National Facility Research Vessel

RV FRANKLIN

VOYAGE DOCUMENTS

RV SOUTHERN SURVEYOR

CSIRO AUSTRALIA

CSIRO MARINE AND ATMOSPHERIC RESEARCH

Voyage Plans and Summaries

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Franklin Voyage Summary No. FR07/2000

Title

Tidal Mixing and the Seasonal Cycle of the Leeuwin Current.

Itinerary

Depart Broome 0800 hrs, Friday 11th August 2000
Arrive Darwin 0800 hrs, Friday 18th August 2000

Principal Investigators

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*denotes a Principal Investigator not present on the cruise.

Scientific Objectives

The objectives of the study will be:

1) To estimate temperatures and currents (both directly and via geostrophy) over a year, within a closed region from Darwin to the southern North West Shelf, with a view to

(a) testing the closure of mass and heat budgets;

(b) documenting the "Rochford Current", observed in 1962 by Mr. David Rochford as a tongue of high-nutrient water intruding from the Arafura Sea towards the Gulf of Carpentaria, in winter.

2) To examine the probable role of tidal mixing in forming the 50-100m deep internal mixed layers observed in XBT traces near the continental shelf edge, off Darwin; in converting cool inflow to warmer outflow; in removing SST minima contrasts during the summer upwelling regime; and in surveying the predicted regions of intense internal tides.

3) To measure ocean skin temperature, for validating the new Terra satellite.

The scientific background is described in more detail in Godfrey and Mansbridge (JGR, in press).

Cruise Objectives

To recover nine moorings deployed in July 1999. These should have data on currents and temperatures, from which we should be able to analyse the amount of heat exported out of the region by tidal mixing over a year; indications of the relative roles of tidal mixing and wind-driven upwelling; and relate longshore currents in this region to the better-known Leeuwin Current system, further southwest. In addition we will undertake CTD stations opposite each mooring, mostly to calibrate the temperature and salinity recorders on the moorings. As time permits, we will undertake further CTD's to explore flow and hydrographic features in the Arafura Sea.

Cruise Track

See Figure 1.

Results

We recovered eight of the nine moorings. There was, as anticipated, considerable fouling, but it was not as bad as it might have been due to the use of antifouling paint on the instruments. We will not know the quality of the data until the instruments have been read; the readers, being delicate instruments, were not brought on the cruise. The one mooring not recovered unfortunately represents a major part of the ADFA equipment resource.

The time available for performing CTD studies were minimal; however:

- we obtained ADCP and (CTD or XBT) data opposite each mooring while the instruments were in place, permitting tests of all quantities except the tide gauges
- we noted a salinity front along the shelf edge that extends ESE from Ashmore Reef towards the Australian mainland - this implies a weak permanent near-surface current
- we confirmed the deep mixed layer in the Lambert Valley and the "Rochford Current", found by Cresswell and Quadfasel on their deployment cruise (FR5/99).

Cruise Narrative

NB: Times in the narrative are in local time; subtract 8 hrs for UTC, until 14/08/2000.

11/8/00

We were concerned that we might have to drag for moorings, so we arranged to leave Broome at 0800 instead of 1000 on 11th August. Clear, sunny conditions; some haze from bushfires. Standard oceanographic sensors were set up and logged, including the topmast pyranometer and pyrgeometer and the Barton radiometer, on the starboard bridge wing. Made good speed (about 12knots), so in combination with the earlier departure we arrived at the 1st waypoint (the AIMS mooring, at 14° 37.6'S, 122° 21.4'E) at 0300 12th, local time.

12/8/00

First tested that the old mooring was in place, then put the new mooring 1.5 km northeast, in the same water depth (180m) as the old. The CTD was not yet working, due to problems with software; hence we deployed an XBT instead, to get data for checking the current meter temperatures. Finally, at first light

(0630 local time) we released the old mooring. It appeared about 200m from the ship and was recovered with no difficulty by 0800 local time. Fouling of meters did not appear as serious as we had feared, though later we found that the rotors of the upper Anderaas on mooring 3 (above about 100m) were snagged.

