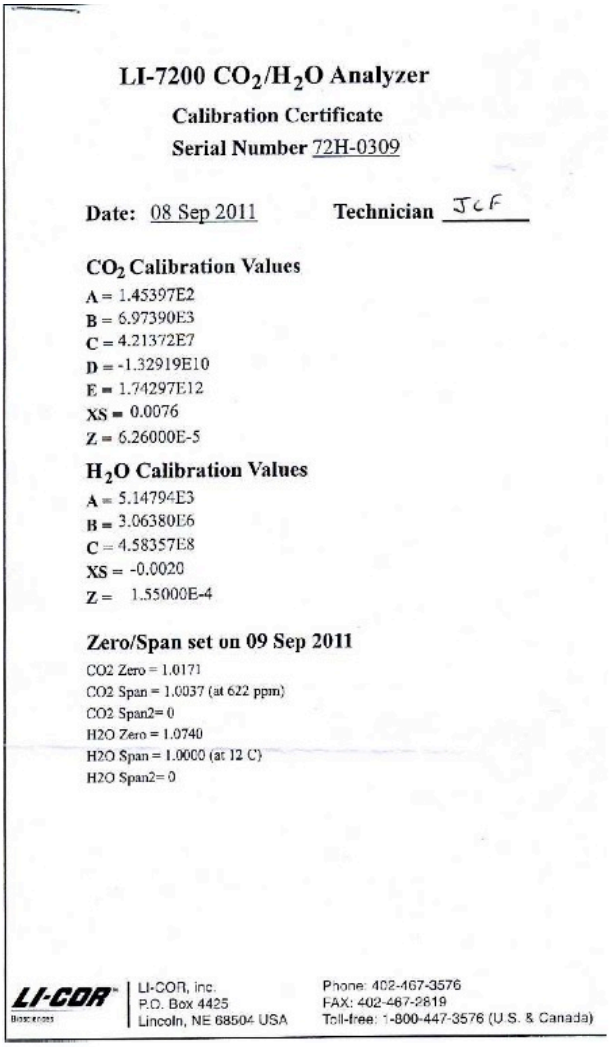
### Pressure Calibration*

**A0** = 57.250
**A1** = 15.230
* Ver 3.0.1 and above

### Zero/Span set on 23.08.2012

CO2 Zero = 0.9198
CO2 Span = 0.9979 (at 750 ppm)
CO2 Span2= 0
H2O Zero = 1.1611
H2O Span = 0.9805 (at 15 C)
H2O Span2= 0

*C.6 72H-0309*



**LI-7200 $CO_2$/$H_2O$ Analyzer**

**Calibration Certificate**

**Serial Number** 72H-0309

**Date:** 08 Sep 2011 **Technician** JCF

**$CO_2$ Calibration Values**

**A** = 1.45397E2
**B** = 6.97390E3
**C** = 4.21372E7
**D** = -1.32919E10
**E** = 1.74297E12
**XS** = 0.0076
**Z** = 6.26000E-5

**$H_2O$ Calibration Values**

**A** = 5.14794E3
**B** = 3.06380E6
**C** = 4.58357E8
**XS** = -0.0020
**Z** = 1.55000E-4

**Zero/Span set on 09 Sep 2011**

CO2 Zero = 1.0171
CO2 Span = 1.0037 (at 622 ppm)
CO2 Span2= 0
H2O Zero = 1.0740
H2O Span = 1.0000 (at 12 C)
H2O Span2= 0

LI-COR Biosciences | LI-COR, Inc. P.O. Box 4425 Lincoln, NE 68504 USA | Phone: 402-467-3576 FAX: 402-467-2819 Toll-free: 1-800-447-3576 (U.S. & Canada)

*C.7 72H-0387*

# LI-7200 $CO_2/H_2O$ Analyzer

## Calibration Certificate

**Serial Number** 72H-0387

**Date:** 06 Sep 2012 **Technician** JLF

### $CO_2$ Calibration Values

**A** = 1.57323E2
**B** = 3.57168E3
**C** = 5.42207E7
**D** = -1.87501E10
**E** = 2.59531E12
**XS** = 0.0016
**Z** = -1.26000E-5

### Max Reference

CX = 40800
WX = 46500

### $H_2O$ Calibration Values

**A** = 5.37416E3
**B** = 4.24685E6
**C** = -5.40753E8
**XS** = -0.0028
**Z** = 1.46000E-4

### Zero/Span set on 06 Sep 2012

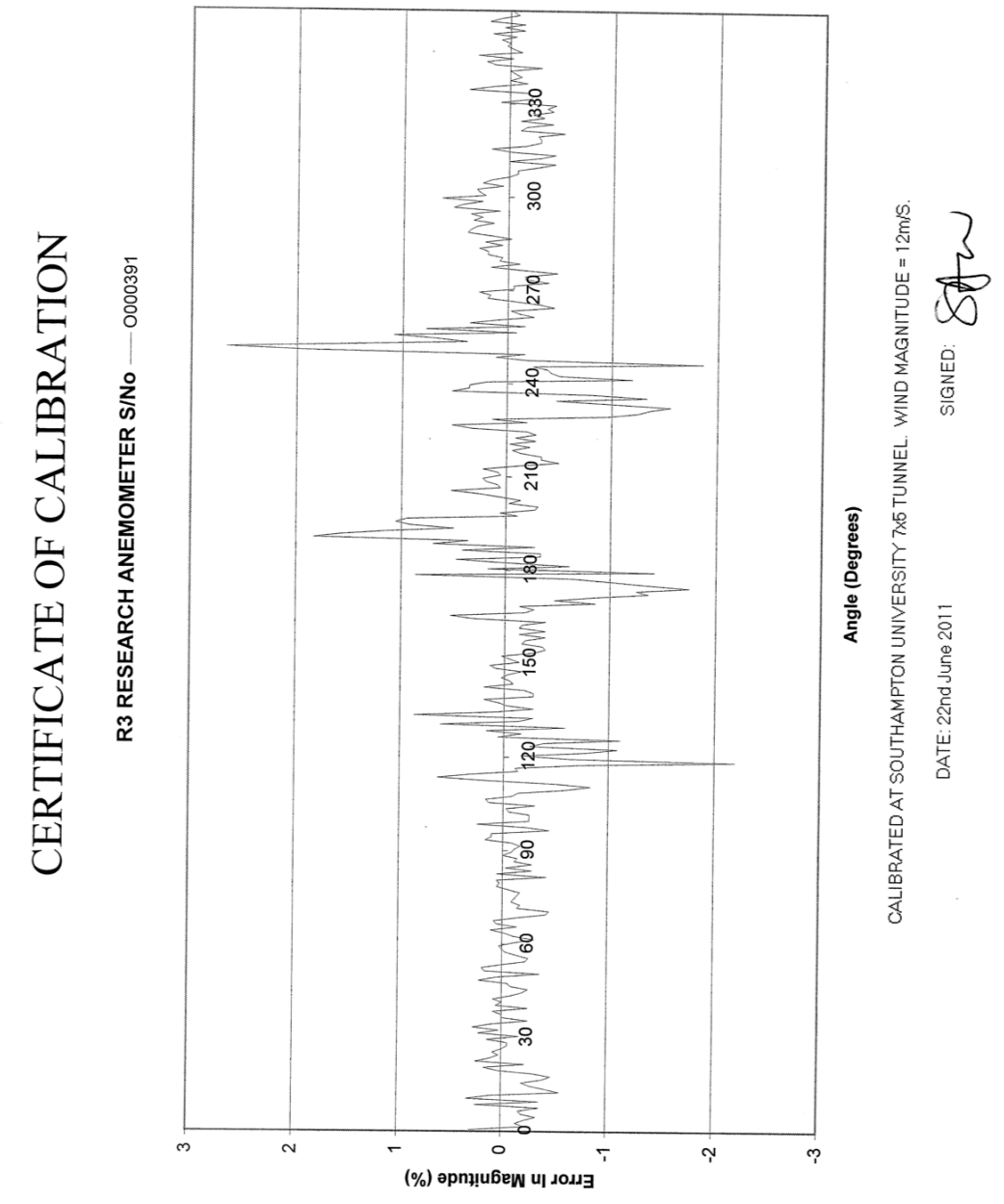
CO2 Zero = 0.8952
CO2 Span = 1.0032 (at 743 ppm)
CO2 Span2= 0.0000
H2O Zero = 1.0689
H2O Span = 1.0036 (at 12 C)
H2O Span2= 0.0000

We are no longer automatically sending along all of the pages of data and graphs associated with most of our gas analyzer calibrations. Instead, we are sending just this summary sheet. The data and analysis graphs are available on request as a .pdf file. This policy saves about 2,000 sheets of paper per month.

LI-COR Biosciences
LI-COR, inc.
P.O. Box 4425
Lincoln, NE 68504 USA
Phone: 402-467-3576
FAX: 402-467-2819
Toll-free: 1-800-447-3576 (U.S. & Canada)

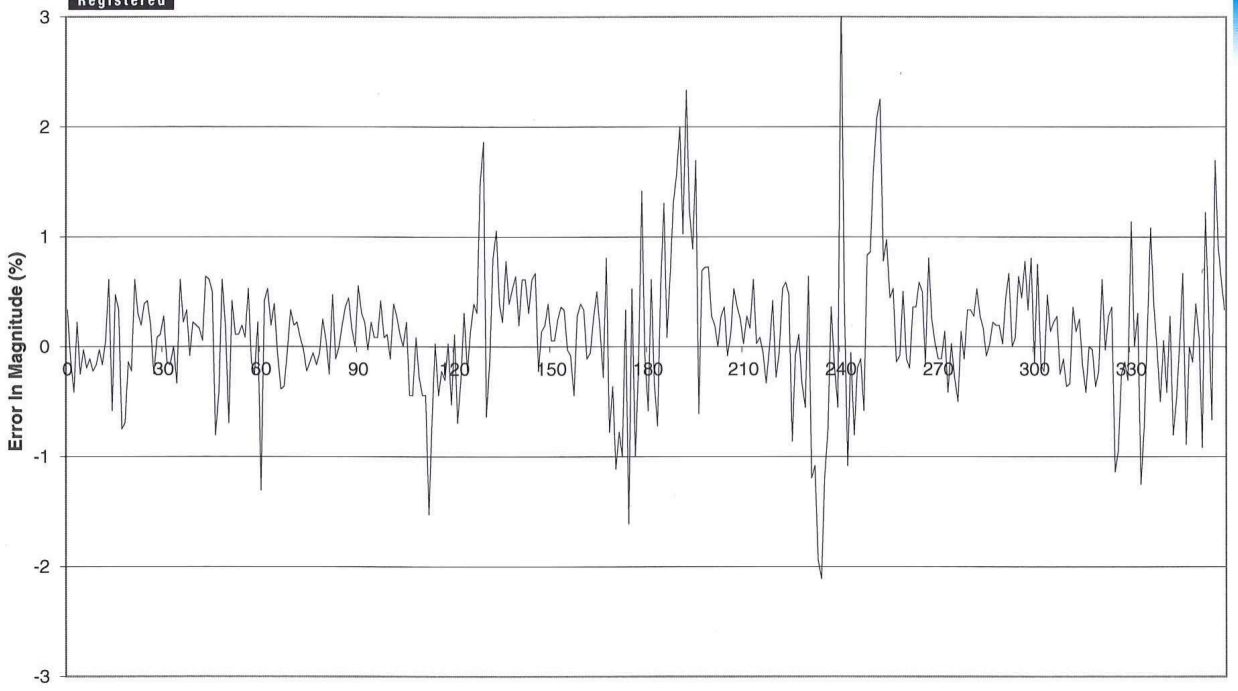
**APPENDIX D Sonic anemometer calibrations**

*D.1 Sonic 0391*



# CERTIFICATE OF CALIBRATION

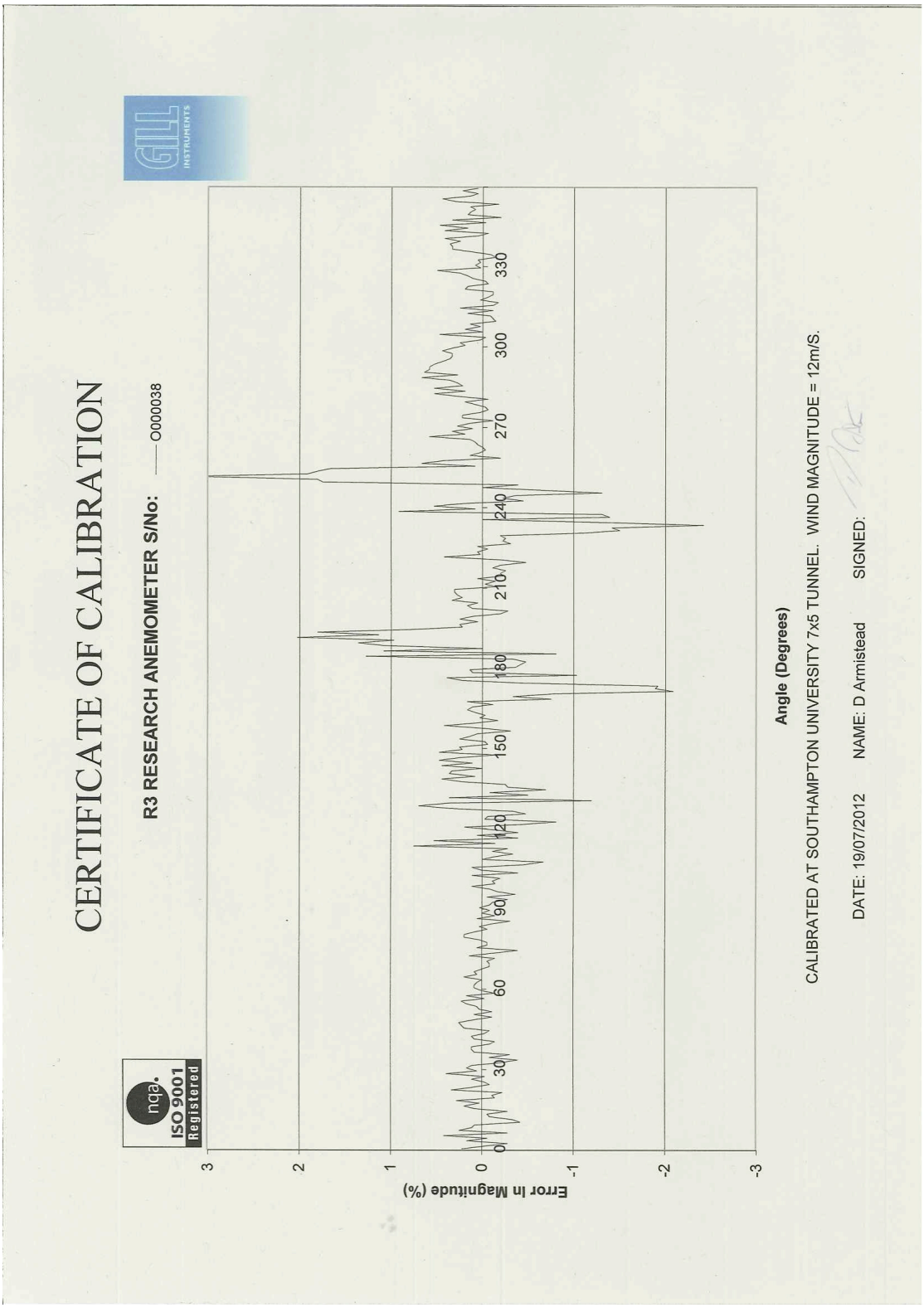
**R3 RESEARCH ANEMOMETER S/No:** —— O000391




CALIBRATED AT SOUTHAMPTON UNIVERSITY 7x5 TUNNEL. WIND MAGNITUDE = 12m/S.

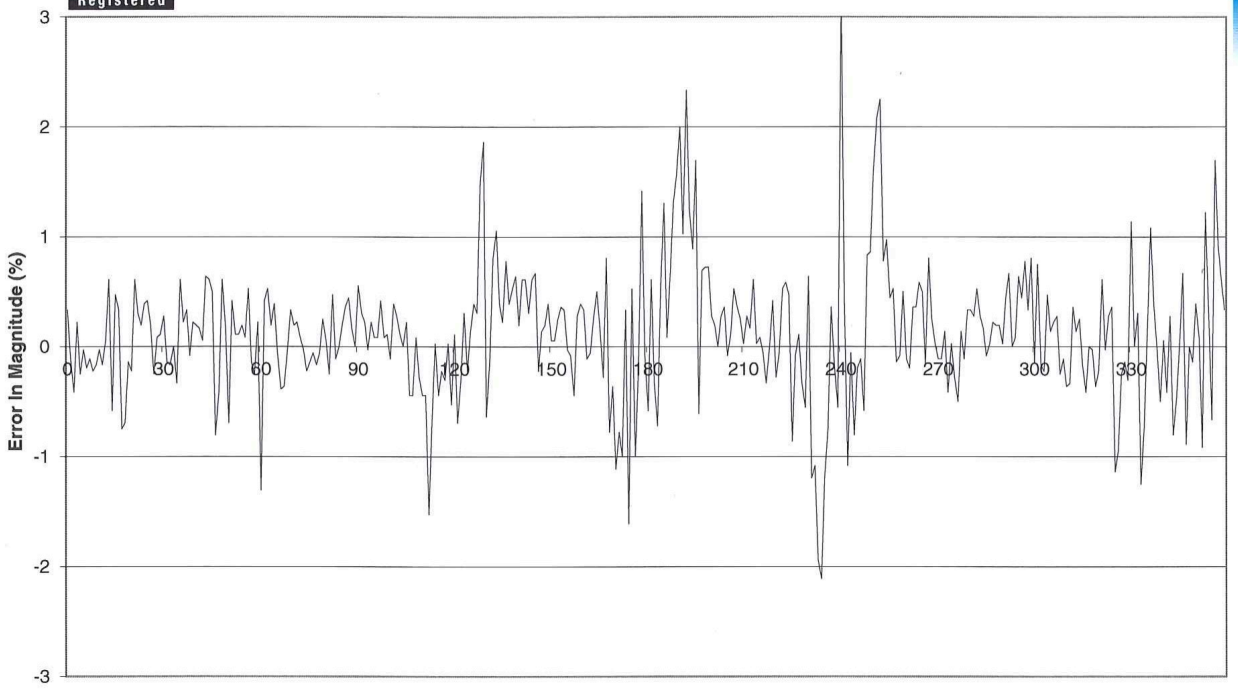
DATE: 23/01/2014 NAME: D Armistead SIGNED:

*D.2 sonic 038*


CERTIFICATE OF CALIBRATION
R3 RESEARCH ANEMOMETER S/No: ——0000038
nqa.
ISO 9001
Registered
GILL
INSTRUMENTS
Error In Magnitude (%)
3
2
1
0
-1
-2
-3
0
30
60
90
120
150
180
210
240
270
300
330
Angle (Degrees)
CALIBRATED AT SOUTHAMPTON UNIVERSITY 7x5 TUNNEL. WIND MAGNITUDE = 12m/S.
DATE: 19/07/2012 NAME: D Armistead SIGNED:

# CERTIFICATE OF CALIBRATION

**R3 RESEARCH ANEMOMETER S/No:** —— O000391



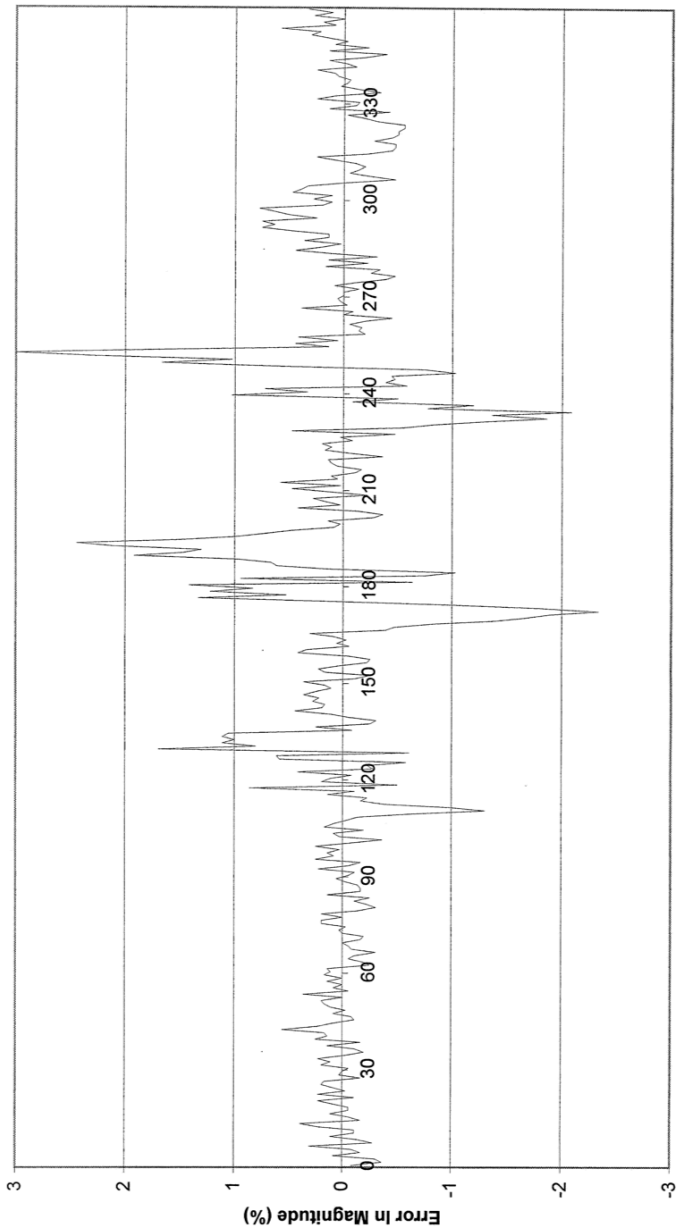

CALIBRATED AT SOUTHAMPTON UNIVERSITY 7x5 TUNNEL. WIND MAGNITUDE = 12m/S.

DATE: 23/01/2014 NAME: D Armistead SIGNED:

*D.3 Sonic 0227*

# CERTIFICATE OF CALIBRATION

**R3 RESEARCH ANEMOMETER S/No** —— O000227



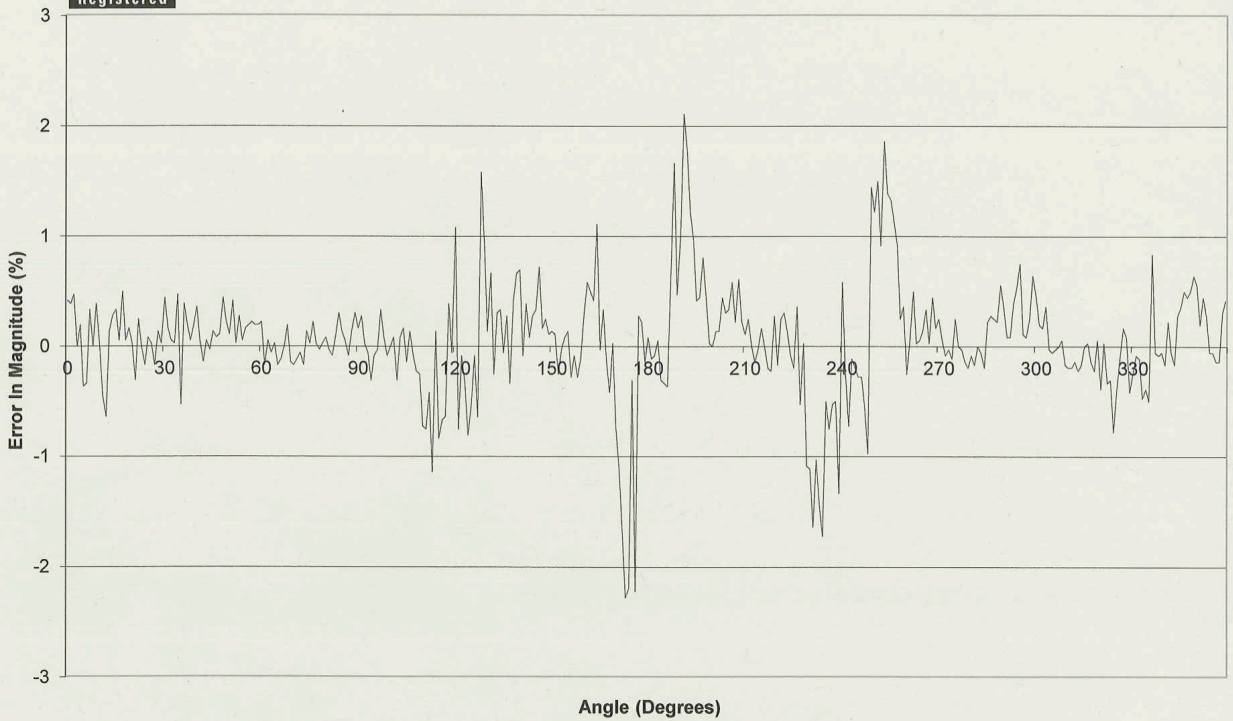

CALIBRATED AT SOUTHAMPTON UNIVERSITY 7x5 TUNNEL. WIND MAGNITUDE = 12m/S.

