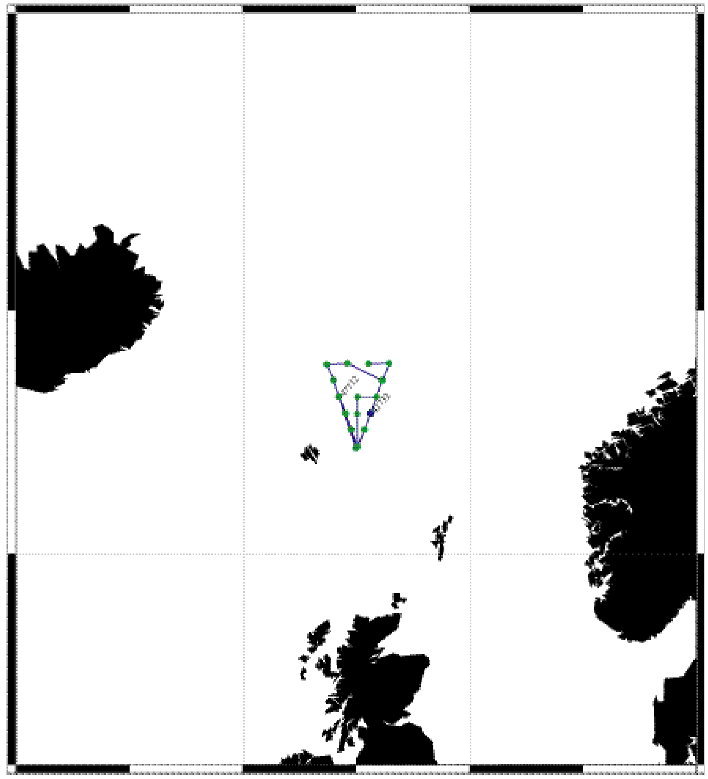
A. Cruise Narrative: AR18



A.1. Highlights

WHP Cruise Summary Information

WOCE section designation	**AR18**
Expedition designation (EXPOCODE)	**74AB62A**
Chief Scientist(s) and their affiliation	**M. A. Srokosz/**RSADU/JRC
Dates	1991.08.06 - 1991.09.28
Ship	RRS CHARLES DARWIN
Number of stations	32
Geographic boundaries of the stations	63° 57.77 ' N 6° 17.92' E 3° 32.15' E 62° 15.9 ' S
Floats and drifters deployed Moorings deployed or recovered	See Mooring Operations

INSTITUTE OF OCEANOGRAPHIC SCIENCES
DEACON LABORATORY
CRUISE REPORT NO. 229

RRS CHARLES DARWIN CRUISE 62A
06/09/1991 – 28/09/1991

ERS-1 calibration and validation in the region of the Iceland-Faeroes Front

Principal Scientist
M A Srokosz

1992

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ABSTRACT

RRS Charles Darwin cruise 62A in September 1991 was a joint venture involving RSADU, JRC and IOSDL. The primary aim of the cruise was to gather ***in situ*** data for the calibration and validation of measurements made by sensors on the recently launched European Space Agency satellite ERS-1. To this end a mixture of buoy and shipboard meteorological, wave, sea surface temperature, current and hydrographic measurements were made. The measurements were made in a triangular region to the east and north of the Faeroes, two sides of the triangle being coincident with the ground track of the satellite.

KEYWORDS
“CHARLES DARWIN”/RRS – cruise (1991) (62A)
ERS-1
ICELAND-FAEROES FRONT

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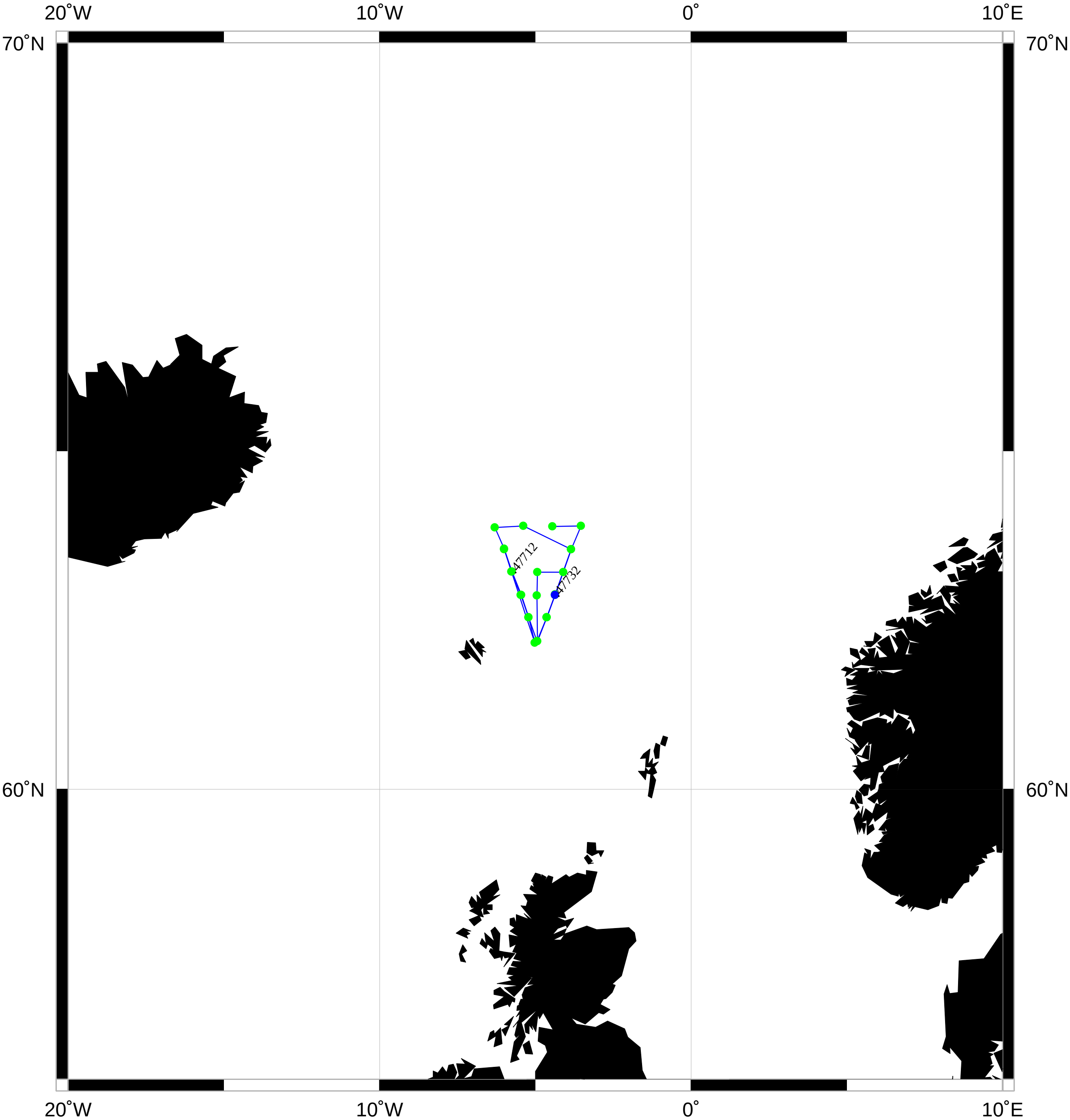
SROKOSZ, M. A.	RSADU / JRC
ALDERSON, S. G.	IOSDL
BIRCH, K. B.	IOSDL
CLAYSON, C. H.	IOSDL
CRISP, N. A.	IOSDL
FORRESTER, T. N.	JRC
GUYMER, T. H.	JRC
JONES, A. K.	JRC
JORDAN, S. M.	RVS
KENT, E. C.	JRC
LEWIS, D.	RVS
MORRISON, A. I.	RSADU / JRC
PASCAL, R. W.	IOSDL
PHIPPS, R. A.	RVS
TAYLOR, P. K.	JRC
TOKMAKIAN, R. T.	JRC
WADDINGTON, I.	IOSDL
YELLAND, M. J.	JRC

Key

RSADU	Remote Sensing Applications Development Unit
JRC	James Rennell Centre for Ocean Circulation
IOSDL	Institute of Oceanographic Sciences Deacon Laboratory
RVS	Research Vessel Services

SHIP'S PERSONNEL	
HARDING, M. A.	Master
LOUCH, A. R.	Chief Officer
CLARKE, J. L.	Second Officer
WARNER, R. A.	Third Officer
BAKER, J. G.	Radio Officer
McGILL, I. G.	Chief Engineer
MOSS, S. A.	Second Engineer
HOLT, J. M.	Third Engineer
PERRIAM, R. J.	Electrical Engineer
MACDONALD, R.	CPO (D)
BOWEN, A. M.	Seaman
HARRISON, M. A.	Seaman
OLDS, A. E.	Seaman
DEAN, P. H.	Seaman
PETERS, K.	CPO (C)
BISHOP, P.	COOK
OSBORN, J. A.	Second Steward
ELLIOTT, C. J.	Steward
LINK, W. J.	Steward
BRENNENSTHUL, M. J.	Motorman

Station locations for AR18 : SROKOSZ



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SCIENTIFIC OBJECTIVES

The overall objective of the cruise was to calibrate and validate data from the sensors on board the European Space Agency ERS-1 satellite against ***in situ*** measurements, to improve the utility of that data for oceanographic studies. Specific objectives included:

- The validation of ERS-1 altimeter significant wave height measurements.
- The calibration and validation of ERS-1 altimeter wind speed measurements.
- The validation of ERS-1 altimeter sea surface topography measurements.
- The calibration and validation of ERS-1 scatterometer wind speed and direction measurements.
- The investigation of the relationship between wind stress at the sea surface and radar backscatter as measured by the scatterometer (including the effect of wave conditions on this relationship).
- The calibration and validation of ERS-1 Along Track Scanning Radiometer (ATSR) sea surface temperature (SST) measurements.

These objectives were to be achieved by a mixture of shipboard and buoy measurements. Despite some problems due to bad weather and the loss of the directional Waverider Buoy, the objective of obtaining ***in situ*** data for comparison with ERS-1 measurements was met. In fact, it proved possible to make some initial comparisons between ***in situ*** and ERS-1 data during the cruise as data from altimeter and scatterometer on the satellite were received on board the Darwin in near real time (typically, a day after acquisition).

NARRATIVE

The RRS Charles Darwin sailed from Troon on the morning of Friday 6th September (day 249, 1020 GMT; all subsequent times will be given by day number and GMT). Sailing had been delayed to await the arrival of some CTD spare parts from RVS. These failed to arrive on time and the Darwin was forced to sail to catch the tide. The ship subsequently waited off Ayr for the spare parts to be brought out by small boat and finally departed Ayr at 1200, heading towards the Faeroes along the so-called “Garden Route” between the Scottish islands. Logging of GPS and MX1107 transit satellite fixes on the shipboard computing system had been started in Troon, prior to departure. Additionally, while in Troon harbour, some ERS-1 altimeter data were received on the Marinet system from the Rennell Centre (via RVS), as a test for receiving ERS-1 data at sea.