We then set course for the northeast end of Scott Reef (13°56'S, 121°57'E) where our second mooring had been placed; we arrived at 1130. We undertook a cross pattern centred on the mooring location, to give details of local topography for Scott Noreika. After lunch we again dropped an XBT, and released the mooring. This mooring was also recovered with no difficulty, with minor fouling problems. We left for Mooring 3 location (near Ashmore Reef; 12° 16.775'E, 122°50.161'E) . Efforts to get the CTD working were not successful , so the planned test CTD station to 1000m near 12°S, 122°25'E had to be abandoned. We performed a 3rd XBT instead.

Weather continued mild and sunny, with red skies at night, apparently from smoke.

13/8/00

We arrived at Mooring 3 location at 0600. After launching a 4th XBT, we released the mooring at 0630. It appeared within 100m of the ship. This mooring took more time to recover, due to the fact that the 200m thermistor chain had to be cut from the wire. Once again, fouling did not appear very severe, though one Anderaa meter was definitely stopped by fouling, and a second slowed. After completion, we proceeded to Mooring 4, at 13°S, 123° 42'E, launching 3 more XBTs along the way.

On arrival at Mooring 4 (Holloway mooring, 12°59.889'S, 123°41.935'E), we undertook the first CTD after having reverted to older software, compatible with the Mark 3 CTD. We took 4 bottle samples; at 10m from bottom (230m), 160m, 100m and 5m below the surface. From then on we generally took 4 bottle samples in water deeper than 140m and 2 bottles in shallower water.

On searching for the mooring, we heard no response to the deck unit. After trying for about an hour, we performed a search pattern over the mooring location, crossing within 60m of it about 5 times; it was felt that the lower steel ball on the mooring should show up clearly over a swath width of about 60 meters. After some hours of this, it was decided to drag for it till nightfall. This again did not yield results, though we hooked an object that was so heavy the ship stopped and briefly went backwards. The Master thought this was much too heavy to be the mooring.

After dark, we looked with the deck unit over a wider area by deploying it at the corners of a square 10 miles to a side and back in the centre. Again, no response was heard. It was decided that we could afford to stay till dawn, because we would catch up with the schedule by Mooring 6 if we used the pre-

dawn waiting times allowed for in the original Plan.

14/8/00:

(Clocks advanced 0.5 hours).

At dawn, we again trawled for the mooring at its original location; we again had no result. Therefore we abandoned the search at 0800, and continued towards Mooring 5. We undertook two CTDs on the way, in depths of 200m and 150m. The CTD and thermosalinograph showed a salinity front, with fresh water over the shelf; geostrophic calculations indicate a weak current carrying this water eastward, to the inner shelf.

Mooring 5 (in 128m, at 13°24.797'S, 124°29.997'E) came up cleanly, though we needed to set off the second release before it came clear. Substantial fouling was evident at most instruments, mid-depths being least affected. After completion of this release, we continued to Mooring 6 on the middle of the wide region of shallow shelf.

Balloons launched, 11.00, 2240 .

15/8/00:

(Clocks advanced 1 hr, to be on Darwin time).

We arrived at Mooring 6 (73m, at 11°23.050'S, 126°36.674'E) at about 1000 local time and took a CTD there. Prior to that, we undertook 3 shallow CTDs and crossed the Lambert Valley, again encountering the 250m deep hole explored by Cresswell and Quadfasel in the deployment cruise. It was not quite as well-mixed as they found it, however oxygen decreased only slightly from top to bottom, suggesting rapid water turnover. It was found that the thermosalinograph had a very large offset (reading about 0.8 psu low). It was tolerated to start with, since it was thought to be constant.

Mooring 6 responded but did not release. A fairly accurate position was obtained for it by ranging, and trawling commenced; the complete mooring surfaced after two tries, without serious damage (the hook caught it near the anchor). We then continued towards the 3 moorings north of Darwin. It was noticed that the CTD usually read substantially (0.3 psu) lower on first deployment than 2 minutes later; the problem was not understood, but an empirical "fix""of leaving it just below the surface for 2 minutes before lowering the CTD seemed to generate satisfactory results.

