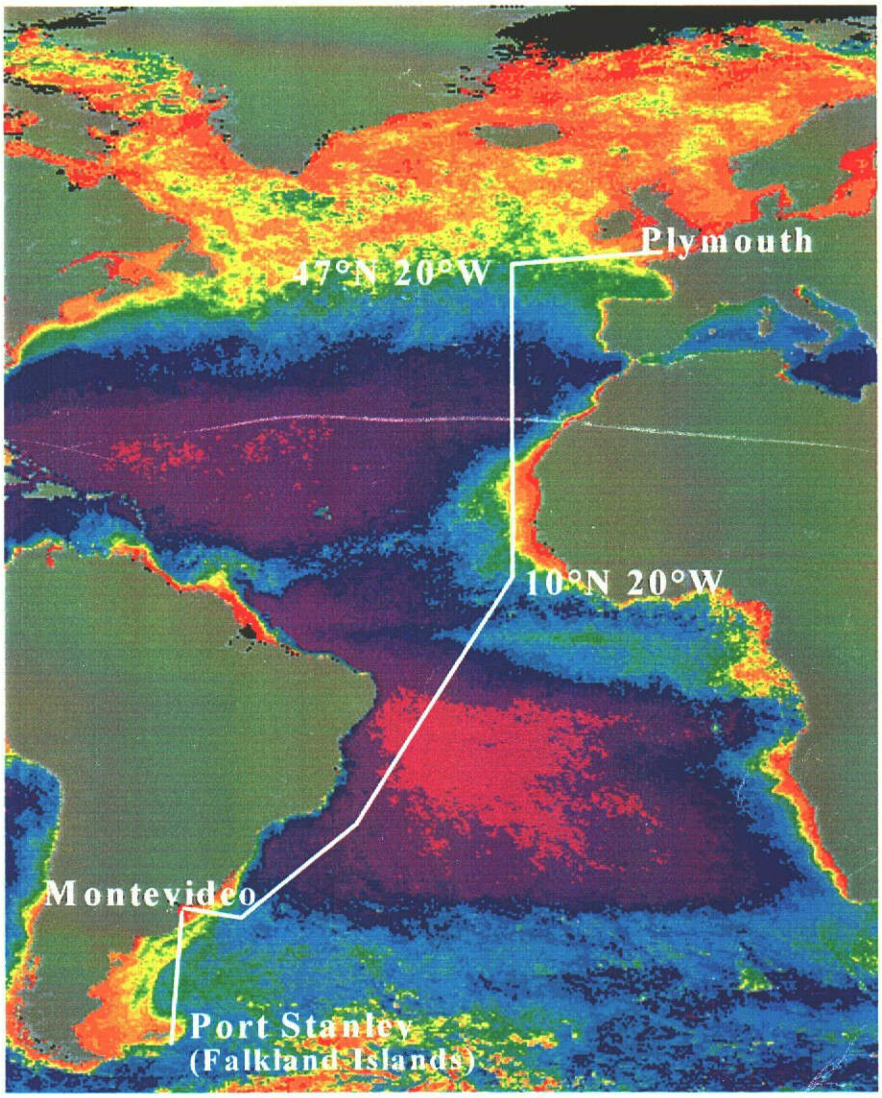
ATLANTIC MERIDIONAL TRANSECT (AMT)



AMT-4 CRUISE REPORT

Atlantic Meridional Transect

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cruise period
21st April - 27th May 1997

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Acknowledgements

The AMT has been underpinned financially by the NERC Centre for Coastal and Marine Science (CCMS). The AMT programme scientists are grateful to the Director of CCMS, Prof. Brian Bayne, for this support and for his personal endorsement of the AMT programme, and would like to extend our best wishes for his retirement. We also thank Prof. Fauzi Mantoura, (Director PML) for his commitment and support for the AMT programme.

The AMT programme is grateful to the Directorate at the British Antarctic Survey (BAS), Drs. Barry Heywood and Dougal Goodman, and their staff both at Cambridge and at sea. Particular thanks go to Frank Curry, John Hall, David Blake, Graham Hughes, Ian Collinge, Kath Nicholson, Mary Sutton, Prof. Andrew Clark and Dr Julian Priddle at Cambridge. Everyone associated with the AMT programme would like to wish Dr Heywood well for his forthcoming retirement.

The AMT-4 passage was unique so far in being the first to achieve continuous underway sampling along the meridional track. This was only possible because we were given diplomatic clearance to sample in Cape Verdes waters by the Authorities there. The AMT programme is extremely grateful to the Cape Verdes Authorities and looks forward to further co-operative exchange.

The National Aeronautics and Space Administration (NASA) of the USA supported the programme with equipment and funding from the Sea-viewing, Wide-Field-of view Sensor (SeaWiFS) project.

The AMT4 team would like to acknowledge Drs. Roger Harris and Jim Aiken, Dave Robins and numerous colleagues at PML for their encouragement and practical support prior to and during the voyage. We are also extremely grateful for the sterling support at sea provided by Paul Woodroffe (CTD operator and electronics engineering) and Simon Wright (Deck Engineer) of BAS and Paul Duncan of RVS (computing support). As on all the previous AMTs, Malcolm Woodward at PML has co-ordinated Plymouth logistics with the Cambridge operation and we are grateful for his input.

Finally, though already alluded to, the AMT Programme Steering Group and the scientific party on AMT4 would like to extend their gratitude to Captains Chris Elliott (Falklands to Montevideo) and Jerry Burgan (Montevideo to UK) and their respective teams for their professional and positive support throughout the voyage.

1. Rationale and Objectives

Background

The Atlantic Meridional Transect (AMT) was conceived as a means of acquiring a time series of oceanographic, biological, chemical and optical data over large latitudinal ranges (50^{o} N to 50^{o} S) and through a number of contrasting oceanographic provinces. The core scientific objectives are to refine our understanding of the role of the ocean biota in the biogeochemical processes which influence carbon fluxes and ultimately global climate and to develop remotely-sensed measurements of global primary production.

The AMTs take advantage of the twice yearly passage of the NERC vessel, RRS James Clark Ross, operated by the British Antarctic Survey, during its passage to and from Antarctica each year. Since the only ship costs involved are to cover the time required for course deviations and station work, the AMT is a highly cost-effective project for fundamental marine science. AMT-4 is the fourth Atlantic transect in the current series.

Objectives

The AMT forms a significant component of two NERC PRIME Special Topic projects; P19: 'The optical characterisation of zooplankton in relation to ocean physics; discrimination of seasonal, regional and latitudinal variations' (Robins, Harris & Pilgrim) and P20: 'Holistic biological oceanography: mesoscale to basin-scale and seasonal studies of phytoplankton processes linked to functional interpretation of bio-optical signatures and biogeochemistry' (Aiken and Holligan). In addition, through international collaboration, the AMT also forms a component of the calibration and validation of the NASA SeaWiFS and NASDA ADEOS /OCTS programmes as well as providing input to SIMBIOS, a programme to develop the methodology and operational capability to combine data products from various ocean colour missions. In the longer term, the AMT project aims to contribute to the refinement of global (basin scale) primary production and ecosystem models which will be important for our ability to predict climate change. The specific objectives of AMT-4 remained similar to previous transects:

- To improve our understanding of the relationship between physical processes and biological production.
- Identify, define and quantify latitudinal changes in biogeochemical provinces.
- Determine phytoplankton characteristics and photosynthetic parameters.
- Identify nutrient regimes and their role in biogeochemical cycles.
- Characterise plankton community structure, including the accurate determination of carbon values (to JGOFS protocols).
- Relate the partial pressure of CO_2 (pCO_2) in surface waters with the biological production.
- Acquire data for the calibration of remotely sensed observations (primary validation).

- Secondary validation of remotely sensed products (e.g. chlorophyll concentration).
- Interpret basin-scale remote sensing observations.
- Develop models that enable the interpretation of satellite imagery in terms of total water column properties.

2. Cruise Personnel

Plymouth Marine Laboratory:	TONY BALE CHRIS GALLIENNE * COLIN GRIFFITHS GERALD MOORE JAMES WOOLFENDEN MALCOLM WOODWARD* RACHEL WOODD-WALKER
NASA, USA:	STANFORD HOOKER STEVEN SMITH
University of Lille, France:	SYLVIE CARLIER
University of Oviedo, Spain:	IGNACIO HUSKIN NATALIA GONZALEZ-BENITEZ
University of Vigo, Spain:	MARIA-JOSE PAZO FERNANDEZ
Southampton Oceanographic Centre:	DAVID SUGGETT
University of Southampton:	MIKE ZUBKOV
British Antarctic Survey (ISG):	PAUL WOODROFFE
Research Vessel Services (ISG):	PAUL DUNCAN

* STANLEY TO MONTEVIDEO

(NB postal addresses, phone/fax numbers and e.mail addresses are given in Appendix A)

3. Itinerary, cruise track and sampling strategy

Itinerary

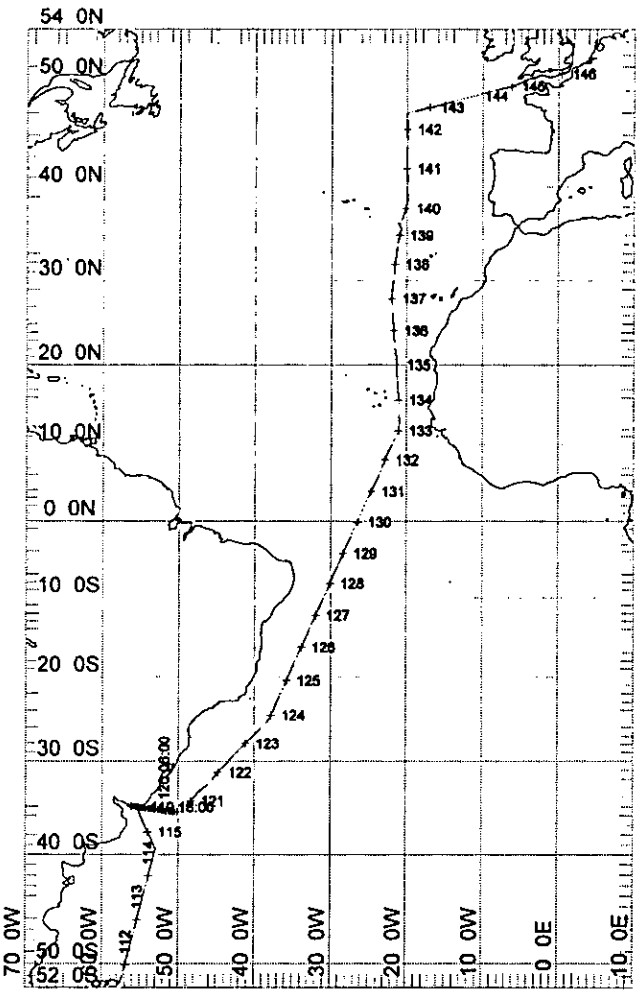
17th April	-RAF flight to Mount Pleasant, F.I.
18th	-joined RRS James Clark Ross
19th	-commenced installation of scientific equipment
21st.	-sailed 08:00
22nd	-first station (SDY, 111)
24th	-last station off Montevideo (SDY, 114)
26th	-docked Montevideo
29th	-sailed Montevideo (new crew)
30th May	-first station north of Montevideo (SDY, 120)
22nd	-47°N x 20°W (SDY, 142)
25th	-off Start Point (SDY, 145), overflight 1
26th	-off Thames (SDY, 146), overflight 2, end science.
27th	-docked Grimsby and demobilise

Cruise track and sampling strategy

The *RRS James Clark Ross* left Port Stanley in the Falkland Islands on April 21st and sailed for Montevideo staying outside Argentinean territorial waters (see Figure 1). From Montevideo the course was about north east to a point at 10°N by 20°W. Thereafter the course was basically northerly with only minor deviations as required to stay outside of territorial waters off Senegal, the Canaries and Madeira. At the next major waypoint, 47°N 20°W, the course was altered for the Western Approaches and the English Channel. A track was then taken along the South Coast of England as far as Start Point where the morning station was synchronised with airborne remote sensing with the NERC aircraft. Underway sampling was completed at Start Point and the vessel then crossed the Channel to join the east-going shipping lane for the passage to Grimsby. Once through the Dover Straits the James Clark Ross sailed north along the East Coast of England. A limited station (optics only) was worked off the Thames Estuary on the morning of May 26th, again in conjunction with the NERC aircraft. This station concluded the scientific work and all scientific equipment was packed and crated for transport. The James Clark Ross docked in Grimsby early on May 27th and the scientific personnel disembarked during the early afternoon on the same day.

Stations

On each day at sea a morning station was started at 10:00h and, at best, took 1 hour to complete. At each station, the vessel was hove to and generally two bottle casts were made to 200m. On the first cast bottles were fired at typically 5 depths to provide water for zooplankton samples and related experiments and for the primary production work. The sampling depths were chosen primarily by reference to the CTD fluorometer mounted on the optical profiling rig (SeaOPS). A second cast with 10 depths was then made to provide water for pigments, microbiology and nutrients. Where possible, the depths of the pigment samples were chosen to be consistent with those employed for the production measurements.



MERCATOR PROJECTION

GRID NO. 1

SCALE 1 TO 75000000 (NATURAL SCALE AT LAT. 0)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

RRS James Clark Ross AMT4 Cruise Track

Figure 1. Mercator projection of the Atlantic showing the cruise track for AMT4 with the location on each day superimposed as SDY.

Simultaneously with CTD casts, vertical hauls were made to 200m for zooplankton from the forward crane and an optical cast was carried out from the aft telescopic crane. We requested that the ship was orientated, when possible, with the sun on the starboard quarter to minimise the effect of ship shade on the optical results. In addition to the wire-deployed light meters, a free-fall light meter and tethered surface reference meter (NASA) were deployed on most stations and a surface up- and down-welling spectrometer (NASA) was deployed on a number of stations. Various ancillary observations (e.g. sea and sky photographs) were also taken on each station.

Approximately every other day, a short optical station (15-30 minutes) was carried during the afternoon. For the first half of the cruise this was alternated with oxygen analyses (filling the oxygen bottles put an extra half hour on the basic morning station time) so the average station time per day was kept at about 90 minutes. North of the Equator the station work was intensified (we had been allocated two extra days of station time over previous AMTs -see Appendix B) and on some days, depending on sun/sky conditions and/or environmental factors, the morning station was extended to 2 or 3 hours to allow extra optical measurements and instrumentation comparisons to be made over local noon. During the more intensive station work, afternoon stations were routine and extra night stations for zooplankton net deployments and CTD profiles were implemented. These were generally started at 22:00h and lasted 1-2 hours depending on the depth to which the CTD was deployed.

At a number of the night stations between 33^{o}N and 47^{o}N, the CTD casts were made to 2000m for physical oceanographic purposes and during the extended morning stations the extra time available was also used to make deep CTD casts. A list of the times and positions of all the stations is given in Appendix C and as a station-event/time map in Figure 2. The bottle firing depths for each CTD/rosette cast are given in Appendix D. The samples taken were used for a number of determinations which are covered in the individual reports. The scientific bridge log recording the timing and order of all scientific operations is given in Appendix E.

Underway

The underway measurements included salinity, temperature and fluorescence which were measured using flow through sensors supplied by the uncontaminated sea water supply drawn from a nominal depth of 7m below the hull. These data were logged continuously to the Level C computer system. The inherent optical properties of the water were monitored using an AC-9 system fed from the sea water supply and logged to PC. In addition, meteorological, environmental and navigational data were also logged continuously to the scientific computer.

At intervals, generally between the morning and afternoon stations, or until 17:15h if the afternoon station was missed, an Undulating Oceanographic Recorder (UOR) instrumented with CTD, F, transmissometer and up- and down-welling Satlantic light meters, was towed at passage speed. However, extended tows (20-30h) were made through the equatorial upwelling and across the shelf break in the Western Approaches. Radiometer measurements were made from the fore deck (SIMBAD) and from the Bridge roof (NASA) to measure sea surface reflectance for comparison with satellite-derived data and to study atmospheric influences on ocean colour. A log of meteorological conditions recorded at 4-hourly intervals is given in Appendix F

AMT-4 Station event -position/time map

SDY	am	pm	night	[redacted]	location/latitude
148	unloaded scientific equipment				
147	docked Grimsby and disembarked				
146	57				overflight: off Thames Estuary
145	56				overflight: off Start Point
144	55				
143	53	54			
142	51	52			47.0°N
141	48	49	50		
140	45	46	47		
139	D 42	D 43	D 44	[redacted]	36.5°N
138	D 37	D 38	[redacted]		33.5°N
137	34	35	D 36		
136	32		D 33		
135	29	30	D 31		
134	27	28			
133	26		25		
132	23	24			
131	22				
130	21		20		Equator
129	18	19			
128	16	17			
127	15				
126	14				
125	13				
124	12				
123	10	11			
122	9				
121	7	8			
120	6				35.5°S
	Montevideo port-call				
114	5				
113	4				
112	2	3			
111	1				51.0°S
110	mobilisation, Stanley				
109					

Figure 2. A time-event plot of stations occupied on AMT4. Numbers identify stations. Stations where deep CTD profiles (> 300m) were carried out are prefixed with the letter D.

In addition to the continuous measurements, a number of discrete samples were taken from the pumped supply at various time intervals (see Appendix G). These were analysed for major nutrients and chlorophyll, and samples were stored for pigments, iodine/iodate determination (Oxford Brook University) and for bacterial enumeration (see below). Samples were also taken from the sea water supply and from CTD bottles for accurate measurement of salinity using the Guildline Autosal precision salinometer on board. These data were used to check the calibration of the Neil Brown conductivity sensors on the CTD and SeaBird sensors on the flow through system. Precision thermometers were deployed with the CTD and used to check the temperature of the effluent from the SeaBird thermosalinometer in order to check the temperature responses.

AMT-4 was unique so far for two reasons. Firstly, the Cape Verdes authorities granted permission for RRS James Clark Ross to sample in their territorial waters. Previously, there had always been an area between The Cape Verdes and Senegal, where the territorial waters were adjacent, and where, without diplomatic clearance, we had been unable to sample for some 300 nautical miles. This time, by remaining in Cape Verdes waters, we were able to make an unbroken sampling transect from Stanley to the English Channel (approximately 50°S to 50°N). Secondly, shortly before sailing we were advised that we had been awarded two extra days ship time through the generous offices of the NERC Centre for Coastal and Marine Science (CCMS). This allowed more stations to be occupied (and thus greater spatial resolution) and also longer time to be spent on station (allowing much higher quality data acquisition) and realisation of greater sampling depths which was valuable for physical studies of oceanographic features in the Canaries-Azores region.

4. Specific cruise reports and preliminary results

4.1 Water chemistry and biogases

4.1.1 Iodine/iodate analyses

Tony Bale, Plymouth Marine laboratory

Samples for iodine-iodate analyses were collected for Dr Victor Truesdale of Oxford Brooks University, Gipsy Lane Campus, Oxford, Headington Oxford OX3 0BP. Iodine in sea water exists as iodate and iodide and is transmuted by microbiological activity though the details of the mechanism are still unknown.

Replicate 15ml tubes were flushed and filled from the ships pumped supply at about 4 hourly frequency, the sampling times for these are given in Appendix G. All the samples were stored at 4°C and were transported to Oxford for subsequent analysis.

Initial results for iodate (see Figure 3) show that the both data sets (AMT3 and AMT4) are very comparable and show a consistent minimum in centred at about 10°N of the equator.

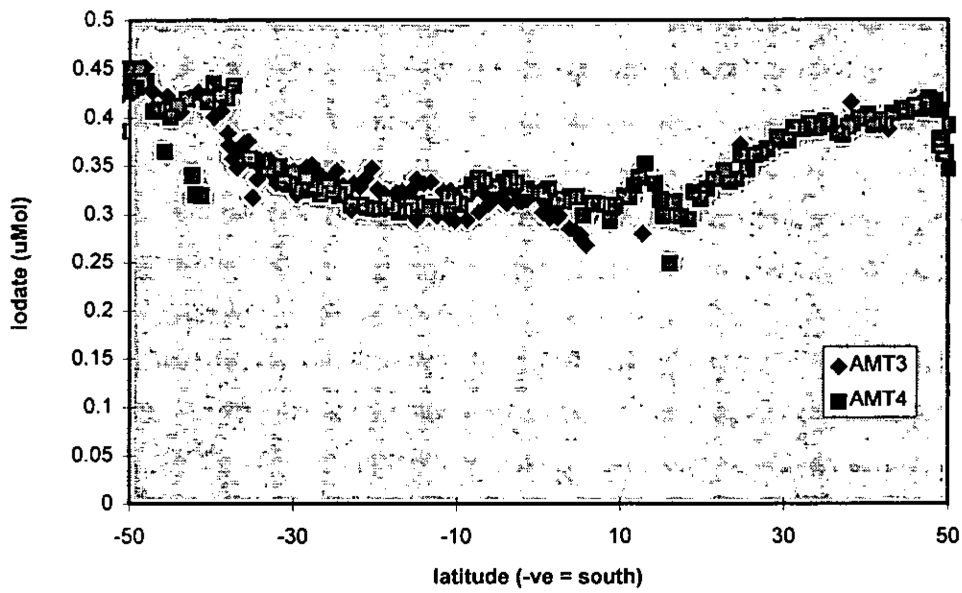


Figure 3 shows a plot of the iodate concentration in μMols obtained on AMT3 and AMT4. The iodate values have been normalised to a salinity value of 35.00 psu.

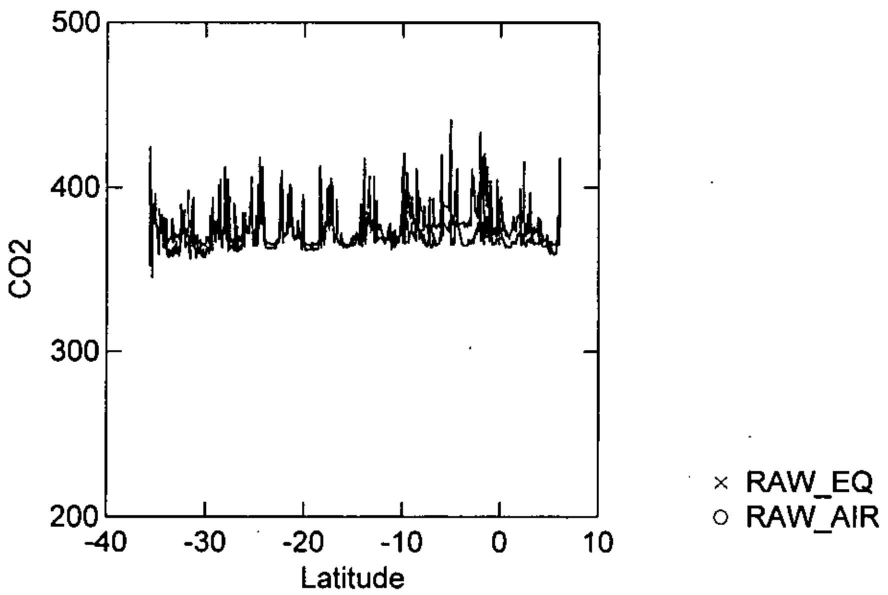
4.1.2 pCO2 analysis

Gerald Moore Plymouth marine laboratory

The CO2 analysis system was commissioned during the call at Montevideo. All gas pipes and the equilibrator were cleaned and checked for flow rate. Refurbished air pumps were fitted, and new standards with values of 424.2 and 241.8 ppm installed.

The system apparently worked without fault, however on analysis of the data, contamination of the results by lab air was found (see Figure 4 below). This was eventually traced to problems with the valve controller. Eventually the Rhopoint IO controller / rs485 system failed. Since there were no spares or circuits for either of these system the system was shut down.

The data may be of some utility for relative CO2 draw down, but the contamination with lab air rules out any quantitative use.



4.1.4 Inorganic nutrient analyses

Tony Bale, Plymouth Marine laboratory

Objective: To determine the concentration of dissolved nitrate, nitrite, silicate and phosphorus in CTD samples in order to contribute to the definition of biological 'provinces' and to support the primary production measurements.

Methods: The concentrations of nutrients were measured colourimetrically using a 4-channel, Technicon auto-analyser with standard methodologies. All depths from the CTD (typically 10) were measured on each cast, generally within 2 hours of collection. Surface samples were not taken from the pumped supply. A total of 35 casts were analysed, 7 of the casts were to depths of 1000m on this voyage whereas previously maximum depths achieved were of the order 200m.

Results: All samples were analysed on board within hours of collection and the data processed to calibrated and salinity-corrected, digital values. The overall patterns were very similar to previous AMT transects. Total nitrogen was only detectable in the surface waters south of Montevideo and north of 47°N. Through the tropics and between these positions, total nitrogen was below detection in the surface waters but could be measured in samples from below the thermocline.

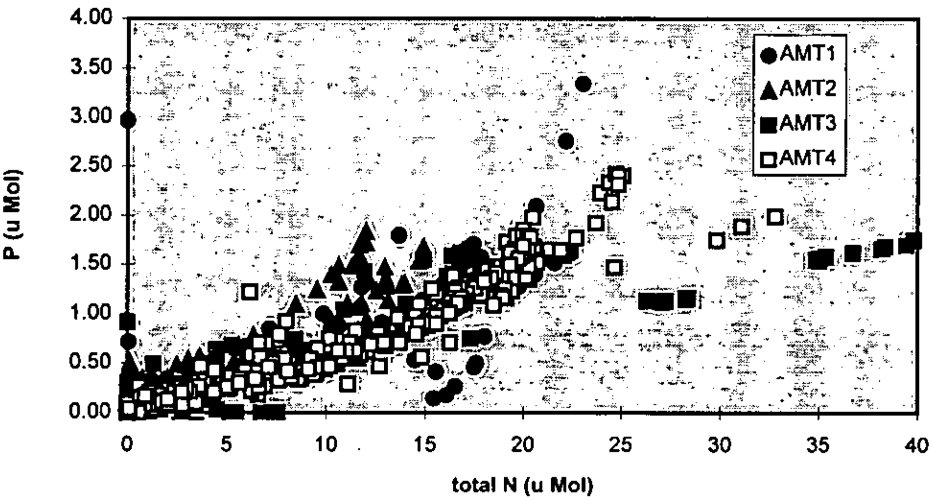


Figure 5 shows AMT4 total nitrogen (nitrate plus nitrite N) plotted against the corresponding phosphorus (phosphate P) values. Open symbols are AMT4 data and solid symbols are from the previous three cruises as identified on the plot.

Although the value of macro-nutrients measured in surface waters are of limited value to biogeochemical studies when the values fall below detection, the data from depth is still useful in the interpretation of primary production. The last four AMT cruises have all been analysed using the same instrument and identical standardisation procedures. Maximum values for all three nutrients were not large during AMT1 because sampling depths tended to be shallower then. However, a plot of the ratio of total nitrogen (μ Mol. N) to total P (μ Mol.

P) obtained on each survey show that all four previous cruises returned similar ranges of values and that the ratios were reasonably consistent. AMT4 data fell within an envelope of all the previous AMT nutrient data when plotted in this way which provides a measure of confidence in the data.

4.1.4 Particle size and numbers

Tony Bale, Plymouth Marine laboratory

Objective To determine particle numbers in the 1.9-60.0μm size range to relate to the IOPs measured by AC-9.

Methods

A standard Coulter multisizer fitted with a 100μm orifice was used to count the particle numbers in the size range 1.9-60.0μm in the surface waters at every station. The sample was taken from the pumped supply while the ship was on station. Calibration of the instrument was checked using 14.02μm latex calibration spheres, supplied and certified by Coulter, and the manometer flow time was calibrated relative to the siphon volume so that particle numbers could be calculated from the sampling time interval (generally 30 seconds). System blanks obtained by passing sea water through a 0.2μm pore-sized filtration cartridge were typically less than 60 particles per ml.

Results

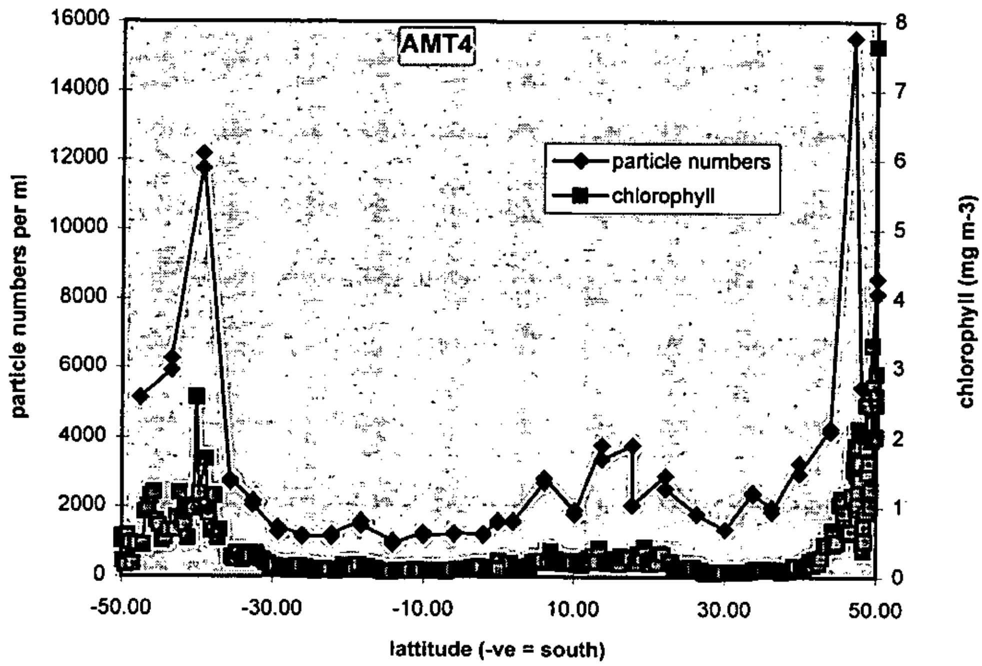


Figure 6 shows particle numbers measured by Coulter Counter as a function of latitude.

The preliminary results obtained are shown in Figure 6 above as numbers per ml against latitude and show a pattern which is closely related to the distribution of surface chlorophyll (super-imposed) as determined from the fluorescence of acetone extracts. The size distribution of the particles measured within the range 1.9-60.0µm was very similar throughout the voyage; the mean value ranged between 3.05 and 3.55 µm and the median between 2.7 and 3.3µm. Mean and median values were well correlated with each other but not with particle numbers.

Particle number and size analyses were also performed on 10 vertical profiles (morning casts on day 131 to day 141) on sub samples of water collected for the AC/9 measurements (Gerald Moore). Particle numbers appeared to co-vary with the chlorophyll distribution.

4.2 Bacteriology and phytoplankton

4.2.1 Microbial web studies: bacterial dynamics

Mike Zubkov , Southampton University

Introduction and objectives

The studies of the microbial community included quantification of two main groups: bacteria (autotrophic and heterotrophic) and bacterivorous flagellates in terms of vertical distribution, biomass, production, and control of bacteria by protozoa.

Bacterioplankton size structure, abundance and production

Generally, the samples from twelve depths were collected daily from CTD casts to provide vertical distribution of picoplankton using flow cytometry. Also the samples collected from these depths were pooled into three integrated samples (on the basis of vertical profiles of temperature, salinity and fluorescence) representative for surface mixed layer, deep chlorophyll maximum layer or layer of hydrophysical gradients and a layer below seasonal thermocline down to 200 or 300 m. Size fractionation of bacteria was used to estimate the biomass of bacterial populations that inhabited these layers. Samples were filtered through Nuclepore filters with pore size 0.4, 0.6, 0.8, 1 and 1.2 µm and filtrates were fixed for subsequent flow cytometry. Production of heterotrophic bacteria was estimated using simultaneous incorporation of ^{3}H-thymidine and ^{14}C-leucine into bacterial macromolecules. The integrated samples were inoculated with radioactive precursors and incubated in the dark at *in situ* temperature. Additionally, the samples from nontoxic water supply system were collected at six hour intervals for flow cytometry.

Abundance of heterotrophic nanoplankton and bacterivory

The samples were collected from the same CTD casts and integrated into three pooled samples to estimate abundance of nanoplankton and common microplankton using epifluorescence microscopy. An acid glucosaminidase assay was employed to estimate the biomass of bacterivorous protozoa. The experiments to study bacterivory in the surface mixed layer were carried out using dilution technique and dual radioactive labelled natural bacterioplankton. The analysis of all collected material and samples will be carried out back in the laboratory.

4.2.2 Phytoplankton distribution, abundance, composition and production. Community net production and metabolicaly fractionated carbon.

Maria Pazo Fernández [1] and Natalia González Benítez [2]
1.-Universidad de Vigo (Spain), 2.-Universidad de Oviedo (Spain)

Objectives

1.-To describe the latitudinal distribution of size-fractionated phytoplankton abundance and taxonomic composition.

2.-To determine the patterns of latitudinal distribution of photosynthetic rate in 3 different size-fractions: picoplankton, nanoplankton and net-plankton.

3.-To characterise the latitudinal and vertical variability in the photosynthetic parameters of the microalgal assemblages and their relationship with the physical and chemical factors.

4.-Production of Dissolved Organic Carbon and determination of Total Organic Carbon in the Azores area.

5.-To determine the community net production and the relationship with the community structure along the latitudinal transect.

6.-To determine the patterns of carbon incorporation into different biomolecules along the surface latitudinal transect.

Methods

Water samples collected from the Niskin Bottles at 5-7 depths on each station were used to conduct a number of different standing stock and rate measurements:-

Size fractionated chlorophyll *a*
Size-fractionated chlorophyll a concentration was determined fluorometrically on a 10 AU Turner Designs Fluorometer after sequential filtration of a 200ml sample through 20µm, 2µm and 0.2µm polycarbonate filters and subsequent extraction in 90 % acetone at - 20°C overnight. The fluorometer had been set up to use the non-acidification technique of Welchsmayer (1994).

Phytoplankton taxonomy
Both formaline and Lugol's iodine samples for microplankton species identification and counting were taken from each station at surface (7m) and from the deep chlorophyll maximum depth. All sampling events and experiments undertaken in this work are tabulated in the log sheets given in Appendix H

Primary production and P/I experiments
Vertical profiles of size-fractionated primary production were obtained from ^{14}C incubations conducted in an on-deck incubator provided with a range of 10 irradiances from 97 % to 1% of Io. Triplicate water samples were contained in 70ml polycarbonate bottles, spiked with 10 µCi NaH^{14}

CO_3 and incubated for 6.5 - 7.5 hours at an irradiance close to that of their original depth, as determined by the optical cast. At the end of the incubations, samples were sequentially filtered through 20μm, 2μm and 0.2μm polycarbonate filters. Filters were exposecd 12 hours to concentraded HCl fumes for removal of inorganic ^{14}C. The radiactivity of each fraction were determinated on a Beckman liquid scintillation counter after addition of 3.5ml scintillation cocktail to each vial.

Photosynthesis-irradiance (P-I) experiments were carried out on a bench incubator equipped with an 100 W halogen lamp which provided a range of light intensities between 5 and 2500μE m^{-2} s^{-1}. At 2 depths (surface and chlorophyll a maximum) at 8 stations along the transect, and at three depths (surface, chlorophyll maximum and an intermediate depth) at 6 stations in Azores area, water samples were collected for P-I experiments. The samples were cooled using the surface water supply and the incubations lasted for 2-2.5 hours. At the end of the incubation, each sample was filtered through 0.2μm polycarbonate filters, decontaminated and counted as described above.

DOC production

At 3 depths on each station in the Azores area, triplicate water samples for the determination of dissolved organic carbon production, were contained in 30 ml glass bottles, spiked with 75 μCi $NaH^{14}CO_3$ and incubated on-deck incubator for 2 hours at an irradiance level close to the original irradiance experienced by the phytoplankton cells. At the end of the incubation 10ml of each sample was filtered by glass microfibre filters (GF/F). After filtration the liquid was acidified with phosphoric acid to pH 2. During 24 hours the samples were stirred for removal of inorganic ^{14}C, and 14 ml of scintillation cocktail was added to each vial and radioactivity determined using a Beckman liquid scintillation counter.

TOC

Samples have been collected for the determination of Total Organic Carbon (TOC) at 10 stations in the CANIGO area (Azores) where Dissolved Organic Carbon production experiments were performed and at 4 night stations. Extremely low particulate organic carbon (POC) levels in open ocean waters prevented us to filter the samples, as contamination during filtration is one of the main sources of error in DOC measurements. Triplicate seawater samples were directly drawn into 10 ml glass ampoules (Ashed 450 degrees, 12 hours). After acidification with phosphoric acid to pH 2, ampoules were heat-sealed and preserved in the dark at 4 degrees, the most convenient and practical method for TOC preservation for long periods. Samples will be analysed in the next few months by the novel High Temperature Catalytic Oxidation (HTCO) technique, at the base laboratory of the Instituto de Investigaciones Marinas (CSIC), in collaboration with the Universidad de Vigo.

Respiration and net production of the planktonic community

Along the latitudinal transect at 3 depths on each station (55%, 1% and maximum of chlorophyll) oxygen samples were taken. The incubation procedure was the same used for primary production. Three kind of experiments with 6 replicates each were performed. One to measure the concentration of the initial oxygen, another for the oxygen respired and the last one for the phytoplankton production. The analysis of the oxygen in the samples was done using the Winkler method. At a limited number of stations in the Azores area, the Winkler titrations were also used to measure the oxygen profile in the deep waters.

Carbon incorporation into biochemical pools

The experiments started at 6 am local time and lasted for 12 and 24 hours. At the end of the incubations, samples were filtered onto GF/F Whatman filters were immediately frozen at -20 C.

The amount of 14C incorporated into the main end- products of photosynthesis was determined using the biochemical fractionation procedure detailed in Marañón et al. (1995). This technique allows partitioning of the newly synthesized material into 4 fractions: proteins, polysaccarides, lipids and low molecular weight metabolites.

Preliminary Results

Results were similar to the obtained during AMT-2 and AMT-3. The vertical distribution of clorophyll a was characterised by the presence of a deep maximum during most of the transect. Lowest values were found in the tropical and subtropical South Atlantic region. In the oligotrophic areas, where phytoplankton abundance was low, most of the chlorophyll a belonged to the picoplankton size class. However, the contribution of large phytoplankton total chlorophyll *a* was high in areas with high levels of microalgal abundance. The latitudinal distribution of total primary production followed in general the same trend as chlorophyll concentration. Picoplankton was the dominant size fraction in terms of productivity during most of the cruise.

