WHP Cruise Summary Information

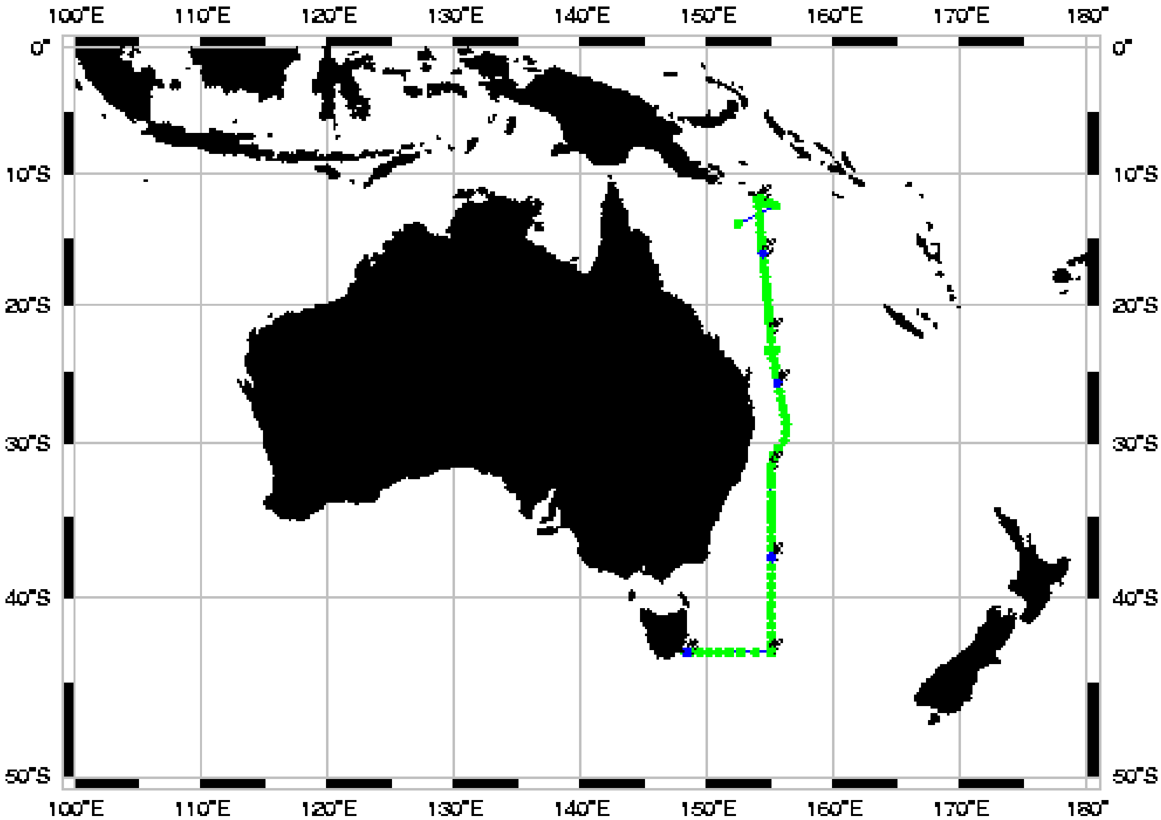
WOCE section designation	P11S, PR28
Expedition designation (EXPOCODE)	09FA693
Chief Scientist(s) and their affiliation	John Church, CSIRO
Dates	1993.06.24 – 1993.07.17
Ship	FRANKLIN
Ports of call	Cairns to Hobart
Number of stations	80
Geographic boundaries of the stations	11°47.23"S 148°11.52"E 156°10.22"E 43°15.96"S
Floats and drifters deployed	none
Moorings deployed or recovered	none
Contributing Authors (in order of appearance)	D. Terhell G. Critchley L. Drury N. White D.J. Vaudrey A. Mantyla

WHP Cruise and Data Information

Instructions: Click on items below to locate primary reference(s) or use navigation tools above.

Cruise Summary Information	Hydrographic Measurements
Description of scientific program	CTD - general
Cruise track (figure)	
Description of stations	CTD - dissolved oxygen
Description of parameters sampled	
	Salinity
	Oxygen
	Nutrients
Principal Investigators for all measurements	
Cruise Participants	
Problems and goals not achieved	
Other incidents of note	
Acoustic Doppler Current Profiler (ADCP)	**DQE Reports**
Thermosalinograph and related measurements	
	S/O2/nutrients

Station locations for P11S



(Produced from .SUM files by WHPO)

RESEARCH SUMMARY

CRUISE FR 6/93

Sailed Cairns 2000 Thursday June 24, 1993
Arrived Hobart 1000 Saturday July 17, 1993

A DEEP MERIDIONAL SECTION THROUGH THE CORAL AND TASMAN SEAS

Principal Investigators
Steven Rintoul
John Church
CSIRO Division of Oceanography

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MARINE ART
Don Braben
Griffith University

July, 1993

Cruise Summary

R.V. Franklin
Fr 6/93

1. Itinerary

Departed Cairns 2000 Thursday June 24, 1993
Arrived Hobart 1000 Saturday July 17, 1993

2. Scientific Program and Objectives

A DEEP MERIDIONAL SECTION THROUGH THE TASMAN AND CORAL SEAS

To estimate deep circulation and water mass properties through the deepest parts of the Coral and Tasman Sea Basins using data collected from CTD sections; specifically, we want to estimate the zonal transports (at all depths) into the western boundary current region of the South Pacific and to estimate the transport of water between the Coral Sea basin and the Solomon Sea basin, between the Coral Sea basin and the Tasman Sea basin.

Principal Investigators
Dr Steven R. Rintoul
Dr John A. Church
CSIRO Division of Oceanography
GPO Box 15-338
Hobart, Tas 7001

MARINE ART

To record a voyage of 'Franklin' through drawing and painting.

Principal Investigator
Don Braben
Lecturer in Art
Faculty of Education
Griffith University
Brisbane, QLD ????.

3. Cruise Track

A completed cruise track is shown on the attached figure. CTD stations are shown as squares.

4. Cruise Narrative

We departed Cairns 13 hours late because of the late delivery of the 24 bottle rosette frames and various other pieces of , gear. We Immediately sailed into 25 knot southeast trades which slowed the transit speed to about 8 knots and made the initial few days uncomfortable. A boat drill was completed at 1030 on Friday 25 followed by Masters briefing and Chief Scientist briefing.

On Friday June 25, we completed a test CTD cast with the new rosette frame and the new bottles. Unfortunately over half of the bottles leaked and the CTD salinity calibration was out by about 0.8 psu. We tightened the rubbers in the bottles we thought were leaking and did a second test cast (on Saturday June 26), but this time with the second CT76unit. The CTD calibration was much better but again at least half the bottles (a different half) leaked. We then re tightened all of the rubbers in the bottles and because we had already lost time started the Pocklington Trough Section firing several bottles at each depth. Analysis of the salinity samples showed that the bottles were still leaking. We immediately gave up all hope of using the small bottles and got the large rosette and the 5 litre bottles out of the hold (in marginal conditions) and did a third bottle test station (on Monday June 28). The 5 litre bottles did not leak and the rest of the cruise was done using them.

After completing the Pocklington Trough Section, we turned and headed south at 8 knots into the trades to commence the P 11 section. At this speed, we did not look like we would complete the section. However, as the wind came more from the east and eventually weakened our speed increased and we started to make up lost time. A short CTD section was completed across the deep water west of Cato Island on Sunday July 4.

We continued southward without major incident until Friday July 9 when strong (30 knot+) winds from the north were experienced. We commenced CTD 54 at 1215 in marginal conditions. After the CTD was down about 100 m., we aborted station because wire was going very slack then snapping taut. We decided to drop an XBT and then sit waiting for more information on the weather and in the hope the weather would ease. Weather started improving dramatically at 2315. By 0300 (Saturday July 10), we were 10 nm south of the original station position and the weather had improved enough to complete a station. The next station was moved 8 nm south and all subsequent stations moved 5 nm south. We lost about 15 hours because of the bad weather.

We then continued south and completed the last of the planned 155°E CTD stations on Wednesday July 14. I decided to complete one more CTD station on 155°E so that the northernmost of the Aurora Australis 155°E stations was repeated. We then completed the section back to the coast at a broader stations spacing so that the number of stations was the same. We were slowed by thick fog for part of Tuesday July 13 and Wednesday July 14. The final CTD station was completed at 1730 on Friday, July 16. We then completed to ADCP runs across the western part of the 43°S section and transducer alignment tests. We then steamed to Hobart and were alongside at 1000 Saturday July 17.

5. Cruise Results

A DEEP MERIDIONAL SECTION THROUGH THE TASMAN AND CORAL SEAS

The station locations, the near surface (50 m depth) currents measured from the ADCP, and the temperature section between stations 11 (Louisiade Archipelago, Papua-New Guinea) and station 70 (43° 15'S) are shown on the attached figures. At the northern end of this section, the surface currents show an eastward flowing boundary current. The temperature section indicates that the eastward currents are not surface trapped but that geostrophic shear extends deep into the water column (at least 2000 m).

Immediately to the south of this boundary current, from about 13°S to 19°S, there is a westward flow into the Coral Sea. Both the ADCP data and the temperature section indicate the strongest inflows occur near stations 20-21 east of the southern end of the Queensland Plateau (latitude of about 17°S). Offshore from the southern end of the Great Barrier Reef there is an eastward flow with a further westward flow near Cato Island (23°S).

Both the ADCP data and the temperature section indicate increasing variability from 20°S to 35°S. There are two major outflows at about 31°S and 34°S. South of 34°S, the variability is much weaker.

The CTD data also indicate the Antarctic Intermediate Water flowing westward at 17°S has a lower salinity than the outflow to the north and the waters of the Tasman Sea (north of 38°S). South of 38°S, there is a tongue of low salinity Antarctic Intermediate Water penetrating north along the section. There is much more variability (interleaving) in this Antarctic Intermediate Water. In the thermocline waters of the Coral Sea, the T/S curve is almost linear between temperatures of 6°C and 18°C. Further south, the salinity, at a given temperature, is increased and as a result the T/S curve is no longer linear.

The temperature section clearly indicates the sill depth into the Coral Sea is at about 3000 m and as a result the deep waters of the Coral Sea are much more weakly stratified than the waters of the Tasman Sea. They are also lower in oxygen (older). The oxygen minimum near depths of 2000 m is most intensified in the northern Coral Sea.

With the exception of nutrients from a few stations, I believe we collected an excellent data set. When combined with the data set collected on board Aurora Australis in May between 43°S and Antarctica, it will be a very valuable contribution to the World Ocean Circulation Experiment.