DATE: 22nd June 2011

SIGNED:

# CERTIFICATE OF CALIBRATION

**R3 RESEARCH ANEMOMETER S/No:** —— O000227

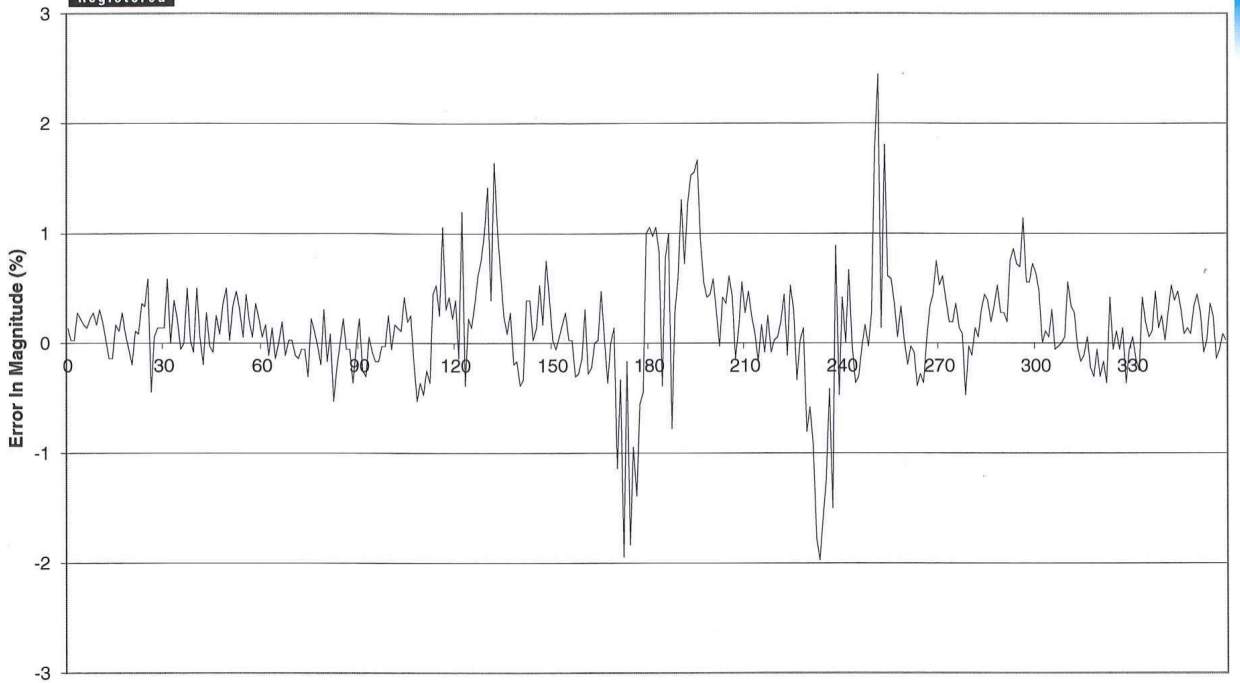



CALIBRATED AT SOUTHAMPTON UNIVERSITY 7x5 TUNNEL. WIND MAGNITUDE = 12m/S.

DATE: 20/07/2012 NAME: D Armistead SIGNED:

# CERTIFICATE OF CALIBRATION

**R3 RESEARCH ANEMOMETER S/No:** —— O000227




CALIBRATED AT SOUTHAMPTON UNIVERSITY 7x5 TUNNEL. WIND MAGNITUDE = 12m/S.

DATE: 23/01/2014 NAME: D Armistead SIGNED:

## APPENDIX E Time series plots

### E.1 Air temperatures

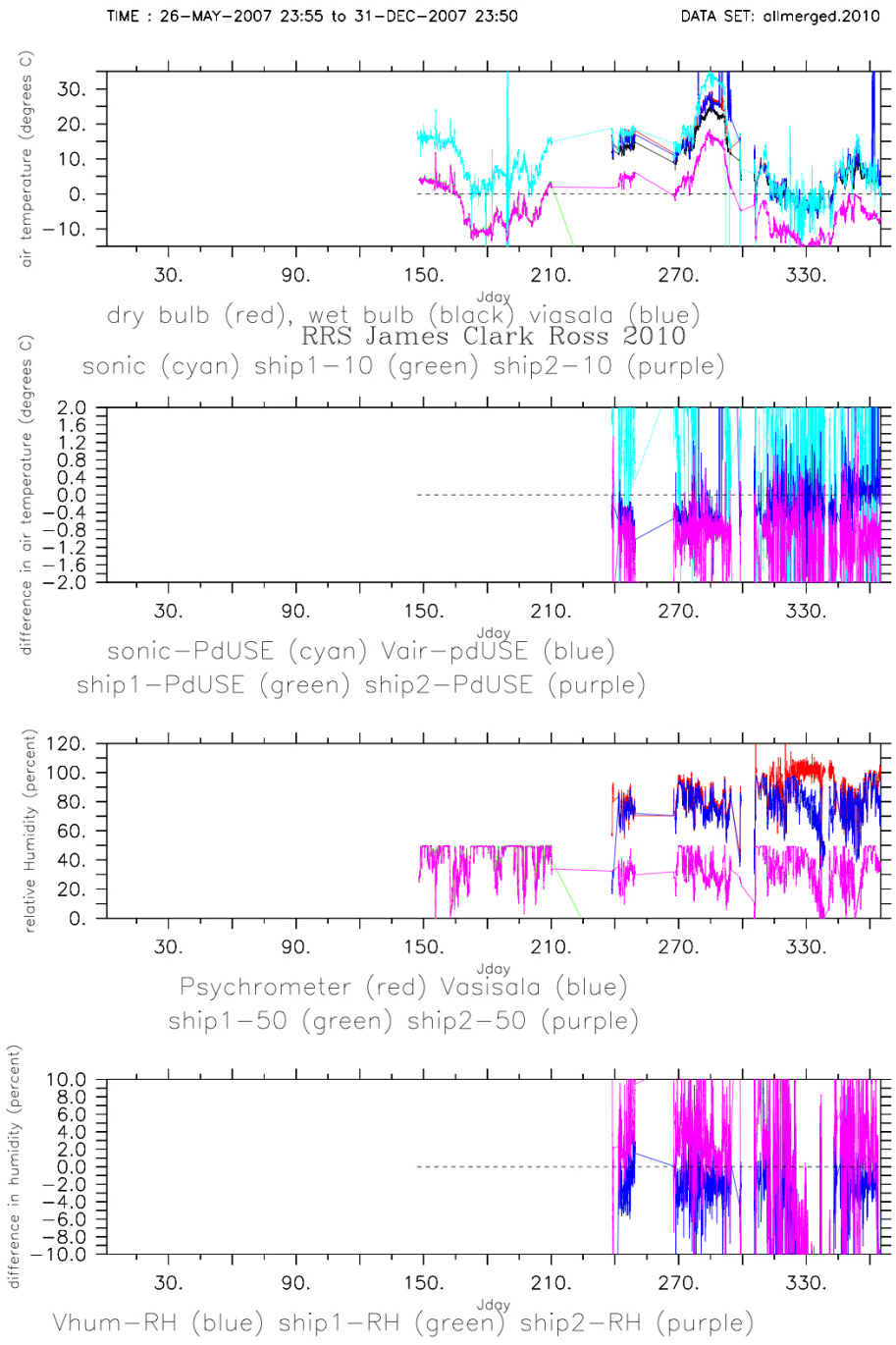
The figures show yearly time series of 10 minute spot values. Only basic quality control criteria have been applied to these data. Each page contains four plots showing different variables over each year.

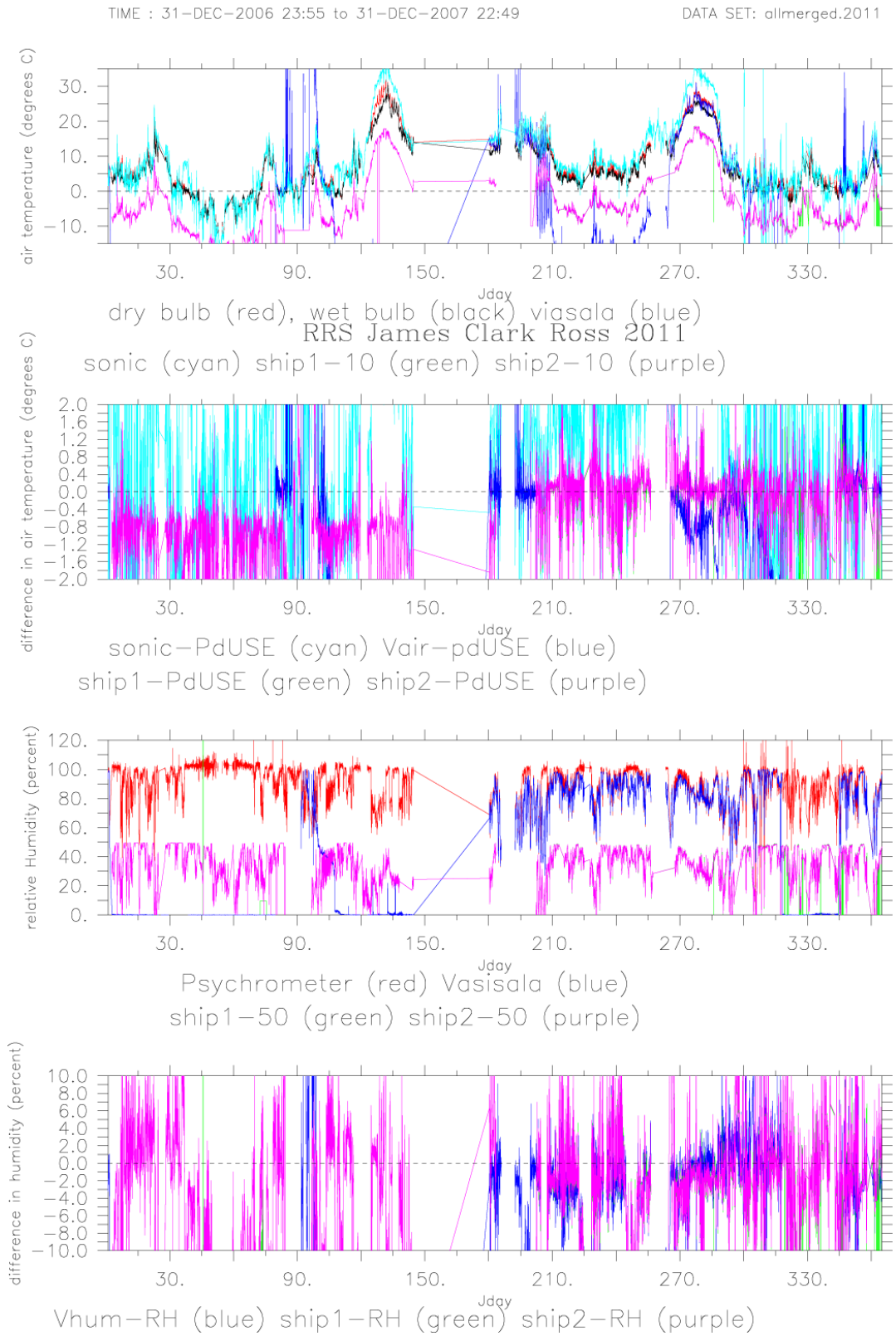
**Top panel** - the wet and dry air temperature from the psychrometer, the Vaisala sensor, the R3 sonic, and the ships two Rotronic air temperature sensors (ship1 and ship2). Note: the Rotronic sensors are offset by -10 in the plot.

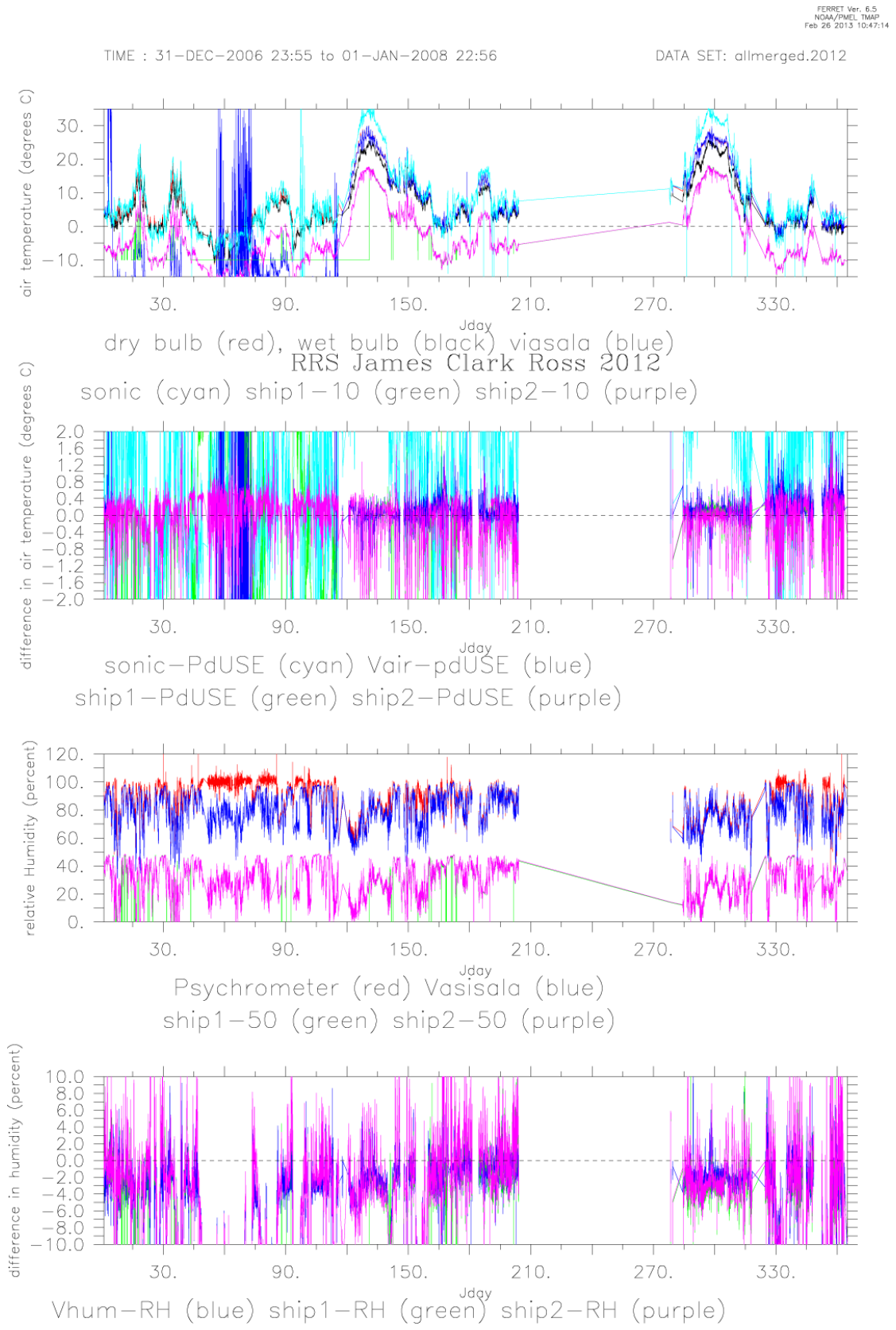
**Upper middle panel** – the difference in air temperature between the psychrometer dry bulb, and the Vaisala, Sonic and Rotronic (ship1 and ship2).

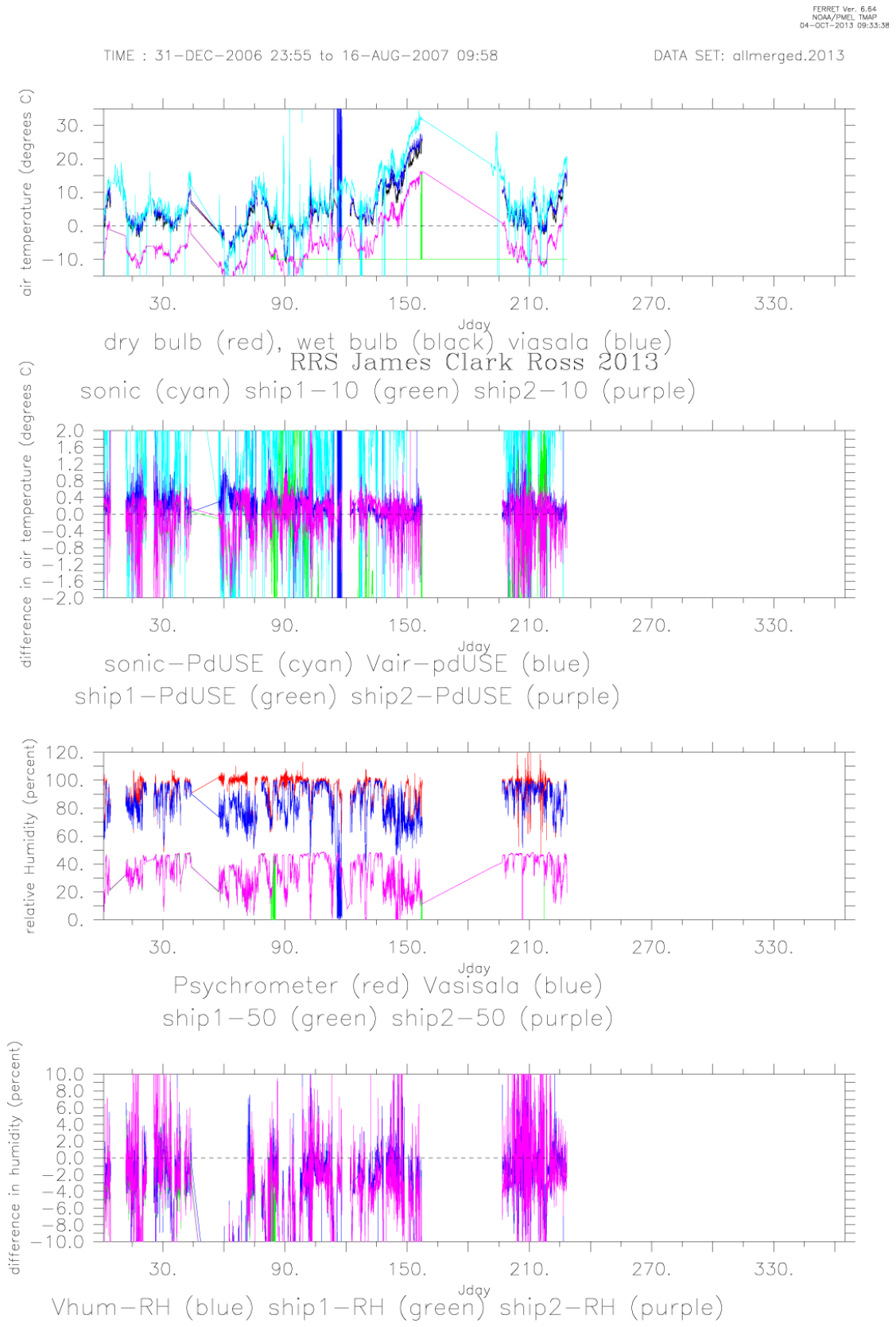
**Lower middle panel** – relative humidity from the Vaisala, Rotronic, and calculated using the Psychrometer. Note: the Rotronic sensors are offset by -50 in the plot.

**Bottom panel** – difference in humidity between the psychrometer, and the Vaisala and Rotronic.


TIME : 26-MAY-2007 23:55 to 31-DEC-2007 23:50
DATA SET: allmerged.2010
air temperature (degrees C)
30.
20.
10.
0.
-10.
30.
90.
150.
210.
270.
330.
Jday
dry bulb (red), wet bulb (black) viasala (blue)
RRS James Clark Ross 2010
sonic (cyan) ship1-10 (green) ship2-10 (purple)
difference in air temperature (degrees C)
2.0
1.6
1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
-1.6
-2.0
30.
90.
150.
210.
270.
330.
Jday
sonic-PdUSE (cyan) Vair-pdUSE (blue)
ship1-PdUSE (green) ship2-PdUSE (purple)
relative Humidity (percent)
120.
100.
80.
60.
40.
20.
0.
30.
90.
150.
210.
270.
330.
Jday
Psychrometer (red) Vasisala (blue)
ship1-50 (green) ship2-50 (purple)
difference in humidity (percent)
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
30.
90.
150.
210.
270.
330.
Jday
Vhum-RH (blue) ship1-RH (green) ship2-RH (purple)


TIME : 31-DEC-2006 23:55 to 31-DEC-2007 22:49
DATA SET: allmerged.2011
air temperature (degrees C)
30.
20.
10.
0.
-10.
30.
90.
150.
210.
270.
330.
Jday
dry bulb (red), wet bulb (black) viasala (blue)
RRS James Clark Ross 2011
sonic (cyan) ship1-10 (green) ship2-10 (purple)
difference in air temperature (degrees C)
2.0
1.6
1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
-1.6
-2.0
30.
90.
150.
210.
270.
330.
Jday
sonic-PdUSE (cyan) Vair-pdUSE (blue)
ship1-PdUSE (green) ship2-PdUSE (purple)
relative Humidity (percent)
120.
100.
80.
60.
40.
20.
0.
30.
90.
150.
210.
270.
330.
Jday
Psychrometer (red) Vasisala (blue)
ship1-50 (green) ship2-50 (purple)
difference in humidity (percent)
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
30.
90.
150.
210.
270.
330.
Jday
Vhum-RH (blue) ship1-RH (green) ship2-RH (purple)

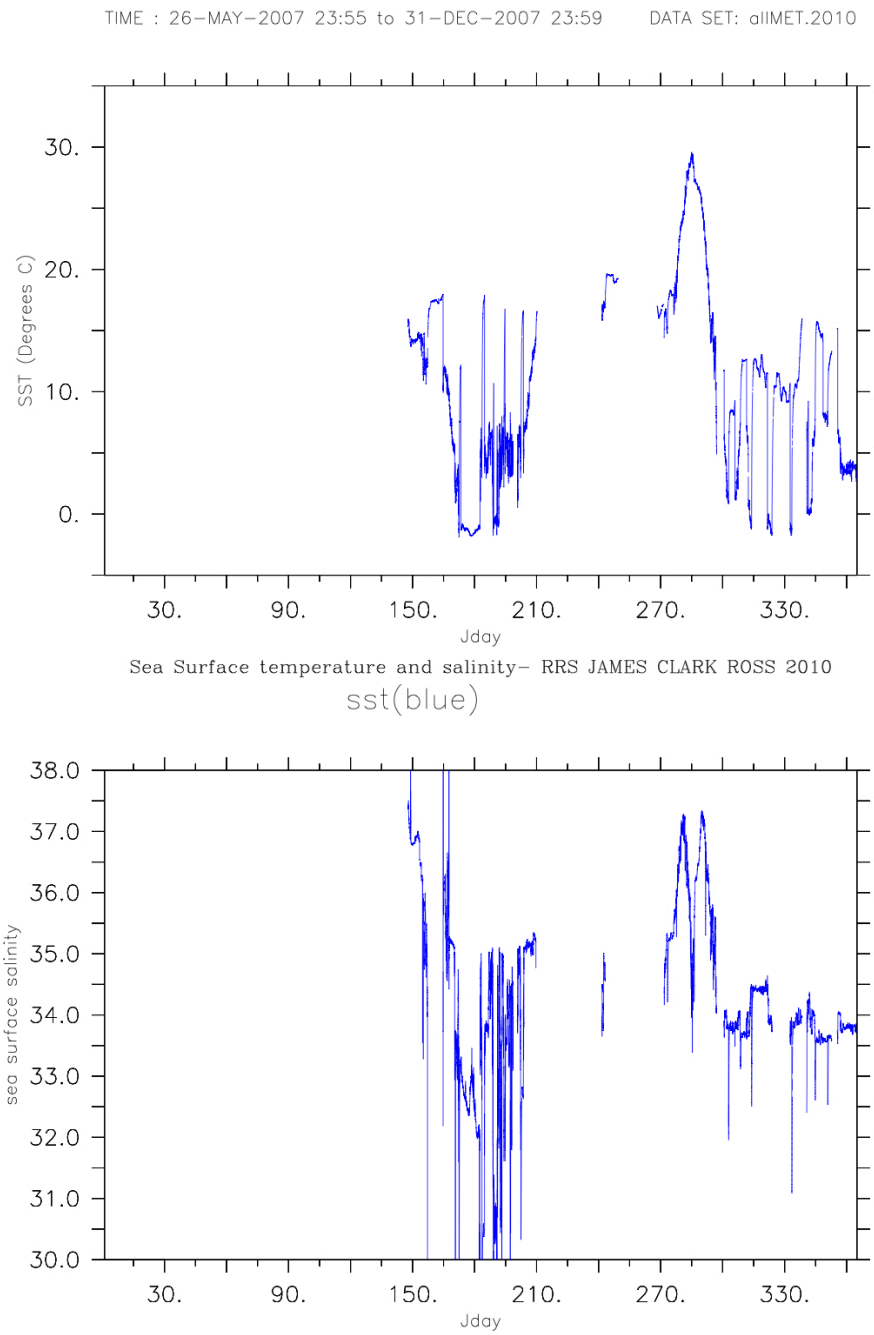

FERRET Ver. 6.5
NOAA/PMEL TMAP
Feb 26 2013 10:47:14
TIME : 31-DEC-2006 23:55 to 01-JAN-2008 22:56
DATA SET: allmerged.2012
air temperature (degrees C)
30.
20.
10.
0.
-10.
30.
90.
150.
210.
270.
330.
Jday
dry bulb (red), wet bulb (black) viasala (blue)
RRS James Clark Ross 2012
sonic (cyan) ship1-10 (green) ship2-10 (purple)
difference in air temperature (degrees C)
2.0
1.6
1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
-1.6
-2.0
30.
90.
150.
210.
270.
330.
Jday
sonic-PdUSE (cyan) Vair-pdUSE (blue)
ship1-PdUSE (green) ship2-PdUSE (purple)
relative Humidity (percent)
120.
100.
80.
60.
40.
20.
0.
30.
90.
150.
210.
270.
330.
Jday
Psychrometer (red) Vasisala (blue)
ship1-50 (green) ship2-50 (purple)
difference in humidity (percent)
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
30.
90.
150.
210.
270.
330.
Jday
Vhum-RH (blue) ship1-RH (green) ship2-RH (purple)