The objective of the cruise (being to obtain data to compare with ERS-1 measurements) had determined the area of operation for which the ship was headed. This was a region to the east and north of the Faeroes where the satellite ground tracks intersected (see Figure 1). ERS-1 was in a three day repeat orbit, re-visiting the same spot on the Earth’s surface every third day, so making measurements at a ‘cross-over’ point would maximise the number of intercomparisons obtained, as such a point would be visited by the satellite twice every three days. (The three day repeat orbit also put a constraint on the timing of various ship measurements, which had to coincide with the satellite overpasses.)

In the afternoon, on the first day, the Acoustic Doppler Current Profiler (ADCP) was tested by dropping the ship speed from 12 knots to 8 knots and increasing the speed by one knot, every ten minutes, back to 12 knots. Good data quality (100%) at the surface was obtained at 8, 9 and 10 knots, dropping to approximately 50% at 11 knots and zero at 12 knots.

On day 250 rostered watches for meteorological observation were started at 0800. Later in the morning the Darwin emerged from the shelter of the Scottish islands allowing the scientists on board to try out their sea-legs. The non-toxic pumped seawater supply was turned on and the PES fish deployed. As a precautionary measure, air was bled from the ADCP “top-hat” housing, but this appeared to make no difference to the ADCP data quality. The first radiosonde was successfully launched from the ship just before noon.

In the afternoon two ADCP calibration runs were made with the ADCP in bottom-tracked mode. This involved the ship performing 90° turns every 20 minutes, in a zigzag pattern, for two hours. A run at 10 knots was made from 1330 to 1530, and one at 8 knots from 1630 to 1830; the gap between the two runs occurring while the ship passed the island of Rona.

The morning of day 251 found the ship in position (62° 18.6 N, 4° 55.8 W) to deploy the first moorings (see Figure 2). The weather was calm, ideal conditions for mooring work. A PES survey of the bottom was carried out prior to deployment. The directional Waverider buoy was deployed successfully at 1334, followed by the VAESAT buoy at 1451, a short distance away. The ship stayed in the vicinity of the buoys and data were received on the shipboard ARGOS receiver. Both buoys appeared to be working satisfactorily. At 1611 a test CTD dip was carried out to check the system. This worked well, except that the first bottle did not fire and, consequently, the reversing thermometers failed to reverse. As the third buoy (sonic anemometer meteorological buoy) was not ready for deployment at this stage the ship departed at 2000 for the deep water meteorological buoy mooring position. During the day a number of fishing vessels were observed in the vicinity of the buoys, leading to some concern for their safety.

The Darwin arrived at the deep water mooring position (63° 57.6 N, 6° 18.6 W; see Figure 2) at 0745 on day 252. A PES survey of the bottom showed it to be relatively flat and the toroidal meteorological buoy was deployed successfully by 1444. The ship remained on position until 2200 to check on the buoy and then departed for the southern mooring position. XBT drops were carried out once per hour on this leg, in an attempt to delineate the structure of the Iceland-Faeroes front. During the day the first ERS-1 data for the study area were received over the Marinet system, consisting of altimeter wind speed, wave height and sea surface topography observations for day 250. At this stage no scatterometer data were received.

The ship arrived at the southern mooring position at 0915 on day 253. The directional Waverider and VAESAT buoys were located and found to be alright. The ship hove to and remained on station making meteorological measurements and receiving data via the onboard Argos receiver from the Waverider. Preparations for the launch of the sonic anemometer buoy continued. Late in the evening the ship's teleprinter terminal failed. Attempts to repair it led to a loss of satellite communications from ship to shore (telephone, fax, Marinet), reducing communications to the radio telephone.

Day 254 found the ship hove to, making further meteorological measurements, while work on the sonic anemometer buoy continued. A problem was discovered with the Oceano release for buoy mooring. The spare release was also found to have a problem, but by combining components from both, a working release was obtained. At 1813, the sonic anemometer buoy still not being ready for deployment, the decision was taken to steam to the northern mooring position to start the first CTD survey (see Figure 2) on the following morning.

Early on day 255 the Darwin was in position (at 63° 57.6 N, 6° 18.6 W) to being a CTD survey round a triangle whose eastern and western sides corresponded to the ground tracks of ERS-1, the northern side being surveyed to complete the box (see Figures 1 and 2). Before commencing the survey a check on the met. Mooring was made. The first CTD station was started at 0629. On completion of the station the ship headed east, going clockwise round the triangle. Thereafter CTD stations were made approximately every 40km, with XBT drops approximately every 10km between stations. A combination of T5 (depth limit 1830m) and T7 (depth limit 760m) XBTs were used depending on the depth of water (the southern end of the triangle being in only 250m of water, while the northern side was in 3000m). Further details of the CTD stations and XBT measurements can be found in Tables 3 and 4. Between stations the ship maintained a speed of 10 knots and underway ADCP measurements were made, as well as those taken while on station.

A major event of day 255 was the restoration of satellite communications, after valiant (and successful) efforts by the radio officer and Derek Lewis (of RVS) to repair the teleprinter terminal.

Day 256 saw the continuation of the CTD survey round the triangle, with the Darwin arriving at the southern corner (62° 18.6 N, 4° 55.8 W) at 1841. On arrival at this position the directional Waverider buoy was found to be missing. Interrogation of Argos showed its last transmission to be at 1031 on day 255. Acoustic interrogation of the mooring release showed it to be present. Further investigation of the mooring was postponed until after the completion of the CTD triangle. At this stage the sonic anemometer buoy was ready for deployment, but the weather was considered too bad for the mooring to be deployed. The decision was made to delay deployment and to continue the CTD survey. In the evening the skies were clear and at 2144 ERS-1 was sighted, passing overhead.

The CTD survey was completed at 1415 on day 257 at the north west corner of the triangle (63° 57.6 N, 6° 18.6 W). Again a check was made on the toroid buoy at that position before returning to the southern corner of the triangle, ready for the deployment of the sonic anemometer buoy the next day.

Day 258 was spent with the ship hove to by the VAESAT buoy waiting for the weather to moderate so that the sonic anemometer buoy could be deployed. This gave opportunity for further shipboard meteorological measurements to be made.

Early on the morning of day 259 the weather had moderated sufficiently and the sonic anemometer buoy deployment was completed successfully by 0723. At 0920 the release for the directional Waverider mooring was triggered acoustically and the subsurface mooring buoy and release recovered. Inspection of the mooring suggested that the Waverider buoy itself had been trawled by a passing fishing vessel. At this time the Argos data transmission from the VAESAT buoy was checked and found not to be working, but it was thought probable that the onboard data logging was unaffected. The ship remained hove to near the sonic anemometer buoy overnight, so that a check could be kept on the buoy and comparison data obtained from the ship's meteorological measurements.

At 0205 on the morning of day 260 the fire alarm went off in the constant temperature laboratory. This was due to a failure of the thermostat, bringing the temperature down below freezing and leading to condensation in the smoke detector. In fact, the temperature was so low that three of the bottles of sea water stored in the laboratory, awaiting salinity determination, froze and cracked. Fortunately, no other bottles were affected.

Later in the morning (0645) the sonic anemometer buoy was observed floating upside down, having overturned the previous evening (as was ascertained subsequently by examining the data logged by the buoy). The acoustic release on the buoy mooring was triggered and the buoy was successfully recovered, with recovery complete by 1040. At 1100 the ship started a sea surface temperature survey, in an attempt to delineate the Iceland-Faeroes front (see Figure 3). At the end of the survey the ship hove to at the southern mooring position, intending to stay there overnight, making meteorological measurements, weather reports having warned of a force 10 storm approaching the Faeroes region. Just before midnight, with the weather deteriorating, the captain decided to head for shelter in the Faeroes.

At 0355 on day 261 the Darwin arrived at the Faeroes and sheltered between the islands of Vidoy and Fugloy, remaining there for the rest of the day. This break in the cruise gave the scientific party an opportunity to play with the fire extinguishers, fire hoses and other fire fighting equipment under the instruction of the first mate!

On day 262, the weather having abated, the ship sailed from the Faeroes at 0315 and returned to the southern mooring position by 0830. The VAESAT buoy was sighted and a check made on its Argos transmission. The ship remained hove to, making meteorological measurements, until 1222, after the mooring overpass of ERS-1 (at 1156), and then the second CTD survey round the triangle was started (see Figure 4). From 2130 to 2200 the ship was hove to for the second ERS-1 overpass (at 2144), so that good wave data could be acquired by the SBWR and a radiosonde launched. The CTD survey was then resumed.

At 0915 on day 263 the Darwin arrived at the northern mooring position (north west corner of CTD survey triangle, 63° 57.6 N, 6° 18.6 W; see Figure 2). The toroid buoy was sighted and the mooring release fired acoustically. Recovery of the mooring was completed at 1250. After an XBT drop and a CTD dip, the ship set off eastward to survey the northern side of the triangle (Figure 4). At this point a revision to the CTD survey plans was made to allow two stations to be made in the interior of the survey triangle. Unfortunately, the weather deteriorated and it was not possible to carry out this plan.

At 0105 on day 264 the ship was in position at 63° 57.6 N, 4° 27.4 W for a CTD station. However, the weather had deteriorated and the decision was made to miss out this station and cut across the corner of the triangle to 63° 38.4 N, 3° 50.0 W for the next CTD station (see Figure 4), where a successful CTD dip was carried out during a lull in the bad weather. This decision to cut the corner was made taking into account the lower speed of the ship in heavy seas and the need to be in position for the ERS-1 overpass on the following day. At the next CTD station (63° 18.5 N, 4° 06.0 W) the ship hove to, making meteorological measurements, waiting for the weather to improve so that a CTD dip could take place. After waiting several hours, at 2000 it was again decided to skip this CTD station and to move on to the next one.

The weather having improved, it was possible on day 265 to make the remaining three CTD stations on the eastern side of the triangle. The final station at the southern corner being completed at 1103. The ship then hove to for the ERS-1 overpass at 1156. After lunch the VAESAT mooring was recovered successfully, recovery being completed by 1405. The light on the top of the buoy and the top of the buoy were damaged during the recovery by the air gun mountings on the hull of the Darwin. (Damage had also been caused by these mountings to the toroid meteorological buoy when it was recovered on day 263). After recovery of the VAESAT buoy the ship again hove to awaiting the ERS-1 overpass at 2144. At 2210 the ship left the southern corner of the triangle and headed due north to make two CTD stations in the interior of the triangle (see Figure 4).

The weather on day 266 being fine it was possible to complete the remaining three CTD stations (including one missed due to bad weather earlier in the cruise) and then to return to the southern corner of the triangle at 1835. The ship was then hove to and remained on station making meteorological measurements until midnight on day 267 when we left the study area on passage back to the RVS base at Barry. At this point rostered watches ceased and the non-toxic water supply was switched off.