Chlorophyll *a* (0.2-2.0μm)

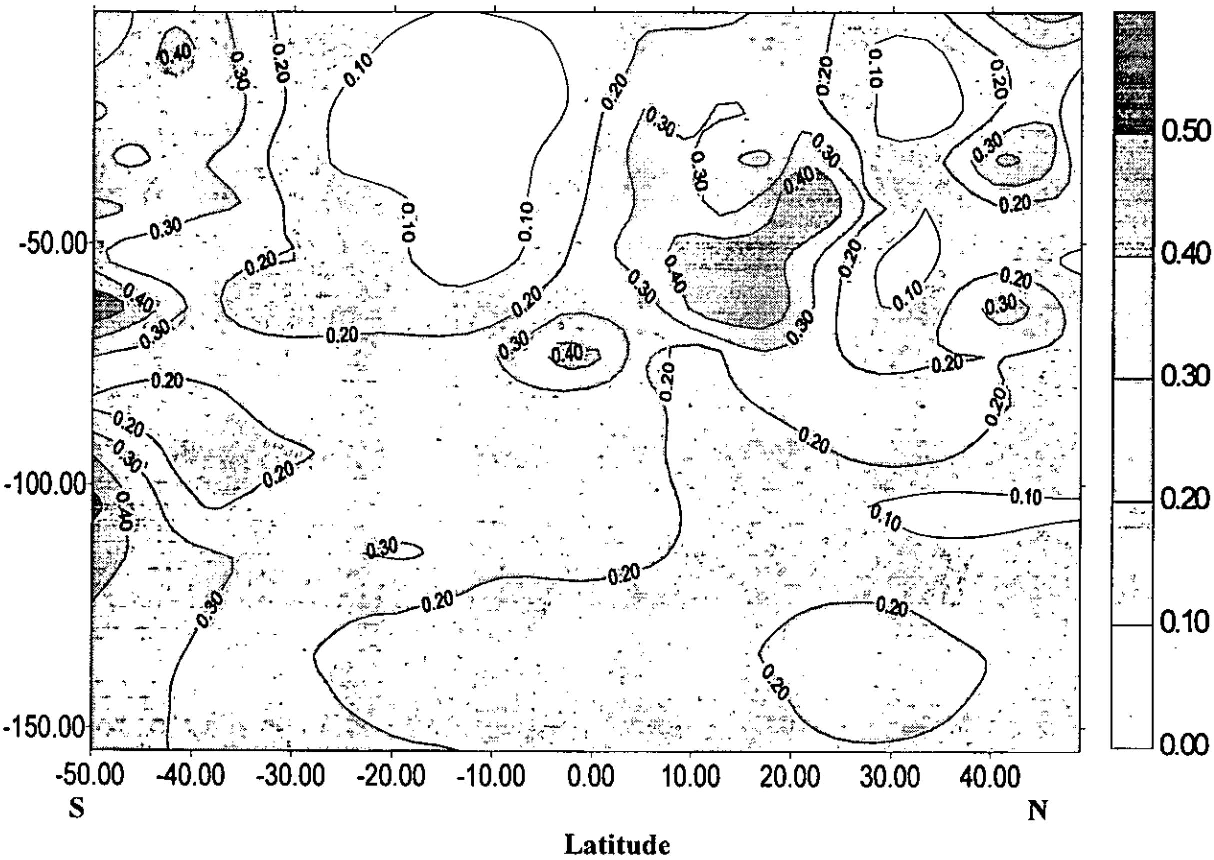


Figure 7 shows a contour plot of chlorophyll a values in the 0.2- 2.0μm size fraction in a frame of water depth (0-160m) and latitude (50°S to 50°N)

Chlorophyll *a* (total)

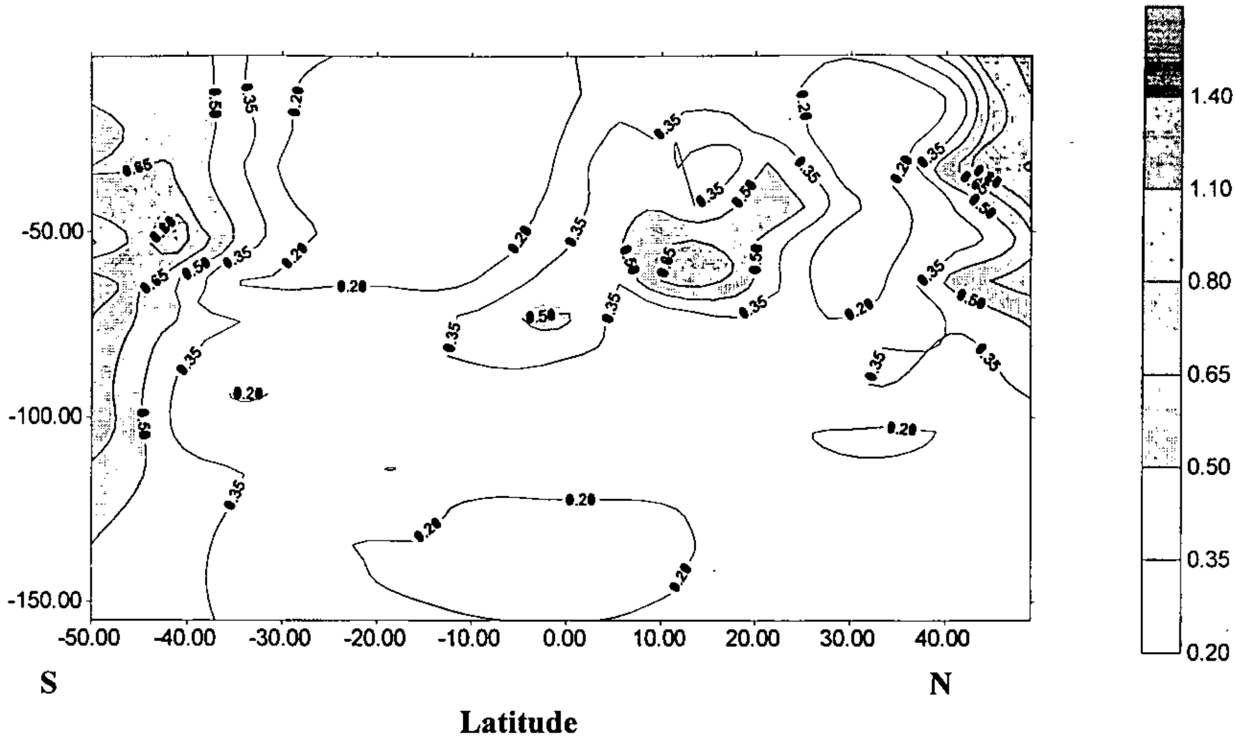


Figure 8 shows a contour plot of total chlorophyll a values in a frame of water depth (0-160m) and latitude (50°S to 50°N).

Picoplankton (0.2-2µm) prodution (mgC m^{-3} h^{-1})

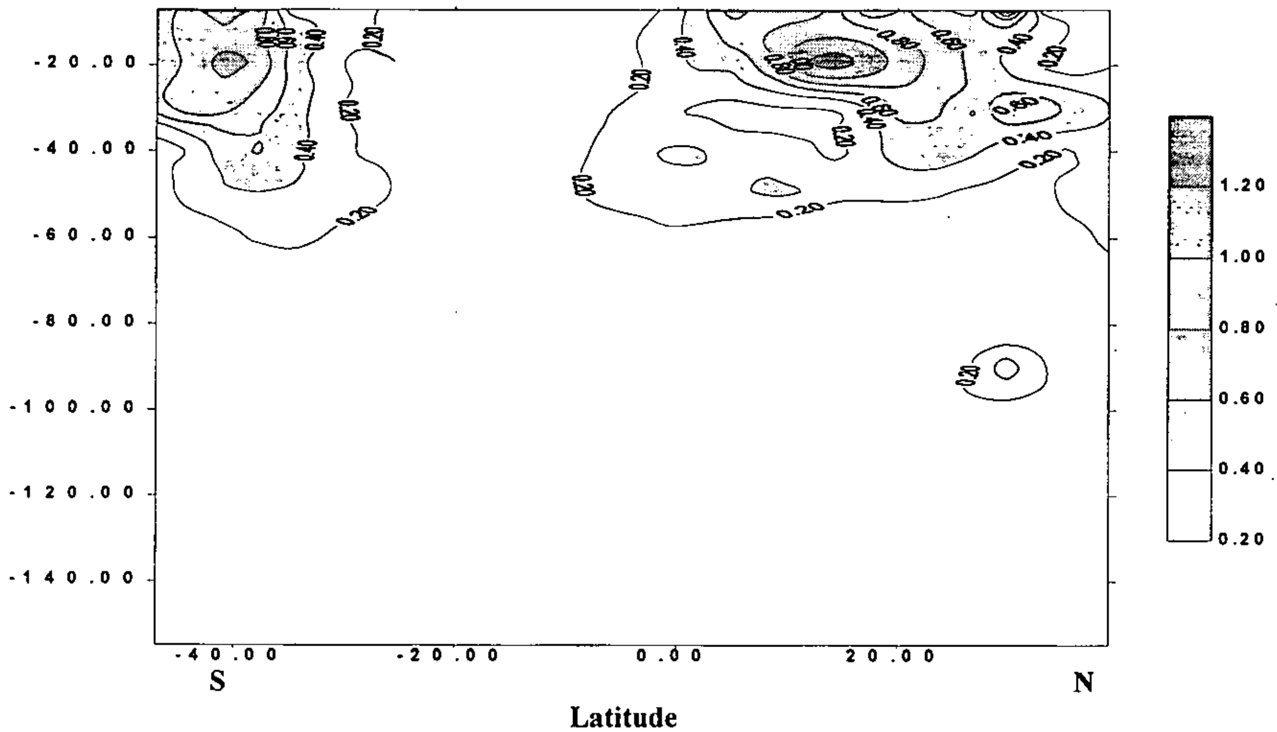


Figure 10 shows a contour plot of picoplankton (0.2-2µm) primary production values in a frame of water depth (0-160m) and latitude (50°S to 50°N).

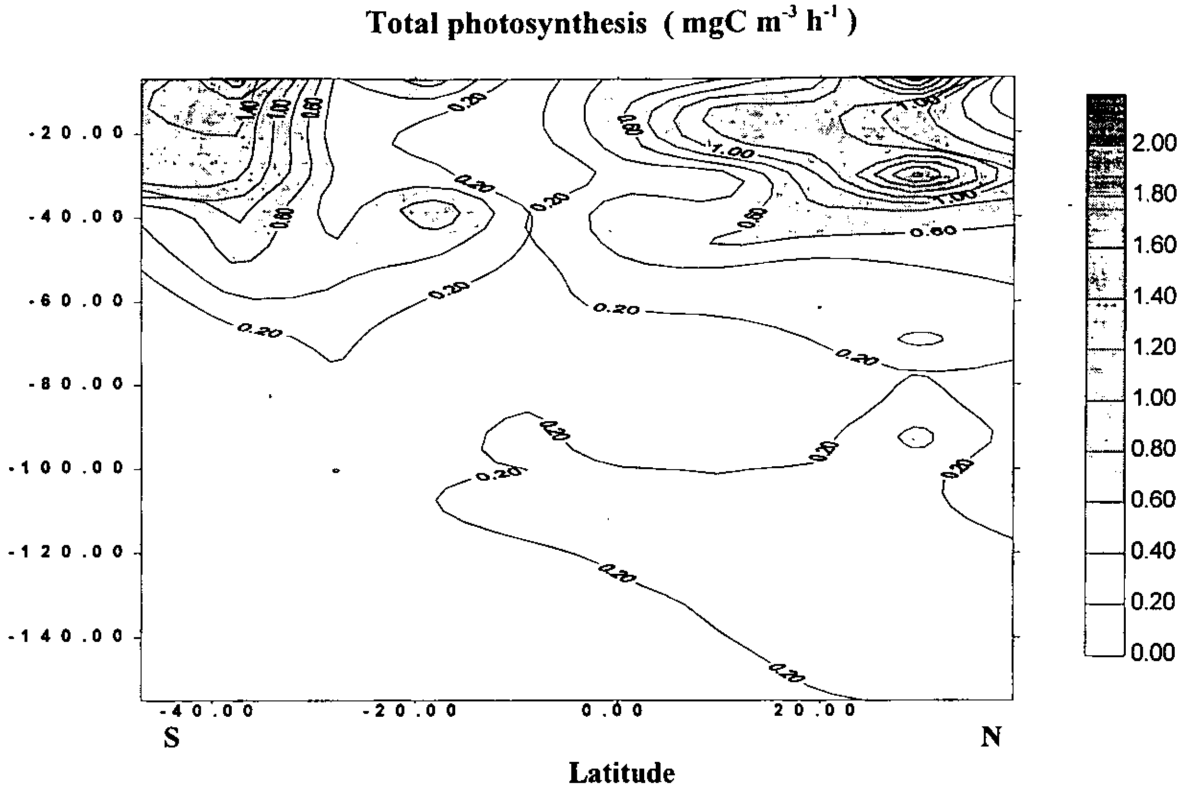


Figure 11 shows a contour plot of total photosynthesis values in a frame of water depth (0-160m) and latitude (50ºS to 50ºN).

4.2.3 Phytoplankton pigment distributions

David Suggett, Southampton Oceanographic Centre

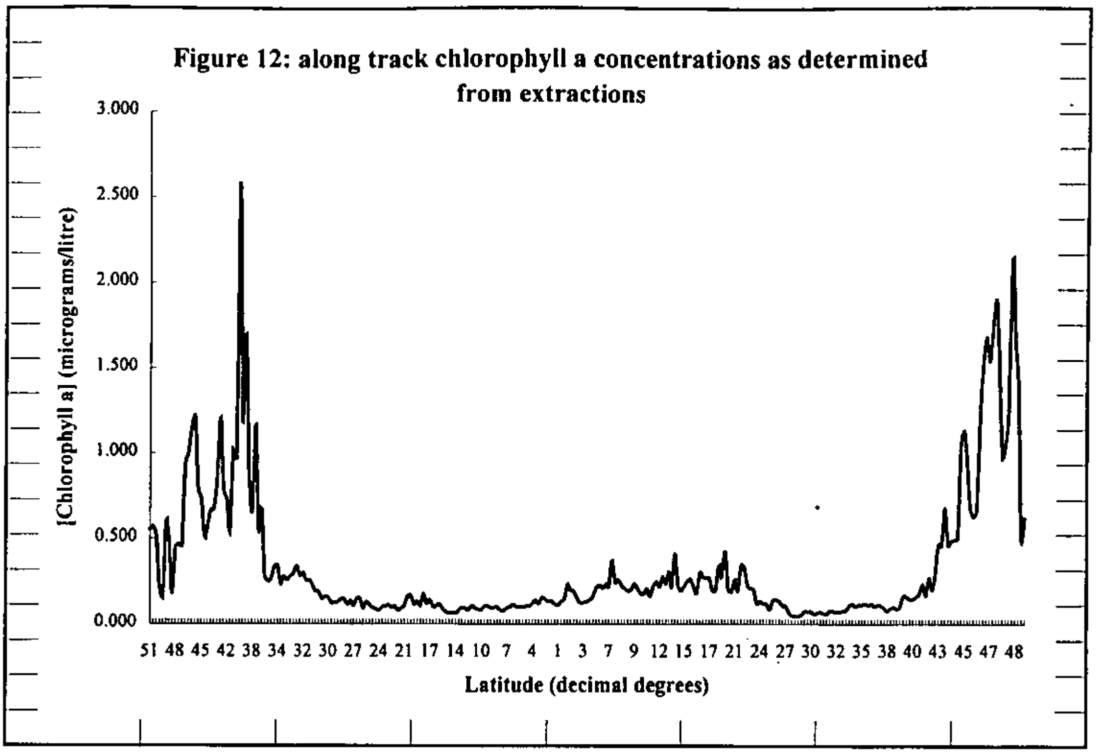
Water was drawn from the non-toxic sea water supply every 2 hours in order to determine the concentration of chlorophyll and to collect material for the future determination of pigments by HPLC. All water was collected into a 10 litre container and subsequently transferred into bottles to filter through GF/F filters. 1 litre of water was filtered for the determination of chlorophyll a concentration. The volume of water filtered for pigment analysis was governed by the relative fluorescence readings in the sea water. These volumes are exhibited in the underway log (Appendix G), however, 1 filter paper represents 2 litre of water filtered except where otherwise noted. The volumes of water were obtained by filling the bottles to accurately, pre-determined levels. These determinations were performed before the ship left Stanley.

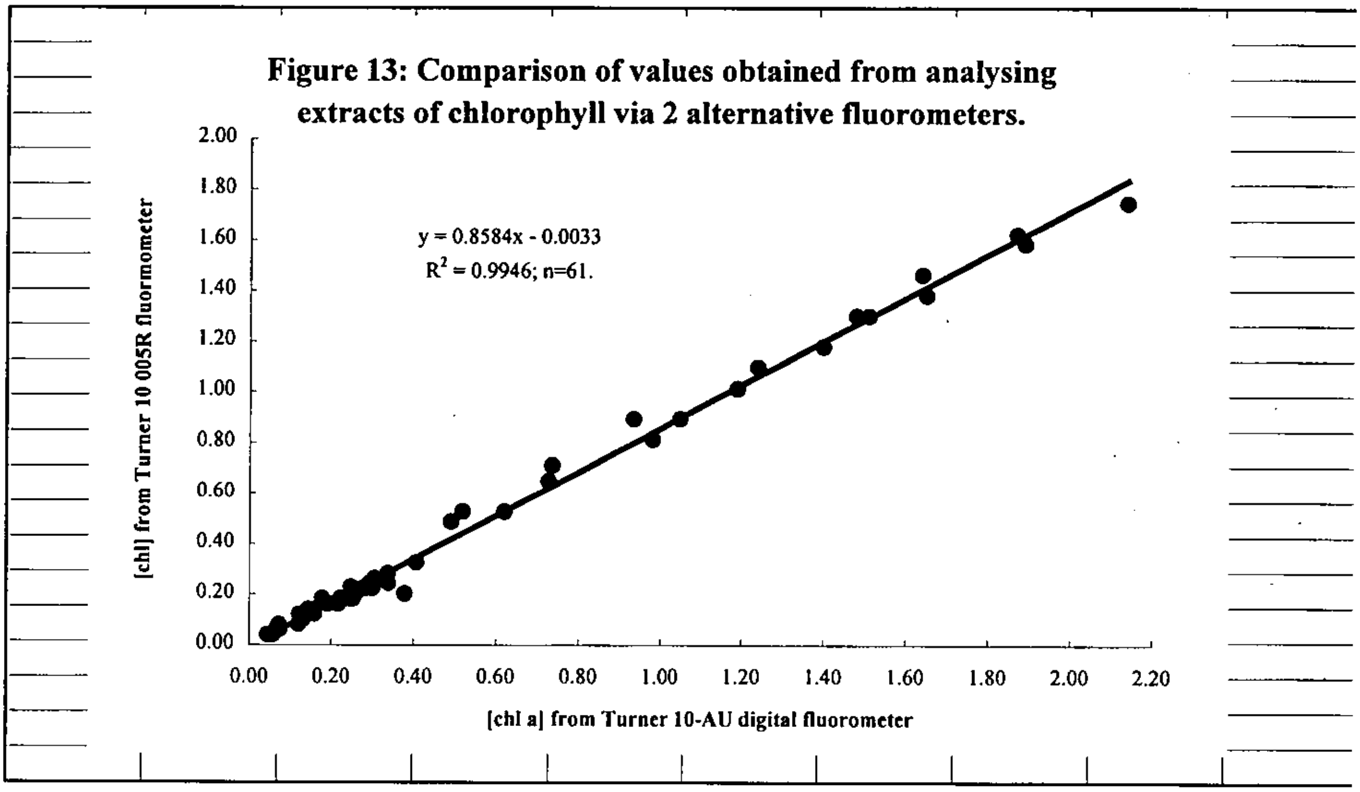
Duplicates of filtrations were made for pigment collection, although replicates of the filtrations were taken for both pigment collection and chlorophyll analysis at various stages of the cruise (see underway log). The filters obtained were dried and carefully folded into their respective vials. Those vials containing filters for pigment collection were stored in liquid nitrogen for the remainder of the cruise, however, the limited space of the shippers meant that the last few samples (from U277; S38) were stored in the -80°C freezer until transferral to an additional shipper could be undertaken upon arrival at Grimsby; Those vials containing filters for chlorophyll analysis were filled with 10ml of 90% acetone. These samples were contained in the -60 freezer for 18-24 hours for extraction and subsequently analysed. The times of analysis are recorded in the underway log.

The analysis of chlorophyll was undertaken by measuring the fluorescence with a Turner Designs 10-AU fluorometer using the method of Welschmeyer (*Limnol.Oceanogr.*, 39, 1985-1992, 1994). The fluorometer was calibrated before the ship left Stanley using a 200 μg/l solution of chlorophyll a. This solution was obtained by diluting a previously determined stock sample of chlorophyll a (1.005 μg/ml). The along track values for the surface (7m) chlorophyll concentrations obtained from these analyses are displayed as Figure 12.This calibration was verified on two further occasions during the cruise. Blanking, using 90% acetone solution, was performed before each analysis period. At intervals during the cruise, samples were additionally analysed on an alternative non-digital Turner designs (10 005R) fluorometer. The comparison is displayed as Figure 13.

Samples of water from depths throughout the water column were taken using a rosette sampler at each morning station (see Appendix I). Water was again collected for pigments and for subsequent chlorophyll analysis. The depths that were significant for the collection of water to represent surface, chlorophyll maximum, below maximum, intermediate depths were determined from values from the CTD fluorometer. Water was collected and treated as above for 6 depths at each station. The available volumes of water from each depth meant that only a duplicate of 2 litres were available for filtration for pigment collection, and 1 litre for chlorophyll concentration at each site. Water was available from both of the 2 casts performed at site 12 (Julian day 127), and subsequent full analysis was performed on all depths to determine the degree of variation between the 2 casts (see Table 2.1). This comparison was also performed to observe the variation in readings that are obtained by setting the fluorometer to different range sensitivity. The volumes of water filtered (1 litre) meant that the high range was employed for readings chlorophyll a concentrations in underway samples and from station samples.

At each day station, a net was deployed to sample the plankton of the area. The time that the net spent in the water varied between stations. All information is noted in the log. The net haul was collected into an attached 250ml beaker. This volume was reduced by carefully re-passing the contents of the beaker over the net and flushing the net surface with water. This volume was divided into 2 x 20ml vials, and treated with several drops of lugol's iodine or 40% formaldehyde solution respectively.





1st cast:

vol.filtered		range high	range medium	range low
1 litre	7	8.57	8.55	over
	60	12	11.9	over
	100	26.2	over	over
	120	27.2	over	over
	140	13.6	13.5	over
0.2 Litre	7	1.64	1.47	1.42
	60	2.51	2.32	over
	100	5.26	5.1	over
	120	6.08	6.01	over
	140	2.89	2.89	over

2nd Cast:

		range high	range medium	range low
1 litre	7	8.39	8.34	over
	20	8.95	8.92	over
	60	13.4	13.3	over
	100	24	over	over
	120	32.5	over	over
	140	16	15.9	over

Table 2.1: readings obtained from the Turner 10-AU fluorometer at the different range settings, and using water obtained from depths sampled by 2 consecutive casts at station 12 (4-127).

4.3 Zooplankton

4.3.1 Zooplankton distribution by OPC and ingestion and gut evacuation studies

Rachel Woodd-Walker, Plymouth Marine Laboratory
Ignacio Huskin, University of Oviedo

At each daily station, three WP-2 (200µm mesh) net casts were made. The first two, using a double net to 200m, and the third using a single net to 20 m. The sample from the double net was used for gut evacuation experiments. The single 200 m net was split and processed as for AMT 1 , 2 & 3, using a Folsom splitter. Half of the sample was passed through the OPC, and collected and preserved (formalin 4%) for subsequent microscopic taxonomy analysis, and half was used for biomass. On night stations, a double net to 200 m was used, and a single to 20 m. One double net was used for gut evacuation experiments, and the other was split for OPC and biomass as the day samples. The 20 m nets were processed through the OPC and preserved in 4% buffered formalin. The biomass was size fractionated by screening the sample through 2000, 1000, 500 and 200 µm sieves to create fractions of 200-500,500-1000,1000-2000 and >2000 µm. Each size fraction was made up to 1 litre, and 50 ml aliquots of each size fraction were filtered onto pre-ashed Whatman GF/C filters (in triplicate). Filters were dried for 48 hours in a 60°C oven and then compacted in aluminium foil for subsequent CN analysis. The remainder of the sample was preserved with borax buffered formaldehyde (4%) for later taxonomic identification. A log of all zooplankton samples taken and samples for analysis are given in Appendix J.

The OPC was used in continuous flow-through mode during the whole cruise, using the uncontaminated seawater supply. This was interrupted only briefly at local dusk and dawn to change data files, and for about two hours each day on station to process the net samples. In line samples, from the OPC outflow were collected through 130 µm mesh collection tube on days without night stations. This was preserved for subsequent analysis to validate the OPC data.

Copepods gut contents and ingestion rates

Ingestion rates were obtained using the Gut fluorescence-evacuation method. At each station, one WP2 plankton net (200µm) was deployed to 200 m. The sample was immediately screened to obtain three different size fractions (200-500,500-1000, and more than 1000 µm. Subsamples of each fraction were filtered onto paper filters and frozen for further determination of initial gut contents in each fraction. The remainder of one f the size fractions (one different fraction each day) were used for gut evacuation experiments. Copepods were introduced in a cold box filled with filtered sea water from the station (7m) and subsamples were taken every 5 minutes during half an hour. Extra subsamples at 45 and 60 minutes were taken if copepod abundance was enough. Subsamples were also filtered onto paper filters and frozen for further gut content analysis.

In some stations along the Azores area, night stations were used to determine night copepod gut contents and compare it with day gut contents. At one station, samples were taken every three hours to study diel cycles in copepod feeding.

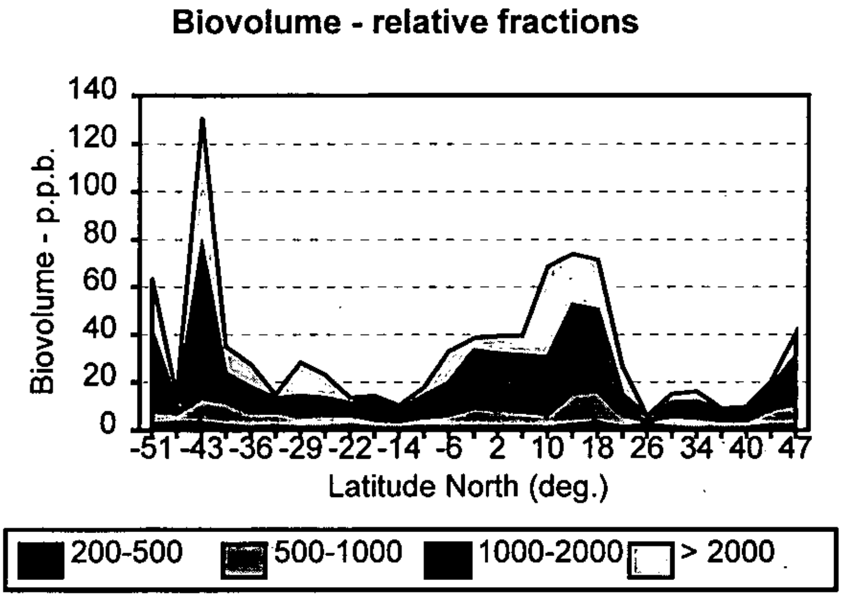
A fixed number of herbivorous copepods were taken from the frozen filters to extract gut contents. the copepod number used was: 25 for the large fraction, 50 for the medium and 75 for the small one. Between one and three replicates were taken at each time. Chlorophyll as extracted using 5 ml acetone (90%) in 20 ml vials during 24 hours at 4 degrees. Copepod gut fluorescence was determined using a turner fluorometer before and after acidification, and expressed as ng chlorophyll a equivalents.

Copepod gut content was plotted against time to obtain gut evacuation curves. Data were fitted to an exponential curve to calculate gut evacuation rate from the slope of the curve.

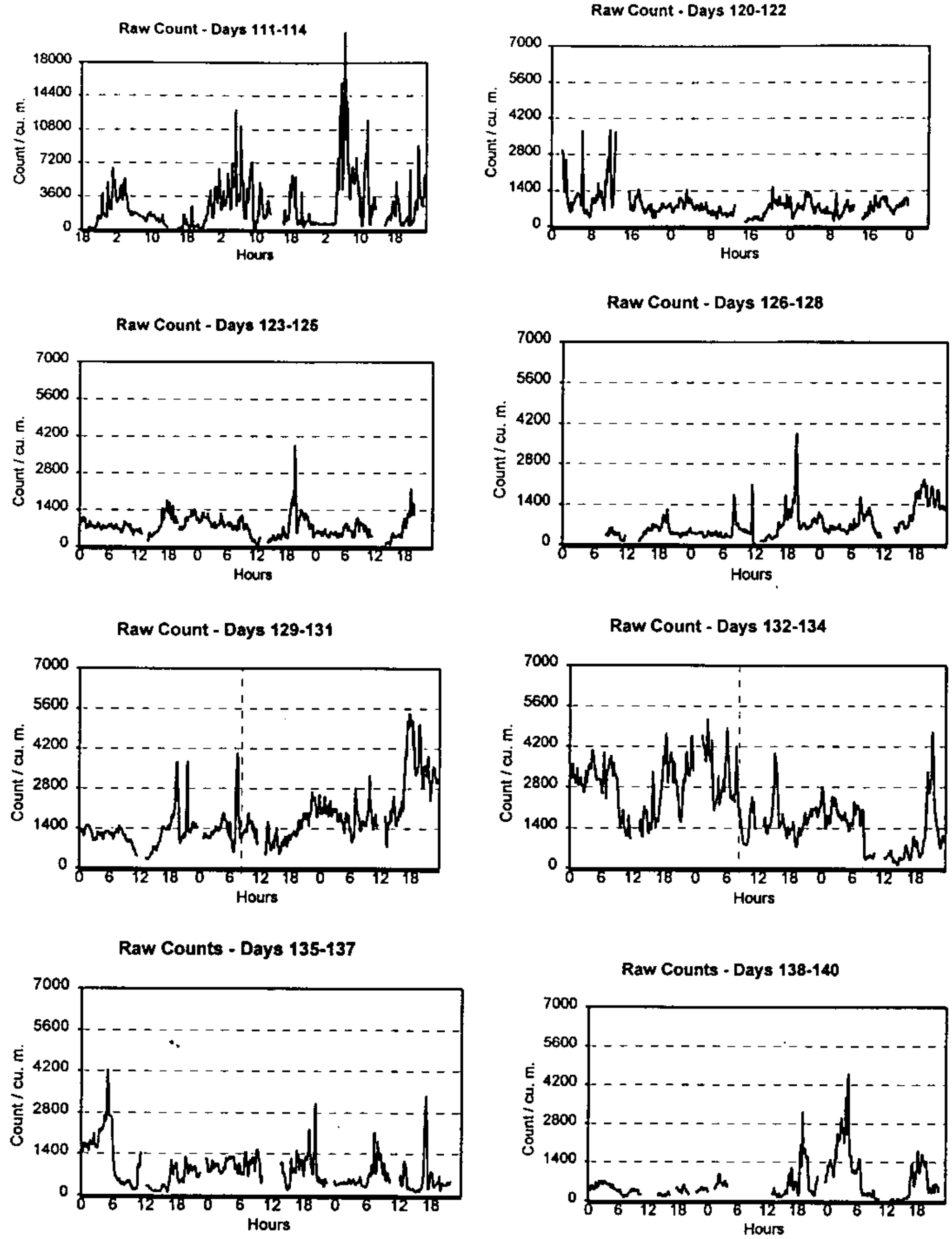
Particulates
Samples for CN analyses were obtained from two different depths: surface (7m) and chlorophyll maximum, as determined by *in situ* fluorescence. Water from the two depths was filtered through membrane filters of 2, 5 and 10 mm and a 200 mm gauze. Filtrate from each size fraction was filtered in triplicate onto pre-ashed Whatman GF/F filters to produce a series of replicate samples of the four size fractions (<2,<5,<10,<200μm). Filters were maintained for 48 hours in the oven (60°C) and then compacted in pre-ashed aluminium foil for CN analysis.

Preliminary Results

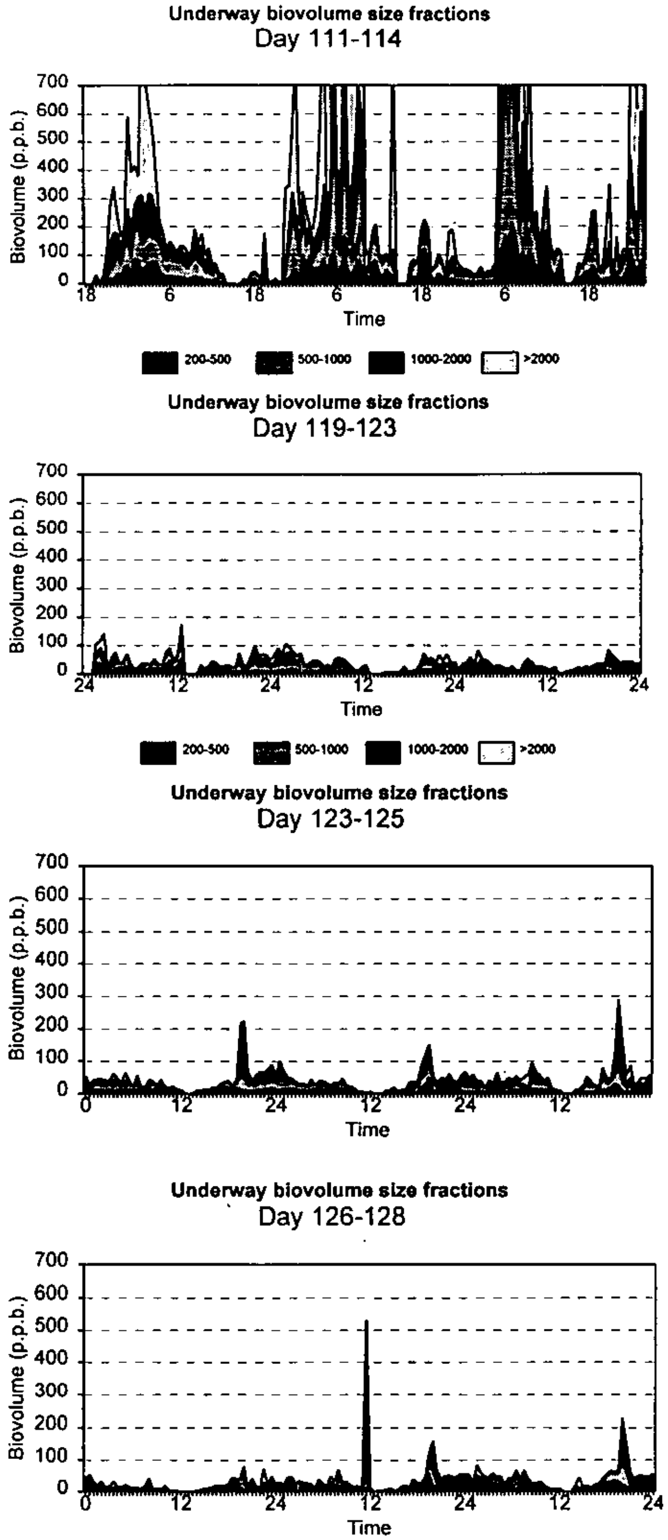
Figure 14. Size fractionated biovolume along transect (from 200 m vertical hauls)



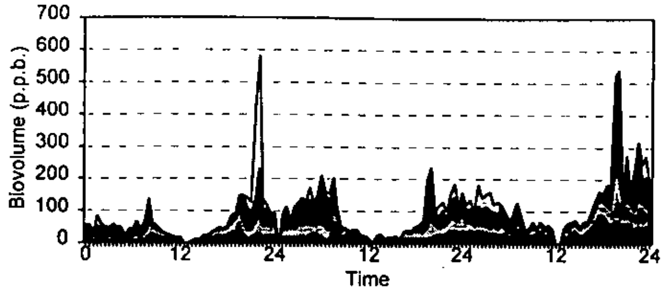
Figures 15a-h. Raw particle counts per cubic metre in underway mode for the whole cruise, showing zooplankton abundance.



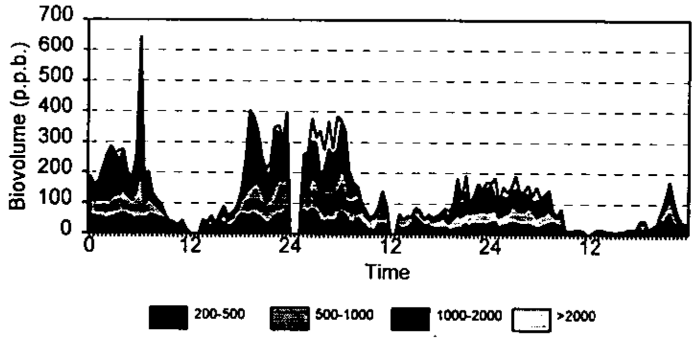
Figures 16 a-i Size fractionated biovolume per cubic metre in underway mode for the whole cruise.



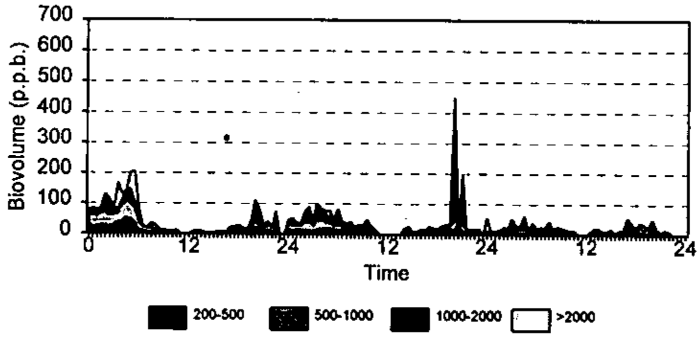
Underway biovolume size fractions
Day 129-131

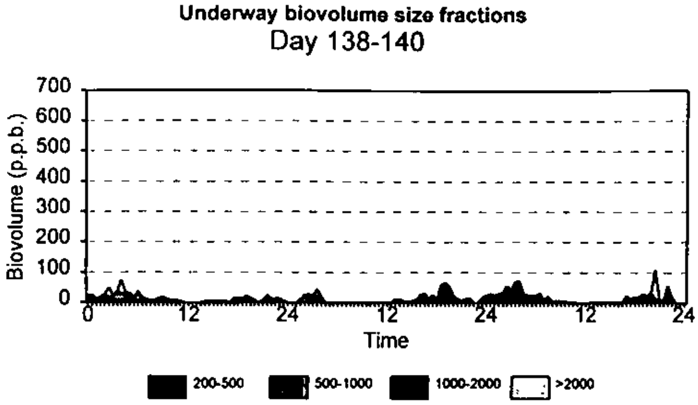


Underway biovolume size fractions
Day 132-134



Underway biovolume size fractions
Day 135-137





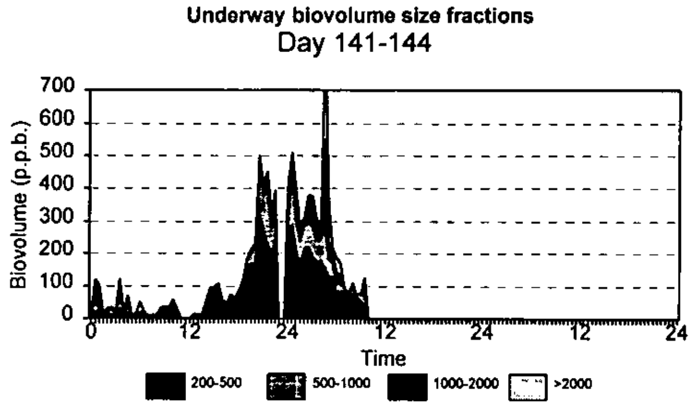


Figure 17 :Example of gut evacuation curve. Size fraction 500-1000μm. Date: 24 -April

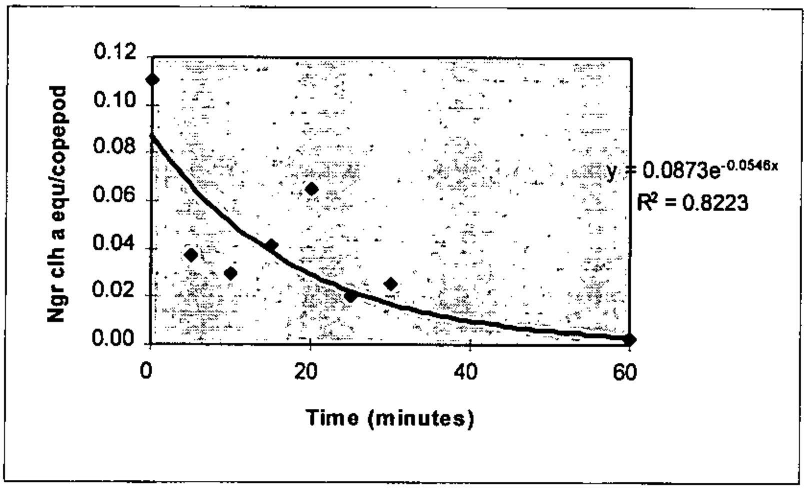


Figure 18 shows the latitudinal variation in copepod gut contents during the AMT 4 transect. Higher values are found in coastal areas and in the Equator, although lower values were found in the oligotrophic gyres.

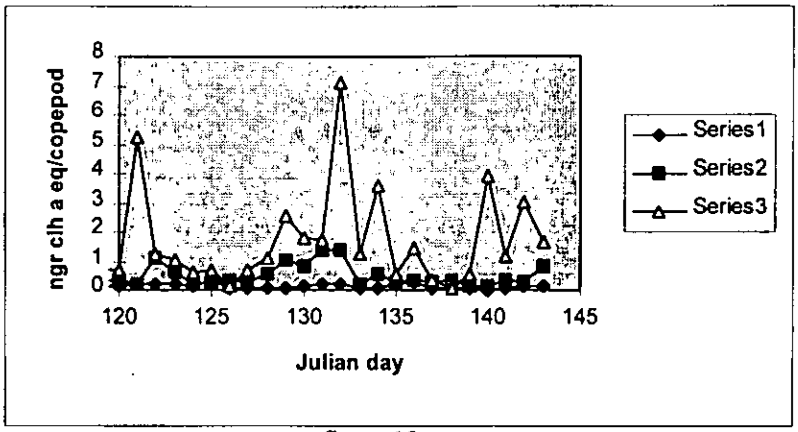


figure 18

This values have to be combined with evacuation rates, herbivorous copepod abundance and primary production to obtain values of mesozooplankton (copepods) grazing effect upon phytoplankton along the AMT transect.