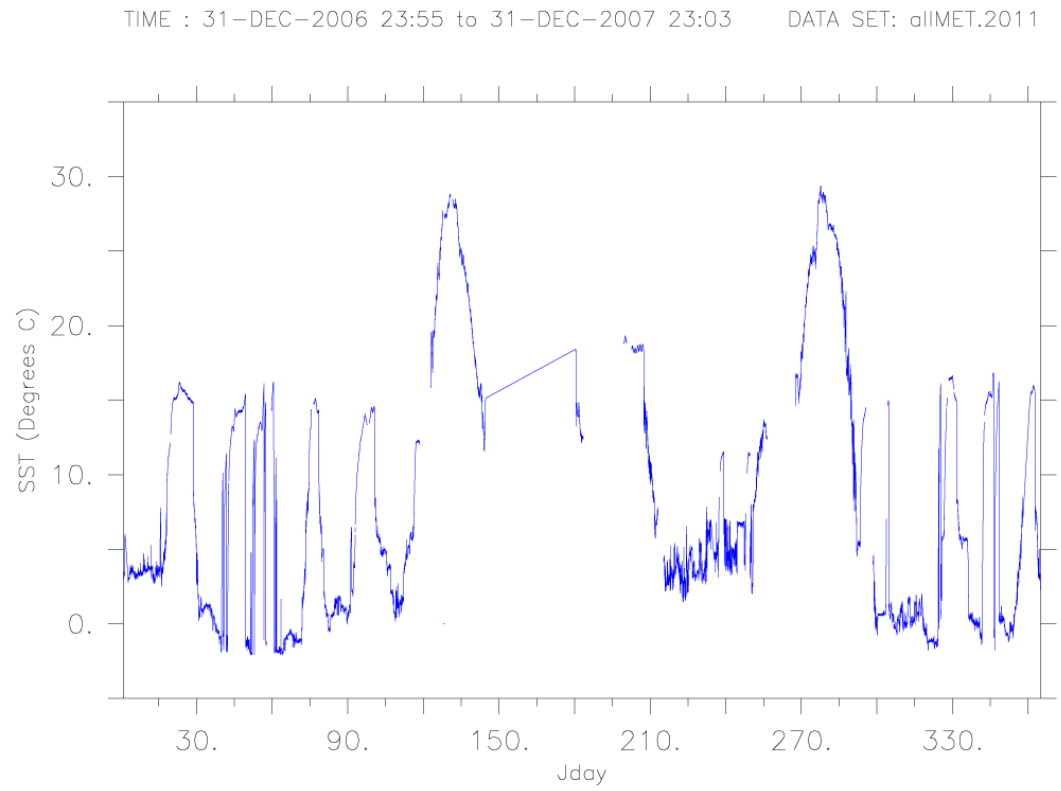

FERRET Ver. 6.64
NOAA/PMEL TMAP
04-OCT-2013 09:33:38
TIME : 31-DEC-2006 23:55 to 16-AUG-2007 09:58
DATA SET: allmerged.2013
air temperature (degrees C)
30.
20.
10.
0.
-10.
30.
90.
150.
210.
270.
330.
Jday
dry bulb (red), wet bulb (black) viasala (blue)
RRS James Clark Ross 2013
sonic (cyan) ship1-10 (green) ship2-10 (purple)
difference in air temperature (degrees C)
2.0
1.6
1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
-1.6
-2.0
30.
90.
150.
210.
270.
330.
Jday
sonic-PdUSE (cyan) Vair-pdUSE (blue)
ship1-PdUSE (green) ship2-PdUSE (purple)
relative Humidity (percent)
120.
100.
80.
60.
40.
20.
0.
30.
90.
150.
210.
270.
330.
Jday
Psychrometer (red) Vasisala (blue)
ship1-50 (green) ship2-50 (purple)
difference in humidity (percent)
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
30.
90.
150.
210.
270.
330.
Jday
Vhum-RH (blue) ship1-RH (green) ship2-RH (purple)

### E.2 Sea surface temperature and uncorrected salinity

The figures show yearly time series of 10 minute spot values. Only basic quality control criteria have been applied to these data. Each page contains three plots showing different variables over each year.
**Top panel -** the sea surface intake temperature.

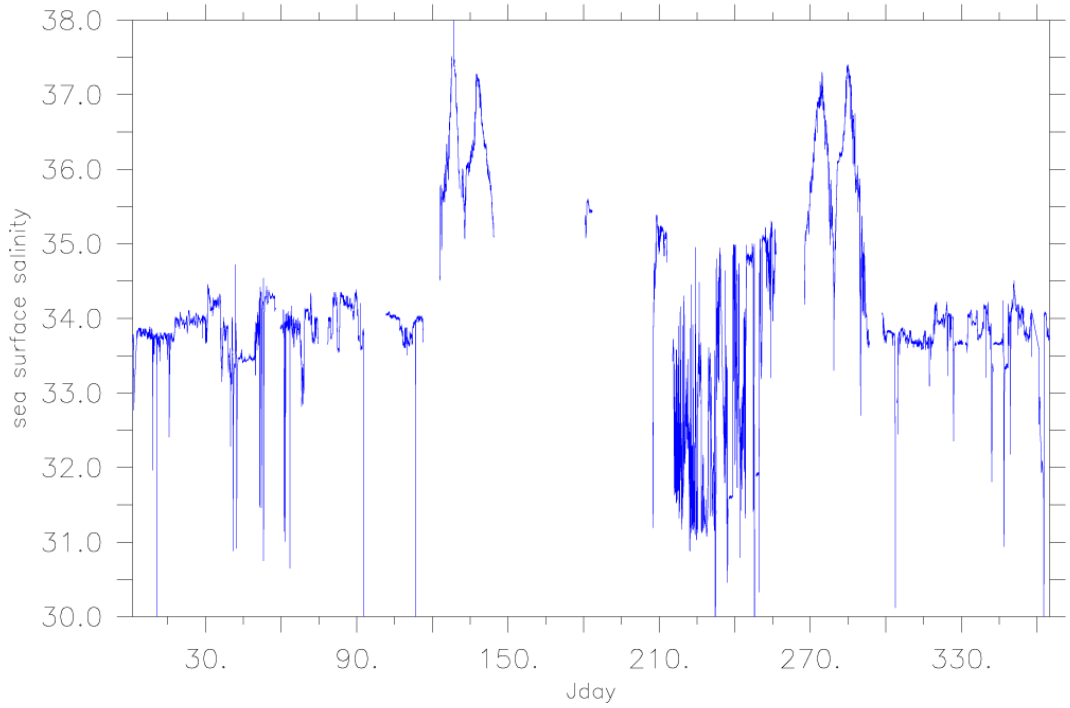
**Bottom panel** – the uncalibrated sea surface salinity.

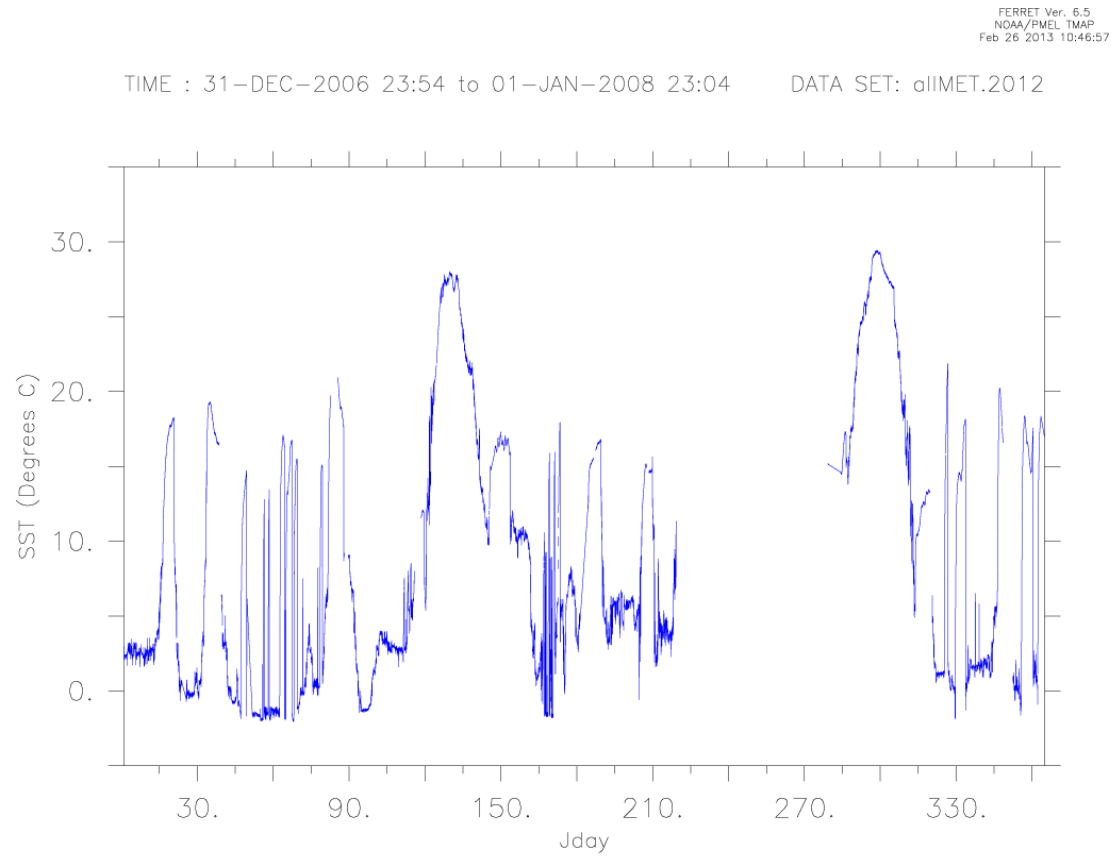

TIME : 26-MAY-2007 23:55 to 31-DEC-2007 23:59
DATA SET: allMET.2010
SST (Degrees C)
30.
20.
10.
0.
30.
90.
150.
210.
270.
330.
Jday
Sea Surface temperature and salinity- RRS JAMES CLARK ROSS 2010
sst(blue)
sea surface salinity
38.0
37.0
36.0
35.0
34.0
33.0
32.0
31.0
30.0
30.
90.
150.
210.
270.
330.
Jday




Sea Surface temperature and salinity- RRS JAMES CLARK ROSS 2011

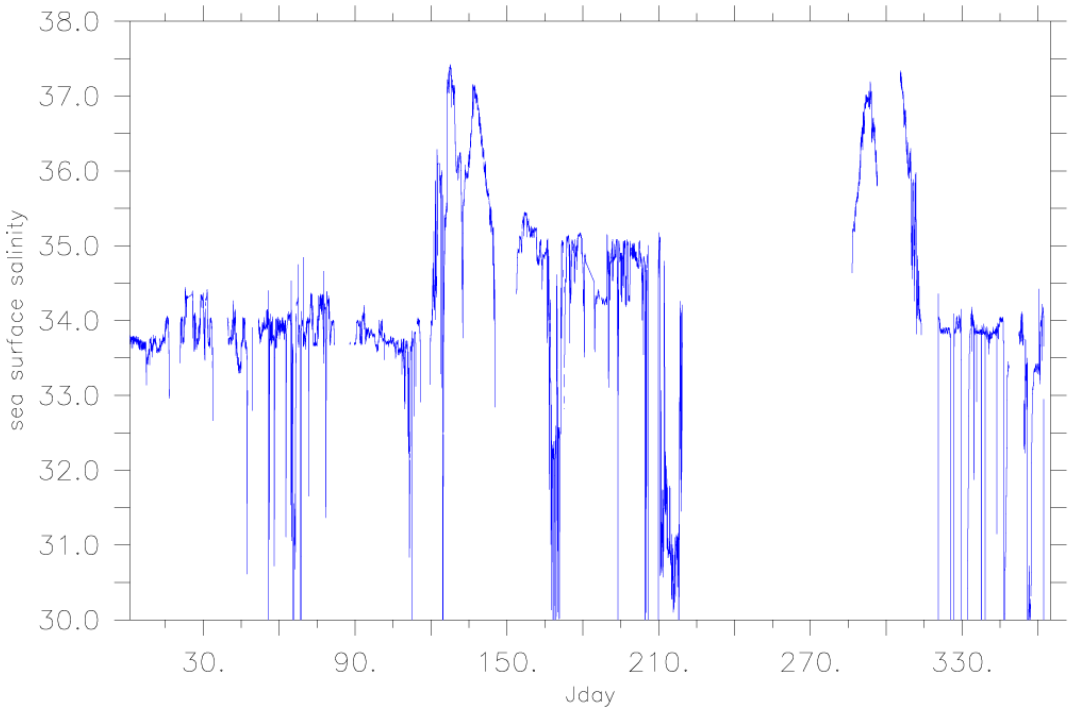
sst(blue)

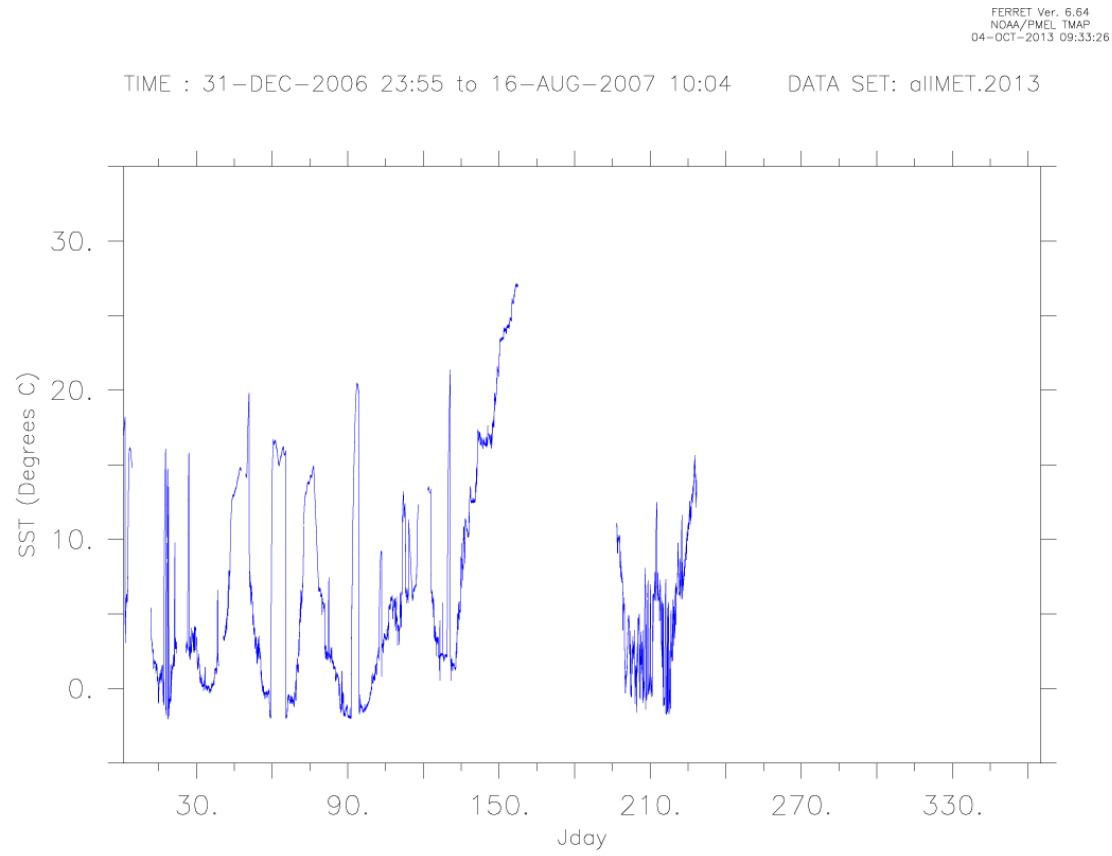





Sea Surface temperature and salinity– RRS JAMES CLARK ROSS 2012

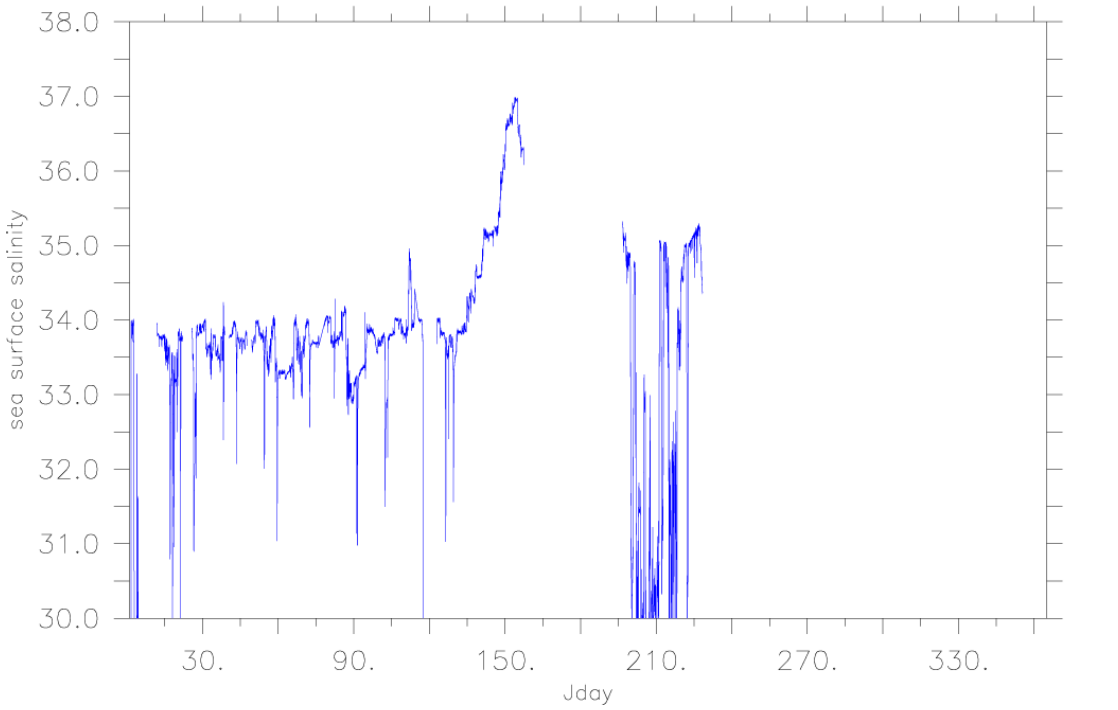
sst(blue)






Sea Surface temperature and salinity- RRS JAMES CLARK ROSS 2013

sst(blue)

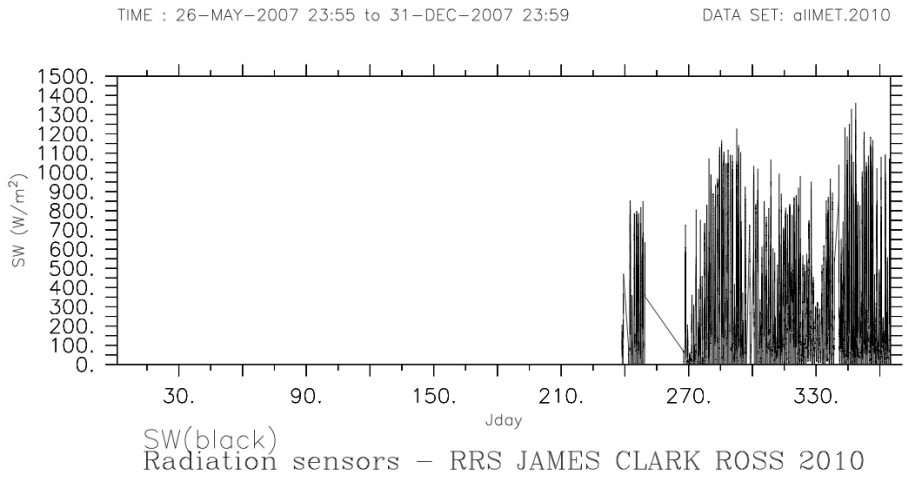


### E.3 Radiation sensors

The figures show yearly time series of 10 minute spot values. Only basic quality control criteria have been applied to these data. Each page contains two plots showing different variables over each year.
**Top panel** - the short wave radiation ( $W/m^2$ ) from the AutoFlux sensors.

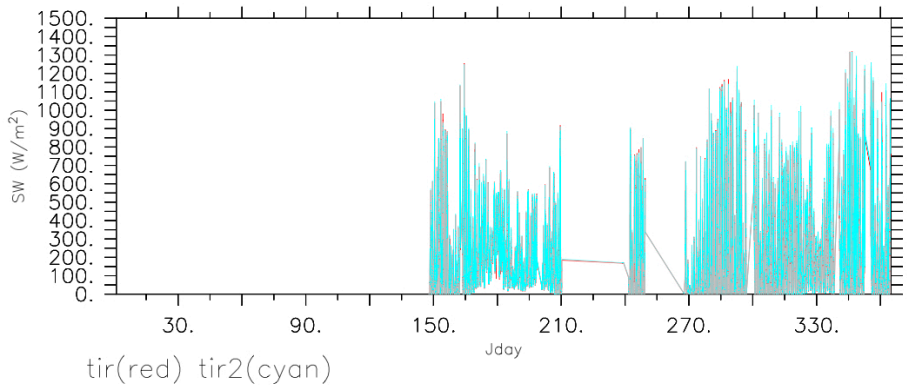
**Middle panel** – the short wave radiation ( $W/m^2$ ) from the ship's sensors.