On day 268 an ADCP calibration run was carried out, beginning at 0825 and ending at 1025, consisting of a series of six zigzags. Each leg of the zigzag pattern was traversed for twenty minutes and a 90° turn made between legs. Due to the weather conditions the speed along legs varied between 8 and 10 knots. At the end of the calibration run the Darwin hove to and the PES fish and “soap-on-a-rope” thermistor were recovered. Passage to Barry was then resumed.

Passage home on day 269 was enlivened by passing through the Kyle of Lochalsh, the Sound of Mull and the Sound of Islay, together with a life boat drill. During the lowering of the lifeboat, one scientist was heard to comment, “This is the nearest I have been to the water for a long time”. The Irish Sea was crossed on day 270, some excitement being caused during the afternoon by an RAF rescue helicopter practicing dropping a man onto the aft deck. The Darwin finally docked at Barry at 2114 on day 270, at the end of an eventful and successful cruise.

MAS

WEATHER

Overall, the weather in the cruise area was characterised by a mobile south-westerly flow with a number of deep depressions passing through from SW to NE. The deepest of these (central pressure 962mb) passed directly over the ship on day 267. The maximum 1 minute mean wind speed was 27m/s recorded whilst sheltering in the lee of the Faeroes on day 261. Air temperatures were mostly 10-11°C and within 1 or 2 degrees of the sea temperature. However, near the beginning a strong northerly brought air temperatures of 6°C for a short period. The maximum visually observed waveheight was 20 feet (compared with 5m on the SBWR).

Details

When the Darwin arrived on station on day 251 a blocking anticyclone was situated to the west of Scotland with small low pressure areas running eastwards along a front on its northern flank and light westerlies in the cruise area. By day 252 the high had begun to move SE into the continent allowing the front to move south, crossing the area at 1700. It was accompanied by a 90° wind veer and increasing winds. Drizzle and mist gave way to rain near the frontal passage followed by a clearance. The following day (253) was one of squally showers, at least one including hail, in the strong northerly winds (16m/s gusting to 25m/s in one shower) which developed behind the cold front. During the night the dry bulb temperature had dropped to 6°C. Throughout the evening and day 254 the wind moderated to 2m/s as an anticyclone moved SE towards Scotland. Stratocumulus began to break. By day 255 the high passed over Scotland and into the North Sea, allowing weak fronts to affect the area with showers and rain in the morning and a freshening WNW wind. A cold front moving slowly south brought a clearance in the evening and the following night was calm and fairly clear.

This period was short-lived as the front returned northwards on day 256 as a warm front in strengthening south-easterlies ahead of a complex area of low pressure to the west of the UK. Several fronts were developing in its circulation. Temperatures rose and for a time the wind waves and swell were in opposing directions.

Altostratus thickened soon after dawn and rain started at 0900, lasting for several hours. The clearance was erratic but by 2145 cloud had almost gone and conditions enabled ERS-1 and several other satellites to be seen with the naked eye, as well as the aurora. Within a short time cloud had increased again and at 0000/257 it was raining from a warm front. This was quickly followed by the cold front which became slow moving in the region. However, further cyclogenesis was taking place and another low with its fronts headed NE. These fronts passed through the area during the day with some rain but again skies had cleared sufficiently behind the last of these for an aurora to be visible at 2300.

On day 258 a NNWly of 14m/s was established as the low moved away to the NE. A transient ridge followed during the night resulting in very light winds and lack of low cloud. The next low pressure, a complex area lying E-W to the west of Scotland, affected the area on day 259. Winds increased from dawn to reach 15m/s ESEly and cloud thickened to produce rain from mid-afternoon until midnight as an occluded front oriented E-W became slow moving over the area. On day 260 a new low to the west of Scotland moved NE and its fronts caught up the old occlusion. Winds moderated to 10m/s and there was some drizzle but in the evening the wind strengthened from SSE and as a force 10 was forecast Darwin headed for shelter in the lee of the Faeroes. All of day 261 was spent in shelter; despite this protection, in the showery airstream which developed behind an occluded front winds were very strong and gusty, reaching 27m/s at 0600. As winds decreased a little during the early hours of day 262 the vessel left shelter. Winds were lighter than expected for a while, due to the effects of a small wave depression running east to the south. Convective cloud was observed, sometimes with cumulus in lines parallel to the wind.

A warm front, accompanied by rain, crossed the area from the SW at 0900 on day 263 associated with a low to the SW of Iceland. The wind, which had dropped light during the night, picked up from the SE ahead of the front. As the front passed it turned foggy. By day 264 the low pressure area had developed several centres to the north and south of Iceland. A strong (18m/s) SSEly prevailed and several front passed through. The low continued to move north and on day 265 a colder, unstable airstream affected the area, with scattered cumulus and cumulonimbus. During the day pressure rose, the wind dropped and the swell died away rapidly. A weak ridge followed (day 266) and convection was organised both in lines and mesoscale cells. In the late afternoon frontal cloud was observed in the SW which spread rapidly across the sky. Winds increased quickly to 18m/s by 0000/267 and rain, moderate to heavy at times started at 2110. The winds then quickly decreased to 5m/s and changed from easterly to Swly as the centre of the low became situated right over the area, with a pressure of 962mb being recorded at the ship; in fact with one centre to the NE and the other to the W. For a few hours the weather was calm and sunny but as the low continued to move slowly ENE winds again picked up quickly to reach 19m/s during the evening, this time from the NNW. RRS Charles Darwin left station for Barry while these winds were still at their height.

THG

METEOROLOGICAL, SST AND WAVE MEASUREMENTS

Introduction

The main aims of the meteorological and wave research during the cruise were to gather data on the meteorological conditions, sea surface temperature, and wave height for the calibration and validation of the ERS-1 satellite, and to measure the wind stress under different conditions of wind velocity and sea state. Instrument development and testing was also undertaken.

For ERS-1 validation, the mean meteorological conditions were measured on the ship using a MultiMet meteorological instrumentation system and also by taking manual observations. Since it was planned that the ship would spend a significant part of the cruise at the southern ERS-1 cross-over point and main mooring site, a meteorological buoy was also moored in the colder water further north along the ascending (western; see Figure 2) ERS-1 ground track to monitor conditions there. For validation of the ERS-1 ATSR, the sea surface temperature was recorded throughout the cruise using a thermosalinograph and trailing thermistor; also preparations were made for mounting an SST radiometer on the ship on later cruises.

Wave measurements were required for validation of the ERS-1 altimeter and for interpretation of the wind stress measurements. These were obtained using a Shipborne Wave Recorder (SBWR), a directional Waverider buoy, and through a video record of the sea state.

The wind stress was measured on the ship using the inertial dissipation method and data from two sonic anemometers and a propeller-vane anemometer. The "sonic buoy", which carries a sonic anemometer based dissipation system was deployed for the first time during the cruise. The plan was to establish a site at the ERS-1 cross-over point at which the sonic buoy wind stress estimates were supported by wave measurements from a directional wave buoy, and near surface current measurements from the VAESAT buoy. Initial problems with the sonic buoy hardware, which delayed deployment, and the early of the Waverider buoy, meant that this plan was not achieved. However, despite the capsize of the buoy some 10 hours after launch, the sonic buoy deployment was successful, in that a good data set was obtained for evaluation of the buoy mounted wind stress system.

As part of the continued development of the MultiMet instrument systems, A GPS and compass system, and a personal computer based weather FAX system were tested during the cruise. These systems are needed primarily for use on ships other than those operated by NERC where a full range of navigational support may not be available.

PKT

Mean Meteorological Conditions

MultiMet

The MultiMet meteorological instrumentation system was operated throughout the cruise with data collection and storage on Eprom logger, and, through a level A interface, on the ship's SUN computer system. There were 14 sensors with 19 channels, measuring air and sea temperature, air pressure, wind speed and direction, downward long and short wave radiation, and ships heading (Table 1).

Table 1: Sensors logged by the MultiMet system

Variable	Instrument	Position
Dry and wet bulb temperature	Vector Instruments psychrometer (x4)	Foremast (x2), port and starboard sides of wheelhouse top
Wind speed	Vector Instruments cup anemometer (x3)	Mainmast, wheelhouse top psychrometer positions
Wind direction	Vector Instruments wind vane	Mainmast
Wind speed and direction	R. M. Young propeller-vane	Foremast
Ship's heading	Ship's gyro	(Logged through a level-A interface)
Sea surface temperature	Trailing thermistor	Deployed from port side of foredeck
Air pressure	IOSDL instrument	In plot
Downward shortwave raidation	Kipp and Zonen radiometer (x2)	Port and starboard sides of foremast platform (gimbal mounted)
Downward longwave radiation	Eppley pyrgeometer	Top of foremast (gimbal mounted)

Difficulties at the start of the cruise in logging the data on the SUN system were overcome on day 252 by using a direct RS232 link from the level A to a terminal server, rather than the Cambridge ring. Because of these problems, the MetMan display program (running on a BBC Master) was modified to enable storage of the uncalibrated data to disk. Later in the cruise the MetMan program was also modified to optionally create a data file of calibrated data in “Cricket graph” or “DaDisp” format. This facility will mainly be of use on non-NERC ships.

Incorrect wiring of the Young anemometer on the foremast resulted in the data having a floating zero up to day 255 at 2116 when the fault was corrected. An attempt to calculate a correction for the data was made after comparison with the Vector Instruments anemometer on the main mast. The resulting linear calibration of the Young wind speed seemed satisfactory. To ensure data quality, the forward mast starboard psychrometer was changed on day 257 after the wet bulb measurements had become noisy. Erroneous data values were also noted from the starboard wheelhouse top psychrometer, air pressure and sea surface temperature sensors during HF radio telephone calls. The sea surface temperature sensor was replaced on day 261.

A series of UNIX scripts were revised to improve daily processing and quality control of the MultiMet data. Reading and calibrating the data from RVS format to Pstar format, merging of navigation and EM log data, calculation of the true wind speed and direction, and plotting of the data were all performed efficiently on a daily basis using these scripts.

The documentation describing the routine maintenance and data processing for the MultiMet system was revised and extended.

KGB, ECK, RWP

Meteorological Observations

Three-hourly weather observations were conducted from 0900 day 250 to 0000 day 268 in order to provide a description of cloud and sea state conditions as well as a check on MultiMet data. Starting at approximately 25 minutes to the hour the following sequence was undertaken: wet and dry bulb temperatures using a clockwork Assmann psychrometer, bucket sea surface temperature (ship's steaming bucket deployed from the bridge), cloud amount and type, present and past weather, eyeball averages of relative wind velocity, ship speed and heading from readouts in the bridge, pressure (precision aneroid barometer on bridge, uncorrected for height above sea level), wind waves and swell waves (visual estimates of height and period and, for swell, the direction). The sequence was concluded on the hour. Occurrences of special features, for example, frontal passages, aurora, were also recorded. Observations were possible in all weather conditions. The highest wind speed recorded by observers was 55 knots. In such conditions it was impossible to get the SST bucket into the water.