Figure 19 (a b and c) shows the differences in copepod gut contains between day and night. A general tendency of higher gut contents during night is shown in the three size fraction, supporting the idea that copepods feed preferentially at night. But this general tendency is not clear and in some cases gut contents are higher during

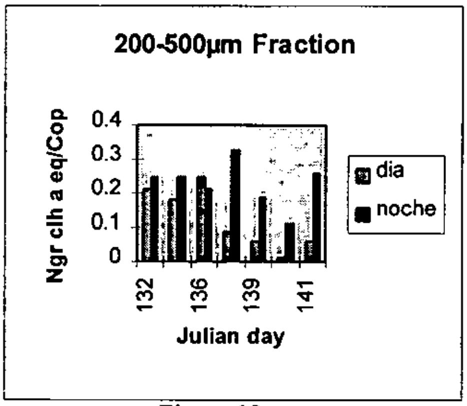


Figure 19 a

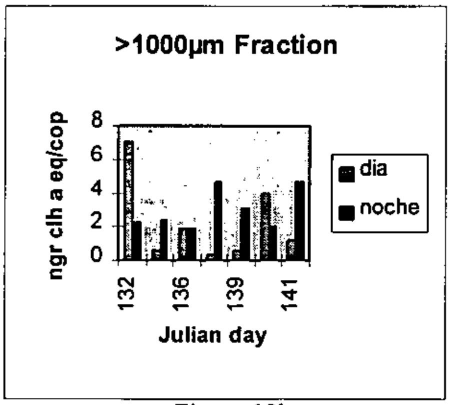


Figure 19b

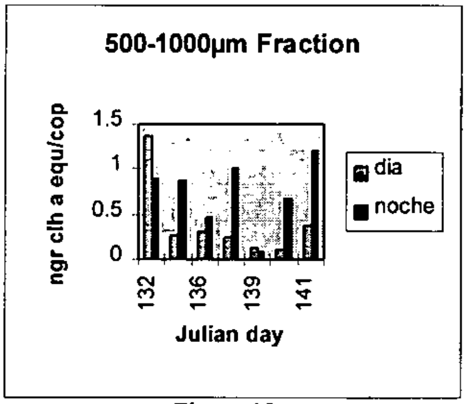


Figure 19c

4.4 Optical Oceanography

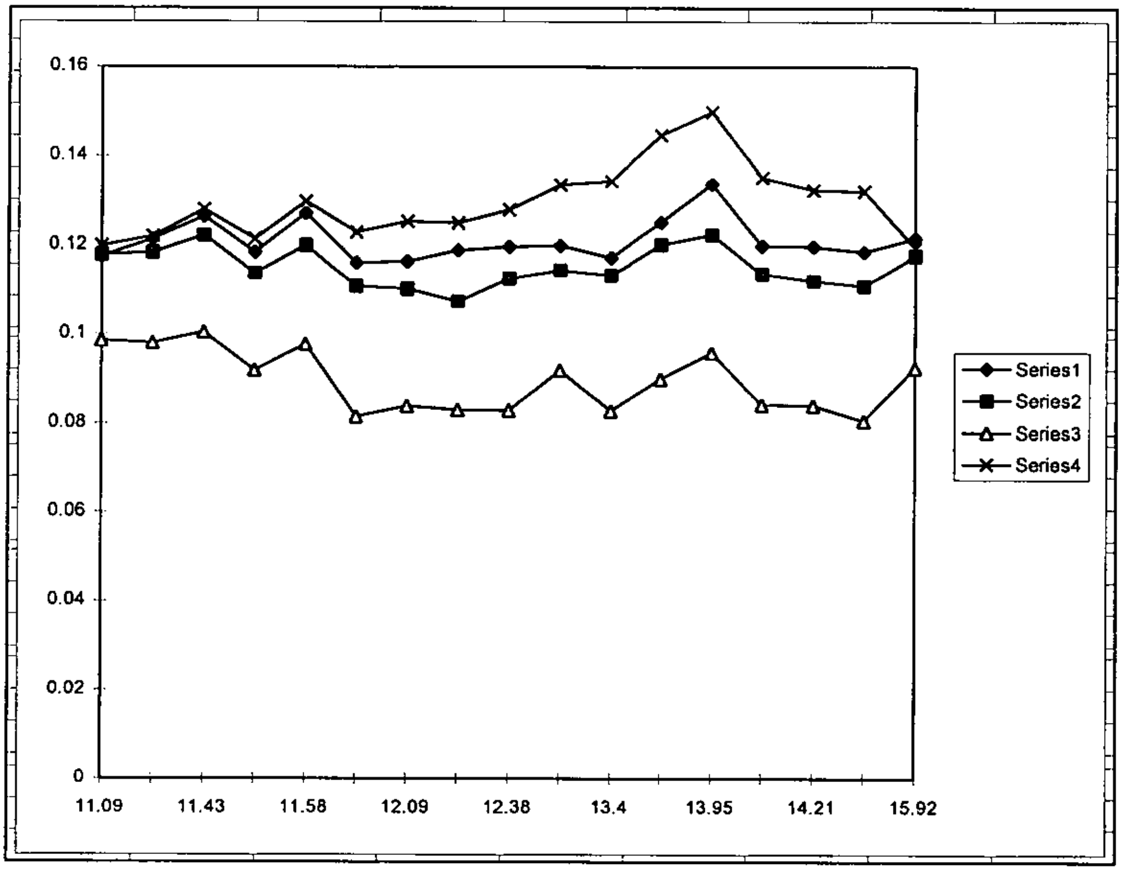
4.4.1 Atmospheric and sea surface radiometry measurements

Sylvie Carlier, University of Lille

SIMBAD
SIMBAD (Satellite Intercomparison for Marine Biology and Aerosol Determination) is a hand-held, visible near infrared radiometer, used to validate the remote sensing measurements of ocean colour made by POLDER. The measurements are affected by atmospheric contribution, so we need, besides marine reflectances, atmospheric observations (optical thickness), which are made at 4 wavelengths: 443, 560, 670 et 870 nm. (+ one black channel)

Measurement technique
In SUN mode, SIMBAD is manually aligned to the sun. One measurement is made every 1/10 sec, over a total period of 10 seconds, with the max value being retained every second.

Figure 20 optical thicknesses measured on the 8th of May:



series1= 443 nm
series2= 560 nm
series3= 670 nm
series4= 870 nm

In SEA mode, SIMBAD allows measurements of sea surface, at angles between 30 and 60 degrees elevation below the horizon and at angles from 90 to 180 degrees azimuth (trying to avoid glitter, foam and shadows), repeating the measurements for horizontal and vertical polarization. Some measurements were made in the SKY mode, scanning the sky in the principal solar plane and 2 directions of polarization. The majority of measurements were made from the forecastle, at the time of POLDER overflight and during surface water samples (every 2 hours).

REFPOL and CIMEL

The polarized photometer REFPOL and the sunphotometer CIMEL are both used to validate POLDER aerosol products, these being optical thickness, size distribution and refractive index.

REFPOL gives measurements of radiance and polarized radiance of the sky between selectable zenith angles (in this case, between -90 degrees and +90 degrees), and at 4 wavelengths, 440, 670, 870 and 1610 nm. All the measurements were made in the principal solar plane.

CIMEL is used here in the sun mode, manually aligned to the sun (only the maximum value is retained), in order to retrieve the optical thicknesses at 440, 670, 870 and 1020 nm. Measurements are made when the sky is as clear as possible, at the same time as POLDER overflight.

Table 4.4 gives the time of the POLDER overflights, for each day, with our position during the day station.

Day	POLDER time	latitude	longitude	Station time	Station number
30/04/97		35°39.1 S	049°49.1 W	13:35	Station #6
01/05/97	13h10	32°36.6 S	046°12.0 W	13:10	Station #7
02/05/97	12h40	29°19.7 S	042°38.5 W	13:00	Station #9
03/05/97	12h12	26°06.2 S	039 °11.0W	12:50	Station #10
04/05/97	13h24	22°09.5 S	036°37.2 W	12:50	Station #12
05/05/97	12h56	18°16.1 S	034°46.3 W	11:50	Station #13
06/05/97	12h28	14°06.9 S	032°50.3 W	11:50	Station #14
07/05/97	12h00	10°02.1 S	030°56.8 W	11:46	Station #15
08/05/97	13h14	05°54.0 S	029°05.0 W	11:55	Station #16
09/05/97	12h46	02°01.45 S	027°19.7 W	11:50	Station #18
10/05/97	12h18	01°53.9 N	025°37.1 W	11:56	Station #21
11/05/97	11h48	06°04.9 N	023°38.3 W	11:55	Station #22
12/05/97	13h02	10°03.4 N	021°55.4 W	12:00	Station #23
13/05/97	12h34	13°44.6 N	020°59.9 W	11:50	Station #26
14/05/97	12h04	17°47.0 N	021°13.0 W	10:50	Station #27
15/05/97	11h36	22°10.1 N	021°33.3 W	10:45	Station #29
16/05/97	12h50	26°16.6 N	21°52.7 W	10:55	Station #32
17/05/97	12h22	30°02.6 N	021°45.6 W	10:50	Station #33
18/05/97	11h54	33°43.8 N	021°18.1 W	10:50	Station #36
19/05/97	13h06	36°06.7 N	021°03 W	10:45	Station #42
20/05/97	12h38	39°51.9 N	020°00.1 W	10:55	Station #45
21/05/97	12h10	43°58.0 N	019°58.9 W	11:00	Station #48
22/05/97	11h42 13h22	47°00.2 N	019°59.9 W	10:00	Station #51

Table 4.5 Log of optical measurements with SIMBAD, REFPOL and CIMEL.

date	SIMBAD	REFPOL	CIMEL	optical thickness 870 nm
		sky measurements	sun measurements	(POLDER time)
03-May	sea, sky measurements	measurements after 12h	measurements after 11h40	0.07
04-May	sea, sun measurements	measurements after 12h55	measurements after 12h20	0.08
08-May	sea, sun measurements	measurements after 12h	measurements after 11h	0.13
09-May	sea, sun measurements	measurements after 12h	measurements after 11h30	0.12
13-May	sea, sun, sky measurements	measurements after 11h30	measurements after 10h50	cimel:0,47 simbad:0,47
15-May	sun, sky measurements	/	measurements after 14h	
18-May	sea, sun measurements	measurements after 11h	measurements after 14h	simbad: 0,202

Table 4.6 Log of sky/cloud conditions during SIMBAD deployments

date	sky	SIMBAD
from 21/04 to 28/04	clouds, rain fog...	/
02-May	cirrus	sea measurements
from 6/05 to 7/05	clouds, rain	sea measurements
10-May	cumulus + cirrus	sea measurements
11-May	overcast	sky and sea
12-May		measurements
17-May	overcast	sky measurements
		sea measurements
19-May	clouds	sea measurements
20-May	cirrus	sea measurements
21-May	overcast	sky measurements
22-May	clouds and light rain	pb with
23-May	clouds and rain	batteries of
24-May	clouds and rain	SIMBAD

Table 4.7 Comments on conditions during SIMBAD, REFPOL and CIMEL observations.

date	SIMBAD	REFPOL	CIMEL	SKY
		sky measurements	sun measurements	
29-Apr	sea, sky and sun measurements	/	measurements after 14h	few cirrus
30-Apr	sea, sun measurements	/	measurements after 14h30	few clouds+ cirrus
01-May	sea, sun measurements	measurements after 14h	measurements after 12h	few clouds+ cirrus
05-May	sea, sun measurements	measurements after 12h44	measurements after 12h22	few clouds
14-May	sea, sky and sun measurements	too much wind	measurements after 13h20	few clouds
16-May	sea, sun measurements	measurements after 12h28	measurements after 12h45	few clouds

4.4.2 AC-9 Measurements

Gerald Moore Plymouth Marine Laboratory

The AC-9 was configured with as an auto-sampling system for underway sampling. Under software control the system monitored the non toxic supply, 0.2µm filtered no toxic supply and Mili-Q water. An additional cycle of bleach was used every 6 hours in underway operation mode. The instrument was operated in underway mode during optical stations and UOR tows. In addition it was run continuously over areas of changing pigment concentration. The main limitation on the deployment was the consumption of 0.2µm filters. In addition to underway operation mode, discrete samples from the CTD casts were analysed during the evening stations. The discrete samples were analysed with a pre and post calibration of Mili-Q water, and were measured both 'raw' and 0.2µm filtered. In addition to the standard calibration, HPLC grade water and water from deep CTD casts (2000 & 1000m) were used as a check on the Mili-Q system.

The system was originally deployed in the main laboratory, but problems were found with bubbles forming in the system when the underway water reached the high temperature of the AC-9 windows. The internal temperature of the AC/9 in the laboratory was between 38 and 42°C, which was almost outside the temperature compensation range of the instrument, and greater than any temperature that would be encountered.

In order to bring the instrument to a correct temperature, the AC-9 system was moved to the 4°C room. This move brought the instrument internal temperature to 18-20°C and removed the bubble effects. There was an additional advantage in this move, in that samples and standards could be kept at constant temperature for processing.

Samples for AC-9 measurements were taken on samples from the CTD for days 120 through 142. Underway data was taken for 121 through 146, and include the aircraft overflights. The samples taken on the leg to Montevideo were too contaminated by bubbles to be useful.

4.4.3 Underway Fluorometry, Phycoerythrin Fluorescence and SeaOPS preparation

Gerald Moore Plymouth Marine Laboratory

Fluorometry

he Turner fluorometer was serviced at the start of the cruise. The cell was cleaned and new O-rings fitted, to avoid small leak. New dessicant was fitted. The instrument was blanked with Milli-Q water. It proved impossible to set the electrical zero of the instrument, since the blank control was faulty. Despite this problem the instrument performed well despite an offset on the highest sensitivity range corresponding to the mid scale reading.
The ocean logger software does not record the fluorometer gain, and the gain was set manually to give the highest reading possible. The was changed at several points during the cruise, and the gain settings are given in Table 4.8.
The fluorometer was calibrated from the underway discrete determinations of chlorophyll. The yield showed a strong latitudinal dependance, and the best fit to this was found to be a log relationship with SST.

Northern Hemisphere $yield = e^{-5.816+0.206.SST}$

Southern Hemishere $yield = e^{-2.875+0.104.SST}$

The final calibration is $Chl = Yield*(Fluor - 1.424)$, where Fluor is the Turner reading scaled to the highest range. A calibration script is given with Table 4.8

Figure 21, Turner fluorometer yield (a) and comparison (b) of underway calibrated fluorometer with measured.

a b

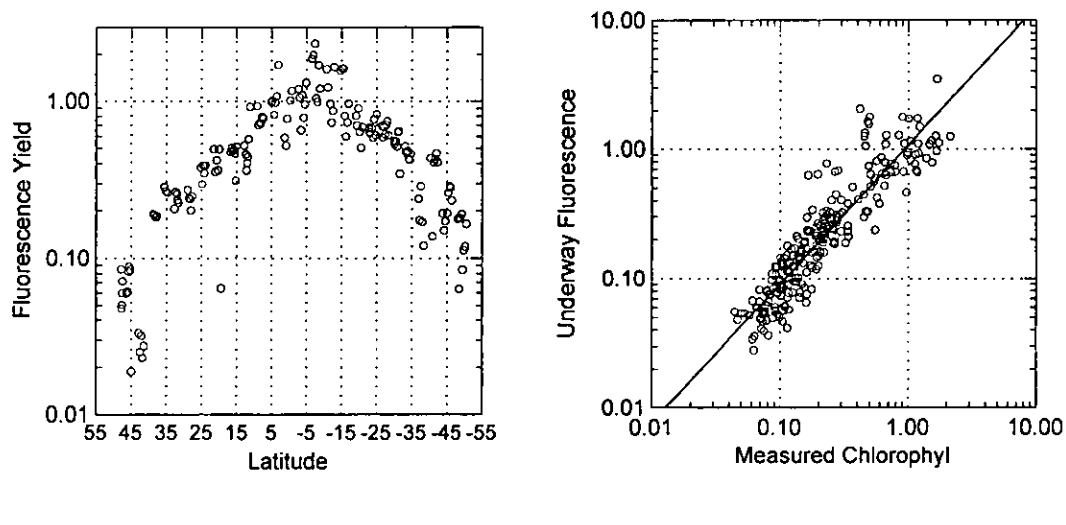


Table 4.8 Ocean Logger underway fluorometer gain settings

Day	Time	Range	Meter	Oceanlog
111	12:00	X10	-----	------
114	11:25	X10	8.9	81.0
114	11:26	X3.16	4.3	47.5
120	01:10	X10	------	-----
120	10:23	X10	2.1	22.8
120	10:24	X31.6	6.6	64.8
120	12:07'	X31.6	Off Scale	98.9
120	12:09	X10	3.4	34.1
120	23:26	X10	2.3	22
120	23:28	x31.6	6.9	68.2
134	21:11	x31.6	Off Scale	2000
134	21:12	x10	3.2	30.3
135	16:19	X10	2.1	19.4
135	16:20	x31.6	6.1	61.2
140	19:13	x31.6	8.8	86.6
140	19:14	x10	2.9	27.9
Day	Time	Range	Meter	Oceanlog
141	19:41	x10	Off Scale	2000.0
141	19:42	x3.16	5.2	52.0
142	18:41	x3.16	Off Scale	2000.0
142	18:42	x1	3.6	36.0
144	10:21	x1	1.8	17.1
144	10:22	x3.16	5.2	50.9

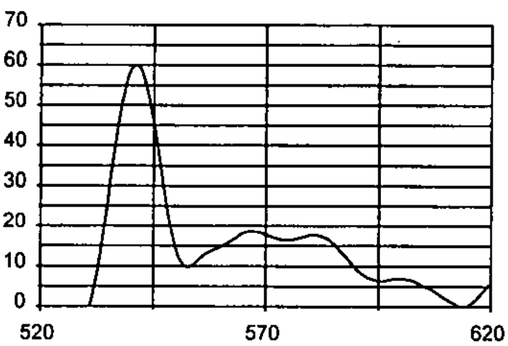
Calibration Script

```
if fluor_u>110 then let fluor_u=.
let jday=jday+hh/24+mm/(24*60)+sec/(24*60*60)
let trange=10
if jday >114.47639 then let trange=3.16
if jday >120.00000 then let trange=10.0
if jday >120.43333 then let trange=31.6
if jday >120.50625 then let trange=10.0
if jday >120.97777 then let trange=31.6
if jday >134.86333 then let trange=10.0
if jday >135.68055 then let trange=31.6
if jday >140.80069 then let trange=10.0
if jday >140.82014 then let trange=3.16
if jday >142.77847 then let trange=1.0
if jdat >144.43125 then let trange=3.16
let fluor_u=fluor_u/trange
let fluor_u=fluor_u-1.424
if lat >=0 then let py=exp(-5.816+tempss*0.206)
if lat <=0 then let py=exp(-2.875+tempss*0.104)
let chl_u=fluor_u*py
```

Phycoerythrin Fluorescence

For AMT-4 a novel fluorometer was designed, using a 542nm coloured HeNe laser and an Ocean Optics Spectrometer. The fluorometer was used in both discrete and underway mode. The underway mode used a 10cc cell attached to the surface non-toxic supply. For the discrete samples Wyman's (1994) method was used. Samples were filtered through 0.6μm nucleopore filters and re-suspended in 50% glycerol solution. As a check on extraction efficiency the chlorophyll remaining in the filters was determined by acetone extract (see underway chlorophyll sample section). The extraction averaged around 80%. The optical arrangement of the system has been kept and the system will be calibrated with extracted phycoerythrhin at a later date.
The ocean optics spectrometer showed considerable periodic noise, which proved difficult to eliminate from the underway sample spectra. It was possible to process the discrete sample spectra, an example is shown in figure 22a. The 570nm peak height was determined for each sample and the contoured result is shown in figure 22b.

Figure 22
a) Sample Fluorescence Spectra



b) Phycoerythrin Fluorescence Distribution

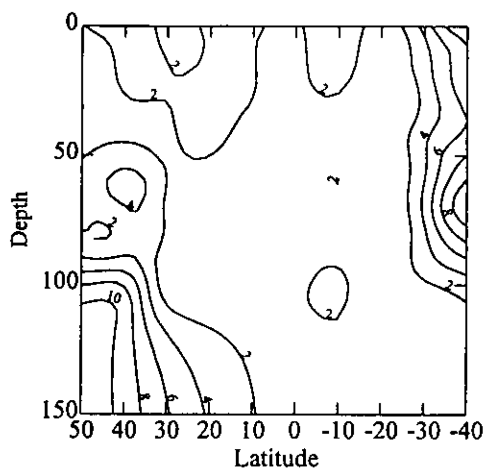


Table 4.9 Extraction Efficiency

Sample	Day	Chl(PE)	Chl(PR)	%Efficiency
GM132A	132	0.119	0.353	66
GM132B	132	0.217	1.150	81
GM132C	132	0.100	0.693	85
GM132D	132	0.038	0.182	79
GM132E	132	0.038	0.183	79
GM134BL	134	0.002	0.000	-
GM134A	134	0.029	0.263	88
GM134B	134	0.058	0.991	94
GM134C	134	0.054	0.570	90
GM134D	134	0.029	0.239	87
GM134E	134	0.024	0.127	81

Table 4.10 Depths for AC/9 and Phycoerythrin Samples

Station	A	B	C	D	E
112A	50	35	20	7	2
113A	50	30	20	7	2
114A	30	20	15	7	2
120A	120	100	40	7	2
121A	90	70	45	20	7
122A	90	70	50	25	7
123A	110	80	55	30	7
124A	140	90	70	30	7
125A	110	90	60	20	7
126A	13-	100	50	25	7
127A	120	100	60	20	7
128A	120	90	60	20	7
129A	90	70	50	20	7
129X	90	70	50	20	7
130A	70	60	40	20	7
131A	60	40	30	15	7
132A	70	50	40	20	7
133A	30	25[1]	15	7	2
134A	70	60	50	30	7
135A	50	40	30	15	7
136A	80	60	40	20	7
137A	90	70	50	30	7
138A	100	90	40	20	7
139A	100	80	60	20	7
140A	80	50	40	20	7
141A	50	35	25	15	7
142A	40	25	15	7	2

[1] Only 350 ml filtered.

Reference

Wyman, M., 1992, An in vivo method for the estimation of phycoerythrin concentrations in marine cyanobacteria. Limnol. Oceanogr. 37, 1300-1306.

AMT 4 CTDF and SeaOPS performance

The SeaOPS rig was re-terminated and fully tested at Stanley prior to departure. A new Chelsea transmissometer, and termination box were fitted. Apart from the first cast, where a change in the RS-432 converter caused a termination resistor problem, the system performed without fault throughout the cruise. Table 4.11 gives the data recorded and vicarious calibrations for the CTDF.
For future comparisons with the AC/9 data the Chelsea transmissometer was cleaned before each cast and, where weather was fine, an air calibration was taken.

Table 4.11 CTDF Log of data files

Station	Cast	Lat	Lon	Up Cast	Down Cast	Offset(v)	Batts	Trans Cal
111A	1	-57.293	-50.989	DF111R16	DF111R33(1)	-0.0360	NEW	None
112A	2	-55.946	-47.618	DF112O02	DF112O20(2)	-0.0360		None
113A	3	-54.402	-43.347	DF113O00	DF113O14	-0.0360		None
114A	4	-52.974	-39.427	DF114O03	DF114O21	-0.0360		None
120A	5	-49.807	-35.658	DF120N41	DF120O01	-0.0595		None
121A	6	-46.200	-32.611	DF121N13	DF121N31	-0.0465		0.0165:4.702
122A	7	-42.650	-29.328	DF122N15	DF122N33	-0.0404		None
122B	8	-42.650	-29.328	DF122N57	DF122O05			-
123A	9	-39.159	-26.104	DF123M58	DF123N13	-0.0385	NEW	0.0235:4.662
123B	10	-39.159	-26.104	DF123N28	DF123N39			-
124A	11	-36.6223	-22.159	DF124M55	DF124N17	-0.359		0.0183,4.671
124B	12	-36.6223	-22.159	DF124N44	DF124N52			-
125A	13	-34.758	-18.273	DF125L55	DF125M16	-0.0375		0.0180,4.656
126A	14	-32.848	-14.111	DF126L57	DF126M22	-0.0362		None
126B	15	-32.848	-14.111	DF126M46	DF126M54			-
127A	16	-30.945	-10.029	DF127M03	DF127M27	-0.0333		0.0131,4.654
128A	17	-29.106	-5.915	DF128L57	DF128M19	-0.0349		0.0151,4.668
128B	18	-29.106	-5.915	DF128M44				-
129A	19	-27.333	-2.021	DF129L56	DF129M10	-0.0328		0.0166,?
129B	20	-27.333	-2.021	DF129M36				-
130A	21	-25.620	+1.891	DF130L58	DF130M16	-0.339		0.0143,4.603
130B	22	-25.620	+1.891	DF130M30	DF130M35			-
131A	23	-23.639	+6.082	DF131L57	DF131M13	-0.0331		0.0150,4.663
131B	24	-23.639	+6.082	DF131M32	DF131M42			-
132A	25	-21.057	+10.057	DF132M03	DF132M19	-0.0327		0.0170,4.669
132B	26	-21.057	+10.057	DF132M37	DF132M46			-
133A	27	-21.001	+13.800	DF133L56	DF133M11	-0.0314		0.0166,4.665
133B	28	-21.001	+13.800	DF133M29	DF133M36			-
133C	29	-21.001	+13.800	DF133M51	DF133M51			-
134A	30	-21.216	+17.784	DF134L04	DF134L18	-0.0291	NEW	0.0130,4.662
134B	31	-21.216	+17.784	DF134L39	DF134L47			-
135A	32	-21.558	+21.168	DF135K51	DF135L05	-0.0311		0.0145,4.600
135B	33	-21.558	+21.168	DF135L23	DF135L31			-
136A	34	-21.878	+26.278	DF136K59	DF136L15	-0.0296		0.0146,4.668
136B	35	-21.878	+26.278	DF136L35	-			-
136C	36	-21.878	+26.278	DF136L47	DF136M27			-
137A	37	-21.761	+30.046	DF137K54	DF137L09	-0.0298		0.0137,4.668
137B	38	-21.761	+30.046	DF137L29	DF137L39			-
138A	39	-21.301	+33.730	DF138K55	DF138L08	-0.0295		0.0130,4.658
138B	40	-21.301	+33.730	DF138L32	DF138L42			-

138C	41	-21.301	+33.730	DF138L57	DF138M14			-
138X[3]	42	-21.229	+34.156	DF138Q58	DF138R14			0.0130,4.658
139A	43	-20.835	+36.224	DF139K53	DF139L10	-0.0276		0.0110,4.675
140A	44	-20.002	+38.850	DF140K56	DF140L14	-0.0275		0.0134,4.668
141A	45	-19.969	+43.968	DF141L03	DF141L12	-0.0264		-
142A	46	-20.158	+47.006	DF142L28	DF142L36	-0.0259		-
143A	47	-13.973	+48.057	DF143L00	DF143L13	-0.0243		0.136,4.640

(1) Corrupt Data Records
(2) Partial Up Cast
(3) PC Clock fast by 8 seconds

Calibrations for cruise - need to be upgraded for further processing

Output = A1 + a0*(Volts-A2)

Channel	Slope(a0)	Offset Physical(a1)	Offset Volts(a2)
Cond	11.845	-0.5420	0.0000
Temp	6.0000	0.0122	0.0000
Press	65.5100	2.1630[1]	0.0000[1]
Chl	5.1300	1.7500	0.0000
x (Tilt[2])	-28.5714	0.0000	2.5000
y (Roll[2])	28.5714	0.0000	2.5000
PAR	5.0000	0.0000	0.0000
Trans	0.2390	0.0000	0.0110

[1] This is the default value - the values in the file table can be used for more accurate processing
[2] Equivalent DATA 100 (OCP-004) channels

4.4.4 In-water optics

Stan Hooker, NASA GSFC

Introduction

As with many of the other types of measurements collected during AMT-4, optical data was collected underway and on station. The UOR, which was fitted with Satlantic[1] radiometers, and a Wetlabs nine-channel absorption and attenuation meter (AC-9) provided the former; whereas, the latter were provided principally by two different multispectral profilers: the SeaWiFS Optical Profiling System (SeaOPS) and the SeaWiFS Free-Falling Advanced Light Level Sensors (SeaFALLS), both of which are based on Satlantic radiometers. Underway and station surface irradiance was provided by SeaOPS and a photosynthetically available radiation (PAR) sensor; the latter was JCR equipment.

In addition to the principal station profilers, SeaOPS and SeaFALLS, three other optical instruments were tested during AMT-4: the Low Cost NASA Environmental Sampling System (LoCNESS), the SeaWiFS Aircraft Simulator (SAS), and SeaSPEC. LoCNESS is configured using the SeaOPS radiometers and data logger, and once built, looks very similar to SeaFALLS. SAS utilizes a Satlantic ocean color radiance (OCR) sensor with a small field of view to make surface reflectance measurements; an ocean color irradiance (OCI) sensor provides surface solar irradiance. SeaSPEC is a dual spectrometer utilizing fibre-optic cables to collect light away from the main body of the instrument and is made by Analytical Spectral Devices. Monitoring of the calibration of the UOR, SeaOPS (and LoCNESS), SeaFALLS, SAS, and SeaSPEC instruments was provided by the SeaWiFS Quality Monitor (SQM).

A summary of the bio-optical sampling used to interpret the biogeochemical fields was as follows:

a) Discrete vertical profiles of the *in situ* light field using the SeaOPS (and LoCNESS), SeaFALLS, and SeaSPEC multispectral instruments;
b) Surface reflectance measurements using the SAS instrument;
c) Synoptic measurements of near-surface optical properties using the UOR light sensors and beam transmissometer; and
d) Underway measurements of the underlying inherent optical properties of absorption and attenuation using the AC-9 instrument.

The UOR, SeaOPS (and LoCNESS), and SeaFALLS instruments all measured optical properties at SeaWiFS wavelengths. SeaSPEC has a spectral resolution of approximately 0.5 nm and a spectral range from the ultraviolet (342 nm) to the infrared (878 nm). The AC-9 was coupled to the uncontaminated seawater supply and its data can be used to interpret and model the optical measurements made by the light sensors. Additionally, the AC-9 provided the interpretation of the other underway measures when *in situ* optical observations were unavailable. For the light measurements, the diffuse attenuation coefficient Kd of the water was used as a quick-look product to determine the efficacy of the sensors.

Profiling Rig

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[1] Identification of commercial equipment does not imply recommendation or endorsement, nor does it imply the equipment identified is necessarily the best available.

A custom-built profiling rig was used to carry SeaOPS, a CTD package with fluorometer and tilt and roll sensors (CTDFTR), a transmissometer, and an underwater PAR sensor. This rig was the same one used during AMT-1, AMT-2, and AMT-3. The positioning of the equipment on the rig was developed with a geometry that ensured all radiance sensors did not view any part of the support. The narrow geometry of the rig was designed to provide the minimum optical cross section. The field of view of the irradiance sensors was only influenced by the 7 mm dia. wire and careful attention was paid to the balance of the rig, even though SeaOPS and the CTD FTR have tilt and roll sensors. The rig was trimmed with lead weights in air, accounting for the in-water weights of the sensors; after final assembly of the rig, visual checks for correct trim were carried out *in situ*.

The profiling rig was deployed from a stern crane with a reach of about 8-9 m over the side of the ship. The typical lowering and raising speed of the winch used was approximately 20-25 cm/s. Since the crane was on the starboard side of the ship, the sun was kept on the starboard side during all stations except during adverse weather conditions. In addition, sea- and sky-state digital photographs were taken at the bottom of the down cast whenever the optical instruments were deployed.

Data was logged on a Macintosh Quadra 700 using software developed at the University of Miami Rosenstiel School for Marine and Atmospheric Science (RSMAS) and GSFC. The software, called Combined Operations (C-OPS), is written in LabVIEW and is used to control both the in-air and in-water SeaOPS data streams. The primary task of C-OPS is to integrate the RS-232 outputs from the deck box that handles the power and telemetry to the underwater optical instruments and to control the logging and display of these data streams as a function of the data collection activity being undertaken: dark data (caps on the radiometers), upcast, downcast, bottom soak, surface soak, along track, etc. All of the telemetry channels are displayed in real time and the operator can select from a variety of plotting options to visualize the data being collected.

C-OPS file naming is handled automatically, so all an operator has to do is select what data streams are to be recorded and then set the execution mode of the data collection activity. Each tab-delimited file has a single header, identifying what is recorded in each column, and all data records are time stamped. The files are written in ASCII and are easily viewed with a simple text editor or ingested into a commercial off-the-shelf (COTS) spreadsheet software package.

SeaOPS

SeaOPS is composed of an above-water and in-water set of sensors comprising five subsystems. The in-water sensors are a downward-looking radiance sensor which measures upwelling radiance, Lu, and an upward-looking irradiance sensor which measures downwelling irradiance, Ed. The former is a Satlantic ocean color radiance (OCR-200) sensor (S/N 021), and the latter a Satlantic ocean color irradiance (OCI-200) sensor (S/N 029). The two units send their analog signals to an underwater data unit, a Satlantic DATA-100 (S/N 004), that converts the analog signals to RS-485 serial communications. The above water unit, a Satlantic Multichannel Visible Detector System (MVDS), measures the incident solar irradiance, Es. The MVDS unit (S/N 009), is composed of an OCI-200 irradiance sensor (S/N 030) packaged with an analog-to-digital (A/D) module that converts the analog output of the OCI-200 unit to RS-485 serial communications.

All of the SeaOPS radiometers take measurements in the same six spectral bands (approximately 412, 443, 490, 509, 555, 665, and 683 nm) which have been selected to support SeaWiFS calibration and validation activities (McClain *et al.* 1992). During AMT-1, the underwater SeaOPS sensors were deployed on a T-shaped frame with the OCI-200 and OCR-200 sensors on one side of the frame and a PRR-600 on the other side (Robins et al. 1996); this strategy was repeated for AMT-4. A log of the SeaOPS profiles is given in Appendix K.

The RS-485 signals from the MVDS and the DATA-100 are combined in a Satlantic deck box, the PRO-DCU (S/N 008), and converted to RS-232 communications for computer logging. The DECK-100 also provides the (computer controlled) direct current (DC) power for all the sensors and is designed to avoid instrument damage due to improper power-up sequences over varying cable lengths. For AMT-4, the MVDS cable length was approximately 100 m whereas the DATA-100 cable length was about 260 m (250 m on the winch and 10 m from the winch to the PRO-DCU).

SQM

The validation of ocean color satellite sensors requires a quantification of the uncertainties associated with *in situ* radiometric measurements. Presently, there is no convenient way to check or monitor the calibration of a field radiometer while it is being deployed. Consequently, individual investigators have relied either on the manufacturer's calibration data or on pre- and post-cruise calibrations of their instruments. The severe environmental changes encountered by a radiometer during shipment or a long cruise, however, calls in to question whether either one of these practices is satisfactory which in turn raises the concern of the data quality achieved during field deployments.

In response to a demand for an onboard calibration capability the NASA Goddard Space Flight Center (GSFC) and the National Institute of Standards and Technology (NIST) jointly designed and constructed a prototype of a portable light source to illuminate various radiometers during oceanographic cruises. This device, called the SQM, produces a diffuse and uniform light field and is designed to be flush-mounted to radiance or irradiance sensors with a spectral range from 380-900 nm. The uniformity of this source is less that 2% over an area of 6 inches in diameter. To account for changes in the illuminance of the SQM, three temperature-controlled photodiodes measure the exit aperture light level: one has a responsivity in the blue part of the spectrum, another in the red part of the spectrum, and the third has a broad-band response.

The SQM has two banks of halogen lamps with eight lamps in each bank. For AMT-4, both banks were populated with Gilway model 187 (4.2 V and 1.05 A) lamps. The power supply for the lamps is via two highly regulated Hewlett Packard (HP) model 6030A power supplies. Both power supplies are controlled with voltage sources provided by a computer-controlled 16 bit digital-to-analog (D/A) board. The output current values from the power supplies are monitored by measuring the voltages across two precision 0.5 ohm shunt resistors with a HP 3457 digital voltmeter (DVM). The DVM voltages are acquired over an HP interface bus (HPIB), and the program controlling the D/A boards and acquiring the signals converts the resistance values to current and adjusts the output of the power supplies to ensure a constant current supply to the lamps.

Data logging for the SQM involves two computer systems: one for the device under test (DUT) and one for the SQM. Three of the DUTs were fiducials, that is, dummy radiometers with different reflective surfaces: a white one, a black one, and a black one with a glass face (made of the same glass used in the Satlantic radiometers). The purpose of the fiducials is to be able to collect data with them before and after actual radiometers as another way of tracking the short- and long-term characteristics of the SQM light chamber as determined by the internal photodiodes.

Whenever the DUT was a field radiometer, a computer system was needed to acquire and log the data from the radiometer. For AMT-4, the UOR and SeaOPS radiometers were logged using the C-OPS software running on a Macintosh 180c PowerBook computer, and the SeaFALLS radiometers were logged using ProVIEW and the Compaq computer normally used for that purpose.

The SQM software is written in Visual Basic and is hosted on a Toshiba PC laptop. The SQM computer controls the HP 6030A power supplies and acquires seven other signals from the HP 3457 DVM: three photodiode voltages from inside the SQM, two thermistor (temperature) voltages from the two shunts, and two voltages across the two shunts. The latter are converted into currents, since the resistance of the shunts is known. All of this information is time stamped and logged into a tab-delimited ASCII file. The file has descriptive headers which record the DUT being used and what the configuration of the SQM was during the experiment.

SeaFALLS

SeaFALLS is composed of two sub sytems both manufactured by Satlantic: a SeaWiFS Profiling Multichannel Radiometer (SPMR) and a SeaWiFS Multichannel Surface Reference (SMSR). The latter measures down welling irradiance and up welling radiance as it falls through the water column, while the latter measures down welling irradiance just below the sea surface. The profiler receives its power and sends its data via an umbilical cable; it is sufficiently buoyant in water that one person can deploy and recover the profiler. The reference floats just below the surface suspended from a square floating frame; it can also be deployed and recovered by one person. Because both the profiler and the reference can be deployed far away from the ship, any ship-induced disturbances to the in situ light field are minimized.

The SPMR and SMSR units utilize 13-channel radiometers with the same wavelengths (approximately 406, 412, 443, 470, 490, 509, 532, 555, 590, 665, 670, 683, and 700 nm) and bandwidths (10 nm). The SeaOPS band set is a subset of this: approximately 412, 443, 490, 509, 555, 665, and 683 nm. SeaFALLS is equipped with OCI-1000 and OCR-1000 radiometers which employ 24-bit A/D converters and are capable of detecting light over a seven decade range (SeaOPS uses OCI-200 and OCR-200 radiometers which use 16-bit A/D converters).

Data telemetry for SeaFALLS is very similar to SeaOPS. A deck unit, a PRO-DCU (S/N 020), supplies the power for both the profiler and reference independently. The output voltage is automatically adjusted for the cable length being used. An internal computer shuts the system down under fault conditions while indicating the type of fault. RS-485 telemetry at 19.2 Kbaud is converted in the deck box to RS-232 for input into a microcomputer, in this case a Compaq laptop personal computer (PC).

The logging and display software initially used with SeaFALLS was provided by Satlantic and is called ProVIEW. There are several display windows associated with this software which can show all the channels in raw counts or calibrated units. Data is logged in a packed binary format, although ASCII data can be produced using an included utility. For the majority of the AMT-4 cruise, the SeaFALLS data was logged on a Macintosh PowerPC

7100 using a software package developed by RSMAS and GSFC. This package, called C-FALLS, functions very similarly to C-OPS. The primary difference is C-FALLS has an option for recording the data in the ProVIEW binary format. The profile logs are given in Appendix L.

LoCNESS

LoCNESS is not a new instrument per se, but instead is built up from the SeaOPS components: the DATA-100 (S/N 004) and the two light sensors, OCR-200 (S/N 021) and OCI-200 (S/N 029). Once assembled, LoCNESS is a free-falling unit that looks very similar to SeaFALLS and is deployed in the same fashion. The data acquisition for LoCNESS is the same one used for SeaOPS.

The principle advantage of LoCNESS is its cost; it can be assembled from relatively low cost components. Of course, there is a commensurate loss in sensitivity or capability in comparison to SeaFALLS, so one of the AMT-4 cruise objectives was to evaluate the capabilities of LoCNESS in comparison to SeaFALLS. This was done by making simultaneous deployments of the two with one another or with one of the other profiling instruments: SeaOPS, fitted with a different set of OCR-200 (S/N 035) and OCI-200 (S/N 040) radiometers plus a new DATA-100 (S/N 019), or SeaSPEC. During most deployments of LoCNESS, data was also collected from the SeaFALLS floating irradiance sensor and the SeaOPS MVDS irradiance sensor.

SeaSPEC

SeaSPEC is a new instrument that was used for the first time on AMT-4. SeaSPEC is a dual spectrometer utilizing 1 m fibre-optic cables to collect light away from the main body of the instrument. One fibre-optic cable is used to collect downwelled irradiance data and the other is used to collect upwelled radiance. In both cases, the light collectors are very small (less than 1.5? cm in diameter) to minimize self-shading effects. A log of the profiles obtained with this instrument is given in Appendix M.

4.4.5 AMT-4 UOR

James Woolfenden Plymouth Marine Laboratory

During AMT-4 the undulator was towed for approximately 168 hours covering 3,400 km of the Atlantic transect. The UOR was usually deployed once per day after the morning station being recovered at the afternoon station. The three exceptions to this rule were the tows 415, 420, 432. The first and last of these being overnight tows through regions of interest- the equatorial upwelling (see Figure 23) and the Celtic sea shelf break. Similar to the strategy adopted for the undulator on previous AMT's, the UOR was towed on 400 metres of cable at 11-12 knots with a programmed depth range of 3-72 metres undulating over a cycle of 288 seconds. The log of UOR tows is given in Appendix N.

The undulator carried a Plymouth Marine Laboratory CTDF (Conductivity, temperature, depth and fluorometer) unit JA5 and data logger JA8 & 10, Satlantic downwelling irradiance (OCI-200, S/N 001) and upwelling radiance (OCR-2--, S/N 001) a Chelsea instruments Alphatracka Mk11, 660 nm, 0.25m transmissometer (S/N 006).

Equipment failures during the cruise were low compared to previous AMT's, with the only major failure, a data cable to the Satlantics, before tow 410 . Towards the end of the cruise, anomalies in the temperature record (power failures on the temperature board of CTDF JA5) and later with data dropouts (from the logger JA10). A preliminary analysis of CTDF data from the equator clearly showed the presence of the this phenomena.