**Bottom panel** – the long wave radiation ($W/m^2$ ).

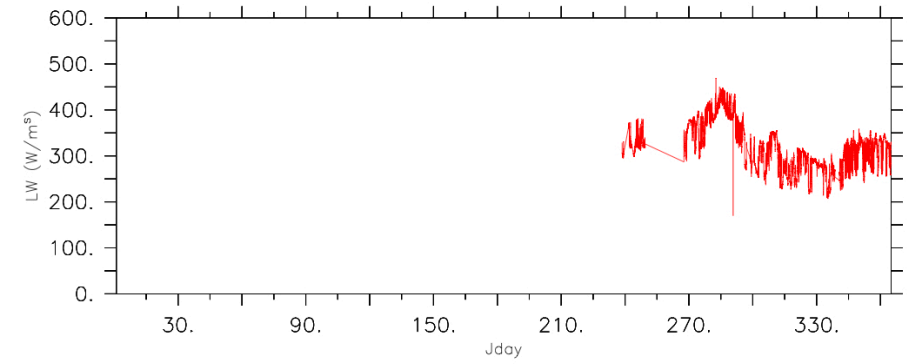


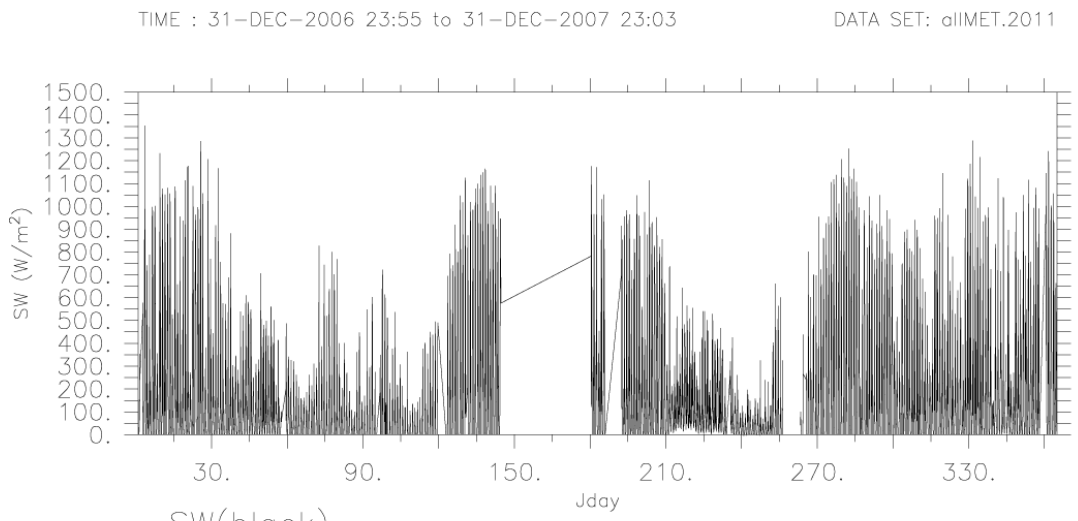

SW(black)

Radiation sensors – RRS JAMES CLARK ROSS 2010

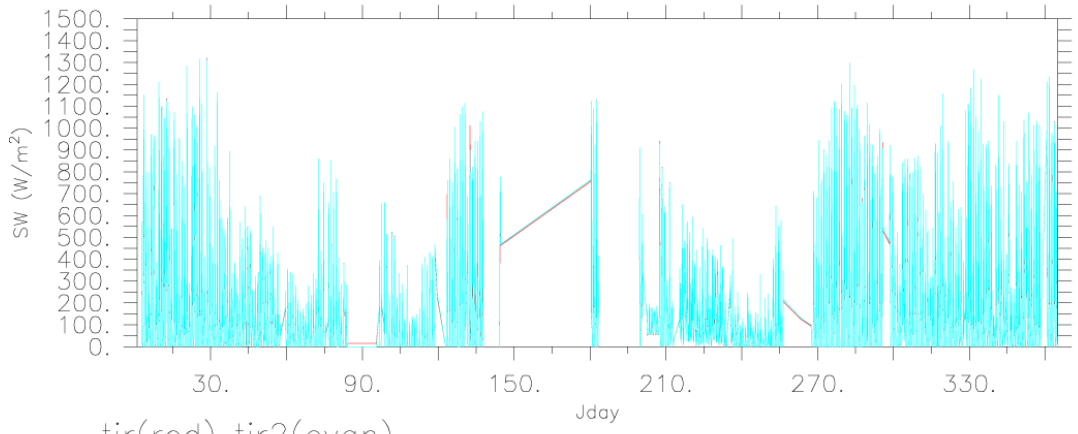



tir(red) tir2(cyan)

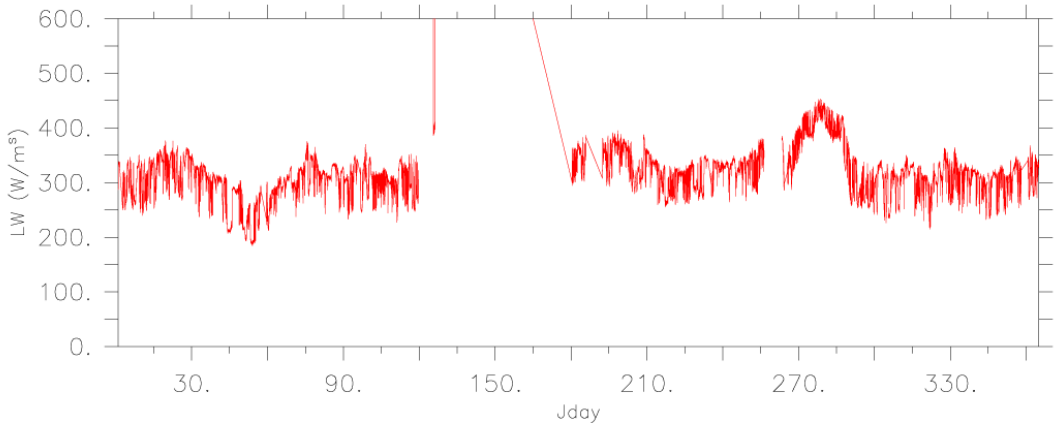





SW(black)
Radiation sensors – RRS JAMES CLARK ROSS 2011

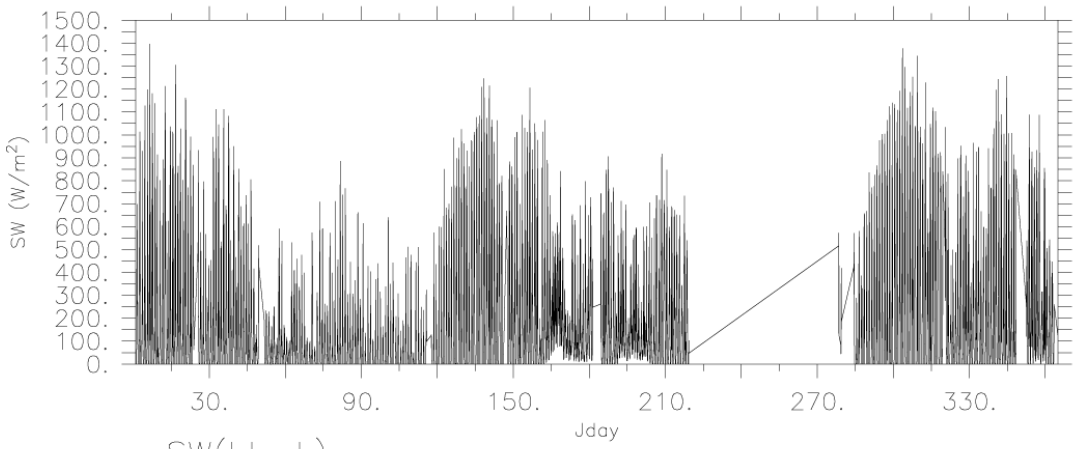



tir(red) tir2(cyan)

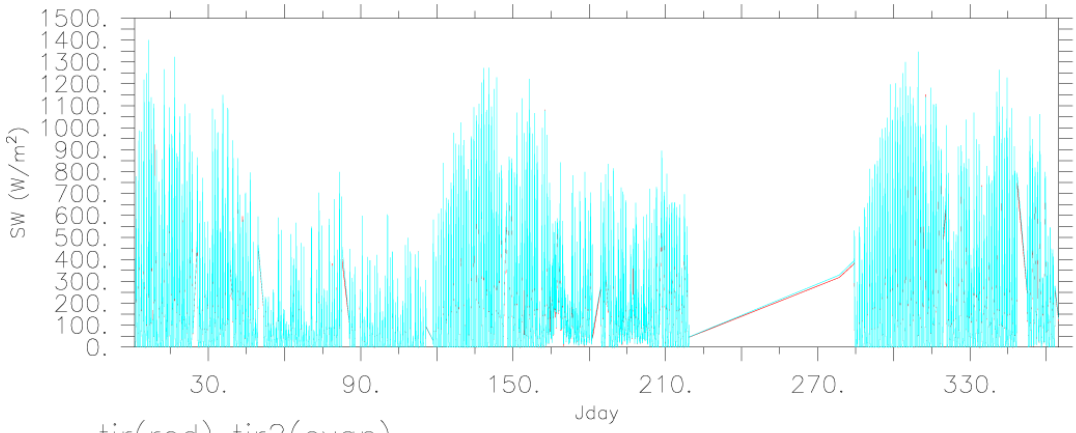


FERRET Ver. 6.5
NOAA/PMEL TMAP
Feb 26 2013 10:46:49

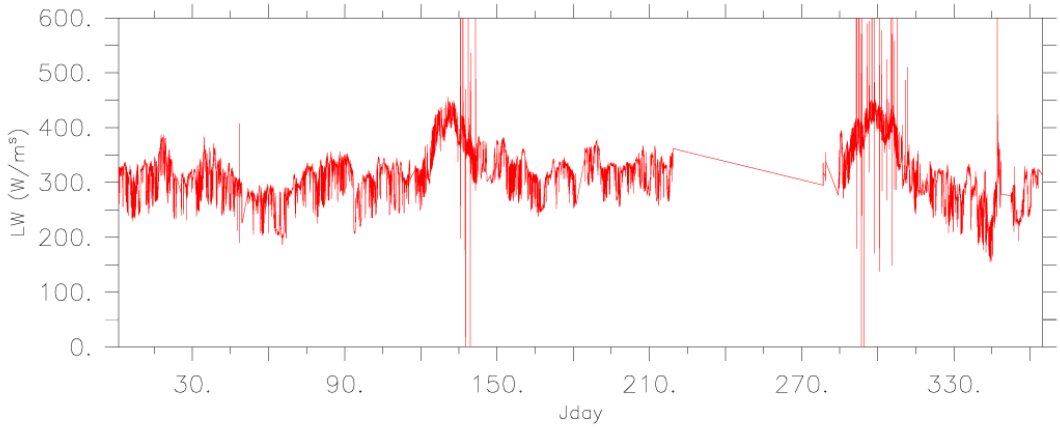
TIME : 31-DEC-2006 23:54 to 01-JAN-2008 23:04 DATA SET: allMET.2012




SW(black)
Radiation sensors – RRS JAMES CLARK ROSS 2012

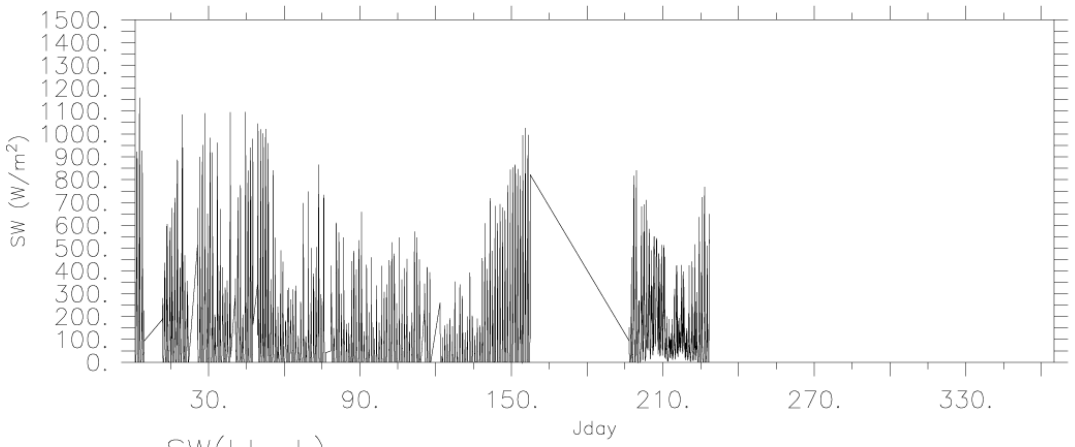



tir(red) tir2(cyan)

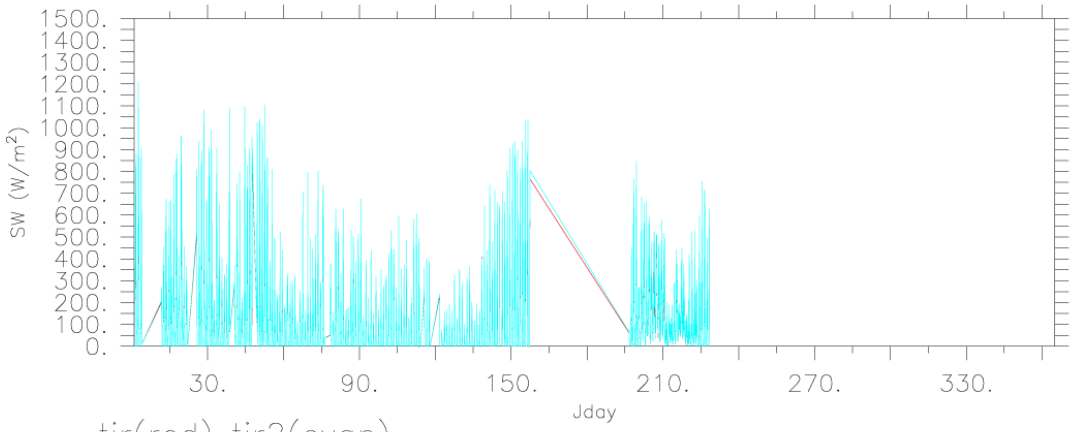


FERRET Ver. 6.64
NOAA/PMEL TMAP
04-OCT-2013 09:33:23

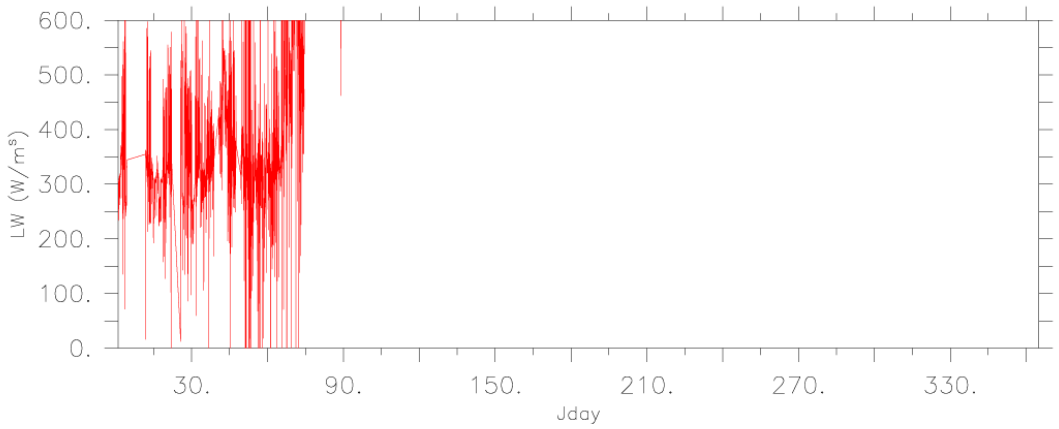
TIME : 31-DEC-2006 23:55 to 16-AUG-2007 10:04 DATA SET: allMET.2013




SW(black)
Radiation sensors - RRS JAMES CLARK ROSS 2013




tir(red) tir2(cyan)



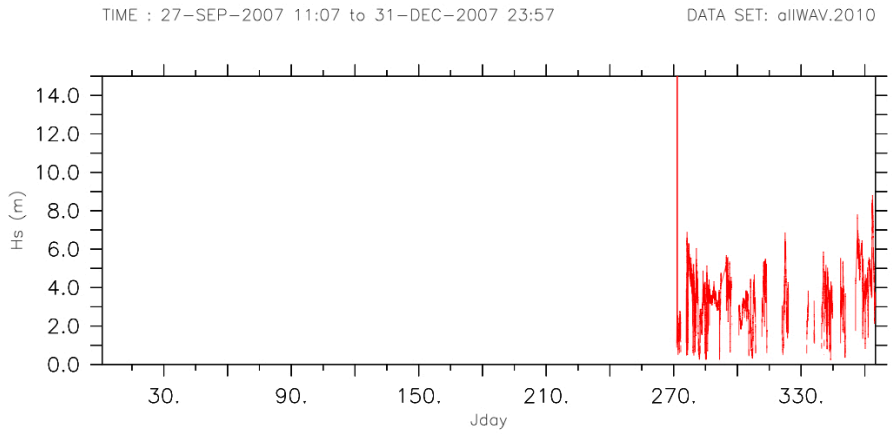
### E.4 Wave systems

The figures show a yearly time series of 10 minute spot values. Only basic quality control criteria have been applied to these data. Each page contains four plots showing different variables over each year. WAVEX plots only show the data obtained via the serial link. Absent data are often a problem due to the link and raw WAVEX data maybe present in the data set.

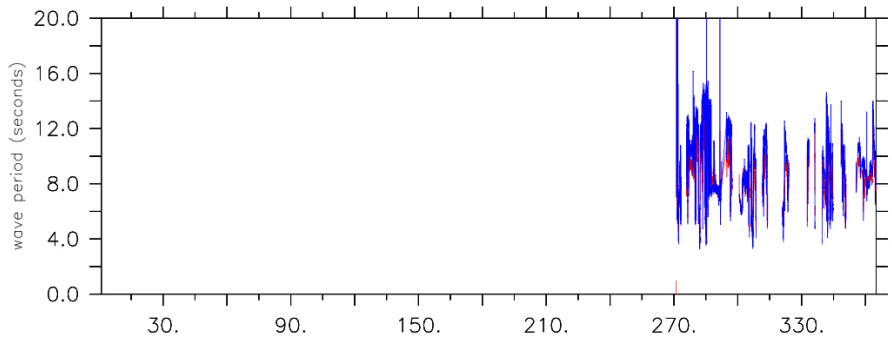
**Top panel** - the significant wave height (Hs) measured by the WAVEX wave radar.

**Middle panel** – the energy period ($T_E$) and the primary wave peak period.

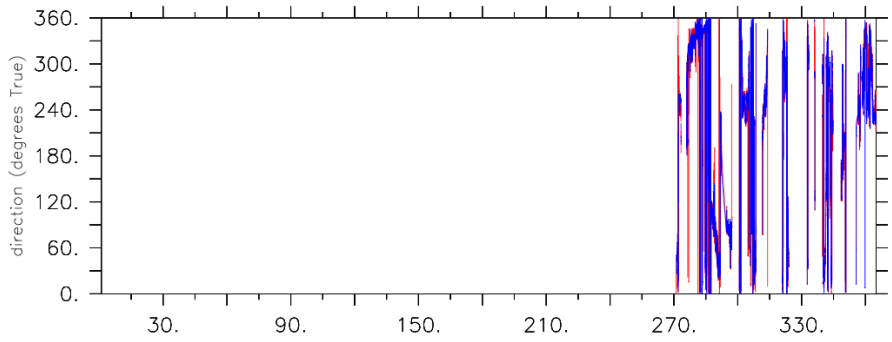
**Bottom panel** – the wave directions.



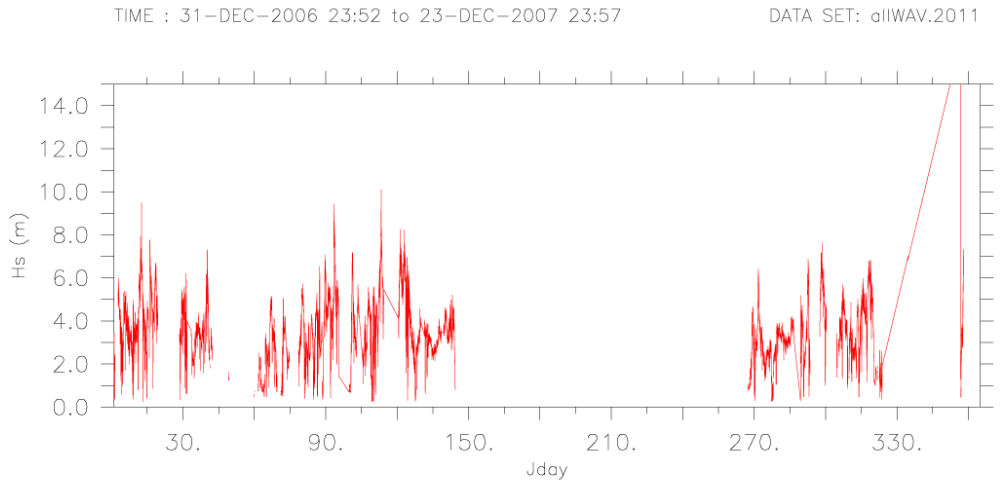

WAVE SYSTEMS – James Clark Ross 2010



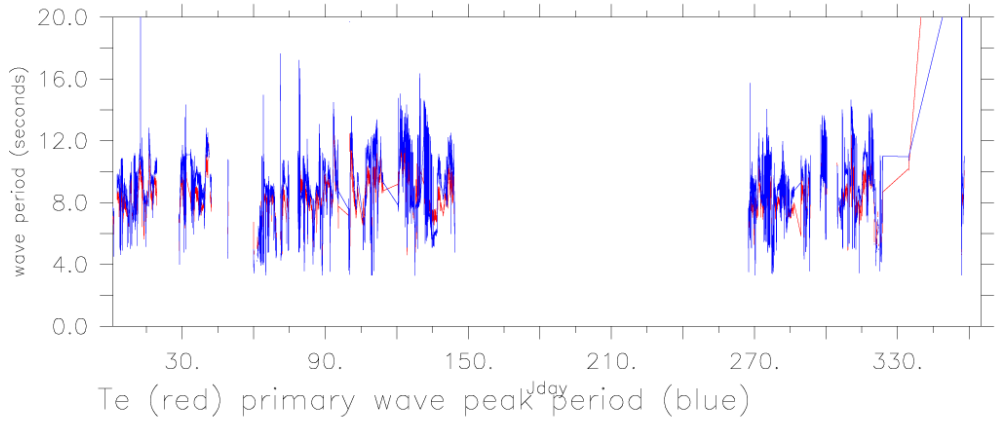

Te (red) primary wave peak period (blue)



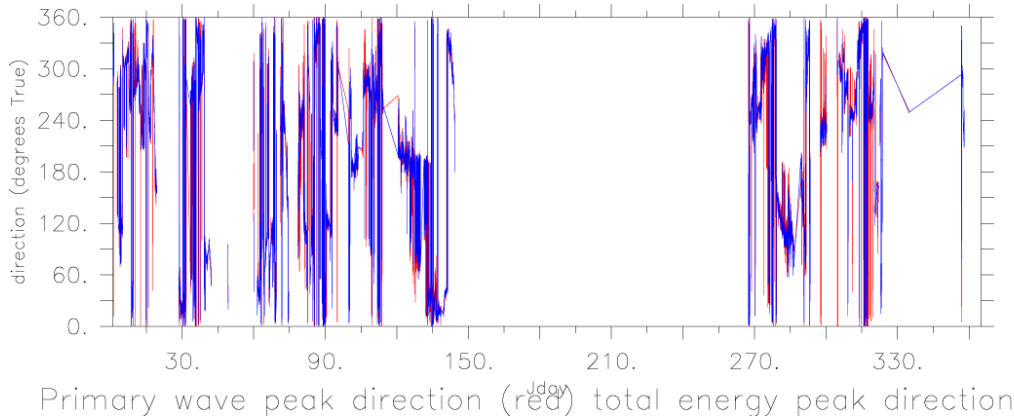

Primary wave peak direction (red) total energy peak direction (blue)



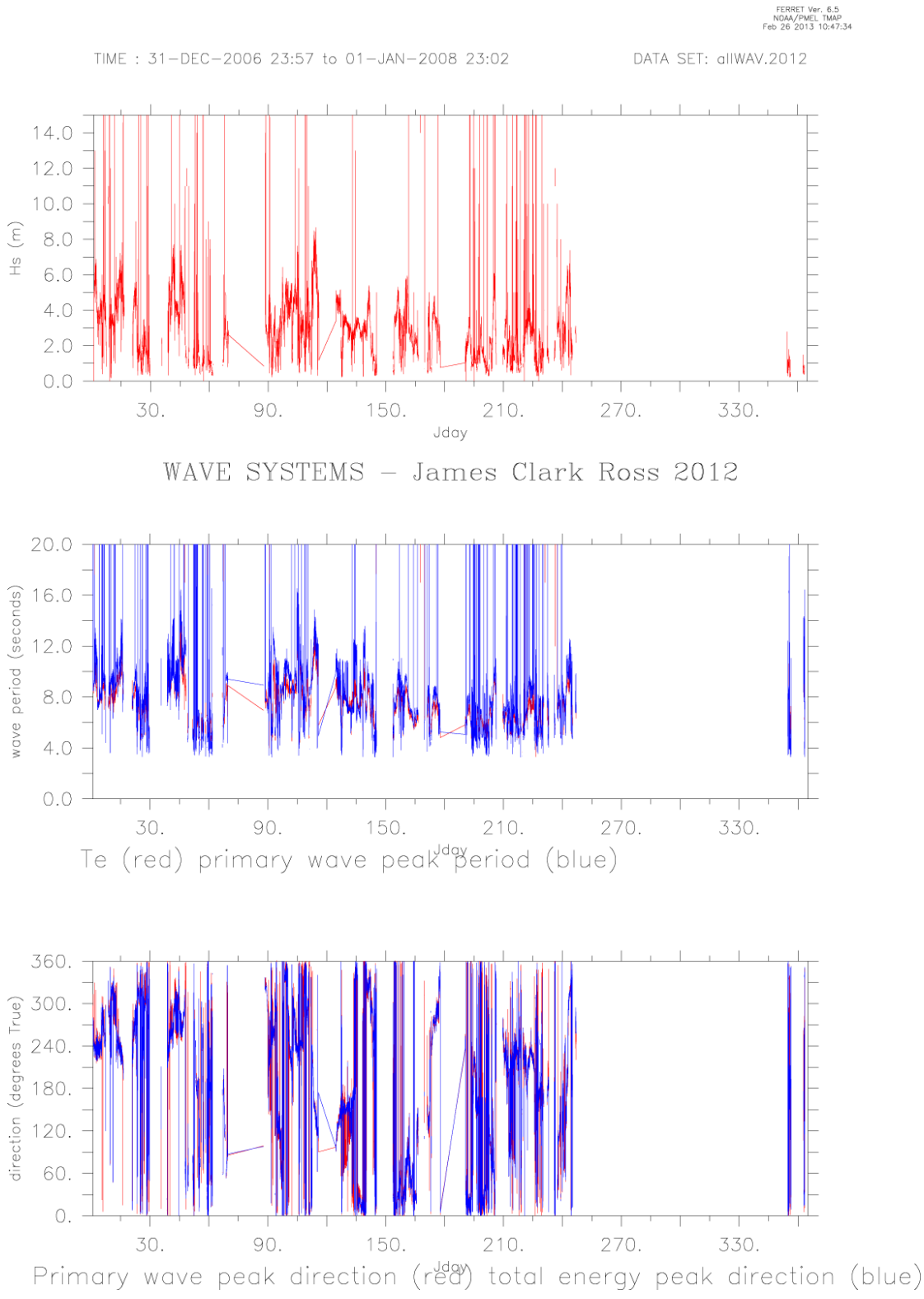

WAVE SYSTEMS – James Clark Ross 2011

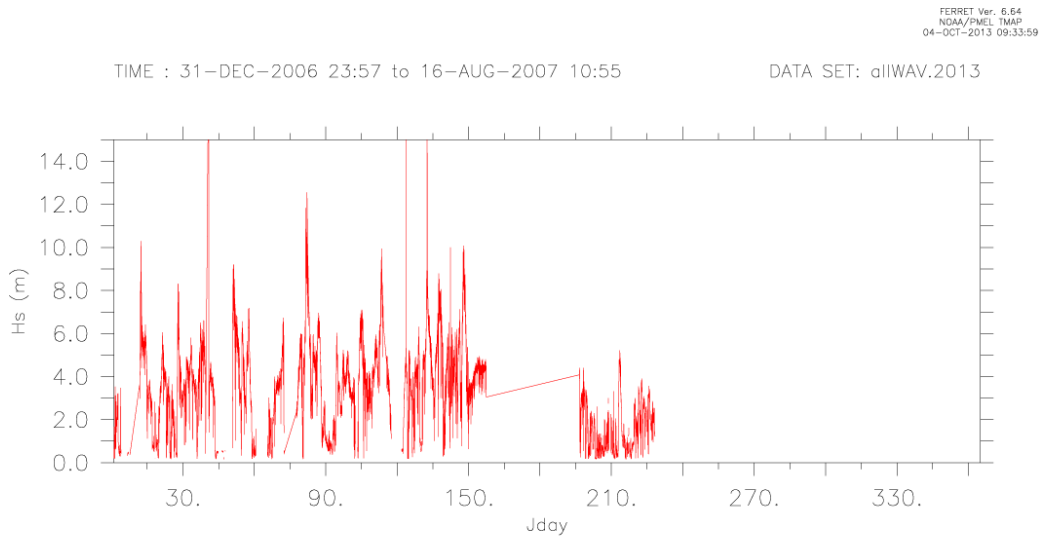



Te (red) primary wave peak period (blue)

