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R/V Mirai Cruise Report
MR01-K01
(Leg 1 – 2)

February 14 – March 23, 2001
Tropical Ocean Climate Study (TOCS)

Edited by
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Japan Marine Science and Technology Center
(JAMSTEC)

MR01-K01 TRITON/TOCS CRUISE

Feb. 14 – Mar. 23, 2001

Sekinehama – Hachinohe – Guam – Yokosuka

Contents

1. Cruise name and Code

Cruise name: Tropical Ocean Climate Study

Cruise Code: MR01-K01

Under taking institute: Japan Marine Science and Technology Center (JAMSTEC)

2-15, Natsushima, Yokosuka, 237, Japan

Ship: R/V Mirai

Captain: Masaharu Akamine

2. Introduction and observation summary

2.1. Introduction

The purpose of this cruise 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 global climate change. The surface layer in the western tropical Pacific Ocean is characterized by high sea surface temperature area, which plays major role in driving global atmospheric circulation. Especially, 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 small rainfall when the "El Nino" occurred, as in 1997-98. This atmospheric and oceanic system is so complicated and interacted each other, and we still do not have enough knowledge about it. This climate system has the long time scale. To investigate the mechanism, we need precise and detailed data for the long period continuously. 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 by JAMSTEC for the long term measurements of ocean and atmosphere in the western tropical Pacific Ocean.

The other purposes of this cruise are,

1) CO_2 measurements in the boundary layer by Meteorological Research Institute of Japan,

2) Lidar backscatter measurements of lower atmosphere by National Institute of Environment of Japan, Tohoku Institute of Technology and CRI,

3) ARGO floats launching, and evaluation experiment of ARGO sensors by free-rising profiler,

4) Surface meteorological measurement, underway geophysical measurements, and

5) Validation experiment for ocean lidar system. These measurements and experiments are also made successfully during this cruise.

2.2. Overview

TRITON buoys deployment:	8 sites
TRITON buoys recovery:	6 sites
TRITON buoy repair:	2 sites
ADCP subsurface buoy deployment:	1 site
ADCP subsurface buoy recovery:	1site
CTD (Salinity, Temperature, Depth):	14 casts down to 1000m
XCTD (Salinity, Temperature, Depth):	43 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. All observations are described in details in this report.

2.3. Observation summary

This MR01-K01 cruise has been carried out after the historical 1997-1998 El Nino and followed 1998-2000 La Nina events. The vertical section of temperature along the 156E line by CTD and XCTD showed that the sea surface temperature (SST) was more than 29 degree-C in almost casts, and the depth of 20 degree-C was around 200 meters and deep between 5 N and 5 S. Compared with the same vertical section in MR00-K02, SST became little bit higher than in March 2000, especially between 2 N and 2S, suggesting the oceanic condition returned (or is returning) to the normal condition after the La Nina. Actually, the equatorial upwelling during this cruise suggested by temperature contour showed weaker upwelling than in MR00-K02. The vertical section of salinity showed the surface strong meridional front down to 100 meters between 2N and 5N, changing the salinity from 35.4 at 2N to 34.5 at 5N. On the equator, the strong meridional front was found, too. Compared with the same vertical section in MR00-K02, the surface salinity showed from 35.3 at 2N to 34.2 at 5N. The comparison of salinity section in two cruises showed large changes which cannot be found in the temperature section, and maybe showing clearer signal of inter-annual phenomena in this area.

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

3.1. Periods

February 14, 2001 – March 23, 2001

3.2. Ports of call

Sekinehama, Japan (February 14, 2001)

Hachinohe, Japan (February 15, 2001)

Guam, USA (March 17-18, 2001)

Yokosuka, Japan (March 23, 2001)

3.3. Cruise Log

February 14 (Wed.)

14:00 Departure from Sekine-hama (Japan)

14:30-15:00 Boat drill

15:00-16:00 Instruction for safety life on Mirai

16:45-17:00 Konpira-San ceremony

February 15 (Th.)

08:00 Arrival at Hachinohe (Japan)

Immigration

13:30 Departure from Hachinohe

15:00-16:00 Meeting for this cruise

18:00 all continuous observations start

February 16 (Fri.)

00:26 XCTD01 (38-19.96N, 143-03.39E)

01:52 XCTD02 (38-00.00N, 143-12.30E)

03:52 XCTD03 (37-39.97N, 143-23.55E)

05:43 XCTD04 (37-21.56N, 143-34.59E)

06:03 Float01 (37-20.13N, 143-35.25E)

07:47 XCTD05 (36-59.89N, 143-43.98E)

09:09 XCTD06 (36-41.68N, 143-51.19E)

09:23-09:43 CTD01 (36-39.84N, 143-52.19E)

10:48 Float02 (36-40.14N, 143-55.32E)

12:36 XCTD07 (36-18.40N, 144-04.66E)

13:57 XCTD08 (36-00.91N, 144-12.18E)

14:05 Float03 (35-59.81N, 144-13.36E)

15:38 XCTD09 (35-40.35N, 144-22.45E)

17:02 XCTD10 (35-20.82N, 144-31.75E)

17:09 Float04 (35-19.92N, 144-32.22E)

18:35 XCTD11 (34-59.89N, 144-41.15E)

19:50 XCTD12 (34-40.74N, 144-49.09E)

20:02 Float05 (34-38.81N, 144-49.84E)

21:15 XCTD13 (34-19.99N, 144-56.96E)

22:29 XCTD14 (33-59.96N, 144-59.72E)

22:38 Float06 (33-58.21N, 145-00.05E)

22:55 XCTD15 (33-39.99N, 145-10.22E)

February 17 (Sat.)

01:34 XCTD16 (33-20.97N, 145-27.55E)

01:43 Float07 (33-20.09N, 145-28.62E)

03:18 XCTD17 (33-00.01N, 145-38.14E)

04:42 XCTD18 (32-40.90N, 145-47.00E)

04:50 Float08 (32-39.83N, 145-47.56E)

06:17 XCTD19 (32-19.71N, 145-55.95E)

07:40 XCTD20 (32-01.08N, 146-04.96E)

07:48 Float09 (31-59.82N, 146-05.49E)

09:58 XCTD21 (31-30.05N, 146-18.29E)

12:03 XCTD22 (31-01.55N, 146-30.99E)

12:12 CTD02 (31-00.28N, 146-31.82E)

14:13 Float10 (31-00.28N, 146-30.09E)

16:38 XCTD23 (30-29.94N, 146-44.72E)

18:48 XCTD24 (30-01.01N, 146-58.22E)

18:54 Float11 (30-00.26N, 146-58.62E)

21:08 XCTD25 (29-30.00N, 147-11.75E)

23:07 XCTD26 (29-01.90N, 147-24.34E)

23:27-01:09 CTD03 (29-00.33N, 147-25.15E)

February 18 (Sun.)

01:14 Float12 (28-59.77N, 147-25.61E)

03:25 XCTD27 (28-30.01N, 147-38.18E)

05:33 XCTD28 (28-00.01N, 147-51.34E)

05:39 Float13 (27-59.29N, 147-51.84E)

07:39 XCTD29 (27-31.56N, 148-04.87E)

07:50 CTD04 (27-30.10N, 148-05.12E)

11:40 XCTD30 (27-00.32N, 148-16.98E)

13:47 XCTD31 (26-30.01N, 148-30.38E)

15:53 XCTD32 (26-00.14N, 148-43.12E)

February 19 (Mon.)-21(Wed.)

Cruising towards 8N156E

February 22 (Th.)

08:55-13:13 Deployment of the 8N156E TRITON buoy

13:53-14:30 CTD05 (8-01.18N, 155-58.75E)

February 23 (Fri.)

07:56-11:50 Recovery of the 8N156E TRTION buoy (old buoy)

16:03 XCTD33 (6-59.99N, 155-59.53E)

20:02 XCTD34 (5-59.82N, 156-01.90E)

February 24 (Sat.)

08:52-17:22 Deployment of the 5N156E TRITON buoy

17:54-18:31 CTD06 (4-59.51N, 156-01.05E)

February 25 (Sun.)

07:51-11:21 Recovery of the 5N156E TRITON buoy (old buoy)

15:22 XCTD35 (3-59.97N, 156-00.27E)

19:18 XCTD36 (2-59.71N, 155-55.88E)

February 26 (Mon.)

08:49-12:06 Deployment of the 2N156E TRITON buoy

13:26-14:02 CTD07 (2-03.27N, 156-01.07E)

15:07-15:43 CTD08 (1-57.59N, 155-51.98E)

15:48-16:10 Measurement of the anchor position of the old 2N156E TRITON buoy

16:20-17:06 Calibration of the three component magnetometer

February 27 (Tue.)

07:55-10:45 Recovery of the 2N156E TRITON buoy (old)

12:58-14:13 Acoustic releaser test (1-25.29N, 155-55.09E)

14:36-14:54 ARGO sensor free-rising profile test (1-22.68N, 155-58.00E)

16:42 XCTD37 (0-59.71N, 155-58.91E)

February 28 (Wed.)

07:58-09:18 Recovery of the ADCP mooring at 0N156E

10:05-11:27 ARGO sensor free-rising profile test (0-01.13N, 156-12.82E)

13:02-14:21 Deployment of the ADCP mooring at 0N156E

March 1 (Th.)

Day off

March 2 (Fri.)

08:51-12:04 Deployment of the 0N156E TRITON buoy

13:37-14:11 CTD09 (0-00.10N, 155-57.30E)

15:00 Measurement of the anchor position of the 0N156E TRITON buoy

March 3 (Sat.)

07:51-10:27 Recovery of the 0N156E TRITON buoy (old)

14:20 XCTD38 (1-00.07S, 155-53.03E)

March 4 (Sun.)

07:58-09:37 ARGO sensor free-rising profile test (1-30.19S, 155-55.64E)

10:12-11:33 Acoustic releaser test (1-30.07S, 155-53.95E)

13:27-15:08 ARGO sensor free-rising profile test (1-30.09S, 155-55.67E)

March 5 (Mon.)

08:53-11:21 Deployment of the 2S156E TRITON buoy

13:24-14:02 CTD10 (2-00.22S, 155-57.11E)

March 6 (Tue.)

07:49-10:06 Recovery of the 2S156E TRITON buoy

14:37 XCTD39 (3-00.01S, 155-58.68E)

18:38 XCTD40 (4-00.16S, 156-00.04E)

March 7 (Wed.)

08:53-10:55 Deployment of the 5S156E TRITON buoy

11:22-11:56 CTD11 (5-00.06S, 156-01.35E)

13:40-15:18 ARGO sensor free-rising profile test (5-00.04S, 156-24.11E)

March 8 (Th.)

07:52-10:01 Recovery of the 5S156E TRITON buoy (old)

13:04-14:38 ARGO sensor free-rising profile test (4-57.10S, 156-24.02E)

March 9 (Fri.)

08:32-11:30 ARGO sensor free-rising profile test (4-56.95S, 156-24.01E)

11:30-12:12 Calibration of the three components magnetron

March 10 (Sat.)

Cruising to the 2N156E TRITON buoy position.

March 11 (Sun.)

07:58-08:51 Replacement of the antenna on the 2N156E TRITON buoy

13:52-14:50 Replacement of the transmitter system on the 2N156E TRITON buoy

March 12 (Mon.)

Cruising to the 0N147E TRITON position

March 13 (Tue.)

07:55-09:15 Replacement of the wind sensor on the 0N147E TRITON

09:49-11:27 CTD12 (0-05.76N, 147-01.14E)

14:00-16:33 Releasers test at the planned depth

18:11 XCTD41 (1-00.03N, 147-12.18E)

March 14 (Wed.)

09:21-12:20 Deployment of the 2N147E TRITON

13:27-14:06 CTD13 (2-06.95N, 146-56.15E)

17:35 XCTD42 (3-00.02N, 146-58.36E)

21:27 XCTD43 (4-00.02N, 147-00.17E)

March 15 (Th.)

08:51-11:56 Deployment of the 5N147E TRITON

13:22-14:02 CTD14 (4-58.50N, 146-59.64E)

March 16 (Fri.)

Cruising to Guam

March 17 (Sat.)

09:00 Arrival to Guam

March 18 (Sun.)

09:00 Departure from Guam

11:30- Start Ocean-lidar system

13:00-13:18 Ocean particle and backscatter measurement profiler (100m)

March 19 (Mon.)

13:01-13:13 Ocean particle and backscatter measurement profiler (100m)

March 20 (Tue.)

13:01-13:15 Ocean particle and backscatter measurement profiler (100m)

March 21 (Wed.)

13:00-13:13 Ocean particle and backscatter measurement profiler (100m)

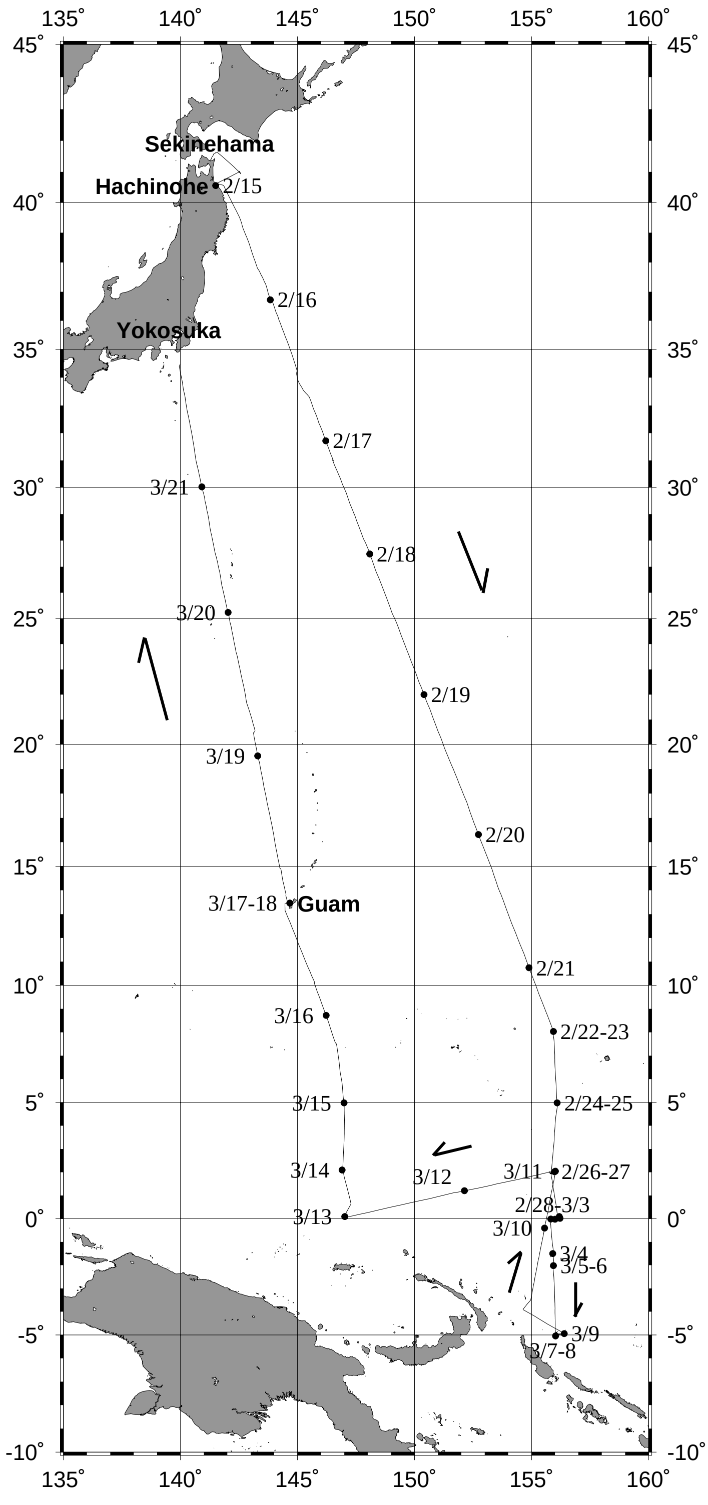
March 22 (Th.)

09:56-10:10 Ocean particle and backscatter measurement profiler (100m)

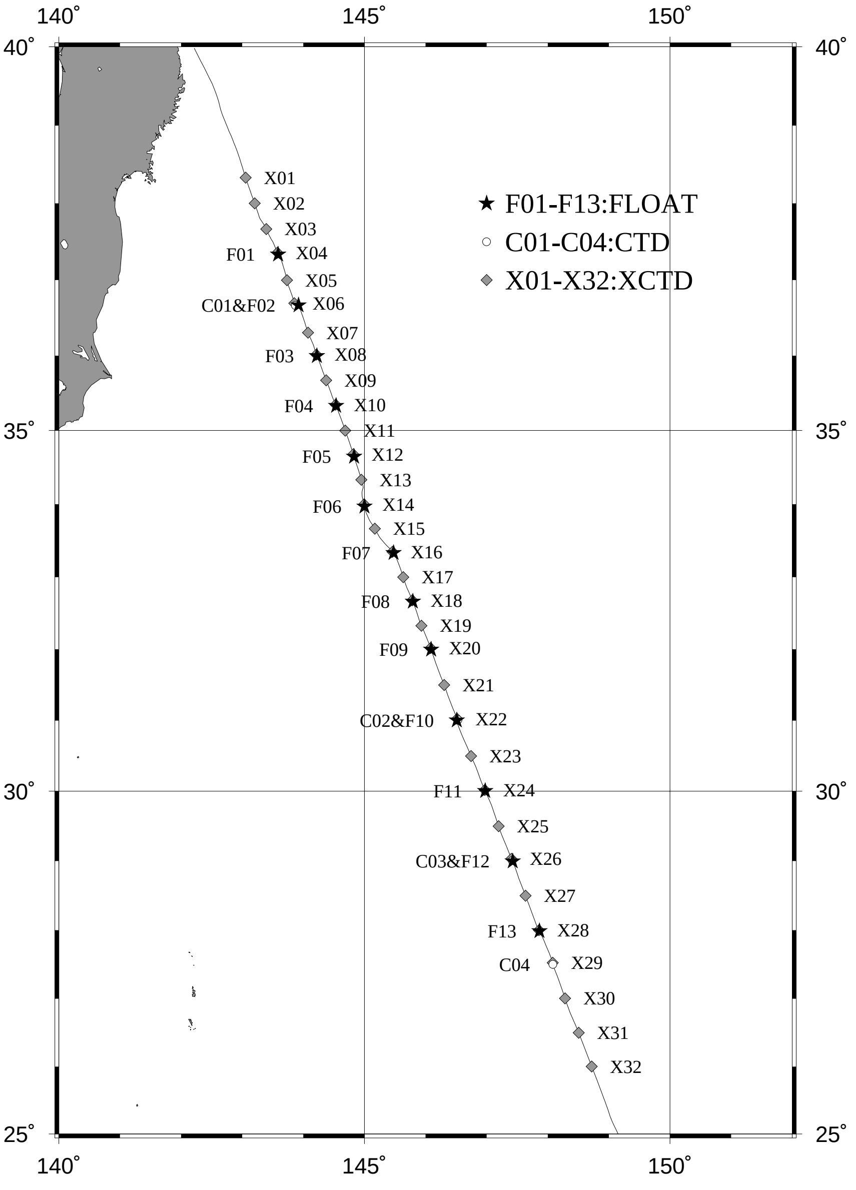
March 23 (Fri.)

09:00 Arrival to Yokosuka-shinko, and unloading all instruments and gears

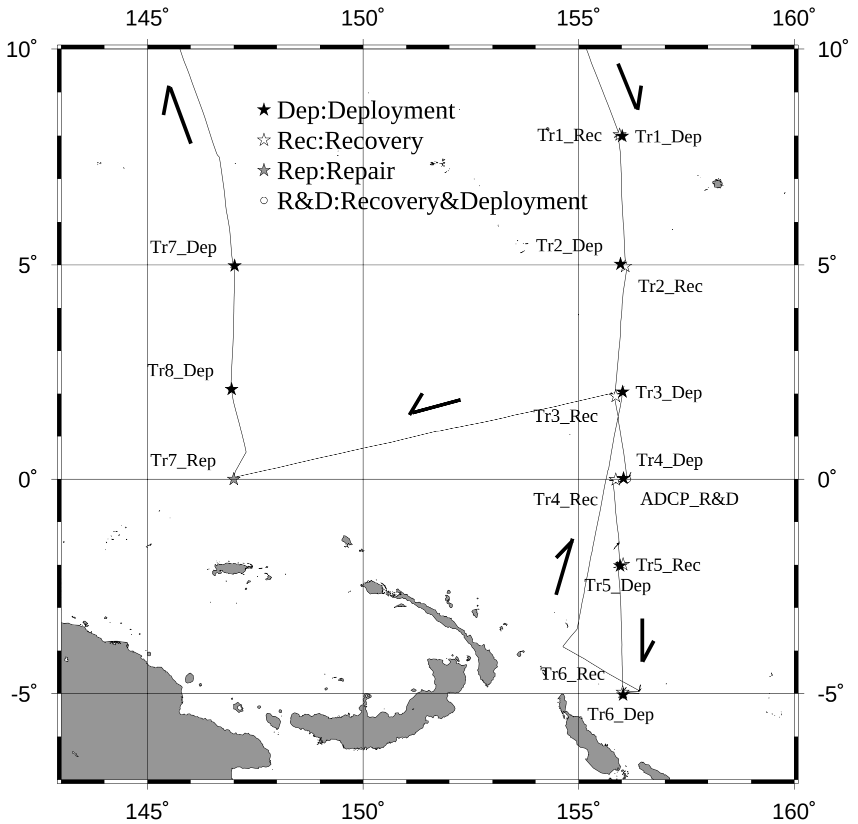
3.4 Cruise Track



MR01-K01 Curise Track

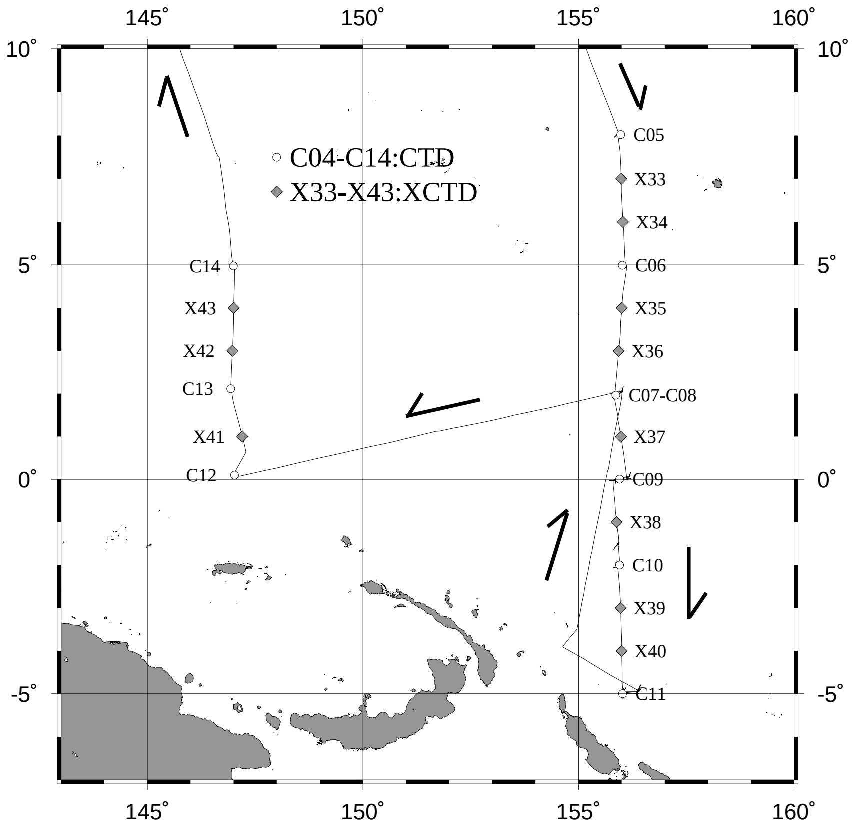


FLOAT & CTD & XCTD



145˚
150˚
155˚
160˚
10˚
5˚
0˚
-5˚
Dep:Deployment
Rec:Recovery
Rep:Repair
R&D:Recovery&Deployment
Tr1_Rec
Tr1_Dep
Tr2_Dep
Tr2_Rec
Tr7_Dep
Tr8_Dep
Tr7_Rep
Tr3_Dep
Tr3_Rec
Tr4_Dep
Tr4_Rec
ADCP_R&D
Tr5_Rec
Tr5_Dep
Tr6_Rec
Tr6_Dep

TRITON & ADCP


145˚
150˚
155˚
160˚
10˚
5˚
0˚
-5˚
C04-C14:CTD
X33-X43:XCTD
C05
X33
X34
C06
X35
X36
C07-C08
X37
C09
X38
C10
X39
X40
C11
C14
X43
X42
C13
X41
C12

CTD & XCTD

4. Chief scientist

Kentaro Ando
Researcher
Ocean Research Department
Japan Marine Science and Technology Center
2-15, Natsushima, Yokosuka, Kanagawa, Japan

5 Participants List

5.1 R/V MIRAI scientist and Technical staff

Name	Institute	On board
Kentaro Ando	JAMSTEC	Sekinehama-Yokosuka
Toru Nakamura	JAMSTEC	Sekinehama-Yokosuka
Takeshi Kawano	JAMSTEC	Guam- Yokosuka
Kasis Inape	NWS/PNG	Sekinehama-Guam
Motoki Miyazaki	FORSGC	Sekinehama-Yokosuka
Koichi Goto	KANSO	Sekinehama-Yokosuka
Osamu Takahashi	Tohoku Inst. of Tech.	Sekinehama-Yokosuka
Fumitaka Yoshiura	GODI	Sekinehama-Yokosuka
Wataru Tokunaga	GODI	Sekinehama-Yokosuka
Hirokatsu Uno	MWJ	Sekinehama-Guam
Takeo Matsumoto	MWJ	Sekinehama-Yokosuka
Asako Inoue	MWJ	Sekinehama-Guam
Hiroshi Matsunaga	MWJ	Sekinehama-Guam
Miki Yoshiike	MWJ	Sekinehama-Yokosuka
Kenichiro Sato	MWJ	Sekinehama-Yokosuka
Taeko Ohama	MWJ	Sekinehama-Guam
Kaori Akizawa	MWJ	Sekinehama-Guam
Kei Suminaga	MWJ	Sekinehama-Guam
Shigehiko Ohara	MWJ	Sekinehama-Guam
Masato Muranaka	MWJ	Sekinehama-Guam
Ai Yasuda	MWJ	Guam- Yokosuka
Keisuke Wataki	MWJ	Guam- Yokosuka

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Tohoku Institute of Technology
35-1, Yagiyamakasumicho, Taihaku-ku, Sendai 982-0831, JAPAN

Global Ocean Development Inc.(GODI)
3-65, Oppamahigashi-cho, Yokosuka 237-0063, JAPAN

Marine Works Japan Ltd.(MWJ)
1-1-7, Mutsuura, Kanazawa-ku, Yokohama 236-0031, JAPAN

5.2. R/V MIRAI Crew member

Master	Masaharu Akamine
Chief Officer	Yukio Dowaki
1st Officer	Hiroki Maruyama
2nd Officer	Haruhiko Inoue
3rd Officer	Takeshi Isohi
Chief Engineer	Akiteru Ono
1st Engineer	Nobuya Araki
2nd Engineer	Koji Masuno
3rd Engineer	Katsumi Bansho
C.R.Officer	Shuji Nakabayashi
2nd.R.Officer	Keiichirou Shishido
Boatswain	Tadao Suzuki
Able Seaman	Kenetsu Ishikawa
Able Seaman	Hisashi Naruo
Able Seaman	Yasuyuki Yamamoto
Able Seaman	Seiichiro Kawata
Able Seaman	Hisao Oguni
Able Seaman	Yuji Inoue
Able Seaman	Masaru Suzuki
Able Seaman	Yosuke Kuwahara
Able Seaman	Kazuyoshi Kudo
Able Seaman	Tsuyoshi Sato
Able Seaman	Tsuyoshi Monzawa
No.1 Oiler	Sadanori Honda
Oiler	Sunao Araki
Oiler	Yoshihiro Sugimoto
Oiler	Takashi Miyazaki
Oiler	Toshio Matsuo
Oiler	Daisuke Taniguchi
Chief Steward	Yasuaki Koga
Cook	Hatsuji Hiraishi
Cook	Hitoshi Ota
Cook	Wataru Sasaki
Cook	Kozo Uemura

6.1 Meteorological measurement

6.1.1 Surface meteorological observation

(1) Personnel

Fumitaka Yoshiura (GODI): Operation Leader

Wataru Tokunaga (GODI): Operator

(2) Objectives

The surface meteorological parameters are observed as a basic dataset of the meteorology. These parameters bring us the information about temporal variation of the meteorological condition surrounding the ship.

(3) Methods

The surface meteorological parameters were observed throughout MR01-K01 cruise from the departure of Sekinehama, Japan on 14 February 2001 to the arrival of Yokosuka, Japan on 23 March 2001.

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

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

The measured parameters of each system are listed in Table 6.1.1-1, 6.1.1-2, 6.1.1-3 and 6.1.1-4.