MARINE ART

The project objective has been partially accomplished. The period of the voyage provided the opportunity to make preliminary drawings and paintings together with a photographic record. The visual resources from this voyage will be used to create a series of paintings depicting 'Franklin' and associated activities and events. However, some of the works completed on 'Franklin' may be included in the body of work. A total of thirty paintings is the target and these will be exhibited at the Strickland Gallery in Hobart from January 3 to January 24.

6. Action Items/Recommendations

The new rosette was good. However, the new Niskin bottles leaked (even after the rubbers springs were correctly tensioned) and we were forced to switch to the old rosette frame and the 5 litre Niskin bottles. The new Niskin bottles need attention and testing before they are an essential part of any cruise.

I recommend that a new log for Niskin bottles be kept. While the information on bottles is often available on CTD log sheets this is not as readily available throughout the cruise and from one cruise to the next as a separate Niskin bottle log would be. This log would be kept aboard Franklin from one cruise to the next and if available on the computers could be immediately available to give information on the history of different bottles.

I recommend that consideration be given to putting a CTD wire on the forward hydrology winch. At the moment if there is any major problem with the wire a physical oceanographic cruise dependent on the CTD has to be aborted. A second CTD wire would allow the cruise to continue even if there were major problems. Also, a central lug on the CTD A-frame would allow the large 24 bottle rosette to be brought aboard (using either winch drum) more safely than at present. The spooling and in particular the packing on the cheek plates on the CTD drum need attention.

Having the audio tape backup for the CTD was useful during this cruise for replaying stations when the CTD deck unit gave problems and for diagnosing faults with the deck unit.

7. Personnel

Scientific personnel		*Ship's Crew*
J. Church (Chief Scientist)	CSIRO DO	Paddy Lorraine (Master)
John Wilkin	CSIRO DO	Dick Dougal
Peter McIntosh	CSIRO DO	Bryce Bathe
Neil White	CSIRO ORV	Max Cameron
Phil Adams	CSIRO ORV	Ian Hayward-Bryant
David Terhell	CSIRO ORV	Don Roberts
Gary Critchley	CSIRO ORV	Jannik Hansen
Les Drury	CSIRO ORV	Kris Hallen
Jeremy Harris	Antarctic CRC	Norm Marsh
Don Braben	Griffith University	Bluey Hughes
		Phil French
		Gary Hall
		Bob Clayton
		Reg Purcell

I would like to thank all the scientific staff and the ship's crew and officers for the excellent work they completed during the cruise.

I would also like to thank the Steering Committee and Bob Edwards for their efforts to ensure that the Franklin cruise was as close as possible in time to the Aurora Australis Voyage that extended this section to Antarctica.

John Church
Chief Scientist

Appendix A. Equipment Reports
Hydrology

HYDROCHEMISTRY VOYAGE REPORT: Fr06/93
Dave Terhell, Gary Critchley and Les Drury

Summary:
80 CTD stations were completed.

Analyses carried out:

Salinity -	1811
Dissolved Oxygen -	1763
Nitrate -	1763
Silicate	1763
Phosphate -	1763

Data entry completed up until: 80

Standard ranges run for nutrients:

Nitrate -	0 - 35 umole
Silicate -	0 - 140 umole
Phosphate -	0 - 3 umole

Thermometry :
Temperatures were measured at surface and second from bottom with mercury in glass deep sea reversing thermometers.

Rosette :
A new 24 bottle rosette, built for the new 3.51. sampling bottles, was used for the first 7 casts. The larger 24 bottle rosette was used for the remainder of the cruise as the G.O. 51. bottles could not fit on the new frame.

Water sampling bottles :
New 3.51. sampling bottles used for the first 7 casts were found to leak erratically and were replaced by 51. General Oceanics Niskin bottles. Apart from some bottles leaking, the G.O. bottles performed fairly well.

Additional sampling :
For this cruise C-14 sampling was conducted.

Computing :
HYDRO performed well and some suggestions on fine-tuning will be given to D. Terhell. DAPA behaved itself but again some suggestions for fine tuning need to be given to P. Sheppard.

Nutrient Sampling
Problems with overfilling of nutrient samples were again experienced on some stations.

DETAILED REPORT (OMS):

General Laboratory:
On arrival at the vessel the lab was in an extremely poor state. The chemistry lab had been dismantled for a Geology trip. Drawers had been emptied into plastic bags and (fortunately) the plastic bags returned to the appropriate drawer by CSIRO staff. Benches had been cleared and the apparatus returned. But there was filth everywhere on the benches, the top of the A.A. cover on the floor and in the sinks. This was mentioned in passing to Ray Binns (cruise leader of the previous voyage) who replied that the lab was in a better condition when given back to us than when they came on board! This may have been the case due to the sand blasting performed by NQEA prior to the Geology voyage.

In addition to the lab being dirty there were glass microscope slide cover slips on and in the port sink and wash cloth. This caused Gary to cut his hand as they were not easily visible.

Autoanalyser.
The reagent chemicals normally stored under the A.A. had been cleared out and placed in the heat of the aft hold. This caused some to discolour indicating they were starting to break down. The reagent lines to the A.A. were in disarray as lines were cut off, pulled off and generally thrown about. A fair amount of time had to be dedicated to getting the plumbing for the A.A. up to scratch. During the replumbing it was found that the Nitrate Flow-by and Flow-though lines had been interchanged for each other. This was rectified.

As a suggestion, it might be an idea to replace pump tubes according to the flow diagrams that Ron has prepared, rather than at random on the pump. This may help prevent mix-ups such as the flo-through/by lines and make it easier for trouble shooting etc.

The sample line also was found to have a small split in it near the probe and was replaced. (Could either of these have contributed to the problems on previous trips?)

A quantity of Cadmium metal was cleaned with HCl and used to make up some Cadmium columns which were stored in 50% Imidazole buffer. The unused metal was stored in the fridge in 10% HCl as was agreed to at the last OMS meeting.

The peristaltic pump was lubricated fully. Some adjustments needed to be made to the sample probe to get it sucking at the correct position. A waste tube has been installed from the spill tray outlet to the starboard scupper, rather than to the benchtop behind the A.A.

Long runs were conducted for this cruise without any major hassles.

Apart from problems with UPS interruptions, the A.A. performed well and only needed to be fed reagents, samples and standards.

As previously found, washing the phosphate line with dilute sodium hydroxide solution followed by 10% HCl caused the phosphate analysis to perform very well. Virtually no stunted first standard was experienced and the standard curve was very close to a straight line.

It was also found that running 3 top standards at the beginning of each run allowed the system to settle nicely for the remainder of the run. It is recommended that this become standard practice in the future.

It was found that at present DAPA will not accept more than 100 samples in the peak naming file. This means that the number of tubes (including standards, washes, samples, etc) analysed in each run can not be more than 100. This will be brought to the attention of Peter Sheppard.

At present the facility within DAPA which is supposed to allow sections of traces to be cut, is not working. This will also be brought to the attention of Peter Sheppard.

The waste system for the A.A. needs to be reworked as the waste is presently backing up and flowing out into the cupboard under the starboard sink. We would suggest that the colorimeters be lifted up higher as recommended by Technicon and that wide bore poly pipe be used for the drainage. Perhaps the waste should be drained to a carboy under the AA bench for free flow of waste.

Dissolved Oxygens:
As usual, no great problems with this analysis were encountered except that there were too many of them. There was barely enough time to dry the sample bottles before re-use. The system for drying bottles is inadequate.

The automated analysis system was trialed at sea but due to the work load and the difficulty in performing development work at sea, it was decided that the remainder of the development should be performed in the laboratory in Hobart.

Salinities:
Once again problems with the salinometers were encountered. Firstly the old faithful WF/74 died when the upper perspex collar for the stirrer came away from

the main perspex cell. Prior to this there had been a steady flow of bubbles at the junction of the collar and the main body of the cell apparently the collar was held in place only by the stirrer rubber. There was also an intermittent inflow of air around the stopcock. Two replacements were tried before an appropriate stopcock was found. Apiezon grease also aided in sealing from the air. Too much Apiezon can cause problems with cell contamination and a source on which air bubbles can form.

The spare salinometer (new) was tried out. It was found however that the cell was very difficult to fill and measure due to the formation of many tiny bubbles in the cell during filling and the inflow of air around the stopcock.

WF/74 was resurrected (chloroform was used to glue the perspex) and it was used for the rest of the trip. Samples however took three or more times longer than usual to measure due to the formation of persistent bubbles on the toroid, occasional bubbles from the stopcock and from other hidden from view places within the cell.

It is believed that the cause of some of the problems associated with persistent bubbles in the cell may be the use of paraffin to prevent the sub standard from evaporating. Although all operators are careful not to allow paraffin to enter the cell, it may be introduced over time just through normal analysis. It is therefore recommended that paraffin not be used in the sub standard any more. Evaporation during a batch of salinities is insignificant so the sub standard conductivity ratio will not drift due to evaporation. The only instance that evaporation may be noticed will be between batches which are analysed a number of days apart. If some sub standard is stored in a salinity sample bottle after a batch of salts is analysed, then this can be used to check calibration of the salinometer at the begginning of the next batch. The sub standard itself can then be used to monitor drift in the salinometer over the batch.

At times it was difficult to maintain the samples at a temperature which is within the tolerance of the temperature compensation interval on the salinometer. This is sometimes made more difficult when the analysis times are long and the samples are many. It is recommended that an adjustable constant temperature bath, able to accommodate a crate of salinities, be designed and built in order to combat this problem. The sub standard water could also be circulated through a portion of this bath to allow it to be kept at the same temperature. The bath temperature would be adjusted to the approximate room temperature.

Sampling

The sampling was performed by personnel other than hydrochem technicians. At the beginning of the voyage the samplers were shown the correct sampling procedure by the hydrochem technicians . During analysis of the nutrients, it was noticed (initially from the shape of the phosphate peaks) that the nutrient tubes were being overfilled. This was confirmed later from plots of silicate v depth for stations 19, 20, 23, 27, 34, 37, 38, 41, 42, 44 and 45. All of these stations except station 27 were sampled by the one watch. The problem was immediately brought to the attention of all samplers. The duplicates for stations 37, 38, 41, 42, 44 and 45 were analysed during later runs. Duplicates for stations 19, 20, 23, 27 and 34 had been discarded and therefore were not available for analysis. Although the point about overfilling the nutrient tubes was strongly made during the sampling demonstration it is advisable that a nutrient tube with suitable labeling should be placed in a prominent position in the weblab at the beginning of the voyage.