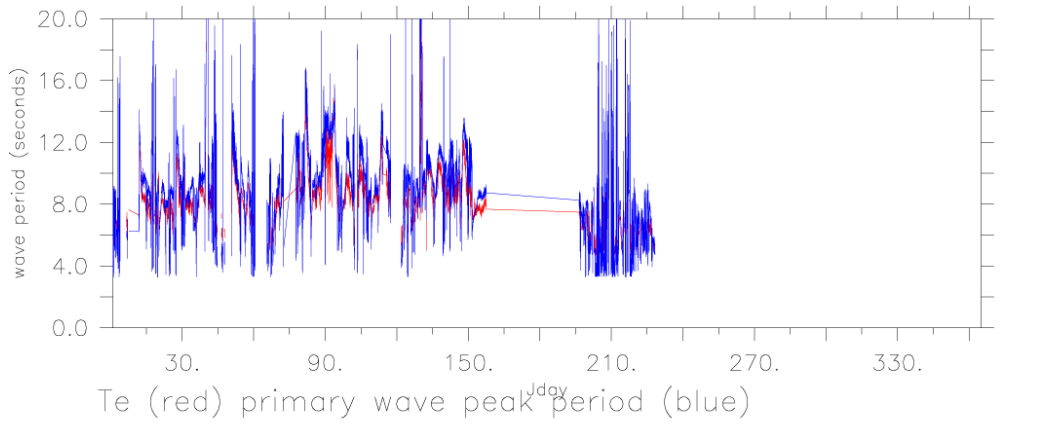



Primary wave peak direction (red) total energy peak direction (blue)

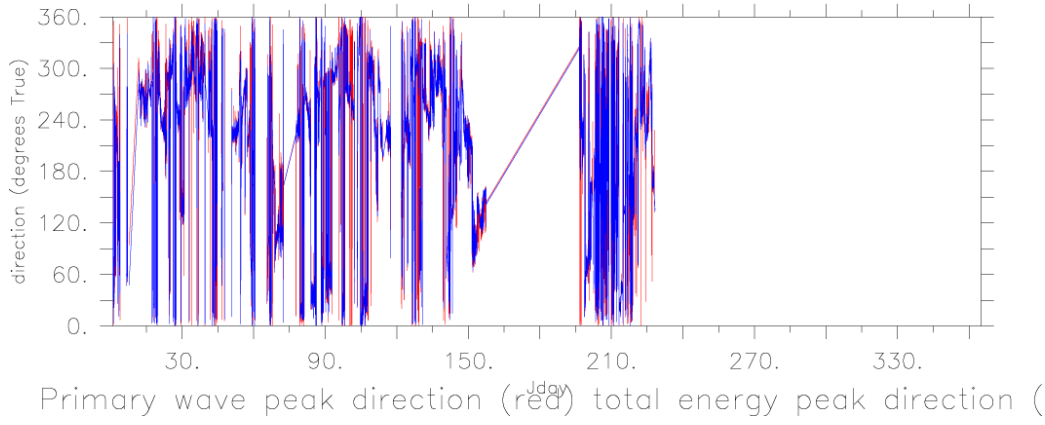

FERRET Ver. 6.5
NOAA/PMEL TMAP
Feb 26 2013 10:47:34
TIME : 31-DEC-2006 23:57 to 01-JAN-2008 23:02
DATA SET: allWAV.2012
Hs (m)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
30.
90.
150.
210.
270.
330.
Jday
WAVE SYSTEMS - James Clark Ross 2012
wave period (seconds)
20.0
16.0
12.0
8.0
4.0
0.0
30.
90.
150.
210.
270.
330.
Jday
Te (red) primary wave peak period (blue)
direction (degrees True)
360.
300.
240.
180.
120.
60.
0.
30.
90.
150.
210.
270.
330.
Jday
Primary wave peak direction (red) total energy peak direction (blue)




WAVE SYSTEMS – James Clark Ross 2013




Te (red) primary wave peak period (blue)




Primary wave peak direction (red) total energy peak direction (blue)

## E.5 Wind speed and direction

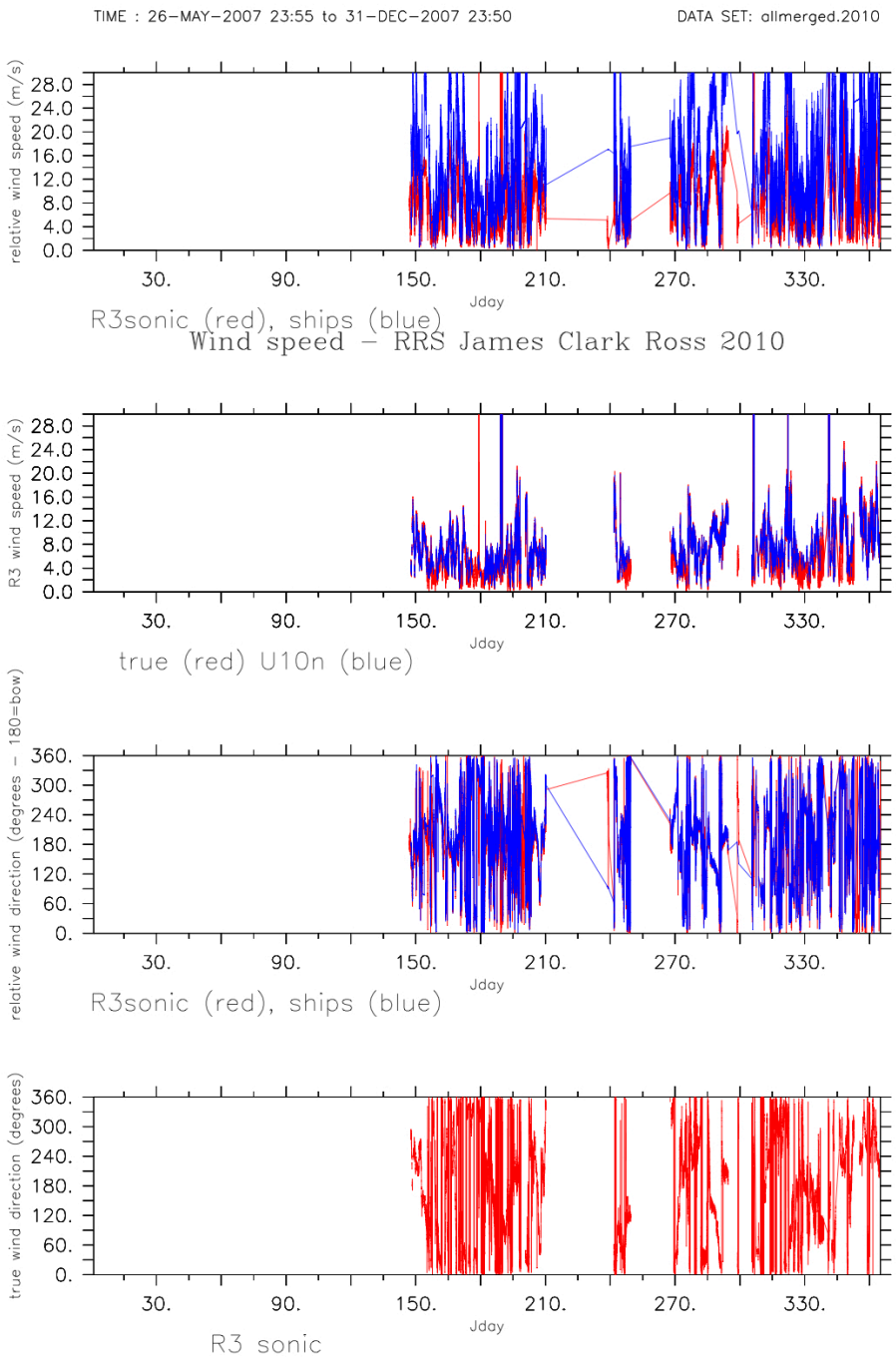
The figures show a yearly time series of 10 minute spot values. Only basic quality control criteria have been applied to these data. Each page contains four plots showing different variables over each year.

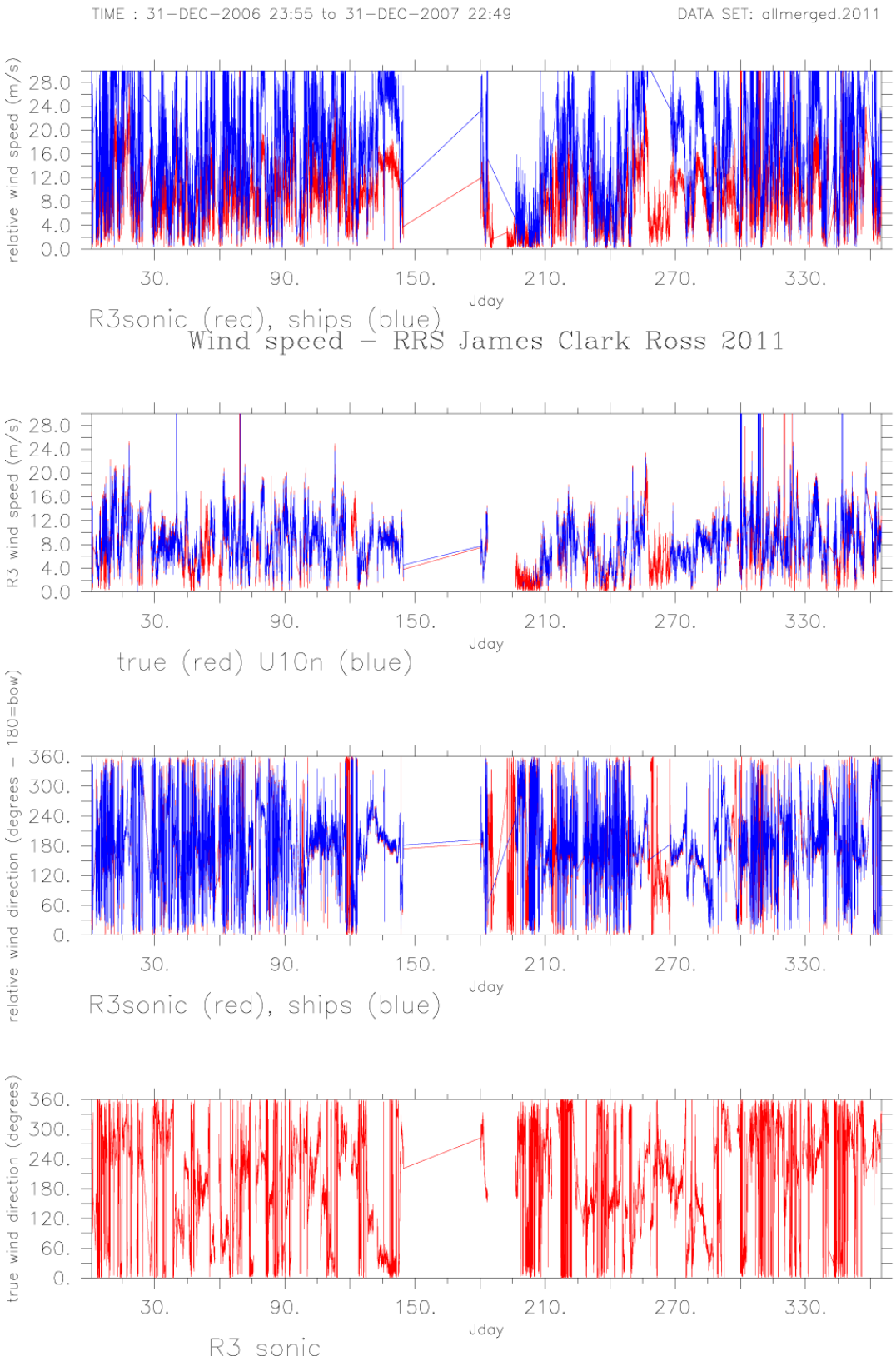
**Top panel** - the relative wind speed measured by the AutoFlux R3 sonic and the ship's WindMaster anemometer.

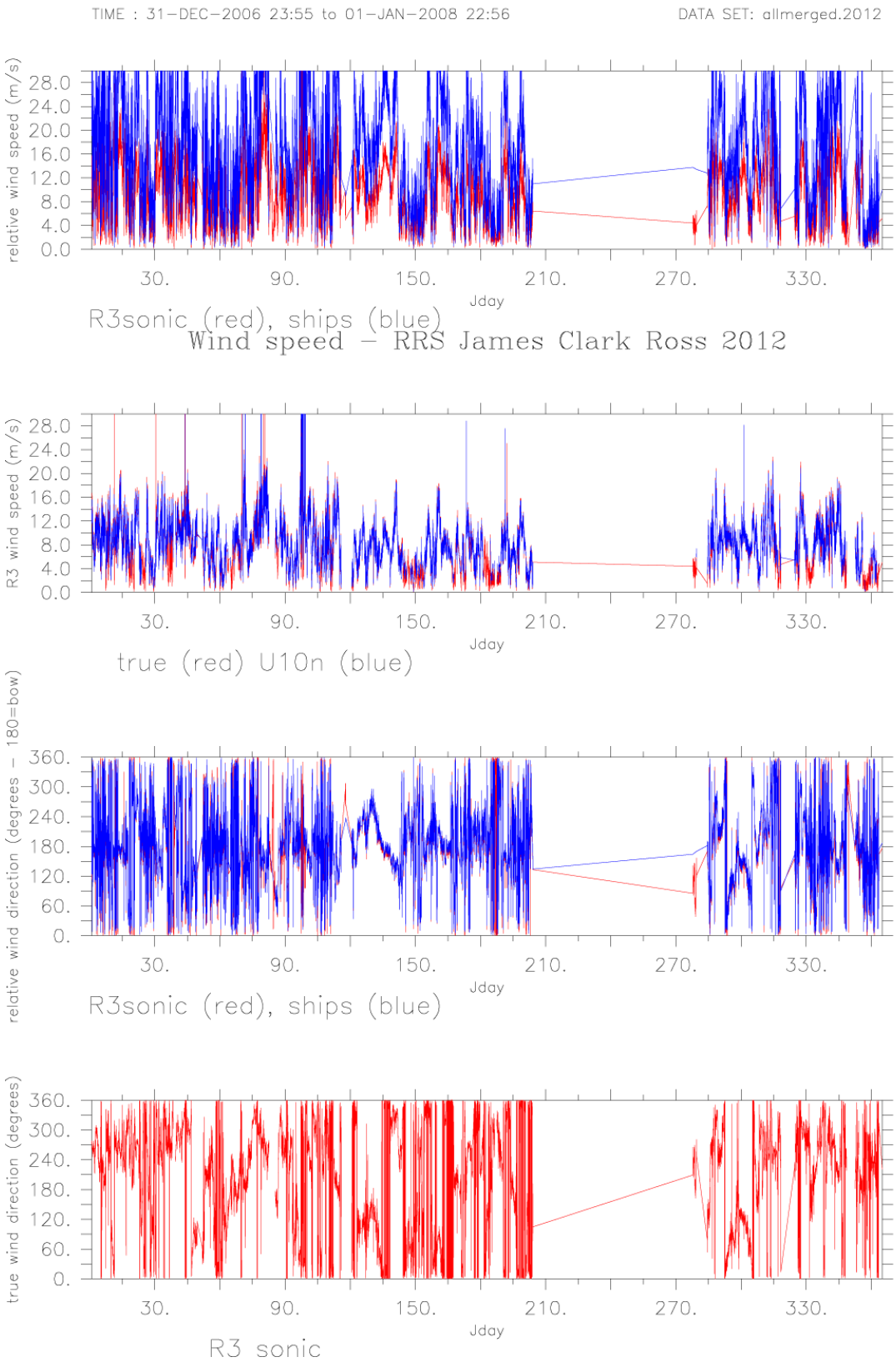
**Upper middle panel** – the true wind speed measured from the R3 anemometer and the R3 anemometer wind speed speed corrected to a height of 10 m and neutral atmospheric stability.

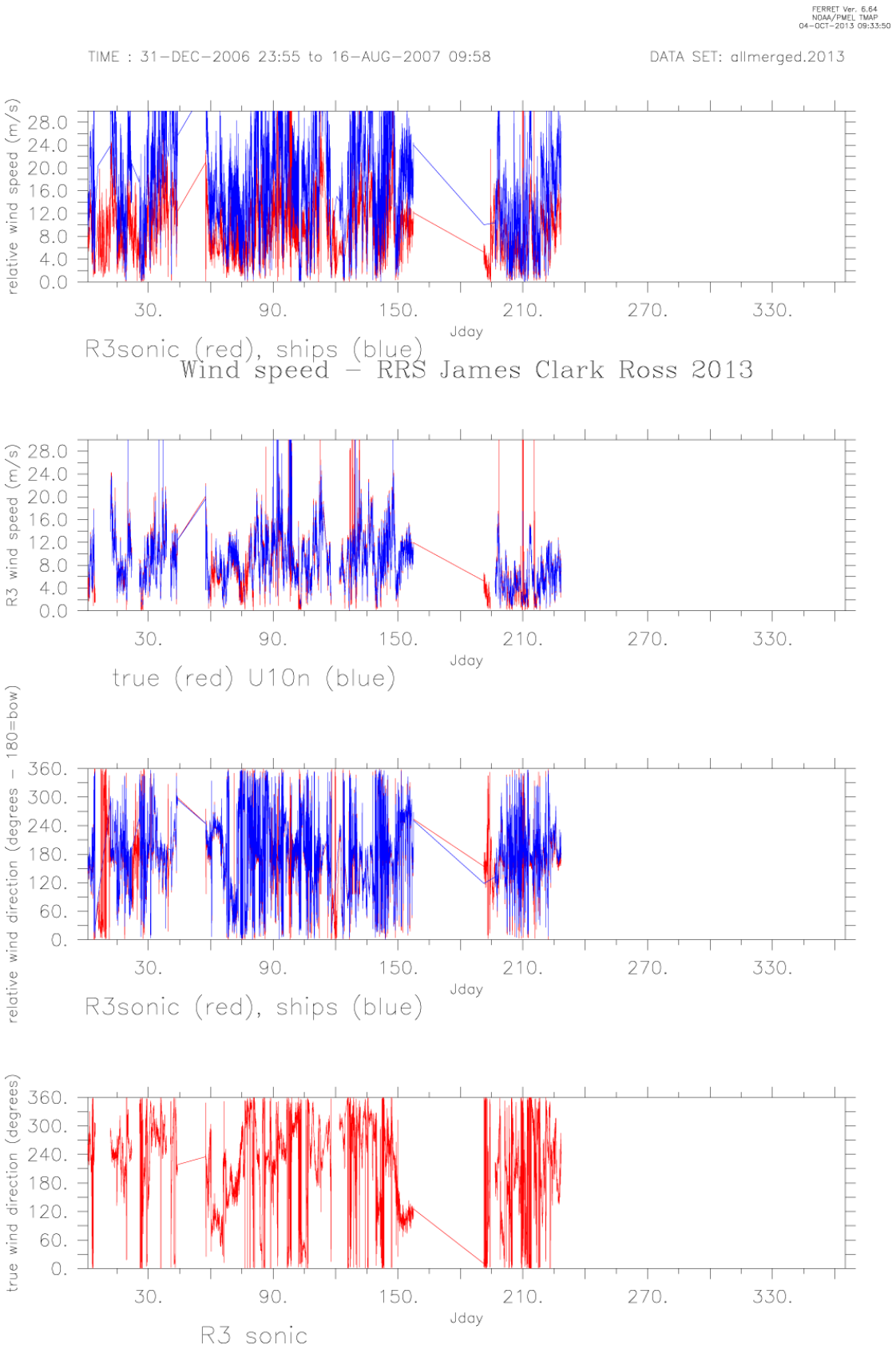
**Lower middle panel** –wind direction relative to the ship measured using the AutoFlux R3 sonic and the ship's WindMaster anemometer. Note: the relative wind direction for flows directly over the bow is 180 degrees.

**Bottom panel** – the true wind direction from the R3 sonic. Note: direction is from, e.g. 180 degrees is from the South.