(3-1) Mirai meteorological observation system

Instruments and archived parameters of Mirai meteorological observation system are listed in the table below. 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 6.1.1-1 Instrument and their installation locations of Mirai meteorological observation system

Sensors	Type	Manufacturer	location (altitude from surface)
Anemometer	KE-500	Koshin Denki, Japan	foremast (24m)
Thermometer	FT	Koshin Denki, Japan	compass deck (21m)
Dewpoint meter	DW-1	Koshin Denki, Japan	compass deck (21m)
Barometer	F451	Yokogawa, Japan	captain deck (13m) Weather station room (tubing outside)
Rain gauge	50202	R. M. Young, USA	compass deck (21m)
Optical Rain gauge	ORG-115DR	ScTi, USA	compass deck (21m)
Radiometer (short wave)	MS-801	Eiko Seiki, Japan	radar mast (28m)

Table 6.1.1-1 (continued)

Radiometer (long wave)	MS-200	Eiko Seiki, Japan	radar mast (28m)
Wave height meter	MW-2	Tsurumi-seiki, Japan	Bow

Table 6.1.1-2 Parameter of Mirai meteorological observation system

	Parameter	Units	Remarks
1	Latitude	Degree	
2	Longitude	Degree	
3	Ship's speed	Knot	Mirai log
4	Ship's heading	Degree	Mirai gyro
5	Relative wind speed	m/s	6 sec. / 10 min. average
6	Relative wind direction	Degree	6 sec. / 10 min. average
7	True wind speed	m/s	6 sec. / 10 min. average
8	True wind direction	Degree	6 sec. / 10 min. average
9	Barometric pressure	HPa	6 sec. / 10 min. average Adjusted to the sea surface level
10	Air temperature (starboard side)	deg-C	6 sec. / 10 min. average
11	Air temperature (port side)	deg-C	6 sec. / 10 min. average
12	Dewpoint temperature (starboard side)	deg-C	6 sec. / 10 min. average
13	Dewpoint temperature (port side)	deg-C	6 sec. / 10 min. average
14	Relative humidity (starboard side)	%	6 sec. / 10 min. average
15	Relative humidity (port side)	%	6 sec. / 10 min. average
16	Rain rate (optical rain gauge)	mm/hr	1 hr / 12 hr accumulated
17	Rain rate (capacitive rain gauge)	mm/hr	1 hr / 12 hr accumulated
18	Down welling shotwave radiometer		Momentary / 12 hr accumulated
19	Down welling infra-red radiometer		Momentary / 12 hr accumulated
20	Sea surface temperature	deg-C	Under the water line –5 m
21	Significant wave height (fore)	M	3 hourly
22	Significant wave height (aft)	M	3 hourly
23	Significant wave period (fore)	Second	3 hourly
24	Significant wave period (aft)	Second	3 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 and Zeno meteorological data every 10 seconds. Instruments and their location are listed in Table 6.1.1-3. The archived parameters are in Table 6.1.1-4.

Table 6.1.1-3 Instruments installation locations of SOAR system

Sensor	Type	Manufacturer	location (altitude from surface)
Anemometer	05106	R. M. Young, USA	foremast (24m)
Tair/RH	HMP45A	R. M. Young, 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-115DA	ScTi, USA	foremast (24m)
Radiometer (short wave)	PSP	Eppley labs, USA	foremast (24m)
Radiometer (long wave)	PIR	Eppley labs, USA	foremast (24m)
Fast rotating Shadowband radiometer		Yankee, USA	foremast (24m)

Table 6.1.1-4 Parameters of SOAR system

	Parameters	units	Remarks
1	Latitude	degree	
2	Longitude	degree	
3	Sog	knot	
4	Cog	degree	
5	Relative wind speed	m/s	
6	Relative wind direction	degree	
7	Barometric pressure	hPa	
8	Air temperature	deg-C	
9	Relative humidity	%	
10	Rain rate (optical rain gauge)	mm/hr	
11	Precipitation (capacitive rain gauge)	mm	Reset at 50 mm
12	Down welling shortwave radiation	W/m^2	
13	Down welling infra-red radiation	W/m^2	
14	Defuse irradiation	W/m^2	

(4) Preliminary results

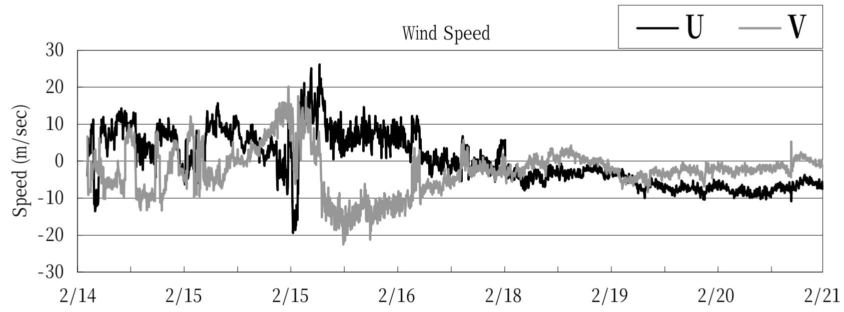
Wind (converted to U, V component), Air temperature, Relative Humidity, Rainfall and surface pressure observed during the cruise from SOAR system via navigation system are shown in Fig.6.1.1-1. Table of 3-hourly summary data from Mirai meteorological observation system is Table 6.1.1-5.

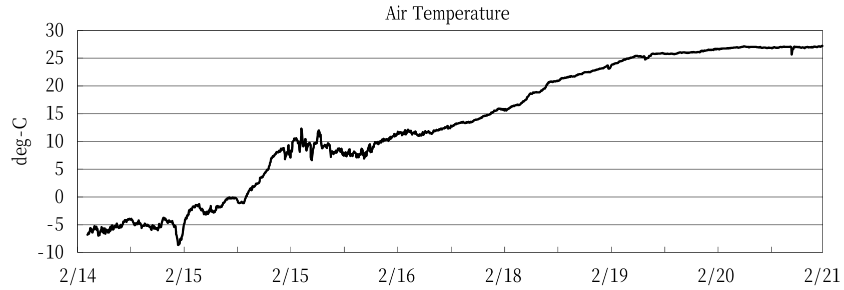
(5) Data archives

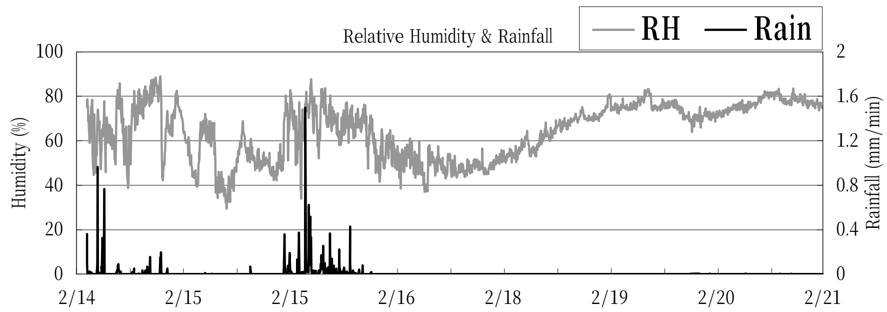
These raw data obtained in this cruise will be submitted to the Data Management Office (DMO) in JAMSTEC just after the cruise.

Remarks concerning about data quality are as follows;

1. Radiometers for upwelling radiation measurement of Mirai meteorological observation system were not installed during this cruise.
2. PRP stopped from 2301 to 2325 UTC 28 February caused by software trouble.


Wind Speed
U
V
Speed (m/sec)
30
20
10
0
-10
-20
-30
2/14
2/15
2/15
2/16
2/18
2/19
2/20
2/21


Air Temperature
deg-C
30
25
20
15
10
5
0
-5
-10
2/14
2/15
2/15
2/16
2/18
2/19
2/20
2/21


Relative Humidity & Rainfall
RH
Rain
Humidity (%)
Rainfall (mm/min)
100
80
60
40
20
0
2
1.6
1.2
0.8
0.4
0
2/14
2/15
2/15
2/16
2/18
2/19
2/20
2/21

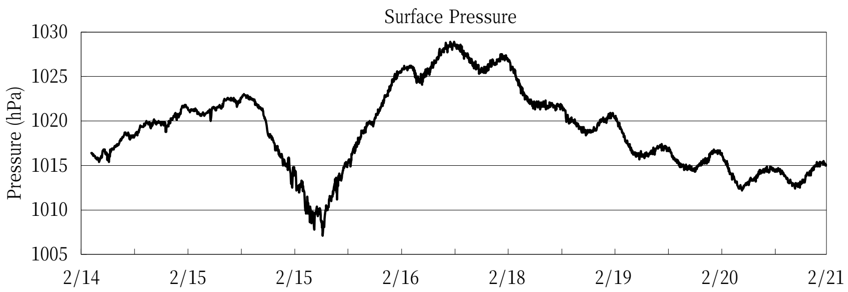

Surface Pressure
Pressure (hPa)
1030
1025
1020
1015
1010
1005
2/14
2/15
2/15
2/16
2/18
2/19
2/20
2/21

Fig.6.1.1-1 Time series of measured parameter by SOAR system

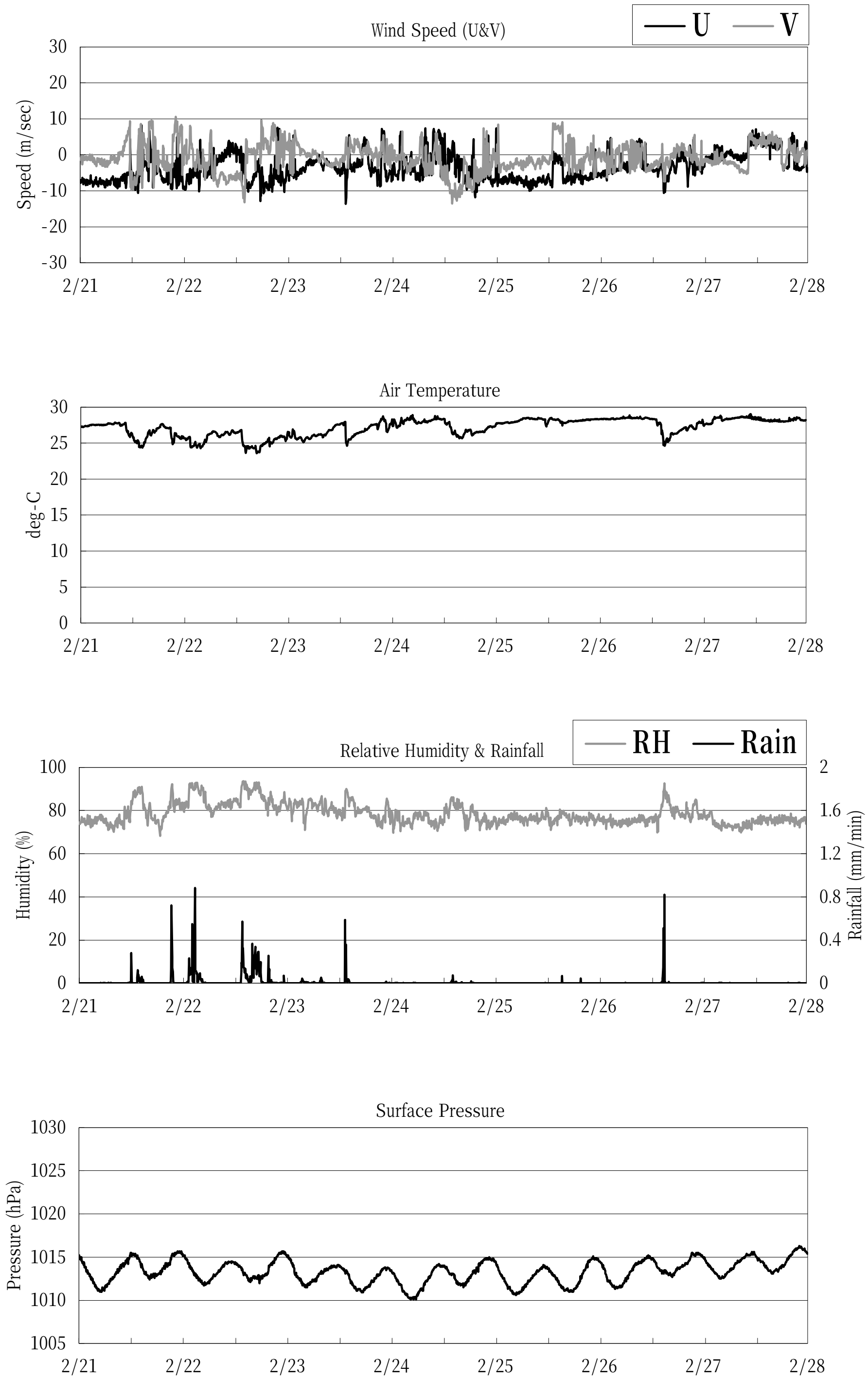


Fig.6.1.1-1 (continued)

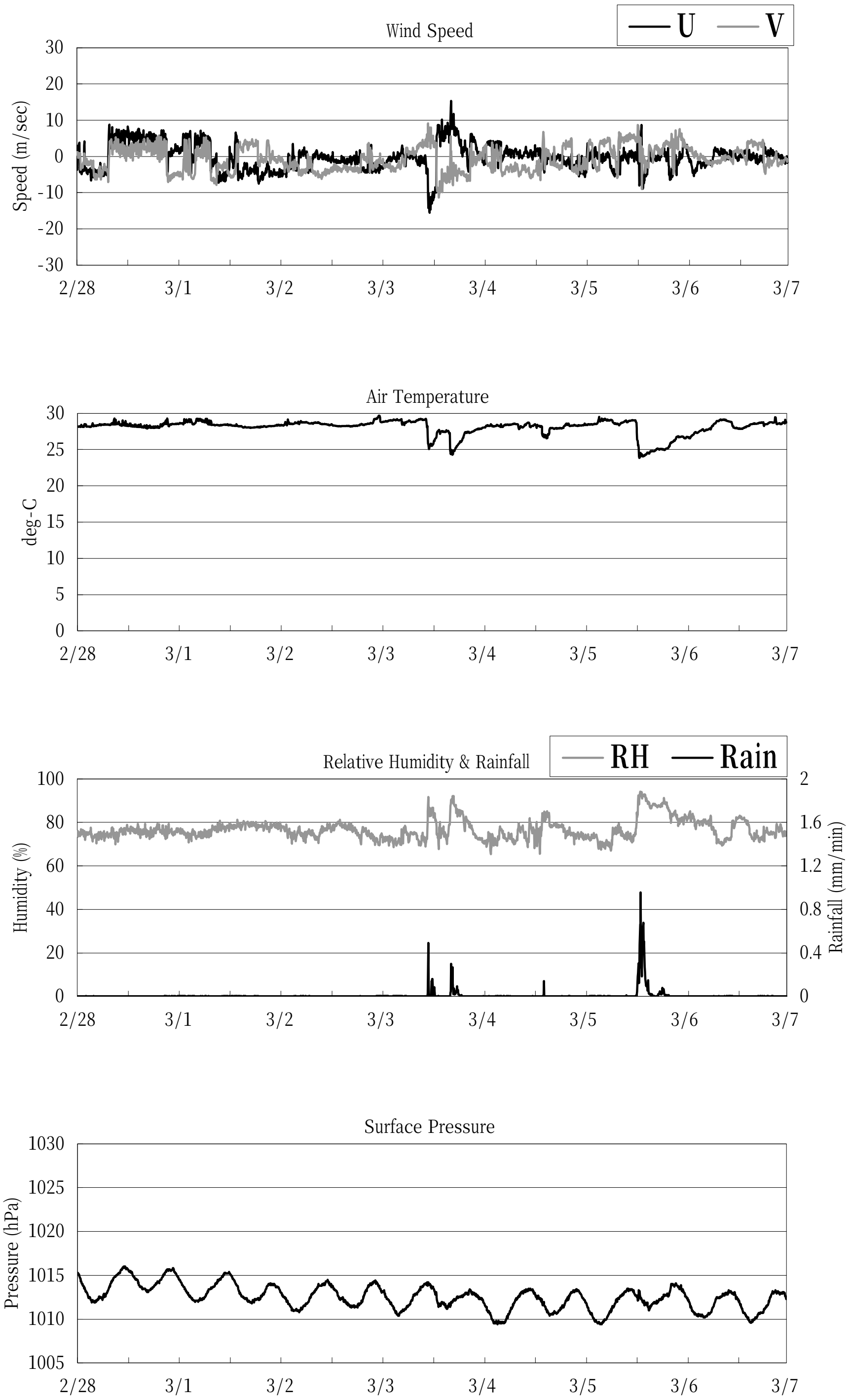
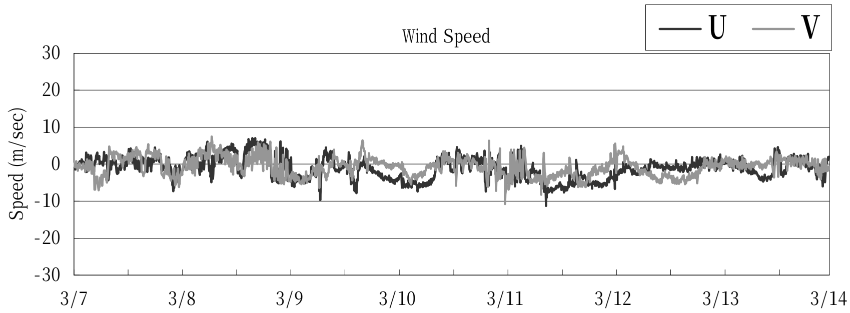
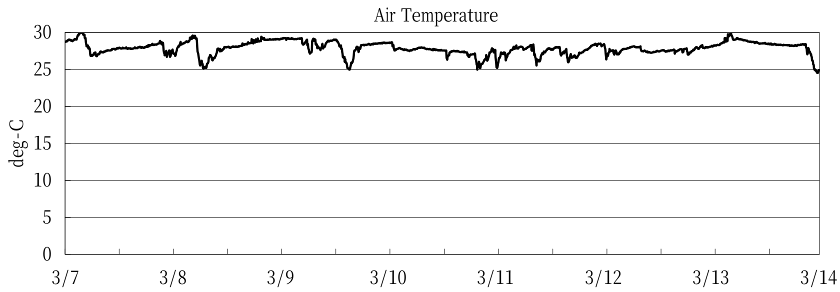
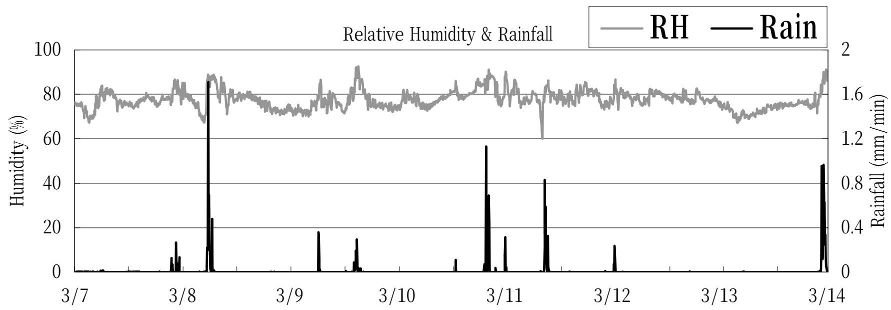


Fig.6.1.1-1 (continued)







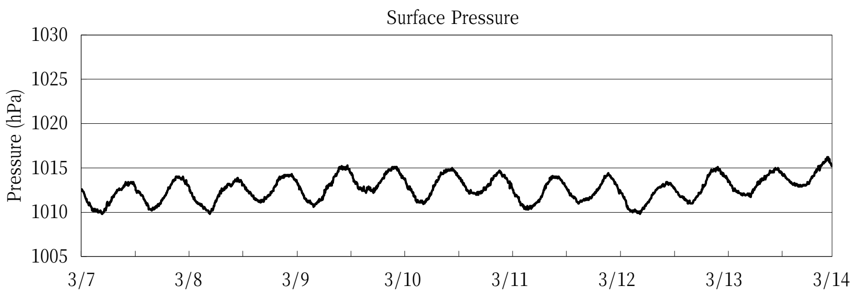
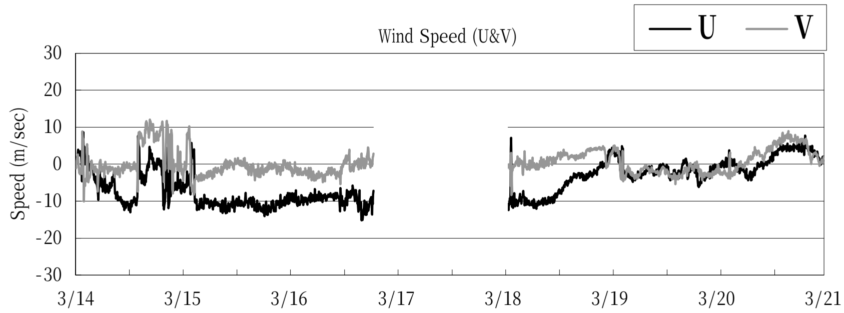
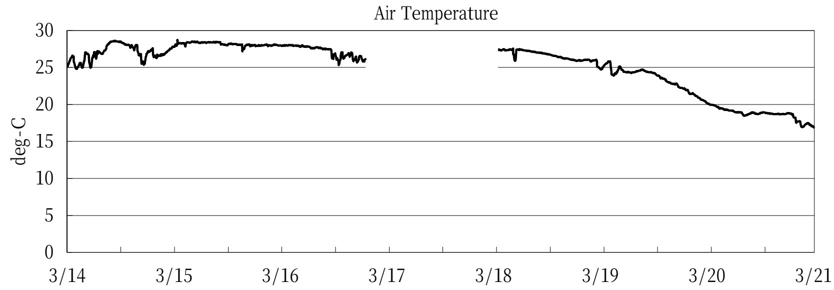
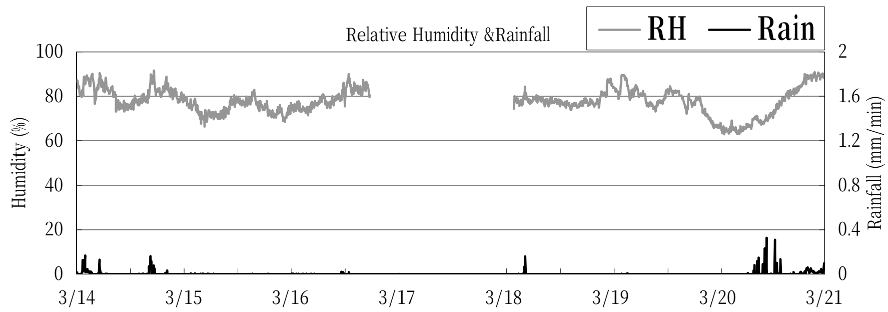


Fig.6.1.1-1 (continued)







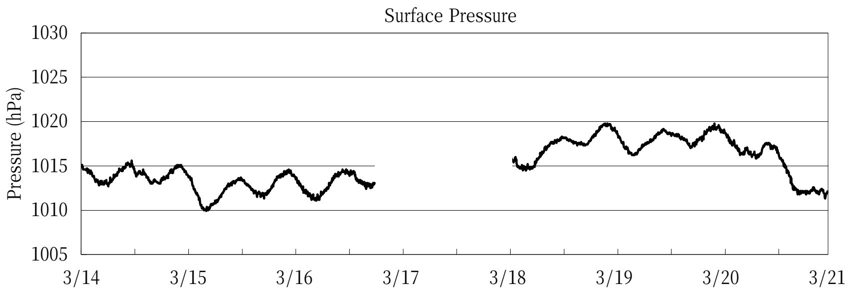
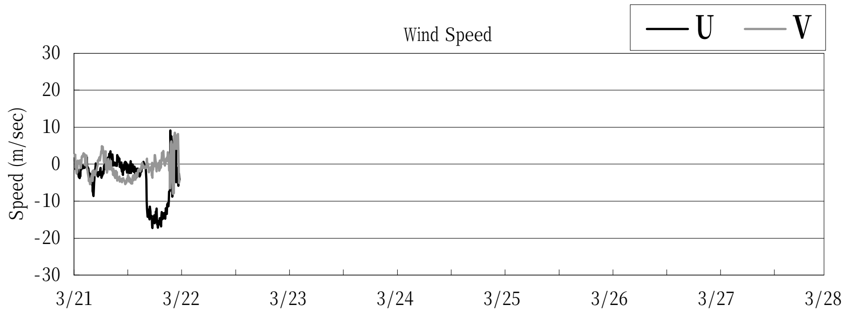
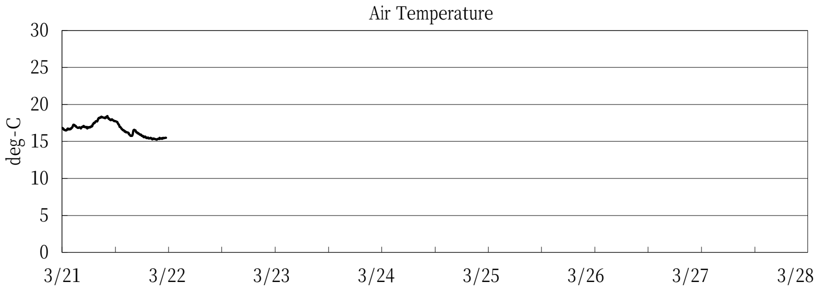
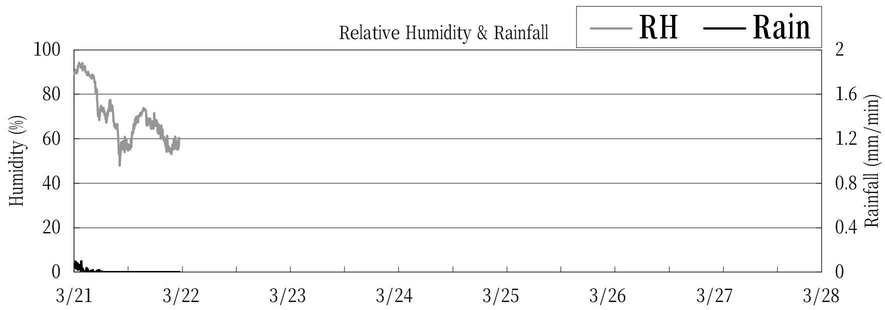


Fig.6.1.1-1 (continued)







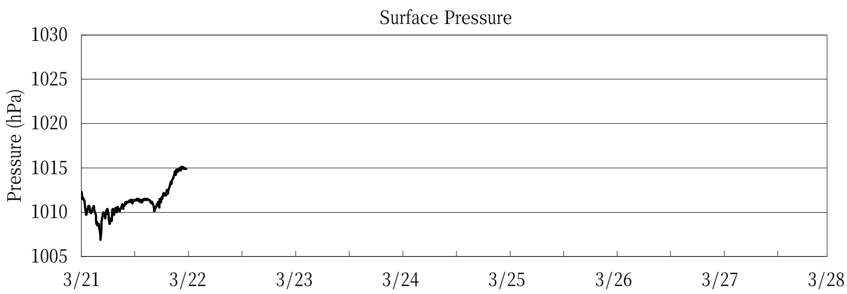


Table 6.1.1-5

UTC		SMT		Postion Lat.	Lon.	Weather	P (hPa)	T (deg-C)	RH (%)	WD (deg)	WS (m/s)	R (mm/h)	Wv.Ht. (m)	Wv.Pd. (sec)
	18:00	2/14	3:00	41-21 N	141-14 E	-	1012.7	-5.8	60	285	6.3	0	0.2	6.5
	21:00		6:00	41-21 N	141-14 E	-	1012.0	-5.5	61	279	6.6	0	0.2	6.3
2/14	0:00		9:00	41-21 N	141-14 E	-	1012.3	-3.3	53	284	6.6	0	0.2	6.4
	3:00		12:00	41-21 N	141-14 E	bc	1012.0	-3.1	62	306	8.2	0.6	0.3	6.0
	6:00		15:00	41-29 N	141-21 E	s	1012.1	-4.4	64	298	11.6	0.5	0.9	4.0
	9:00		18:00	41-18 N	142-04 E	o/s	1013.4	-3.2	74	282	11	0	2.2	22.9
	12:00		21:00	40-58 N	142-32 E	o	1014.1	-2.7	59	312	12.7	0	1.6	5.6
	15:00	2/15	0:00	40-58 N	142-32 E	c	1015.6	-3.3	72	315	10.5	0	1.5	5.5
	18:00		3:00	41-01 N	142-30 E	o	1015.4	-4.5	84	324	11.5	3.8	1.5	5.8
	21:00		6:00	40-43 N	141-49 E	c	1016.6	-3.9	62	256	8.4	0.1	1.2	9.4
2/15	0:00		9:00	40-33 N	141-30 E	-	1017.6	-3.5	64	228	6.3	0	0.2	5.4
	3:00		12:00	40-33 N	141-30 E	bc	1016.8	0.8	38	269	8	0	0.2	5.2
	6:00		15:00	40-34 N	141-47 E	c	1017.4	-1.0	60	292	11.8	0	1.3	19.4
	9:00		18:00	39-52 N	142-16 E	bc	1018.5	0.6	42	301	8.1	0	1.5	21.5
	12:00		21:00	39-08 N	142-40 E	bc	1018.7	0.1	46	253	9.1	0	1.0	8.2
	15:00	2/16	0:00	38-25 N	143-01 E	c	1018.5	2.0	49	242	5.7	0	1.0	10.9
	18:00		3:00	37-47 N	143-17 E	bc	1014.9	4.5	49	170	6.5	0	1.1	11.7
	21:00		6:00	37-20 N	143-35 E	c	1012.9	8.5	43	181	11.3	0	1.2	8.1
2/16	0:00		9:00	36-43 N	143-50 E	q	1011.5	7.4	79	201	11	4.9	1.5	4.0
	3:00		12:00	36-25 N	144-01 E	o	1007.6	9.8	65	233	15.3	2.6	2.1	5.6
	6:00		15:00	35-48 N	144-18 E	o	1005.6	10.2	82	245	9.3	0.3	3.3	8.9
	9:00		18:00	35-08 N	144-37 E	o/r	1008.8	8.1	82	316	16.4	1.3	3.3	9.8
	12:00		21:00	34-24 N	144-55 E	r	1011.6	8.1	74	343	16.8	0.7	4.0	13.3
	15:00	2/17	0:00	33-39 N	145-10 E	r	1014.5	7.5	77	321	15.8	0.2	5.0	16.0
	18:00		3:00	33-03 N	145-36 E	o	1016.4	8.2	74	334	17.1	0.1	6.0	19.3
	21:00		6:00	32-23 N	145-54 E	c	1019.4	10.9	55	328	15.2	0	5.5	17.5
2/17	0:00		9:00	31-43 N	146-12 E	c	1021.4	11.7	50	333	13.8	0	5.5	18.2
	3:00		12:00	31-01 N	146-30 E	bc	1021.6	12.2	54	337	11.7	0	6.2	19.9
	6:00		15:00	30-52 N	146-33 E	bc	1021.6	12.5	45	346	7.7	0	6.1	18.3
	9:00		18:00	30-11 N	146-53 E	bc	1023.5	12.4	51	353	7	0	5.8	18.0
	12:00		21:00	29-31 N	147-11 E	c	1024.5	12.8	48	30	7	0	5.4	19.0
	15:00	2/18	0:00	29-00 N	147-25 E	bc	1023.4	13.8	46	46	4.8	0	3.7	10.5
	18:00		3:00	28-35 N	147-35 E	bc	1021.8	14.3	47	51	2.6	0	4.9	18.3
	21:00		6:00	27-55 N	147-54 E	o	1022.8	15.3	46	59	4.9	0	4.4	15.7
2/18	0:00		9:00	27-29 N	148-05 E	o	1022.8	16.1	51	57	5.3	0	3.5	10.7
	3:00		12:00	26-55 N	148-18 E	c	1019.9	17.3	56	59	4.9	0	4.2	16.5
	6:00		15:00	26-12 N	148-37 E	c	1017.8	19.0	56	88	8.3	0	3.1	18.1
	9:00		18:00	25-30 N	148-55 E	c	1017.6	19.7	60	84	7.8	0	4.7	19.2
	12:00		21:00	24-48 N	149-14 E	c	1017.5	21.2	63	104	5.1	0	5.1	20.0
	15:00	2/19	0:00	24-05 N	149-32 E	bc	1016.0	21.9	66	111	6.2	0	4.0	18.6
	18:00		3:00	23-23 N	149-49 E	bc	1014.6	22.5	73	94	5.9	0	4.5	19.4
	21:00		6:00	22-41 N	150-06 E	bc	1015.5	23.1	68	90	3.3	0	4.1	19.5
2/19	0:00		9:00	22-00 N	150-24 E	bc	1016.4	23.6	78	80	6.4	0	4.0	19.3
	3:00		12:00	21-16 N	150-42 E	bc	1013.6	25.5	73	21	7.7	0	3.5	16.6
	6:00		15:00	20-32 N	150-59 E	c	1011.9	25.8	75	40	8	0	3.3	17.0
	9:00		18:00	19-49 N	151-17 E	o	1012.4	25.3	83	35	8.3	0	3.0	16.0
	12:00		21:00	19-08 N	151-35 E	bc	1012.8	26.0	77	46	8.2	0	3.3	18.2
	15:00	2/20	0:00	18-26 N	151-53 E	bc	1011.2	25.9	77	68	9.8	0	3.0	16.9
	18:00		3:00	17-44 N	152-11 E	bc	1010.5	26.0	72	68	9.5	0	3.5	17.6

