

## VOYAGE SUMMARY SS06/2003

### Title

International Nusantara Stratification And Transport program.

### Itinerary

Depart Darwin 1100 hrs, Tuesday, 5 August, 2003  
Arrive Dampier 1100hrs, Saturday, 16 August, 2003.

### Principal Investigator(s)

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### Scientific Objectives

The aim of INSTANT is to directly measure the leakage of Pacific thermocline and intermediate waters from the western equatorial Pacific into the South Indian Ocean. The Indonesian Passages represent an important 'choke point' of the global ocean overturning circulation and the climate system. The size and depth distribution of the flow through this choke point remains a troublesome unknown, with currently available observations giving ranges from 0-20Sv, thus giving little guide to model results and introducing large uncertainties into ocean-based heat, freshwater, nutrient and carbon budgets of the South Pacific and Indian Oceans. The deep portion of the flow, in particular, is poorly known and can only be measured by long term in situ instruments. INSTANT will deliver 3 years of in situ velocity, temperature and salinity data from the sea-floor to the surface in the major inflow and outflow straits that make up the Indonesian choke point. The array is designed to measure the mass, heat and freshwater transports that flow into and out of the Indonesian Seas. Five nations will participate in INSTANT: Indonesia, France, the Netherlands, the USA and Australia. By far the major share of INSTANT will be carried out by the USA and Australia, with the bulk of the work subcontracted to CSIRO Marine and Atmospheric Research by Lamont Doherty Earth Observatory, Palisades, NY. The Indonesian Ministry of Marine and Fisheries is sponsoring the Indonesian involvement.

### Voyage Objectives

- To deploy one of the moorings comprising the INSTANT array in the waters of East Timor in Ombai Strait
- To deploy two of the INSTANT shallow pressure gauges (SPGA): one on the north coast of East Timor and one off Ashmore Reef in Australian waters.
- To collect highly-spatially resolved property and velocity sections across Timor Strait

**Summary:**

The voyage objectives were achieved safely and on time, in pleasant, though sometimes high-current conditions. The INSTANT mooring was deployed in an excellent location and without incident. Two shallow pressure gauges were deployed by our Scripps colleagues with success, and a five year old instrument was recovered and found to be in good condition — we have high hopes for the data it contained. Our first use of the Lowered Acoustic Doppler Profiler from the Southern Surveyor went very well, and we have collected a fascinating series of hydrographic and velocity profiles from the Ombai and Timor Strait. The data retrieved from the CTD system looks excellent.

**Voyage Narrative**

All times are local.

**August 5, 2003**

RV Southern Surveyor (SS) left Darwin around 1100 and steamed towards the test station location in the center of the Timor Trench opposite the eastern tip of Timor. Science crew underwent induction with First Mate. We had a briefing from the Master and on the science plan.

The mooring gear was set up in the fish lab for checkout and initialization.

The Lowered Acoustic Doppler Current Profiler (LADCP) acquisition PC set up opposite wet lab bulkhead door. LADCP was cabled together and tested. Once a power supply to a converter plug was connected, we were able to successfully communicate with instrument.

Preparation for test cast began: the CTD frame was put together, conducting wire re-terminated, bottles and LADCP began to be installed. Underway logging systems were put on line.

**August 6, 2003**

Arrived at the test cast around 1030 in 3200m of water. Acquisition software came up well. The tension reading on the winch was not working, and the altimeter did not work. We came to within 160m of the bottom, when the primary conductivity channel showed large spikes and offsets. Without the altimeter, we were conservative, we stopped lowering, began the upcast and fired all bottles at a depth where the salts looked stable ~2500db. Rest of the cast went OK.

On deck, we discovered the package had not hit the bottom, but the primary conductivity cell was cracked. It was replaced. Secondary cell looked fine. LADCP data confirmed we were 160m off the bottom.

The pylon had malfunctioned and none of the bottles had fired properly. No water samples were taken.

We steamed on to the mooring site in Ombai Strait.

Conditions: Sunny, calm and no swell — gorgeous! Wind picks up from the east in the afternoons near the coast.

### August 7, 2003: Setting up for Mooring Deployment

CTD 002: Electronics check.