It was brought to our attention that some people like to restart the numbering of nutrient tubes once the numbers go over 1000. The hydrology programs matches the nutrient concentrations for each depth using the nutrient tube number and therefore it is imperative that no 2 samples have the same number. Duplicates of course are given the same number.

C14 sampling was performed as per instructions from Bronte Tilbrook by personnel other than hydrochern. technicians. The only problem experienced was the misplacement of some of the apiezon grease which is used to help seal the stoppers. The grease was therefore used sparingly.

Chemicals
The hydrochloric acid on board has become discoloured and perhaps it should be replaced. See note under autoanalyser about the A.A. chemicals.

Power supplies
The UPS system was going down intermittently during the cruise. It actually went down 3 times during one AA run. The AA was therefore connected to normal power for the remainder of the voyage.

Software
Word for Windows version 2.0 should be purchased for the PC in the GP lab as all other PCs on board have version 2.0. See Dave Edwards.

Computers
The DAPA acquisition PC has only a small amount of Hard Disk space - 20Mb. With software etc. on it, the disk rapidly fills with data during the course of a heavy cruise. It is strongly suggested that the present Hard disk be replaced with one of greater capacity, or supplemented with a Hard card.

Water Sampling Bottles
This was the first voyage where the new CSIRO made 3.5 litre Niskins were used. Prior to the first cast these Niskins were rigged with lanyards to fit on the new 24 bottle rosette. The new lanyards incorporated an extension for use with the 24 bottle rosette which can easily be removed so that the bottles may be

used with a 12 bottle rosette. The new bottles were used during the first 7 stations when they were found to leak erratically as shown by analysis of salinity samples from these casts. From careful inspection of the bottles it appears that some may be out of round which may cause the caps to not seat properly on the ends of the bottles. This problem should be addressed in Hobart by the workshop. It is recommended that some rigorous pressure testing procedure be designed to test bottles before they are taken to sea.

It was also found that the slot in the end caps for the new Niskins which hold the rubber in place are too wide and therefore the rubber occasionally slips out when loading. The bottles will therefore require new end caps.

Following station 7, 24 5 litre General Oceanics bottles were refurbished and fitted with lanyard extensions for the older larger 24 bottle rosette. Although these bottles performed fairly well, some bottles did require attention at various times during the voyage after they were found to leak. It is recommended that a log book for Niskin bottles, together with instructions, should be placed in the operations room. Entries should be made in this book whenever bottles leak or are serviced. Some system of routine maintenance also needs to be introduced - e.g. All O-rings to be replaced every 18 months, and closure rubber every 24 months.

Housekeeping
Clear and consistent labeling of chemicals should be carried out as a matter of course.

Water Distillation
The ship has a new vacuum distillation system for making fresh water. This works extremely well at producing very clean water. The Romer still, that is used to make water suitable for the Milli Q system, works on conductivity through the water being distilled to generate the heat required to boil the water. As the ships water is now so clean, the Romer still does not work very efficiently at all. The Romer still was not able to produce water at a fast enough rate during the voyage. It was decided with the generous help and input from the ships chief engineer, that we try using the water straight from the ships vacuum distillation system to fill the 100 litre tank. Prior to doing so this water was tested for nutrients and effect on DO analysis and found to be as good as our normal distilled water. It was therefore used for the remainder of the trip.

The chief engineer has recommended that a line be placed between the VAP system and the 100 litre tank so that when the VAP water is of sufficient quality it can be used to fill the tank. Perhaps we should also look at buying a still which does not use conductivity of the water to heat the water in the still. An RO cartridge should be placed on board as an emergency backup. It is also recommended that the RO unit be repositioned so that the pre filter and RO cartridge can be fitted in the recommended way with convenient access.

Hydro Program
The HYDRO program worked well. Dave Terhell will be modifying it before the next voyage, hopefully, so that the nav and depth data will come across from the new computer system without any hassles.

Additional Recommendations
The chemistry laboratory on the ship has been used for analysis of hydrological samples for 9 years now without any major modifications. Over that time the sampling regime has increased significantly in that we are now regularly using a 24 bottle rosette instead of a 12 bottle rosette. The demands on the methods of analysis and data collection from instruments have also increased as a result of stringent guidelines required by such programs as WOCE. The hydrochem group staff have taken it upon themselves to endeavour to improve data generated by the group. Examples of this are the automation of the data collection from the AA, introducing modifications to analytical and sampling procedures and the development of an automated dissolved oxygen rig which will soon be used routinely.

Some of the cupboards, drawers and other fittings are well worn and need rejuvenating.

As a result of the changes and increased demand from the hydrochem lab, we believe it may be time to consider some future modifications to the work area to allow for more efficient use of the limited space, and to allow for easier use of equipment by the technicians. This would include modification to benches, installation of racks and general rejuvenation of lab fittings.

It is also recommended that a new milli Q system be installed in the laboratory itself. This would be similar to the smaller one which is installed on the Southern Surveyor.

ELECTRONICS

CRUISE REPORT FR06-93
Technician: P Adams
Date: 17-July-93

FREIGHT

Equipment despatched through Kwikasair(express road freight), was late, delaying, departure by 12 hours. IPEC have been used in the past without fault and appear to have a quicker service. There use in the future should be considered.

The new Davis protective rosette cast and the old 24 bottle pylon were damaged in transit. It appeared that the case had been dropped forcing the seacon connector, on the pylon, through the case, damaging the connector. A company representative (driver) was show the damage and informed of a possible claim, pictures were taken of the damage.

ADCP

The unit was returned from RDI, after updates and calibration, in an unserviceable condition. Several of the faults were fixed in Hobart, the last fault requiring parts to arrive from RDI.

The butterfly board was replaced prior to departure.

The transducer trolley was found to be incomplete and covered with antifouling paint and primer. The appropriate pieces were purchased prior to the cruise and the trolley wheels, shafts and bearings were stripped, regreased and reassembled.

The transducer assembly would not fit in the trolley due a change in transducer dimensions, (not mentioned by RDI). The trolley was modified to accept the new housing, strips of timber were installed on the base of the trolley to protect the protruding transducer.

The protruding transducer may have been responsible for an apparent loss of quality in the data near the surface.

Due to the problems encountered with the unit prior to the cruise, and several inconsistencies in the data during the cruise, it is important that some of the data be analysed prior to the next cruise.

CTD's and ROSETTES

CTD 1 was installed on the new 24 bottle rosette with the new 24 bottle pylon (#2). The CTD 1 was found to have a large Salinity offset. It was decided to use CTD 2 for the rest of the trip, this was installed on the new rosette.

Due to Niskin bottle problems the old rosette frame was removed from the hold and setup with CTD 2 and rosette pylon #1.

Except for changes in pylons this configuration was used for the rest of the cruise.

EG&G ROSETTE PYLONS.
The new 24 bottle rosette pylon(#2), would not work reliably at temperatures below 2°C. The unit was disassemble and a nylon bush was machined to provide sufficient clearance for correct operation. A thinner oil was used to surround the stepper motor.

The wafer position switch, and some contacts, were realigned.

The unit performed without fault during the final stages of the cruise.

The original 24 bottle rosette pylon(#1),was used, without fault, during the periods pylon #2 was being worked on.

EG&G 1401 Deck Unit No #1
The CTD traces became spiky at approx 300m intervals. Using the audio tape recorder, the fault was isolated to the deck unit. All the connectors and removable Ic's were reseated and the unit reassembled. The unit was given a functional test as well as heat and cold tests and then re-installed in the system, it performed without fault for the rest of trip.

EG&G 1401 Deck Unit No #2
This unit was installed in place on unit #1 to allow scientific work to continue. This unit was not fully operational and required some work to rectify factory wiring faults to the audio playback circuit and correct internal jumper settings.

THERMO SALINOGRAPH
The thermosalinograph was reading low by a considerable amount. The conductivity sensor was cleaned, reducing the offset to it's usual amount.

MICRO 1
Micro 1 crashed due to disk drive problems. The fault was eventually traced to bad sectors on disk. The disk was reformatted and rebuilt.

MICRO 6
Micro 6 began crashing during casts. The power supply cable to the back plane was removed and cleaned, removing the fault.

The micro crashed several times during the remainder of the cruise. The boards and cables were reseated reducing the crash occurrence.

The CTD data tape drive experienced read write problems on mounting. The tape head was cleaned removing the fault.

EA500
The Pinger boards were installed into the deck unit. The old 12KHZ boards were re-installed into the spare unit in the electronics workshop.

SUGGESTIONS
The problems associated with the CTD EG&G 1401 deck units were quickly found with the use of the audio tape deck. If this form of backup was removed, as proposed in the new computing system, the ability to fault find deck unit, and cable faults, are much reduced.

Some form of recording raw analogue data, possibly a DAT should be included.

Fr 6/93 computing report
The computer system worked well this cruise, the main problems being with micro 1.

VAX
The Vax was serviced in Cairns and gave no problems through the cruise except for the usual minor frustrations with tape drives. Even the air-conditioning worked reliably!

Micro 1 (MTSPOL micro)
This micro had a number of problems early in the cruise. The disk was eventually replaced and this micro (and MTSPOL) worked reliably after the second restore from backup.

Micro 6 (CTD micro)
There were some hardware problems with the disk on this micro early in the cruise. These ceased after a thorough cleaning of the contacts. Some stations early in the cruise were replayed from audio tape for safety, although the digital files seemed OK.