TIME : 26-MAY-2007 23:55 to 31-DEC-2007 23:50
DATA SET: allmerged.2010
relative wind speed (m/s)
28.0
24.0
20.0
16.0
12.0
8.0
4.0
0.0
30.
90.
150.
210.
270.
330.
Jday
R3sonic (red), ships (blue)
Wind speed - RRS James Clark Ross 2010
R3 wind speed (m/s)
28.0
24.0
20.0
16.0
12.0
8.0
4.0
0.0
30.
90.
150.
210.
270.
330.
Jday
true (red) U10n (blue)
relative wind direction (degrees - 180=bow)
360.
300.
240.
180.
120.
60.
0.
30.
90.
150.
210.
270.
330.
Jday
R3sonic (red), ships (blue)
true wind direction (degrees)
360.
300.
240.
180.
120.
60.
0.
30.
90.
150.
210.
270.
330.
Jday
R3 sonic

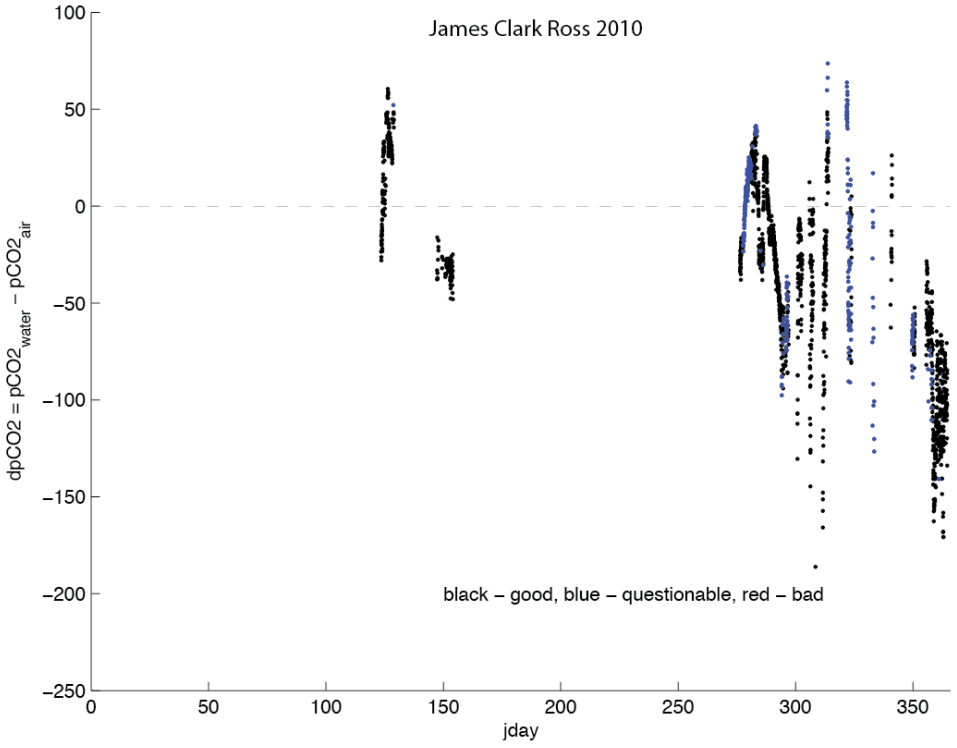

TIME : 31−DEC−2006 23:55 to 31−DEC−2007 22:49
DATA SET: allmerged.2011
relative wind speed (m/s)
28.0
24.0
20.0
16.0
12.0
8.0
4.0
0.0
30.
90.
150.
210.
270.
330.
Jday
R3sonic (red), ships (blue)
Wind speed − RRS James Clark Ross 2011
R3 wind speed (m/s)
28.0
24.0
20.0
16.0
12.0
8.0
4.0
0.0
30.
90.
150.
210.
270.
330.
Jday
true (red) U10n (blue)
relative wind direction (degrees − 180=bow)
360.
300.
240.
180.
120.
60.
0.
30.
90.
150.
210.
270.
330.
Jday
R3sonic (red), ships (blue)
true wind direction (degrees)
360.
300.
240.
180.
120.
60.
0.
30.
90.
150.
210.
270.
330.
Jday
R3 sonic

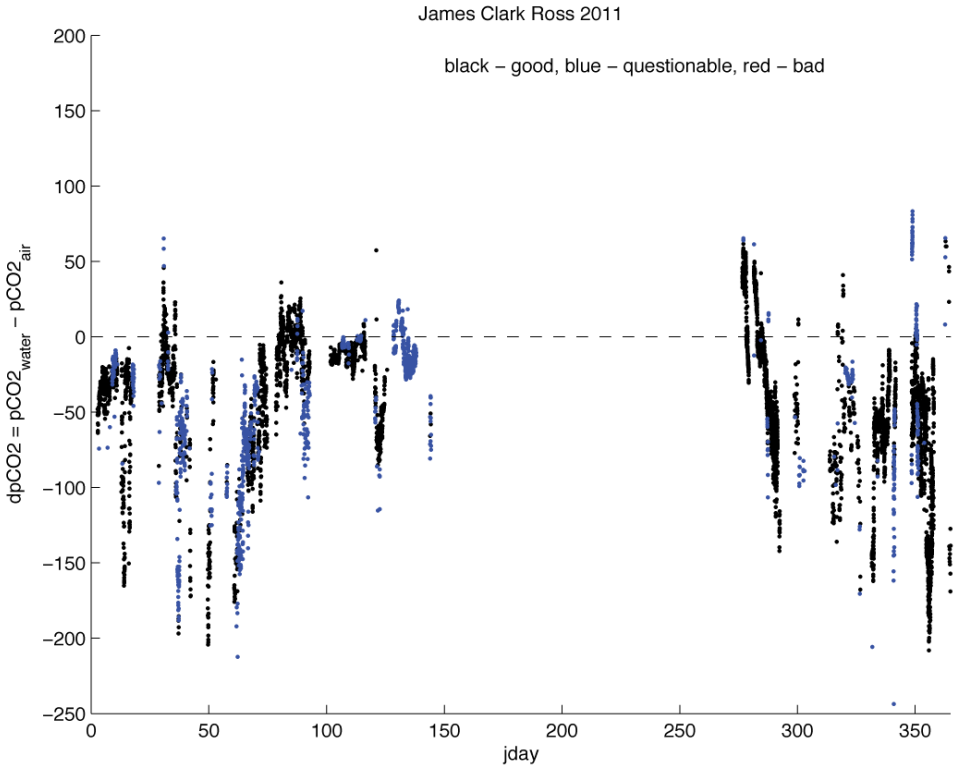

TIME : 31−DEC−2006 23:55 to 01−JAN−2008 22:56
DATA SET: allmerged.2012
relative wind speed (m/s)
28.0
24.0
20.0
16.0
12.0
8.0
4.0
0.0
30.
90.
150.
210.
270.
330.
Jday
R3sonic (red), ships (blue)
Wind speed − RRS James Clark Ross 2012
R3 wind speed (m/s)
28.0
24.0
20.0
16.0
12.0
8.0
4.0
0.0
30.
90.
150.
210.
270.
330.
Jday
true (red) U10n (blue)
relative wind direction (degrees − 180=bow)
360.
300.
240.
180.
120.
60.
0.
30.
90.
150.
210.
270.
330.
Jday
R3sonic (red), ships (blue)
true wind direction (degrees)
360.
300.
240.
180.
120.
60.
0.
30.
90.
150.
210.
270.
330.
Jday
R3 sonic

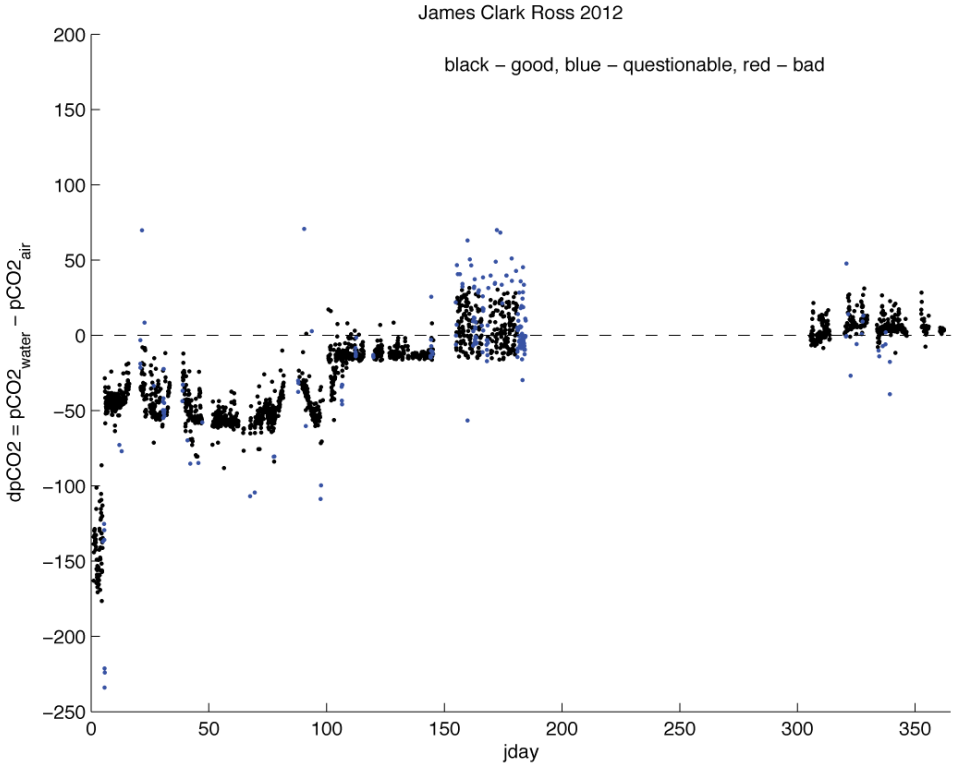

FERRET Ver. 6.64
NOAA/PMEL TMAP
04-OCT-2013 09:33:50
TIME : 31-DEC-2006 23:55 to 16-AUG-2007 09:58
DATA SET: allmerged.2013
relative wind speed (m/s)
28.0
24.0
20.0
16.0
12.0
8.0
4.0
0.0
30.
90.
150.
210.
270.
330.
Jday
R3sonic (red), ships (blue)
Wind speed - RRS James Clark Ross 2013
R3 wind speed (m/s)
28.0
24.0
20.0
16.0
12.0
8.0
4.0
0.0
30.
90.
150.
210.
270.
330.
Jday
true (red) U10n (blue)
relative wind direction (degrees - 180=bow)
360.
300.
240.
180.
120.
60.
0.
30.
90.
150.
210.
270.
330.
Jday
R3sonic (red), ships (blue)
true wind direction (degrees)
360.
300.
240.
180.
120.
60.
0.
30.
90.
150.
210.
270.
330.
Jday
R3 sonic

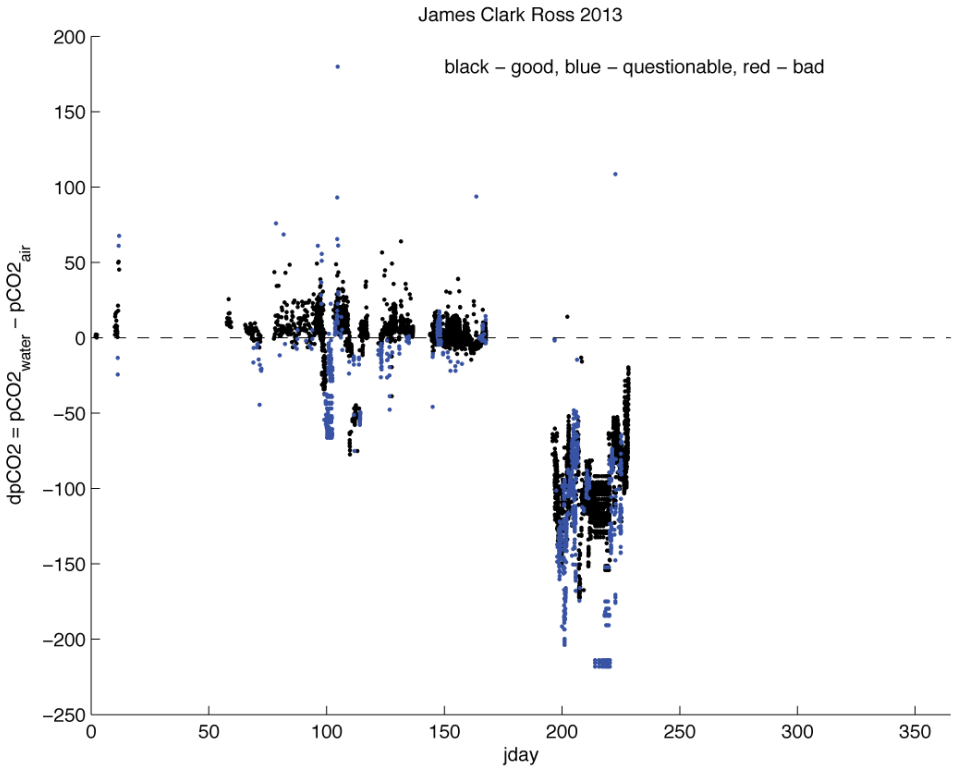
## E.6 PML $CO_2$ system

The figures show a yearly time series of the 30 minute values of $\Delta pCO_2$. Only basic quality control criteria have been applied to these data.




James Clark Ross 2012
black – good, blue – questionable, red – bad
dpCO2 = pCO2water – pCO2air
jday


James Clark Ross 2013
black – good, blue – questionable, red – bad
dpCO2 = pCO2water – pCO2air
jday

## APPENDIX F Mast heights 2010 to 2013

NOTE: The foremast platform was 20.1 m above the ships keel, and the R3 measurement volum was 1.98 m above the platform.
Hence a forward draught of 5.6 m means that the R3 measurement volume is (20.1 - 5.6 + 1.98=) 16.48 m above the waterline.
(The tables below assumes the height of the foremast top rail was 21.05 m above the keel, whereas it was actually 21.20 m).

### May 2010

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 25/05/2010 | 5.60 m | 6.34 m | 5.97 m | 0.74 m Stern | 15.45 m | |
| 27/05/2010 | 5.59 m | 6.29 m | 5.94 m | 0.70 m Stern | 15.46 m | Departure Vigo |
| 29/05/2010 | 5.59 m | 6.28 m | 5.94 m | 0.69 m Stern | 15.46 m | |

### June 2010

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 01/06/2010 | 5.60 m | 6.20 m | 5.90 m | 0.60 m Stern | 15.45 m | |
| 02/06/2010 | 5.69 m | 6.13 m | 5.91 m | 0.44 m Stern | 15.36 m | |

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|---|---|---|---|---|---|---|
| 03/06/2010 | 5.48 m | 6.20 m | 5.84 m | 0.72 m Stern | 15.57 m | |
| 06/06/2010 | 5.43 m | 6.18 m | 5.81 m | 0.75 m Stern | 15.62 m | Arrival Immingham |
| 13/06/2010 | 5.37 m | 7.06 m | 6.22 m | 1.69 m Stern | 15.68 m | Departure Immingham |
| 15/06/2010 | 5.43 m | 6.97 m | 6.20 m | 1.54 m Stern | 15.62 m | |
| 17/06/2010 | 5.45 m | 6.92 m | 6.19 m | 1.47 m Stern | 15.6 m | |
| 20/06/2010 | 5.44 m | 6.83 m | 6.14 m | 1.39 m Stern | 15.61 m | Departure Longyearbyen |
| 22/06/2010 | 5.45 m | 6.79 m | 6.12 m | 1.34 m Stern | 15.6 m | In Arctic Pack Ice |
| 24/06/2010 | 5.45 m | 6.75 m | 6.10 m | 1.30 m Stern | 15.6 m | In Arctic Pack Ice |
| 26/06/2010 | 5.45 m | 6.72 m | 6.09 m | 1.27 m Stern | 15.6 m | In Arctic Pack Ice |
| 28/06/2010 | 5.43 m | 6.68 m | 6.06 m | 1.25 m Stern | 15.62 m | In Arctic Pack Ice |
| 30/06/2010 | 5.43 m | 6.64 m | 6.04 m | 1.21 m Stern | 15.62 m | In Arctic Pack Ice |

## July 2010

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 01/07/2010 | 5.49 m | 6.34 m | 5.92 m | 0.85 m Stern | 15.56 m | |
| 03/07/2010 | 5.51 m | 6.55 m | 6.03 m | 1.04 m Stern | 15.54 m | Departure Longyearbyen |
| 05/07/2010 | 5.54 m | 6.52 m | 6.03 m | 0.98 m Stern | 15.51 m | |
| 07/07/2010 | 5.52 m | 6.56 m | 6.04 m | 1.04 m Stern | 15.53 m | |
| 10/07/2010 | 5.49 m | 6.50 m | 6.00 m | 1.01 m Stern | 15.56 m | |
| 11/07/2010 | 5.50 m | 6.47 m | 5.99 m | 0.97 m Stern | 15.55 m | Departure Ny-Alesund |
| 13/07/2010 | 5.49 m | 6.49 m | 5.99 m | 1.00 m Stern | 15.56 m | Departure Longyearbyen |
| 14/07/2010 | 5.49 m | 6.49 m | 5.99 m | 1.00 m Stern | 15.56 m | |
| 16/07/2010 | 5.50 m | 6.44 m | 5.97 m | 0.94 m Stern | 15.55 m | |

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|---|---|---|---|---|---|---|
| 22/07/2010 | 5.45 m | 6.36 m | 5.91 m | 0.91 m Stern | 15.6 m | Departure Longyearbyen |
| 23/07/2010 | 5.42 m | 6.37 m | 5.90 m | 0.95 m Stern | 15.63 m | |
| 25/07/2010 | 5.42 m | 6.31 m | 5.87 m | 0.89 m Stern | 15.63 m | |
| 29/07/2010 | 5.40 m | 6.16 m | 5.78 m | 0.76 m Stern | 15.65 m | Departure Peterhead |
| 31/07/2010 | 5.42 m | 6.10 m | 5.76 m | 0.68 m Stern | 15.63 m | Arrival Frederikshavn |

## August 2010

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 28/08/2010 | 5.10 m | 6.28 m | 5.69 m | 1.18 m Stern | 15.95 m | Departure Frederikshavn |
| 31/08/2010 | 5.20 m | 6.10 m | 5.65 m | 0.90 m Stern | 15.85 m | Arrival Portsmouth |

## September 2010

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 01/09/2010 | 5.56 m | 6.04 m | 5.80 m | 0.48 m Stern | 15.49 m | Departure Portsmouth |
| 03/09/2010 | 5.45 m | 6.09 m | 5.77 m | 0.64 m Stern | 15.6 m | |
| 28/09/2010 | 5.80 m | 6.94 m | 6.37 m | 1.14 m Stern | 15.25 m | DEP Immingham |
| 30/09/2010 | 5.85 m | 6.80 m | 6.33 m | 0.95 m Stern | 15.2 m | |

## October 2010

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 02/10/2010 | 5.85 m | 6.83 m | 6.34 m | 0.98 m Stern | 15.2 m | DEP Falmouth |
| 04/10/2010 | 5.90 m | 6.75 m | 6.33 m | 0.85 m Stern | 15.15 m | |
| 07/10/2010 | 5.92 m | 6.68 m | 6.30 m | 0.76 m Stern | 15.13 m | |
| 10/10/2010 | 5.97 m | 6.62 m | 6.30 m | 0.65 m Stern | 15.08 m | |
| 11/10/2010 | 5.81 m | 6.68 m | 6.25 m | 0.87 m Stern | 15.24 m | Post de-ballasting |
| 14/10/2010 | 5.86 m | 6.56 m | 6.21 m | 0.70 m Stern | 15.19 m | |
| 16/10/2010 | 5.89 m | 6.48 m | 6.19 m | 0.59 m Stern | 15.16 m | |
| 18/10/2010 | 5.91 m | 6.46 m | 6.19 m | 0.55 m Stern | 15.14 m | |
| 20/10/2010 | 5.78 m | 6.44 m | 6.11 m | 0.66 m Stern | 15.27 m | Ballasting |
| 22/10/2010 | 5.81 m | 6.35 m | 6.08 m | 0.54 m Stern | 15.24 m | |
| 24/10/2010 | 5.79 m | 6.30 m | 6.05 m | 0.51 m Stern | 15.26 m | |
| 26/10/2010 | 5.70 m | 6.30 m | 6.00 m | 0.60 m Stern | 15.35 m | |
| 28/10/2010 | 5.65 m | 6.33 m | 5.99 m | 0.68 m Stern | 15.4 m | |
| 30/10/2010 | 5.62 m | 6.30 m | 5.96 m | 0.68 m Stern | 15.43 m | |
| 31/10/2010 | 5.60 m | 6.25 m | 5.93 m | 0.65 m Stern | 15.45 m | |

## November 2010

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 01/11/2010 | 5.58 m | 6.22 m | 5.90 m | 0.64 m Stern | 15.47 m | |

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|---|---|---|---|---|---|---|
| 03/11/2010 | 5.60 m | 6.16 m | 5.88 m | 0.56 m Stern | 15.45 m | |
| 05/11/2010 | 5.50 m | 6.10 m | 5.80 m | 0.60 m Stern | 15.55 m | |
| 07/11/2010 | 5.59 m | 7.03 m | 6.31 m | 1.44 m Stern | 15.46 m | Bunkers taken stanley |
| 09/11/2010 | 5.62 m | 6.98 m | 6.30 m | 1.36 m Stern | 15.43 m | |
| 11/11/2010 | 5.67 m | 6.88 m | 6.28 m | 1.21 m Stern | 15.38 m | |
| 13/11/2010 | 5.70 m | 6.82 m | 6.26 m | 1.12 m Stern | 15.35 m | In Pack Ice |
| 14/11/2010 | 5.90 m | 6.81 m | 6.36 m | 0.91 m Stern | 15.15 m | |
| 17/11/2010 | 5.79 m | 6.65 m | 6.22 m | 0.86 m Stern | 15.26 m | |
| 20/11/2010 | 5.95 m | 6.66 m | 6.31 m | 0.71 m Stern | 15.1 m | |
| 23/11/2010 | 5.97 m | 6.60 m | 6.29 m | 0.63 m Stern | 15.08 m | |
| 26/11/2010 | 5.92 m | 6.61 m | 6.27 m | 0.69 m Stern | 15.13 m | |
| 28/11/2010 | 5.86 m | 6.62 m | 6.24 m | 0.76 m Stern | 15.19 m | |
| 30/11/2010 | 5.80 m | 6.64 m | 6.22 m | 0.84 m Stern | 15.25 m | |

## December 2010

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 03/12/2010 | 5.40 m | 6.40 m | 5.90 m | 1.00 m Stern | 15.65 m | Cargo at Rothera |
| 04/12/2010 | 5.20 m | 6.20 m | 5.70 m | 1.00 m Stern | 15.85 m | Cargo at Rothera |
| 05/12/2010 | 5.03 m | 6.08 m | 5.56 m | 1.05 m Stern | 16.02 m | Cargo at Rothera |
| 06/12/2010 | 4.93 m | 6.12 m | 5.53 m | 1.19 m Stern | 16.12 m | |
| 08/12/2010 | 4.87 m | 6.15 m | 5.51 m | 1.28 m Stern | 16.18 m | |
| 11/12/2010 | 4.88 m | 6.12 m | 5.50 m | 1.24 m Stern | 16.17 m | |
| 13/12/2010 | 5.80 m | 6.60 m | 6.20 m | 0.80 m Stern | 15.25 m | Bunkered Stanley |
| 16/12/2010 | 5.83 m | 6.51 m | 6.17 m | 0.68 m Stern | 15.22 m | |
| 19/12/2010 | 5.82 m | 6.56 m | 6.19 m | 0.74 m Stern | 15.23 m | |
| 21/12/2010 | 5.84 m | 6.61 m | 6.23 m | 0.77 m Stern | 15.21 m | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 24/12/2010 | 5.90 m | 6.50 m | 6.20 m | 0.60 m Stern | 15.15 m | |
| 26/12/2010 | 5.93 m | 6.44 m | 6.19 m | 0.51 m Stern | 15.12 m | |
| 27/12/2010 | 5.59 m | 6.55 m | 6.07 m | 0.96 m Stern | 15.46 m | |
| 29/12/2010 | 5.63 m | 6.47 m | 6.05 m | 0.84 m Stern | 15.42 m | |
| 31/12/2010 | 5.62 m | 6.40 m | 6.01 m | 0.78 m Stern | 15.43 m | |

## January 2011

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 01/01/2011 | 5.64 m | 6.37 m | 6.005 m | 0.73 m Stern | 15.41 m | |
| 04/01/2011 | 5.67 m | 6.30 m | 5.985 m | 0.63 m Stern | 15.38 m | |
| 06/01/2011 | 5.38 m | 6.38 m | 5.880 m | 1.00 m Stern | 15.67 m | |
| 08/01/2011 | 5.47 m | 6.29 m | 5.880 m | 0.82 m Stern | 15.58 m | |
| 11/01/2011 | 5.51 m | 6.18 m | 5.845 m | 0.67 m Stern | 15.54 m | |
| 14/01/2011 | 5.54 m | 6.13 m | 5.835 m | 0.59 m Stern | 15.51 m | |
| 16/01/2011 | 5.55 m | 6.09 m | 5.820 m | 0.54 m Stern | 15.50 m | |
| 18/01/2011 | 5.51 m | 6.11 m | 5.810 m | 0.60 m Stern | 15.54 m | |
| 20/01/2011 | 5.41 m | 6.11 m | 5.760 m | 0.70 m Stern | 15.64 m | |
| 28/01/2011 | 5.62 m | 6.88 m | 6.250 m | 1.26 m Stern | 15.43 m | Departure Stanley |
| 30/01/2011 | 5.66 m | 6.83 m | 6.245 m | 1.17 m Stern | 15.39 m | |

## February 2011

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above | Remarks |
|---|---|---|---|---|---|---|

| | | | | | Waterline (m) | |
|---|---|---|---|---|---|---|
| 01/02/2011 | 5.67 m | 6.81 m | 6.240 m | 1.14 m Stern | 15.38 m | |
| 03/02/2011 | 5.72 m | 6.75 m | 6.235 m | 1.03 m Stern | 15.33 m | |
| 05/02/2011 | 5.75 m | 6.69 m | 6.220 m | 0.94 m Stern | 15.30 m | |
| 07/02/2011 | 5.78 m | 6.63 m | 6.205 m | 0.85 m Stern | 15.27 m | |
| 09/02/2011 | 5.82 m | 6.53 m | 6.175 m | 0.71 m Stern | 15.23 m | Working in Ice |
| 11/02/2011 | 5.83 m | 6.51 m | 6.170 m | 0.68 m Stern | 15.22 m | Working in Ice |
| 13/02/2011 | 5.82 m | 6.47 m | 6.145 m | 0.65 m Stern | 15.23 m | Working in Ice |
| 15/02/2011 | 5.82 m | 6.44 m | 6.130 m | 0.62 m Stern | 15.23 m | Working in Ice |
| 17/02/2011 | 5.77 m | 6.43 m | 6.100 m | 0.66 m Stern | 15.28 m | Working in Ice |
| 19/02/2011 | 5.80 m | 6.36 m | 6.080 m | 0.56 m Stern | 15.25 m | Working in Ice |
| 21/02/2011 | 5.81 m | 6.32 m | 6.065 m | 0.51 m Stern | 15.24 m | Working in Ice |
| 23/02/2011 | 5.72 m | 6.37 m | 6.045 m | 0.65 m Stern | 15.33 m | Working in Ice |
| 25/02/2011 | 5.72 m | 6.32 m | 6.020 m | 0.60 m Stern | 15.33 m | Working in Ice |
| 27/02/2011 | 5.67 m | 6.34 m | 6.005 m | 0.67 m Stern | 15.38 m | |