Table 6.1.1-5 (continued)

				Postion		Weather	P	T	RH	WD	WS	R	Wv.Ht.	Wv.Pd.
UTC		SMT		Lat.	Lon.		(hPa)	(deg-C)	(%)	(deg)	(m/s)	(mm/h)	(m)	(sec)
	21:00		6:00	17-01 N	152-27 E	bc	1011.5	26.5	74	61	9.4	0.5	3.1	16.4
2/20	0:00		9:00	16-19 N	152-43 E	bc	1012.4	27.1	70	71	8.5	0	3.1	17.6
	3:00		12:00	15-38 N	153-00 E	bc	1009.7	27.3	72	65	9.3	0	4.1	18.2
	6:00		15:00	14-57 N	153-16 E	bc	1008.5	27.3	76	68	9.7	0	3.3	15.1
	9:00		18:00	14-15 N	153-31 E	bc	1010.0	27.1	76	67	10	0	3.6	17.5
	12:00		21:00	13-33 N	153-47 E	bc	1010.5	26.9	81	70	10.4	0	3.9	18.1
	15:00	2/21	0:00	12-51 N	154-03 E	bc	1009.5	27.0	79	78	8.8	0	3.9	18.1
	18:00		3:00	12-09 N	154-20 E	bc/p	1008.8	27.0	81	90	9.1	0.3	3.9	18.1
	21:00		6:00	11-27 N	154-37 E	bc	1010.4	27.1	78	94	7.4	0	3.9	18.1
2/21	0:00		9:00	10-44 N	154-53 E	bc	1010.7	27.6	74	82	9.1	0	3.9	18.1
	3:00		12:00	10-02 N	155-09 E	bc	1008.3	27.9	75	80	9.9	0	3.9	18.1
	6:00		15:00	09-20 N	155-26 E	bc	1007.2	27.9	76	63	9.7	0	2.8	17.9
	9:00		18:00	08-37 N	155-43 E	bc	1009.4	27.8	75	84	10.8	0	2.0	13.0
	12:00		21:00	08-00 N	155-55 E	bc	1011.3	26.4	78	129	9.5	0.1	2.1	9.9
	15:00	2/22	0:00	08-00 N	155-53 E	c/p	1009.3	24.6	86	117	5.4	1.1	2.1	10.1
	18:00		3:00	08-00 N	155-53 E	bc	1008.6	27.1	77	66	5.9	0	2.0	10.3
	21:00		6:00	08-02 N	155-57 E	bc	1010.0	27.1	81	58	7.3	0	1.8	8.9
2/22	0:00		9:00	08-02 N	155-57 E	o	1011.1	26.0	83	71	9.8	0	2.0	9.2
	3:00		12:00	07-59 N	155-59 E	r	1008.6	24.4	92	42	5.3	10.1	1.9	9.7
	6:00		15:00	08-00 N	155-56 E	o	1007.8	26.2	85	51	5.8	0.1	2.0	9.2
	9:00		18:00	07-59 N	155-53 E	o	1009.7	26.2	82	55	5.6	0	1.8	9.1
	12:00		21:00	07-58 N	155-51 E	o	1010.1	26.4	85	42	6.7	0	1.6	8.4
	15:00	2/23	1:00	07-58 N	155-49 E	r	1008.7	24.3	92	112	10	6.6	1.7	8.5
	18:00		4:00	08-01 N	155-53 E	r	1008.5	24.1	93	128	11.7	14.3	1.6	9.0
	21:00		7:00	08-01 N	155-56 E	r	1010.2	25.1	86	112	9.6	1	1.8	8.0
2/23	0:00		10:00	08-01 N	155-55 E	r	1010.9	25.6	86	131	6	0.1	1.7	8.5
	3:00		13:00	07-46 N	155-56 E	o	1008.4	26.0	82	109	7.4	0	2.1	13.3
	6:00		16:00	07-00 N	155-59 E	o	1008.0	25.9	85	101	3.4	0.1	1.8	12.7
	9:00		19:00	06-15 N	156-01 E	o	1009.2	26.2	83	73	3.6	1.2	1.8	12.8
	12:00		22:00	05-30 N	156-03 E	c	1009.9	27.7	78	71	6.8	0	1.9	12.6
	15:00	2/24	1:00	05-00 N	156-05 E	o	1007.9	25.3	89	127	3.7	2	1.6	8.1
	18:00		4:00	04-59 N	156-05 E	bc	1006.9	26.8	82	78	3.7	0	1.5	7.8
	21:00		7:00	04-57 N	156-04 E	bc	1008.4	27.4	77	76	6.3	0	1.7	8.3
2/24	0:00		10:00	05-02 N	155-59 E	bc	1009.1	28.6	75	85	5.7	0	1.4	8.0
	3:00		13:00	05-03 N	156-00 E	bc	1006.9	28.0	73	69	6.8	0	1.4	7.5
	6:00		16:00	05-01 N	155-57 E	bc	1005.8	28.1	77	71	5.7	0	1.8	8.0
	9:00		19:00	04-59 N	156-01 E	bc	1008.3	28.1	79	68	5.7	0	1.4	7.9
	12:00		22:00	04-59 N	156-01 E	bc	1009.8	28.4	75	65	6.7	0	1.5	8.3
	15:00	2/25	1:00	04-59 N	156-00 E	r	1008.8	26.2	87	84	11.2	0.2	1.7	8.9
	18:00		4:00	04-56 N	156-05 E	o	1008.3	26.6	77	77	8.8	0	1.8	7.2
	21:00		7:00	04-57 N	156-04 E	o	1010.0	26.5	76	38	9.2	0	2.0	9.7
2/25	0:00		10:00	04-59 N	156-05 E	c	1010.3	27.6	75	58	8.6	0	2.0	9.1
	3:00		13:00	04-36 N	156-04 E	bc	1007.5	28.5	74	55	7.7	0	2.1	15.4
	6:00		16:00	03-50 N	155-59 E	bc	1006.7	28.4	77	61	7.6	0	2.1	17.5
	9:00		19:00	03-04 N	155-56 E	bc	1008.6	28.2	79	67	8.2	0	2.4	17.4
	12:00		22:00	02-19 N	155-52 E	c	1009.8	28.0	80	68	7.8	0	2.2	19.0
	15:00	2/26	1:00	01-56 N	155-48 E	bc/p	1008.0	28.2	77	61	9	0	1.6	9.6
	18:00		4:00	01-56 N	155-47 E	bc/p	1007.1	28.1	76	60	8	0	1.6	8.9
	21:00		7:00	01-58 N	155-51 E	bc/p	1009.3	28.3	79	66	6.4	0	1.7	8.7

Table 6.1.1-5 (continued)

UTC		SMT		Postion Lat.	Lon.	Weather	P (hPa)	T (deg-C)	RH (%)	WD (deg)	WS (m/s)	R (mm/h)	Wv.Ht. (m)	Wv.Pd. (sec)
2/26	0:00		10:00	02-01 N	155-58 E	bc/p	1010.5	28.5	75	87	6.2	0	1.5	8.7
	3:00		13:00	02-03 N	156-01 E	bc/p	1007.7	28.5	76	89	5	0	1.7	8.3
	6:00		16:00	01-57 N	155-51 E	bc	1007.6	29.1	74	105	4	0	1.4	8.7
	9:00		19:00	01-56 N	155-50 E	c	1010.0	28.6	76	109	4.6	0	1.2	8.9
	12:00		22:00	01-57 N	155-48 E	bc	1011.0	28.4	75	127	5	0	1.4	8.6
	15:00	2/27	1:00	01-59 N	155-46 E	r	1009.2	27.5	81	149	2.3	0.1	1.2	8.1
	18:00		4:00	02-01 N	155-45 E	bc	1009.1	26.3	80	160	4.8	0	1.4	8.0
	21:00		7:00	01-56 N	155-50 E	bc	1010.3	26.9	82	79	8.9	0	1.4	8.9
2/27	0:00		10:00	01-55 N	155-50 E	bc	1010.8	27.7	79	35	5.1	0	1.1	8.2
	3:00		13:00	01-25 N	155-55 E	bc	1008.9	28.3	74	29	3.1	0	1.1	10.5
	6:00		16:00	01-10 N	155-57 E	bc	1008.8	28.8	72	16	1.8	0	1.4	13.1
	9:00		19:00	00-25 N	156-04 E	bc	1010.4	28.7	72	18	4.8	0	1.3	14.6
	12:00		22:00	00-01 N	156-07 E	bc	1011.1	28.7	75	23	6.3	0	1.0	8.6
	15:00	2/28	1:00	00-04 N	156-10 E	bc	1009.7	28.5	75	23	5.9	0	1.0	8.0
	18:00		4:00	00-08 N	156-12 E	bc	1009.3	28.3	75	33	4.8	0	0.9	8.1
	21:00		7:00	00-00 N	156-08 E	o	1010.9	28.4	76	69	5.2	0	1.0	7.9
2/28	0:00		10:00	00-01 N	156-12 E	o	1011.5	28.7	76	90	3.3	0	1.2	10.1
	3:00		13:00	00-00 S	156-05 E	c	1008.6	28.7	75	48	4.7	0	1.2	8.9
	6:00		16:00	00-00 S	155-51 E	c	1008.2	28.8	72	40	5.8	0	1.4	13.9
	9:00		19:00	00-01 N	156-02 E	bc	1010.3	28.6	77	43	6.5	0	1.1	7.8
	12:00	3/1	22:00	00-02 N	156-04 E	bc	1011.7	28.8	75	51	5.6	0	1.0	8.1
	15:00		1:00	00-02 N	156-07 E	bc	1010.1	28.8	76	58	5.4	0	1.0	7.3
	18:00		4:00	00-04 N	156-10 E	bc	1009.2	28.6	74	52	6.2	0	0.9	8.7
	21:00		7:00	00-05 N	156-12 E	bc	1010.5	28.8	77	58	6.1	0	0.9	7.8
3/1	0:00		10:00	00-05 N	156-11 E	bc	1010.9	28.7	75	74	6	0	1.1	7.5
	3:00		13:00	00-03 N	156-10 E	bc	1008.4	28.6	76	58	6.3	0	0.9	7.7
	6:00		16:00	00-04 N	156-11 E	bc	1007.9	29.0	75	69	5.1	0	0.8	7.2
	9:00		19:00	00-04 N	156-11 E	bc	1009.6	28.5	78	71	6.6	0	1.1	7.7
	12:00		22:00	00-01 S	155-53 E	bc	1011.0	28.6	77	63	6.4	0	1.5	12.1
	15:00	3/2	1:00	00-01 S	155-51 E	bc	1009.1	28.4	80	69	6.2	0	1.0	7.3
	18:00		4:00	00-04 S	155-52 E	bc	1007.7	28.2	80	63	5.8	0	1.3	7.1
	21:00		7:00	00-01 S	155-52 E	bc	1008.8	28.6	76	66	6.7	0	1.4	9.8
3/2	0:00		10:00	00-01 S	156-00 E	bc	1009.4	28.8	78	66	5	0	1.2	8.1
	3:00		13:00	00-00 N	156-01 E	bc	1007.4	28.9	75	68	3.5	0	1.3	8.8
	6:00		16:00	00-01 S	155-50 E	bc	1007.0	29.1	74	57	4.5	0	1.3	8.5
	9:00		19:00	00-01 S	155-51 E	b	1009.1	28.9	73	69	4.3	0	1.4	9.0
	12:00		22:00	00-01 S	155-48 E	b	1010.2	28.7	78	81	4.4	0	1.6	10.6
	15:00	3/3	1:00	00-01 S	155-45 E	b	1008.2	28.5	80	67	3.9	0	1.6	9.5
	18:00		4:00	00-01 S	155-43 E	b	1007.3	28.4	77	93	4.2	0	1.7	10.0
	21:00		7:00	00-00 S	155-49 E	bc	1008.9	28.9	75	71	4.4	0	1.4	9.2
3/3	0:00		10:00	00-01 S	155-49 E	bc	1009.6	29.1	73	66	3.4	0	1.4	10.7
	3:00		13:00	00-39 S	155-51 E	bc	1007.6	29.6	70	32	3.2	0	1.4	19.1
	6:00		16:00	01-25 S	155-55 E	bc	1006.8	29.2	69	49	0.8	0	1.9	20.1
	9:00		19:00	01-32 S	155-53 E	bc	1008.7	29.1	74	28	1.9	0	1.5	10.2
	12:00		22:00	01-35 S	155-50 E	p	1010.4	26.2	82	301	15.8	0.6	1.3	10.1
	15:00	3/4	1:00	01-28 S	155-56 E	o	1007.9	27.7	76	323	10.6	0	1.7	8.0
	18:00		4:00	00-01 S	155-49 E	r	1009.6	29.1	73	66	3.4	0	1.4	10.7
	21:00		7:00	00-39 S	155-51 E	o	1007.6	29.6	70	32	3.2	0	1.4	19.1
3/4	0:00		10:00	01-30 S	155-54 E	o	1008.1	28.2	73	51	0.8	0	2.0	7.9

Table 6.1.1-5 (continued)

UTC		SMT		Postion Lat.	Lon.	Weather	P (hPa)	T (deg-C)	RH (%)	WD (deg)	WS (m/s)	R (mm/h)	Wv.Ht. (m)	Wv.Pd. (sec)
	3:00		13:00	01-29 S	155-56 E	o	1005.9	28.9	68	301	5.6	0	2.1	8.3
	6:00		16:00	01-40 S	155-56 E	o	1005.3	28.7	72	350	4.7	0	2.7	18.9
	9:00		19:00	02-00 S	155-57 E	c	1008.1	28.8	70	350	1.9	0	1.8	8.5
	12:00		22:00	02-02 S	155-53 E	c	1009.2	28.6	80	11	5	0	1.6	8.3
	15:00	3/5	1:00	02-03 S	155-49 E	o	1008.0	28.3	76	314	2.2	0	1.6	9.0
	18:00		4:00	02-01 S	155-56 E	bc	1006.5	28.1	79	357	2	0	1.5	8.8
	21:00		7:00	02-00 S	155-52 E	bc	1007.9	28.8	75	22	3.7	0	1.3	8.7
3/5	0:00		10:00	02-01 S	155-56 E	bc	1008.8	28.9	72	36	5.8	0	1.7	8.8
	3:00		13:00	02-00 S	155-56 E	bc	1006.1	28.9	71	54	4.2	0	1.6	8.9
	6:00		16:00	01-58 S	155-54 E	bc	1005.6	30.5	65	68	3.5	0	1.3	9.5
	9:00		19:00	01-59 S	155-56 E	c	1008.2	28.9	75	100	6	0	1.4	9.3
	12:00		22:00	01-57 S	155-54 E	c	1009.3	29.3	74	100	5.7	0	1.3	8.6
	15:00	3/6	1:00	01-56 S	155-52 E	r	1008.0	24.0	92	204	7.3	31.2	1.6	9.4
	18:00		4:00	01-57 S	155-55 E	o	1008.0	24.7	91	15	2.6	0.2	1.4	8.3
	21:00		7:00	01-56 S	155-53 E	r	1008.4	25.1	88	100	6.3	0.5	1.2	9.0
3/6	0:00		10:00	01-56 S	155-55 E	o	1009.4	27.4	82	187	4.9	0	1.6	8.4
	3:00		13:00	02-36 S	155-57 E	o	1006.7	27.5	82	86	5.6	0	2.0	16.8
	6:00		16:00	03-20 S	155-59 E	o	1006.1	28.0	80	71	3.4	0	1.8	17.0
	9:00		19:00	04-05 S	156-00 E	o	1008.2	29.2	71	11	1	0	1.6	15.4
	12:00		22:00	04-51 S	156-01 E	c	1008.9	29.0	72	34	1.4	0	1.3	17.2
	15:00	3/7	1:00	05-01 S	156-04 E	bc	1006.6	28.0	82	310	0.9	0	1.5	8.6
	18:00		4:00	04-57 S	156-05 E	c	1006.0	28.8	73	326	3.1	0	1.2	9.2
	21:00		7:00	04-58 S	156-02 E	c	1007.7	29.2	73	326	1.5	0	1.4	8.7
3/7	0:00		10:00	05-02 S	156-01 E	bc	1008.6	29.1	74	6	1.8	0	1.5	8.0
	3:00		13:00	04-59 S	156-15 E	bc	1006.7	29.5	71	7	2.6	0	1.4	8.1
	6:00		16:00	04-59 S	156-17 E	c	1005.7	28.6	76	324	3.7	0	1.5	12.3
	9:00		19:00	04-57 S	156-02 E	o	1008.2	27.5	81	329	4.2	0	1.2	9.8
	12:00		22:00	04-54 S	156-03 E	o	1009.2	28.1	75	76	1.6	0	1.2	10.0
	15:00	3/8	1:00	04-52 S	156-05 E	c	1007.5	28.0	75	356	3.5	0	1.2	10.1
	18:00		4:00	04-55 S	156-01 E	c	1006.5	28.1	78	15	3.7	0	1.1	10.3
	21:00		7:00	04-56 S	156-01 E	o	1008.5	28.5	78	24	3.7	0	1.6	12.9
3/8	0:00		10:00	04-57 S	155-59 E	o/p	1009.5	27.4	83	36	4.3	3.1	1.3	10.5
	3:00		13:00	04-57 S	156-24 E	bc	1006.6	28.8	79	313	2.3	0	1.3	10.9
	6:00		16:00	04-55 S	156-24 E	bc	1005.7	30.4	66	342	3.1	0	1.1	10.7
	9:00		19:00	04-52 S	156-24 E	o	1008.5	25.9	86	27	4.2	0.3	1.1	10.1
	12:00		22:00	04-48 S	156-25 E	o	1009.5	27.7	81	71	4.4	0	1.2	10.3
	15:00	3/9	1:00	04-57 S	156-23 E	bc	1008.0	28.2	79	79	3.8	0	1.4	10.1
	18:00		4:00	04-55 S	156-25 E	bc	1007.0	28.7	78	69	6.3	0	1.1	10.1
	21:00		7:00	04-53 S	156-26 E	bc	1009.0	29.4	72	54	5	0	1.2	9.9
3/9	0:00		10:00	04-56 S	156-23 E	bc	1009.9	29.6	71	50	5.4	0	1.2	9.9
	3:00		13:00	04-49 S	156-12 E	bc	1007.8	29.7	72	38	4	0	1.2	10.9
	6:00		16:00	04-25 S	155-31 E	bc	1007.0	28.9	75	0	2.8	0	1.4	12.1
	9:00		19:00	04-01 S	154-50 E	r	1009.3	28.6	78	282	5	0.1	1.4	12.7
	12:00		22:00	03-28 S	154-58 E	c	1011.1	28.9	77	47	1.5	0	1.2	7.0
	15:00	3/10	1:00	02-41 S	155-07 E	r	1009.3	27.1	81	22	3.9	0	1.4	8.4
	18:00		4:00	01-56 S	155-15 E	o	1008.6	27.8	83	236	3.9	0.1	1.3	8.1
	21:00		7:00	01-10 S	155-24 E	bc	1010.0	28.9	74	51	2.1	0	1.4	8.0
3/10	0:00		10:00	00-24 S	155-33 E	bc	1010.9	29.1	73	63	3.8	0	1.4	9.0
	3:00		13:00	00-21 N	155-42 E	c	1008.8	28.1	76	55	5.7	0	1.3	8.2

Table 6.1.1-5 (continued)

				Postion		Weather	P	T	RH	WD	WS	R	Wv.Ht.	Wv.Pd.
UTC		SMT		Lat.	Lon.		(hPa)	(deg-C)	(%)	(deg)	(m/s)	(mm/h)	(m)	(sec)
	6:00		16:00	01-08 N	155-51 E	bc	1007.4	27.8	77	48	6.1	0	1.5	8.6
	9:00		19:00	01-54 N	156-00 E	bc	1009.9	28.2	75	68	3.4	0	1.3	8.2
	12:00		22:00	02-03 N	156-00 E	bc	1010.7	27.8	78	65	3.1	0	1.3	10.8
	15:00	3/11	1:00	02-04 N	156-00 E	c	1008.8	27.4	79	87	3.7	0.6	1.4	10.5
	18:00		4:00	02-07 N	156-00 E	o	1007.9	27.5	81	57	1	0	1.4	10.0
	21:00		7:00	02-06 N	156-01 E	r	1009.4	25.5	82	88	5.9	6.6	1.5	10.7
3/11	0:00		10:00	02-02 N	156-01 E	o	1010.2	27.4	80	53	3.2	0.2	1.4	10.4
	3:00		13:00	02-03 N	155-59 E	o	1007.5	27.6	82	115	4	0	1.6	9.4
	6:00		16:00	02-02 N	156-00 E	c	1006.3	28.0	79	90	5	0	1.6	8.9
	9:00		19:00	02-02 N	155-57 E	p/o	1008.7	28.6	76	73	5.2	0	1.7	8.7
	12:00		22:00	01-52 N	155-12 E	c	1009.7	27.5	81	66	7.4	0.2	2.6	19.3
	15:00	3/12	1:00	01-42 N	154-28 E	bc	1007.7	28.1	77	73	7	0	2.4	18.1
	18:00		4:00	01-32 N	153-42 E	bc	1007.2	27.1	79	33	5.2	0	1.9	18.1
	21:00		7:00	01-21 N	152-55 E	c	1008.3	27.7	81	84	4.4	0	1.8	18.1
3/12	0:00		10:00	01-12 N	152-08 E	bc/p	1009.5	28.8	74	83	4.4	0.1	2.2	19.1
	3:00		13:00	01-02 N	151-21 E	bc	1007.2	28.0	81	156	4.8	0	2.1	18.6
	6:00		16:00	00-50 N	150-34 E	bc	1005.9	28.4	76	117	1.8	0	1.4	14.7
	9:00		19:00	00-40 N	149-47 E	c	1007.9	28.2	76	25	1.9	0	1.5	15.7
	12:00		22:00	00-30 N	149-01 E	bc	1009.1	27.5	81	349	3.3	0	1.9	17.2
	15:00	3/13	1:00	00-19 N	148-15 E	bc	1008.0	27.7	80	4	3.6	0	1.7	15.3
	18:00		4:00	00-09 N	147-31 E	bc	1006.9	27.8	78	18	3.3	0.4	1.6	15.1
	21:00		7:00	00-04 N	146-59 E	c	1008.8	27.8	78	315	2	0	1.6	9.8
3/13	0:00		10:00	00-05 N	147-00 E	c	1010.7	28.5	76	285	1.3	0	1.8	8.0
	3:00		13:00	00-25 N	147-10 E	bc	1008.7	28.8	73	287	1.6	0	1.7	7.8
	6:00		16:00	00-37 N	147-17 E	bc	1007.6	30.5	67	286	2.6	0	1.5	9.2
	9:00		19:00	01-11 N	147-09 E	c	1009.3	29.2	69	77	0.9	0	1.6	7.4
	12:00		22:00	01-57 N	146-58 E	c	1010.6	28.7	75	92	2.5	0	1.5	7.9
	15:00	3/14	1:00	02-05 N	146-55 E	c	1009.9	28.6	76	101	3.1	0	1.3	9.6
	18:00		4:00	02-07 N	146-54 E	c	1008.9	28.6	74	53	1.4	0	1.2	8.8
	21:00		7:00	02-08 N	146-53 E	c	1009.8	28.6	74	107	1.4	0	1.3	9.6
3/14	0:00		10:00	02-05 N	146-54 E	r	1011.8	25.6	80	86	5.1	4.1	1.5	8.3
	3:00		13:00	02-06 N	146-56 E	r	1010.4	25.8	88	9	8.3	2	1.3	9.1
	6:00		16:00	02-35 N	146-57 E	o	1009.1	27.0	85	52	4.2	0.3	1.4	8.5
	9:00		19:00	03-21 N	146-59 E	o	1010.0	27.0	85	61	5.5	0	1.3	8.3
	12:00		22:00	04-08 N	147-00 E	c	1011.4	28.8	75	74	9.5	0	1.5	7.0
	15:00	3/15	1:00	04-54 N	147-01 E	o	1010.2	28.3	77	76	8.6	0	1.4	6.5
	18:00		4:00	04-57 N	146-59 E	r	1009.4	26.4	89	81	7.2	1.3	1.4	7.6
	21:00		7:00	04-56 N	146-56 E	r	1009.9	26.7	87	68	10.6	0	1.6	7.0
3/15	0:00		10:00	04-58 N	146-59 E	o	1010.7	27.5	81	74	6.4	0	1.8	6.8
	3:00		13:00	04-58 N	146-59 E	o	1008.1	28.8	75	55	8.7	0	1.5	7.1
	6:00		16:00	05-18 N	146-56 E	o	1006.4	28.8	69	63	10	0	1.9	8.2
	9:00		19:00	05-53 N	146-53 E	c	1008.0	28.6	72	74	9.6	0	1.7	8.7
	12:00		22:00	06-27 N	146-48 E	bc	1009.4	28.3	78	80	10.9	0	1.6	8.0
	15:00	3/16	1:00	07-02 N	146-44 E	bc	1008.8	28.4	76	86	9.4	0	1.5	8.3
	18:00		4:00	07-36 N	146-35 E	bc	1007.9	28.2	77	73	10.8	0	1.6	9.6
	21:00		7:00	08-10 N	146-24 E	bc	1009.4	28.2	72	82	11.1	0.1	1.9	8.6
3/16	0:00		10:00	08-43 N	146-13 E	bc	1010.5	28.6	69	83	9.7	0	2.1	8.2
	3:00		13:00	09-20 N	145-59 E	bc	1008.5	28.3	75	73	8	0	2.0	8.7
	6:00		16:00	10-04 N	145-43 E	bc	1007.3	28.2	75	68	8.3	0	2.3	10.0

Table 6.1.1-5 (continued)

UTC		SMT		Postion Lat.	Lon.	Weather	P (hPa)	T (deg-C)	RH (%)	WD (deg)	WS (m/s)	R (mm/h)	Wv.Ht. (m)	Wv.Pd. (sec)
	9:00		19:00	10-46 N	145-26 E	c	1008.7	27.7	79	63	8.8	0	2.3	10.9
	12:00		22:00	11-30 N	145-08 E	bc	1010.4	27.6	79	65	8	0	2.2	10.6
	15:00	3/17	1:00	12-14 N	144-51 E	c	1009.9	26.8	86	101	7.5	0.8	2.3	10.3
	18:00		4:00	12-57 N	144-33 E	c	1009.0	26.1	88	90	11.9	0	2.2	9.7
3/18														
	3:00		13:00	14-17 N	144-24 E	bc	1011.6	27.7	75	82	9.3	0	2.0	10.0
	6:00		16:00	14-56 N	144-14 E	p/bc	1010.8	26.0	82	70	6.9	0.9	2.1	12.7
	9:00		19:00	15-38 N	144-06 E	bc	1012.4	27.3	79	82	9.4	0	1.7	9.6
	12:00		22:00	16-28 N	143-56 E	bc/p	1013.8	27.2	77	93	8.4	0	1.8	10.9
	15:00	3/19	0:00	17-15 N	143-47 E	bc	1013.9	26.7	75	112	5.7	0	1.8	11.4
	18:00		3:00	18-01 N	143-37 E	bc	1013.5	26.4	74	118	2.3	0	1.6	11.1
	21:00		6:00	18-47 N	143-28 E	bc	1014.5	26.2	76	152	4	0	1.7	14.2
3/19	0:00		9:00	19-31 N	143-18 E	c	1015.3	26.6	79	184	4.6	0	1.4	13.3
	3:00		12:00	20-12 N	143-09 E	c	1013.3	26.3	77	219	5.5	0	1.8	14.1
	6:00		15:00	20-50 N	143-05 E	bc	1012.3	25.1	81	37	3.1	0.1	1.3	13.3
	9:00		18:00	21-32 N	142-52 E	bc	1013.3	24.6	79	36	1.8	0	1.2	12.6
	12:00		21:00	22-17 N	142-42 E	bc	1014.9	24.6	77	16	2.5	0	1.3	14.3
	15:00	3/20	0:00	23-01 N	142-32 E	o	1014.4	23.7	82	34	4.5	0	1.5	13.9
	18:00		3:00	23-45 N	142-21 E	bc	1013.8	23.0	73	323	4.1	0	1.5	9.9
	21:00		6:00	24-31 N	142-11 E	o	1014.3	22.3	77	41	1.1	0	1.9	7.5
3/20	0:00		9:00	25-14 N	142-02 E	o	1015.3	21.0	66	354	3.9	0	1.8	9.1
	3:00		12:00	25-59 N	141-50 E	c	1014.0	20.4	62	330	3.5	0	1.7	7.8
	6:00		15:00	26-30 N	141-43 E	o	1012.0	19.6	63	352	2.4	0	1.6	8.0
	9:00		18:00	27-06 N	141-35 E	o	1012.0	19.3	66	107	2.1	0	1.4	7.2
	12:00		21:00	27-43 N	141-26 E	o	1013.4	19.1	67	217	1.3	0	1.3	8.4
	15:00	3/21	0:00	28-19 N	141-17 E	bc	1011.5	19.1	74	207	7	0	1.2	9.5
	18:00		3:00	28-54 N	141-11 E	o	1008.5	19.0	81	204	9.2	0	1.4	11.6
	21:00		6:00	29-27 N	141-03 E	r	1007.8	18.4	89	204	8	0.9	1.1	12.1
3/21	0:00		9:00	30-01 N	140-54 E	r	1008.4	17.6	91	250	4.7	0.7	1.3	9.3
	3:00		12:00	30-28 N	140-48 E	r	1006.5	16.6	92	359	1.6	1.4	1.3	8.7
	6:00		15:00	31-03 N	140-39 E	r	1004.7	17.0	89	58	4.7	1.3	1.2	9.3
	9:00		18:00	31-40 N	140-32 E	r	1006.2	18.0	72	320	3.6	0	1.1	9.4
	12:00		21:00	32-17 N	140-24 E	c	1007.3	18.4	58	343	6.2	0	1.1	9.8
	15:00	3/22	0:00	32-55 N	140-15 E	bc	1007.4	17.1	65	3	4.7	0	1.1	8.8
	18:00		3:00	33-31 N	140-08 E	bc	1006.6	16.8	68	86	11.6	0	1.1	7.4
	21:00		6:00	34-04 N	140-01 E	bc	1009.0	15.9	64	87	13.3	0	2.1	8.2
3/22	0:00		9:00	34-25 N	139-58 E	bc	1010.8	16.1	56	102	9.5	0	1.8	6.7

6.1.2 Ceilometer Observation

(1) Personnel

Fumitaka Yoshiura (GODI): Operation Leader

Wataru Tokunaga (GODI): Operator

(2) Objectives

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

(3) Parameters

(3-1) Cloud base height [m]

(3-2) Backscatter profile, sensitivity and range normalized at 30 m resolution

(4) Methods

We measured cloud base height and backscatter profiles using CT-25K ceilometer (Vaisara, Finland) throughout MR01-K01 cruise from the departure of Sekinehama, Japan on 14 February 2001 to the arrival of Yokosuka, Japan on 23 March 2001.