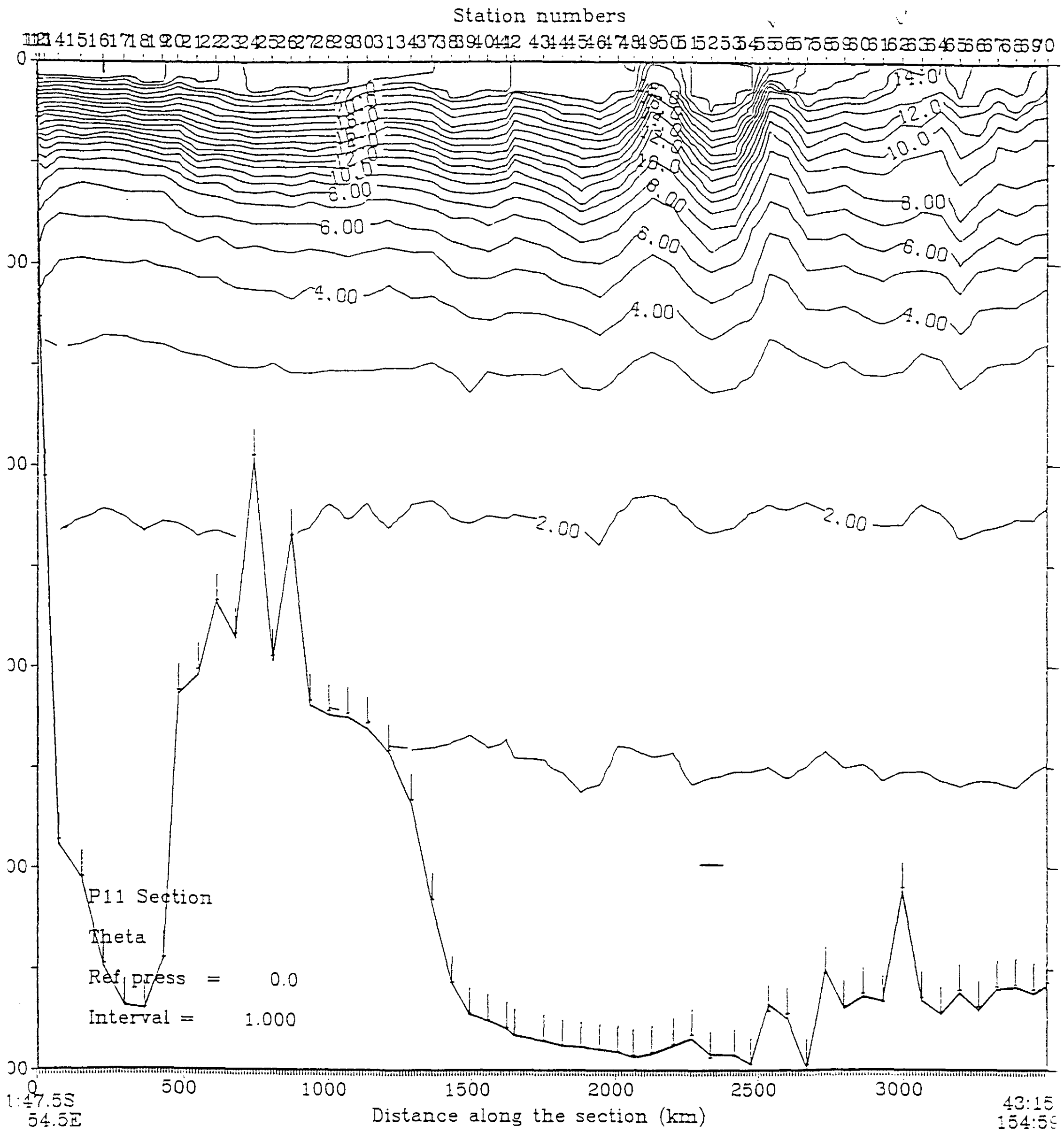
Other micros
All worked with very little fuss.

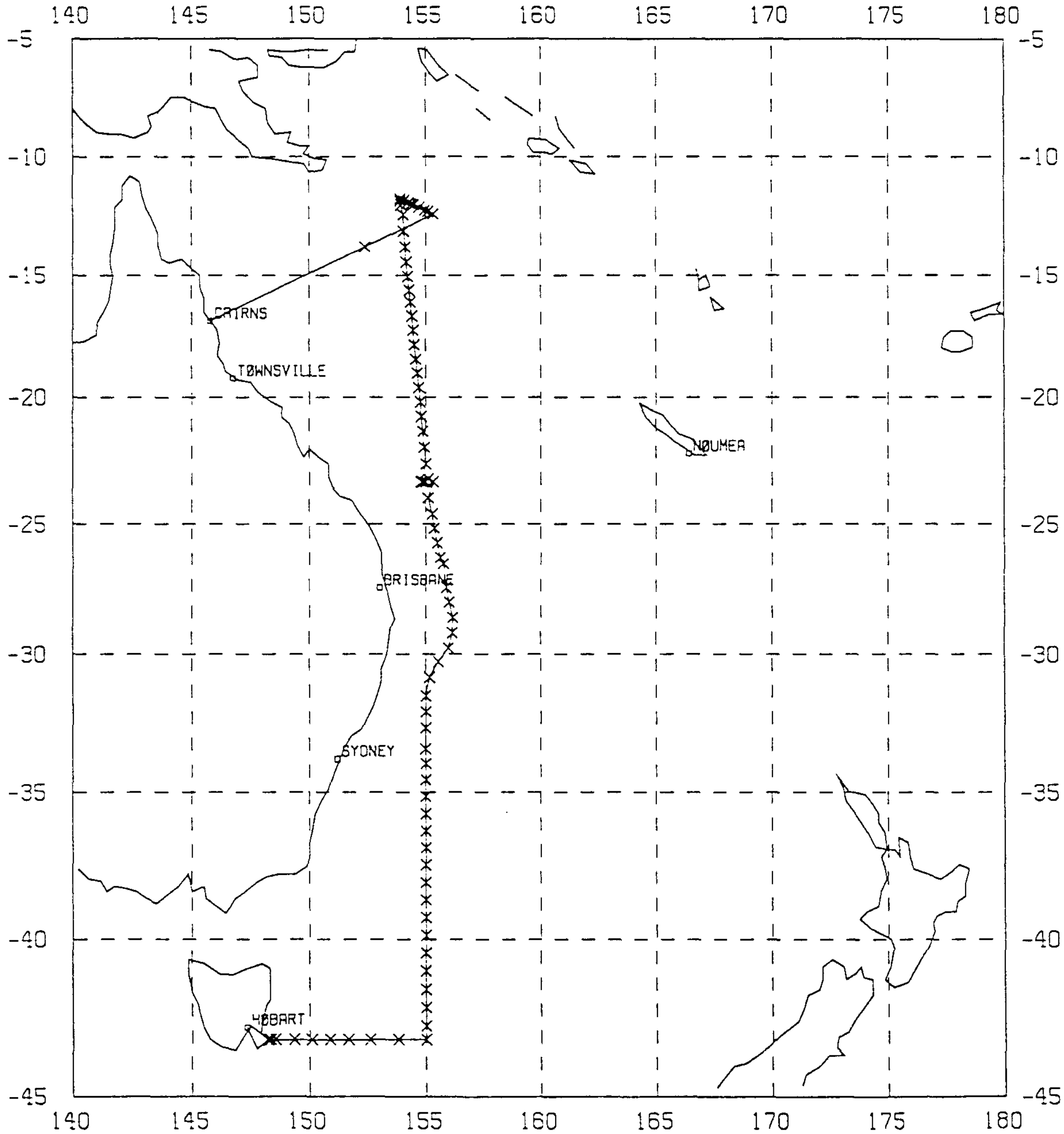
General comments
The data from the Shipmate SATNAV was inaccurate to the point of being useless much of the time when GPS was unavailable (up to 15 miles out). For the new system, we should probably use dead-reckoned positions from the last good GPS position as our backup position.

There have been a couple of suggestions that the'depth to go to' could be displayed on the winch display on the bridge - these depths would be entered from the ops room.

The ship's officers will all appreciate the total absence of ops room alarms (e.g. tape request messages) from the bridge DELP display.

Neil White





CAIRNS
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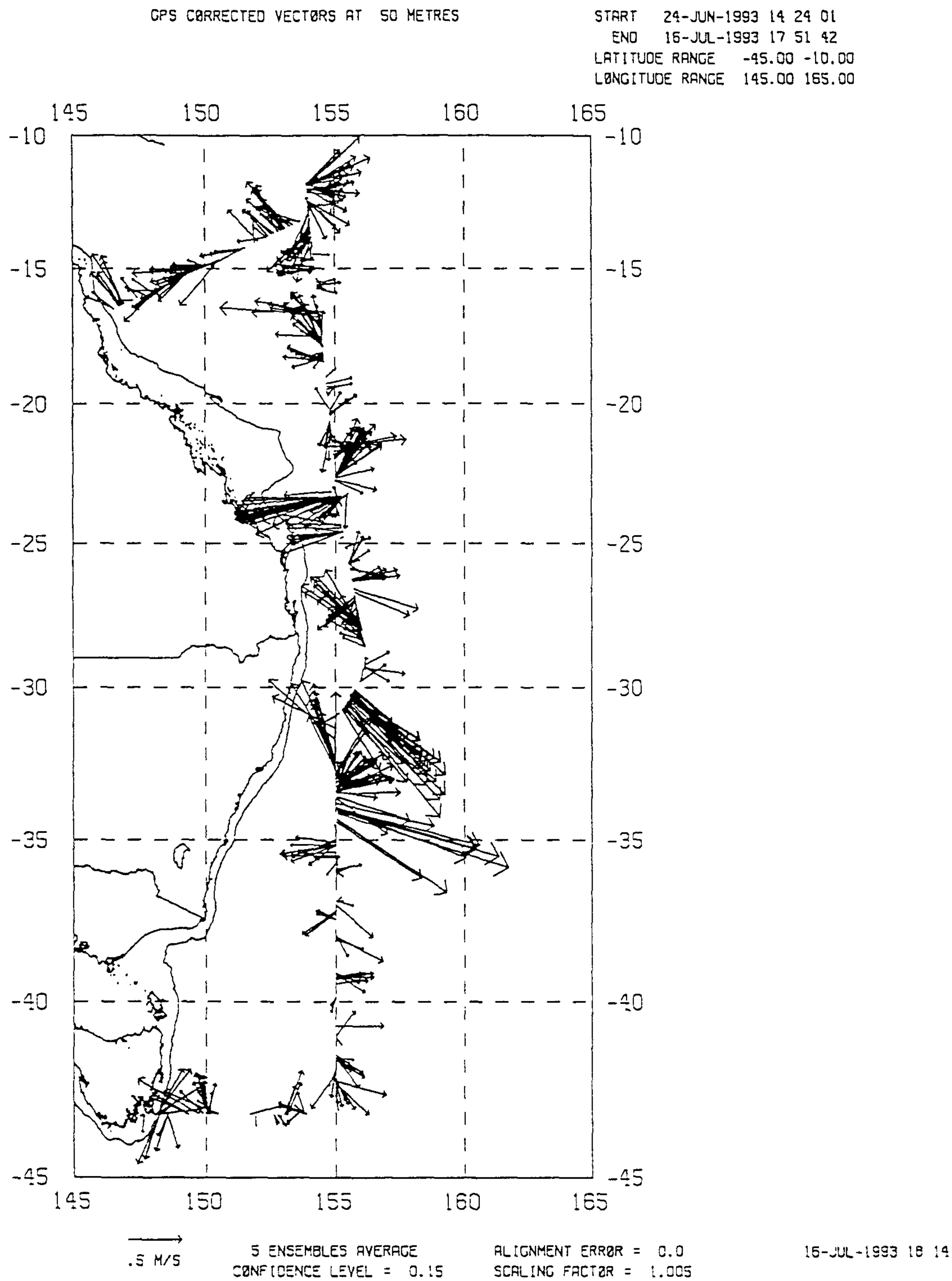
BRISBANE
SYDNEY
HØBART


GPS CØRRECTED VECTØRS AT 50 METRES
START 24-JUN-1993 14 24 01
END 16-JUL-1993 17 51 42
LATITUDE RANGE -45.00 -10.00
LØNGITUDE RANGE 145.00 165.00
145
150
155
160
165
-10
-15
-20
-25
-30
-35
-40
-45
.5 M/S
5 ENSEMBLES AVERAGE
CØNFIDENCE LEVEL = 0.15
ALIGNMENT ERRØR = 0.0
SCALING FACTØR = 1.005
16-JUL-1993 18 14

Notes on ADCP data for Fr 6/93

1 Features of this voyage

This was the only voyage after the 1993 refurbishment of the ADCP and before conversion of the ship's computer systems to SUN Sparcstations, and it had a unique problem.