CTD 003: Performed at mooring site: a shallow 50m cast to check pylon function. The problem appeared fixed.

North of Timor, we began logging ADCP surface velocities to help determine the phase of the tidal cycle. As we approached the nominal mooring site, we began a bathymetric survey sweep, and logged currents. As the day progressed the currents built from 0.9m/s SW to 2.0 m/s W and we decided not to attempt a mooring deployment in such extreme conditions.

Using information sent from Robert Molcard, LODYC, and with the current information we had collected, we were able to determine that slack tide would be around 0700 on August 8. We aimed to begin the mooring deployment early the next day.

We conducted CTD/LADCP stations between the mooring site and the coastal sea level gauge site, as well as performed two underway transects between these sites. CTD 004-7.

### August 8, 2003. Mooring Deployment

Mooring layout began around 0800 in calm, still conditions. Ship was about 5NM up stream of the target position in case the layout was held up, giving us sea room to drift down on the site. However, the layout went smoothly and took about 3 hours in total a great job by the mooring engineers and ships crew. Rather than deploy in water a little too deep, we decided to drift back to the target position for a few hours. The underway ADCP and GPS attitude array kept going off line during the mooring layout which made estimating drift a bit difficult. Conditions were very calm and there was little shipping, making this possible and safe.

The mooring anchor was dropped at 1503 in calm seas. The drogue used to slow the anchor fall rate opened successfully. We observed the top floats run down towards the ship, taking until 1535 to disappear, indicating a fall rate of about 1.6m/s as predicted. After about 20 minutes, Kevin and Lindsay used the transponder to communicate with the releases successfully.

To utilize the daylight, we steamed into the coastal pressure gauge site to locate the likely position using photos from past installations. We then steamed back to the mooring position to range in the mooring position more precisely. Figure 1 and Table 1, show the mooring locations. We were happy with the final location, as the further west in the strait, the further the mooring is away from the region where the flow is experiencing strong cyclostrophic forces as it changes direction from southward to westward.

What	Latitude	Longitude	Depth (m)
Anchor release	8° 31.62'S	125° 4.72'E	
Position of last sighting	8° 32.31'S	125° 3.11'E	
Ranged in mooring position	8° 32.00'S	125° 3.86'E	3224

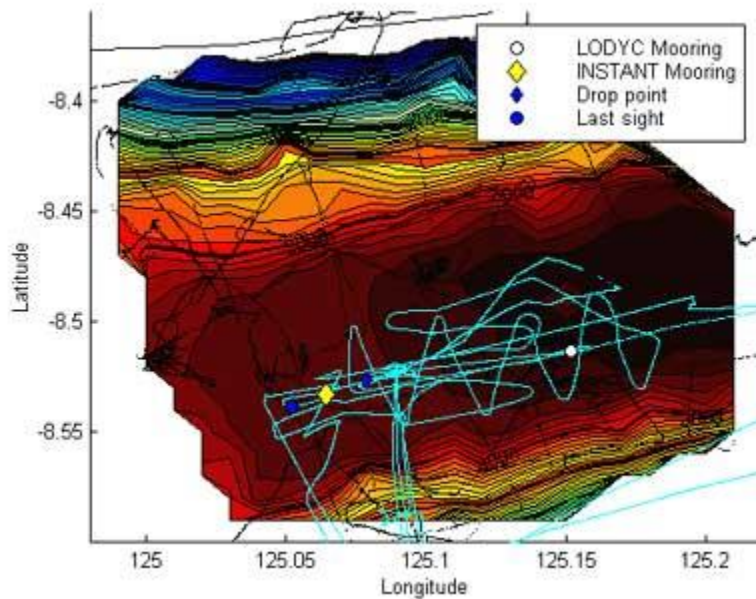
**Table 1:** Positions associated with mooring deployment.

We then completed CTD008-010 down the strait axis east of the mooring site through the following night.

### August 9, 2003: Shallow Pressure Gauge Installation

The ship was at the pressure gauge position at 0800 in lovely calm conditions with no wind. Timor Island has no shelf or coastal plains to speak of, and the land slopes steeply into the ocean and continues down to a 3000m depth. We were a few cables from the beach in several hundred meters of water.