Cloud and sea state observations are rather subjective and their accuracy depends much on observer experience. Despite the uncertainties they are still valuable because it is difficult or impossible to obtain all the required parameters by instrumental techniques. The quality of the psychrometer data was variable and readings were nearly always high compared with the MultiMet values. A major reason is the difficulty of holding the instrument in a well-exposed location for long enough (5-10 minutes) to get a stable reading. It would have helped if the psychrometer could have been fixed to a supporting bracket each time the observer started his measurements. Also, at night a low-intensity, wide-beam lamp slung round the neck would have allowed observers to have both hands free for handling equipment. This would have reduced the number of thermometers broken and would generally be safer in rough weather. A stronger case in which to carry the SST thermometer on deck would also have reduced the likelihood of breakage.

MJY, SGA, AIM, ECK, PKT, TNF, RTT, THG

Radiosondes

Radiosonde data were gathered to give a description of the atmospheric conditions for the cruise period and area, as well as to derive the water vapour content at various levels for validation of ERS-1 altimeter and ATSR atmospheric corrections.

Vaisala RS-80-15 sondes, measuring temperature, pressure and relative humidity were launched twice per day from days 250 to 267 using 200g TOTEX balloons fitted with string unwinders. Ascents were generally timed for 1100 and 2300 but were adjusted when ERS-1 altimeter overpasses occurred to be a few minutes before the overpass time (1156 and 2144). A total of 35 flights were made most of which reached a height of greater than 50mb, well into the stratosphere (see Table 5). On one occasion the sonde reached only 690mb before slowly descending due, it is suspected, to leakage of gas from the neck of the balloon.

Balloons were inflated in a restrainer, placed on the aft portion of the boat deck (port side) with plastic tubing connecting it to helium bottles secured on the aft deck. Launching usually required two people, although in light winds (less than 10m/s) one would be sufficient. Provided the relative wind was at least 20° on the starboard bow balloons could be released clear of obstructions for all wind strengths. In light winds a wide range of relative wind directions could be tolerated. Successful launches were made in winds up to 20m/s. On two or three of the strong wind occasions, however, the balloons were caught in eddies shed by the ship which caused the sondes to come very close to hitting the sea. The best way of avoiding this was for the person launching the balloon to wait for a suitable lull using the pull of the wind on the balloon to judge the optimum moment for release.

Signals from the sondes were received by a Vaisala UR-15 unit via an omni-directional antenna located on the port rail of the wheelhouse top. Strong signals were obtained by the receiver which was being used for the first time (in place of the ancient and unwieldly LO-CATE W2 set). The receiver performed extremely well, the only problem being interference from other sondes launched from upper air meteorological stations. This was overcome by retuning our sondes' transmitting frequencies to greater than 404MHz. After passing through the PTU processor the calibrated data were displayed and written to floppies using a BBC Master.

The raw data were transferred onto a SUN computer and edited to the required limits. A series of shell scripts were written to process the data using Pstar programs. Potential temperature and specific humidity were calculated and plotted against pressure, as was relative humidity and temperature. A set of contour plots for each parameter set against time and pressure for various periods throughout the cruise was produced.

THG, TNF

Meteorological Buoy (Mooring 510)

The meteorological buoy consisted of a 2.45m diameter toroidal hull supporting a 1m deep steel keel to which was bolted a 2.5m high aluminium instrument tower. The meteorological logging package was an Aanderaa Sensor Scanning unit type 511 utilising ten channels scanning analogue and digital sensors with a DSU 2990E (Expanded) data storage unit. The package scanned and logged all sensors at five minute intervals.

The sensor suite (Table 2) was designed to measure wind speed and direction, sea and air temperature, solar radiation, and buoy orientation. Wind speed and direction sensors were duplicated due to the past incidence of damage during launch and other operational failures, and a ruggedised IOSDL vane was fitted to one wind direction sensor. During the deployment the wind direction sensor on channel 2, a new manufacturer's supplied unit, failed due to the sealed vane locking screw becoming loose.

Table 2: Sensors on the Meteorological buoy

Channel	Sensor	Type	Number
1	Reference	Fixed reference value	n/a
2	Wind direction	Rotary vane	2053
3	Wind speed	Three cup rotor (mean wind speed)	2740
4	Wind speed	Three cup rotor (maximum wind speed)	2740
5	Solar radiation	Pyranometer	2770
6	Buoy orientation	Magnetic compass	2084
7	Sea temperature 1 metre depth	Platinum resistor in IOSDL underwater housing	2812
8	Air temperature	Platinum resistor radiation screen	1289 4011
9	Wind direction	Rotary vane IOSDL modified	2053
10	Wind speed	Three cup rotor IOSDL interface	VI1991

On recovery, all the sensors except the VI1991 and 2812 suffered extensive damage (see Mooring Operations, section 6). The tower was also damaged, several welds having cracked and the top protective ring and supports being severely distorted. The buoy hull was relatively intact, the only apparent minor damage being to the glass reinforced external lugs.

The data were downloaded from the DSU to a PC using the P3059 software with raw and calibrated listings and plots. The data for the ten day deployment period indicated no data errors and a clean record has been produced.

IW

SST Measurements

Thermosalinograph

The thermosalinograph (TSG) was built and provided by RVS, it has two CTD Seabird sensors which measure conductivity and temperature from water taken through the non-toxic intake at a depth of 5m. Conversion of the sensor outputs to actual temperature and salinity was computed using two separate techniques, one as used by RVS (programs ***gencal*** and ***protsg***) and one developed by IOSDL (***ptsgcal***). The temperatures calculated from bothe methods agreed to the fifth decimal place in all cases. Temperature was calibrated against CTD measurements coincident in time but averaged between a depth of 4.5m and 5.5m. A constant offset of +0.041°C was found for the TSG reading.

The salinity readings from the TSG, as calculated using the IOSDL method, were between 0.0205 and 0.0274 above those of the RVS method. This offset was inversely related to the magnitude of the total salinity and temperature readings, giving a low offset when the reading of each parameter is high and vice versa. The salinity of bottle samples, (which were taken at four hour intervals from the TSG outflow) were derived from comparisons against standard sea water (this work was carried out by N. Crisp, A. Morrison and R. Tokmakian) using an Autosal salinometer. These data were compared to the TSG salinity, giving a correlation coefficient of 0.0962 and a standard error of 0.058. Further calibration of the salinity against calibrated CTD data showed that the TSG salinity was under reading by 0.01.

Contour plots of both temperature and salinity from the TSG data were prepared to give an indication of the SST distribution over the cruise area. This information was used to guide an SST survey, which was carried out on day 260. The aim of this survey was to observe the SST distribution within the triangular course of the cruise and to attempt to “link up” regions of strong SST gradients on opposing sides of the triangle. The range of SST’s throughout the cruise was between 7.8°C to 11.3°C.

TNF

Trailing Thermistor

The MultiMet system measured the sea surface temperature using a trailing thermistor (“soap-on-a-rope”). The thermistor, which was set inside a protective casing attached to the end of a rope containing the conducting cable, was deployed from an outboard extending pole, on the port side of the ship near the bow. Weights attached to the rope were adjusted to minimise the horizontal undulations of the sensor at varying ship speeds.

Throughout the cruise the thermistor sea surface temperature readings varied significantly from those of the thermosalinograph. During the first ten days (from day 251) the thermistor reading slowly drifted from 0.2°C below that of the thermosalinograph to 0.6°C above. Such a slow and steady drift in accuracy was uncharacteristic of the instrument's behaviour as observed on past cruises. Attempts to correlate this trend with other physical parameters being measured was made but to no avail.

This first sensor failed completely on day 261, and the replacement gave an approximately constant offset of +3.5°C (compared to the thermosalinograph) throughout the remainder of the cruise, despite a thorough check of the instrument electronics and calibrations.

TNF, KGB, RWP

SST Radiometer and Video

For ATSR validation it is planned to mount an SST radiometer on the foremast of the RRS Charles Darwin looking out to starboard of the bow. Although the mounting and wiring were installed for this cruise, the radiometer, which is being specially built by a commercial firm, was not available in time. A video camera will be operated alongside the SST radiometer to record any contamination of the field of view by the ship's bow wave. This camera was operated during the cruise. The video signals were connected to a monitor and a recorder in the plot. Recordings obtained under different sea state conditions and at varying ship's speed confirmed that the foremast site will provide a view of a region of the sea surface which, for most of the time, is undisturbed by the bow wave from the ship.

KGB, PKT

Wave Measurements

Ship-Borne Wave Recorder

A standard IOS Mk3 SBWR was logged continuously throughout the cruise by a PC-based system. The instrument was also connected via a level A unit to the ship's level B system; one second samples were logged continuously as a back up, but were not processed. At 20 minute intervals, the PC-based system initiated the collection of 2 x 1024 sample time series at 2Hz sampling rate. The time series were spectrally analysed, averaged and filed as two sets of 128 spectral estimates. The files were periodically backed up and transferred to the SUN computer system, for further processing and archiving. Uncorrected readings of significant wave height were also printed out by the PC for diagnostic purposes.

The pairs of ten minute spectra were read into a Pstar format using the program "***rdvalid***", and a frequency response correction was applied (Pitt, 1988). The significant wave heights were then recalculated for comparison with the ERS-1 altimeter data.

CHC, MJY

Directional Waverider Buoy

A Datawell Directional Waverider was used to give estimates of the directional wave spectrum. This buoy was equipped with on-board processor and transmitter for acquisition of the processed data via the Argos system. The buoy was deployed at 1334 on day 251, using a mooring design which followed the Datawell recommendations. In addition to the asynchronous acquisition of data via Service Argos, Toulouse, the buoy transmissions were also received on the ship, when within about a 5 mile range. The significant wave height was extracted from the condensed message format for comparison with the ERS-1 altimeter values; significant wave heights of up to 5 metres were obtained, comparing favourably with the SBWR. Directional spectra were also plotted out at intervals and were found to agree with visual observations.

At some time after the last transmission was received via Argos at 1031, day 255, it is believed that the buoy was trawled. No further transmissions were received either by Service Argos or the ship. The buoy was not sighted in position at 1841, day 256, but the mooring was checked acoustically at 1900, day 256, and found to be in the correct position. On recovery of the mooring at 1010, day 259, the upper mooring cord was found to have been broken near the buoy end and both cords had been damaged in a number of places. In addition, one of the glass float hard hats above the release had been damaged. It must be assumed that the transmitter antenna was damaged at the time of this incident.

CHC, THG

Video System

A time-lapse video system (loaned by the Physics Department of UMIST) was mounted with the camera on the bridge viewing the port bow of the ship. This will provide a visual record of the sea state, from which the presence and direction of any significant wave swell can be detected. It will also provide an indication of periods of precipitation. The latter may be important in evaluating the performance of the sonic anemometer systems.

PKT

Measurement of Wind Stress

Shipborne Dissipation Measurements

For measurement of the wind stress using the dissipation technique, three fast response wind sensors were deployed on the forward mast; two Solent sonic anemometers and a Gill propeller vane. The Solent sonic anemometers were operated in 56Hz sampling mode, with the twelve minute data cycle of collecting data, calculating and storing the spectra commencing on each quarter hour under the control of an NEC PC. The Gill anemometer was digitised at 8Hz by a Fast MultiMet Logger with 10 minute samples logged and processed by an Archimedes computer on a continuous free running sampling scheme.

