JAMES RENNELL CENTRE FOR OCEAN CIRCULATION

INTERNAL DOCUMENT No. 7

Project SOFIA - IOS Cruise Report

E C Kent & R W Pascal

1992

Gamma House
Chilworth Research Park
Chilworth
Southampton SO1 7NS
Tel 0703 766184
Telefax 0703 767507

1. INTRODUCTION

Le Suroit took part in SOFIA in the ASTEX region near the Azores. IOS mounted meteorological instrumentation on the ship and Robin Pascal and Elizabeth Kent participated in the cruise. This report summarizes the main measurement systems (section 2), briefly describes the weather and ship operations, and describes in more detail the performance of the IOS instruments. SST measurements were a major task, particularly for comparison with ATSR on ERS-1, intercomparisons of SST are summarized in section 5 and ERS-1 comparisons are tabulated in section 6.

2. SYSTEMS ON SHIP "LE SUROIT"

2.1 IOS Systems

The IOS measurements were designed to determine the wind stress using the dissipation techniques, to measure the mean meteorological variables, and to determine the skin temperature of the ocean using an SST radiometer. Figure 1 shows plans of Le Suroit giving positions of all the instruments deployed on the SOFIA cruise.

Mean meteorology was recorded using MultiMet. Air temperature and humidity were measured on a carriage fitted to the IOS 10 metre meteorological mast on the foredeck. Two sets of wet and dry bulbs were used and both port and starboard sensors were fitted with large radiation shields. Atmospheric pressure was measured by a sensor in the aft wet lab approximately 2 metres above sea level and wind speed and direction by a Young AQ sensor fitted to the port rail on the foredeck. The anemometer was poorly exposed but no other suitable sites were available. A trailing thermistor 'soap' was used to measure sea surface temperature (SST) which was deployed from a pole outboard from the starboard foredeck. The soap trailed close to the surface (except when stationary) and was usually clear of the ships bow-wake.

For the dissipation stress measurements a Solent sonic anemometer was deployed on top of the IOS 10 metre mast on the foredeck, approximately 16 metres above sea level. The skin temperature was measured by a microwave radiometer was fixed to the starboard foredeck rail measuring 11 micron wavelength radiation emitted from the sea surface. The ships position and heading were measured using a Magnavox GPS system with the aerial positioned on the rail of the aft walkway and a KVH fluxgate compass located in the wet lab. Data from the ships electromagnetic log were logged to a pc which was situated along with all the other IOSDL logging equipment in the wet lab. Appendix 1 contains daily tables of the status of the IOS equipment along with an indication of ship operations.

2.2 University of Washington Systems

Two pairs of thermocouples were fixed to the lower section of the 10 metre mast carriage and wet and dry bulb data were logged at 20 Hz for 2 hour periods when the ship was head to wind. A Lyman-α sensor was deployed (weather permitting) on a boom in front of the ship and also logged at 20Hz. One minute averages of incoming long wave (3-50 μm) , short wave (0.28 - 2.8μm) and infra-red (0.7 - 2.8 μm) radiation were measured continuously from the roof of the winch control cabin. Instrument locations are shown in Figure 1.

2.3 French Systems

Continuous measurements of microwave, short wave and long wave incoming radiation and net longwave radiation and air pressure were made, and stored as ten minute averages with a rms value. The microwave radiometer was situated on the wheelhouse top, the short and longwave sensors were on the walkway in front of the bridge and the net longwave sensor was on a boom in front of the ship. Radiosondes were launched every six hours at 0500h, 1100h, 1700h and 2300h starting as 2300h on 1 June 1992 (153) and finishing at 1100h on 20 June 1992 (172). All times are in GMT. A drifting wave buoy transmitted directional wave spectra via Argos.

During experimental periods various additional measurements were made. The SODAR was used to measure vertical velocity and reflectivity in the atmosphere between 20 and 400 metres. During SODAR operation the ship pitch, roll and vertical acceleration were measured. The MINISODAR gives the wind profile between 10m and 80m and also gives an indication of the turbulence in the atmosphere. The tethered balloon system measures profiles of pressure, temperature, wind speed and the structure function of temperature fluctuations. A drifting hydrophone buoy records the audio signal of turbulence at the sea surface to indicate wave period and amount of bubble entrainment. Stereo photographs of the sea surface were also taken to give sea state.

In addition measurements of the concentrations of Dimethyl Sulphide (DMS) were made by the Centre des Faibles Radioactivites. A comparison was made of two methods of determining the flux of DMS between the atmosphere and ocean. The traditional method calculating the flux from a single concentration measurement in seawater using a empirically derived piston velocity was compared with a profiling technique with concentrations measured at three levels in the lower atmosphere.

3. NOTES ON WEATHER AND SHIP OPERATIONS

Figure 2a shows the ship track for the whole period when navigation data was logged. Figures 2b and 2c show the ship track for leg 1 and leg 2 of the cruise respectively on an expanded scale. Figure 3 shows daily weather charts from Weather magazine.

3.1 Overview of Weather

During days 152 to 160 high pressure was centred over or to the west of the work area resulting in a northeasterly to northerly wind which varied between 4 to 8m/s. Until day 156 the air was relatively dry with 2/8 to 3/8 cumulus and stratocumulus increasing to 7/8 in the afternoon on day 154 and 155. Moister air followed a weak warm front on day 156 with 6 to 8/8 cloud cover and light rain and showers on day 158.

Following a cold front passage on day 160 a dry airflow from the west or northeast and small cloud amounts continued until a warm front passage on day 163. The high pressure region, initially centred to the south, became centred over the work area. Wind speeds were low, generally below 5m/s veering to the north on day 163 and northeast on days 164 and 165.

The high pressure centre continued to move north from days 167 to 172. It was centred north of the work area resulting in a 5 to 10m/s wind from the east or north east. The airflow was generally warm and moist and there was extensive cloud cover.

3.2 Passage to Ponta Delgada, Sao Miguel

Sailed 1400h 26 May 1992 (147) from Brest on heading of 235° at speed of approximately 10 knots. Although the weather was fine for the remainder of the day a complex area of low pressure dominated the weather during the passage to Ponta Delgada. 27 May (148) was generally cloudy and raining, the wind gathered strength in the evening as the pressure continued to fall.

28 May (149) early morning was overcast with wind speeds reaching 12 m/s and there was a large swell. By mid-morning the cloud had broken up to give some sunny periods and the pressure started to rise. The cloud cover ranged from 3/8 to 6/8 Cumulus for the remainder of the day.

29 May (150) 8/8 cloud cover in the morning which then started to break up, quite sunny through thin cloud. The air pressure rose gradually throughout the day to reach about 1020mb[1]. Wind waves were about 1 metre high all day and there were a couple of swells present.

30 May (151) saw 7 or 8/8ths of stratocumulus early in the day, breaking up slightly at 0900h following light rain at 0800h. After midday the cloud cover was 4/8 of big cumulus clouds, but by the evening stratocumulus covered the sky. Weather was sunny with the temperature remaining fairly constant at about 15°C, but the sea was quite choppy. 31 May (152) docked in Ponta Delgada at 9am, day fairly overcast.

---

[1]Throughout the cruise a pressure tide of approximately 2mb was apparent, with maxima of pressure occurring slightly before midday

3.3 First Leg of Experiment

Sailed from Ponta Delgada at 1800h on 31 May 1992 (152) and steamed Southeast to position 35°35N 23°50W.

A drifting wave buoy was launched at 0800 on 1 June (153), the SODAR and MINISODAR were started and the hydrophone buoy deployed. Wind speeds were between about 6 and 8 m/s all day and the wind direction moved from north to northnortheast during the course of the day. The day started off overcast with cumulus and stratocumulus but cleared to 2/8 stratus on the horizon with showers within sight. Patchy cloud for the most of the day. Pressure rose gradually all day; from 1025 to 1027mb. The air temperature was between about 16 and 17°C with the sea surface temperature usually about 2°C or so warmer. The maximum air temperature reached was 18°C at about 1500h when the cloud cover had dropped to 4/8 cumulus. In the afternoon the tethered balloon was tested and there was an overpass by a C130 aircraft. At 1800h started steaming south with rain within sight. Wave heights were generally less than a metre. A couple of swells were present, one at about 1 metre height and another at 2 metres. Whitecapping was observed for most of the day but by 2100h the sea was calm Radiosonde launches were started at 2300h (then every 6 hours).

On 2 June 1992 (154) the ship continued to steam south to 34°30N 23°45W to be in position for an ERS-1 overpass the following day. Most of the day was spent head to wind except for the deployment and retrieval of the hydrophone buoy. At 2100h started steaming for next ERS-1 orbit. For much of the day there was low cloud cover with stratocumulus and cumulus on the horizon, increasing to 6/8 cover by 2100h. At midday however there was 7/8 stratus which gave way to 8/8 cumulus and stratocumulus. The cloud cover dropped to 2/8 flattened cumulus before reverting back to cumulus and stratocumulus. The wind speed dropped from 9 down to 4 m/s and the wind direction shifted gradually from northnortheast to northeast. There was a significant wind sea and also two swells. The air pressure rose gradually to over 1030mb. Air temperature measured on the mast started at about 17°C, reached a minimum at 16°C at about 0900h the temperature rose gradually back to 17°C before falling half a degree in the late evening. Sea surface temperature was again significantly warmer than the air temperature and the humidity was low.

3 June 1992 (155). Sea was calm, a sunny day with variable cloud cover. At 0600h the cover was 6/8 cumulus and stratocumulus, falling to 3/8 by 0900h. Cloud cover remained low but the type then changed to flattened cumulus. The rest of the day saw extensive cloud cover, cumulus and stratocumulus followed by stratocumulus. Air temperature started at about 16.2°C, rose to a maximum of nearly 18°C at about 1600h then fell to between 16.5 and 17°C. Humidity remained low and the SST between 18 and 19°C. Wind speed fell to about 3m/s at about 0900h then rose gradually to 7-8m/s. The wind direction moved from northeast to north by midday then back to northeast. Pressure continued to rise. Sea state was mainly calm with small wind waves and long period swell. Most of day spent head to wind parallel to ERS-1 orbit. SODAR and MINISODAR on, hydrophone buoy deployed and tethered balloon aloft for 4 hours. Also stereo photos of sea surface were taken. 1600 started to steam into position for the next ERS-1 overpass.

