doi : 10.17596/0003678

R/V Mirai Cruise Report
MR02-K04
(Leg 1 and Leg 2)

June 25 – August 22, 2002
Tropical Ocean Climate Study (TOCS)

Edited by
Yoshifumi Kuroda
Hideaki Hase

Japan Marine Science and Technology Center
(JAMSTEC)

Leg 1

Leg 2

Contents

1. Cruise name and code

Tropical Ocean Climate Study
MR02-K04 (Leg 1 and Leg 2)
Ship: R/V MIRAI
Captain: Takaaki Hashimoto

2. Introduction and observation summary

2.1. Introduction

This cruise has two major purposes. One is to observe physical oceanographic conditions in the western tropical Pacific Ocean for better understanding of air-sea interaction affecting on the ENSO (El Nino/Southern Oscillation) phenomena and its related climate change. The surface layer in the western tropical Pacific Ocean is characterized by high sea surface temperature, which plays major role in driving global atmospheric circulation. El Nino occurs when warm water migrates eastward, and causes short-term climate changes in the world dramatically. For example, the western Pacific area has very little rainfall when the "El Nino" occurred, as in 1997-98. This atmospheric and oceanic system is so complicated, and we still do not have enough knowledge about it.

The other purpose is to observe hydrographic conditions and its variability in the eastern tropical Indian Ocean associated with Asian Monsoon and Dipole Mode variability. Asian Monsoon may play an important role as a trigger of El Nino in the Pacific Ocean. Also the Indian Ocean has basin-scale interannual variability independent to ENSO mentioned as Dipole Mode variability. This climate system has various time scales. To investigate the mechanism, we need precise and detailed data for long period. Therefore, ocean and atmosphere observing mooring array is effective to obtain such data set. The major mission of this cruise is to deploy TRITON buoys developed at JAMSTEC for the long term measurements of ocean and atmosphere in the western tropical Pacific Ocean and the eastern Indian Ocean. We also deployed ADCP subsurface buoys in the Pacific and the Indian Oceans during this cruise.

The other purposes of this cruise are,

1) Currents, temperature and salinity measurement using a subsurface ADCP mooring and ARGO floats by Frontier Observational Research System for Global Change (FORSGC).
2) Optical measurement of properties of atmospheric aerosols by particle counter and sky radiometer by Hokkaido University.
3) Lidar backscatter measurements of lower atmosphere by National Institute for Environmental Studies (NIES) of Japan.

These measurements are also made successfully during this cruise.

2.2. Overview

2.2.1 Ship

R/V Mirai
Captain Takaaki Hashimoto
Total 34 crew members during Leg 1
Total 35 crew members during Leg 2

2.2.2 Cruise code

MR02-K04

2.2.3 Project name

Tropical Ocean Climate Study

2.2.4 Undertaking institution

Japan Marine Science and Technology Center (JAMSTEC)
2-15, Natsushima, Yokosuka, 237-0061, Japan

2.2.5 Chief scientist

Leg1: Yoshifumi Kuroda (JAMSTEC)
Leg2: Hideaki Hase (JAMSTEC)

2.2.6 Period

Leg1: June 25, 2002 (Sekinehama)-July 23, 2002 (Port Kelang)
Leg2: July 25, 2002 (Port Kelang)-August 22, 2002 (Sekinehama)

2.2.7 Research participants

Total 30 scientists and technical stuff participated from 10 different institutions, universities and companies including 6 foreign scientists and officers from Indonesia, Malaysia and USA.

2.3 Observation summary

TRITON buoy deployment:	9 sites
TRITON buoy recovery:	7 sites
ADCP subsurface buoy deployment:	2 sites
ADCP subsurface buoy recovery:	2 sites
CTD (Salinity, Temperature, Depth):	28 casts down to 1000 or 2000m
XCTD (Salinity, Temperature, Depth):	114 times down to 1000m
Surface meteorology:	continuous
ADCP measurements:	continuous
Surface temperature, salinity measurements by intake method:	continuous

Other specially designed observations have been carried out successfully.

Observed oceanic and atmospheric conditions

ENSO status from TAO/TRITON buoy data:

The TRITON and TAO (Tropical Atmosphere and Ocean) buoy data along the equator in the Pacific Ocean indicates development of El Nino in 2002. The warm water pool in the western tropical Pacific Ocean had stored enough heat for causing next El Nino during the La Nina years of 1998-2000. The condition for the onset of El Nino is to have a series of westerly wind bursts associated with intraseasonal atmospheric disturbance over the western tropical Pacific Ocean that pushes the warm water from west to east. Major events of westerly wind bursts were observed in June- July and November-December 2001. After these events, the warm water anomaly reached the Pacific eastern boundary and raised the sea surface temperature (SST) in the eastern Pacific. The monthly sea surface temperature from TRITON and TAO mooring array in June 2002 indicated that 1 deg-C positive anomaly was widely spread from 170E to 100W. By this warming in the entire equatorial Pacific Ocean, Japan Meteorological Agency and National Centers for Environmental Prediction in USA announced in July 2002 that an El Nino has been developing. The relatively low warming level compare to 1997/1998 indicates the developing El Nino to be moderate.

Leg 1: Observation in the western tropical Pacific

During the Leg 1 period, the four typhoons were born and hit Japan. This may be due to the Pacific high-pressure system migrated eastward associated with the El Nino development. By the typhoon RAMMASUN passing through west of the ship course, we encountered strong winds (30 m/s) and high waves (6-8 m) during June 30 - July 1 and delayed one day, otherwise another three typhoons (CHATAAN, HALONG, NAKRI) passed north of the ship and less affected to the observational works.

SST in the western tropical Pacific Ocean on the ship course was almost normal. Along the 130E section, strong SSE winds associated with southwesterly monsoon and the typhoons dominated. By this enhanced southwesterly monsoon, the Halmahera eddy was strongly enhanced, and at the 2N130E near Halmahera Island the high salinity core water over 35.4 psu distributed thickly from 160-230 m depth, which may be transported by the direct inflow of the enhanced northward flowing New Guinea Coastal Current and its Under Current into the Halmahera eddy. The surface layer of the Mindanao Current is also strengthened up to 2.0 m/s during this cruise compare to 1 m/s during the previous cruise of October 2001 based on the shipboard ADCP and moored ADCP data. The current at the TRITON site of 5N130E is also strong as 1.5 m/s due to the enhanced Mindanao Current and Halmahera Eddy.

During the previous cruise of October 2001, the Mindanao Current was extended to southward and low salinity North Pacific Tropical Water was dominated in the Halmahera region. Thus the results indicate how the water masses in the region can vary with the Pacific low latitude western boundary currents in the seasonal and El Nino time scales. The water mass change is important to investigate the heat and salt transport process in the warm pool region and understand the slowly varying ocean conditions in the process of El Nino development.

Leg 2: Observation in the eastern Indian Ocean

July/August is in summer monsoon season in the Indian Ocean. The climatology indicates that southwesterly winds dominate in the northern hemisphere, and wind curl is anticyclonic north of about 15S. Upper ocean layer current is forced by these wind fields, current is expected to flow eastward north of equator and westward south of equator, respectively. However, the observed current was different from climatological seasonal pattern. Strong westward currents were observed in the northern hemisphere along 90E.

SST (at 5 m depth) in the northern hemisphere along 90E is warmer as 29.3-29.8 deg-C than in the southern hemisphere, and water masses less than 34 psu was observed north of Sumatra Island, indicating the low saline water from the Bay of Bengal.

Two TRITON buoys and one ADCP mooring were recovered/re-deployed in the eastern Indian Ocean, and deployed four Argo floats successfully. We also carried out CTD and shipboard ADCP measurements without significant problem.

During the way back to Japan steaming in the Pacific, one typhoon (PHANFONE) was born and hit our ship course. Due to the severe oceanic condition associated with the typhoon, R/V Mirai arrived on 21 August with one-day delay at the port of Hachinohe.

3. Period, ports of call, cruise log and cruise track

3.1 Period

June 25, 2002 – August 22, 2002

3.2 Ports of call

Sekinehama, Japan	(Departure; June 25, 2002)
Hachinohe, Japan	(June 25, 2002)
Klang, Malaysia	(July 23 – 25, 2002)
Hachinohe, Japan	(August 21 , 2002)
Sekinehama, Japan	(Arrival; August 22 , 2002)

3.3 Cruise log

SMT (Ship Mean Time)	UTC	Event
Jun. 25 (Tue)		
06:00	21:00	Departure at Sekinehama, Japan (SMT = UTC + 9) Start of continuous shipboard observations
09:00-	00:00-	Safety guidance on the R/V Mirai
12:20	03:20	Arrival at Hachinohe, Japan Immigration for going aboard
16:00	07:00	Departure from Hachinohe
16:45-17:00	07:45-08:00	Konpira-san
17:00-	08:00-	Start of Lidar observation
18:00-	09:00-	Start of continuous water observation
Jun. 26 (Wed.)		
09:00-10:30	00:00-01:30	Meeting for leg 1 observation, and for editing cruise report
13:00-13:30	04:00-04:30	Boat station drill
19:42-20:48	10:42-11:48	C01 (34-53.91 N, 142-21.95 E, 7042m) CTD cast with water sampling, down to 2000 m depth
20:59	11:59	Deployment of ARGO profiling float ID20231 (34-54.99 N, 142-22.20 E)
21:02	12:02	Deployment of ARGO profiling float ID7995 (34-54.95 N, 142-22.17 E)
Jun.27 (Thu)		
		Steaming
Jun. 28 (Fri.)		
		Steaming
Jun. 29 (Sat.)		
		Steaming (Severe Tropical Storm Rammasun hit R/V Mirai) Science seminar "Water mass and sea surface height variabilities in the Halmahera eddy region" Speaker: Agus Atmadipoera

Jun. 30 (Sun)		
		Steaming
Jul. 1 (Mon)		
		Steaming (Severe Tropical Storm Rammasun hit R/V Mirai)
Jul. 2 (Tue)		
07:45-11:22	22:45-02:33	Deployment of TRITON buoy (07-39.69 N, 136-41.59E, 3144 m)
13:04-13:54	04:04-04:54	C-02 (07-40.51 N, 136-41.97 E, 3147m) CTD cast with 12 water sampling, down to 1000 m depth
15:32-16:15	06:32-07:15	C-03 (07-51.39 N, 136-28.76 E, 3352m) CTD cast with 2 water sampling, down to 1000 m depth
Jul. 3 (Wed.)		
08:00-11:46	23:00-02:17	Recovery of TRITON buoy (07-50.53N, 136-29.45 E)
14:55	05:55	XCTD: X001 (07-00.13N, 136-45.77E, 4555m)
19:00	10:00	X002 (06-00.02N, 136-58.15E, 4426m)
Jul. 4 (Thu.)		
08:33-11:29	23:33-02:29	Deployment of TRITON buoy (04-51.55 N, 137-16.04E, 4109 m)
		Restore operation of buoy data transmission
15:04-16:37	06:04-06:37	C-04 (04-54.22 N, 137-17.26E, 4043 m) CTD cast with 2 water sampling, down to 1000 m depth
Jul. 5 (Fri.)		
09:17-12:02	00:17-03:02	Recovery of TRITON buoy (04-56.66N, 137-18.65 E)
16:03	07:03	X003 (04-00.08N, 137-33.99E, 4759m)
20:03	11:15	X004 (02-59.94N, 137-49.75E, 4478m)
19:42	11:42	X005 (02-59.48N, 137-50.72E, 4474m)
Jul. 6 (Sat.)		
08:16-11:13	23:16-02:13	Deployment of TRITON buoy (02-00.06N, 138-06.16E, 4317 m)
13:03-13:37	04:03-04:37	C-05 (02-01.97N, 138-05.13E, 4288m) CTD cast with 2 water sampling, down to 1000 m depth
21:23	12:23	X006 (02-00.01N, 137-00.07E, 4114m)
Jul. 7(Sun.)		
08:41-11:16	23:41-02:16	Recovery of TRITON buoy (02-03.76N, 138-04.32 E)
15:47	06:47	X007 (01-00.03N, 138-00.30E, 4233m)
Jul. 8 (Mon.)		
08:16-11:53	23:16-01:53	Deployment of TRITON buoy (00-01.97N, 137-53.15E, 4371 m)
13:12-13:45	04:12-04:45	C-06 (00-02.97N, 137-53.42E, 4344m) CTD cast with 2 water sampling, down to 1000 m depth
15:00-15:38	06:00-06:38	C-07 (00-04.48N, 138-02.50E, 4212m) CTD cast with 2 water sampling, down to 1000 m depth
21:58	12:58	X008 (00-59.95N, 137-00.05E, 3852m)

Jul. 9 (Tue.)		
09:01-11:40	00:01-02:40	Recovery of TRITON buoy (00-04.94N, 138-03.20E)
15:36	06:36	X009 (00-00.14N, 137-00.00E, 4446m)
19:19	10:19	X010 (00-00.05N, 136-00.01E, 5043m)
21:14	12:14	X011 (00-00.00S, 135-30.00E, 4274m)
Jul. 10 (Wed.)		
01:06	16:06	X012 (00-59.99N, 135-29.90E, 4343m)
04:53	19:53	X013 (02-00.01N, 135-29.99E, 4316m)
08:54	23:54	X014 (02-00.02N, 134-30.00E, 4173m)
12:44	03:44	X015 (02-00.14N, 133-30.00E, 3820m)
16:27	07:27	X016 (01-59.98N, 132-29.99E, 3154m)
20:14	11:14	X017 (01-60.00N, 131-30.00E, 4083m)
23:56	14:56	X018 (02-00.00N, 130-30.01E, 4352m)
Jul. 11 (Thu.)		
08:16-11:02	23:16-02:02	Deployment of TRITON buoy (02-00.07N, 130-02.34E, 4400 m)
13:02-13:41	04:02-04:41	C-08 (02-00.59N, 130-03.35E, 4399m) CTD cast with 2 water sampling, down to 1000 m depth
15:02-15:42	06:02-06:42	C-09 (01-58.57N, 129-54.82E, 4424m) CTD cast with 2 water sampling, down to 1000 m depth
18:18	09:18	X019 (02-00.03N, 129-30.01E, 4046m)
Jul. 12 (Fri.)		
09:01-11:42	00:01-02:42	Recovery of TRITON buoy (01-58.66N, 129-5481E)
17:00	06:00	X020 (03-00.02N, 129-55.40E, 3130m)
18:26	09:26	X021 (04-00.02N, 129-56.86E, 4642m)
Jul. 13 (Sat.)		
08:16-12:11	23:16-03:11	Deployment of TRITON buoy (04-59.89N, 129-56.95E, 5096 m)
13:14-13:57	04:14-04-57	C-10 (05-01.07N, 129-57.16E, 5102m) CTD cast with 2 water sampling, down to 1000 m depth
16:35	07:35	X022 (05-15.85N, 129-30.02E, 4895m)
19:06	10:06	X023 (05-32.18N, 129-00.01E, 5412m)
21:32	12:32	X024 (05-49.07N, 128-30.03E, 4914m)
23:54	14:54	X025 (06-05.98N, 127-59.98E, 5436m)
Jul. 14 (Sun.)		
00:47	15:47	X026 (06-11.74N, 127-50.04E, 5662m)
01:37	16:37	X027 (06-17.21N, 127-40.02E, 5893m)
02:28	17:28	X028 (06-22.67N, 127-30.03E, 7836m)
03:20	18:20	X029 (06-33.56N, 127-20.03E, 9345m)
04:13	19:13	X030 (06-28.09N, 127-10.00E, 7895m)
05:08	20:08	X031 (06-39.65N, 127-00.00E, 6935m)
06:01	21:01	X032 (06-45.48N, 126-50.01E, 5142m)
07:26	22:26	X033 (06-52.54N, 126-37.43E, 2981m)
09:55-11:30	00:55-02:30	Recovery of subsurface ADCP buoy (06-49.29 N, 126-42.65 E, 3441m)

12:14-12:54	03:14-03-54	C-11 (06-50.05N, 126-42.63E, 3429m) CTD cast with 2 water sampling, down to 1000 m depth
14:01-15:12	05:01-06:12	Deployment of subsurface ADCP buoy (06-48.97N, 126-42.59 E, 3435 m)
18:17	09:17	X034 (06-59.98N, 127-14.75E, 8186m)
Jul. 15 (Mon.)		
05:53	20:53	X035 (08-00.01N, 129-59.98E, 5680m)
		Bathymetry survey for 8N130E TRITON site
10:22	01:22	X036 (08-60.00N, 129-21.58E, 5807m)
13:00-13:30	04:00-04:30	Anti-piracy measures orientation
14:44	05:44	X037 (09-59.98N, 128-39.38E, 5680m)
19:11	10:11	X038 (10-59.99N, 127-57.05E, 5564m)
23:47	14:47	X039 (11-60.00N, 127-14.86E, 5658m)
Jul. 16 (Tue.)		
04:29	19:29	X040 (13-00.00N, 126-30.44E, 5186m)
09:04	00:04	X041 (13-59.96N, 125-49.63E, 6053m)
13:00-14:00	04:00-05:00	Anti-piracy drill
13:40	04:40	X042 (14-59.99N, 125-06.59E, 5525m)
18:23	09:23	X043 (16-00.08N, 124-24.00E, 3168m)
23:12	14:12	X044 (16-59.95N, 123-38.15E, 4265m)
Jul. 17 (Wed.)		
02:21	17:21	X045 (17-40.01N, 123-07.83E, 2801m)
03:10	18:10	X046 (17-50.01N, 123-00.56E, 3739m)
03:59	18:59	X047 (17-59.99N, 122-52.86E, 3579m)
04:49	19:49	X048 (18-10.01N, 122-45.23E, 3775m)
05:36	20:36	X049 (18-20.00N, 122-37.47E, 2964m)
06:06	21:06	X050 (18-26.00N, 122-32.80E, 1765m)
22:00-	13:00-	Ship mean time adjustment (SMT = UTC + 8)
Jul. 18 (Thu.)		
		Steaming
Jul. 19 (Fri.)		
		Steaming
Jul. 20 (Sat.)		
		Steaming
Jul. 21 (Sun.)		
13:00-15:20	05:00-07:20	Science meeting to review obtained data
		Steaming
Jul. 22 (Mon.)		
		Steaming
Jul. 23 (Tue.)		
08:30	00:30	Arrival at Port Klang, Malaysia
		Open house for special guests

Jul. 24 (Wed.)		
		Anchor at Port Klang, Malaysia
Jul. 25 (Thu.)		
10:00	02:00	Departure from Port Klang
11:00-11:45	03:00-03:45	Safety guidance for participants joining from leg 2
13:00-13:45	05:00-05:45	Meeting for leg 2 observation
16:45	08:45	Konpira-san
Jul. 26 (Fri.)		
09:00-	01:00-	Start of Doppler radar observation
13:34	05:34	X051 (06-11.87N, 095-00.02E, 843m)
16:11	08:11	X052 (05-44.85N, 094-30.03E, 1855m)
18:54	10:54	X053 (05-15.81N, 094-00.01E, 704m)
21:31	13:31	X054 (04-49.47N, 093-30.01E, 1216m)
Jul. 27 (Sat.)		
00:14	16:14	X055 (04-21.66N, 092-59.97E, 4507m)
03:03	19:03	X056 (03-53.77N, 092-30.02E, 4257m)
05:50	21:50	X057 (03-41.77N, 092-00.01E, 4104m)
07:29	23:29	Radio sonde observation RS-001 (03.83N, 091.80E)
08:32	00:32	X058 (04-01.31N, 091-29.99E, 4028m)
11:24	03:24	X059 (04-21.12N, 090-59.99E, 2618m)
13:25	05:25	RS-002 (04.53N, 090.74E)
14:25	06:25	X060 (04-40.90N, 090-30.01E, 3162m)
19:26	11:26	RS-003 (05.00N, 090.00E)
19:31	11:31	X061 (05-00.14N, 089-59.65E, 3440m)
19:38	11:38	X062 (04-59.21N, 089-59.63E, 3360m)
21:39	13:39	X063 (04-30.00N, 089-59.99E, 3266m)
23:59-01:31	15:59-17:31	C-12 (03-59.46N, 090-00.00E, 2841m) CTD cast with 12 water sampling, down to 2000 m depth
01:24	17:24	RS-004 (03.99N, 090.00E)
Jul. 28 (Sun.)		
03:35	19:35	X064 (03-29.99N, 090-00.01E, 2461m)
06:00-07:22	22:00-23:22	C-13 (02-59.97N, 089-59.89E, 2467m) CTD cast with 12 water sampling, down to 2000 m depth
07:30	23:30	RS-005 (03.00N, 090.00E)
09:39	01:39	X065 (02-29.99N, 089-59.90E, 2718m)
11:59-13:12	03:59-05:12	C-14 (02-00.35N, 089-59.89E, 2648m) CTD cast with 12 water sampling, down to 2000 m depth
13:24	05:24	RS-006 (02.00N, 089.99E)
15:36	07:36	X066 (01-29.78N, 089-59.99E, 2301m)
17:55-19:06	09:55-11:06	C-15 (00-59.94N, 089-59.97E, 2307m) CTD cast with 12 water sampling, down to 2000 m depth
19:25	11:25	RS-007 (00.99N, 090.00E)
21:32	13:32	X067 (00-30.00N, 090-01.82E, 4056m)
Jul. 29 (Mon.)		
01:24	17:24	RS-008 (00.04N, 090.06E)
07:25	23:25	RS-009 (00.01N, 090.05E)

07:50-10:32	23:50-02:32	Recovery of subsurface ADCP buoy (00-00.44N, 090-03.35 E, 4399m)
10:24	02:24	RS-010 (00.01N, 090.06E)
11:15-12:31	03:15-04:31	C-16 (00-00.17N, 090-00.81E, 4248m) CTD cast with 12 water sampling, down to 2000 m depth
12:56-14:43	04:56-06:43	Deployment of subsurface ADCP buoy (00-00.37N, 090-03.38E, 4399m)
13:25	05:25	RS-011 (00.02N, 090.01E)
15:02	07:02	X068 (00-00.36S, 090-03.51E, 4290m)
16:37	08:37	RS-012 (00.28S, 090.05E)
17:29	09:29	X069 (00-30.04S, 089-59.28E, 3067m)
19:24	11:24	RS-013 (00.85S, 090.02E)
19:41	11:41	X070 (01-00.03S, 090-01.19E, 3190m)
22:26	14:26	RS-014 (01.61S, 090.07E)
Jul. 30 (Tue.)		
01:25	17:25	RS-015 (01.62S, 090.06E)
04:22	20:22	RS-016 (01.60S, 090.08E)
07:25	23:25	RS-017 (01.62S, 090.09E)
07:54-11:38	23:54-03:38	Deployment of TRITON buoy (01-36.09S, 090-04.47E, 4715m)
10:23	02:23	RS-018 (01.64S, 090.08E)
11:48-12:57	03:48-04:57	C-17 (01-35.95S, 090-03.63E, 4707m) CTD cast with 12 water sampling, down to 2000 m depth at TRITON buoy deployment point
13:24	05:24	RS-019 (01.60S, 090.06E)
13:47-14:53	05:47-06:53	C-18 (01-39.25S, 090-00.64E, 4688m) CTD cast with 3 water sampling, down to 2000 m depth at TRITON buoy recovery point
16:25	08:25	RS-020 (01.74S, 89.99E)
17:32-18:51	09:32-10:51	C-19 (02-00.01S, 090-00.02E, 4735m) CTD cast with 12 water sampling, down to 2000 m depth
19:23	11:23	RS-021 (02.00S, 090.00E)
22:22	14:22	RS-022 (01.70S, 089.99E)
Jul. 31 (Wed.)		
01:22	17:22	RS-023 (01.72S, 089.97E)
04:27	20:27	RS-024 (01.73S, 089.97E)
07:25	23:25	RS-025 (01.67S, 090.00E)
08:12-12:02	00:12-04:02	Recovery of TRITON buoy (01-39.30S, 089-59.45E, 4715m)
13:35	05:35	RS-026 (02.01S, 089.98E)
15:28	07:28	X071 (02-30.00S, 090-00.21E, 3502m)
17:58-19:11	09:58-11:11	C-20 (03-00.01S, 090-00.28E, 3328m) CTD cast with 12 water sampling, down to 2000 m depth
19:27	11:27	RS-027 (03.01S, 090.01E)
19:23	11:23	Deployment of ARGO profiling float ID 10918 (03-00.87S, 090-00.69E)
21:23	13:23	X072 (03-30.01S, 090-00.28E, 3882m)
23:55-01:05	15:55-17:05	C-21 (03-59.91S, 090-00.01E, 3140m) CTD cast with 12 water sampling, down to 2000 m depth

Aug. 1 (Thu.)

01:22	17:22	RS-028 (04.00S, 090.00E)
03:39	19:39	X073 (04-31.32S, 090-00.16E, 4699m)
06:00-07:13	22:00-23:13	C-22 (04-59.87S, 089-59.93E, 5004m) CTD cast with 12 water sampling, down to 2000 m depth
07:22	23:22	RS-029 (04.99S, 090.00E)
07:23	23:23	Deployment of ARGO profiling float ID 17441 (04-59.42S, 089-59.86E)
07:29	23:29	X074 (04-59.49S, 090-00.42E, 4999m)
09:28	01:28	X075 (04-59.82S, 090-29.99E, 5044m)
11:58-13:13	03:58-05:13	C-23 (04-59.94S, 090-59.96E, 4985m) CTD cast with 12 water sampling, down to 2000 m depth
13:35	05:35	RS-030 (04.99S, 091.00E)
15:41	07:41	X076 (04-59.98S, 091-30.00E, 5007m)
17:54-19:02	09:54-11:02	C-24 (04-59.89S, 092-00.07E, 5009m) CTD cast with 12 water sampling, down to 2000 m depth
19:25	11:25	RS-031 (04.99S, 092.00E)
21:23	13:23	X077 (05-00.59S, 092-29.98E, 5002m)
23:56-01:12	15:56-17:12	C-25 (04-59.96S, 092-59.79E, 4621m) CTD cast with 12 water sampling, down to 2000 m depth

Aug. 2 (Fri.)

01:27	17:27	RS-032 (05.00S, 093.00E)
03:30	19:30	X078 (05-00.27S, 093-30.00E, 5000m)
05:59-07:12	21:59-23:12	C-26 (05-00.02S, 093-59.94E, 4970m) CTD cast with 12 water sampling, down to 2000 m depth
07:22	23:22	Deployment of ARGO profiling float ID 18378 (05-00.32S, 094-00.02E)
07:25	23:25	RS-033 (05.00S, 094.00E)
09:27	01:27	X079 (04-59.25S, 094-30.02E, 4977m)
13:23	05:23	RS-034 (05.06S, 094.90E)
13:33-16:52	05:33-06:52	Deployment of TRITON buoy (05-02.02S, 094-58.62E, 5017m)
17:05-18:17	09:05-10:17	C-27 (05-02.34S, 094-57.66E, 5007m) CTD cast with 12 water sampling, down to 2000 m depth at TRITON buoy deployment point
18:36	10:36	X080 (05-02.78S, 094-58.98E, 5007m)
19:28	11:28	RS-035 (05.34S, 94.99 E)
20:51-21:57	12:51-13:57	C-28 (05-34.17S, 094-59.77E, 5068m) CTD cast with 12 water sampling, down to 2000 m depth
22:03	14:03	Deployment of ARGO profiling float ID 17483 (05-34.57S, 094-59.84E)

Aug. 3 (Sat.)

02:00	18:00	RS-036 (04.93S, 095.02E)
07:26	23:26	RS-037 (04.98S, 094.99E)
07:59-11:36	23:59-03:36	Recovery of TRITON buoy (04-57.34S, 094-58.85E, 5017m)
10:26	02:26	RS-038 (04.99S, 095.00E)
11:42	03:42	X081 (05-00.36S, 095-00.93E, 5010m)
12:01	04:01	X082 (05-01.79S, 095-04.22E, 5042m)

13:25	05:25	RS-039 (05.10S, 095.28E)
13:51	05:51	X083 (05-11.43S, 095-30.00E, 5029m)
15:53	07:53	X084 (05-19.22S, 096-00.02E, 4814m)
16:25	08:25	RS-040 (05.32S, 096.01E)
18:01	10:01	X085 (05-29.84S, 096-30.01E, 4860m)
19:26	11:26	RS-041 (05.58S, 096.76E)
20:06	12:06	X086 (05-40.47S, 096-59.98E, 4837m)
22:08	14:08	X087 (05-50.72S, 097-30.01E, 4975m)
22:25	14:25	RS-042 (05.84S, 097.48E)

Aug. 4 (Sun.)

00:16	16:16	X088 (06-01.05S, 097-59.97E, 5463m)
01:26	17:26	RS-043 (06.07S, 098.14E)
02:28	18:28	X089 (06-13.05S, 098-29.96E, 5040m)
04:29	20:29	RS-044 (06.36S, 098.88E)
04:40	20:40	X090 (06-25.80S, 099-00.01E, 5365m)
06:48	22:48	X091 (06-36.15S, 099-30.00E, 4765m)
07:25	23:25	RS-045 (06.62S, 099.57E)
09:01	01:01	X092 (06-43.80S, 100-00.00E, 4993m)
10:25	02:25	RS-046 (06.80S, 100.21E)
11:25	03:25	X093 (06-55.72S, 100-30.00E, 5366m)
13:25	05:25	RS-047 (07.04S, 100.84E)
13:52	05:52	X094 (07-07.60S, 101-00.00E, 5531m)
16:02	08:02	X095 (07-16.71S, 101-30.00E, 5270m)
17:00	09:00	RS-048 (07.30S, 101.56E)
18:26	10:26	X096 (07-27.41S, 101-59.99E, 5472m)
19:26	11:26	RS-049 (07.49S, 102.11E)
20:50	12:50	X097 (07-37.88S, 102-29.99E, 5845m)
22:25	14:25	RS-050 (07.71S, 102.77E)
23:16	15:16	X098 (07-48.93S, 103-00.00E, 6016m)

Aug. 5 (Mon.)

01:26	17:26	RS-051 (07.93S, 103.35E)
01:45	17:45	X099 (07-59.90S, 103-29.99E, 6118m)
03:58	19:58	X100 (08-08.54S, 103-59.98E, 6243m)
05:00	21:00	RS-052 (08.14S, 103.99E)
06:27	22:27	X101 (08-19.75S, 104-29.99E, 6353m)
07:25	23:25	RS-053 (08.36S, 104.59E)
08:56	00:56	X102 (08-31.73S, 105-00.00E, 6607m)
11:13	03:13	X103 (08-41.82S, 105-29.99E, 6178m)
13:25	05:25	RS-054 (08.83S, 105.91E)
13:39	0539	X104 (08-52.70S, 106-00.04E, 4335m)
15:53	07:53	X105 (09-01.36S, 106-30.00E, 4074m)
18:09	10:09	X106 (09-11.95S, 107-00.00E, 3854m)
19:25	11:25	RS-055 (09.26S, 107.17E)
20:32	12:32	X107 (09-24.30S, 107-29.99E, 3659m)
22:40	14:40	X108 (09-34.06S, 108-00.01E, 3297m)

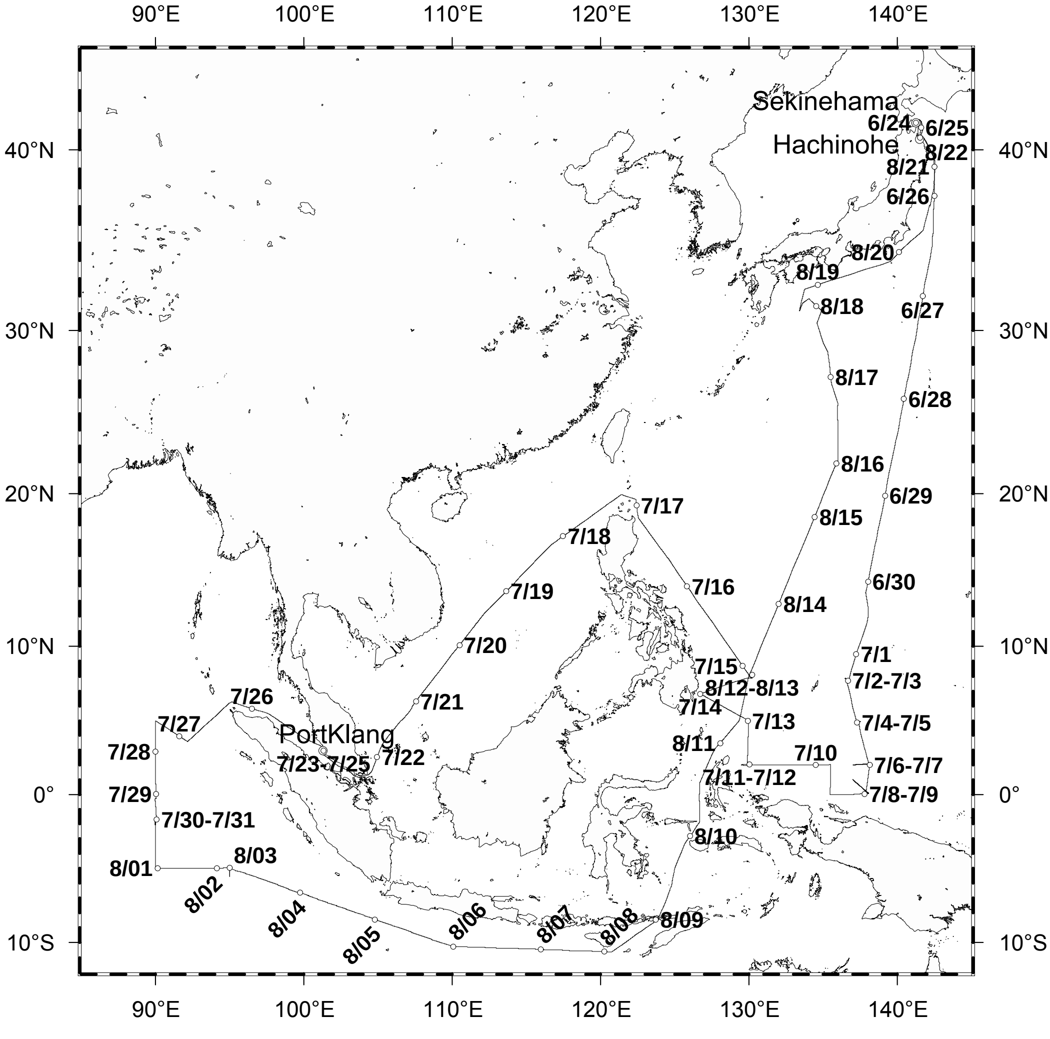
Aug. 6 (Tue.)

00:50	16:50	X109 (09-44.09S, 108-29.98E, 3348m)
01:26	17:26	RS-056 (09.73S, 108.49E)

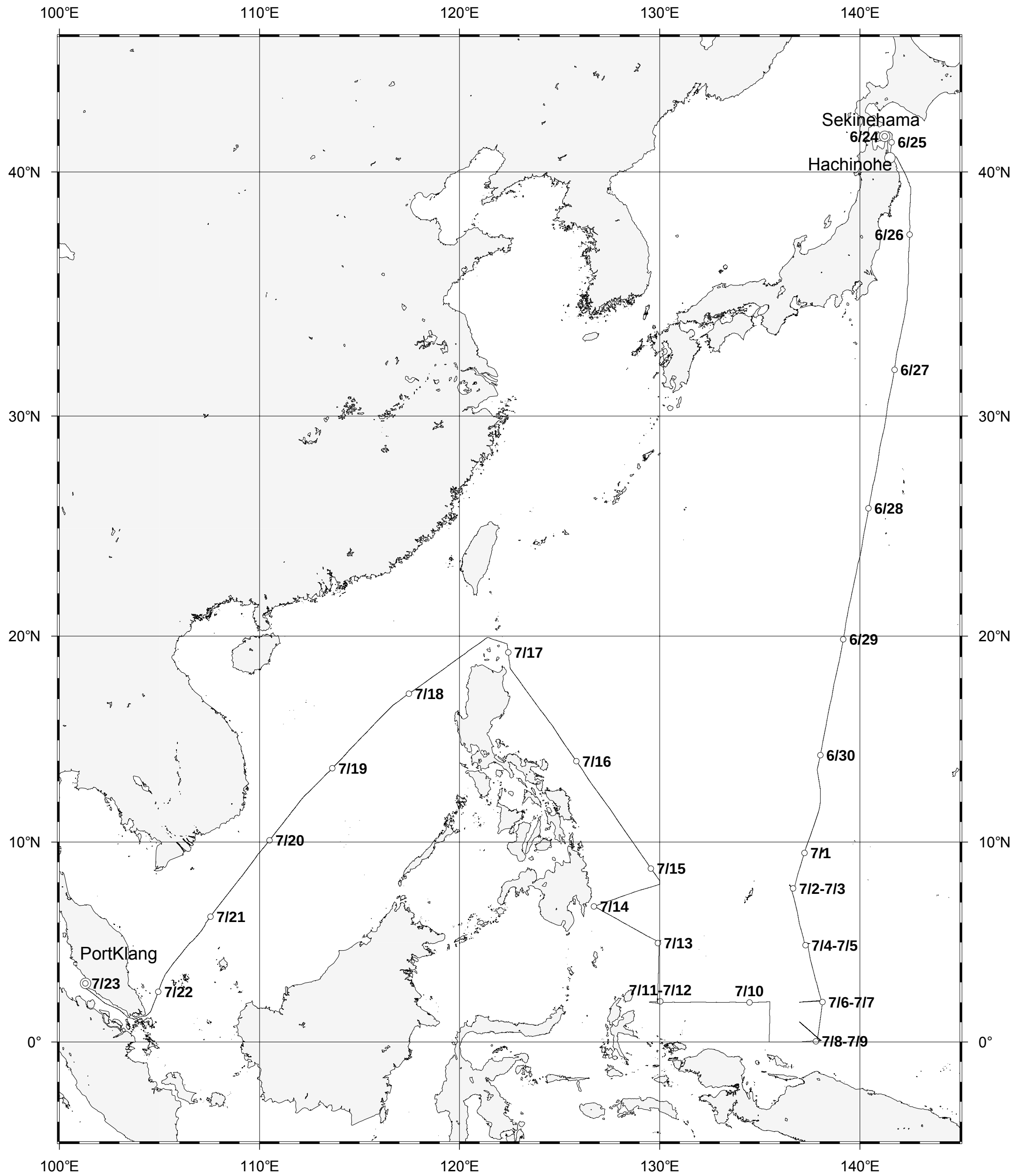
03:12	19:12	X110 (09-55.49S, 109-00.00E, 3759m)
05:23	21:23	X111 (10-04.78S, 109-30.01E, 4670m)
07:25	23:25	RS-057 (10.19S, 109.84E)
07:44	23:44	X112 (10-15.30S, 109-59.99E, 6898m)
Aug. 7 (Wed.)		
		Steaming
Aug. 8 (Thu.)		
14:00-14:30	06:00-06:30	Meeting for editing cruise report
Aug. 9 (Fri.)		
18:00	10:00	Ship mean time adjustment (SMT = UTC + 9)
Aug. 10 (Sat.)		
		Steaming
Aug. 11 (Sun.)		
		Steaming
Aug. 12 (Mon.)		
		Steaming
Aug. 13 (Tue.)		
07:33-11:53	22:33-02:53	Deployment of TRITON buoy (07-58.65N, 130-00.39E, 5723m)
12:19	03:19	X113 (08-00.28N, 130-01.31E, 5636m)
12:40	03:40	X114 (08-00.31N, 130-01.30E, 5572m)
Aug. 14 (Wed.)		
08:27	23:27	RS-058 (12.64N, 131.93E)
14:25	05:25	RS-059 (14.07N, 132.52E)
20:25	11:25	RS-060 (15.55N, 133.15E)
Aug. 15 (Thu.)		
02:26	17:26	RS-061 (17.02N, 133.80E)
08:28	23:28	RS-062 (18.35N, 134.37E)
Aug. 16 (Fri.)		
		Steaming
Aug. 17 (Sat.)		
		Steaming (Severe Tropical Storm Phanfone hit R/V Mirai)
Aug. 18 (Sun.)		
09:00	0:00	Finish of Doppler radar observation
Aug. 19 (Mon.)		
		Steaming (Severe Tropical Storm Phanfone hit R/V Mirai)
Aug. 20 (Tue.)		
		Steaming

Aug. 21 (Wed.)		
17:50	08:50	Arrival at Hachinohe, Japan
Aug. 22 (Thu.)		
17:00	08:00	Arrival at Sekinehama, Japan

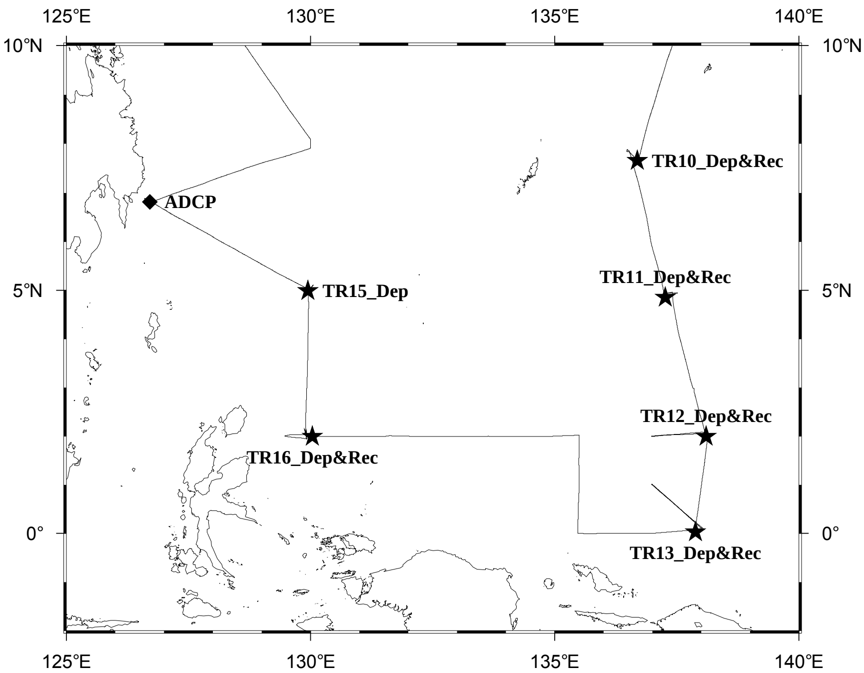
3.4 Cruise Track



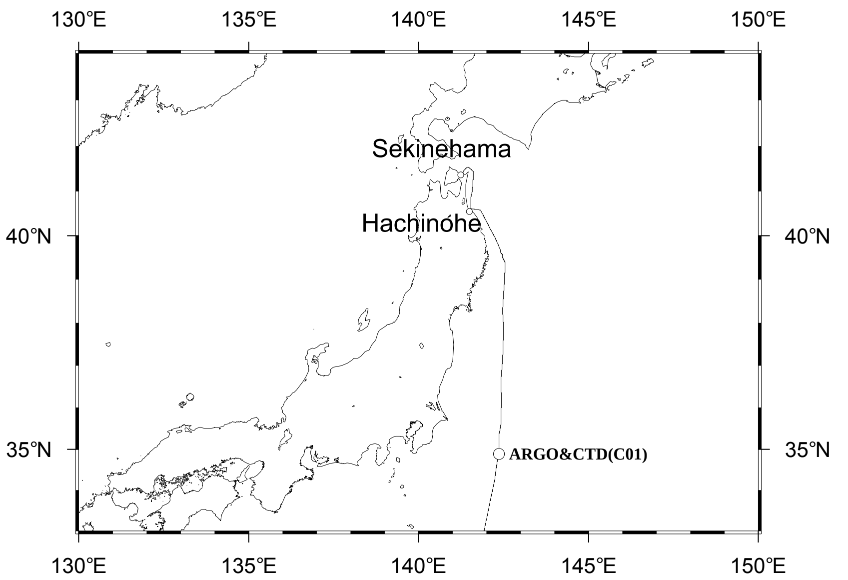
MR02-K04 Cruise Track



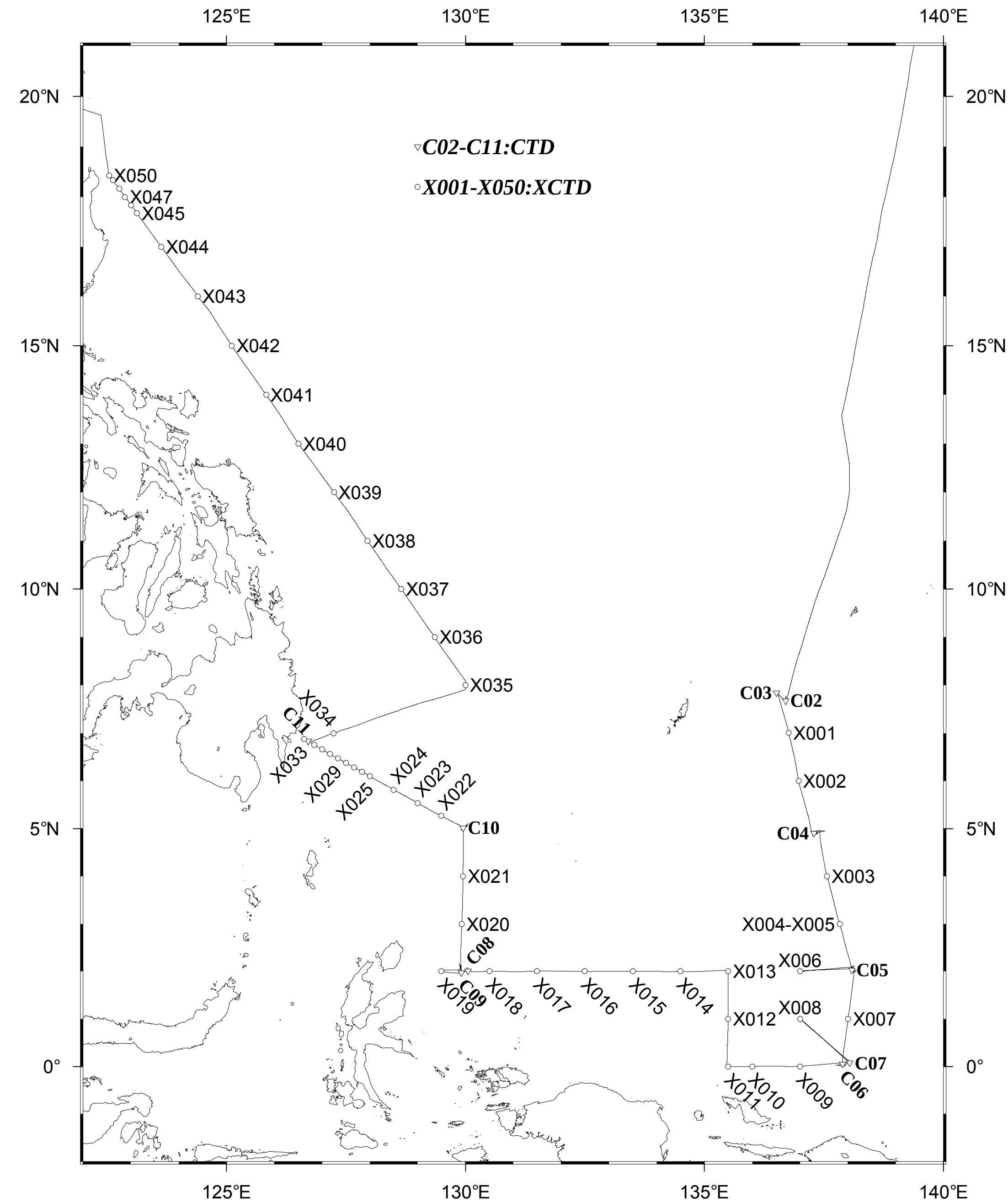
MR02-K04 Leg1 Cruise Track



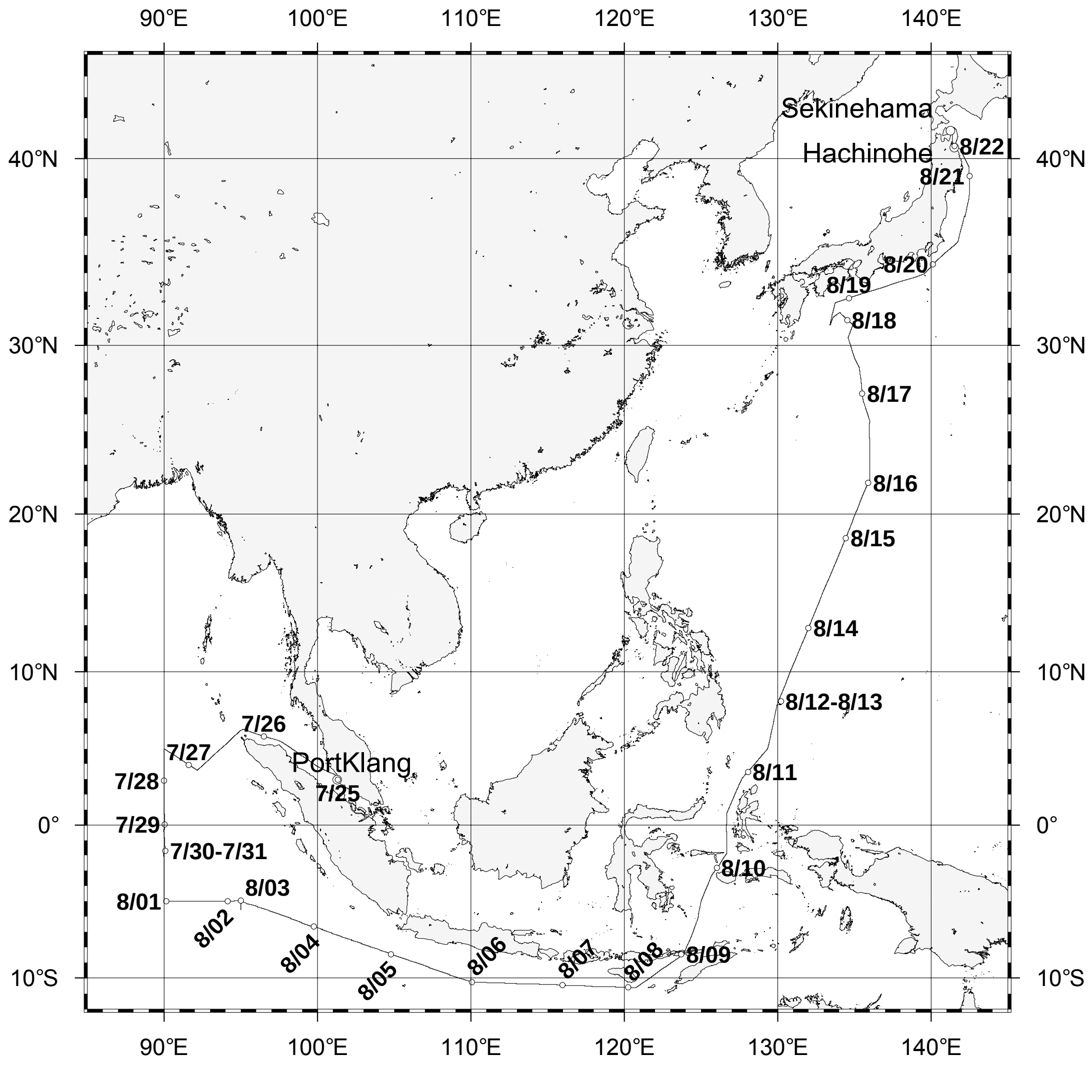
MR02-K04 Leg1 TRITON & ADCP



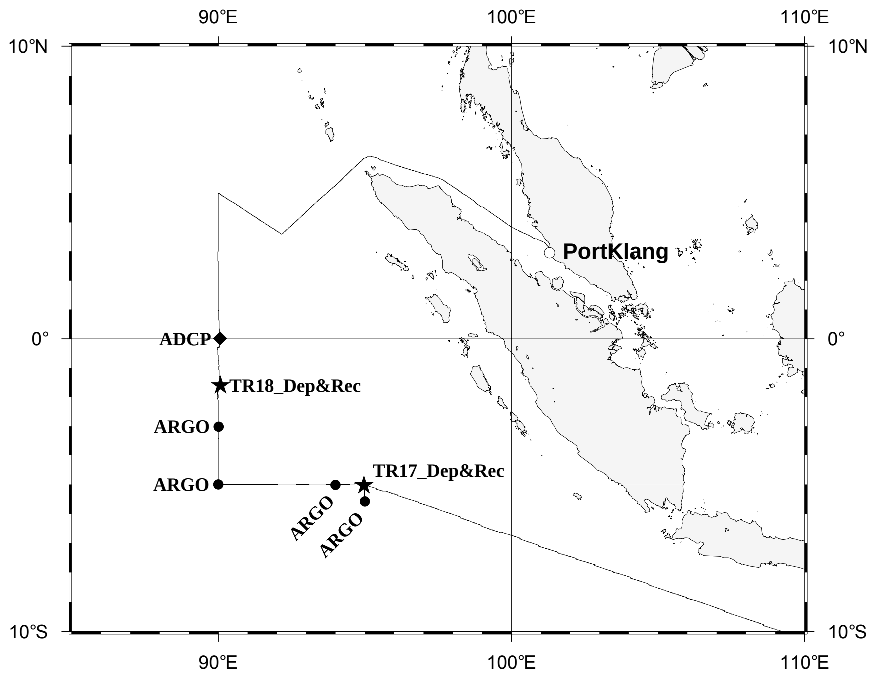
MR02-K04 Leg1 ARGO & CTD



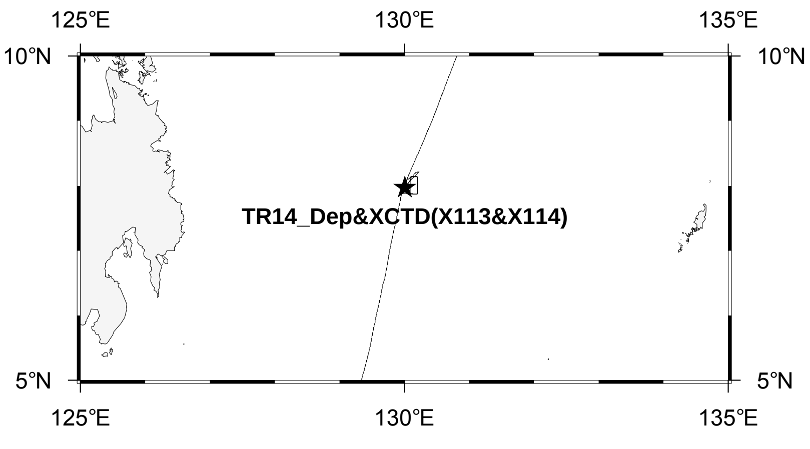
MR02-K04 Leg1 CTD & XCTD



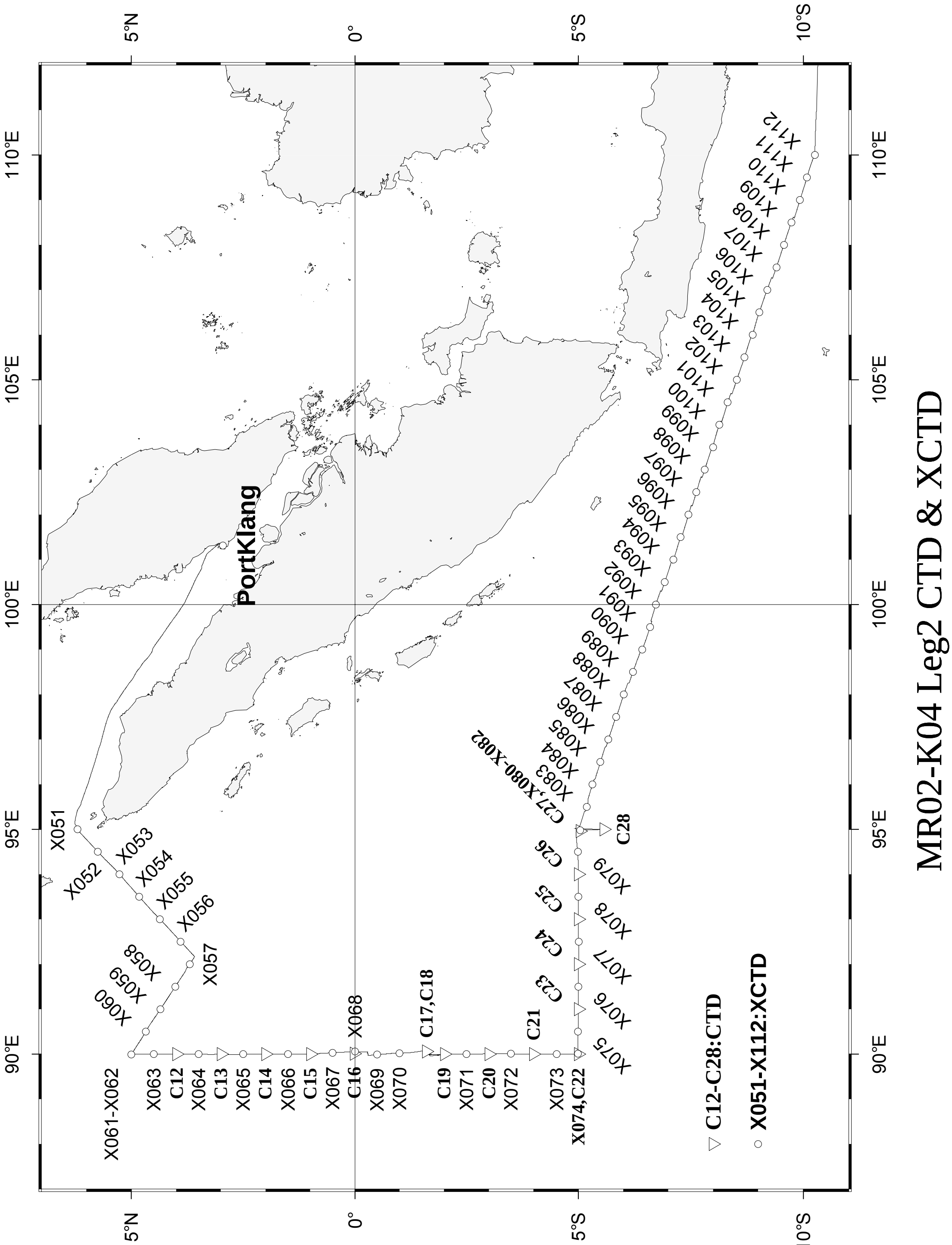
MR02-K04 Leg2 Cruise Track

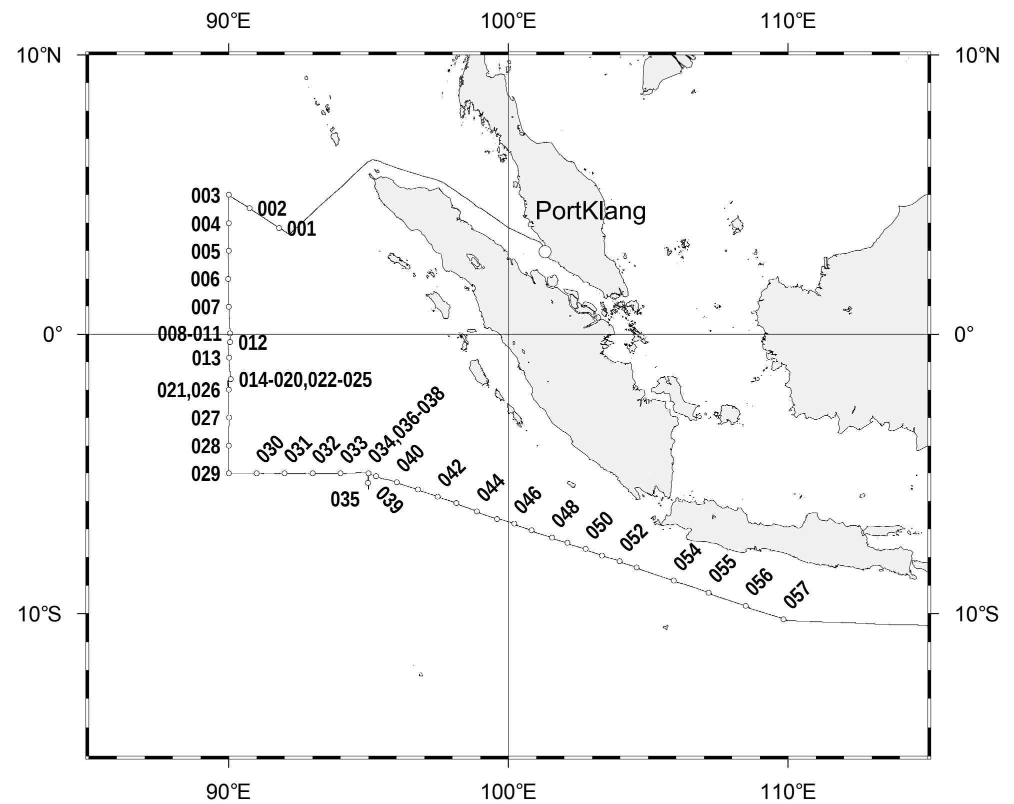


MR02-K04 Leg2 TRITON & ADCP & ARGO



MR02-K04 Leg2 TRITON-14 & XCTD


MR02-K04 Leg2 CTD & XCTD
C12-C28:CTD
X051-X112:XCTD
PortKlang
90°E
95°E
100°E
105°E
110°E
5°N
0°
5°S
10°S
X051
X052
X053
X054
X055
X056
X057
X058
X059
X060
X061-X062
X063
C12
X064
C13
X065
C14
X066
C15
X067
C16
X068
X069
X070
C17,C18
C19
X071
C20
X072
C21
X073
X074,C22
X075
C23
X076
C24
X077
C25
X078
C26
X079
C28
C27,X080-X082
X083
X084
X085
X086
X087
X088
X089
X090
X091
X092
X093
X094
X095
X096
X097
X098
X099
X100
X101
X102
X103
X104
X105
X106
X107
X108
X109
X110
X111
X112



MR02-K04 Radio Sonde

4. Chief scientist

<Leg 1>
Yoshifumi Kuroda
Associate Scientist
Ocean Observation and Research Department,
Japan Marine Science and Technology Center (JAMSTEC)
2-15, Natsushima, Yokosuka, Kanagawa 237-0061, JAPAN

<Leg 2>
Hideaki Hase
Researcher
Ocean Observation and Research Department,
Japan Marine Science and Technology Center (JAMSTEC)
2-15, Natsushima, Yokosuka, Kanagawa 237-0061, JAPAN

5. Participants list

5.1 R/V MIRAI scientist and technical staff

Yoshifumi Kuroda*	Japan Marine Science and Technology Center (JAMSTEC)
Hideaki Hase**	JAMSTEC
Shuichi Mori**	FORSGC
Hiroshi Matsuura**	FORSGC
Ichiro Matsui*	National Institute for Environmental Studies (NIES)
Atsushi Shimizu**	NIES
Yuji Fujitani***	Division of Environmental and Resource Engineering Graduate school of Hokkaido University

Masaki Hanyu*	Global Ocean Development Inc. (GODI)
Yasutaka Imai***	GODI
Wataru Tokunaga**	GODI
Shinya Iwamida***	GODI
Takeo Matsumoto***	Marine Works Japan (MWJ)
Masayuki Fujisaki***	MWJ
Masaki Taguchi*	MWJ
Hiroshi Matsunaga*	MWJ
Miki Yoshiike*	MWJ
Tomoyuki Takamori***	MWJ

Atsuo Ito**	MWJ
Kentaro Shiraishi**	MWJ
Kei Suminaga***	MWJ
Yuuichi Sonoyama***	MWJ
Hiroyasu Muramatsu***	MWJ
Takahiro Suzuki***	MWJ
Masahiko Nishino***	MWJ
Albertus Sulaiman***	TISDA-BPPT
Agus Saleh Atmadipoera***	Bogor Agricultural University, Marine Science Department
Mekky Mukarrom Santoso**	PUSSURTA TNI / DIS HIDROS

Maqrun Fadzli bin Mohd Fahmi**	Malaysian Meteorological Services
Kamaruddin Bin Yusoff**	Hydrography Department
Saji N.Hameed**	International Pacific Research Center (IPRC)

Legend

*	Leg-1	(Sekinehama, JAPAN – Port Klang, MALAYSIA)
**	Leg-2	(Port Klang, MALAYSIA – Sekinehama, JAPAN)
***	Leg-1,2	(Sekinehama, JAPAN – Port Klang, MALAYSIA – Sekinehama, JAPAN)

5.2 R/V MIRAI crew member

Crew List (Leg1)

Takaaki Hashimoto	Master
Yukio Dowaki	Chief Officer
Hiroki Maruyama	1st Officer
Masaki Fuchi	2nd Officer
Shingo Fujita	3rd Officer
Koichi Higashi	Chief Engineer
Nobuya Araki	1st Engineer
Koji Masuno	2nd Engineer
Kyoichi Hashimoto	3rd Engineer
Keiichirou Shishido	C.R.Officer
Naoto Morioka	2nd R.Officer
Kenetsu Ishikawa	Boatswain
Hisashi Naruo	Able Seaman
Yasuyuki Yamamoto	Able Seaman
Keiji Yamauchi	Able Seaman
Kunihiko Omote	Able Seaman
Yukiharu Suzuki	Able Seaman
Masaru Suzuki	Able Seaman
Yosuke Kuwahara	Able Seaman
Kazuyoshi Kudo	Able Seaman
Tsuyoshi Sato	Able Seaman
Takeharu Aisaka	Able Seaman
Masashige Okada	Able Seaman
Sadanori Honda	No.1 Oiler
Yukitoshi Horiuchi	Oiler
Takashi Miyazaki	Oiler
Nobuo Boshita	Oiler
Kazumi Yamashita	Oiler
Daisuke Taniguchi	Oiler
Yasutaka Kurita	Chief Steward
Takayuki Akita	Cook
Hitoshi Ota	Cook
Kozo Uemura	Cook
Hiroyuki Yoshizawa	Cook

Crew List (Leg2)

Takaaki Hashimoto	Master
Hiroki Maruyama	Chief Officer
Masaki Fuchi	1st Officer
Takeshi Isohi	2nd Officer
Shingo Fujita	3rd Officer
Koichi Higashi	Chief Engineer
Nobuya Araki	1st Engineer
Koji Masuno	2nd Engineer
Kyoichi Hashimoto	3rd Engineer
Keiichirou Shishido	C.R.Officer
Naoto Morioka	2nd R.Officer
Kenetsu Ishikawa	Boatswain
Hisashi Naruo	Able Seaman
Yasuyuki Yamamoto	Able Seaman
Keiji Yamauchi	Able Seaman
Kunihiko Omote	Able Seaman
Yukiharu Suzuki	Able Seaman
Masaru Suzuki	Able Seaman
Yosuke Kuwahara	Able Seaman
Kazuyoshi Kudo	Able Seaman
Tsuyoshi Sato	Able Seaman
Takeharu Aisaka	Able Seaman
Masashige Okada	Able Seaman
Sadanori Honda	No.1 Oiler
Yukitoshi Horiuchi	Oiler
Takashi Miyazaki	Oiler
Nobuo Boshita	Oiler
Kazumi Yamashita	Oiler
Daisuke Taniguchi	Oiler
Yasutaka Kurita	Chief Steward
Takayuki Akita	Cook
Hitoshi Ota	Cook
Kozo Uemura	Cook
Hiroyuki Yoshizawa	Cook
Tatsuya Hamabe	Cook

6.1 Meteorological Measurement

6.1.1 Surface meteorological observation

(1) Personnel

Kunio Yoneyama (JAMSTEC):	Principal Investigator	- Shore-side participant -
Masaki Hanyu (GODI):	Operation Leader	- Leg 1 -
Yasutaka Imai (GODI)		- Leg 1, Leg 2 -
Shinya Iwamida (GODI)		- Leg 1, Leg 2 -
Wataru Tokunaga (GODI)		- Leg 2 -

(2) Objective

Surface meteorological parameters are obtained as a basic meteorological dataset. These parameters provide us the information about temporal variation of the meteorological condition surrounding the ship.