Figure 23

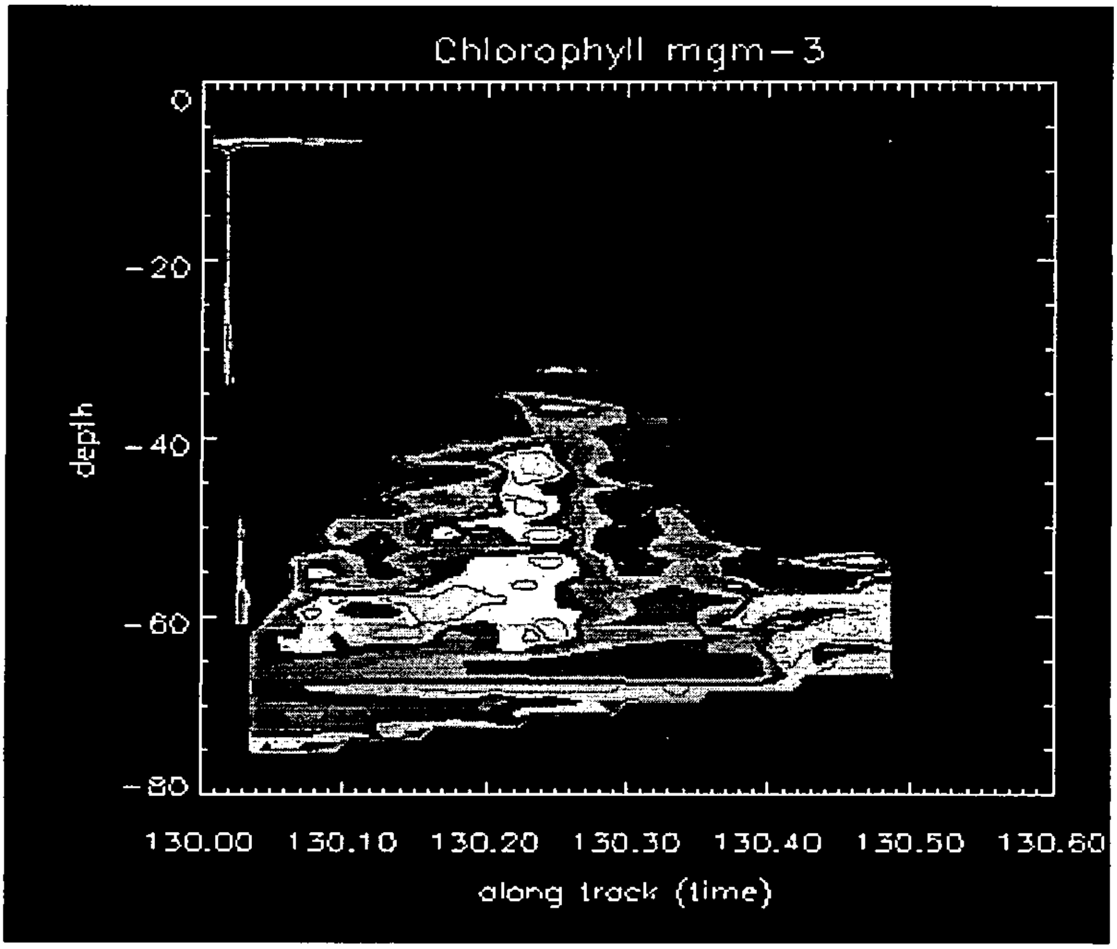


Figure 23 shows a 'dome' of upwelling chlorophyll fluorescence measured with the UOR on day 130 approximately on the equator. Light shades are high fluorescence, dark shades are low fluorescence.

AMT3 – 24/10/1996. -13;06

(OK 23/10/96 14:08;50) 0.3,

AMT5 13/10 dodgy ch1 !

look for jump in signal between 13/10 and 14/10.

between 10th + 11th

4.5 Physical Oceanography

4.5.1 Salinity and temperature calibrations

Colin Griffiths and Tony Bale, Plymouth Marine laboratory

The precision of the Neil Brown CTD unit was checked by reference to salinity values determined for bottle samples taken on each CTD cast (typically at three depths) and with certified, ISO reversing digital thermometers. The SeaBird, flow-through thermosalinograph interfaced to the Ocean Logger was then checked by reference to the CTD values.

The salinity bottles were analysed for conductivity using a Guildline, Autosal, precision salionometer standardised against standard seawater (Ocean Scientific Ltd.) according to the operating instructions. Salinity was calulated from the conductivity ratio at the temperature of the measurements using the algorithm developed by A. Bennett (B.I.O.) which is consistent with the UNESCO salinity tables.

CTD temperature sensor
A total of 180 thermometer readings were used to check the temperature values produced by the Neil Brown CTD unit. The thermometer values were individually corrected using the calibration certificates supplied with each thermometer. The differences between the thermometer value and the CTD value are plotted as CTD errors against the respective temperature values and against time over the duration of the cruise in Figure 24a & b. Although temperature calibration work for oceanographic purposes would not normally be carried out on near-surface samples, where large variations in temperature over small vertical distances can give rise to rapid chenges in CTD values and consequently less precise readings, the temperature errors were not large and ranged from -0.02^{o}C at 5^{o}C to zero at 28^{o}C. There was no significant trend with time over 33 days. Based on these thermometer readings, the calibration of the CTD temperature sensor is:-

true temperature = CTD temperature x 0.9995 + 0.02222, $\mathbf{r^2 = 1.000}$

CTD conductivity sensor
Based on the measurement of 96 salinity bottles samples, the salinity values generated by the CTD instrument were, for the most part negligible but appeared to read very slightly high at low salinity values (around 34 psu) and slightly low at high values (around 37 psu). The values are plotted in Figure 24c & d. The calibration of the CTD sensor is given as:-

true salinity = CTD salinity x 1.004 - 0.1364, $\mathbf{r^2 = 0.9998}$

SeaBird (Ocean Logger) thermosalinograph
Values of sea surface temperature (SST) measured at the hull thermistor and salinity obtained from the SeaBird (SBE) thermosalinograph (derived from conductivity and temperature), respectively, were compared with surface CTD values obtained throughout the voyage. The limitations of this method in surface waters have been pointed out previously. The errors obtained from these comparisons are plotted in Figure 25a-d. Despite some scatter, the salinity and temperature values recorded on the ocean logger appear be very closely similar to the CTD values.

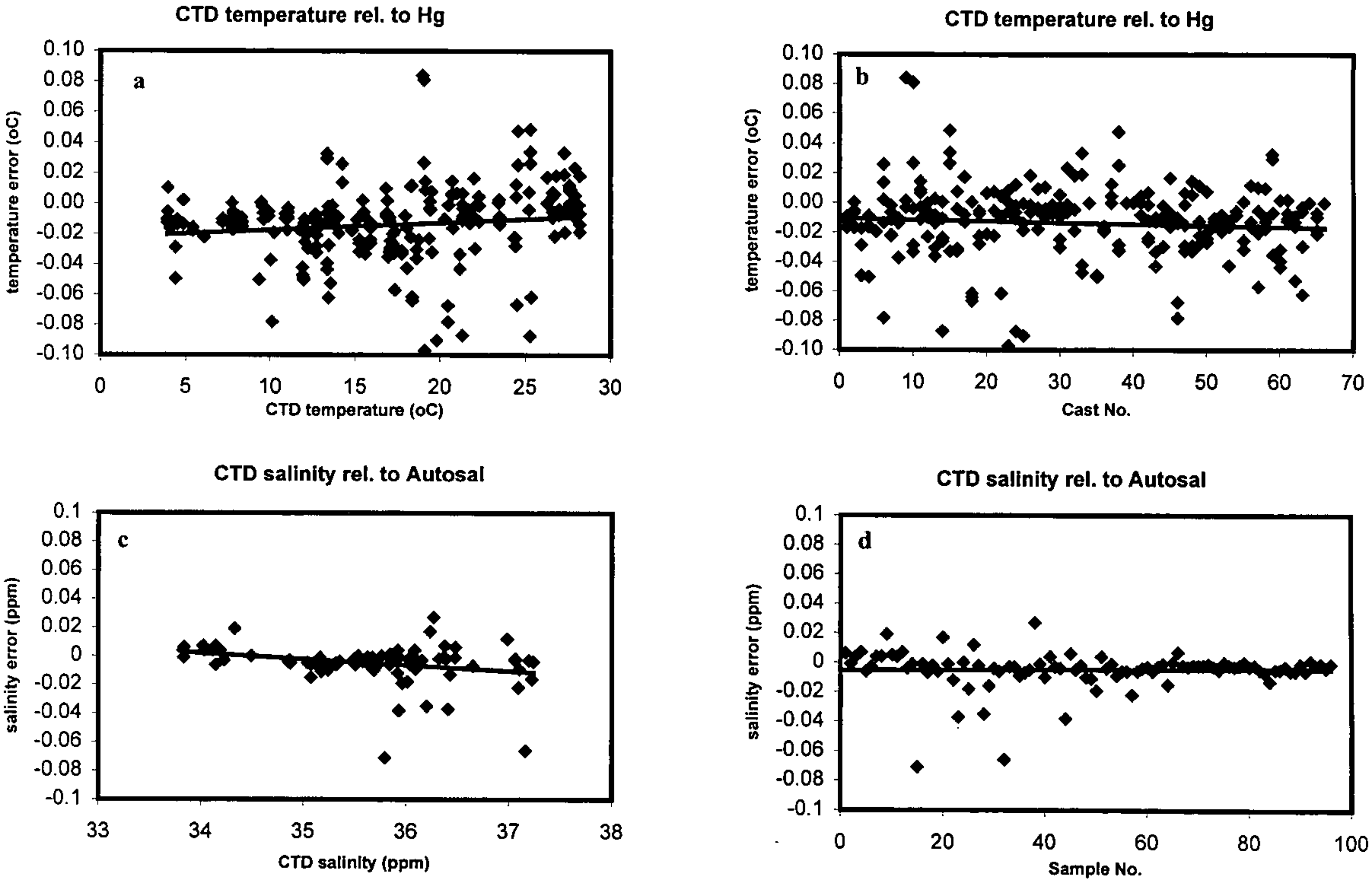

CTD temperature rel. to Hg
a
temperature error (oC)
CTD temperature (oC)
CTD temperature rel. to Hg
b
temperature error (oC)
Cast No.
CTD salinity rel. to Autosal
c
salinity error (ppm)
CTD salinity (ppm)
CTD salinity rel. to Autosal
d
salinity error (ppm)
Sample No.

Figure 24 a-d

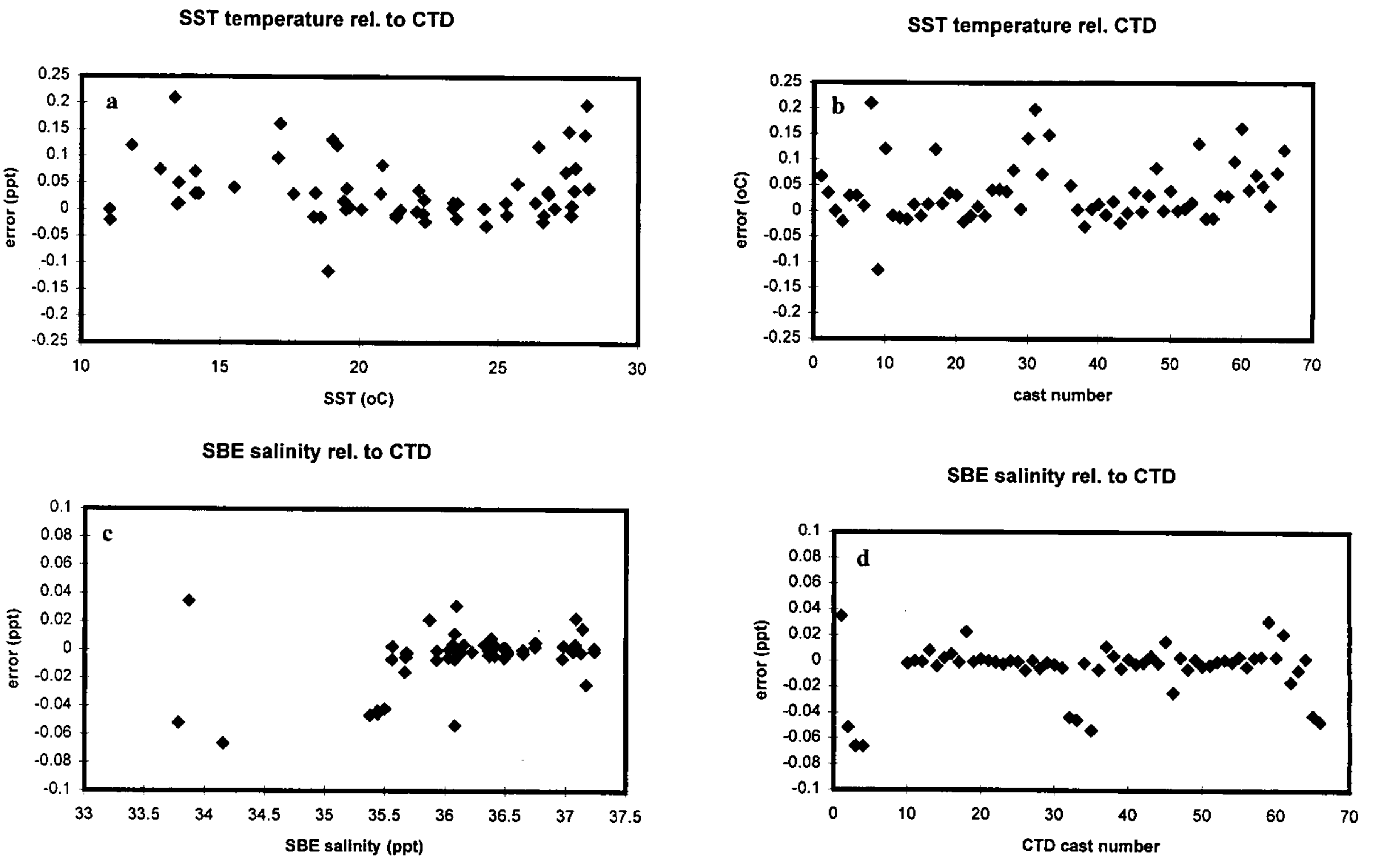

SST temperature rel. to CTD
a
error (ppt)
SST (oC)
SST temperature rel. CTD
b
error (oC)
cast number
SBE salinity rel. to CTD
c
error (ppt)
SBE salinity (ppt)
SBE salinity rel. to CTD
d
error (ppt)
CTD cast number

Figure 25 a-d

4.5.2 CTD operations

Colin Griffiths, Plymouth Marine Laboratory

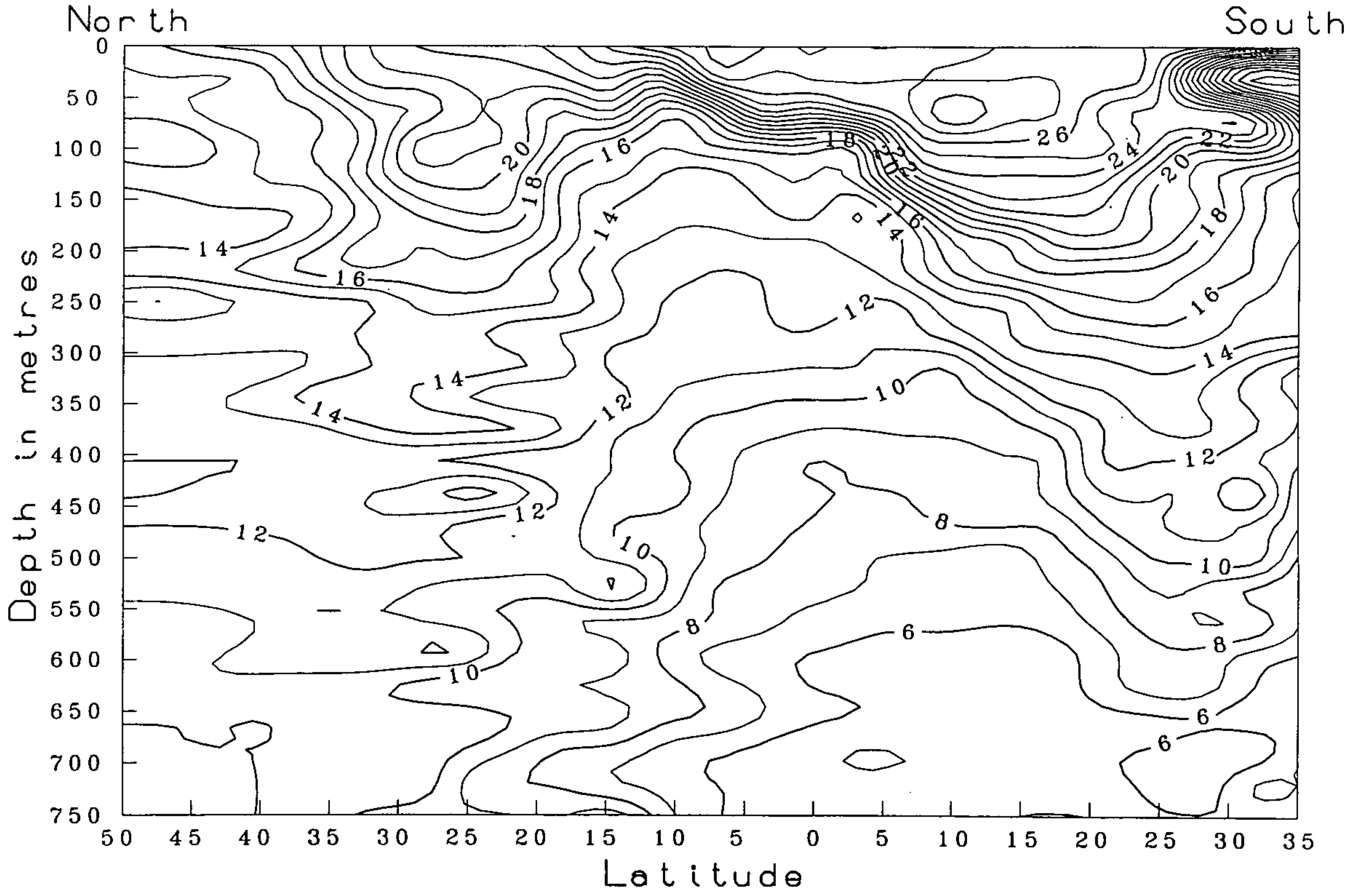
Measurements of conductivity and temperature with depth were made by profiling a Neil Brown Mk IIIB CTD (Instrument Systems, Inc.) when the ship was stationary. Also fitted to the CTD was a PML (Aiken, 1981) fluorometer. The CTD package contained a rosette sampling system fitted with 12 x 10l General Oceanics water bottles. There was one station mid morning each day. At each station the CTD profiled to 200m on the first cast for 'Productivity etc..' and typically to 200m on the second cast for 'Pigments', (see Appendix C). Data was logged onto a PC as well as the Level ABC system which reduced the 8Hz samples to 1 Hz averages. Processing and presentation was performed on the level C system using RVS software. In addition to the daily morning samples to 200m it was possible to do some additional deeper CTD's to either 2000m or 1000m as time allowed in the area between 24°N and 47°N. In total 7 casts were made to 2000m and 6 casts were made to 1000m. The station references (Appendix C) for the 2000m casts were 137c, 138a 139c 139e 140a 141a and 142a, and for the 1000m casts 135c, 136b, 138b, 138c, 139a and 139b. It was possible to take bottle samples through the water column during the night stations. Oxygen measurements were taken from 136b, 137c, 138c, 139c and 139e. Nutrient measurements were taken from 135c, 137c, 138, 139a, 139c and 139e.

4.5.3 Expendable Bathythermographs (XBT) profiles

Colin Griffiths, Plymouth Marine Laboratory

During the cruise a total of 33 Sippican T5 XBT's and 108 Sparton T7 XBT's were deployed. The system worked very well on AMT4 with none of the problems experienced on AMT3. The probe boxes were stored on deck outside the UIC. Temperature profiles were obtained down to a depth of 1830m for the T5's with ship speed down to 7 knts and 760m for the T7's with no restriction on speed. The sampling strategy was modified from earlier AMT cruises. Typically XBT's were launched at 0400,1600 and 2000 (T5) local time each day. Special attention was given to the Province boundaries identified from analysis of earlier AMT2 data. The strategy was to sample 150Km either side of the boundary at 50Km intervals using T7's. The latitudinal boundaries were -46, -40, -37, -34, -15, -2, 1, 5, 8, 12, 19, 26 and 37 (-ve South, +ve North). This sampling strategy was superimposed on the daily sampling. There were insufficient probes to sample on the CTD stations with one exception, in this case the temperatures from the CTD and XBT compared well especially below 100m. In general the XBT surface values were higher than the SST measured by the hull mounted thermistor by ~0.5°C. This is being examined. All data has been banked with the Hydrographic Office Taunton who kindly supplied the probes. A contour plot of the temperature structure (surface to 750m) on the UK to Montevideo leg is given in Figure 26.

Figure 26 AMT4 XBT section Montevideo to UK



4.5.4 Acoustic Doppler Current Profiler (ADCP)

Colin Griffiths, Plymouth Marine Laboratory

The James Clark Ross has a 150khz RDI ADCP unit mounted in the hull. The transducer is enclosed in an oil-filled sea chest recessed into the hull in order to protect it from ice. This chest is closed by a 33 mm thick window of low density polyethylene and filled with silicone oil. Acoustic Doppler current profiling (ADCP) uses the doppler shift of the signals reflected from four, pulsed acoustic beams radiating out and downwards to derive sub-surface currents. The method relies on particulate material in the water to reflect the acoustic signals and the acoustic frequency employed is optimal for scattering from particles of the dimensions of zooplankton. Contained within the backscattered signal data, therefore, is information on the number density (signal strength) of zooplankton in the surface waters. Data was collected in water and bottom track modes, in both modes data was recorded at 2 minute intervals in 64 8m bins. The data was corrected for clock drift, sound speed, misalignment angle and gyro error. The ADCP data obtained during AMT4 was logged and archived for subsequent processing. Distinct migration patterns on diel timescales were observed as the zooplankton migrated to great depths during the day and returned to surface waters (within the depth range of the ACDP) by night. The combination of the special housing of the ADCP with high ship speed and very low particle numbers during the day time meant that signal returns were undetectable for large parts of the transect within the oligotrophic gyres.

Appendix A: Addresses and contact numbers for cruise participants

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Appendix B: AMT4 Ancillary cruise programme -outline plan.

Cruise participants will know that the AMT Programme has been awarded two extra days sea time by CCMS. The additional work proposed here should accommodate most of the suggestions put forward to make use of this time but the actual implementation will have to be flexible dependent on weather conditions, general progress and factors such as crew working hours etc.

Stanley to Monte': 'Basic' mid-morning stations with opportunistic pm optical casts if weather conditions suitable (also an element of practice and work -up for all personnel).

Monte' to Equator: Same basic (am) stations but aiming to achieve greater depth with CTD (if time permits) plus opportunistic pm optical casts.

Equator to 33°N: Same pattern -but plus introduction of some extra mid-depth casts (750-1000m) possibly early am -combined with extra/extended production work; and/or longer basic (am) stations and/or pm combined with extended optical work. Sample Mauritanian waters if Dip. Clearances approved but no major course dev'n.

33°N: Deep cast (3000m = about 1.5 hours plus standard shallow cast) and possibilities for repetitive sampling of other parameters?

33°N to 36°N: Mid-depth cast every approx 1 degree (as convenient crew hours/sampling requirements etc) and fitted around/into routine programme. Possible extra late night casts? 36°N - 2nd deep cast with long station (NB will try to time the deep cast for good optics as well)

36°N to 40 °N: Continue basic programme progressively reducing number of opportunistic mid-depth casts/extended optics.

40 °N to 47 °N: Basic AMT routine plus opportunistic pm station for optics.

47 °N to Channel: Basic AMT routine but prepared to alter course for 'features' in response to satellite information and prospects of aircraft over flights.

English Channel to Dover Straits and then to Grimsby: shallow water stations (if required) followed by shallow optic casts and surface underway sampling with limited optical casts (Case II waters).

Appendix C: Station times and position

Station	Day	Start	End	Lat	Lon	date/notes
1	111a	17:00	18:32	S50 58.4	W57 17.7	21st April
2	112a	14:00	15:20	S47 37.2	W55 56.5	22nd
3	112b	18:57	19:13	S47 01.7	W55 41.7	22nd
4	113a	13:55	15:25	S43 28.9	W54 24.0	23rd
5	114a	14:04	15:04	S39 26.2	W52 58.2	24th
			into	Monte'		25th-29th
6	120a	13:43	14:46	S35 39.0	W49 49.0	30th
7	121a	13:15	14:10	S32 36.6	W46 12.0	1st May
8	121b	18:00	18:15	S32 06.5	W45 37.2	1st
9	122a	13:00	14:16	S29 19.7	W42 38.5	2nd
10	123a	13:00	13:50	S26 06.2	W39 11.0	3rd
11	123b	17:56	18:07	S25 34.2	W38 34.9	3rd
12	124a	13:00	14:02	S22 09.5	W36 37.2	4th
13	125a	11:55	12:50	S18 16.1	W34 46.3	5th
14	126a	11:55	13:10	S14 06.9	W32 50.3	6th
15	127a	11:50	12:56	S10 02.1	W30 56.8	7th
16	128a	11:55	13:05	S05 54.0	W29 05.0	8th
17	128b	16:52	17:16	S05 54.3	W29 07.5	8th
18	129a	11:50	12:50	S02 01.5	W27 19.7	9th
19	129b	17:01	17:10	S01 19.6	W27 03.1	9th
20	130a	00:00	00:40	S 00 07.9	W26 28.4	10th, crossed at 23.45 approx
21	130b	11:55	13:00	N01 53.9	W25 37.1	10th, line ceremony
22	131a	11:55	12:51	N06 04.9	W23 38.3	11th Sunday,
23	132a	12:00	13:00	N10 03.4	W21 55.4	12th
24	132b	16:51	17:05	N1035.1	W23.38.3	rocket
25	133a	00:00	00:50	N11 44.4	W21 05.3	13th, clocks fwd 1hr
26	133b	11:50	12:15	N13 44.6	W20 59.9	13th
27	134a	10:50	11:50	N17 47.0	W21 13.0	14th,
28	134b	16:00	17:00	N18 29.2	W21 16.2	14th, rocket only
29	135a	10:45	11:10	N22 10.1	W21 33.3	15th,
30	135b	15:54	16:05	N22 50.0	W21 36.6	15th, rocket
31	135c	22:55	23:50	N24 10.0	W21 42.4	15th, night cast + net
32	136a	10:55	14:00	N26 16.6	W21 52.7	16th, extended optics
33	136b	22:55	23:50	N27 57.6	W21 57.8	16th night cast 1000m
34	137a	10:50	11:50	N30 02.6	W21 45.6	17th
35	137b	15:55	16:13	N30 44.7	W21 38.7	17th, rocket
36	137c	22:30	23:55	N31 48.4	W21 33.6	17th , 2000m
37	138a	10:50	14:03	N33 43.8	W21 18.1	18th, 2000m +extended optics
38	138b	17:00	17:50	N34 09.3	W21 13.7	18th, 1000m + rocket
39	138c	20:45	21:50	N34 36.7	W21 05.9	18th, 1000m intermediate
40	139a	00:50	01:30	N35 06.3	W20 57.7	19th, 1000m intermediate
41	139b	04:33	05:30	N35 36.1	W20 47.9	19th, 1000m + divert

Station	Day	Start	End	Lat	Lon	date/notes
42	139c	10:45	13:00	N36 13.0	W20 50.0	19th, 2000m +extended optics
43	139d	15:54	16:04	N36 41.0	W20 38.9	19th, rocket drop
44	139e	22:30	23:50	N37 45.5	W20 04.0	19th, 2000m
45	140a	10:55	13:00	N39 51.9	W20 00.1	20th, 2000m +extended optics
46	140b	16:00	15:55	N40 24.5	W19 59.5	20th, rocket drop
47	140c	23:00	23:20	N41 43.4	W20 01.5	20th, net cast
48	141a	11:00	12:55	N43 58.0	W19 58.9	21st, 2000m +extended optics
49	141b	16:00	16:15	N44 30.8	W19 57.9	21st, rocket drop
50	141c	23:00	23:30	N45 29.2	W19 59.4	21st, net cast
51	142a	10:00	12:00	N47 00.2	W19 59.9	22nd, 2000m +extended optics
52	142b	16:00	15:55	N47 11.7	W19 04.6	22nd, rocket drop (no nets)
53	143a	11:00	13:00	N48 03.5	W13 59.1	23rd, 200m plus 20m (oxygen)
54	143b	16:00	16:15	N48 12.7	W13 10.0	22nd, rockets, UOR shelf break
55	144a	10:00	11:00	N48 57.3	W08 46.0	24th, tandard am; lost reference
56	145a	10:00	11:00	N50 04.1	W03 28.1	25th, SeaSPEC + overflight StPt
57	146a	08:50	10:00	N51 43.0	E01 47.2	26th, SeaSPEC + overflight Tha.

Appendix D: CTD-rosette water bottle log

stn/SDY/cast	1/111a/1	2/112a/3	4/113a/5	5/114a/7	
	7	7	2	2	
	20	20	7	7	
production	40	35	20	20	
& zoopl	60	50	30	40	
	80*	65	40	60	
	100	150	50	80	
			60	100	
stn/SDY/cast	**1/111a/2**	**2/112a/4**	**4/113a/6**	**5/114a/8**	
	7	2	7	2	
chem &	20	7	20	7	
micro biol	30	20	30	15	
	40	30	40	20	
	50	35	50	30	
	60	40	60	40	
	70	50	70	60	
	80	60	80	80	
	90	80	100	100	
	100	100	120	120	
		150	160	160	
		200	200	200	

stn/SDY/cast	6/120a/9	7/121a/11	9/122a/13	10/123a/15	12/124a/17
	7	7	7	7	7
	20	20	20	20	30
production	40	40	30	40	60
& zoopl	60	50	40	60	70
	70	70	60	80	90
	80	90	80	110	110
			100		140
stn/SDY/cast	**6/120a/10**	**7/121a/12**	**9/122a/14**	**10/123a/16**	**12/124a/18**
	2	7	7	7	7
chem &	7	20	25	20	20
micro biol	20	45	40	30	30
	40	60	50	55	50
	60	70	60	70	70
	80	80	70	80	80
	100	90	90	90	90
	120	110	110	110	115
	140	130	130	130	140
	160	150	150	150	160
	180	175	175	175	180
	200	200	200	200	200

stn/SDY/cast	13/125a/19	14/126a/21	15/127a/23	16/128a/25	18/129a/27
	7	7	7	7	7
	40	40	30	30	20
production	60	60	60	50	30
& zoopl	110	100	100	90	50
		130	120	110	70
		155	140	120	80
					90
Stn/SDY/cast	**13/125a/20**	**14/126a/22**	**15/127a/24**	**16/128a/26**	**18/129a/28**
	7	7	7	7	7
chem &	20	25	20	20	20
micro biol	40	50	40	40	40
	60	70	50	60	50
	80	80	60	70	60
	90	100	80	90	70
	100	115	100	110	90
	110	130	120	120	100
	130	160	140	150	120
	150	200	200	200	150
	175	250	250	250	175
	200	300	300	300	200

Stn/SDY/cast		21/130b/30	22/131a/32	23/132a/34	
		7	7	7	
		20	20	20	
production		40	30	40	
& zoopl		60	40	50	
		72	60	60	
			70*	70	
					(night)
Stn/SDY/cast	**20/130a/29**	**21/130b/31**	**22/131a/33**	**23/132a/35**	**25/133a/36**
	7	7	7	2	7
chem &	20	20	15	7	40
micro biol	40	40	20	20	100
	50	50	30	30	200
	60	60	40	40	300
	70	70	50	50	400
	80	80	60	60	500
	90	90	70	70	600
	100	100	80	80	700
	120	120	100	100	800
	150	150	150	150	900
	200	200	200	200	1000

Stn/SDY/cast	26/133b/37	27/134a/39	29/135a/41		32/136a/44
Cast 1	7*	7	7		7
	20	30	30		30
production	30	60	40		60
& zoopl	40	70	53		80
	55*	87	100		90
			150		150
			200	(night)	200
Stn/SDY/cast	**26/133b/38**	**27/134a/40**	**29/135a/42**	**31/135c/43**	**32/136a/45**
	2	7	7	7	7
chem &	7	20	15	50	20
micro biol	15	30	20	100	30
	20	40	30	200	40
	25	50	40	300	50
	30	60	50	400	60
	40	70	60	500	70
	50	80	70	600	80
	70	90	80	700	90
	100	100	100	800	120
	150	150	150	900	160
	200	200	200	1000	200

Stn/SDY/cast		34/137a/47		37/138a/50	
		7		7	
		30		20	
production		50		40	
& zoopl		70		90	
		90		100	
		130			
	(night)	200			
Stn/SDY/cast	**33/136b/46**	**34/137a/48**	**36/137c/49**	**37/138a/51**	**38/138b/52**
	7	7	7	7	7
chem &	50	20	50	50	50
micro biol	100	30	100	100	100
	200	40	200	200	200
	300	50	300	300	300
	400	70	400	400	400
	500	90	500	500	500
	500	110	600	600	500
	700	130	800	800	700
	800	150	1000	1000	800
	900	175	1500	1500	900
	1000	200	2000	2000	1000

Stn/SDY/cast				**42/139c/56**	
				7	
				20	
production				60	
& zoopl				80	
				100	
Stn/SDY/cast	**39/138c/53**	**40/139a/54**	**41/139b/55**	**42/139c/57**	**44/139e/58**
	7	7	7	7	7
chem &	50	50	50	50	50
micro biol	100	100	100	100	100
	200	200	200	200	200
	300	300	300	300	300
	400	400	400	400	400
	500	500	500	500	500
	500	500	500	600	500
	700	700	700	800	700
	800	800	800	1000	800
	900	900	900	1500	900
	1000	1000	1000	2000	1000

Stn/SDY/cast	**45/140a/59**	**48/141a/61**	**51/142a/62**	**53/143a/63**	**55/144a/65**
	7	7	2	2	2
	20	15	7	7	7
production	50	25	15	20	20
& zoopl	60	35	25	40	30
	80	50	40	60	40
	100	70	60	80	50
	200	90	80	100	60
		100	100	120	80
Stn/SDY/cast	**45/140a/60**	150	150	160	100
	7	200	200	200	
chem &	20				
micro biol	30			**53/143a/64**	
	40			extra for O2	
	50				
	60			7	
	70			20	
	80				
	90				
	100				
	150				
	200				

Stn/SDY/cast	56/145a/66	57/146a			
	2	no bottles			
	7				
production	20				
& zoopl	30				
	40				
	50				

Appendix E: Scientific Bridge Log

Date	SDY	Latitude	Longitude	Time (GMT)	Activity
21/04/97	111	**50°59.35 S**	**057°17.7 W**	**17:00**	**Stopped on station #1**
				17:07	Plankton net deployed to100m
				17:13	Deployed optics rig
				17:15	Plankton net recovered
				17:17	Plankton net redeployed to 100m
				17:22	CTD deployed
				17:26	Plankton net recovered
				17:28	Plankton net deployed to 20 metres
				17:33	Drift net deployed
				17:43	Optics recovered
				17:45	CTD recovered
				18:08	CTD redeployed
				18:11	Rocket and reference (OPTICS) deployed
				18:30	Rocket and reference recovered
				18:32	CTD and net recovered, vessel increases to 6 knots for UOR
				18:40	UOR deployed at 11.0 knots
				18:49	UOR recovered at 6 knots
				18:50	UOR deployed at 12 knots
				21:00	Vessel at 12 knots for UOR recovery
				21:08	UOR recovered
22/04/97	112	50°01.9 S	056°53.8 W	00:20	XBT 1 launched
		48°18.2 S	055°13.2 W	10:05	XBT 2 launched
		47°37.1 S	**055°56.7 W**	**14:00**	**Stopped on station #2**
				14:03	Optics rig and plankton net deployed to 200 metres
				14:15	CTD deployed
				14:20	CTD deployed to 150 metres
				14:23	Plankton net recovered
				14:26	Plankton net redeployed
				14:28	Optics rig recovered
				14:33	CTD recovered
				1445	Plankton net recovered
				14:50	CTD deployed to 200 metres
				14:53	Plankton and CTD deployed
				15:20	Optics rig and plankton net recovered
				15:35	UOR deployed
				18:42	Slow to recover UOR
				18:50	UOR recovered
		47° 01.7 S	**055° 41.7 W**	**18:57**	**Stopped at station #3, Rocket and reference deployed**
				19:13	Rocket and reference recovered
		46° 59.3 S	055° 40.6 W	19:30	XBT 3 launched
		46° 34.6 S	055° 31.1 W	21:45	XBT 4 launched
		46° 11.9 S	055° 24.3°W	23:51	XBT 5 launched

23/04/97	113	45°48.04 S	055°15.3 W	02:05	XBT 6 launched
		45° 23.1 S	055° 05.6 W	04:26	XBT 7 launched
		45° 03.6 S	054° 58.4 W	06:03	XBT 8 launched
		44° 40.5 S	054° 50.2 W	07:57	XBT 9 launched
		44° 16.5 S	054° 40.7 W	10:00	XBT 10 launched
		43° 29.0 S	**054° 24.0 W**	**13:55**	**Stopped at station #4**
				13:58	Plankton net deployed
				14:00	Optics rig deployed
				14:01	CTD deployed
				14:04	CTD deployed to 100 metres
		44°14.6 S	054°40.0 W	14:07	XBT launched
				14:17	Plankton net recovered
				14:21	CTD recovered
				14:22	Plankton net deployed
				14:24	Optics rig deployed
				14:32	Reference deployed
				14:36	Rocket deployed
				14:38	Plankton net recovered
				14:40	Plankton net deployed
				14:44	Plankton net recovered
				14:48	Surface net deployed
				14:53	Reference recovered
				14:55	Rocket recovered
				15:00	CTD deployed to 200 m
				15:23	CTD recovered
				15:35	UOR deployed @ 4 knots
		42°41.2 S	054°06.1 W	20:11	XBT 11 launched
				21:09	UOR recovered @ 4 knots
		42°24.4 S	054°00.1 W	21:58	XBT 12 launched

24/04/97	114	41°59.0 S	053°52.1 W	00:20	XBT 13 launched
		41°38.3 S	053°45.1 W	02:20	XBT 14 launched
		41°07.4 S	053°34.7 W	05:08	XBT 15 launched
		40°35.2 S	053°22.8 W	07:50	XBT 16 launched
		40°05.8 S	053°13.2 W	10:25	XBT 17 launched
		39°45.8 S	053°05.5 W	12:12	XBT 18 launched
		39°26.2 S	**052°58.2 W**	**14:00**	**Stopped at station #5**
				14:02	Plankton net deployed
				14:03	CTD deployed to 108 metres
				14:04	Optics rig deployed
				14:08	Reference deployed
				14:10	Rocket deployed
				14:18	Plankton net recovered
				14:23	CTD recovered
				14:24	Plankton net deployed
				14:32	Optics rig recovered
				14:33	Rocket recovered
				14:36	Reference deployed, CTD deployed to 200 m
				14:41	Plankton net recovered
				14:44	Plankton net deployed
				14:45	CTD @ 200 metres

				14:47	Plankton net recovered
				14:51	Surface net deployed
				15:05	CTD and surface net recovered
				15:11	Vessel moves off station
		38°26.4 S	053°33.2 W	20:30	XBT 19 launched
30/04/97	**120**	**35°39.1 S**	**049°49.1 W**	**13:35**	**Station #6**
				13:40	Optics rig deployed
				13:41	CTD and second optics rig deployed
				13:45	Rocket and reference deployed
				13:47	CTD @ 150 m
				14:00	Optics rig recovered
				14:02	CTD recovered
				14:04	Optics rig on deck
				14:12	Plankton net deployed
				14:15	2nd optics rig on deck/rocket deployed
				14:16	Reference recovered
				14:26	CTD redeployed
				14:30	Plankton net recovered
				14:31	Plankton net deployed
				14:44	2nd CTD recovered
				14:48	Plankton net recovered
				14:56	UOR deployed
		35°20.6 S	049°26.0 W	17:20	XBT 20 launched
		35°03.6 S	049°05.4 W	19:35	XBT 21 launched
				20:25	UOR recovered
		34°48.5 S	048°46.8 W	21:24	XBT 22 launched
		34°33.4 S	048°27.7 W	23:15	XBT 23 launched
01/05/97	121	34°17.3 S	048°08.7 W	01:06	XBT 24 launched
		34°02.3 S	047°52.8 W	02:55	XBT 25 Launched
		33°39.5 S	047°29.4 W	05:20	XBT 26 Launched
		33°21.9 S	047°07.8 W	07:30	XBT 27 Launched
		33°05.4 S	046°48.0 W	09:32	XBT 28 Launched
		32°36.6 S	**046°12.0 W**	**13:10**	**Station #7**
				13:12	Optics rig deployed
				13:14	Plankton net deployed
				13:18	Reference deployed
				13:19	Rocket deployed
				13:21	Plankton net to 200 metres
				13:30	Plankton net recovered
				13:34	Plankton net redeployed to 200 metres
				13:35	Optics rig recovered
				13:38	CTD recovered
				13:46	Rocket recovered
				13:49	Reference recovered
				13:50	CTD deployed to 200 metres
				13:54	Plankton net recovered
				13:56	Plankton net deployed to 20 metres
				13:58	Net recovered
				14:05	Drift net deployed