4 June 1992 (156). Cumulus and stratocumulus clouds were observed for most of the day; cumulus on their own at 1800h but the cover was variable (4/8 at 0600h, 8/8 at 0900h, 2/8 at 1200 and 1500h and 3/8 at 1800 and 2100h). Wind speeds rose gradually from about 4m/s to about 6m/s, direction moved from northeast to north. The pressure reached its maximum value of

about 1034mb. Air temperatures initially about 16.5°C fell slightly before rising sharply by about 2.5 degrees due to the passage of a weak warm front in the late morning which resulted in significantly greater humidity levels. Sea was calm with some slight whitecapping developing in the afternoon, small wind waves and two weak swells. Overnight and early morning steamed at about 5 knots at heading of 250°, crossing the Azores front region at about 0300h, (maximum SST 19.7°C). The SST fluctuated for the remainder of the day but fell from about 2100h to 18.5°C. From 0600 head to wind most of the day (except for hydrophone buoy recovery at 1800h) parallel to ERS-1 orbit.

5 June 1992 (157). After a clear night (2/8 stratocumulus at midnight) the cover had increased to 8/8 stratocumulus at 0600h. The sky cleared somewhat in the early evening to 3/8 small cumulus but then covered over again with 7/7 stratocumulus. The wind speed varied between about 4m/s and 8.4m/s, starting the day at about 5 m/s and ending it at about 7m/s. The direction moved from north to northnorthwest. Air temperature and humidity both generally rose gradually throughout the day and the SST remained between 18 and 18.5°C until rising to 19.5°C at 2200h. Pressure fell gradually. Wind waves were still small and a small amount of whitecapping was observed but the swell increased in height to about 2 metres. At midnight started to steam to Santa Maria for aircraft comparison. Arrived off Santa Maria at 1000 and remained head to wind until 2100 with tethered balloon aloft and measurements made with a sonde close to the sea surface on a boom in front of the ship. 2100h steamed south to be in position for ERS-1 overpass on 6 June.

6 June 1992 (158). Cloud cover was nearly complete all day with rain clouds observed at 0300h, 0600h and 1800h in addition to cumulus and stratocumulus. Light rain fell in the early morning and at about 1700h. Rain was observed away from the station at 2100h. The wind speed rose slightly, from about 7m/s to 8-9m/s then dropped back to 7m/s while the direction shifted from northnorthwest to northeast. Air temperature fell erratically and the humidity fell sharply just after midday but then rose again. SST increased slightly in the early morning to nearly 20°C then remained fairly constant. The wind sea was significant and the sea appeared choppy, the swells remained large. Most of day spent head to wind following the orbit of ERS-1, except for a period of tethered balloon measurements. SODAR, MINISODAR, hydrophone buoy operated as usual. At 2100h steamed off at heading of 270°.

7 June 1992 (159). Extensive cloud cover of stratocumulus and then cumulus with stratocumulus was observed in the morning. The sky cleared to 4/8 cumulus with stratocumulus the 3/8 small cumulus in the early evening. Cloud cover then increased to 5/8 cumulus and stratocumulus by 2100h. Wind speeds were initially 8m/s but fell to 2m/s at midday then rose back to 7m/s. The direction changed from northeast to north then northeast. Pressure was steady (except for the daily pressure tide) at about 1028mb. The wind sea and the swell were both small and the sea surface was calm. Air temperatures were again erratic in the morning but steadied and rose gradually in the afternoon, peaking at about 19°C at 1800h then falling by about a degree. SST fell sharply by a degree at 1400h then reached a maximum for the cruise of 20.7°C in the early evening, finishing the day at about 20.5°C. The ship stopped steaming at about 0300h and most of day was then spent head to wind except for balloon operations and buoy retrieval. 2300h started steaming at heading of 50° for LandSat overpass at 36°00N 25°20W and to easily get to Santa Maria for aircraft comparison on 8 June 1992.

8 June 1992 (160). The night and early morning were overcast with stratocumulus followed by 5 or 6/8 cumulus with stratocumulus until cumulonimbus was observed at 2100h. Pressure

remained steady. Wind speed fell through the day from 8m/s down to 1m/s and the direction was mainly northeast then moving to north. The air temperature and humidity fell sharply in the early morning due to the passage of a cold front finishing the day at about 16°C. SST was between 18 and 18.5°C all day. The sea state was similar to the previous day. Ship stopped steaming at about 1000h to be head to wind for LandSat overpass at 1300h. Head to wind for most of the day except for balloon and buoy operations. 2100h steamed at heading of 150° towards Santa Maria.

9 June 1992 (161). Cloud cover in the early morning was between 4 and 7/8 cumulus and stratocumulus. At 0900h 3/8 large cumulus was observed and 1/8 flattened cumulus at 1200h. In the afternoon and early evening there was also 1/8 of cirrus but by 2100h cumulus and stratocumulus had returned. Wind speeds were low all day, between 1 and 3m/s in the morning rising to 5m/s by the end of the day, the pressure remained steady. Air temperature rose from about 15.5°C to over 17°C and the humidity remained low. Crossed Azores front so SST rose to nearly 20°C in the afternoon/evening before falling again. The sea remained calm but the swell increased. The ship stopped steaming at 0200h, head to wind for most of day for aircraft comparisons (except for buoy retrieval) until 1900h when ship steamed at 140° to cross the Azores front.

10 June 1992 (162). Cloud cover was 4/8 large cumulus at 0000 but the remainder of the day saw small cumulus with cirrus. Wind speed fell from 5m/s to 1.5 m/s at midday then rose back to 5m/s . The wind direction varied between west and northwest. The sea was again calm with some swell. A weak warm front caused the air temperature to rise throughout the day finishing at between 18 and 18.5°C and the humidity to also rise. SST rose gradually to over 10°C then fell gradually. Pressure remained steady. Ship steamed in the morning until 0800h, then head to wind as there was no planned experiment. 1800h started to steam at 300° for aircraft comparison at Santa Maria on 11 June.

11 June 1992 (163) Cloud cover was high after 1/8 cirrus at midnight. Cover varied from 5/8 to 8/8 stratocumulus which was accompanied at 0600h and 2100h by dense cirrus. Wind speed remained around 5m/s. The wind direction changed from northwest to westnorthwest then to north. Air temperatures rose gradually until about 1800 when they reached 19°C but then fell gradually then steeply. SST remained low for the whole day. Pressure began to rise and the sea state remained similar to the previous day. Within range of Santa Maria for aircraft comparisons. Head to wind for most of the day with usual measurements with balloon and buoy. 1800h started steaming north for port call at Ponta Delgada.

12 June 1992 (164) 0900h docked in Ponta Delgada.

3.4 Second Leg of Experiment

13 June 1992 (165). Left Ponta Delgada at 1800h, steamed southwest to Santa Maria.

14 June 1992 (166). The frontal trough caused the pressure to fall steadily for most of the day with rain in the morning. Pressure rose in the evening to reach 1027mb. SST was fairly constant all day at slightly under 19°C, temperatures were between 16 and 18°C and the humidity was high. Cloud cover was 7/8 or 8/8 all day. Wind waves were present and there was also a swell in the wind direction, the sea was choppy. Wind speed fairly constant in the morning

between 6 and 8 m/s but rose in the afternoon and evening to over 12 m/s, the wind direction remained northeast. Head to wind near Santa Maria for new scientific crew to practice with the tethered balloon. 2000h steamed northwest in evening to be in position for LandSat overpass.

15 June 1992 (167). Extensive cloud cover all day, cumulus, stratocumulus and altocumulus. Wind speed fell from 13m/s to 7m/s and the direction remained northeast. Pressure rose fairly sharply in the morning to over 1029mb then fell slightly during the afternoon. Temperature was steady at between 17 and 18°C all day, the humidity was fairly high. SST between 17.9 and 18.5°C. Steamed overnight to LandSat overpass position then head to wind from 0800h to 1600h. 1600h started to steam southeast towards Santa Maria. Head to wind at midnight for ERS-1 overpass.

16 June 1992 (168) 8/8 cloud cover for most of the morning mainly cumulus and stratocumulus. Midday saw 3/8 small cumulus, the cover increasing gradually until 2100 when there was 7/8 cumulus and stratocumulus. Wind speeds fell gradually to end the day at about 7m/s and the direction remained at northeast. Pressure falling. Temperature rising gradually from 17°C to 18°C and SST rising from 18.5°C to 19°C, the air was fairly dry. Off Santa Maria (36°30N 24°00W) by 1200h for aircraft comparisons. Head to wind steaming slowly for most of day then at 2000 started steaming south to try to cross the Azores front.

17 June 1992 (169). Full cloud cover all day but in the afternoon and evening altostratus could be seen through the low level stratocumulus. SST rose by 1°C across the Azores front (19.5°C on the north side and 20.5°C on the south side). Air temperature was a minimum of 17.5°C at 0200h then rose to above 19°C for most of the day, falling slightly in the evening. The air progressively dried out through the day after being quite humid up to 0600h. Wind speed rose from 6m/s to 8-9m/s and the wind direction shifted from northeast to east at about 0900h. Pressure was steady at about 1026mb. There was a large swell of about 2 metres in the wind sea direction and the sea became rougher in the afternoon. Steaming southsouthwest overnight to cross Azores front, 0830h turned to steam back northeast across the front with the balloon aloft. Just as we started to cross the front at 1300h, the balloon had been lowered as it was thought that the front had been missed and the ship started to steam. The ship then retracked and crossed the front with the balloon aloft.