(3) Methods

The surface meteorological parameters were observed throughout MR02-K04 cruise from the departure of Sekinehama on 25th June 2002 to the arrival of Sekinehama on 21st August 2002 .

This cruise, we used 2 systems for the surface meteorological observation.

1. R/V Mirai meteorological observation system
2. Shipboard Oceanographic and Atmospheric Radiation (SOAR) system

(3-1) R/V Mirai meteorological observation system

Instruments of R/V Mirai met system are listed in Table 6.1-1 and measured parameters are listed in Table 6.1-2. Data was collected and processed by KOAC-7800 weather data processor made by Koshin Denki, Japan. The data set has 6-second averaged every 6-second record and 10-minute averaged every 10-minute record.

Table 6.1-1: Instruments and their installation locations of R/V Mirai met system

sensors	type	manufacturer	location (altitude from surface)
anemometer	KE-500	Koshin Denki, Japan	foremast (24m)
thermometer	FT	Koshin Denki, Japan	compass deck (21m) AT
	RFN1-0	Koshin Denki, Japan	4th deck (-1m, inlet –5m) SST
dewpoint meter	DW-1	Koshin Denki, Japan	compass deck (21m)
barometer	F-451	Yokogawa, Japan	captain deck (13m)
rain gauge	50202	R. M. Young, USA	compass deck (19m)
optical rain gauge	ORG-115DR	ScTi, USA	compass deck (19m)
radiometer (SW)	MS-801	Eiko Seiki, Japan	radar mast (28m)
radiometer (IR)	MS-202	Eiko Seiki, Japan	radar mast (28m)
wave height meter	MW-2	Tsurumi-seiki, Japan	bow (10m)

Table 6.1-2: Parameters of R/V Mirai meteorological observation system

parmeters	units	remarks
1. latitude	degree	
2. longitude	degree	
3. ship's speed	knot	Mirai log, DS-30 Furuno
4. ship's heading	degree	Mirai gyro, TG-6000, Tokimec
5. relative wind speed	m/s	6sec/10min averaged
6. relative wind direction	degree	6sec/10min averaged
7. true wind speed	m/s	conducted by 3/4/5/6 6sec/10min averaged
8. true wind direction	degree	conducted by 3/4/5/6 6sec/10min averaged
9. barometric pressure	hPa	adjusted to sea surface level 6sec/10min averaged
10. air temperature (starboard side)	degC	6sec/10min averaged
11. air temperature (port side)	degC	6sec/10min averaged
12. dewpoint temperature (starboard side)	degC	6sec/10min averaged
13. dewpoint temperature (port side)	degC	6sec/10min averaged
14. relative humidity (starboard side)	%	conducted by 9/10/12 6sec/10min averaged
15. relative humidity (port side)	%	conducted by 9/11/13 6sec/10min averaged
16. sea surface temperature	degC	6sec/10min averaged
17. rain rate (optical rain gauge)	mm/hr	hourly accumulation
18. rain rate (capacitive rain gauge)	mm/hr	hourly accumulation
19. down welling shortwave radiation	W/m^2	6sec/10min averaged
20. down welling infra-red radiation	W/m^2	6sec/10min averaged
21. significant wave height	m	hourly
22. significant wave period	second	hourly

(3-2) Shipboard Oceanographic and Atmospheric Radiation (SOAR) system

SOAR system, designed by BNL (Brookhaven National Laboratory, USA), is consisted of 3 parts.

1. Portable Radiation Package (PRP) designed by BNL – short and long wave down welling radiation
2. Zeno meteorological system designed by BNL – wind, Tair/RH, pressure and rainfall measurement
3. Scientific Computer System (SCS) designed by NOAA (National Oceanographic and Atmospheric Administration, USA) – centralized data acquisition and logging of all data sets

SCS recorded PRP data every 6.5 seconds, Zeno/met data every 10 seconds.

Instruments and their locations are listed in Table 6.1-3 and measured parameters are listed in Table 6.1-4

Table 6.1-3: Instrument installation locations of SOAR system

sensors	type	manufacturer	location (altitude from surface)
Zeno/Met			
anemometer	05106	R. M. Young, USA	foremast (25m)
T/RH	HMP45A	Vaisala, USA	foremast (24m)
		with 43408 Gill aspirated radiation shield (R. M. Young)	
barometer	61201	R. M. Young, USA	foremast (24m)
		with 61002 Gill pressure port (R. M. Young)	
rain gauge	50202	R. M. Young, USA	foremast (24m)
optical rain gauge	ORG-815DA	Optical Science Inc., USA	foremast (24m)
PRP			
radiometer (SW)	PSP	Eppley labs, USA	foremast (25m)
radiometer (IR)	PIR	Eppley labs, USA	foremast (25m)
fast rotating shadowband radiometer		Yankee Environmental Sys	foremast (25m)

Table 6.1-4: Parameters of SOAR System

parmeters	units	remarks
1. latitude	degree	
2. longitude	degree	
3. ship's speed	knot	Mirai log, DS-30 Furuno
4. ship's heading	degree	Mirai gyro, TG-6000, Tokimec
5. relative wind speed	m/s	
6. relative wind direction	degree	
7. true wind speed	m/s	conducted by 3/4/5/6
8. true wind direction	degree	conducted by 3/4/5/6
9. barometric pressure	hPa	
10. air temperature	degC	
11. relative humidity	%	
12. rain rate (optical rain gauge)	mm/hr	
13. precipitation (capacitive rain gauge)	mm	reset at 50mm
14. down welling shortwave radiation	W/m^2	
15. down welling infra-red radiation	W/m^2	
16. defused radiation	W/m^2	

(4) Preliminary results

Wind (converted to U, V component, from SOAR), Tair (from SOAR) / SST (from EPCS), RH (from SOAR) / precipitation (from SOAR), solar radiation (from SOAR), pressure (from SOAR) and hourly significant wave height observed during the cruise are shown in Figure 6.1-1, Figure 6.1-2, Figure 6.1-3, Figure 6.1-4, and Figure 6.1-5 respectively. In the figures, accumulated precipitation data from SOAR capacitive rain gauge was converted to the precipitation amount in every minute and obvious noises were eliminated but not calibrated. Other figures are showing uncorrected data.

(5) Data archives

These raw data will be submitted to the Data Management Office (DMO) in JAMSTEC just after the cruise and archived there.

(6) Remarks

1. We did not sample the data in the EEZ of Socialist Republic of Vietnam from 16:43 (UTC) 17 July to 23:06 (UTC) 21 July 2002.

2. Radiometers for the upwelling radiation measurement of R/V Mirai meteorological observation system were not installed during this cruise.
3. Shortwave radiometer for down welling radiation data was not available from 15:00 (UTC) 29 June to 05:00 (UTC) 2 July due to bad cable connection.
4. PRP stopped from 00:40 (UTC) to 02:03 (UTC) 13 August 2002, caused by software trouble.
5. Plotting SST (Sea Surface Temperature) data was not available from 04:22 (UTC) 22 July to 07:19 (UTC) 25 July 2002 in Figure 6.1-3.

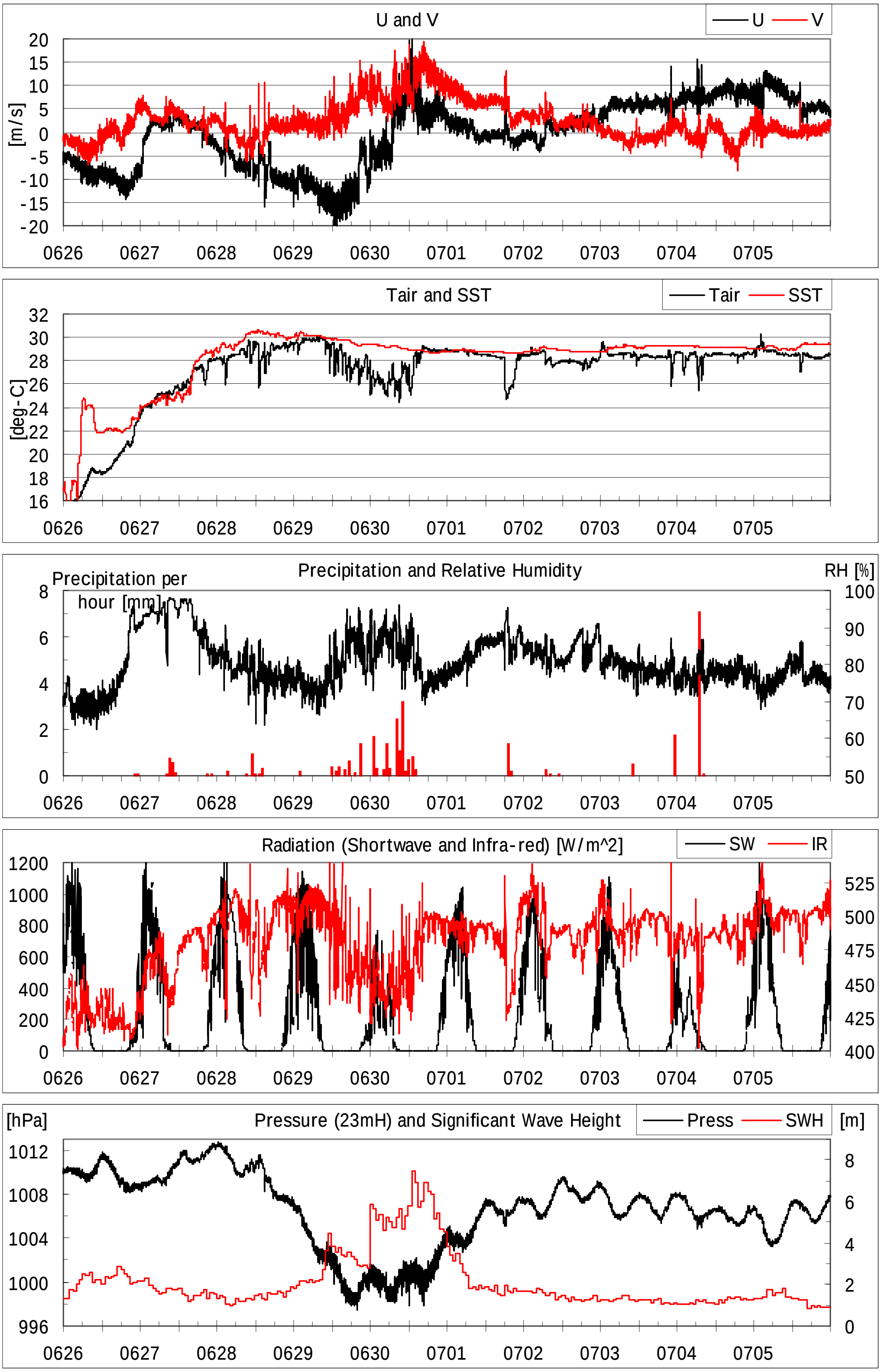

U and V
U
V
[m/s]
20
15
10
5
0
-5
-10
-15
-20
0626 0627 0628 0629 0630 0701 0702 0703 0704 0705
Tair and SST
Tair
SST
[deg-C]
32
30
28
26
24
22
20
18
16
0626 0627 0628 0629 0630 0701 0702 0703 0704 0705
Precipitation and Relative Humidity
Precipitation per hour [mm]
RH [%]
8
6
4
2
0
100
90
80
70
60
50
0626 0627 0628 0629 0630 0701 0702 0703 0704 0705
Radiation (Shortwave and Infra-red) [W/m^2]
SW
IR
1200
1000
800
600
400
200
0
525
500
475
450
425
400
0626 0627 0628 0629 0630 0701 0702 0703 0704 0705
[hPa]
Pressure (23mH) and Significant Wave Height
Press
SWH
[m]
1012
1008
1004
1000
996
8
6
4
2
0
0626 0627 0628 0629 0630 0701 0702 0703 0704 0705

Figure 6.1-1

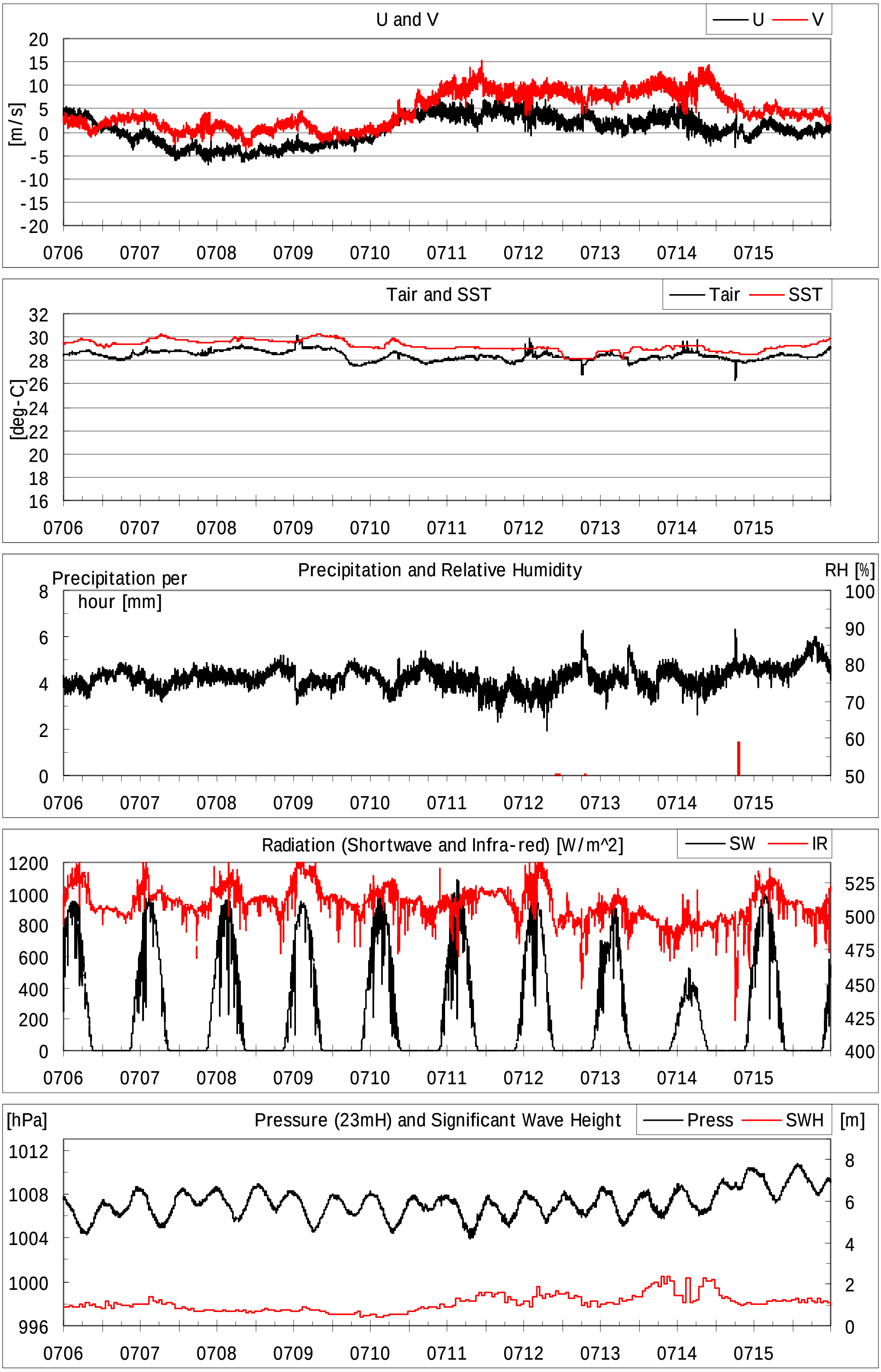

U and V
U
V
[m/s]
20
15
10
5
0
-5
-10
-15
-20
0706
0707
0708
0709
0710
0711
0712
0713
0714
0715
Tair and SST
Tair
SST
[deg-C]
32
30
28
26
24
22
20
18
16
Precipitation and Relative Humidity
Precipitation per hour [mm]
RH [%]
8
6
4
2
0
100
90
80
70
60
50
Radiation (Shortwave and Infra-red) [W/m^2]
SW
IR
1200
1000
800
600
400
200
0
525
500
475
450
425
400
[hPa]
Pressure (23mH) and Significant Wave Height
Press
SWH
[m]
1012
1008
1004
1000
996
8
6
4
2
0

Figure 6.1-2

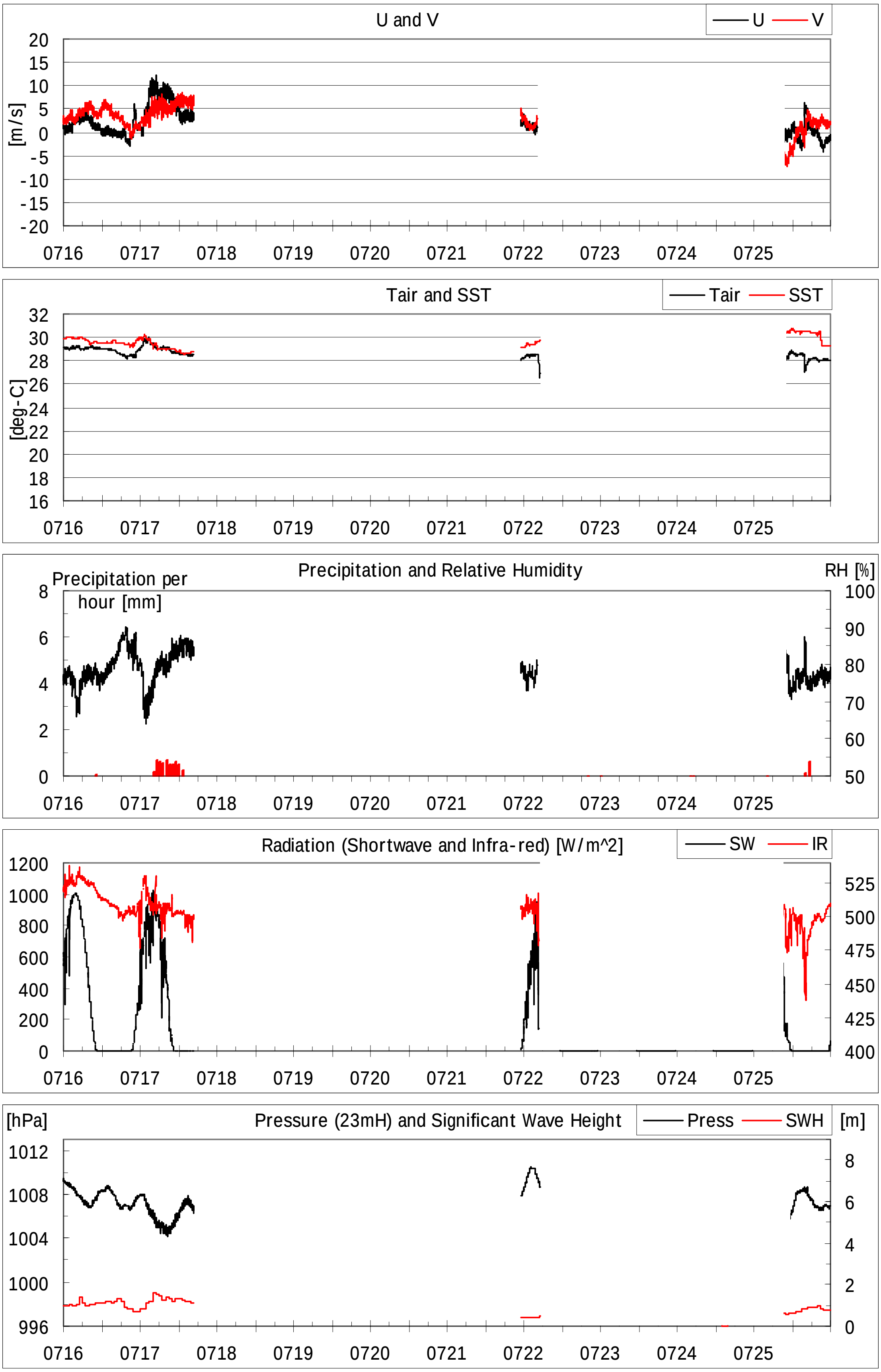
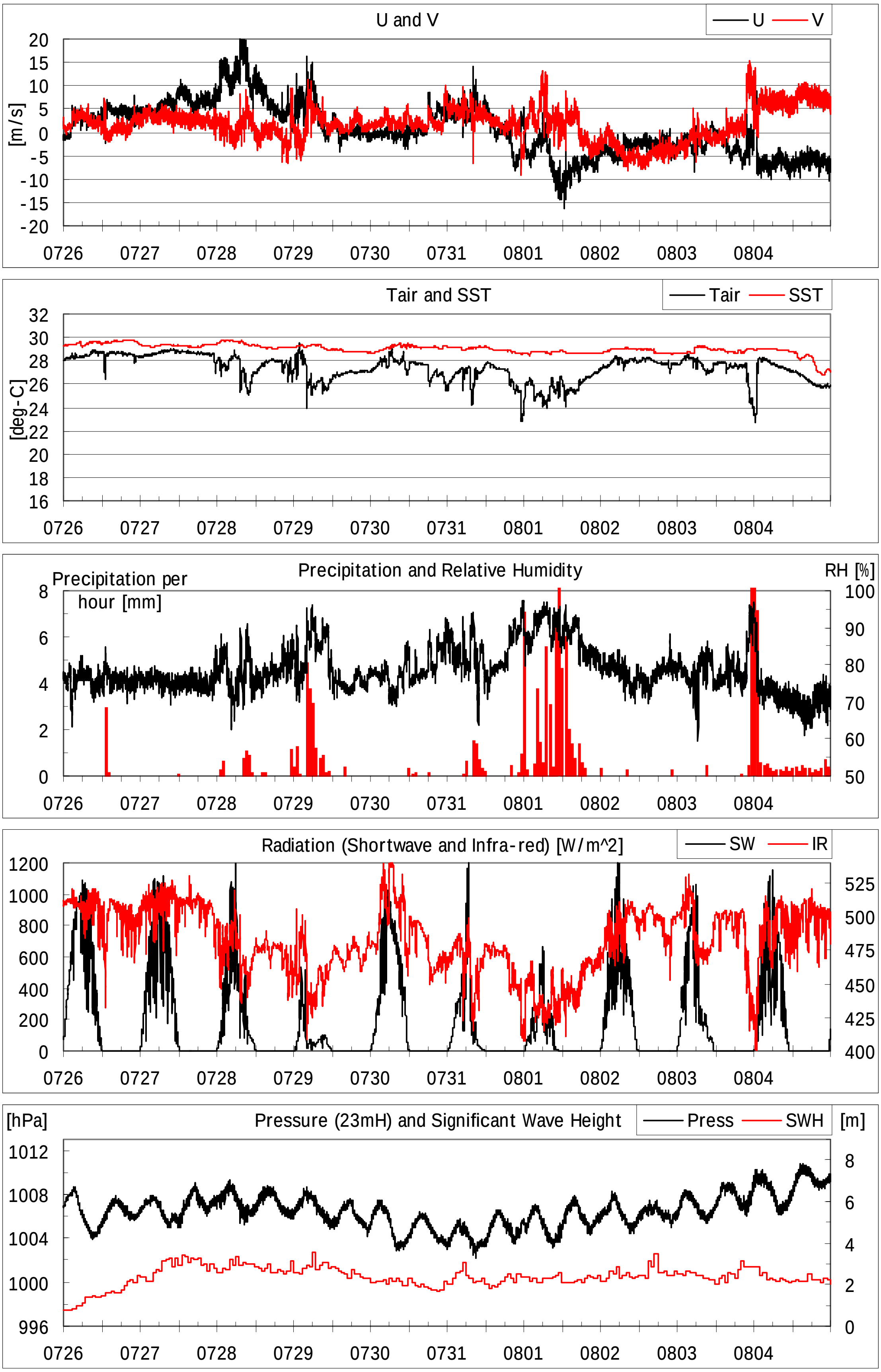

U and V
U
V
[m/s]
20
15
10
5
0
-5
-10
-15
-20
0716
0717
0718
0719
0720
0721
0722
0723
0724
0725
Tair and SST
Tair
SST
[deg-C]
32
30
28
26
24
22
20
18
16
Precipitation and Relative Humidity
Precipitation per hour [mm]
RH [%]
8
6
4
2
0
100
90
80
70
60
50
Radiation (Shortwave and Infra-red) [W/m^2]
SW
IR
1200
1000
800
600
400
200
0
525
500
475
450
425
400
Pressure (23mH) and Significant Wave Height
Press
SWH
[hPa]
[m]
1012
1008
1004
1000
996
8
6
4
2
0

Figure 6.1-3



U and V
U
V
[m/s]
20
15
10
5
0
-5
-10
-15
-20
0726
0727
0728
0729
0730
0731
0801
0802
0803
0804
Tair and SST
Tair
SST
[deg-C]
32
30
28
26
24
22
20
18
16
Precipitation and Relative Humidity
Precipitation per hour [mm]
RH [%]
8
6
4
2
0
100
90
80
70
60
50
Radiation (Shortwave and Infra-red) [W/m^2]
SW
IR
1200
1000
800
600
400
200
0
525
500
475
450
425
400
[hPa]
Pressure (23mH) and Significant Wave Height
Press
SWH
[m]
1012
1008
1004
1000
996
8
6
4
2
0

Figure 6.1-4

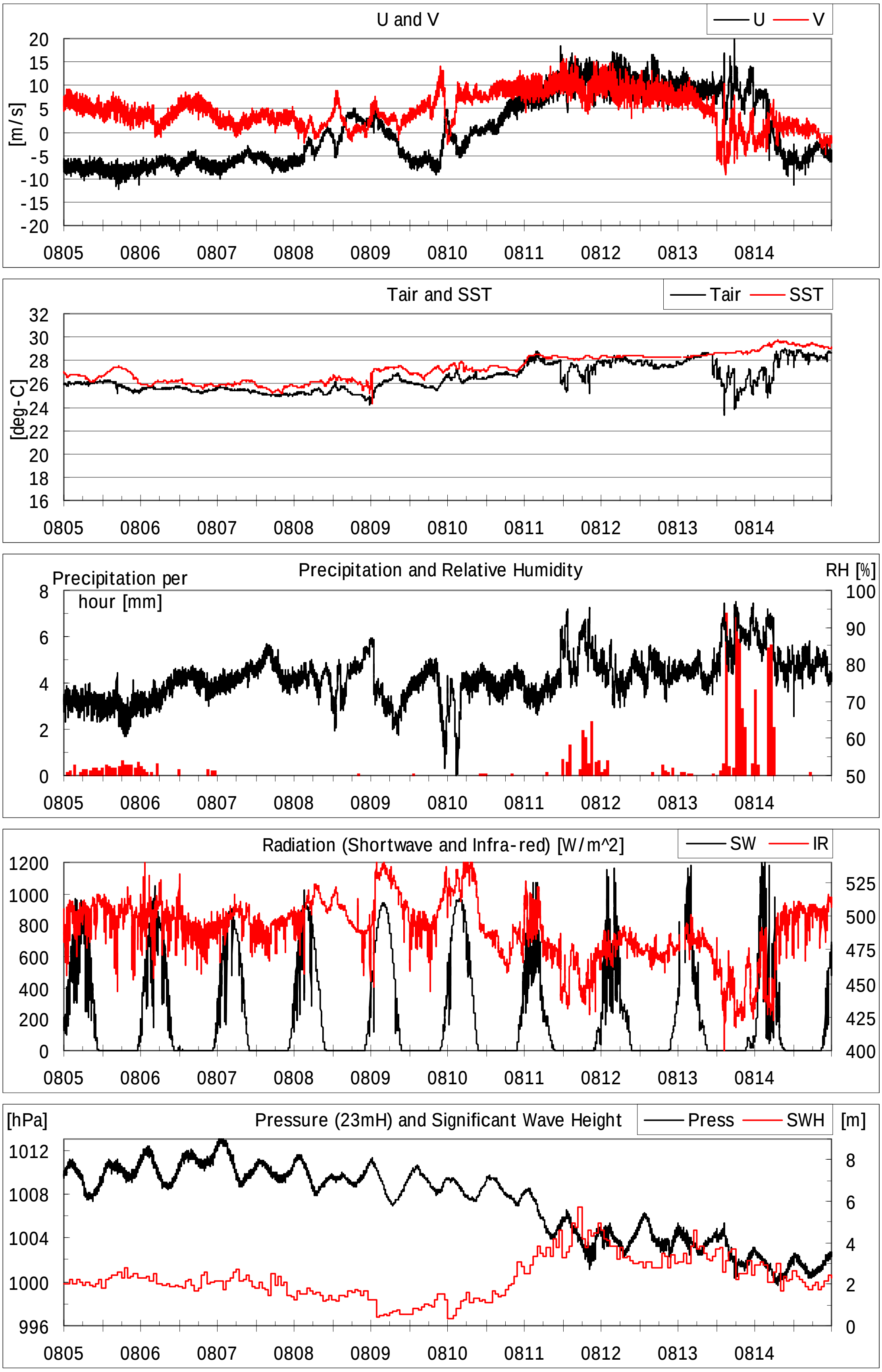

U and V
U
V
[m/s]
20
15
10
5
0
-5
-10
-15
-20
0805
0806
0807
0808
0809
0810
0811
0812
0813
0814
Tair and SST
Tair
SST
[deg-C]
32
30
28
26
24
22
20
18
16
Precipitation and Relative Humidity
Precipitation per hour [mm]
RH [%]
8
6
4
2
0
100
90
80
70
60
50
Radiation (Shortwave and Infra-red) [W/m^2]
SW
IR
1200
1000
800
600
400
200
0
525
500
475
450
425
400
[hPa]
Pressure (23mH) and Significant Wave Height
Press
SWH
[m]
1012
1008
1004
1000
996
8
6
4
2
0

Figure 6.1-5

6.1.2 Ceilometer

(1) Personnel

Kunio Yoneyama (JAMSTEC):	Principal Investigator	- Shore-side participant -
Masaki Hanyu (GODI):	Operation Leader	- Leg 1 -
Yasutaka Imai (GODI)		- Leg 1, Leg 2 -
Shinya Iwamida (GODI)		- Leg 1, Leg 2 -
Wataru Tokunaga (GODI)		- Leg 2 -

(2) Objective

The information of the cloud base height and the liquid water amount around cloud base is important to understand the processes on the formation of the cloud. As one of the methods to measure them, the ceilometer observation was carried out.

(3) Methods

We measured cloud base height and backscatter profiles using CT-25K ceilometer (Vaisala, Finland) throughout MR02-K04 cruise from the departure of Sekinehama on 25th June to the arrival of Sekienehama on 21st August 2002.

Major parameters for the measurement configuration are as follows;

Laser source:	Indium Gallium Arsenide (InGaAs) Diode Laser
Transmitting wave length:	905 +/- 5 nm at 25 deg-C
Transmitting average power:	8.9 mW
Repetition rate:	5.57 kHz
Detector:	Silicon avalanche photodiode (APD)
Responsibility at 905 nm:	65 A/W
Measurement range:	0 – 7.5 km
Resolution:	50 ft in full range
Sampling rate:	60 sec.
Location:	Compass deck (18m above the sea level)

On the archived dataset, cloud base height and backscatter profile are recorded with the resolution of 30 m (100 ft).

(4) Preliminary results

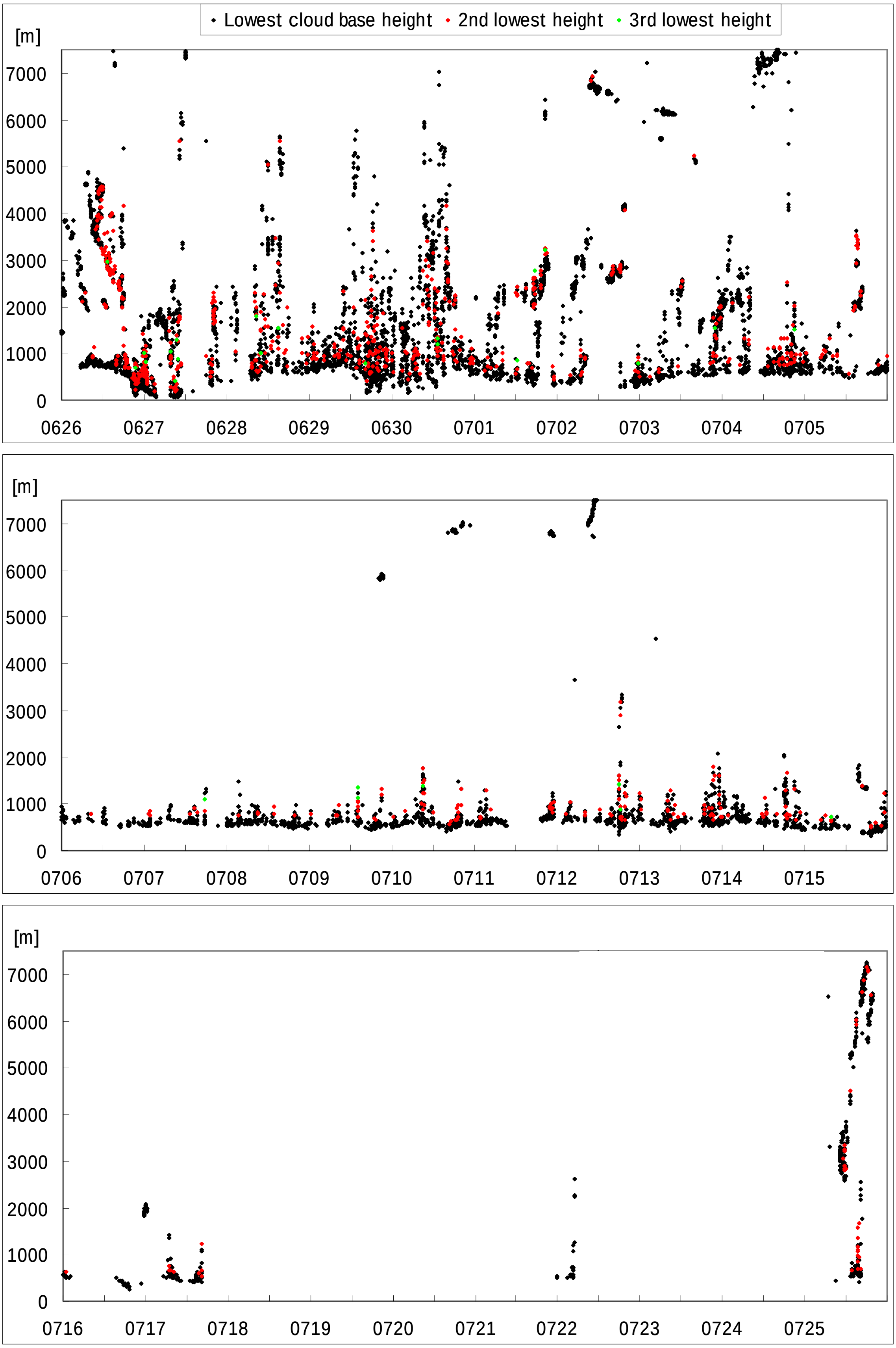
The first, second and third lowest cloud base height which the ceilometer detected during the cruise are plotted in Fig. 6.1.2-1 and Fig. 6.1.2-2. Sometimes the ceilometer records calculated vertical visibility and the height of detected highest signal instead of the cloud base heights. But they are not plotted in the figure.

(5) Data archives

These raw data will be submitted to the Data Management Office (DMO) in JAMSTEC just after the cruise and archived there.

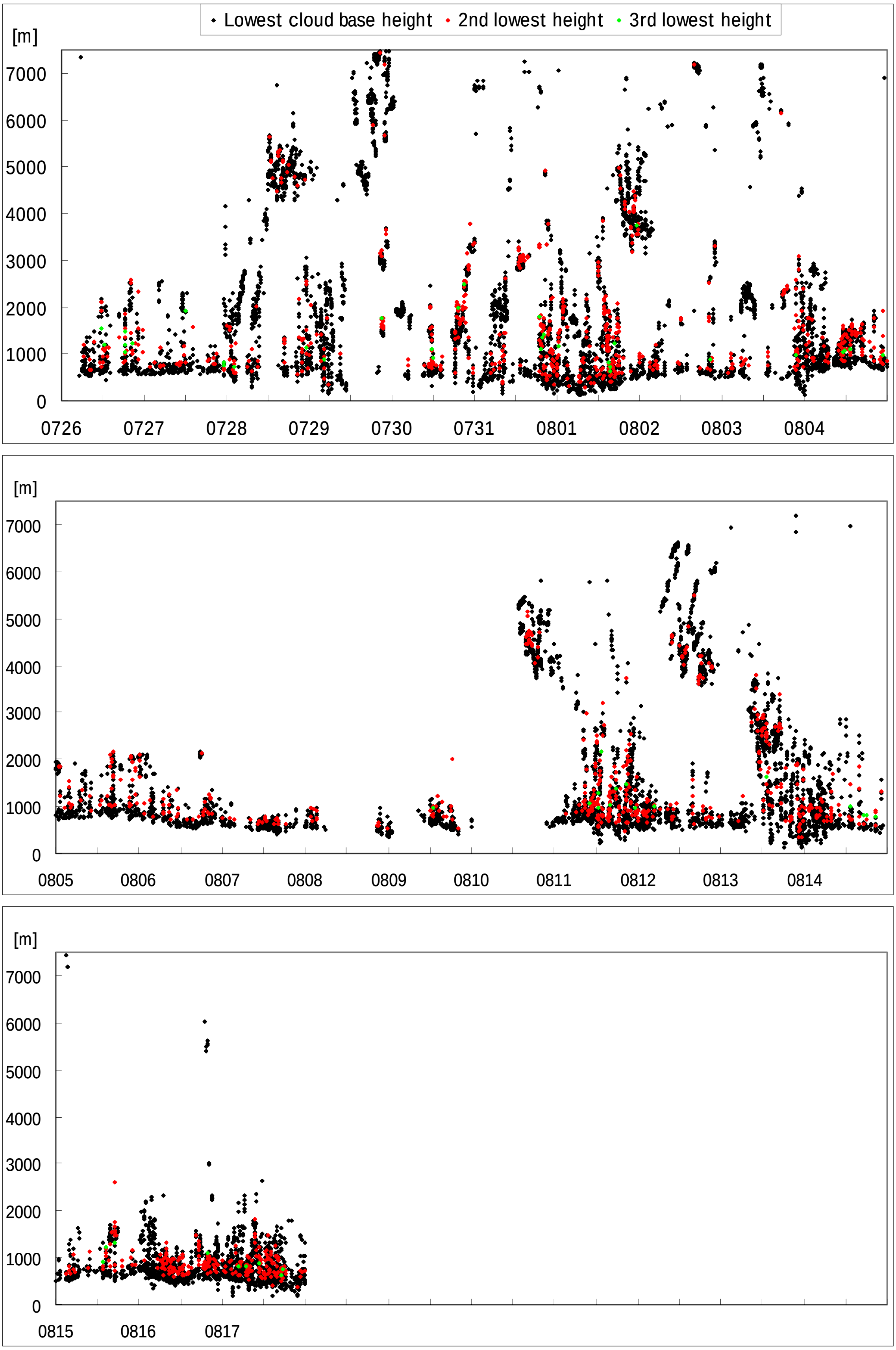
(6) Remarks

1. We did not sample the data in the EEZ of Socialist Republic of Vietnam from 16:43(UTC) 17 July to 23:06(UTC) 21 July 2002.
2. Data logging was stopped from 00:30(UTC) to 02:15(UTC) 13th August 2002, caused by logging PC trouble.
3. Following records are missing (MMDDhhmm in UTC).
   07031327



Lowest cloud base height
2nd lowest height
3rd lowest height
[m]
7000
6000
5000
4000
3000
2000
1000
0
0626
0627
0628
0629
0630
0701
0702
0703
0704
0705
[m]
7000
6000
5000
4000
3000
2000
1000
0
0706
0707
0708
0709
0710
0711
0712
0713
0714
0715
[m]
7000
6000
5000
4000
3000
2000
1000
0
0716
0717
0718
0719
0720
0721
0722
0723
0724
0725

Fig. 6.1.2-1



Lowest cloud base height
2nd lowest height
3rd lowest height
[m]
7000
6000
5000
4000
3000
2000
1000
0
0726
0727
0728
0729
0730
0731
0801
0802
0803
0804
[m]
7000
6000
5000
4000
3000
2000
1000
0
0805
0806
0807
0808
0809
0810
0811
0812
0813
0814
[m]
7000
6000
5000
4000
3000
2000
1000
0
0815
0816
0817

Fig. 6.1.2-2

6.2 CTD/XCTD
6.2.1 CTD

(1) Personnel

Yoshifumi Kuroda*	(JAMSTEC): Principal Investigator (Leg 1)	
Hideaki Hase**	(JAMSTEC): Principal Investigator (Leg 2)	
Masayuki Fujisaki***	(MWJ): Operation Leader	
Takeo Matsumoto***	(MWJ): Technical staff	
Atsuo Ito**	(MWJ): Technical staff	
Masaki Taguchi*	(MWJ): Technical staff	
Hiroshi Matsunaga*	(MWJ): Technical staff	
Kei Suminaga***	(MWJ): Technical staff	
Kentaro Shiraishi**	(MWJ): Technical staff	
Miki Yoshiike*	(MWJ): Technical staff	
Tomoyuki Takamori***	(MWJ): Technical staff	* : Leg 1
Hiroyasu Muramatsu***	(MWJ): Technical staff	** : Leg 2
Takahiro Suzuki***	(MWJ): Technical staff	*** : Leg 1,2

(2) Objective

Investigation of oceanic structure.

(3) Parameters

Temperature
Conductivity
Pressure
Dissolved Oxygen（Leg 2）

(4) Methods

CTD/Carousel water sampling system (CWS), which is a 12-position Carousel water sampler with Sea-Bird Electronics Inc. CTD (SBE9plus), was used during this cruise. 12-litter Niskin bottles were used for sampling seawater. The sensors attached on the CTD were a temperature sensor, conductivity sensor and pressure sensor and D.O. sensor (during Leg2). Salinity was calculated from measured values of pressure, conductivity and temperature. The CTD/CWS was deployed from starboard on working deck.

The CTD raw data were acquired on real time by using the Seasave-Win32 (ver.5.25b) provided by Sea-Bird Electronics, Inc. and stored on a hard disk of the personal computer. Seawater was sampled during up-cast by sending a fire command from the personal computer. We sampled seawater to calibrate salinity data.

Total 28 casts of CTD measurements have been carried out. (See Table 6.2.1-1)

The CTD raw data was processed using SBE Data Processing-Win32 (ver.5.25). Data processing procedures and used utilities SBE Data Processing-Win32 were as follows:

DATCNV : Convert the binary raw data to output on physical units.
This utility selects the CTD data when bottles closed to output on another file.

SECTION : Remove the unnecessary data.

ALIGNCTD* : ALIGNCTD aligns oxygen measurements in time relative to pressure.
Oxygen sensor relative to pressure = 3 seconds

WILDEDIT : Obtain an accurate estimate of the true standard deviation of the data.
Std deviation for pass 1= 2
Std deviation for pass 2= 10
Scan per block= 48

Keep data within this distance of mean= 1000
Exclude Scan Marked Bad = Check

CELLTM： Remove conductivity cell thermal mass effects from measured conductivity.
Alpha = 0.03
1/beta = 7.0

FILTER： Filter the high frequency noise on the data
Filter A = 0.15sec
Variable to Filter: Pressure: Low Pass Filter A

LOOPEDIT： Mark scan with ‘bad flag’, if the CTD velocity is less than 0 m/s.
Minimum Velocity Type = Fixed Minimum Velocity
Minimum CTD Velocity [m/sec] = 0.0
Exclude Scan Marked Bad = Check

DERIVE*： Calculate dissolved oxygen concentration

BINAVG： Calculate the averaged data in every 1 db.

DERIVE： Calculate oceanographic parameters.

SPLIT： Splits the data made in CNV files into up-cast and down-cast files.

ROSSUM： Edits the data of water sampled to output a summary file.

*：only Leg 2

Configuration file

Leg1: MR02K04.con
Leg2: MR02K04d.con

Specifications of the sensors are listed below.

CTD system： SBE911plus CTD system

Under water unit：
Leg1･2：CTD 9plus (S/N 09P21746-0575, Sea-bird Electronics, Inc.)

Temperature sensors：
Leg1･2：SBE3-04/F Primary sensor (S/N 031525, Sea-bird Electronics, Inc.)
Calibrated Date: 21 May. 2002

Conductivity sensors：
Leg1･2：SBE4-04/F Primary sensor (S/N 041088, Sea-bird Electronics, Inc.)
Calibrated Date: 21 May. 2002

Pressure sensor：
Leg1･2：Digiquartz pressure sensor (S/N 79492)
Calibrated Date: 27 Oct. 1999
Deadweight test date: 08 Apr. 2002

Oxygen sensor：
Leg2：SBE13 sensor (S/N 130339, Sea-bird Electronics, Inc.)
Calibrated Date: 17 May. 2002

Deck unit：
Leg1･2：SBE11 (S/N 11P7030-0272, Sea-bird Electronics, Inc.).

Carousel water sampler：
Leg1･2：SBE32 (S/N 3227443-0389, Sea-bird Electronics, Inc.).

(5) Preliminary result

Temperature and salinity profiles are shown in Fig.6.2.1-1 – Fig.6.2.1-12. Cross sections of temperature and salinity down-casting profile are shown. Note that in these figures, the correction of salinity data by sampled water is not applied.

(6) Data archive

All raw and processed CTD data files were copied onto magnet-optical disk (MO). The data will be submitted to the Data Management Office (DMO), JAMSTEC, and will be opened to public via “R/V MIRAI Data Web Page” in JAMSTEC home page.

Table 6.2.1-1 CTD Cast Table

Line	St.	File Name	Lat.	Long.	Date [UTC]	Start Time	End Time	Max. Press. [db]	Max. Wire Out [m]	Depth [m]	Water Sampling	Note
Leg1	C01	C01S01	34-53.91N	142-21.95E	26.Jun.2002	10:32	11:52	2001	2000.3	7042	○	Argo Float deployed point
Leg1	C02	C02S01	07-40.51N	136-41.97E	02.Jul.2002	03:58	04:54	1001	992.4	3147	○	TRITON deployment
Leg1	C03	C03S01	07-51.39N	136-28.76E	02.Jul.2002	06:26	07:15	1002	1006.4	3352	○	TRITON recovery
Leg1	C04	C04S01	04-54.22N	137-17.26E	04.Jul.2002	05:58	06:39	1002	997.9	4043	○	TRITON deployment & recovery
Leg1	C05	C05S01	02-01.97N	138-05.13E	06.Jul.2002	03:58	04:40	1000	996.5	4288	○	TRITON deployment & recovery
Leg1	C06	C06S01	00-02.97N	137-53.42E	08.Jul.2002	03:57	04:48	1001	997.0	4344	○	TRITON deployment
Leg1	C07	C07S01	00-04.48N	138-02.50E	08.Jul.2002	05:55	06:42	1001	998.7	4212	○	TRITON recovery
Leg1	C08	C08S01	02-00.59N	130-03.35E	11.Jul.2002	03:56	04:45	1000	993.0	4399	○	TRITON deployment
Leg1	C09	C09S01	01-58.57N	129-54.82E	11.Jul.2002	05:57	06:45	1001	995.2	4424	○	TRITON recovery
Leg1	C10	C10S01	05-01.07N	129-57.16E	13.Jul.2002	04:08	05:00	1014	1094.6	5102	○	TRITON deployment
Leg1	C11	C11S01	06-50.05N	126-42.63E	14.Jul.2002	03:10	03:57	1000	1062.0	3429	○	ADCP Mooring deployment & recovery
Leg2	C12	C12S01	03-59.46N	090-00.00E	27.Jul.2002	15:53	17:34	2024	2010.4	2841	○	
Leg2	C13	C12S01	02-59.97N	089-59.89E	27.Jul.2002	21:53	23:26	2022	2006	2467	○	
Leg2	C14	C14S01	02-00.35N	089-59.89E	28.Jul.2002	03:55	05:15	2022	2013.6	2648	○	
Leg2	C15	C15S01	00-59.94N	089-59.97E	28.Jul.2002	09:51	11:09	2023	2008	2307	○	
Leg2	C16	C16S01	00-00.17N	090-00.81E	29.Jul.2002	03:05	04:34	2023	2001.2	4248	○	ADCP Mooring deployment & recovery
Leg2	C17	C17S01	01-35.95S	090-03.63E	30.Jul.2002	03:43	05:00	2023	2007.7	4707	○	TRITON deployment
Leg2	C18	C18S01	01-39.25S	090-00.64E	30.Jul.2002	05:42	06:55	2023	2023.5	4688	○	TRITON recovery
Leg2	C19	C19S01	02-00.01S	090-00.02E	30.Jul.2002	09:27	10:53	2023	2006.2	4735	○	
Leg2	C20	C20S01	03-00.10S	090-00.28E	31.Jul.2002	09:52	11:13	2023	2003.4	3328	○	Argo Float deployed point
Leg2	C21	C21S01	03-59.91S	090-00.01E	31.Jul.2002	15:51	17:08	2022	2004.0	3140	○	
Leg2	C22	C22S01	04-59.87S	089-59.93E	31.Jul.2002	21:53	23:15	2021	2009.1	5004	○	Argo Float deployed point
Leg2	C23	C23S01	04-59.94S	090-59.96E	01.Aug.2002	03:50	05:16	2023	2003.7	4985	○	
Leg2	C24	C24S01	04-59.89S	092-00.07E	01.Aug.2002	09:51	11:05	2022	2000	5009	○	
Leg2	C25	C25S01	04-59.96S	092-59.79E	01.Aug.2002	15:52	17:14	2024	2002	4621	○	
Leg2	C26	C26S01	05-00.02S	093-59.94E	01.Aug.2002	21:54	23:15	2023	2003.1	4970	○	Argo Float deployed point
Leg2	C27	C27S01	05-02.34S	094-57.66E	02.Aug.2002	09:01	10:19	2023	2006.4	5007	○	TRITON deployment & recovery
Leg2	C28	C28S01	05-34.17S	094-59.77E	02.Aug.2002	12:46	14:00	2022	2006.9	5068	○	Argo Float deployed point

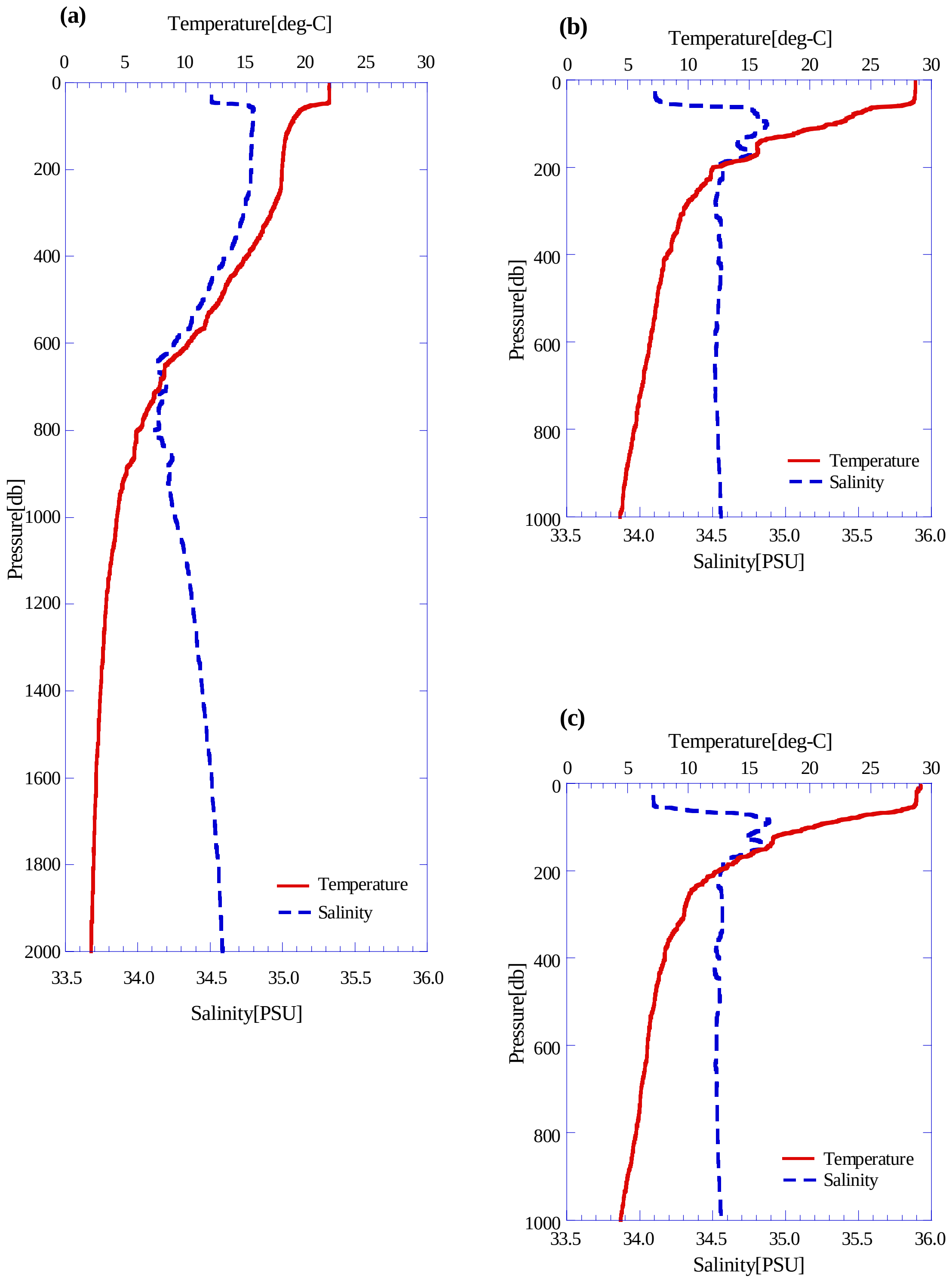
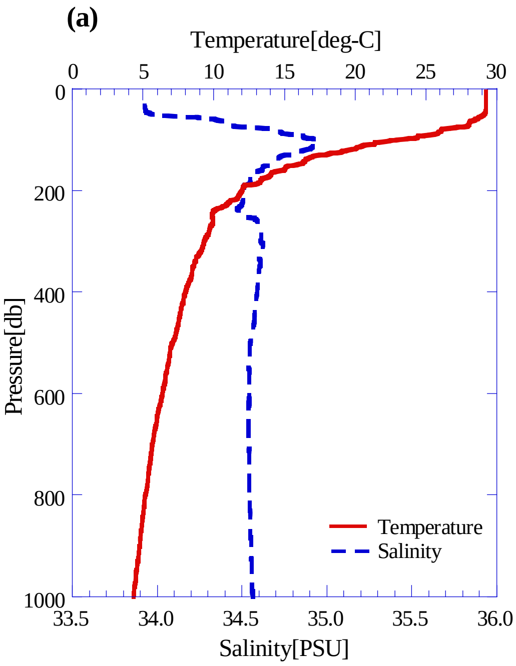


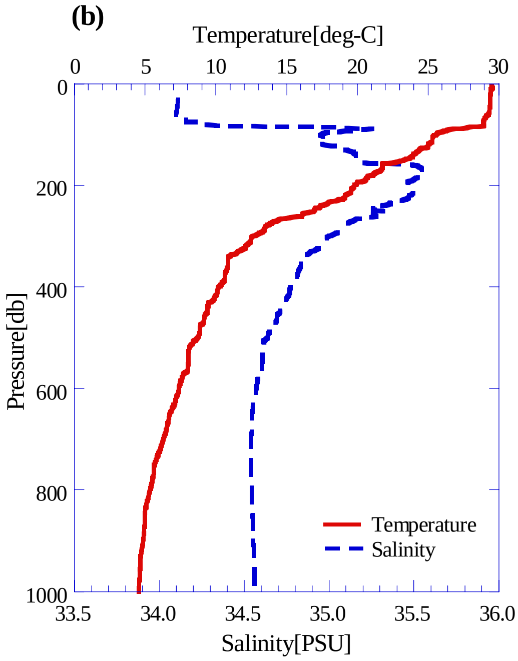
Fig6.2.1-1 CTD Profile

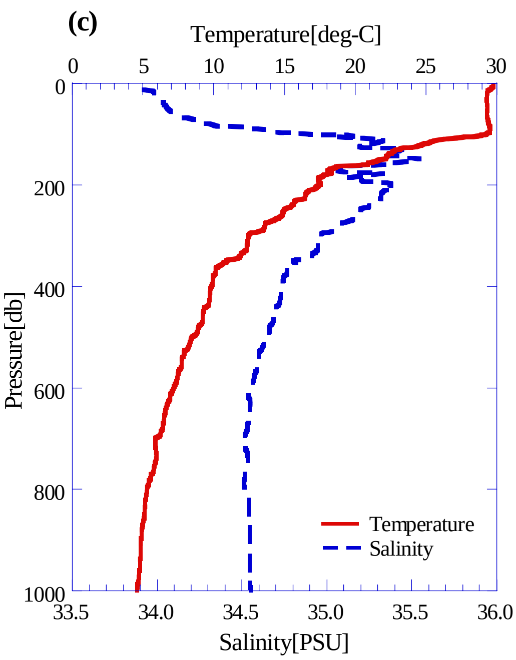
(a) C01-Argo Float deployed point

(b) C02-8N137E TRITON deployment

(c) C03-8N137E TRITON recovery







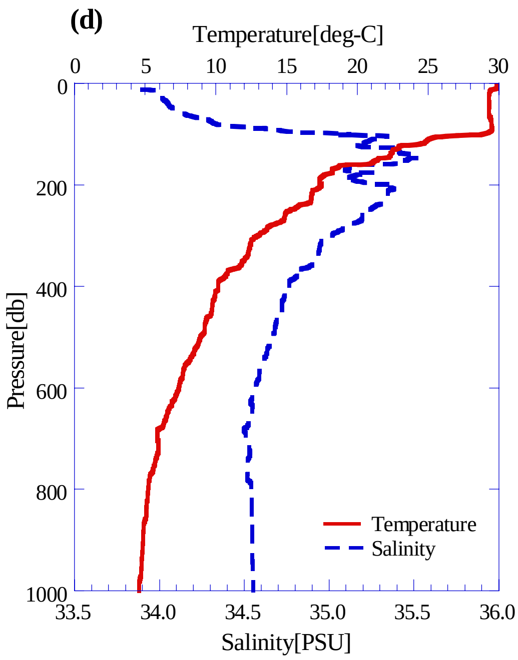


Fig6.2.1-2 CTD Profile

(a) C04-5N137E TRITON deployment&recovery

(b) C05-2N138E TRITON deployment&recovery

(c) C06-EQ138E TRITON deployment

(d) C07-EQ138E TRITON recovery

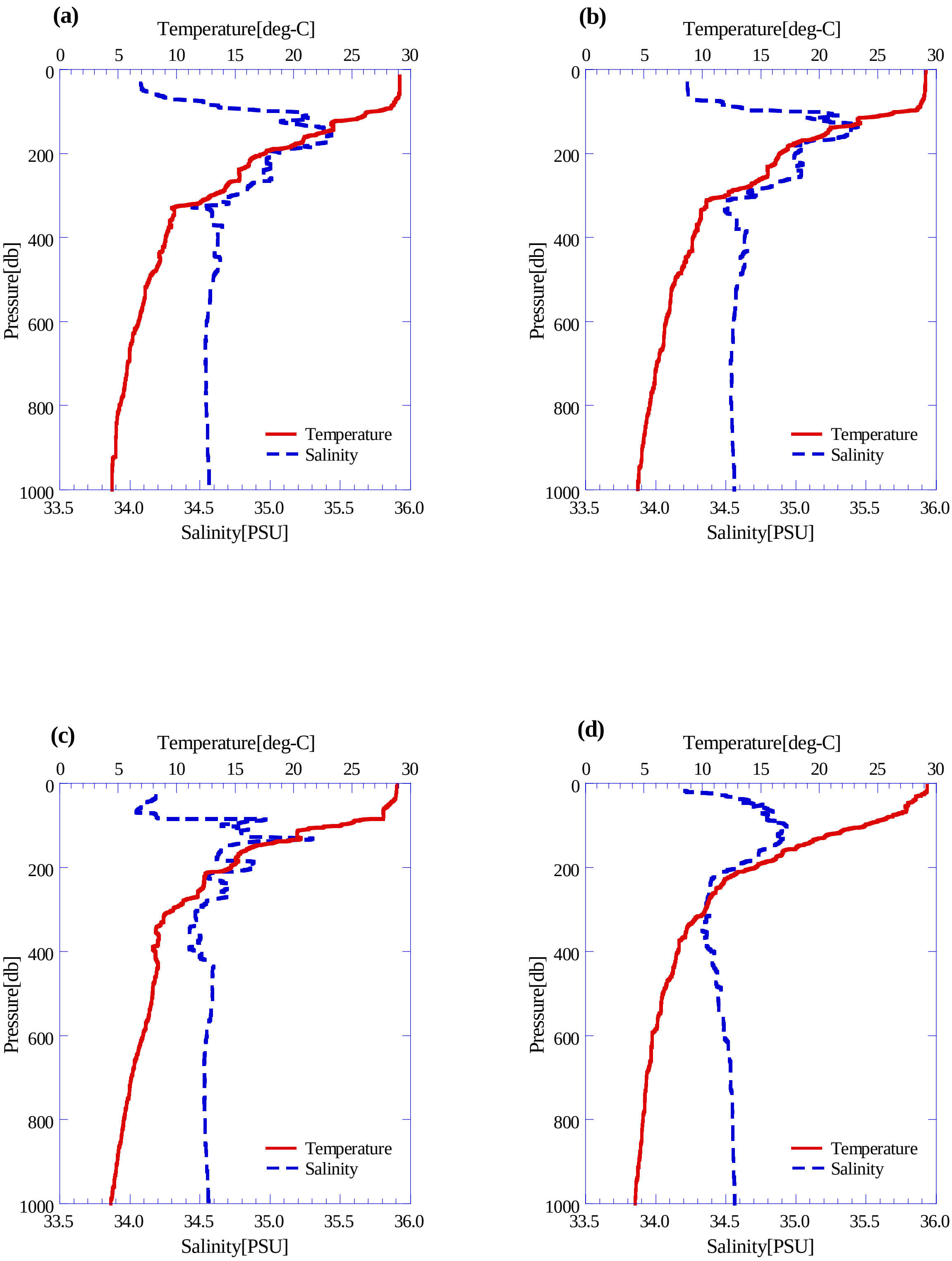


Fig6.2.1-3 CTD Profile

(a) C08-2N130E TRITON deployment

(b) C09-2N130E TRITON recovery

(c) C10-5N130E TRITON deployment

(d) C11-ADCP Mooring deployment & recovery

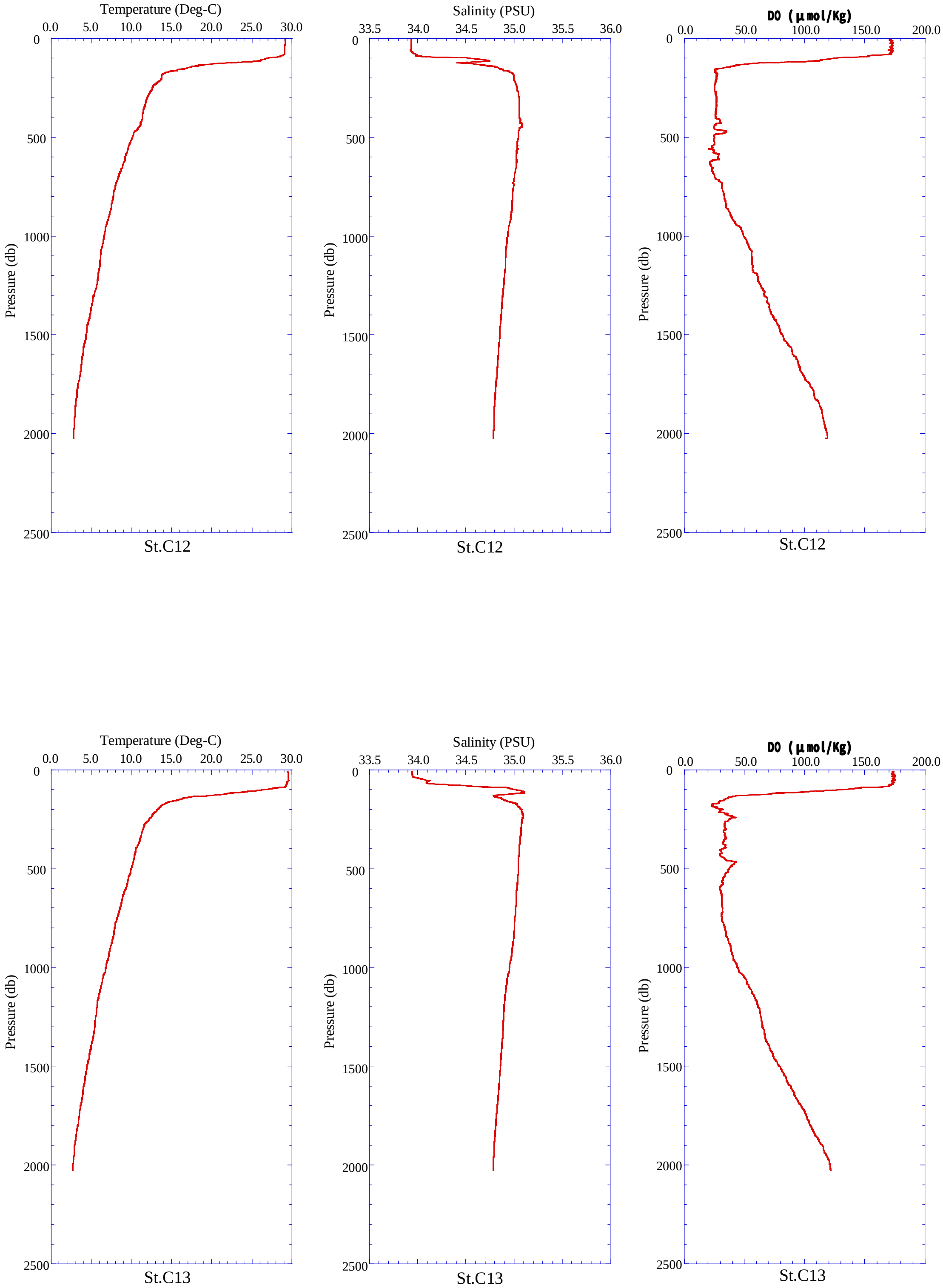


Fig 6.2.1-4

The upper section : St.C12 (temp. Salinity D.O.)