The Gill was deployed in the same location on the forward mast portside throughout the cruise. Initially the two Solent sonic anemometers were mounted side by side on the starboard side of the foremast platform. From day 257 the inboard sonic anemometer was deployed upside down below the foremast platform to allow a comparison of turbulence and mean wind measurements as a function of height. In case of calibration differences the two sonic anemometers were exchanged one for another on day 265. From day 266 the lower sonic anemometer was removed. An Asymmetric Head Solent sonic (as used on the sonic buoy) was mounted side by side with the symmetric head instrument to compare the effects of the different head configurations.

The two symmetric head anemometers agreed to within 1% for wind speed estimates, when deployed at the same height, but differed in PSD (power spectral density) estimates by 20% on average. The reason for this is not yet known. When the two sonics were deployed at different heights, the lower one produced lower wind speed readings and higher PSD values, as expected. For this period the estimates of the friction velocity, u_*, and drag coefficient, C_D, from the two systems were in good agreement.

KGB, CHC, RWP, MJY

Sonic Buoy

Problems with the operation of the sonic buoy on the internal batteries prevented deployment on day 254, and although the buoy was ready for deployment on day 257, the first deployment opportunity was on day 259 at 0723. During the day the ship kept station on the buoy to allow observation of the buoy performance in the rising wind and sea conditions. The buoy was seen to generally align with the wind, but the cross swell and adverse current occasionally caused oscillations to 90° to the wind. The buoy light was not sighted during repositioning on day 260 at 0400, and at first light it was observed that the buoy had overturned. It was recovered by 1040 without any further damage.

All recording systems were still functioning on recovery, however the wind sensors were no longer operational due to immersion. Data from the sonic and MultiMet loggers were replayed to allow comparison with the ship mounted systems. Initial analysis showed the buoy to be working successfully until the moment of capsize (day 259, 1705), although the data from the air temperature sensors suffered from periodic interference from the Argos transmitter.

Overall, the deployment was a successful instrument trial which highlighted the need for further development of the mooring and for the resolution of the radio interference problems.

The sonic anemometer produced PSD estimates which showed clearly the expected increasing trend with wind speed. The wind speeds measured by the Young anemometers were significantly higher than those from the sonic. This may have been due to the buoy motion causing over-speeding in the propeller-vane instruments.

KGB, CHC, RWP, MJY

Instrument Developments

GPS System

This was the first operational trial of a portable GPS and Flux Gate Compass data logging system designed to obtain ship's velocity and ship's head information for the calculation of true wind and wind stress. The system will mainly be used on non-NERC ship's where data from a full navigational system may not be available.

The GPS aerial was mounted on the wheelhouse top with the receiver, flux gate compass and controlling NEC PC computer located in the plot. System initialisation was completed on day 248 prior to sailing. Data recording was continued throughout the cruise, however a software problem caused the logging program to halt on a number of occasions throughout the cruise. Attempts to identify this intermittent error were successful, with a software fix on day 265.

Although the KVH compass has a self correcting facility, attempts to initiate this by steaming the ship in a circle failed. It was therefore the uncorrected compass readings which were compared with data on the ship's heading derived from gyro readings. The compass deviation varied with heading by about ±50°, following a characteristic curve which suggested that the ship's magnetic field strength was about 0.8 of that of the Earth. For a given site on the ship it should be possible to determine this curve and correct for the ship's deviation error. After correction, it should be possible to routinely obtain bearing accuracies significantly better than the ±5° required for true wind calculation.

It was hoped during the cruise to determine setup parameters for the GPS system in order to optimise both the quality and period of record of the ship's velocity data. GPS coverage in the region was good with satellite fixing possible for all but two half-hour periods per day. It was difficult to correlate differences between fixes from the portable GPS with the ship's GPS with the satellite constellation parameters, so effort was concentrated on devising an editing routine for ship's speed to minimise the difference between the speeds from the two systems. The apparent acceleration of the ship was calculated using successive fixes from the portable GPS system. Following the subtraction of a 5 minute running average, representing genuine large accelerations by the ship, the time series of residual acceleration data was examined for values greater than two knots per minute. The speed data associated with these large residual accelerations were then removed from the GPS system comparisons. This scheme succeeded in reducing the standard deviation of the speed difference between one GPS system and the other by about 30%, and brought the 15 minute mean speed measurements to within the required accuracy of ±0.1m/s. The accuracy of these speed measurements did not appear to change significantly with the different setup parameter combinations used.

ECK, RWP, PKT

WFAX

A weather facsimile system, using a communication receiver and an “ICS-FAX” software on an MS-DOS personal computer, was tested during the cruise. The system successfully captured a large number of weather charts in automatic mode. However, attempts to computer control the communications receiver, to selectively receive charts at set times on chosen frequencies, were not successful. The addition of the commercially available computer interface will probably be necessary.

RWP, PKT

HYDROGRAPHIC AND CURRENT MEASUREMENTS

CTD

Two CTD surveys were conducted on Cruise 62A. The surveys were defined by a triangle under the location of a descending and ascending pass of the ERS-1 satellite (see Figures 1, 2 and 4). It was planned to have both surveys cover the same track. The bottom corner of the survey is the point at which the two satellite tracks cross. Due to rough weather the second survey was modified slightly by missing out the top right corner of the survey triangle (see Figure 4). Hence, the sampling order, in time, of the stations was different for the two surveys. Two additional stations were added to the second survey to sample the interior of the CTD triangle. There were a total of 27 stations (see Table 3; station 1, a test dip, and station 10, a failure, were excluded from the data analysed).

The CTD equipment, supplied by RVS, consisted of a Neil Brown MkIIIb CTD, an Aquatracka fluorometer, a SeaTech transmissometer with a path length of 25cm and an IOS 10kHz pinger. Calibration coefficients for all the instruments were supplied by RVS. The initial set of calibration values were not complete and part way through the first survey, RVS received a second set of coefficients that were then entered into the calibration file. Twelve 1.7 litre Niskin sampling bottles were used on the rack to calibrate the conductivities measured by the CTD. Also attached to the sampling bottles were two SIS digital reversing thermometers.

The first survey began at approximately 0630 on day 255 and finished on day 257 at noon. This survey included 13 stations; 2 through 15, excluding 10; with depths of the casts varying from 3400m at the northwest corner to about 200m at the southern corner on the Faeroes shelf. Sampling bottles were triggered at various depths depending on the total depth of water at the station. Twelve bottles were triggered for the deep stations, two at each of six depths. The shallow stations had fewer bottles triggered. The only problem encountered during the first survey was the breakdown of the RVS deck unit. Station 11 was a repeat of the shallow station 10. It was repeated because the bottle firing pin had not been placed in the correct location. No loss of data occurred.

The second survey, from 1200 on day 262 to 1200 on day 266, took longer to complete than the first survey due to bad weather, the additional two stations in the middle of the survey, and a delay due to a mooring recovery. The two right stations on the top leg of the triangle were skipped due to bad weather (see Figure 4). There was also the constraint that the ship needed to be at the cross-over location at the time of the next satellite overpass. One station, 18, was not logged onto the level C at the time of the cast, due to a problem with the RVS logging system. It was recovered from tape satisfactorily at the end of the survey.

Data collection occurred via the RVS logging system, first through the level A, then level B archive, and finally to the level C on the Sun computer system. Data were extracted from the level C system into Pstar by Pexec command files. The calibration constants were supplied by RVS for their CTD equipment. The calibration coefficients were not consistent with the values needed for the Pexec programs. Additional values were requested by RVS personnel from Barry for the fluorometer and the transmissometer. The fluorometer were not examined in the processing because the calibration coefficients could not be applied correctly. The oxygen sensor data were not calibrated and, therefore, not used. Bottle salinities were analysed using the IOSDL Autosal. The CTD conductivity measurements were calibrated to the bottle salinities. The downcast data were then recalibrated, despiked and averaged to 2 decibars. Contour plots for sigma-0 and potential temperature were also created.

The calibrated data show a cold core, eddy-like feature in the middle portion of the triangle to approximately 500m. Below this depth, the water mass is uniform. The mixed layer, with an approximate potential temperature of 9-10°C extends to about 70m across the whole survey triangle. The southern region of the triangle has warmer water over the shelf.

Although, no overwhelming problems occurred during the CTD surveys, we think that a considerable amount of confusion in the processing of the CTD data could be eliminated if calibration coefficients for the instruments being used were obtained before the cruise. Additionally, the processing path used for processing the data should be standardised. Hooks should be placed in the command files to allow a PSO to change the manner of processing the CTD data instead of requiring the command files to be modified for each separate cruise. A straight forward CTD processing package should be available for cruises that do not require extremely high precision.

AIM, MAS, SGA, NAC, RTT

CTD Data for Cruise Charles Darwin 62A
(6^{th} September 1991 – 28^{th} September 1991)

1. Introduction

CTD profile and bottle data are presented from the ERS-1 validation cruise Charles Darwin 62A, as reported by Srokosz ***et al.*** (1992). The data collection and calibration procedures have been described by Tokmakian ***et al.*** (1992).

2. Instrumentation

The CTD profiles were taken with a Neil Brown Systems MkIIIb CTD, mounted beneath a 12 by 1.75 litre bottle rosette. The CTD was fitted with a pressure sensor, conductivity cell, platinum resistance thermometer, a dissolved oxygen sensor, an Aquatracka fluorometer, a Sea Tech 25cm path transmissometer and an IOS 10kHz pinger. 3 SIS (Sensoren Instrumente Systeme) digital reversing thermometers (T219, T220, T260) were attached to the Niskin bottles.

For the bottle rosette system the bases and tops of the bottles were, respectively, 0.00m and 0.55m above the CTD pressure sensor. The digital reversing thermometers were mounted 0.20m above the CTD temperature sensor.

3. Data Acquisition

Lowering rates for the CTD package were generally in the range 0.5-1.0ms^{-1} but could be up to 1.5ms^{-1}. CTD data were logged at 16 frames per second. The CTD deck unit passes raw data to a dedicated Level A microcomputer where 1 second averages are assembled. During this process the Level A calculates the rate of change of temperature and a median sorting routine detects and removes pressure spikes. This data is sent to the Level B for archival. The data are then passed to a Level C workstation for conversion to Pstar format and calibration.

Water samples were acquired on the up cast with the winch stopped. The CTD data acquisition system sends out a bottle firing code at the time of bottle firing. The code is logged as serial data by the Level A which timestamps its arrival.

A total of 27 stations (01 – 29) were occupied. Station 01 was a test dip and station 10 a failure. Station 11 was a repeat of station 10. The reversing thermometer T260 was only used at station 02.

