INSTANT CRUISE REPORT

LEG-4

Deployment and recovery of the INSTANT mooring in

the Lifamatola Passage and CTD Casts

R/V Baruna Jaya I

July 16 to July 25 2005

by

Dr. Dwi Susanto (chief scientist)

Lamont-Doherty Earth Observatory of Columbia University, New York

Dr. Hendrik M. van Aken (co-chief scientist)

Royal Netherlands Institute for Sea Research, Texel

1. Introduction

In the International Nusantara Stratification and Transport program (INSTANT) a multi-national group of scientists (from Indonesia, the USA, Australia, France, and the Netherlands) strive to measure directly the leakage of Pacific water through the waters of the Indonesian archipelago into the Indian Ocean. The Indonesian Marine and Fisheries Research (BRKP), Ministry of Marine Affairs and Fisheries (DKP) is sponsoring the Indonesian involvement. This throughflow possibly represents a 'choke point' for the global overturning oceanic circulation and the climate system, locally in South-East Asia as well as globally. While the Indonesian Throughflow (ITF) is assumed to have a considerable impact on the heat and fresh water budgets of the South Pacific and Indian Oceans, as well as on the local climate of Indonesia, the magnitude and distribution of the ITF is not known well. By simultaneous long-term (3 years) observations of the main transports in the main entrance passages at the northern side of the Indonesian seas and in the main exit passages at the southern side of the Indonesian seas (Figure 1) INSTANT hopes to establish a reliable estimate of the mean magnitude of the ITF and its main pathways. Also insight will be gained on the seasonal and inter-annual variability of the ITF.

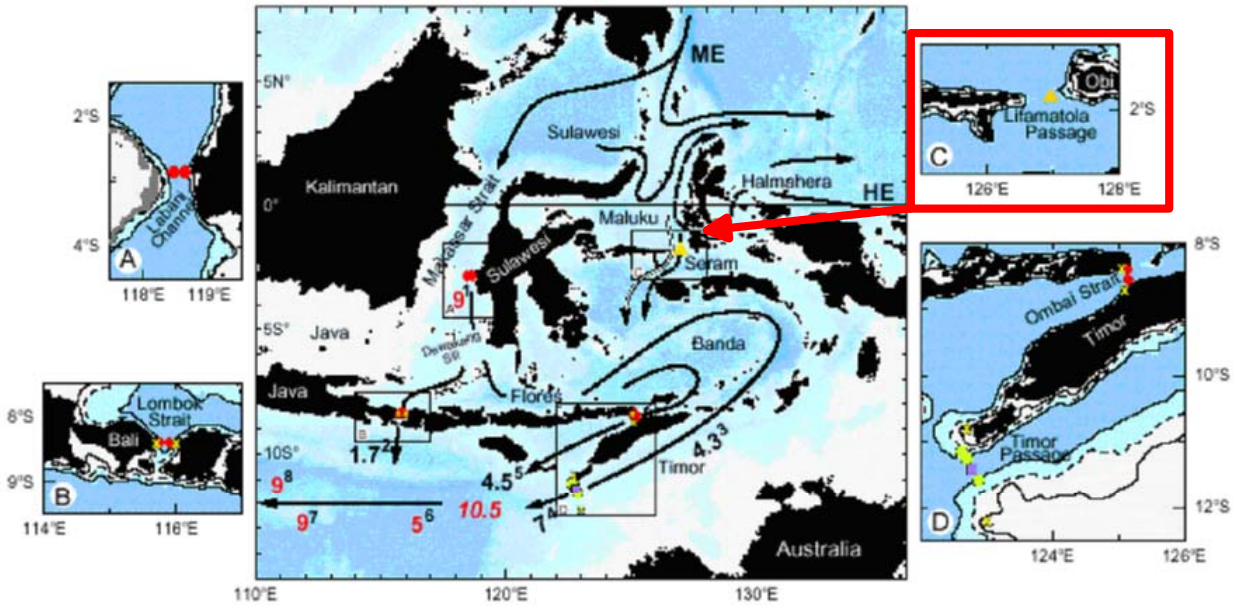

Figure 1. Inserts A-D show positions of INSTANT moorings. Insert C: Netherland's mooring within the main channel of Lifamatola Passage (yellow triangle).