The lower section : St.C13 (temp. Salinity D.O.)

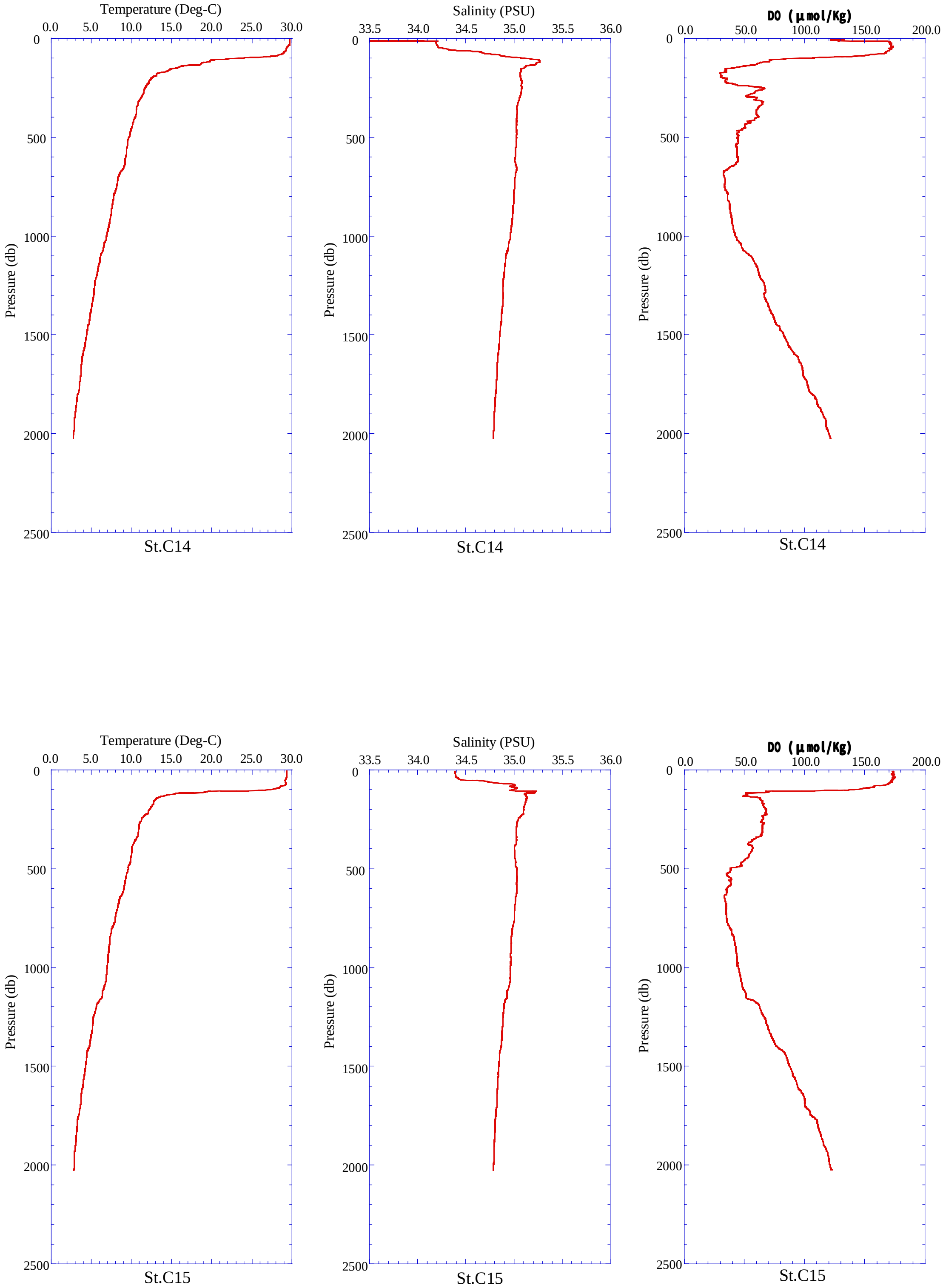


Fig 6.2.1-5

The upper section : St.C14 (temp. Salinity D.O.)

The lower section : St.C15 (temp. Salinity D.O.)

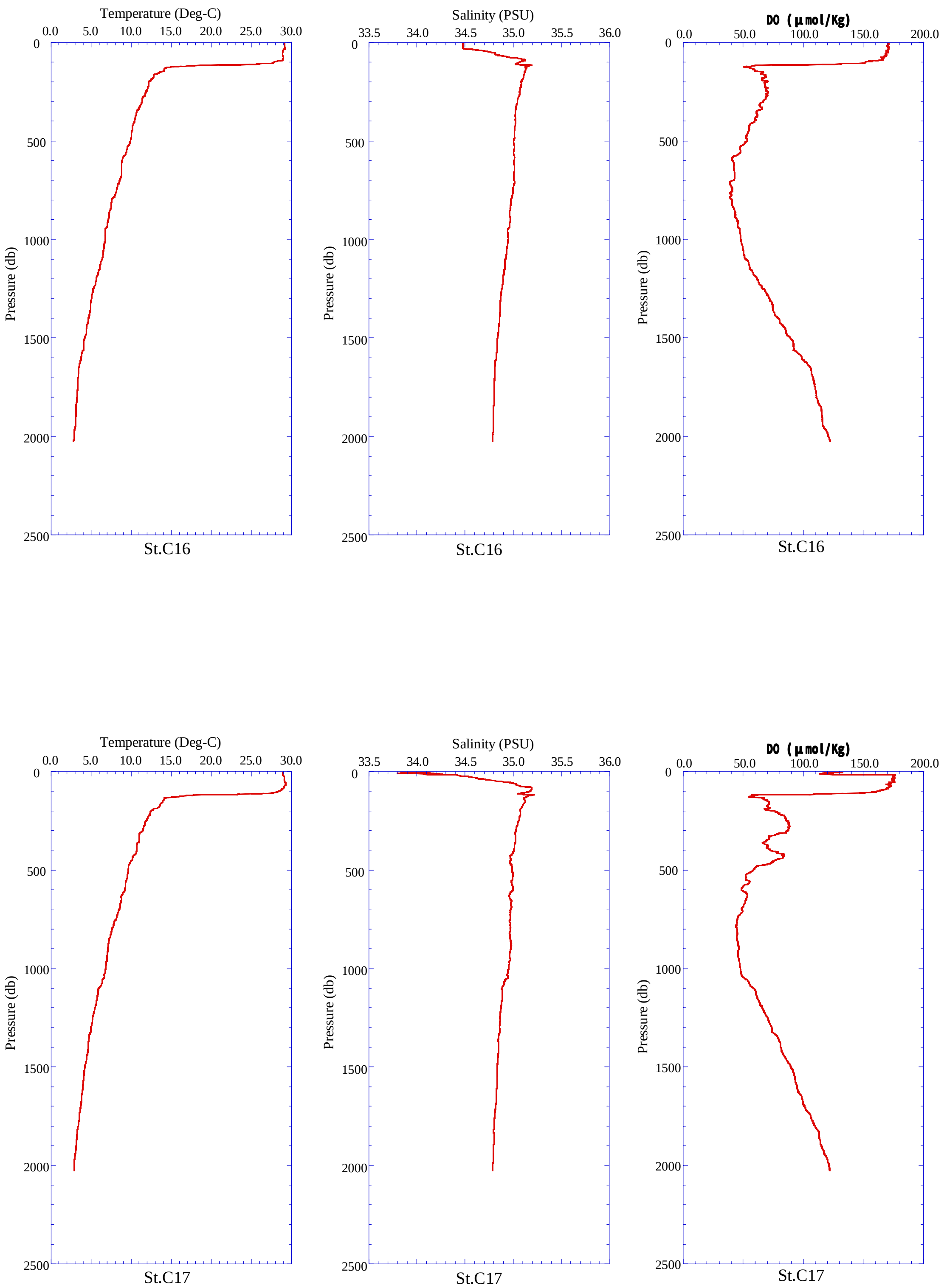


Fig 6.2.1-6

The upper section : St.C16 (temp. Salinity D.O.)

The lower section : St.C17 (temp. Salinity D.O.)

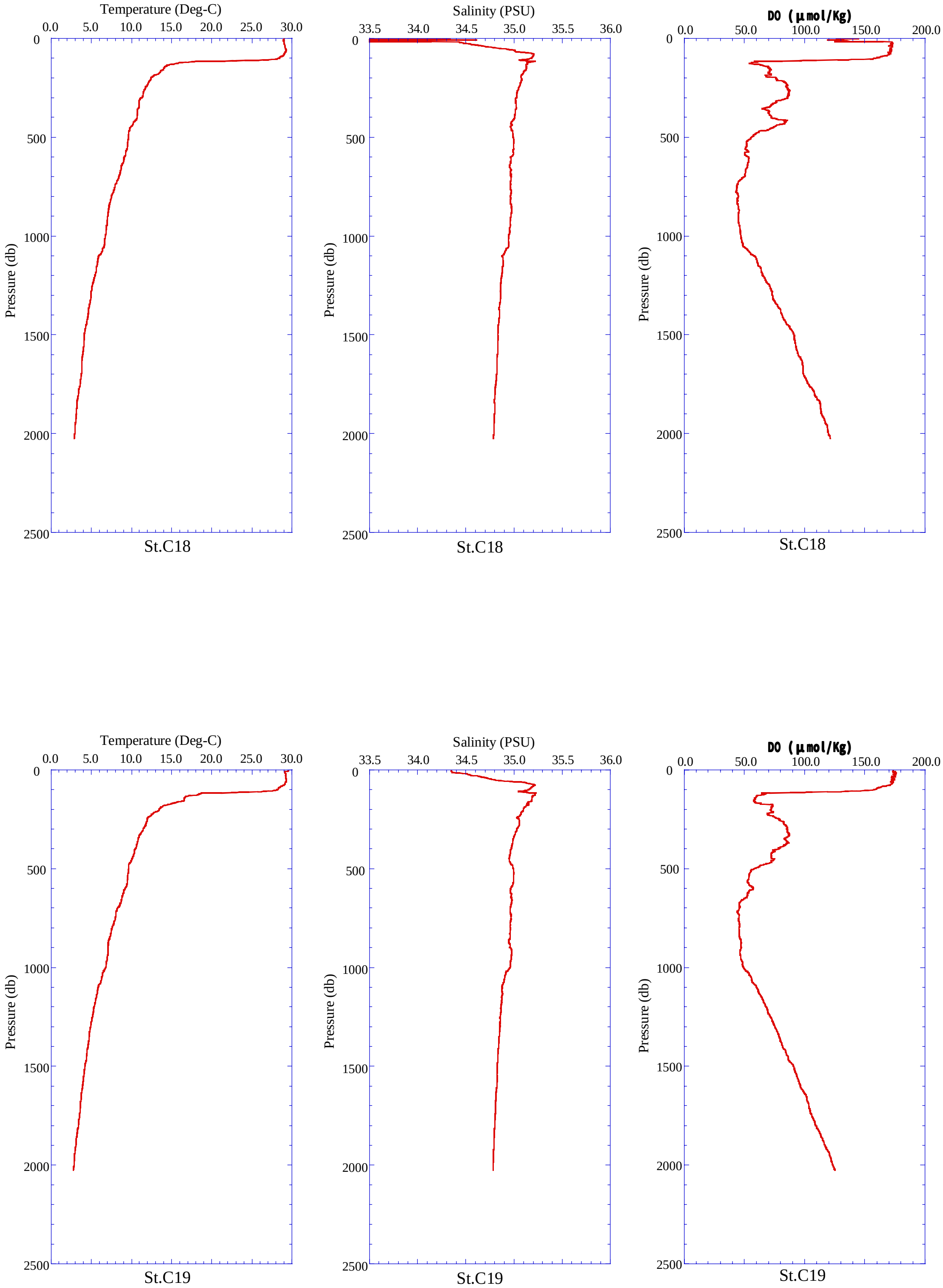


Fig 6.2.1-7

The upper section : St.C18 (temp. Salinity D.O.)

The lower section : St.C19 (temp. Salinity D.O.)

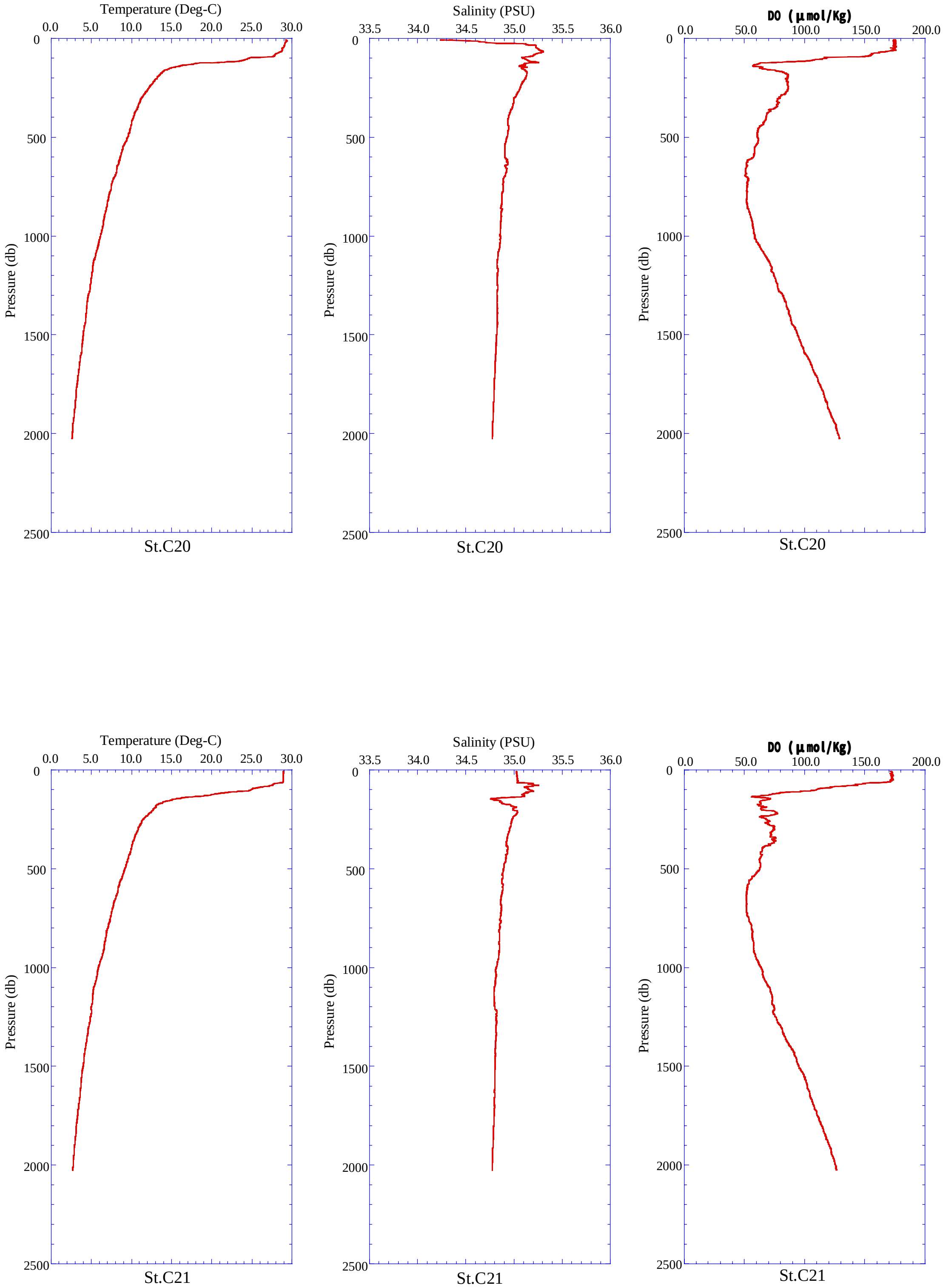


Fig 6.2.1-8

The upper section : St.C20 (temp. Salinity D.O.)

The lower section : St.C21 (temp. Salinity D.O.)

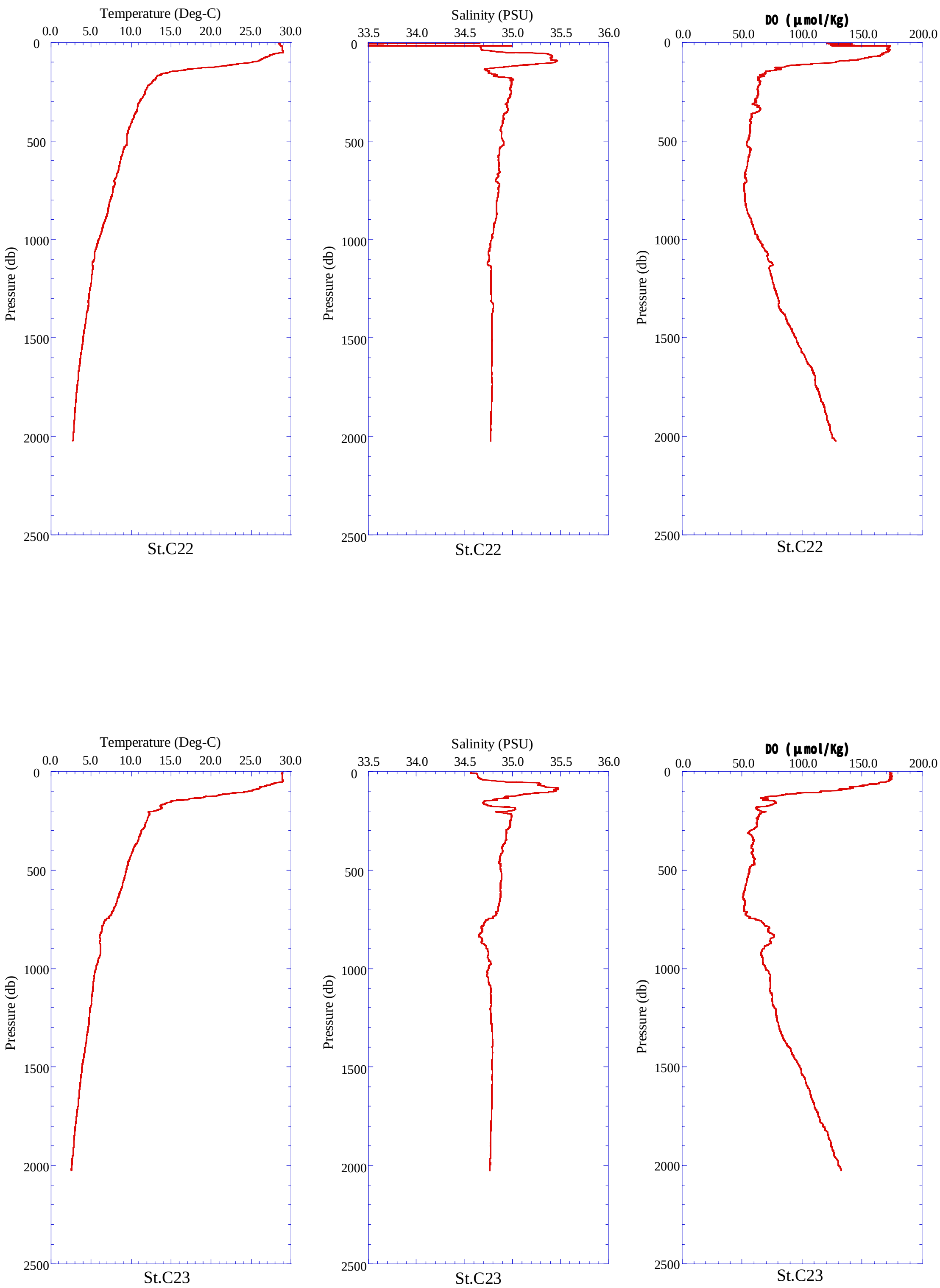


Fig 6.2.1-9

The upper section : St.C22 (temp. Salinity D.O.)

The lower section : St.C23 (temp. Salinity D.O.)

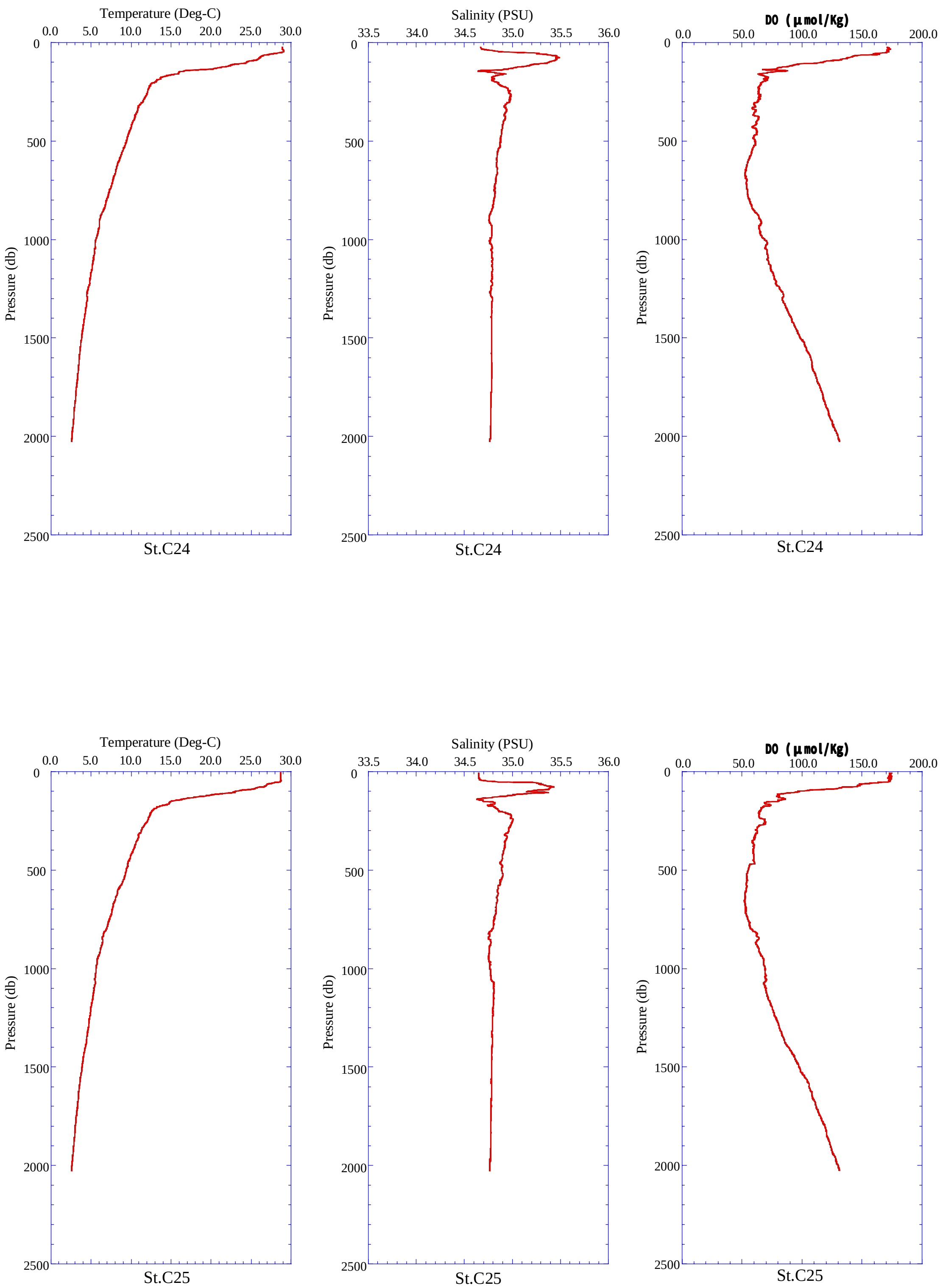
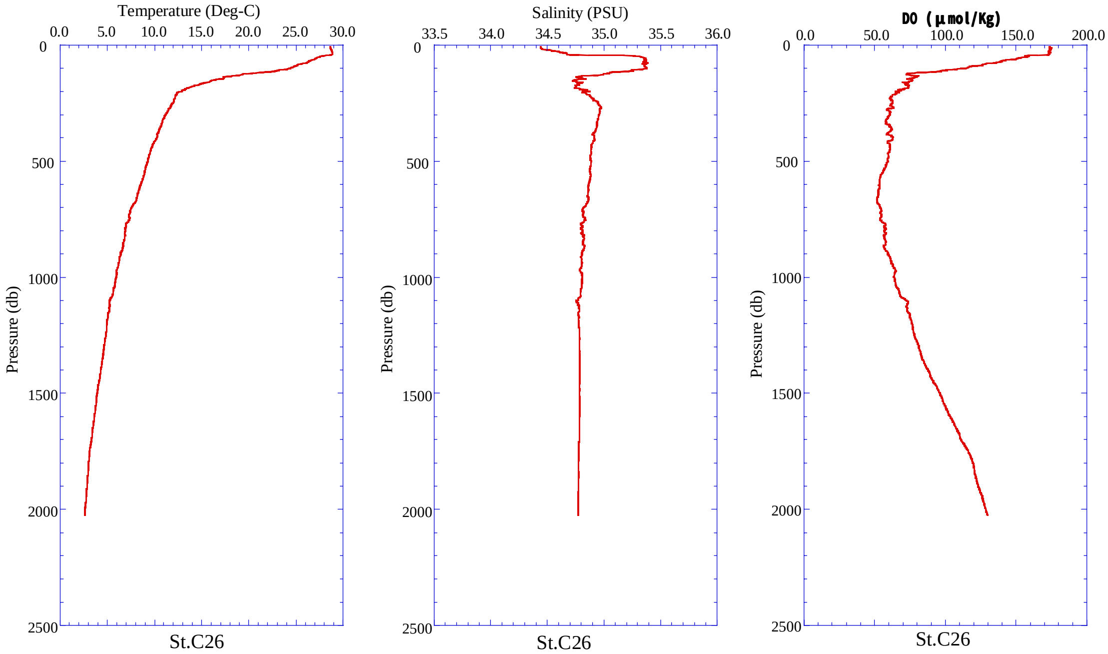


Fig 6.2.1-10

The upper section : St.C24 (temp. Salinity D.O.)

The lower section : St.C25 (temp. Salinity D.O.)



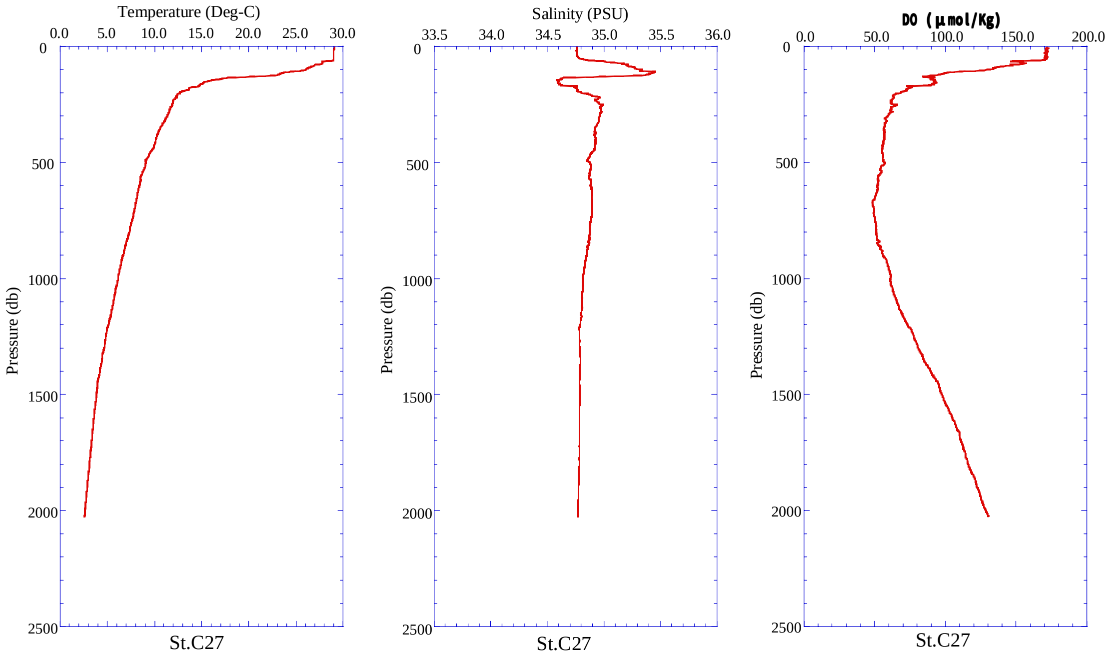


Fig 6.2.1-11

The upper section : St.C26 (temp. Salinity D.O.)

The lower section : St.C27 (temp. Salinity D.O.)

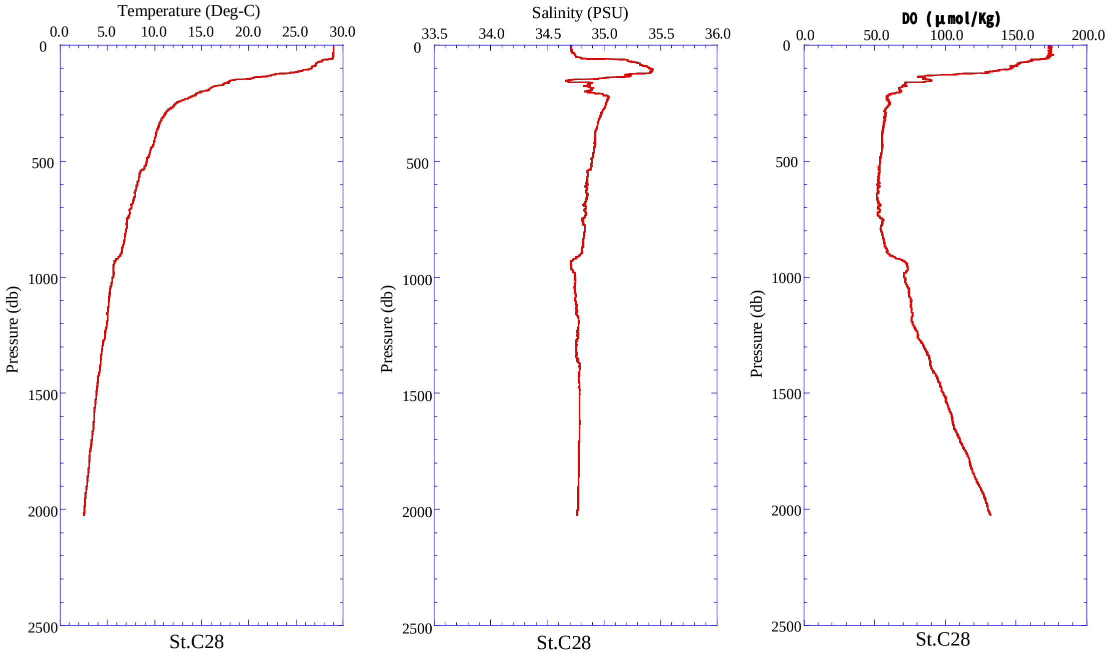


Fig 6.2.1-12 : St.C28 (temp. Salinity D.O.)

6.2.2. XCTD obserevation

(1) Personnel

Yoshifumi Kuroda (JAMSTEC)	Principal Investigator	- Leg 1 -
Hideaki Hase (JAMSTEC)	Principal Investigator	- Leg 2 -
Masaki Hanyu (GODI)		- Leg 1 -
Yasutaka Imai (GODI)		- Leg 1, 2 -
Wataru Tokunaga (GODI)		- Leg 2 -
Shinya Iwamida (GODI)		- Leg 1, 2 -
Naoto Morioka (R/V Mirai Crew)		- Leg 1, 2 -

(2) Objectives

Investigation of oceanic structure.

(3) Parameters

According to the manufacturer's nominal specifications, the range and accuracy of parameters measured by the XCTD (eXpendable Conductivity, Temperature & Depth profiler) are as follows;

Parameter	Range	Accuracy
Conductivity	0 ~ 60 mS/cm	+/- 0.03 mS/cm
Temperature	-2 ~ 35 deg-C	+/- 0.02 deg-C
Depth	0 ~ 1000 m	

(4) Methods

We observed the vertical profiles of the sea water temperature and salinity measured by XCTD-1 manufactured by Tsurumi-Seiki Co.. The signal was converted by MK-100, Tsurumi-Seiki Co. and was recorded by WinXCTD software (Ver.1.06) provided by Tsurumi-Seiki Co.. We casted 114 probes (X001 – X114) by using automatic launcher.

(5) Observation log

Table 6.2.2-1 XCTD observation log

Station	Date	Time	Lat.	Lon.	SST	SSS	MD	WD	Probe S/N
X001	2002/07/03	05:55	07-00.13N	136-45.77E	29.15	33.933	1036	4555	02059143
X002	2002/07/03	10:00	06-00.02N	136-58.15E	29.27	34.046	1036	4426	01127082
X003	2002/07/05	07:03	04-00.08N	137-33.99E	29.15	33.957	1036	4759	01127079
X004	2002/07/05	11:15	02-59.94N	137-49.75E	28.97	33.957	1035	4478	01127077
X005	2002/07/05	11:42	02-59.48N	137-50.72E	28.96	33.965	1036	4474	01127080
X006	2002/07/06	12:23	02-00.01N	137-00.07E	29.17	33.942	1035	4114	01127083
X007	2002/07/07	06:47	01-00.03N	138-00.30E	30.17	33.810	1035	4233	01127086
X008	2002/07/08	12:58	00-59.95N	137-00.05E	29.73	34.044	1035	3852	01127087
X009	2002/07/09	06:36	00-00.14N	137-00.00E	30.14	33.961	1035	4446	02059144
X010	2002/07/09	10:19	00-00.05N	136-00.01E	30.06	34.020	1036	5043	01127084
X011	2002/07/09	12:14	00-00.00S	135-30.00E	30.06	34.030	1035	4724	01127078
X012	2002/07/09	16:06	00-59.99N	135-29.90E	29.62	34.093	1035	4343	02059147
X013	2002/07/09	19:53	02-00.01N	135-29.99E	29.19	34.187	1036	4316	01127081

X014	2002/07/09	23:54	02-00.02N	134-30.00E	29.15	34.187	1035	4173	02059146
X015	2002/07/10	03:44	02-00.14N	133-30.00E	29.01	34.080	1035	3820	02059150
X016	2002/07/10	07:27	01-59.98N	132-29.99E	29.82	34.149	1035	3154	02059154
X017	2002/07/10	11:14	01-60.00N	131-30.00E	29.27	34.064	1035	4083	02059155
X018	2002/07/10	14:56	02-00.00N	130-30.01E	29.14	34.055	1035	4352	02059148
X019	2002/07/11	09:18	02-00.03N	129-30.01E	29.12	34.153	1034	4046	02059149
X020	2002/07/12	06:00	03-00.02N	129-55.40E	29.10	34.202	1030	3130	02059152
X021	2002/07/12	09:26	04-00.02N	129-56.86E	29.05	34.300	1034	4642	02059156
X022	2002/07/13	07:35	05-15.85N	129-30.02E	28.61	34.374	1035	4895	02059151
X023	2002/07/13	10:06	05-32.18N	129-00.01E	29.11	34.086	1034	5412	02059167
X024	2002/07/13	12:32	05-49.07N	128-30.03E	29.11	34.101	1036	4914	02059164
X025	2002/07/13	14:54	06-05.98N	127-59.98E	28.90	34.087	1035	5436	02059161
X026	2002/07/13	15:47	06-11.74N	127-50.04E	28.85	34.098	1035	5662	02059166
X027	2002/07/13	16:37	06-17.21N	127-40.02E	28.90	34.095	1033	5893	02059168
X028	2002/07/13	17:28	06-22.67N	127-30.03E	28.99	34.121	1035	7836	02059157
X029	2002/07/13	18:20	06-28.09N	127-20.03E	28.87	34.050	1035	9345	02059160
X030	2002/07/13	19:13	06-33.56N	127-10.00E	29.01	34.009	1033	7895	02059163
X031	2002/07/13	20:08	06-39.65N	127-00.00E	29.19	34.189	1035	6935	02059158
X032	2002/07/13	21:01	06-45.48N	126-50.01E	29.21	34.119	1035	5142	02059165
X033	2002/07/13	22:26	06-52.54N	126-37.43E	28.95	34.297	1035	2981	02059162
X034	2002/07/14	09:17	06-59.98N	127-14.75E	28.91	34.021	1036	8186	02059159
X035	2002/07/14	20:53	08-00.01N	129-59.98E	28.51	33.996	1035	5680	02059169
X036	2002/07/15	01:22	08-60.00N	129-21.58E	28.58	34.069	1035	5807	02059175
X037	2002/07/15	05:44	09-59.98N	128-39.38E	29.06	34.102	1034	5680	02059172
X038	2002/07/15	10:11	10-59.99N	127-57.05E	29.23	34.275	1035	5564	02059170
X039	2002/07/15	14:47	11-60.00N	127-14.86E	29.25	34.287	1034	5658	02059171
X040	2002/07/15	19:29	13-00.00N	126-30.44E	29.36	34.254	1036	5186	02059180
X041	2002/07/16	00:04	13-59.96N	125-49.63E	29.85	34.449	1036	6053	02059179
X042	2002/07/16	04:40	14-59.99N	125-06.59E	29.95	34.426	1035	5525	02059174
X043	2002/07/16	09:23	16-00.08N	124-24.00E	29.56	34.530	1035	3168	02059173
X044	2002/07/16	14:12	16-59.95N	123-38.15E	29.57	34.689	1035	4265	02059184
X045	2002/07/16	17:21	17-40.01N	123-07.83E	29.56	34.439	1036	2801	02059177
X046	2002/07/16	18:10	17-50.01N	123-00.56E	29.52	34.435	1036	3739	02059176
X047	2002/07/16	18:59	17-59.99N	122-52.86E	29.50	34.430	1035	3579	02059183
X048	2002/07/16	19:49	18-10.01N	122-45.23E	29.41	34.431	1036	3775	02059178
X049	2002/07/16	20:36	18-20.00N	122-37.47E	29.34	34.447	1036	2954	02059181
X050	2002/07/16	21:06	18-26.00N	122-32.80E	29.27	34.494	1035	1765	02059182
X051	2002/07/26	05:34	06-11.87N	095-00.02E	29.29	33.410	826	843	02059187
X052	2002/07/26	08:11	05-44.85N	094-30.03E	29.62	33.674	1035	1855	02059185
X053	2002/07/26	10:54	05-15.81N	094-00.01E	29.58	33.651	700	704	02059186
X054	2002/07/26	13:31	04-49.47N	093-30.01E	29.60	33.809	1035	1216	02059191
X055	2002/07/26	16:14	04-21.67N	092-59.98E	29.71	33.947	1036	4507	02059189
X056	2002/07/26	19:03	03-53.77N	092-30.03E	29.78	33.976	1035	4257	02059188
X057	2002/07/26	21:50	03-41.77N	092-00.01E	29.76	34.099	1036	4104	02059190
X058	2002/07/27	00:32	04-01.32N	091-30.00E	29.31	33.790	1036	4028	02059192
X059	2002/07/27	03:24	04-21.13N	090-60.00E	29.19	33.868	1036	2618	02058973
X060	2002/07/27	06:25	04-40.90N	090-30.02E	29.36	33.783	1035	3162	02058971
X061	2002/07/27	11:31	05-00.15N	089-59.65E	29.27	33.874	1036	3440	02059109
X062	2002/07/27	11:38	04-59.22N	089-59.64E	29.28	33.876	1035	3360	02058972

X063	2002/07/27	13:39	04-30.01N	089-60.00E	29.31	33.861	1035	3266	02058974
X064	2002/07/27	19:35	03-29.99N	090-00.01E	29.33	33.965	1036	2461	02059108
X065	2002/07/28	01:39	02-29.99N	089-59.90E	29.82	34.161	1035	2718	02058975
X066	2002/07/28	07:36	01-29.78N	089-60.00E	29.72	34.301	1035	2301	02059106
X067	2002/07/28	13:32	00-30.00N	090-01.82E	29.19	34.421	1035	4056	02059111
X068	2002/07/29	07:02	00-00.37S	090-03.51E	29.33	34.331	1036	4290	02059107
X069	2002/07/29	09:29	00-30.05S	089-59.28E	29.12	34.434	1035	3067	02027710
X070	2002/07/29	11:41	01-00.03S	090-01.20E	28.98	34.353	1036	3190	02059110
X071	2002/07/31	07:28	02-30.01S	090-00.21E	29.10	34.355	1033	3502	02027713
X072	2002/07/31	13:23	03-30.02S	090-00.29E	29.03	34.203	1035	3882	02027709
X073	2002/07/31	19:39	04-31.33S	090-00.15E	28.85	34.745	1035	4699	02027719
X074	2002/07/31	23:29	04-59.50S	090-00.43E	28.56	34.365	1035	4999	02027718
X075	2002/08/01	01:28	04-59.82S	090-30.00E	28.57	34.519	1035	5044	02027715
X076	2002/08/01	07:41	04-59.98S	091-30.00E	28.66	34.310	1035	5007	02027712
X077	2002/08/01	13:23	05-00.59S	092-29.99E	28.67	34.591	1035	5002	02027711
X078	2002/08/01	19:30	05-00.28S	093-30.00E	28.66	34.536	1035	5000	02027708
X079	2002/08/02	01:27	04-59.25S	094-30.02E	28.77	34.603	1035	4977	02027714
X080	2002/08/02	10:36	05-02.79S	094-58.98E	28.99	34.742	1035	5007	02027717
X081	2002/08/03	03:42	05-00.37S	095-00.93E	28.74	34.359	1034	5010	02059129
X082	2002/08/03	04:01	05-01.79S	095-04.23E	28.69	34.201	1035	5042	02059128
X083	2002/08/03	05:51	05-11.44S	095-30.01E	29.30	34.590	1035	5029	02059132
X084	2002/08/03	07:53	05-19.22S	096-00.03E	29.20	34.550	1033	4814	02059137
X085	2002/08/03	10:01	05-29.84S	096-30.02E	29.05	34.504	1035	4860	02059139
X086	2002/08/03	12:06	05-40.47S	096-59.98E	28.92	34.515	1035	4837	02048765
X087	2002/08/03	14:08	05-50.72S	097-30.02E	28.95	34.547	1035	4975	02048764
X088	2002/08/03	16:16	06-01.06S	097-59.98E	28.77	34.398	1035	5463	02059141
X089	2002/08/03	18:28	06-13.06S	098-29.97E	28.65	34.480	1035	5040	02059130
X090	2002/08/03	20:40	06-25.80S	099-00.02E	28.71	33.983	1035	5365	02059140
X091	2002/08/03	22:48	06-36.15S	099-30.00E	29.00	34.041	1035	4765	02059127
X092	2002/08/04	01:01	06-43.80S	100-00.01E	28.96	34.085	1036	4993	02059142
X093	2002/08/04	03:25	06-55.72S	100-30.00E	28.97	34.187	1033	5366	02059135
X094	2002/08/04	05:52	07-07.60S	101-00.00E	29.04	34.267	1035	5531	02048767
X095	2002/08/04	08:02	07-16.71S	101-30.01E	28.91	34.139	1035	5270	02048766
X096	2002/08/04	10:26	07-27.41S	101-60.00E	28.87	34.289	1035	5472	02048768
X097	2002/08/04	12:50	07-37.89S	102-29.99E	28.71	34.236	1035	5845	02048771
X098	2002/08/04	15:16	07-48.93S	103-00.00E	28.28	33.943	1036	6016	02048772
X099	2002/08/04	17:45	07-59.90S	103-30.00E	28.42	33.922	1034	6118	02048770
X100	2002/08/04	19:58	08-08.54S	103-59.99E	27.04	33.931	1035	6243	02048773
X101	2002/08/04	22:27	08-19.76S	104-30.00E	27.09	33.977	1035	6353	02048769
X102	2002/08/05	00:56	08-31.74S	105-00.01E	26.60	34.145	1033	6607	02048800
X103	2002/08/05	03:13	08-41.83S	105-30.00E	26.76	34.300	1034	6178	02048774
X104	2002/08/05	05:39	08-52.71S	106-00.04E	26.60	34.260	1035	4335	02048775
X105	2002/08/05	07:53	09-01.37S	106-30.00E	26.27	34.207	1033	4074	02048802
X106	2002/08/05	10:09	09-11.95S	107-00.00E	26.37	34.158	1035	3854	02048801
X107	2002/08/05	12:32	09-24.31S	107-30.00E	26.74	34.047	1033	3659	02048810
X108	2002/08/05	14:40	09-34.06S	108-00.01E	27.21	33.960	1035	3297	02048811
X109	2002/08/05	16:50	09-44.10S	108-29.99E	27.46	33.960	1035	3348	02048808
X110	2002/08/05	19:12	09-55.49S	109-00.01E	27.33	34.009	1035	3759	02048804
X111	2002/08/05	21:23	10-04.78S	109-30.01E	26.80	34.066	1035	4670	02048807

X112	2002/08/05	23:44	10-15.30S	109-59.99E	26.06	34.090	1034	6898	02048805
X113	2002/08/13	03:19	08-00.29N	130-01.32E	28.30	34.001	1035	5636	02048806
X114	2002/08/13	03:40	08-00.31N	130-01.31E	28.31	34.005	1034	5572	02048803

Acronyms in Table 6.2.2-1 are as follows;

- SST: Sea surface temperature [deg-C] measured by Continuous Sea Surface Monitoring System
- SSS: Sea surface salinity [PSU] measured by Continuous Sea Surface Monitorring System
- MD: Maximum measured depth [m]
- WD: Water Depth [m]

(6) Preliminary results

Vertical sections are shown in the following figures. Fig.6.2.2-1 and Fig.6.2.2-2 are temperature and salinity plots along 2N from 137E to 129_30E, Fig.6.2.2-3 and Fig.6.2.2-4 are along Ship’s track from 5_16N129_30E to 6_53N126_37E, Fig.6.2.2-5 and Fig.6.2.2-6 are along Ship’s track from 8N130E to 18_26N122_33E, Fig.6.2.2-7 and Fig.6.2.2-8 along Ship’s track from 6_12N95E to 5N90E, Fig.6.2.2-9 and Fig.6.2.2-10 along 90E from 5N to 5S, Fig.6.2.2-11 and Fig.6.2.2-12 are along Ship’s track from 5S90E to 10_15S110E respectively.

(7) Data archive

XCTD data obtained during this cruise will be submitted to the DMO (Data Management Office), JAMSTEC and will be available via “R/V Mirai Data Web Page” in JAMSTEC home page.