When the ADCP was returned (very late) after refurbishment it was not in a working condition. Fortunately it was sent first to Hobart where it was tested and the main electronic and configuration problems were found and corrected. It was then sent to the ship but a change in the mounting structure meant that the transducer now projected slightly below the hull instead of being slightly recessed. This may have contributed to the high data loss experienced. However, the main problem was that a new algorithm had been included which, unless explicitly disabled, would rejected data that was considered to have been corrupted by fish echoes. This feature was not described or even mentioned in the documentation returned with the instrument.

The fish detection algorithm was extremely overactive, possibly due to the 4 acoustic beams being badly matched in strength. A great deal of the rejections occurred in the upper profile, in the region normally used as the Reference Layer (RL). This brought into play a hitherto fairly dormant bug in the Reference Layer Averaging (RLA) code which had been imported from software provided by Oregon State University in late 1988. As a result, a large portion of the profiles were corrupted.

The RLA bug occurred when a pin, was rejected from all bins in the RL, so that no reference velocity could be computed for that ping. However, that ping would often be accepted in other bins, in which case instead of the difference between the reference velocity and the bin velocity being accumulated, the whole bin velocity would accumulate. When the ensemble was then averaged the mean reference velocity is added back to each bin's difference velocity. Acceptance of a ping into each bin is, for our purposes, fairly random, so the level of error in each bin is not predictable. All that can be estimated is the maximum error that could have occurred. Note that whenever this error occurs it will always cause an overestimate of bin velocity so it will cause a mean bias.

More than half of all profiles had the potential for this error (that is, they had incomplete RL). Note that the main errors in absolute currents derived from ADCP data are in estimating the ship's velocity and in calibration. The error in measuring (the shape of) profiles relative to the ship is relatively small. It therefore introduces little error to use only one or two good profiles to determine the profile shape for a 20 minute averaging period. The absolute currents can then be derived from the integrated reference velocities of all participating profiles, since these are not subjected to the error. This treatment is really just an extreme case of the RLA which is always applied during the final integration stage of processing.

It is then necessary to select the "good" profiles which provide the integrated profile's shape. Selecting only profiles with complete RL would not restore much of the dataset. Instead, a maximum, possible error threshold is set for profiles and for each bin within a profile. Note that the maximum possible error is dependant on the number of gaps in the RL, the magnitude of the reference velocity, and the number of pings accepted in a given bin (although the probable error is fairly independant of this last number). Note also that there will usually be either no error or a an error smaller than the maximum. The threshold of 0.04 m/s used in processing this dataset has been effective in restoring a high proportion of the possible final profiles (86%) while not introducing any visible errors.

GPS "SA" degradation (see section 2) was in force during this voyage, and GPS coverage was about 89%.

There was only a minute amount of bottom track data. It was also subject to the RLA gap) error described above, for which it had to be appropriately screened.

The alignment angle calibration coefficient apparently changed with time throughout this voyage, probably due to some drift or inadequate latitude compensation in the ship's gyro. A correction for this has been estimated and applied, ranging in magnitude from -0.5° to +0.9°. A heading-dependant correction for a known fault in the gyro's Synchro-Digital Convertor was also applied.

1.1 Profiles integrated

Bottom track corrected
17 20 minute profiles (1% of voyage covered).

GPS corrected
1216 20 minute profiles (76% of voyage covered). Use with care, if at all, as SA was active.

415 60 minute profiles (77% coverage).

2 GPS data degraded by SA (Selective Availability)

The US Department of Defense, who operates the GPS satellites, has introduced deliberate complex errors into GPS data. It is generally considered that these errors cannot be removed without extra equipment and post processing (and even then cannot be achieved with deep ocean work.)

The characteristics of SA errors are probably changed from time to time, however they usually seem to be across quite a wide time spectrum. Of most concern for ADCP data are the errors of order 50 cm/s over 5 to 10 minute periods. There also appears to be a smaller and lower frequency component, the worst case so far observed had a residual error of 6 cm/s after averaging an hour's data.

2.1 The implications for ADCP data are:

* individual GPS corrected ensembles (3 minute or less) often have errors of around .5 m/s.
* The existence of such errors prohibits the use of some quality control measures, especially of course dv/dt.
* 20 minute integrated profiles will usually have little extra error, maybe 1 or 2 cm/s. However, at times low frequency components of SA may cause larger errors, up to 10 or 20 cm/s.
* 60 minute profiles will rarely have more than 1 or 2 cm/s extra error.
* Incomplete 20 minute profiles (low 'cover' percentage) are less reliable because they are probably incomplete due to a break in GPS coverage, and data adjacent gaps is usually of poorer quality. Also, the SA errors are less likely to have been removed by averaging.
* Bottom track and shear data are, of course, unaffected by this. When using GPS to get ship's position, these errors are negligible (200m or 300m at most).

3 Calculating the Bin Depth

The depth to the centre of bin j, in metres, is approximately:

depth(j) = draught + (plen + blen)/2 + delay + blen*(j-1) + blen/10

where

draught - 4 m
blen -bin length
plen - pulse length
delay - delay after transmit (also known as DTFB - Depth To First Bin).

The depth bins are generated by the instrument using the assumption of a sound speed of 1475 m/s. The above approximation can therefore be refined by correcting for the approximate real sound speed, that is, by multiplying the above-derived depth by (estimated_real_sound_speed)/1475. This sound speed estimate would be made by estimating the mean temperature, salinity and depth for the main study area.

4 Calibration

ADCP water profile vectors are calibrated by being rotated through an angle α and multiplied by scaling factor $1+\beta$. The rotational calibration primarily corrects for misalignment of the transducer with respect to the ship, of the Ship with respect to the gyro compass, and the error in the gyro compass. The scaling multiplier primarily corrects biases arising from the profiler itself. Both of these calibrations make a large difference to the resultant currents, particularly because they are both applied to the usually large ship-relative currents. For example, a scaling multiplier of .01 applied when the water velocity with respect to the ship is 6 m/s alters the measured absolute currents by 6 cm/s. Calibration is particularly difficult when the coefficients change with time, as appears to be the case on this voyage.

Results for this voyage:

$$1+\beta \sim = 1.011$$

$$\alpha \text{ varying between } -0.5^\circ \text{ and } +0.9^\circ$$

5 Data Quality

The data provided should not be taken as absolutely true and accurate. There are many sources of error, some of which are very hard to quantify. Often the largest error is that of determining the ship's actual velocity.

Accuracy of water velocity relative to the ship

The theoretical approximate short-term velocity error for our 150 kHz ADCP is:

sigma = (pulse length X square root of pings per average) - 1

For a 3 minute ensemble with say 170 pings, using 8m pulse, this gives a theoretical error of 1 cm/s for each value (that is, independantly for each bin).

For 20 minute profiles, with say 1150 pings averaged, the error in measuring the velocity of the water relative to the ship is probably reduced to the long term systematic bias. Of this bias, RDI says

"Bias is typically of the order of 0.5 - 1.0 cm/s. This bias depends on a variety of factors including temperature, mean current speed, signal/noise ratio, beam geometry errors, etc. It is not yet possible to measure ADCP bias and to calibrate or remove it in post-processing."

As discussed on page 1 of this report, this dataset often has fewer than normal ensembles contributing to the shape of the final profile, and these ensembles may rarely have up to 4cm/s RLA gap error, so the relative water velocity measurement error may sometimes rise to about 5 cm/s for a given bin.

As well as that, there are the transducer alignment and gyro-compass errors, which probably have a residual effect after calibrating of roughly:

0.5 cm/s per m/s of ship speed, due to say 0.5 uncertainty in alignment angle (but higher or lower at different times through the voyage)
0.3 cm/s per m/s of ship speed, due to say 0.003 uncertainty in scaling factor

This gives us say 0.6 cm/s error per m/s of ship speed, or 3.5 cm/s at 12 knots.

Other sources of bias might be the real-time and post-processing data screening, and depth-dependant bias.

GPS profiles

In the presence of SA, errors are larger and even very large errors cannot be removed by dv/dt screening (because this would bias the long term average - there is reason to assume that given a long enough period the accumulated SA error is close to zero).

Bottom track profiles

Note that errors arising from transducer alignment and gyro limitations will substantially cancel out. Normally, the accuracy of screened bottom track data appears to be of the same order of accuracy as non-SA GPS, that is, about 2 - 3 cm/s for a 20 minute profile.

CTD Processing Notes
Fr06/93
D.J. Vaudrey

General.

The major objective of RV Franklin Cruise Fr6/93 was to carry out a deep meridional section through the Tasman and Coral Seas from north to south, primarily along 155°E latitude to 43° 15.0'S as part of the WOCE section P11, the southern part of which was carried out by the MV Aurora Australis during April 1993. The section was meant to mate up with the Section. 81 CTD Stations were carried out to the bottom with CTD Unit 2 utilizing the 24 bottle rosette sampler. One station (#0) was carried out with CTD 1 but not processed.

Station 1 to 7 where carried out with new 3.5L Niskin type bottles on a small low profile rosette sampler. Following poor performance of these bottles with various leak problems the Rosette was changed to the large frame model to allow use of the 5L niskin bottles for the remainder of the cruise. Some misfiring problems with the Rosette continued to cause some difficulties and one cast was carried out with the spare 24 bottle pylon as a test but its operation was even more uncertain.