Most entrance passages, especially the assumed main passage through Makassar Strait, have depths, shallower than ~800 m. This allows a throughflow of only surface, thermocline and intermediate water from the Pacific to the Indian Ocean. At Lifamatola Passage the sill depth however is about 2000 m deep. This large depth allows deep water with a temperature of 2 to 3ºC from the Pacific Ocean to enter the Banda Sea system. Since the southern exit passages are definitely shallower (<1200 m) the deep water from Lifamatola Passage will well up in the Banda Sea and mix with the overlying thermocline waters. So a heat sink is created in the Banda Sea, probably influencing the local sea surface temperature.

The prime objective of the current meter mooting at the Lifamatola passage (Figure 1) is to determine the mean transport and the properties of the deep inflow of cold water into the Seram Sea and the Banda Sea, and its seasonal and inter-annual variability. A secondary objective is to establish the importance of the Lifamatola passage for the through-flow of Pacific water in the upper 1000 m, and to supply an approximate estimate for that through-flow.

The specific objectives of the Leg-4 INSTANT cruise are:

- To recover and redeploy mooring in the Lifamatola passage deployed in January 2004.
- To collect water mass properties along the cruise track from Bitung (North Sulawesi) to Lifamatola passage and Makassar.
- To provide training for young Indonesian scientists and students on ocean mooring technology, oceanography of the Indonesian throughflow, data processing using Matlab and various topics on the dynamics of Indonesian Seas.

Itinerary

- Depart Bitung: 08:10 WITA (Central Indonesian Time, UTC+8 hours), Saturday 16 July 2005
- Arrive in Makassar: 07:00 WITA, Friday 22 July 2005

2. Recovery of the mooring

On July 17, 2005 the Baruna Jaya I arrived at the Lifamatola Passage. After acoustic contact had been established with the release it appeared that the ship was within 150 m from the mooring. The acoustic release command was given. It lasted longer than expected before the buoyancy float of the mooring surfaced, which was later explained by a considerable blow-down of the mooring due to a strong current.

After recovery of the mooring the instruments were checked. It appeared that all instruments had performed well with the exception of the deepest SBE-37, mounted about 30 m above the bottom. The latter was caused by leakage of the pressure resistant container. Additionally it was noted that some instruments showed some damage (scratched hulls and torn off plastic clamps, as well as cable damage). Analysis of the data suggested that this was probably due to an encounter with a deep floating object (free drifting fishing gear?) in June 2004, when the mooring had a permanent blow-down of a few 100 m during several successive days.

3. Recovery of the data

The data, stored in the instruments, were downloaded after recovery of the mooring. Their present status is given in the accompanying table. Compass calibrations and a final conversion to the ASCII-format have to be made after the end of the cruise.

A first inspection of the data showed the serious problem that both ADCPs had recorded only data from the first 7 of the 80 ADCP bins. This problem was also encountered during in a similar instrument recovered in 2004. It is probably due to an undocumented feature of the installation software, not known at the time of deployment.

Further inspection of the data showed that the current speed occasionally reached values of over 1.4 m/s. These high speeds apparently are mainly caused by internal tidal waves. This unexpected high speed was well above the assumed speed for the mooring design, based on previous measurements, and caused a serious blow-down of the mooring, lowering the top of the mooring from the intended 1535 m above the bottom to only less than 400 m above the bottom. This problem will require extensive interpolation and extrapolation efforts to produce a usable data set for transport estimates.

4. Re-deployment of the mooring

After servicing the instruments from the mooring, installing new batteries etc. the mooring was re-deployed. The ADCPs were now initialized following the guidelines to avoid the feature which caused the loss of 73 of the 80 ADCP bins during the previous mooring period. In order to reduce the blow-down the mooring was shortened with 300 m, while one Aanderaa current meter and one SBE-37 CTD were removed from the design. The deployment started in the evening of July 18 with the launch of the upper buoyancy. At 10:20 PM Central Indonesian Time the anchor weight of the mooring was finally released from the ship at the position: 126º57'48"E, 01º49'6"S.