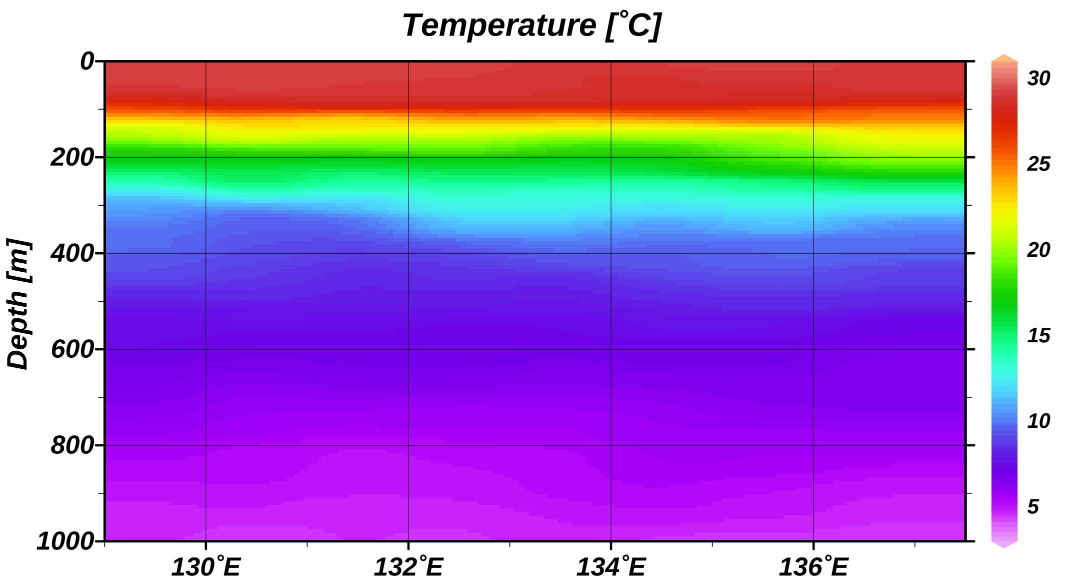


Fig.6.2.2-1 Temperature along 2N from 137E to 129_30E

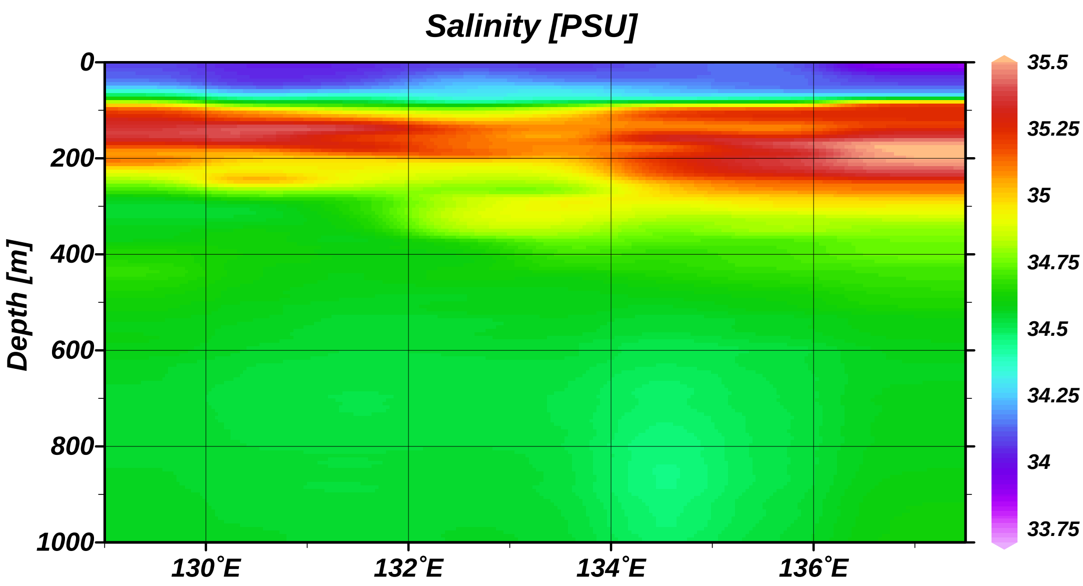


Fig.6.2.2-2 Salinity along 2N from 137E to 129_30E

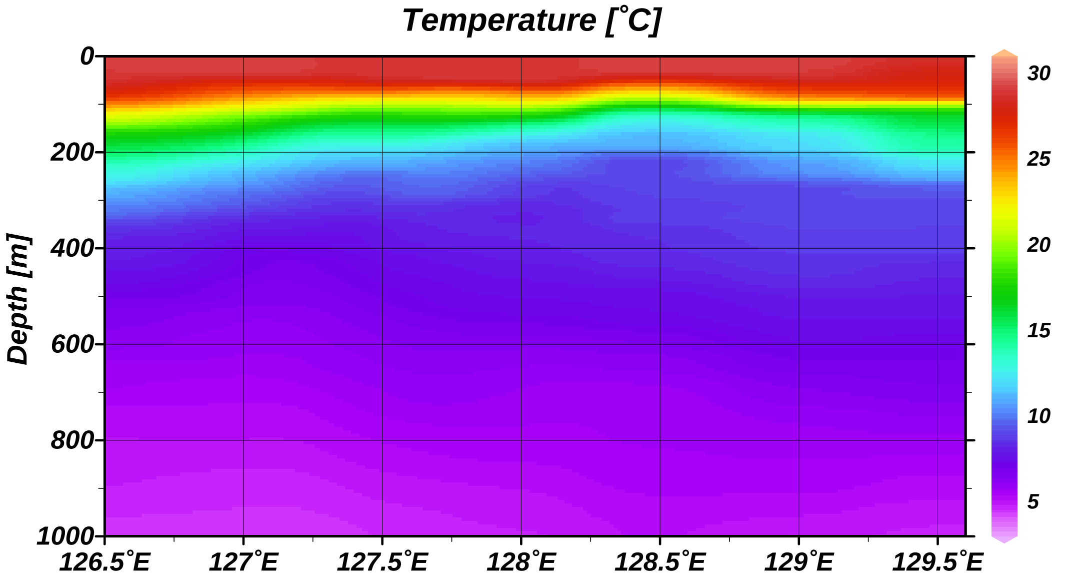


Fig.6.2.2-3 Temperature along Ship's track from 5_16N129_30E to 6_53N126_37E

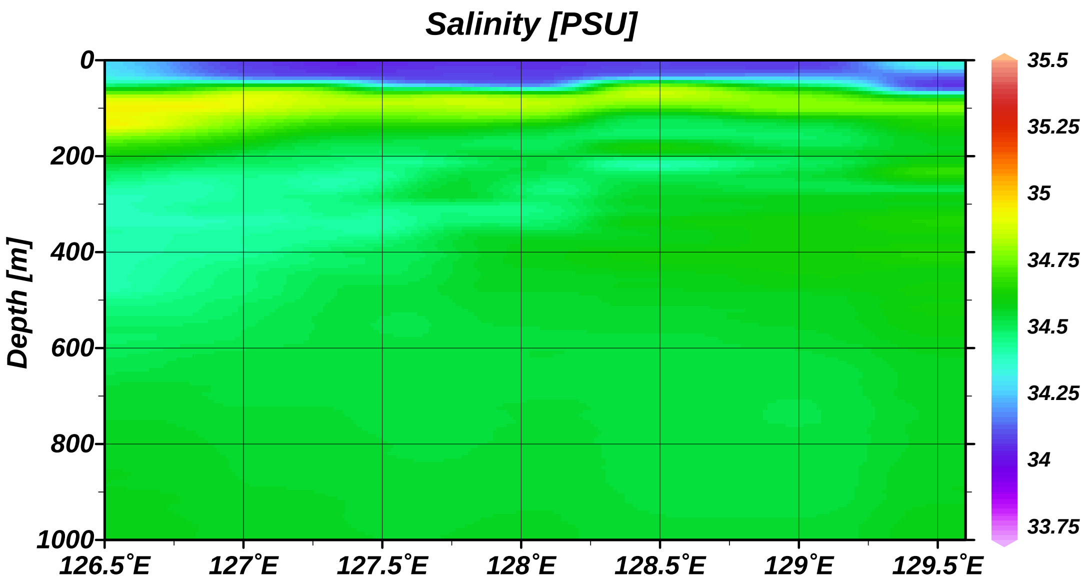


Fig.6.2.2-4 Salinity along Ship's track from 5_16N129_30E to 6_53N126_37E

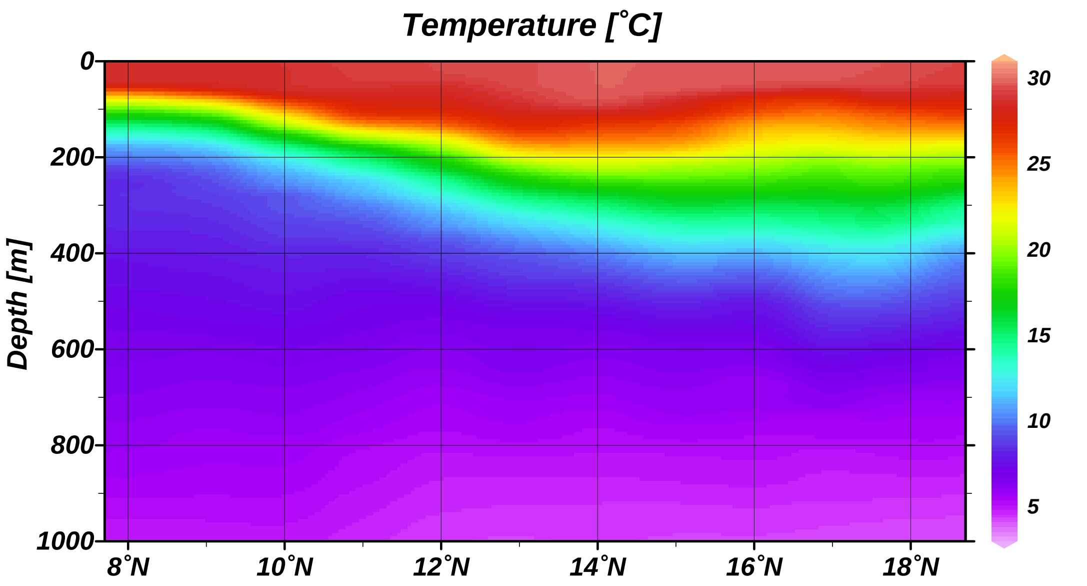


Fig.6.2.2-5 Temperature along Ship's track from 8N130E to 18_26N122_33E

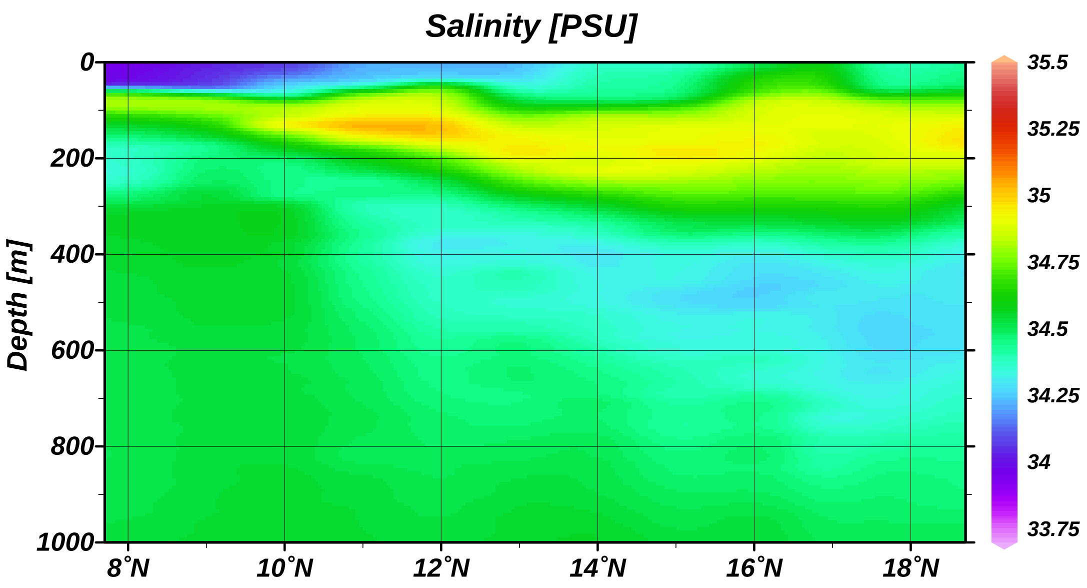


Fig.6.2.2-6 Salinity along Ship's track from 8N130E to 18_26N122_33E

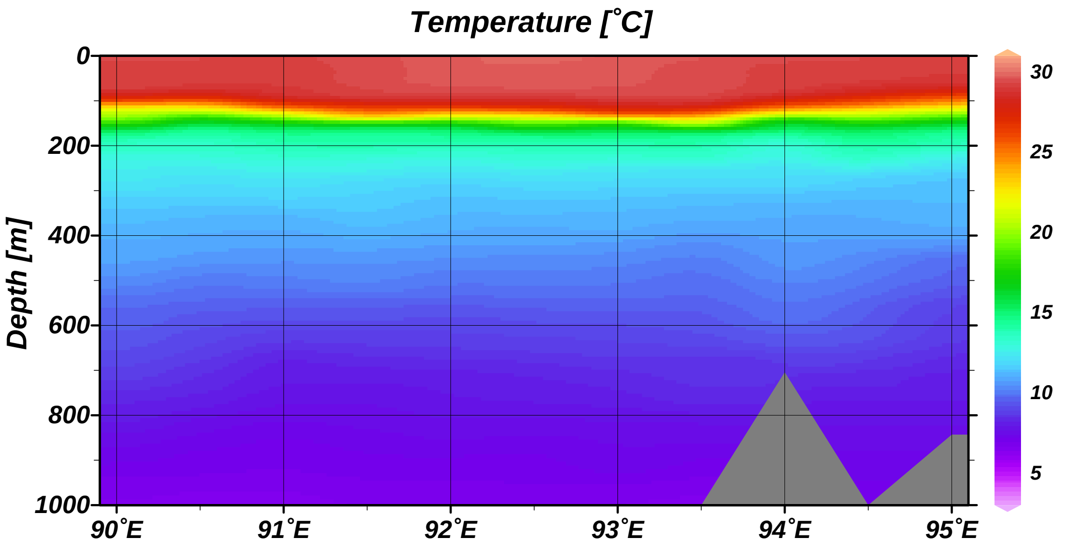


Fig.6.2.2-7 Temperature along Ship's track from 6_12N95E to 5N90E

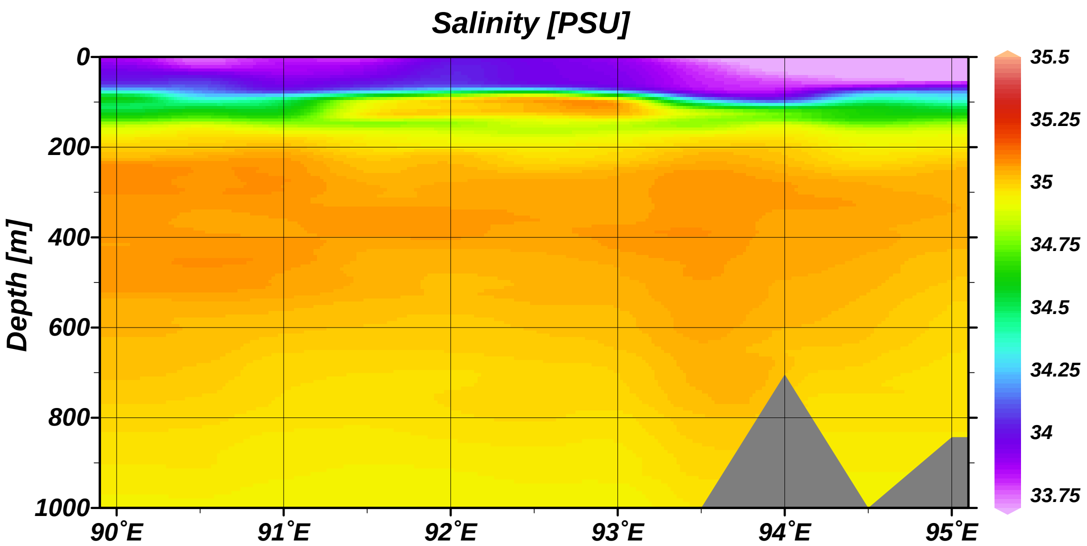


Fig.6.2.2-8 Salinity along Ship's track from 6_12N95E to 5N90E

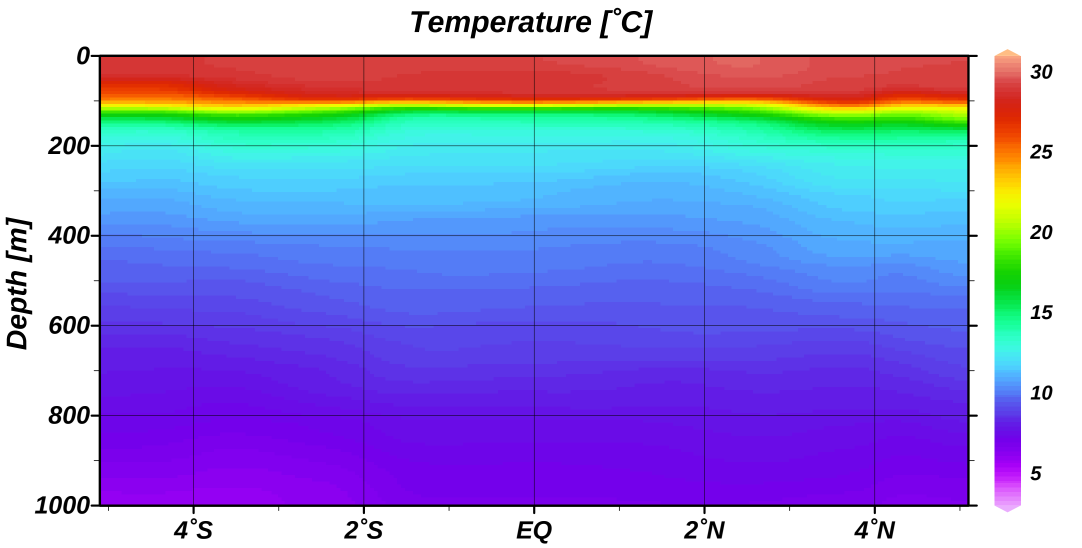


Fig.6.2.2-9 Temperature along 90E from 5N to 5S

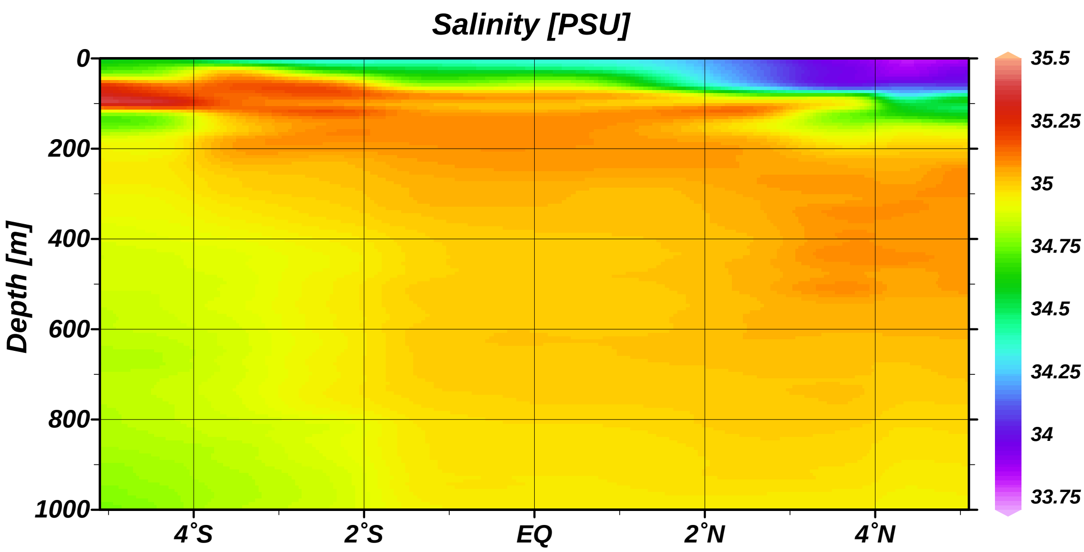


Fig.6.2.2-10 Salinity along 90E from 5N to 5S

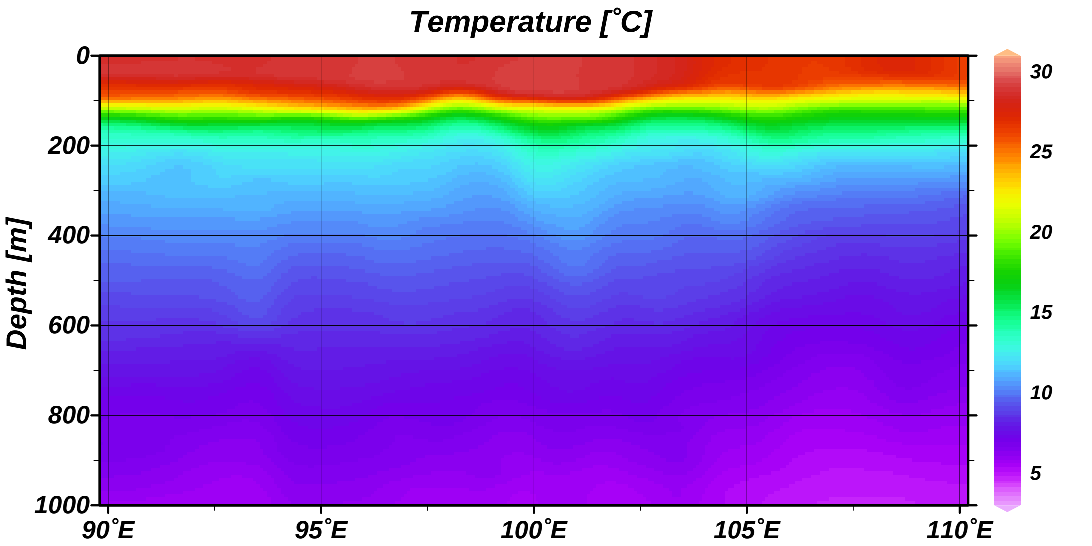


Fig.6.2.2-11 Temperature along Ship’s track from 5S90E to 10_15S110E

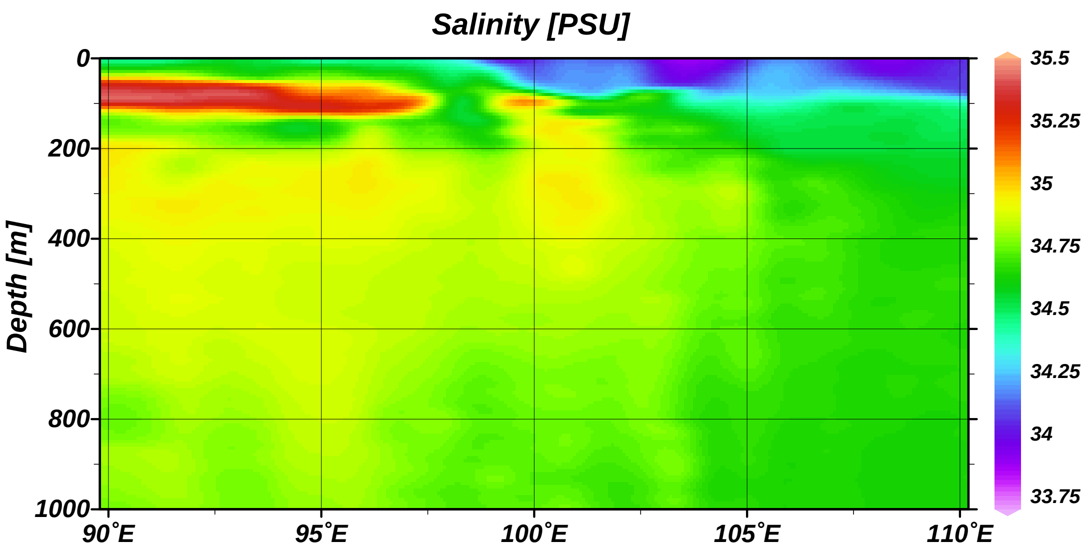


Fig.6.2.2-12 Salinity along Ship’s track from 5S90E to 10_15S110E

6.3.1 Salinity measurements of sampled seawater for validation of CTD cast data

(1) Personnel

Yoshifumi Kuroda	(JAMSTEC):on board Leg 1 Principal Investigator
Hideaki Hase	(JAMSTEC):on board Leg 2 Principal Investigator
Takeo Matsumoto	(MWJ): on board Leg 1, 2 Operation Leader
Atsuo Ito	(MWJ): on board Leg 2
Masayuki Fujisaki	(MWJ): on board Leg 1, 2

(2) Objectives

To check the quality of CTD salinity.

(3) Parameters

Salinity of sampled water

(4) Method

Seawater samples were collected with a bucket for the surface, 12-liter Niskin bottles for the deepest layer (2020db) and the other layers. They were stored in 250ml Phoenix brown glass bottles. The salinity analysis of samples were carried out using “Guildline Autosal 8400B Salinometer”, which was modified by addition of an Ocean Scientific International peristaltic-type sample intake pump. The instrument was operated “Autosal Room” of R/V Mirai constant temperature laboratory at a bath temperature of 24 deg-C with the laboratory set under 24 deg-C.A double conductivity ratio was defined as a median of 31 readings of the salinometer. Data collection was started after 5 seconds and it took about 10 seconds to collect 31 readings by a personal computer. The salinometer standardzations were made with IAPSO Standard Seawater batch P142, of which 10 ampoules were consumed. These conductivity ratio is 0.99991 (2K 1.99982, salinity 34.996). Sub-standard seawater was used to check the drift of the Autosal.

(5) Results

Data of all samples were shown in Table 6.3.1. - 1. We estimated the precision of this method using ten pairs of duplicate samples taken by the same Niskin bottle and bucket, and compared the salinity of all samples except for the surface samples to check the salinity data of CTD.

The mean standardization drift was 0.00001 by 2K. There were 2 pairs of duplicate samples drawn. The standard deviations and mean of sample pairs were shown in Table 6.3.1. - 2.

(6) Data archive

The data of salinity sample will be submitted to the DMO at JAMSTEC.

Table 6.3.1.-1. Difference between bottle-sampling salinity and CTD salinity

Station	Bottle	Sal. measure	Niskin Bottle No.	Pressure	CTD Sal.	Sal Difference
C01	1	34.5716	1	1999.859	34.5712	0.0004
	2	34.5711	1	1999.859	34.5712	-0.0001
C02	3	34.5528	1	1000.695	34.5516	0.0012
	4	34.5527	1	1000.695	34.5516	0.0011
	5	34.5226	2	750.761	34.5208	0.0018
	6	34.5348	3	500.146	34.5327	0.0021
	7	34.5226	4	299.322	34.5159	0.0067
	8	34.5247	5	250.140	34.5223	0.0024
	9		6	199.773	34.5433	-
	10	34.6853	7	150.085	34.6692	0.0161
	11	34.7737	8	125.320	34.7664	0.0073
	12	34.8321	9	100.164	34.8406	-0.0085
	13	34.7957	10	75.353	34.7894	0.0063
	14	34.2983	11	49.973	34.2386	0.0597
	15	34.1059	12	25.669	34.0932	0.0127
C03	16	34.5536	1	1000.690	34.5522	0.0014
	17	34.5535	1	1000.690	34.5522	0.0013
C04	18	34.5589	1	1000.721	34.5568	0.0021
	19	34.5583	1	1000.721	34.5568	0.0015
C05	20	34.5574	7	998.723	34.5555	0.0019
	21	34.5573	7	998.723	34.5555	0.0018
C06	22	34.5476	7	1000.454	34.5467	0.0009
	23	34.5479	7	1000.454	34.5467	0.0012
C07	24	34.5485	1	1000.851	34.5477	0.0008
	25	34.5485	1	1000.851	34.5477	0.0008
C08	26	34.5596	1	998.847	34.5582	0.0014
	27	34.5595	1	998.847	34.5582	0.0013
C09	28	34.5566	1	1000.844	34.5552	0.0014
	29	34.5572	1	1000.844	34.5552	0.0020
C10	30	34.5585	1	1006.887	34.5576	0.0009
	31	34.5581	1	1006.887	34.5576	0.0005
C11	32	34.5598	1	996.867	34.5585	0.0013
	33	34.5596	1	996.867	34.5585	0.0011
C12	1	33.9336	Bucket	-	-	-
	2	33.9277	12	50.787	33.9182	0.0095
	3	34.6022	11	100.920	34.6083	-0.0061
	4	34.8488	10	150.289	34.8298	0.0190
	5	34.9868	9	201.655	34.9846	0.0022
	6	35.0432	8	302.369	35.0395	0.0037
	7	35.0487	7	401.825	35.0471	0.0016
	8	35.0373	6	502.646	35.0370	0.0003
	9	34.9986	5	756.785	34.9913	0.0073
	10	34.9299	4	1010.006	34.9287	0.0012
	11	34.9394	4	1010.006	34.9287	0.0107
	12	34.8456	3	1514.009	34.8438	0.0018
	13	34.7785	2	2022.124	34.7766	0.0019
	14	34.7783	2	2022.124	34.7766	0.0017
	15	34.7785	1	2020.745	34.7766	0.0019
C13	16	33.9458	Bucket	-	-	-
	17	34.1177	12	51.130	34.1080	0.0097
	18	35.0500	11	100.907	35.0523	-0.0023
	19	34.9296	10	151.573	34.9079	0.0217
	20	35.0646	9	202.669	35.0631	0.0015
	21	35.0649	8	302.811	35.0645	0.0004
	22	35.0434	7	402.571	35.0428	0.0006
	23	35.0374	6	503.449	35.0363	0.0011
	24	35.0009	5	754.965	35.0000	0.0009
	25	34.9459	4	1008.441	34.9451	0.0008
	26	34.9459	4	1008.441	34.9451	0.0008
	27	34.8491	3	1513.140	34.8478	0.0013
	28	34.7749	2	2021.222	34.7729	0.0020
	29	34.7751	1	2022.182	34.7728	0.0023
	30	34.7753	1	2022.182	34.7728	0.0025

Table 6.3.1.-1. Continued

Station	Bottle	Smeasure	Niskin Bottle No.	Pressure	CTD Sal.	Sal Difference
C14	31	34.2020	Bucket	-	-	-
	32	34.3170	12	49.486	34.3089	0.0081
	33	35.1955	11	101.162	35.1902	0.0053
	34	35.0708	10	150.276	35.0716	-0.0008
	35	35.0586	9	201.694	35.0573	0.0013
	36	35.0461	8	301.782	35.0452	0.0009
	37	35.0216	7	401.641	35.0209	0.0007
	38	35.0208	6	502.362	35.0197	0.0011
	39	34.9973	5	754.980	34.9976	-0.0003
	40	34.9527	4	1008.140	34.9515	0.0012
	41	34.9527	4	1008.140	34.9515	0.0012
	42	34.8434	3	1514.126	34.8414	0.0020
	43	34.7765	2	2019.806	34.7740	0.0025
	44	34.7759	1	2021.593	34.7737	0.0022
	45	34.7758	1	2021.593	34.7737	0.0021
C15	46	34.4055	Bucket	-	-	-
	47	34.4684	12	50.454	34.4286	0.0398
	48	34.9846	11	100.345	34.9553	0.0293
	49	35.1087	10	150.625	35.1071	0.0016
	50	35.0870	9	201.388	35.0846	0.0024
	51	35.0204	8	301.998	35.0183	0.0021
	52	35.0039	7	402.825	34.9980	0.0059
	53	35.0175	6	503.681	35.0153	0.0022
	54	34.9960	5	755.504	34.9947	0.0013
	55	34.9584	4	1007.894	34.9570	0.0014
	56	34.9578	4	1007.894	34.9570	0.0008
	57	34.8344	3	1513.517	34.8316	0.0028
	58	34.7778	2	2021.030	34.7754	0.0024
	59	34.7788	1	2020.384	34.7757	0.0031
	60	34.8383	1	2020.384	34.7757	0.0626
C16	61	34.7696	12	51.652	34.7958	-0.0262
	62	35.0642	11	100.781	35.0510	0.0132
	63	35.1017	10	150.305	35.1017	0.0000
	64	35.0742	9	201.857	35.0742	0.0000
	65	35.0337	8	301.934	35.0326	0.0011
	66	35.0164	7	403.616	35.0149	0.0015
	67	35.0024	6	502.933	34.9981	0.0043
	68	34.9942	5	756.276	34.9920	0.0022
	69	34.9395	4	1009.735	34.9374	0.0021
	70	34.8285	3	1512.065	34.8255	0.0030
	71	34.7776	2	2020.272	34.7748	0.0028
	72	34.7779	1	2021.525	34.7749	0.0030
C17	73	34.4288	Bucket	-	-	-
	74	34.8652	12	49.174	34.7984	0.0668
	75	35.1515	11	100.246	35.1465	0.0050
	76	35.0969	10	151.304	35.0957	0.0012
	77	35.0603	9	200.967	35.0580	0.0023
	78	35.0072	8	301.552	35.0053	0.0019
	79	34.9874	7	403.527	34.9892	-0.0018
	80	34.9874	6	503.783	34.9850	0.0024
	81	34.9572	5	756.693	34.9552	0.0020
	82	34.9402	4	1007.386	34.9394	0.0008
	83	34.8287	3	1512.977	34.8261	0.0026
	84	34.7787	2	2022.031	34.7765	0.0022
	85	34.7792	1	2022.292	34.7765	0.0027
C18	86	34.9387	9	1008.928	34.9370	0.0017
	87	34.8277	6	1513.009	34.8257	0.0020
	88	34.7791	1	2021.864	34.7763	0.0028

Table 6.3.1.-1. Continued

Station	Bottle	Smeasure	Niskin Bottle No.	Pressure	CTD Sal.	Sal Difference
C19	89	34.3705	Bucket	-	-	-
	90	34.8224	12	50.606	34.8172	0.0052
	91	35.1308	11	102.056	35.1063	0.0245
	92	35.1399	10	150.156	35.1430	-0.0031
	93	35.0802	9	202.279	35.0803	-0.0001
	94	35.0209	8	302.756	35.0189	0.0020
	95	34.9601	7	403.477	34.9578	0.0023
	96	34.9901	6	505.186	34.9889	0.0012
	97	34.9613	5	756.006	34.9602	0.0011
	98	34.9415	4	1009.073	34.9435	-0.0020
	99	34.8197	3	1513.734	34.8174	0.0023
	100	34.7721	2	2021.491	34.7695	0.0026
	101	34.7725	1	2020.207	34.7696	0.0029
C20	102	35.2362	12	50.146	35.2313	0.0049
	103	35.1003	11	100.915	35.0917	0.0086
	104	35.0982	10	150.923	35.0984	-0.0002
	105	35.1067	9	202.254	35.1039	0.0028
	106	34.9866	8	301.832	34.9848	0.0018
	107	34.9287	7	403.581	34.9263	0.0024
	108	34.9120	6	503.295	34.9106	0.0014
	109	34.8821	5	754.192	34.8803	0.0018
	110	34.8543	4	1008.368	34.8536	0.0007
	111	34.8117	3	1513.518	34.8092	0.0025
	112	34.7671	2	2021.185	34.7645	0.0026
	113	34.7673	1	2022.199	34.7644	0.0029
C21	114	35.0317	Bucket	-	-	-
	115	35.0365	12	50.662	35.0252	0.0113
	116	35.1873	11	100.038	35.1812	0.0061
	117	34.7618	10	151.932	34.7593	0.0025
	118	34.9773	9	201.047	34.9739	0.0034
	119	34.9402	8	302.266	34.9398	0.0004
	120	34.9212	7	402.323	34.9239	-0.0027
	121	34.8782	6	502.337	34.8775	0.0007
	122	34.8503	5	755.689	34.8498	0.0005
	123	34.8109	4	1007.901	34.8101	0.0008
	124	34.7951	3	1514.549	34.7933	0.0018
	125	34.7659	2	2021.585	34.7637	0.0022
	126	34.7660	1	2020.727	34.7637	0.0023
C22	127	34.3967	Bucket	-	-	-
	128	35.1463	12	50.430	35.2034	-0.0571
	129	35.4390	11	100.045	35.4276	0.0114
	130	34.7418	10	149.905	34.7396	0.0022
	131	34.9796	9	202.051	34.9786	0.0010
	132	34.9363	8	300.946	34.9338	0.0025
	133	34.8948	7	400.694	34.8930	0.0018
	134	34.8975	6	503.745	34.8967	0.0008
	135	34.8523	5	757.006	34.8500	0.0023
	136	34.7702	4	1009.953	34.7675	0.0027
	137	34.7826	3	1516.090	34.7801	0.0025
	138	34.7599	2	2018.496	34.7574	0.0025
	139	34.7605	1	2019.885	34.7573	0.0032
C23	140	34.9185	12	50.096	34.8761	0.0424
	141	35.4248	11	100.021	35.4242	0.0006
	142	34.7752	10	151.008	34.7345	0.0407
	143	34.8803	9	203.100	34.8223	0.0580
	144	34.9301	8	300.944	34.9291	0.0010
	145	34.8831	7	403.147	34.8831	0.0000
	146	34.8735	6	504.574	34.8731	0.0004
	147	34.7481	5	754.055	34.7455	0.0026
	148	34.7459	4	1008.498	34.7450	0.0009
	149	34.7830	3	1513.777	34.7828	0.0002
	150	34.7544	2	2019.596	34.7523	0.0021
	151	34.7547	1	2020.918	34.7524	0.0023

Table 6.3.1.-1. Continued

Station	Bottle	Smeasure	Niskin Bottle No.	Pressure	CTD Sal.	Sal Difference
C24	152	35.2693	12	50.920	35.2542	0.0151
	153	35.1968	11	100.344	35.2009	-0.0041
	154	34.9115	10	148.964	34.9139	-0.0024
	155	34.8509	9	199.529	34.8384	0.0125
	156	34.9345	8	304.225	34.9354	-0.0009
	157	34.9004	7	402.168	34.8987	0.0017
	158	34.8701	6	504.077	34.8698	0.0003
	159	34.8154	5	754.605	34.8138	0.0016
	160	34.7622	4	1007.540	34.7598	0.0024
	161	34.7761	3	1513.794	34.7739	0.0022
	162	34.7575	2	2019.102	34.7552	0.0023
	163	34.7574	1	2021.025	34.7553	0.0021
C25	164	34.9770	12	50.697	34.8407	0.1363
	165	35.1698	11	101.002	35.1405	0.0293
	167	34.6489	10	150.656	34.6420	0.0069
	166	34.8290	9	201.778	34.8316	-0.0026
	168	34.9588	8	302.018	34.9549	0.0039
	169	34.9037	7	404.052	34.9023	0.0014
	170	34.8885	6	504.478	34.8867	0.0018
	171	34.7973	5	755.430	34.7972	0.0001
	172	34.7677	4	1006.881	34.7659	0.0018
	173	34.7272	3	1515.483	34.7744	-0.0472
	174	34.7550	2	2021.895	34.7528	0.0022
	175	34.7549	1	2021.398	34.7528	0.0021
C26	176	34.4683	Bucket	-	-	-
	177	35.0223	12	50.543	35.1412	-0.1189
	178	35.3489	11	100.884	35.3676	-0.0187
	179	34.7499	10	150.128	34.7495	0.0004
	180	34.8403	9	200.021	34.8299	0.0104
	181	34.9462	8	301.567	34.9462	0.0000
	182	34.9068	7	402.139	34.9058	0.0010
	183	34.8782	6	504.172	34.8764	0.0018
	184	34.8175	5	754.371	34.8168	0.0007
	185	34.8014	4	1009.132	34.8003	0.0011
	186	34.7787	3	1513.833	34.7765	0.0022
	187	34.7618	2	2021.680	34.7567	0.0051
	188	34.7590	1	2021.755	34.7568	0.0022
C27	189	34.7479	Bucket	-	-	-
	190	34.7782	12	50.208	34.7692	0.0090
	191	35.3367	11	101.507	35.3234	0.0133
	192	34.5791	10	149.776	34.5771	0.0020
	193	34.7740	9	201.118	34.7539	0.0201
	194	34.9461	8	302.731	34.9471	-0.0010
	195	34.9142	7	402.069	34.9123	0.0019
	196	34.8715	6	503.559	34.8695	0.0020
	197	34.8721	5	756.206	34.8699	0.0022
	198	34.8115	4	1008.454	34.8094	0.0021
	199	34.7809	3	1512.952	34.7788	0.0021
	200	34.7583	2	2020.405	34.7562	0.0021
	201	34.7586	1	2019.397	34.7563	0.0023
C28	202	34.7217	12	10.931	34.7155	0.0062
	203	34.7214	11	10.651	34.7153	0.0061
	204	34.7719	10	51.552	34.7381	0.0338
	205	35.3920	9	102.119	35.3850	0.0070
	206	35.3987	8	99.692	35.3788	0.0199
	207	34.9990	7	252.132	34.9986	0.0004
	208	34.8835	6	503.314	34.8818	0.0017
	209	34.7414	5	1008.581	34.7396	0.0018
	210	34.7415	4	1008.767	34.7395	0.0020
	211	34.7773	3	1512.049	34.7740	0.0033
	212	34.7560	2	2021.532	34.7538	0.0022
	213	34.7559	1	2020.341	34.7538	0.0021

Table 6.3.1.-2. Difference of salinity of duplicately sample bottles.

Station	Sample Bottle	Sample Bottle	Sal. Meas.	Sal. Meas.	Niskin Bottle No.	CTD Pressure	CTD Sal.	Dupri. Sal.
C01	1	2	34.5718	34.5713	1	1999.859	34.5712	0.0005
C02	3	4	34.5530	34.5529	1	1000.695	34.5516	0.0001
C03	16	17	34.5538	34.5537	1	1000.69	34.5522	0.0001
C04	18	19	34.5591	34.5585	1	1000.721	34.5568	0.0006
C05	20	21	34.5576	34.5575	7	998.723	34.5555	0.0001
C06	22	23	34.5478	34.5481	7	1000.454	34.5467	0.0003
C07	24	25	34.5487	34.5487	1	1000.851	34.5477	0.0000
C08	26	27	34.5598	34.5597	1	998.847	34.5582	0.0001
C09	28	29	34.5568	34.5573	1	1000.844	34.5552	0.0006
C10	30	31	34.5587	34.5583	1	1006.887	34.5576	0.0004
C11	32	33	34.5600	34.5598	1	996.867	34.5585	0.0002
C12	10	11	34.9299	34.9394	4	1010.006	34.9287	
	13	14	34.7785	34.7783	2	2022.124	34.7766	0.0002
C13	25	26	34.9459	34.9459	4	1008.441	34.9451	0.0000
	29	30	34.7751	34.7753	1	2022.182	34.7728	0.0002
C14	40	41	34.9527	34.9527	4	1008.14	34.9515	0.0000
	44	45	34.7759	34.7758	1	2021.593	34.7737	0.0001
C15	55	56	34.9584	34.9578	4	1007.894	34.9570	0.0006
	59	60	34.7788	34.8383	1	2020.384	34.7757	
							Avg.	0.0002
							Std. Dev.	0.0002

6.3.2 Dissolved Oxygen

(1) Personnel

Hideaki Hase	(JAMSTEC)	Principal Investigator (Leg 2)
Yuichi Sonoyama	(Marine Works Japan Ltd.)	
Masahiko Nishino	(Marine Works Japan Ltd.)	

(2) Objective

Precise determination of dissolved oxygen (below D.O.) using the Winkler titration with potentiometric detection.

(3) Methods

(a) Instruments and Apparatus

Sample flasks:

BOD flasks of 180ml nominal capacity with glass stoppers.

OPTIFIX:

Capable of dispensing 1ml pickling reagents.

Thermometers:

Thermometer is used to measure the water temperature at sampling to within 0.5℃.

Dispensers:

Metrohm Model 725 Multi Dosimat, capable of dispensing standard KIO_3 solution.

Eppendorf:

Capable of dispensing 1ml 5M H_2SO_4 and standard KIO_3 solution.

Titrator:

Metrohm Model 716 DMS Titrino, capable of titrating $Na_2S_2O_3$ solution for 0.001 ml.
Metrohm Pt Electrode 6.9904.030

Software:

Metrohm,Titrino Workcell, capable of date acquisition and endpoint evaluation

(b) Methods

Sampling and analytical methods were based on the WHP Operations and Methods (Culberson, 1991, Dickson, 1994).

(b-1) Sampling

Seawater were sampled from 12 litters Niskin bottles to the calibrated dry glass bottles on the stations whose number was from C12 to C27. At each station, we collected seawater samples from 2000m to surface for 12 layers, except for C18 (C18: 3 layers). During each sampling, 3 bottle volumes of seawater were overflowed to minimize contamination with atmospheric oxygen, and the seawater temperature at the time of collection was measured with thermometers. After the sampling, $MnCl_2$ (aq.) 1ml and NaOH / NaI (aq.) 1ml were added into the glass bottle, and then shook well. After the precipitation was setteled, we shook the bottle vigorously to disperse the precipitation.

(b-2) Dissolved Oxygen analysis

The samples were analyzed by 1 sets of Metrohm titrator with 10 ml piston burette and Pt electrode. Titration values were determined by the potentiometeric methods, and the endpoint for titration was evaluated by the software of Metrohm, Titrino Workcell. From the titration values, we calculated concentration of dissolved oxygen by WHP Operations and Methods (Culberson, 1991, Dickson, 1994).

(4) Preliminary Result

The vertical profiles of dissolved oxygen were shown in Figs. 6.3.2-1～3, and the correlation between D.O. sensor values and Winkler method values were shown in Fig. 6.3.2-4.

In our measurements, the standard deviations of the duplicate sample were from 0.003 μmol/kg-sw to 0.498 μmol/kg-sw (Table 6.3.2) that satisfied WOCE precision (below 0.5μmol/kg-sw).

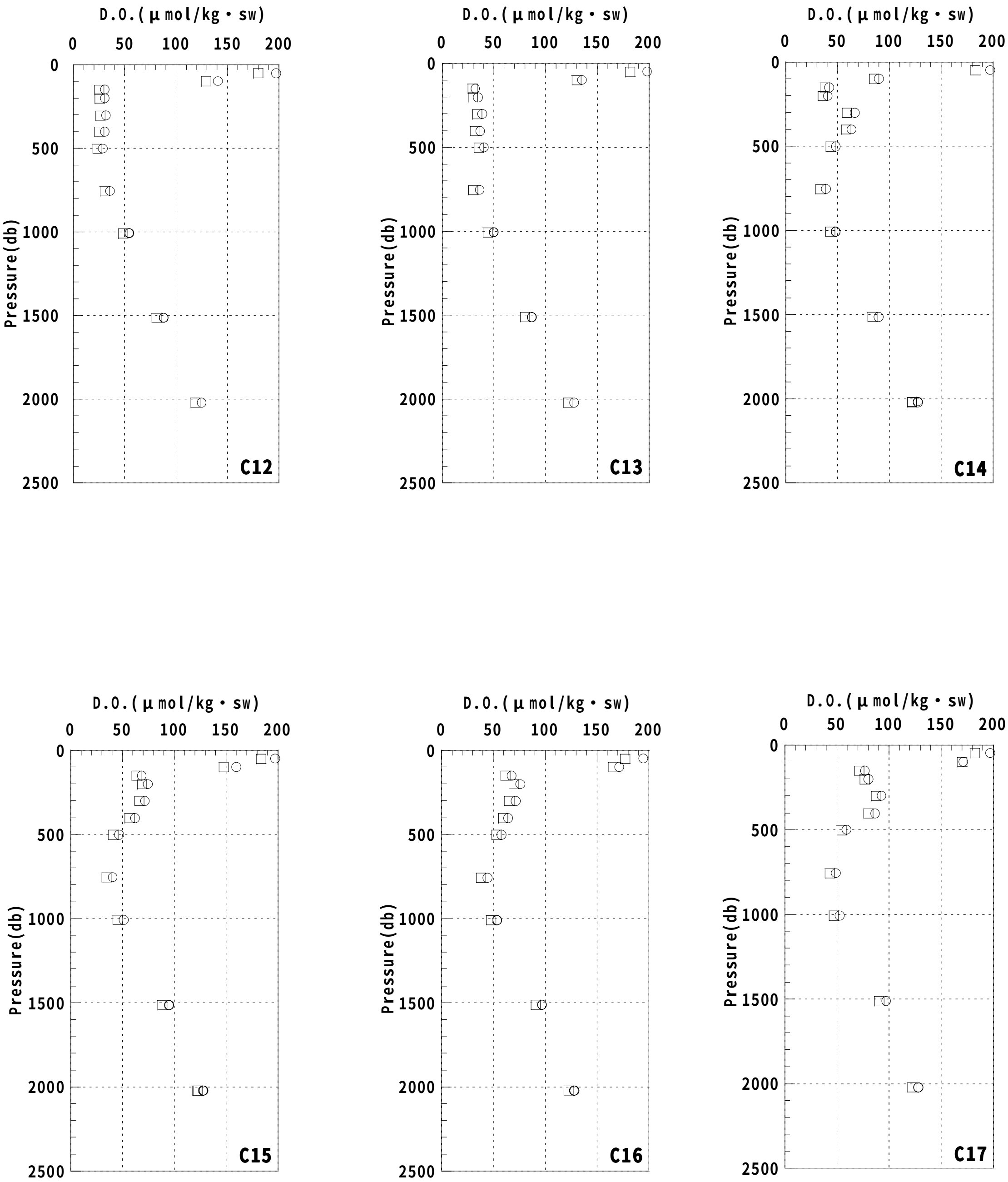
(5) References

Culberson, C.H. (1991) Dissolved Oxygen, in WHP Operations and Methods, Woods Hole., pp1-15.

Culberson, C.H., G.Knapp, R.T.Williams and F.Zemlyak (1991) A comparison of methods for the determination of dissolved oxygen in seawater. (WHPO 91-2)

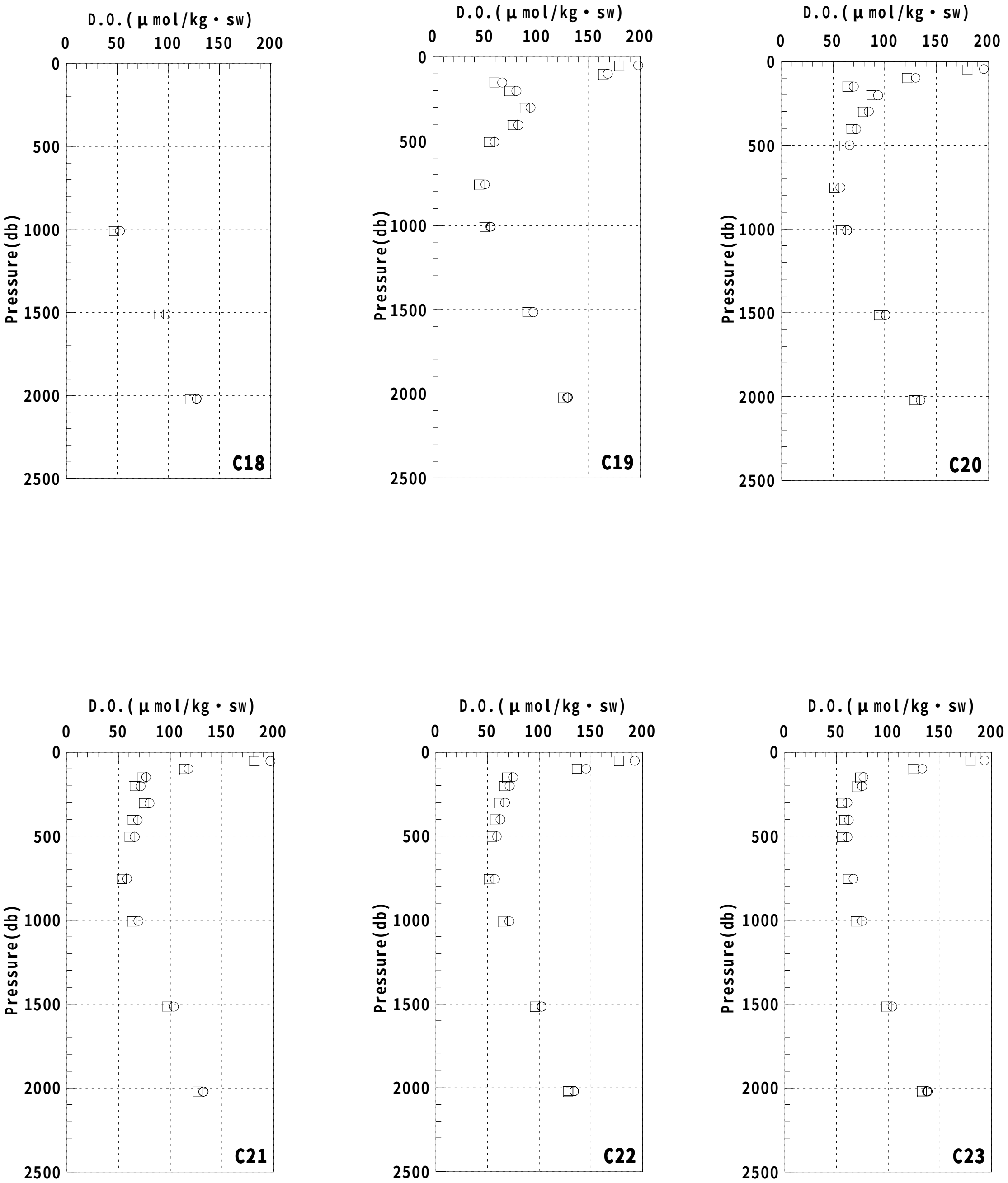
Dickson, A.G. (1994) Determination of dissolved oxygen in seawater by Winkler titration, in WHP Operations and Methods, Woods Hole., pp1-14.

Murray, N., J.P.Riley and T.R.S. Wilson (1968) The solubility of oxygen in Winkler regents used for the determination of dissolved oxygen, Deep-Sea Res.,15, 237-238.



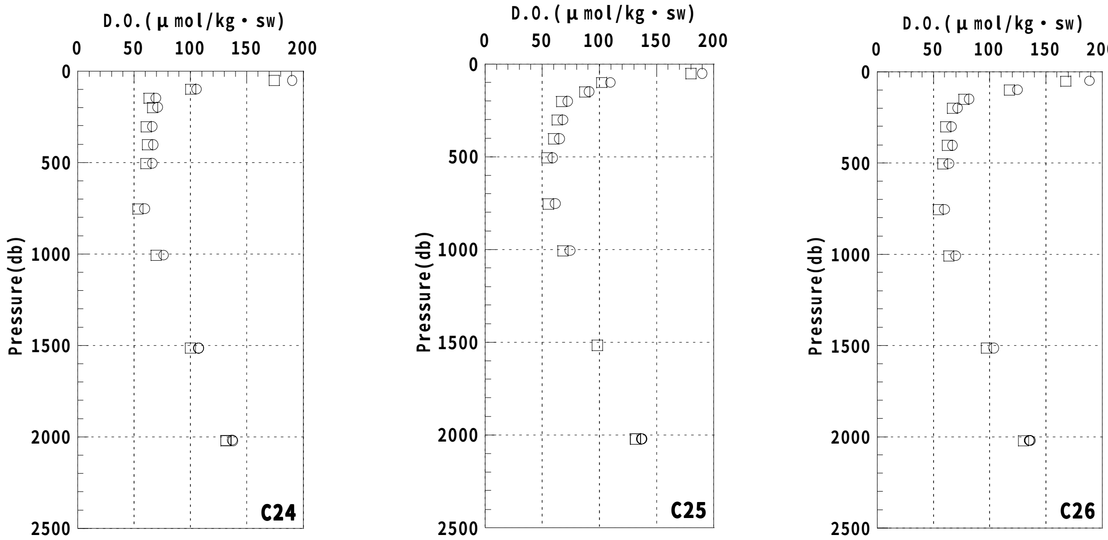
○; Winkler titration method (μmol/kg　sw)
□; D.O. sensor (μmol/kg　sw)

Fig. 6.3.2-1 Vertical profile of dissolved oxygen at each station (Cast12～17).



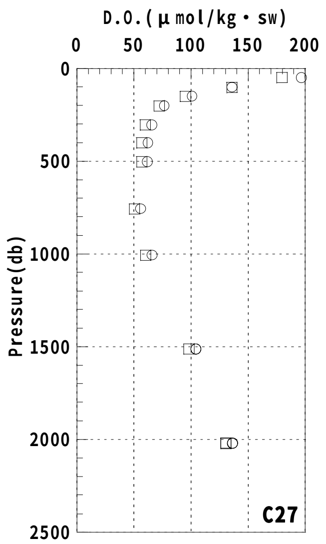
○; Winkler titration method (μmol/kg sw)
□; D.O. sensor (μmol/kg sw)

Fig. 6.3.2-2 Vertical profile of dissolved oxygen at each station (Cast18～23).



○; Winkler titration method (μmol/kg　sw)
□; D.O. sensor (μmol/kg　sw)

Fig. 6.3.2-3 Vertical profile of dissolved oxygen at each station (Cast24～27).



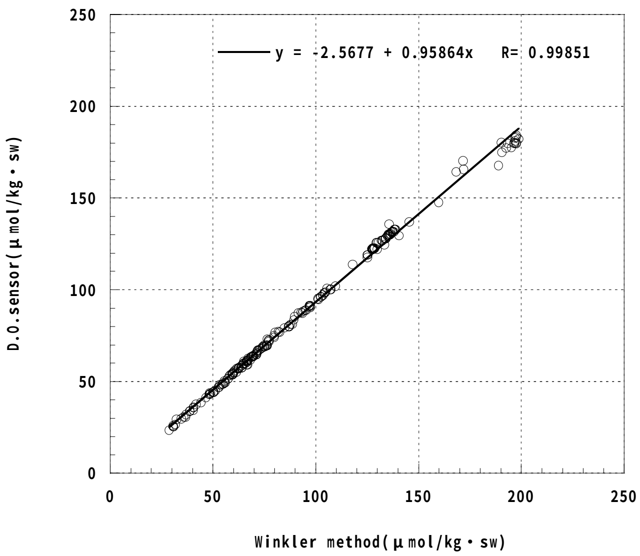


Fig. 6.3.2-4 The correlation between D.O. sensor values and Winkler method values in all stations.

Table 6.3.2 Standard deviation derived from the duplicate samples at each station.

Station	Niskin	Depth(m)	Sampling person	Analyst	S.D.(μmol/kg-sw)
C12	2	2000	T.Matsumoto	M.Nishino	0.057
	3	1500			0.440
	4	1000			0.139
C13	2	2000	M.Fujisaki	Y.Sonoyama	0.152
	3	1500			0.207
	4	1000			0.258
C14	3	1500	A.Ito	Y.Sonoyama	0.011
	4	1000			0.146
C15	2	2000	T.Matsumoto	M.Nishino	0.325
	3	1500			0.365
	4	1000			0.018
C16	2	2000	M.Fujisaki	M.Nishino	0.498
	3	1500			0.254
	4	1000			0.344
C17	2	2000	T.Matsumoto	Y.Sonoyama	0.152
C18	1	2000	A.Ito	Y.Sonoyama	0.283
C19	2	2000	M.Fujisaki	M.Nishino	0.406
	3	1500			0.144
	4	1000			0.196
C20	2	2000	M.Fujisaki	M.Nishino	0.019
	3	1500			0.060
	4	1000			0.177
C21	2	2000	T.Matsumoto	M.Nishino	0.300
C22	2	2000	A.Ito	Y.Sonoyama	0.006
	3	1500			0.098
	4	1000			0.139
C23	2	2000	M.Fujisaki	Y.Sonoyama	0.306
C24	2	2000	T.Matsumoto	M.Nishino	0.133
	3	1500			0.294
	4	1000			0.276
C25	2	2000	A.Ito	M.Nishino	0.447
C26	2	2000	M.Fujisaki	Y.Sonoyama	0.288
C27	2	2000	A.Ito	M.Nishino	0.003
	3	1500			0.211
	4	1000			0.021

6.4 Continuous monitoring of surface seawater
6.4.1 EPCS

(1) Personnel

Yoshifumi Kuroda	(JAMSTEC) Principal Investigator (Leg 1)
Hideaki Hase	(JAMSTEC) Principal Investigator (Leg 2)
Yuichi Sonoyama	(Marine Works Japan Ltd.)
Masahiko Nishino	(Marine Works Japan Ltd.)

(2) Objective

Measurement of temperature, salinity, dissolved oxygen and fluorescence in the sea surface water.

(3) Methods

EPCS (Nippon Kaiyo co., Ltd.) has five kinds of sensors and fluorescence photometer, and can measure automatically temperature, salinity, dissolved oxygen, fluorescence and particle size of plankton in near-sea surface water continuously every 1-minute. This system is located in the “*sea surface monitoring laboratory*” of R/V Mirai, and connected to the shipboard LAN-system. Measured data are stored in a hard disk of PC machine every 1-minute with time and position of ship, and displayed on a data management PC machine.

Near-sea surface water is continuously pumped up to the laboratory and flows into the *EPCS* through a vinyl-chloride pipe. The flow rate for the system is controlled by several valves to be 12L/min except the fluorometer (about 0.3L/min). The flow rate is measured with two flow meters and each values are checked by marine technicians everyday.

Specification of the each sensor in this system are listed below.

a) Temperature and salinity sensor

SEACAT THERMOSALINOGRAPH

Model:	SBE-21, SEA-BIRD ELECTRONICS, INC.	
Serial number:	2126391-3126	
Measurement range:	Temperature -5 to +35℃,	Salinity0 to 6.5 S /m
Accuracy:	Temperature 0.01 ℃ /6month,	Salinity0.001 S /m month
Resolution:	Temperature 0.001℃,	Salinity0.0001 S /m

b) Bottom of ship thermometer

Model:	SBE 3S, SEA-BIRD ELECTRONICS, INC.
Serial number:	032607
Measurement range:	-5 to +35℃
Resolution:	±0.001℃
Stability:	0.002 ℃/ year

c) Dissolved oxygen sensor

Model:	2127A, Oubisufair Laboratories Japan INC.
Serial number:	44733
Measurement range:	0 to 14 ppm
Accuracy:	±1% at 5 ℃ of correction range
Stability:	1% /month

d) Fluorometer

Model:	10-AU-005, TURNER DESIGNS
Serial number:	5562 FRXX

Detection limit: 5 ppt or less for chlorophyll a
Stability: 0.5% /month of full scale

e) Particle size sensor
Model: P-05, Nippon Kaiyo LTD.
Serial number: P5024
Measurement range: 0.02681 mmt to 6.666 mm
Accuracy: ±10% of range
Reproducibility: ±5%
Stability: 5% /week

f) Flow meter
Model: EMARG2W, Aichi Watch Electronics LTD.
Serial number: 8672
Measurement range: 0 to 30 l /min
Accuracy: ±1%
Stability: ±1% /day

The monitoring periods (UTC) during this cruise are listed below.
Leg.1 11:15-25-June to 4:21-22-July 2002
The periods when data were not acquired due to system down.
6:37-6-July to 7:01-6-July 2002
7:48-17-July to 8:48-17-July 2002

Leg.2 9:25-25-July to 9:00-19-August 2002
The periods when data were not acquired due to system down.
22:43-29-July to 23:20-29-July 2002
4:13-3-August to 5:21-3-August 2002
0:03-11-August to 0:20-11-August 2002
9:25-15-August to 9:45-15-August 2002
1:51-16-August to 3:00-16-August 2002

(4) Preliminary Result

Time series of the temperature, salinity, dissolved oxygen and fluorescence in Leg 1 were shown in Fig. 6.4.1-1-4.

Time series of the temperature, salinity, dissolved oxygen and fluorescence in Leg 2 were shown in Fig. 6.4.1-5-8.

Correlation between sensor salinity and water-sampling salinity were shown in Fig. 6.4.1-9.

Correlation between sensor D.O. and water-sampling D.O. were shown in Fig. 6.4.1-10.

(5) Date archive

The data were stored on a magnetic optical disk, which will be submitted to the Data Management Office (DMO) JAMSTEC, and will be opened to public via “ R/V MIRAI Data Web Page ” in JAMSTEC homepage.

(6) Remarks

We did not sample the data in the EEZ of Socialist Republic of Vietnam from 16:43-17-July to 23:06-21-July 2002.

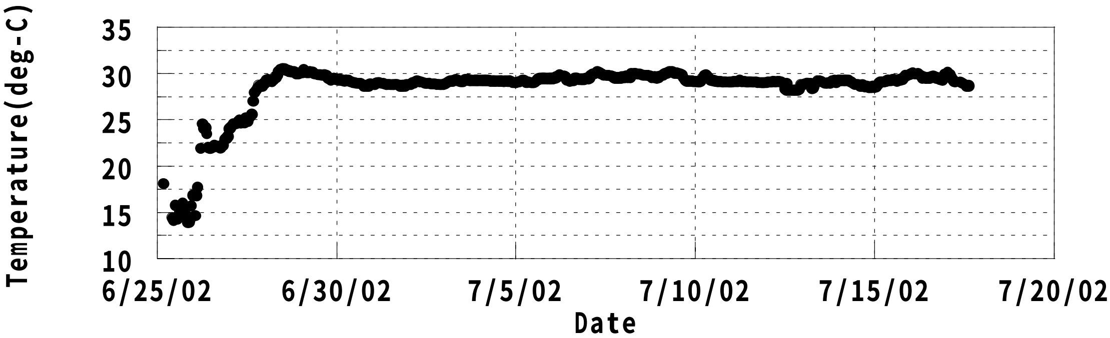


Fig. 6.4.1-1 Time series of sea surface temperature (Leg 1)

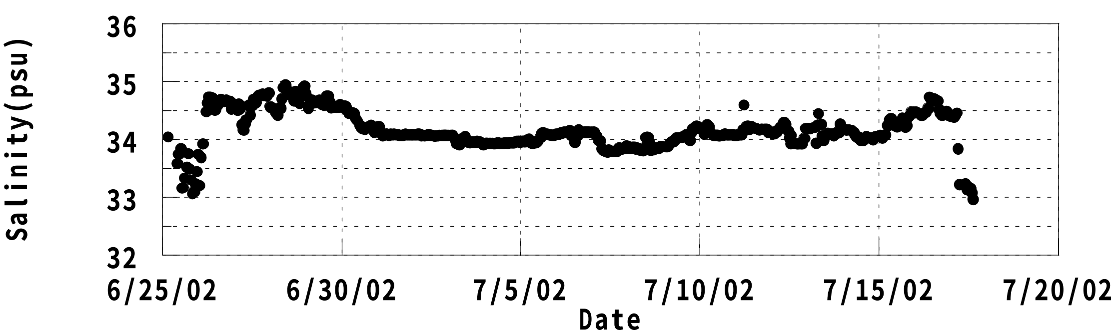


Fig. 6.4.1-2 Time series of sea surface salinity (Leg 1)

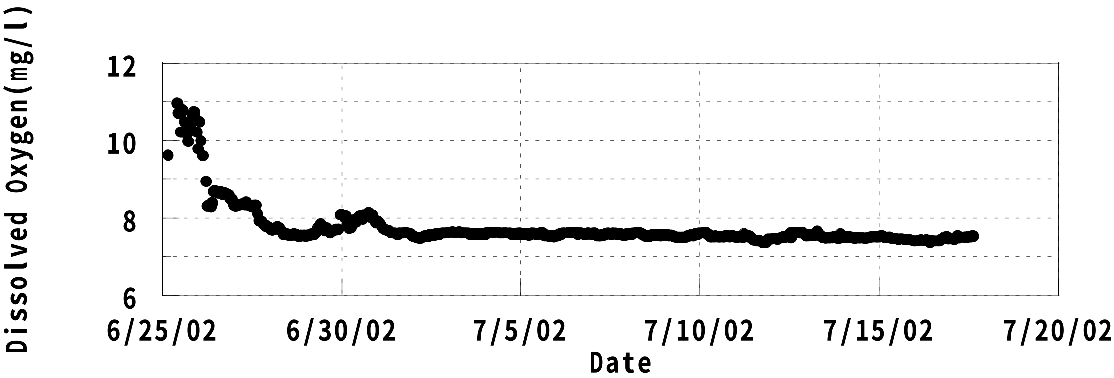


Fig. 6.4.1-3 Time series of sea surface dissolved oxygen (Leg 1)

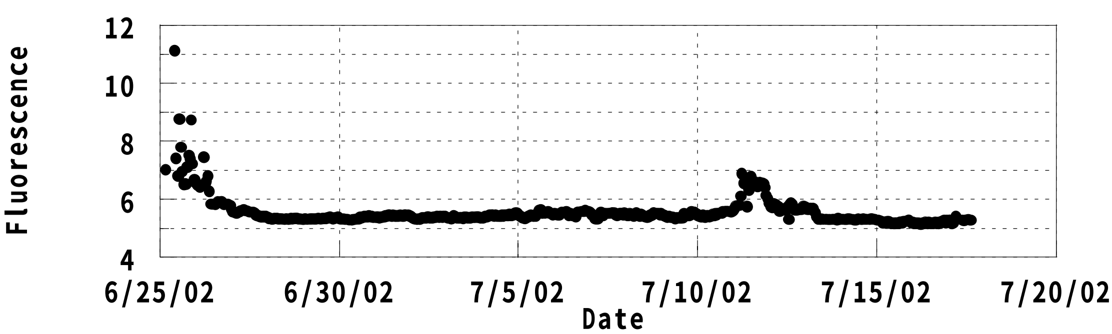


Fig. 6.4.1-4 Time series of sea surface fluorescence (Leg 1)

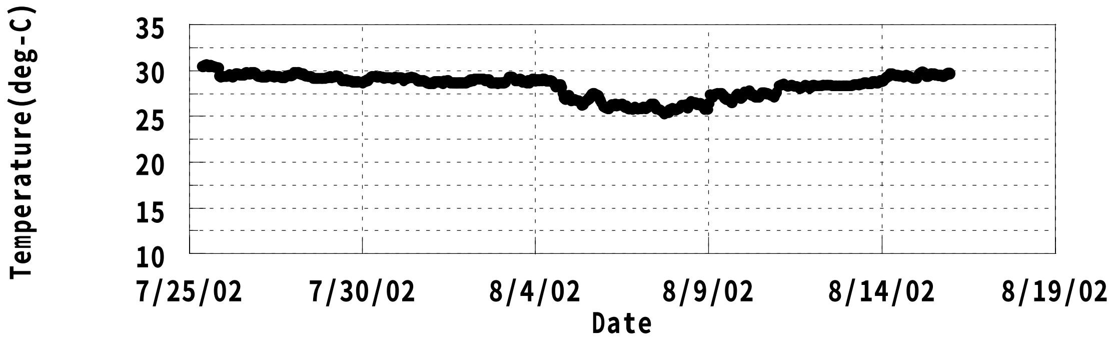


Fig. 6.4.1-5 Time series of sea surface temperature (Leg 2)

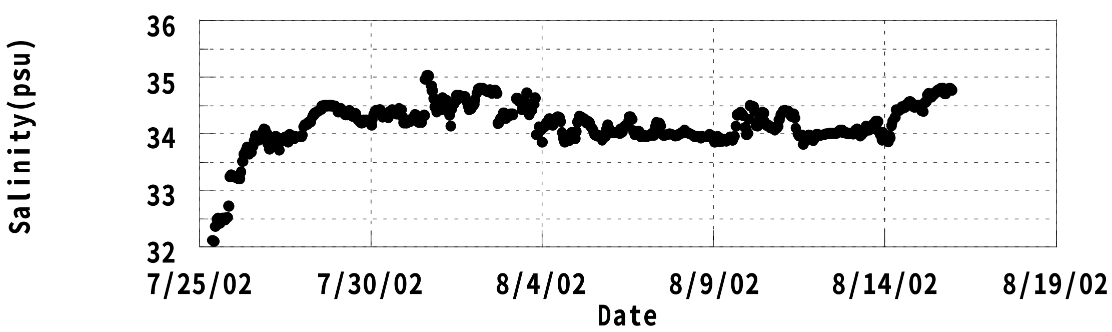


Fig. 6.4.1-6 Time series of sea surface salinity (Leg 2)

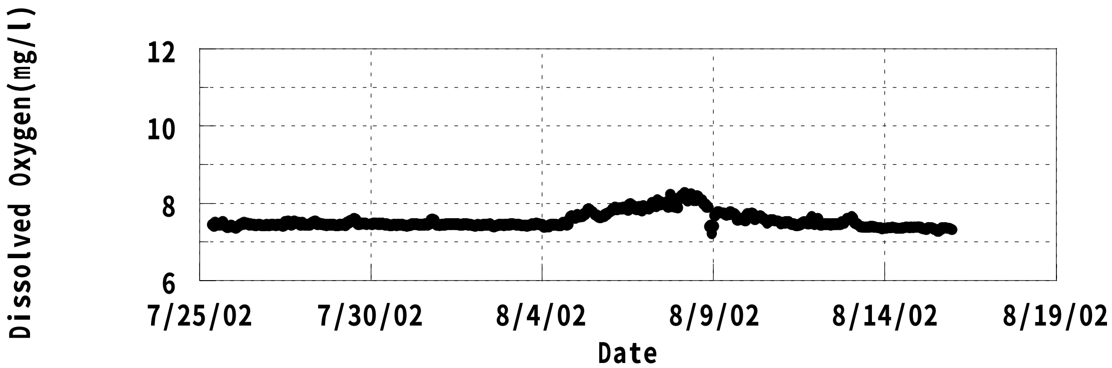


Fig. 6.4.1-7 Time series of sea surface dissolved oxygen (Leg 2)

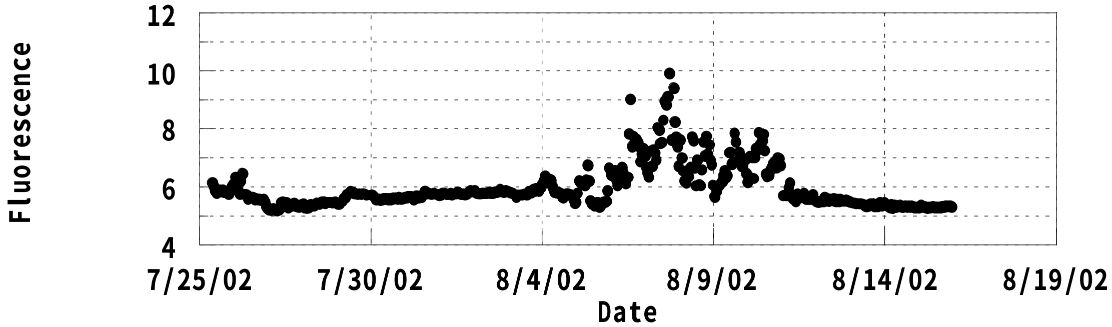


Fig. 6.4.1-8 Time series of sea surface fluorescence (Leg 2)

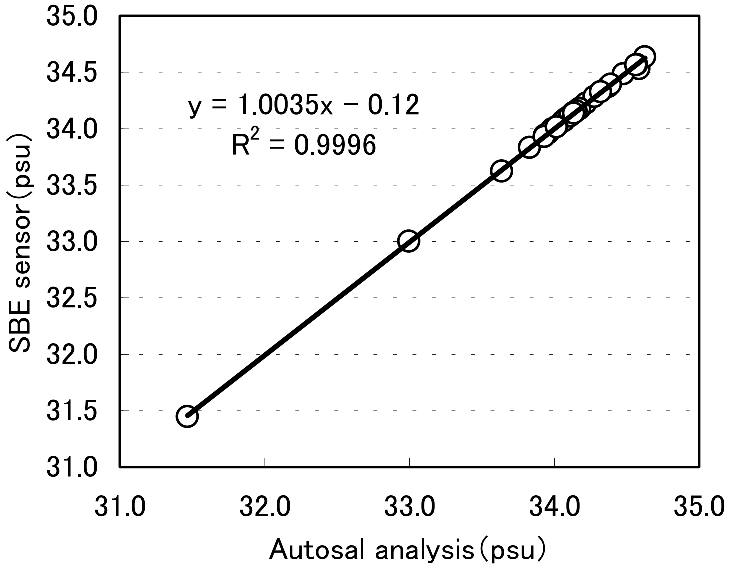


Fig. 6.4.1-9 Correlation between sensor salinity and water-sampling salinity

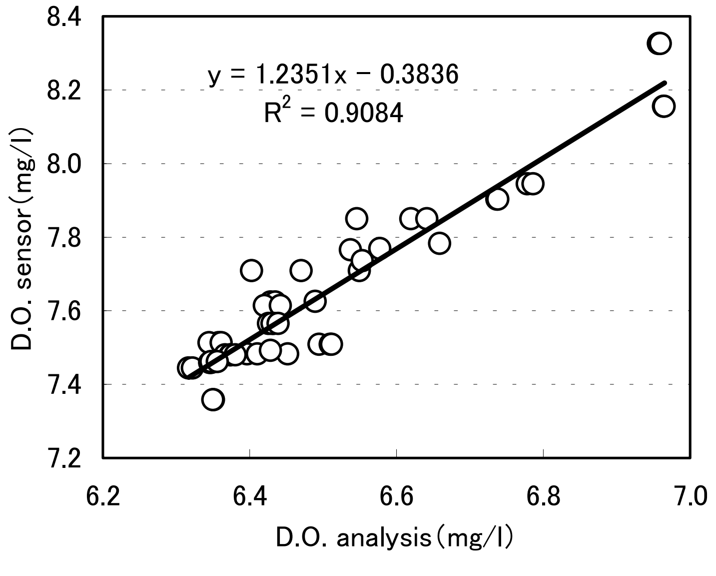


Fig. 6.4.1-10 Correlation between sensor D.O. and water-sampling D.O.

6.5 Shipboard ADCP

(1) Personnel

Yoshifumi Kuroda	(JAMSTEC) Principal Investigator -Leg 1-
Hideaki Hase	(JAMSTEC) Principal Investigator -Leg 2-
Masaki Hanyu	(GODI) Operation Leader -Leg 1-
Yasutaka Imai	(GODI) -Leg 1, 2-
Shinya Iwamida	(GODI) -Leg 1, 2-
Wataru Tokunaga	(GODI) -Leg 2-

(2) Parameters
Current velocity of each depth cell [cm/s]
Echo intensity of each depth cell [dB]

(3) Methods

Upper ocean current measurements were made throughout MR02-K04 cruise (25/June/2002 --- 20 /August/2002, Sekinehama --- Port Klang --- Sekinehama) using the hull-mounted Acoustic Doppler Current Profiler (ADCP) system that is permanently installed on the R/V Mirai. The system consists of following components;

1) a 75 kHz Broadband width ADCP (RD Instruments, USA) with 4-beam Doppler sonar pointing 30 degrees from the vertical that is mounted 45 degrees azimuth from the keel;
2) the Ship's main gyro compass (Tokimec , Japan) continuously providing ship's heading to the ADCP;
3) a GPS navigation receiver (Leica MX9400) providing position fixes;
4) an IBM-compatible personal computer running data acquisition software (VmDas version 1.3 ; RD Instruments, USA). The clock of the logging PC was adjusted to GPS time every 5 minutes.

The ADCP was configured for 16-m processing bin, a 8-m blanking interval. The sound speed is calculated from temperature (thermistor near the transducer faces), salinity (constant value; 35.0 psu) and depth (6.5 m; transducer depth) by the equation in Medwin (1975). The transducer depth was 6.5 m; 64 velocity measurements were made at 16-m intervals starting 31m below the surface. Each 1 ping was recorded as raw ensemble data. Also, 60 seconds and 300 seconds average data were recorded as short-term average (STA) and long-term average (LTA) data.