The workboat was launched and the divers, Janet Sprintall and Paul Harvey from Scripps Institution of Oceanography, took the frame for the new gauge and snorkeling gear to the site of the old anchor. In the boat were two marine crew and Celestino da Cunha Barreto, our East Timorese observer.



**Figure 1:** Bathymetry in Ombai Strait based on data collected by Robert Molcard in 1995 (black), and SS (cyan). The green square shows the final mooring position, the blue diamond, the drop point and the blue circle the position the last flow went under. The 'fall back' from the drop point is about 1.7km, indicating currents of 0.8m/s, in agreement with those observed at the surface. Depth is contoured every 100m with every 200m bolded.

They found the old anchor within an hour. They then chose a site for the new gauge, and installed the new anchor frame. After marking these with floats, they returned to the vessel for the weights. On the second trip they installed the weights, took accurate GPS positions. Then they managed to recover a gauge that had been installed in 1995 and was not recovered due to the unrest associated with the Timor Independence vote. This gauge, when opened later, proved to be in perfect condition, giving us hopes that the data will still be available!

Conditions remained calm and sunny — perfect for the work. Dolphins, turtles and possibly marlin were seen. The flow was roiling and eddying in the strong Indonesian Throughflow currents.

After recovery of the workboat, we then began steaming east to round the eastern end of Timor and back west into Timor Strait. The crew and other rugby fans rushed down to the mess to watch a match coming in from Dili.

A tension test was performed on the tension controller on the CTD winch. The tension controller was not functioning properly, confirming what the seamen had reported. A temporary workaround was decided upon, but this problem needs to be fixed as soon as possible to avoid over tensioning the wire and losing the entire CTD/LADCP package. As the termination epoxy hadn't cured yet we moved over to the second CTD winch drum.

#### **August 10, 2003: CTD/LADCP Section across Timor Strait**

We arrived at our first station location in ~100m depth at 1130. Conditions continue to be clear, calm and still. The south coast of Timor is lush and green compared to the north side which was experiencing its dry season.

During the 3rd station along the transect, the wire began to crossover on the drum. We had to stop the upcast for 3 hours while the ships engineers and Lindsay Pender worked on the winch. The bottom chased us for a while but all was well and the cast finished normally.

The rest of the section proceeded without incident. The LADCP seems to be working well and collecting good data.

#### **August 11, 2003: CTD/LADCP Section across Timor Strait**

We continued the Timor CTD/LADCP section, finishing around 1500. Having some extra time up our sleeves we ran down the section again to do extra stations along the Timor slope part of the section. Weather and conditions remain very calm. Janet and Celestino saw two large whales in the distance today.

#### **August 12, 2003**

Steamed to Ashmore Reef. Catching up on sleep and processing the LADCP data sets. CTD calibration underway. Autoanalyser still misbehaving.

#### **August 13, 2003**

SS arrived at Ashmore at dawn and anchored about 2.5 NM off the reef. To our surprise, it was quite a busy place with at least 5 yachts, a tall ship, a Navy patrol boat and the permanent Australian Customs boats were moored in the lagoon. At 0840 the ships' boat left with Janet Sprintall, Paul Harvey and Ann Gronell to locate the old anchor and install the new anchor frame and gauge. They first checked in with the Customs boat. At 1125 they returned to the ship. On the second trip after lunch, the weights were installed in strong currents and poor visibility. RV Southern Surveyor left Ashmore at 1600 to return to Dampier

#### **August 14, 2003**

Steaming to Dampier. In preparation for the next voyage, the tow wire was spooled out in deep water and wound back on to test the spooling gear (jury rigged as the spooler is broken). Mark Rayner found the last remaining problem with commissioning the autoanalyser — a leak in the phosphate channel in the heating coil. Now the nutrient samples collected during this voyage can be processed.