4. Data Processing

4.1. CTD Data

The 1 second data passed to the Level C were converted to Pstar format and initially calibrated with coefficients from laboratory calibrations. The up cast data were extracted for merging with the bottle firing codes, on time, thus the CTD variables were reconciled with the bottle samples. Final calibrations were applied using the sample bottle data.

The oxygen, fluorometer and transmissometer data cannot be used because of problems with the calibration coefficients supplied by RVS.

Pressure

The pressure values were calibrated using the equation:

$$p \text{ (dbar)} = 0.394 + 0.99986 \times p_{raw} \times 0.1$$

No further pressure corrections were applied.

Temperature

The temperature values were calibrated using the equation:

$$T\ (°C) = 0.999978 \times (0.0005 \times T_{raw}) + 0.03176$$

No further temperature corrections were applied.

Salinity

Raw conductivities were scaled to physical units using the relationship:

$$C \text{ (mmho/cm)} = CR \times (0.001 \times C_{raw}) + 0.0$$

where the conductivity ratio (CR) = 1.000. The conductivity ratio was recomputed for each survey by comparing the conductivities computed from the bottle salinities and the average conductivity from the up casts at the time the bottles were fired. For the first survey, the conductivity ratio was recalculated as 1.001, and for the second survey it was 1.0015. The up cast and down cast data were recomputed using these values.

For each station the differences between the bottle sample salinities (S_{bot}) and the down cast CTD salinity (S_{ctd}) were calculated. The CTD salinity values were taken from those down cast locations which match closest the average pressure and potential temperature around the time each bottle fired in the up cast. A routine was used to derive coefficients for the relationship:

$$S_{bot} - S_{ctd} = a + (b \times press) + (c \times potemp)$$

The derived a, b, and c coefficients for a station were then used to correct all CTD salinities for the down cast of that station.

4.2. Sample Data

Salinity

Salinity samples from the Niskin bottles were analysed using a Guildline 8400 bench salinometer set to run at 24°C in the temperature controlled laboratory (22°C). After every 12 analyses standardisation was done using IAPSO Standard Seawater batches P114 and P115.

Two bottles were fired at each selected depth, and two samples were taken from one of these; the other bottle only being sampled if a problem occurred with the first. Only 5% of the paired samples from the same position differed by more than 0.002psu.

Reversing Thermometers

3 SIS digital reversing thermometers were attached to the Niskin bottles.

5. BODC Data Processing

No further calibrations were applied to the data received by BODC. BODC were mainly concerned with the screening and banking of the data.

5.1. CTD Data

The CTD data were received as 2db averaged pressure sorted down cast data. The data were converted into the BODC internal format (PXF) to allow the use of in-house software tools, notably the graphics editor. During this process all the oxygen, fluorometer and transmissometer data were set null. Spikes in the data were manually flagged ‘suspect’ by modification of the associated quality control flag. In this way none of the original data values were edited or deleted during quality control. These data from cruise CD62a required little flagging and just a few points were set suspect.

Once screened, the CTD data were loaded into a database under the Oracle relational database management system. The start time stored in the database is the CTD deployment time, and the end time is the time the CTD reached the bottom. The start time is more precisely the start of data logging. Latitude and longitude are the mean positions between the start and end times calculated from the master navigation in the binary merged file.

5.2. Sample Data

BODC conducted extensive quality control to eliminate rosette misfiring and any incorrectly assigned flag codes. Before loading to the database the data were averaged if bottles fired within ±4.0db of each other. The reversing thermometer data were received with only a ‘wire out’ value and were therefore manually associated with the bottles.

6. References

Srokosz, M.A. ***et al.*** (1992). ***RRS Charles Darwin Cruise 62A.*** Institute of Oceanographic Sciences Deacon Laboratory, Cruise Report No. 229, 49pp.

Tokmakian, R.T. ***et al***. (1992). ***CTD and XBT collected on ERS-1 validation cruise RRS Charles Darwin Cruise 62A, Iceland-Faeroes region.*** Institute of Oceanographic Sciences Deacon Laboratory, Report No. 294, 86pp.

XBT

During the cruise a number of XBTs were launched to add to the information gained from the CTDs over the survey triangle. 83 probes were launched in total with varying degrees of success. Two different types of probe were used, the first, T5 had an operating depth of 1830m, the second, T7 was limited to 760m.

XBTs were controlled by a Bathysystems SA810 controller connected to an IBM PS2 running Bathysystems software, both of which were in the plot. The XBT launcher itself was connected via a cable to a socket on the aft end of the main laboratory, and from there to the PC. This arrangement required the launcher and cable to be stored between launches and connected immediately before a drop. This operation raises the chances of breaks and snags in the cable, since there was no proper storage for the cable. Also two people were required for each launch since the deck unit was so far away from the launch point, that the software would time out before a single operator could get in position. A simple set of signals from the bridge wing was adopted to tell the launcher when to load the XBT and when to begin the drop. At night this was effected using a torch. Safety gear in the form of ear protectors and gloves were provided, but on the whole not used.

New software was loaded into the system before Cruise 62 by the Hydrographic Office. However, no documentation was provided, and the correct sequence of steps was only established by trial and error. The format that the software writes data to disk was also changed, which forced the introduction of two new steps in procedures on Cruise 62.

Since the XBT system is provided by the Hydrographic Office, they require that the data should then be transmitted to them by satellite. This is carried out by queuing the data, which are then automatically sent out during four transmission windows throughout the day. However, the queuing buffer allows only two XBT drops to be sent at one time, which led to a backlog of unsent data at the times when four or more XBTs were being launched in a six hour period.

Two distinct groups of XBT failures occurred. The first were simply caused by operator error, when the software was told that the launcher was loaded when it was not, or the controller was not reset before launch. The second was associated with bad weather when the ship was underway. Here the drop terminated abnormally before either the bottom or the maximum operating depth was reached.
It was soon observed that the near surface temperatures calculated by the XBT were often wrong. This was especially true in the top metre, within which the data was always a number of degrees different from other observations. To provide some degree of understanding of the characteristics of the XBTs, at each corner of the survey triangle, before a CTD was lowered, an XBT was launched. Early comparisons suggest that XBT temperatures in the whole of the mixed layer may be suspect.

Further consistency checks were made by performing a number of drops at the same location and changing the input parameters to the program. Most significantly varying the injection (or bucket) temperature value required by the program from 9 to 10°C or using 99.9 which is its default value, produced temperatures in the first metre which ranged from -1 to 12°C, when other observations suggested an SST of 10°C. It was decided from this point to use an injection temperature of 99.9 throughout. This was an arbitrary choice, since an error of 2°C is as bad as one of 11°C.

The depths are calculated from the time elapsed using a quadratic function of time whose parameters vary between types of XBT. A comparison of the depths reached by XBTs which hit the bottom with the corrected echo sounder readings in the same time interval suggest the XBT depths are too shallow by more than 10 metres.

It is clear from these problems that the software used to control and interpret the XBT data needs to be corrected. Ideally the user should be provided with an exact description of the algorithms used to produce the data from the measurements, so that they can more easily interpret and correct their data.

The data were copied to floppy disk and then read into the level C Sun where it was translated into ASCII and then into RVS data format, at the same time calculating depth from elapsed time. Copies were then made in Pstar format. Each XBT was despiked before they were gridded into sections along each side of the survey triangle. Comparisons of the deeper structure (below about 200m) between the CTD and XBT sections show quite good agreement. It is hoped to use the XBTs to improve the resolution of the survey.

A summary of the XBT drops is given in Table 4.

SGA, AIM, DL

ADCP (Acoustic Doppler Current Profiler)

The shipboard R. D. Instruments 150kHz ADCP was set up to give 64 x 8m bins, and an ensemble average every 2 minutes. As only a small portion of the work was to take place in waters shallower than 400m, this set-up was used throughout the cruise. In addition, bottom tracking mode was enabled for the purpose of calibrating the ADCP (Pollard and Read, 1989) and was successful to a depth of about 650m. The use of bottom tracking meant that the set-up was the same for the calibration as for the rest of the work, but at the price of a lower ping rate.

The data quality from shipboard ADCPs seems very dependent on the ship’s speed, heading relative to the wind, and sea state, so initial calibration runs were made at both 8 and 10 knots. Although much better at 8 knots, the data quality whilst underway was generally very poor and extremely variable from ensemble to ensemble. The results of both calibration runs were very similar and so could be applied to the data collected at either speed, however, an effort was made to adhere to 8 knots when the timing of satellite overpasses would allow.

Initial data processing, to the derivation of absolute currents, was achieved through the use of a set of Pstar command files which have accumulated during the last few years use of ADCPs by IOSDL and JRC.

The Data Acquisition Software (DAS) crashed once after a restart, necessitating a reset of the PC, but otherwise the ADCP and its associated hardware operated without any problems.

After subtracting the ship’s velocity from the ADCP currents, underway currents appeared to be larger than those on-station by a factor of 2 or 3. Initially this difference was thought related to the values obtained for misalignment angle and amplitude correction in the initial calibration runs, as they were slightly larger than those measured on previous Darwin cruises. Unless, however, a mechanical shift of the transducers had occurred since the previous cruise (62) which immediately preceded this one, the amount by which they differ cannot account for the difference.

The ADCPs four transducers allow quantities like ‘vertical velocity’ and ‘error velocity’ to be measured, and these play a part in determining the data quality measured by the ADCP. The ‘error velocity’ was found to be negatively biased whilst underway as noticed by Saunders (Saunders, 1991) on Cruise 42, resulting in an under-estimation of the ship’s velocity and, therefore, larger absolute currents. This is the most likely explanation, but what effect it has on the possible interpretation of the underway data is not yet known.

Bubbles passing under the ship and collecting in the “top-hat” housing in which the ADCP is mounted are one of the possible causes of the under-estimation, so to minimise this build-up of air, the top-hat was bled on two occasions; 0830 on day 250, and 1600 on day 261.

NAC

VAESAT Buoy

The VAESAT buoy consists of an Electromagnetic Current Meter (ECM) providing measurements at a depth of 1m every minute, and a 1MHz Acoustic Doppler Current Profiler set up for sixteen 1.5m bins starting 2.5m below the surface, and a data interval of 5 minutes. The data from both instruments are recorded on Sea Data cassettes, and a portion of the ECM data is transmitted to the Argos satellite. This also allows data (including diagnostics) to be received on the ship whilst within a two mile radius of the buoy, and means that backup data including positional information are recorded.
Useful communication with the buoy ceased on day 255 when the Argos link showed only zeros instead of data. Unfortunately, this was also the case with the data that were recorded to tape and suggests failure of one of the analogue-to-digital converters in the ECM hardware.

Post recovery checks on the ADCP showed normal operation. However, attempting to read the data cassette showed a deterioration in recording quality soon after the buoy was deployed and means that the amount of recoverable data is as yet unknown.

Any data that are recovered from the buoy will provide useful comparison data for the shipboard ADCP.

NAC

MOORING OPERATIONS

Shelf Slope Moorings

A bathymetric survey (day 251) of the proposed mooring sites showed a gentle gradient from 220m to 256m deepening towards the north east. Depths at the mooring locations were determined and mooring line lengths adjusted for correct subsurface positioning.