Major parameters for the measurement (Direct Command) are listed in the appendix.

(4) Preliminary result
Figures 6.5-1 to 6.5-9 show the current vectors at depth of 31, 63, 111, 159, 207 and 303m during Leg 1. Figures 6.5-7 to 6.5-9 show the current vectors in the equatorial region. Figures 6.5-10 to 6.5-12 show the current vectors at depth of 31, 63, 111, 159, 207 and 303m during Leg 2.

(5) Data archive
These data obtained during this cruise will be submitted to the JAMSTEC DMO (Data Management Office), and will be opened to the public via "R/V Mirai Data Web Page" in JAMSTEC home page.

(6) Remarks
We did not sample the data in the EEZ of Socialist Republic of Vietnam from 1643UTC 17 July to 2307UTC 21July2002.

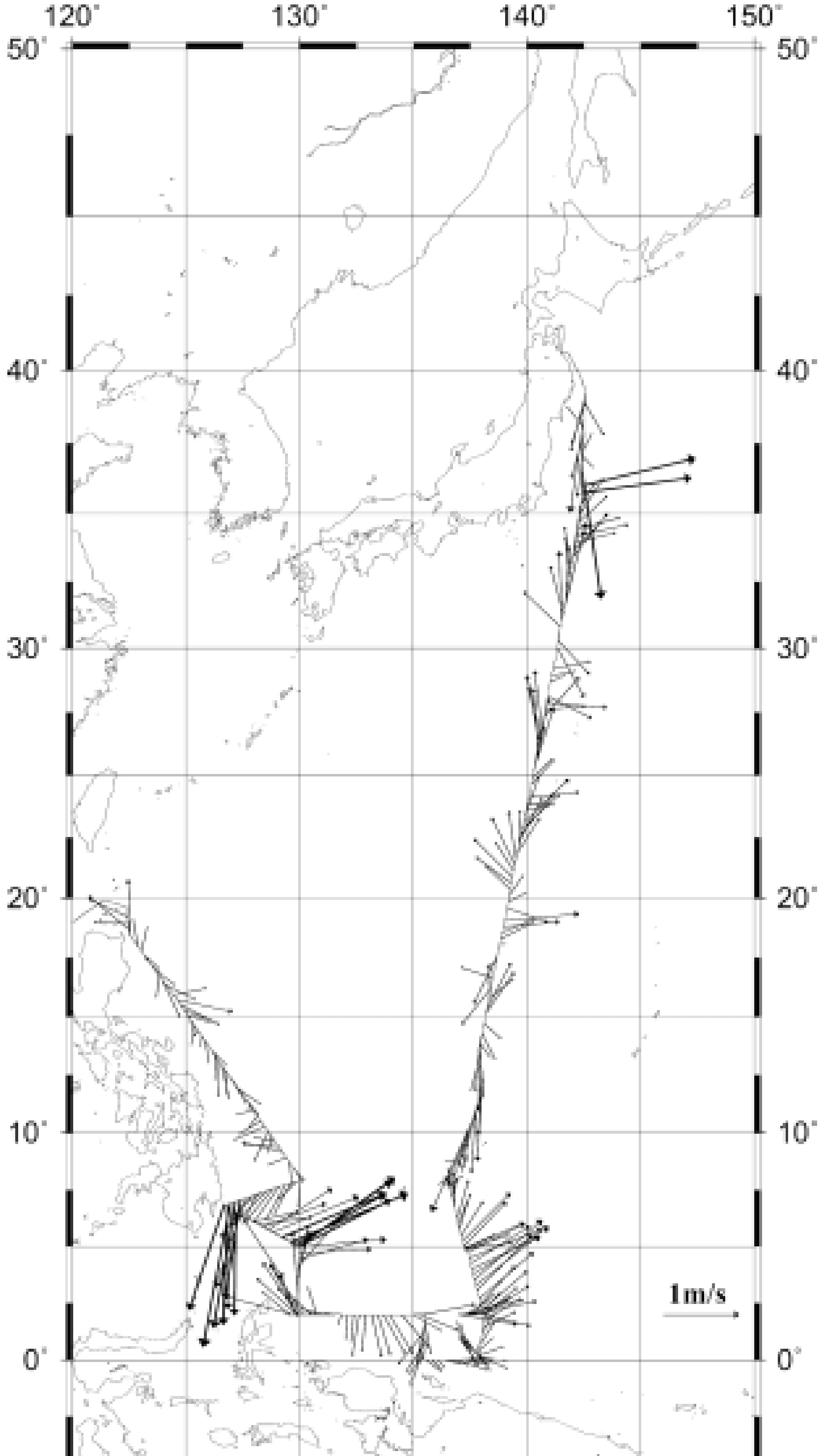


Fig. 6.5-1 Current vectors at 31m depth (5minutes average)

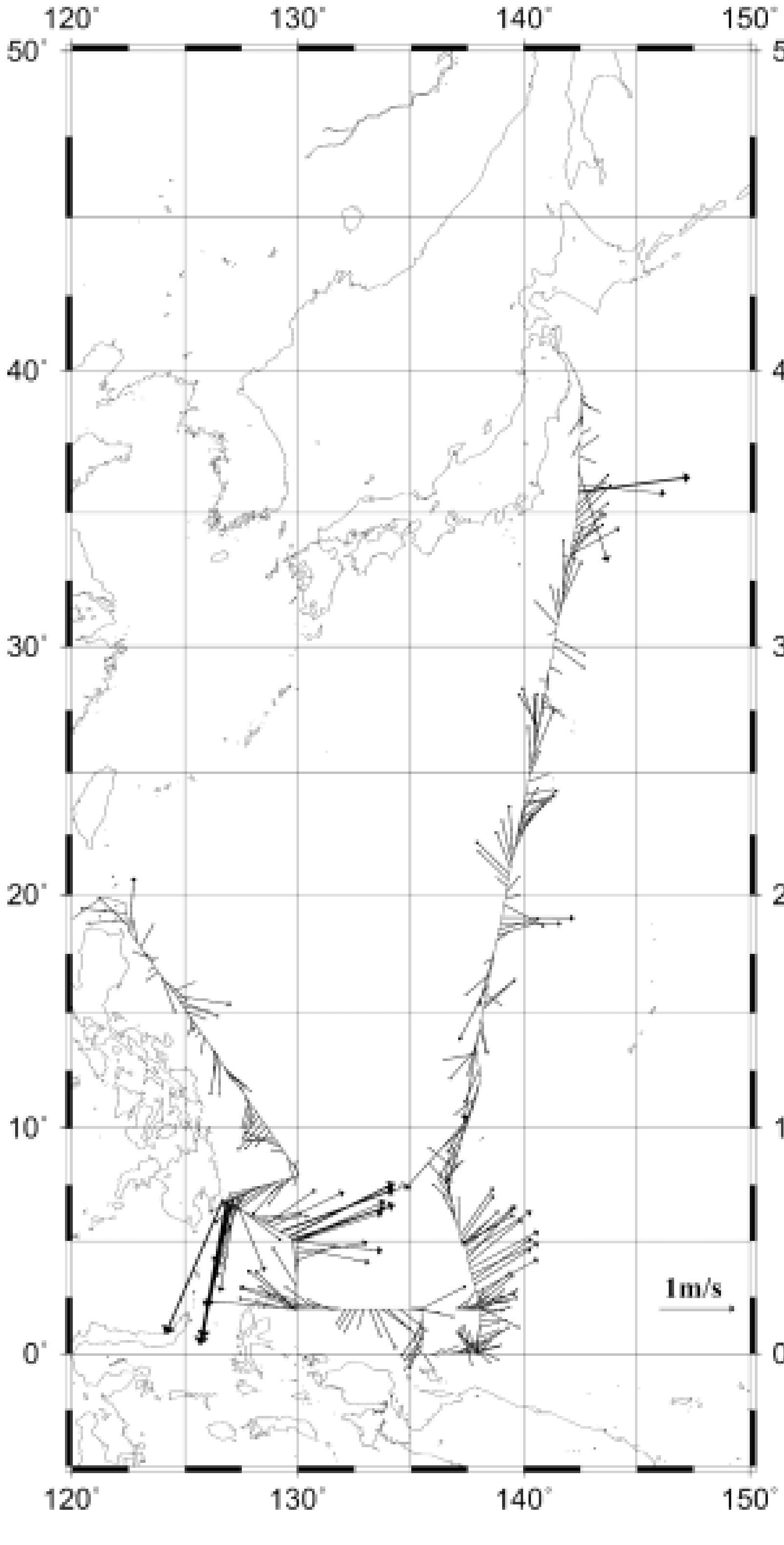


Fig. 6.5-2 Current vectors at 63m depth (5minutes average)

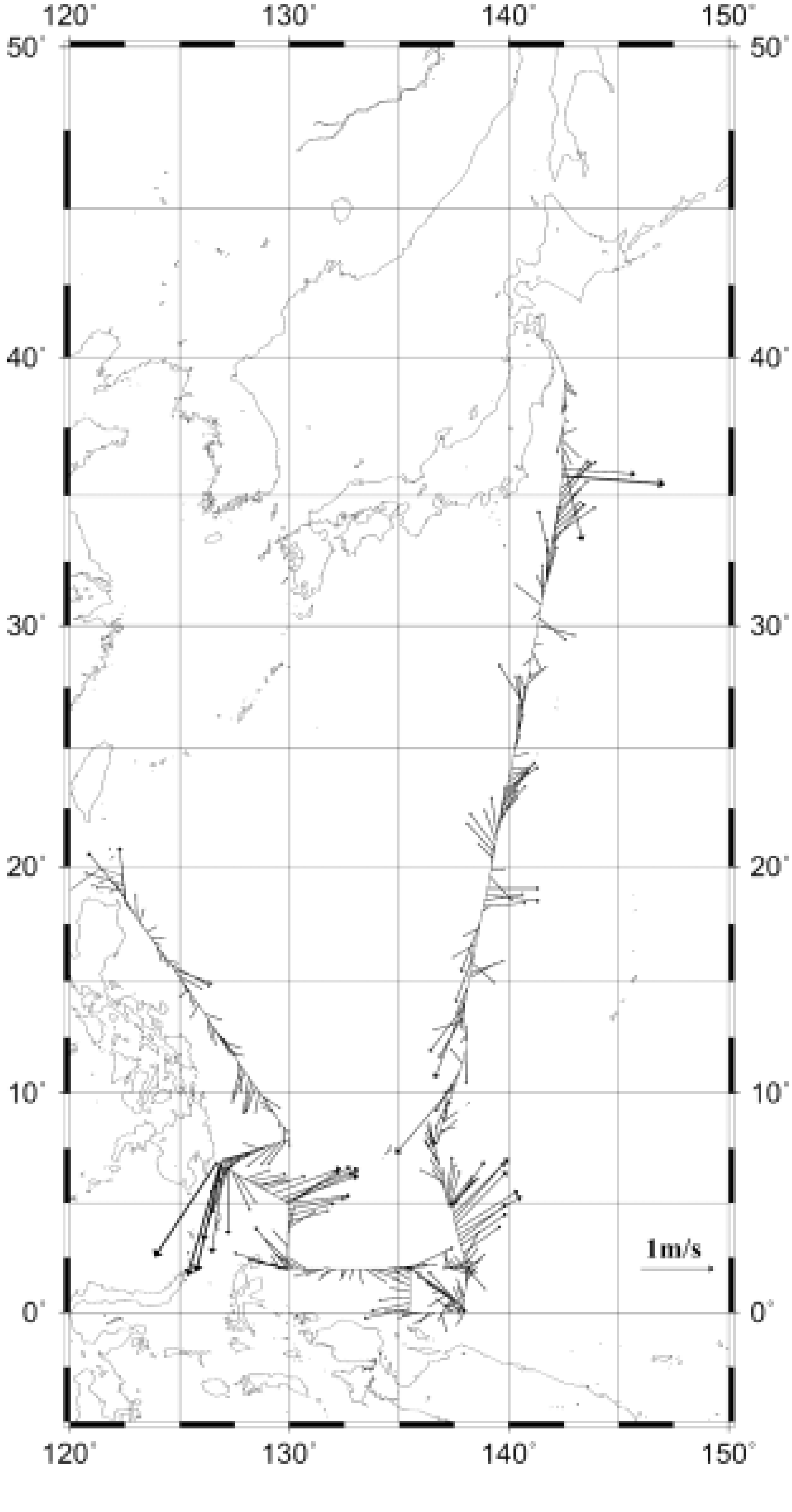


Fig. 6.5-3 Current vectors at 111m depth (5minutes average)

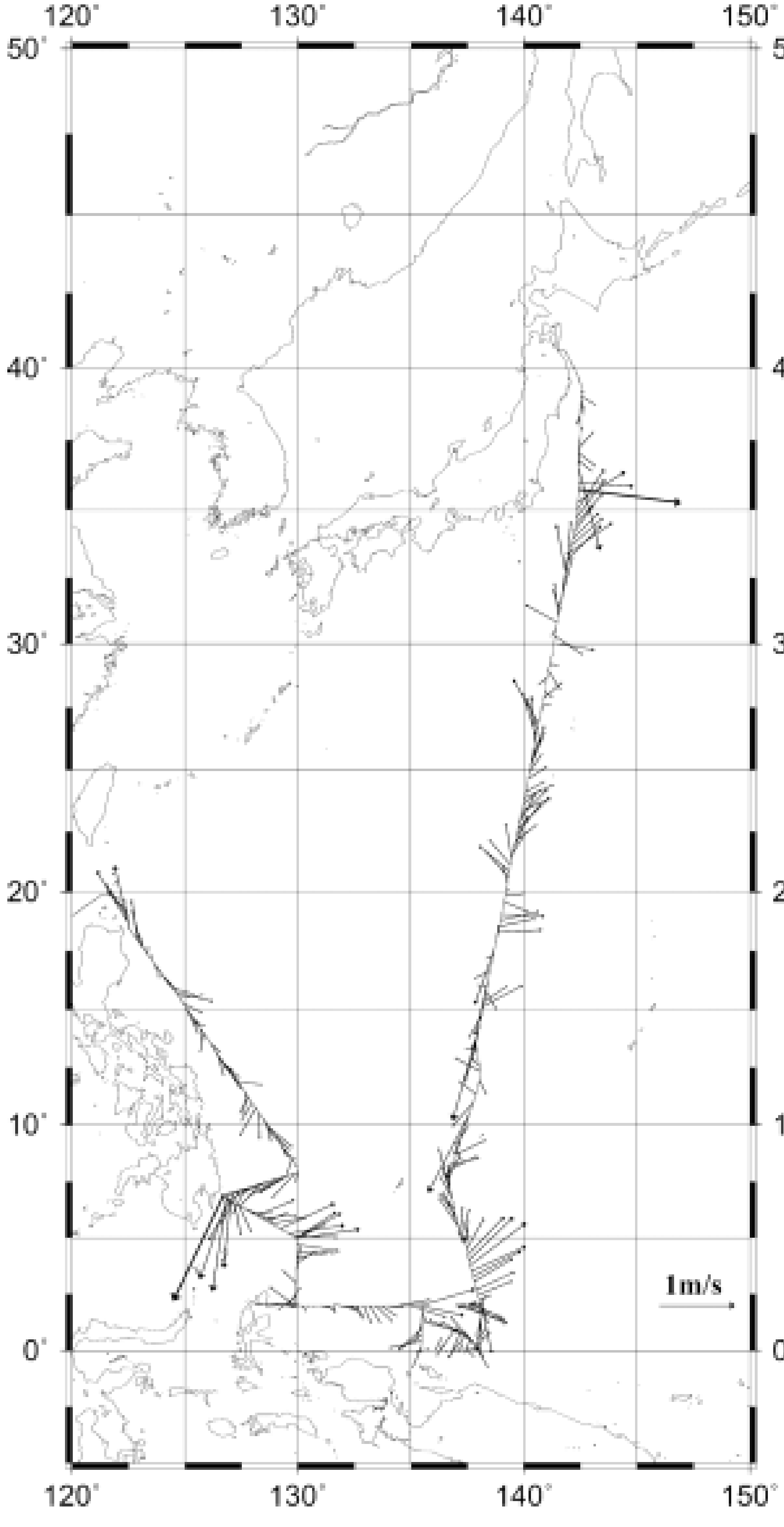


Fig. 6.5-4 Current vectors at 159m depth (5minutes average)

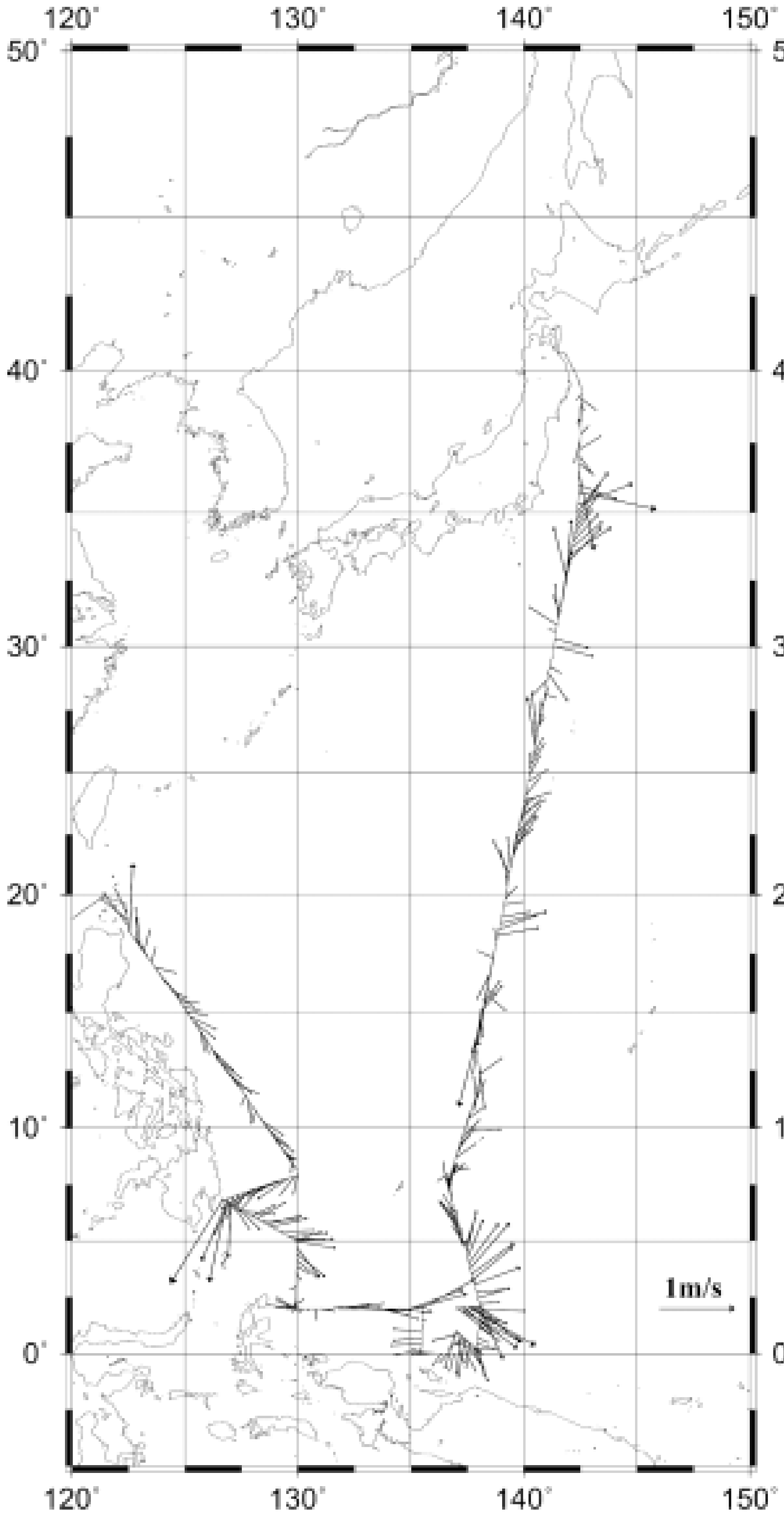


Fig. 6.5-5 Current vectors at 207m depth (5minutes average)

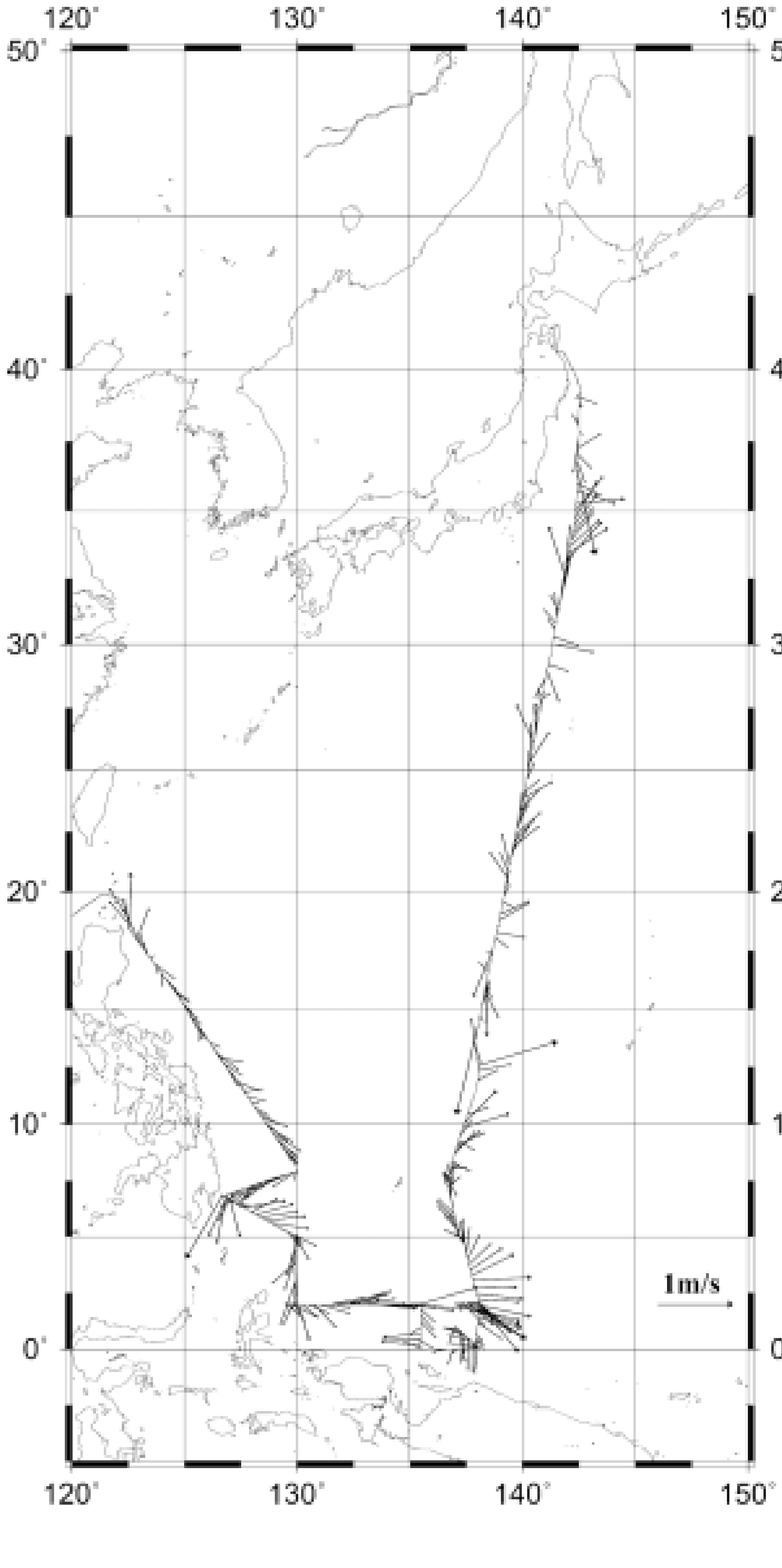


Fig. 6.5-6 Current vectors at 303m depth (5minutes average)

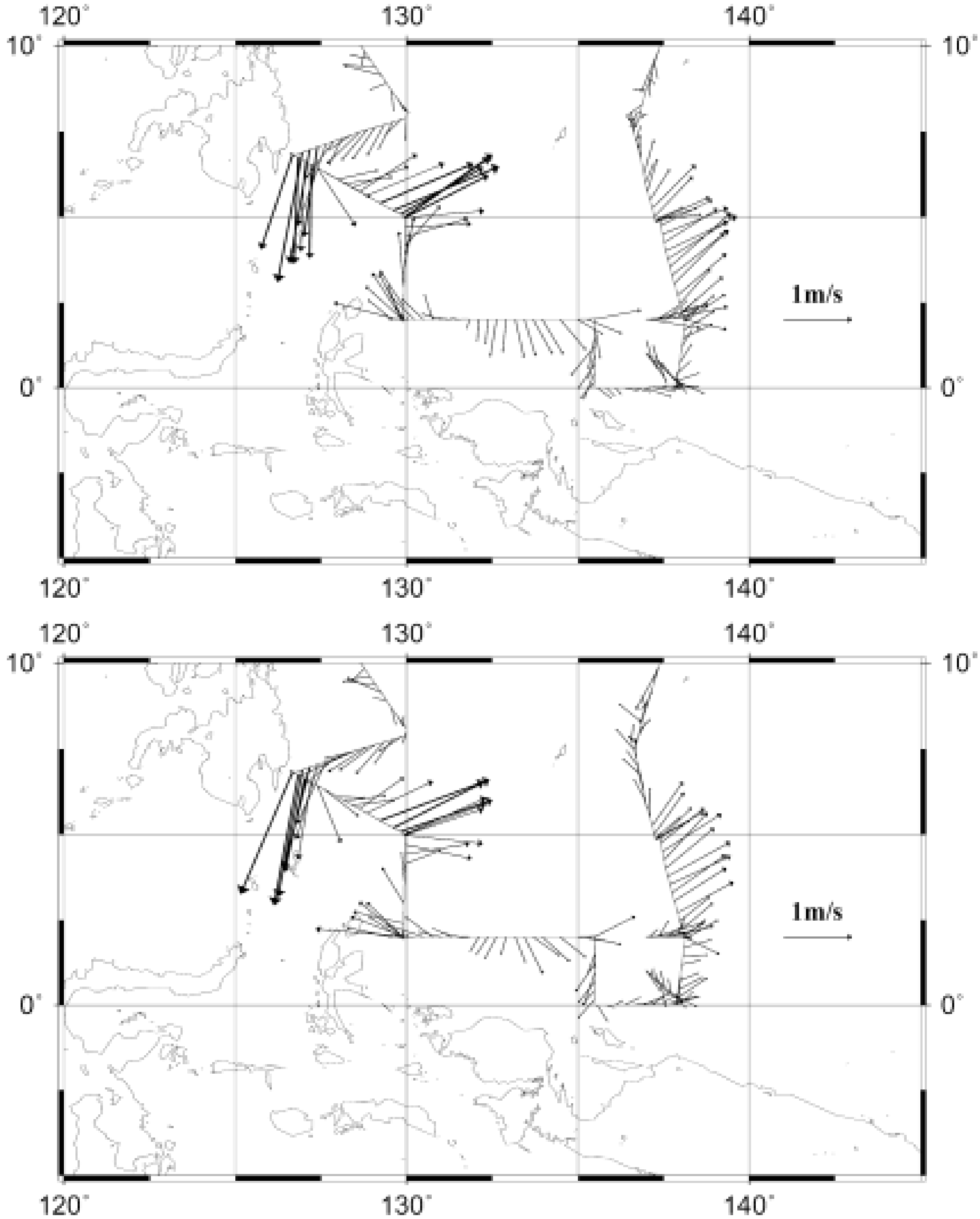


Fig. 6.5-7 Current vectors at 31m depth (above) and 63m depth (below)

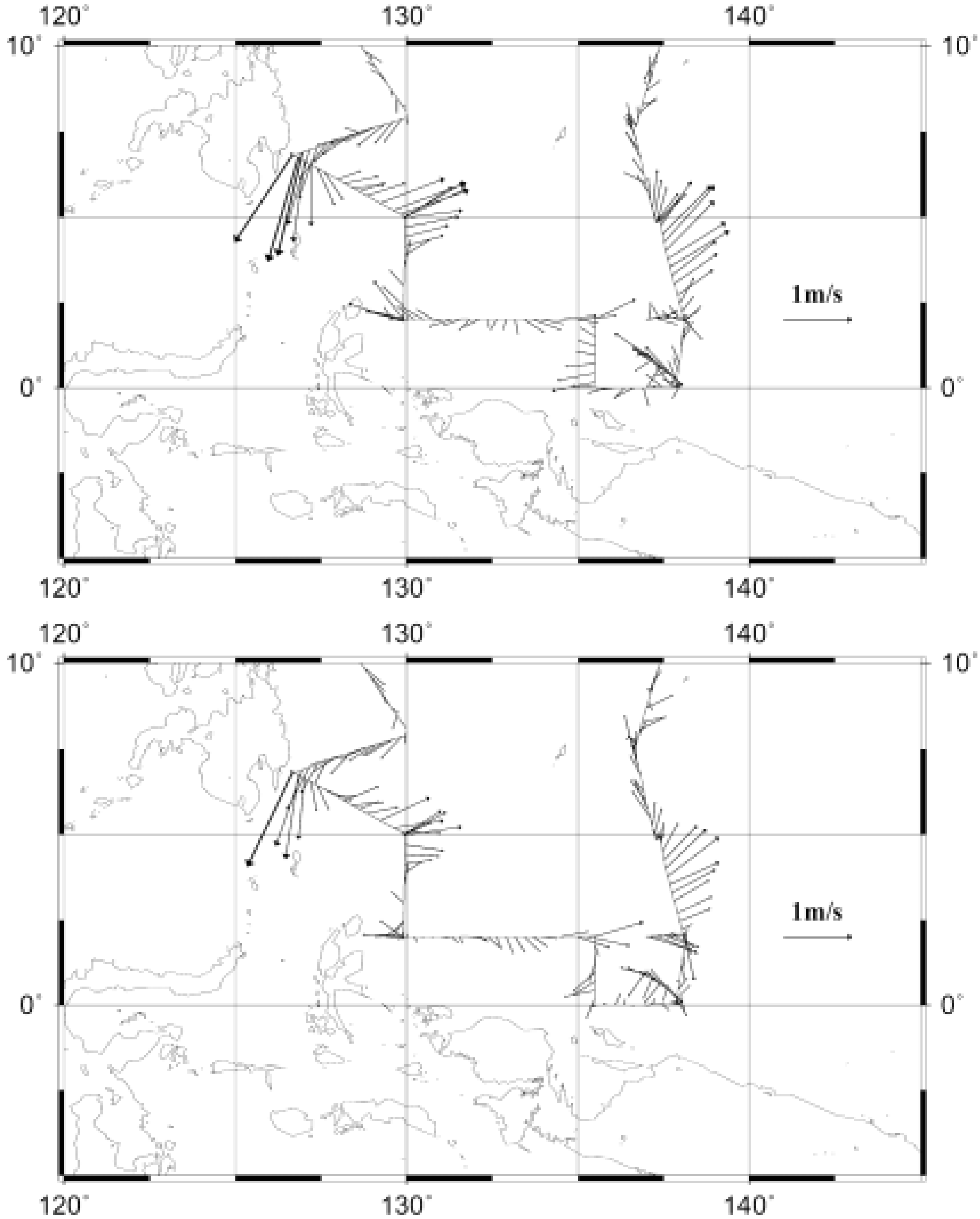


Fig. 6.5-8 Current vectors at 111m depth (above) and 159m depth (below)

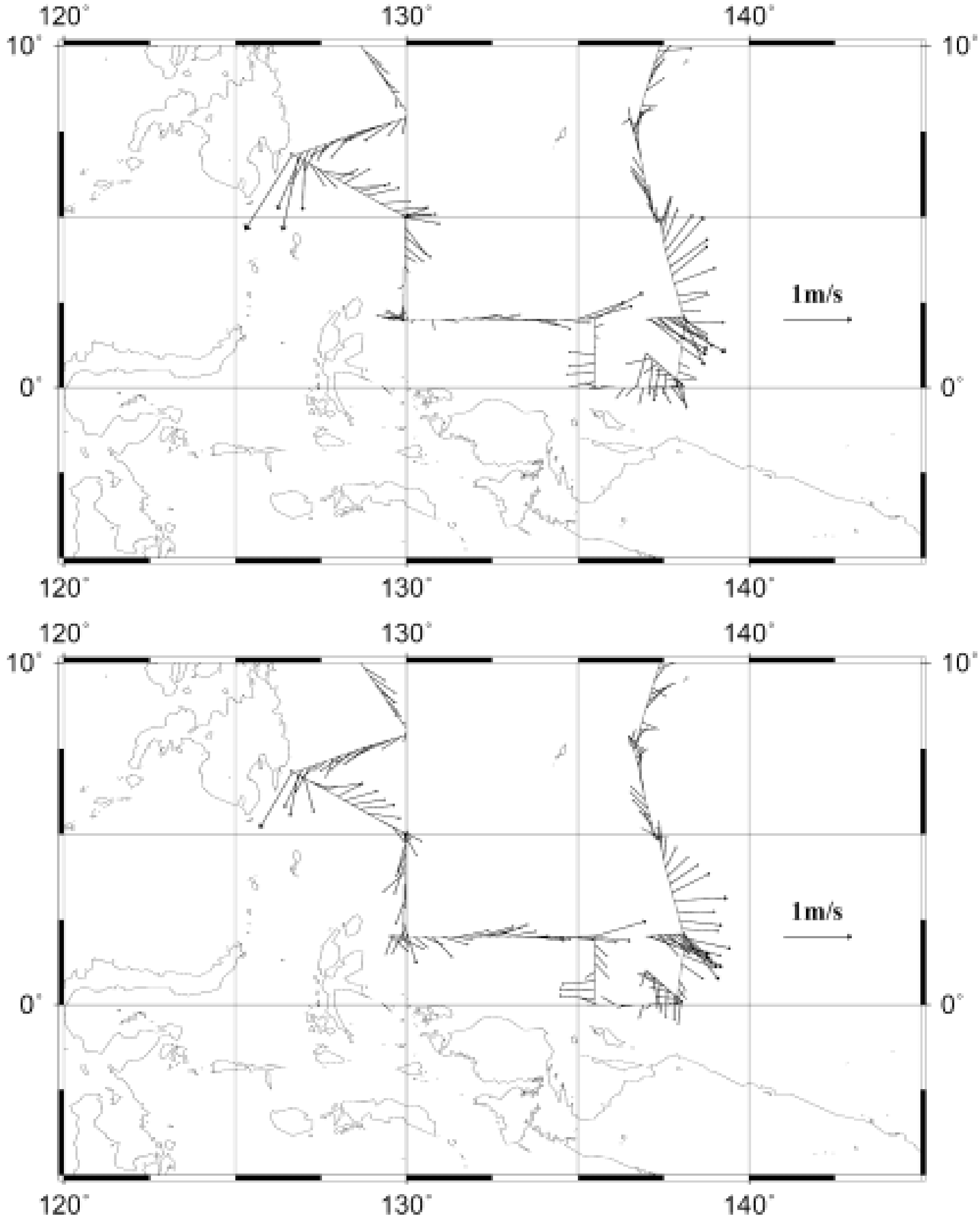


Fig. 6.5-9 Current vectors at 207m depth (above) and 303m depth (below)

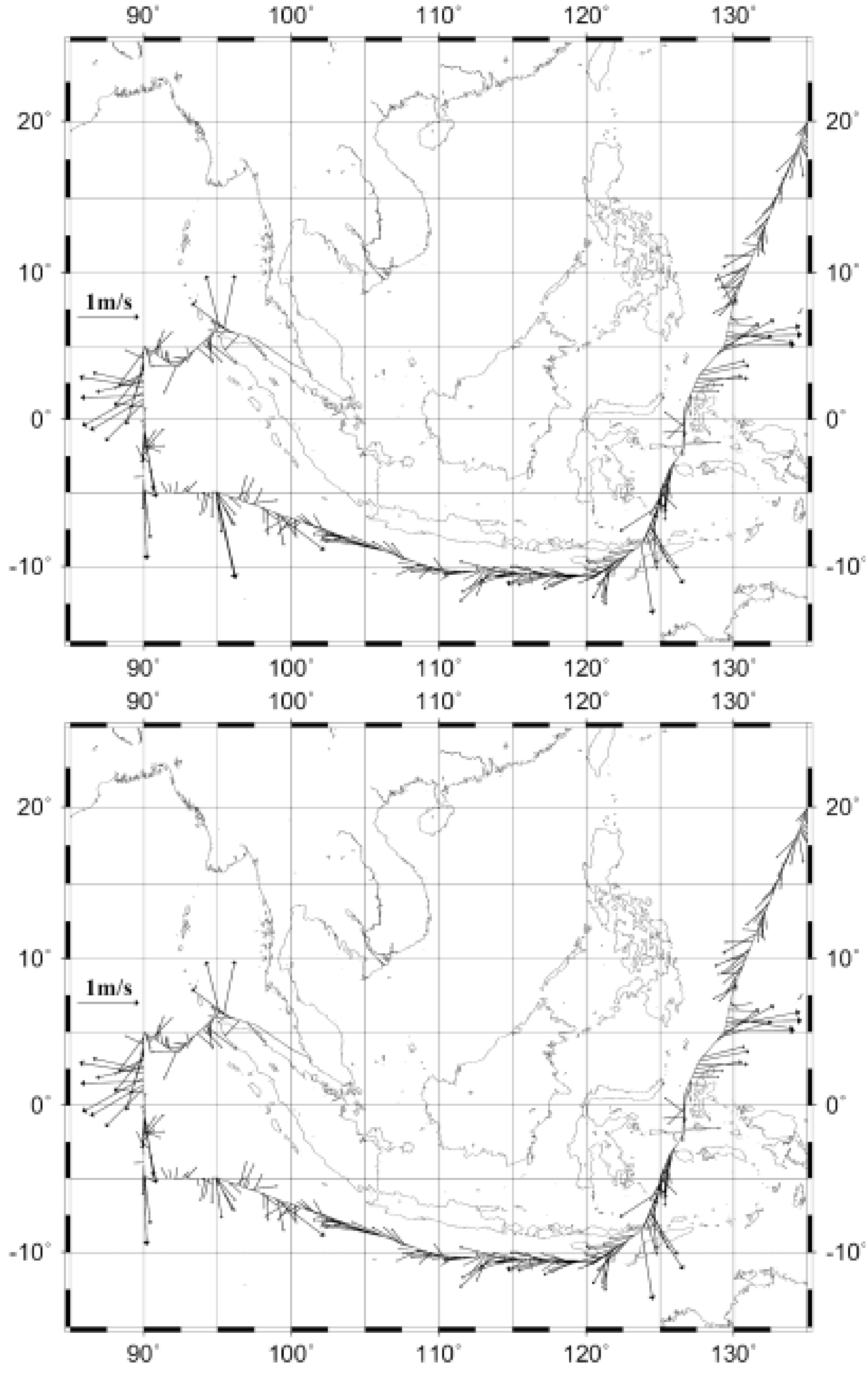


Fig. 6.5-10 Current vectors at 31m depth (above) and 63m depth (below)

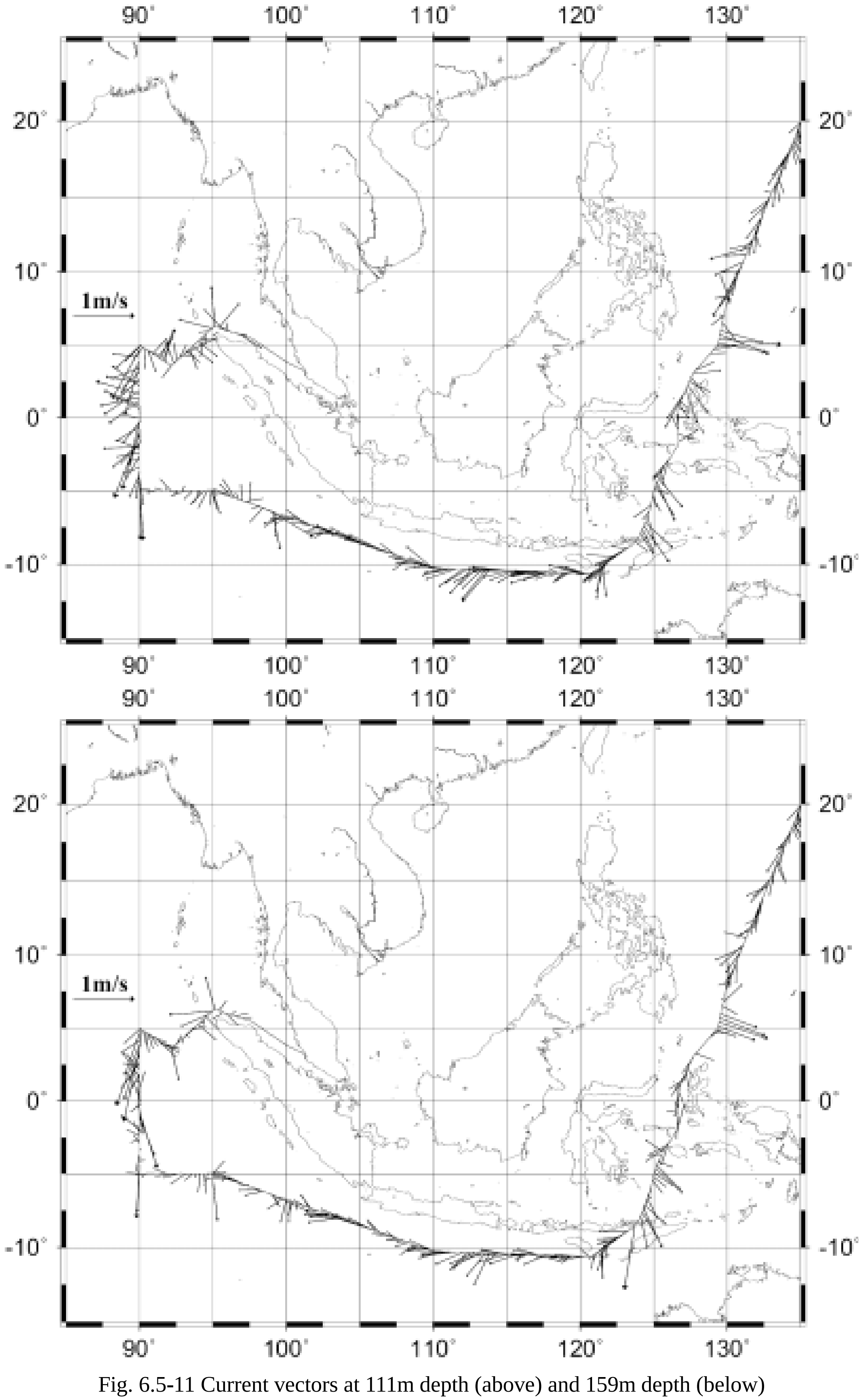


Fig. 6.5-11 Current vectors at 111m depth (above) and 159m depth (below)

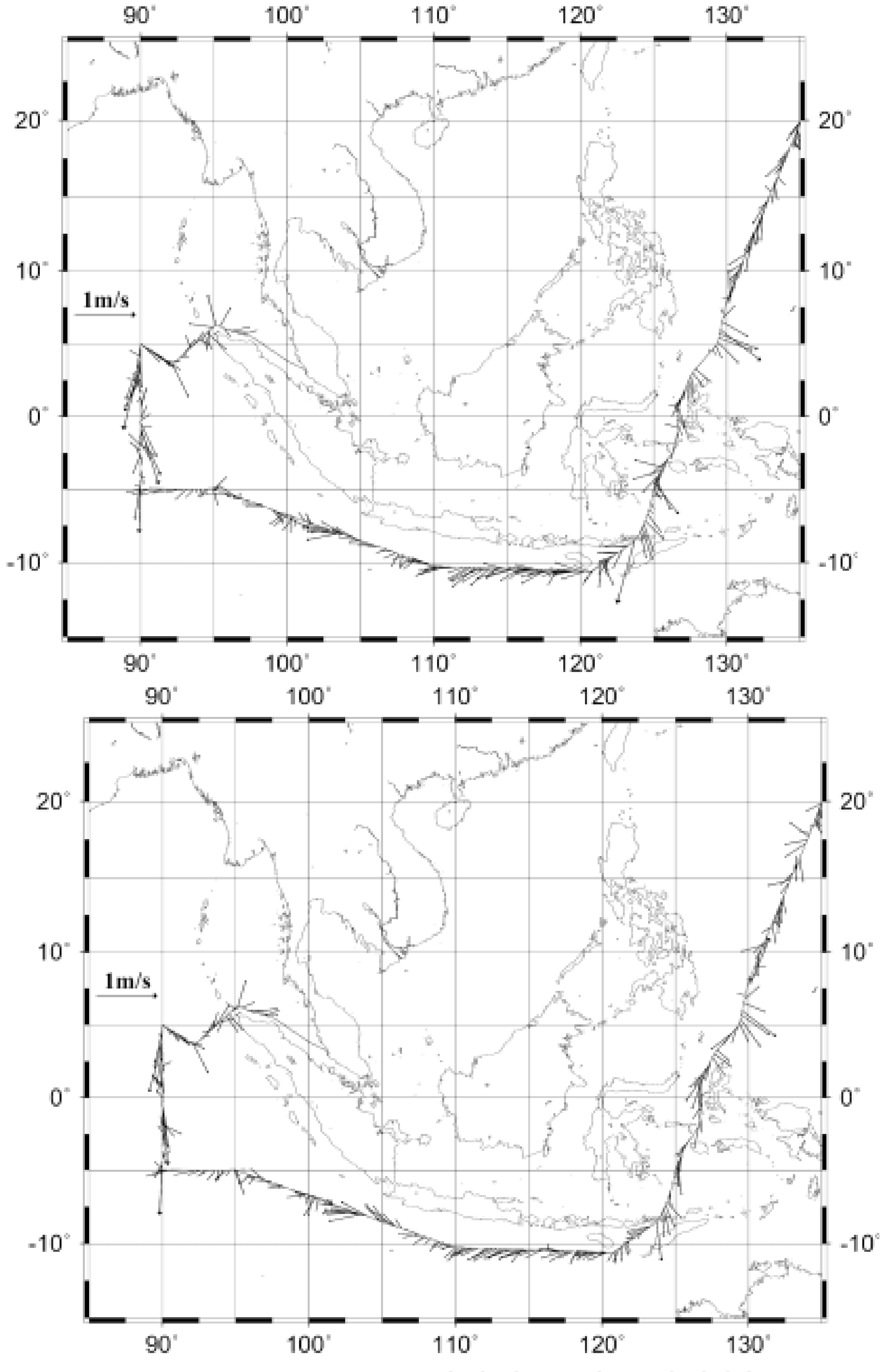


Fig. 6.5-12 Current vectors at 207m depth (above) and 303m depth (below)

6.6 Underway Geophysics
6.6.1 Sea Surface Gravity

(1) Personnel

Toshiya Fujiwara	(JAMSTEC) Principal investigator (not on board)
Masaki Hanyu	(GODI) Operation Leader -Leg 1-
Yasutaka Imai	(GODI) -Leg 1, 2-
Shinya Iwamida	(GODI) -Leg 1, 2-
Wataru Tokunaga	(GODI) -Leg 2-

(2) Objectives

The difference of local gravity is an important parameter in geophysics. We measured relative gravity at the sea surface during MR02-K04 cruise (25/June/2002 --- 20 /August/2002, Sekinehama --- Port Klang --- Sekinehama)

(3) Parameters

Gravity [mgal]

(4) Methods

The relative gravity was continuously measured using LaCoste-Romberg onboard gravity meter S-116 during MR02-K04 (25/June/2002 --- 20 /August/2002, Sekinehama --- Port Klang --- Sekinehama). We measured the absolute gravity at the reference point of Sekinehama port using portable gravity meter (Scintrex gravity meter CG-3M) to desire the absolute gravity along the cruise track. Information of crust and upper-mantle structures is derived from measured gravity.

(5) Results

Absolute gravity (Table 6.6.1-1)

(6) Data archives

Gravity data obtained during this cruise will be submitted to the JAMSTEC DMO (Data Management Office), and archived there.

Table 6.6.1-1

No	Date	UTC	Port	Absolute Gravity (mGal)	Sea Level (cm)	Draft (cm)	Gravity at sensor (mGal)	L&R (mGal)	Remarks
1	2002/Jun/24	08:31	Sekine	980371.84	234	625	980372.60	12666.2	
3	2002/Aug/23	04:30	Sekine	980371.88	252	615	980372.69	12663.8	

- Gravity at sensor = Absolute gravity + sea level*0.3086/100 + (Draft－530)/100*0.0431
- L&R: LaCoste - Romberg onboard gravity meter S-116

(7) Remarks

We did not sample the data in the EEZ of Socialist Republic of Vietnam from 1643UTC 17 July to 2307UTC 21July2002.

6.6.2 Surface three-component magnetometer

(1) Personnel

Toshiya Fujiwara	(JAMSTEC) Principal investigator (not on board)
Masaki Hanyu	(GODI) Operation Leader -Leg 1-
Yasutaka Imai	(GODI) -Leg 1, 2-
Shinya Iwamida	(GODI) -Leg 1, 2-
Wataru Tokunaga	(GODI) -Leg 2-

(2) Objectives

Measurements of magnetic force that is induced by magnetized body beneath the sub-bottom and the earth dipole on the sea surface are required for studying of the geophysical crust structure. We measured a geomagnetic field at the sea surface using a three-component magnetometer, two horizontals and one vertical component.

(3) Parameters

Three-component magnetic force [nT]
Ship's attitude [1/100deg]

(4) Method

A three-component fluxgate magnetometer is set on the top of foremast. Sampling is controlled by the 1pps (pulse per second) standard clock of GPS signal. Every one-second data is composed of navigation information, 8Hz three component of magnetic forces and vertical reference unit (VRU) data.

(5) Preliminary results

The magnetic force is continuously measured during MR02-K04 cruise (25/June/2002 --- 20 /August/2002, Sekinehama --- Port Klang --- Sekinehama).

(6) Data archives

Magnetic force data obtained during this cruise will be submitted to the JAMSTEC DMO (Data Management Office), and archived there.

(7) Remarks

We did not sample the data in the EEZ of Socialist Republic of Vietnam from 1643UTC 17 July to 2307UTC 21July2002.

6.6.3 Multi-narrow beam echo sounding system

(1) Personnel

Toshiya Fujiwara	(JAMSTEC) Principal investigator (not on board)
Masaki Hanyu	(GODI) Operation Leader -Leg 1-
Yasutaka Imai	(GODI) -Leg 1, 2-
Shinya Iwamida	(GODI) -Leg 1, 2-
Wataru Tokunaga	(GODI) -Leg 2-

(2) Objectives

To obtain the bathymetry for buoy deployment, geophysical investigation and water sampling.

(3) Methods

A multi-narrow beam echo sounding system “SeaBeam 2100” on R/V Mirai was used for bathymetry mapping during the MR02-K04 cruise (25/June/2002 --- 20 /August/2002, Sekinehama --- Port Klang --- Sekinehama).

(4) Data archives

Bathymetry data obtained during this cruise will be submitted to the JAMSTEC DMO (Data Management Office), and archived there.

(5) Remarks

We did not sample the data in the EEZ of Socialist Republic of Vietnam from 1643UTC 17 July to 2307UTC 21July2002.

7 Special Observation

7.1 TRITON moorings

7.1.1 TRITON Mooring Operation

(1) Personnel

Yoshifumi Kuroda	(JAMSTEC): Principal Investigator (on board Leg1)
Hideaki Hase	(JAMSTEC): Principal Investigator (on board Leg2)
Takeo Matsumoto	(MWJ): Operation leader (on board Leg1, 2)
Masayuki Fujisaki	(MWJ): Technical staff (on board Leg1, 2)
Masaki Taguchi	(MWJ): Technical staff (on board Leg1)
Hiroshi Matsunaga	(MWJ): Technical staff (on board Leg1)
Miki Yoshiike	(MWJ): Technical staff (on board Leg1)
Tomoyuki Takamori	(MWJ): Technical staff (on board Leg1, 2)
Yuuichi Sonoyama	(MWJ): Technical staff (on board Leg1, 2)
Atsuo Ito	(MWJ): Technical staff (on board Leg2)
Kentaro Shiraishi	(MWJ): Technical staff (on board Leg2)
Kei Suminaga	(MWJ): Technical staff (on board Leg1, 2)
Hiroyasu Muramatsu	(MWJ): Technical staff (on board Leg1, 2)
Takahiro Suzuki	(MWJ): Technical staff (on board Leg1, 2)
Masahiko Nishino	(MWJ): Technical staff (on board Leg1, 2)

(2) Objectives

The large-scale air-sea interaction over the warmest sea surface temperature region in the western tropical Pacific Ocean called warm pool affects the global atmosphere and causes El Nino phenomena. The formation mechanism of the warm pool and the air-sea interaction over the warm pool have not been well understood. Long term data sets of temperature, salinity, currents, so on have been required at fixed locations. In particular, the oceanic change due to the surface winds over the western tropical Pacific is important to study the relation with El Nino and rain fall over the ocean is also important parameter to study El Nino and Asia-Australian Monsoon. The TRITON program aims to obtain the basic data to improve the predictions of El Nino and variations of Asia-Australian Monsoon system.

TRITON buoy array is integrated with the existing TAO(Tropical Atmosphere Ocean) array, which is presently operated by the Pacific Marine Environmental Laboratory/National Oceanic and Atmospheric Administration of the United States. TRITON is a component of international research program of CLIVAR (Climate Variability and Predictability), which is a major component of World Climate Research Program sponsored by the World Meteorological Organization, the International Council of Scientific Unions, and the Intergovernmental Oceanographic Commission of UNESCO. TRITON will also contribute to the development of GOOS (Global Ocean Observing System) and GCOS (Global Climate Observing System).

The seven TRITON buoys have been successfully recovered during this R/V Mirai cruise (MR02-K04), deployed nine TRITON buoys.

(3) Measured parameters

Meteorological parameters:	wind speed, direction, atmospheric pressure, air temperature, relative humidity, radiation, precipitation.
Oceanic parameters:	water temperature and conductivity at 1.5m, 25m, 50m, 75m, 100m, 125m, 150m, 200m, 300m, 500m 750m, depth at 300m and 750m, currents at 10m.

(4) Instrument

1) CTD and CT

SBE-37 IM MicroCAT

A/D cycles to average :	4
Sampling interval :	600sec
Measurement range Temperature :	-5～+35
Measurement range Conductivity :	0～+7
Measurement range Pressure :	0～full scale range

2) CRN(Current meter)

SonTek　Argonaut ADCM

Sensor frequency :	1500kHz
Sampling interval :	1200sec
Average interval :	120sec

3) Meteorological sensors

Precipitation

SCTI　ORG-115DX

Atmospheric pressure

PARPSCIENTIFIC. Inc.　DIGIQUARTZ FLOATING BAROMETER 6000SERIES

Relative humidity/air temperature, Shortwave radiation, Wind speed/direction

Woods Hole Institution　ASIMET

Sampling interval :	600sec
Average interval :	60sec

(5) Locations of TRITON Buoys

1) TRITON buoys deployed

Nominal location	8N, 137E
ID number at JAMSTEC	10002
Number on surface float	T13
ARGOS PTT number	20275
ARGOS backup PTT number	24229
Deployed date	02 July 2002
Exact location	07－39.69Ｎ, 136－41.59Ｅ
Depth	3144 m

Nominal location	5N, 137E
ID number at JAMSTEC	11002
Number on surface float	T21
ARGOS PTT number	20417
ARGOS backup PTT number	24230
Deployed date	04 July 2002
Exact location	04－51.55Ｎ, 137－16.04Ｅ
Depth	4109 m
Option sensors	CT sensor at 175m: S/N 0512, Precipitation sensor (capacitive type) at Tower

Nominal location	2N, 138E
ID number at JAMSTEC	12004
Number on surface float	T22
ARGOS PTT number	20371
ARGOS backup PTT number	24231
Deployed date	06 July 2002
Exact location	02 - 00.06N, 138 - 06.16E
Depth	4317 m
Option sensors	CT at 175m:S/N 0523, Precipitation sensor (capacitive type) at Tower

Nominal location	EQ, 138E
ID number at JAMSTEC	13004
Number on surface float	T23
ARGOS PTT number	none
ARGOS backup PTT number	24232, 24233
Deployed date	08 July 2002
Exact location	00 - 01.97N, 138 - 53.15E
Depth	4371 m
Option sensors	CT at 175m:S/N 0558

Nominal location	8N, 130E
ID number at JAMSTEC	14001
Number on surface float	T24
ARGOS PTT number	20384
ARGOS backup PTT number	24235
Deployed date	13 Aug 2002
Exact location	07 - 58.65N, 130 - 00.39E
Depth	5723m

Nominal location	5N, 130E
ID number at JAMSTEC	15001
Number on surface float	T25
ARGOS PTT number	20439
ARGOS backup PTT number	24236
Deployed date	13 July 2002
Exact location	04 - 59.89S, 129 - 56.95E
Depth	5096 m

Nominal location	2N, 130E
ID number at JAMSTEC	16002
Number on surface float	T26
ARGOS PTT number	20384
ARGOS backup PTT number	24235
Deployed date	11 July 2002
Exact location	02 - 00.07N, 130 - 02.34E

Depth	4400 m
Option sensors	CT at 175m:S/N 0579

Nominal location	5S, 95E
ID number at JAMSTEC	17002
Number on surface float	T27
ARGOS PTT number	20434
ARGOS backup PTT number	24239
Deployed date	02 Aug 2002
Exact location	05 - 02.02S, 94 - 58.62E
Depth	5017m

Nominal location	1.5S, 90E
ID number at JAMSTEC	18002
Number on surface float	T28
ARGOS PTT number	20380
ARGOS backup PTT number	24240
Deployed date	30 July 2002
Exact location	01 - 36.09S, 90 - 04.47E
Depth	4715m
Option sensors	Precipitation sensor (capacitive type) at Tower

2) TRITON recovered

Nominal location	8N, 137E
ID number at JAMSTEC	10001
Number on surface float	T03
ARGOS PTT number	11825
ARGOS backup PTT number	24242
Deployed date	28 Sep. 2001
Recovered date	03 July 2002
Exact location	07 - 50.39Ｎ, 136 - 29.14Ｅ
Depth	3353 m

Nominal location	5N, 137E
ID number at JAMSTEC	11001
Number on surface float	T04
ARGOS PTT number	11826
ARGOS backup PTT number	24243
Deployed date	29 Sep. 2001
Recovered date	05 July 2002
Exact location	04 - 56.40Ｎ, 137 - 17.57Ｅ
Depth	4133 m
Option sensors	CT sensor at 175m: S/N 1056

Nominal location	2N, 138E
ID number at JAMSTEC	12003
Number on surface float	T05

ARGOS PTT number	1132
ARGOS backup PTT number	13065
Deployed date	30 Sep. 2001
Recovered date	07 July 2002
Exact location	02 - 03.79N, 138 - 03.10E
Depth	4335 m
Option sensors	CRN at 40m:S/N D86, CT at 175m:S/N 0625 Pressure at 1.5m, Precipitation at tower

Nominal location	EQ, 138E
ID number at JAMSTEC	13003
Number on surface float	T06
ARGOS PTT number	none
ARGOS backup PTT number	24245, 24246
Deployed date	03 Oct. 2001
Recovered date	09 July 2002
Exact location	00 - 04.70N, 138 - 02.61E
Depth	4206 m
Option sensors	CRN at 40m:S/N D88, CT at 175m:S/N 0985

Nominal location	2N, 130E
ID number at JAMSTEC	16001
Number on surface float	T07
ARGOS PTT number	3594
ARGOS backup PTT number	24244
Deployed date	07 Oct. 2001
Recovered date	12 July 2002
Exact location	01 - 56.38N, 129 - 55.71E
Depth	4428 m
Option sensors	CT at 175m:S/N 0995

Nominal location	5S, 95E
ID number at JAMSTEC	17001
Number on surface float	T08
ARGOS PTT number	3595
ARGOS backup PTT number	13066
Deployed date	26 Oct. 2001
Recovered date	03 Aug 2002
Exact location	04 - 57.13S, 94 - 58.64E
Depth	5009 m

Nominal location	1.5S, 90E
ID number at JAMSTEC	18001
Number on surface float	T08
ARGOS PTT number	3779
ARGOS backup PTT number	13067
Deployed date	23 Oct. 2001

Recovered date	31 July 2002
Exact location	01 - 39.51N, 89 - 59.57E
Depth	4697 m

*: Dates are UTC and represent anchor drop times for deployments and release time for recoveries, respectively.

(6) Details of deployed

We deployed nine TRITON buoys, as in the list.

Deployed and Repaired TRITON buoys

Observation No.	Location.	Details.
10002	8N 137E	Deploy with full spec.
11002	5N 137E	Deploy with full spec.
12004	2N 138E	Deploy with full spec.
13004	EQ 138E	Deploy with only underwater sensors.No data transmission system.
14001	8N 130E	Deploy with only underwater sensors.
15001	5N 130E	Deploy with only underwater sensors.
16002	2N 130E	Deploy with only underwater sensors.
17002	5S 95E	Deploy with full spec.
18002	1.5S 90E	Deploy with full spec.

(7) Data archive

Hourly averaged data transmitted are through ARGOS satellite data transmission system in near real time. The real time data are provided to meteorological organizations via Global Telecommunication System and utilized for daily weather forecast. The data will be also distributed world wide through Internet from JAMSTEC and PMEL home pages. All data will be archived at JAMSTEC Mutsu Institute.

TRITON Homepage: http://www.jamstec.go.jp/jamstec/triton

7.1.2 Intercomparison between shipboard CTD and TRITON data

(1) Personnel

Kentaro Ando (JAMSTEC): not on board Principal investigator
Takeo Matsumoto (MWJ): on board Leg1, 2
Tetsuya Nagahama (MWJ): not on board

(2) Objectives

TRITON CTD data validation.

(3) Measured parameters

- Temperature
- Conductivity
- Pressure

(4) Methods

TRITON buoy underwater sensors are equipped along wire cable of buoy below sea surface. We used the same CTD (SBE 9/11Plus) system with general CTD observation (See section 6.2.1) on R/V MIRAI for this inter-comparison. We conducted 1 CTD cast at each TRITON buoy site. The cast was performed immediately after the deployment and before recovery. R/V MIRAI was kept the distance from the TRITON buoy within 2 nm.

TRITON buoy data was sampled every 1 hour except for transmission to the ship. We compared CTD observation by R/V MIRAI data with TRITON buoy data using the 1 hour averaged value.

As our temperature sensors are expected to be more stable than conductivity sensors, conductivity data and salinity data are selected at the same value of temperature data. Then, we calculated difference of salinity and conductivity between CTD casting and TRITON buoy for each deployment and recovery.

(5) Results

Most of temperature, conductivity and salinity data from TRITON buoy showed good agreement with CTD cast data. See the Figures 7.1.2-1(a), (b).
To evaluate the performance of the conductivity sensors on TRITON buoy, the data from deployed buoy and shipboard CTD data at the same location were analyzed.

The estimation was calculated as deployed buoy data minus shipboard CTD data. The salinity differences are from –0.129 to 0.200 psu for all depths. Below 300 db, salinity differences are from –0.016 to 0.085 psu (See the Figures 7.1.2-2(a) and Table 7.1.2-1(a)). The average of salinity differences was 0.003 psu with standard deviation of 0.047 psu.

The estimation was calculated as recovered buoy data minus shipboard CTD (9Plus) data. The salinity differences are from –1.040 to 0.164 psu for all depths. Below 300 db, salinity differences are from –0.036 to 0.009 psu (See the Figures 7.1.2-2(b) and Table 7.1.2-1(b)). The average of salinity differences was 0.037 psu with standard deviation of 0.177 psu.

The estimation of time-drift was calculated as recovered buoy data minus deployed buoy data. The salinity change for 1 year is from –0.216 to 0.053 psu, for all depths. Below 300 db, salinity change for 1 year are from –0.020 to 0.015 psu (See the Figures 7.1.2-3 and Table 7.1.2-3). The average of salinity differences was －0.010 psu with standard deviation of 0.045 psu.