## March 2011

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 01/03/2011 | 5.64 m | 6.35 m | 6.00 m | 0.71 m Stern | 15.41 m | Departure Halley |
| 03/03/2011 | 5.59 m | 6.35 m | 5.97 m | 0.76 m Stern | 15.46 m | |
| 05/03/2011 | 5.55 m | 6.37 m | 5.96 m | 0.82 m Stern | 15.50 m | |
| 07/03/2011 | 5.49 m | 6.40 m | 5.95 m | 0.91 m Stern | 15.56 m | |
| 11/03/2011 | 5.44 m | 6.40 m | 5.92 m | 0.96 m Stern | 15.61 m | James Ross Island |
| 13/03/2011 | 5.43 m | 6.35 m | 5.89 m | 0.92 m Stern | 15.62 m | |
| 16/03/2011 | 5.34 m | 6.38 m | 5.86 m | 1.04 m Stern | 15.71 m | Arrival Stanley |
| 19/03/2011 | 5.78 m | 6.40 m | 6.09 m | 0.62 m Stern | 15.27 m | Departure Stanley |

| | | | | | | |
|---|---|---|---|---|---|---|
| 21/03/2011 | 5.71 m | 6.44 m | 6.08 m | 0.73 m Stern | 15.34 m | |
| 23/03/2011 | 5.67 m | 6.48 m | 6.08 m | 0.81 m Stern | 15.38 m | |
| 25/03/2011 | 5.62 m | 6.52 m | 6.07 m | 0.90 m Stern | 15.43 m | |
| 27/03/2011 | 5.58 m | 6.56 m | 6.07 m | 0.98 m Stern | 15.47 m | |
| 29/03/2011 | 5.57 m | 6.53 m | 6.05 m | 0.96 m Stern | 15.48 m | Arrival / Departure Signy |
| 31/03/2011 | 5.49 m | 6.56 m | 6.03 m | 1.07 m Stern | 15.56 m | |

## April 2011

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 01/04/2011 | 5.49 m | 6.57 m | 6.030 m | 1.08 m Stern | 15.56 m | |
| 03/04/2011 | 5.42 m | 6.58 m | 6.000 m | 1.16 m Stern | 15.63 m | |
| 05/04/2011 | 5.36 m | 6.59 m | 5.975 m | 1.23 m Stern | 15.69 m | |
| 06/04/2011 | 5.40 m | 6.60 m | 6.000 m | 1.20 m Stern | 15.65 m | Arrival Punta Arenas |
| 09/04/2011 | 5.39 m | 6.58 m | 5.985 m | 1.19 m Stern | 15.66 m | Departure Punta Arenas |
| 11/04/2011 | 5.35 m | 6.58 m | 5.965 m | 1.23 m Stern | 15.70 m | |
| 13/04/2011 | 5.34 m | 6.57 m | 5.955 m | 1.23 m Stern | 15.71 m | |
| 15/04/2011 | 5.37 m | 6.51 m | 5.940 m | 1.14 m Stern | 15.68 m | |
| 17/04/2011 | 5.38 m | 6.50 m | 5.940 m | 1.12 m Stern | 15.67 m | |
| 19/04/2011 | 5.40 m | 6.45 m | 5.925 m | 1.05 m Stern | 15.65 m | |
| 21/04/2011 | 5.43 m | 6.36 m | 5.895 m | 0.93 m Stern | 15.62 m | |
| 23/04/2011 | 5.44 m | 6.34 m | 5.890 m | 0.90 m Stern | 15.61 m | |
| 24/04/2011 | 5.45 m | 6.33 m | 5.890 m | 0.88 m Stern | 15.60 m | |
| 27/04/2011 | 5.64 m | 6.36 m | 6.000 m | 0.72 m Stern | 15.41 m | Departure East Cove |
| 30/04/2011 | 5.80 m | 6.22 m | 6.010 m | 0.42 m Stern | 15.25 m | Departure Stanley |

## May 2011

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 01/05/2011 | 5.61 m | 6.28 m | 5.945 m | 0.67 m Stern | 15.44 m | Discharged Forepeak. |
| 03/05/2011 | 5.59 m | 6.26 m | 5.925 m | 0.67 m Stern | 15.46 m | |
| 05/05/2011 | 5.60 m | 6.24 m | 5.920 m | 0.64 m Stern | 15.45 m | |
| 06/05/2011 | 5.46 m | 6.35 m | 5.905 m | 0.89 m Stern | 15.59 m | |
| 08/05/2011 | 5.49 m | 6.30 m | 5.895 m | 0.81 m Stern | 15.56 m | |
| 10/05/2011 | 5.50 m | 6.24 m | 5.870 m | 0.74 m Stern | 15.55 m | |
| 12/05/2011 | 5.51 m | 6.18 m | 5.845 m | 0.67 m Stern | 15.54 m | |
| 14/05/2011 | 5.50 m | 6.17 m | 5.835 m | 0.67 m Stern | 15.55 m | |
| 16/05/2011 | 5.50 m | 6.14 m | 5.820 m | 0.64 m Stern | 15.55 m | |
| 18/05/2011 | 5.49 m | 6.11 m | 5.800 m | 0.62 m Stern | 15.56 m | |
| 20/05/2011 | 5.40 m | 6.14 m | 5.770 m | 0.74 m Stern | 15.65 m | |
| 22/05/2011 | 5.39 m | 6.09 m | 5.740 m | 0.70 m Stern | 15.66 m | |
| 23/05/2011 | 5.24 m | 6.10 m | 5.670 m | 0.86 m Stern | 15.81 m | |
| 24/05/2011 | 5.10 m | 6.30 m | 5.700 m | 1.20 m Stern | 15.95 m | Arrival Portland ! |

## June 2011

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| | | | | | | |

## July 2011

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 26/07/2011 | 5.98 m | 6.86 m | 6.420 m | 0.88 m Stern | 15.07 m | Departure Glascow |

## August 2011

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 01/08/2011 | 6.05 m | 6.55 m | 6.300 m | 0.50 m Stern | 15.00 m | Departure Ny Alesund |
| 02/08/2011 | 5.78 m | 6.19 m | 5.985 m | 0.41 m Stern | 15.27 m | Departure Longyearbean |
| 25/08/2011 | 5.68 m | 6.30 m | 5.990 m | 0.62 m Stern | 15.37 m | Departure Longyearbean |

## September 2011

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 06/09/2011 | 5.69 m | 6.21 m | 5.950 m | 0.52 m Stern | 15.36 m | Departure Longyearbean |
| 24/09/2011 | 5.64 m | 7.17 m | 6.405 m | 1.53 m Stern | 15.41 m | Departure Immingham |
| 26/09/2011 | 5.74 m | 7.02 m | 6.380 m | 1.28 m Stern | 15.31 m | |
| 28/09/2011 | 5.77 m | 6.94 m | 6.355 m | 1.17 m Stern | 15.28 m | |
| 30/09/2011 | 5.80 m | 6.91 m | 6.355 m | 1.11 m Stern | 15.25 m | |

## October 2011

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 02/10/2011 | 5.83 m | 6.84 m | 6.335 m | 1.01 m Stern | 15.22 m | |
| 04/10/2011 | 5.86 m | 6.77 m | 6.315 m | 0.91 m Stern | 15.19 m | |
| 06/10/2011 | 5.79 m | 6.80 m | 6.295 m | 1.01 m Stern | 15.26 m | |
| 08/10/2011 | 5.71 m | 6.82 m | 6.265 m | 1.11 m Stern | 15.34 m | |
| 10/10/2011 | 5.63 m | 6.84 m | 6.235 m | 1.21 m Stern | 15.42 m | |
| 12/10/2011 | 5.56 m | 6.88 m | 6.220 m | 1.32 m Stern | 15.49 m | |
| 14/10/2011 | 5.56 m | 6.80 m | 6.180 m | 1.24 m Stern | 15.49 m | |
| 16/10/2011 | 5.61 m | 6.73 m | 6.170 m | 1.12 m Stern | 15.44 m | |
| 18/10/2011 | 5.64 m | 6.69 m | 6.165 m | 1.05 m Stern | 15.41 m | |
| 20/10/2011 | 5.70 m | 6.64 m | 6.170 m | 0.94 m Stern | 15.35 m | Arrival Mare Harbour |
| 22/10/2011 | 5.58 m | 7.25 m | 6.415 m | 1.67 m Stern | 15.47 m | |
| 24/10/2011 | 5.60 m | 7.16 m | 6.380 m | 1.56 m Stern | 15.45 m | |
| 26/10/2011 | 5.62 m | 7.12 m | 6.370 m | 1.50 m Stern | 15.43 m | |
| 29/10/2011 | 5.68 m | 7.01 m | 6.345 m | 1.33 m Stern | 15.37 m | |
| 31/10/2011 | 5.72 m | 6.89 m | 6.305 m | 1.17 m Stern | 15.33 m | Depart KEP |

## November 2011

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 05/11/2011 | 5.80 m | 6.60 m | 6.200 m | 0.80 m Stern | 15.25 m | |
| 09/11/2011 | 5.75 m | 6.84 m | 6.295 m | 1.09 m Stern | 15.3 m | |
| 12/11/2011 | 5.79 m | 6.76 m | 6.275 m | 0.97 m Stern | 15.26 m | |
| 16/11/2011 | 5.55 m | 6.65 m | 6.100 m | 1.10 m Stern | 15.5 m | |
| 19/11/2011 | 5.57 m | 6.63 m | 6.100 m | 1.06 m Stern | 15.48 m | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 22/11/2011 | 5.58 m | 6.62 m | 6.100 m | 1.04 m Stern | 15.47 m | |
| 26/11/2011 | 5.70 m | 7.02 m | 6.360 m | 1.32 m Stern | 15.35 m | |
| 27/11/2011 | 5.83 m | 6.88 m | 6.355 m | 1.05 m Stern | 15.22 m | Depart Mare Harbour |
| 29/11/2011 | 5.87 m | 6.81 m | 6.340 m | 0.94 m Stern | 15.18 m | |
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## December 2011

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 04/12/2011 | 5.93 m | 6.70 m | 6.315 m | 0.77 m Stern | 15.12 m | |
| 09/12/2011 | 4.96 m | 6.50 m | 5.730 m | 1.54 m Stern | 16.09 m | |
| 10/12/2011 | 5.48 m | 6.35 m | 5.915 m | 0.87 m Stern | 15.57 m | |
| 11/12/2011 | 5.50 m | 6.36 m | 5.930 m | 0.86 m Stern | 15.55 m | |
| 15/12/2011 | 5.47 m | 6.32 m | 5.895 m | 0.85 m Stern | 15.58 m | |
| 19/12/2011 | 5.35 m | 6.35 m | 5.850 m | 1.00 m Stern | 15.7 m | |
| 22/12/2011 | 5.21 m | 6.35 m | 5.780 m | 1.14 m Stern | 15.84 m | |
| 24/12/2011 | 5.17 m | 6.35 m | 5.760 m | 1.18 m Stern | 15.88 m | Arrival Stanley |
| 26/12/2011 | 5.15 m | 6.30 m | 5.725 m | 1.15 m Stern | 15.9 m | |
| 28/12/2011 | 5.42 m | 7.05 m | 6.235 m | 1.63 m Stern | 15.63 m | Departure Stanley |
| 31/12/2011 | 5.45 m | 6.97 m | 6.210 m | 1.52 m Stern | 15.6 m | |

## January 2012

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 03/01/2012 | 5.48 m | 6.91 m | 6.195 m | 1.43 m Stern | 15.57 m | |
| 06/01/2012 | 5.55 m | 6.79 m | 6.170 m | 1.24 m Stern | 15.50 m | |
| 09/01/2012 | 5.57 m | 6.70 m | 6.135 m | 1.13 m Stern | 15.48 m | |
| 12/01/2012 | 5.60 m | 6.65 m | 6.125 m | 1.05 m Stern | 15.45 m | |
| 15/01/2012 | 5.66 m | 6.53 m | 6.095 m | 0.87 m Stern | 15.39 m | |
| 20/01/2012 | 5.64 m | 6.57 m | 6.105 m | 0.93 m Stern | 15.41 m | Departed Stanley |
| 22/01/2012 | 5.65 m | 6.51 m | 6.080 m | 0.86 m Stern | 15.40 m | |
| 24/01/2012 | 5.68 m | 6.47 m | 6.075 m | 0.79 m Stern | 15.37 m | |
| 26/01/2012 | 5.69 m | 6.42 m | 6.055 m | 0.73 m Stern | 15.36 m | |
| 28/01/2012 | 5.72 m | 6.39 m | 6.055 m | 0.67 m Stern | 15.33 m | |
| 30/01/2012 | 5.73 m | 6.32 m | 6.025 m | 0.59 m Stern | 15.32 m | |

## February 2012

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 04/02/2012 | 5.70 m | 6.90 m | 6.300 m | 1.20 m Stern | 15.35 m | Departure East Cove |
| 07/02/2012 | 5.70 m | 6.89 m | 6.295 m | 1.19 m Stern | 15.35 m | Departure Stanley |
| 09/02/2012 | 5.77 m | 6.79 m | 6.280 m | 1.02 m Stern | 15.28 m | |
| 11/02/2012 | 5.81 m | 6.73 m | 6.270 m | 0.92 m Stern | 15.24 m | |
| 13/02/2012 | 5.81 m | 6.69 m | 6.250 m | 0.88 m Stern | 15.24 m | |
| 15/02/2012 | 5.85 m | 6.64 m | 6.245 m | 0.79 m Stern | 15.20 m | |

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|---|---|---|---|---|---|---|
| 17/02/2012 | 5.85 m | 6.60 m | 6.225 m | 0.75 m Stern | 15.20 m | |
| 19/02/2012 | 5.78 m | 6.61 m | 6.195 m | 0.83 m Stern | 15.27 m | |
| 21/02/2012 | 5.73 m | 6.61 m | 6.170 m | 0.88 m Stern | 15.32 m | |
| 23/02/2012 | 5.68 m | 6.63 m | 6.155 m | 0.95 m Stern | 15.37 m | |
| 25/02/2012 | 5.59 m | 6.66 m | 6.125 m | 1.07 m Stern | 15.46 m | |
| 27/02/2012 | 5.57 m | 6.67 m | 6.120 m | 1.10 m Stern | 15.48 m | |
| 29/02/2012 | 5.52 m | 6.69 m | 6.105 m | 1.17 m Stern | 15.53 m | |

## March 2012

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 01/03/2012 | 5.53 m | 6.68 m | 6.11 m | 1.15 m Stern | 15.52 m | |
| 03/03/2012 | 5.55 m | 6.61 m | 6.08 m | 1.06 m Stern | 15.50 m | |
| 05/03/2012 | 5.59 m | 6.54 m | 6.07 m | 0.95 m Stern | 15.46 m | |
| 07/03/2012 | 5.60 m | 6.48 m | 6.04 m | 0.88 m Stern | 15.45 m | |
| 09/03/2012 | 5.63 m | 6.41 m | 6.02 m | 0.78 m Stern | 15.42 m | |
| 11/03/2012 | 5.66 m | 6.36 m | 6.01 m | 0.70 m Stern | 15.39 m | |
| 13/03/2012 | 5.68 m | 6.32 m | 6.00 m | 0.64 m Stern | 15.37 m | |
| 15/03/2012 | 5.67 m | 6.30 m | 5.99 m | 0.63 m Stern | 15.38 m | |
| 17/03/2012 | 5.61 m | 6.33 m | 5.97 m | 0.72 m Stern | 15.44 m | |
| 19/03/2012 | 5.57 m | 6.30 m | 5.94 m | 0.73 m Stern | 15.48 m | |
| 27/03/2012 | 5.74 m | 6.66 m | 6.20 m | 0.92 m Stern | 15.31 m | Departure East Cove |
| 29/03/2012 | 5.74 m | 6.63 m | 6.19 m | 0.89 m Stern | 15.31 m | |
| 31/03/2012 | 5.79 m | 6.53 m | 6.16 m | 0.74 m Stern | 15.26 m | |

## April 2012

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 02/04/2012 | 5.82 m | 6.49 m | 6.16 m | 0.67 m Stern | 15.23 m | |
| 04/04/2012 | 5.81 m | 6.50 m | 6.16 m | 0.69 m Stern | 15.24 m | |
| 06/04/2012 | 5.76 m | 6.53 m | 6.15 m | 0.77 m Stern | 15.29 m | |
| 08/04/2012 | 5.68 m | 6.58 m | 6.13 m | 0.90 m Stern | 15.37 m | |
| 10/04/2012 | 5.64 m | 6.60 m | 6.12 m | 0.96 m Stern | 15.41 m | |
| 12/04/2012 | 5.57 m | 6.64 m | 6.11 m | 1.07 m Stern | 15.48 m | |
| 14/04/2012 | 5.53 m | 6.65 m | 6.09 m | 1.12 m Stern | 15.52 m | |
| 16/04/2012 | 5.52 m | 6.63 m | 6.08 m | 1.11 m Stern | 15.53 m | |
| 18/04/2012 | 5.50 m | 6.58 m | 6.04 m | 1.08 m Stern | 15.55 m | |
| 20/04/2012 | 5.53 m | 6.51 m | 6.02 m | 0.98 m Stern | 15.52 m | |
| 22/04/2012 | 5.55 m | 6.47 m | 6.01 m | 0.92 m Stern | 15.50 m | |
| 24/04/2012 | 5.60 m | 6.40 m | 6.00 m | 0.80 m Stern | 15.45 m | Arrival Stanley |
| 28/04/2012 | 5.60 m | 6.48 m | 6.04 m | 0.88 m Stern | 15.45 m | Departure Stanley |
| 30/04/2012 | 5.64 m | 6.43 m | 6.04 m | 0.79 m Stern | 15.41 m | |

## May 2012

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 02/05/2012 | 5.68 m | 6.38 m | 6.030 m | 0.70 m Stern | 15.37 m | |
| 03/05/2012 | 5.31 m | 6.56 m | 5.935 m | 1.25 m Stern | 15.74 m | Working Ballast |
| 04/05/2012 | 5.30 m | 6.57 m | 5.935 m | 1.27 m Stern | 15.75 m | |
| 05/05/2012 | 5.28 m | 6.57 m | 5.925 m | 1.29 m Stern | 15.77 m | |
| 07/05/2012 | 5.26 m | 6.58 m | 5.920 m | 1.32 m Stern | 15.79 m | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 09/05/2012 | 5.25 m | 6.53 m | 5.890 m | 1.28 m Stern | 15.80 m | |
| 10/05/2012 | 5.27 m | 6.50 m | 5.885 m | 1.23 m Stern | 15.78 m | |
| 11/05/2012 | 5.28 m | 6.48 m | 5.880 m | 1.20 m Stern | 15.77 m | |
| 13/05/2012 | 5.30 m | 6.43 m | 5.865 m | 1.13 m Stern | 15.75 m | |
| 14/05/2012 | 5.30 m | 6.40 m | 5.850 m | 1.10 m Stern | 15.75 m | |
| 16/05/2012 | 5.37 m | 6.28 m | 5.825 m | 0.91 m Stern | 15.68 m | |
| 18/05/2012 | 5.37 m | 6.24 m | 5.805 m | 0.87 m Stern | 15.68 m | |
| 20/05/2012 | 5.32 m | 6.23 m | 5.775 m | 0.91 m Stern | 15.73 m | |
| 21/05/2012 | 5.27 m | 6.26 m | 5.765 m | 0.99 m Stern | 15.78 m | |
| 22/05/2012 | 5.44 m | 6.16 m | 5.800 m | 0.72 m Stern | 15.61 m | |
| 23/05/2012 | 5.43 m | 6.15 m | 5.790 m | 0.72 m Stern | 15.62 m | |
| | | | | | | |

## June 2012

| Date | Forward Draft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 01/06/2012 | 5.70 m | 7.10 m | 6.400 m | 1.40 m Stern | 15.35 m | Sailed Immingham |
| 10/06/2012 | 5.82 m | 6.82 m | 6.320 m | 1.00 m Stern | 15.23 m | At sea |
| 17/06/2010 | 5.83 m | 6.68 m | 6.255 m | 0.85 m Stern | 15.22 m | In pack ice |
| 21/06/2012 | 5.86 m | 6.70 m | 6.280 m | 0.84 m Stern | 15.19 m | Ny Alesund |
| 23/06/2012 | 5.82 m | 6.56 m | 6.190 m | 0.74 m Stern | 15.23 m | At sea |
| 29/06/2012 | 5.66 m | 6.61 m | 6.135 m | 0.95 m Stern | 15.39 m | At sea |
| | | | | | | |

## July 2012

| Date | Forward Draft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 02/07/2012 | 5.59 m | 6.63 m | 6.110 m | 1.04 m Stern | 15.46 m | Est. arr. Reykjavik |
| 07/07/2012 | 5.82 m | 6.72 m | 6.270 m | 0.90 m Stern | 15.23 m | Departure Reykjavik |
| 13/07/2012 | 5.90 m | 6.54 m | 6.220 m | 0.64 m Stern | 15.15 m | At sea |
| 20/07/2012 | 5.86 m | 6.45 m | 6.155 m | 0.59 m Stern | 15.19 m | At sea |
| 27/07/2012 | 5.71 m | 6.60 m | 6.155 m | 0.89 m Stern | 15.34 m | Departure Reykjavik |
| 31/07/2012 | 5.69 m | 6.56 m | 6.125 m | 0.87 m Stern | 15.36 m | At sea |
| | | | | | | |

## August 2012

| Date | Forward Draft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 05/08/2012 | 5.73 m | 6.43 m | 6.080 m | 0.70 m Stern | 15.32 m | At sea |
| 06/08/2012 | 5.80 m | 6.30 m | 6.050 m | 0.50 m Stern | 15.25 m | Siglufjordur |
| 11/08/2012 | 5.74 m | 6.33 m | 6.035 m | 0.59 m Stern | 15.31 m | At sea |
| 19/08/2012 | 5.52 m | 6.37 m | 5.945 m | 0.85 m Stern | 15.53 m | At sea |
| 22/08/2012 | 5.43 m | 6.34 m | 5.885 m | 0.91 m Stern | 15.62 m | At sea |
| 26/08/2012 | 5.46 m | 6.26 m | 5.860 m | 0.80 m Stern | 15.59 m | Longyearbyen |
| 30/08/2012 | 5.49 m | 6.17 m | 5.830 m | 0.68 m Stern | 15.56 m | At sea |
| | | | | | | |

## September 2012

| Date | Forward | Aft | Mean | Trim | Height of Fore Mast Cross | Remarks |
|---|---|---|---|---|---|---|

| | Draft | Draft | Draft | | Tree Top Rail Above Waterline (m) | |
|---|---|---|---|---|---|---|
| 01/09/2012 | 5.46 m | 6.10 m | 5.780 m | 0.64 m Stern | 15.59 m | Peterhead |
| | | | | | | |

## October 2012

| Date | Forward Draft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 12/10/2012 | 5.68 m | 7.14 m | 6.410 m | 1.46 m Stern | 15.37 m | Departure Portsmouth |
| 14/10/2012 | 5.69 m | 7.08 m | 6.385 m | 1.39 m Stern | 15.36 m | Calculated at sea |
| 16/10/2012 | 5.68 m | 7.10 m | 6.390 m | 1.42 m Stern | 15.37 m | Calculated at sea |
| 18/10/2012 | 5.77 m | 6.95 m | 6.360 m | 1.18 m Stern | 15.28 m | Calculated at sea |
| 20/10/2012 | 5.77 m | 6.94 m | 6.355 m | 1.17 m Stern | 15.28 m | Calculated at sea |
| 22/10/2012 | 5.78 m | 6.93 m | 6.355 m | 1.15 m Stern | 15.27 m | Calculated at sea |
| 23/10/2012 | 5.79 m | 6.91 m | 6.350 m | 1.12 m Stern | 15.26 m | Calculated at sea |
| 25/10/2012 | 5.83 m | 6.85 m | 6.340 m | 1.02 m Stern | 15.22 m | Calculated at sea |
| 27/10/2012 | 5.84 m | 6.80 m | 6.320 m | 0.96 m Stern | 15.21 m | Calculated at sea |
| 29/10/2012 | 5.86 m | 6.76 m | 6.310 m | 0.90 m Stern | 15.19 m | Calculated at sea |
| 31/10/2012 | 5.72 m | 6.78 m | 6.250 m | 1.06 m Stern | 15.33 m | Be-ballasted Fore Peak |
| | | | | | | |