18 June 1992 (170). Cloud cover was 7 or 8/8 all day with nimbostratus observed between 0900h and 1800h. SST between 18.9 and 19.4°C. Air temperature after rising and falling erratically in the morning remained constant at about 17°C after 1000h. Wind speed fell from 8.5/s to 3m/s and the direction was mainly easterly. Pressure remained steady. Swell remains mainly in wind sea direction. Steamed to Santa Maria for aircraft overpasses. The poor weather, with persistent rain, prevented the aircraft flying so we hove to head to wind for most of the day. The dismantling of the SODAR system was begun in the evening.

19 June 1992 (171). Sunny day with patchy cumulus following a period of high cloud cover in the early morning. Air was dry and the temperature constant at 17°C all day. SST rising to a maximum of 20.1°C at 1800 but 18.9°C by 2100h. Wind speed increasing gradually to over 6m/s, the direction shifting back towards north. Pressure remains constant. Swell present not aligned with the wind sea with a small amount of whitecapping. Head to wind for much of the day. The SODAR dismantled in the morning, but the MINISODAR was still working. Head to wind for ERS-1 overpass at midnight.

3.5 Passage to Brest

20 June 1992 (172). Started steaming am for Brest. Last radiosonde launched at 1100h. Cloud cover 5/8 large cumulus in the morning, 8/8 stratocumulus at midday, cumulus and altocumulus at 1500h then stratocumulus developing reaching 8/8 cover at 2100h. The wind speed rose to 9m/s from the north, then northeast. Pressure still fairly constant. Large wind sea started to develop.

21 June 1993 (173). Pressure started to drop sharply. Air temperature falling slowly, humidity low. Steaming at 6-7 knots due to very large swell.

22 June 1992 (174). Sea remained lumpy with high cloud cover, pressure and air temperature still falling.

23 June 1992 (175). Swell dropped a bit.

24 June 1992 (176). Sea state still dropping. MultiMet logging stopped at 0700h.

4. IOS MEASUREMENTS

4.1 Manual Meteorological Observations

Whilst in the study area manual meteorological observations were made on the synoptic hours, excepting 0300h when the observations were copied from the ships log on the bridge. Dry and wet bulb temperatures were measured by an Assman psychrometer on the windward side of the ships' bow. SST measurement was by insulated UK Meteorological Office bucket from the fore end of the aft deck. Relative wind speed and direction and air pressure were taken from the ship's Pommar system. Wet and dry bulb and sea surface temperatures were also recorded from the ship system; the ships engine intake temperature 3m below the sea surface, generally agreed to within 1/10°C with the bucket measurements. Present and past weather codes were completed along with ship's navigational parameters from the bridge. Cloud observations were also made (type and cover at three levels, not significant layers) and visual observations of wind sea and swell.

In addition for much of the cruise, where possible, hourly SST measurements were made with the bucket between 0700h and 2300h for comparison with the radiometer and the MultiMet soap measurements.

4.2 MultiMet

MultiMet installation was started during the day prior to sailing (26/5/92), and completed during the second day at sea (27/5/92). The IOS 10m Meteorological Mast was mounted on the foredeck, the base plate assembly having previously been welded into position following a visit to the ship in Toulon. Two aspirated psychrometers with large radiation shields were mounted to the carriage on the 10 metre mast, due to the forward stay fouling the carriage, the carriage could only be pulled 9 meters up the mast. The psychrometers were positioned 2 metres below the sonic anemometer; 14.5 metres above sea level. A Young AQ monitor anemometer was mounted to the ships port rail on the foredeck; the exposure was poor, but was thought to be the best possible. When in the working area the trailing thermistor SST sensor ("soap") was deployed from a towing point on the starboard side next to the SIL Radiometer. An IOS Air pressure sensor was mounted in the lab at about 2m above sea level.

Data output from MultiMet were recorded by the internal Eprom logger from day 147 (27/5/92) at 0845h when the time and date were set to GMT on the MultiMet logger and the Eprom logger initialised. Sensor deployment details are summarised in Table 2. In addition data was recorded via an RS232 link to the MetMan system on a Master 128K Microprocessor. MetMan recorded both raw and geophysical data on floppy disk and displayed calibrated data in real time. The geophysical data was exported to a PC running DaDisp software from which daily plots of calibrated data were produced. Calibration coefficients for the MultiMet sensors are given in Table 3. Data were logged from all systems until 0700h on 24 June 1992 (day 176), except for SST which failed at about 1000h on 19 June 1992 (day 171).

During the cruise only the SST sensor suffered any malfunctions, and was replaced three times. At the mid-port call (day 164) it was decided to replace the SST sensor (IO0015) which was reading 0.3°C high, although it had remained stable at this value for some days. The subsequent SST sensor (IO0016) performed very well for two days before it failed altogether, requiring a third sensor to be deployed (IO0012) which failed immediately and a fourth sensor (IO0014) was deployed. This fourth sensor failed at 1000h on day 171 but appeared to read correctly after it had dried out on deck. It was replaced in the water just before the ERS-1 overpass at 2345h on day 171 but failed again when in the water. All the soaps deployed suffered severely from radio and satellite communication interference but the periods of poor data can be easily identified.

TABLE 2 - MULTIMET SENSOR DEPLOYMENT

Position	Sensor	Data Collection Period	Serial No.
10 m mast port	Psychrometer 1	27-5-92 (148) 0845 - 24-6-92 (176) 0700	VI1059
10 m mast starbd.	Psychrometer 2	27-5-92 (148) 0845 - 24-6-92 (176) 0700	VI1065
Port forward rail	AQ anemometer	27-5-92 (148) 0845 - 24-6-92 (176) 0700	YG6992
Lower Lab.	Air Pressure	27-5-92 (148) 0845 - 24-6-92 (176) 0700	IO0001
Stbd forward rail	SST SOAP	1-6-92 (153) 0830 - 13-6-92 (165) 1315	SPIO0015
		13-6-92 (165) 1830 - 16-6-92 (168) 1540	SPIO0016
		16-6-92 (168) 1540 - 16-6-92 (168) 2030	SPIO0012
		16-6-92 (168) 2030 - 19-6-92 (171) 1000	SPIO0014

TABLE 3 - MULTIMET CHANNEL NUMBERS AND CALIBRATIONS

CH. NO.	SENSOR	CALIBRATION	SERIAL NO.
5	AQ Direction	72	YG6992
9	Psychrometer 1 WET	C0 -21.39254 C1 2.756665E-03 C2 7.43534E-06 C3 8.278165E-10	VI1059
10	Psychrometer 1 DRY	C0 -20.21075 C1 9.586889E-04 C2 7.659772E-06 C3 5.990184E-10	VI1059
11	Psychrometer 2 WET	C0 -22.65925 C1 5.368657E-03 C2 6.014839E-06 C3 1.02851E-09	VI1065
12	Psychrometer 2 DRY	C0 -22.87023 C1 3.143176E-03 C2 6.724451E-06 C3 7.377544E-10	VI1065
19	SST SOAP	C0 -3619.094656 C1 4.9384785 C2 -2.2641304E-03 C3 3.5234383E-07	SPIO0015 ELECTRONICS 41
		C0 -2256.503417 C1 2.9199493 C2 -1.2713237E-03 C3 1.8944089E-07	SPIO0016 ELECTRONICS 41
		C0 -4016.020614 C1 5.5272275 C2 -2.5553637E-03 C3 4.0055086E-07	SPIO0012 ELECTRONICS 41
		C0 -2208.826058 C1 2.8502135 C2 -1.2378783E-03 C3 1.84151952E-07	SPIO0014 ELECTRONICS 41
20	Air Pressure	C0 -2.372132E3 C1 1.6222621	IO0001
22	AQ SPEED	C0 8.77708E-02 C1 9.86428E-02	YG6992 Prop 52245

4.3 Navigation System

4.3.1 GPS System

The GPS system was installed on 27 May 1992 (day 148) and logging started at 1150h; data was then recorded continuously until 24 June 1992 1000h (day 176). During the passage from Brest to Ponta Delgada it was discovered that the GPS software was producing an incorrect Julian day number (i.e. not accounting for the leap year). The program was corrected during the port call and logging restarted at 0000h on day 153 with the correct Julian day. At 1800h on day 153 the antenna was moved two meters to allow crane movement. There were two occasions when the PC software crashed, but both were quickly noticed and little data was lost. Daily plots were produced using the reduced data set records stored on floppy disk which did not show any gaps in the data set. Satellite coverage appeared to be very good, with few periods when the three or more satellites required for position fixing could not be tracked.

4.3.2 Compass

The KVH compass was logged for the same period as the GPS (see 4.3.1). Self calibration was performed by the compass periodically throughout the cruise even though no specific 'compass rose' was made by the ship. There appeared to be no problems with the ships heading data logged.

4.4 Ships Electromagnetic Log System

An RS 232 output of the ships electromagnetic log and Gyro compass, from the ships navigation system, was provided producing one data value per second. Initial attempts to read the data on an NEC 286 failed, but no problems were encountered when the Tandon 386 was used. Software was then developed on board to read and average the data to produce one minute means, which were recorded to floppy disk. There were some problems with the software for averaging the ships heading until 5 June 1992 (day 157) at 2025h when the program was finally modified with a correct averaging routine. Data before this date can be corrected by comparison with other navigation data to determine the correct quadrant for the heading and applying a correction to the data logged as in the wrong quadrant. There were no problems with logging the speed data, although only longitudinal speed was provided without any transverse information (as the ship system was not working correctly). Logging continued until 24 June 1992 (day 176) at 0713h.

4.5 Sonic Anemometer System

The Solent sonic anemometer (serial no.038) was mounted to the top of the 10 metre mast which was erected while in port on day 146. The sonic anemometer was thus well exposed 16.5 meters above sea level.

Data logging started on day 148 at 12:10 hrs and consisted of 4, 10 minute data acquisition periods, followed by 5 minutes of data processing, each period starting on each quarter hour. The acquisition cycle starting at 30 minutes past the hour was sampled at 56 Hz, for the other three acquisition periods data were sampled at 21 Hz.