Mooring LOCO-INSTANT-10-1 in Lifamatola Passage

Height above bottom (m)	Instrument linformation	Buoyancy (kg)	Sample interval (min)	download status	data file name	data status
1535	RDI ADCP, 75 kHz, upward looking, S/N 3553	-50	30	OK	ADCP3553.000	binary, not calibrated
1534	SBE 37 Seacat CTD, S/N 2672	-2.5	5	OK	SBE37_SN2672.txt	ASCII not calibrated
1232	Aanderaa RCM 11 CM, S/N 243, DSU S/N 13747	-27	15	OK	Aan243_DSU13747.dsu	binary, not calibrated
1231	SBE 37 Seacat CTD, S/N 2673	-2.5	5	OK	SBE37_SN2673.txt	ASCII not calibrated
931	Aanderaa RCM 11 CM, S/N 244, DSU S/N 13748	-27	15	OK	Aan244_DSU13748.dsu	binary, not calibrated
930	SBE 37 Seacat CTD, S/N 2674	-2.5	5	OK	SBE37_SN2674.txt	ASCII not calibrated
630	Aanderaa RCM 11 CM, S/N 245, DSU S/N 13749	-27	15	OK	Aan245_DSU13749.dsu	binary, not calibrated
613	SBE 37 Seacat CTD, S/N 2659	-2.5	5	OK	SBE37_SN2959.txt	ASCII not calibrated
608	RDI ADCP, 75 kHz, downward looking S/N 3714	-100	30	OK	ADCP3714.000	binary, not calibrated
10	SBE 37 Seacat CTD, S/N 2961	-2.5	5	data lost		

deployment position 01º49’05.88”S
126º57’50.80”E
Uncorrected water depth (m) 2030 m

5. CTD Casts and Calibrations

Despite high winds and swells, we could manage to have keeping watch to take notes of the ship speed, position, direction and various meteorological parameters every 30 minutes. We took 15 CTD casts during the cruise from Bitung to Lifamatola Passage and Makassar (Figures 2 and 3 and Table 1). Due to high winds which reached more than 7 knots and swells more than 7 m in Seram Sea (Station CTD #25 4 hours after the mooring deployment), we decided to abort the CTD cast. Most of the students and some crew members were seasick. High waves overflowed to the deck and knocked-down some cable rolls. We had some broken glasses and disks in the kitchen and dining room.

Because R/V Baruna Jaya I has a Guildline CTD which may have a long overdue calibration and NIOZ has a self-contained Seabird CTD, we installed the Seabird CTD in the CTD frame to perform some calibrations. Calibrations have been made for CTD stations #27 to #30 with CTD depths varies from 2000m to 2500m. During the CTD casts, we kept the CTD standby for 10 to 15 minutes at certain depths which had stable temperature and salinity, allowing both CTDs to have stable measurements. Preliminary analysis of CTD Station # 27 indicates that at 2000m the TSeabird – TGuildline = 0.228^{o}C and SSeabird – SGuildline = -0.321ppt. Meanwhile, at 650m depth, TSeabird – TGuildline = 0.248^{o}C and SSeabird – SGuildline = -0.295ppt.