## November 2012

| Date | Forward Draft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|

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|---|---|---|---|---|---|---|
| 01/11/2012 | 5.72 m | 6.76 m | 6.240 m | 1.04 m Stern | 15.33 m | Calculated at sea |
| 03/11/2012 | 5.74 m | 6.71 m | 6.225 m | 0.97 m Stern | 15.31 m | Calculated at sea |
| 05/11/2012 | 5.76 m | 6.67 m | 6.215 m | 0.91 m Stern | 15.29 m | Calculated at sea |
| 07/11/2012 | 5.78 m | 6.60 m | 6.190 m | 0.82 m Stern | 15.27 m | Calculated at sea |
| 13/11/2012 | 5.50 m | 7.00 m | 6.250 m | 1.50 m Stern | 15.55 m | Departure Stanley |
| 14/11/2012 | 5.50 m | 6.97 m | 6.235 m | 1.47 m Stern | 15.55 m | Calculated at sea |
| 21/11/2012 | 5.61 m | 6.63 m | 6.120 m | 1.02 m Stern | 15.44 m | Post BI and KEP |
| 23/11/2012 | 5.62 m | 6.59 m | 6.105 m | 0.97 m Stern | 15.43 m | Calculated at sea |
| 26/11/2012 | 5.60 m | 6.44 m | 6.020 m | 0.84 m Stern | 15.45 m | Visual at Signy |
| 27/11/2012 | 5.60 m | 6.42 m | 6.010 m | 0.82 m Stern | 15.45 m | Calculated at sea |
| 29/11/2012 | 5.62 m | 6.35 m | 5.985 m | 0.73 m Stern | 15.43 m | Calculated at sea |
| | | | | | | |

## December 2012

| Date | Forward Draft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 02/12/2012 | 5.61 m | 6.37 m | 5.990 m | 0.76 m Stern | 15.44 m | Calculated at sea |
| 03/12/2012 | 5.59 m | 6.35 m | 5.970 m | 0.76 m Stern | 15.46 m | Calculated at sea |
| 05/12/2012 | 5.56 m | 6.33 m | 5.945 m | 0.77 m Stern | 15.49 m | Calculated at sea |
| 07/12/2012 | 5.54 m | 6.32 m | 5.930 m | 0.78 m Stern | 15.51 m | Calculated at sea |
| 09/12/2012 | 5.53 m | 6.30 m | 5.915 m | 0.77 m Stern | 15.52 m | Calculated at sea |
| 12/12/2012 | 5.36 m | 7.20 m | 6.280 m | 1.84 m Stern | 15.69 m | Arrival East Cove |
| 15/12/2012 | 5.80 m | 7.04 m | 6.420 m | 1.24 m Stern | 15.25 m | Departure Stanley |
| 17/12/2012 | 5.82 m | 6.98 m | 6.400 m | 1.16 m Stern | 15.23 m | Calculated at sea |
| 19/12/2012 | 5.81 m | 6.95 m | 6.380 m | 1.14 m Stern | 15.24 m | Calculated at sea |
| 24/12/2012 | 5.36 m | 6.57 m | 5.965 m | 1.21 m Stern | 15.69 m | Rothera Departure (calc) |
| 26/12/2012 | 5.40 m | 6.51 m | 5.955 m | 1.11 m Stern | 15.65 m | Calculated at sea |

| | | | | | | |
|---|---|---|---|---|---|---|
| 28/12/2012 | 5.43 m | 6.45 m | 5.940 m | 1.02 m Stern | 15.62 m | Calculated at sea |
| 29/12/2012 | 5.42 m | 6.43 m | 5.925 m | 1.01 m Stern | 15.63 m | Arrival Signy |
| 30/12/2012 | 5.46 m | 6.36 m | 5.910 m | 0.90 m Stern | 15.59 m | Calculated at sea |
| | | | | | | |

## January 2013

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 01/01/2013 | 5.47 m | 6.30 m | 5.885 m | 0.83 m Stern | 15.58 m | Calculated at sea |
| 09/01/2013 | 5.74 m | 6.92 m | 6.330 m | 1.18 m Stern | 15.31 m | Departure Stanley |
| 11/01/2013 | 5.74 m | 6.89 m | 6.315 m | 1.15 m Stern | 15.31 m | Calculated at sea |
| 12/01/2013 | 5.79 m | 6.83 m | 6.310 m | 1.04 m Stern | 15.26 m | Calculated at sea |
| 14/01/2013 | 5.80 m | 6.80 m | 6.300 m | 1.00 m Stern | 15.25 m | Calculated at sea |
| 16/01/2013 | 5.80 m | 6.78 m | 6.290 m | 0.98 m Stern | 15.25 m | Calculated at sea |
| 18/01/2013 | 5.86 m | 6.69 m | 6.275 m | 0.83 m Stern | 15.19 m | Calculated at sea |
| 20/01/2013 | 5.88 m | 6.65 m | 6.265 m | 0.77 m Stern | 15.17 m | Calculated at sea |
| 22/01/2013 | 5.86 m | 6.62 m | 6.240 m | 0.76 m Stern | 15.19 m | Calculated at sea |
| 24/01/2013 | 5.90 m | 6.56 m | 6.230 m | 0.66 m Stern | 15.15 m | Calculated at sea |
| 26/01/2013 | 5.90 m | 6.49 m | 6.195 m | 0.59 m Stern | 15.15 m | Departure K.E.P. |
| 28/01/2013 | 5.56 m | 6.63 m | 6.095 m | 1.07 m Stern | 15.49 m | Calculated at sea |
| 30/01/2013 | 5.59 m | 6.57 m | 6.080 m | 0.98 m Stern | 15.46 m | Calculated at sea |
| | | | | | | |

## February 2013

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 01/02/2013 | 5.58 m | 6.55 m | 6.065 m | 0.97 m Stern | 15.47 m | Calculated at sea |
| 03/02/2012 | 5.61 m | 6.50 m | 6.055 m | 0.89 m Stern | 15.44 m | Calculated at sea |
| 05/02/2013 | 5.65 m | 6.45 m | 6.050 m | 0.80 m Stern | 15.40 m | Calculated at sea |
| 07/02/2013 | 5.68 m | 6.38 m | 6.030 m | 0.70 m Stern | 15.37 m | Calculated at sea |
| 09/02/2013 | 5.72 m | 6.28 m | 6.000 m | 0.56 m Stern | 15.33 m | Calculated at sea |
| 10/02/2013 | 5.71 m | 6.25 m | 5.980 m | 0.54 m Stern | 15.34 m | Calculated at sea |
| 12/02/2013 | 5.58 m | 6.22 m | 5.900 m | 0.64 m Stern | 15.47 m | Arrival Stanley |
| 18/02/2013 | 5.55 m | 6.25 m | 5.900 m | 0.70 m Stern | 15.50 m | Depart Stanley |
| 19/02/2013 | 5.50 m | 7.00 m | 6.250 m | 1.50 m Stern | 15.55 m | Calculated at Mare Harbour (Bunkers) |
| 21/02/2013 | 5.60 m | 6.90 m | 6.250 m | 1.30 m Stern | 15.45 m | Calculated at sea |
| 23/02/2013 | 5.67 m | 6.81 m | 6.240 m | 1.14 m Stern | 15.38 m | Calculated at sea |
| 25/02/2013 | 5.69 m | 6.74 m | 6.215 m | 1.05 m Stern | 15.36 m | Calculated at sea |
| 27/02/2013 | 5.72 m | 6.70 m | 6.210 m | 0.98 m Stern | 15.33 m | Calculated at sea |
| | | | | | | |

## March 2013

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 01/03/2013 | 5.74 m | 6.64 m | 6.19 m | 0.90 m Stern | 15.31 m | Arrive Halley |
| 05/03/2013 | 5.85 m | 6.62 m | 6.24 m | 0.77 m Stern | 15.20 m | Depart Halley |
| 07/03/2013 | 5.89 m | 6.57 m | 6.23 m | 0.68 m Stern | 15.16 m | Calculated at sea |
| 09/03/2013 | 5.86 m | 6.58 m | 6.22 m | 0.72 m Stern | 15.19 m | Calculated at sea |

| | | | | | | |
|---|---|---|---|---|---|---|
| 11/03/2013 | 5.85 m | 6.57 m | 6.21 m | 0.72 m Stern | 15.20 m | Calculated at sea |
| 13/03/2013 | 5.78 m | 6.55 m | 6.17 m | 0.77 m Stern | 15.27 m | Arrive Mare Harbour |
| 13/03/2013 | 5.63 m | 7.05 m | 6.34 m | 1.42 m Stern | 15.42 m | Depart Mare Harbour |
| 14/03/2013 | 5.63 m | 7.05 m | 6.34 m | 1.42 m Stern | 15.42 m | Arrrive Stanley |
| 17/03/2013 | 5.52 m | 7.01 m | 6.27 m | 1.49 m Stern | 15.53 m | Alongside Stanley |
| 18/03/2013 | 5.56 m | 6.98 m | 6.27 m | 1.42 m Stern | 15.49 m | Depart Stanley |
| 20/03/2013 | 5.58 m | 6.93 m | 6.26 m | 1.35 m Stern | 15.47 m | Calculated at sea |
| 22/03/2013 | 5.59 m | 6.92 m | 6.26 m | 1.33 m Stern | 15.46 m | Calculated at sea |
| 24/03/2013 | 5.63 m | 6.86 m | 6.25 m | 1.23 m Stern | 15.42 m | Calculated at sea |
| 26/03/2013 | 5.68 m | 6.76 m | 6.22 m | 1.08 m Stern | 15.37 m | Calculated at sea |
| 28/03/2013 | 5.70 m | 6.72 m | 6.21 m | 1.02 m Stern | 15.35 m | Calculated at sea |
| 30/03/2013 | 5.71 m | 6.69 m | 6.20 m | 0.98 m Stern | 15.34 m | Calculated at sea |

## April 2013

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 01/04/2013 | 5.72 m | 6.63 m | 6.175 m | 0.91 m Stern | 15.33 m | Calculated at sea |
| 03/04/2013 | 5.73 m | 6.57 m | 6.150 m | 0.84 m Stern | 15.32 m | Calculated at sea |
| 05/04/2013 | 5.75 m | 6.53 m | 6.140 m | 0.78 m Stern | 15.30 m | Calculated at sea |
| 07/04/2013 | 5.76 m | 6.50 m | 6.130 m | 0.74 m Stern | 15.29 m | Calculated at sea |
| 08/04/2013 | 5.44 m | 6.66 m | 6.050 m | 1.22 m Stern | 15.61 m | Calculated at sea |
| 10/04/2013 | 5.46 m | 6.60 m | 6.030 m | 1.14 m Stern | 15.59 m | Calculated at sea |
| 12/04/2013 | 5.45 m | 6.58 m | 6.015 m | 1.13 m Stern | 15.60 m | Alongside KEP |
| 13/04/2013 | 5.46 m | 6.58 m | 6.020 m | 1.12 m Stern | 15.59 m | Depart KEP |
| 14/04/2013 | 5.50 m | 6.51 m | 6.005 m | 1.01 m Stern | 15.55 m | Calculated at sea |
| 16/04/2013 | 5.51 m | 6.50 m | 6.005 m | 0.99 m Stern | 15.54 m | Calculated at sea |
| 17/04/2013 | 5.51 m | 6.51 m | 6.010 m | 1.00 m Stern | 15.54 m | Calculated at sea |

| | | | | | | |
|---|---|---|---|---|---|---|
| 19/04/2013 | 5.54 m | 6.47 m | 6.005 m | 0.93 m Stern | 15.51 m | Calculated at sea |
| 20/04/2013 | 5.55 m | 6.44 m | 5.995 m | 0.89 m Stern | 15.50 m | Calculated at sea |
| 22/04/2013 | 5.56 m | 6.39 m | 5.975 m | 0.83 m Stern | 15.49 m | Calculated at sea |
| 23/04/2013 | 5.50 m | 6.42 m | 5.960 m | 0.92 m Stern | 15.55 m | Calculated at sea |
| 25/04/2013 | 5.41 m | 6.47 m | 5.940 m | 1.06 m Stern | 15.64 m | Calculated at sea |
| 27/04/2013 | 5.40 m | 6.41 m | 5.905 m | 1.01 m Stern | 15.65 m | Arrival Stanley |
| | | | | | | |

## May 2013

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 01/05/2013 | 5.52 m | 6.30 m | 5.910 m | 0.78 m Stern | 15.53 m | Depart Stanley/Arrive Mare Harbour |
| 02/05/2013 | 5.67 m | 6.88 m | 6.275 m | 1.21 m Stern | 15.38 m | Depart Mare Harbour |
| 03/05/2013 | 5.65 m | 6.88 m | 6.265 m | 1.23 m Stern | 15.40 m | Calculated at sea |
| 05/05/2013 | 5.71 m | 6.82 m | 6.265 m | 1.11 m Stern | 15.34 m | Calculated at sea |
| 07/05/2013 | 5.74 m | 6.76 m | 6.250 m | 1.02 m Stern | 15.31 m | Calculated at sea |
| 09/05/2013 | 5.77 m | 6.70 m | 6.235 m | 0.93 m Stern | 15.28 m | Calculated at sea |
| 11/05/2013 | 5.79 m | 6.63 m | 6.210 m | 0.84 m Stern | 15.26 m | Calculated at sea |
| 13/05/2013 | 5.81 m | 6.62 m | 6.215 m | 0.81 m Stern | 15.24 m | Calculated at sea |
| 15/05/2013 | 5.54 m | 6.77 m | 6.155 m | 1.23 m Stern | 15.51 m | Calculated at sea |
| 17/05/2013 | 5.49 m | 6.80 m | 6.145 m | 1.31 m Stern | 15.56 m | Calculated at sea |
| 19/05/2013 | 5.45 m | 6.81 m | 6.130 m | 1.36 m Stern | 15.60 m | Calculated at sea |
| 20/05/2013 | 5.44 m | 6.80 m | 6.120 m | 1.36 m Stern | 15.61 m | Calculated at sea |
| 21/05/2013 | 5.46 m | 6.76 m | 6.110 m | 1.30 m Stern | 15.59 m | Calculated at sea |
| 23/05/2013 | 5.48 m | 6.71 m | 6.095 m | 1.23 m Stern | 15.57 m | Calculated at sea |
| 25/05/2013 | 5.50 m | 6.65 m | 6.075 m | 1.15 m Stern | 15.55 m | Calculated at sea |

| | | | | | | |
|---|---|---|---|---|---|---|
| 27/05/2013 | 5.52 m | 6.59 m | 6.055 m | 1.07 m Stern | 15.53 m | Calculated at sea |
| 29/05/2013 | 5.52 m | 6.58 m | 6.050 m | 1.06 m Stern | 15.53 m | Calculated at sea |
| 31/05/2013 | 5.54 m | 6.54 m | 6.040 m | 1.00 m Stern | 15.51 m | Calculated at sea |

## June 2013

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 02/06/2013 | 5.57 m | 6.48 m | 6.025 m | 0.91 m Stern | 15.48 m | Calculated at sea |
| 04/06/2013 | 5.58 m | 6.47 m | 6.025 m | 0.89 m Stern | 15.47 m | Calculated at sea |
| 06/06/2013 | 5.59 m | 6.43 m | 6.010 m | 0.84 m Stern | 15.46 m | Calculated at sea |
| | | | | | | Equipment removed from mast |

## July 2013

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 13/07/2013 | 5.63 m | 6.68 m | 6.155 m | 1.05 m Stern | 15.42 m | Departed Immingham |
| 15/07/2013 | 5.64 m | 6.61 m | 6.125 m | 0.97 m Stern | 15.41 m | Calculated at sea. |
| 17/07/2013 | 5.64 m | 6.59 m | 6.115 m | 0.95 m Stern | 15.41 m | Calculated at sea. |
| 19/07/2013 | 5.68 m | 6.50 m | 6.090 m | 0.82 m Stern | 15.37 m | Calculated at sea. |
| 21/07/2013 | 5.70 m | 6.44 m | 6.070 m | 0.74 m Stern | 15.35 m | Calculated at sea. |
| 23/07/2013 | 5.72 m | 6.39 m | 6.055 m | 0.67 m Stern | 15.33 m | Calculated at sea. |
| 25/07/2013 | 5.74 m | 6.33 m | 6.035 m | 0.59 m Stern | 15.31 m | Calculated at sea. |
| 27/07/2013 | 5.72 m | 6.30 m | 6.010 m | 0.58 m Stern | 15.33 m | Calculated at sea. |

| | | | | | | |
|---|---|---|---|---|---|---|
| 29/07/2013 | 5.67 m | 6.29 m | 5.980 m | 0.62 m Stern | 15.38 m | Calculated at sea. |
| 30/07/2013 | 5.67 m | 6.26 m | 5.965 m | 0.59 m Stern | 15.38 m | Calculated at sea. |
| 31/07/2013 | 5.66 m | 6.22 m | 5.940 m | 0.56 m Stern | 15.39 m | Departure Longyearbyen |
| | | | | | | |

## August 2013

| Date | Foreward Darft | Aft Draft | Mean Draft | Trim | Height of Fore Mast Cross Tree Top Rail Above Waterline (m) | Remarks |
|---|---|---|---|---|---|---|
| 02/08/2013 | 5.64 m | 6.21 m | 5.925 m | 0.57 m Stern | 15.41 m | Calculated at sea. |
| 04/08/2013 | 5.58 m | 6.24 m | 5.910 m | 0.66 m Stern | 15.47 m | Calculated at sea. |
| 06/08/2013 | 5.54 m | 6.23 m | 5.885 m | 0.69 m Stern | 15.51 m | Calculated at sea. |
| 08/08/2013 | 5.49 m | 6.25 m | 5.870 m | 0.76 m Stern | 15.56 m | Calculated at sea. |
| 10/08/2013 | 5.51 m | 6.20 m | 5.855 m | 0.69 m Stern | 15.54 m | Calculated at sea. |
| 12/08/2013 | 5.53 m | 6.16 m | 5.845 m | 0.63 m Stern | 15.52 m | Calculated at sea. |
| 14/08/2013 | 5.54 m | 6.12 m | 5.830 m | 0.58 m Stern | 15.51 m | Calculated at sea. |
| 15/08/2013 | 5.54 m | 6.10 m | 5.820 m | 0.56 m Stern | 15.51 m | Calculated at sea. |
| 20/08/2013 | 5.46 m | 6.07 m | 5.765 m | 0.61 m Stern | 15.59 m | Departure Dundee |
| | | | | | | |

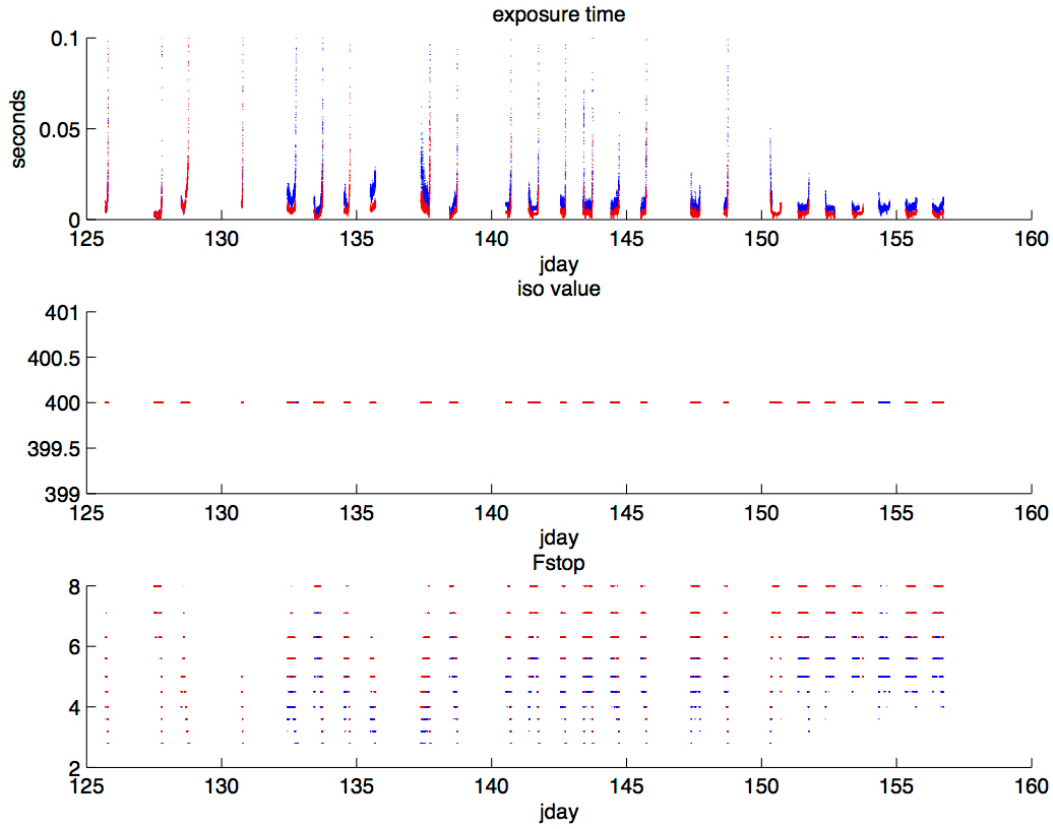
## APPENDIX G Manned Cruise and visit dates

| Cruise/visit | Start | End |
|---|---|---|
| **2010** | | |
| Visit | 22nd May 2010 (J142) - Vigo, Spain | 22nd May 2010 (J142) - Vigo, Spain |
| **JR254A** | 27th May 2010 (J147) - Vigo, Spain | 6th June 2010 (J157) – Immingham, UK |
| Visit | 29th July 2010 (J210) – Peterhead, UK | 29th July 2010 (J210) – Peterhead, UK |
| Visit | August 25th 2010 (J237) - Frederickshaven, Denmark | August 25th 2010 (J237)- Frederickshaven, Denmark |
| Visit | September 27th 2010 (J270) - Immingham | September 27th 2010 (J270) - Immingham |
| **JR254B 3 days short fetch study off the Falklands only. Original Drake Passage cruise cancelled at short notice due to problems with the Dash-7 aircraft.** | 14th December 2010 Stanley | 17th December 2010 (J355) - Stanley |
| **2011** | | |
| **JR254C** | 19th March 2011(J078) – Falkland Islands | 6th April 2011(J096)– Punta Arenas |
| Visit | May 24th 2011 (J144)- Portland, UK | May 27th 2011 (J147) - Portland, UK |
| Visit | June 20th 2011 (J171) - Portsmouth, UK | June 23rd 2011 (J174)- Portsmouth, UK |
| Visit | September 19th 2011(J262)- Portsmouth, UK | September 22nd 2011 (J265) - Portsmouth, UK |
| **JR254D** | 26th November 2011 (J330) - Falkland Islands | 24th December 2011 (J358) - Falkland Islands |
| **2012** | | |
| **JR254E** | 29th March 2012 (J089) - Falkland Islands | 26th April 2012 (J117) - Falkland Islands |
| Visit | May 25th 2012 (J146) - Immingham, UK | May 27th 2012 (J148) - Immingham, UK |
| Visit | September 3rd 2012 (J247) - Frederickshaven, Denmark | September 6th 2012 (J250) - Frederickshaven, Denmark |
| Visit | October 2nd 2012 (J276) - Immingham, UK | October 5th 2012 (J279) - Immingham, UK |
| **2013** | | |
| Visit | January 3rd 2013 (J003) - Stanley, FI | January 8th 2013 (J008) - Stanley, FI |

| | | |
|---|---|---|
| **JR254F** | May 2nd 2013 (J122) - Falkland Islands | June 7th 2013 (J158) – Ascension Island |
| Visit | July 8th 2013 (J189) - Immingham, UK | July 11th 2013 (J192) - Immingham, UK |
| | September 25th 2013(J268) - Immingham, UK | September 29th 2013 (J272) - Immingham, UK |

## APPENDIX H Time series of NIKON camera settings

Figure showing the exposure time, iso setting and fstop for the two Nikon Coolpix 8800 compact cameras ( blue - no filter and red - with polarising filter ) during the manned cruise JR254F in 2013.



**APPENDIX I Example of EXIF metadata associated with an image from the NIKON 8800 camera.**

```
              SubjectDistanceRange: 0
                        Sharpness: 0
                       Saturation: 0
                         Contrast: 0
                      GainControl: 1
                  SceneCaptureType: 0
               FocalLengthIn35mmFilm: 35
                  DigitalZoomRatio: 0
                     WhiteBalance: 0
                     ExposureMode: 0
                    CustomRendered: 0
                        SceneType: 1
                       FileSource: 3
                    PixelYDimension: 1536
                    PixelXDimension: 2048
                        ColorSpace: 1
                    FlashpixVersion: '0100'
                       UserComment: '                '
                       FocalLength: 8.9000
                             Flash: 16
                      LightSource: 0
                     MeteringMode: 5
                  MaxApertureValue: 3.1000
                 ExposureBiasValue: 0
            CompressedBitsPerPixel: 1
           ComponentsConfiguration: [1 2 3 0]
                DateTimeDigitized: '2013:05:05 16:43:13'
                 DateTimeOriginal: '2013:05:05 16:43:13'
                    ExifVersion: '0220'
                   ISOSpeedRatings: 400
                   ExposureProgram: 2
                         FNumber: 5.6000
                    ExposureTime: 0.0066
                  YCbCrPositioning: 2
                        DateTime: '2013:05:05 16:43:13'
                        Software: 'E8800v1.4'
                   ResolutionUnit: 2
                      YResolution: 300
                      XResolution: 300
                      Orientation: 1
                            Model: 'E8800'
                             Make: 'NIKON'
                 ImageDescription: '         '
                        Thumbnail: [1x1 struct]
```