Major parameters for the measurement configuration are as follows;

Laser source:	Indium Gallium Arsenide (InGaAs) Diode Laser
Transmitting wavelength:	905 +/- 5 nm at 25 deg-C
Transmitting average power:	8.9 mW
Repetition rate:	5.57 kHz
Detector:	Silicon Avalanche Photodiode (APD)
Responsively at 905 nm:	65 A/W
Measurement range:	0 ~ 7.5 km
Resolution:	50 ft. in full range
Sampling rate:	60 sec.

(5) Preliminary results

The time series of the detected cloud base height along 156E is shown in Fig. 6.1.2-1. The upper panel, for 22 to 28 February. The lower panel, for 1 to 7 March. C1 is the lowest cloud base height, C2 is the second lowest cloud base height, C3 is the highest cloud base height. The results will be public after the analyses in the future.

(6) Data archives

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

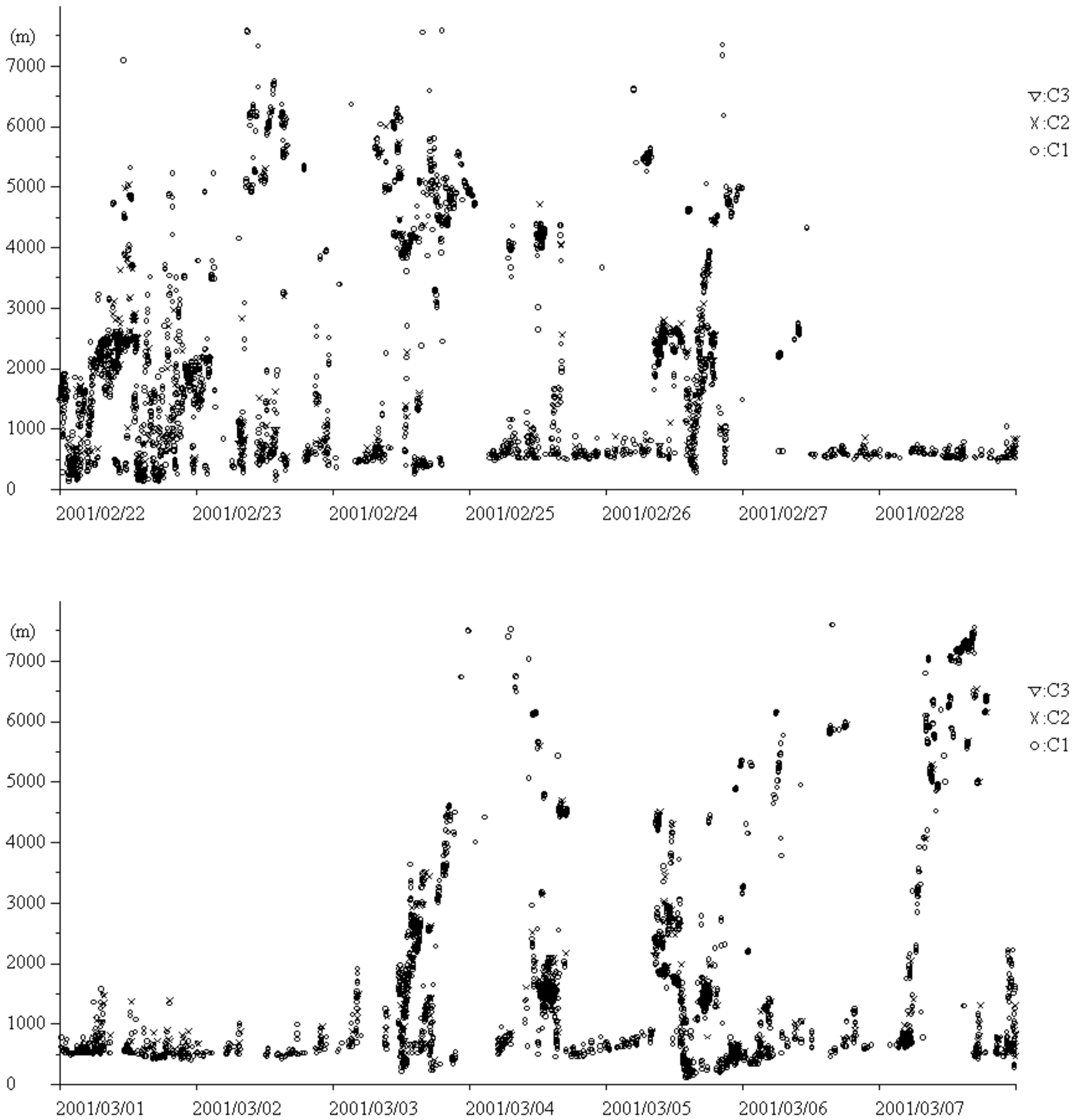


Fig. 6.1.2-1 Cloud base height along 156E

6.2.1 CTD

CTD Observation

(1) Personal

Hirokatsu Uno (MWJ):Operation Leader
Kenichiro Sato (MWJ):Technical Staff
Hiroshi Matsunaga (MWJ):Technical Staff
Asako Inoue (MWJ):Technical Staff
Miki Yoshiike (MWJ):Technical Staff

(2) Objectives

Investigation of the oceanic structure.

(3) Methods

We observed vertical profile of temparature and salinity by CTD/Carousel (Conductivity Temperature Depth profiler/Carousel Water Sampler).12litters Niskin Bottoles were used for sampling seawater.The senser attached on CTD were temperature sensor S/N 031464, conductivity sensor S/N 041202, pressure sensor S/N 09P21746-0575. The Temperature sensor S/N 031207 and Conductivity sensor S/N 040960 were added newly on CTD after C12 cast. Salinity was calculated by measured data of pressure, conductivity and temperature. The CTD/Carousel was deployed from starboard on working deck.

The CTD raw data was acquired in real time by using the SEASAVE utility from SEASOFT software (ver.4.232) provided by SBE and stored on the hard disk of an IBM personal computer. Water samplings were made during up-cast by sending a fire command from the computer. We sampled seawater at 2000m,1500m,1000m until C04 cast, and at 1000m from C05 cast for calibration of salinity data. In total, 14 castings were carried out (see Table. 6.2.1).

The CTD raw data was processed using SEASOFT (ver.4.232). Data processing and used utilities of SEASOFT were as follows:

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

SECTION: Remove the unnecessary data.

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
Point per block: 100

BINAVG: Calculates the averaged in every 1 db.

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

SPLIT: Splits the data made in CNVfiles into upcast and downcast files.

Specifications of the sensers are listed below.

Under water unit:

CTD 9plus (S/N 09P21746-0575, Sea-Bird Electronics, Inc.).

Calibrated Data: 27.Oct.2000

Temperature Senser:

SBE3-04/F (S/N 031464, Sea-Bird Electronics, Inc.).

Calibrated Data: 08.Jan.2001

SBE3-04/F (S/N 031207, Sea-Bird Electronics, Inc.).

Calibrated Date: 18.Nov.2000

Conductivity Senser:

SBE4-04/0 (S/N 041202, Sea-Bird Electronics, Inc.).

Calibrated Data: 12.Jan.2001

SBE4-04/0 (S/N 040960, Sea-Bird Electronics, Inc.).

Calibrated Data: 21.Nov.2000

Deck unit: SBE11 (S/N 11P8010-0308, Sea-Bird Electronics, Inc.).

Carousel water sampler: SBE32 (S/N 3222295-0171, Sea-Bird Electronics, Inc.).

(4) Preliminary result

Vertical profiles at each CTD cast are attached Fig. 6.2.1-1,2.

(5) Trouble

The pump was replaced with S/N 050984 from S/N 050985 at C12 cast due to the trouble of reak.

(6) Data archive

All raw and processed CTD data files were copied onto magnetic optical disks (MO) and will be submitted to JAMSTEC Data Management Office (DMO) .

Table 6.2.1 CTD cast table

Cast No.	File Name	Lat.	[N,S]	Long.	[E]	Date	Start Time	End Time	Max. Press. [db]	Max. Wire Out	Depth [m]	Remarks
C01	C01S01	36-39.84	N	143-52.22	E	2001/02/16	00:23	01:42	2000.629	2162	6094.0	
C02	C02S01	31-00.28	N	146-31.84	E	2001/02/17	03:19	05:05	2001.940	2003	6203.0	
C03	C03S01	29-00.30	N	147-25.05	E	2001/02/17	14:21	16:08	2005.446	1991	6143.0	
C04	C04S01	27-30.10	N	148-05.12	E	2001/02/17-18	22:49	00:31	2003.299	2025	5812.0	
C05	C05S01	08-01.18	N	155-58.74	E	2001/02/22	03:55	04:28	1000.515		4856.0	
C06	C06S01	04-59.49	N	156-01.05	E	2001/02/24	07:57	08:31	1001.041		3599.0	
C07	C07S01	02-03.28	N	156-01.07	E	2001/02/26	03:27	03:59	1000.749	1005	2578.0	
C08	C08S01	01-58.00	N	155-51.98	E	2001/02/26	05:10	05:42	1000.380	1008	2558.0	
C09	C09S01	00-00.10	N	155-57.30	E	2001/03/02	03:36	04:11	1002.318	1012	1939.0	
C10	C10S01	02-00.21	S	155-57.06	E	2001/03/05	03:27	04:02	1002.318	1015	1749.0	
C11	C11S01	05-00.04	S	156-01.34	E	2001/03/07	01:25	01:54	1001.188	1013	1502.0	
C12	C12S02	00-05.76	N	147-01.15	E	2001/3/13	00:49	01:27	1001.000	997	4450.0	
C13	C13S01	02-06.97	N	146-56.14	E	2001/3/14	03:30	04:07	1001.000	1006	4451.0	
C14	C14S01	04-58.50	N	146-59.63	E	2001/3/15	03:25	04:00	1001.000	1008	4248.0	

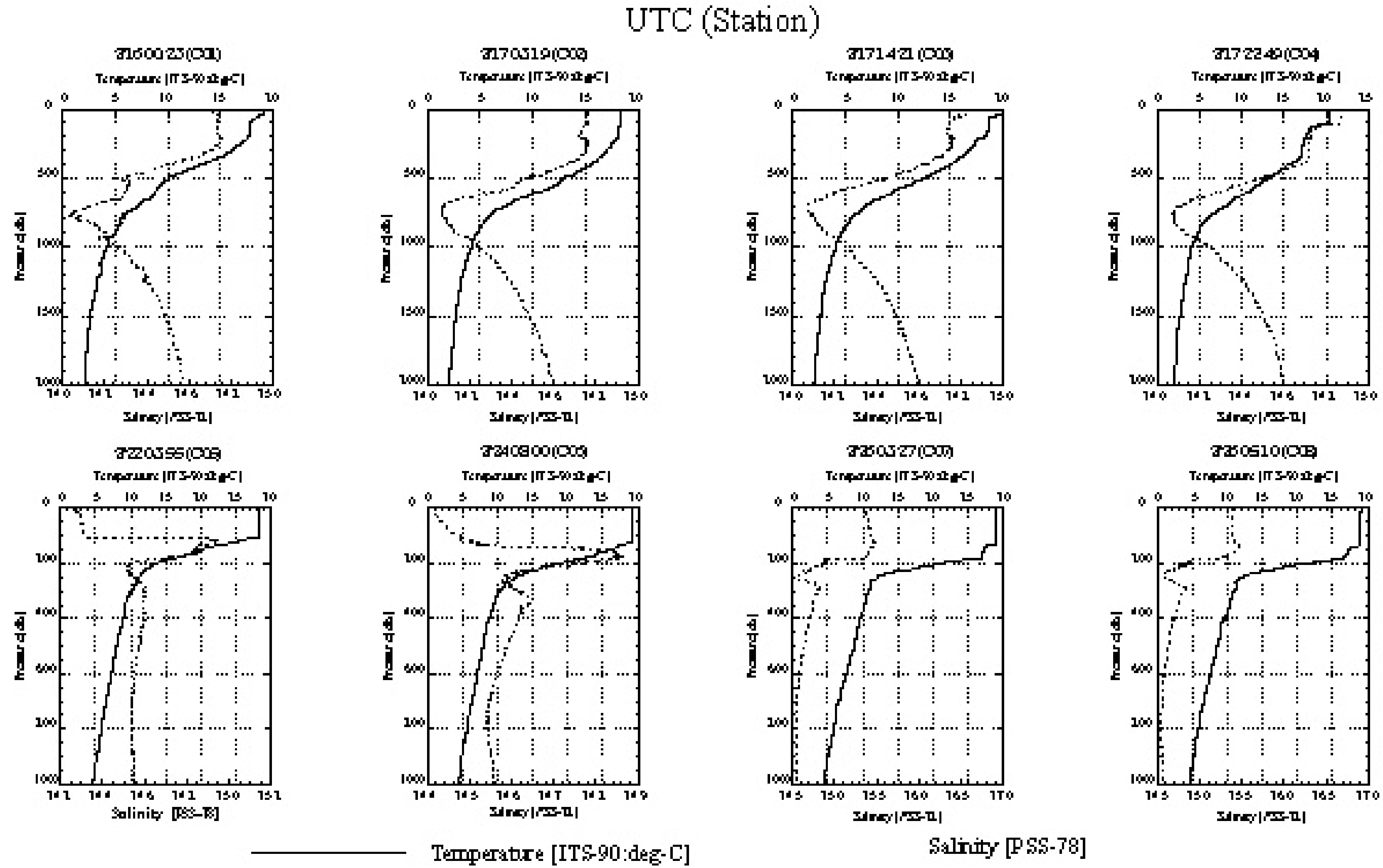


Fig 6.2.1-1

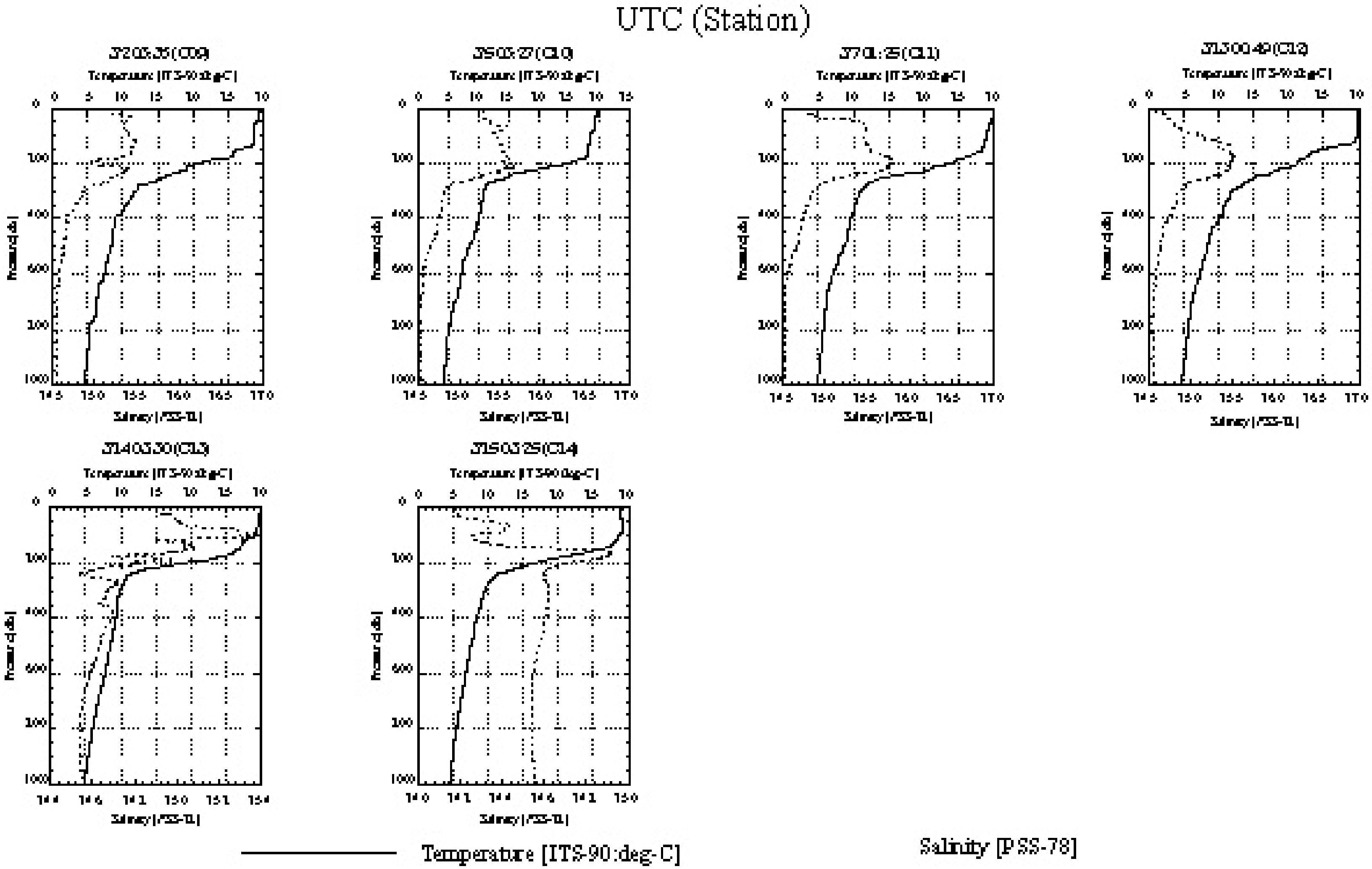


Fig 4.2.1-2

6.2.2 XCTD

(1) Personnel

Fumitaka Yoshiura (GODI): Operation Leader

Wataru Tokunaga (GODI): Operator

Kasis Inape (PNG NWS): Operator

Keiichiro Shishido (R/V Mirai Crew): Operator

(2) Objectives

Investigation of oceanic structure.

(3) Parameters

Accoding to the manufacturer's information, 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	+/- 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 the XCTD-1 manufactured by Tsurumi-Seiki Co.. The signal was converted by MK-100, Tsurumi-Seiki Co. and was recorded by WinXCTD software (Ver.1.03) made by Tsurumi-Seiki Co.. We dropped 44 probes (X01-X43) by using automatic launcher.

Table 6.2.2-1 shows the summary of XCTD observation log.

Station	Date	Time	Lat.	Lon.	SST	SSS	MMD	WD	Probe S/N
X01	2001/2/15	15:25:44	38-19.96N	143-03.38E	11.332	34.328	1037	1887	00092764
X02	2001/2/15	16:52:22	38-00.00N	143-12.30E	6.883	33.808	1038	2625	00092766
X03	2001/2/15	18:51:34	37-39.97N	143-23.65E	10.745	34.307	1037	4823	00092765
X04	2001/2/15	20:47:34	37-21.55N	143-34.58E	14.188	34.604	1037	7301	00092768
X05	2001/2/15	22:46:38	36-59.88N	143-43.97E	19.151	34.708	1037	6971	00092763
X06	2001/2/16	0:09:07	36-41.68N	143-51.18E	19.312	34.722	1037	6208	00092769
X07_1	2001/2/16	3:26:40	36-19.81N	144-04.05E	17.544	34.741	727	5152	00092770
X07_2	2001/2/16	3:35:33	36-18.39N	144-04.65E	17.557	34.738	1037	4905	00092767
X08	2001/2/16	4:56:51	36-00.91N	144-12.78E	17.706	34.734	1038	5714	00113311
X09	2001/2/16	6:38:26	35-40.35N	144-22.45E	18.021	34.740	1037	4491	00092760
X10	2001/2/16	8:02:27	35-20.82N	144-31.75E	17.681	34.734	1038	5707	00092762

X11	2001/2/16	9:35:07	34-59.88N	144-41.15E	17.592	34.734	1036	5791	00092759
X12	2001/2/16	10:50:37	34-40.74N	144-49.08E	17.552	34.741	1036	5788	00092761
X13	2001/2/16	12:15:15	34-19.98N	144-56.96E	17.588	34.744	1038	5803	00113312
X14	2001/2/16	13:28:39	33-59.95N	144-59.72E	17.629	34.713	1038	5778	00113310
X15	2001/2/16	14:55:15	33-39.99N	145-10.22E	13.680	34.485	1037	5801	00113313
X16	2001/2/16	16:33:44	33-20.96N	145-27.55E	15.930	34.621	1037	5669	00092633
X17	2001/2/16	18:17:51	33-00.01N	145-38.14E	18.069	34.734	1038	5804	00092629
X18	2001/2/16	19:41:34	32-40.89N	145-47.00E	19.373	34.719	1037	5943	00092632
X19	2001/2/16	21:16:54	32-19.71N	145-55.95E	18.682	34.753	1037	6023	00092631
X20	2001/2/16	22:40:11	32-01.08N	146-04.96E	19.130	34.765	1038	6128	00092628
X21	2001/2/17	0:58:28	31-30.04N	146-18.28E	18.750	34.753	1037	6054	00092681
X22	2001/2/17	3:02:45	31-01.54N	146-30.99E	18.370	34.758	1037	6172	00092624
X23	2001/2/17	7:38:16	30-29.94N	146-44.72E	18.440	34.735	1038	6219	00092627
X24	2001/2/17	9:47:54	30-01.00N	146-58.22E	18.723	34.760	1037	6246	00092626
X25	2001/2/17	12:07:40	29-30.00N	147-11.75E	19.091	34.786	1037	6234	00092669
X26	2001/2/17	14:06:53	29-01.90N	147-24.33E	18.635	34.763	1037	6148	00092683
X27	2001/2/17	18:25:20	28-30.00N	147-38.18E	20.113	34.854	1037	6084	00092625
X28	2001/2/17	20:32:53	28-00.01N	147-51.34E	20.377	34.851	1038	5698	00092630
X29	2001/2/17	22:39:08	27-31.56N	148-04.87E	20.459	34.869	1037	5828	00092622
X30	2001/2/18	2:39:32	27-00.31N	148-16.97E	20.526	34.900	1037	5654	00092623
X31	2001/2/18	4:47:02	26-30.01N	148-30.38E	22.791	35.009	1037	6164	00092656
X32	2001/2/18	6:52:32	26-00.13N	148-43.12E	23.688	35.210	1037	6321	00092658
X33	2001/2/23	6:02:34	06-59.99N	155-59.52E	28.321	34.184	1037	4439	00092654
X34	2001/2/23	10:02:41	05-59.81N	156-01.89E	28.637	33.917	1037	4065	00092653
X35	2001/2/25	5:22:23	03-59.97N	156-00.26E	29.245	34.760	1037	3475	00092651
X36	2001/2/25	9:17:44	02-59.71N	155-55.87E	29.127	35.234	1037	2820	00092652
X37	2001/2/27	6:41:30	00-59.71N	155-58.91E	29.503	35.346	1037	2271	00092648
X38	2001/3/3	4:19:32	01-00.07S	155-53.03E	30.313	35.364	1041	2109	00092649
X39	2001/3/6	4:37:10	03-00.00S	155-58.68E	29.513	34.902	1038	1812	00092708
X40	2001/3/6	8:38:01	04-00.15S	156-00.03E	30.124	34.951	1043	1780	00092650
X41	2001/3/13	8:10:50	01-00.03N	147-12.17E	30.305	34.775	1026	4543	00092707
X42	2001/3/14	7:34:57	03-00.02N	146-58.36E	29.695	34.898	1037	4455	00092706
X43	2001/3/14	11:26:45	04-00.02N	147-00.17E	29.616	34.724	1036	4697	00092703

Acroyms in Table 6.2.2-1 are as follow;

SST: Sea Surface Temperature [deg-C] mesured by Continuous Sea Surface Monitoring System.

SSS: Sea Surface Salinity [PSU] measured by Continuous Sea Surface Monitoring System.

MMD: Maximum Measured Depth [m]

WD: Water Depth [m]

(5) Preliminary results

Verivcal sections are shown in the following figures combined with CTD data. Fig. 6.2.2-1 and Fig. 6.2.2-2 are temperature and salinity plots along ship's track from 38-20N to 26-00N, Fig. 6.2.2-3 and Fig. 6.2.2-4 are along 156E, Fig. 6.2.2-5 and Fig. 6.2.2-6 are along 147E respectivity.