Balloons launched, 1012, 2200 .

16/8/00:

Two more CTDs were undertaken en route to the innermost (61m) Mooring 9, at (10°31.882'S, 129°49.892'E), the innermost of the "Darwin" line. On arrival, we confirmed that the mooring was responding; we then continued northwards to release the moorings with the most valuable equipment first. On the way north we undertook CTDs at 60m, 100m, 180m and 300m, the last two opposite the remaining moorings (10°00.913'S, 130°12.117'E; and 9°42.342'S, 130°11.924'E). Both the outer moorings released without trouble. Fouling patterns were as before, with worst effects in the top 100m and near the bottom. On completion of these releases, we had enough time to undertake 3 traverses of the slope region between 100m and 300m depth, i.e. three traverses of the Rochford Current. These occurred at the same locations as on the first traverse. The Current was clearly evident in the CTD traces and in the ADCP, flowing northeastward at about 0.3 m/s between 100 and 150m. Analysis of CTD compared to the thermosalinograph salinity showed the drift to vary quite erratically.

Balloon launched, 2300 .

17/8/00 and 18/8/00:

The three sections mentioned above were completed at 0530 local time; we then proceeded to the location of the 60m mooring, reaching there at 0815. It released immediately, and was quickly on board (with spectacular fouling). Consequently we had enough time to do one more section to the shelf edge - this time further west, in the neighbourhood of Evans Shoal, 9°55'S, 129°31'E. We took an XBT near 150m depth, then two CTDs. Once again the Rochford Current was clearly evident in the ADCP data. We then turned towards Darwin, docking at 0800hrs at high tide.

Balloon launched, 1030 .

Summary

This cruise was designed primarily to recover moorings deployed a year previously on Fr5/99. It has been reasonably successful in this regard, having recovered 8 of the 9 moorings; unfortunately the exception is the ADFA mooring, which deprives the ADFA Geography Department of a major part of their equipment pool. The fouling of instruments was not quite as severe as expected, but nevetheless serious. An assessment should be made once the instruments have been read, on what the optimum deployment time should be in this region, as a function of instrument depth and broad location.

The cruise turned out to be quite short-staffed, placing pressure on the electronics and computing personnel, who had to participate in most CTDs; it would have been seriously inadequate for a longer cruise.

Despite these problems, the mooring data set certainly represents a very large increase in information available for studying this little-researched region. In

view of the increasing strategic importance of the region to Australia, it seems fair to say that the data will prove to be well worth the considerable effort spent in obtaining it.

Aside from the mooring data (and in spite of problems with the thermosalinograph and CTD referred to above) the cruise confirmed the wintertime presence of the "Rochford Current", and found evidence of a salinity front (with associated weak current to ESE) along the section of shelf ESE of Ashmore Reef. The Chief Scientist (SG) is looking forward to being able to analyse the total data set from FR5/99 and FR7/00, to learn what he can of the role of tidal mixing in the dynamics of the region.

Personnel

Stuart Godfrey	Chief Scientist, CSIRO Marine Research
Andreas Welsch	Hamburg
Scott Norieka	WNI
Kevin Miller	CMR Moorings
Dan McLaughlan	CMR Moorings
Phil Adams	CMR Electronics
Dave Terhell	CMR Hydrochemistry
Helen Beggs	CMR Computing
Ken Suber	CMR
Ian Taylor	Master
Arthur Staron	1st Officer
John Boyse	2nd Officer
Ian Murray	Chief Engineer
Rob Cave	1st Engineer
Hugh McCormick	Electrical Engineer
Phil French	Greaser
Bill Hughes	Bosun
Tony Hearne	A/B
Terry Ganim	A/B
Norm Irvine	A/B
Ron Culliney	Chief Steward
Garry Hall	Chief Cook
Wayne Hatton	2nd Cook

Acknowledgements

I have thoroughly enjoyed this cruise; it is the first time I have seen serious mooring operations in action. I have been impressed both with the efforts of the ship's complement and of the mooring group (Dan McLaughlan, Kevin Miller, Scott Noreika and Andreas Welsch). It has made me particularly appreciative of the fine arts of driving ships and winches and of the work

involved in mooring preparation. Thanks also to Helen Beggs, Phil Adams and Dave Terhell for handling more CTDs than they are usually asked to do and for dealing patiently with one of your slower 30-year veterans of oceanography. Thanks also to the cooks and steward for maintaining the continued high living standards that we enjoy on Franklin.