(6) Data archive

All raw and processed CTD data files were copied on 3.5 inch magnetic optical disks and submitted to JAMSTEC Data Management Office. All original data will be stored at JAMSTEC Mutsu brunch. (See section 6.2.1)

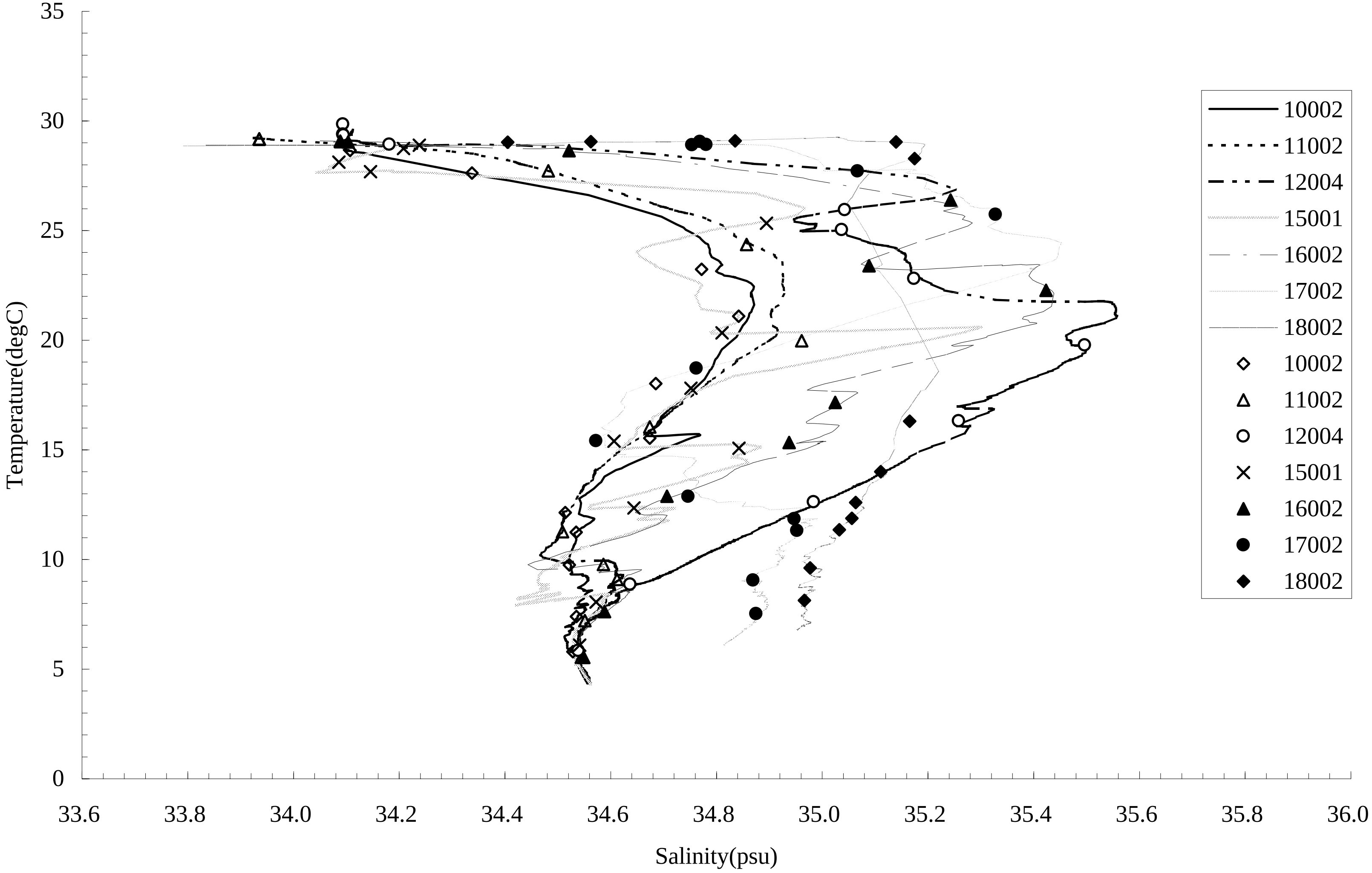


Fig.7.1.2.-1(a) T-S diagram of TRITON buoys data and shipboard CTD data after deployment

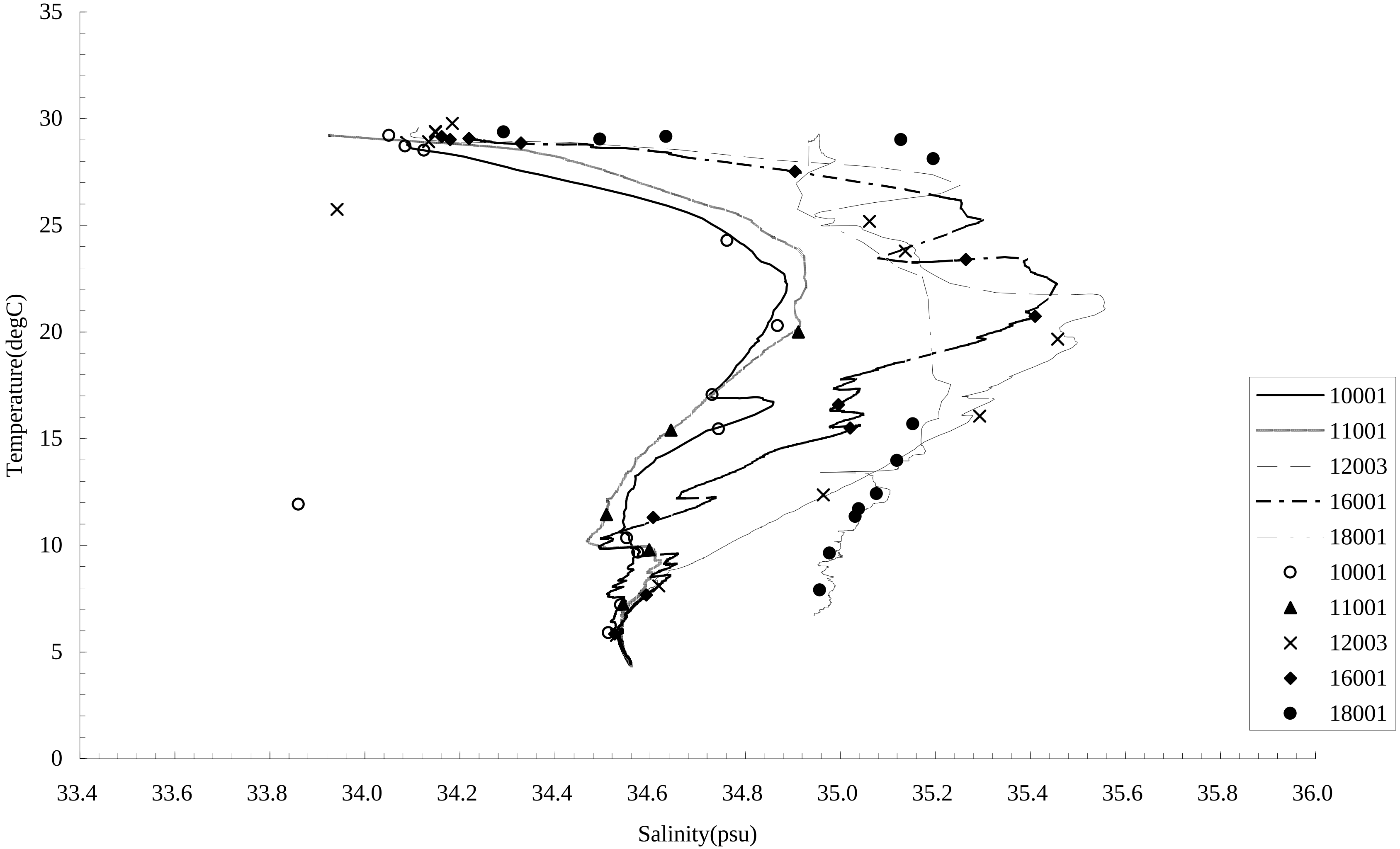


Fig.7.1.2.-1(b) T-S diagram of TRITON buoys data and shipboard CTD data before recover

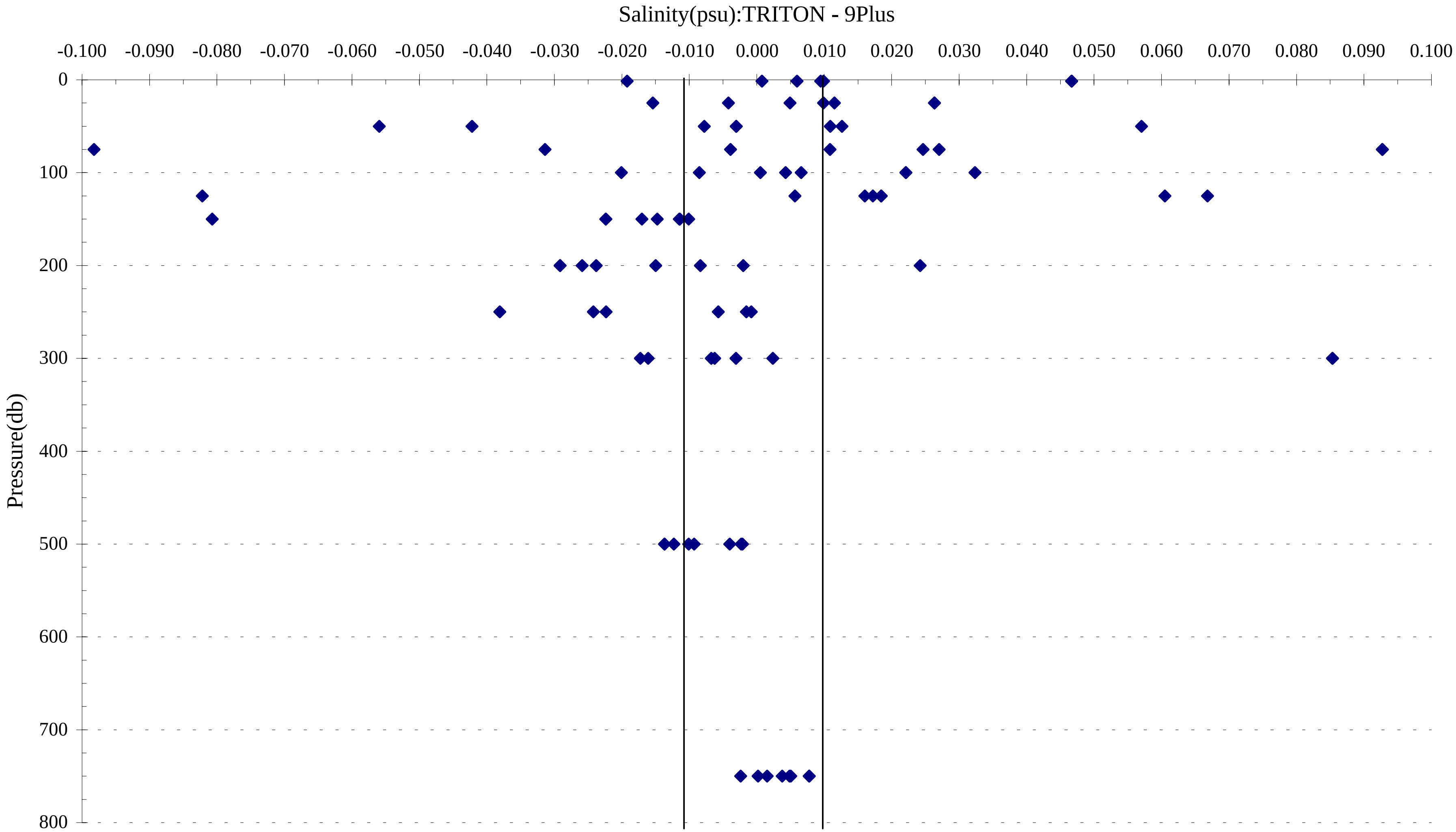


Fig.7.1.2.-2 (a) Salinity differences between TRITON buoys data and shipboard CTD data after deployment

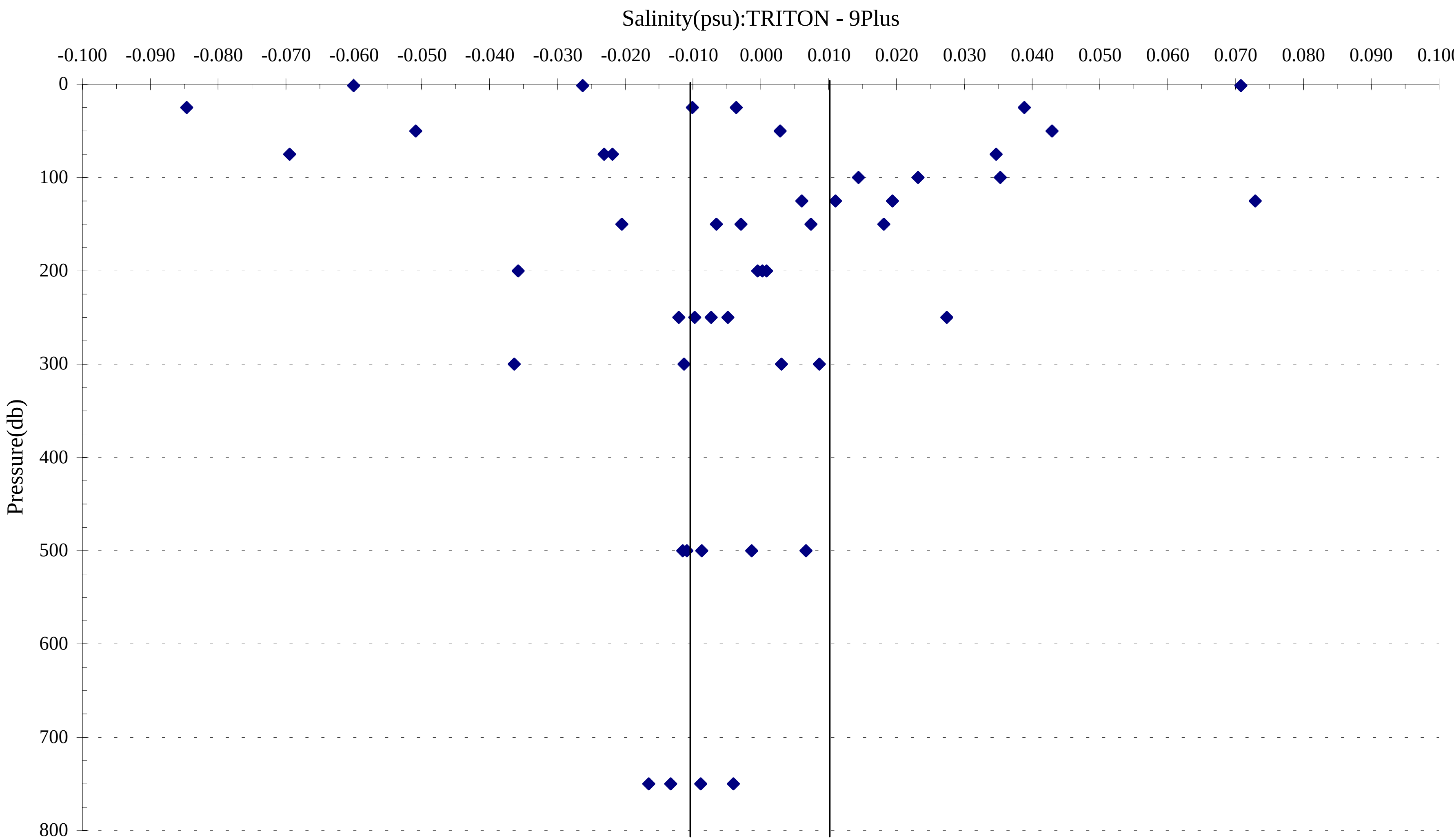


Fig.7.1.2.-2 (b) Salinity differences between TRITON buoys data and shipboard CTD data before recover

Table 7.1.2.-1(a) Data differences between TRITON buoys data and ship board CTD data after deployment

Observation No.	Pressure (db)	Temperature (degC)	Conductivety (S/m)	Salinity (psu)
10002	1.5	0.38	0.039	0.001
10002	25	0.00	0.000	0.005
10002	50	0.00	0.000	0.011
10002	75	-0.02	-0.007	-0.031
10002	100	-0.11	-0.015	-0.020
10002	125	0.03	-0.007	-0.082
10002	150	-0.02	-0.012	-0.081
10002	200	0.07	0.003	-0.026
10002	250	-0.02	-0.001	-0.001
10002	300	0.01	0.001	-0.003
10002	500	0.00	-0.001	-0.002
10002	750	0.00	0.001	0.005
11002	1.5	-0.04	-0.004	0.010
11002	25	-0.04	-0.003	0.010
11002	50	0.05	-0.001	-0.042
11002	75	-0.17	-0.014	0.025
11002	100	-0.02	-0.004	-0.008
11002	125	-0.03	0.004	0.061
11002	150	-0.07	-0.008	-0.011
11002	200	-0.04	-0.005	-0.002
11002	250	0.00	-0.003	-0.022
11002	300	0.00	-0.002	-0.006
11002	500	0.01	0.001	-0.002
11002	750	0.00	0.001	0.004
12004	1.5	0.28	0.025	-0.019
12004	25	0.00	-0.003	-0.015
12004	50	0.00	-0.002	-0.008
12004	75	-0.01	0.002	0.027
12004	100	-0.01	0.000	0.004
12004	125	0.00	0.009	0.067
12004	150	0.03	0.000	-0.015
12004	200	0.00	0.003	0.024
12004	250	0.12	0.010	-0.006
12004	300	-0.04	-0.006	-0.017
12004	500	0.00	0.000	-0.012
12004	750	0.00	0.000	0.000
16002	1.5	0.00	0.000	0.009
16002	25	0.00	0.001	0.012
16002	50	0.00	-0.009	-0.056
16002	75	-0.02	-0.003	-0.004
16002	100	0.04	0.008	0.032
16002	125	0.00	0.000	0.006
16002	150	0.03	0.001	-0.011
16002	200	-0.03	-0.005	-0.015
16002	250	-0.02	-0.004	-0.024
16002	300	-0.03	-0.005	-0.016
16002	500	0.00	-0.001	-0.004
16002	750	0.00	0.000	0.005

Table 7.1.2.-1(a) Data differences between TRITON buoys data and ship board CTD data after deployment

Observation No.	Pressure (db)	Temperature (degC)	Conductivety (S/m)	Salinity (psu)
15001	1.5	0.04	0.010	0.047
15001	25	0.01	0.003	0.026
15001	50	-0.01	-0.003	-0.003
15001	75	0.00	0.013	0.093
15001	100	0.01	0.004	0.022
15001	125	0.00	0.002	0.018
15001	150	0.01	-0.001	-0.022
15001	200	-0.01	-0.003	-0.029
15001	250	-0.01	0.024	0.200
15001	300	0.01	0.010	0.085
15001	500	0.00	0.000	-0.014
15001	750	0.00	0.000	0.008
16002	1.5	0.00	0.000	0.047
16002	25	0.00	0.001	0.026
16002	50	0.00	-0.009	-0.003
16002	75	-0.02	-0.003	0.093
16002	100	0.04	0.008	0.022
16002	125	0.00	0.000	0.018
16002	150	0.03	0.001	-0.022
16002	200	-0.03	-0.005	-0.029
16002	250	-0.02	-0.004	0.200
16002	300	-0.03	-0.005	0.085
16002	500	0.00	-0.001	-0.014
16002	750	0.00	0.000	0.008
17002	1.5	0.03	0.003	0.006
17002	25	0.00	-0.002	-0.004
17002	50	0.00	0.001	0.013
17002	75	0.00	-0.014	-0.098
17002	100	-0.07	-0.008	0.001
17002	125	0.15	0.016	0.016
17002	150	0.03	0.001	-0.017
17002	200	0.02	-0.001	-0.024
17002	250	0.01	-0.004	-0.038
17002	300	-0.01	-0.002	-0.007
17002	500	0.00	-0.001	-0.009
17002	750	0.00	0.000	-0.002
18002	1.5	0.00	-0.021	-0.129
18002	25	0.00	-0.019	-0.123
18002	50	0.00	0.008	0.057
18002	75	-0.01	0.000	0.011
18002	100	0.01	0.001	0.007
18002	125	-0.08	-0.006	0.017
18002	150	-0.01	-0.002	-0.010
18002	200	-0.03	-0.004	-0.008
18002	250	0.00	-0.001	-0.002
18002	300	0.00	0.000	0.002
18002	500	0.00	-0.001	-0.010
18002	750	0.00	0.000	0.002

Table 7.1.2.-1(b) Data differences between TRITON buoys data and shipboard CTD data before recover

Observation No.	Pressure (db)	Temperature (degC)	Conductivety (S/m)	Salinity (psu)
10001	1.5	0.06	0.002	-0.026
10001	25	0.00	-0.003	-0.010
10001	50	-0.01	-0.002	0.003
10001	75	0.04	0.001	-0.023
10001	100	0.04	0.006	0.023
10001	125	0.01	0.002	0.006
10001	150	0.04	0.005	0.018
10001	200	-0.09	-0.080	-0.689
10001	250	-0.01	-0.001	-0.005
10001	300	0.00	0.002	0.009
10001	500	0.00	-0.001	-0.009
10001	750	0.00	-0.001	-0.017
11001	1.5	***	***	***
11001	25	***	***	***
11001	50	***	***	***
11001	75	***	***	***
11001	100	***	***	***
11001	125	0.00	0.001	0.011
11001	150	0.10	0.010	0.007
11001	200	-0.09	-0.010	0.000
11001	250	-0.02	-0.004	-0.010
11001	300	***	***	***
11001	500	-0.01	-0.001	-0.011
11001	750	***	***	***
12003	1.5	0.21	0.031	0.071
12003	25	0.00	0.005	0.039
12003	50	0.00	0.006	0.043
12003	75	0.01	-0.003	-0.022
12003	100	0.04	-0.139	-1.040
12003	125	-0.03	0.006	0.073
12003	150	0.02	-0.001	-0.020
12003	200	-0.01	-0.006	-0.036
12003	250	-0.01	0.001	0.027
12003	300	-0.03	-0.005	-0.011
12003	500	0.00	-0.001	0.007
12003	750	0.00	0.000	-0.009
16001	1.5	0.03	-0.007	-0.060
16001	25	0.00	-0.002	-0.004
16001	50	0.00	-0.008	-0.051
16001	75	0.00	0.005	0.035
16001	100	-0.04	-0.002	0.014
16001	125	0.00	0.021	0.164
16001	150	-0.01	-0.001	-0.003
16001	200	-0.01	-0.002	0.000
16001	250	-0.04	-0.006	-0.012
16001	300	-0.10	-0.014	-0.036
16001	500	0.01	0.000	-0.001
16001	750	0.00	-0.001	-0.013
18001	1.5	***	***	***
18001	25	0.00	-0.014	-0.085
18001	50	0.00	-0.032	-0.212
18001	75	0.00	-0.011	-0.069
18001	100	-0.03	0.001	0.035
18001	125	-0.06	-0.004	0.019
18001	150	0.00	-0.001	-0.007
18001	200	0.00	0.000	0.001
18001	250	0.01	0.000	-0.007
18001	300	0.00	0.000	0.003
18001	500	0.00	-0.001	-0.012
18001	750	0.00	0.000	-0.004

*** : no data

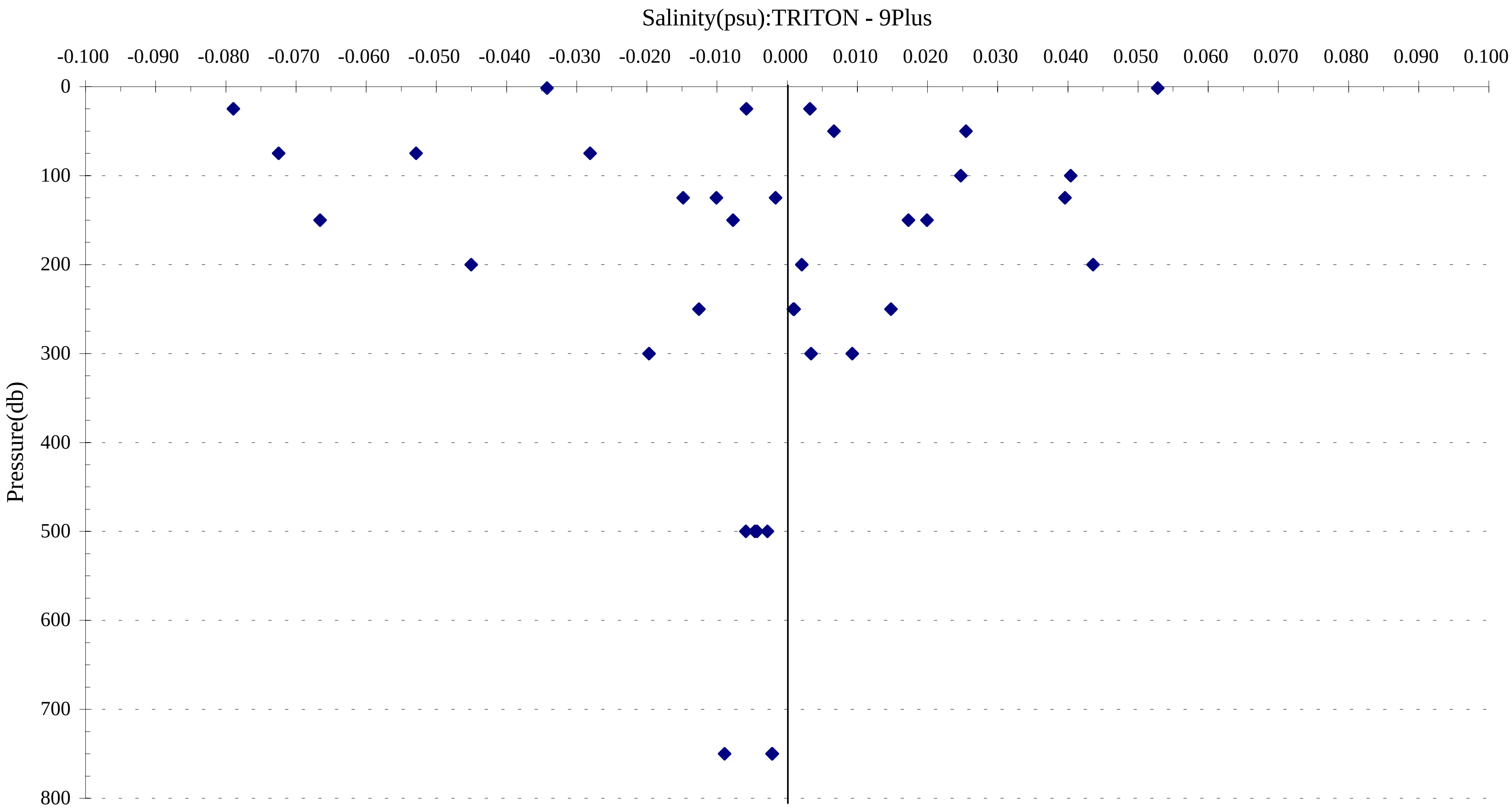


Fig.7.1.2.-3 Salinity differences between TRITON buoys data and shipboard CTD data for 1 year

Table 7.1.2-3 Difference between R/V MIRAI CTD casting data and TRITON data for 1 year

R/V MIRAI CTD DATA - TRITON CT DATA

		Recovery	Deploy	Drift
Observation No.	Pressure (db)	Salinity (psu)	Salinity (psu)	Salinity (psu)
10001	300	0.009	-0.001	0.009
10001	500	-0.009	-0.004	-0.005
10001	750	-0.017	-0.008	-0.009
11001	300	0.000	-0.015	0.015
11001	500	-0.011	-0.007	-0.004
11001	750	0.000	0.005	-0.005
12003	300	-0.011	0.008	-0.020
12003	500	0.007	0.013	-0.006
12003	750	-0.009	-0.007	-0.002
18001	300	0.003	0.000	0.003
18001	500	-0.012	-0.009	-0.003
18001	750	-0.004	-0.002	-0.002
	Average	-0.005	-0.002	-0.003
	Stdev.	0.009	0.009	0.010

7.2 ADCP subsurface mooring

(1) Personnel

Yoshifumi Kuroda	(JAMSTEC): Principal Investigator (Leg 1)
Hideaki Hase	(JAMSTEC): Investigator (Leg 2)
Hiroshi Matsuura	(FORSGC): Principal Investigator (Leg 2)
Masaki Taguchi	(MWJ): Operation leader (Leg 1)
Atsuo Ito	(MWJ): Operation leader (Leg 2)
Hiroshi Matsunaga	(MWJ): Technical staff (Leg 1)
Kei Suminaga	(MWJ): Technical staff (Leg 1-2)
Miki Yoshiike	(MWJ): Technical staff (Leg 1)
Tomoyuki Takamori	(MWJ): Technical staff (Leg 1-2)
Hiroyasu Muramatsu	(MWJ): Technical staff (Leg 1-2)
Takahiro Suzuki	(MWJ): Technical staff (Leg 1-2)

(2) Objectives

The purpose is to get the knowledge of physical process in the western equatorial Pacific Ocean and the equatorial Indian Ocean. We have been observing subsurface currents along the equator. In this cruise (MR02-K04), we recovered two subsurface ADCP mooring at 7° N-127° E, EQ-90° E, and re-deployed two ADCP moorings at the same place.

(3) Parameters

Current profiles
Echo intensity
Pressure, Temperature and Conductivity

(4) Methods

Two instruments are mounted at the top float of the mooring. One is an ADCP (Acoustic Doppler Current Profiler) to observe upper ocean layer currents above 300m depth, and the other is a CTD to observe pressure, temperature and salinity at the top of the mooring. Obtained upper ocean layer current velocities are corrected for depths using CTD pressure data.

Two current meters are equipped on the mooring at 400m and 700m depth of 7° N-127° E. Details of the instruments and their parameters are as follows:

1) ADCP

(a) Self-Contained Broadband ADCP 150 kHz (RD Instruments)

Distance to first bin:	8 m
Pings per ensemble:	16
Time per ping:	2.00 seconds
Bin length:	8.00 m
Sampling Interval:	3600 seconds
Recovered ADCP	
・Serial Number:	1154 (Mooring No.011008-7N127E)
Deployed ADCP	
・Serial Number:	1678 (Mooring No.020714-7N127E)

(b) Self-Contained Workhorse Long Ranger ADCP 75 kHz (RD Instruments)

Distance to first bin:	7.04 m
Pings per ensemble:	27
Time per ping:	6.66 seconds
Bin length:	8.00 m
Sampling Interval:	3600 seconds

Recovered ADCP
・Serial Number: 1645 (Mooring No.011022-EQ90E)
Deployed ADCP
・Serial Number: 1248 (Mooring No.020729-EQ90E)

2) CTD

(a) SBE-16 (Sea Bird Electronics Inc.)

Sampling Interval: 1800 seconds

Recovered CTD
・Serial Number: 1281 (Mooring No.011008-7N127E)
Deployed CTD
・Serial Number: 1275 (Mooring No.020714-7N127E)

(b) SBE-37 (Sea Bird Electronics Inc.)

Sampling Interval: 3600 seconds

Recovered CTD
・Serial Number: 1775 (Mooring No.011022-EQ90E)
Deployed CTD
・Serial Number: 1388 (Mooring No.020729-EQ90E)

3) Other instrument

(a) Acoustic Releaser (BENTHOS, Inc.)

Recovered Acoustic Releaser
・Serial Number: 664 (Mooring No.011008-7N127E)
・Serial Number: 689 (Mooring No.011008-7N127E)
・Serial Number: 960 (Mooring No.011022-EQ90E)
・Serial Number: 961 (Mooring No.011022-EQ90E)
Deployed Acoustic Releaser
・Serial Number: 716 (Mooring No.020714-7N127E)
・Serial Number: 666 (Mooring No.020714-7N127E)
・Serial Number: 844 (Mooring No.020729-EQ90E)
・Serial Number: 937 (Mooring No.020729-EQ90E)

(b) RCM-9 (AANDERAA Instruments)

Temperature range: low
Recording: 60min
Conductivity range: 0-74 mS
Channel: 7ch

Recovered RCM9
・Serial Number: 355 (Mooring No.011008-7N127E)
・Serial Number: 357 (Mooring No.011008-7N127E)
Deployed RCM9
・Serial Number: 541 (Mooring No.020714-7N127E)
・Serial Number: 542 (Mooring No.020714-7N127E)

(5) Deployment

At 7° N-127° E and EQ-90° E, ADCPs were planned to placed the ADCP at about 310m, 371m depth. After we dropped the anchor, we monitored the depth of the acoustic releaser (Fig.7-2-1).

The position of the mooring No.020714-7N127E

Date: 14 Jul. 2002 Lat: 06-48.97N Long: 126-42.59E Depth: 3435m

The position of the mooring No.020729-EQ90E
Date: 29 Jul. 2002 Lat: 00-00.44N Long: 90-03.35E Depth: 4399m

(6) Recovery

Recovered moorings (during MR01-K05 cruise) were deployed at 7° N-127° E on 9 Oct. 2001 and EQ-90° E on 22 Oct. 2001. After the recovery, we uploaded ADCP, RCM-9 and CTD data into a computer, then raw data were converted into ASCII code. Results were shown in the figures in the following pages. Figures 7-2-2～7-2-3 show CTD pressure, temperature and salinity data. Figures 7-2-4～7-2-9 show the velocity data (zonal and meridional component) at bin#25, bin#19 ,bin#12 ,bin#6 and bin#1. Figures 7-2-10～7-2-14 show the velocity data (zonal and meridional component) at bin#47, bin#44 ,bin#41 ,bin#35 and bin#29. Depth of bins was calculated from CTD data. Figures 7-2-16 , 7-2-17 show velocity data of RCM-9.

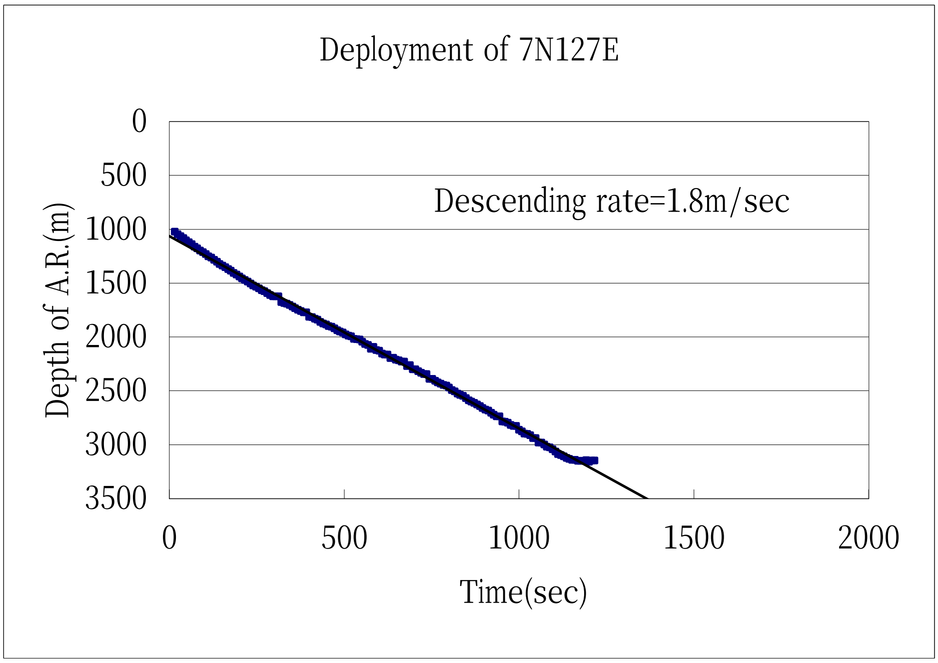
(7) Remarks

・Current data of RCM-9 at 400m depth of 7° N-127° E were missing from 20 Feb.2002 to 14 Jul.2002.
・Pressure data of CTD at EQ-90° E indicated getting shallower from deployment with time, and were missing from 18 Apr.2002 to 29 Jul.2002. It suggests that the pressure data cannot be used to determine the ADCP depth for this mooring.

(8) Data archive

The ADCP and CTD data at 7° N-127° E and EQ-90° E will be archived by the member of TOCS project at JAMSTEC and FORSGC, respectively.

All data will be submitted to DMO at JAMSTEC within 3 years after each recovery.



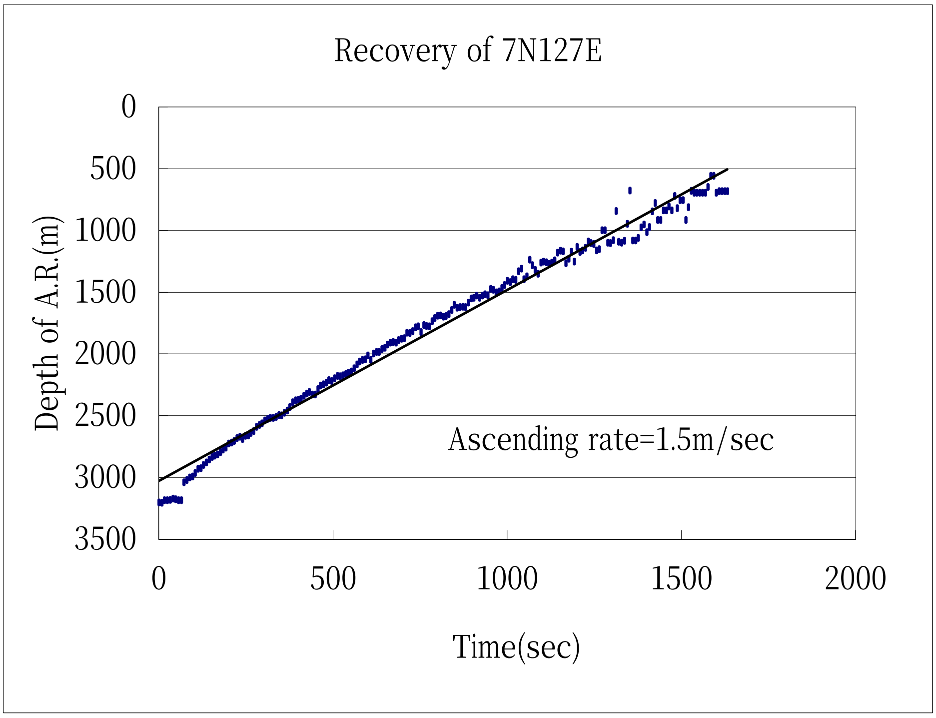
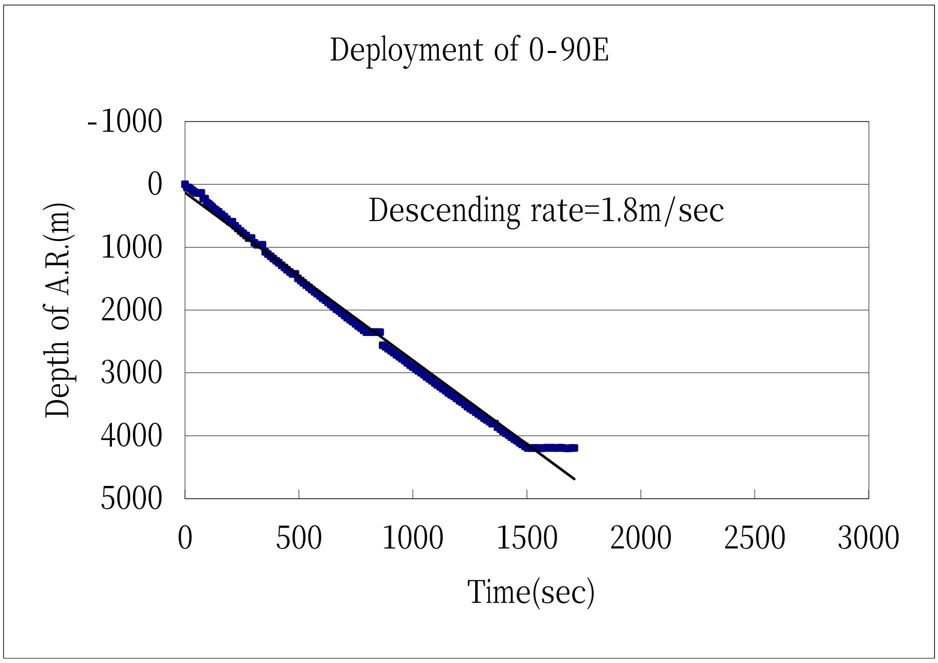


Fig7-2-1 Depth monitoring of acoustic release
(A.R. : Acoustic Release)



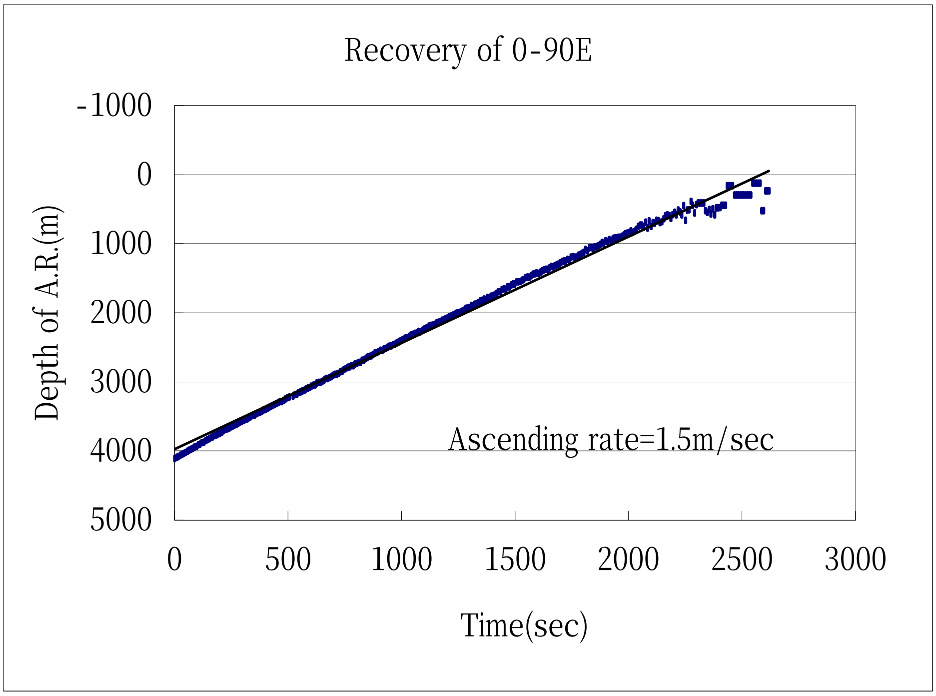
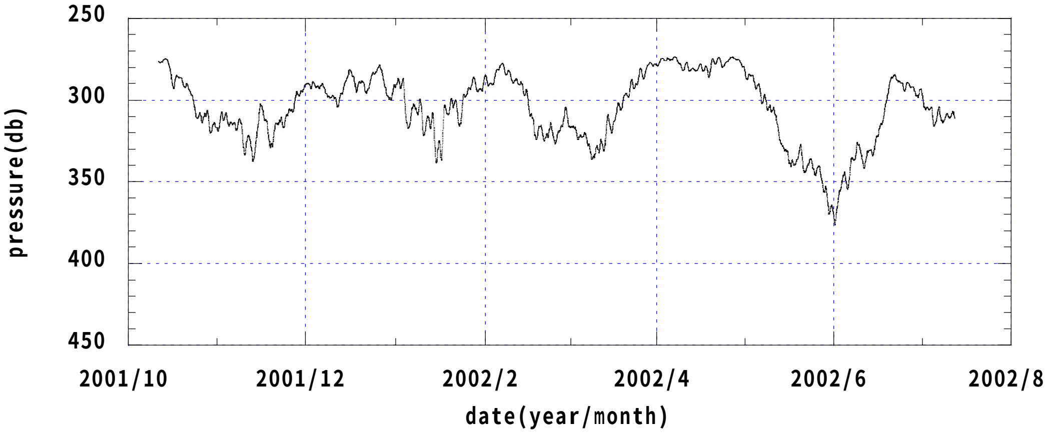
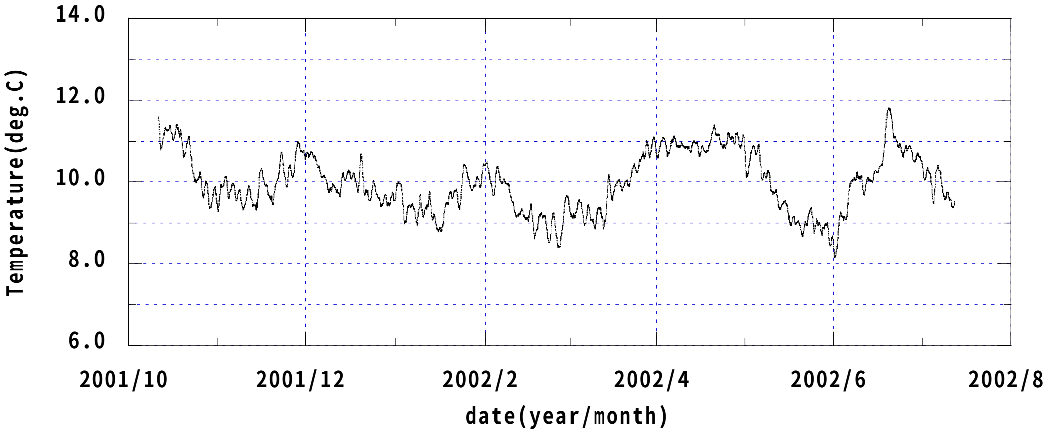


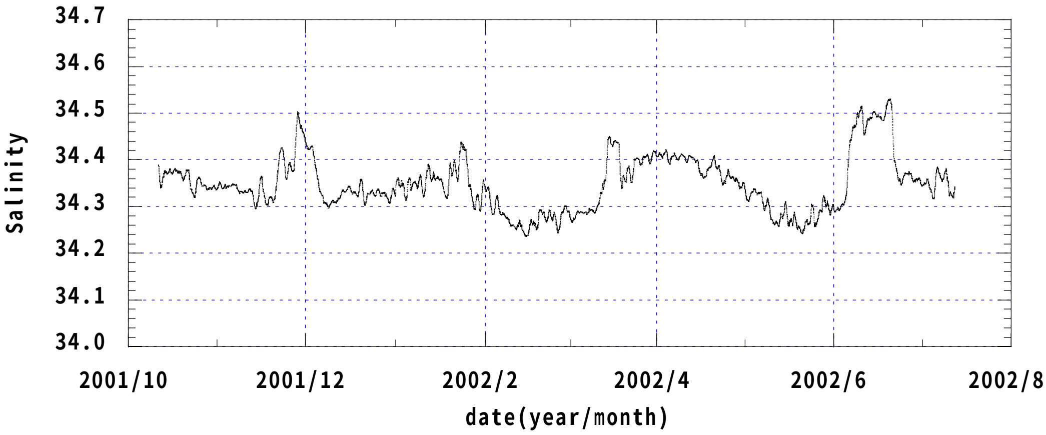
Fig7-2-2 Depth monitoring of acoustic release
(A.R. : Acoustic Release)



(a) Pressure



(b) Temperature



(c) Salinity

Fig. 7-2-3 Time series (25-hour low pass filtered) of (a) pressure, (b) temperature and (c) salinity obtained with CTD of 7°N-127°E mooring from 09 Oct. 2001 to 14 Jul. 2002 a)

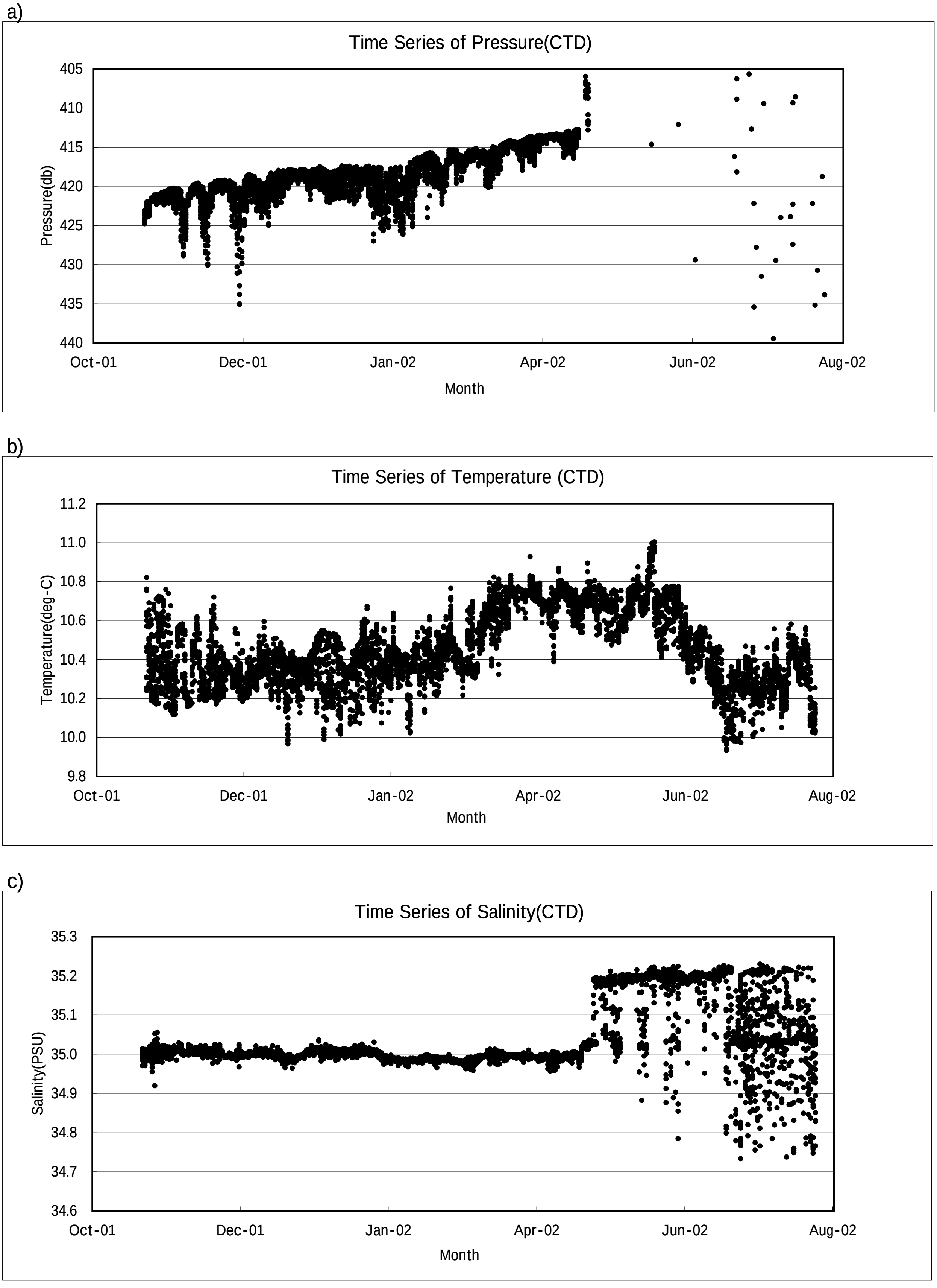


Fig. 7-2-4 Time series of (a) pressure, (b)temperature and (c)salinity obtained with CTD of EQ-90°E mooring from 22 Oct. 2001 to 29 Jul. 2002

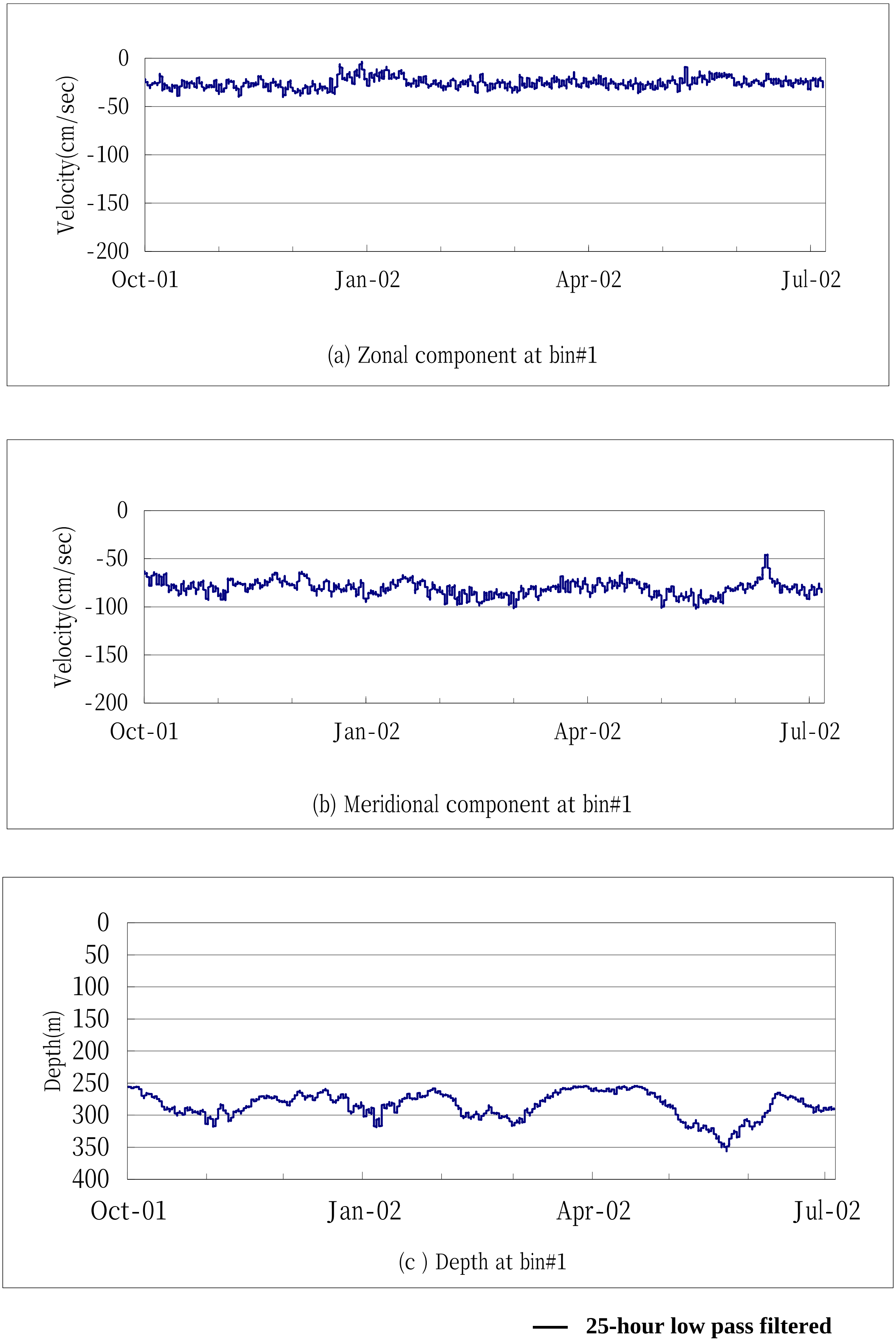
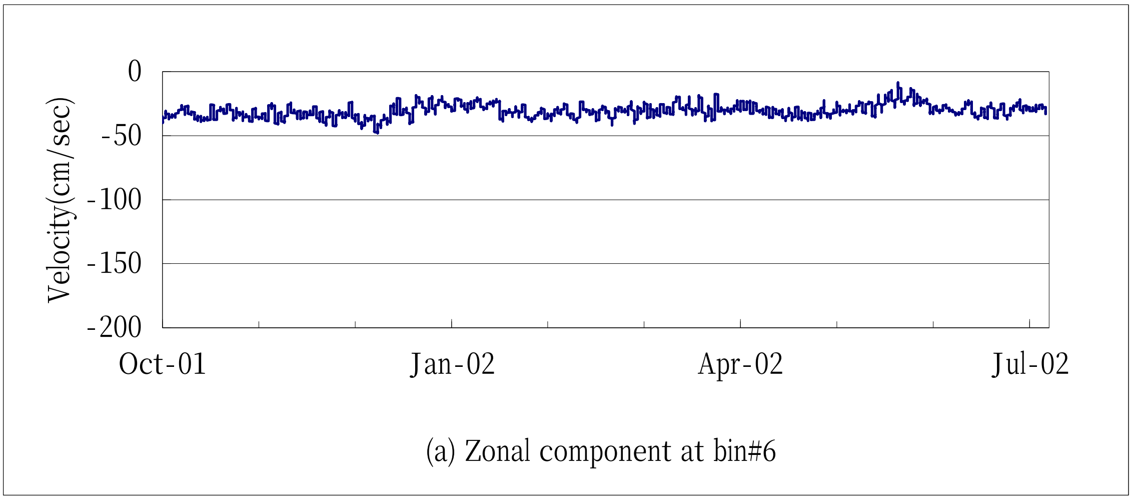
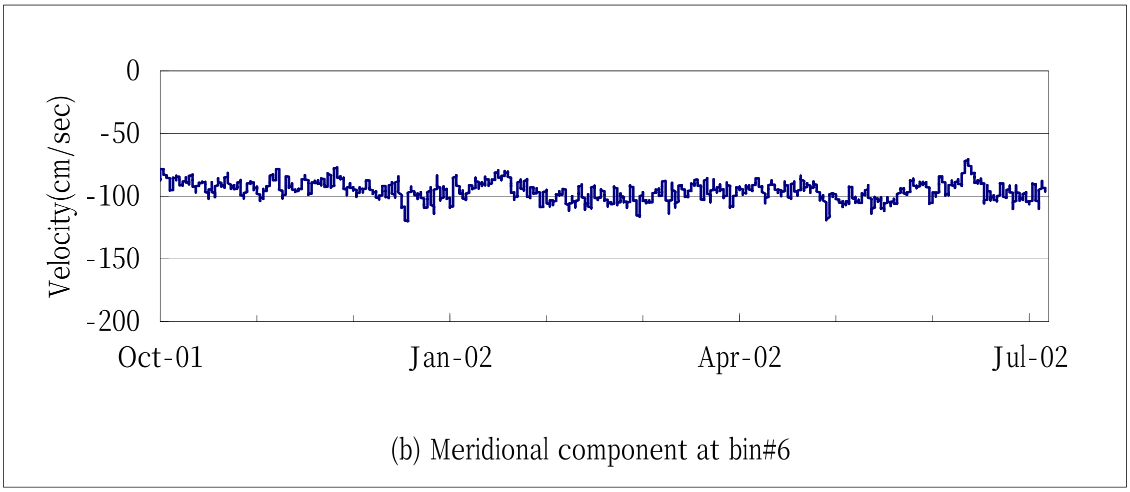
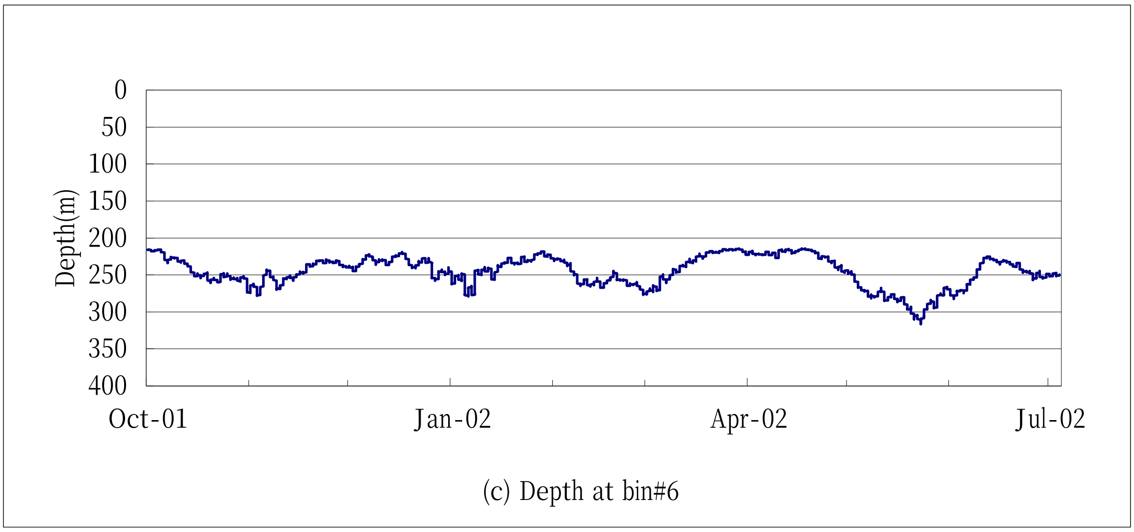


Fig.7-2-5 Time series of (a)zonal, (b)meridional velocities and (c) cell depth of 7°N-127°E mooring at bin #1.

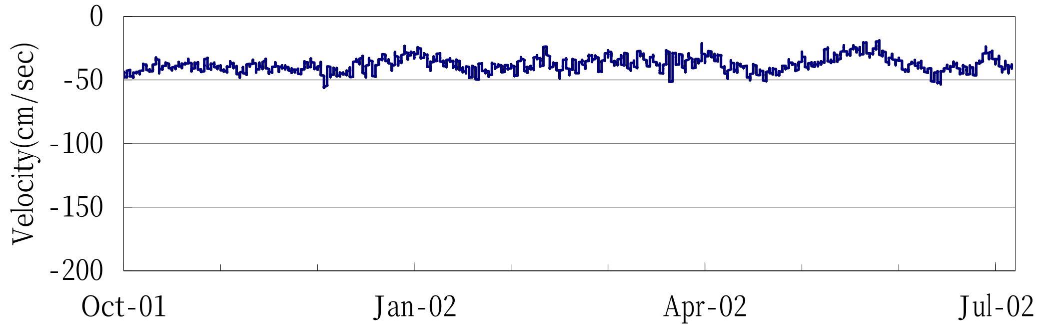




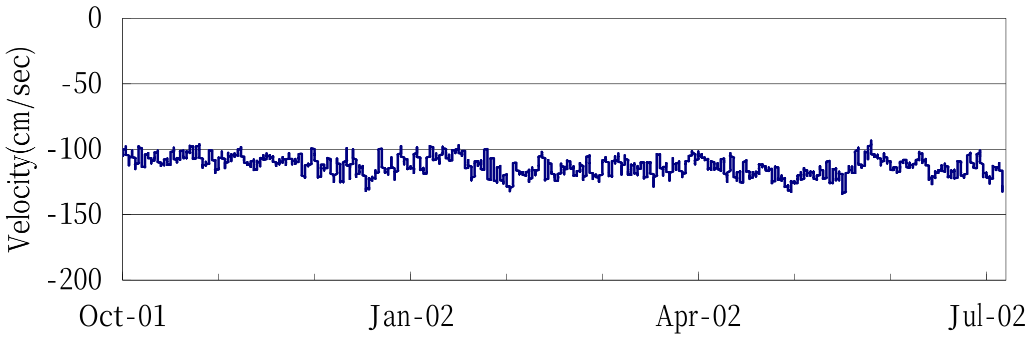


— 25-hour low pass filtered

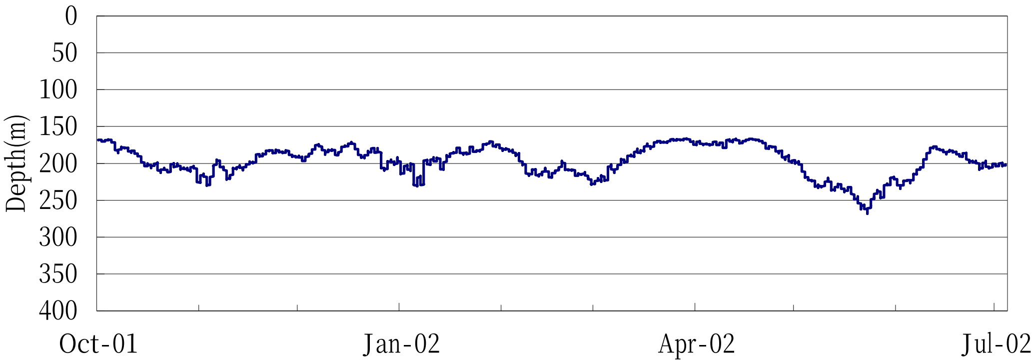
Fig.7-2-6 Time series of (a)zonal, (b)meridional velocities and (c) cell depth of 7°N-127°E mooring at bin #6.