(6) Data archives

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

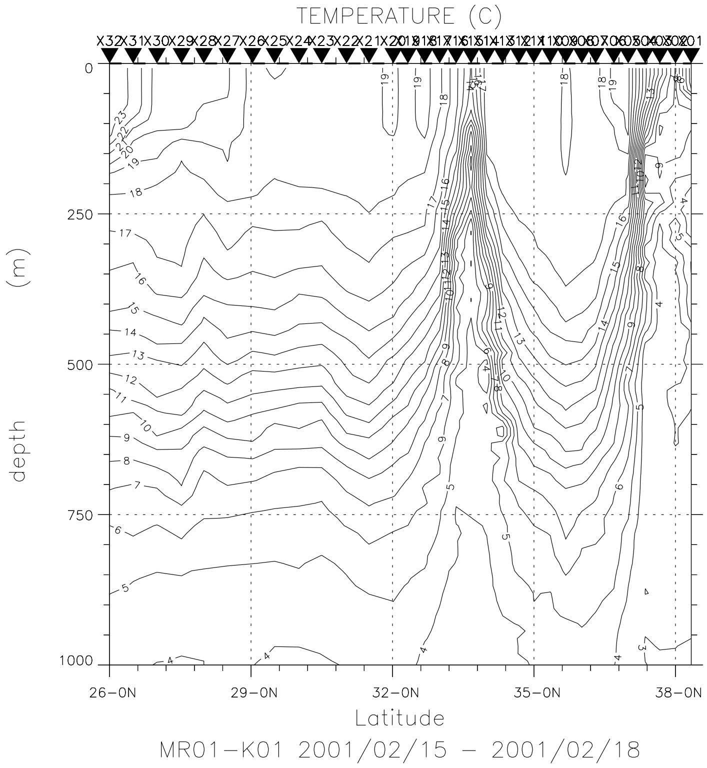


Fig. 6.2.2-1 Temperature along ship's track from 38-20N to 26-00N

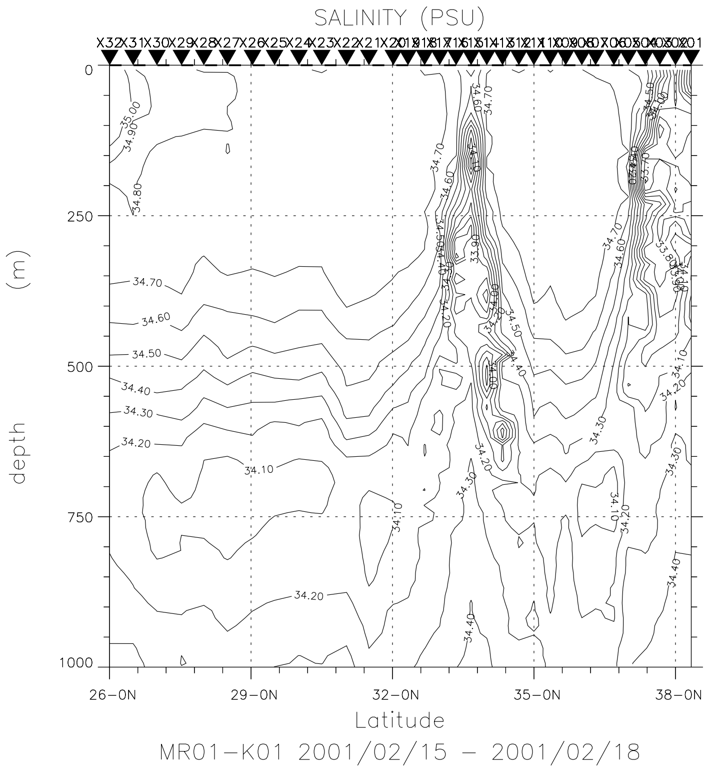


Fig. 6.2.2-2 Salinity along ship's track from 38-20N to 26-00N

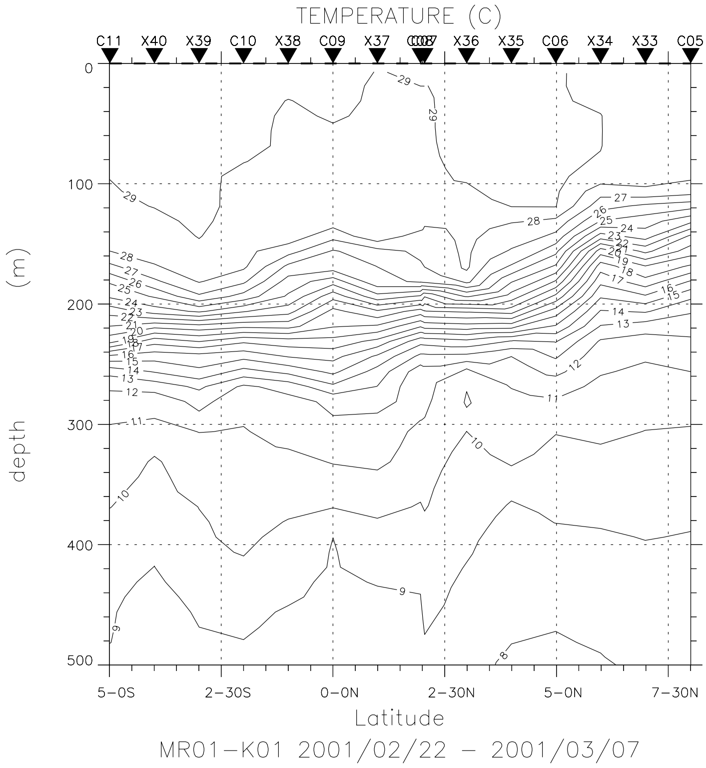


Fig. 6.2.2-3　Temperature along 156E

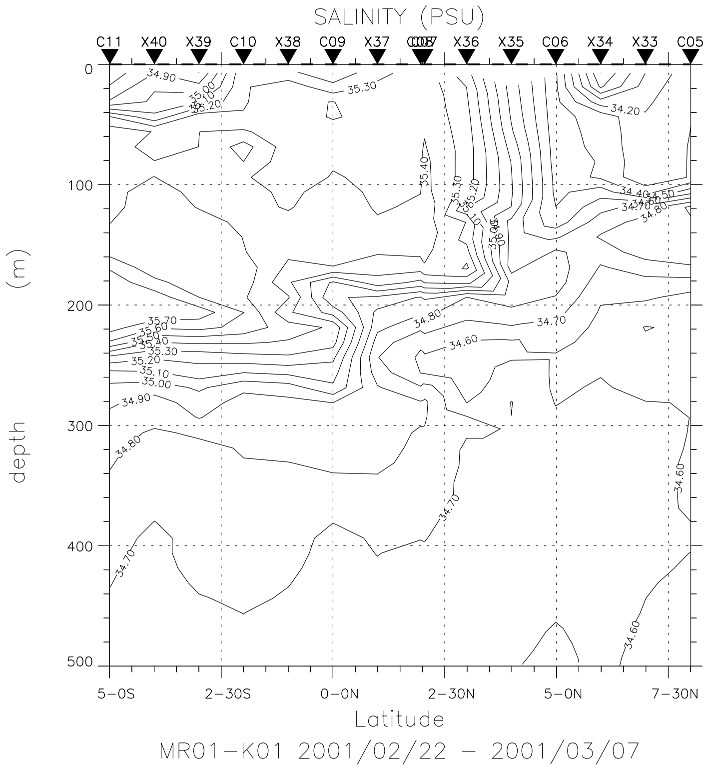


Fig. 6.2.2-4　Salinity along 156E

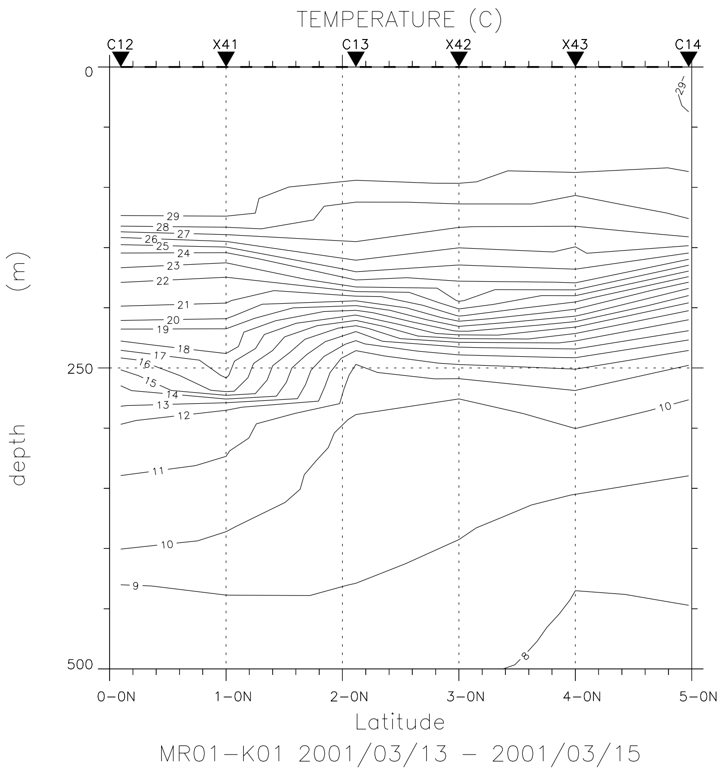


Fig. 6.2.2-5 Temperature along 147E

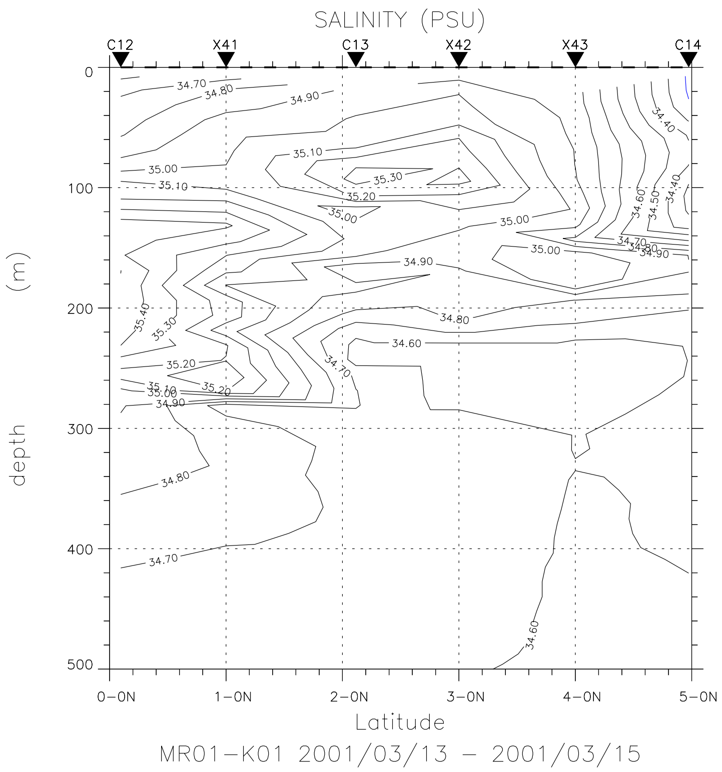


Fig. 6.2.2-6 Salinity along 147E

6.2.3 Salinity measurement of sampled seawater for validation of CTD salinity data

(1) Personnel

Hirokatsu UNO (MWJ): Operation Leader
Kaori AKIZAWA (MWJ)
Miki YOSHIIKE (MWJ)

(2) Objective

To check the quality of CTD

(3) Parameter

Salinity of sampled seawater

(4) Method

Seawater samples were collected 12-litter Niskin Bottle. Sampling layer at St.C01, C02, C03, C04 are 2,000 db, 1,500 db, and 1,000 db, and the other stations are sampled at only 1,000 db. The bottles in which the salinity was sampled stored were 250ml Phoenix brown glass bottles with screw caps. Each bottle was rinsed three times and filled with sample water. Salinity samples were stored in the same laboratory as the salinity measurement was made.

The salinity measurements were carried out using the laboratory salinometer (Model 8400B AUTOSAL S/N 62823; Guildline Instruments Ltd.), which was modified with Ocean Scientific International peristaltic-type sample intake pump. The instrument was operated in the "AUTOSAL Room" of R/V Mirai with a bath temperature 24 deg-C. A double conductivity ratio was defined as a median of 31 readings of the salinometer. Data collection was started after 15 data readings and it took about 10 seconds by a PC. We obtained two conductivity reading for each sample, and averaged values were used to calculate salinity. The salinometer was standardized with IAPSO Standard Seawater batch P137 whose conductivity ratio is 0.99995 (salinity 34.998). Sub-standard was used to check the drift of the AUTOSAL and measured in every 8 sampled.

(5) Results

Measurement data of all samples were shown in Table 6.2.3-1 and Table 6.2.3-2. Salinity comparison between CTD data and AUTOSAL data sampled ware shown in Table 6.2-2, Fig.6.2.3-3, Fig.6.2.3-1 and Fig.6.2.3-2.

(6) Data archive

The data of sample will be submitted to the Data Management Office (DMO) in JAMSTEC together with the MO disk of CTD data in this cruise.

Table6.2.3-1 Salinity comparison between CTD and AUTOSAL

St.	Niskin No.	Date	Depth (m)	CTD-Sal. (PSU)	Bottle No.	AUTOSAL (PSU)	Difference (PSU)	Ex. Bad Sample (PSU)	Remarks
C01	1	15 Feb. 2001	1997.48	34.5767	1	34.5729	0.0038	0.0038	
	1		1997.48	34.5767	2	34.5726	0.0041	0.0041	
	3		1994.24	34.5763	3	34.5728	0.0035	0.0035	
	3		1994.24	34.5763	4	34.5726	0.0037	0.0037	
	5		1500.85	34.4920	5	34.4884	0.0036	0.0036	
	5		1500.85	34.4920	6	34.4886	0.0034	0.0034	
	7		1502.20	34.4924	7	34.4887	0.0037	0.0037	
	7		1502.20	34.4924	8	34.4886	0.0038	0.0038	
	9		1000.74	34.2605	9	34.3003	0.0398		
	9		1000.74	34.2605	10	34.3005	0.0400		
	11		1000.41	34.2600	11	34.2572	0.0028	0.0028	
	11		1000.41	34.2600	12	34.2577	0.0023	0.0023	
C02	1	17 Feb. 2001	1998.55	34.5965	25	34.5926	0.0039	0.0039	
	1		1998.55	34.5965	14	34.5924	0.0041	0.0041	
	3		1997.07	34.5958	15	34.5925	0.0033	0.0033	
	3		1997.07	34.5958	16	34.5930	0.0028	0.0028	
	5		1499.72	34.4943	17	34.4914	0.0029	0.0029	
	5		1499.72	34.4943	18	34.4902	0.0041	0.0041	
	7		1500.51	34.4951	19	34.4905	0.0046	0.0046	Niskin Bottle Leak
	7		1500.51	34.4951	20	34.4899	0.0052	0.0052	Niskin Bottle Leak
	9		1000.94	34.2487	21	34.3092	0.0605		
	9		1000.94	34.2487	22	34.3088	0.0601		
	11		1002.68	34.2497	23	34.2456	0.0041	0.0041	
	11		1002.68	34.2497	24	34.2455	0.0042	0.0042	
C03	1	17 Feb. 2001	2002.62	34.5969	26	34.5947	0.0022	0.0022	
	1		2002.62	34.5969	27	34.5938	0.0031	0.0031	
	5		1498.75	34.4956	28	34.4921	0.0035	0.0035	
	5		1498.75	34.4956	29	34.4940	0.0016	0.0016	
	9		1000.08	34.2542	30	34.2513	0.0029	0.0029	
	9		1000.08	34.2542	31	34.2508	0.0034	0.0034	
C04	1	18 Feb. 2001	1999.67	34.5998	32	34.5973	0.0025	0.0025	
	1		1999.67	34.5998	33	34.5963	0.0035	0.0035	
	5		1499.06	34.5034	34	34.4997	0.0037	0.0037	
	5		1499.06	34.5034	35	34.4991	0.0043	0.0043	
	9		999.85	34.2588	36	34.2552	0.0036	0.0036	
	9		999.85	34.2588	37	34.2552	0.0036	0.0036	
C05	1	22 Feb. 2001	1000.00	34.5546	1	34.5522	0.0025	0.0025	
	1		1000.00	34.5546	2	34.5522	0.0025	0.0025	
	7		999.50	34.5545	3	34.5521	0.0025	0.0025	
	7		999.50	34.5545	4	34.5525	0.0020	0.0020	
C06	7	24 Feb. 2001	1000.18	34.5581	5	34.5553	0.0028	0.0028	
	7		1000.18	34.5581	6	34.5553	0.0028	0.0028	
C07	1	26 Feb. 2001	1000.10	34.5579	7	34.5557	0.0022	0.0022	
	1		1000.10	34.5579	8	34.5558	0.0021	0.0021	
	7		1000.06	34.5579	9	34.5554	0.0025	0.0025	
	7		1000.06	34.5579	10	34.5552	0.0027	0.0027	
C08	1	26 Feb. 2001	999.14	34.5555	11	34.5534	0.0021	0.0021	
	1		999.14	34.5555	12	34.5534	0.0021	0.0021	
	7		999.15	34.5556	14	34.5531	0.0025	0.0025	
	7		999.15	34.5556	15	34.5545	0.0011	0.0011	

St.	Niskin No.	Date	Depth (m)	CTD-Sal. (PSU)	Bottle No.	AUTOSAL (PSU)	Difference (PSU)	Ex. Bad Sample (PSU)	Remarks
C09	1	02 Mar. 2001	1000.79	34.5546	16	34.5527	0.0019	0.0019	
	1		1000.79	34.5546	17	34.5531	0.0015	0.0015	
	7		1000.77	34.5546	18	34.5519	0.0027	0.0027	Niskin Bottle Leak
	7		1000.77	34.5546	19	34.5520	0.0027	0.0027	Niskin Bottle Leak
C10	1	05 Mar. 2001	998.75	34.5514	20	34.5482	0.0032	0.0032	Niskin Bottle Leak
	1		998.75	34.5514	21	34.5487	0.0027	0.0027	Niskin Bottle Leak
	7		998.32	34.5514	22	34.5485	0.0029	0.0029	Niskin Bottle Leak
	7		998.32	34.5514	23	34.5491	0.0023	0.0023	Niskin Bottle Leak
C11	1	07 Mar. 2001	1000.27	34.5313	24	34.5292	0.0021	0.0021	
	1		1000.27	34.5313	25	34.5286	0.0027	0.0027	
	7		1001.02	34.5315	26	34.5295	0.0020	0.0020	
	7		1001.02	34.5315	27	34.5304	0.0011	0.0011	
C12	1	13 Mar. 2001	1000.37	34.5538	1	34.549	0.0050	0.0050	
	1		1000.37	34.5538	2	34.549	0.0044	0.0044	
	7		1000.83	34.5538	3	34.549	0.0044	0.0044	
	7		1000.83	34.5538	4	34.550	0.0041	0.0041	
C13	1	14 Mar. 2001	1000.35	34.5537	5	34.549	0.0048	0.0048	
	1		1000.35	34.5537	6	34.550	0.0032	0.0032	
	7		1000.17	34.5535	7	34.550	0.0032	0.0032	
	7		1000.17	34.5535	8	34.549	0.0047	0.0047	
C14	1	15 Mar. 2001	1000.71	34.5563	9	34.551	0.0051	0.0051	
	1		1000.71	34.5563	10	34.552	0.0047	0.0047	
	7		1000.24	34.5561	11	34.552	0.0041	0.0041	
	7		1000.24	34.5561	12	34.551	0.0050	0.0050	
						Avg.	0.0057	0.0032	
						Std Dev.	0.0110	0.0010	

Note: The shadow line show the Ex. Samples.

Table6.2.3-2 Salinity comparison each replicate samples

St.	Niskin No.	Date	Depth (m)	CTD-Sal. (PSU)	Bottle No.	AUTOSAL (PSU)	Difference (PSU)
C01	1		1997.48	34.5767	1	34.5729	0.0003
	1		1997.48	34.5767	2	34.5726	
	3		1994.24	34.5763	3	34.5728	0.0002
	3		1994.24	34.5763	4	34.5726	
	5		1500.85	34.4920	5	34.4884	0.0002
	5		1500.85	34.4920	6	34.4886	
	7		1502.20	34.4924	7	34.4887	0.0001
	7		1502.20	34.4924	8	34.4886	
	9		1000.74	34.2605	9	34.3003	0.0002
	9		1000.74	34.2605	10	34.3005	
	11		1000.41	34.2600	11	34.2572	0.0006
	11		1000.41	34.2600	12	34.2577	
C02	1		1998.55	34.5965	25	34.5926	0.0002
	1		1998.55	34.5965	14	34.5924	
	3		1997.07	34.5958	15	34.5925	0.0005
	3		1997.07	34.5958	16	34.5930	
	5		1499.72	34.4943	17	34.4914	0.0012
	5		1499.72	34.4943	18	34.4902	
	7		1500.51	34.4951	19	34.4905	0.0006
	7		1500.51	34.4951	20	34.4899	
	9		1000.94	34.2487	21	34.3092	0.0005
	9		1000.94	34.2487	22	34.3088	
	11		1002.68	34.2497	23	34.2456	0.0001
	11		1002.68	34.2497	24	34.2455	
C03	1		2002.62	34.5969	26	34.5947	0.0009
	1		2002.62	34.5969	27	34.5938	
	5		1498.75	34.4956	28	34.4921	0.0020
	5		1498.75	34.4956	29	34.4940	
	9		1000.08	34.2542	30	34.2513	0.0005
	9		1000.08	34.2542	31	34.2508	
C04	1		1999.67	34.5998	32	34.5973	0.0010
	1		1999.67	34.5998	33	34.5963	
	5		1499.06	34.5034	34	34.4997	0.0006
	5		1499.06	34.5034	35	34.4991	
	9		999.85	34.2588	36	34.2552	0.0000
	9		999.85	34.2588	37	34.2552	
C05	1		1000.00	34.5546	1	34.5522	0.0000
	1		1000.00	34.5546	2	34.5522	
	7		999.50	34.5545	3	34.5521	0.0005
	7		999.50	34.5545	4	34.5525	
C06	7		1000.18	34.5581	5	34.5553	0.0000
	7		1000.18	34.5581	6	34.5553	
C07	1		1000.10	34.5579	7	34.5557	0.0001
	1		1000.10	34.5579	8	34.5558	
	7		1000.06	34.5579	9	34.5554	0.0002
	7		1000.06	34.5579	10	34.5552	
C08	1		999.14	34.5555	11	34.5534	0.0000
	1		999.14	34.5555	12	34.5534	
	7		999.15	34.5556	14	34.5531	0.0014
	7		999.15	34.5556	15	34.5545	

St.	Niskin No.	Date	Depth (m)	CTD-Sal. (PSU)	Bottle No.	AUTOSAL (PSU)	Difference (PSU)
C09	1		1000.79	34.5546	16	34.5527	0.0004
	1		1000.79	34.5546	17	34.5531	
	7		1000.77	34.5546	18	34.5519	0.0001
	7		1000.77	34.5546	19	34.5520	
C10	1		998.75	34.5514	20	34.5482	0.0005
	1		998.75	34.5514	21	34.5487	
	7		998.32	34.5514	22	34.5485	0.0006
	7		998.32	34.5514	23	34.5491	
C11	1		1000.27	34.5313	24	34.5292	0.0006
	1		1000.27	34.5313	25	34.5286	
	7		1001.02	34.5315	26	34.5295	0.0010
	7		1001.02	34.5315	27	34.5304	
C12	1	13 Mar. 2001	1000.37	34.5538	1	34.549	0.0006
	1		1000.37	34.5538	2	34.549	
	7		1000.83	34.5538	3	34.549	0.0003
	7		1000.83	34.5538	4	34.550	
C13	1	14 Mar. 2001	1000.35	34.5537	5	34.549	0.0016
	1		1000.35	34.5537	6	34.550	
	7		1000.17	34.5535	7	34.550	0.0015
	7		1000.17	34.5535	8	34.549	
C14	1	15 Mar. 2001	1000.71	34.5563	9	34.551	0.0004
	1		1000.71	34.5563	10	34.552	
	7		1000.24	34.5561	11	34.552	0.0010
	7		1000.24	34.5561	12	34.551	
						Avg.	0.0005
						Std Dev.	0.0005

Table6.2.3-3 Salinity comparison between CTD data and AUTOSAL data sampled at 1,000m

St.	Niskin No.	Pressure (db)	Salinity (PSU)			Bottle No.
			CTD	AUTOSAL	Difference	
C01	11	1000.41	34.2600	34.2577	0.0023	12
C02	11	1002.68	34.2497	34.2456	0.0041	23
C03	9	1000.08	34.2542	34.2513	0.0029	30
C04	9	999.85	34.2588	34.2552	0.0036	36
C05	7	999.50	34.5545	34.5525	0.0020	4
C06	7	1000.18	34.5581	34.5553	0.0028	5
C07	1	1000.10	34.5579	34.5558	0.0021	8
C08	7	999.15	34.5556	34.5545	0.0011	15
C09	1	1000.79	34.5546	34.5531	0.0015	17
C10	7	998.32	34.5514	34.5491	0.0023	23
C11	7	1001.02	34.5315	34.5304	0.0011	27
C12	7	1000.83	34.5538	34.5497	0.0041	4
C13	1	1000.35	34.5537	34.5505	0.0032	6
C14	7	1000.24	34.5561	34.5521	0.0041	11
				Avg.	0.0027	
				Std Dev.	0.0011	

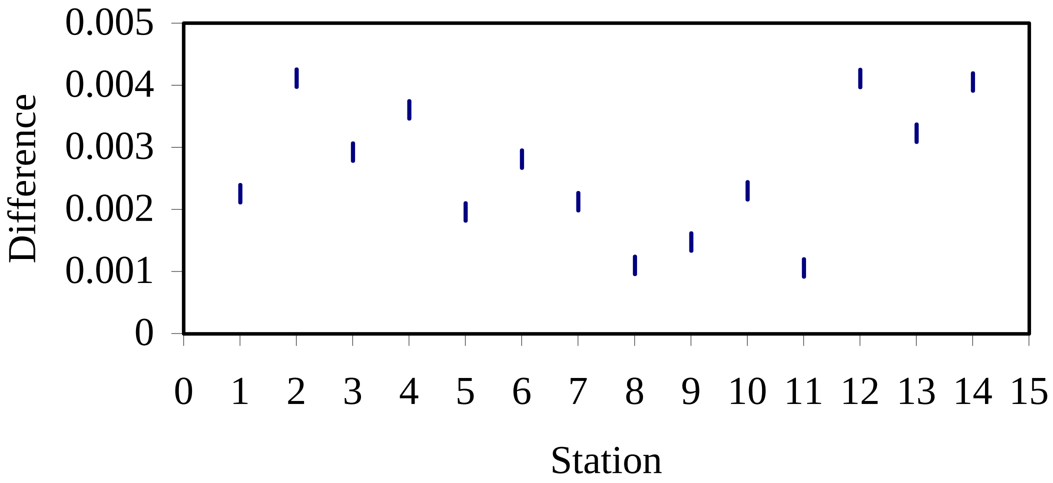


Fig.6.2.3-1 Difference of salinity between CTD and AUTOSAL.

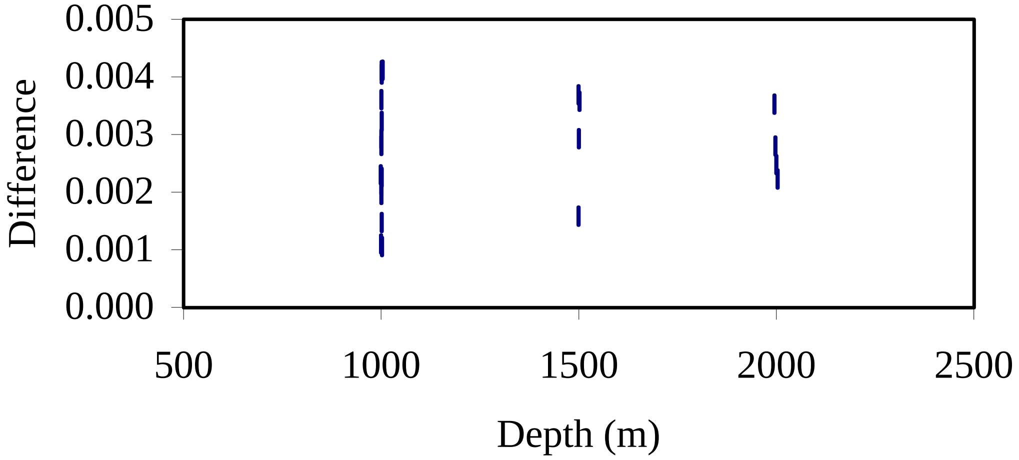


Fig.6.3.2-2 Difference of salinity between CTD and AUTOSAL.

6.3 Continuous monitoring of surface seawater

6.3.1 Continuous monitoring of surface seawater

(1) Personnel name and affiliation

Taeko OHAMA	(MWJ) Leg.1
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(2) Objective

To monitor continuously the physical, chemical and biological characteristics of near-sea surface water.

(3) Methods

The *Continuous Sea Surface Water Monitoring System* (Nippon Kaiyo co., Ltd.) is located in the "*sea surface monitoring laboratory*" on R/V Mirai. It can automatically measure temperature, salinity, dissolved oxygen, fluorescence and particle size of plankton in the near-surface water every 1-minute. Measured data are saved every one-minute together with time and the position of ship, and displayed in the data management PC machine. This system is connected to shipboard LAN-system and provides the acquired data for p-CO_2 measurement system, etc.

The uncontaminated seawater intake is 4.5m below the sea surface. Near-surface water was continuously pumped up about 200 L/min. from the intake to the laboratory and then flowed into *the Continuous Sea Surface Water Monitoring System* and p-CO_2 measurement system etc. through a steel pipe. The flow rate of surface water for this system was 12L/min, which controlled by some valves and passed through some sensors except with fluorometer (about 0.3 L/min.) through vinyl-chloride pipes.

The Continuous Sea Surface Water Monitoring System has six kinds of sensors, which TSG comprises of two SBE sensor modules. Sea surface temperature is measured by a ship bottom oceanographic thermometer situated on the suction side of the uncontaminated seawater supply in the forward hold. Specification and calibration date of the each sensor in this system of listed below.

a-1) Temperature and salinity sensors

SEACAT THERMOSALINOGRAPH

Model:	SBE-21, SEA-BIRD ELECTRONICS, INC.	
Serial number:	2118859-2641	
Measurement range:	Temperature -5 to +35 deg-C,	Salinity 0 to 6.5 S/m
Accuracy:	Temperature 0.01 deg-C/6month,	Salinity 0.001 S/m/month
Resolution:	Temperature 0.001 deg-C,	Salinity 0.0001 S/m
Calibration date:	09-Jan-01.	

a-2) Ship bottom oceanographic thermometer (mounted at the back of the pump for surface water)

Model:	SBE 3S-A, SEA-BIRD ELECTRONICS, INC.
Serial number:	032067
Measurement range:	-5 to +35 deg-C
Initial Accuracy:	0.001 deg-C per year typical
Stability:	0.002 deg-C per year typical
Calibration date:	23-Aug.-00.

b) Dissolved oxygen sensor

Model:	2127, Oubisufair Laboratories Japan INC.
Serial number:	31757
Measurement range:	0 to 14 ppm
Accuracy:	±1% at 5 deg-C of correction range
Stability:	1% per month
Calibration date:	15-Feb-01.

c) Fluorometer

Model:	10-AU-005, TURNER DESIGNS
Detection limit:	5 ppt or less for chlorophyll a
Stability:	0.5% per month of full scale

d) Particle size sensor

Model:	P-05, Nippon Kaiyo LTD.
Serial number:	P5024
Accuracy:	±10% of range
Measurement range:	0.02681mm to 6.666mm
Reproducibility:	±5%
Stability:	5% per week

e) Flowmeter

Model:	EMARG2W, Aichi Watch Electronics LTD.
Serial number:	8672
Measurement range:	0 to 30 L/min
Accuracy:	±1%
Stability:	±1% per day

The monitoring periods (UTC) during this cruise are listed below.

Leg.1 15-Feb.-01. to 16-Mar.-01. (From Hachinohe to Guam)

Leg.2 18-Mar.-01. to 22-Mar.-01. (From Guam to Yokosuka)

(4) Preliminary Result

(4-1) Salinity sensor

We sampled one (leg 1) and three (leg 2) times every day for salinity sensor calibration. All salinity samples were collected from the course of the system while on station or from regions with weak horizontal gradients. All samples were analyzed on the Guildline 8400B.