Some data stream problems occurred when the deck unit failed and was swapped to the spare which also had some problems. After the original unit was repaired, it was re-installed.

Station List.

0. Bottle test cast with 3.5 L bottles and CTD Unit 1. All fired at 650 decibars.
1. Bottle test with 3.5 L bottles. All fired at 700 decibars.
2 3 misfires recorded at positions 1, 3 and 8.
3 4 misfires recorded at position 1, 2, 3 and 7. Of first group one bottle only failed. Problems with raw data. Some how raw file was taped with 124 byte records rather than the 127 byte records. The data stream was correct but the record footers were corrupted. Modified ref_ ff to handle the fault. Two dips to merge at 1784 decibars. Bottle position 17 had warm water, suspect hangup which released later and not sampled.
4. Misfires reported on position 1, 2 x4, 6 and 8.
5. 7 reported misfires, only one failed to close. Position 23 had lanyard caught in mouth and not sampled.
6. Misfires reported at positions 1 to 7. 'No Response' from position 9. Positions 22. 23,224 did not close. Position 6 lost caps, no sample.
7. Altimeter failed to sense bottom. Misfires reported at positions 1, 3, 4, 11 and 13. Position 24 not closed on recovery.

8. Test station with Large frame 24 bottle rosette and 'old' 5 L bottles. Position 4 and 17 did not close correctly and not sampled.
9. Problems occurred with logging program due to disk fault. Station replayed from audio as Stn 19, dip5 but missed data from 350 to 1350 decibars. Station ignored.
10. Position 9 failed leak test, Lanyard caught in mouth of bottle at position 11 and neither sampled.
11. No apparent problems.
12. Position 10, lanyard caught in mouth of bottle and not sampled. Data removed from scans 16191 - 16193 (Bad pressure point) and 16230 - 16420 due to apparent wake problems.
13. Position 3 did not close due to a broken rubber. Wake problems removed with scans 17500 to 17515 and 17745 to 17770.
14. Logging program crashed at 1450 decibars on downcast. CTD raised to 1425 decibars before commencing logging. Data files replaced with file derived from audio replay (replayed as Stn 19, 7). Data removed from wake effect at points 12425 to 12440.
15 Logging crashes caused a number of problems and station eventually replayed from audio backup, although data was missed from 2150 to 2450 decibars. Wake effects removed from data at 138 decibars (scans 9175 to 9215 and 9430 and 9480) and 268 decibars (scans 16879 to 16910). Cleaned power cable contacts on logging computer.
16. No apparent problems. Dip 5 for this station used as replay fro station 15.
17. Position 24 decidedly cold. Salinity, DO and Nutes all indicated it fired at bottom. Niskin in position 18 damaged during recovery (handle broken).
18. No apparent problem.
19. Lanyard fouled in niskin mouths at positions 12, 16 and 17, not sampled. Apparent partial blockage of conductivity cell at 4422.0 decibars, Scans removed 16886 to 161045. Dip 5 was replay of Station 9, Dip7 was replay of Station 14.
20. Position 16 not sampled as leaking and lost most of water.
21. 'No response' at position 20 (2600 decibars), Two fired at 2400 decibars.
22. Position 3 failed the leak test and not sampled.
23. Position 13 indicated misfire, appeared to have fired.
24. Position 4 indicated 'No Response' on first attempt, then 'Misfire' on second but appears to have fired.
25. No apparent problems.
26. No apparent problems.
27. No apparent problems. Position 13 fail leak test and not sampled.
28. No apparent problems.
29. Position 23 indicated 'No response' on first attempt. OK on second.
30. No apparent problems.
31. No apparent problems.
32. Salinity spike at 412 decibars. Dab data points removed 17304 to 17309.
33 No apparent problems.
34. C14 station. No apparent problems.

35. No apparent problems. Position 4 fail leak test and not sampled.
36. No apparent problems. Position 4 fail leak test and not sampled.
37. O-rings niskin at position 4 replaced prior to this station.
38. Position 24 seems to have pre-tripped. Too cold. Positions 21 and 22 seemed to leak.
39. C 14 station. Positions 1, 11, 14 and 21 failed leak test and not sampled.
40. Positions 12 and 21 failed the leak test and not sampled.
41. 'Misfire' reported at position 15 and was refired consequently two firings at 1600 decibars.
42. Position 12 leaked after sampling.
43. C14 station. Testing new rosette pylon. Misfires indicated at positions 1, 2, 3, 4, 5, 6, 7, 8, 20 and 22. Break in data stream at 3381 decibars. Brought back to 3312 decibars. Files merged at 3380 decibars. 3 bottles remain unclosed at surface.
44. CTD Deck Unit failure at 2625 decibars. Back down to 2625 decibars and restarted. Old rosette pylon. New O-ring in Position 21 prior to cast. Dips 1 and 2 merged at 2624 decibars. Dips 2 and 3 merged at 3588 decibars.
45. Numerous small spikes and glitches in raw data but processing software appeared to cope. Position 13 indicated misfire. Position 15 failed the leak test and not sampled. Position 24 closed at bottom.
46. Positions 8 and 17 failed leak test and not sampled. Thermometers affected by sun.
47. C14 station. Positions 3, 9, 17 and 19 failed leak test and not sampled. Return to original deck unit repaired. Position 24 cold.
48. Position 19 not sampled- O-ring damaged and caught.
49 Upcast interrupted by logging crash. Position 19 failed leak test, not sampled.
50. Restarted cast several times as initial logging problems. Dips 1, 2, 3 empty.
51. Wire out 5230 metres. (11/2 layers on winch). Misfire reported at position 8.
52. UPS failed at 3990 decibars. Restart logging. Merge dip 1 and 2 at 3980 decibars. Position 24 cold.
53. Down cast aborted at 140 decibars due to weather. Restarted 15 hours later. Some wake effects could not be removed with out creating holes in data at 218 decibars and 245 decibars. Steep pycnocline and rough seas?
54. C14 station. Misfire reported at position 6, appeared to have fired.
55. Problems with CTDCLE. Micro 6 crashed during upcast. Rebooted successfully after 3 attempts. Misfires indicated on position 1 and 2. Leak test failures on position 4 and 13 and not sampled. Position 24 did not close.
56. Misfires indicated at position 1 and 3 actually fired.
57. Misfires indicated at position 1 and 2. Next fire indicated 'Even', hence it was likely one did not fire (position 2). Position 5 indicated 'Odd' instead of even as expected. Position- 6 also indicated 'Odd', perhaps return signal for 5 garbled. Position 24 was not closed on return to surface.
58. Misfire indicated at position 1. All bottles closed. Position 9 failed leak test and not sampled.

59. No apparent problems.
60. Position 20 O ring, dislodged and not sampled.
61. Position 20 failed leak test and not sampled.
62. New O rings on Niskin at position 20. Stopped winch at 1555 decibars on down cast. Brought back to 1540 before continuing downcast. 'No Response' indicated at position 1. Fired two bottles at 4000 decibars (Positions 1 and 2).
63. Position 23 failed leak test and not sampled. Position 11 warm.
64. Position 19 failed leak test and not sampled.
65. 'Misfire' indicated on position 1 and 4.
66. C14 station. Positions 13 and 19 failed leak test.
67. Position 15 failed leak test and not sampled. Misfires indicated at position 1, 3 and 5.
68. Misfire indicated at position 1.
69. C14 station. Misfires indicated at positions 1 and 4.
70. Paused at 128 decibars due to Hydraulic alarm. Raised to 100 decibars before re-commenced downcast. Positions 4 and 8 failed the leak test and not sampled. Misfires indicated at position 1.
71. Misfires reported at positions 1, 2, 3, 4 and 5.
72. Misfires reported at positions 1 and 4.
73. Misfires reported at positions 3 and 5. Position 4 failed leak test and not sampled.
74. Position 17 and 4 failed leak test and not sampled.
75. No apparent problems.
76. Misfire indicated at position 6. Thermometer frame broken off Position 5 during recovery operation.
77. Positions 1, 7, 13 and 18 failed leak test and not sampled.
78. No apparent problems.
79. Total loss of ships power at 200 decibars. UPS OK.
80. No apparent problems.

Calibration Information.

Temperature Coefficients (CSIRO Calibration Facility May 93)

Temperature Bias =0.99966

Temperature Offset = 2.0030e-03 °C

Conductivity (1496 samples accepted out of 1646)

S.D Salinity following calibration = 0.0020 ps

Offset Term	Cond Term	Stn. Dep. Term
Stations **1**	**21** pres. bounds	0.0 6500.0 edit = 2.8
0.60419057E-01	0.99986307E-03	-.39128168E-08, n = 362
		std. dev. = 0.19696E-02
Stations **22**	**34** pres. bounds	0.0 6500.0 edit = 2.8
0.59709446E-01	0.99951174E-03	0.10638023E-07, n = 240
		std. dev. = 0.19733E-02

Stations **35**	**37** pres. bounds	0.0 6500.0 edit = 2.8
0.61372526E-01	0.99982893E-03	0.86295471E-10, n = 56
		std. dev. = 0.20865E-02
Stations **38**	**44** pres. bounds	0.0 6500.0 edit = 2.8
0.59789858E-01	0.10005530E-02	-.17013288E-07, n = 144
		std. dev. = 0.15230E-02
Stations **45**	**55** pres. bounds	0.0 6500.0 edit = 2.8
0.61324505E-01	0.10000289E-02	-.88528422E-09, n = 221
		std. dev. = 0.1 8419E-02
Stations **56**	**59** pres. bounds	0.0 6500.0 edit = 2.8
0.60031424E-01	0.99872904E-03	0.24181801E-07, n = 88
		std. dev. = 0.21044E-02
Stations **60**	**65** pres. bounds	0.0 6500.0 edit = 2.8
0.59687868E-01	0.99931166E-03	0.1143 -3 3 656E-07, n = 130
		std. dev. = 0.161-37E-02
Stations **66**	**70** pres. bounds	0.0 6500.0 edit = 2.8
0.56374888E-01	0.100 14253E-02	-.19471641E-07, n = 98
		std. dev. = 0.10490E-02
Stations **71**	**74** pres. bounds	0.0 6500.0 edit = 2.8
0.56521752E-01	0.99725421E-03	0.40071525E-07, n = 84
		std. dev. = 0.12603E-02
Stations **75**	**80** pres. bounds	0.0 6500.0 edit = 2.8
0.55451630E-01	0.10006793E-02	-.63217401E-08, n = 72
		std. dev. = 0.17279E-02