For the 21 Hz sampling the values of U, V, W, and C were processed in 15 sections of 1024 points using an fast fourier transform routine, this produces 256 power estimates which are summed over the 15 sections. For 56 Hz sampling 26 * 1024 samples of 6 transit time counts are processed.

Data files produced are:-

time.PRN saved to hard disk and floppy. Files consists of 256 frequencies along with the corresponding $\log_{10}$(PSD*freq^5/3)

time.MWS saved to hard disk and floppy. Files consist of mean windspeed and mean $\log_{10}$ (PSD*freq^5/3) over specified frequency range.

time.RAW saved to WORM optical disk drive. Data produced by acquisition program Fastcom.exe.

During day 149 (May 28 1992) it was discovered that the new disk inserted at 0000h had the incorrect software version and was not writing to optical disk. This was corrected at 0610h and the system started writing to the optical drive. During the afternoon the system crashed a number of times requiring a complete system reboot, sonic and PC, and then the time set on the PC. At 17:25 FFTSET.EXE was replaced with FFTSET.NCK; a version without the routine which resets the PC time, as it was thought that this might be the cause of the problem. The PC and sonic still occasionally crashed but it appeared to be less frequently. This problem occurred throughout the cruise resulting in some data loss, particularly during the return passage to Brest. Apart from the occasional bad spectrum giving 'domain square root errors', the sonic system worked well and there seemed to be little noise in the spectra.

Logging ran continuously while at sea, and was only stopped for the periods when Le Suroit was in port: logging was terminated on day 176.

4.6 SIL Microwave Radiometer

On reaching Ponta Delgada the SIL radiometer was mounted on the ships starboard rail on the foredeck. This gave the radiometer a clear sea view, forward of the ships bow-wake, for most sea conditions. Logging commenced at 0955h on 31 May 1992 (day 152) and was in operation continuously throughout the first leg. On 7 June 1992 (day 159) at 1445h the radiometer was dismounted from the rail and suspended over a bucket of water to perform a calibration over a range of different water temperatures. Initially the default settings were used to log data, but from day 160 the time between black body calibrations was extended from three minutes to ten minutes. During the second leg the logging also ran continuously, although there were occasions where the weather was severe enough that a plastic bag was placed over the aperture to protect the radiometer from water spray. Logging was terminated on 20 June 1992 (day 172) at 1017h and the radiometer

dismounted from the ships rail and stowed in the lab in preparation for the ship steaming from the working area back to Brest.

The radiometer operated without any detectable problems throughout the entire period of deployment. Changes in the calibration sequences had no detectable effect on the quality of data produced. Clear skies produced sea temperature values within 0.1°C of the bucket temperatures whereas thick stratus produced values of 0.8°C above those of the bucket. The default value for the clear sky temperature was set to 240K throughout the period of data acquisition.

5. SST MEASUREMENT INTERCOMPARISONS

5.1 Bucket Measurements

For much of the cruise bucket SST measurements were taken during the day (0700h to 2300h) when possible and used to validate the alternative methods of sea surface temperature measurement. The three thermometers used were compared in bucket tests and agreed to within reading accuracy.

5.2 MultiMet Soap Measurements

The trailing thermistor SST sensors ("soaps") were compared to the SST bucket thermometer by inserting both thermometer and soap sensor into the bucket. The bucket temperature was read by thermometer at the start of three consecutive minutes, allowing MultiMet to produce two separate minute averages for the Soap temperature. Initially it was discovered that the Soap gave erratic readings, and it was concluded that the Soap probe had a significant thermal heat capacity compared two the amount of water in the SST bucket. There was also a possibility of solar heating of the part of the soap probe that remained out side the bucket. To counter these effects the comparison was performed in the shade and the probe was inserted into the bucket and left to stabilise for 5 minutes before any readings were taken. This procedure produced stable, repeatable readings. Table 4 gives the result of the soap comparison with the thermometer.

TABLE 4 - SOAP SST VALIDATION RESULTS

TIME	BUCKET	SOAP 12
14:25	21.1	21.2
14:26	21.2	21.2
14:27	21.2	
14:57	20.1	20.2
14:58	20.1	20.2
14:59	20.1	
TIME	BUCKET	SOAP 15
13:21	18.9	19.3
13:22	18.9	19.4
13:23	18.8	
14:37	19.3	19.6
14:38	19.3	19.6
14:39	19.2	
TIME	BUCKET	SOAP 16
13:46	18.7	18.8
13:47	18.7	18.8
13:48	18.7	
14:46	19.6	19.6
14:47	19.6	19.6
14:48	19.6	

5.3 SST Radiometer Measurements

The SST measured by the radiometer, soap and thermometer were compared on 7 June 1992 at 1445h. The radiometer was suspended over a bucket of water with the aperture of the radiometer approximately six inches from the water surface. The water in the bucket was about four inches from the rim of the bucket, helping to remove any sky reflections. The water temperature in the bucket was modified by either adding hot water or ice, and this was measured by thermometer and the Soap (serial no. 015). During the period of measurement the water was vigorously stirred for two minutes, while the readings were taken.

Measurements were initially taken using sea water at about 20°C, then ice was added, some readings were taken by the radiometer while ice covered the surface but the actual water temperature was still well above zero. When the ice had all melted the water was thoroughly mixed giving a temperature of about 8°C. Hot water was added to give two further values of water temperature at about 15.5°C and 34°C, the water being mixed each time hot water was added.

Values of SST for the radiometer and Soap were averaged over the two minute periods of vigorous mixing. Table 5 gives the results of the comparison. The soap readings differ significantly from the thermometer and radiometer readings, the reason for this is not known as the soap appeared to be working correctly when deployed.

TABLE 5 - RESULTS OF SST MEASUREMENT COMPARISON

TEMP	RAD	SOAP
0.0	-0.1	-
8.2	8.5	3.2
11.1	11.1	8.0
16.0	16.2	15.7
20.2	20.8	18.8
32.2	33.7	32.0

6. ERS-1 COMPARISONS

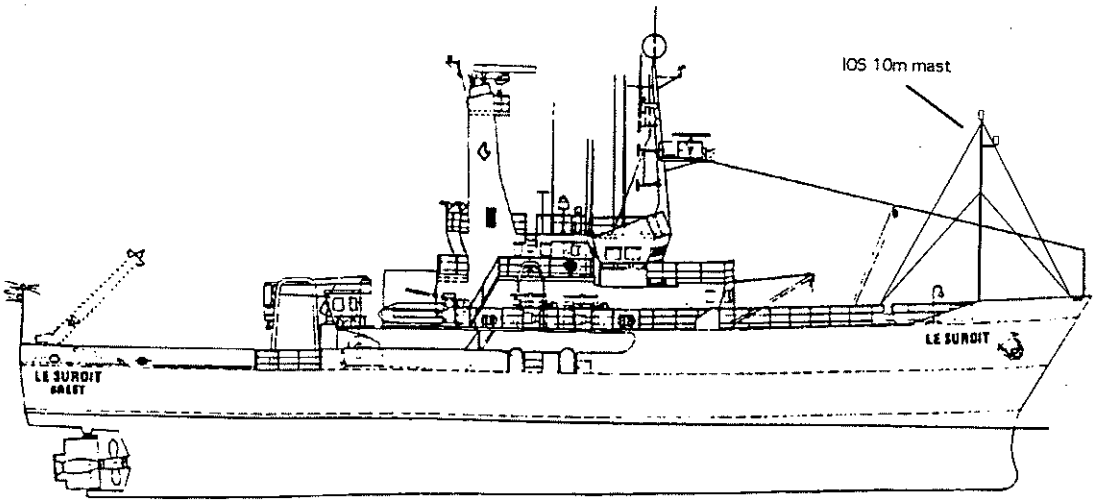
For the first leg of the cruise the times of the ascending passes of the ERS-1 satellite (which occurred near midnight) were 24 hours later than the predicted times being used to schedule the ship activities so we were not always in the desired position for the overpass. Figure 4 shows the ERS-1 orbits for the area and period of the SOPHIA cruise. Table 1 shows the overpass times and the ship position and status at those times.

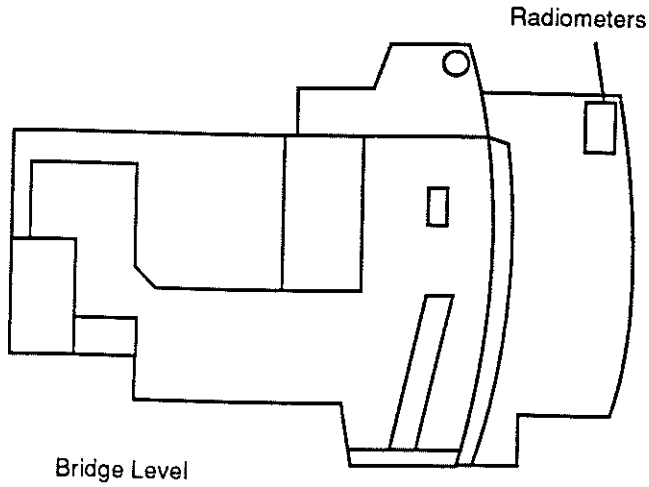
Table 1 - Ship Position and Status for ERS-1 Overpasses

Time	Ship Position	Ship status	Cloud amount
3 June 1992 1230	35 15N 23 40W	Head to wind	3/8
3 June 1992 2345	35 09N 23 59W	Steaming 5 kn	8/8
6 June 1992 1230	35 09N 25 02W	Head to wind	7/8
6 June 1992 2345	35 06N 25 21W	Steaming 7 kn	7/8
9 June 1992 1245	37 01N 24 09W	Head to wind	1/8
9 June 1992 2400	36 35N 23 53W	Steaming 7 kn	4/8
10 June 1992 2330	35 56N 24 10W	Steaming 9 kn	1/8
12 June 1992 1245	37 44N 25 40W	Port - Ponta Delgada	
13 June 1992 0000	37 44N 25 40W	Port - Ponta Delgada	
13 June 1992 1215	37 44N 25 40W	Port - Ponta Delgada	
13 June 1992 2330	37 17N 25 17W	Steaming 6 kn	8/8
15 June 1992 1300	37 43N 26 19W	Head to wind	8/8
16 June 1992 0015	37 07N 25 43W	Head to wind	8/8
16 June 1992 1215	36 30N 24 03W	Head to wind	3/8
16 June 1992 2330	35 54N 24 28W	Steaming 7 knots	8/8
18 June 1992 1300	36 02N 23 57W	Head to wind	7/8
19 June 1992 1230	36 24N 25 09W	Head to wind	3/8
19 June 1992 2345	36 33N 24 07W	Head to wind	2/8

7. ACKNOWLEDGEMENTS

The Institute of Oceanographic Sciences would like to thank the Principal Scientists for the SOFIA Project, all the participating scientists and technicians, the officers and crew of Le Suroit and all those who supported the cruise work. IOS participation in the cruise was partially funded by the Ministry of Agriculture Fisheries and Food. The Weather Log charts for May and June 1992 are used by permission of the Royal Meteorological Society.