(a) Zonal component at bin#12



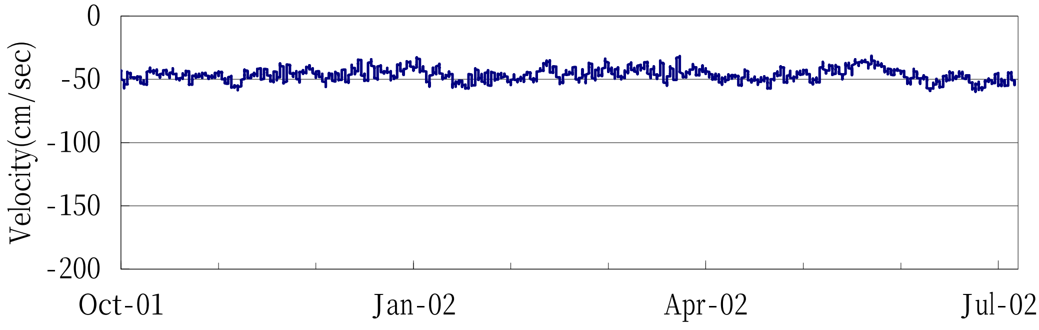
(b) Meridional component at bin#12



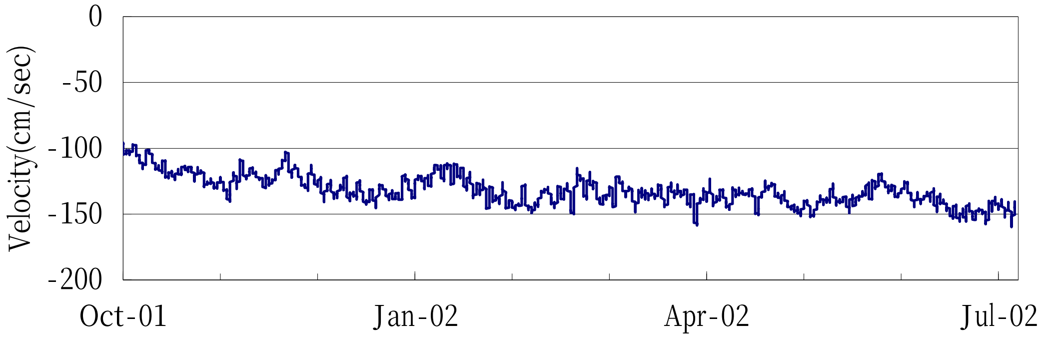
(c) Depth at bin#12

25-hour low pass filtered

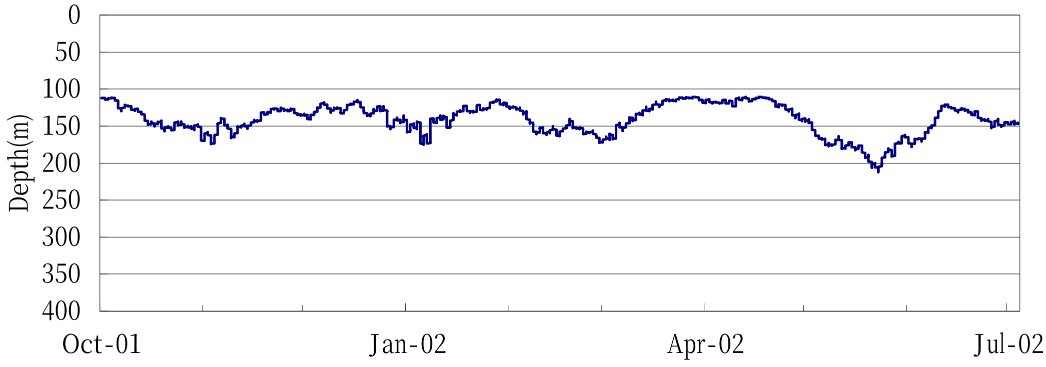
Fig.7-2-7 Time series of (a)zonal, (b)meridional velocities and (c) cell depth of 7°N-127°E mooring at bin #12.



(a) Zonal component at bin#19



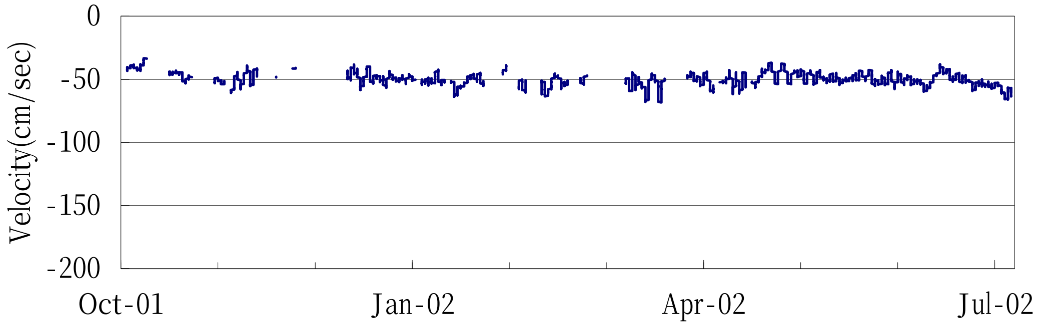
(b) Meridional component at bin#19



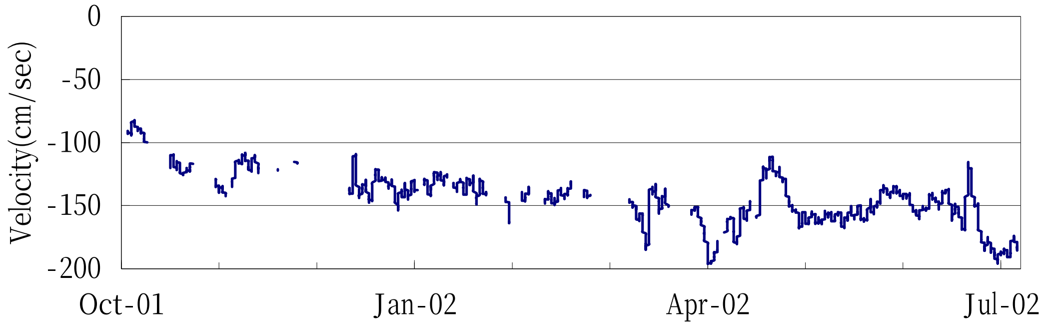
(c) Depth at bin#19

— 25-hour low pass filtered

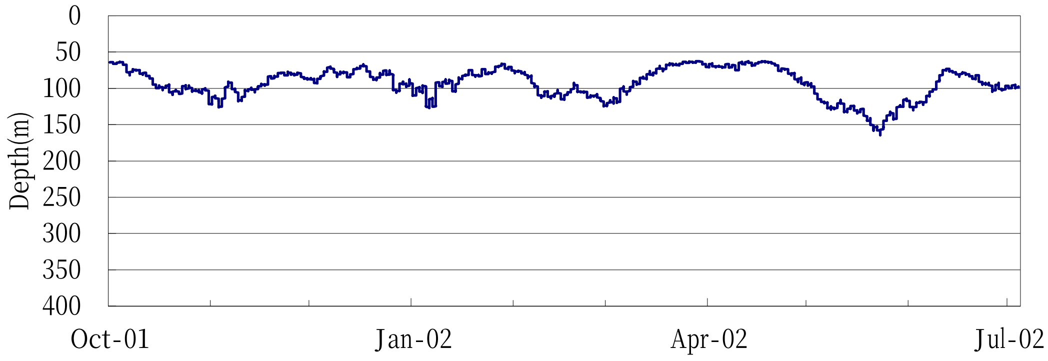
Fig.7-2-8 Time series of (a)zonal, (b)meridional velocities and (c) cell depth of 7°N-127°E mooring at bin #19.



(a) Zonal component bin#25



(b) Meridional component at bin#25

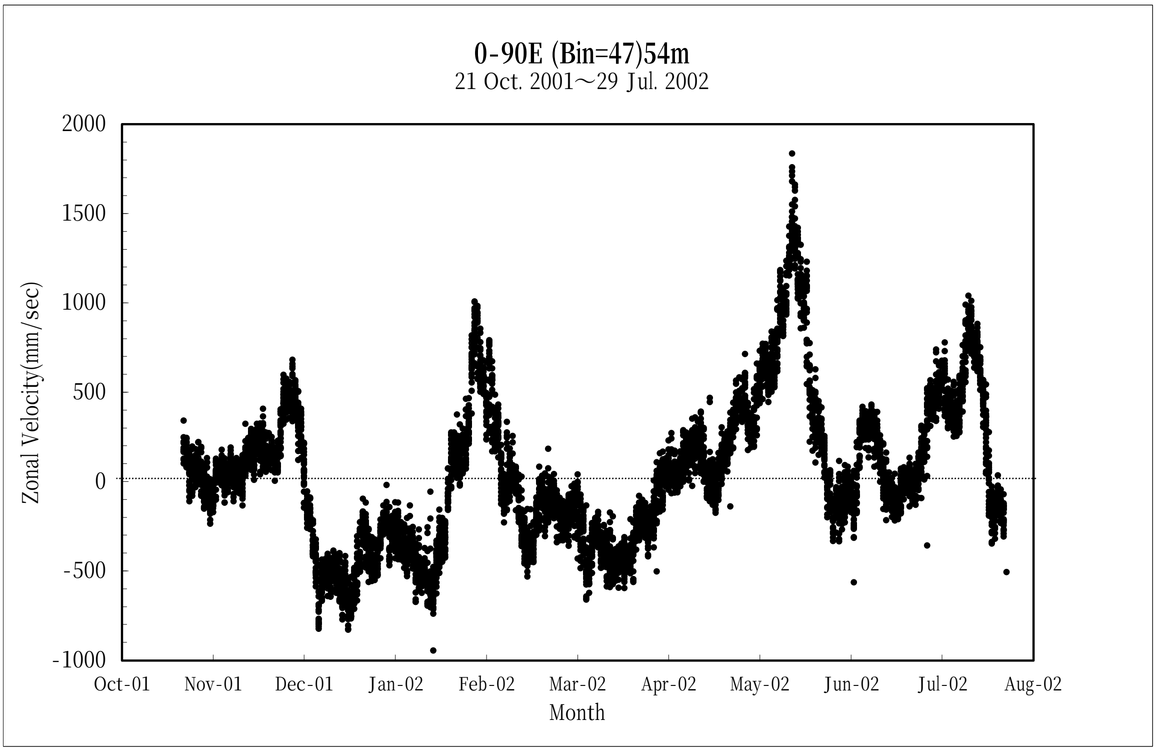


(c) Depth at bin#25

— 25-hour low pass filtered

Fig.7-2-9 Time series of (a)zonal, (b)meridional velocities and (c) cell depth of 7°N-127°E mooring at bin #25.

ADCP zonal and meridional velocity



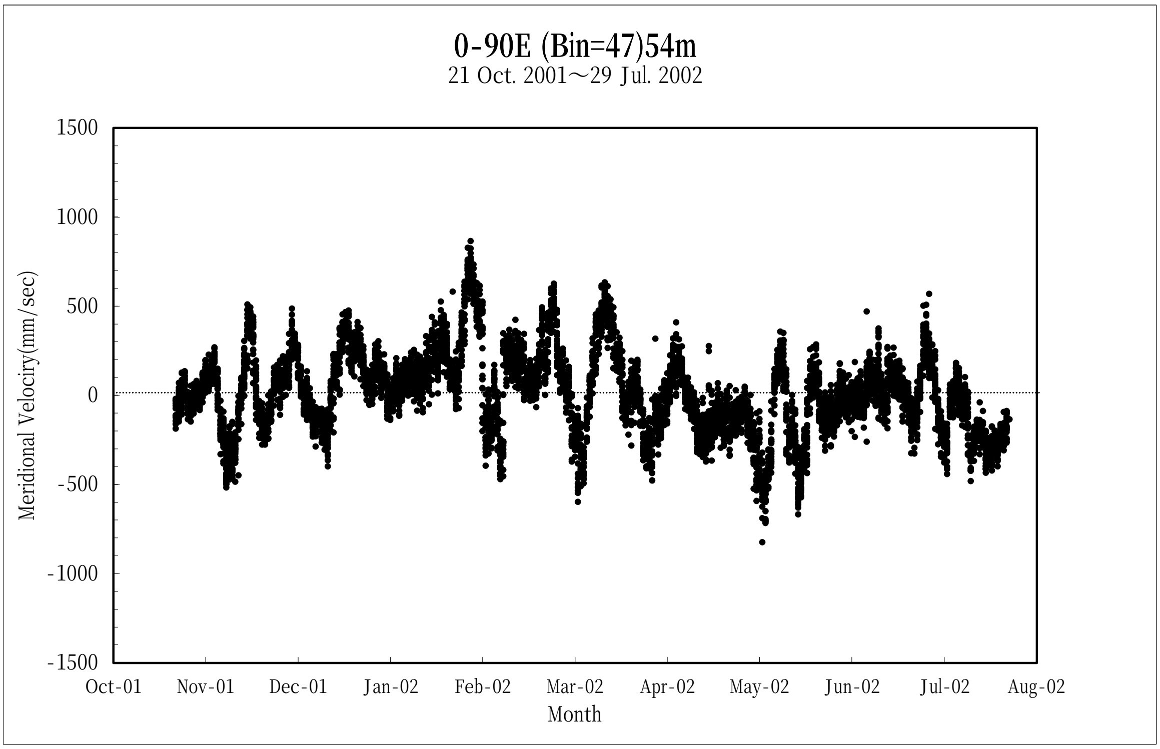
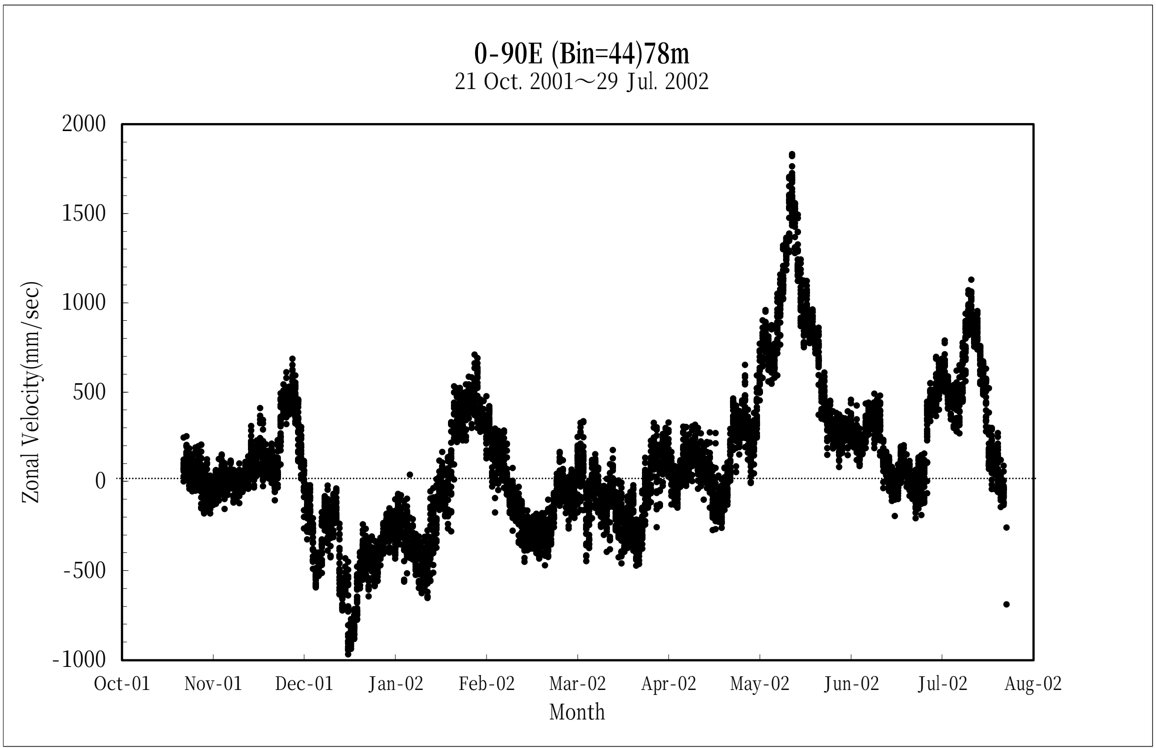


Fig.7-2-10 Time series of zonal and meridional velocities of EQ-90°E mooring at 54m depth.

ADCP zonal and meridional velocity



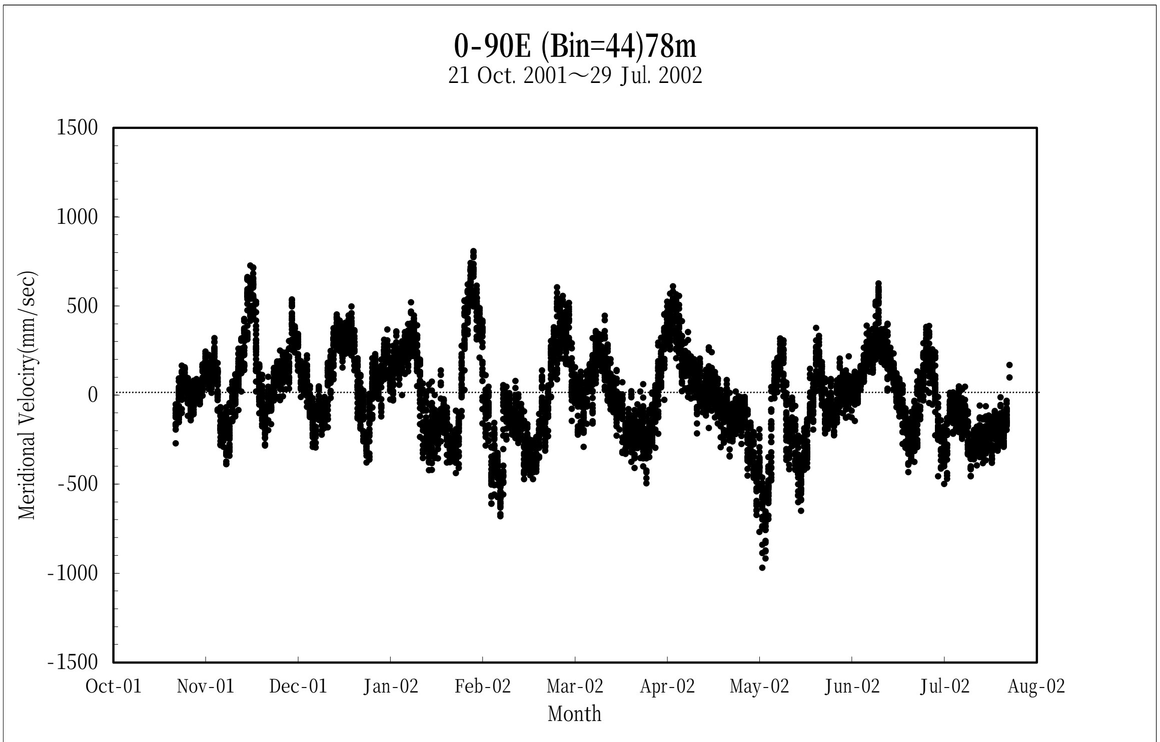
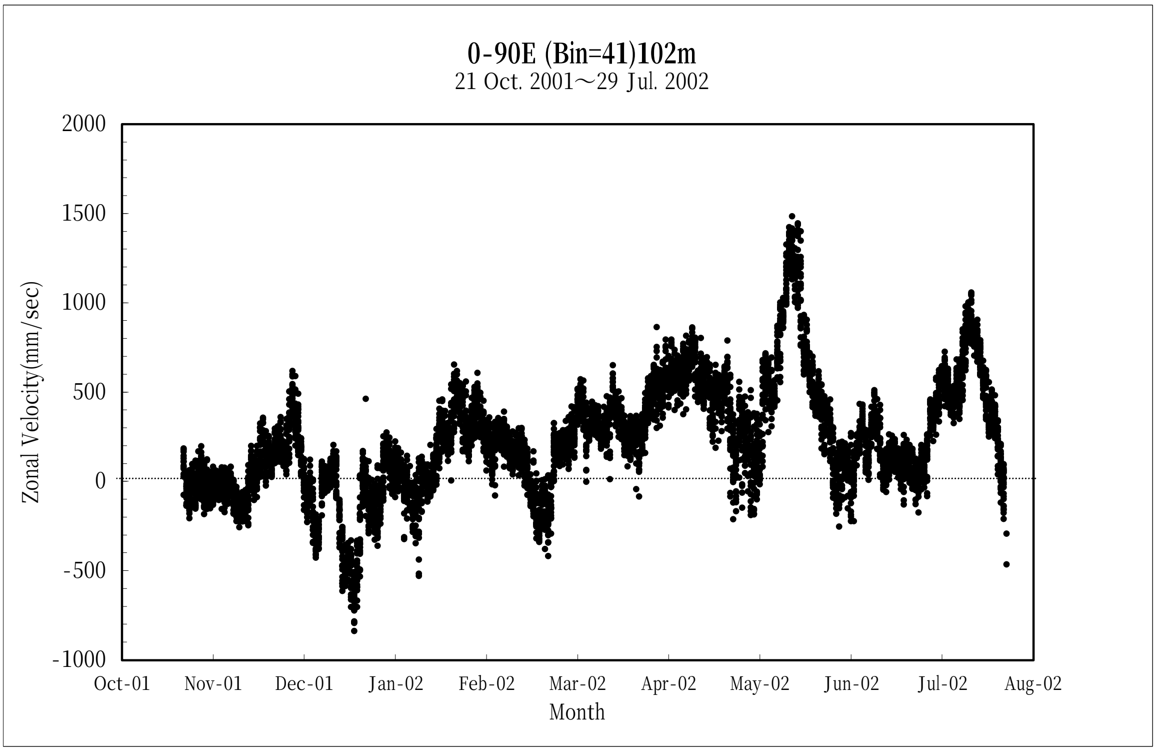


Fig.7-2-11 Time series of zonal and meridional velocities of EQ-90°E mooring at 78m depth.

ADCP zonal and meridional velocity



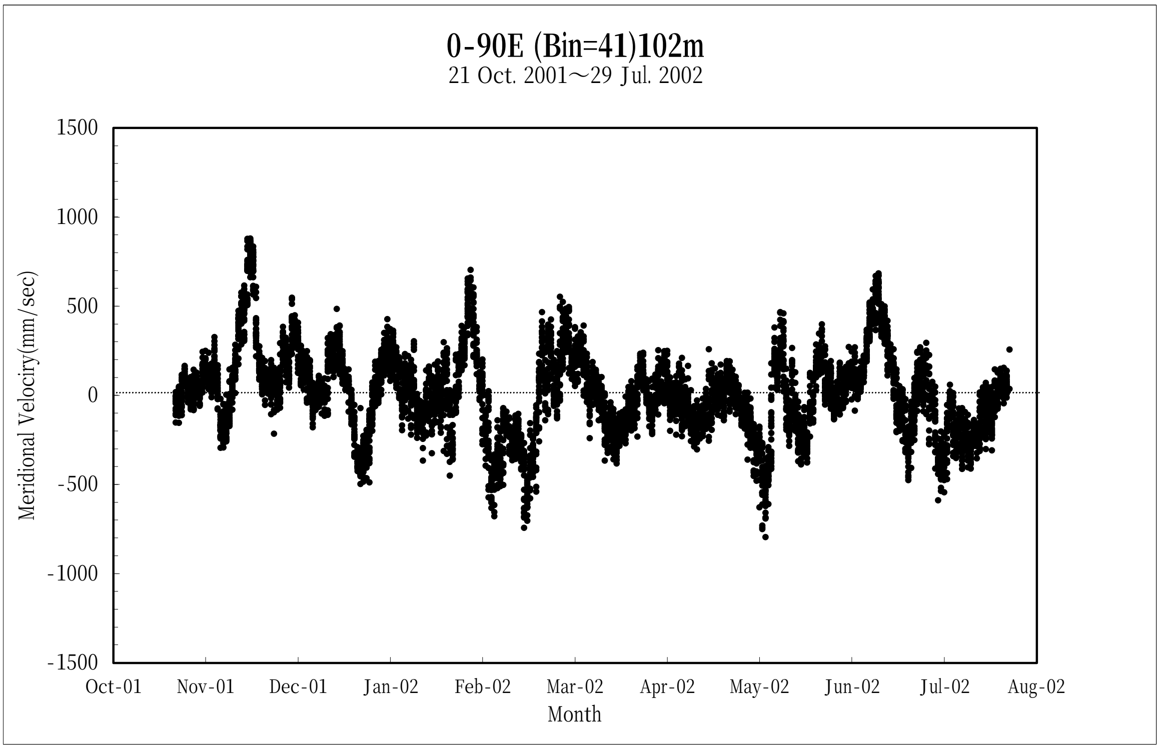
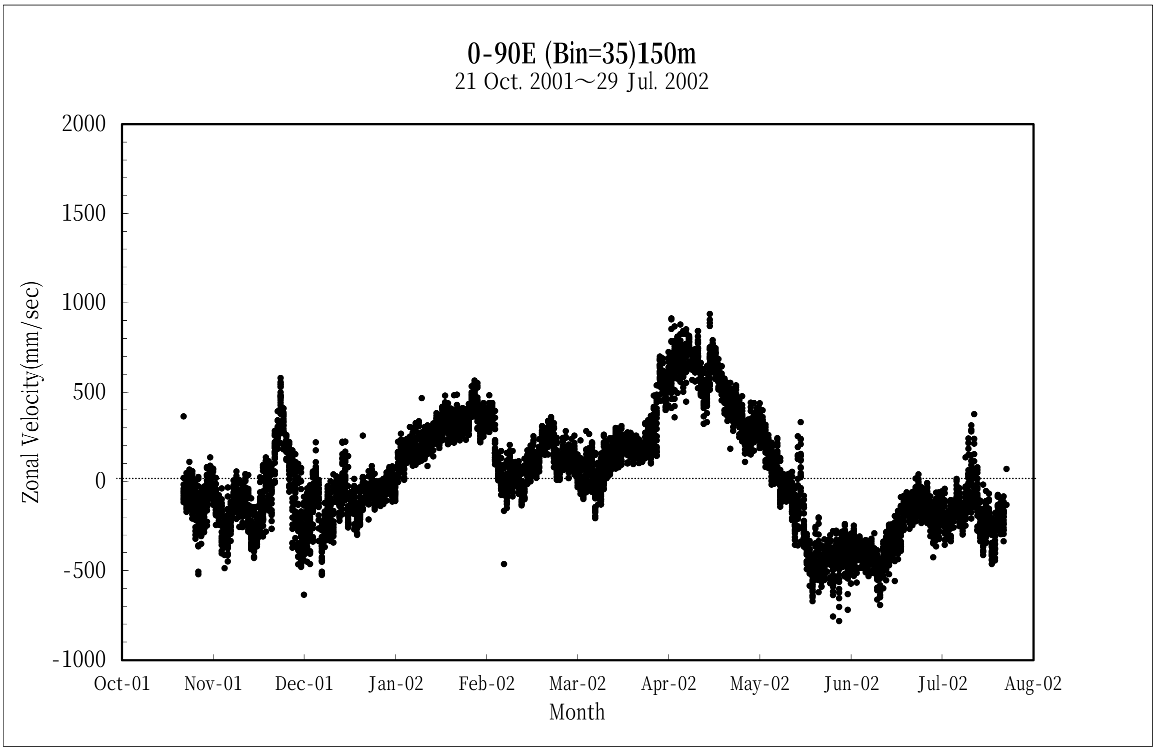


Fig.7-2-12 Time series of zonal and meridional velocities of EQ-90°E mooring at 102m depth.

ADCP zonal and meridional velocity



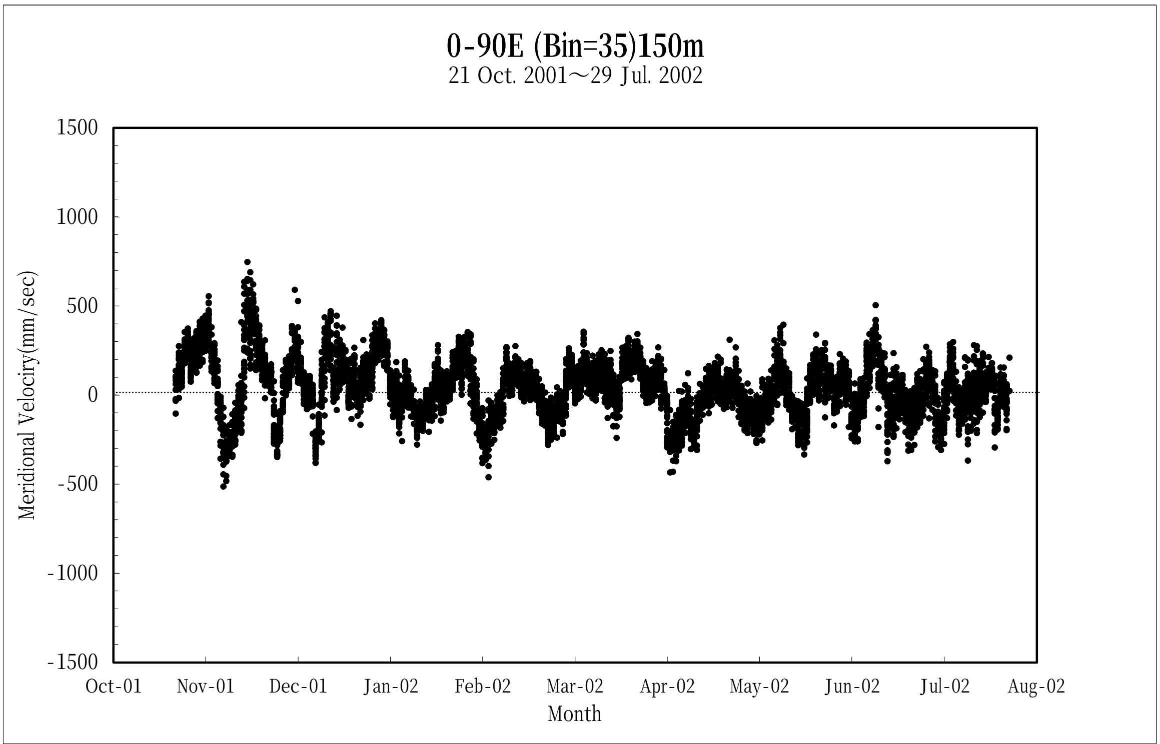
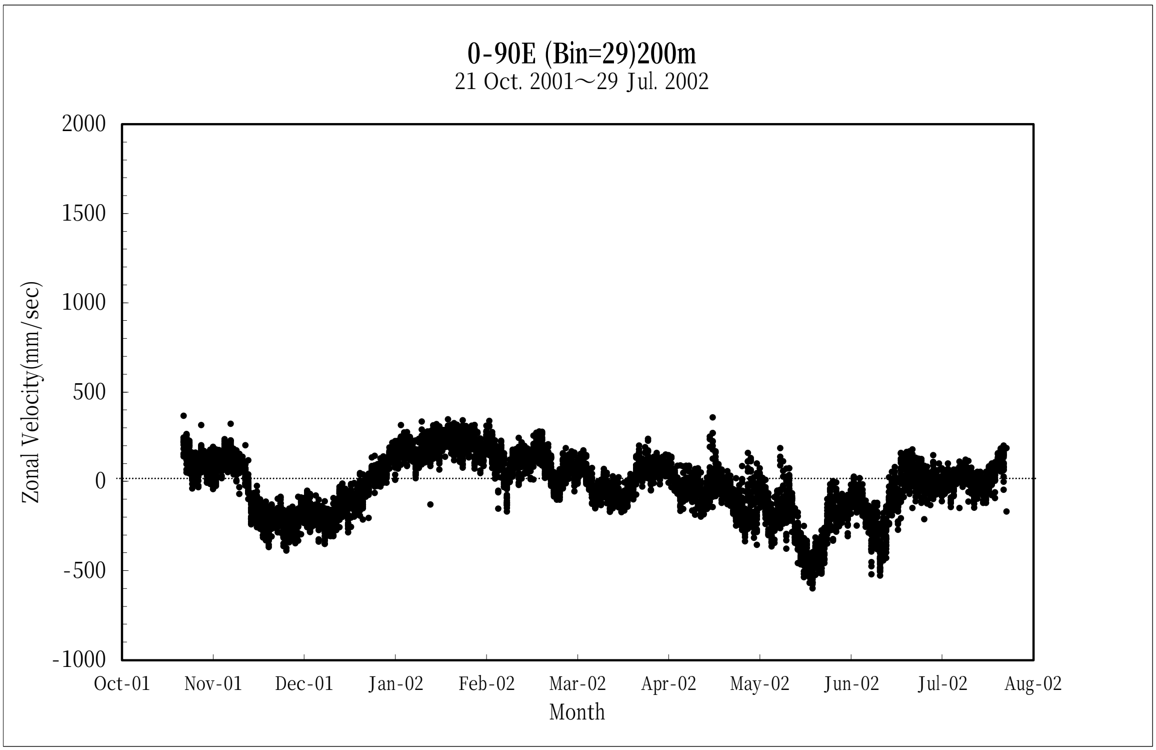


Fig.7-2-13 Time series of zonal and meridional velocities of EQ-90°E mooring at 150m depth.

ADCP zonal and meridional velocity



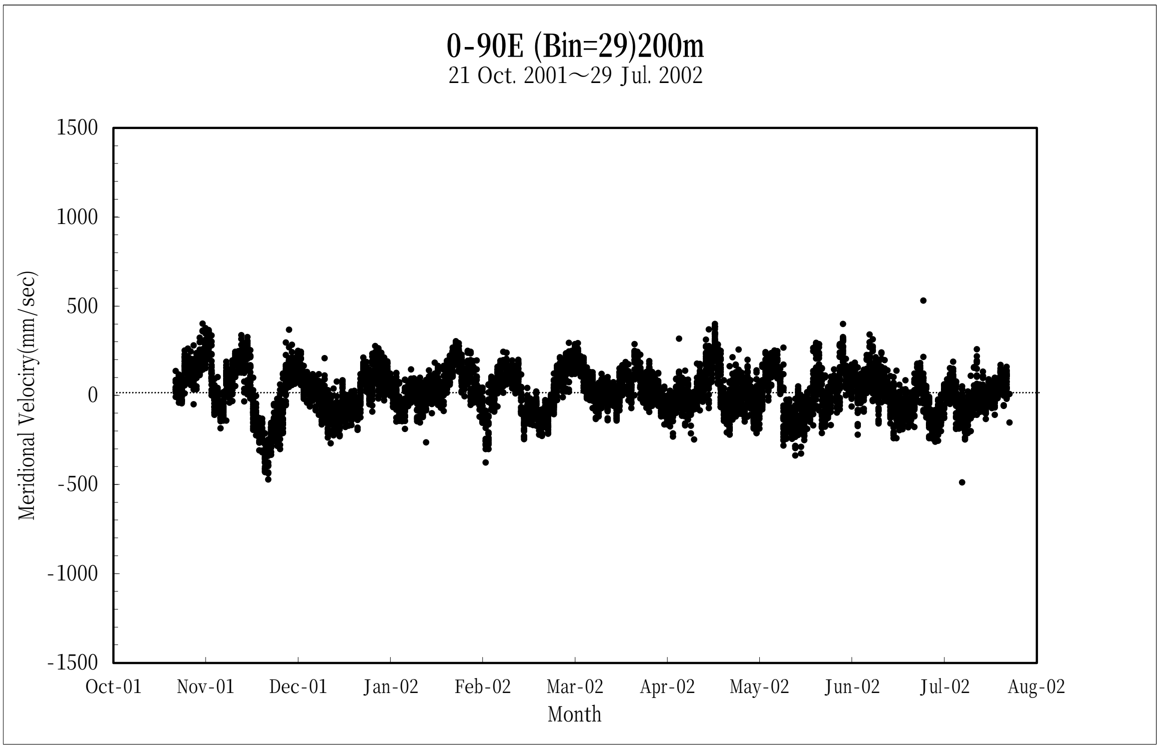
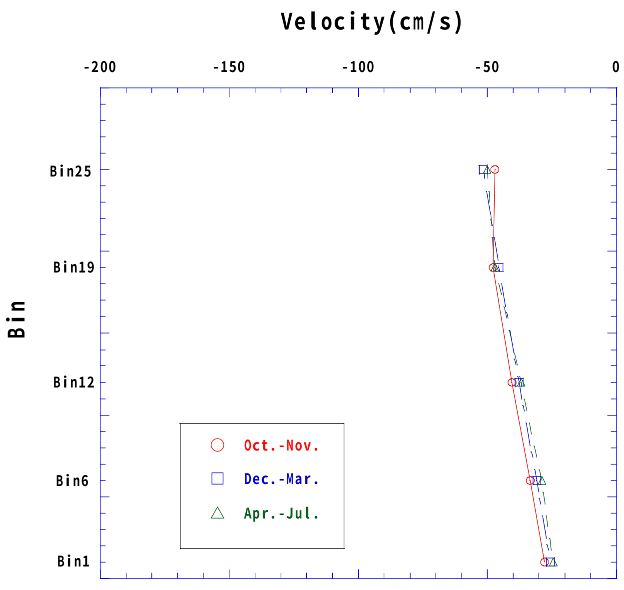
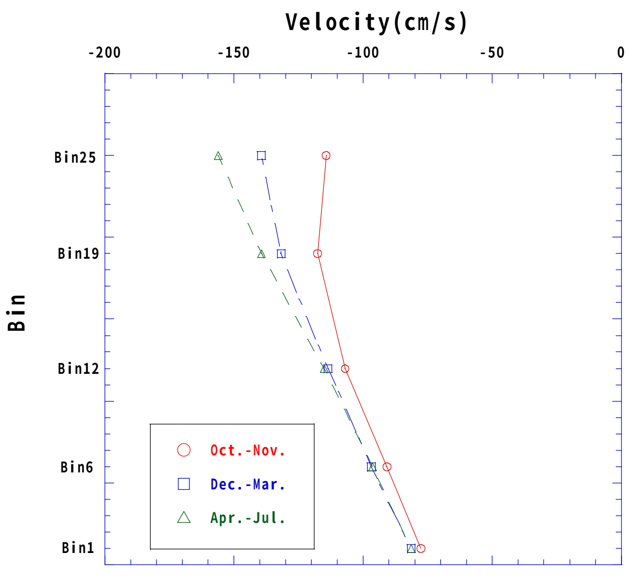


Fig.7-2-14 Time series of zonal and meridional velocities of EQ-90°E mooring at 200m depth.

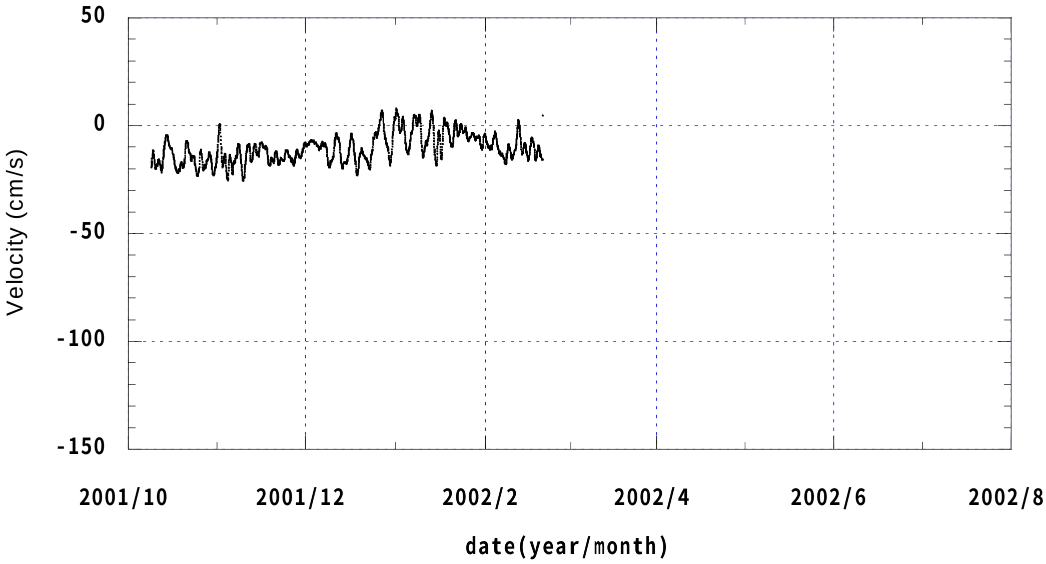


(a) Zonal component

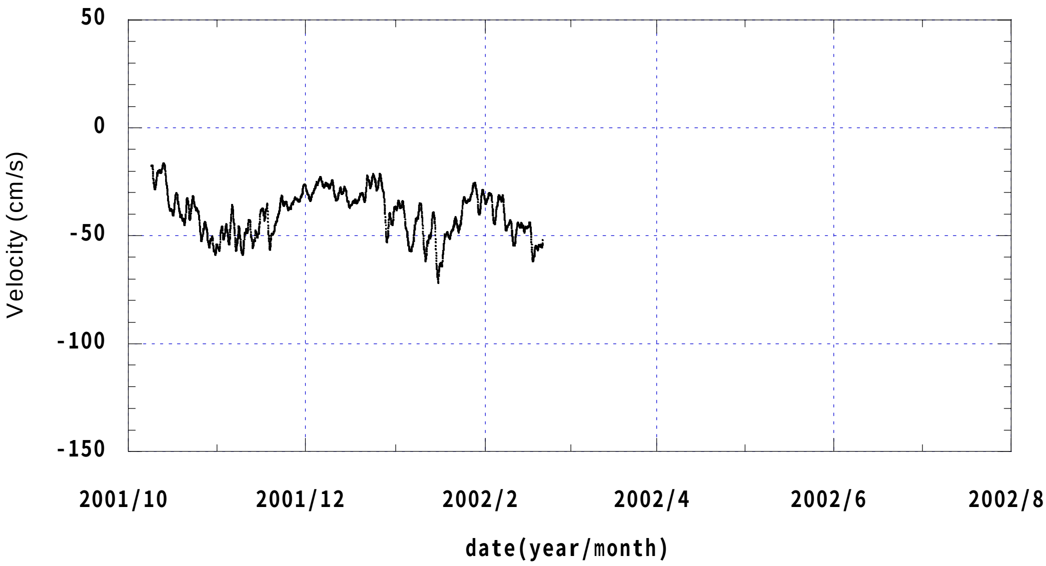


(b) Meridional component

Fig.7-2-15 Vertical profile of velocity (a)zonal and (b)meridional velocities of 7 ° N-127 ° E mooring.

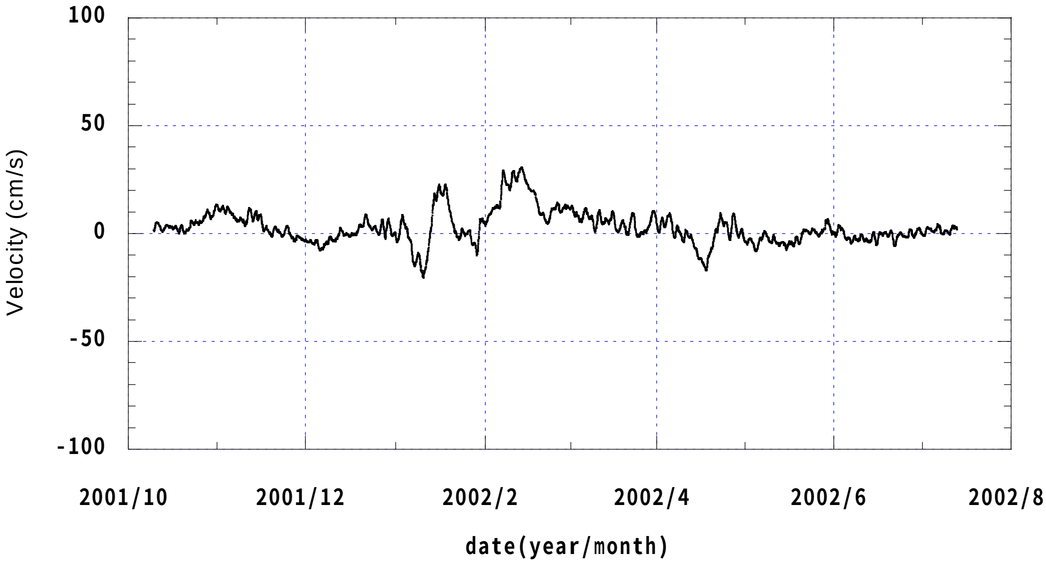


(a) Zonal component

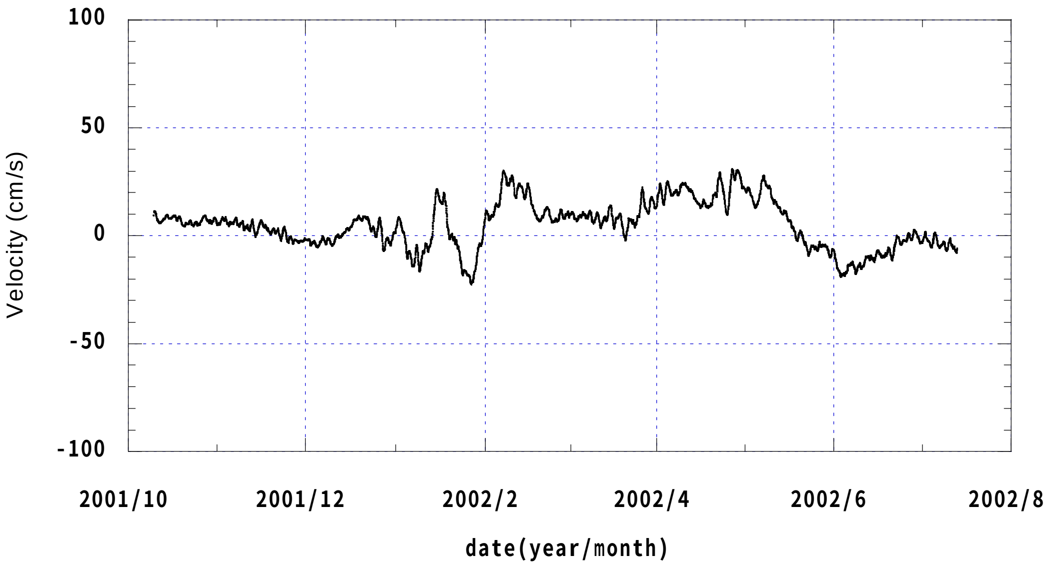


(b) Meridional component

Fig. 7-2-16 Time series of current velocity (25-hour low pass filtered) obtained with RCM-9 at 400 m depth of 7 ° N-127 ° E mooring.



(a) Zonal component



(b) Meridional component

Fig. 7-2-17 Time series of current velocity (25-hour low pass filtered) obtained with RCM-9 at 700 m depth of 7 ° N-127 ° E mooring.

7.3 Aerosol Measurement

(1) Personnel

On board scientists

Yuji Fujitani (Graduate school of Engineering, Hokkaido University) Graduate student

Principal investigators (not on board)

Tatsuo Endoh (Institute of Low Temperature Science, Hokkaido University): Associate Professor
Sachio Ohta (Graduate school of Engineering, Hokkaido University): Professor
Tamio Takamura (Center for Environmental Remote Sensing, Chiba University): Professor
Teruyuki Nakajima (Center for Climate System Research, University of Tokyo): Professor

(2) Objectives

Anthropogenic aerosols affect on climate by perturbing radiation budget through scattering and absorbing solar radiation, which is called the direct effect of aerosol. At present, uncertainty of radiative forcing due to greenhouse gases is 15%, whereas it lies in a factor of 2 of the direct aerosol forcing. As in The Third Assessment Report of IPCC in 2001, a chapter was spared about aerosols effect on climate, this problem had been regarded as important. The larger uncertainty of aerosol forcing comes from little available information about aerosol distribution of optical properties. Aerosols have various sources and sinks, the lifetime is short as a week or 10 days. As a result, aerosols have various spatial and temporal distributions. Furthermore, aerosol optical properties are function of aerosol chemical species, aerosol size distribution, and mixed state (i.e. internal mixture or external mixture). To calculate radiative forcing, the various input parameters are needed, but there are still shortages of them. It is then necessary to conduct long term and large-scale observations to understand aerosol distribution of optical properties.

There are few measurements, in particular, of aerosol optical properties over the Pacific Ocean, whereas this region is very important. Anthropogenic materials are increasingly emitted from Asian countries, and more amounts of aerosols may be transported to the Pacific Ocean. Thus, it is important to monitor the atmospheric environment in the East Asia and western Pacific ocean. Satellite remote sensing is hoped for monitoring global aerosol distribution. For atmospheric correction of the remote sensing, surface measurements are indispensable to optical and chemical properties of atmospheric aerosols.

During this cruise, we measured spatial distribution of aerosol optical and chemical properties to estimate radiative forcing by aerosol accurately and to do ground truth for satellite remote sensing.

(3) Methods

Sky Radiometer (POM-01MKⅡ; PREDE), equipped on deck, measures direct and aureole sun light intensity every 5min. The sensor provides optical thickness, Åangstrom exponent and size distribution of atmospheric aerosols.

To confirm retrieved optical properties from skyradiometer data analysis, *in-situ* measurement is conducted during this cruise. Sample air is drawn through inlets 5m height on compass deck, to manifold in research room. Particle larger than 2 μm in diameter are removed by cyclone separators. From the manifold, the sample air is distributed to Particle Soot / Absorption Photometer (PSAP; Radiance Research), Integrating Nephelometer (IN; M903; Radiance Research) and Optical Particle Counter (OPC; KC-01C; RION). PSAP measures volume absorption coefficient, IN measures volume scattering coefficient and OPC counts number concentration of aerosols larger than 0.3, 0.5, 1.0, 2.0 and 5.0 μm in diameter. All measurements are conducted every 1min. The aerosols are also collected on filter for chemical analysis by using another sampling system. The sampling system consists of three parts. One is Teflon filter sampling line (FP-500; 47mmφ; SUMITOMO DENKOH), the second is quartz fiber filter sampling line (2500QAT-UP; 47mmφ; Pallflex), and the third is teflon and quartz fiber filters in tandem use line. Aerosol sampling on Teflon filter are also conducted on the compass deck without cyclone separators. Aerosol sampling is performed with the special cautions not to be contaminated with chimney exhaust. The filters are stored in the refrigerator. From the aerosols collected on Teflon filters, amounts of inorganic and metal components are analysed by Ion chromatography and ICP-MS. From the sample on quartz fiber filters amounts of analyzed elemental and total carbons are determined by carbon analyzer.

(4) Results

The sky radiometer has been going well, so measured values will be expected to be considerably stable and provide good calculated parameters in higher quality. The volume scattering and absorption coefficients were $0.2\sim87.6\times10^{-6}$ m^{-1} and $\sim35.8\times10^{-6}$ m^{-1}, respectively. The single scattering albedo ranged 0.56 to 0.99, absorptivity aerosols were dominant during this cruise. Figure 1 shows time series of particle concentration larger than 0.3 μm. The particle number was under 1 to 300 cm^{-3}. Tables 1 and 2 summarized the aerosol sampling results.

(5) Data archive

The data of skyradiometer, PSAP, IN, and OPC are numerically analyzed and filter samples are chemically analyzed. All data are archived at Hokkaido University (Endoh and Ohta), University of Tokyo (Nakajima) and Chiba University (Takamura), and submitted to JAMSTEC within 3-years.

(6) Remarks

We stopped the aerosol sampling in the EEZ of Socialist Republic of Vietnam from 16:43 July 17 to 23:06 July 21, 2002.

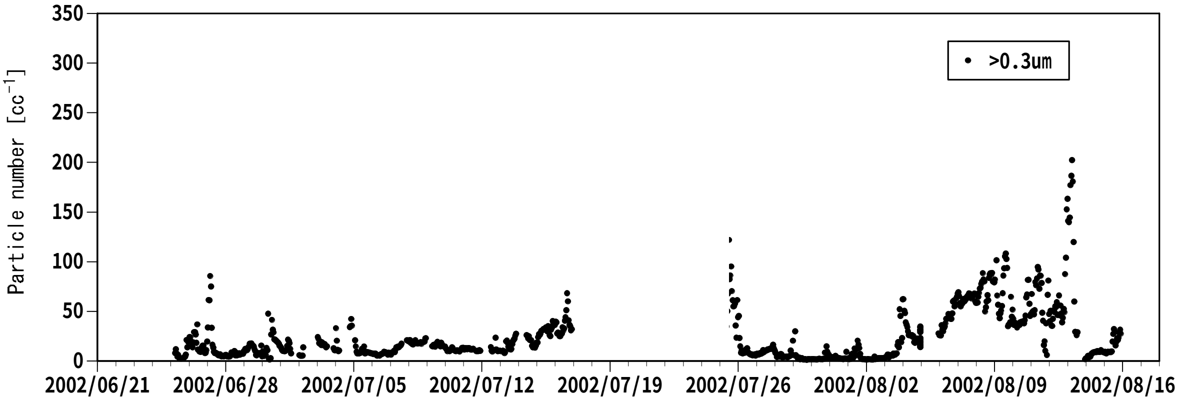


Figure 1. Time series of particle number concentration diameter larger than 0.3 μ m

Table 1. Information of aerosol sampling on Teflon filter

No.	date and time (UTC) start	date and time (UTC) end	sampling period [hh+mm]	total sampling period [min]	sampling volume [m^3]	start (deg) Latitude	start (deg) Longitude	end (deg) Latitude	end (deg) Longitude
1	25Jun. 7:25	26Jun. 6:05	22h+20m	1340	26.8	40.6	141.5	36.0	142.4
2	26Jun. 6:45	27Jun. 6:30	21h+8m	1268	25.4	35.8	142.4	30.4	141.4
3	27Jun. 7:08	28Jun. 6:23	23h+13m	1393	27.9	30.2	141.4	24.3	140.1
4	28Jun. 6:37	30Jun. 23:03	62h+23m	3743	74.9	24.2	140.1	9.6	137.3
5	30Jun. 23:50	4Jul. 23:24	40h	2940	58.8	9.5	137.2	4.9	137.3
6	5Jul. 0:00	7Jul. 6:25	43h+18m	2598	52.0	4.9	137.3	1.1	138.0
7	7Jul. 6:34	9Jul. 23:05	50h+36m	3036	60.7	1.1	138.0	2.0	134.6
8	9Jul. 23:36	13Jul. 3:20	43h+39m	2619	52.4	2.0	134.6	5.0	129.9
9	13Jul. 4:07	15Jul. 8:50	36h+54m	2214	44.3	5.0	130.0	10.7	128.2
10	15Jul. 9:04	17Jul. 1:13	39h+56m	2396	47.9	10.7	128.1	19.6	122.3
11	25Jul. 9:18	26Jul. 4:34	24h+00m	1440	28.8	3.4	101.0	6.2	95.3
12	26Jul. 5:05	27Jul. 4:22	45h+59m	2759	55.2	6.2	95.1	4.5	90.8
13	27Jul. 4:33	1Aug. 2:00	49h+1m	2941	58.8	4.5	90.8	-5.0	90.6
14	1Aug. 2:16	3Aug. 6:36	42h+4m	2524	50.5	-5.0	90.7	-7.2	101.2
15	3Aug. 7:12	5Aug. 2:08	41h+16m	2476	49.5	-7.2	101.3	-8.6	105.3
16	5Aug. 2:18	6Aug. 7:47	29h+17m	1757	35.1	-8.6	105.3	-10.3	112.0
17	6Aug. 8:13	8Aug. 2:11	41h+58m	2518	50.4	-10.3	112.1	-10.6	120.6
18	8Aug. 2:52	10Aug. 0:03	42h+8m	2528	50.6	-10.6	120.8	-2.8	126.0
19	10Aug. 0:15	14Aug. 5:35	-	-	39.8	-2.8	126.1	14.2	132.6

Table 2. Information of aerosol sampling on quartz fiber filter

No.	date and time (UTC)		sampling period	total sampling	sampling volume	start (deg)		end (deg)	
	start	end	[hh+mm]	period [min]	[m^3]	Latitude	Longitude	Latitude	Longitude
1	25Jun. 7:25	26Jun. 6:05	22h+20m	1340	26.8	40.6	141.5	36.0	142.4
2	26Jun. 6:45	27Jun. 6:30	21h+8m	1268	25.4	35.8	142.4	30.4	141.4
3	27Jun. 7:08	30Jun. 23:03	85h+49m	5149	103.0	30.2	141.4	9.6	137.3
4	30Jun. 23:50	6Jul. 5:57	73h+7m	4387	87.7	9.5	137.2	2.1	138.1
5	6Jul. 6:08	9Jul. 23:05	69h+46m	4186	83.7	2.1	138.1	2.0	134.6
6	9Jul. 23:36	13Jul. 3:20	43h+39m	2619	52.4	2.0	134.6	5.0	129.9
7	13Jul. 4:07	15Jul. 23:25	51h+26m	3086	61.7	5.0	130.0	13.9	125.9
8	15Jul. 23:34	17Jul. 1:**13**	25h+37m	1537	30.7	13.9	125.9	19.6	122.3
9	25Jul. **9:18**	26Jul. 4:34	24h+00m	1440	28.8	3.4	101.0	6.2	95.3
10	26Jul. 5:05	30Jul. 4:36	66h+07m	3967	79.3	6.2	95.1	-1.6	90.1
11	30Jul. 4:46	3Aug. 6:36	70h+57m	4257	85.1	-1.6	90.1	-7.2	101.2
12	3Aug. 7:12	6Aug. 7:47	70h+33m	4233	84.7	-7.2	101.3	-10.3	112.0
13	6Aug. 8:13	8Aug. 2:11	41h+58m	2518	50.4	-10.3	112.1	-10.6	120.6
14	8Aug. 2:52	10Aug. 10:45	-	-	58.2	-10.6	120.8	0.0	126.7
15	10Aug. 10:57	14Aug. 5:35	-	-	36.1	0.1	126.7	132.6	1003.7

7.4 ARGO float (profiling float)

(1) Personnel

Kensuke Takeuchi	(FORSGC)	not on board	Principal Investigator
Keisuke Mizuno	(JAMSTEC)	not on board	
Kentaro Ando	(JAMSTEC)	not on board	
Kenji Izawa	(JAMSTEC)	not on board	
Naoto Iwasaka	(FORSGC)	not on board	
Taiyo Kobayashi	(FORSGC)	not on board	
Eitaro Oka	(FORSGC)	not on board	
Asako Inoue	(MWJ)	not on board	

(2) Objectives

Four Argo floats were deployed as a part of the international Argo project and the Japanese ARGO project. The purpose of these projects is to observe the upper ocean on global scales in real-time using numerous profiling floats: for better understanding of ocean variations associated with climate variability, and for improvement of long-range weather forecasts. Since the locations of deployments are near one of the poles of the Indian Ocean Dipole Mode Oscillation, the floats are especially expected to provide information about variations of the upper ocean associated with the oscillation.

(3) Parameters

- Vertical profiles of water temperature, salinity, and pressure
- Location and time of observation
- Ocean currents at the sea surface and the parking depth

(4) Methods

The floats deployed during this cruise were 4 PROVOR floats manufactured by MTEOCEAN Data Systems. The floats were launched at 3°S, 90°E, 5°S, 90°E, 5°S, 94°E, and 5°-34.6S, 94°-59.84E. All the floats are launched just after CTD observation at the same location, so that we can use CTD data for calibration of the float sensors.

The floats are designed to drift at a specified depth called “parking depth” or “drifting depth” for a specified period, and then change their buoyancy by increasing their volume to rise up to the sea surface. During their ascent, they measure temperature, salinity, and pressure. The floats remain at the sea surface for about 10 to 24 hours, transmit their positions and the CTD data to ARGOS satellites, and then return to the parking depth by decreasing their volume. Each of the ascent and descent takes about 5-10 hours. Their detail deployment status are shown in section 3.3 cruise log.

(5) Data archive

All data acquired through the ARGOS system is stored and analyzed at FORSGC. The real-time data are provided to meteorological organizations via the Global Telecommunication System (GTS) and are utilized for analysis and forecasts of sea conditions. In addition, the data will be also opened to the public via "Japan ARGO home page".
(http://www.jamstec.go.jp/ARGO/J_ARGOe.html)

7.5 Mie scattering Lidar observation

(1) Personnel

Ichiro Matsui (National Institute for Environmental Studies) [Leg. 1],

Atsushi Shimizu (National Institute for Environmental Studies) [Leg. 2],

Nobuo Sugimoto (National Institute for Environmental Studies) (not on board)

(2) Objectives

Objectives of the observations and experiments during this cruise are to study distribution and optical characteristics of aerosols and clouds using a two-wavelength dual polarization lidar.

(3) Measured parameters

- Vertical profiles of backscattering coefficient at 532 nm and 1064 nm.
- Vertical profile of depolarization ratio at 532 nm.

(4) Method

Vertical profiles of aerosols and clouds were measured with a two-wavelength dual polarization lidar. The lidar employs a Nd:YAG laser as a light source which generates the fundamental output at 1064 nm and the second harmonic at 532 nm. Transmitted laser energy is typically 100 mJ per pulse at 1064 nm and 50 mJ per pulse at 532 nm. The pulse repetition rate is 10 Hz. The receiver telescope has a diameter of 25 cm. The receiver has three detection channels to receive the lidar signals at 1064 nm and the parallel and perpendicular polarization components at 532 nm. An analog-mode avalanche photo diode (APD) is used as a detector for 1064 nm, and photomultiplier tubes (PMTs) are used for 532 nm. The detected signals are recorded with a digital oscilloscope and stored on a hard disk with a computer. The lidar system was installed in a 20-ft container with the cloud profiling radar (CPR) of the Communications Research Laboratory (CRL). The container has a glass window on the roof, and the lidar was operated continuously regardless of weather.

(5) Results

Figures 7.5-1 and 7.5-2 show the quick-look time-height indications of the range-corrected signal during Leg.1 and 2 of the cruise, respectively.

The lower clouds at 600 m are continuously observed over western Pacific Ocean. Also higher cirrus around 15 km is detected in lower latitude where the tropopause is supposed to be located at 16-18 km. A close look into a middle cloud reveals fine structures of cloud system accompanied by precipitation.

In Leg.2, higher cirrus clouds were often detected around 15-16 km in the Indian Ocean. It was an interesting future that the slightly depolarizing aerosol layer was detected just above (1.5-2 km) the marine (surface) aerosol layer, around the southern region of Java Islands. It suggests that a long-range transport of some land-origin aerosols has occurred.

(6) Data archive

- raw data
  - lidar signal at 532 nm (parallel polarization)
  - lidar signal at 532 nm (perpendicular polarization)
  - lidar signal at 1064 nm
  - temporal resolution 10 sec.
  - vertical resolution 6 m.
- processed data
  - cloud base height, apparent cloud top height, cloud phase
  - cloud fraction
  - boundary layer height (aerosol layer upper boundary height)
  - backscatter coefficient of aerosols
  - depolarization ratio

All data will be archived at National Institute for Environmental Studies, and submitted to JAMSTEC within 3-years.

(7) Remarks

We did not observe the atmosphere in the EEZ of Socialist Republic of Vietnam from 16:43-17-July to 23:06-21-July 2002.

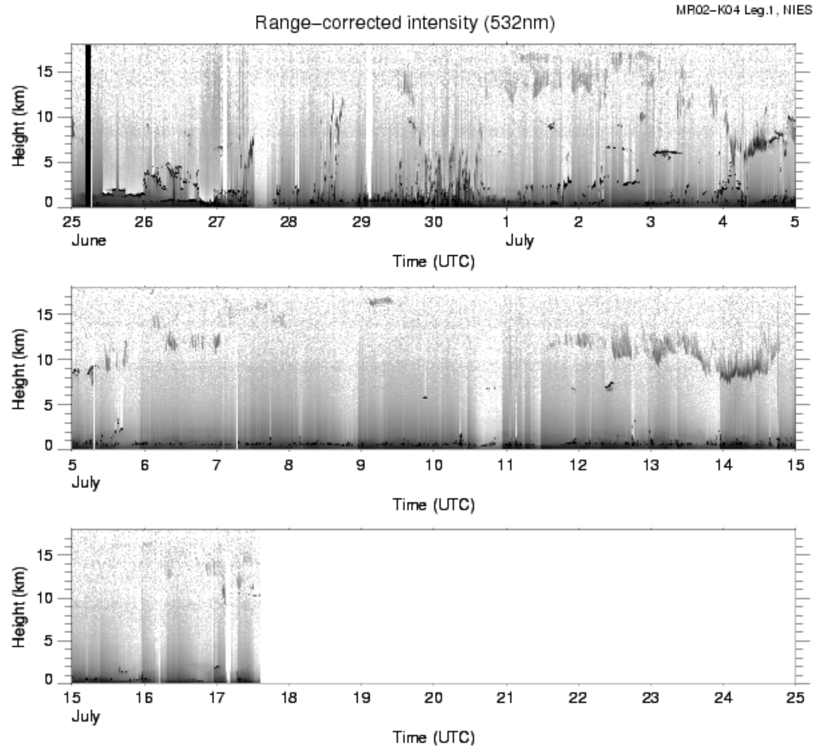


Fig. 7.5-1 Range-corrected signal at 532 nm during Leg 1.

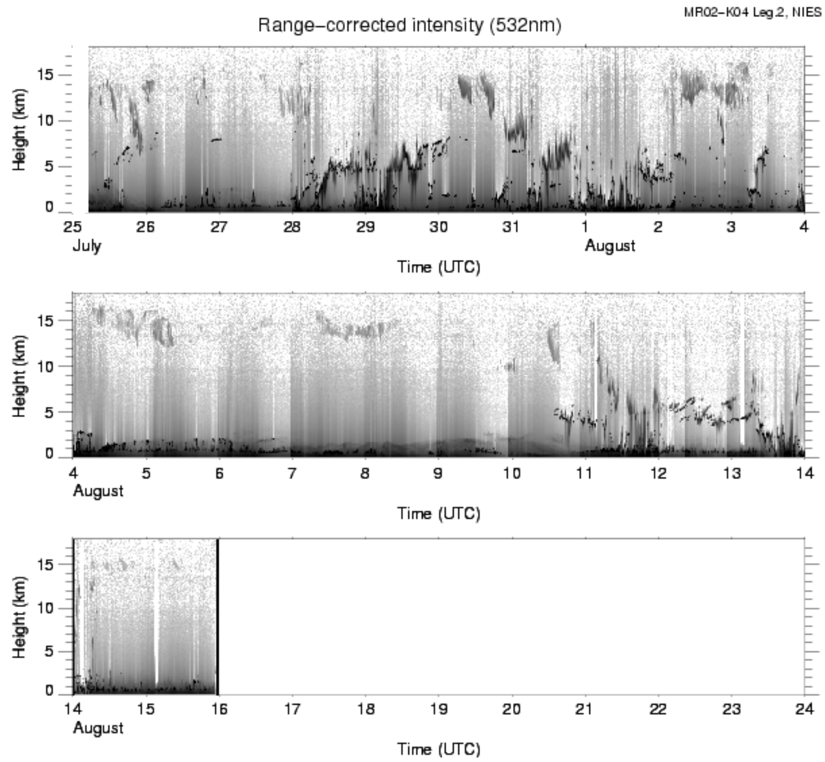


Fig. 7.5-2 Same as Fig. 7.5-1 but for Leg 2.