Stuart Godfrey
Chief Scientist.

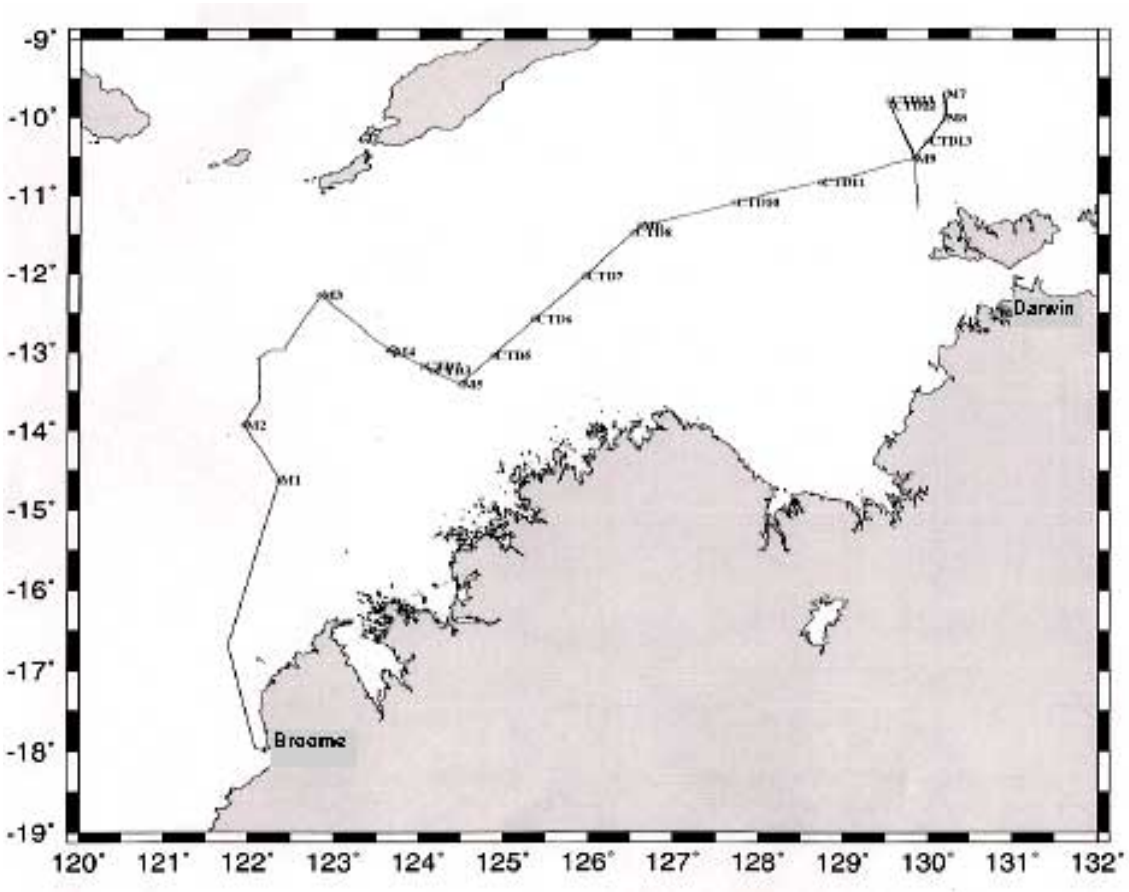

Figure 1. Cruise Track FR07/2000

Updated: 31/01/03