Pressure Offset (Individual Stations)

station 001	offset = 0.80	station 002	offset = 0.80
station 003	offset = 1.00	station 004	offset = 1.00
station 005	offset = 0.90	station 006	offset = 1.00
station 007	offset = 1.00	station 008	offset = 1.00
station 009	offset = 0.90	station 010	offset = 0.80
station 011	offset = 1.00	station 012	offset = 1.00
station 013	offset = 1.10	station 014	offset = 0.80
station 015	offset = 0.80	station 016	offset = 0.80
station 017	offset = 1.00	station 018	offset = 1.00
station 019	offset =-1.90	station 020	offset = 0.90
station 021	offset = 0.90	station 022	offset = 0.80
station 023	offset = 0.90	station 024	offset = 0.90
station 025	offset = 0.80	station 026	offset = 1.00
station 027	offset = 0.90	station 028	offset = 0.80
station 029	offset = 0.40	station 030	offset = 0.70
station 031	offset = 1.00	station 032	offset = 0.80
station 033	offset = 1.20	station 034	offset = 1.20
station 035	offset = 1.10	station 036	offset = 1.20
station 037	offset = 0.80	station 038	offset = 1.20

station 039	offset = 0.90	station 040	offset = 1.10
station 041	offset = 1.10	station 042	offset = 1.00
station 043	offset = 1.00	station 044	offset = 1.00
station 045	offset = 1.20	station 046	offset = 1.20
station 047	offset = 0.80	station 048	offset = 1.00
station 049	offset = 0.90	station 050	offset = 0.70
station 051	offset = 1.20	station 052	offset = 1.10
station 053	offset = 0.80	station 054	offset = 1.20
station 055	offset = 1.30	station 056	offset = 1.40
station 057	offset = 1.40	station 058	offset = 1.20
station 059	offset = 1.10	station 060	offset = 1.30
station 061	offset = 1.40	station 062	offset = 1.30
station 063	offset = 1.30	station 064	offset = 1.30
station 065	offset = 1.40	station 066	offset = 1.30
station 067	offset = 1.50	station 068	offset = 1.40
station 069	offset = 1.50	station 070	offset = 1.60
station 071	offset = 1.40	station 072	offset = 1.50
station 073	offset = 1.60	station 074	offset = 1.90
station 075	offset = 1.80	station 076	offset = 1.40
station 077	offset = 1.70	station 078	offset = 1.50
station 079	offset = 1.80	station 080	offset = 1.80

Downcast	First Order :-2.9653e-04	Upcast	First Order: -1.4676e-02
"	Second Order: -7.5998e-06	"	Second Order: +9.2760e-06
"	Third Order: +5.6853e-09	"	Third Order: -1.9224e-09
"	Fourth Order -1.3605e-12	"	Fourth Order : + 1.2969e-13
"	Fifth Order + 1.0510e-16	"	Fifth Order: +0.0000e+00

(March 93)

CTD Processing Report
Dissolved Oxygen: Fr06/93.
D.J. Vaudrey

General.

The major objective of RV Franklin Cruise Fr6/93 was to carry out a deep meridional section through the Tasman and Coral Seas from north to south, primarily along, 155°E latitude to 43°15.0'S as part of the WOCE section P11, the southern part of which was carried out by the MV Aurora Australis during April 1993. The section was meant to mate up with the Section. 81 CTD Stations were carried out to the bottom with CTD Unit 2 utilizing the 24 bottle rosette sampler. One station (#0) was carried out with CTD 1 but not processed.

Station 1 to 7 where carried out with new 3.5L Niskin type bottles on a small low profile rosette sampler. Following poor performance of these bottles with various leak problems the Rosette was changed to the large frame model to allow use of the 5L niskin bottles for the remainder of the cruise. Some misfiring problems with the Rosette continued to cause some difficulties and one cast was carried out with the spare 24 bottle pylon as a test but its operation was even more uncertain.

No samples where drawn for dissolved oxygen analyses for stations 1, 8, 28 or stations 78 to 80. Station 9 was not calibrated due to a failure of the logging system. The replay was missed 1000 decibars of the cast between 350 and 1350 decibars. Some immersion effects could be seen on stations 24 (from 0 to 20 decibars), 26 (from 0 to 32 decibars), 40 (0-30 decibars) and 69 (0-60 decibars). These immersion effects exhibited abnormally high dissolved oxygen concentrations (highly super saturated) at or near the surface. The cause is unknown. Perhaps it is due to the CTD being lowered into the propeller wash from the stem thruster? The anomalously high dissolved oxygen values were edited out over the ranges specified above.

Grouping.

1-10, 11-20, 21-30, 31-40, 41-50, 51-60, 61-70, 71-80.

Calibration.

Mean residual over all stations = -0.387 µmo/L (Not removed)
Standard Deviation of residuals = 2.453 µmol/L (Equiv. to 0.055 mL/L).
1443 samples used out of 1523.
[Samples > 750m SD=1.699 µmol/L (Equiv to 0.038mL/L).]

stn	bias	slope	pcor	tcor	tau	wt	sd group	#
1	0.032	1.18740E+01	0.14192E-03	-0.23661E-01	0.81348E+00	0.80000E+0.1	0.17086E+00	134
2	0.032	1.18740E+01	0.14192E-03	-0.23661E-01	0.81348E+00	0.80000E+0.1	0.17086E+00	134
3	0.032	1.18740E+01	0.14192E-03	-0.23661E-01	0.81348E+00	0.80000E+0.1	0.17086E+00	134

4	0.032	1.18740E+01	0.14192E-03	-0.23661E-01	0.81348E+00	0.80000E+0.1	0.17086E+00	134
5	0.032	1.18740E+01	0.14192E-03	-0.23661E-01	0.81348E+00	0.80000E+0.1	0.17086E+00	134
6	0.032	1.18740E+01	0.14192E-03	-0.23661E-01	0.81348E+00	0.80000E+0.1	0.17086E+00	134
7	0.032	1.18740E+01	0.14192E-03	-0.23661E-01	0.81348E+00	0.80000E+0.1	0.17086E+00	134
8	0.032	1.18740E+01	0.14192E-03	-0.23661E-01	0.81348E+00	0.80000E+0.1	0.17086E+00	134
9	0.032	1.18740E+01	0.14192E-03	-0.23661E-01	0.81348E+00	0.80000E+0.1	0.17086E+00	134
10	0.032	1.18740E+01	0.14192E-03	-0.23661E-01	0.81348E+00	0.80000E+0.1	0.17086E+00	134
11	0.017	0.19229E+01	0.15145E-03	-0.25925E-01	0.77051E+00	0.80000E+0.1	0.16627E+00	171
12	0.017	0.19229E+01	0.15145E-03	-0.25925E-01	0.77051E+00	0.80000E+0.1	0.16627E+00	171
13	0.017	0.19229E+01	0.15145E-03	-0.25925E-01	0.77051E+00	0.80000E+0.1	0.16627E+00	171
14	0.017	0.19229E+01	0.15145E-03	-0.25925E-01	0.77051E+00	0.80000E+0.1	0.16627E+00	171
15	0.017	0.19229E+01	0.15145E-03	-0.25925E-01	0.77051E+00	0.80000E+0.1	0.16627E+00	171
16	0.017	0.19229E+01	0.15145E-03	-0.25925E-01	0.77051E+00	0.80000E+0.1	0.16627E+00	171
17	0.017	0.19229E+01	0.15145E-03	-0.25925E-01	0.77051E+00	0.80000E+0.1	0.16627E+00	171
18	0.017	0.19229E+01	0.15145E-03	-0.25925E-01	0.77051E+00	0.80000E+0.1	0.16627E+00	171
19	0.017	0.19229E+01	0.15145E-03	-0.25925E-01	0.77051E+00	0.80000E+0.1	0.16627E+00	171
20	0.017	0.19229E+01	0.15145E-03	-0.25925E-01	0.77051E+00	0.80000E+0.1	0.16627E+00	171
21	0.003	0.19758E+01	0.15989E-03	-0.28081E-01	0.76812E+00	0.80000E+0.1	0.17304E+00	176
22	0.003	0.19758E+01	0.15989E-03	-0.28081E-01	0.76812E+00	0.80000E+0.1	0.17304E+00	176
23	0.003	0.19758E+01	0.15989E-03	-0.28081E-01	0.76812E+00	0.80000E+0.1	0.17304E+00	176
24	0.003	0.19758E+01	0.15989E-03	-0.28081E-01	0.76812E+00	0.80000E+0.1	0.17304E+00	176
25	0.003	0.19758E+01	0.15989E-03	-0.28081E-01	0.76812E+00	0.80000E+0.1	0.17304E+00	176
26	0.003	0.19758E+01	0.15989E-03	-0.28081E-01	0.76812E+00	0.80000E+0.1	0.17304E+00	176
27	0.003	0.19758E+01	0.15989E-03	-0.28081E-01	0.76812E+00	0.80000E+0.1	0.17304E+00	176
28	0.003	0.19758E+01	0.15989E-03	-0.28081E-01	0.76812E+00	0.80000E+0.1	0.17304E+00	176
29	0.003	0.19758E+01	0.15989E-03	-0.28081E-01	0.76812E+00	0.80000E+0.1	0.17304E+00	176
30	0.003	0.19758E+01	0.15989E-03	-0.28081E-01	0.76812E+00	0.80000E+0.1	0.17304E+00	176
31	0.003	0.20082E+01	0.15290E-03	-0.29771E-01	0.77912E+00	0.80000E+0.1	0.16173E+00	193
32	0.003	0.20082E+01	0.15290E-03	-0.29771E-01	0.77912E+00	0.80000E+0.1	0.16173E+00	193
33	0.003	0.20082E+01	0.15290E-03	-0.29771E-01	0.77912E+00	0.80000E+0.1	0.16173E+00	193
34	0.003	0.20082E+01	0.15290E-03	-0.29771E-01	0.77912E+00	0.80000E+0.1	0.16173E+00	193
35	0.003	0.20082E+01	0.15290E-03	-0.29771E-01	0.77912E+00	0.80000E+0.1	0.16173E+00	193
36	0.003	0.20082E+01	0.15290E-03	-0.29771E-01	0.77912E+00	0.80000E+0.1	0.16173E+00	193
37	0.003	0.20082E+01	0.15290E-03	-0.29771E-01	0.77912E+00	0.80000E+0.1	0.16173E+00	193
38	0.003	0.20082E+01	0.15290E-03	-0.29771E-01	0.77912E+00	0.80000E+0.1	0.16173E+00	193
39	0.003	0.20082E+01	0.15290E-03	-0.29771E-01	0.77912E+00	0.80000E+0.1	0.16173E+00	193
40	0.003	0.20082E+01	0.15290E-03	-0.29771E-01	0.77912E+00	0.80000E+0.1	0.16173E+00	193
41	0.005	0.20006E+01	0.15065E-03	-0.29714E-01	0.77953E+00	0.80000E+0.1	0.12494E+00	216
42	0.005	0.20006E+01	0.15065E-03	-0.29714E-01	0.77953E+00	0.80000E+0.1	0.12494E+00	216
43	0.005	0.20006E+01	0.15065E-03	-0.29714E-01	0.77953E+00	0.80000E+0.1	0.12494E+00	216
44	0.005	0.20006E+01	0.15065E-03	-0.29714E-01	0.77953E+00	0.80000E+0.1	0.12494E+00	216
45	0.005	0.20006E+01	0.15065E-03	-0.29714E-01	0.77953E+00	0.80000E+0.1	0.12494E+00	216
46	0.005	0.20006E+01	0.15065E-03	-0.29714E-01	0.77953E+00	0.80000E+0.1	0.12494E+00	216
47	0.005	0.20006E+01	0.15065E-03	-0.29714E-01	0.77953E+00	0.80000E+0.1	0.12494E+00	216
48	0.005	0.20006E+01	0.15065E-03	-0.29714E-01	0.77953E+00	0.80000E+0.1	0.12494E+00	216
49	0.005	0.20006E+01	0.15065E-03	-0.29714E-01	0.77953E+00	0.80000E+0.1	0.12494E+00	216
50	0.005	0.20006E+01	0.15065E-03	-0.29714E-01	0.77953E+00	0.80000E+0.1	0.12494E+00	216
51	0.009	0.19802E+01	0.15018E-03	-0.29367E-01	0.83518E+00	0.80000E+0.1	0.14662E+00	216
52	0.009	0.19802E+01	0.15018E-03	-0.29367E-01	0.83518E+00	0.80000E+0.1	0.14662E+00	216
53	0.009	0.19802E+01	0.15018E-03	-0.29367E-01	0.83518E+00	0.80000E+0.1	0.14662E+00	216
54	0.009	0.19802E+01	0.15018E-03	-0.29367E-01	0.83518E+00	0.80000E+0.1	0.14662E+00	216
55	0.009	0.19802E+01	0.15018E-03	-0.29367E-01	0.83518E+00	0.80000E+0.1	0.14662E+00	216
56	0.009	0.19802E+01	0.15018E-03	-0.29367E-01	0.83518E+00	0.80000E+0.1	0.14662E+00	216
57	0.009	0.19802E+01	0.15018E-03	-0.29367E-01	0.83518E+00	0.80000E+0.1	0.14662E+00	216
58	0.009	0.19802E+01	0.15018E-03	-0.29367E-01	0.83518E+00	0.80000E+0.1	0.14662E+00	216
59	0.009	0.19802E+01	0.15018E-03	-0.29367E-01	0.83518E+00	0.80000E+0.1	0.14662E+00	216