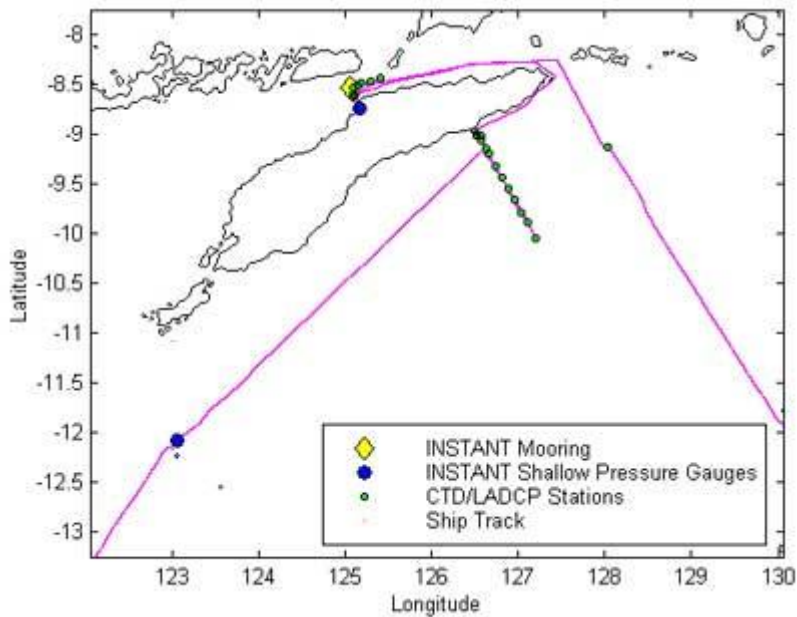
#### **August 15, 2003**

Steaming to Dampier. Autoanalyser not working again. Packing and writing reports.

#### **August 16, 2003**

Arrived in Dampier at 1100.

## Voyage Track



## Ships' Crew

Murray Doyle – Master  
Roger Pepper – Chief Officer  
John Boyes – Second Officer  
John Morten – Chief Engineer  
David Jonker – First Engineer  
John Hinchliffe – Electrical Engineer  
Malcolm McDougall – Bosun  
Graham McDougall – IR  
Tony Hearne – IR  
Manfred Germann – IR  
Laurence Murray – Greaser  
David Willcox – Chief Steward  
Peter Williams – Chief Cook  
Andy Goss – Second Cook

## Science Crew

Susan Wijffels – Chief Scientist (CSIRO)  
Janet Sprintall – Co-investigator (Scripps Institution of Oceanography)  
Paul Harvey – Mooring engineer (Scripps Institution of Oceanography)  
Kevin Miller – Mooring Engineer (CSIRO)  
Lindsay Pender – Mooring Engineer (CSIRO)  
Bernadette Heaney – Computer (RV)  
Jeff Cordell – Electronics (RV)  
Kate Berry – Hydrochemistry (RV)  
Mark Rayner – Hydrochemistry (RV)  
Peter Mantel – CTD watch-stander (CSIRO)  
Helen Phillips – CTD watch-stander (CSIRO)  
Ann Thresher – CTD watch-stander (CSIRO)  
Celestino da Cunha Barreto – Observer, East Timor Ministry of Agriculture, Forestry and Fisheries.

**Acknowledgements**

Thanks to the master and crew of the RV Southern Surveyor for their cooperation and hard work during the voyage. We particularly thank the ships' engineers for their work on the ships' winches, and the bosun and IR's for their excellent work in the small boat and during the mooring layout. We are also grateful to Jeff Cordell, who with some help from others, worked tirelessly throughout the voyage to keep the scientific equipment operating, and to Mark Rayner for his epic struggles with the autoanalyser. We thank Ron Plaschke and Don McKenzie from the Research Vessel Operations Group, Mark Underwood and Serguei Sokolov for their assistance in preparing the LADCP system for use on this voyage. Thank also to Sophia Carson from the Australian Department of Foreign Affairs for her assistance in facilitating the voyage, Celestino da Cunha Barreta for his assistance, patience and excellent company during the voyage and the Government of East Timor for granting permission to carry out this research. This voyage was sponsored by the CSIRO, the Australian Greenhouse Research Program and the National Science Foundation, United States of America.

**Susan Wijffels**  
**Chief Scientist**