				14:10	CTD recovered
				14:12	Plankton net recovered
				14:20	UOR deployed
				17:56	UOR recovered
		32°06.5 S	**045°37.2 W**	**18:00**	**Station #8**
				18:05	Reference deployed
				18:08	Rocket deployed
				18:15	Rocket and reference recovered
		31°54.7 S	045°24.0 W	19:40	XBT 29 launched
02/05/97	122	30°54.8 S	044°20.0 W	02:20	XBT 30 launched
		30°12.1 S	043°38.5 W	07:22	XBT 31 launched
		29°19.7 S	**042°38.5 W**	**13:00**	**Station #9**
				13:06	Plankton net deployed
				13:10	CTD deployed
				13:16	Optics rig deployed
				13:17	CTD @ 200 metres
				13:20	Rocket and reference deployed
				13:25	Plankton net recovered
				13:26	Plankton net deployed
				13:30	CTD recovered
				13:40	Plankton net recovered
				13:45	Plankton net deployed and rocket recovered
				13:47	Plankton net recovered
				13:49	Optics rig recovered
				13:51	Plankton net deployed
				13:55	CTD deployed
				13:56	Optics rig deployed
				14:15	Optics rig recovered
				14:16	CTD and plankton net recovered
				14:30	UOR deployed
				20:15	UOR recovered
		28°31.3 S	041°44.1 W	20:26	XBT 32 launched
03/05/97	123	27°42.4 S	040°52.7 W	01:45	XBT 33 launched
		27°03.1 S	040°09.7 W	06:27	XBT 34 launched
		26°06.2 S	**039 °11.0 W**	**12:50**	**Station #10**
				13:00	CTD and plankton net deployed
				13:05	Plankton net recovered
				13:15	CTD recovered
				13:18	Plankton net deployed
				13:22	Optics rig recovered
				13:27	Rocket recovered
				13:30	Optics rig deployed
				13:31	CTD deployed
				13:36	Plankton net deployed
				13:40	Plankton net recovered
				13:42	Plankton net deployed
				13:48	Optics rig and CTD recovered
				13:50	Plankton net recovered

				14:00	UOR deployed
				17:52	UOR recovered
		25°34.2 S	**038°34.9 W**	**17:56**	**Station #11**
				17:58	Reference deployed
				18:00	Rocket deployed
				18:07	Reference recovered
				18:08	Rocket recovered
		25°25.2 S	038°25.1 W	19:08	XBT 35 launched
04/05/97	124	23°10.0 S	037°25.1 W	07:27	XBT 36 launched
		22°09.5 S	**036°37.2 W**	**12:50**	**Station #12**
				12:55	Plankton net, optics rig, CTD, rocket and reference deployed
				13:10	Plankton net recovered
				13:15	Plankton net deployed
				13:20	CTD recovered
				13:30	Plankton net recovered
				13:32	Plankton net deployed
				13:33	Optics rig recovered
				13:35	Net recovered
				13:44	Optics rig and CTD redeployed
				13:50	Rocket recovered
				14:00	CTD and optics rig recovered
				14:02	Drift net recovered
				14:12	UOR launched
		21°14.6 S	036°10.5 W	19:30	XBT 37 launched
				20:20	UOR recovered
05/05/97	125	19°52.7 S	035°31.7 W	02:59	XBT 38 launched
		19°25.8 S	035°18.7 W	05:29	XBT 39 launched
		18°16.1 S	**034°46.3 W**	**11:50**	**Station #13**
				11:55	Optics rig, CTD, plankton , rocket and reference deployed
				12:10	Plankton net recovered
				12:17	CTD recovered
				12:28	Plankton net recovered
				12:30	CTD deployed
				12:31	Plankton net deployed
				12:34	Plankton net recovered
				12:35	Optics rig recovered
				12:39	Rocket and reference recovered
				12:49	CTD recovered
				12:51	Plankton net recovered
				13:00	UOR deployed
				19:20	UOR recovered
		16°58.7 S	034°09.4 W	20:32	XBT 40 launched
		16°35.7 S	033°57.9 W	22:25	XBT 41 launched
06/05/97	126	16°15.3 S	033°48.4 W	00:21	XBT 42 launched
		15°53.2 S	033°38.7 W	02:22	XBT 43 launched
		15°34.2 S	033°30.5 W	04:01	XBT 44 launched

		15°09.7 S	033°19.4 W	06:09	XBT 45 launched
		14°45.8 S	033°08.4 W	08:13	XBT 46 launched
		14°26.0 S	032°58.8 W	10:00	XBT 47 launched
		14°06.9 S	**032°50.3 W**	**11:50**	**Station #14**
				11:55	Optics rig, CTD, plankton net and rocket deployed
				12:10	Plankton net recovered
				12:20	CTD recovered
				12:30	Plankton net recovered
				12:34	Plankton net deployed
				12:36	Plankton net recovered
				12:40	Plankton net deployed
				12:41	Optics rig recovered
				12:48	Optics rig deployed
				12:49	Rocket recovered
				12:50	Reference recovered
				13:02	Optics rig recovered
				13:06	CTD recovered
				13:09	Drift net recovered
				13:18	UOR deployed
		14°02.8 S	032°50.0 W	13:38	XBT 48 launched
		13°40.6 S	032°39.3 W	15:47	XBT 49 launched
		13°22.0 S	032°29.9 W	17:37	XBT 50 launched
				19:18	UOR recovered
07/05/97	127	12°08.2 S	031°54.5 W	00:24	XBT 51 launched
		10°57.4 S	031°21.9 W	06:39	XBT 52 launched
		10°02.1 S	**030°56.8 W**	**11:46**	**Station #15**
				11:54	Plankton net deployed
				11:59	CTD deployed
				12:03	Optics rig deployed
				12:07	Rocket and reference deployed
				12:11	Plankton net recovered
				12:18	CTD recovered, plankton net deployed
				12:30	Plankton net recovered
				12:32	Plankton net deployed
				12:35	Plankton net recovered, CTD deployed
				12:37	Drift net deployed
				12:45	Optics rig recovered
				12:55	CTD and rocket and reference recovered
				13:07	UOR deployed
		09°04.0 S	030°56.8 W	19:00	XBT 53 launched
				19:20	UOR recovered
08/05/97	128	08°04.9 S	030°02.5 W	00:20	XBT 54 launched
		06°48.9 S	029°29.8 W	07:00	XBT 55 launched
		05°54.0 S	029°05.0 W	**11:55**	**Station #16**
				12:00	CTD, plankton net, optics rig and the rocket and reference deployed
				12:10	Plankton net recovered
				12:13	Plankton net deployed
				12:16	CTD recovered

				12:29	Plankton net recovered
				12:34	Plankton net recovered
				12:35	Optics rig recovered
				12:38	Plankton net deployed
				12:41	CTD and optic's rig deployed
				12:52	Reference recovered
				12:55	
				13:00	UOR deployed
				13:01	CTD and optics rig recovered
				13:03	UOR recovered
				13:07	Plankton net recovered
				13:19	UOR deployed
				16:47	UOR recovered
		05°54.3 S	**029°07.5 W**	**16:52**	**Station #17**
				17:00	Optics rig deployed
				17:05	Reference deployed
				17:07	Rocket deployed
				17:15	Rocket recovered
				17:16	Reference and optics rig recovered
		05°12.4 S	028°48.3 W	18:26	XBT 56 launched
09/05/97	129	04°06.6 S	028°18.9 W	00:35	XBT 57 launched
		03°48.5 S	028°11.0 W	02:14	XBT 58 launched
		03°25.3 S	028°00.3 W	04:20	XBT 59 launched
		03°02.0 S	027°49.4 W	06:42	XBT 60 launched
		02°38.5 S	027°38. 0W	08:28	XBT 61 launched
		02°16.5 S	027°27.0 W	10:20	XBT 62 launched
		02°01.45 S	**027°19.7 W**	**11:50**	**Station #18**
				11:55	Plankton net, CTD, optics rig, reference and rocket deployed
				12:10	Plankton net recovered
				12:14	Plankton net deployed
				12:19	CTD recovered
				12:26	Optic's rig and plankton net recovered
				12:30	CTD and plankton net deployed
				12:34	Plankton net recovered
				12:37	Optics rig and Plankton net deployed
				12:41	Reference recovered
				12:50	CTD recovered
				12:51	Plankton net and optics recovered
				13:06	UOR deployed
		01°35.2 S	027°10.2 W	15:30	XBT 63 launched
				16:51	UOR recovered
		01°19.6 S	**027°03.1 W**	**17:01**	**Station #19**
				17:02	Reference deployed
				17:04	Rocket deployed
				17:09	Reference recovered
				17:10	Rocket recovered
				17:24	UOR deployed
		01°11.8 S	026°59.5 W	18:00	XBT 64 launched
		00°23.0 S	026°36.0 W	22:25	XBT 65 launched
				23:50	UOR recovered

10/05/97	130	00°07.9 S	026°28.4 W	00:02	**Station #20**
				00:07	Plankton net and CTD deployed
				00:12	Plankton net recovered
				00:15	Plankton net deployed
				00:18	Plankton net recovered
				00:32	CTD recovered
				00:44	UOR deployed
		00°06.5 N	026°27.5 W	00:50	XBT 66 launched
		00°03.1 N	026°22.8 W	01:46	XBT 67 launched
		00°29.5 N	026°11.4 W	04:12	XBT 68 launched
		00°51.5 N	026°02.3 W	06:12	XBT 69 launched
		01°14.4 N	025°53.3 W	08:12	XBT 70 launched
		01°35.6 N	025°44.6 W	10:06	XBT 71 launched
		01°53.9 N	**025°37.1 W**	**11:56**	**Station #21**
				11:58	Plankton net, CTD, Optics rig, reference and rocket deployed
				12:05	Plankton net recovered
				12:15	Plankton net deployed
				12:19	CTD and plankton net recovered
				12:28	Optics rig recovered
				12:34	Plankton net deployed
				12:36	Plankton net and optics rig recovered
				12:41	CTD deployed
				12:54	Rocket and reference deployed
				13:00	Optics rig, CTD and plankton net recovered
				13:24	UOR deployed
		02°48.4 N	025°11.0 W	18:32	XBT 72 launched
				19:20	UOR recovered
		03°34.0 N	024°48.1 W	22:30	XBT 73 launched
11/05/97	131	03°54.9 N	024°38.3 W	00:18	XBT 74 launched
		04°15.7 N	024°28.3W	02:10	XBT 75 launched
		04°42.7 N	024°15.0 W	04:32	XBT 76 launched
		05°03.9 N	024°05.1 W	06:22	XBT 77 launched
		05°21.4 N	023°57.0 W	07:55	XBT 78 launched
		05°53.3 N	023°42.9 W	10:45	XBT 79 launched
		06°04.9 N	**023°38.3 W**	**11:55**	**Station #22**
				11:56	Plankton net optics rig, CTD, reference and rocket deployed
				12:12	Plankton net recovered
				12:15	Plankton net deployed
				12:17	CTD recovered
				12:21	Optics rig recovered
				12:30	Plankton net recovered
				12:34	Plankton net, CTD and optics rig deployed
				12:35	Plankton net recovered
				12:39	Plankton net deployed
				12:50	Optics rig, rocket and reference recovered
				12:51	CTD and plankton net recovered
				13:05	UOR deployed
		06°50.3 N	023°19.8 W	17:17	XBT 80 launched

				18:30	UOR recovered
12/05/97	132	08°06.8 N	022°47.6 W	00:40	XBT 81 launched
		08°25.4 N	022°40.4 W	02:26	XBT 82 launched
		08°50.3 N	022°30.0 W	04:41	XBT 83 launched
		09°09.5 W	022°21.9 W	06:25	XBT 84 launched
		09°30.7 N	022°11.6 W	08:25	XBT 85 launched
		09°55.3 N	021°59.1 W	10:42	XBT 86 launched
		10°03.4 N	**021°55.4 W**	**12:00**	**Station #23**
				12:05	SeaOPS, CTD, plankton net and SeaFalls and reference deployed
				12:18	Plankton net retrieved
				12:24	CTD recovered, plankton net deployed
				12:28	SeaOPS, plankton net recovered
				12:36	SeaOPS and CTD deployed
				12:41	Plankton net deployed
				12:42	Plankton net retrieved
				12:44	Plankton net deployed
				12:51	SeaFalls and reference retrieved
				12:52	SeaOPS recovered
				12:56	CTD recovered and plankton net deployed
				13:12	UOR deployed
		10°28.8 N	21°55.9 W	15:47	XBT 87 launched
				16:49	UOR recovered
		10°35.1 N	**21°38.3 W**	**16:51**	**Station #24**
				16:53	Reference deployed
				16:58	SeaFalls deployed
				17:02	SeaFalls and reference retrieved
				17:11	UOR deployed
		10°44.6 N	021°34.9 W	17:50	XBT 88 launched
		11°13.5 N	021°20.5 W	20:43	XBT 89 launched
		11°32.1 N	021°10.8 W	22:38	XBT 90 launched
				23:45	UOR recovered
13/05/97	133	**11°44.4 N**	**021°05.3**	**00:00**	**Station #25**
				00:05	CTD and plankton net deployed
				00:15	Plankton net deployed ? rec ?
				00:18	Plankton net deployed
				00:20	Plankton net recovered
				00:25	Plankton net launched
				00:30	Plankton net recovered
				00:50	CTD recovered
		12°01.8 N	021°00.1 W	02:33	XBT 91 launched
		12°25.6 N	021°00.2 W	04:32	XBT 92 launched
		12°50.0 N	021° 00.0 W	06:36	XBT 93 launched
		13°15.0N	021° 00.0 W	08:50	XBT 94 launched
		13°44.6 N	020°59.9 W	11:30	XBT 95 launched
		13°44.6 N	**020°59.9 W**	**11:50**	**Station #26**
				11:56	Plankton net, CTD SeaOPS , SeaFalls and reference deployed
				12:10	Plankton net recovered

				12:15	CTD recovered and plankton net deployed
				12:18	SeaOPS recovered
				12:29	SeaOPS deployed
				12:35	Plankton net recovered
				12:37	CTD deployed
				12:39	Plankton net launched
				12:41	SeaOPS recovered
				12:42	Plankton net recovered
				12:46	Plankton net launched
				12:47	SeaFalls and reference recovered
				12:49	SeaOPS recovered
				12:59	SeaOPS recovered
				13:00	Plankton net recovered
				13:04	SeaOPS recovered
				13:06	UOR deployed
14/05/97	134			00:06	UOR recovered
		16°09.2 N	021°05.5 W	02:20	XBT 96 launched
		17°47.0 N	**021°13.0 W**	**10:50**	**Station #27**
				10:55	SeaOPS and plankton net deployed
				10:57	CTD deployed, SeaFalls and reference deployed
				11:07	Plankton net recovered
				11:14	CTD deployed, plankton net deployed
				11:21	SeaOPS recovered
				11:25	CTD deployed
				11:26	Plankton net recovered
				11:29	SeaOPS deployed
				11:30	Plankton net deployed
				11:32	Plankton net recovered
				11:36	Plankton net deployed
				11:46	SeaOPS, CTD, reference and SeaFalls recovered
				11:48	Plankton net recovered
				12:00	UOR deployed
		18°08.2 N	021°15.0 W	13:58	XBT 97 launched
				15:51	UOR recovered
		18°29.2 N	**021°16.2 W**	**15:53**	**Station #28**
				15:55	Reference deployed
				15:58	SeaFalls deployed
				16:04	Reference recovered
				16:08	SeaFalls recovered
		18°34 N	021°16.8 W	16:40	XBT 98 launched
		18°55.2 N	021°17.6 W	18:25	XBT 99 launched
		19°29.5 N	021°19.1 W	21:14	XBT 100 launched
		19°55.5 N	021°20.0 W	23:24	XBT 101 launched
15/05/97	135	20°19.2 N	021°21.9 W	01:38	XBT 102 launched
		20°41.2 N	021°23.6 W	03:27	XBT 103 launched
		21°06.5 N	021°25.8 W	05:27	XBT 104 launched
		22°10.1 N	**021°33.3 W**	**10:45**	**Station #29**
				10:50	SeaOPS , reference and SeaFalls deployed
				10:55	CTD and plankton net deployed

				11:12	SeaOPS recovered
				11:15	CTD recovered
				11:16	Plankton net recovered
				11:18	Plankton net deployed
				11:25	SeaOPS deployed
				11:30	Reference recovered
				11:34	SeaFalls recovered
				11:36	SeaOPS and plankton net recovered
				11:38	CTD and plankton net deployed
				11:43	Plankton net recovered
				11:45	Plankton net deployed
				12:00	CTD and plankton net recovered
				12:06	UOR deployed
		22°50 N	**021°36.6 W**	**15:54**	**Station #30**
				15:55	Reference deployed
				15:58	SeaFalls deployed
				16:04	SeaFalls and reference recovered
		23°10 N	021°38.2 W	17:45	XBT 105 launched
		24°10.0 N	**021°42.4 W**	**22:55**	**Station #31**
				22:56	CTD and plankton net deployed
				23:10	Plankton net recovered
				23:14	Plankton net deployed
				23:16	Plankton net recovered
				23:18	Plankton net deployed
				23:25	Plankton net recovered
				23:45	CTD recovered
16/05/97	136	24°55.6 N	021°46.4 W	03:50	XBT 106 launched
		24°58.7 N	021°46.7 W	04:12	XBT 107 launched
		25°48.1 N	021°50.3 W	08:26	XBT 108 launched
		26°16.6 N	**21°52.7 W**	**10:55**	**Station #32**
				10:56	Plankton net, SeaOPS, CTD, reference and SeaFalls deployed
				11:10	Plankton net recovered
				11:20	CTD recovered
				11:26	SeaOPS recovered
				11:30	SeaOPS deployed and plankton net recovered
				11:34	JR1 launched (Rigid inflatable boat)
				11:37	CTD and plankton net deployed
				11:55	Plankton net and CTD recovered
				12:05	SeaOPS recovered
				12:06	JR1 recovered
				12:15	SeaOPS and JR1 deployed
				12:35	SeaOPS and SeaFalls recovered
				12:46	JR1 recovered
				13:01	SeaFalls and SeaOPS deployed
				13:54	Reference recovered
				13:56	SeaFalls and SeaOPS recovered
				14:00	UOR deployed
		26°30.4 N	021°54.6 W	15:08	XBT 109 launched
		27°05.7 N	021°56.5 W	18:15	XBT 110 launched
				18:19	UOR recovered

		27°57.6 N	**021°57.8 W**	**22:55**	**Station #33**
				23:00	CTD & plankton net deployed
				23:18	Plankton net recovered
				23:22	Plankton net deployed
				23:35	Plankton net recovered
				23:50	CTD recovered
17/05/97	137	29°00.0 N	021°52.8 W	05:26	XBT 111 launched
		30°02.6 N	**021°45.6 W**	**10:50**	**Station #34**
				10:55	CTD, SeaOPS and plankton net deployed
				11:00	Reference deployed
				11:05	SeaFaLLS deployed
				11:14	Plankton net recovered
				11:16	Plankton net deployed
				11:17	CTD recovered
				11:22	SeaOPS recovered
				11:30	SeaOPS and CTD deployed
				11:32	Plankton net recovered
				11:35	Plankton net deployed and reference recovered
				11:37	Plankton net recovered
				11:40	Plankton net deployed
				11:49	CTD, SeaOPS and plankton net recovered
				12:00	UOR deployed
		30°23.8 N	021°41.7 W	13:53	XBT 112 launched
				15:50	UOR recovered
		30°44.7 N	**021°38.7 W**	**15:55**	**Station #35**
				15:57	Reference deployed
				16:00	SeaFallS and LOC NESS deployed
				16:13	SeaFallS, reference and LOC NESS recovered
		30°44.3 N	021°38.7 W	16:21	XBT 113 launched
		31°14.0 N	021°33.6 W	19:15	XBT 114 launched
		31°48.4 N	**021°33.6 W**	**22:30**	**Station #36**
				22:35	CTD and plankton net deployed
				22:46	Plankton net recovered
				22:50	Plankton net deployed
				22:51	Plankton net recovered
				23:55	CTD recovered
18/05/97	138	32°32.8 N	021°26.5 W	04:18	XBT 115 launched
		33°08.3 N	021°22.0 W	07:33	XBT 116 launched
		33°43.8 N	**021°18.1 W**	**10:50**	**Station #37**
				10:55	Plankton net, CTD, SeaOPS, reference and SeaFaLLS deployed
				11:00	Plankton net recovered
				11:10	Plankton net deployed
				11:15	CTD recovered
				11:24	SeaOPS recovered
				11:26	Plankton net recovered
				11:30	Plankton net deployed
				11:34	SeaOPS deployed
				11:40	CTD deployed

				11:44	Plankton net recovered
				11:46	Plankton net deployed
				11:50	Plankton net recovered
				11:51	Plankton net deployed
				11:53	SeaFaLLS and reference recovered
				11:58	SeaOPS recovered
				12:08	SeaOPS deployed
				12:36	SeaOPS recovered
				12:58	CTD recovered
				13:00	Plankton recovered
				13:02	Reference recovered
				13:05	SeaFaLLS recovered, SeaOPS redeployed
				14:03	SeaOPS recovered
				14:13	UOR deployed
		34°06.1 N	021°14.7 W	16:26	XBT 117 launched
				16:48	UOR recovered
		34°09.3 N	**021°13.7 W**	**16:56**	**Station #38**
				16:58	Optics rig deployed
				16:59	Plankton net, CTD and reference deployed
				17:03	Rocket deployed
				17:04	Rocket recovered
				17:11	Rocket redeployed
				17:12	Plankton net recovered
				17:16	Plankton net deployed
				17:20	Plankton net recovered
				17:22	Rocket redeployed
				17:25	Plankton recovered and Rocket deployed
				17:30	Optics rig recovered
				17:36	Reference recovered
				17:38	Rocket recovered
				17:50	CTD recovered
		34°36.7 N	**021°05.9 W**	**20:45**	**Station #39**
				20:50	Plankton net deployed
				20:54	CTD deployed
				21:07	Plankton net recovered
				21:09	Plankton net deployed
				21:21	Plankton net recovered
				21:45	CTD recovered
19/05/97	139	**35°06.3 N**	**020°57.7 W**	**00:36**	**Station #40**
				00:45	Plankton nets deployed
				00:47	CTD deployed
				01:00	Plankton net recovered
				01:02	Plankton net deployed
				01:06	Plankton net recovered
				01:37	CTD recovered
		35°36.0 N	**020°47.9 W**	**04:25**	**Station #41**
				04:30	Plankton net deployed
				04:33	CTD deployed
				04:45	Plankton net recovered
				04:49	Plankton nets deployed
				04:51	Plankton nets recovered

				05:26	CTD recovered
		36°05.0 N	021°02.0 W	08:10	XBT 118 launched
		36°06.7 N	021°03.0 W	08:19	XBT 119 launched
		36°13.0 N	**020°50.0 W**	**10:45**	**Station #42**
				10:50	Plankton net deployed
				10:52	Optics rig and CTD deployed
				11:00	Reference deployed
				11:07	Plankton net recovered
				11:11	Plankton net redeployed
				11:19	CTD recovered
				11:24	Rocket deployed
				11:26	Plankton net recovered
				11:28	Plankton net deployed
				11:32	Optics rig and plankton net recovered
				11:36	Plankton net recovered and Rocket recovered
				11:46	Optics rig deployed
				12:12	Rocket deployed
				12:13	Rocket recovered
				12:15	Rocket deployed
				12:24	Rocket recovered
				12:38	Rocket deployed
				12:46	Rocket and reference recovered
				13:00	CTD and plankton net recovered
				13:03	Optics recovered
				13:13	UOR deployed
		36°29.0 N	20°44.2 W	14:42	XBT 120 launched
				15:50	UOR recovered
		36°41.0 N	**020°38.9 W**	**15:54**	**Station #43**
				15:54	Reference deployed
				15:56	Rocket deployed
				16:04	Reference and rocket recovered
		36°53.6 N	020°33.6 W	17:20	XBT 121 launched
		37°11.2 N	020°25.6 W	19:00	XBT 122 launched
		37°34.7 N	020°15.7 W	21:05	XBT 123 launched
		37°45.5 N	**020°04.0 W**	**22:25**	**Station #44**
				22:30	Plankton net deployed
				22:32	CTD deployed
				22:44	Plankton nets recovered
				22:47	Plankton net deployed
				22:50	Plankton net recovered
				23:52	CTD recovered
20/05/97	140	38°03.3 N	020°04.3 W	01:15	XBT 124 launched
		38°22.3 N	019°59.8 W	03:05	XBT 125 launched
		38°48.7 N	019°59.2 W	05:24	XBT 126 launched
		39°10.0 N	019°59.4 W	07:18	XBT 127 launched
		39°29.5 N	020°00.0 W	09:00	XBT 128 launched
		39°51.9 N	**020°00.1 W**	**10:55**	**Station #45**
				10:57	Optics rig and plankton net deployed
				11:00	Reference and CTD deployed
				11:04	Plankton net recovered, Rocket deployed
				11:06	Plankton net deployed, Rocket recovered

				11:12	Plankton net recovered
				11:14	Plankton net deployed
				11:16	CTD recovered
				11:21	Optics rig recovered
				11:26	Plankton net recovered
				11:31	Plankton nets deployed
				11:32	CTD deployed
				11:35	Optics rig deployment aborted
				11:45	Optics rig deployed and plankton nets recovered
				11:50	Plankton net deployed
				11:52	Plankton net recovered
				11:54	Rocket deployed
				11:55	Plankton net deployed
				12:05	Rocket recovered
				12:07	Rocket deployed
				12:09	Rocket recovered
				12:21	Rocket deployed
				12:50	CTD recovered
				12:51	Optics rig recovered
				12:52	Plankton net recovered
				12:54	Rocket and reference recovered
				13:10	UOR deployed
				15:52	UOR recovered
		40°24.5 N	**019°59.5 W**	**15:55**	**Station #46**
				15:58	Rocket deployed
				16:05	Rocket recovered
		40°29.3 N	019°59.5 W	16:35	XBT 129 launched
		41°11.4 N	019°59.7 W	20:19	XBT 130 launched
		41°43.4 N	**020°01.5 W**	**23:00**	**Station #47**
				23:01	Plankton net deployed
				23:12	Plankton net recovered
				23:16	Plankton net deployed
				23:20	Plankton net recovered
		41°44.4 N	020°01.8 W	23:30	XBT 131 launched
21/05/97	141	42°19.4 N	020°00.4 W	02:28	XBT 132 launched
		42°56.2 N	020°00.5 W	05:35	XBT 133 launched
		43°39.5 N	019°59.9 W	09:10	XBT 134 launched
		43°58.0 N	**019°58.9 W**	**11:00**	**Station #48**
				11:02	Plankton nets and Optics rig deployed
				11:05	CTD deployed
				11:10	Reference deployed
				11:11	Rocket deployed
				11:19	Rocket aborted
				11:20	Plankton nets recovered
				11:21	Plankton nets deployed
				11:35	Plankton net recovered
				11:40	Plankton nets deployed
				11:45	Optics rig deployed
				11:46	Plankton nets recovered
				11:48	Plankton net deployed
				11:49	Rocket deployed

				12:00	Rocket recovered
				12:09	Rocket deployed
				12:20	Rocket recovered
				12:24	CTD and plankton net recovered
				12:34	Reference recovered
				12:41	Optics rig recovered
				12:50	UOR deployed
				15:51	UOR recovered
		44°30.8 N	**019°57.9 W**	**15:58**	**Station #49**
				15:59	Reference deployed
				16:02	Rocket deployed
				16:09	Rocket and reference recovered
		44°39.3 N	019°59.4 W	17:13	XBTs 135 & 136 launched
		45°29.2 N	**019°59.4 W**	**23:00**	**Station #50**
				23:05	Plankton net deployed
				23:20	Plankton net recovered
				23:25	Plankton net deployed
				23:28	Plankton net recovered
22/05/97	142	45°46.3 N	019°58.5 W	01:36	XBT 137 launched
		46°19.7 N	019°59.4 W	05:29	XBT 138 launched
		47°00.2 N	**019°59.9 W**	**10:00**	**Station #51**
				10:03	Plankton nets deployed
				10:05	CTD and optics rig deployed
				10:06	Rocket and reference deployed
				10:16	Plankton nets recovered
				10:20	Plankton nets deployed
				10:26	Rocket recovered
				10:30	Plankton nets recovered
				10:39	Plankton nets deployed
				11:02	SeaSpec and plankton net recovered
				11:30	CTD recovered and optics rig deployed
				11:32	Plankton net recovered
				11:33	Rocket deployed
				11:45	Rocket and reference recovered
				11:46	Optics rig recovered
				11:55	UOR deployed
				15:49	UOR recovered
		47°11.7 N	**019°04.6 W**	**15:55**	**Station #52**
				15:56	Reference deployed
				15:59	Rocket deployed
				16:06	Rocket and reference recovered
		47°27.2 N	017°34.0 W	22:05	XBT 139 launched
23/05/97	143	47°39.8 N	016°13.6 W	02:57	XBT 140 launched
		48°03.5 N	**013°59.1 W**	**11:00**	**Station #53**
				11:02	CTD, plankton net, optics rig and reference deployed
				11:03	Rocket deployed
				11:14	Plankton net recovered
				11:15	Plankton net deployed
				11:20	Optics rig recovered

				11:30	CTD recovered
				11:32	Plankton net recovered
				11:35	Plankton net deployed
				11:40	Plankton net recovered
				11:43	Optics rig deployed
				12:00	Rocket recovered
				12:05	CTD deployed
				12:12	CTD recovered
				12:21	Rocket, reference and plankton nets deployed
				12:48	Optics rig recovered
				12:55	UOR deployed
				15:52	UOR recovered
		48°12.7 N	**013°10.0 W**	**15:56**	**Station #54**
				15:57	Reference deployed
				16:01	Rocket deployed
				16:08	Rocket and reference recovered
				16:23	UOR deployed
		48°17.6 N	012°24.3 W	19:00	XBT 141 launched
				23:00	UOR recovered
				23:38	UOR redeployed
24/05/97	144			09:45	UOR recovered
		48°57.3 N	**008°46.0 W**	**09:55**	**Station #55**
				10:00	CTD and plankton net deployed
				10:06	Optics rig deployed
				10:09	Plankton net deployed
				10:11	Reference deployed
				10:14	Plankton net deployed
				10:16	Plankton net recovered
				10:18	Rocket deployed
				10:20	Plankton net deployed
				10:26	CTD recovered
				10:33	Optics rig recovered
				11:00	Rocket and optics rig recovered
				11:34	Plankton net recovered
				12:33	UOR deployed
				14:54	UOR recovered
25/05/97	145	**50°04.1 N**	**003°28.1 W**	**10:00**	**Station #56 (overflight)**
				10:05	CTD, optics rig, plankton net and rocket deployed
				10:16	CTD recovered and rocket recovered
				10:30	Rocket deployed
				10:40	Rocket recovered
				10:50	Plankton net recovered
26/05/97	146	**51°43.0 N**	**001°47.2 E**	**08:50**	**Station #57 (overflight)**
				08:55	Optics rig deployed, pumped samples only

Appendix F: Bridge meteorological log

Day	Time	Vis	Wind Dir	Force	Pressure	Temp Air	Sea	Sea State	Swell	Comments
111	1600	Mod	NNE	4	996.4	8.1	8.4	Slight	Low	Overcast with light rain/drizzle and mist
Mo21	2000	V. Poor	NW	3	989.0	8.3	8.2	Slight	Low	Thick fog
112	0000	Good	NNW	5	990.2	8.5	7.8	Mod	Heavy	Clear skies
Tu22	0400	Good	NNW	5	990.9	8.9	7.7	Mod	Large	Mainly clear skies
	0800	Good	NWxN	5	992.4	9.4	7.9	Mod	Large	5/8 thin cloud
	1200	Good	NNW	6	996.1	9.6	7.4	Mod/Rough	Heavy	Overcast and clear, drizzle earlier
	1600	Good	WNW	4	1000.1	12.6	11.4	Slight	Mod/Low	Overcast at first, becoming sunny and clear
	2000	Good	NW	3	1001.5	12.8	12.5	Slight	Falling	Clouding over
113	0000	Good	NW	4	1003.6	13.2	13.6	Slight	Heavy	Overcast with passing rain showers
We23	0400	Good	NWxN	4	1003.6	13.1	13.1	Mod	Mod	Overcast with light rain and drizzle at times
	0800	Good	NxW	3	1002.4	13.1	12.9	Falling	Low/Mod	Overcast with occaisonal drizzle
	1200	Mod	NxW	5	1002.4	14.3	13.1	Mod	Mod/Heavy	Overcast with rain throughout
	1600	Mod	NxW	6	1000.2	15.2	14.1	Rough	Mod	Overcast with mist and rain
	2000	Mod	NNW	6	1001.7	15.9	13.2	-	-	Overcast with drizzle
114	0000	Good	NW	6	1003.8	18.0	19.1	Rough	Heavy	Overcast and clear
Th24	0400	Good	NWxN	5/6	1005.3	16.4	18.6	Mod	Mod	Overcast throughout
	0800	Good	N	5	1004.5	14.1	13.8	-	-	Overcast with thin cloud
	1200	V. Poor	N	5	1004.4	14.0	12.5	Mod	Mod	Thick fog throughout
	1600	V. Poor	N	4/5	1002.6	13.6	14.6	Slight	Mod	Thick mist and fog throughout
	2000	Mod/Poor	N	3	1001.8	13.7	13.1	Falling	Falling	Thick fog patches and overcast
115	0000	Good	WNW	3	1000.6	11.8	12.1	Slight	Low/Mod	Partly cloudy and clear. Fair earlier
Fr25	0400	Good	Var	1	999.0	15.4	14.4	Slight	Low	Light occaisonal cloud with light rain later
	0700	Mod	SSW	3	998.8	15.8	18.3	Slight	Low	Overcast with numerous showers
	1100	Mod/Good	SSW	7/8	1002.0	16.8	18.9	Rough	Mod	Overcast with rain showers
	1500	Good	SW	8	1006.4	16.3	19.2	Rough	Mod	Cloudy, sunny fine & clear
	1900	Good	SW	7	1009.2	17.9	18.9	Rough	Neg	3/8 cloud with sun
	2300	Good	SW	7	1009.9	16.9	18.7	-	-	Few clouds, fine & clear
116	0200	Good	SW	7	1010.7	15.7	18.5	-	-	Light cloud, fine & clear
Sa26	0700	Good	SW	5	1008.5	13.2	18.9	-	-	
	0930	Good	SWxW	4/5	1011.4	13.2	18.0	-	-	Partly cloudy & clear
	1500	Good	-	1	1013.2	16.8	18.0	-	-	
	1900	Good	-	1	1011.4	16.9	17.9	-	-	3/8 cloud with sun
	2300	Good	-	1	1009.0	15.9	17.9	-	-	Cloudless with little wind
117	0230	Good	-	1	1008.6	15.8	17.9	-	-	
Su27	0900	Good	-	1	1009.9	16.6	17.4	-	-	Partly cloudy, fine & clear
	1500	Good	WSW	4	1012.1	18.1	18.0	-	-	Cloudy, fine & clear
	2300	Good	SW	3	1012.6	14.3	17.6	-	-	
118	0230	Good	SW	2/3	1013.2	12.1	17.2	-	-	Cloudy, fine & clear
Mo28	1100	Good	SW	2	1014.4	13.8	17.6	-	-	Cloudy, fine & clear
	1900	Good	S	2	1014.5	15.6	17.2	-	-	
119	0200	Good	Var	1	1016.2	12.7	17.6	-	-	
Tu29	1000	Good	N	2	1016.6	10.5	17.3	-	-	Fine and clear
	1500	Good	NNW	3	1014.3	17.0	16.4	Slight	Low	Fine and clear
	1900	Good	NxW	2/3	1014.0	18.5	18.4	Slight	Low	High cloud, bright and clear
	2300	Good	-	1	1014.5	16.0	17.8	Rippled	Low	Few clouds, fine and clear
120	0300	Good	NxW	2/3	1011.5	16.2	16.1	Calm	Low/Mod	Scattered cloud
We30	0700	Good	NxW	4	1010.8	19.1	22.3	Slight	Mod	Partly cloudy, fine and clear
	1100	Good	NW	4/5	1012.0	20.2	22.2	Mod	Low	Cloudy, fine and clear
	1500	Good	NW	5/6	1012.5	21.2	21.0	Mod	Mod	Partly cloudy
	1900	Good	NW	5	1011.4	20.4	20.5	Mod	Mod	High cloud, fine and clear
	2300	Good	NW	5	1012.4	20.3	20.4	Mod	Low	Scattered cloud, fine and clear
121	0300	Good	NWxW	5	1012.7	20.5	20.4	Mod	Mod	Scattered cloud
Th01	0700	Good	NWxW	5	1011.9	20.7	21.2	Mod	Mod	Partly cloudy, fine and clear
	1100	Good	NW	5	1013.9	21.6	21.3	Mod	Low	Scattered cloud, fine and clear
	1500	Good	NW	5	1012.7	23.5	19.8	Mod	Low/Mod	Scattered cloud
	1900	Good	NNW	6	1011.7	23.6	21.5	Mod	Mod	Few clouds, fine and clear
	2300	Good	NNW	5	1013.8	22.7	22.0	Mod	Low	Few clouds, fine and clear
122	0300	Good	NNW	5/6	1011.7	22.9	20.1	Mod	Mod	Partly cloudy
Fr02	0700	Good	NNW	6	1013.5	23.0	23.0	Mod	-	Few clouds, fine and clear
	1100	Good	NxW	5	1016.7	24.1	23.7	Mod	Low	Cloudy, fine and clear

Day	Time	Vis	Wind Dir	Force	Pressure	Temp Air	Sea	Sea State	Swell	Comments
	1500	Good	NNW	5	1016.7	26.1	23.3	Mod	Mod	Partly cloudy
	1900	Good	NWxN	5	1016.7	25.1	24.4	Mod	Low	Cloudy, fine and clear
	2300	Good	NNW	5	1019.3	24.6	24.5	Mod	Low	Fine and clear
123	0300	Good	NNW	5	1020.2	22.4	22.8	Mod	Low	Clear skies
Sa03	0700	Good	WNW	3	1018.9	24.3	24.6	Slight	Low	Few clouds, fine and clear
	1100	Good	NW	4	1020.7	25.5	25.1	Slight	Low	Scattered cloud, fine and clear
	1500	Good	NNW	3/4	1022.1	26.6	23.1	Slight	Long, low	Partly cloudy
	1900	Good	NNW	3	1020.1	25.8	25.6	Slight	Low	Few clouds, fine and clear
	2300	Good	Var	2	1021.2	25.0	24.3	Slight	Low	Cloudy, fine and clear
124	0300	Good	Var	2	1019.6	24.3	21.7	Calm	Low	Scattered cloud
Su04	0700	Good	Var	1	1019.8	24.3	26.0	Rippled	Low	Few clouds, fine with light haze
	1100	Good	Var	1/2	1020.5	26.1	25.9	Rippled	Low	Few scattered clouds, fine and clear
	1500	Good	Var	2	1019.2	28.2	22.2	Rippled	Long, low	Partly cloudy
	1900	Good	ESE	3	1018.7	26.3	26.5	Slight	Low	Cloudy, fine and clear
	2300	Good	SE	2	1019.9	25.1	26.7	Rippled	Low	Fine and clear
125	0300	Good	Var	2	1020.1	25.0	22.1	Calm	Long, low	Scattered cloud with intermittant showers
Mo05	0600	Good	SE	3	1017.0	24.7	26.7	Slight	Low	Few clouds with light rain showers earlier
	1000	Good	SSE	3/4	1017.2	26.3	26.7	Slight	Low	Few clouds, fine and clear
	1400	Good	SE	3/4	1016.2	27.3	22.7	Mod	Low	Partly cloudy
	1800	Good	SE	3	1014.1	25.2	26.9	Slight	Low	Cloudy with occaisonal rain showers
	2200	Good	SExS	3/4	1016.8	25.3	26.9	Slight	Low	Cloudy with scattered showers
126	0200	Good	SE	3/4	1017.0	25.8	26.8	Slight	Low	Scattered cloud
Tu06	0600	Good	SExE	4	1014.5	25.3	26.5	Slight	Low	Few clouds, fine and clear
	1000	Good	SE	4	1015.9	26.3	26.4	Slight	Low	Cloudy, showers earlier, otherwise fine
	1400	Good	SE	4	1016.5	27.7	26.6	Mod	Low	Cloudy skies with showers
	1800	Good	SE	4	1014.1	27.3	27.3	Slight	Low	Cloudy, fine and clear
	2200	Good	SE	5	1015.2	26.4	27.5	Mod	Low	Cloudy, fine and clear
127	0200	Good	SE	5	1014.4	26.4	27.4	Mod	Low	Sky overcast with scattered showers
We07	0600	Good	ESE	5	1013.9	24.6	27.5	Mod	Mod	Overcast, showers, vis. poor in showers
	1000	Good	ExS	5	1015.2	25.0	27.4	Mod	Low	Overcast with occaisonal rain showers
	1400	Good	E	5/6	1013.6	27.6	27.6	Mod	Mod	Partly cloudy
	1800	Mod/Good	ExS	5	1013.2	25.0	27.6	Mod	Mod	Overcast with frequent rain showers
	2200	Good	SE	3	1014.6	25.5	27.8	Slight	Low	Overcast, rain showers earlier, clearing later
128	0200	Good	SE	3/4	1016.0	25.6	27.6	Slight/Mod	Low	Occaisonal rain showers
Th08	0600	Good	SExE	4	1013.5	26.7	27.8	Slight	Oceanic	Few clouds, fine and clear
	1000	Good	ESE	4	1014.7	27.9	27.9	Slight	Low	Scattered cloud, fine and clear
	1400	Good	ESE	3	1016.2	28.2	28.3	Slight	Low	Partly cloudy
	1800	Good	ESE	3	1012.6	28.8	28.2	Slight	Low	Few clouds, fine and clear
	2200	Good	SE	4	1014.4	27.2	28.0	Slight	Low	Few clouds, fine and clear
129	0200	Good	SE	4	1015.2	27.3	28.0	Slight	Long/Low	Scattered cloud
Fr09	0600	Good	ESE	3	1013.6	26.8	28.0	Slight	Low	Few clouds, fine and clear
	1000	Good	SE	4	1015.3	28.8	28.0	Slight	Low	Few scattered clouds, fine and clear
	1400	Good	SE	3/4	1013.2	29.1	27.7	Slight	Low	Fine and clear
	1800	Good	SE	4	1012.6	28.8	27.6	Slight	Low	Few clouds, fine and clear
	2200	Good	SE	4	1013.9	26.7	27.1	Slight	Low	Cloudy, fine and clear
130	0200	Good	SE	4	1013.6	26.8	27.0	Slight	Low	Clear skies
Sa10	0600	Good	SE	3	1013.2	25.9	26.9	Slight	Low	Few clouds, fine and clear
	1000	Good	SE	3	1014.3	27.5	27.4	Slight	Low	Cloudy, fine and clear
	1400	Good	SE	3	1012.5	29.0	28.2	Slight	Long/Low	Partly cloudy
	1800	Good	SE	2/3	1013.1	28.1	28.4	Slight	Low	Partly cloudy, fine and clear
	2200	Good	SExE	2/3	1014.1	27.1	28.3	Very slight	Low	Few scattered clouds, fine and clear
131	0200	Good	SExE	2	1014.9	27.0	27.9	Calm	Low	Cloudy
Su11	0600	Good	WxN	3	1012.7	26.3	28.0	Slight	Low	Few clouds, fine and clear
	1000	Good	WNW	3	1014.0	26.2	27.8	Slight	Low	Overcast with occaisonal light showers
	1400	Good	W	2/3	1013.8	28.1	27.4	Calm	Low	Sky overcast
	1800	Good	WxN	3	1012.5	27.3	27.6	Slight	Low	Overcast, fine and clear
	2200	Moderate	NNE	2	1013.7	25.0	26.9	Very slight	Low	Overcast with continuous light rain
132	0200	Moderate	Var	1	1012.6	26.5	27.7	Slight	Low	Sky overcast with drizzle throughout
Mo12	0600	Moderate	NNE	2/3	1012.0	26.7	27.2	Slight	Low	Mainly overcast with light rain earlier
	1000	Good	NNE	2/3	1013.9	27.1	27.3	Slight	Low	Cloudy, overcast, fine and hazy
	1400	Good	NNE	2/3	1011.6	28.2	27.5	Slight	Low	Partly cloudy
	1800	Good	NxW	3	1012.4	26.7	26.8	Slight	Low	
	2200	Good	NW	3	1013.8	25.1	26.0	Slight	Low	Light cloud, fine and clear
133	0200	Good	NWxN	3	1012.9	24.8	25.8	Slight	Low	Clear skies
Tu13	0600	Moderate	N	4	1012.5	24.4	25.5	Slight	Low	Partly cloudy and fine. Light horizon haze