60	0.009	0.19802E+01	0.15018E-03	-0.29367E-01	0.83518E+00	0.80000E+0.1	0.14662E+00	216
61	0.012	0.20122E+01	0.14863E-03	-0.32242E-01	0.61298E+00	0.80000E+0.1	0.13381E+00	215
62	0.012	0.20122E+01	0.14863E-03	-0.32242E-01	0.61298E+00	0.80000E+0.1	0.13381E+00	215
63	0.012	0.20122E+01	0.14863E-03	-0.32242E-01	0.61298E+00	0.80000E+0.1	0.13381E+00	215
64	0.012	0.20122E+01	0.14863E-03	-0.32242E-01	0.61298E+00	0.80000E+0.1	0.13381E+00	215
65	0.012	0.20122E+01	0.14863E-03	-0.32242E-01	0.61298E+00	0.80000E+0.1	0.13381E+00	215
66	0.012	0.20122E+01	0.14863E-03	-0.32242E-01	0.61298E+00	0.80000E+0.1	0.13381E+00	215
67	0.012	0.20122E+01	0.14863E-03	-0.32242E-01	0.61298E+00	0.80000E+0.1	0.13381E+00	215
68	0.012	0.20122E+01	0.14863E-03	-0.32242E-01	0.61298E+00	0.80000E+0.1	0.13381E+00	215
69	0.012	0.20122E+01	0.14863E-03	-0.32242E-01	0.61298E+00	0.80000E+0.1	0.13381E+00	215
70	0.012	0.20122E+01	0.14863E-03	-0.32242E-01	0.61298E+00	0.80000E+0.1	0.13381E+00	215
71	0.009	0.20073E+01	0.15264E-03	-0.31517E-01	0.60574E+00	0.80000E+0.1	0.16352E+00	130
72	0.009	0.20073E+01	0.15264E-03	-0.31517E-01	0.60574E+00	0.80000E+0.1	0.16352E+00	130
73	0.009	0.20073E+01	0.15264E-03	-0.31517E-01	0.60574E+00	0.80000E+0.1	0.16352E+00	130
74	0.009	0.20073E+01	0.15264E-03	-0.31517E-01	0.60574E+00	0.80000E+0.1	0.16352E+00	130
75	0.009	0.20073E+01	0.15264E-03	-0.31517E-01	0.60574E+00	0.80000E+0.1	0.16352E+00	130
76	0.009	0.20073E+01	0.15264E-03	-0.31517E-01	0.60574E+00	0.80000E+0.1	0.16352E+00	130
77	0.009	0.20073E+01	0.15264E-03	-0.31517E-01	0.60574E+00	0.80000E+0.1	0.16352E+00	130
78	0.009	0.20073E+01	0.15264E-03	-0.31517E-01	0.60574E+00	0.80000E+0.1	0.16352E+00	130
79	0.009	0.20073E+01	0.15264E-03	-0.31517E-01	0.60574E+00	0.80000E+0.1	0.16352E+00	130
80	0.009	0.20073E+01	0.15264E-03	-0.31517E-01	0.60574E+00	0.80000E+0.1	0.16352E+00	130

DQ Evaluation of Franklin Cruise 9306 (WOCE line P11S)

A. Mantyla

This report is an assessment of the hydrographic data on RV Franklin Cruise 9306 along roughly 155E from southeast Papua, New Guinea, across the eastern Coral Sea Basin, and down the length of the Tasman Sea, ending up near Tasmania. This is a very useful transect, as there is little high quality historical data available from the region. The cruise crossed WOCE lines P21, P06, P11, and both SCORPIO transects, which offers a few cruise to cruise data comparisons.

I could not find any DOC files in the WHPO files, a cruise report from the Chief Scientist is needed so that a record of methods and equipment used is available. The Standard Seawater batch number should also be a permanent part of the record.

A 24 place rosette system was used instead of the 36 sampling levels preferred by WOCE protocols; and only about a quarter of the stations successfully sampled 24 different depths. Apparently there were numerous rosette trip malfunctions as indicated by large vertical data gaps with associated missing sample numbers. Use of a 36 place system might have made the data loss less severe, and it would have been useful to leave in the CTD p, t, and s information at the intended sampling depths.

There were few data flags, but considerable missing data. The data from this cruise has clearly been carefully scrutinized as evidenced by the large amount of data that has been deleted, including 14 CTD temperatures! This is the first WOCE cruise that I have seen with any temperature data missing. It is especially puzzling in light of the CTD salinities being ok (when listed), because that calculation requires a good temperature. Temperature is also needed to locate a water sample in density space, which is as important as the geographical coordinates and pressure (or depth). I recommend the temperatures be restored to the following:

sta. 10, 1772db
sta. 12, 249db
sta. 41, 4745db
sta. 43, 1590db and 2998db
sta. 47, 2200db
sta. 48, 1793db
sta. 52, 2599db and 4820db
sta. 55, 401db and 600db
sta. 61, 4657db
sta. 65, 3801db
sta. 72, 201db

Even a slightly noisy temperature is likely to be more useful than an interpolated or extrapolated value.

There were no CTD oxygen data reported on this cruise and the CTD temperatures and salinities were reported to one less decimal place than the WOCE guidelines specify.

The water sample salinity data were ok, but not quite up to WOCE standards as indicated by the multiple trips on station 1 (n=20, S.D.=.003) and on station 8 (n=23, S.D.=.002), as well as by some deep water salinity scatter. It appears as if an older single conductivity ratio salinometer may have been used rather than the more sensitive double conductivity ratio salinometer.

Oxygen data were missing entirely from stations 13 and 28, but otherwise appeared to be ok, comparable to P6W and better than P21.

The biggest uncertainty in this cruise data set is in the nutrients, particularly for phosphate and nitrate. Both are higher than the other 3 WOCE cruise crossings; and the variable NO3/PO4 slopes. Often either the PO4 or the NO3 profiles would shift independently of the other. See for example station 27, 31, and 37. All had a PO4 intercept near 2. PO4 at zero NO3, but the high ends were quite different with different NO3/PO4 slopes (16.7, 13.9, and 15.9 respectively). Silicate also showed some unlikely station to station shifts; so this nutrient data set appears to have fallen short of the WOCE nutrient accuracy goals.

The following are remarks on some specific problems that should be looked into and corrected, if possible:

Sta. 16, 995-1392db - 3 O2's were flagged uncertain because they appear to have been listed one depth too deep (793 and 995db O2's are essentially the same), compared to the adjacent station profiles. I suspect a sample drawing error. Are there any CTD O2 probe data to verify the correct location for these samples?

Sta. 21, 792db - Nutrients are listed for this depth, but not salinity or oxygen. The next depth lists salinity and oxygen, but no nutrients. From the adjacent profiles, the nutrients appear to belong with the T and S one depth deeper and would be ok there. As listed, there are flagged uncertain. Could this be a data tabulation error?

Sta. 43 - Two bottle trips are listed at 3598db, but the two temperatures differ by .045 deg at the same pressure, an unlikely difference at this depth. Could bottle 3 (and 2) be from deeper pressures? No data is shown for a 1000db interval, the colder temperature looks like it came from a deeper level.

Sta. 51, 2798 and 3003db - No temperature is reported at 2599db and those at 2798 and 3003db appear to be one depth too deep. Check the original data to see if the two depths belong one depth shallower.

The following stations have lines with no data at all, not even CTD pressure. These lines should be deleted:

Sta. 7, sample 24
Sta. 55, sample 24
Sta. 75, sample 24 23, 22, 21, and 20
Sta. 78, sample 13 and 12
Sta. 79, sample 8 and 7