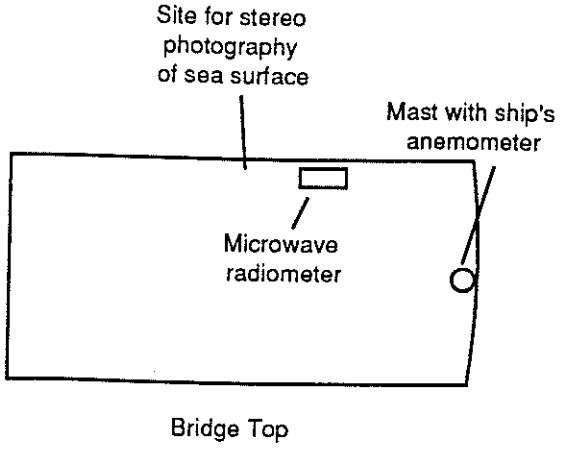


Figure 1 - Instrument Locations on Le Suroit for SOFIA Cruise

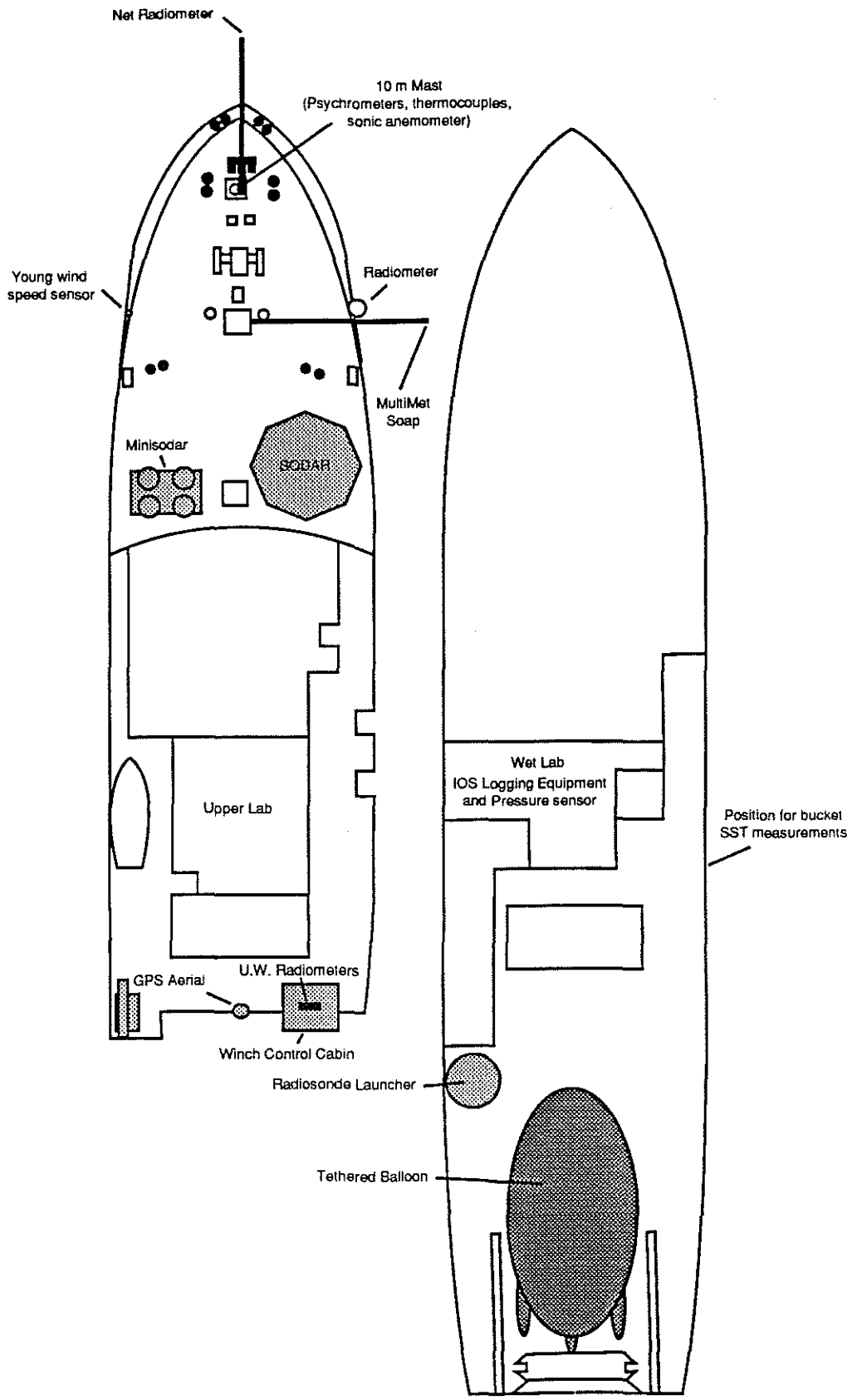


Figure 1 - Instrument Locations on Le Suroit for SOFIA Cruise

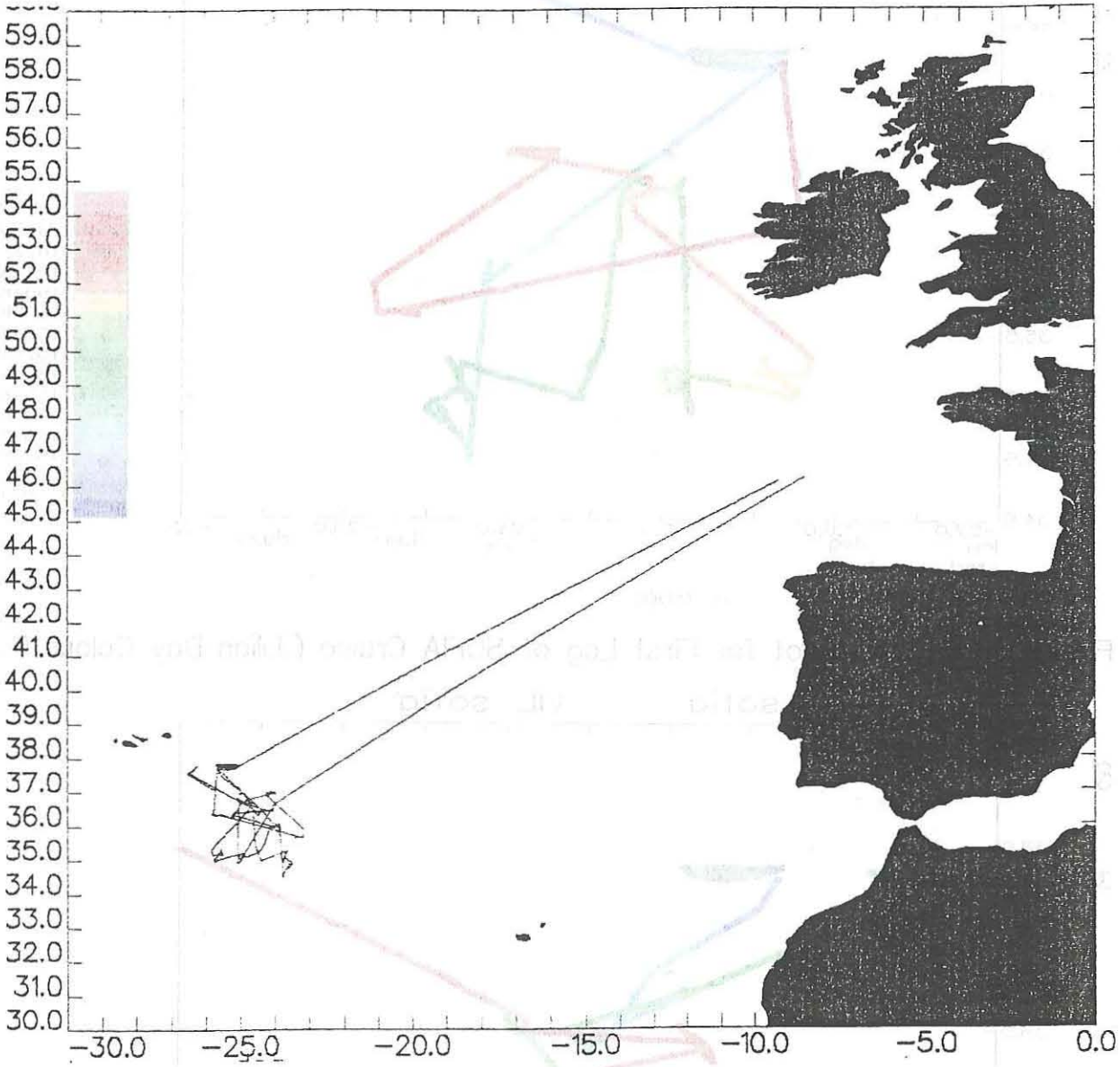