Day	Time	Vis	Wind Dir	Force	Pressure	Temp Air	Sea	Sea State	Swell	Comments
	1000	Good	N	4/5	1014.6	24.9	25.1	Slight/Mod	Moderate	Lightly overcast, fine and hazy
	1400	Good	N	6/7	1012.5	25.7	24.7	Rough	Moderate	Clear skies
	1800	Good	N	6	1012.6	24.6	24.6	Moderate	Moderate	Cloudless with horizon haze
	2200	Mod	NNE	6	1013.5	23.0	24.2	Moderate	Moderate	Overcast with light haze
134	0200	Moderate	NNE	6	1013.4	22.7	24.3	Moderate	Moderate	Clear skies
We14	0500	Good	NNE	6	1014.0	22.1	23.7	Moderate	Moderate	Mainly high cloud and fine
	0900	Good	NExN	7	1016.0	22.5	23.7	Rough	Moderate	Cloudy, fine and slightly hazy
	1300	Good	NExN	7/8	1015.6	22.0	23.4	Rough	Moderate	Scattered cloud
	1700	Good	NExN	6	1016.2	22.2	23.1	Moderate	Moderate	
	2100	Good	NE	5/6	1017.5	21.5	22.7	Moderate	Moderate	Cloudy, fine and clear
135	0100	Good	NE	5	1018.6	21.4	22.7	Moderate	Moderate	Clear sky
Th15	0500	Good	NE	5	1018.1	21.1	22.5	Moderate	Moderate	Cloudless, fine and clear
	0900	Good	NE	5	1020.0	22.5	22.4	Moderate	Moderate	Cloudy, fine and clear
	1300	Good	NE	5	1020.6	22.2	22.4	Moderate	Moderate	Sky cloudy with showers of rain
	1700	Good	NNE	6	1019.2	22.0	22.3	Moderate	Low	Few clouds, fine and clear
	2100	Good	NExN	5	1020.1	22.4	22.3	Moderate	Moderate	Cloudy, fine and clear
136	0100	Good	NExN	5	1021.2	21.7	22.1	Moderate	Moderate	Partly cloudy with scattered showers
Fr16	0500	Good	NE	4	1020.9	20.4	22.9	Moderate	Moderate	Clouds developing latterly, fine and clear
	0900	Good	NNE	4/5	1021.9	20.9	22.0	Moderate	Moderate	Scattered cloud, fine and clear
	1300	Good	NNE	3	1022.0	23.3	22.1	Slight	Moderate	
	1700	Good	NxE	5	1021.2	21.1	22.1	Slight/Mod	Low	Partly cloudy, fine and clear
	2100	Good	NxE	5	1022.0	20.1	22.0	Moderate	Moderate	Cloudy, fine and clear
137	0100	Good	NxE	4	1021.6	19.8	22.3	Moderate	Low	Scattered cloud
Sa17	0500	Good	NNE	3	1020.6	19.4	20.9	Slight	Low	Few clouds, fine and clear
	0900	Good	NNW	3	1022.0	21.0	20.8	Slight	Low	Cloudy, fine and clear
	1300	Good	NWxN	3	1021.8	21.2	20.9	Slight	Long/Low	Sky overcast with openings
	1700	Good	WNW	3	1020.0	21.7	20.5	Slight	Low	Cloudy with isolated rain showers
	2100	Good	NNW	4	1019.3	19.4	20.5	Slight	Low	Cloudy with occaisonal light showers
138	0100	Good	NNW	3	1018.9	19.1	20.3	Slight	Low	Scattered cloud
Su18	0500	Good	NNW	3	1017.8	18.6	20.0	Slight	Slight	Mainly overcast with occaisonal rain
	0900	Good	NW	4	1018.1	18.5	20.0	Slight	Low	Cloudy, fine and clear
	1300	Good	NW	4	1017.8	20.6	19.6	Moderate	Moderate	
	1700	Good	NW	4	1017.7	20.0	19.7	Moderate	Moderate	Cloudy, fine and clear
	2100	Good	NW	4/5	1017.9	17.8	19.5	Moderate	Moderate	Cloudy, fine and clear
139	0100	Good	NW	4	1016.5	17.5	19.0	Moderate	Moderate	Overcast
Mo19	0500	Good	NW	3	1017.2	16.8	18.7	Slight	Heavy	
	0900	Good	NW	4	1018.0	17.1	18.5	Slight	Moderate	Cloudy, fine and clear
	1300	Good	NW	4	1017.7	18.5	18.5	Moderate	Long/Mod	Partly cloudy
	1700	Good	NW	4	1019.0	18.0	18.4	Slight	Heavy	Cloudy, fine and clear
	2100	Good	NW	4	1020.3	16.8	17.9	Slight	Moderate	Cloudy, fine and clear
140	0100	Good	NW	4	1019.2	16.7	17.0	Moderate	Long/Med	Traces of low cloud, otherwise clear
Tu20	0500	Good	WNW	3	1019.3	15.8	17.4	Slight	Mod/Heavy	Few clouds, fine and clear
	0900	Good	WNW	3	1019.7	16.0	17.2	Slight	Moderate	Fine and clear
	1300	Good	Var	2/3	1018.3	18.7	17.3	Slight	Moderate	
	1700	Good	SWxS	3/4	1018.7	19.0	17.0	Slight	Moderate	Cloudy, fine and clear
	2100	Good	SW	4	1017.3	16.5	16.8	Slight	Moderate	Overcast, fine and clear
141	0100	Good	SWxS	3/4	1014.0	16.3	16.4	Slight	Medium	Sky overcast
We21	0500	Moderate	SxW	3	1012.6	16.1	16.1	Slight	Low	Overcast with light rain latterly
	0900	Moderate	S	5	1010.6	16.6	15.7	Moderate	Moderate	Overcast with intermittent drizzle
	1300	Moderate	SxE	5	1008.7	17.1	15.6	Moderate	Moderate	Sky overcast with rain showers
	1700	Moderate	SxW	5	1004.6	16.4	15.4	Moderate	Low	Overcast with continuous light rain
	2100	Moderate	SxE	5	999.6	15.9	15.2	Moderate	Moderate	Overcast, occasional moderate drizzle
142	0100	Moderate	SxE	5	996.0	15.8	14.2	Moderate	Moderate	Overcast,intermittent heavy rain showers
Th 22	0500	Good	S	3	993.5	15.2	14.8	Slight	Low	Cloudy, fine and clear
	0900	Good	SSE	4	992.3	16.2	14.8	Moderate	Moderate	Cloudy, rain in sight and mainly clear
	1300	Good	ExS	4	989.5	15.0	14.4	Moderate	Moderate	Sky overcast with intermittent rain showers
	1700	Good	ExN	6	989.2	14.8	14.4	Moderate	Moderate	Mainly overcast with rain showers
	2100	Good	SE	6/7	993.8	14.3	14.1	Rough	Moderate	Cloudy with intermittent moderate rain
143	0100	Mod/Good	SE	6		14.3	14.1	Rough	High	Intermittent heavy rain showers
Fr 23	0500	Moderate	ESE	3	1001.3	14.1	14.1	Slight	Moderate	Cloudy and fine with light mist/low cloud
	0900	Moderate	E	4	1004.8	14.4	13.8	Slight	Moderate	Cloudy and showery
	1300	Good	E	4	1007.9	15.0	13.8	Moderate	Moderate	Partly cloudy
	1700	Moderate	E	5	1010.0	14.7	13.9	Moderate	Moderate	Partly cloudy
	2100	Moderate	E	5/6	1014.2	13.3	13.6	Moderate	Moderate	Overcast, occaisonal light drizzle
144	0100	Moderate	E	6	1015.7	13.0	13.3	Mod/Rough	Moderate	Sky overcast with scattered showers

Day	Time	Vis	Wind Dir	Force	Pressure	Temp Air	Sea	Sea State	Swell	Comments
Sa24	0400	Moderate	E	6	1017.7	12.3	12.8	Moderate	Short/Mod	Overcast with occaisonal rain
	0800	Moderate	ExN	6	1020.8	12.2	13.0	Rough	Short/Mod	Overcast
	1200	Moderate	ENE	7	1026.0	12.1	12.2	Rough	Moderate	
	1600	Moderate	ENE	7/8	1022.9	11.9	12.5	Rough	Moderate	Cloudy and fine, clearing latterly
	2000	Good	ENE	6	1024.5	12.1	12.4	Mod/Rough	Moderate	Slightly cloudy, fine and clear
145	0000	Good	ENE	7/8	1025.0	11.8	12.3	Mod/Rough	Moderate	Clear skies
Su25	0400	Good	ENE	6	1026.1	10.8	12.2	Moderate	Moderate	Partly cloudy, fine and clear
	0800	Good	ENE	6	1027.3	10.6	12.1	Moderate	Moderate	Scattered cloud, fine and clear
	1200	Good	ENE	6	1028.3	11.4	12.3	Moderate	Moderate	Partly cloudy
	1600	Good	ExS	3	1027.1	12.9	12.0	Slight	Low	Few clouds, fine and clear
	2000	Good	ExN	5	1026.2	12.0	11.8	Slight	Low	Fine and clear
146	0000	Good	ENE	4	1026.9	11.5	11.7	Moderate	Low	Clear skies
Mo26	0300	Good	NE	3	1025.9	12.1	11.3	Slight	Low	Few clouds, fine and clear
	0700	Good	NNE	3	1026.6	11.8	12.4	Slight	Low	Fine and clear

Appendix G: Underway chlorophyll, pigments, bacteria and iodine,

Time (GMT)	Date	Julian Day	Sample Number	Position lat.	long.	chl.	Surface Temp.	Sal.	HPLC Vol.	Vol.Chl. filetered	[ug/l chl a	Iodine Samples*	Bacterial Samples**
15:00	21.4.97	111	1	51.20.9S	57.26.5W	32.2	8.10	33.78		1 litre	0.552	S1	1
21:04	21.4.97	111	2	50.36.1S	57.08.3W	42.3	7.35	33.87		1 litre	0.571	S2	2
22:59	21.4.97	111	3	50.16.1S	56.59.5W	47.8	7.22	33.92		1 litre	0.509	S3	
01:05	22.4.97	112	4	49.52.9S	56.50.1W	40.1	7.18	33.96		1 litre	0.222	S4	
03:06	22.4.97	112	5	49.32.6S	56.42.1W	32.9	7.16	34.01		1 litre	0.163	S5	3
05:02	22.4.97	112	6	49.13.1S	56.34.4W	44.8	7.31	34.06		1 litre	0.595	S6	
07:03	22.4.97	112	7	48.52.2S	56.26.1W	41.4	7.38	34.03		1 litre	0.484	S7	
09:00	22.4.97	112	8	48.30.5S	56.17.9W	42.0	7.30	34.30		1 litre	0.179	S8	4
11:00	22.4.97	112	9	48.08.1S	56.09.4W	38.8	6.98	34.06		1 litre	0.451		
12:00	22.4.97	112	10	47.57.7S	56.05.5W	44.4	6.41	33.95		1 litre	0.467	S9	
18:00	22.4.97	112	11	47.09.6S	55.45.9W	38.0	11.40	34.12	2litres	1 litre	0.453	S10	
20:00	22.4.97	112	12	46.53.6S	55.38.3W	67.9	12.46	34.49	2litres	1 litre	0.932		
22:00	22.4.97	112	13	46.31.5S	55.30.1W	57.0	12.94	34.56	2litres	1 litre	1.000	S11	5
00:00	23.4.97	113	14	46.10.0S	55.23.7W	54.3	13.20	34.84	2litres	1 litre	1.150		
02:00	23.4.97	113	15	45.44.4S	55.15.5W	56.5	13.05	34.72	2litres	1 litre	1.210	S12	
04:00	23.4.97	113	16	45.28.1S	55.07.8W	44.7	13.05	34.45	2litres	1 litre	0.796		6
06:00	23.4.97	113	17	45.04.9S	54.58.8W	52.4	12.14	34.12	2litres	1 litre	0.735	S13	
08:00	23.4.97	113	18	44.39.9S	54.49.9W	44.4	12.81	33.78	2litres	1 litre	0.511		
10:00	23.4.97	113	19	44.16.0S	54.40.5W	59.2	12.76	33.83	2litres	250ml	0.568	S14	7
12:00	23.4.97	113	20	43.51.2S	54.31.5W	49.1	13.38	33.70	2litres	1 litre	0.664		
18:01	23.4.97	113	21	43.02.5S	54.14.1W	65.1	13.17	33.48	4 x 2litres	1 litre	0.669		
20:01	23.4.97	113	22	42.43.0S	54.06.8W	74.2	12.83	33.57	2litres	1 litre	0.847		
21:56	23.4.97	113	23	42.24.7S	54.00.2W	43.7	18.25	34.64	2litres	1 litre	1.200	S16	8
00:00	24.4.97	114	24	42.02.0S	53.53.1W	34.3	19.72	35.40	2litres	1 litre	0.790	S17	9
02:00	24.4.97	114	25	41.41.9S	53.46.4W	32.6	18.47	35.28	2litres	1 litre	0.732		
04:00	24.4.97	114	26	41.17.5S	53.38.3W	29.9	19.08	35.51	2litres	1 litre	0.545	2 x S18	10
06:00	24.4.97	114	27	40.56.9S	53.30.2W	86.2	13.69	33.37	2litres	1 litre	1.010		

Time (GMT)	Date	Julian Day	Sample Number	Position lat.	long.	chl.	Surface Temp.	Sal.	HPLC Vol.	Vol.Chl. filetered	[ug/l chl a	Iodine Samples*	Bacterial Samples**
08:00	24.4.97	114	28	40.31.2S	53.22.0W	55.7	12.75	33.27	2litres	1 litre	0.971	S19	
10:00	24.4.97	114	29	40.10.3S	53.14.7W	99.7	12.82	33.40	2litres	1 litre	2.580		11
12:00	24.4.97	114	30	39.47.2S	53.06.4W	32.1	12.03	33.41	2litres	1 litre	1.190	S20	
18:00	24.4.97	114	31	38.55.8S	53.16.2W	51.5	13.75	33.63	2litres	1 litre	1.694	S21	
20:00	24.4.97	114	32	38.31.9S	53.30.0W	28.3	13.57	33.69	2litres	1 litre	0.907		
22:02	24.4.97	114	33	38.07.8S	53.44.5W	16.7	12.50	33.69	2litres	1 litre	0.653	S22	12
00:00	25.4.97	115	34	37.42.7S	53.59.5W	17.5	10.55	33.76	2litres	1 litre	1.160		
02:00	25.4.97	115	35	37.16.9S	54.14.0W	14.5	11.66	33.83	2litres	1 litre	0.552	S23	
03:00	25.4.97	115	36	37.03.2S	54.21.8W	13.6	13.03	33.49	2litres	1 litre	0.671		13
ontevideo													
17:01	30.4.97	120	37	35.22.7S	49.28.6W	21.0	20.77	36.00	2litres	1 litre	0.277	2 x S24	
19:00	30.4.97	120	38	35.06.9S	49.09.3W	20.5	20.40	35.83	2litres	1 litre	0.248		
21:00	30.4.97	120	39	34.52.0S	48.51.0W	19.9	20.36	35.79	2litres	1 litre	0.262	2 x S25	14
23:03	30.4.97	120	40	34.49.4S	48.47.9W	22.2	20.32	35.89	2litres	1 litre	0.337		15
01:06	01.5.97	121	41	34.24.9S	48.19.9W	69.8	20.46	35.84	2litres	1 litre	0.341	2 x S26	
03:11	01.5.97	121	42	33.59.5S	47.49.9S	60.5	21.02	36.06	2litres	1 litre	0.234		16
05:05	01.5.97	121	43	33.41.9S	47.32.1W	62.1	21.24	36.05	2litres	1 litre	0.277	2 x S27	
07:00	01.5.97	121	44	33.26.0S	47.13.0W	61.8	21.47	36.06	2litres	1 litre	0.255		
09:00	01.5.97	121	45	33.09.9S	46.53.5W	62.0	21.35	36.08	2litres	1 litre	0.280	2 x S28	17
11:01	01.5.97	121	46	32.53.1S	46.32.5W	63.3	21.48	36.11	2litres	1 litre	0.293		
17:01	01.5.97	121	47	32.14.5S	45.45.7W	63.6	21.21	36.06	2litres	1 litre	0.339	2 x S29	
18:00	01.5.97	121	48	32.06.7S	45.37.3W	62.5	21.55	36.07	2litres	1 litre	0.284		
19:00	01.5.97	121	49	32.00.6S	45.30.3W	66.8	22.53	36.59	2litres	1 litre	0.300		
21:00	01.5.97	121	50	31.42.7S	45.12.2W	69.1	21.90	36.31	2litres	1 litre	0.252	2 x S30	18
23:00	01.5.97	121	51	31.25.3S	44.52.8W	58.7	21.85	36.21	2litres	1 litre	0.254		19
01:00	02.5.97	122	52	31.07.9S	44.34.6W	57.0	22.60	36.11	2litres	1 litre	0.222	2 x S31	
03:00	02.5.97	122	53	30.51.3S	44.16.2W	55.8	22.91	36.42	2litres	1 litre	0.191		20
04:58	02.5.97	122	54	30.33.9S	43.57.3W	56.0	23.17	36.43	2litres	1 litre	0.188	2 x S32	
07:00	02.5.97	122	55	30.16.4S	43.38.6W	54.0	22.94	36.36	2litres	1 litre	0.145		
09:00	02.5.97	122	56	29.57.7S	43.18.7W	53.9	22.84	36.40	2litres	1 litre	0.159	2 x S33	21
11:00	02.5.97	122	57	29.38.3S	42.58.7W	54.7	23.30	36.36	2litres	1 litre	0.154		
17:00	02.5.97	122	58	28.59.8S	42.15.4W	51.6	24.32	36.51	2litres	1 litre	0.120	2 x S34	

Time (GMT)	Date	Julian Day	Sample Number	Position lat.	long.	chl.	Surface Temp.	Sal.	HPLC Vol.	Vol.Chl. filetered	[ug/l chl a	Iodine Samples*	Bacterial Samples**
19:03	02.5.97	122	59	28.42.2S	41.56.9W	53.9	24.10	36.64	4 x 2litres	1 litre	0.123		
21:00	02.5.97	122	60	28.26.7S	41.39.3W	51.2	24.57	36.58	2litres	1 litre	0.127	2 x S35	22
23:00	02.5.97	122	61	28.08.8S	41.19.8W	51.1	24.53	36.56	2litres	1 litre	0.143		
01:00	03.5.97	123	62	27.50.4S	41.08.0W	51.8	24.33	36.51	2litres	1 litre	0.143	2 x S36	
03:01	03.5.97	123	63	27.32.6S	40.42.3W	50.6	24.11	36.62	2litres	1 litre	0.113		23
05:00	03.5.97	123	64	27.15.6S	40.23.4W	50.5	24.76	36.72	2litres	1 litre	0.135	2 x S37	
07:00	03.5.97	123	65	26.58.4S	40.04.7W	50.6	24.51	36.53	2litres	1 litre	0.104		
09:00	03.5.97	123	66	26.40.4S	39.46.7W	51.3	25.19	36.65	2litres	1 litre	0.147	2 x S38	24
11:00	03.5.97	123	67	26.22.6S	39.28.0W	51.3	25.16	36.71	2litres	1 litre	0.149		
17:00	03.5.97	123	68	25.41.2S	38.43.2W	47.8	25.24	36.42	2litres	1 litre	0.090	2 x S39	
18:01	03.5.97	123	69	25.34.2S	38.34.9W	51.1	25.58	36.59	2litres	1 litre	0.129		
19:00	03.5.97	123	70	25.27.1S	38.27.3W	51.1	25.63	36.78	2litres	1 litre	0.110		
21:00	03.5.97	123	71	25.08.1	38.08.7W	48.7	24.71	36.53	2litres	1 litre	0.094	2 x S40	25
23:01	03.5.97	123	72	24.46.8S	37.53.6W	49.3	25.10	36.36	2litres	1 litre	0.087		
01:00	04.5.97	124	73	24.23.6S	34.42.4W	49.4	24.82	36.27	2litres	1 litre	0.080	2 x S41	
03:01	04.5.97	124	74	24.00.6S	37.30.3W	50.9	25.97	36.88	2litres	1 litre	0.101		26
05:00	04.5.97	124	75	23.37.8S	37.19.4W	49.2	26.12	36.87	2litres	1 litre	0.102	2 x S42	
07:00	04.5.97	124	76	23.15.1S	37.09.1W	50.5	26.12	36.86	2litres	1 litre	0.112		
09:00	04.5.97	124	77	22.53.5S	35.58.2W	48.7	26.17	36.98	2litres	1 litre	0.096	2 x S43	27
11:01	04.5.97	124	78	22.29.9S	36.46.7W	50.2	26.26	36.92	2litres	1 litre	0.103		
17:00	04.5.97	124	79	21.40.6S	36.23.7W	47.1	26.47	37.00	2litres	1 litre	0.080	2 x S44	28
19:00	04.5.97	124	80	21.20.1S	36.13.1W	49.6	26.59	36.92	2litres	1 litre	0.092		29
21:00	04.5.97	124	81	20.59.8S	36.03.3W	50.0	26.77	36.71	2litres	1 litre	0.108	2 x S45	30
23:00	04.5.97	124	82	20.37.1S	35.53.3W	52.7	26.93	36.71	2litres	1 litre	0.162		31
01:05	05.5.97	125	83	20.14.5S	35.42.3W	52.7	26.97	36.91	2litres	1 litre	0.164	2 x S46	32
03:00	05.5.97	125	84	19.52.5S	35.31.6W	49.0	26.84	36.99	2litres	1 litre	0.114		33
05:10	05.5.97	125	85	19.28.5S	35.20.0W	50.7	26.83	37.00	2litres	1 litre	0.130	2 x S47	
07:00	05.5.97	125	86	19.09.0S	35.10.8W	50.9	26.81	37.00	2litres	1 litre	0.107		
10:00	05.5.97	125	87	18.35.3S	34.54.2W	52.6	26.80	37.14	2litres	1 litre	0.171	2 x S48	34
16:00	05.5.97	125	88	17.45.3S	34.31.4W	47.5	26.98	37.04	2litres	1 litre	0.117	2 x S49	
18:00	05.5.97	125	89	17.24.8S	34.21.0W	51.9	26.97	37.09	2litres	1 litre	0.139		
20:00	05.5.97	125	90	17.04.8S	34.11.9W	48.4	26.93	37.19	2litres	1 litre	0.101	2 x S50	35

Time (GMT)	Date	Julian Day	Sample Number	Position lat.	long.	chl.	Surface Temp.	Sal.	HPLC Vol.	Vol.Chl. filetered	[ug/l chl a	Iodine Samples*	Bacterial Samples**
22:00	05.5.97	125	91	16.42.7S	34.01.1W	49.4	26.98	37.18	2litres	1 litre	0.104		
00:00	06.5.97	126	92	16.19.7S	33.50.5W	51.1	26.86	37.23	2litres	1 litre	0.115	2 x S51	
02:00	06.5.97	126	93	15.57.6S	33.40.7W	49.1	26.62	37.06	2litres	1 litre	0.087		36
04:00	06.5.97	126	94	15.34.5S	33.30.4W	46.4	26.84	37.04	2litres	1 litre	0.072	2 x S52	
06:00	06.5.97	126	95	15.10.8S	33.19.9W	46.4	26.56	36.98	2litres	1 litre	0.062		
08:02	06.5.97	126	96	14.48.6S	33.10.0W	46.9	26.42	37.18	2litres	1 litre	0.064	2 x S53	37
10:00	06.5.97	126	97	14.26.3S	32.59.0W	46.4	26.50	37.14	2litres	1 litre	0.063		
16:00	06.5.97	126	98	13:38.4S	32.38.2W	48.3	27.36	36.95	2litres	1 litre	0.095	2 x S54	
18:00	06.5.97	126	99	13.18.4S	32.28.0W	47.8	27.45	36.92	2litres	1 litre	0.075		
20:00	06.5.97	126	100	12.58.3S	32.17.4W	47.3	27.55	36.76	2litres	1 litre	0.079	2 x S55	37
22:00	06.5.97	126	101	12.36.2S	32.06.7W	48.8	27.62	36.71	2litres	1 litre	0.094		
00:00	07.5.97	127	102	12.12.9S	31.56.8W	48.0	27.40	36.95	2litres	1 litre	0.092	2 x S56	
02:00	07.5.97	127	103	11.51.1S	31.46.9W	46.9	27.43	36.93	2litres	1 litre	0.079		38
06:00	07.5.97	127	104	11.04.9S	31.25.4W	47.9	27.60	36.74	2litres	1 litre	0.105	2 x S57	
08:00	07.5.97	127	105	10.42.5S	31.15.4W	47.5	27.52	36.84	2litres	1 litre	0.092		
10:00	07.5.97	127	106	10.20.3S	31.05.0W	47.5	27.48	36.63	2litres	1 litre	0.085	2 x S58	39
16:00	07.5.97	127	107	09.34.2S	30.44.2W	47.4	27.58	36.69	2litres	1 litre	0.082	2 x S59	
18:00	07.5.97	127	108	09.13.8S	30.34.5W	49.6	27.74	36.31	2litres	1 litre	0.104		
20:00	07.5.97	127	109	08.54.6S	30.24.0W	47.4	28.04	36.40	2litres	1 litre	0.103	2 x S60	40
22:00	07.5.97	127	110	08.31.8S	30.13.9W	46.8	27.98	36.14	2litres	1 litre	0.092		
00:00	08.5.97	128	111	08.08.6S	30.04.1W	47.0	27.94	35.95	2litres	1 litre	0.094	2 x S61	
02:00	08.5.97	128	112	07.47.0S	29.55.2W	49.2	27.95	36.14	2litres	1 litre	0.099		41
04:00	08.5.97	128	113	07.23.3S	29.45.6W	46.3	27.99	36.14	2litres	1 litre	0.082	2 x S62	
06:00	08.5.97	128	114	07.00.4S	29.35.2W	46.2	27.87	36.00	2litres	1 litre	0.075		
08:00	08.5.97	128	115	06.37.1S	29.24.7W	46.6	28.02	35.96	2litres	1 litre	0.095	2 x S63	42
10:02	08.5.97	128	116	06.13.7S	29.14.1W	47.7	28.02	35.90	2 x 2litres	1 litre	0.099		
16:00	08.5.97	128	117	05.29.0S	28.55.8W	46.2	28.40	35.96	2 x 2litres	1 litre	0.114	2 x S64	
17:00	08.5.97	128	118	05.20.7S	28.51.9W	47.4	28.32	35.95	2 x 2litres	1 litre	0.101		
18:00	08.5.97	128	119	05.15.9S	28.49.9W	46.9	28.40	35.94	2 x 2litres	1 litre	0.100		
20:00	08.5.97	128	120	04.58.8S	28.42.5W	47.3	28.29	35.89	2 x 2litres	1 litre	0.096	2 x S65	43
22:00	08.5.97	128	121	04.36.0S	28.32.2W	47.2	28.05	35.94	2 x 2litres	1 litre	0.103		
00:00	09.5.97	129	122	04.13.4S	28.22.0W	49.4	27.98	35.92	2 x 2litres	1 litre	0.104	2 x S66	

Time (GMT)	Date	Julian Day	Sample Number	Position lat.	long.	chl.	Surface Temp.	Sal.	HPLC Vol.	Vol.Chl. filetered	[ug/l chl a	Iodine Samples*	Bacterial Samples**
02:00	09.5.97	129	123	03.52.6S	28.12.9W	49.3	27.94	35.94	2 x 2litres	1 litre	0.118		44
04:00	09.5.97	129	124	03.29.2S	28.02.2W	50.5	27.96	35.97	2 x 2litres	1 litre	0.135	2 x S67	
06:00	09.5.97	129	125	03.06.6S	27.51.6W	48.6	28.12	36.03	2 x 2litres	1 litre	0.117		
08:00	09.5.97	129	126	02.44.0S	27.40.7W	49.2	28.02	35.99	2 x 2litres	1 litre	0.152	2 x S68	45
10:00	09.5.97	129	127	02.21.5S	27.29.7W	49.1	27.89	36.00	2 x 2litres	1 litre	0.146		
16:00	09.5.97	129	128	01.28.8S	27.07.3W	47.9	27.73	36.23	2 x 2litres	1 litre	0.129	2 x S69	
16:58	09.5.97	129	129	01.19.7S	27.03.2W	47.9	27.65	36.24	2 x 2litres	1 litre	0.134		
18:00	09.5.97	129	130	01.11.8S	26.59.6W	48.8	27.55	36.25	2 x 2litres	1 litre	0.116		
19:50	09.5.97	129	131	00.51.7S	26.50.1W	47.9	27.31	36.26	2 x 2litres	1 litre	0.107	2 x S70	46
22:00	09.5.97	129	132	00.27.8S	26.28.4W	49.1	27.07	36.27	2 x 2litres	1 litre	0.131		
04:00	10.5.97	130	133	00.27.3N	26.12.3W	50.8	26.89	36.14	2 x 2litres	1 litre	0.144	2 x S71	
06:00	10.5.97	130	134	0049.3N	26.03.3W	59.0	26.84	36.01	2 x 2litres	1 litre	0.231		47
08:00	10.5.97	130	135	01.12.1N	25.54.3W	55.6	27.11	35.94	2 x 2litres	1 litre	0.197	2 x S72	
10:00	10.5.97	130	136	01.34.2N	25.45.2W	54.6	27.68	35.77	2 x 2litres	1 litre	0.193		
15:51	10.5.97	130	137	02.20.7N	25.25.3W	47.7	28.46	35.62	2 x 2litres	1 litre	0.149	2 x S73	
18:00	10.5.97	130	138	02.42.9N	25.13.9W	48.0	28.66	35.49	2 x 2litres	1 litre	0.123		
19:55	10.5.97	130	139	03.02.7N	25.03.7W	47.6	28.53	35.45	2 x 2litres	1 litre	0.125	2 x S74	49
22:02	10.5.97	130	140	03.27.9N	24.51.1W	48.7	28.48	35.50	2 x 2litres	1 litre	0.126		
00:00	11.5.97	131	141	03.50.8N	24.40.2W	49.6	28.41	35.54	2 x 2litres	1 litre	0.140	2 x S75	
02:00	11.5.97	131	142	04.13.1N	24.29.5W	50.3	28.27	35.49	2 x 2litres	1 litre	0.158		50
04:05	11.5.97	131	143	04.37.6N	24.17.4W	53.0	28.19	35.55	2 x 2litres	1 litre	0.210	2 x S76	
06:03	11.5.97	131	144	05.00.0N	24.06.9W	51.1	28.04	35.19	2 x 2litres	1 litre	0.227		
08:05	11.5.97	131	145	05.23.0N	23.56.3W	49.5	27.96	35.05	2 x 2litres	1 litre	0.207	2 x S77	51
10:00	11.5.97	131	146	05.44.9N	23.46.7W	55.4	27.89	35.25	2 x 2litres	1 litre	0.233		
16:00	11.5.97	131	147	06.36.4N	23.25.3W	53.5	27.60	36.02	2 x 2litres	1 litre	0.216	2 x S78	
18:01	11.5.97	131	148	06.57.9N	23.17.0W	62.6	27.74	35.99	2 x 2litres	1 litre	0.369		
20:00	11.5.97	131	149	07.18.2N	23.08.3W	55.7	27.31	36.10	2 x 2litres	1 litre	0.242	2 x S79	52
22:00	11.5.97	131	150	07.39.8N	22.59.5W	54.5	26.87	35.42	2 x 2litres	1 litre	0.258		
00:00	12.5.97	132	151	07.59.6N	22.50.7W	55.4	27.49	35.97	2 x 2litres	1 litre	0.224	2 X S80	
02:00	12.5.97	132	152	08.19.4N	22.42.3W	53.1	27.72	36.07	2 x 2litres	1 litre	0.207		53
04:02	12.5.97	132	153	08.42.9N	22.33.5W	54.0	27.80	36.08	2 x 2litres	1 litre	0.192	2 X S81	
06:04	12.5.97	132	154	09.05.0N	22.23.8W	52.3	27.98	36.07	2 x 2litres	1 litre	0.199		

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08:00	12.5.97	132	155	09.26.5N	22.13.8W	53.1	27.98	36.04	2 x 2litres	1 litre	0.235	2 X S82	54
10:00	12.5.97	132	156	09.47.8N	22.02.9W	53.1	27.23	36.13	2 x 2litres	1 litre	0.206		
16:00	12.5.97	132	157	10.30.6N	21.42.2W	47.9	26.93	36.04	2 x 2litres	1 litre	0.177	2 X S83	
16:55	12.5.97	132	158	10.38.1N	21.38.3W	51.0	26.73	36.02	2 x 2litres	1 litre	0.174		
18:00	12.5.97	132	159	10.46.2N	21.34.1W	54.1	26.65	36.02	2 x 2litres	1 litre	0.206		
20:00	12.5.97	132	160	11.06.2N	21.25.0W	50.2	26.13	36.03	2 x 2litres	1 litre	0.161	2 X S84	55
22:00	12.5.97	132	161	11.26.5N	21.14.0W	56.5	25.83	36.14	2 x 2litres	1 litre	0.218		
00:00	13.5.97	133	162	11.44.5N	21.05.4W	62.5	25.62	36.09	2 x 2litres	1 litre	0.245	2 X S85	
02:00	13.5.97	133	163	11.55.3N	21.00.5W	61.5	25.74	36.06	2 x 2litres	1 litre	0.215		56
02:41	13.5.97	133	164	12.03.5N	21.00.0W	67.7	25.70	36.04	2 x 2litres	1 litre	0.274		
04:00	13.5.97	133	165	12.18.9N	21.00.1W	61.3	25.40	35.95	2 x 2litres	1 litre	0.233	2 X S86	
06:00	13.5.97	133	166	12.43.0N	21.00.1W	63.1	25.33	35.58	2 x 2litres	1 litre	0.306		
08:00	13.5.97	133	167	13.06.1N	20.59.9W	62.7	24.90	35.80	2 x 2litres	1 litre	0.216	2 X S87	57
10:00	13.5.97	133	168	13.28.6N	20.59.9W	69.5	25.02	35.81	2 x 2litres	1 litre	0.407		
16:00	13.5.97	133	169	14.17.6N	21.01.0W	63.2	24.46	36.10	2 x 2litres	1 litre	0.227	2 X S88	
18:00	13.5.97	133	170	14.38.7N	21.00.7W	57.5	24.39	36.30	2 x 2litres	1 litre	0.192		
20:00	13.5.97	133	171	14.58.4N	21.00.0W	58.5	24.31	36.24	2 x 2litres	1 litre	0.218	2 X S89	58
21:10	13.5.97	133	172	15.12.2N	21.07.7W	69.2	23.99	36.15	2 x 2litres	0.9 litre	0.248		
22:00	13.5.97	133	173	15.20.5N	21.01.4W	63.3	24.11	36.13	2 x 2litres	1 litre	0.260	2 X S90	
00:00	14.5.97	134	174	15.41.6N	21.03.5W	58.8	24.31	36.21	2 x 2litres	1 litre	0.219		59
02:00	14.5.97	134	175	16.06.0N	21.05.2W	55.9	24.16	36.26	2 x 2litres	1 litre	0.178	2 X S91	
03:10	14.5.97	134	176	16.19.1N	21.06.1W	63.9	23.62	36.24	2 x 2litres	1 litre	0.301		
05:00	14.5.97	134	177	16.41.9N	21.07.4W	64.8	23.41	36.30	2 x 2litres	1 litre	0.271	2 X S92	60
07:50	14.5.97	134	178	17.04.0N	21.08.6W	62.1	23.64	36.27	2 x 2litres	1 litre	0.268		
09:00	14.5.97	134	179	17.27.7N	21.10.9W	60.5	23.47	36.23	2 x 2litres	1 litre	0.267	2 X S93	
15:00	14.5.97	134	180	18.19.9N	21.15.5W	55.6	23.18	36.45	2 x 2litres	1 litre	0.192	2 X S94	
15:55	14.5.97	134	181	18.29.2N	21.16.2W	58.4	23.11	36.44	2 x 2litres	1 litre	0.194		
17:10	14.5.97	134	182	18.40.2N	21.17.0W	66.0	22.90	36.40	2 x 2litres	1 litre	0.338		
18:55	14.5.97	134	183	19.01.9N	21.17.8W	72.2	22.93	36.42	2 x 2litres	1 litre	0.277	2 X S95	61
21:03	14.5.97	134	184	19.27.1N	21.19.0W	77.7	22.55	36.35	2 x 2litres	1 litre	0.421		
23:00	14.5.97	134	185	19.50.5N	21.19.8W	18.3	22.51	36.75	2 x 2litres	1 litre	0.200	2 X S96	
01:00	15.5.97	135	186	20.12.2N	21.21.4W	19.3	22.58	36.64	2 x 2litres	1 litre	0.187		62