Directional Waverider (Mooring 508, Figure 5)

Deployment

The Waverider buoy was deployed on day 251 (at position 62° 18.329 N, 04° 55.795 W) from the after deck using the starboard Effer crane and no load release hook. Mooring rubber cord and line was deployed by hand as the vessel moved ahead at one knot. The subsurface sphere was lifted over and released using the crane and no load hook technique. The remaining line and acoustic release being preconnected were deployed to the anchor hung overside on a cut-off rope. A short tow commenced onto position where the anchor was cut away to freefall to the sea bed.

The mooring was observed to settle correctly on position and the acoustic release transponder was interrogated to establish correct depth and operation.

Recovery

The Waverider was known to be either missing or sunk when retrieval operations commenced (day 259). The acoustic release was located and triggered to release the anchor. The subsurface buoy was sighted at the surface within one minute of triggering and the vessel moved alongside to grapple. During this phase a glass Benthos sphere was seen floating close by. Once grappled, the subsurface was hauled aboard by winch with the remaining mooring parts being rapidly hand hauled aboard.
The Waverider was not recovered as the rubber cord had parted due to severe laceration of the upper five metres. This was caused by a fishing wire, traces of broken strands being embedded in the cord and blue paint streaks evident near the parted end. One of the two line support buoys above the subsurface had been punctured by impact and was flooded. The mooring line to the anchor was abraded along its length with frequent traces of grease. The upper release support buoy was missing and the casing shattered, the sphere seen earlier was likely to have come from this casing, presumable shaken out of the remnants when the anchor was released. This evidence indicates that the mooring had been trawled from seabed to surface with the Waverider bungee parting as the mooring load was exceeded.

VAESAT Buoy (Mooring 509, Figure 6)

Deployment

The VAESAT buoy was deployed on day 251 (position 62° 18.641 N, 04° 55.238 W) using the same technique as the Waverider. A short tow was necessary to position the mooring with the anchor cut away on reaching the position. The buoy was observed to settle on position and the acoustic release transponder interrogated.

Argos transmissions were monitored onboard with a useful range of two miles.

Recovery

The buoy was relocated on position day 266. The poor weather conditions precluded use of the Searider work boat and necessitated the ship manoeuvering to the buoy. The acoustic release was triggered with the ship two cables downwind and the subsurface buoy seen to surface approximately 100m clear of the VAESAT. The ship came alongside the surface buoy where with some difficulty a line was attached to the lifting strops. The buoy was easily passed astern on a handling line for winching aboard. Unfortunately the buoy was hit by the protruding airgun boom mounting and the light and top cone were destroyed. The buoy was winched aboard with the remaining mooring well astern. The subsurface buoy and acoustic release then being recovered by winch.

The damage to the light and top cone was caused by the airgun boom mounting which is a steel fabricated structure faired fore and aft but not vertically. Thus when the ship is pitching a flat steel surface is presented directly over any buoy alongside. It would be desirable to have this faired in such a way that a buoy would be deflected out and clear of this hazard.

Sonic Buoy (Mooring 511, Figure 7)

Deployment

The sonic buoy was deployed on day 259 (position 62° 18.52 N, 04° 56.37 W) using the technique employed for the Waverider. As the buoy has extremely vulnerable sensors mounted on the top ring two control lines were used to position the sensors as far outboard as possible. The no load release control string was broken twice on lifting the buoy outboard as the correct pull angle was difficult to achieve. On the third attempt the release operated and the buoy moved slowly clear of the ship. On anchor release the buoy was seen to move rapidly towards the drop position and apparently almost capsize due to the speed of pull and wave motion.

Recovery

The buoy was relocated capsized on day 260 and a recovery operation was mounted. The acoustic release was triggered and the subsurface buoy located shortly afterwards. The ship then made a close pass of the rig to establish the condition of the lines.

By maneouvering the ship alongside the subsurface buoy, the lines could be grappled and brought aboard. The buoy and acoustic release were then recovered by winch. With the sonic buoy line connected to the winch, the buoy was hauled aboard inverted. Although the buoy was capsized the mooring had not been damaged.

Deepwater Mooring

The deepwater mooring was designed to locate a meteorological buoy in 3000m water depth for the duration of the cruise. The technique chosen was a long line mooring of scope (line length/water depth) 1.5. The line to be compliant nylon near the surface and near seabed with the remainder of polyester. All previous IOSDL moorings have utilised polypropylene as the main line with steel wire near the surface. Deployment was to be buoy first with freefall anchor.

A bathymetric survey of the mooring site was carried out on day 252 and the on-site depth determined at 3180m situated on a gentle slope.

Meteorological Buoy (Mooring 510, Figure 8)

Deployment

The buoy was deployed first using the release hook on the starboard. Effer crane through the stern A frame. The ship made way at 1 knot to draw clear of the buoy as it was released. The buoy chain was deployed by hand to the ballast which was freefall off the stern taking away the carefully coiled nylon line off the deck. Mooring line was then deployed off wooden storage drums through the double barrel capstan as the vessel made headway of 1 to 1.5 knots. The depth having been determined of the site the mooring lines were adjusted during deployment.

With the line fully deployed a short tow commenced onto position to stretch out the mooring.

On anchor release (63° 57.58 N, 06° 18.826 W) the ship was turned towards the buoy and visual contact established. Some buoy motion was observed towards the anchor release position. The buoy was monitored into the dark hours to check the light and radar signature.

Relocation

The toroid was relocated on day 255 by Argos reception onboard and acoustic range, 3210m, on the release. No visual contact could be established due to poor visibility.

A further relocation was made on day 257. Radar at 3 miles, Argos at 2.5 miles, visual at 1.5 miles. A close pass was made observing the buoy sensors. The red wind direction vane appeared distorted.

Recovery

On arrival at the anchor lay position on day 263 the buoy could not be seen or detected on Argos. The ship then steamed to the location of last visual sighting on day 257. With the ship hove to an acoustics range of approximately 3500m was obtained. Argos contact was then established, intermittent probably due to swell. Visual and radar detection were severely restricted due to sea state and rain clutter. The buoy was detected visually at 3 cables. The ship then steamed to a position 1 cable downwind of the buoy and the release was triggered at the first transmission.

The ship maneouvred alongside the buoy and grappling attempts commenced. The buoy deployment strop was hooked with a heavy duty hook on a pole and hauled astern with the winch. The tower took several hard knocks without sustaining any sensor damage. However, as the buoy passed around the quarter, the tower came up beneath the steel airgun boom mounting and most of the sensors were effectively destroyed. Once astern the buoy was recovered using DBC and Rexroth winches to alternately haul and stop off the buoy chain. The line was hauled on the DBC and fed into a large wooden crate for stowage. The top 500m of line had several turns taken into itself which were cleared by stopping off using a rope stopper. No significant damage was apparent at these turns.

The tower had suffered damage due to being under the airgun fender, several welds having cracked and severe distortion of the top protective ring and supports having occurred. The buoy hull was relatively intact, all impact with the ship being on the tower. The only apparent minor damage being to the glass reinforced external lugs. As with the VAESAT buoy (mooring 509) the damage sustained by the buoy was entirely due to the airgun boom mounting. If this is not modified further damage will occur when attempting this type of operation.

Overall the mooring appears to have worked as expected. Future deployments will perhaps incorporate a longer nylon section near to the surface to reduce the tangling seen in the upper polyester line. Further studies of this should take place at IOSDL.

IW

Oceano Releases

The Oceano releases used with the moorings again proved to be very reliable and capable of working equally well in shallow and deep water. The only problem that occurred was prior to the launch of the sonic buoy, the release and the spare were found to have faults but a working release was obtained by combining parts from both.

AKJ

SATELLITE DATA

ERS-1

The ERS-1 satellite, launched on the 16th July of 1991, provided Cruise 62A with the satellite data to be validated against the ***in situ*** data measured. The satellite, two months after launch, was still in the commissioning phase. Data from two instruments, the altimeter and the scatterometer, were examined during the cruise. The altimeter data, at 7km resolution along track, has a temporal sampling of 1 second. Wind speed, significant wave height and range values were extracted from the ESA altimeter URA fast delivery product. The scatterometer gathered data, stored as a 19 x 19 array with spatial separation of 25km, to the side of the satellite track at a temporal rate of one array approximately every minute. Wind speeds and directions were examined from the scatterometer fast delivery, UWI product.

The satellite data are received, initially, by the ERS-1 receiving station at Kiruna, Sweden. It is then passed to the data processing facility at ESRIN in Frascati, Italy. Once the fast delivery products have been created, they are sent to the individual ESA member countries' meteorological offices. The Met Office in Bracknell receives the satellite data for the UK. Due to contractual problems, the Met Office does not pass the data along to any institute that may require it. Mullard Space Science Laboratory has paid for a link between itself and the Met Office to receive ERS-1 altimeter and scatterometer data. The Rennell Centre, with a contract with the Earth Observation Data Centre, was allowed to extract the data for the altimeter and the scatterometer for the region between 55° and 70°N for the time period of Cruise 62A. The altimeter data were extracted for only the two passes, one ascending and one descending, which were located within the cruise region. With the much appreciated help of Peter Challenor and David Cotton at the Rennell Centre, the data were formatted and sent via RVS in Barry, on the Marinet system, to the RRS Charles Darwin.
On board the ship, the satellite data were formatted into Pstar files and plotted. Wave heights were compared with the directional Waverider and the shipborne wave recorder for the coincident location and times. Wind speeds from the altimeter and the scatterometer were compared with coincident Young wind vane anemometer data on the foremast and the cup anemometer data on the main mast. In addition, the scatterometer plots were compared qualitatively with the synoptic weather charts received by the ship. The altimeter range measurements were averaged to produce a mean range value along track. This mean was then subtracted from the range values and the residual range values plotted. The range data were used only qualitatively to note the possible change in sea surface height along each track. Without a long time series and a known satellite orbit, the range data contain too many errors to be used onboard the ship in a quantitative manner.

The algorithm for the altimeter wind speeds was not known to be in a stable configuration. Before the cruise, Richard Francis, the ERS-1 altimeter engineer, indicated that the algorithm for computing wind speeds might be changed. (In fact, the altimeter algorithms for significant wave height and wind speed were altered on the 17th of September, day 260.) The scatterometer data received were of low quality when the product confidence was examined. In the earlier portion of the cruise, the product confidence word on the scatterometer data received indicated that one of the three beams, the forebeam, was not being used to produce the estimate of the wind speeds and directions. This would introduce ambiguity in the wind direction indicated. There was also a contradiction in how the data were scaled between the documents supplied by ESA and the Met Office. We were not able to resolve the contradiction while onboard the ship. (Subsequently, it was found that there was a calibration problem with the ERS-1 scatterometer.)

Since the objective of the cruise was to calibrate and validate instruments onboard the ERS-1 satellite, the ability to receive the data onboard the ship was worthwhile. It was a little frustrating, however, that the specifications for the satellite algorithms and data were unclear or contradictory. It would have been helpful to have more pre-cruise time to sort the problems out, which was not possible. The problems encountered were not surprising because the satellite was still in its commissioning phase.