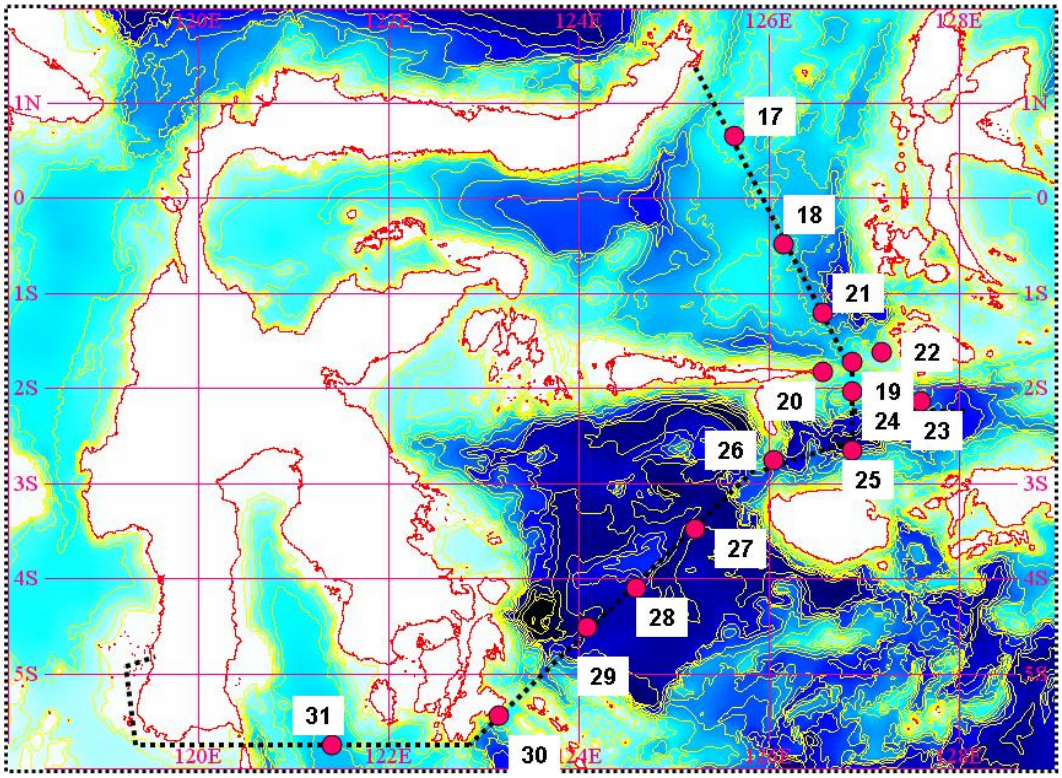

Figure 2. CTD Stations along the cruise track from Bitung to Lifamatola Passage and Makassar.

Station	Date Start/Time (WITA)	Longitude (DMS)	Latitude (DMS)	Water Depth/ CTD Depth (m)	Remark
17	16/7/2005 12:10:00	125 24 4.8	00 57 9.66 N	2148/1000	
18	16/7/2005 20:30:00	125 59 53.55	00 00 03.18 N	1487/1000	Water sample
19 19 A	18/7/2005 14:48:20	126 57 53.26	01 48 53.04 S	1981/1800 1991/200	Water sample, Chla
20	18/7/2005 20:00:00	126 42 21.50	01 49 41.82 S	831/500	Water sample, chla
21	18/7/2005 23:15:00	126 59 56.66	01 29 57.90 S	2421/1000	Water sample, Chla
22	18/7/2005 04:15:00	127 16 42.07	01 43 58.62 S	940.05/850	Water sample
23	18/7/2005 09:31:00	127 26 55.08	02 08 03.96 S	2922/1000	
24	18/7/2005 14:10:00	127 04 58.83	01 56 37.38 S	2122/2000	Water sample, Chla
25	19/7/2005	126 57 40	02 20 54.00 S		Abort due to high wind and swell
26	19/7/2005 06:55:00	126 01 43.83	02 47 49.74 S	2709/2500	Water sample
27	19/7/2005 17:27:00	125 18 39.14	03 27 38.52 S	4725/2000	Calibration, water sample
28	20/7/2005 02 21 00	124 37 54.32	04 05 59.64 S	4590/1500	Calibration, water sample
29	20/7/2005 11 28 00	123 55 18.98	04 41 04.62 S	4588 /2500	Calibration, water sample
30	20/7/2005 21 00 00	123 15 48.52	05 24 39.30 S	1972/1700	Calibration, water sample
31	21/7/2005 10 48 00	121 20 23.32	05 41 54.72 S	2468/1500	

Table 1. Locations, times and depths of CTD casts completed.