The results were shown in Table 6.3.1-1., Figure 6.3.1-1.

(4-2) Dissolved Oxygen (D.O.) sensor

D.O. sensor of this system was calibrated before this cruise. To estimate of accuracy of the sensor, we collected the samples from the course of the system and analyzed by Winkler method. The standardization and pure water blank determination have been performed before the sample titration.

The results were shown in Table 6.3.1-2., Figure 6.3.1-2. Precision of the sensor was different from the concentration and each calibration.

(5) Result

Preliminary data 10 minutes from Hachinohe to Yokosuka. These data were compared with five part of Hachinohe to long.156E, long.156E, long.156E to 147E, long.147E to Guam, Guam to Yokosuka (shown in Fig. 6.3.1-3, Fig. 6.3.1-4, Fig. 6.3.1-5, Fig. 6.3.1-6, Fig. 6.3.1-7) . All salinity and dissolved oxygen data were not corrected.

(6) Other remarks

Equation was to obtain values of temperature (IPTS-68) converted into ITS-90 as follows.

$$T_{90} = 0.99976 * T_{68}$$

(7) Data archive

Format of raw data files was ASCII, calibration values of salinity and temperature (IPTS-68, ITS-90) were Microsoft excel files and ASCII format files, were stored on a magnetic optical disk (M.O.disk). All the data will be submitted to the DMO at JAMSTEC.

Table 6.3-1 Comparison of salinity between salinity sensor of Sea Surface Monitoring System and samples analyzed by Autosal salinometer.

Leg. No.	Sampling Date and Time (UTC)		Sampling Position		Tctd	Sctd	Ssal	Sctd-Ssal
			latitude	longitude	(IPTS-68)	(PSS78)	(PSS78)	(PSS78)
1	2/15/01	11:53	39-10.441N	142-39.609E	5.9001	33.5434	33.5457	-0.0023
1	2/16/01	12:54	34-09.434N	144-57.601E	17.7210	34.7501	34.7454	0.0047
1	2/17/01	11:14	29-42.569N	147-06.886E	18.7856	34.7483	34.7451	0.0032
1	2/18/01	11:18	24-57.706N	149-10.193E	24.1996	35.1956	35.1867	0.0089
1	2/20/01	11:41	13-38.275N	153-46.010E	27.3763	34.3575	34.3537	0.0038
1	2/21/01	11:29	08-01.435N	155-55.469E	28.2576	34.2987	34.2934	0.0053
1	2/22/01	10:14	07-59.227N	155-52.874E	28.2041	34.2756	34.2722	0.0034
1	2/23/01	10:07	05-58.990N	156-01.955E	28.6366	33.8853	33.8896	-0.0043
1	2/24/01	10:54	04-59.620N	156-01.084E	29.1305	34.4329	34.4278	0.0051
1	2/25/01	10:25	02-43.522N	155-54.551E	29.1034	35.3128	35.3156	-0.0028
1	2/26/01	9:20	01-56.721N	155-50.454E	29.2373	35.3854	35.3788	0.0066
1	2/27/01	11:15	00-00.341N	156-07.651E	29.4359	35.2201	35.2154	0.0047
1	2/28/01	10:19	00-01.590N	156-03.689E	29.3550	35.0750	35.0692	0.0058
1	3/1/01	10:06	00-04.302N	156-08.977E	29.4192	35.1145	35.1117	0.0028
1	3/2/01	8:28	00-01.219S	155-51.442E	29.8294	35.1318	35.1262	0.0056
1	3/3/01	10:33	01-34.093S	155-52.070E	29.9602	35.2247	35.2209	0.0038
1	3/5/01	10:25	01-58.859S	155-55.367E	29.8116	35.2633	35.2612	0.0021
1	3/6/01	10:40	04-30.694S	156-00.697E	30.3364	34.9186	34.9270	-0.0084
1	3/7/01	10:32	04-56.396S	156-03.041E	30.1066	34.7044	34.7013	0.0031
1	3/8/01	10:12	04-50.970S	156-24.897E	30.1117	34.6033	34.5991	0.0042
1	3/9/01	10:51	03-42.468S	154-47.247E	30.6900	34.9887	34.9995	-0.0108
1	3/10/01	10:15	02-03.111N	156-00.414E	29.1324	35.3135	34.6359	0.6776
1	3/11/01	22:45	01-16.009N	152-27.638E	29.6882	35.1867	35.0431	0.1436
1	3/12/01	9:18	00-39.680N	149-43.104E	29.9805	34.8983	34.7664	0.1319
1	3/14/01	12:47	04-20.450N	147-00.640E	29.7496	34.8161	34.8130	0.0031
2	3/18/01	04:11	14-29.925N	144-21.311E	27.908	34.7692	34.7676	0.0100
2	3/18/01	12:05	16-30.279N	143-56.656E	27.8032	34.8753	34.8705	0.0092
2	3/18/01	20:08	18-34.457N	143-30.721E	27.1285	34.9207	34.9160	-0.0009
2	3/19/01	04:06	20-28.251N	143-07.101E	25.1747	35.0103	35.0059	-0.0024
2	3/19/01	12:06	22-19.206N	142-42.198E	24.9262	35.0419	35.0356	0.0125
2	3/19/01	20:06	24-18.021N	142-14.698E	24.0478	35.0114	35.0121	0.0098
2	3/20/01	04:07	26-12.595N	141-47.340E	22.1656	34.9220	34.9122	-0.0007
2	3/20/01	11:59	27-43.640N	141-26.085E	20.9064	34.8823	34.8698	0.0063
2	3/20/01	20:07	29-18.820N	141-05.710E	19.0979	34.7723	34.7747	0.0044
2	3/21/01	04:03	30-46.228N	140-43.192E	19.5024	34.7045	34.7054	0.0047
2	3/21/01	12:02	32-18.074N	140-24.573E	20.2905	34.7644	34.7552	0.0048
2	3/21/01	20:07	33-54.881N	140-03.690E	17.1478	34.7009	34.6909	0.0016

Table 6.3-2 Comparison of D.O. values between D.O. sensor of Sea Surface Monitoring System and water samples from the system using Winkler method.

Leg. No.	Sampling Date and Time (UTC)		Sampling Positon		Salinity (PSU)	T of SBE21 (deg-C)	T of IPTS-9 (deg-C)	D.O. sensor (ml/l)	Winkler (ml/l)	difference
			Latitude	Longitude						
1	2/16/01	12:54	34-09.137N	144-57.586E	34.748	17.723	17.719	5.919	5.330	0.589
1	2/16/01	12:57	34-08.271N	144-57.572E	34.748	17.720	17.716	5.899	5.179	0.720
1	2/18/01	11:21	24-57.456N	149-10.312E	35.191	24.182	24.176	5.708	4.771	0.937
1	2/18/01	11:24	24-56.774N	149-10.653E	35.189	24.151	24.145	5.696	4.770	0.926
1	2/20/01	11:45	13-37.360N	153-46.360E	34.356	27.387	27.380	5.385	4.530	0.855
1	2/20/01	11:49	13-36.440N	153-46.716E	34.358	27.401	27.394	5.387	4.552	0.835
1	2/23/01	10:11	05-58.179N	156-02.011E	33.691	28.481	28.474	5.258	4.490	0.768
1	2/23/01	10:13	05-57.689N	156-02.043E	33.610	28.428	28.421	5.258	4.495	0.763
1	2/25/01	10:29	02-42.541N	155-54.460E	35.323	29.109	29.102	5.098	4.382	0.716
1	2/25/01	10:32	02-41.806N	155-54.387E	35.320	29.106	29.099	5.101	4.358	0.743
1	2/28/01	10:23	00-01.622N	156-03.721E	35.075	29.351	29.344	5.178	4.453	0.725
1	2/28/01	10:26	00-01.632N	156-03.727E	35.076	29.350	29.343	5.177	4.450	0.727
1	3/3/01	23:39	01-30.093S	155-54.475E	35.189	29.599	29.592	5.145	4.442	0.703
1	3/3/01	23:41	01-30.091S	155-54.445E	35.191	29.599	29.592	5.141	4.439	0.702
1	3/3/01	23:45	01-30.086S	155-54.412E	35.192	29.603	29.596	5.144	4.423	0.721
1	3/6/01	10:43	04-31.450S	156-00.701E	34.929	30.488	30.481	5.119	4.397	0.722
1	3/6/01	10:46	04-32.216S	156-00.704E	34.940	30.495	30.488	5.111	4.408	0.703
1	3/9/01	10:54	03-42.262S	154-47.409E	34.992	30.743	30.736	5.107	4.384	0.723
1	3/11/01	22:47	01-15.959N	152-27.372E	35.187	29.693	29.686	5.091	4.411	0.680
1	3/11/01	22:49	01-15.858N	152-26.838E	35.191	29.704	29.697	5.089	4.439	0.650

*：This data shows Temperature of IPTS-68.

Table Results of fluorescence and chl.a concentraion for the sea surface samples.

Leg. No.	Sampling Date and Time (UTC)		Sampling Positon		Fluorescence	extraction Vol.	concentraion of
			Latitude	Longitude		(ml)	chl a (µg/l)
1	2/16/01	12:49	34-10.916N	144-57.812E	108.000	7	0.240
1	2/17/01	11:17	29-41.835N	147-07.166E	114.520	7	0.224
1	2/18/01	11:25	24-56.183N	149-10.952E	89.602	7	0.067
1	2/20/01	11:42	13-37.821N	153-46.185E	71.038	7	0.027
1	2/22/01	10:15	07-59.221N	155-52.859E	72.616	7	0.045
1	2/23/01	10:08	05-58.990N	156-01.955E	70.556	7	0.060
1	2/24/01	10:55	04-59.636N	156-01.087E	69.735	7	0.065
1	2/25/01	10:24	02-43.773N	155-54.573E	94.734	7	0.272
1	2/26/01	9:21	01-56.718N	155-50.457E	86.795	7	0.169
1	2/27/01	11:16	00-00.360N	156-07.651E	88.657	7	0.175
1	2/28/01	10:20	00-01.604N	156-03.707E	84.102	7	0.192
1	3/2/01	8:30	00-01.223S	155-51.408E	70.370	7	0.122
1	3/3/01	10:32	01-34.080S	155-52.087E	76.112	7	0.121
1	3/5/01	10:28	01-58.833S	155-55.341E	71.893	7	0.082
1	3/6/01	10:41	04-30.940S	156-00.697E	64.820	7	0.080
1	3/7/01	10:31	04-56.411S	156-03.040E	64.194	7	0.139
1	3/10/01	10:17	02-03.108N	156-00.410E	83.369	7	0.144
1	3/11/01	22:43	01-16.110N	152-28.175E	64.649	7	0.119
1	3/12/01	9:17	00-39.740N	149-43.365E	61.409	7	0.056
2	3/18/01	4:13	14-30.451N	144-21.218E	59.841	7	0.033
2	3/18/01	8:10	15-30.005N	144-07.818E	60.020	7	0.049
2	3/18/01	12:04	16-30.019N	143-56.709E	60.648	7	0.092
2	3/18/01	16:00	17-30.516N	143-43.650E	60.693	7	0.070
2	3/18/01	20:07	18-34.199N	143-30.771E	63.641	7	0.061
2	3/18/01	23:59	19-31.821N	143-18.079E	64.162	7	0.052
2	3/19/01	4:04	20-28.270N	143-07.111E	63.725	7	0.064
2	3/19/01	8:02	21-18.966N	142-57.183E	66.624	7	0.051
2	3/19/01	11:59	22-17.524N	142-42.546E	68.923	7	0.052
2	3/19/01	16:00	23-16.087N	142-28.841E	67.493	7	0.055
2	3/19/01	20:06	24-17.761N	142-14.751E	67.858	7	0.098
2	3/19/01	23:59	25-14.354N	142-02.219E	73.811	7	0.092
2	3/20/01	4:06	26-12.598N	141-47.343E	77.263	7	0.188
2	3/20/01	8:02	26-55.212N	141-38.459E	78.312	7	0.084
2	3/20/01	11:59	27-43.640N	141-26.085E	90.809	7	0.159
2	3/20/01	15:59	28-30.882N	141-15.349E	94.119	7	0.209
2	3/20/01	20:06	29-18.636N	141-05.755E	98.296	7	0.461
2	3/20/01	23:59	30-01.033N	140-54.868E	101.287	7	0.490
2	3/21/01	4:02	30-46.230N	140-43.212E	103.029	7	0.687
2	3/21/01	8:02	31-28.234N	140-34.896E	101.636	7	0.438
2	3/21/01	12:01	32-17.856N	140-24.623E	104.603	7	0.345
2	3/21/01	16:03	33-07.808N	140-13.414E	105.495	7	0.670
2	3/21/01	20:06	33-54.700N	140-03.734E	110.138	7	0.555
2	3/21/01	23:59	34-25.919N	139-58.199E	101.453	7	0.544

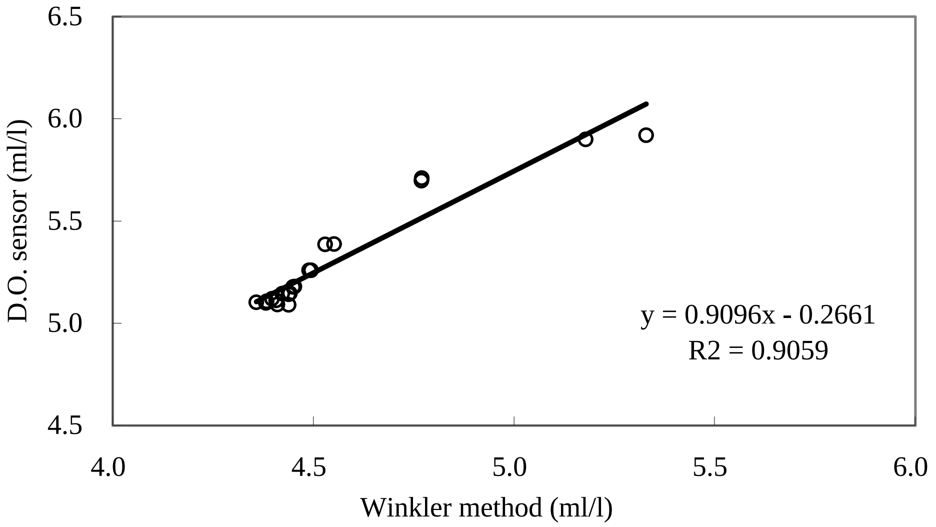


Fig.6.3-1 Correlation with D.O. sensor-Winkler method.

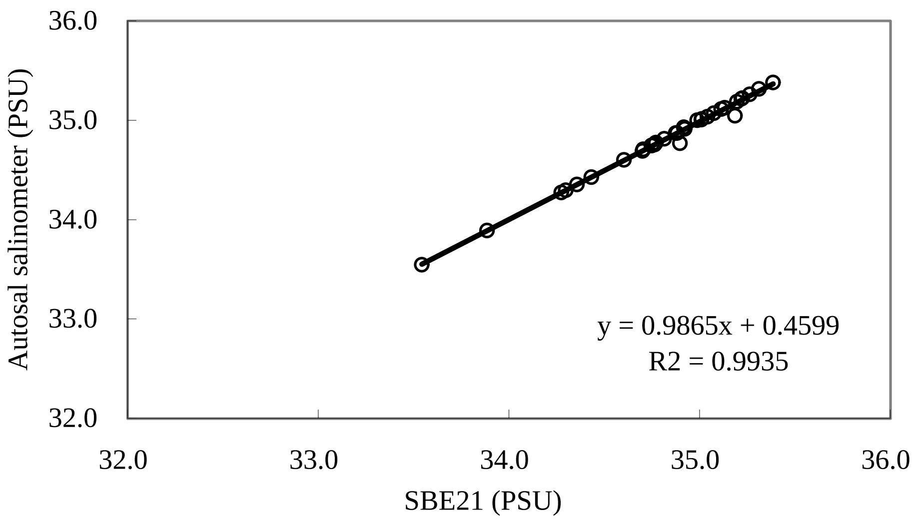


Fig.6.3-2 Correlation with Autosal salinometer-SBE21.

6.3.2. Nutrients monitoring in sea water (Leg. 2)

(1) Personnel

Kenichiro Sato (MWJ)

(2) Objectives

The distribution of nutrients of sea surface water is important to investigate the primary production.

(3) Parameters

- Nitrate
- Nitrite
- Silicate
- Phosphate

(4) Methods

The nutrients monitoring system was performed on BRAN+LUEBBE continuous monitoring system Model TRAACS 800 (4 channels). It was located at the surface seawater laboratory for monitoring in R/V Mirai. The seawater of 4.5 m depth under sea surface was continuously pumped up to the laboratory inner R/V Mirai. The seawater was poured in 5 L of polyethylene beaker through a faucet of the laboratory. The seawater was introduced direct to monitoring system with narrow tube continuously. The methods are as follows.

Nitrate + Nitrite: Nitrate in the seawater was reduced to nitrite by reduction tube (Cd-Cu tube) and the nitrite reduced was determined by the nitrite method described to next, but the flow cell used in nitrate analysis was 3 cm length type. Nitrite initially present in the seawater was corrected after measuring.

Nitrite: Nitrite was determined by diazotizing with sulfanilamide by coupling with N-1-naphthyl-ethylendiamine (NED) to form a colored azo compound, and by being measured the absorbance of 550 nm using 3 cm length flow cell in the system.

Phosphate: Phosphate was determined by complexing with molybdate, by reducing with ascorbic acid to form a colored complex, and by being measured the absorbance of 800 nm using 5 cm length flow cell in the system.

Silicate: Silicate was determined by complexing with molybdate, by reducing with ascorbic acid to form a colored complex, and by being measured the absorbance of 800 nm using 3 cm length flow cell in the system.

(5) Preliminary results

The nutrients monitoring was operated during the period of Sekinehama to Honolulu. Monitoring data was obtained every 1 minute. Preliminary data of every 10 minutes were shown in Fig. 6.3.2. We didn’t make a recalculation for this data by TRAACS 800 (4 channels) method.

(6) Data archive

All data will be archive at JAMSTEC Data Management Office.

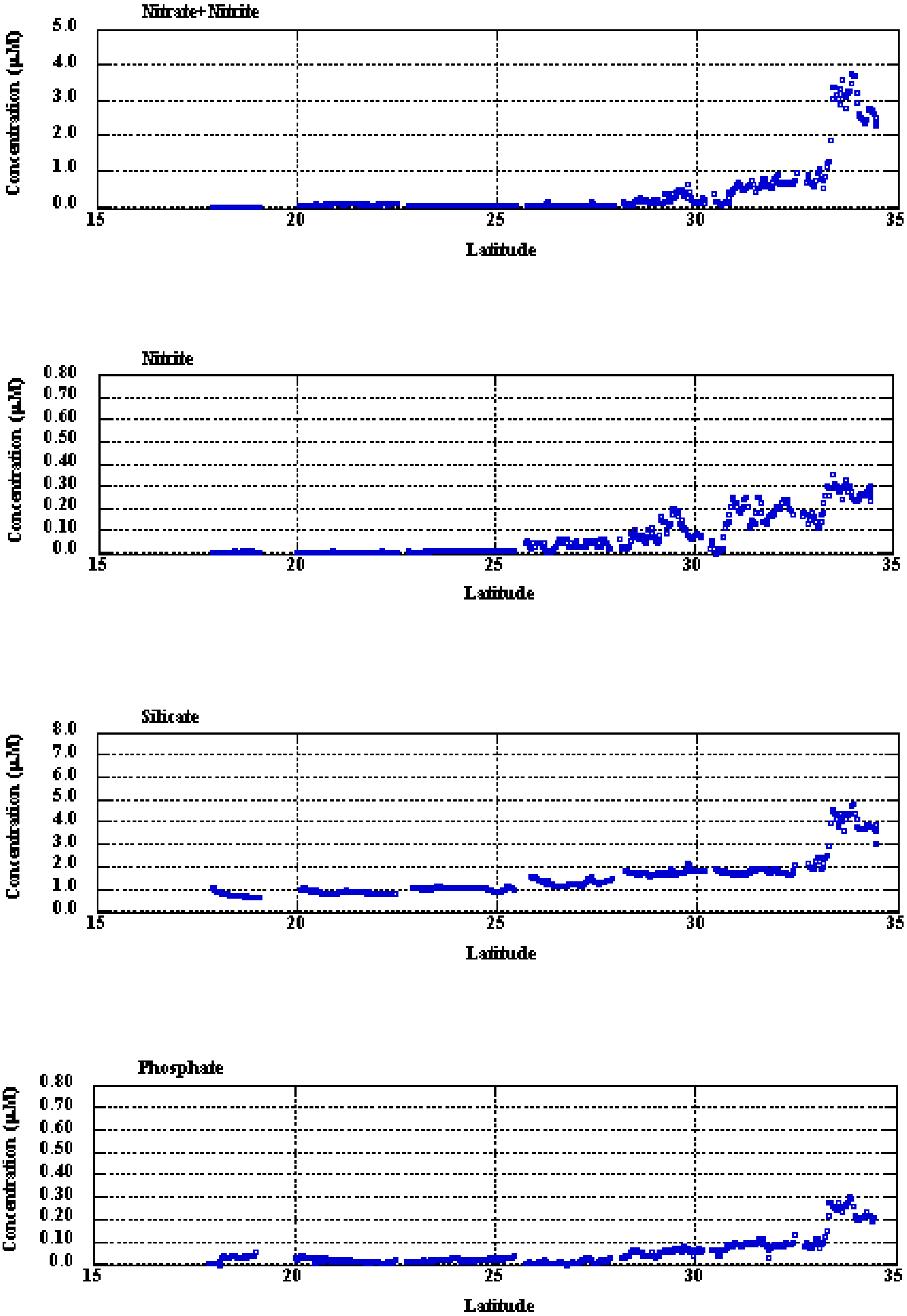


Fig. 6.3.2. Temporal variations of sea surface Nitrate+Nitrite, Nitrite, Silicate and Phosphate.

6.4 Shipboard ADCP

(1) Personnel

Kentaro Ando (JAMSTEC): Principal Investigator

Fumitaka Yoshiura (GODI): Operation Leader

Wataru Tokunaga (GODI): Operator

(2) Parameters

(2-1) N-S (North-South) and E-W (East-West) velocity components each depth cell [cm/s]

(2-2) Echo intensity of each depth cell [dB]

(3) Methods

We measured current profiles by VM-75 (RD Instruments, Inc. U.S.A.) shipboard ADCP (Acoustic Doppler Current Profiler) throughout MR01-K01 cruise from the departure of Sekinehama, Japan on 14 February 2001 to the arrival of Yokosuka, Japan on 23 March 2001.

Major parameters for the measurement configuration are as follows;

Frequency:	75 kHz
Average:	every 300 sec.
Depth cell length:	1600 cm
No. of depth cells:	40
First cell depth position:	30.9 m
Last cell depth position:	654.9 m
Ping per ADCP raw data:	16

(4) Preliminary results

Hourly current vectors of an hour running mean averaged data are plotted. Fig.6.4-1, -2 and –3 are shown form Sekinehama to Guam. Fig.6.4-4 is shown from Guam to Yokosuka.

(5) Remarks

ADCP logging stopped from 0523 to 0926 UTC 18 February because logging PC was freezing.

(6) Data archives

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

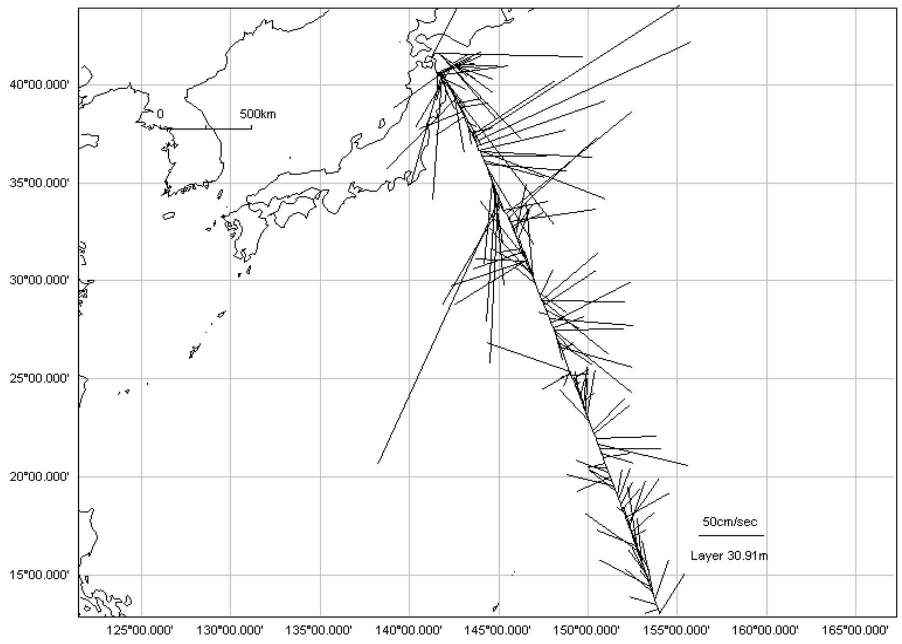


Fig.6.4-1 An hour averaged current vectors for every hour along the ship track at 31m depth

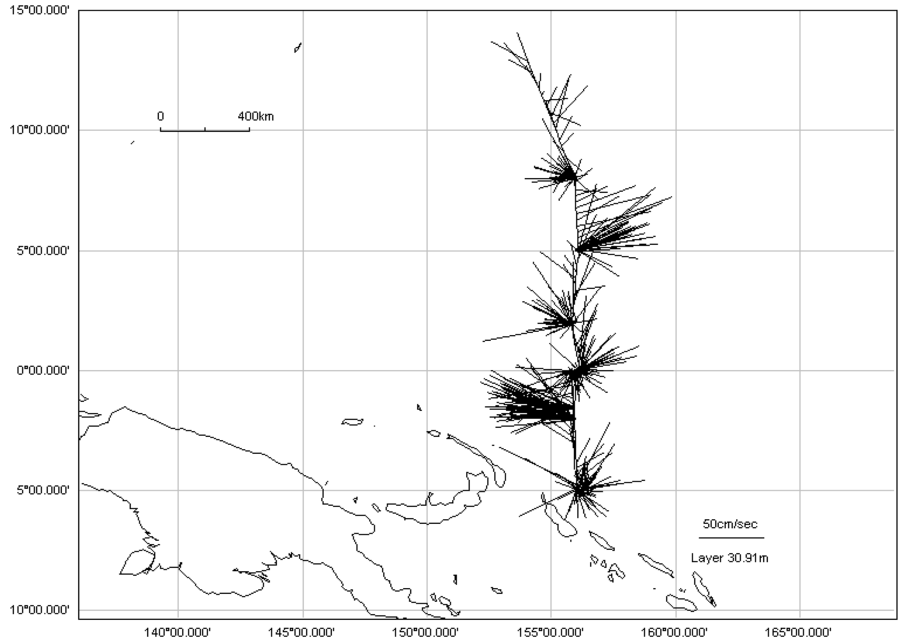


Fig.6.4-2 An hour averaged current vectors for every hour along the ship track at 31m depth

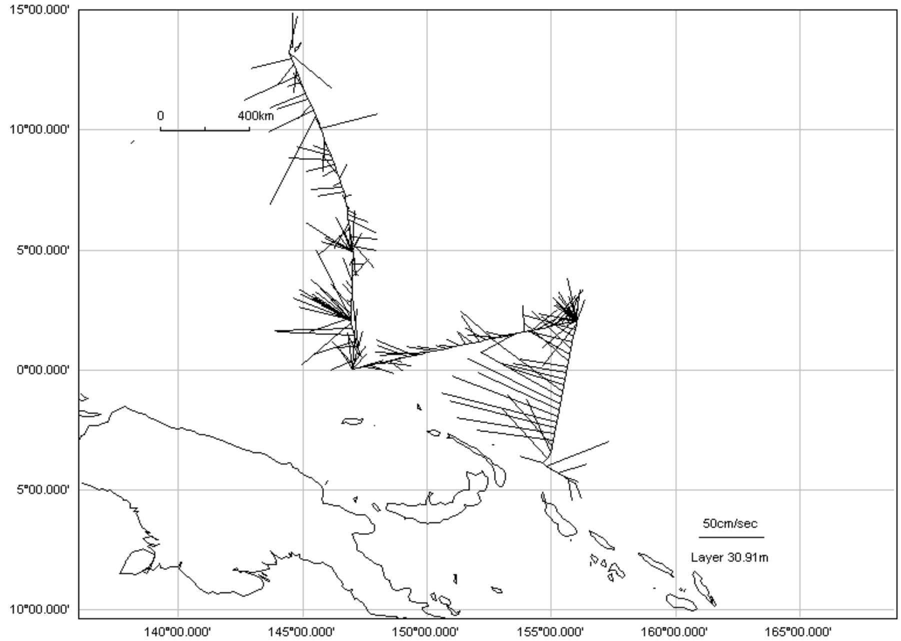


Fig.6.4-3　An hour averaged current vectors for every hour along the ship track at 31m depth

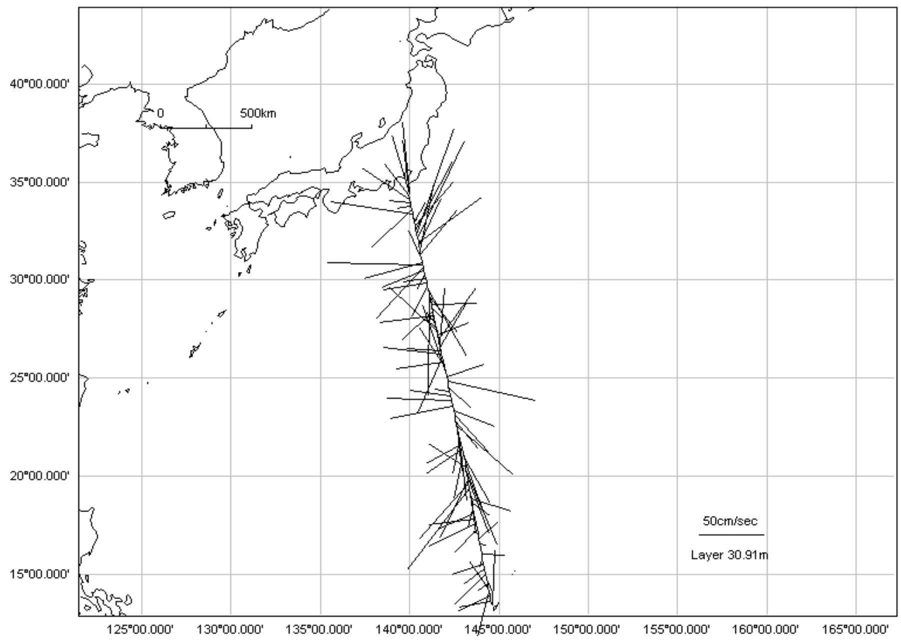


Fig.6.4-4　An hour averaged current vectors for every hour along the ship track at 31m depth

6.5 Underway geophysics

6.5.1 Sea surface gravity

(1) Personnel

Fumitaka Yoshiura (GODI): Operation Leader

Wataru Tokunaga (GODI): Operator

(2) Objectives

To obtain the continuous gravity data for contribution of geophysical investigation. To perform the above item, sea surface gravity is measured relative variation of gravity values throughout the cruise.