[During the cruise, ERS-1 went over the area in which measurements were being made on days 253, 256, 259, 262 and 265. Its times at the cross-over point (see Figures 1 and 2) were 1156 on the descending track (eastern side of the triangle, travelling south), and 2144 on the ascending track (western side of the triangle, travelling north).]

RTT, MAS, THG

MacSat

MacSat is a satellite data acquisition and data display package built around the Apple Macintosh II computer, enabling Automatic Picture Transmission data to be received from a number of meteorological satellites at a spatial sampling of 5km. At sea its use is restricted to polar orbiting satellites. The object on the cruise was to monitor weather systems in real-time and, when cloud conditions allowed, to identify sea surface temperature features. However, it was first necessary to investigate several problems which had arisen on its last use at sea (Charles Darwin 58; Pollard, Leach & Griffiths, 1991) and which had rendered the system virtually useless at the time.

After some experimentation the omni-directional antenna and its preamp were fixed to the port rail of the wheelhouse top. This position was a compromise between minimisation of interference from the HF and INMARSAT antennas and avoidance of obstruction by the main mast and funnel. In neither of these respects was the location ideal. Cabling from the preamp ran via a conduit into the plot where the receiver and Mac II were situated. This avoided use of the ship'' cabling which can be a potential source of signal loss, through impedance mismatching. Good quality images were obtained soon after the ship sailed from Russian satellites using a transmitting frequency of 137.30MHz. No data of usable quality could be obtained from the NOAA satellites which use 137.50 and 137.62MHz. This behaviour was similar to that found on Cruise 58 and appeared to be caused by interference confined to these two channels. Investigations suggested that this was probably not from the ship but from feedback within the synthesized receiver.

By tuning the receiver manually in 10kHz steps instead of relying on the preset channels it was found that much higher signal to noise ratios could be obtained on 137.53 and 137.64MHz. These were used on the rest of the cruise for acquiring data from NOAA 10, 11 and 12, giving adequate picture quality on the majority of occasions.

The MacSat software enables predictions to be made of when each satellite should be visible for a given geographical position. These were found to be accurate to within a minute but the signal strength was usually insufficient for the first and last two minutes of each transmission to be usable. Several passes per day were acquired and, after discarding the poorer quality data, over 60 images were stored on hard disk. A subset of these (the best pass for each day) were saved to floppy disks. A choice has to be made between visible or infra-red channels when displaying and saving images and the latter was normally selected. However, from day 255 onwards the analogue signal was also stored on cassette by connecting a domestic tape recorder to the output socket of the MacSat receiver. Replay of these tapes will allow VIS and IR to be replayed and optimum A/D conversion to be chosen via the MacSat software (not always possible in real-time). Because the signals were not all that strong the option of using the computer's internal clock to synchronise signals rather than the spacecraft clock was selected. This is important if the images are not to get out of sync every time the signal fades and was undoubtedly a problem on Cruise 58. It is then straightforward to position the start of each scan line at the left hand edge of the window on the monitor.

All of the images which have been archived show cloud patterns associated with the weather systems observed at the time. It was, however, difficult to geographically register the images. A reasonably successful solution was to construct an overlay based on gridded images obtained from the NERC Satellite Station at Dundee. By identifying coastlines and knowing the predicted orbits of each pass it was often possible to position the overlay on the monitor screen and thereby reference features to latitude and longitude. (The latest version of MacSat overlays grids on NOAA images as part of the processing and this would be of great benefit for our applications.)

In cloud free areas an attempt was made to identify sea surface temperature features for real-time cruise planning. Although some gradients could be seen in UK coastal waters none were discernible in the cruise area, possibly because they were relatively small in magnitude (typically, a few tenths of a degree in 10km). One problem is a 'herring-bone' interference pattern on most images which dominates in any attempt to enhance the IR images. Another is that complete dropouts in signal occurred, probably when the line-of-sight to the satellite was obstructed by structures on the ship. It is recommended that in future the MacSat antenna should be placed in a more elevated position to improve the view of the horizon in all directions.

Although there are still problems to be sorted out, the performance of MacSat on the cruise showed the viability of this cheap system for acquiring satellite images in real-time. The images will be used as a quick-look to identify priority occasions for detailed processing of the 1km resolution NOAA data obtained by Dundee and for ERS-1 ATSR data.

THG, TNF

MISCELLANEOUS

PES

The PES fish and Simrad echosounder deck unit worked well throughout the cruise.

AKJ

Computing

The RVS computer system was used to log data from ten instruments, these being EM Log, Gyro, GPS and MX1107 satellite navigators, echo sounder, CTD, thermosalinograph, MultiMet, Shipborne Wave Recorder and ADCP. In addition, XBT temperature data were transferred from the XBT PC on floppy disks and processed on the level C to produce a depth versus temperature file.

Most of the data processing on board was done using the IOSDL Pstar suite of programs, but the RVS system was used for producing navigation plots and provided corrected navigation for the Pstar processing.

The system worked well after initial problems getting the logging started for the MultiMet and Shipborne Wave Recorder.

For some reason not determined, the MultiMet level A data could not be transferred over the Cambridge Ring network that links the level A's in the plot to the level B in the computer room. The problem was overcome by transferring the data on a hard-wire link.

The Wave Recorder logging failed shortly after it had been started due to the level A interface becoming faulty. This was due to failure of the level A, analogue input PCB. Of the spare analogue PCB's on board the first two that were tried were also faulty, but eventually a good one was found and the interface made operational again.

DL

Communications

A contributor to the success of the cruise was the ability to receive ERS-1 data a day after it was acquired, via the Marinet system, from the Rennell Centre. The failure of the teleprinter terminal (on day 253) and the consequent loss of the satellite communications could have impaired the work on the cruise. All credit must go to the radio operator and Derek Lewis (RVS) for managing to fix it. However, the incident raises serious concerns about the lack of adequate spares or alternative means for maintaining the satellite link.

MAS

ACKNOWLEDGEMENTS

Being a principal scientist for the first time on this cruise, I am grateful for all the help, advice and encouragement that I received from the Master and Officers of the Darwin, and also from the more experienced sea-goers amongst the scientific staff. The success of the cruise is more a reflection of the skills and dedication of the Master, Officers, crew and scientists taking part in the cruise, than of any ability on the part of the principal scientist.

In addition, I wish to express thanks to the Mullard Space Science Laboratory and also particularly to Peter Challenor and David Cotton of the Rennell Centre for their work in gettin the ERS-1 altimeter and scattermometer data transmitted out to the RRS Charles Darwin during the cruise.

MAS

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Figure 5: Directional Waverider mooring (No. 508).
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Figure 8: Meteorological buoy mooring (No. 510).

TABLE 3: CTD CASTS ON CRUISE 62A

Cast No.	Date yymmdd	Time hhmm	Latitude deg. min.	Longitude deg. min.	Depth m	Closest approach m	Comment
01	910908	1623	62 19.20	04 55.26	260	20	trial dip
02	910912	0730	63 56.50	06 12.07	3400	50	
03	910912	1228	63 57.60	05 22.80	3372	80	
04	910912	1750	63 57.00	04 27.00	3206	40	
05	910912	2247	63 57.89	03 32.14	3055	40	
06	910913	0321	63 38.21	03 51.19	2738	60	
07	910913	0739	63 18.66	04 05.34	2661	130	
08	910913	1209	62 59.13	04 21.25	2190	50	
09	910913	1605	62 38.78	04 37.93	707	45	
10							failed
11	910913	2007	62 17.40	04 57.00	224	25	
12	910913	2323	62 38.40	05 12.60	578	25	
13	910914	0253	62 58.80	05 27.60	1812	50	
14	910914	0703	63 19.01	05 45.79	2211	25	
15	910914	1102	63 37.91	05 59.86	2141	45	
16	910919	1214	62 15.60	05 01.20	192	15	
17	910919	1603	62 39.00	05 12.60	585	25	
18	910919	1951	62 58.80	05 28.20	1754	45	
19	910920	0042	63 18.60	05 45.00	2175	30	
20	910920	0511	63 38.40	05 59.40	2162	55	
21	910920	1433	63 56.40	06 18.00	3194	25	
22	910920	1953	63 57.60	05 23.40	3371	25	
23	910921	0657	63 38.40	03 50.40	2737	20	
24	910922	0004	62 58.80	04 22.20	2176	50	
25	910922	0612	62 39.00	04 37.80	715	20	
26	910922	1055	62 17.40	04 55.80	225	20	
27	910923	0313	62 58.20	04 57.00	2010	45	
28	910923	0703	63 18.60	04 56.40	2368	30	
29	910923	1115	63 18.60	04 06.00	2695	35	

TABLE 5: RADIOSONDE ASCENTS ON CRUISE 62A

Flight Number	Day/Time	Tcor	Ucor	Height mb	Comments
1	250/1144	0	0	221	Cap off. Disk filled.
2	250/2337	-0.2	2	148	Cap off. Unwinder not working?
3	251/1115	-0.1	1	120	Cap off. Little low cloud.
4	251/2308	-0.2	2	350	Cap off.
5	252/1110	-0.2	2	29	Cap on. First data cycles not logged.
6	252/2159	-0.4	1	39	Cap off. Hit sea then recovered.
7	253/1140	-0.2	1	53	Cap off. Unwinder not working?
8	253/2142	-0.2	1	25	Cap off.
9	254/1120	-0.3	2	61	Cap off. Into cloud at 915mb.
10	254/2325	-0.2	1	23	
11	255/1126	0.1	1	45	Cap on. Raining.
12	255/2144	-0.4	1	44	Cap off.
13	256/1120	-0.4	0	30	Cap on.
14	256/2135	-0.4	1	29	Cap off.
15	257/1010	-0.3	2	43	Cap off. Into cloud 10:14:06.
16	257/2301	-0.4	0	45	Cap off.
17	258/1140	-0.1	0	43	Cap off.
18	258/2325	-0.1	1	31	Cap off.
19	259/1135	0	1	41	Cap off. Into cloud 11:42:41.
20	259/2140	0	1	50	Cap on. Raining.
21	260/1138	-0.2	0	60	
22	260/2309	-0.3	0	50	Cap on.
23	262/1130	-0.2	0	42	Cap off.
24	262/2130	-0.1	1	52	Cap off.
25	263/1122	-0.3	1	41	Cap on.
26	263/2300	-0.8	0	78	Cap on.
27	264/1128	-0.3	0	34	Cap off.
28	264/2334	-0.2	0	81	Cap off.
29	265/1129	0.0	3	34	Cap off.
30	265/2133	-0.2	0	80	Cap off.
31	266/1059	-0.1	0	35	Cap off.
32	266/2300	0.1	0	690	Cap on. Balloon leaking?
33	267/0014	-0.1	0	48	Cap on. Replacement flight.
34	267/1138	-0.1	-1	30	Cap on.
35	267/2135	0.1	0	39	Cap off.