Figure 2a - Track Plot for SOFIA Cruise

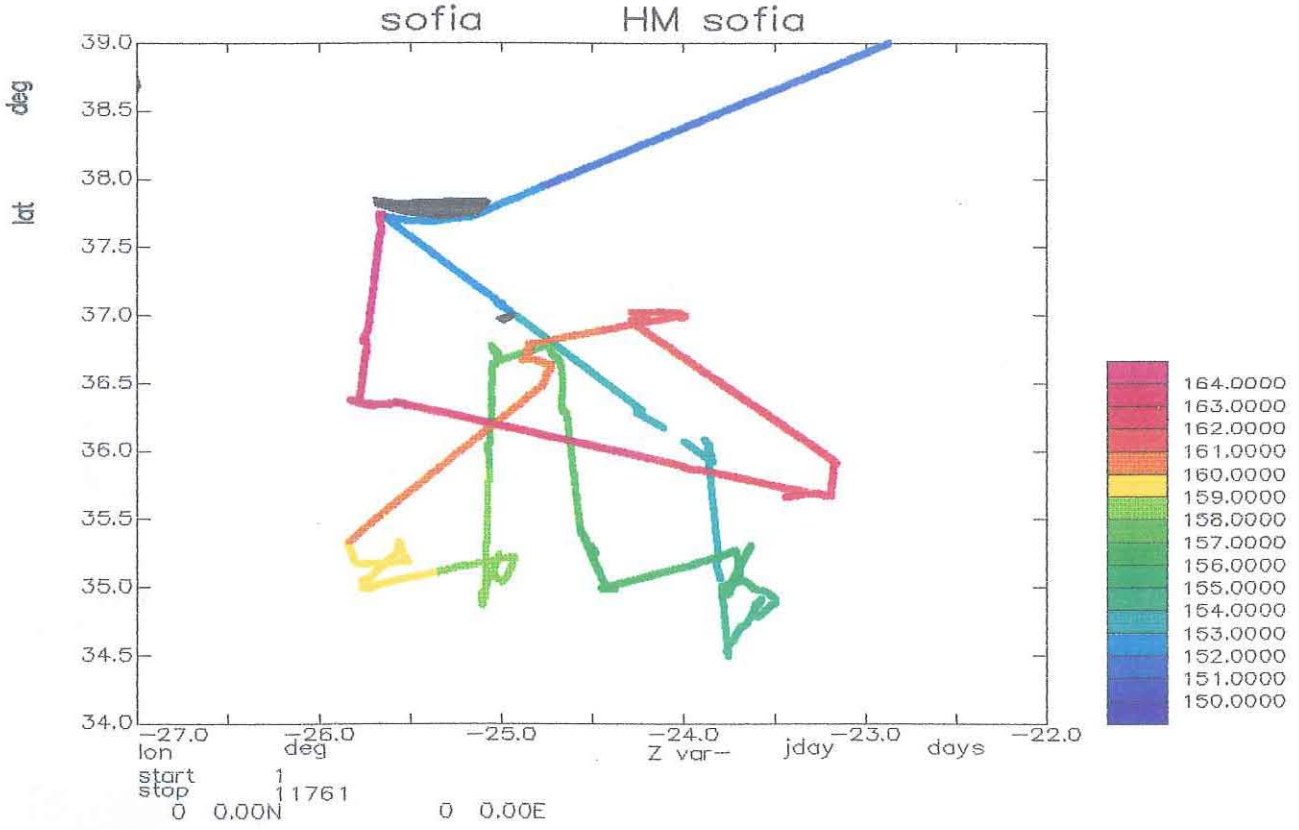


Figure 2b – Track Plot for First Leg of SOFIA Cruise (Julian Day Colour Coded)

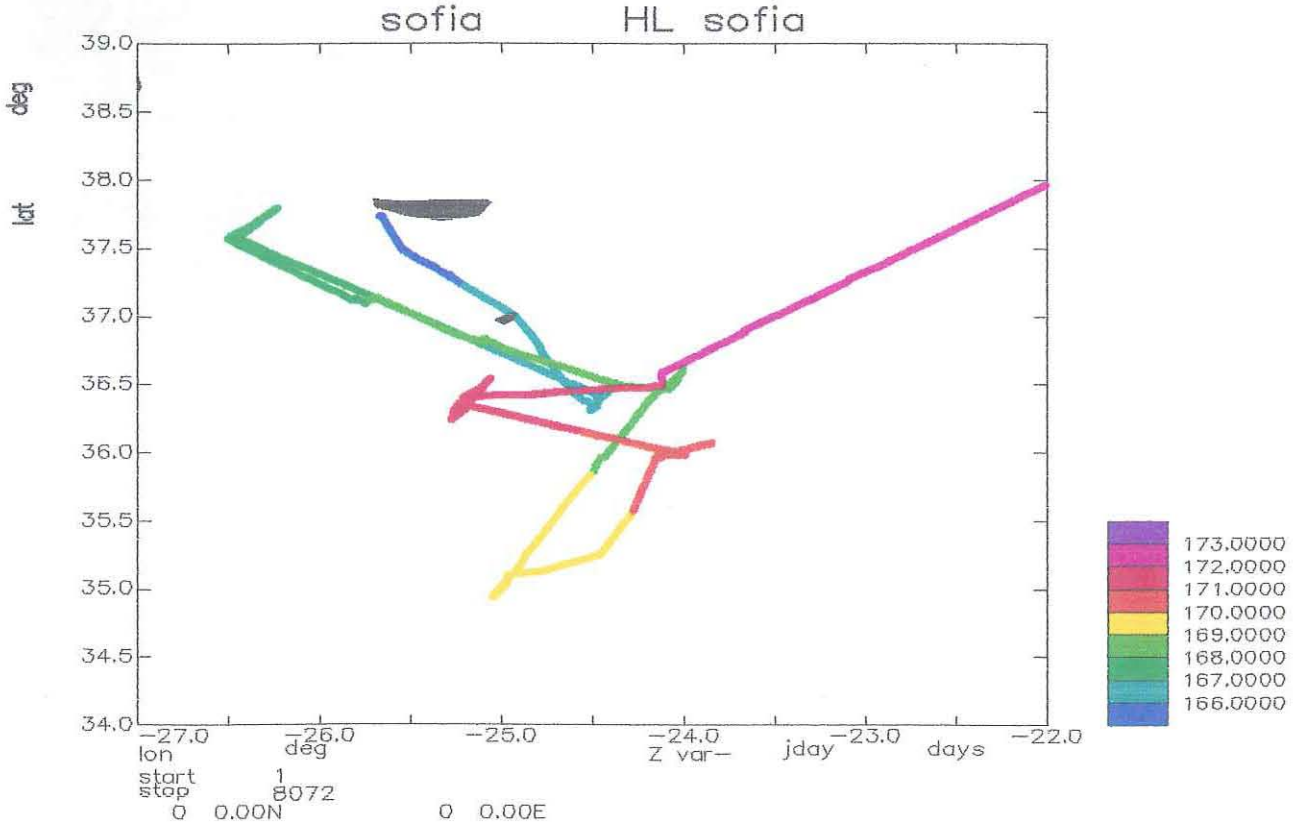


Figure 2c – Track Plot for Second Leg of SOFIA Cruise (Julian Day Colour Coded)