(3) Parameters

Gravity [mgal]

(4) Methods

We measured relative gravity values by LaCoste-Romberg onboard gravity meter S-116 throughout MR01-K01 cruise from the departure of Sekinehama, Japan on 14 February 2001 to arrival of Yokosuka, Japan on 23 March 2001.

To obtain absolute gravity value, we usually measure relative value by portable gravity meter (Scintrex gravity meter CG-3M) at comparable points, Sekinehama gravity base and Yokosuka reference points, already known absolute gravity values. Moreover, measured values are corrected based on the bathymetry and ship movement. Consequently, the corrected gravity data should involve the information of crustal and upper mantle structures how they compensate the discrepancy from isostatic balance.

(5) Preliminary results

The absolute gravity values calculated in comparison with absolute values of reference point at Sekinehama Port and Yokosuka Port are shown in Table 6.5.1-1.

(6) Data archives

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

6.5.2 Surface three component magnetometer

(1) Personnel

Fumitaka Yoshiura (GODI): Operation Leader

Wataru Tokunaga (GODI): Operator

(2) Objectives

In order to continuously obtain the geomagnetic field vectors on the sea surface, a three component magnetometer is very useful equipment. The magnetic force on the sea is affected by induction of magnetized body beneath the subbottom in addition to the earth dipole magnetic field. The magnetic measurement on the sea is, therefore, one of utilities for geophysical reconstruction of crustal structure and so on. The geomagnetic field can be divided into three components, i.e., two horizontal (x & y) and one vertical (z) moments. Three-component observation instead of total force includes much information of magnetic structure of magnetized bodies.

(3) Parameters

Three component magnetic force	[nT]
Ship's attitude (Picht, Roll and Heading)	[1/100 deg]

(4) Methods

The sensor is a three axes fluxgate magnetometer on the top of foremast and sampling period is 8 Hz. The timing of sampling is controlled by the 1pps standard clock of GPS signal. Every one second data set which consists of 310 bytes; navigation information, 8 Hz three component of magnetic forces and vertical reference unit (VRU) data were recorded in the external hard disk. The data set is simultaneously fed to the R/V Mirai network server through ethernet LAN system.

(5) Preliminary results

During MR01-K01 cruise, the magnetic force is continuously measured from the departure of Sekinehama, Japan on 14 February 2001 to arrival of Yokosuka, Japan on 23 March 2001. Data obtained on the sea will be analyzed in near future. The procedure of quality control is mainly to eliminate the effect of ship's magnetized vector condition.

(6) Data archives

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

6.5.3 Multi-narrow beam echo sounding system

(1) Personnel

Fumitaka Yoshiura (GODI): Operation Leader

Wataru Tokunaga (GODI): Operator

(2) Objectives

(2-1) To obtain the bathymetry data for the contribution of geophysical investigation.

(2-2) To obtain the bathymetry data for the sea water sampling during the cruise.

(3) Methods

R/V Mirai has installed a multi narrow beam echo sounding system manufactured by SeaBeam Inc., SeaBeam 2100 system. This system utilized bathymetry mapping. The newest one can measure more than 120 degrees wider swath and available all depth of the world ocean floor.

We surveyed from Sekinehama, Japan on 14 February 2001 to Yokosuka, Japan on 23 March 2001.

(4) Preliminary results

The results will be public after the analyses in future.

(5) Remarks

Bathymetry data logging stopped from 1402 UTC 12 February to 0111 UTC 13 February because of surveying system trouble.

(6) Data archives

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

7 Special Observation

7.1 TRITON moorings

7.1.1 TRITON Mooring Operation

(1) Personnel

Kentaro Ando	(JAMSTEC): Principal Investigator (on board Leg1, 2)
Toru Nakamura	(JAMSTEC): Engineer (on board Leg1, 2)
Hirokatsu Uno	(MWJ): Technical staff
Takeo Matsumoto	(MWJ): Technical staff
Shigehiko Ohara	(MWJ): Technical staff
Hiroshi Matsunaga	(MWJ): Technical staff
Asako Inoue	(MWJ): Technical staff
Muranaka	(MWJ): Technical staff
Kenichiro Sato	(MWJ): Technical staff
Kaori Akizawa	(MWJ): Technical staff
Taeko Ohama	(MWJ): Technical staff
Yoshiike	(MWJ): Technical staff

(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 six TRITON buoys have been successfully recovered during this R/V Mirai cruise (MR01-K01), deployed eight TRITON buoys, and repaired two 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 : 60sec
Data analysis : 600sec averaged

(5) Locations of TRITON Buoys

1) TRITON buoys deployed

Nominal location	8N, 156E
ID number at JAMSTEC	01004
Number on surface float	T22
ARGOS PTT number	20392
ARGOS backup PTT number	24231
Deployed date	22 Feb. 2001
Exact location	07 - 59.41N, 156 - 00.47E
Depth	4847 m

Nominal location	5N, 156E
ID number at JAMSTEC	02004
Number on surface float	T23
ARGOS PTT number	20417
ARGOS backup PTT number	24232
Deployed date	24 Feb. 2001
Exact location	05 - 01.33N, 155 - 58.25E
Depth	3608 m

Nominal location	2N, 156E
ID number at JAMSTEC	03005
Number on surface float	T26
ARGOS PTT number	20439*

ARGOS backup PTT number	24235
Deployed date	26 Feb. 2001
Exact location	02 - 02.32N, 156 - 01.14E
Depth	2577 m

Nominal location	EQ, 156E
ID number at JAMSTEC	04005
Number on surface float	T27
ARGOS PTT number	20451
ARGOS backup PTT number	24236
Deployed date	02 Mar. 2001
Exact location	00 - 01.08N, 156 - 02.56E
Depth	1953 m

Nominal location	2S, 156E
ID number at JAMSTEC	05003
Number on surface float	T28
ARGOS PTT number	20380
ARGOS backup PTT number	24237
Deployed date	05 Mar. 2001
Exact location	02 - 01.02S, 155 - 57.25E
Depth	1755 m

Nominal location	5S, 156E
ID number at JAMSTEC	06003
Number on surface float	T10
ARGOS PTT number	3780
ARGOS backup PTT number	24239
Deployed date	07 Mar. 2001
Exact location	05 - 01.95S, 156 - 01.53E
Depth	1520 m

Nominal location	2N, 147E
ID number at JAMSTEC	08002
Number on surface float	T12
ARGOS PTT number	09794
ARGOS backup PTT number	24229
Deployed date	14 Mar. 2001
Exact location	02 - 06.04N, 146 - 56.94E
Depth	4495 m

Nominal location	5N, 147E
ID number at JAMSTEC	07003
Number on surface float	T11
ARGOS PTT number	03781
ARGOS backup PTT number	24240

Deployed date	15 Mar. 2001
Exact location	04 - 58.70N, 147 - 01.03E
Depth	4287 m

2) TRITON recovered

Nominal location	8N, 156E
ID number at JAMSTEC	01003
Number on surface float	T14
ARGOS PTT number	07962
ARGOS backup PTT number	20299
Deployed date	14 Mar. 2000
Recovered date	23 Mar. 2001
Exact location	08 - 01.10N, 155 - 56.73E
Depth	4834 m

Nominal location	5N, 156E
ID number at JAMSTEC	02003
Number on surface float	T15
ARGOS PTT number	09770
ARGOS backup PTT number	20594
Deployed date	12 Mar. 2000
Recovered date	25 Feb. 2001
Exact location	04 - 57.87N, 156 - 04.55E
Depth	3596 m

Nominal location	2N, 156E
ID number at JAMSTEC	03004
Number on surface float	T18
ARGOS PTT number	09792
ARGOS backup PTT number	20298
Deployed date	10 Mar. 2000
Recovered date	27 Mar. 2001
Exact location	01 - 57.12N, 155 - 59.28E
Depth	2564 m

Nominal location	EQ, 156E
ID number at JAMSTEC	04004
Number on surface float	T19
ARGOS PTT number	20374
ARGOS backup PTT number	20879
Deployed date	07 Mar. 2000
Recovered date	03 Mar. 2001
Exact location	00 - 01.19N, 155 - 56.64E
Depth	1950 m

Nominal location	2S, 156E

ID number at JAMSTEC	05002
Number on surface float	T20
ARGOS PTT number	20458
ARGOS backup PTT number	20878
Deployed date	06 Mar. 2000
Recovered date	06 Mar. 2001
Exact location	01 - 59.16S, 156 - 01.46 E
Depth	1758 m

Nominal location	5S, 156E
ID number at JAMSTEC	06002
Number on surface float	T21
ARGOS PTT number	20384
ARGOS backup PTT number	20595
Deployed date	03 Mar. 2000
Recovered date	08 Mar. 2001
Exact location	04 - 58.00S, 156 - 00.97E
Depth	1507

3) TRITON repaired

Nominal location	2N, 156E
ID number at JAMSTEC	03005
Number on surface float	T26
ARGOS PTT number	07960
ARGOS backup PTT number	24235
Deployed date	11 Mar. 2001
Exact location	02 - 02.32N, 156 - 01.14 E
Depth	2577 m

Nominal location	EQ, 147E
ID number at JAMSTEC	09003
Number on surface float	T13
ARGOS PTT number	20434
ARGOS backup PTT number	24230
Deployed date	28 Oct. 2000
Repaired date	13 Mar. 2001
Exact location	00 - 03.72N, 147 - 00.71 E
Depth	4468 m

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

(6) Details of deployed and repaired

We had deployed eight TRITON buoys and repaired two TRITON buoys, described them details in the list.

Deployed and Repaired TRITON buoys

Observation No.	Location.	Details.
01004	8N 156E	Deploy at full spec.
02004	5N 156E	Deploy at full spec.
03005	2N 156E	Deploy at full spec.
04005	EQ 156E	Deploy at full spec.
05003	2S 156E	Deploy at full spec.
06003	5S 156E	Deploy at full spec.
03005	2N 156E	Changed system for communication system and antenna
09003	EQ 147E	Changed a sensor for measure wind speed and direction.
08002	2N 147E	Deploy at full spec.
07003	5N 147E	Deploy at full spec.

(7) Data archive

Those hourly averaged data transmitted 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 Branch.

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

7.1.2 Intercomparison between shipboard CTD and TRITON data

(1) Personnel

Kentaro Ando (JAMSTEC)
Takeo Matsumoto (MWJ)
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 system with general CTD observation (See section 6.2.1) by R/V MIRAI for this intercomparision. 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 1 nm.

TRITON buoy data was sampled every 1 hour except and transmitted 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 the same selected at the temperature data. Then, we calculated difference of salinity and conductivity between MIRAI CTD 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 attached figures (fig.7.1.2-1).

To estimate time drift of conductivity sensors on TRITON buoy, the data from deployed buoy and recovered buoy at the same location were analysed. The estimation's of time-drift were calculated as recovered buoy data minus deployed buoy data.The salinity change for 1 year are –0.0700 from 0.1400 psu, conductivity are -0.052 from 0.025 S/m for all depths. Below 300db, salinity change for 1 year are –0.0212 from 0.0113 psu, conductivity are -0.003 from 0.002 S/m (See the attached figures fig 7.1.2-2 and table table.7.1.2-1). The average of salinity differences was 0.0023 with standard deviation of 0.0097 psu, and the average of conductivity differences was 0.000 with standard deviation of 0.001 S/m.

(6) Data archive

All of raw and processed CTD data files were copied into 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)

Table 7.1.2-1 Difference between MIRAI CTD DATA and TRITON DATA

		MIRAI CTD DATA - TRITON CT DATA				volume of a change	
		Deploy DATA		Recovery DATA		Recovery DATA - Deploy DATA	
Observation No.	Pressure (db)	Conductivity (S/m)	Salinity (PSS 78:psu)	Conductivity (S/m)	Salinity (PSS 78:psu)	Conductivity (S/m)	Salinity (PSS 78:psu)
01003	300	0.000	0.0027	0.000	0.0065	0.000	0.0037
03004	300	0.000	-0.0025	0.001	0.0034	0.001	0.0059
04004	300	-0.002	0.0068	-0.002	0.0080	0.000	0.0012
01003	500	0.000	-0.0017	0.000	0.0032	0.001	0.0050
03004	500	0.002	0.0155	-0.001	-0.0058	-0.003	-0.0212
04004	500	0.000	0.0004	0.000	-0.0014	0.000	-0.0018
01003	750	0.000	-0.0062	0.000	0.0051	0.000	0.0113
03004	750	0.000	-0.0075	0.002	0.0029	0.002	0.0104
04004	750	0.000	-0.0009	0.000	0.0052	0.000	0.0061
	Average	0.000	0.0007	0.000	0.0030	0.000	0.0023
	Stdev.	0.001	0.0070	0.001	0.0042	0.001	0.0097

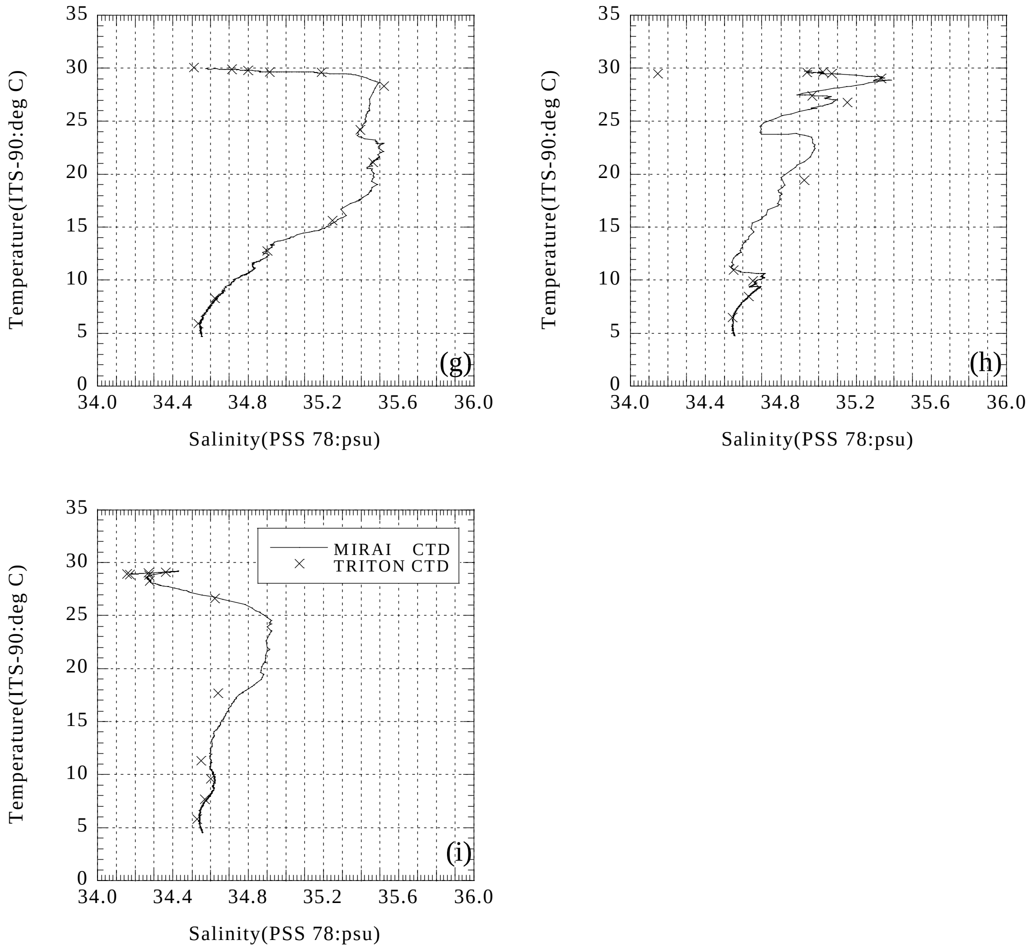
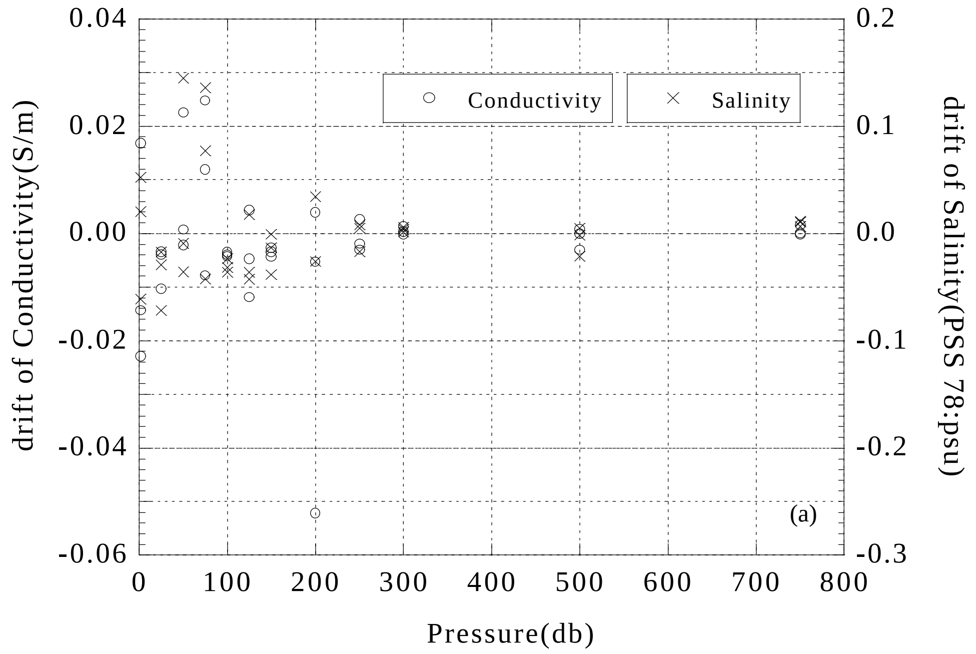


fig. 7.1.2-1 T-S Diagrams(continued) (g)Observation No.09003 EQ 147E (h)Observation No.08002 2N 147E (i)Observation No.07003 5N 147E



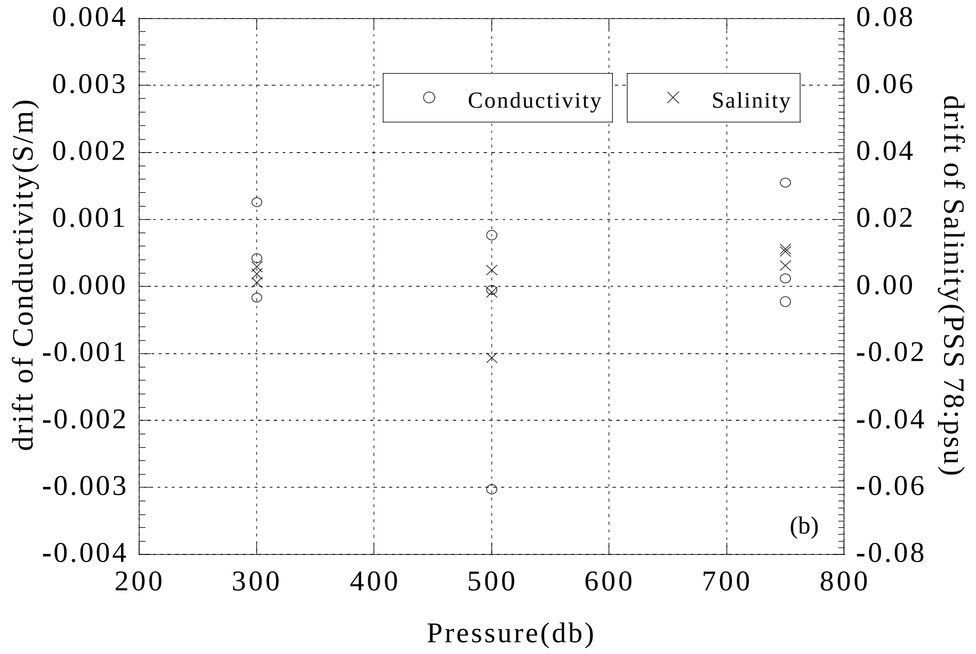


fig. 7.1.2-2 :Volume of a change for 1year (recovery sensor - deployment sensor) (a)all sensors (b)CTD sensor about 300db,CT sensors about 500db,CTD sensors about 750db

7.2 ARGO Float

7.2.1 ARGO Float (profiling float) deployment

(1) Personnel

Naoto Iwasaka	(FORSGC): Principal Investigator (not on board)	
Motoki Miyazaki	(FORSGC)	
Kentaro Ando	(JAMSTEC)	
Asako Inoue	(MWJ)	
Fumitaka Yoshiura	(GODI)	
Wataru Tokunaga	(GODI)	
Kenji Izawa	(JAMSTEC)	not on board
Yasushi Takatsuki	(JAMSTEC)	not on board
Taiyo Kobayashi	(FORSGC)	not on board
Eitaro Oka	(FORSGC)	not on board
Yasuko Ichikawa	(FORSGC)	not on board

(2) Objectives

The objective of deployment is to clarify the temporal and spatial variability of the North Pacific Subtropical Mode Water (NPSTMW).

The NPSTMW, characterized by a thermostad of around 18°C, is formed by wintertime deep convection just in the south of the Kuroshio and the Kuroshio extension region, and spreads away from its formation region by lateral advection. However, these studies only used the climatological data, and detailed analysis was needed.

The profiling floats deployed in this cruise and measure vertical profiles of temperature and salinity automatically in every ten days. The data from the floats will enable us to understand the formation and advection processes of the NPSTMW with time scales much smaller than the past studies.

(3) Parameters

- vertical profiles of water temperature, salinity, and pressure

(4) Methods

All the observations were made between 37°N and 28°N on the track from Hachinohe to the deployment point of TRITON mooring at 8°N, 156°E in Leg 1 (see Session. 3.4).

1) Profiling float deployment

The floats are designed to drift at specified depth (called "parking depth") for specified period, and then change their buoyancy by increasing volume and 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 hours, transmit their positions and the CTD data to ARGOS satellites, and then return to the parking depth by decreasing its volume. Each of the ascent and descent takes about 5-6 hours. The statuses of the deployed floats are shown in Table 7.2.2.1. It should be noted that the periods for which the floats are actually at the parking depth or the sea surface are less than those specified by the periods for descent and ascent, respectively.

2) CTD observation

4 CTD cast down to a depth of 2000 m was made just before the deployment of floats for calibration of the float sensor (Session. 6.2.1).

3) XCTD observation

XCTD observations to a depth of about 1000 m were made at 32 stations between 38°20'N and 26°N with intervals of 20 (station 1-20) and 30 (station 21-32) latitude minutes in order to observe distributions of salinity and temperature around the float-deployment point, and a meridional distribution of the NPSTMW (Session. 6.2.2).

(5) Preliminary result

1) Sea conditions around the deployment point of floats

Distributions of temperature and salinity measured with the XCTD are shown in Figs. 7.2.1-1 and 7.2.1-2, respectively.

The main thermocline between 7°C and 16°C lies at depths of about 200-700 db. The thermocline shallows greatly to the south at 34-35°N and deepens greatly to the south at 32-33.5°N and 36-37°N, respectively. The main halocline between 34.2 and 34.7 shows almost the same spatial change as the thermocline.

In a surface layer, a mixed layer is developed to about 200-400db. This layer has the temperature of 17-19°C and the salinity of about 34.7 psu. The maximum and minimum salinity is found at the top and bottom of the thermocline, respectively. Salinity exceeds 34.7 at depths between 50 db and 250 db throughout the section. Salinity reaches the minimum less than 34.2 at depths of 600-950 db, except around 33-34°N and the north of 37°N where the minimum lies at shallower depths of 200-400 db. Several low salinity cores spread around 34°N, corresponding to the strong westward current. The water in the salinity maximum and the minimum originates in the North Pacific Tropical Water and the North Pacific Intermediate Water, respectively.

The distributions of temperature and salinity suggest that the westward and eastward currents at 36-38°N and 33.5-36°N are a part of an anti-cyclonic mesoscale eddy. Six profiling floats that were deployed at the north of 34°N moved in an anti-cyclonic way with a radius of about 200 km. Their movements are maybe related to this anti-cyclonic eddy.

2) Observation with profiling float

The vertical profiles of temperature and salinity from the 13 floats during their ascent and are floats location map shown in Fig. 7.2.1-3 to 7.2.1-15, 7.2.1-16, respectively.

(6) 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 Global Telecommunication System (GTS) and utilized for analysis and forecasts of sea conditions.

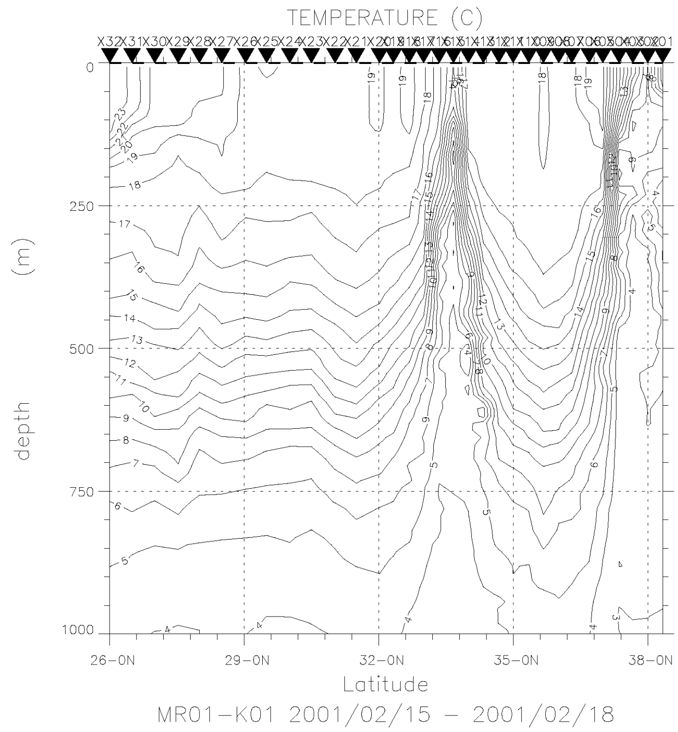


Fig 7.2.1-1 Distribution of temperature (°C) measured with the XCTD.

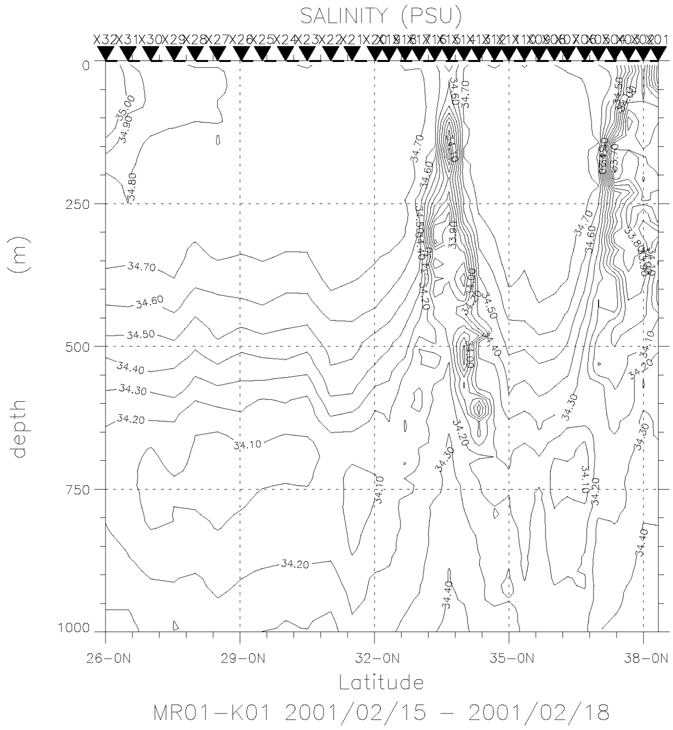


Fig 7.2.1-2 Same as Fig. 7.2.1-1 but for salinity.