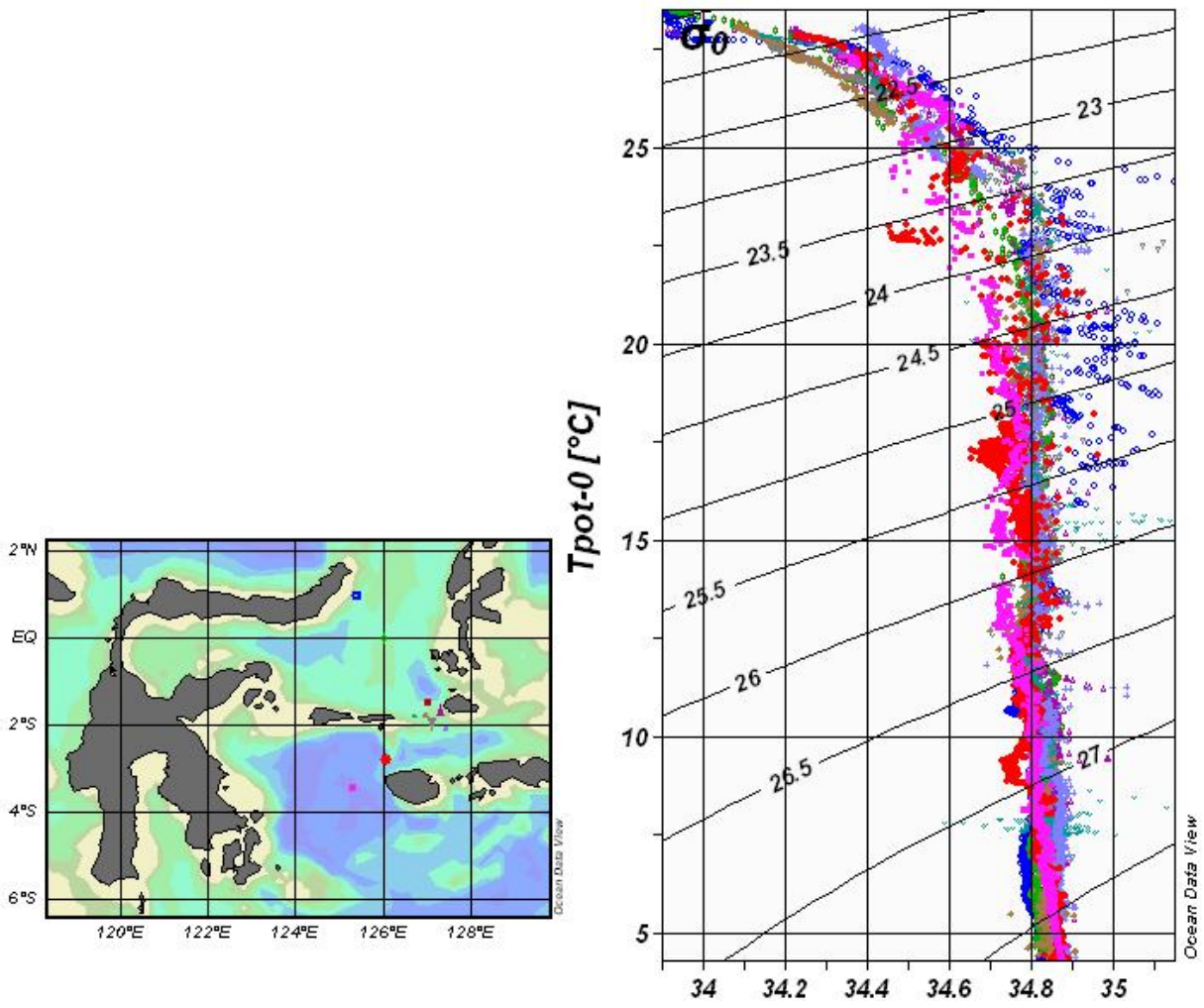

Figure 3. Preliminary results of CTD casts #17 to 27.