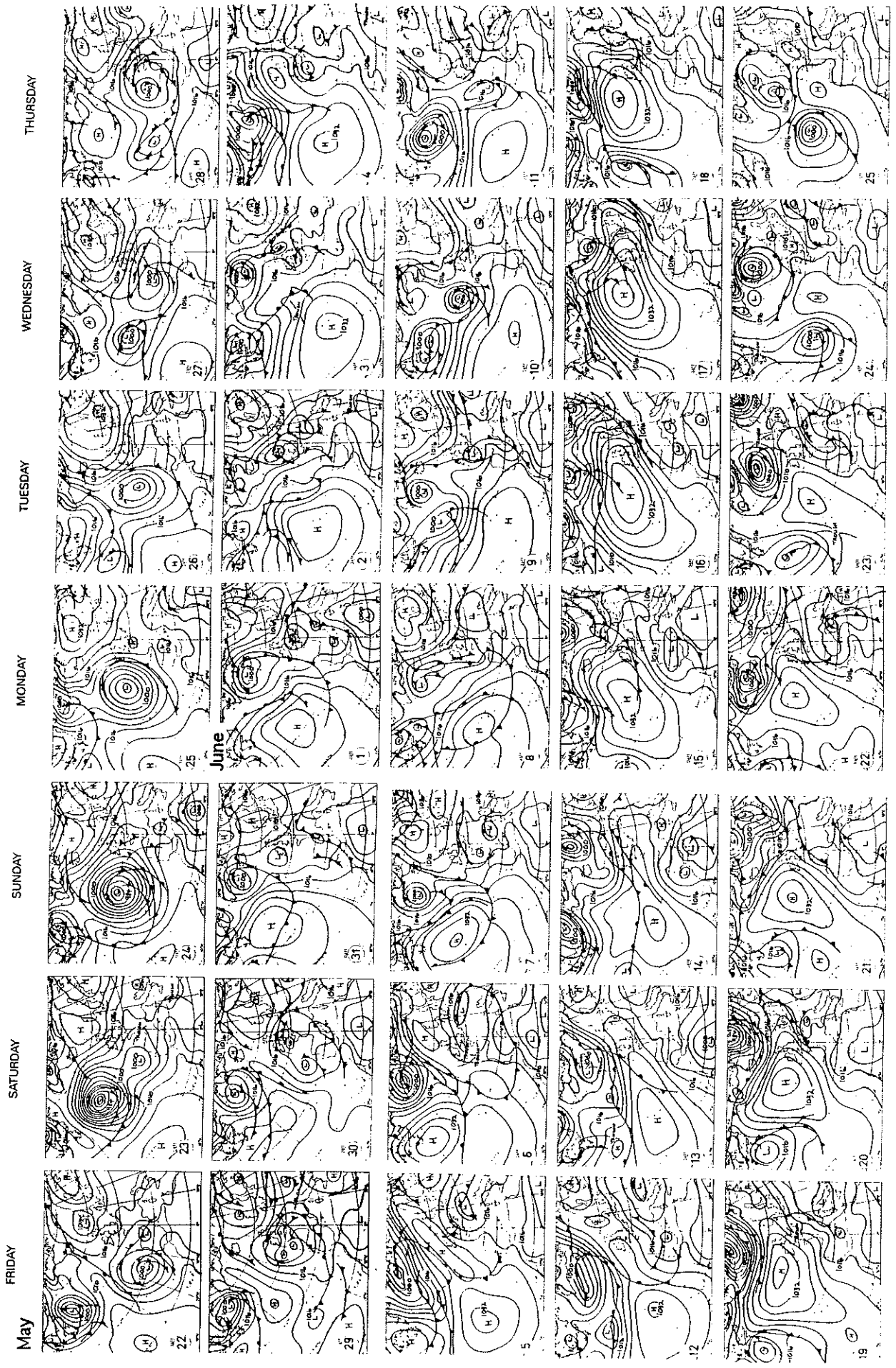


Figure 3 - Weather Maps from Weather Magazine for Period of SOFIA Cruise

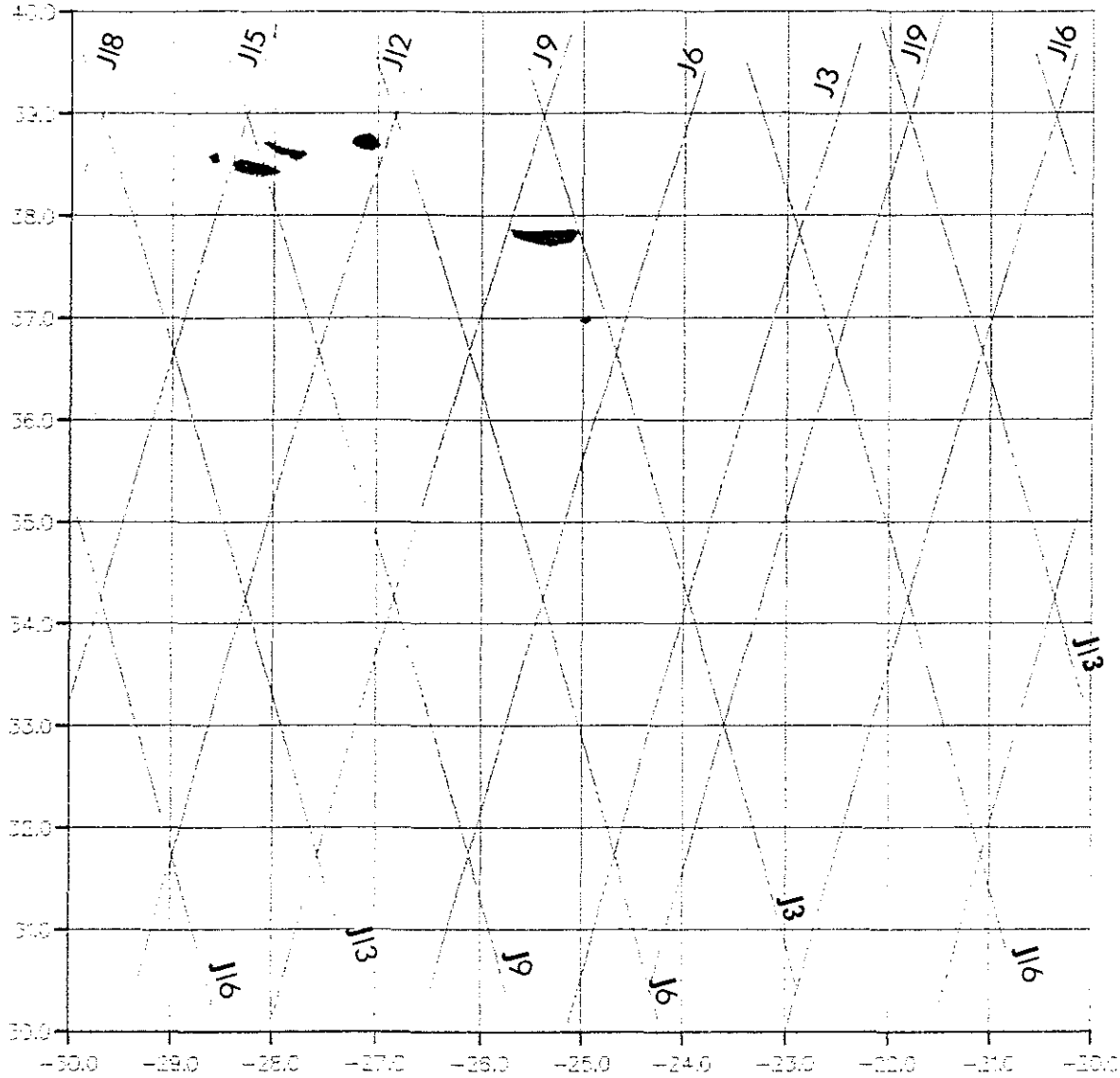


Figure 4 - ERS-1 35-day Repeat Orbits for Region and Period of SOFIA Cruise

APPENDIX 1

DIAGRAMS SHOWING STATUS OF IOS INSTRUMENTATION ON SOFIA CRUISE

Each page shows a block diagram indicating the status of the ship and IOS instrumentation for two days of the cruise.

26 May 1992 (147)

	147	0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head															234										Steaming to Ponta Delgada
	speed															10 knots										
GPS																										
Compass																Compass heading displayed on screen - data not logged										Still on Cumulus calibration
em-log																										
sonic																										Fastcom display running but data not logged
multimet	Td port															MDisplay running but data not logged - sensors appear to be OK										Serial no. 1059
	Tw port																									
	Td stbd																									Serial no. 1065
	Tw stbd																									
	press																									Serial no. API0001
	soap																									
	Young																									
Met obs																										
Radiometer																										

27 May 1992 (148)

	148	0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	234																								Steaming to Ponta Delgada
	speed	6 - 10 knots																								
GPS																										Logging to floppy - jday one day out (ie logged as
Compass																										147, really day 148) Robin has corrected data
em-log																										
sonic														started to log sonic data		sonic hung on rebooting fftvga6 run from floppy by mistake										checked writing to optical drive, no raw data written
multimet	Td port	MDisplay running																								to optical by fftvga6, PRN files copied from hard disk
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap																		soap in lab		soap logged but on foredeck					Serial no. 15 (ele 41)
	Young																									
Met obs																										
Radiometer																										

28 May 1992 (149)

		149 0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	234																								Steaming to Ponta Delgada
	speed	10 - 12 knots																								
GPS																										
Compass																										
em-log																										logged time one day early as GPS
sonic		using fltvga6															changed program to fltwl.ngc doesn't update time									645-1545 sonic hanging, problem updating time?
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap	soap logged but on foredeck																								soap on deck
Met obs																										
Radiometer																										

29 May 1992 (150)

		150 0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	234																								Steaming to Ponta Delgada
	speed	10 - 12 knots																								
GPS																										Logged time still one day early
Compass																										
em-log																										Logged time still one day early
sonic																										5pm cable to optic drive dislodged; couldn't write data
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap	soap logged but on foredeck																								Soap still on foredeck
Met obs																										
Radiometer																										

30 May 1992 (151)

		151 0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	234																								Steaming to Ponta Delgada
	speed	10 - 12 knots																								
GPS																										jday one day early
Compass																										jday one day early
em-log																										jday one day early
sonic																										sonic hung at 1535
multimet	Td port															Physical data not logged to disk as we looked at relative humidity channels; data is available from raw logged data if required											
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap																									soap on deck; awful test cal at 1012, interference?
Met obs																										
Radiometer																										

31 May 1992 (152)

		152 0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	240-260									Ponta Delgada												140			
	speed	11 knots dropping gradually to 4 knots																					10 - 12 knots			
GPS																										Jday corrected at midnight
Compass																										Compass self calibrated by 1700
em-log																										Jday corrected at midnight
sonic																			fastcom display							logging restarted at midnight
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap	soap on foredeck																				soap on foredeck				
Met obs																										
Radiometer																										radiometer logging with default settings

1 June 1992 (153)

	153	0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	140								head to wind									160 - 200			180				on station at 35°55N 23°50W
	speed	10 - 12 knots								~ 2 knots									6 knots			10 knots				
GPS																										18:10 moved antenna 2m (away from crane)
Compass																										jday correct (also for GPS)
em-log																										jday correct; program kept crashing (/0)
sonic																										had crashed; restarted 0646
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap	soap on deck																								soap out of water @13:56 and 17:12
Met obs										SST																
Radiometer																										bad cals at 13:30, C130 overpass?