Time (GMT)	Date	Julian Day	Sample Number	Position lat.	long.	chl.	Surface Temp.	Sal.	HPLC Vol.	Vol.Chl. filetered	[ug/l chl a	Iodine Samples*	Bacterial Samples**
03:00	15.5.97	135	187	20.35.2N	21.23.2W	20.3	22.50	36.58	2 x 2litres	1 litre	0.258	2 X S97	
05:00	15.5.97	135	188	21.01.7N	21.25.3W	19.6	22.41	36.65	2 x 2litres	1 litre	0.194		
07:00	15.5.97	135	189	21.25.8N	21.27.9W	20.9	22.43	36.56	2 x 2litres	1 litre	0.343	2 X S98	63
09:00	15.5.97	135	190	21.49.6N	21.30.9W	20.5	22.34	36.55	2 x 2litres	1 litre	0.326		
15:00	15.5.97	135	191	22.41.3N	21.36.2W	19.7	22.19	36.72	2 x 2litres	0.8 litre	0.221	2 X S99	
15:58	15.5.97	135	192	22.50.1N	21.36.6W	19.9	22.22	36.78	2 x 2litres	1 litre	0.207		
17:00	15.5.97	135	193	23.00.6N	21.37.5W	61.5	22.16	36.81	2 x 2litres	1 litre	0.202		
19:00	15.5.97	135	194	23.24.3N	21.39.3W	57.0	22.32	36.86	2 x 2litres	1 litre	0.118	2 X S100	64
21:00	15.5.97	135	195	23.48.9N	21.40.5W	56.2	22.34	37.09	2 x 2litres	1 litre	0.133		
23:00	15.5.97	135	196	24.10.1N	21.42.4W	54.9	22.38	37.07	2 x 2litres	1 litre	0.117	2 X S101	
01:00	16.5.97	136	197	24.22.8N	21.43.6W	54.3	22.33	37.06	2 x 2litres	1 litre	0.117		65
03:00	16.5.97	136	198	24.46.2N	21.45.3W	54.0	21.86	37.24	2 x 2litres	1 litre	0.082	2 X S102	
05:00	16.5.97	136	199	25.08.1N	21.47.5W	56.0	21.83	37.09	2 x 2litres	1 litre	0.135		
07:00	16.5.97	136	200	25.31.1N	21.48.9W	56.2	21.95	37.12	2 x 2litres	1 litre	0.139	2 X S103	66
09:00	16.5.97	136	201	25.54.9N	21.50.9W	56.8	21.90	37.13	2 x 2litres	1 litre	0.133		
15:00	16.5.97	136	202	26.28.7N	21.54.5W	53.8	22.30	37.21	2 x 2litres	1 litre	0.106	2 X S104	
17:00	16.5.97	136	203	26.51.6N	21.55.9W	53.0	22.01	37.07	2 x 2litres	1 litre	0.105		
19:00	16.5.97	136	204	27.13.3N	21.56.8W	54.7	21.79	37.24	2 x 2litres	1 litre	0.070	2 X S105	67
21:00	16.5.97	136	205	27.36.8N	21.58.1W	51.6	21.78	37.74	2 x 2litres	1 litre	0.050		
23:01	16.5.97	136	206	27.57.6N	21.57.9W	52.3	21.50	37.18	2 x 2litres	1 litre	0.045	2 X S106	
01:04	17.5.97	137	207	28.09.7N	21.57.4W	51.3	21.33	37.15	2 x 2litres	1 litre	0.047		68
03:00	17.5.97	137	208	28.31.7N	21.55.3W	51.8	21.32	37.12	2 x 2litres	1 litre	0.053		
05:00	17.5.97	137	209	28.54.6N	21.53.2W	53.8	20.83	36.94	2 x 2litres	1 litre	0.074		
07:00	17.5.97	137	210	29.11.3N	21.50.9W	53.8	20.67	36.91	2 x 2litres	1 litre	0.072	2 X S107	69
09:00	17.5.97	137	211	29.41.4N	21.47.8W	53.7	20.76	36.92	2 x 2litres	1 litre	0.073		
15:00	17.5.97	137	212	30.36.1N	21.40.0W	53.1	20.57	36.68	2 x 2litres	1 litre	0.058	2 X S108	
16:00	17.5.97	137	213	30.44.6N	21.38.7W	54.3	20.54	36.75	2 x 2litres	1 litre	0.066		
17:00	17.5.97	137	214	30.51.3N	21.37.4W	55.4	20.48	36.71	2 x 2litres	1 litre	0.070		
19:00	17.5.97	137	215	31.12.1N	21.35.6W	55.4	20.54	36.67	2 x 2litres	0.8 litre	0.062	2 X S109	70
21:00	17.5.97	137	216	31.33.7N	21.35.0W	54.5	20.48	36.71	2 x 2litres	1 litre	0.059		
22:45	17.5.97	137	217	31.48.4N	21.33.7W	55.8	20.16	36.50	2 x 2litres	1 litre	0.077	2 X S110	
01:00	18.5.97	138	218	31.55.0N	21.32.9W	55.0	20.31	36.53	2 x 2litres	1 litre	0.074		71

Time (GMT)	Date	Julian Day	Sample Number	Position lat.	long.	chl.	Surface Temp.	Sal.	HPLC Vol.	Vol.Chl. filetered	[ug/l chl a	Iodine Samples*	Bacterial Samples**
03:00	18.5.97	138	219	32.18.3N	21.29.1W	54.1	20.05	36.61	2 x 2litres	1 litre	0.070	2 X S111	
05:00	18.5.97	138	220	32.39.9N	21.25.4W	54.3	19.99	36.64	2 x 2litres	1 litre	0.067		
07:00	18.5.97	138	221	33.02.6N	21.22.6W	54.7	19.94	36.68	2 x 2litres	1 litre	0.078	2 X S112	72
09:00	18.5.97	138	222	33.23.8N	21.20.4W	54.8	19.94	36.64	2 x 2litres	1 litre	0.077		
15:00	18.5.97	138	223	33.50.0N	21.16.0W	56.1	19.70	36.38	2 x 2litres	1 litre	0.105	2 X S113	
17:00	18.5.97	138	224	34.09.2N	21.73.7W	59.6	19.60	36.36	2 x 2litres	1 litre	0.116		
			225			60.4	19.63	36.30	2 x 2litres	1 litre	0.113		
19:00	18.5.97	138	226	34.18.9N	21.10.9W	59.0	19.50	36.48	2 x 2litres	1 litre	0.101	2 X S114	73
21:16	18.5.97	138	227	34.36.6N	21.06.0W	58.8	19.40	36.40	2 x 2litres	1 litre	0.114		
01:11	19.5.97	139	228	35.06.5N	20.57.6W	59.2	18.94	36.37	2 x 2litres	1 litre	0.110	2 X S116	74
04:35	19.5.97	139	229	35.36.0N	20.47.8W	58.3	18.65	36.31	2 x 2litres	1 litre	0.118	2 X S117	75
07:04	19.5.97	139	230	35.53.1N	20.52.7W	57.9	18.54	36.07	2 x 2litres	1 litre	0.107		76
09:01	19.5.97	139	231	36.15.4N	21.09.2W	58.8	18.47	36.39	2 x 2litres	1 litre	0.117		
15:00	19.5.97	139	232	36.32.4N	20.42.6W	57.5	18.35	36.42	2 x 2litres	1 litre	0.100	2 X S118	
16:00	19.5.97	139	233	36.41.1N	20.39.0W	59.9	18.33	36.42	2 x 2litres	1 litre	0.109		
17:00	19.5.97	139	234	36.49.9N	20.35.3W	55.9	18.30	36.37	2 x 2litres	1 litre	0.105		
18:55	19.5.97	139	235	37.10.5N	20.25.9W	60.7	17.87	36.21	2 x 2litres	1 litre	0.092	2 X S119	77
21:00	19.5.97	139	236	37.33.8N	20.16.2W	57.3	17.74	36.19	2 x 2litres	1 litre	0.074		78
22:30	19.5.97	139	237	37.48.8N	20.10.1W	61.5	17.60	36.15	2 x 2litres	1 litre	0.092	2 X S120	
01:00	20.5.97	140	238	37.59.2N	20.06.5W	61.4	17.36	36.10	2 x 2litres	1 litre	0.098		79
02:58	20.5.97	140	239	38.22.2N	19.59.8W	59.3	17.34	36.14	2 x 2litres	1 litre	0.088	2 X S121	
05:00	20.5.97	140	240	38.44.8N	19.59.2W	61.4	17.28	36.17	2 x 2litres	1 litre	0.096		
07:00	20.5.97	140	241	39.06.9N	19.59.9W	67.6	17.17	36.09	2 x 2litres	1 litre	0.162	2 X S122	80
09:00	20.5.97	140	242	39.26.7N	20.00.0W	65.7	16.91	36.04	2 x 2litres	1 litre	0.160		
15:00	20.5.97	140	243	40.15.6N	19.59.5W	68.0	16.88	35.99	2 x 2litres	1 litre	0.142	2 X S123	
16:00	20.5.97	140	244	40.24.4N	19.59.4W	72.0	16.88	35.93	2 x 2litres	1 litre	0.144		
17:00	20.5.97	140	245	40.34.2N	19.59.6W	73.3	16.79	35.97	2 x 2litres	1 litre	0.156		
19:01	20.5.97	140	246	40.57.7N	19.59.4W	84.6	16.95	35.94	2 x 2litres	1 litre	0.178	2 X S124	81
20:50	20.5.97	140	247	41.19.0N	20.00.1W	31.7	16.65	35.94	2 x 2litres	1 litre	0.232		82
23:00	20.5.97	140	248	41.43.4N	20.01.5W	27.4	16.41	35.99	2litres	1 litre	0.166	2 X S125	
01:01	21.5.97	141	249	42.02.0N	20.00.6W	31.2	15.94	35.93	2litres	1 litre	0.269		83
03:00	21.5.97	141	250	42.26.0N	20.00.0W	29.2	16.04	35.93	2litres	1 litre	0.198	2 X S126	

Time (GMT)	Date	Julian Day	Sample Number	Position lat.	long.	chl.	Surface Temp.	Sal.	HPLC Vol.	Vol.Chl. filetered	[ug/l chl a	Iodine Samples*	Bacterial Samples**
05:00	21.5.97	141	251	42.49.5N	20.00.3W	32.4	15.95	35.91	2litres	1 litre	0.285		
07:02	21.5.97	141	252	43.12.9N	20.00.2W	47.9	15.76	35.90	2litres	1 litre	0.466	2 X S127	84
09:03	21.5.97	141	253	43.37.0N	20.00.6W	59.4	15.33	35.82	2litres	1 litre	0.456		
14:29	21.5.97	141	254	44.16.1N	20.00.0W	64.2	15.23	35.81	2litres	1 litre	0.676		
15:00	21.5.97	141	255	44.21.5N	20.19.6W	68.1	15.09	35.78	2litres	1 litre	0.460	2 X S128	
16:01	21.5.97	141	256	44.30.8N	19.58.3W	79.1	15.24	35.80	2litres	1 litre	0.485		
16:59	21.5.97	141	257	44.37.3N	19.58.8W	76.0	15.31	35.79	2litres	1 litre	0.492		
19:00	21.5.97	141	258	44.54.9N	19.59.5W	89.6	15.04	35.76	2litres	1 litre	0.503	2 X S129	85
21:00	21.5.97	141	259	45.11.9N	19.59.7W	43.9	14.97	35.79	2litres	1 litre	1.050		
23:00	21.5.97	141	260	45.28.9N	19.59.3W	44.3	14.57	35.68	2litres	1 litre	1.130		
01:00	22.5.97	142	261	45.42.3N	19.58.7W	39.7	14.57	35.70	2litres	1 litre	0.923		
03:00	22.5.97	142	262	45.58.0N	19.58.3W	39.6	14.56	35.70	2litres	1 litre	0.676	2 X S130	
05:00	22.5.97	142	263	46.15.2N	19.59.0W	37.9	14.66	35.69	2litres	1 litre	0.628		86
07:00	22.5.97	142	264	46.33.6N	20.01.0W	32.1	14.69	35.67	2litres	1 litre	0.655	2 X S131	87
09:00	22.5.97	142	265	46.52.0N	20.00.2W	38.7	14.64	35.71	2litres	1 litre	1.180		
14:31	22.5.97	142	266	47.07.1N	19.24.7W	69.6	14.35	35.77	4 x 1 litre	1 litre	1.560		reps:
15:00	22.5.97	142	267	47.08.7N	19.17.3W	57.7	14.34	35.66	2litres	1 litre	1.680	2 X S132	
16:00	22.5.97	142	268	47.11.5N	19.04.5W	47.6	14.34	35.68	2litres	1 litre	1.540		
17:01	22.5.97	142	269	47.13.9N	18.51.3W	74.4	14.30	35.69	2litres	1 litre	1.750		
18:48	22.5.97	142	270	47.18.2N	18.25.1W	33.2	13.96	35.66	2litres	1 litre	1.890	2 X S133	88
21:00	22.5.97	142	271	47.24.0N	17.51.7W	23.1	13.94	35.75	2litres	1 litre	1.480		
23:05	22.5.97	142	272	47.29.8N	17.19.0W	19.1	14.00	35.74	2litres	1 litre	0.981	2 X S134	
01:00	23.5.97	143	273	47.34.7N	16.46.8W	22.5	14.13	35.72	2litres	1 litre	1.050		89
03:00	23.5.97	143	274	47.40.0N	16.12.8W	26.0	14.24	35.77	2litres	1 litre	1.240	2 X S135	
05:00	23.5.97	143	275	47.46.0N	15.39.3W	26.6	13.66	35.63	2litres	1 litre	2.140		
07:00	23.5.97	143	276	47.52.7N	15.05.1W	25.6	13.84	35.58	2litres	1 litre	1.650	2 X S136	90
09:01	23.5.97	143	277	47.58.0N	14.30.8W	18.6	13.63	35.59	2litres	1 litre	1.400		
15:00	23.5.97	143	278	48.10.0N	13.23.5W	17.2	13.38	35.58	2litres	1 litre	0.492	2 X S137	
16:08	23.5.97	143	279	48.12.8N	13.09.9W	18.6	13.67	35.64	2litres	1 litre	0.620		
17:00	23.5.97	143	280	48.14.74N	13.00.3W	21.8	13.81	35.62	2litres	1 litre	0.736		
19:00	23.5.97	143	281	48.17.5N	12.28.9W	16.1	13.92	35.71	2litres	1 litre	0.379	2 X S138	91
20:46	23.5.97	143	282	48.23.2N	12.00.4W	19.5	13.48	35.66	2litres	1 litre	0.727		

Time (GMT)	Date	Julian Day	Sample Number	Position lat.	long.	chl.	Surface Temp.	Sal.	HPLC Vol.	Vol.Chl. filetered	[ug/l chl a	Iodine Samples*	Bacterial Samples**
22:56	23.5.97	143	283	48.29.6N	11.24.6W	17.8	13.08	35.64	2litres	1 litre	0.519	2 X S139	
02:00	24:05:97	144	284	48.38.0N	10.39.0W	21.6	12.97	35.62	2litres	1 litre	0.935		92
04:00	24:05:97	144	285	48.44.3N	10.09.5W	26.4	12.62	35.60	2litres	1 litre	2.480	2 X S140	
06:04	24:05:97	144	286	48.49.4N	09.36.8W	19.7	12.59	35.59	2litres	1 litre	1.870		
08:00	24:05:97	144	287	48.59.0N	09.08.4W	16.5	13.02	35.45	2litres	1 litre	1.510	2 X S141	93
14:00	24:05:97	144	288	48.59.8N	08.33.6W	48.3	12.65	35.51	2litres	1 litre	1.190	2 X S142	
16:00	24:05:97	144	289	49.05.1N	08.07.1W	54.7	12.41	35.49	2litres	1 litre	1.640		
17:40	24:05:97	144	290	49.08.6N	07.44.6W	53.5	12.38	35.48	2litres	1 litre	1.140	2 X S143	94
20:00	24:05:97	144	291	49.14.0N	07.12.1W	54.3	12.28	35.50	2litres	1 litre	1.020		
22:00	24:05:97	144	292	49.17.3N	04.44.3W	56.1	12.17	35.51	2litres	1 litre	1.260	2 X S144	
00:04	25:05:97	145	293	49.23.4N	06.16.4W	62.4	12.27	35.45	2litres	1 litre	1.980		95
02:01	25:05:97	145	294	49.30.1N	05.50.4W	71.6	12.11	35.29	2litres	1 litre	3.340	2 X S145	
04:04	25:05:97	145	295	49.37.9N	05.19.7W	72.8	11.92	35.25	2litres	1 litre	2.740		
06:00	25:05:97	145	296	49.46.8N	04.44.7W	67.7	11.97	35.28	2litres	1 litre	2.040	2 X S146	96
08:00	25:05:97	145	297	49.56.9N	04.46.4W	70.7	11.88	35.19	2litres	1 litre	7.640		
10:00	25:05:97	145	298	50.04.1N	03.28.0W	75.2	11.83	35.27	2litres	1 litre	2.600		
11:39	25:05:97	145	299	50.05.6N	03.15.3W	70.4	11.75	35.34	2litres	1 litre	2.920		
13:18	25:05:97	145	300	50.11.7N	02.45.6W	67.4	11.72	35.19	2litres	1 litre	2.480	2 X S147	o.flight
14:00	25:05:97	145	301	50.14.6N	02.33.0W				2litres	1 litre	2.020		
15:59	25:05:97	145	302	50.16.7N	02.04.3W	75.9	11.81	35.35	1.75L	1 litre	2.200	2 X S148	
08:45	26:05:96	146	303						1L EACH				
09:00	26:05:96	146	304						1L EACH				
09:15	26:05:96	146	305						1L EACH				o.flight
09:30	26:05:96	146	306						1L EACH				
09:45	26:05:96	146	307						1L EACH				
10:00	26:05:96	146	308						1L EACH				

Appendix H: Primary production log sheets

Date	*JD*	*Stn*	*Cast*	*Depth*	*Latitude*	*Longitude*	*Size-photo.*	*P-I exp.*	*Net prod.*	*Size Chla*	*Total Chla*	*Taxon omy*	*DOC prod.*	*TOC*
21.04.97	111	1	1	7	50.59 S	57.17 W				X	X	X		
				20						X	X			
				40						X	X			
				60						X				
				80						X		X		
				100						X				
22.04.97	112	2	3	7	47.37 S	55.56 W	X			X	X	X		
				20			X			X				
				35			X			X				
				50			X			X	X	X		
23.04.97	113	4	5	7	43.29 S	54.24 W	X	X		X		X		
				20										
				30			X			X				
				40			X			X				
				50			X	X		X		X		
				60			X			X				
24.04.97	114	5	7	7	39.25 S	52.58 S	X			X			X	
				20			X			X			X	
				40			X			X				
				60			X			X				
				80			X			X				
				100			X			X				
30.04.97	120	6	9	7	35.39 S	49.48 W	X	X	X	X		X		
				20			X	X	X	X		X		
				40			X			X				
				60			X			X				
				70			X		X	X				
				80			X			X				
01.05.97	121	7	11	7	32.36 S	46.12 W	X			X	X	X	X	
				20			X			X				
				40			X			X				
				50			X			X	X	X		
				70			X			X				
				90			X			X				
02.05.97	122	9	13	7	29.19 S	49.19 W	X	X	X	X		X		
				20			X			X				
				30			X			X				
				40			X			X				
				60			X			X				
				80			X	X	X	X		X		
				100			X			X				
03.05.97	123	10	15	7	26.06 S	39.11 W	X			X		X		
				20			X			X				
				40			X			X				
				60			X			X				
				80			X			X		X		
				110			X			X				

Date	JD	Stn	Cast	Depth	Latitude	Longitude	Size-photo.	P-I exp.	Net prod.	Size Chla	Total Chla	Taxonomy	DOC prod.	TOC
04.05.97	124	12	17	7	22.09 S	36.37 W	X	X	X	X		X		
				30			X			X				
				60			X			X				
				70			X			X				
				90			X			X				
				110			X	X	X	X		X		
				130			X		X	X				
05.05.97	125	13	19	7	18.16 S	34.45 W	X			X	X	X		
				40			X			X	X	X		
				60			X			X				
				110			X			X				
06.05.97	126	14	21	7	14.06 S	32.50 W	X	X	X	X		X		
				40			X			X				
				60			X			X				
				100			X			X				
				130			X	X	X	X		X		
				155			X		X	X				
07.05.97	127	15	23	7	10.01 S	3.56 W	X			X		X	X	
				30			X			X				
				60			X			X				
				100			X			X				
				120			X			X		X		
				140			X			X				
08.05.97	128	16	25	7	5.54 S	29.05 N	X	X	X	X		X		
				30			X			X				
				50			X			X				
				90			X			X				
				110			X	X	X	X		X		
				120			X		X	X				
09.05.97	129	18	27	7	2.02 S	27.19 W	X			X		X	X	
				20			X			X				
				30			X			X				
				50			X			X				
				70			X			X		X	X	
				80			X			X				
				90			X			X				
10.05.97	130	21	30	7	1.53 N	25.37 W	X		X	X		X		
				20			X			X				
				40			X			X				
				60			X			X				
				72			X		X	X		X		
11.05.97	131	22	32	7	6.04 N	23.38 W	X	X	X	X		X		
				20			X			X				
				30			X			X				
				40			X	X	X	X		X		
				60			X			X				
				70			X			X				
12.05.97	132	23	34	7	10.03 N	21.55 W	X			X	X	X		
				20			X			X				
				40			X			X				
				50			X			X				

Date	JD	Stn	Cast	Depth	Latitude	Longitude	Size-photo.	P-I exp.	Net prod.	Size Chla	Total Chla	Taxonomy	DOC prod.	TOC
				60			X			X	X	X		
				70			X			X				
13.05.97	133	26	37	7	13.48 N	21.00 W	X	X	X	X		X	X	
				20			X			X				
				30			X	X	X	X		X	X	
				40			X			X				
				55			X		X	X				
14.05.97	134	27	39	7	17.47 N	21.12 W	X			X		X		
				30			X			X				
				60			X			X		X		
				70			X			X				
				87			X			X				
15.05.97	135	29	41	7	22.10 N	21.33 W	X	X	X	X		X	X	X
				30			X	X		X			X	X
				40			X	X	X	X		X	X	X
				53			X		X	X				X
				100										X
				150										X
				200										X
15.5.97	135	31	43	7	24.10 N	21.42 W								X
				50										X
				100										X
				200										X
				500										X
16.05.97	136	32	44	7	26.16 N	21.52 W	X	X		X		X	X	X
				30			X	X		X			X	X
				60			X			X				X
				80			X	X		X		X	X	X
				90			X			X				X
				150										X
				200										X
16.05.97	136	33	46	7	27.57 N	21.57 W								X
				50										X
				100										X
				200										X
				500										X
17.05.97	137	34	47	7	30.02 N	21.45 W	X	X		X	X	X	X	X
				30			X			X				X
				50			X	X		X			X	X
				70			X			X				X
				90			X	X		X	X		X	X
				130			X							X
				200										X
18.05.97	138	37	50	7	33.43 N	21.17 W	X	X	X	X		X	X	X
				20			X		X	X				X
				40			X	X		X			X	X
				90			X	X	X	X		X	X	X
				100			X			X				X
18.05.97	138	38	51	7	33.43 N	21.17 W								X
				200										X
				500										X

Date	JD	Stn	Cast	Depth	Latitude	Longitude	Size-photo.	P-I exp.	Net prod.	Size Chla	Total Chla	Taxonomy	DOC prod.	TOC
				1000										X
				2000										X
19.05.97	139	40	54	7	35.06 N	20.57 W								X
				50										X
				100										X
				200										X
				500										X
				700										X
				1000										X
19.05.97	139	42	56	7	36.13 N	20.50 W	X	X	X	X		X	X	X
				20			X	X		X			X	X
				60			X		X	X				X
				80			X	X		X		X	X	X
				100			X			X				X
19.05.97	139	42	57	7	36.13 N	20.50 W								X
				50										X
				100										X
				500										X
				1000										X
				2000										X
19.05.97	139	44	58	7	37.48 N	20.10 W								X
				50										X
				100										X
				200										X
				500										X
				1000										X
				2000										X
20.05.97	140	45	59	7	39.51 N	20.00 W	X	X		X		X	X	X
				20			X	X		X			X	X
				50			X	X		X		X	X	X
				60			X			X				X
				80			X			X				X
				100										X
				200										X
21.05.97	141	48	61	7	43.59 N	19.58 W				X		X		
				15						X				
				25						X		X		
				35						X				
				50						X				
22.05.97	142	51	62	2	47.00 N	19.59 W				X				
				7						X				
				15						X		X		
				25						X				
				40						X				
				60						X				
23.05.97	143	53	63	2	48.03 N	13.59 W								
				7					X	X		X		
				20					X	X		X		
				40						X				
				60						X				
				80						X				

Date	*JD*	*Stn*	*Cast*	*Depth*	*Latitude*	*Longitude*	*Size-photo.*	*P-I exp.*	*Net prod.*	*Size Chla*	*Total Chla*	*Taxonomy*	*DOC prod.*	*TOC*
24.04.97	144	55	65	7	48.57 N	8.45 W			X	X		X		
				20						X				
				30						X				
				40					X	X		X		
25.05.97	145	56	66	7	50.04 N	03.28 W				X		X		
				10						X				
				20						X		X		
				30						X				
				40						X				
				50						X				

Appendix I: Chlorophyll and pigment station log

Time (GMT)	Date	SDY	Station No	position lat.	long.	underway chl.	Temp.	Sal.	HPLC Volume	ID	Depth	chlorophyll Volume	[ug/l chl a]
18:05	21.4.97	111	**1**	50.59.3S	57.17.7W	42.5	8.1	33.78	2litres	**1**	7	1 litre	0.68
									2litres		20	1 litre	0.176
									2litres		40	1 litre	0.165
									2litres		60	0.6 litre	0.542
									2litres		80	1 litre	0.49
									2litres		100	1 litre	0.415
15:00	22.4.97	112	**2**	47.37.2S	55.56.8W	38	11.4	34.12	2litres	**2**	2	1 litre	0.51
									2litres		7	1 litre	0.49
									2litres		20	1 litre	0.468
									2litres		35	1 litre	0.47
									2litres		50	1 litre	0.116
									2litres		80	1 litre	0.038
15:05	23.4.97	113	**4**	43.28.4S	54.24.4W	54.9	14.2	53.75	2litres	**3**	2	1 litre	0.746
									2litres		7	1 litre	0.932
									2litres		20	1 litre	0.918
									2litres		30	1 litre	0.993
									2litres		50	1 litre	0.404
									2litres		70	1 litre	0.162
14:45	24.4.97	114	**5**	39.25.9S	52.58.3W	27	13.4	33.73	2litres	**4**	2	1 litre	0.906
									2litres		7	1 litre	0.826
									2litres		15	1 litre	0.591
									2litres		20	1 litre	0.441
									2litres		30	1 litre	0.429
									2litres		60	1 litre	0.383
14:32	30.4.97	120	**6**	35.39.1S	49.49.2W	27.1	19.94	35.76	2litres	**5**	2	1 litre	0.331

Time (GMT)	Date	SDY	Station No	position lat.	long.	underway chl.	Temp.	Sal.	HPLC Volume	ID	Depth	chlorophyll Volume	[ug/l chl a]
									2litres		7	1 litre	0.376
									2litres		40	1 litre	0.479
									2litres		100	1 litre	0.18
									2litres		120	1 litre	0.082
									2litres		160	1 litre	0.041
13:56	01.05.97	121	**7**	32.36.5S	46.11.8W	59	21.3	36.09	2litres	**6**	7	1 litre	0.256
									2litres		20	1 litre	0.252
									2litres		45	1 litre	0.299
									2litres		70	1 litre	0.304
									2litres		90	1 litre	0.121
									2litres		130	1 litre	0.016
14:02	02.5.97	122	**9**	29.19.7S	42.39.0W	52.1	23.51	36.356	2litres	**7**	7	1 litre	0.149
									2litres		25	1 litre	0.142
									2litres		50	1 litre	0.18
									2litres		70	1 litre	0.326
									2litres		90	1 litre	0.447
									2litres		130	1 litre	0.091
13:45	03.5.97	123	**10**	26.06.1S	39.11.2W	50.3	25.36	36.74	2litres	**8**	7	1 litre	0.141
									2litres		30	1 litre	0.144
									2litres		55	1 litre	0.18
									2litres		80	1 litre	0.326
									2litres		110	1 litre	0.447
									2litres		130	1 litre	0.091
13:48	04.5.97	124	**12**	22.09.3S	36.37.8W	40.4	26.87	37.07	2litres	**9**	7	1 litre	0.094
									2litres		30	1 litre	0.107
									2litres		70	1 litre	0.236
									2litres		90	1 litre	0.286
									2litres		140	1 litre	0.167

Time (GMT)	Date	SDY	Station No	position lat.	long.	underway chl.	Temp.	Sal.	HPLC Volume	ID	Depth	chlorophyll Volume	[ug/l chl a]
									2litres		180	1 litre	0.041
12:36	05.0.97	125	**13**	18.16.8S	34.45.6W	48.2	26.79	37.17	2litres	**10**	7	1 litre	0.147
									2litres		20	1 litre	0.15
									2litres		60	1 litre	0.178
									2litres		90	1 litre	0.408
									2litres		110	1 litre	0.495
									2litres		130	1 litre	0.185
12:51	06.5.97	126	**14**	14.06.5S	32.51.3W	46	26.6	37.06	2litres	**11**	7	1 litre	0.058
									2litres		25	1 litre	0.058
									2litres		50	1 litre	0.064
									2litres		100	1 litre	0.146
									2litres		130	1 litre	0.236
									2litres		160	1 litre	0.196
12:39	07.5.97	127	**15**	10.01.9S	30.56.9W	46.4	27.61	36.64	2litres	**12**	7	1 litre	0.084
									2litres		20	1 litre	0.09
									2litres		60	1 litre	0.134
									2litres		100	1 litre	0.24
									2litres		120	1 litre	0.325
									2litres		140	1 litre	0.16
12:48	08.5.97	128	**16**	05.54.3S	29.05.8W	47.9	28.21	35.91	2litres	**13**	7	1 litre	0.134
									2litres		20	1 litre	0.13
									2litres		60	1 litre	0.234
									2litres		90	1 litre	0.352
									2litres		120	1 litre	0.203
									2litres		150	1 litre	0.094
12:37	09.5.97	129	**18**	02.01.0S	27.20.3W	47.7	27.73	36.03	2litres	**14**	7	1 litre	0.119
									2litres		20	1 litre	0.118
									2litres		50	1 litre	0.228

Time (GMT)	Date	SDY	Station No	position lat.	long.	underway chl.	Temp.	Sal.	HPLC Volume	ID	Depth	chlorophyll Volume	[ug/l chl a]
									2litres		70	1 litre	0.666
									2litres		90	1 litre	0.619
									2litres		120	1 litre	0.135
00:13	10.5.97	130A	**20**	00.07.9S	26.28.3W	50.5	27.01	36.22	2litres	**15**	7	1 litre	0.132
									2litres		20	1 litre	0.141
									2litres		50	1 litre	0.366
									2litres		70	1 litre	0.493
									2litres		90	1 litre	0.292
									2litres		120	1 litre	0.114
12:47	10.5.97	130B	**21**	01.53.9N	25.37.0W	47.8	28.14	35.68	2litres	**16**	7	1 litre	0.174
									2litres		20	1 litre	0.196
									2litres		40	1 litre	0.362
									2litres		60	1 litre	0.62
									2litres		70	1 litre	0.38
									2litres		100	1 litre	0.121
12:38	11.5.97	131	**22**	06.05.0N	23.38.1W	57.6	27.48	35.45	2litres	**17**	7	1 litre	0.337
									2litres		15	1 litre	0.411
									2litres		30	1 litre	0.626
									2litres		40	0.95 litre	0.532
									2litres		60	1 litre	0.23
									2litres		70	1 litre	0.315
12:43	12.5.97	132A	**23**	10.03.3N	21.55.9W	49	27.26	36.17	2litres	**18**	7	1 litre	0.183
									2litres		20	1 litre	0.182
									2litres		40	1 litre	0.693
									2litres		50	1 litre	1.15
									2litres		70	1 litre	0.353
									2litres		80	1 litre	0.222

Time (GMT)	Date	SDY	Station No	position lat.	long.	underway chl.	Temp.	Sal.	HPLC Volume	ID	Depth	chlorophyll Volume	[ug/l chl a]
12:46	13.5.97	133A	**26**	13.48.7N	21.00.5W	66.1	24.46	36.04	2litres	**19**	2	1 litre	0.297
									2litres		7	1 litre	0.311
									2litres		15	1 litre	0.313
									2litres		25	1 litre	0.592
									2litres		30	1 litre	1.09
									2litres		40	1 litre	0.443
11:33	14.5.97	134A	**27**	17.47.3N	21.13.3W	56.3	23.32	36.493	2litres	**20**	7	1 litre	0.213
									2litres		30	1 litre	0.263
									2litres		50	1 litre	0.991
									2litres		60	1 litre	0.57
									2litres		70	1 litre	0.329
									2litres		90	1 litre	0.127
11:45	15.5.97	135A	**29**	22.09.9N	21.33.8W	23	22.27	36.52	2litres	**21**	7	1 litre	0.449
									2litres		15	1 litre	0.524
									2litres		30	1 litre	0.772
									2litres		40	1 litre	0.875
									2litres		50	1 litre	0.684
									2litres		60	1 litre	0.447
11:41	16.5.97	136A	**32**	26.16.8N	21.53.1W	54.6	22.06	37.12	2litres	**23**	7	1 litre	0.113
									2litres		20	1 litre	0.126
									2litres		40	1 litre	0.142
									2litres		60	1 litre	0.15
									2litres		80	1 litre	0.273
									2litres		90	1 litre	0.209
11:36	17.5.97	137A	**34**	30.02.9N	21.45.5W	51.9	20.81	36.94	2litres	**25**	7	1 litre	0.06
									2litres		30	1 litre	0.068
									2litres		50	0.95 litre	0.08

Time (GMT)	Date	SDY	Station No	position lat.	long.	underway chl.	Temp.	Sal.	HPLC Volume	ID	Depth	chlorophyll Volume	[ug/l chl a]
									2litres		70	1 litre	0.139
									2litres		90	1 litre	0.392
									2litres		130	1 litre	0.291
11:04	18.5.97	138A	**37**	33.43.7N	21.17.9W	55.9	19.58	36.36	2litres	**27**	7	1 litre	0.022
									2litres		20	1 litre	0.135
									2litres		40	1 litre	0.158
									2litres		90	1 litre	0.544
									2litres		100	1 litre	0.447
17:20	18.5.97	138B	**38**	34.09.2N	21.13.8W	60.4	19.73	36.3	2litres	**28**	7	1 litre	0.106
									2litres		50	1 litre	0.201
11:07	19.5.97	139C	**42**	36.13.3N	20.51.0W	49.4	18.35	36.42	2litres	**32**	7	1 litre	0.101
									2litres		20	1 litre	0.105
									2litres		60	1 litre	0.22
									2litres		80	1 litre	0.725
									2litres		100	1 litre	0.429
12:08	20.5.97	140A	**45**	39.52.2N	20.05.0W	68.9	17.26	36.99	2litres	**34**	7	1 litre	0.161
									2litres		20	1 litre	0.163
									2litres		40	1 litre	0.243
						note 1			2litres		50	1 litre	0.583
									2litres		80	1 litre	0.197
									2litres		100	1 litre	0.138
11:41	21.5.97	141A	**48**	43.58.1N	19.58.6W	41	15.51	35.86	2litres	**36**	7	1 litre	0.379
									2litres		15	1 litre	0.392
									2litres		25	1 litre	0.508
									2litres		35	0.75 litre	0.747
									2litres		50	1 litre	0.201
									2litres		70	1 litre	0.108

Time (GMT)	Date	SDY	Station No	position lat.	long.	underway chl.	Temp.	Sal.	HPLC Volume	ID	Depth	chlorophyll Volume	[ug/l chl a]
10:44	22.5.97	142A	**51**	47.00.4N	20.00.8W	58.4	14.07	35.68	2litres	**38**	2	1 litre	1.51
									2litres		7	0.6 litre	1.535
									2litres		15	1 litre	1.37
									2litres		25	1 litre	0.757
									2litres		40	1 litre	0.524
									2litres		60	1 litre	0.521
11:12	23.05.97	143A	**53**	48.03.4N	13 50.4W	22.9	13.49	35.55	2litres	**39**	2	1 litre	2.34
									2litres		7	1 litre	2.76
									2litres		20	1 litre	1.72
									2litres		40	1 litre	1.32
									2litres		60	1 litre	0.603
									2litres		80	1 litre	0.375
10:16	24.05.97	144	**55**	48.57.2N	08 46.8W	50	12.76	35.53	2litres	**40**	2	1 litre	1.09
									2litres		7	1 litre	1.2
									2litres		20	1 litre	1.13
									2litres		30	1 litre	1.11
									2litres		40	1 litre	1.03
									2litres		50	1 litre	0.378
10:10	25.06.97	145	**56**	50.04.1N	03.28.0W	75.2	11.83	35.27	2litres	**41**	2	1 litre	3.08
									2litres		7	1 litre	2.7
									2litres		20	1 litre	2.6
									2litres		30	1 litre	3.2
									2litres		40	1 litre	3.54
									2litres		50	1 litre	3.32
09:50	26.06.97	146	**57**	note 2									

nb. 1. HPLC samples taken at station S34 have been labelled incorrectly as S33

2. Off Thames, no water samples or CTD

Appendix J: Log of size fractionated zooplankton

Station	Time (local)	Depth (m)	Tray	Size fraction >2000	1000-2000	500-1000	200-500	Comments
111	13:00	100	1	C1-3	C4-6	C7-9	C10-12	
112	10:00	200	2	A1-3	A4-6	A7-9	A10-12	
113	10:00	200	3	A1-3	A4-6	A7-9	A10-12	
114	10:00	200	3	F1-3	F4-6	F7-9	F10-12	
120	10:30	200	4	A1-3	A4-6	A7-9	A10-12	
121	10:00	200	5	A1-3	A4-6	A7-9	A10-12	
122	10:00	200	6	A1-3	A4-6	A7-9	A10-12	
123	10:00	200	7	A1-3	A4-6	A7-9	A10-11	
124	10:00	200	7	D1-2	D3-4	D5-7	D8-10	1x>2000 & 1x1000-2000 lost
125	10:00	200	8	A1-3	A4-6	A7-9	A10-12	
126	10:00	200	9	A1-3	A4-6	A7-9	A10-12	
127	10:00	200	10	A1-3	A4-6	A7-9	A10-12	
128	10:00	200	11	A1-3	A4-6	A7-9	A10-12	
129	10:00	200	11	B1-3	B4-6	B7-9	B10-12	A1 fell on
	22:00	200	12	A1-3	A4-6	A7-9	A10-12	floor
130	10:00	200	12	B1-3	B4-6	B7-9	B10-12	
131	10:00	200	13	A1-3	A4-6	A7-9	A10-12	
132	10:00	200	14	A1-3	A4-6	A7-9	A10-12	
	22:00	200	14	B1-3	B4-6	B7-9	B10-12	
133		200	15	A1-3	A4-6	A7-9	A10-12	
134	10:00	200	16	A1-3	A4-6	A7-9	A10-12	
135	10:00	200	17	A1-3	A4-6	A7-9	A10-12	
	22:00	200	17	B1-3	B4-6	B7-9	B10-12	
136	10:00	200	18	A1-3	A4-6	A7-9	A10-12	
	22:00	200	18	B1-3	B4-6	B7-9	B10-12	
137	10:00	200	19	A1-3	A4-5	A7-9	A10-12	1x1000-
	22:00	200	19	B1-3	B4-6	B7-9	B10-12	2000 lost
138	10:00	200	20	A1-3	A4-6	A7-9	A10-12	Total
	16:00	200						B1-3
	19:30	200						B4-6
	23:30	200						B7-9
139	03:30	200	20					B10-12
	10:00	200	21	A1-3	A4-6	A7-9	A10-12	
	22:00	200	21	B1-3	B4-6	B7-9	B10-12	
140	10:00	200	22	A1-3	A4-6	A7-9	A10-12	
	22:00	200	22	B1-3	B4-6	B7-9	B10-12	
141	10:00	200	23	A1-3	A4-6	A7-9	A10-11	1x200-500 lost(day)
	22:00	200	23	B1-2	B4-6	B7-9	B10-12	1x>2000 lost (night)
142	09:00	200	24	A1-3	A4-6	A7-9	A10-12	
143	10:00	200	24	D1-3	D4-6	D7-9	D10-12	
144	10:00	100						

Appendix ??b Log of samples for analysis

Day	Station				Underway	
	Time (local)	1/2 net-Biomass	1/2 net through OPC	20m net though OPC	time (GMT)	Duration
111	13:00	1	1	1	01:35	1.58
112	10:00	1	1	1	05:02	0.53
113	10:00	1	1	1		
114	10:00	1	1	1	20:30 00:44	0.75 1.00
120	11:00	1	1		22:36	2.48
121	10:00	1	1	1	22:30	2.00
122	10:00	1	1	1	22:25	2.08
123	10:00	1	1	1		
124	10:00	1	1	1	04:05	2.08
125	10:00	1	1	1	22:15	2.25
126	10:00	1	1	1	21:45	3.17
127	10:00	1	1	1	22:15	2.17
128	10:00	1	1	1	22:30	2.50
129	10:00 22:00	1 1	1 1	1 1		
130	10:00	1	1	1		
131	10:00	1	1	1	22:00	2.33
132	10:00 22:00	1 1	1 1	1 1		
133	10:00	1	1	1		
134	10:00	1	1	1	07:30	1.17
135	10:00 22:00	1 1	1 1	1 1		
136	10:00 22:00	1 1	1 1	1 1		
137	10:00 22:00	1 1	1 1	1 1		
138						
139	10:00 22:00	1 1	1 1	1 1		
140	10:00 22:00	1 1	1 1	1 1		
141	10:00 22:00	1 1	1 1	1 1		
142	9:00	1	1	1		
143	10:00	1	1	1		
144	10:00	1 (100m only)	1	1		
145	10:00			1		