7.6 Doppler Radar Observation

(1) Personnel

Shuichi Mori (FORSGC): Principal Investigator

Yasutaka Imai (GODI)

Shin-Ya Iwamida (GODI)

Wataru Tokunaga (GODI)

(2) Objective

The objective of Doppler radar observation is to understand precipitating convective systems in the eastern Indian Ocean during the Indian monsoon season by obtain both special and temporal distribution of rainfall amount, and structures of the precipitating convective system.

(3) Method

The hardware specifications of this shipboard Doppler radar (RC-52B, manufactured by Mitsubishi Electric Co. Ltd., Japan) are:

Frequency:	5290 MHz
Beam Width:	better than 1.5 degrees
Output Power:	250kW (Peak Power)
Signal Processor:	RVP-7 (Sigmet Inc., U.S.A.)
Inertial Navigation Unit:	DRUH (Honeywell Inc., U.S.A.)
Application Software:	IRIS/Open (Sigmet Inc., U.S.A.)

The hardware is calibrated by checking (1) frequency, (2) mean power output, (3) pulse repetition frequency (PRF) for once a day, (4) transmitting pulse width and (5) receiver linearity at the beginning and the end of the observation period.

The observation is performed continuously from July 25 through August 18, 2002. during the observation, the programmed “tasks” are repeated every 10 minutes. One cycle consists of one “volume scan” (consists of PPIs for 21 elevations) with Doppler-mode (160 km range for reflectivity and Doppler velocity), one-elevation “surveillance” PPI with Intensity-mode (300 km range for reflectivity). In the interval of the cycles, RHI (Range Height Indicator) scans were operated to obtain detailed vertical cross sections with Doppler-mode. The Doppler velocity is unfolded automatically by dualPRF unfolding algorithm. The parameters for the above three tasks are listed in Table 7.6-1.

Table 7.6-1

	Surveillance PPI	Volume Scan	RHI
Pulse Width	2 [microsec.]	0.5 [microsec.]	
Scan Speed	18 [deg./sec.]		Automatically determined
PRF	260 [Hz]	900/720 [Hz]	
Sweep Integration	32 samples		
Ray Spacing	1.0 [deg.]		0.2 [deg.]
Bin Spacing	250 [m]	125 [m]	
Elevations	0.5	0.5, 1.2, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.1, 11.3, 12.8, 14.6, 16.6, 18.9, 21.6, 25.0, 29.0, 34.0, 40.0	0.0 to 70.0
Azimuths	Full Circle		Optional
Range	300 km	160 [km]	

(4) Preliminary results

Continuous observation of Doppler radar has been carried out successfully without any trouble during this period. Major disturbance events were observed on July 29, August 01, 03, and 04 in the Indian Ocean, August 14-15 in eastern offshore area of Philippine, when the vessel passed through cloud cluster areas observed by Geostationary Meteorological Satellite (GMS). Furthermore, a typhoon (T0213; Phanfone) related convective systems were also detected after August 18, 2002 as shown in Figs. 7.6-1 through 7.6-3.

The detailed analyses for these observed events with other obtained datasets are in future work.

(5) Data archive

The inventory information of the Doppler radar data obtained during this cruise will be submitted to JAMSTEC Data Management Office (DMO). The original data will be archived at and available from Frontier Observational Research System for Global Change (FORSGC).

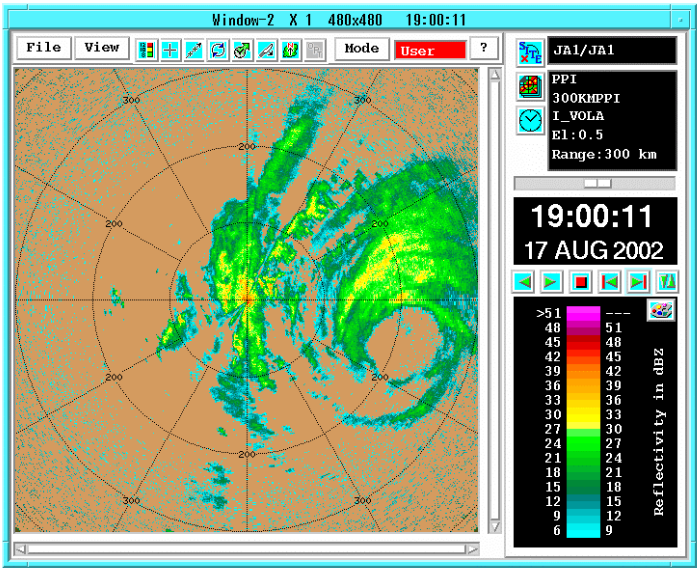


Fig. 7.6-1 Radar reflectivity field by surveillance (intensity-mode) PPI at 19UTC on August 17, 2002. TS0213 (Phanfone) is indicated centered on 210 km SSW from R/V Mirai.

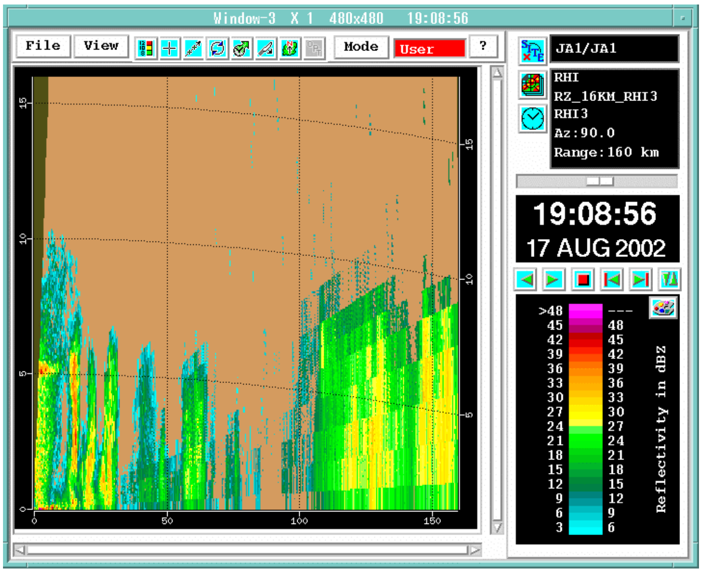


Fig. 7.6-2 RHI of radar reflectivity at 19UTC on August 17, 2002. Azimuth from the radar is 90 degree and horizontal range is 160 km.

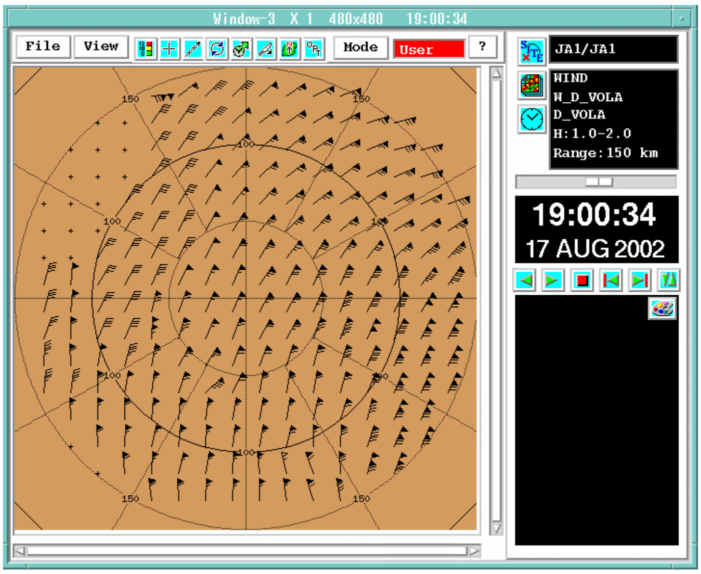


Fig. 7.6-2 Horizontal wind field by VVP technique at 19UTC on August 17, 2002. Horizontal range is 150 km centered from the radar.

7.7 Rawinsonde Observation

(1) Personnel

Shuichi Mori (FORSGC): Principal Investigator

Yasutaka Imai (GODI)

Shin-Ya Iwamida (GODI)

Wataru Tokunaga (GODI)

(2) Objective

The objective of rawinsonde observation is to understand precipitating convective systems in the eastern Indian Ocean during the Indian monsoon season by obtaining the atmospheric environmental profiles of pressure, temperature, relative humidity, wind direction, and wind speed.

(3) Method

Atmospheric sounding by rawinsonde was carried out 6 or 3 hours during July 27 and August 06, 2002 along the cruise track described in Fig. 7.7-1. Table 7.7-1 shows the summary of 62 launches in total including special observations in eastern offshore area of Philippine during August 14-15, 2002. The observation system consists of receiver/processor (Vaisala DigiCORA MW11), GPS antenna (GA20), UHF telemetry antenna (RB20), balloon launcher (ASAP), 200g balloon (Totex TA-200), and GPS rawinsonde transmitter (Vaisala RS80-15GH).

Every transmitter except one marked with * in Table 7.7-1 were calibrated before launch by using the digital barometer (Vaisala PTB220 Class A) and the humidity calibrator (General Eastern C-1 RH Generator) set at approximately 70 %. Other transmitters marked with * in the Table 7.7-1 were calibrated with the ground check kit (Vaisala GC23) which humidity was set at 0 % because of some malfunction with Vaporpak H-31 calibrator at that time.

(4) Preliminary results

Time-height cross sections of temperature, zonal and meridional wind components, relative humidity, specific humidity, and equivalent potential temperature are shown in Fig. 7.7-2. Vertical profiles of temperature, dew-point temperature are plotted on the thermodynamic chart wind profiles in Fig7.7-3. Both southwesterly wind in the lower troposphere and northeasterly wind in the upper troposphere are observed along 90E line from 5N through 4S (July 27 – 31) corresponding to Indian monsoon circulation. Especially, rather strong westerly wind with much water vapor is indicated around the equator (July 28 – 29) when the ship passed through a large precipitating cloud system. The wind field is replaced by easterly wind, corresponding to winter circulation in the southern hemisphere, in the area from 90E through 110E (August 01 - 06) over southwestern side of Sumatra Island. Notable dry southeasterly wind is indicated after August 04 that may be caused by winter Australian monsoon.

A typical tropical atmospheric structure with convective unstable condition is indicated throughout the observation period, which has both much specific humidity of 15-20 g/kg in the near surface and rather dries air in the middle of troposphere. Rainfall of 5 mm or above a day observed this period only on July 29, 31, August 01, 03, and 04, however, quasi diurnal variations of humidity in the lower troposphere are indicated throughout the period.

(5) Data archive

All sounding data have been sent to the world meteorological community by Global Telecommunication System (GTS) through Japan Meteorological Agency (JMA) immediately after the each observation. Raw data are stored in digital ASCII format that are available through JAMSTEC Data Management Office (DMO).

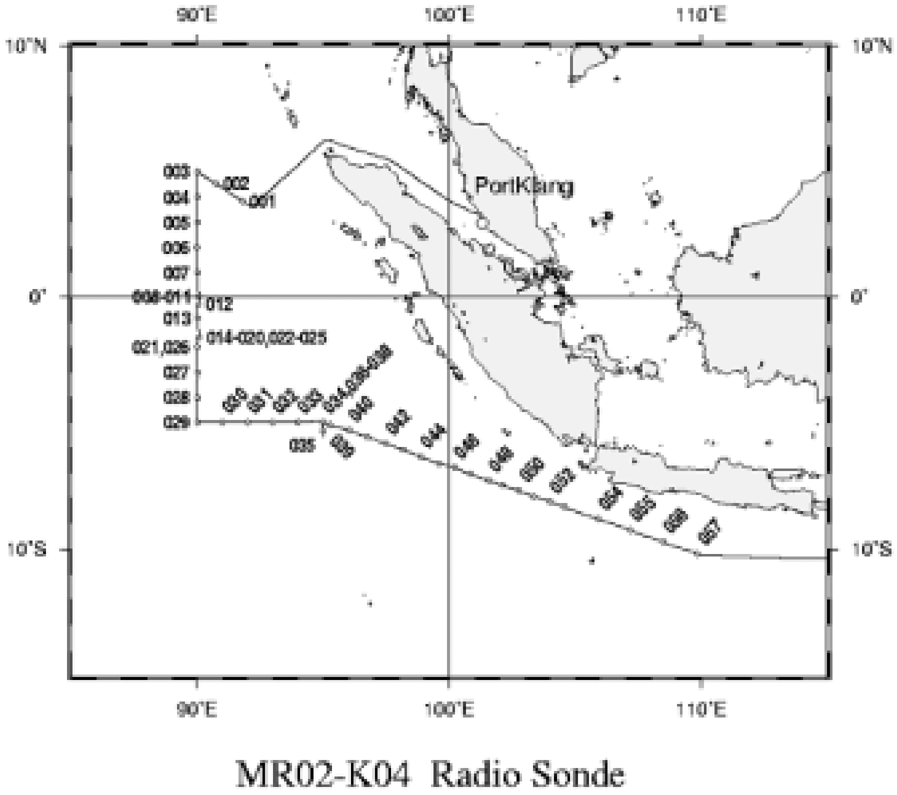


Fig. 7.7-1 Locations of rawinsonde launching along the cruise track of MR02-K04. Numbers indicated in the figure show the observation number

Table 7.7-1 Rawinsonde Observation Log

No.	Date & Time (UTC)				Position		Surface Data					Maximum Altitude		Cloud Amount & Type	
					Lon. E	Lat. N	P	T	RH	WD	WS				
	YY	MM	DD	HH	(deg.)	(deg.)	(hPa)	(deg. C)	(%)	(deg.)	(m/s)	(hPa)	(gpm)		
RS-001	02	07	27	00	91.80	3.83	1009.3	28.5	75	245	5.5	31.5	23550	8	Cu, Ac, As
RS-002	02	07	27	06	90.74	4.53	1008.2	29.0	74	246	6.5	20.9	26150	3	Cu
RS-003	02	07	27	12	90.00	5.00	1006.2	29.2	74	240	8.2	31.0	23593	3	Cu, Cb, Ac
RS-004	02	07	27	18	90.00	3.99	1009.5	28.7	74	236	5.9	32.5	23353	1	Cu
RS-005	02	07	28	00	90.00	3.00	1008.2	27.3	79	277	5.4	41.2	21839	8	Cu, Ac, As
RS-006	02	07	28	06	89.99	2.00	1009.2	29.3	69	278	13.1	35.0	22908	9	Cb, Ac
RS-007	02	07	28	12	90.00	0.99	1008.0	29.2	73	249	6.6	33.2	23250	10	Sc, Cu, Ac
RS-008	02	07	28	18	90.06	0.04	1009.4	28.2	77	241	5.7	55.4	20053	10	Cu, Ac
RS-009	02	07	29	00	90.05	0.01	1007.2	27.5	79	223	10.3	42.3	21683	10	Cu, Ac, As
RS-010	02	07	29	03	90.06	0.01	1008.2	29.0	80	285	7.2	26.5	24686	10	Cu, Cb, Ac, As
RS-011	02	07	29	06	90.01	0.02	1008.2	27.3	82	247	10.9	397.9	7635	10	St, Sc, Cu
*RS-012	02	07	29	09	90.02	-0.28	1007.8	26.5	86	214	2.8	28.1	24235	10	Cu, Cb, As
*RS-013	02	07	29	12	90.02	-0.85	1006.9	26.4	79	215	1.4	32.4	23342	10	St, Cu
*RS-014	02	07	29	15	90.07	-1.61	1007.6	27.0	75	110	1.8	41.7	21783	10	Unknown
*RS-015	02	07	29	18	90.06	-1.62	1008.9	27.3	71	107	0.1	28.0	24300	10	Cu, Ac
RS-016	02	07	29	21	90.08	-1.60	1006.2	27.2	77	161	3.7	38.4	22255	10	Ac
RS-017	02	07	30	00	90.09	-1.62	1006.2	27.3	75	144	1.2	38.3	22278	8	Cu, Ac, As
RS-018	02	07	30	03	90.08	-1.64	1008.0	27.8	76	179	1.0	25.0	25016	9	Cu, Cb, Ac, As
RS-019	02	07	30	06	90.06	-1.60	1007.2	27.8	75	177	4.2	23.1	25533	6	Cu, Cb, Ac, Ci
RS-020	02	07	30	09	89.99	-1.74	1004.2	28.3	70	137	2.5	27.6	24383	7	Ac, As
RS-021	02	07	30	12	90.00	-2.00	1005.0	27.6	78	165	4.1	31.9	23459	8	Cu, Cb, As, Ci
RS-022	02	07	30	15	89.99	-1.70	1006.6	27.9	78	162	2.2	29.1	24070	0	
RS-023	02	07	30	18	89.97	-1.72	1006.9	27.9	74	149	0.3	42.0	21752	10	Unknown
RS-024	02	07	30	21	89.97	-1.73	1005.6	27.4	77	230	3.9	40.1	22022	10	Sc
RS-025	02	07	31	00	90.00	-1.67	1004.2	25.8	85	201	10.3	34.4	22979	9	Unknown
RS-026	02	07	31	06	89.99	-2.02	1006.2	27.5	82	210	8.2	24.8	25072	10	Cu, As
RS-027	02	07	31	12	90.01	-3.01	1004.8	27.5	82	227	7.7	44.6	21365	10	Cu, Cb, Ac
RS-028	02	07	31	18	90.00	-4.00	1007.1	27.4	78	190	1.3	29.7	23936	10	Unknown
RS-029	02	08	01	00	90.00	-4.99	1006.2	22.9	92	328	5.0	165.4	13604	10	Cu, Cb, Ac, As
RS-030	02	08	01	06	91.00	-4.99	1006.2	25.5	93	161	8.5	20.1	26475	10	As
RS-031	02	08	01	12	92.00	-4.99	1006.4	26.4	89	80	11.8	556.7	4995	10	Cu, As
RS-032	02	08	01	18	93.00	-5.00	1007.9	26.5	86	83	11.3	34.1	23050	10	Unknown
RS-033	02	08	02	00	94.00	-5.00	1006.2	27.3	79	60	6.5	36.0	22664	9	Cu, Ac, As
RS-034	02	08	02	06	94.97	-5.06	1007.2	28.0	80	45	5.8	25.2	25016	8	Cu, Cb, Ac
RS-035	02	08	02	12	94.99	-5.34	1006.2	28.0	76	30	5.4	36.3	22653	5	Cu, Ac
RS-036	02	08	02	18	95.02	-4.93	1008.1	28.1	75	24	5.0	1008.1	18	1	Ac
RS-037	02	08	03	00	94.99	-4.98	1007.2	27.9	77	30	5.3	24.7	25042	6	Cu, Cb, Ci, Cs
RS-038	02	08	03	03	95.00	-4.99	1008.2	28.8	76	30	3.0	33.6	23117	3	Cu
RS-039	02	08	03	06	95.28	-5.10	1008.3	28.3	77	84	4.4	90.7	17079	7	Cu, Cb, Ac
RS-040	02	08	03	09	96.01	-5.32	1007.2	27.5	78	84	5.0	23.4	25351	8	Cu, Cb, As
RS-041	02	08	03	12	96.76	-5.58	1007.6	27.9	71	40	1.5	25.6	24821	6	Sc, Cb, Ac
RS-042	02	08	03	15	97.48	-5.84	1010.0	28.0	74	56	3.6	47.3	21009	1	Unknown
RS-043	02	08	03	18	98.14	-6.07	1009.5	27.3	79	102	5.3	51.1	20520	1	Cu
*RS-044	02	08	03	21	98.88	-6.36	1008.3	27.7	73	95	7.5	33.8	23038	1	Cu
*RS-045	02	08	04	00	99.60	-6.63	1009.2	24.5	89	170	9.2	22.1	25725	10	Cu, Cb, As
RS-046	02	08	04	03	100.21	-6.80	1011.1	28.4	75	127	11.4	42.9	21619	7	Sc, Ac
RS-047	02	08	04	06	100.84	-7.04	1010.2	28.0	75	127	10.5	26.8	24555	8	Cu, As
RS-048	02	08	04	09	101.56	-7.30	1008.2	27.9	71	136	10.0	29.5	23938	—	Unknown
RS-049	02	08	04	12	102.11	-7.49	1009.4	27.4	72	120	10.9	33.1	23204	8	Sc, Cu
RS-050	02	08	04	15	102.77	-7.71	1011.1	27.0	71	129	9.5	25.8	24784	3	Cu
RS-051	02	08	04	18	103.35	-7.93	1011.5	26.5	67	132	9.6	30.4	23758	1	Cu
RS-052	02	08	04	21	103.99	-8.14	1010.9	26.3	69	125	10.9	33.0	23240	2	Cu
RS-053	02	08	05	00	104.59	-8.36	1010.2	26.4	70	124	12.1	41.2	21818	5	Cu, Cb, Ci
RS-054	02	08	05	06	105.91	-8.83	1010.2	26.4	72	116	10.6	20.7	26172	3	Cu, Ac
RS-055	02	08	05	12	107.17	-9.26	1010.8	26.3	68	107	9.0	29.3	23980	2	Cu
RS-056	02	08	05	18	108.49	-9.73	1011.8	26.3	70	109	11.2	40.6	21941	1	Cu
RS-057	02	08	06	00	109.84	-10.19	1011.2	25.7	69	100	9.1	34.8	22860	3	Cu
RS-058	02	08	14	00	131.93	12.64	1004.2	25.4	94	305	4.0	49.7	20757	10	Cu, Cb, As
RS-059	02	08	14	06	132.52	14.07	1001.2	26.2	97	208	4.8	24.4	25172	8	Cu, Cb, As
RS-060	02	08	14	12	133.15	15.55	1002.6	28.9	77	95	6.1	80.7	17863	8	Cu, Ac, As
RS-061	02	08	14	18	133.80	17.02	1001.2	28.6	77	94	4.2	110.1	16043	—	Unknown
RS-062	02	08	15	00	134.39	18.40	1003.2	28.8	75	60	4.9	39.4	22203	3	Cu, Ci

*: Calibrated with Vaisala Ground Check Kit GC23

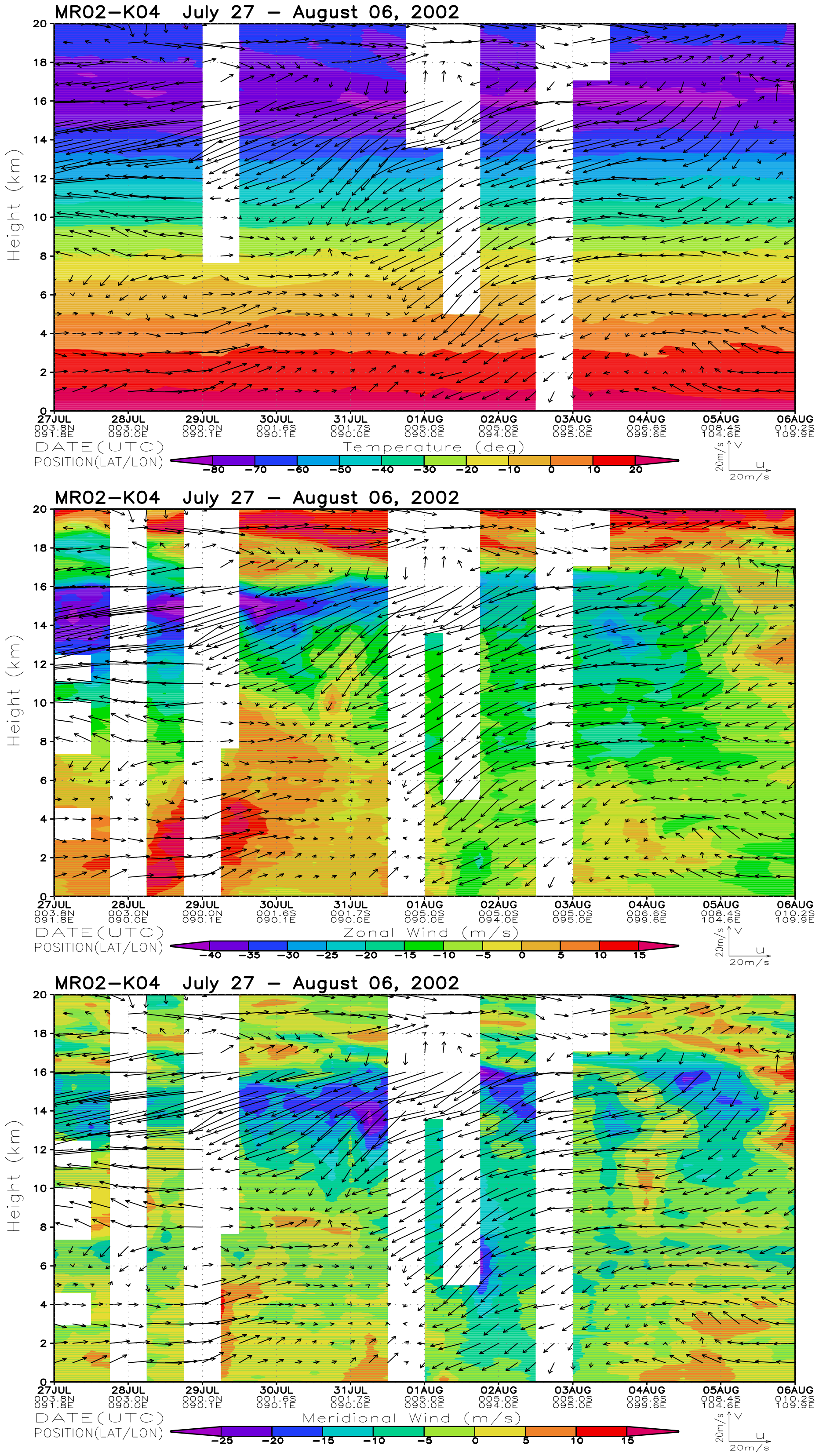


Fig. 7.7-2 Time-height cross sections of temperature (upper panel), zonal wind component (middle panel), and meridional wind component (lower panel), respectively.

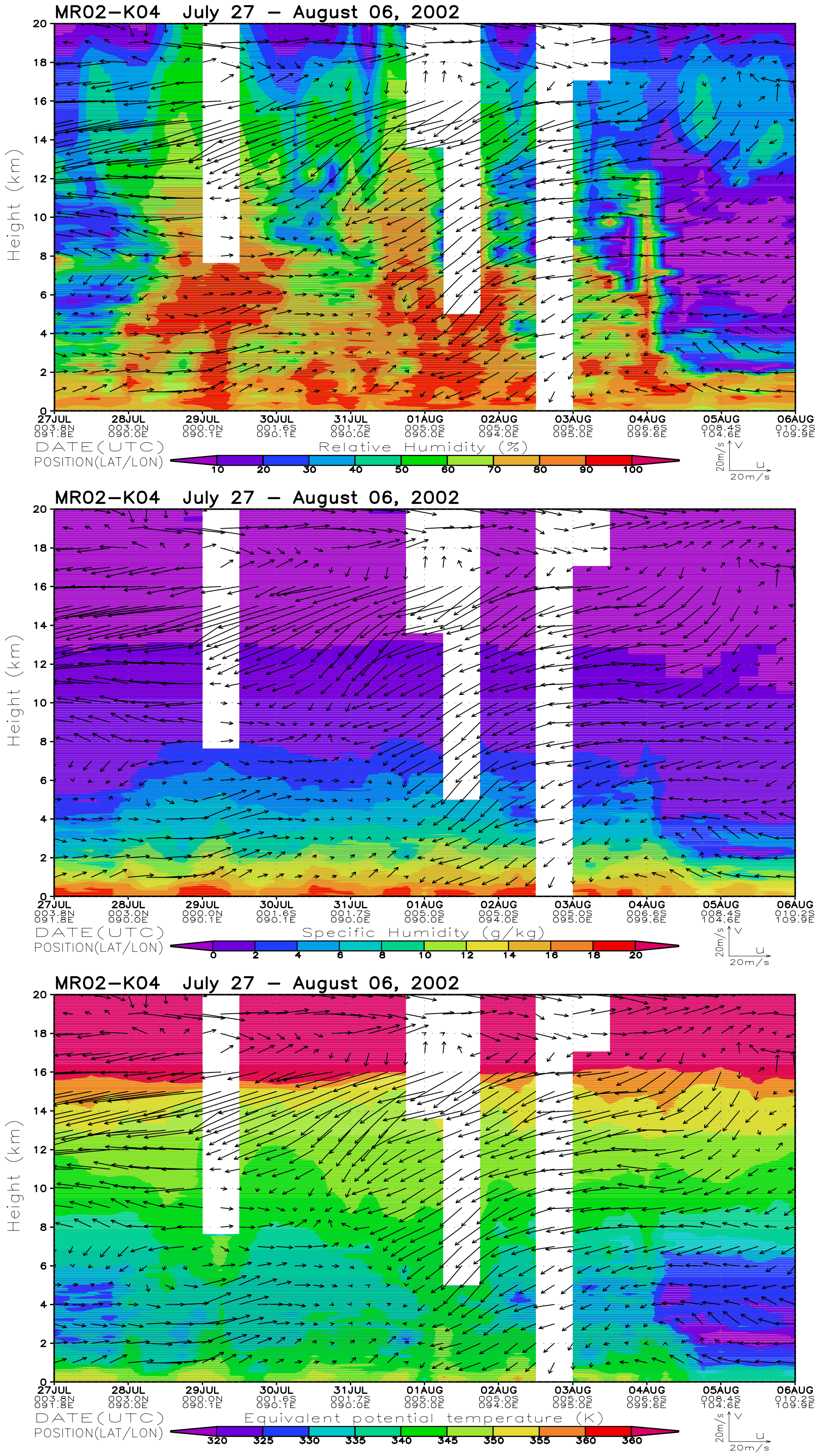


Fig. 7.7-2 (continued) Time-height cross sections of relative humidity (upper panel), specific humidity (middle panel), and equivalent potential temperature (lower panel), respectively.

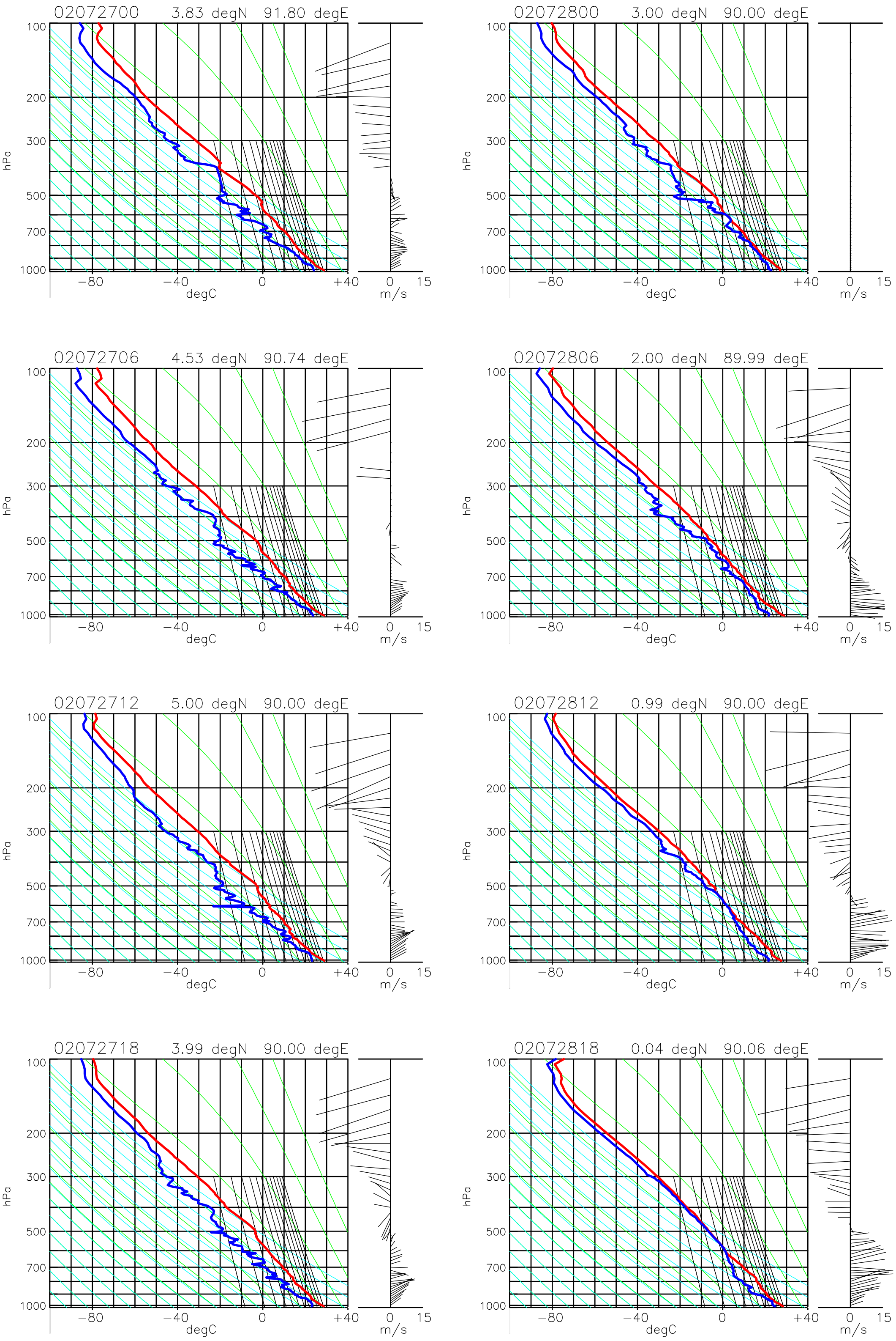


Fig. 7.7-3 Vertical profiles of temperature (red line) and dew-point temperature (blue line), respectively, described on the emagram. Wind direction and speed are indicated by vector on the right hand of each panel.

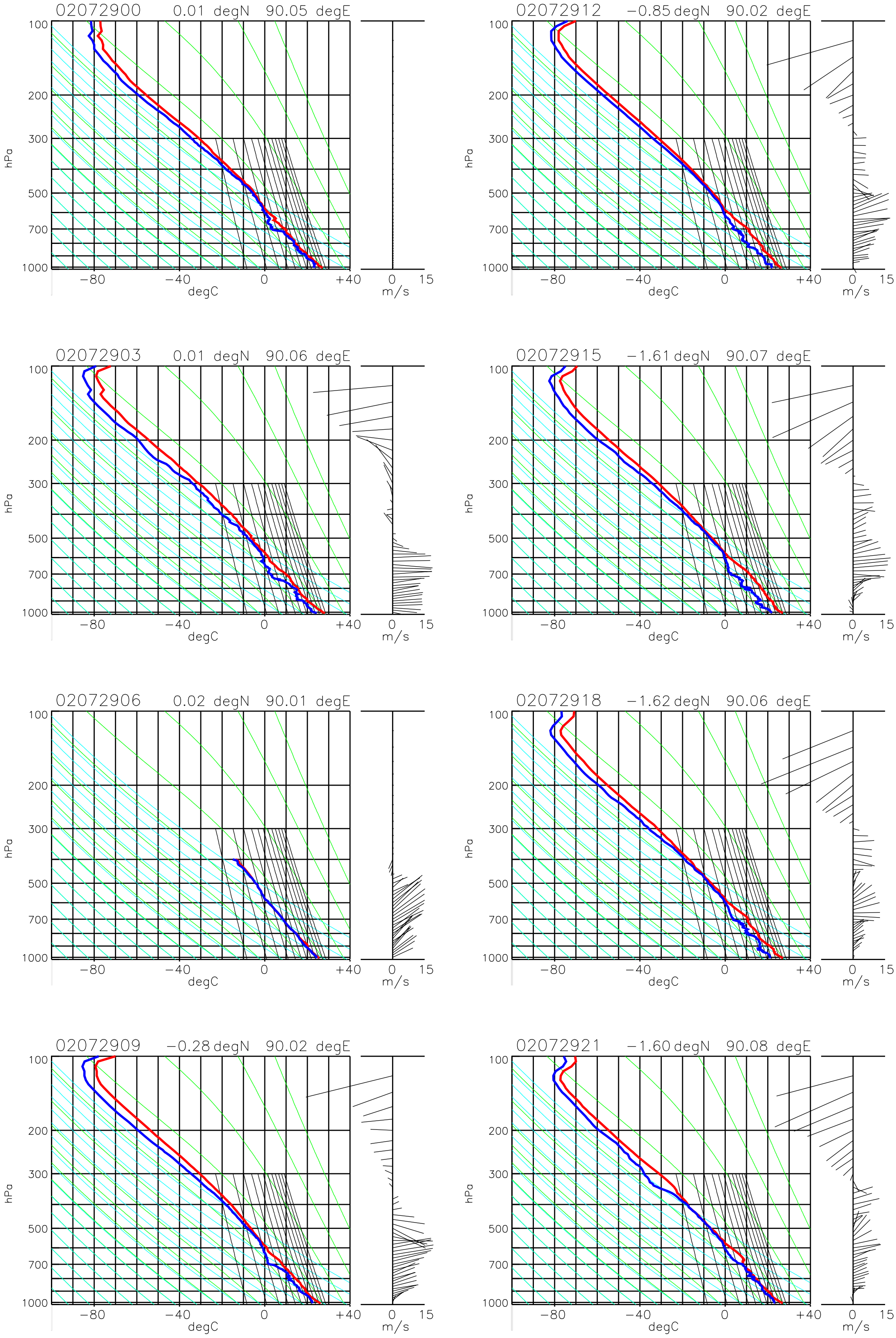


Fig. 7.7-3 (continued)

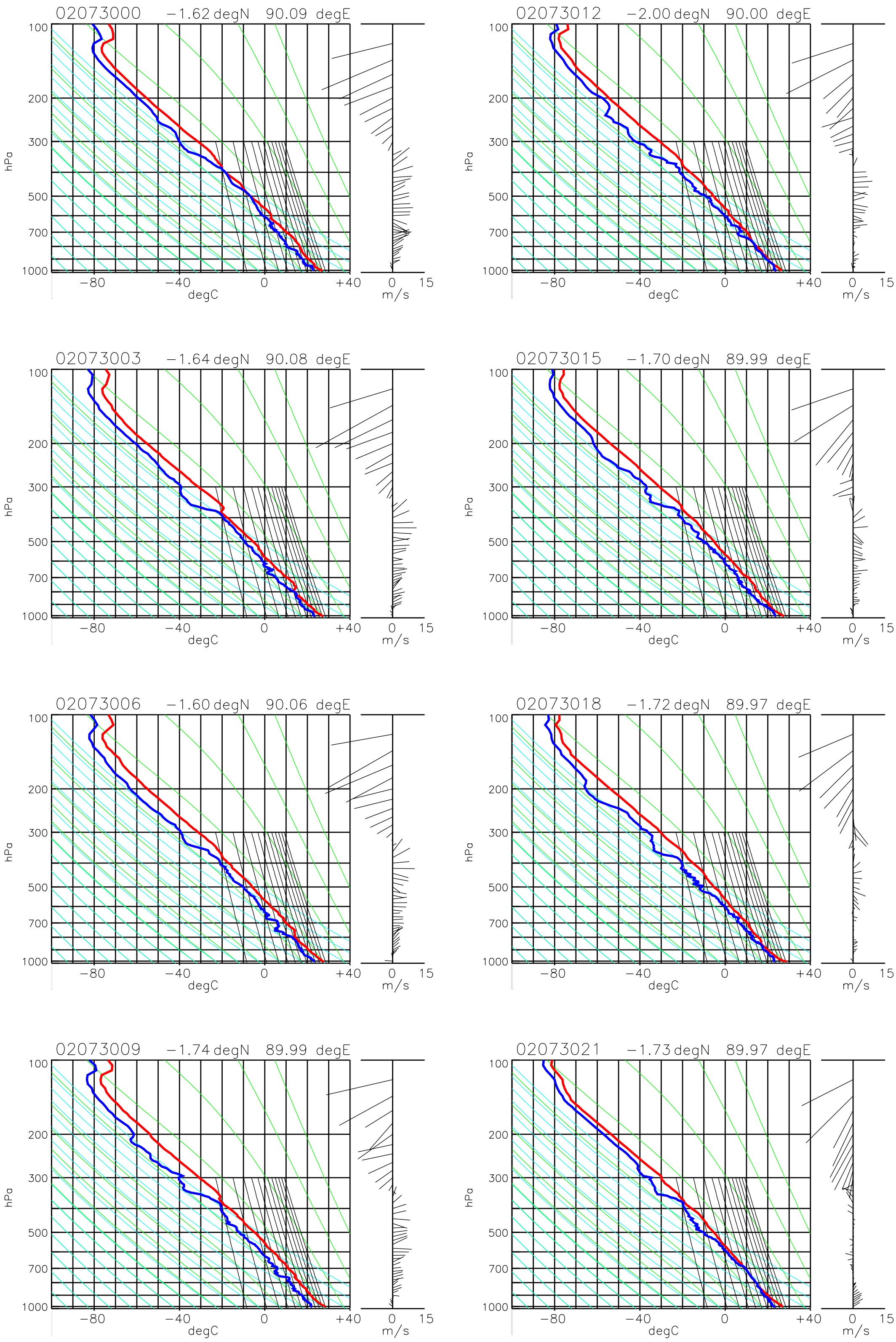


Fig. 7.7-3 (continued)

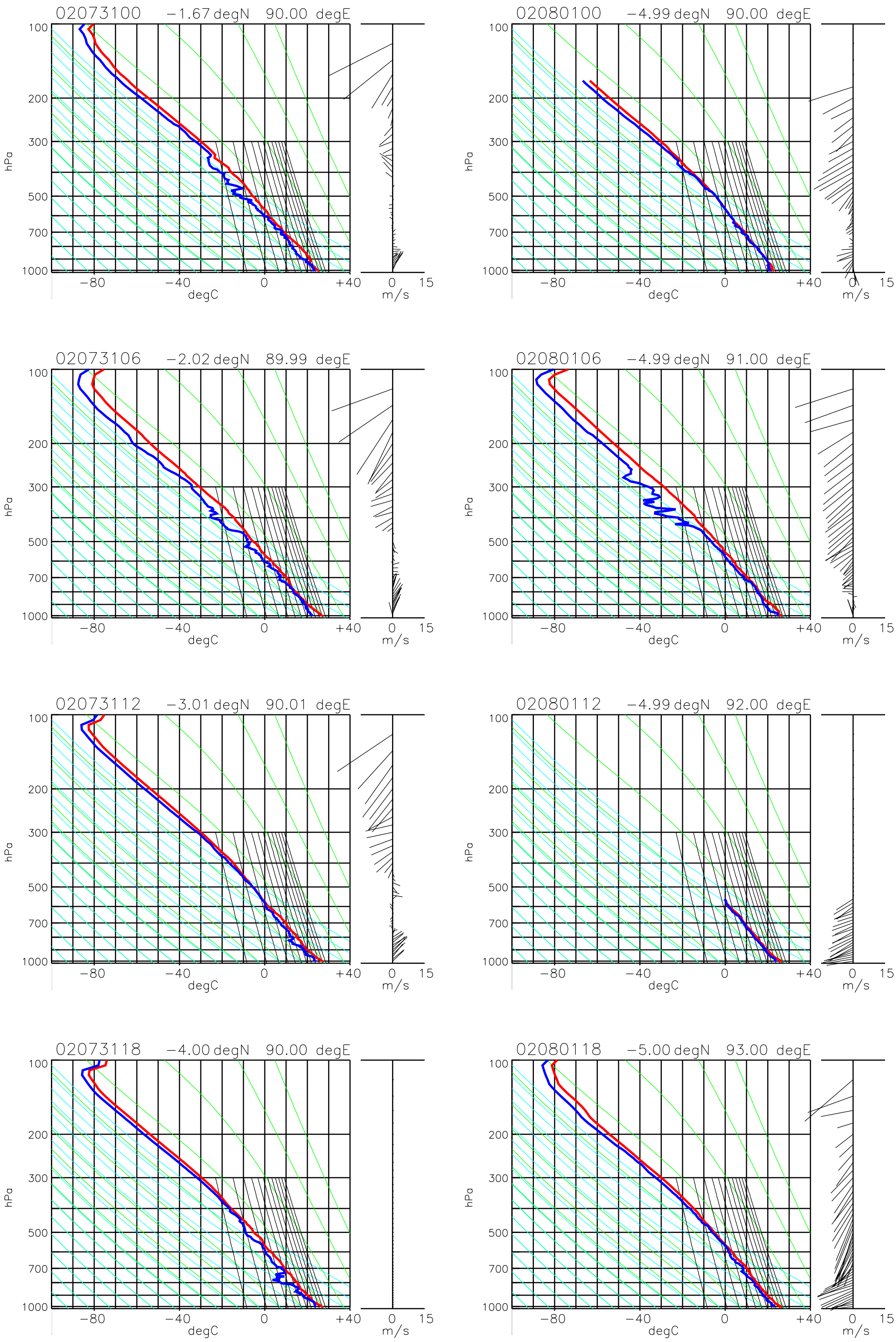


Fig. 7.7-3 (continued)

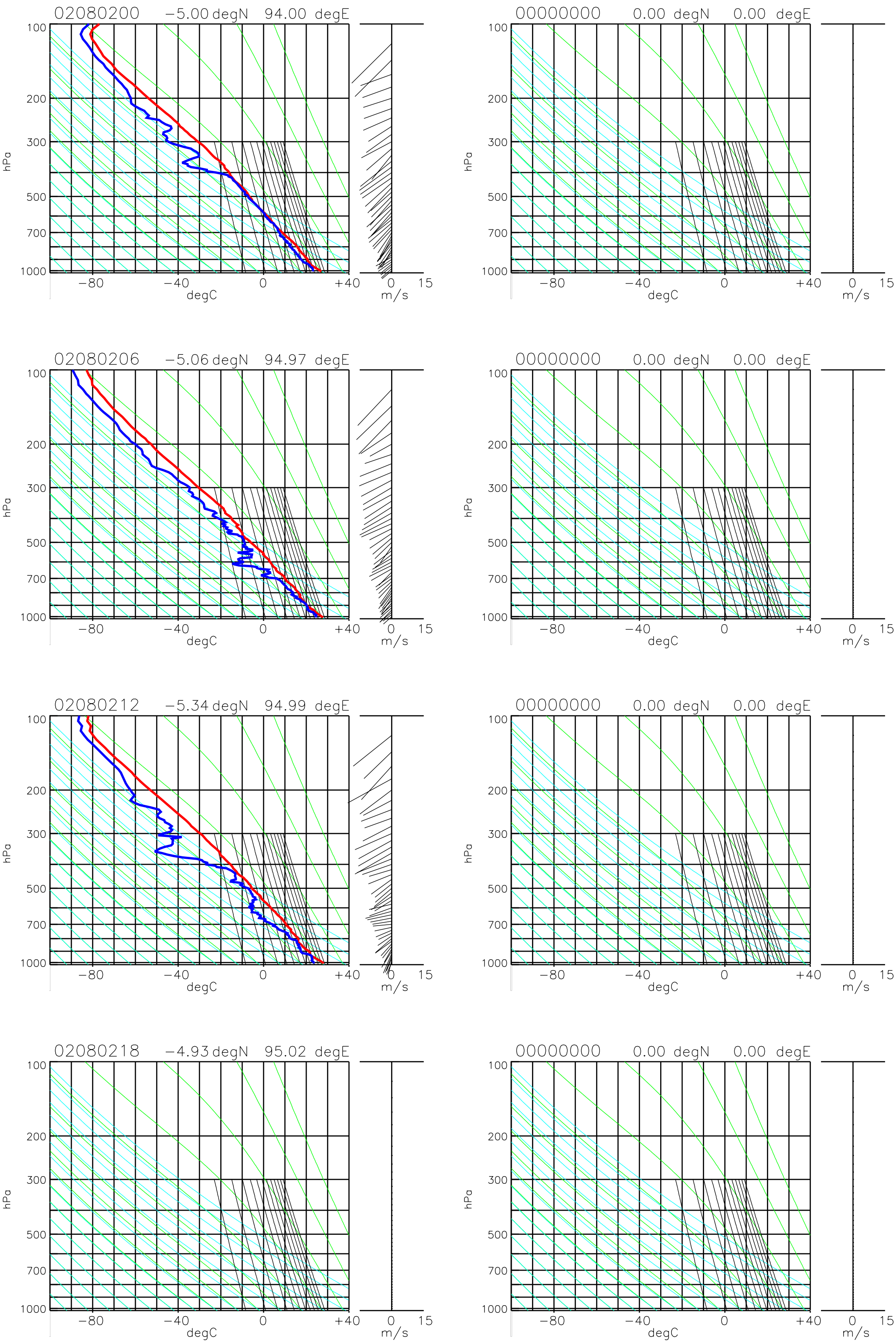


Fig. 7.7-3 (continued)

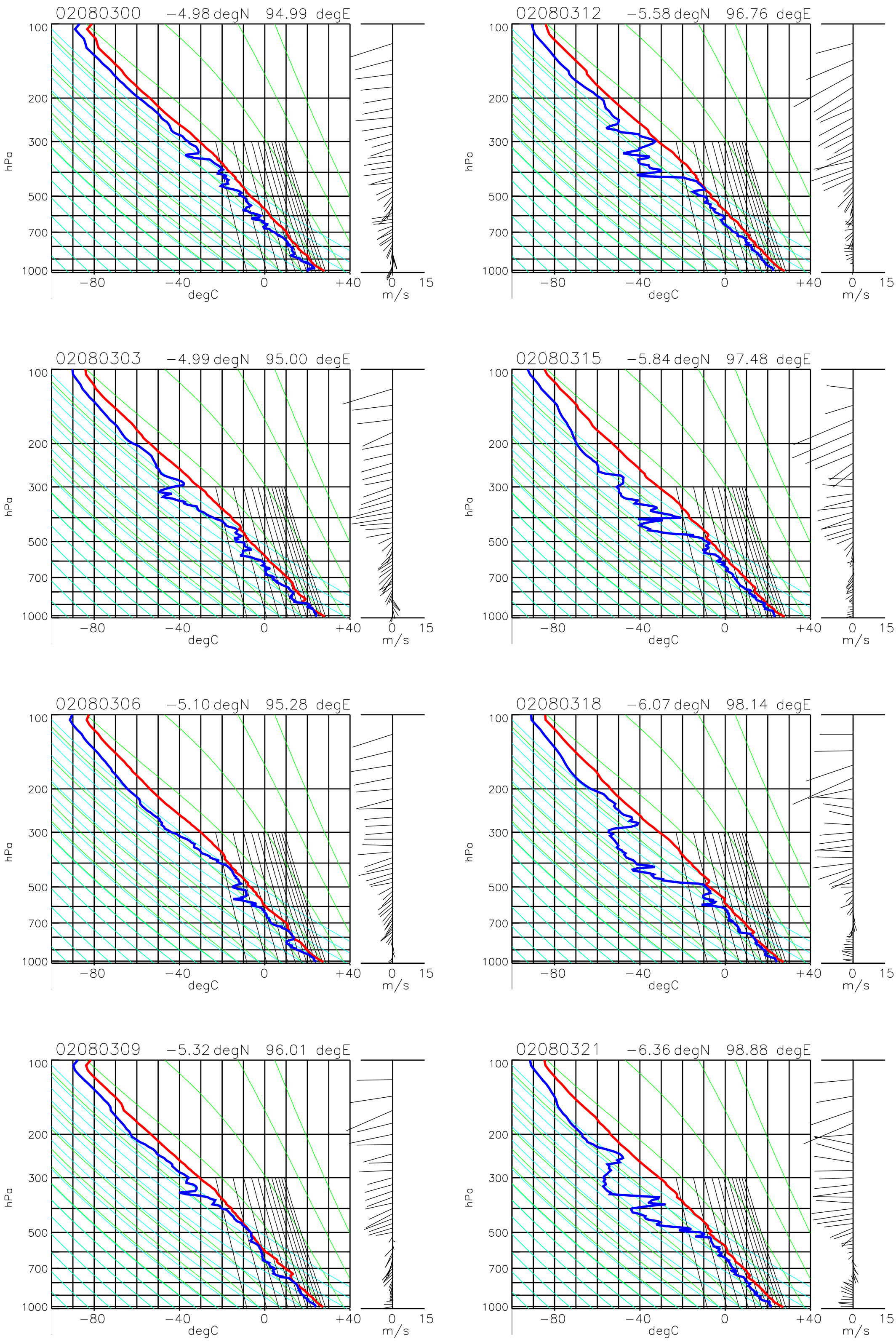


Fig. 7.7-3 (continued)

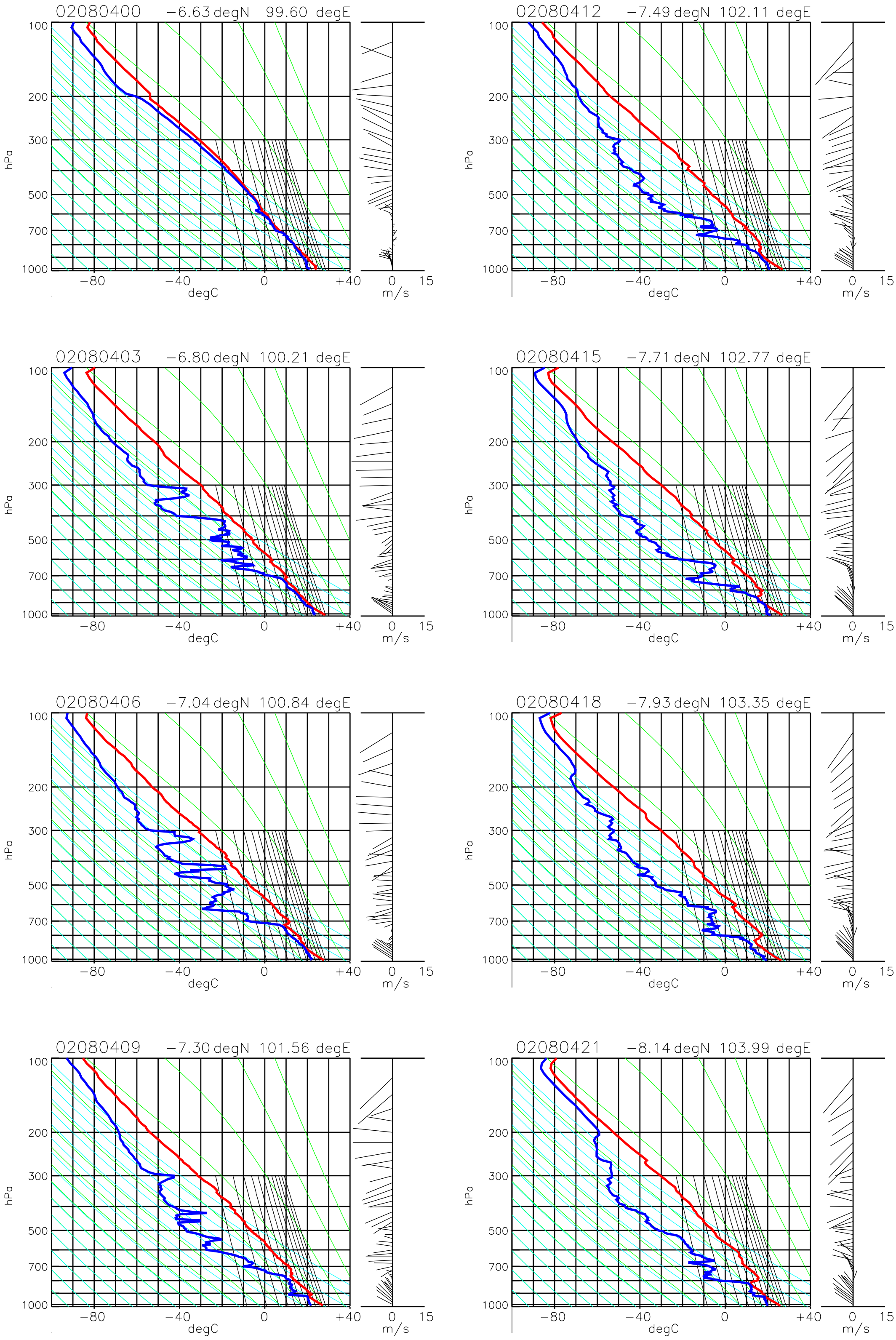


Fig. 7.7-3 (continued)

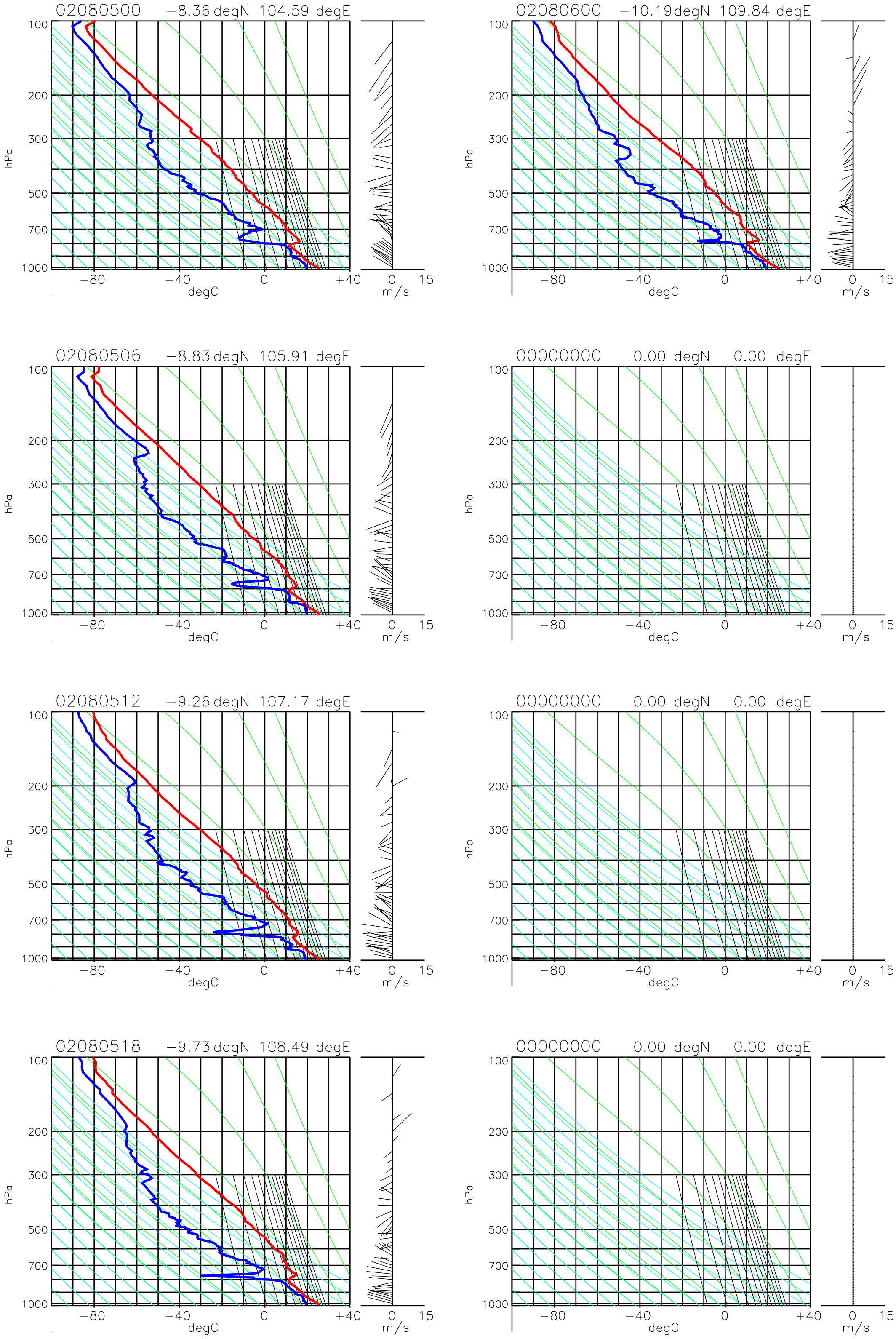


Fig. 7.7-3 (continued)

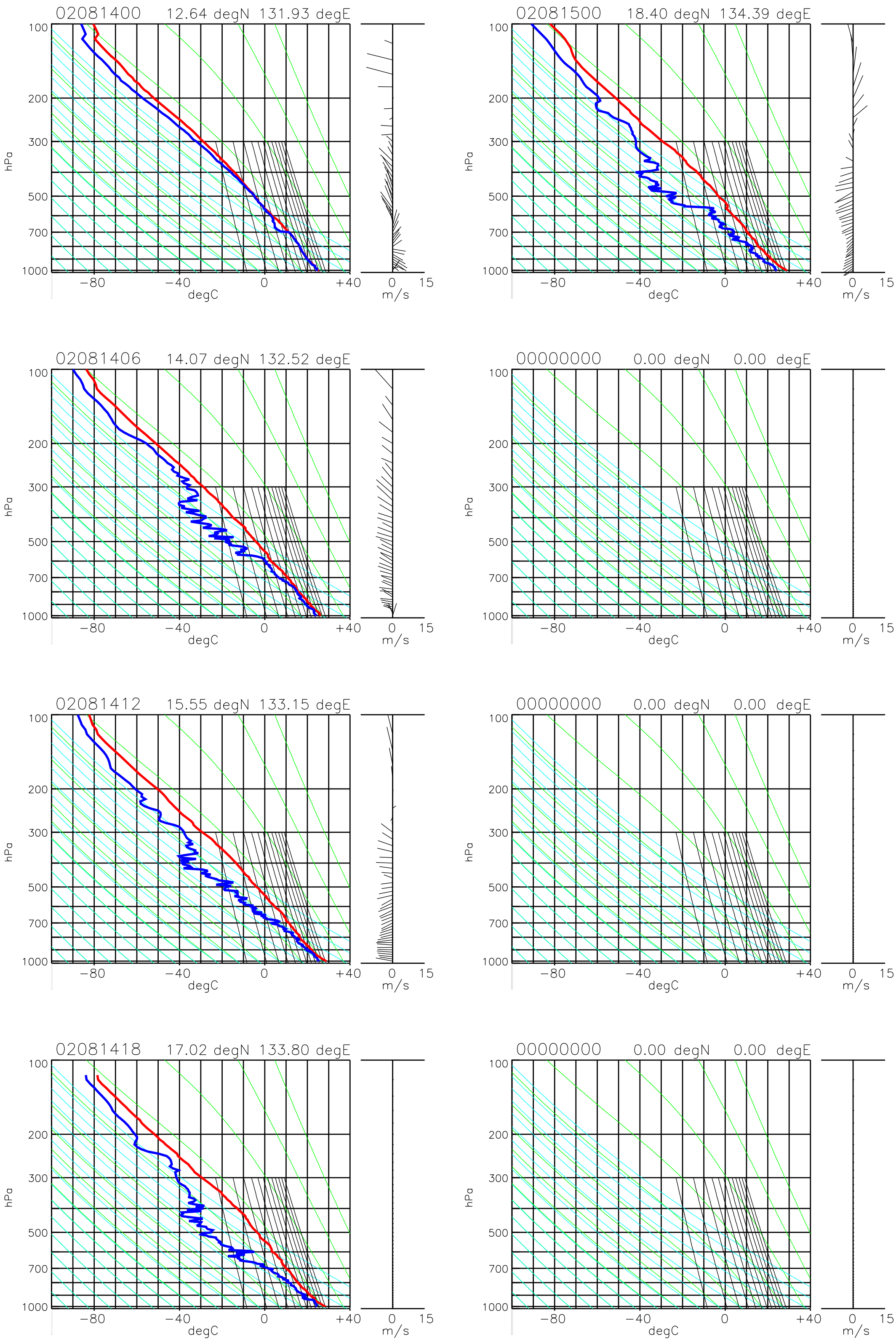


Fig. 7.7-3 (continued)

7.8 Observation of Rainfall Drop Size Distribution

(1) Personnel

Shuichi Mori (FORSGC): Principal Investigator

Yasutaka Imai (GODI)

Shin-Ya Iwamida (GODI)

Wataru Tokunaga (GODI)

(2) Objective

Rainfall Drop Size Distribution (DSD) data is obtained to study rainfall characteristics, that vary with its originated precipitating cloud system, i.e., clouds type (convective and stratiform) and development stage of precipitating clouds system (developing, mature, and dissipating). Both temporal and spatial variations of DSD characteristics are also interested over the Indian Ocean during the Indian monsoon season.

(3) Method

A Joss type disdrometer (Distromet RD-80) is installed over the Compass Deck of the vessel, with an optical rain gauge (Sato Keiryoki Mfg. Co., Ltd. No. 7980-S-43) for calibration of rainfall amount. The range of drop diameters that can be measured spans from 0.3 mm to 5 mm. DSD data are collected then recorded every one minute with 20 drop size classes.

(4) Preliminary results

Continuous observation of DSD has been carried out, however, we found the data were contaminated with noise caused by both vibration of vessel body and strong wind over the deck in the cruise. The detailed analyses with other obtained datasets are in future work because the data have to be examined with quality check after the cruise.

(5) Data archive

Original samples will be preserved at Frontier Observational Research System for Global Change (FORSGC). Both inventory information and analyzed dataset will be submitted to JAMSTEC Data Management Office (DMO).