2 June 1992 (154)

	154	0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	190								head to wind									120-300			head to wind			300 - 340	
	speed	9 knots								~ 2 knots									6-8 knots			2 - 4 knots				
GPS																										crashed at 00:18
Compass																										
em-log																										program mods to update jday correctly
sonic																										14:37 noticed pc had hung
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap																									radio interference on soap
Met obs																										
Radiometer																										default values

3 June 1992 (155)

		0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
155																										
Ship	head	340		280	turning		20	200-340	head to wind								220		head to wind				260			
	speed	3 knots			3-5 knots		2-3 knots	4 knots	3 knots								9 knots		3 knots				4 knots	7 knots		
GPS																										
Compass																										
em-log		lost most of the days data as power loss to the tandon caused it to reboot twice																								
sonic																										
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap																									occasional transmission interference
Met obs									SST			SST			SST	SST		SST	SST							
Radiometer																										

4 June 1992 (156)

		0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
156																										
Ship	head	260					100	300	head to wind										180		head to wind					
	speed	5 - 6 knots				4 knots		3 knots										9 knots		3 knots					4-6 knots	
GPS																										
Compass																										
em-log																										program mods to do vector average correctly
sonic																										clock reset 16:43
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap																									some interference
Met obs									SST				SST		SST	SST		SST	SST		SST	SST		SST	SST	
Radiometer																										

5 June 1992 (157)

		0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
157																										
Ship	head	000								head to wind			260		head to wind				100							
	speed	7-8 knots			11 knots					2 - 3 knots			8-9 knots		0 - 3 knots				6 - 8 knots				10 - 11 knots			
GPS																										
Compass																										compass autocal
em-log																										another program mod for averaging
sonic																										10:44 time reset; 13:30 & 15:00 hung
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap					soap on deck																				
Met obs												SST		SST	SST	SST		SST	SST		SST	SST				thermometer broken after 0600 ob
Radiometer																		radiometer settings changed; 10m between cals								

6 June 1992 (158)

		0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
158																										
Ship	head	190					140				head to wind						160 - 220			head to wind				260		
	speed	10 - 12 knots					7 kn				2 - 4 knots						6 - 8 knots			3 knots				7 knots		
GPS																										
Compass																										
em-log																										crashed at 13:50
sonic																										light rain pm
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap																									16:30 soap out of water for buoy recovery
Met obs									SST	SST		SST	SST		SST	SST		SST	SST		SST	SST		SST	SST	
Radiometer																										

7 June 1992 (159)

		159 0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	380				60 - 320								head to wind					180	280			360			
	speed	7 - 8 knots												2 - 3 knots					9 kn	6 - 8 knots			3 knots			
GPS																										clock reset at midnight
Compass																										
em-log																										crashed 18:00; 19:00 program mod test /0
sonic																										comms problems at 23:00
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap	soap on deck																								soap out of water @18:00
Met obs									SST	SST		SST	SST		SST	SST					SST	SST		SST	SST	
Radiometer																										bucket calibration 14:00 - 15:00

8 June 1992 (160)

		160 0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	040									head to wind				320	head to wind			200 - 260	040			080			
	speed	10 knots									2 knots				8 kn	2 knots			7 knots	3 knots			7 - 8 knots			
GPS																										
Compass																										
em-log																										
sonic																										
multimet	Td port																									carriage down 15:50
	Tw port																									water bottles filled (not empty); fans OK
	Td stbd																									
	Tw stbd																									
	press																									
	soap	soap out of water																								mod to mdisplay to show soap
Met obs									SST	SST		SST	SST		SST	SST		SST	SST		SST	SST				
Radiometer																										10min between cals

9 June 1992 (161)

		161 0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	080				head to wind												100°	head to		160					
	speed	7 knots				~ 2 knots												7 kts	~ 2 knots		8 knots					
GPS																										
Compass																										
em-log																										
sonic																										comms error 0645
multimet	Td port																Carriage down									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap																									Collecting buoy 1500
Met obs										SST		SST	SST		SST	SST		SST	SST		SST	SST		SST	SST	
Radiometer																										Default values

10 June 1992 (162)

		162 0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	150							190		Head to wind								080	H to W		300				
	speed	7 - 10 knots							7 knots		2 - 3 knots								5 knots	2 knots		9 - 10 knots				
GPS																										
Compass																										
em-log																										
sonic																										hung 0108, 0910, 1440
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap																					soap inboard				0640 - 0650 collecting buoy
Met obs									SST	SST		SST	SST		SST	SST		SST	SST		SST					
Radiometer																										10 min between cals; disk full 2130

11 June 1992 (163)

	163	0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	300								head to wind									120	Head to Wind		020				Steaming to Ponta Delgada
	speed	10 - 12 knots								~ 2 knots									7 kn	2 - 3 knots		9 - 12 knots				
GPS																										
Compass																										
em-log																										
sonic																										rebooted 0645, 2148
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap	soap on deck																						soap & pole inboard		
Met obs									SST	SST		SST	SST		SST	SST		SST	SST							
Radiometer																										cals every 10 min

12 June 1992 (164)

	164	0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	020								Ponta Delgada																
	speed	10 - 11 kn			6 - 8 kn				5 kn																	
GPS																										
Compass																										
em-log																										stopped logging 0919 in port
sonic										fastcom																stopped logging 0919 in port
multimet	Td port																									
	Tw port									CARRIAGE DOWN																
	Td stbd																									
	Tw stbd																									
	press																									
	soap	soap on deck																								
Met obs																										
Radiometer																										cals every 10 min

13 June 1992 (165)

		0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	PONTA DELGADA																		140 - 180						Steaming to Santa Maria
	speed																			6 - 10 knots						
GPS																										
Compass																										
em-log																										1803 started logging
sonic		fastcom																								reset time 1759, rebooted 2016 & 2032
multimet	Td port	Logging but carriage down																								Carriage up 1520
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap	soap on deck											comp. of soaps													soap 16 deployed 1820
Met obs												SST		SST								SST		SST	SST	
Radiometer																										10 min betwen cals

14 June 1992 (166)

		0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	140 - 160										head to wind						240		head to wind		320				1520 getting buoy, steaming to landsat pass
	speed	6 - 9 knots										2 knots						9 knots		2 knots		8 - 11 knots				
GPS																										
Compass																										
em-log																										
sonic																										hung 1220
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap																					soap on deck				
Met obs									SST	SST		SST	SST		SST	SST		SST	SST		SST	SST		SST	SST	
Radiometer																						covered with bag				10 min between cals

15 June 1992 (167)

		167 0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	320								Head to wind								240			140				HW	Head to wind at midnight for ERS-1 overpass
	speed	9 - 11 knots								2 - 3 knots								9 -10 knots			9 - 11 knots				1-3k	
GPS																										
Compass																										
em-log																										
sonic																										sonic hung 1040, 1605
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap																				soap on deck					
Met obs										SST		SST	SST		SST	SST		SST	SST		SST	SST		SST		
Radiometer		covered with bag																								

16 June 1992 (168)

		168 0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	HW	120 - 140										Head to wind					230	HW	220						
	speed	1-3k	7 - 11 knots										2 - 3 knots					7 - 8 kn	3 kn	7 - 9 knots						
GPS																										
Compass																										noted new cal 976 @ 1510
em-log																										
sonic																										rebooted at 1350
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap		soap on deck																							soap 12 deployed at 1500, soap 14 at 2030
Met obs		SST						SST	SST		SST	SST		SST	SST		SST	SST		SST	SST		SST	SST		
Radiometer																										

17 June 1992 (169)

		0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
	169																									
Ship	head	220 - 240								040	Head to wind					260	Head to wind					040				
	speed	7 - 9 knots									2 - 4 knots					6 kn	3 - 5 knots					5 - 7 knots				
GPS																										
Compass																										noted compass cal 977 @ 1834
em-log																										
sonic																										
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap									soap out of water												soap out of water				bucket soap cal at 0930
Met obs									SST	SST		SST	SST		SST	SST		SST	SST		SST	SST				
Radiometer										bag over end												bag over end				

18 June 1992 (170)

		0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
	170																									
Ship	head	020 - 040					H to W	250	Head to Wind									260	Head to Wind			300 - 310				
	speed	3 - 6 knots					2 - 3 kn	4-6k	1 - 3 knots									8-9 kn	1 - 3 knots			6 - 9 knots				
GPS																										
Compass																										
em-log																										
sonic																										rebooted at 0020, 1504, 1808, 2116
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap		soap on deck																							
Met obs									SST	SST		SST	SST		SST	SST		SST	SST		SST	SST				
Radiometer		plastic bag over end																								logging restarted 1848 with new settings

19 June 1992 (171)

		171 0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	300					210	05 0	21	Head to Wind								200							HW	Head to wind for ERS-1 overpass at midnight
	speed	6 - 8 knots					4 kn		6kn	2 - 3 knots								10 - 11 knots							3 kn	
GPS																										
Compass																										
em-log																										
sonic																										rebooted 0545, 1430, 2259
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap																									
Met obs									SST	SST		SST	SST		SST	SST		SST	SST		SST	SST		SST	SST	~ 1000 soap failed, put in water @ 2338 for ERS-1
Radiometer																										

20 June 1992 (172)

		172 0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	HW	060																							Steaming for Brest 1430
	speed	1kn	7 - 8 knots								5 knots	7 kn	10 knots													
GPS																										
Compass																										
em-log																										
sonic																										
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap																									
Met obs			SST						SST	SST		SST														
Radiometer																										1017 logging stopped

21 June 1992 (173)																									
	173	0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	060																								
	speed	7 - 9 knots																								
GPS																										
Compass																										
em-log																										
sonic																										rebooted 1420 and 2242
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap																									
Met obs																										
Radiometer																										
22 June 1992 (174)																									
	174	0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	060																								
	speed	8 - 10 knots																								
GPS																										
Compass																										
em-log																										
sonic																										rebooted 0630, 0735, 1620 and 1904
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap																									
Met obs																										
Radiometer																										

23 June 1992 (175)

		175 0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	060																								
	speed	9 - 11 knots																								
GPS																										
Compass																										
em-log																										
sonic																										rebooted 0830
multimet	Td port																									1249 disconnected young wind sensor
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap																									
Met obs																										
Radiometer																										

24 June 1992 (176)

		176 0000h	0100h	0200h	0300h	0400h	0500h	0600h	0700h	0800h	0900h	1000h	1100h	1200h	1300h	1400h	1500h	1600h	1700h	1800h	1900h	2000h	2100h	2200h	2300h	Notes
Ship	head	060																								
	speed	10 - 11 knots																								
GPS																										
Compass																										
em-log																										
sonic																										
multimet	Td port																									
	Tw port																									
	Td stbd																									
	Tw stbd																									
	press																									
	soap																									
Met obs																										
Radiometer																										