Appendix K: AMT-4 SeaOPS Log, all times reported as GMT

ast		Position		Darks		Data	Radiometers		Measure		Dow	Cast	CCD	Up	Cast	
No.	SDY	Long	Lat	Es	u/E	Logger	Port1	Port2	Port	ort	Beg.	End	Pic.	Beg.	End	Comments
1	111	-57.2928	-50.9888	1619	1619	OCP-004	OCR-021	OCI-029	Lu	Ed	1721	1727	1729	1733	1740	Completely overcast; CTDFTR problems during the upcast.
2	112	-55.9463	-47.6178	1334	1334	OCP-004	OCR-021	OCI-029	Lu	Ed	1406	1412	1414	1417	1423	Overcast, but clearing slowly.
3	113	-54.4018	-43.3473	1333	1333	OCP-004	OCR-021	OCI-029	Lu	Ed	1404	1410	1413	1414	1421	Overcast.
4	114	-52.9737	-39.4273	1330	1330	OCP-004	OCR-021	OCI-029	Lu	Ed	1410	1417	1419	1421	1428	Completely overcast; simultaneous SeaFALLS casts.
5	120	-49.8072	-35.6580	1159	1159	OCP-004	OCR-021	OCI-029	Lu	Ed	1343	1354	1358	1400	1412	Down cast better than up cast;
6	121	-46.2005	-32.6108	1225	1225	OCP-004	OCR-021	OCI-029	Lu	Ed	1316	1327	1329	1331	1343	Clear with some high cirrus.
7	122	-42.6505	-29.3272	1218	1218	OCP-004	OCR-021	OCI-029	Lu	Ed	1320	1331	1333	1335	1346	Clear with high cirrus.
8	122	-42.6503	-29.3280		1352	OCP-004	OCR-021	OCR-001	Lu	Lu	1358	1404		1405	1412	Clear with high cirrus; radiometer incomparison.
9	123	-39.1857	-26.1037	1221	1221	OCP-004	OCR-021	OCI-029	Lu	Ed	1259	1309	1311	1313	1323	Clear with an infrequent cloud; up cast the best.
10	123	-39.1873	-26.1025			OCP-004	OCI-029	OCR-021	Eu	Lu	1330	1338		1339	1347	Clear with an infrequent cloud; data glitches.
11	124	-36.6227	-22.1585	1200	1200	OCP-004	OCR-021	OCI-029	Lu	Ed	1300	1313	1316	1318	1330	Clear with an occasional cloud; down cast is the best.
12	124	-36.6302	-22.1545		1338	OCP-004	OCI-001	OCI-029	Ed	Ed	1345	1352		1352	1359	Clear with an occasional cloud; up cast is the best.
13	125	-34.7585	-18.2730	1120	1150	OCP-004	OCR-021	OCI-029	Lu	Ed	1159	1212	1253	1217	1231	Partly cloudy; down cast is the best.
14	126	-32.8482	-14.1108	1100	1100	OCP-004	OCR-021	OCI-029	Lu	Ed	1201	1222	1225	1222	1236	Very cloudy with occasional sun breaks.
15	126	-32.8550	-14.1082		1241	OCP-004	OCI-040	OCI-029	Ed	Ed	1247	1254		1254	1302	Very cloudy with occasional sun breaks.
16	127	-30.9447	-10.0290	1132	1158	OCP-004	OCR-021	OCI-029	Lu	Ed	1209	1221	1225	1228	1241	Very cloudy with a lot of brightening and darkening.
17	128	-29.1058	-5.9147	1106	1106	OCP-004	OCR-021	OCI-029	Lu	Ed	1200	1213	1216	1219	1232	Clear with an infrequent cloud; down cast is the best.
18	128	-29.1218	-5.9148		1239	OCP-004	OCR-021	OCR-035	Lu	Lu	1246	1252		1252	1259	Clear with an infrequent cloud.
19	129	-27.3328	-2.0208	1142	1142	OCP-004	OCR-021	OCI-029	Lu	Ed	1159	1210	1212	1214	1226	Clear with an infrequent cloud.
20	129	-27.3390	-2.0158		1231	OCP-004	OCR-021	OCR-035	Lu	Lu	1237	1243		1244	1251	Clear with an infrequent cloud; down cast is the best.
21	130	-25.6193	1.8907	1036	1036	OCP-004	OCR-021	OCI-029	Lu	Ed	1200	1208	1213	1216	1225	Complex sky with lots of clouds; down cast is the best.
22	130	-25.6282	1.8982		1231	OCP-004	OCI-040	OCI-029	Ed	Ed	1237	1247		1249	1259	Complex sky with lots of clouds; down cast is the best.
23	131	-23.6368	6.0817	1110	1110	OCP-004	OCR-021	OCI-029	Lu	Ed	1200	1208	1210	1213	1221	Very variable light conditions; down cast is the best.
24	131	-23.6347	6.0827		1227	OCP-004	OCI-001	OCI-029	Ed	Ed	1235	1241		1242	1249	Very variable light conditions; up cast is the best.
25	132	-21.9268	10.0568	1137	1137	OCP-004	OCR-021	OCI-029	Lu	Ed	1205	1214	1217	1219	1228	Very variable light conditions; neither cast very good.
26	132	-21.9318	10.0553		1233	OCP-004	OCR-021	OCR-001	Lu	Lu	1239	1245		1246	1252	Very variable light conditions; up cast is the best.
27	133	-21.0028	13.7997	1109	1109	OCP-004	OCR-021	OCI-029	Lu	Ed	1159	1205	1208	1211	1218	Very overcast and hazy; diffuse light.
28	133	-21.0068	13.7987		1224	OCP-004	OCR-021	OCR-035	Lu	Lu	1232	1236		1236	1241	Very overcast and hazy; diffuse light.
29	133	-21.0092	13.7987		1247	OCP-004	OCI-040	OCI-029	Ed	Ed	1253	1257		1258	1302	Very overcast and hazy; diffuse light.
30	134	-21.2178	17.7857	1012	1028	OCP-004	OCR-021	OCI-029	Lu	Ed	1056	1104	1106	1109	1117	Overcast and hazy; up cast is the best.

ast		Position		Darks		Data	Radiometers		Measure		Dow	Cast	CCD	Up	Cast	
No.	SDY	Long	Lat	Es	u/E	Logger	Port1	Port2	Port	ort	Beg.	End	Pic.	Beg.	End	Comments
31	134	-21.2208	17.7893		1123	OCP-004	OCR-021	OCR-001	Lu	Lu	1130	1136		1137	1143	Overcast and hazy; up cast is the best.
32	135	-21.5577	22.1683	1013	1013	OCP-004	OCR-021	OCI-029	Lu	Ed	1054	1059	1102	1105	1112	Very cloudy with occasional sun breaks.
33	135	-21.5617	22.1658		1118	OCP-004	OCI-001	OCI-029	Ed	Ed	1125	1131		1132	1138	Very cloudy with occasional sun breaks.
34	136	-21.8803	26.2782	1004	1004	OCP-004	OCR-021	OCI-029	Lu	Ed	1101	1109	1112	1115	1124	Partly cloudy with sun breaks; down cast is the best.
35	136	-21.8853	26.2808		1129	OCP-004	OCR-021	OCI-029	Lu	Eu	1138	1146		1148	1158	Partly cloudy with sun breaks; down cast is the best.
36	136	-21.8955	26.2842		1207	OCP-004	OCI-040	OCI-029	Ed	Eu	1216	1226		1227	1235	Partly cloudy with sun breaks; down cast is the best.
37	137	-21.7612	30.0458	1005	1005	OCP-019	OCI-040	OCR-035	Ed	Lu	1056	1105	1108	1110	1118	Very cloudy with occasional brightening.
38	137	-21.7573	30.0487		1124	OCP-019	OCI-040	OCR-035	Eu	Lu	1130	1139		1139	1148	Very cloudy with occasional brightening.
39	138	-21.2983	33.7285	1006	1006	OCP-019	OCI-040	OCR-035	Ed	Lu	1058	1107	1110	1113	1122	Clear with an infrequent cloud.
40	138	-21.2953	33.7267			OCP-019	OCI-040	OCR-035	Eu	Lu	1134	1142		1143	1152	Clear with an infrequent cloud.
41	138	-21.2912	33.7245		1159	OCP-019	OCI-040	OCI-001	Eu	Ed	1205	1214		1215	1224	Clear with an infrequent cloud.
42	138	-21.2293	34.1548		1643	OCP-019	OCI-040	OCR-035	Ed	Lu	1700	1710		1710	1715	Plartly cloudy; down cast is the best.
43	139	-20.8487	36.2225	1037	1037	OCP-019	OCI-040	OCR-035	Ed	Lu	1055	1109	1112	1114	1127	Very cloudy with occasional sun breaks.
44	140	-20.0027	39.8655	1020	1034	OCP-019	OCI-040	OCR-035	Ed	Lu	1100	1107	1111	1114	1121	Overcast with high cirrus.
45	141	-19.9795	43.9683	1013	1105	OCP-019	OCI-040	OCR-035	Ed	Lu	1105	1111		1112	1118	Completely overcast and raining.
46	142	-20.0155	47.0060	856	1121	OCP-019	OCI-040	OCR-035	Ed	Lu	1130	1135		1136	1143	Overcast and occasionally raining.
47	143	-13.9837	48.0583	1016	1016	OCP-019	OCI-040	OCR-035	Ed	Lu	1103	1108	1111	1113	1119	Mostly cloudy.
48	144	-8.7747	48.9540	1000	1000	OCP-019	OCI-040	OCR-035	Ed	Lu	1009	1016	1018	1020	1027	Completely overcast; up cast is the best.
49	145	-8.7912	48.9482		1034	OCP-019	OCI-040	OCI-001	Ed	Ed	1043	1049		1050	1057	Completely overcast; up cast is the best.

Notes:

1. Casts 8, 26, and 31 were intercomparison casts for radiometers OCR-021 and OCR-001.
2. Casts 10, 35, 38, and 40 were Q-casts; OCI-029 was oriented downwards to measure Eu. For cast 10, the MVDS unit was shaded from direct illumination with a lollipop; this data is in A410M030.SHM.
3. The data glitches during cast 10 were probably due to the connectors being improperly tightened; the OCR-029 cables had a lot of corrosion in them after the deployment.
4. During casts 11 and 12, hydraulic fluid was dripping from the CTD gantry into the water and moving down the side of the ship towards the stern.
5. Casts 12, 24, and 33 were intercomparison casts for radiometers OCI-029 and OCI-001.
6. For cast 14, the winch cable was marked every 10 m during the down cast.
7. Casts 15, 22, and 29 were intercomparison casts for radiometers OCI-029 and OCI-040.
8. ** For casts 1-18, the gain on OCR-021 was set to LOW; this might not be true on cast 10, because OCR-021 was on logger port 2.
9. ** For casts 19-?? the gain on OCR-021 was set to HIGH.

Notes continued:

10. Casts 18, 20, and 28 were intercomparison casts for radiometers OCR-021 and OCR-035.
11. Casts 36 and 41 were irradiance remote-sensing reflectance casts.
12. Casts 37-?? were done with OCP-019 which does not have pressure, tilt, or roll sensors; this data will have come from the corresponding CTDF data files.
13. Cast 42 was done simultaneously with LoCNESS casts 2-4.
14. Cast 46 was done simultaneously with LoCNESS casts 21-23.
15. Cast 47 was done simultaneously with LoCNESS casts 25-28.
16. Cast 48 was done simultaneously with LoCNESS casts 35-36.
17. Cast 49 was done simultaneously with LoCNESS cast 38.

Appendix L1: AMT-4 SeaFalls Log, all times reported as GMT

Cast No.	SDY	Longitude	Latitude	Dark	Cast Beg.	End	CCD Pic.	Depth [m]	Good data Lu	Ed	Es	ta CF	Data Program	Comments
1	111	-57.288	-50.991	1804	1824	1826		75	X	X	X	X	ProVIEW	Completely overcast; rocket trim a bit off.
2	112	-55.7085	-47.1933	1828	1904	1906		76	X	X	X	X	ProVIEW	Overcast sky; rocket trim better.
3	113	-54.3995	-43.4793	1425	1446	1448		77	X	X	X	X	ProVIEW	Overcast sky, rough seas; rocket trim better.
4	114	-52.9737	-39.4273	1359	1411	1412		75	X	X	X	X	ProVIEW	Completely overcast; simultaneous SeaOPS
5	114	-52.9737	-39.4273		1414	1416		75	X	X	X	X	ProVIEW	Completely overcast sky.
6	114	-52.9737	-39.4273		1418	1420	1419	75	X	X	X	X	ProVIEW	Completely overcast sky.
7	114	-52.9737	-39.4273		1421	1423		75	X	X	X	X	ProVIEW	Completely overcast sky.
8	114	-52.9737	-39.4273		1427	1429		75	X	X	X	X	ProVIEW	Completely overcast sky.
9	120	-49.8072	-35.658	1309	1342	1345		125	X	X	X	X	C-FALLS	Sunny with small occasional clouds.
10	120	-49.8072	-35.658		1350	1352		125	X	X	X	X	C-FALLS	Sunny with small occasional clouds.
11	120	-49.8072	-35.658		1354	1357	1358	125	X	X	X	X	C-FALLS	Sunny with small ocasional clouds.
12	120	-49.8072	-35.658		1359	1402		125	X	X	X	X	C-FALLS	Sunny with small occasional clouds.
13	120	-49.8072	-35.658		1404	1406		125	X	X	X	X	C-FALLS	Sunny with small occasional clouds.
14	120	-49.8072	-35.658		1408	1410		125	X	X	X	X	C-FALLS	Sunny with small occasional clouds.
15	121	-46.2005	-32.6108	1259	1320	1323		125	X	X	X	X	C-FALLS	Clear with high cirrus.
16	121	-46.2005	-32.6108		1325	1327		125	X	X	X	X	C-FALLS	Clear with high cirrus.
17	121	-46.2005	-32.6108		1329	1332	1329	125	X	X	X	X	C-FALLS	Clear with high cirrus.
18	121	-46.2005	-32.6108		1336	1338		125	X	X	X	X	C-FALLS	Clear with high cirrus.
19	121	-46.2005	-32.6108		1341	1343		125	X	X	X	X	C-FALLS	Clear with high cirrus.
20	121	-45.6232	-32.1147	1749	1808	1810		126	X	X	X	X	C-FALLS	Fairly clear with high cirrus.
21	122	-42.6505	-29.3272	1254	1323	1325		130	X	X	X	X	C-FALLS	Clear with high cirrus.
22	122	-42.6505	-29.3272		1327	1329		131	X	X	X	X	C-FALLS	Clear with high cirrus.
23	122	-42.6505	-29.3272		1332	1334	1333	137	X	X	X	X	C-FALLS	Clear with high cirrus.
24	122	-42.6505	-29.3272		1336	1338		130	X	X	X	X	C-FALLS	Clear with high cirrus.
25	122	-42.6505	-29.3272		1340	1342		131	X	X	X	X	C-FALLS	Clear with high cirrus.
26	123	-39.1857	-26.1037	1255	1303	1305		130	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
27	123	-39.1857	-26.1037		1308	1309		134	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
28	123	-39.1857	-26.1037		1311	1313	1311	131	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
29	123	-39.1857	-26.1037		1318	1321		129	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
30	123	-39.1857	-26.1037		1323	1325		134	X	X	X	X	C-FALLS	Clear with an infrequent cloud.

Cast No.	SDY	Longitude	Latitude	Dark	Cast Beg.	End	CCD Pic.	Depth [m]	Good data Lu	Ed	Es	ta CF	Data Program	Comments
31	123	-38.5817	-25.5695	1748	1800	1802		133	X	X	X	X	C-FALLS	Clear with an occasional cloud.
32	124	-36.6227	-22.1585	1245	1301	1304		125	X	X	X	X	C-FALLS	Clear with an occasional cloud.
33	124	-36.6227	-22.1585		1307	1311	1316	150	X	X	X	X	C-FALLS	Clear with an occasional cloud.
34	124	-36.6227	-22.1585		1317	1320		150	X	X	X	X	C-FALLS	Clear with an occasional cloud.
35	124	-36.6227	-22.1585		1327	1330		150	X	X	X	X	C-FALLS	Clear with an occasional cloud.
36	124	-36.6227	-22.1585		1338	1342		150	X	X	X	X	C-FALLS	Clear with an occasional cloud.
37	125	-34.7585	-18.273	1143	1203	1206		150	X	X	X	X	C-FALLS	Partly cloudy.
38	125	-34.7585	-18.273		1211	1213		150	X	X	X	X	C-FALLS	Partly cloudy.
39	125	-34.7585	-18.273		1219	1221		150	X	X	X	X	C-FALLS	Partly cloudy.
40	125	-34.7585	-18.273		1227	1229		150	X	X	X	X	C-FALLS	Partly cloudy.
41	126	-32.855	-14.1082	1449	1202	1205		145	X	X	X	X	C-FALLS	Very cloudy with occasional sun breaks.
42	126	-32.855	-14.1082		1210	1213		150	X	X	X	X	C-FALLS	Very cloudy with occasional sun breaks.
43	126	-32.855	-14.1082		1219	1221	1225	150	X	X	X	X	C-FALLS	Very cloudy with occasional sun breaks.
44	126	-32.855	-14.1082		1228	1230		175	X	X	X	X	C-FALLS	Very cloudy with occasional sun breaks.
45	126	-32.855	-14.1082		1238	1240		175	X	X	X	X	C-FALLS	Very cloudy with occasional sun breaks.
46	127	-30.9447	-10.029	1200	1210	1213		175	X	X	X	X	C-FALLS	Very cloudy with a lot of brightening and dark
47	127	-30.9447	-10.029		1222	1225	1225	175	X	X	X	X	C-FALLS	Very cloudy with a lot of brightening and dark
48	127	-30.9447	-10.029		1234	1237		175	X	X	X	X	C-FALLS	Very cloudy with a lot of brightening and dark
49	127	-30.9447	-10.029		1244	1247		175	X	X	X	X	C-FALLS	Very cloudy with a lot of brightening and dark
50	128	-29.1058	-5.9147	1149	1202	1205		175	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
51	128	-29.1058	-5.9147		1212	1215	1216	175	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
52	128	-29.1058	-5.9147		1231	1234		175	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
53	128	-29.1058	-5.9147		1239	1242		180	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
54	128	-28.865	-5.345	1702	1709	1712		180	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
55	129	-27.3328	-2.0208		1207	1210	1212	160	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
56	129	-27.3328	-2.0208		1216	1219		150	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
57	129	-27.3328	-2.0208		1225	1228		150	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
58	129	-27.3328	-2.0208	1246	1234	1236		150	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
59	129	-27.052	1.3272	1641	1705	1708		156	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
60	130	-25.6193	1.8907	1149	1216	1218	1213	125	X	X	X	X	C-FALLS	Complex sky with lots of different cloud types.
61	130	-25.6193	1.8907	1149	1223	1224		125	X	X	X	X	C-FALLS	Complex sky with lots of different cloud types.
62	130	-25.6193	1.8907	1149	1239	1241		125	X	X	X	X	C-FALLS	Complex sky with lots of different cloud types.

Cast No.	SDY	Longitude	Latitude	Dark	Cast Beg.	End	CCD Pic.	Depth [m]	Good data Lu	Ed	Es	ta CF	Data Program	Comments
63	130	-25.6193	1.8907	1149	1246	1248		125	X	X	X	X	C-FALLS	Complex sky with lots of different cloud types.
64	131	-23.6368	6.0817	1144	1206	1209	1210	150	X	X	X	X	C-FALLS	Very cloudy with a lot of brightening and dark
65	131	-23.6368	6.0817		1217	1219		100	X	X	X	X	C-FALLS	Very cloudy with a lot of brightening and dark
66	131	-23.6368	6.0817		1224	1226		100	X	X	X	X	C-FALLS	Very cloudy with a lot of brightening and dark
67	131	-23.6368	6.0817		1231	1235		110	X	X	X	X	C-FALLS	Very cloudy with a lot of brightening and dark
68	131	-23.6368	6.0817		1242	1244		100	X	X	X	X	C-FALLS	Very cloudy with a lot of brightening and dark
69	132	-21.9268	10.0568	1156	1211	1213	1217	150	X	X	X	X	C-FALLS	Very variable light conditions.
70	132	-21.9268	10.0568		1219	1221		125	X	X	X	X	C-FALLS	Very variable light conditions.
71	132	-21.9268	10.0568		1225	1227		125	X	X	X	X	C-FALLS	Very variable light conditions.
72	132	-21.9268	10.0568		1233	1235		125	X	X	X	X	C-FALLS	Very variable light conditions.
73	132	-21.9268	10.0568		1240	1242		125	X	X	X	X	C-FALLS	Very variable light conditions.
74	132	-21.6373	10.6345	1639	1658	1700		131	X	X	X	X	C-FALLS	High cirrus and hazy; fairly homogeneous ligh
75	133	-21.0028	13.7997	1152	1204	1207	1208	150	X	X	X	X	C-FALLS	Very overcast and hazy; diffuse light.
76	133	-21.0028	13.7997		1214	1216		100	X	X	X	X	C-FALLS	Very overcast and hazy; diffuse light.
77	133	-21.0028	13.7997		1220	1222		100	X	X	X	X	C-FALLS	Very overcast and hazy; diffuse light.
78	133	-21.0028	13.7997		1226	1228		100	X	X	X	X	C-FALLS	Very overcast and hazy; diffuse light.
79	133	-21.0028	13.7997		1235	1236		90	X	X	X	X	C-FALLS	Very overcast and hazy; diffuse light.
80	133	-21.0028	13.7997		1242	1244		100	X	X	X	X	C-FALLS	Very overcast and hazy; diffuse light.
81	134	-21.2178	17.7857	1050	1102	1106	1106	125	X	X	X	X	C-FALLS	Overcast and hazy; fairly homogeneous light
82	134	-21.2178	17.7857		1112	1114		125	X	X	X	X	C-FALLS	Overcast and hazy; fairly homogeneous light
83	134	-21.2178	17.7857		1121	1123		125	X	X	X	X	C-FALLS	Overcast and hazy; fairly homogeneous light
84	134	-21.2178	17.7857		1129	1131		125	X	X	X	X	C-FALLS	Overcast and hazy; fairly homogeneous light
85	134	-21.2178	17.7857		1137	1139		125	X	X	X	X	C-FALLS	Overcast and hazy; fairly homogeneous light
86	134	-21.2717	18.4875	1545	1600	1602		126	X	X	X	X	C-FALLS	Partly cloudy.
87	135	-21.5577	22.1683	1042	1056	1059	1102	125	X	X	X	X	C-FALLS	Very cloudy with occasional sun breaks.
88	135	-21.5577	22.1683		1104	1106		100	X	X	X	X	C-FALLS	Very cloudy with occasional sun breaks.
89	135	-21.5577	22.1683		1111	1113		100	X	X	X	X	C-FALLS	Very cloudy with occasional sun breaks.
90	135	-21.5577	22.1683		1119	1121		100	X	X	X	X	C-FALLS	Very cloudy with occasional sun breaks.
91	135	-21.5577	22.1683		1128	1130		100	X	X	X	X	C-FALLS	Very cloudy with occasional sun breaks.
92	135	-21.6108	22.8352	1540	1600	1602		130	X	X	X	X	C-FALLS	Clear with an occasional cloud and some haz
93	136	-21.8803	26.2782	1045	1105	1107	1112	125	X	X	X	X	C-FALLS	Partly cloudy with frequent sun breaks.
94	136	-21.8803	26.2782		1113	1115		125	X	X	X	X	C-FALLS	Partly cloudy with frequent sun breaks.

Cast No.	SDY	Longitude	Latitude	Dark	Cast Beg.	End	CCD Pic.	Depth [m]	Good data Lu	Ed	Es	ta CF	Data Program	Comments
95	136	-21.8803	26.2782		1121	1123		125	X	X	X	X	C-FALLS	Partly cloudy with frequent sun breaks.
96	136	-21.8803	26.2782		1129	1132		135	X	X	X	X	C-FALLS	Partly cloudy with frequent sun breaks.
97	136	-21.8803	26.2782		1137	1140		125	X	X	X	X	C-FALLS	Partly cloudy with frequent sun breaks.
98	136	-21.8803	26.2782		1145	1147		125	X	X	X	X	C-FALLS	Partly cloudy with frequent sun breaks.
99	136	-21.8803	26.2782		1152	1154		125	X	X	X	X	C-FALLS	Partly cloudy with frequent sun breaks.
100	136	-21.8803	26.2782		1204	1206		125	X	X	X	X	C-FALLS	Partly cloudy with frequent sun breaks.
101	136	-21.8803	26.2782		1219	1220		125	X	X	X	X	C-FALLS	Partly cloudy with frequent sun breaks.
102	136	-21.8803	26.2782		1225	1227		125	X	X	X	X	C-FALLS	Partly cloudy with frequent sun breaks.
103	136	-21.8803	26.2782		1232	1234		125	X	X	X	X	C-FALLS	Partly cloudy with frequent sun breaks.
104	136	-21.8803	26.2782		1302	1304		125	X	X	X	X	C-FALLS	Partly cloudy with frequent sun breaks.
105	136	-21.8803	26.2782		1311	1313		125	X	X	X	X	C-FALLS	Partly cloudy with frequent sun breaks.
106	136	-21.8803	26.2782		1331	1333		125	X	X	X	X	C-FALLS	Partly cloudy with frequent sun breaks.
107	136	-21.8803	26.2782		1337	1339		125	X	X	X	X	C-FALLS	Partly cloudy with frequent sun breaks.
108	136	-21.8803	26.2782		1342	1344		125	X	X	X	X	C-FALLS	Partly cloudy with frequent sun breaks.
109	136	-21.8803	26.2782		1349	1351		125	X	X	X	X	C-FALLS	Partly cloudy with frequent sun breaks.
110	137	-21.7612	30.0458	1054	1106	1108	1108	150	X	X	X	X	C-FALLS	Very cloudy with occasional brightening.
111	137	-21.7612	30.0458		1113	1116		150	X	X	X	X	C-FALLS	Very cloudy with occasional brightening.
112	137	-21.7612	30.0458		1121	1124		150	X	X	X	X	C-FALLS	Very cloudy with occasional brightening.
113	137	-21.7612	30.0458		1131	1133		150	X	X	X	X	C-FALLS	Very cloudy with occasional brightening.
114	137	-21.7612	30.0458		1139	1142		150	X	X	X	X	C-FALLS	Very cloudy with occasional brightening.
115	137	-21.645	30.745	1548	1607	1609		125	X	X	X	X	C-FALLS	Very cloudy with occasional brightening.
116	138	-21.2983	33.7285	1053	1103	1105	1110	150	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
117	138	-21.2983	33.7285		1112	1114		150	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
118	138	-21.2983	33.7285		1121	1123		150	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
119	138	-21.2983	33.7285		1133	1135		150	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
120	138	-21.2983	33.7285		1142	1144		150	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
121	138	-21.2983	33.7285		1151	1153		150	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
122	138	-21.2983	33.7285		1205	1206		150	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
123	138	-21.2983	33.7285		1212	1215		150	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
124	138	-21.2983	33.7285		1249	1251		150	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
125	138	-21.2983	33.7285		1258	1300		150	X	X	X	X	C-FALLS	Clear with an infrequent cloud.
126	139	-20.8487	36.2225	1054	1126	1128		125	X	X	X	X	C-FALLS	Very cloudy with occasional sun breaks.

Cast No.	SDY	Longitude	Latitude	Dark	Cast Beg.	End	CCD Pic.	Depth [m]	Good data Lu	Ed	Es	ta CF	Data Program	Comments
127	139	-20.8487	36.2225		1215	1217		127	X	X	X	X	C-FALLS	Very cloudy with occasional sun breaks.
128	139	-20.8487	36.2225		1239	1241		128	X	X	X	X	C-FALLS	Very cloudy with occasional sun breaks.
129	139	-20.6502	36.6838	1551	1559	1601		132	X	X	X	X	C-FALLS	Partly cloudy.
130	141	-19.9795	43.9683	1102	1113	1115		125	X	X	X	X	C-FALLS	Completely overcast and raining.

Notes:

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1. The distance from the top of the reference frame to the top of the Es sensor is 0.33 m (the suspension cables are hooked to the side of the cabling cage).
2. C-FALLS software slow on casts 23, 27, 35, 43, 52, 53, 54, 61, 67, 79, 82, 96, 101, 108, and 118 for unknown reasons (probably while writing the PC raw file). There does not appear to be any loss of data; just a slow down in the screen updating.
3. During casts 32-36, hydraulic fluid was dripping from the CTD gantry into the water and moving down the side of the ship towards the stern.
4. The raw files for cast 42 are appended to the corresponding files for cast 41.
5. The dark files for casts 55-58 were done after cast 58.
6. The raw files for casts 110-115, and 119-126 were intentionally not collected.
7. Cast 115 was made simultaneously with LoCNESS cast 1.
8. For cast 126, the reference darks were taken at 1054 and the profiler darks were taken at 1111.
9. For casts 127-129, pre- and post-deployment SQM sessions were done with SeaFALLS, so there are multiple CERTs for OCH-023 and OCQ-016.
10. No data was taken on SDY 140, because the power and telemetry bulkhead connector on the profiler had to be replaced (too frame synchs were being interrupted and this was traced to the bulkhead connector).
11. After cast 130, the data/telemetry cable went to short, so the cable was reterminated. After retermination, the cable showed on open circuit on the deck box. When the profiler was hooked up to the reference cable, the deck box showed a weak and fla
12. During SQM session 32, the RS-485 telemetry to SeaFALLS failed, so the data was collected over the RS-232 port.

Appendix L2: AMT-4 SeaFalls log, all times reported in GMT

Cast No.	SDY	Longitude	Latitude	Dark	Cast Beg.	Cast End	CCD Pic.	Depth [m]	Comments
1	137	-21.6450	30.7450	1533	1606	1608		131	Very cloudy with occasional brightening.
2	138	-21.2293	34.1548	1650	1712	1713		125	Plartly cloudy.
3	138	-21.2293	34.1548		1715	1716		125	Plartly cloudy.
4	138	-21.2293	34.1548		1718	1719		125	Plartly cloudy.
5	140	-20.0083	39.8702	1148	1159	1200		128	Overcast with cirrus.
6	140	-20.0083	39.8702		1215	1216		130	Overcast with cirrus.
7	140	-20.0083	39.8702		1223	1224		131	Overcast with cirrus.
8	140	-20.0083	39.8702		1237	1238		130	Overcast with cirrus.
9	140	-20.0083	39.8702		1248	1250		130	Overcast with cirrus.
10	140	-20.9900	40.4063	1543	1559	1600		129	Overcast with cirrus.
11	141	-19.9582	43.9650	1134	1151	1152		100	Completely overcast and raining.
12	141	-19.9582	43.9650		1156	1157		101	Completely overcast and raining.
13	141	-19.9582	43.9650		1210	1211		109	Completely overcast and raining.
14	141	-19.9582	43.9650		1215	1216		103	Completely overcast and raining.
15	141	-19.9582	43.9650		1223	1224		103	Completely overcast and raining.
16	141	-19.9582	43.9650		1227	1229		102	Completely overcast and raining.
17	141	-19.8378	44.5122	1548	1604	1606		103	Completely overcast and raining.
18	142	-20.0045	47.0058	924	1011	1013		103	Completely overcast and raining.
19	142	-20.0045	47.0058		1016	1018		104	Completely overcast and raining.
20	142	-20.0045	47.0058		1021	1023		103	Completely overcast and raining.
21	142	-20.0193	47.0058		1134	1135		78	Very cloudy with occasional brightening.
22	142	-20.0193	47.0058		1137	1138		77	Very cloudy with occasional brightening.
23	142	-20.0193	47.0058		1142	1143		79	Very cloudy with occasional brightening.
24	142	-19.0753	47.1940	1516	1600	1602		104	Partly cloudy and sunny.
25	143	-13.9837	48.0583	1139	1104	1106		100	Mostly cloudy.
26	143	-13.9837	48.0583		1108	1110	111	100	Mostly cloudy.
27	143	-13.9837	48.0583		1114	1116		100	Mostly cloudy.
28	143	-13.9837	48.0583		1120	1122		100	Mostly cloudy.
29	143	-13.9740	48.0570		1145	1147		100	Partly cloudy.
30	143	-13.9740	48.0570		1150	1151		100	Partly cloudy.
31	143	-13.9740	48.0570		1207	1208		100	Partly cloudy.
32	143	-13.9740	48.0570		1211	1213		100	Partly cloudy.

Cast No.	SDY	Longitude	Latitude	Dark	Cast Beg.	Cast End	CCD Pic.	Depth [m]	Comments
33	143	-13.9740	48.0570		1216	1218		100	Partly cloudy.
34	143	-13.1648	48.2135	1521	1603	1604		81	Almost completely overcast.
35	144	-8.7747	48.9540		1019	1020	101	100	Completely overcast with occasional brightening.
36	144	-8.7747	48.9540		1026	1028		100	Completely overcast with occasional brightening.
37	144	-8.7747	48.9540		1046	1048		100	Completely overcast with occasional brightening.
38	144	-8.7912	48.9482	1249	1052	1055		100	Completely overcast with occasional brightening.
39	145	-3.4637	50.0715	935	1008	1009		50	Mostly clear with high cirrus.
40	145	-3.4637	50.0715		1010	1011		50	Mostly clear with high cirrus.
41	145	-3.4637	50.0715		1011	1012		50	Mostly clear with high cirrus.
42	145	-3.4637	50.0715		1032	1033	102	50	Mostly clear with high cirrus.
43	145	-3.4637	50.0715		1034	1035		50	Mostly clear with high cirrus.
44	145	-3.4637	50.0715		1035	1036		50	Mostly clear with high cirrus.

Notes:

1. The distance from the top of the radiance sensor to the top of the irradiance sensor is 1.344 m, and the distance from the radiance sensor to the pressure outlet port on the data logger is 0.311 m.
2. Cast 1 was done simultaneously with SeaFALLS cast 115.
3. For casts 1, 5-9, and 11-24 simultaneous SeaFALLS reference data is available; this data has a .SHW estension.
4. Casts 2-4 were done simultaneously with SeaOPS cast 42; foam was added to the fins to slow the fall rate.
5. During casts 5-10, lead was removed from the nose and cork added to the fins to try and slow the fall rate.
6. Casts 5-10 were done simultaneously with SeaSPEC cast 3.
7. For casts 11-16, duct tape fairing was added to the fins to increase the drag and slow the fall rate.
8. For casts 15-16, all of the lead was removed from the nose.
9. Casts 11-16 were done simultaneously with SeaSPEC cast 4.
10. Casts 18-20 were done simultaneously with SeaSPEC cast 5.
11. Casts 21-23 were done simultaneously with SeaOPS cast 46.
12. Casts 25-28 were done simultaneously with SeaOPS cast 47.
13. Casts 29-33 were done simultaneously with SeaSPEC cast 6.
14. Casts 35-36 were done simultaneously with SeaOPS cast 48.
15. Cast 38 was done simultaneously with SeaOPS cast 49.
16. Casts 39-44 were done simultaneously with SeaSPEC cast 7.

Appendix M: AMT-4 SeaSPEC log, all times reported as GMT

Cast No.	SDY	Longitude	Latitude	Collectors Port1	Collectors Port2	Cables Port1	Cables Port2	Measurem Port1	Measurem Port2	Down Beg.	Cast End	CCD Pic.	Up C Beg.	ast End	Depth [m]	Comments
1	138	-21.2783	33.7187	1	1	2	1	Ed	Lu	1242	1314		1317	1359	150	Clear with an infrequent cloud.
2	139	-20.8487	36.2225	1	1	2	1	Ed	Lu	1146	1216		1217	1258	100	Very cloudy with occasional sun
3	140	-20.0083	39.8665	1	1	2	1	Ed	Lu	1148	1205		1212	1247	85	Overcast with high cirrus.
4	141	-19.9682	43.9652	1	1	2	1	Ed	Lu	1140	1200		1202	1237	60	Completely overcast and raining.
5	142	-19.9990	47.0055	1	1	2	1	Ed	Lu	1004	1020		1022	1057	60	Overcast tly cloudy for up cast.
6	143	-13.9740	48.0570	1	1	2	1	Ed	Lu	1135	1201		1202	1240	50	Partly cloudy and brightening.
7	145	-3.4637	50.0715	1	1	2	1	Ed	Lu	1006	1022	1025	1027	1051	50	Mostly clear with high cirrus.
8	146	1.7830	51.7148	1	1	2	1	Ed	Lu	955	1007		1008	1030	12	Mostly clear with high cirrus.

Notes

1. The radiance measurement was made using fibre-optic cable number 1.
2. The irradiance measurement was made using fibre-optic cable number 2.
3. The radiance measurement was made using radiance collector number 1.
4. The irradiance measurement was made using radiance collector number 1.
5. The radiance measurement was made using fibre-optic cable connector number 2.
6. The irradiance measurement was made using fibre-optic cable connector number 3.
7. The radiance measurement was made using instrument port number 2 (the bottom port).
8. The irradiance measurement was made using instrument port number 1 (the top port).
9. Cast 1 was done right after SeaOPS casts 39-41 and simultaneously with SeaFALLS casts 124-125.
10. Cast 2 was done right after SeaOPS cast 43 and simultaneously with SeaFALLS casts 126-128.
11. Cast 3 was done right after SeaOPS cast 44 and was done simultaneously with LoCNESS casts 5-9.
12. SeaSPEC was measured during SQM sessions 15 (SDY 126) and 31 (SDY 140).
13. Cast 4 was done right after SeaOPS cast 45 and was done simultaneously with LoCNESS casts 11-16.
14. The time stamps for cast 4 have the wrong day and year.
15. Cast 5 was done right before SeaOPS cast 46 and was done simultaneously with LoCNESS casts 18-20. While the data was being transferred from the in-water instrument to the shipboard computer, the instrument started taking data which corrupted the file transfer. All efforts to rectify this problem failed.
16. Cast 6 was done right after SeaOPS cast 47 and was done simultaneously with LoCNESS casts 29-33.
17. Cast 7 was done simultaneously with overflights by the NERC CASI aircraft and LoCNESS casts 39-44. Incident solar irradiance data was collected using MVDS 009 and this data are in files A9714510.SHM and A9714511.SHM; the darks are in file A004C050.SHM.
17. Cast 8 was done simultaneously with overflights by the NERC CASI aircraft and LoCNESS casts 39-44. Incident solar irradiance data was collected using MVDS 009 and this data are in file A004D051.SHM; the darks are in file A004C051.SHM.

Appendix N: UOR Tow log

Tow	Date	SDY	start (GMT)	finish (GMT)	Start latitude	Start Longitude	End Latitude	End longitude	Duration (hours)	Distance nm	Distance km	Comment
401	21/04/97	111	19:00	20:55	-50.966	-57.280	-50.620	-57.146	01:55	21	39	no useful data
402	22/04/97	112	15:43	18:41	-47.580	-55.924	-47.030	-55.714	02:58	33	61	ok
403	23/04/97	113	15:41	21:10	-43.372	-54.359	-42.575	-54.053	05:29	61	112	ok
404	30/04/97	120	15:00	20:25	-35.646	-49.814	-34.984	-48.993	05:25	60	111	ok
405	01/05/97	121	14:25	17:45	-32.594	-46.182	-32.142	-45.655	03:20	37	68	ok
406	02/05/97	122	14:30	20:20	-29.330	-42.647	-28.531	-41.755	05:50	65	120	ok
407	03/05/97	123	13:50	18:00	-26.105	-39.187	-25.569	-38.582	04:10	46	85	ok
408	04/05/97	124	14:10	20:15	-22.140	-36.625	-21.125	-36.115	06:05	67	125	ok
409	05/05/97	125	12:55	19:20	-18.272	-34.767	-17.199	-34.252	06:25	71	132	ok
410	06/05/97	126	13:15	19:15	-14.109	-32.853	-13.100	-32.358	06:00	67	123	cable failure no Ed sensor
411	07/05/97	127	13:05	19:20	-10.031	-30.950	-9.028	-30.461	06:15	69	128	Lu data only
412	08/05/97	128	13:20	16:45	-5.906	-29.126	-5.356	-28.871	03:25	38	70	Lu data only
413	09/05/97	129	13:05	16:50	-2.003	-27.340	-1.341	-27.059	03:45	42	77	Lu data only
414	09/05/97	129	17:20	23:45	-1.318	-27.049	-0.144	-26.480	06:25	71	132	physical data only, merged tow 41
415	10/05/97	130	00:45	11:45	-0.122	-26.464	1.881	-25.617	11:00	122	226	physical data only
416	10/05/97	130	13:20	19:20	1.913	-25.627	2.938	-25.117	06:00	67	123	suspect dark data
417	11/05/97	131	13:05	18:30	6.086	-23.631	7.047	-23.248	05:25	60	111	no Lu data
418	12/05/97	132	13:05	16:45	10.056	-21.934	10.629	-21.642	03:40	41	75	ok
419	12/05/97	132	17:10	23:50	10.637	-21.635	11.741	-21.089	06:40	74	137	merged with 418, only physical da
420	13/05/97	133	13:00	23:50	13.789	-21.009	15.367	-21.053	10:50	120	222	ok
421	14/05/97	134	12:55	15:45	17.930	-21.239	18.476	-21.267	02:50	31	58	ok
422	15/05/97	135	12:07	18:15	22.166	-21.565	22.823	-21.607	06:08	68	126	temperature board anomaly
423	16/05/97	136	14:04	18:15	26.300	-21.896	27.094	-21.942	04:11	46	86	ok
424	17/05/97	137	11:55	15:45	30.049	-21.755	30.733	-21.648	03:50	42	79	ok
425	18/05/97	138	14:10	16:45	33.711	-21.272	34.152	-21.231	02:35	29	53	ok
426	19/05/97	139	13:10	15:45	36.216	-20.860	36.673	-20.652	02:35	29	53	ok
427	20/05/97	140	13:05	15:50	39.872	-20.013	40.401	-19.989	02:45	30	56	ok
428	21/05/97	141	12:50	15:45	43.967	-19.952	44.494	-19.965	02:55	32	60	ok
429	22/05/97	142	11:55	15:45	47.007	-20.024	47.185	-19.094	03:50	42	79	ok
430	23/05/97	143	12:50	15:50	48.055	-13.967	48.210	-13.183	03:00	33	62	ok
431	23/05/97	143	14:20	23:00	48.214	-13.163	48.495	-11.397	08:40	96	178	logging errors & depth range error
432	23/05/97	143	23:30	10:00	48.513	-11.303	48.956	-8.766	10:30	116	215	logging errors & depth range error
433	24/05/97	144	12:30	15:00	48.937	-8.855	49.044	-8.349	02:30	28	51	logging errors & depth range error