6. Lectures

During the voyage, 20 young students and scientists are attending the lecture series given by the chief scientists on the following topics:

a. Why INSTANT and its significant to Indonesia

b. Global Ocean Circulation

c. Properties of Sea Water and Equation of State

d. Tracers in Oceanography

e. Collecting and analyzing oceanographic observations

f. Dynamics of the Indonesian Seas and throughflow

g. Ocean internal waves in the Lombok Strait

h. Preliminary data analysis using Matlab Software

i. Turbulent mixing in the Banda Sea

j. Ocean optics

k. Ocean color, wind and sea surface temperature variability in the Indonesian Seas

l. Mooring design, recovery and deployment techniques

m. Argo float (presented by Bagus Hendrajana, BRKP).

7. Cruise Summary

Overall, we had a successful voyage. We could recover the Lifamatola mooring in Day 2 (July 17, 2005) and also redeployed in Day 3 (July 18, 2005), as planned. Despite the high wind and swell soon after the mooring deployment in which most of the students and some crews were seasick, we have taken 15 CTD casts and performed some calibrations. 20 young Indonesian students and scientists have been keeping watch, assisting the CTD works and carried their own research such as quantify chlorophyll-a concentration, deep sea water sampling, worked on the INSTANT mooring in the Lifamatola passage (SBE37 and Aanderaa current meter data) using Matlab software as soon as the data came onboard and attended numerous lectures given by the chief scientists. Hence, we believe the training goals during the voyage are achieve as well.

8. Crew

Science Crew:

Chief Scientists
Dwi Susanto (Lamont-Doherty Earth Observatory of Columbia University, USA)
Hendrik van Aken (NIOZ, The Netherlands)

Co-Chief Scientist
Rizki Anggoro Adi, BRKP, Indonesia

Engineers
Sven Ober, NIOZ
Jack Schilling, NIOZ
Danny Maclaughan, CSIRO

Science and Student Team
Aries Dwi Siswanto, UNDIP
Bagus Hendrajana, BRKP
Bayu Priono, BRKP
Bugi Wicaksono,BPPT
Cecep Sujana, BPPT
Engki Andri Kisnarti, UHT
Faisal Hamzah, IPB
Fajri D. Justitianto, UNDIP
Ihksan B. Wahyono, BPPT
Imran, UNHAS
Indah Lutfiyati, UNDIP
Indri Putri, UHT
Krisnoto, IPB
Lucia Manu, UNSRAT
Merlinda Embon, UNHAS
Novi Susetyo Adi, BRKP
Prasetyo Utomo, UNDIP
Rizki Anggoro Adi, BRKP
Yeremia Kiding, UNHAS

Ship Crews

Haryanto	Captain
Ishak Ismail	Chief Officer
Mulyadi	2 nd Officer
Djaenal	Chief Engineer
Marno	1 st Engineer
Sunarto	Electrician
Syamsu	Quarter Master I
Subsrdiya Noor	Quarter Master II
Adi Kurnia	Quarter Master III
Sayut Wiyanto	Oiler I
Agus Setyawan	Oiler II
Ronald	Oiler III
Ahmad	Oiler IV
Daryoto	Cook
Santoso	Steward I
Saifudin	Steward II

Security Officer
Major Laut Kamija, DITWILHAN (DPB)

Acknowledgement

Thanks to the master and crew of the R/V Baruna Jaya I for their hard work and cooperation during the voyage, especially to the deck's crew for their excellent work and help during the mooring recovery and deployment. Captain Haryanto handled the ship with confidence despites the difficulty due to high swell during the mooring recovery and redeployment. We are grateful to Dr. Indroyono Soesilo and Dr. Sugiarta (BRKP) and Dr. Jana Anggadiredja (BPPT) for strong partnership in the INSTANT program. This cruise was sponsored by the Agency for Marine and Fisheries Research (BRKP) and Agency for Assessment and Application of Technology (BPPT), Indonesia, the National Science Foundation (USA) and NIOZ (the Netherlands). The Dutch contribution to the INSTANT program was also supported by the LOCO investment program of NWO and by the climate program COACh.