Table 7.2.1-1 Float Status and Deployment status

Float Type	APEX manufactured by Webb Research Ltd.
CTD sensor	SBE41 manufactured by Sea-Bird Electronics Inc.
Cycle	10 days (Parking Depth: 213 hours, Sea Surface: 27 hours)
ARGOS transmit interval	44sec
Target Parking Pressure	2000 dbar
Sampling layers	63 (Bottom pressure, 2000,1900, 1800, 1700, 1600, 1500, 1400, 1300, 1250, 1200, 1150, 1100, 1050, 1000, 980, 960, 940, 920, 900, 880, 860, 840, 820, 800, 780, 760, 740, 720, 700, 680, 660, 640, 620, 600, 580, 560, 540, 520, 500, 480, 460, 440, 420, 400, 380, 360, 340, 320, 300, 280, 260, 240, 220, 200, 180, 160, 140, 120, 100, 80, 60, 40, 20, 0 [dbar])

WMO ID	Float S/N	ARGOS PTT ID	Reset Date and Time (UTC)	Deployed Date and Time (UTC)	Deployed Position
29042	222	06496	19:30, February 15	21:02, February 15	37-20.13N, 143-35.25E
29043	219	06495	23:40, February 15	01:50, February 16	36-40.14N, 143-55.32E
29044	224	06498	03:05, February 16	05:05, February 16	35-59.81N, 144-13.36E
29045	223	06497	06:07, February 16	08:09, February 16	35-19.92N, 144-32.22E
29046	226	06500	09:06, February 16	11:04, February 16	34-38.81N, 144-49.84E
29047	225	06499	12:03, February 16	13:37, February 16	33-58.21N, 145-00.05E
29048	229	06503	14:21, February 16	16:40, February 16	33-20.09N, 145-28.62E
29049	228	06502	17:30, February 16	19:50, February 16	32-39.83N, 145-47.56E
29050	230	06504	21:08, February 16	22:46, February 16	31-59.82N, 146-05.49E
29051	231	06505	02:40, February 17	05:13, February 17	31-00.28N, 146-30.09E
29052	232	06506	07:27, February 17	09:54, February 17	30-00.26N, 146-58.62E
29053	233	06507	13:45, February 17	16:14, February 17	28-59.77N, 147-25.61E
29054	236	06510	18:42, February 17	20:39, February 17	27-59.29N, 147-51.84E

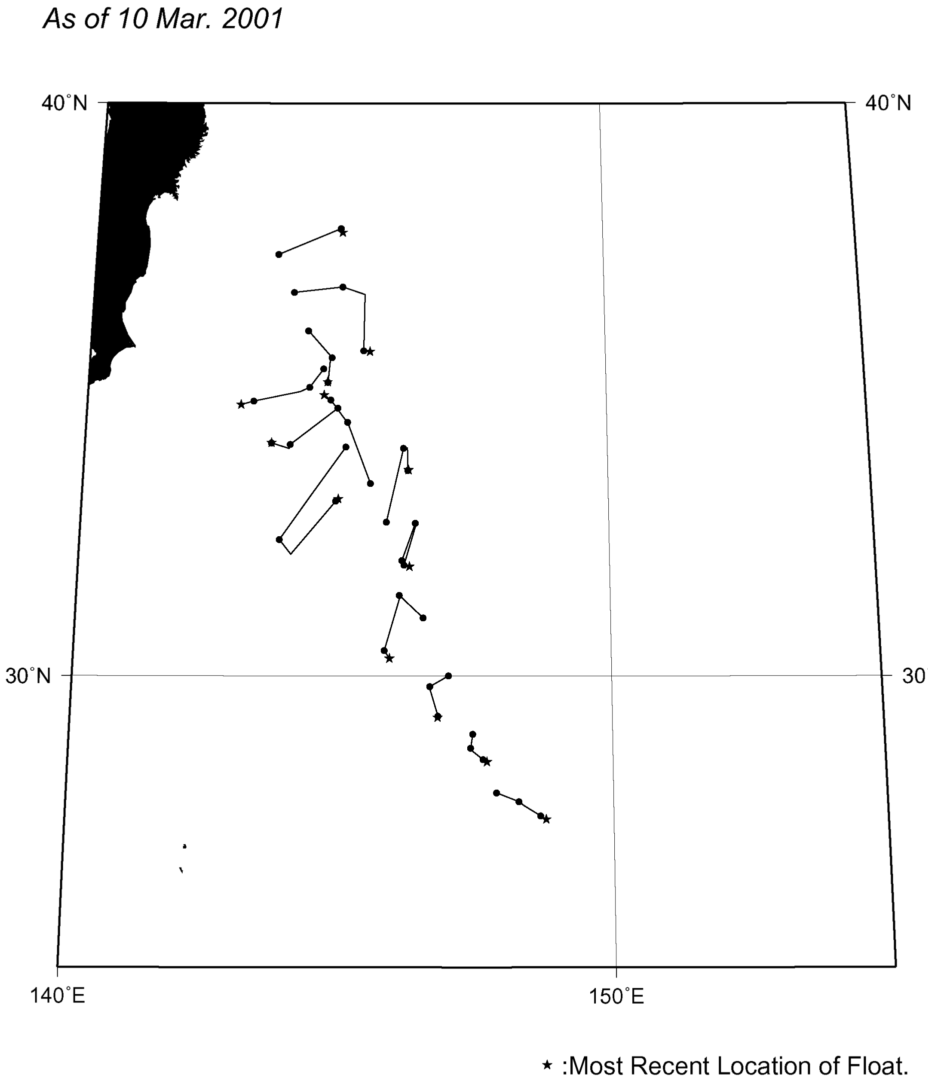


Fig.7.2.1-14 Float location and track.

7.2.2 ARGO sensor test

(1) Personnel

Motoki Miyazaki	(FORSGC): Principal Investigator
Kentaro Ando	(JAMSTEC)
Asako Inoue	(MWJ)
Fumitaka Yoshiura	(GODI)
Wataru Tokunaga	(GODI)
Kenji Izawa	(JAMSTEC) not on board
Yasushi Takatsuki	(JAMSTEC) not on board

(2) Objectives

In the international Argo programs, 3000 Argo floats having a CTP sensor are now planned to deploy in the world ocean in international coordination. The goal of this program is to provide high accuracy temperature (within accuracy of 0.005 degC) and salinity (within accuracy of 0.01 PSS-78) data to improve the forecast ability of world climate change. However, conductivity sensor is not stabled compared to temperature sensor. Therefore, we need to evaluate the accuracy and stability of conductivity sensor designed for Argo floats. During this cruise, we performed two kinds of experiments to estimate accuracy and stability of CTP sensors. The first one is “profiling test” to evaluate the dynamic accuracy during profiling. The second one is “mooring test” to estimate time drift of each sensor. Details will be de described in the next session.

(3) Methods

1) Profiling test

The sensors to be tested are SBE41CP, EXCELL CTD, TSK-CTD (prototype model). They are designed for Argo floats. SBE41CP is manufactured by Sea-Bird Electronics, Inc. EXCELL CTD is manufactured by Falmouth Scientific, Inc. (hereafter EXCELL), and TSK-CTD is manufactured by Tsurumi-Seiki Co., LTD. The conductivity sensor of SBE41CP is conductive type. EXCELL and TSK-CTD are inductive type. The CTD sensors used as reference are SBE9/17plus system with SBE3 and 4 with pump, manufactured by Sea-Bird Electronics, Inc. These sensors are mounted on special “profiling system”, which is designed for free-rising profiling to surface by self-buoyancy along kevler rope (Photos7.2-2-1, 2).

The Argo float is expected to profile with the rising speed of 10-15 cm/sec, therefore we tried to adjust the weight of weight of the profiling system to keep the ascending speed to 10-15 cm/sec. At first, we verified the Cd of our profiling system by the tank test on land before the cruise (fig.7.2.2-1). Generally, Cd can be estimated by:

$$Buoyancy = \frac{1}{2} r CdAv^2$$

A as projective area of profiling frame
ρ as water density
v as ascending speed

Here, A is calculated from design drawings. Cd was estimated as 0.93. At station 001, ascending speed was about 30cm/sec, so at station 002 to 006 we added 5.5kg weight to adjust to 15cm/sec. At station 007, sensor position was changed and added one SBE41CP, so we remove 1.9kg to compensate added sensor and cable weight. Under about 350m and upper from 200m ascending speed was about 15-20cm/sec. But at 350-200m, ascending speed was unstable probably due to the inclination of cable.

The locations of experiment are listed in Table 7.2-2-1 and the specification and serial number of the sensors are listed in Table 7.2-2-2. The data of SBE41CP, EXCELL and TSK-CTD are recorded into internal RAM and the data of SBE9plus are recorded into SBE17plusV2 SEARAM. All data are downloaded after each cast via serial interface.

2) Mooring

The sensors to be tested are EXCELL-CTD, TSK-CTD, and SBE37SM. SBE37 is used in TRITON moorings and used for reference sensor. The specification and serial number of the sensors are listed in Table 7.2-2-3. They are installed along ADCP moorings at 00°-156°E (See details in Session 7.6) on the frame (Photo7-2-2-3) at the depth of about 1800m.

(4) Preliminary result

Vertical profile by SBE9plus and CTP data of difference between SBE41CP (S/N53) and SBE9plus at station 007 are shown in Fig. 7.2.2-2 as example. Except the thermocline depth (350-200m), most part of temperature and salinity are within 0.005 degC and 0.01 psu, respectively. In the thermocline, temperature and salinity exceeded 0.4 degC and 0.04 psu, respectively. However, we don't remove noise yet, for example friction between frame and rope etc. The pressure difference between SBE41CP (S/N53) and SBE9plus was within +/- 2 dbar.

(5) Data archive

CTD data obtained during this cruise will be submitted to the DMO (Data Management Office), JAMSTEC within 1 year after cruise.

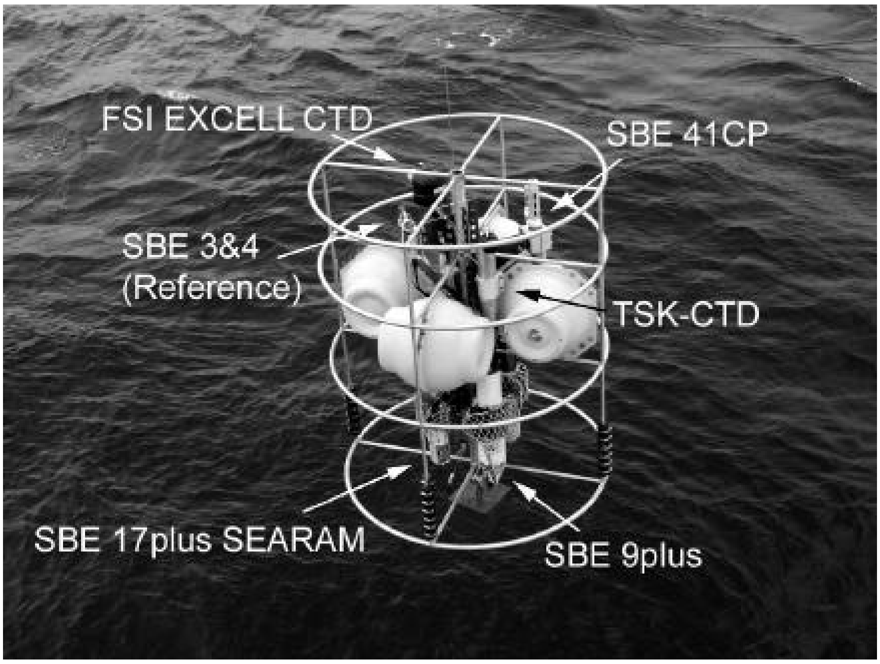


Photo. 7.2.2-1. Appearance of profiling frame and sensors

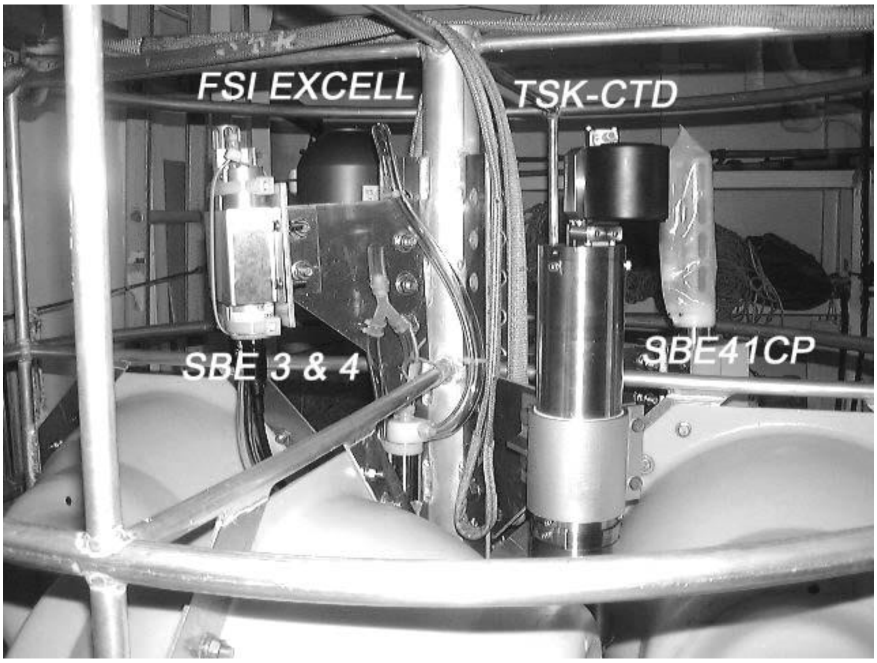


Photo.7.2.2-2. Appearance of target and reference sensors

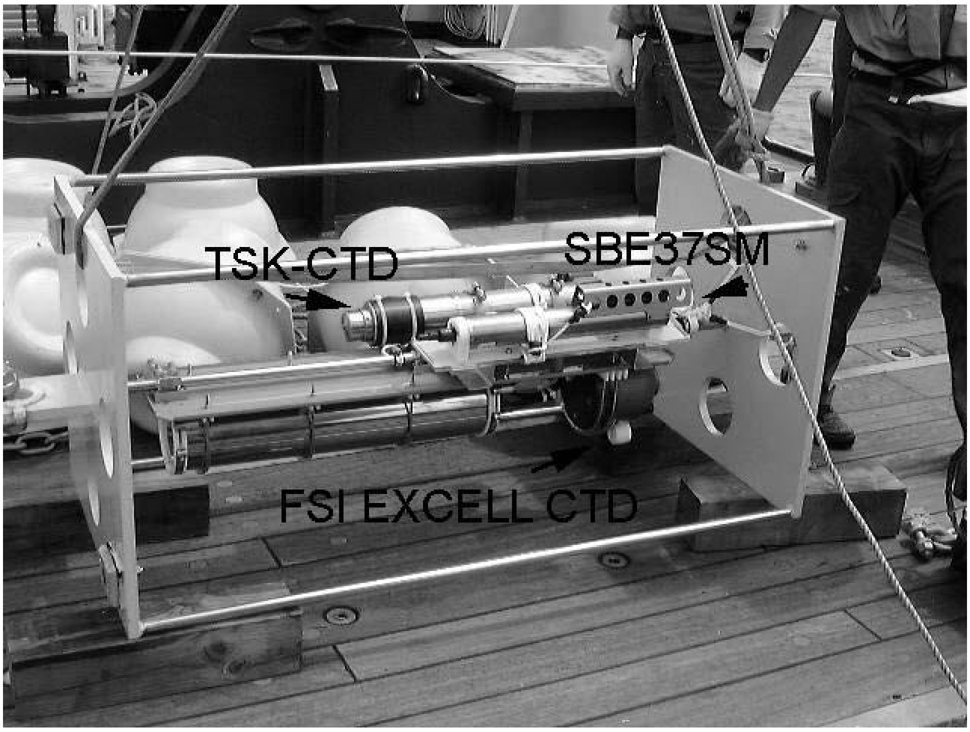


Photo. 7.2.2-3 mooring frame

Table 7.2.2-1. Station List

Station	Date and Time (UTC)	Position	Depth	CTD sensors	Trim weight
001	Feb.27 05:06 - 05:38	Eq., 156E	60	SBE41CP (S/N54) EXCELL (S/N1324) TSK-CTD	19 kg
002	Feb.28 00:07 - 01:26	Eq., 156E	100	SBE41CP (S/N54) EXCELL (S/N1324) TSK-CTD	24.5 kg
003	Mar.3 21:59 - 23:37	1.5S, 156E	300	SBE41CP (S/N54) EXCELL (S/N1324) TSK-CTD	24.5 kg
004	Mar.4 13:28 - 05:08	1.5S, 156E	400	SBE41CP (S/N54) EXCELL (S/N1324) TSK-CTD	24.5 kg
005	Mar.7 03:40 - 05:18	5S, 156E	500	SBE41CP (S/N54) EXCELL (S/N1324) TSK-CTD	24.5 kg
006	Mar.8 03:04 – 04:38	5S, 156E	500	SBE41CP (S/N53) EXCELL (S/N1405) TSK-CTD	24.5 kg
007	Mar.8 22:32 – Mar.9 01:30	5S, 156E	1000	SBE41CP (S/N53, 54) EXCELL (S/N1324) TSK-CTD	22.8 kg

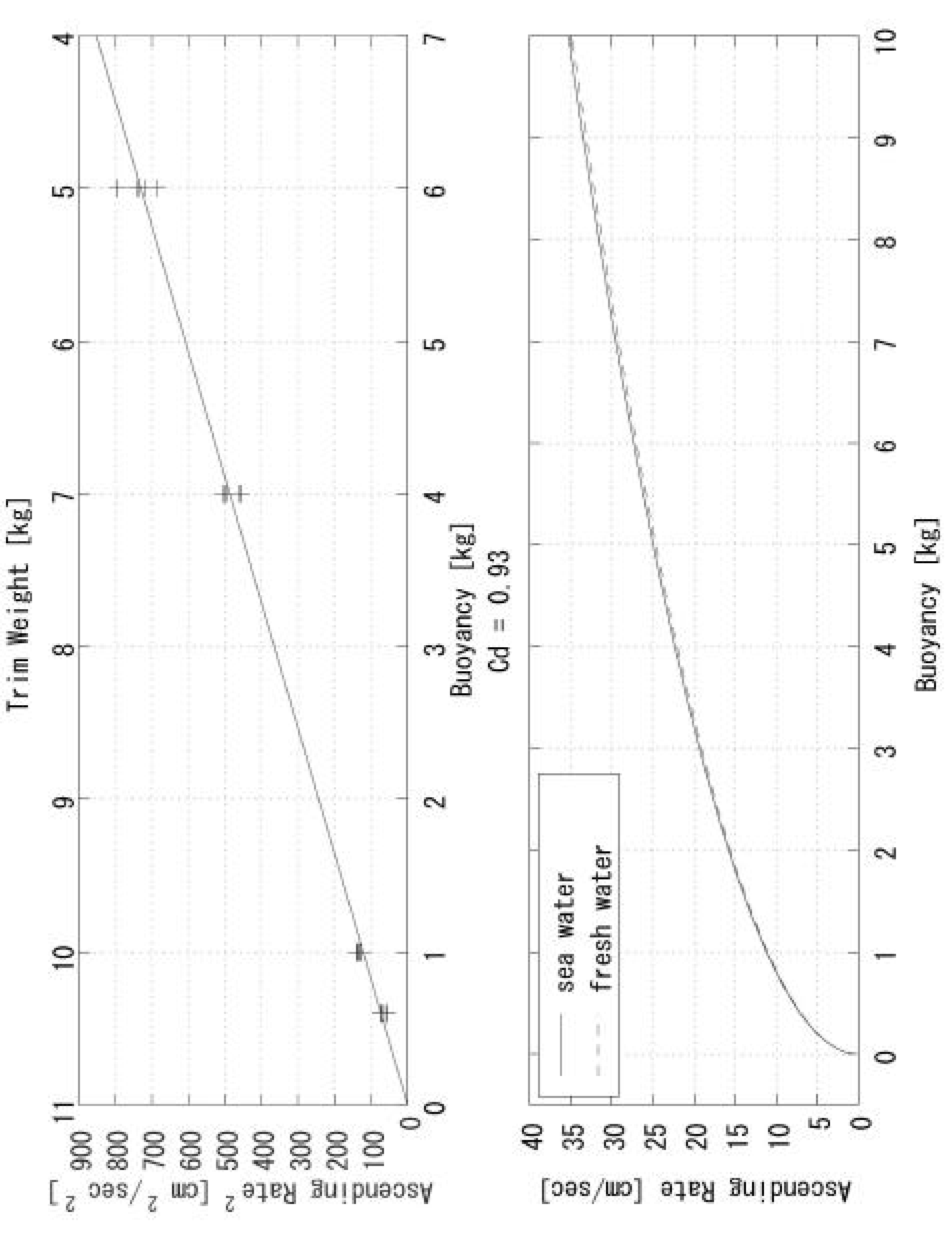

Trim Weight [kg]
Buoyancy [kg]
Cd = 0.93
Ascending Rate 2 [cm 2/sec 2]
sea water
fresh water
Ascending Rate [cm/sec]
Buoyancy [kg]

Fig. 7.2.2-1

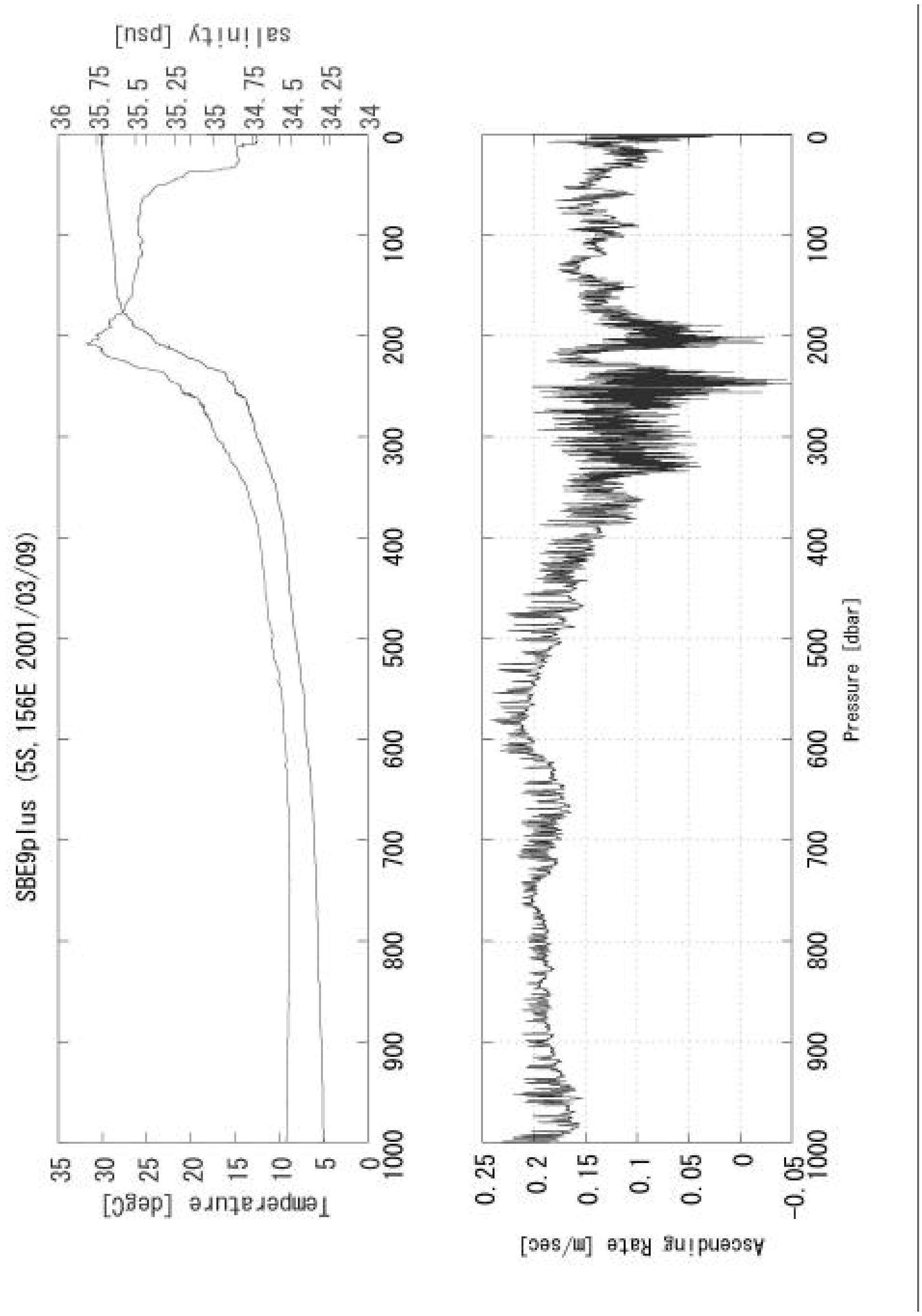


Fig.7.2.2-2 (upper) Vertical profiles of temperature and salinity by reference sensor at station 007

(lower) Vertical profile of ascending rate

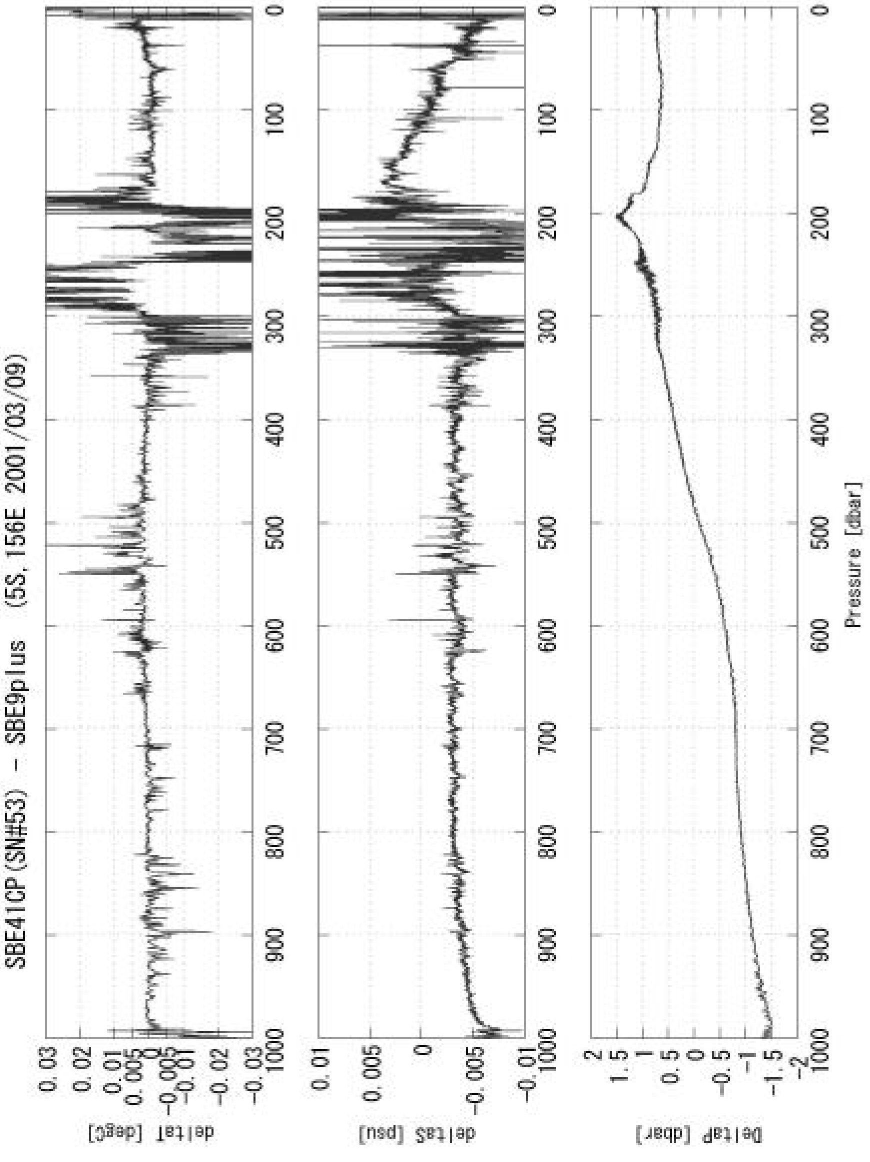


Fig.7.2.2-3 Vertical profiles of temperature, salinity and pressure difference between SBE41CP (S/N53) and SBE9plus at station 007

Table 7.2.2-2. The spec and serial number of the sensors

Target sensor

	Conductivity sensor	S/N	Sampling rate
SBE41CP	Electrode	53,54	1.289 seconds
EXCELL-CTD	Inductive	1324,1405,1406	2.8 frames/second (profiling) 1800 seconds (mooring)
TSK-CTD	Inductive		2 seconds (profiling) 1800 seconds (mooring)

Reference sensor

SBE9plus (Sea-Bird Electronics, Inc.) used for profiling test
S/N 240
Pressure: Paroscientific Digiquarts sensor (S/N 43435)
Temperature: SBE3 [Thermister] (S/N 1207, calibrated at Nov. 18, 2000)
Conductivity: SBE4 [conductivity cell] (S/N 0960, calibrated at Nov. 21, 2000)
Data sampling rate: 24 frames/second

	Range	Resolution	Precision
Temperature	-2 - 32 degC	< 0.0002 degC	< +/- 0.0015 degC
Conductivity	0 – 70 mS/cm	< 0.0004 mS/cm	< +/- 0.003 mS/cm
Pressure	0 – 6500 dbar	< 0.06 dbar	< +/- 1 dbar

SBE37SM (Sea-Bird Electronics, Inc.) used for mooring test
S/N 1593
Conductivity: Electrode conductivity sensor
Data sampling rate 1800 seconds

	Range	Resolution	Precision
Temperature	-5 – 35 degC	< 0.0001 degC	< +/- 0.002 degC
Conductivity	0 – 70 mS/cm	< 0.0001 mS/cm	< +/- 0.003 mS/cm
Pressure	0 – 3500 dbar	< 0.07 dbar	< +/- 0.35 dbar

7.3 Lidar observation

(1) Personnel (* indicates on board personnel)

Ichiro Matsui (NIES)
Atsushi Shimizu (NIES)
Nobuo Sugimoto (NIES)
Osamu Takahashi (TIT)*
Kazuhiro Asai (TIT)

(2) Objectives

Shipborne Mie scattering lidar observation of aerosols and clouds have been started using R/V Mirai. The purposes of the observation are to obtain global distribution and optical characteristics of aerosols and clouds which are used in the climatological study and in the study on the data reduction algorithms and data methods for space borne lidars.

(3) Method

The lidar employs a compact flashlamp pumped second-harmonics Nd:YAG laser. Mie scattering at 1064 nm and 532 nm, and depolarization ratio at 532 nm were recorded. System parameters are as follows;

Laser: Big Sky Laser CFR-200
- Output power: 532 nm 50 mJ/Pulse, 1064 nm 100 mJ/pulse
- Repetition rate: 10 Hz
- Beam div.: 0.5 mrad

Receiver: Schmidt cassegrainian
- Diameter: 280 mm
- Field of view: 1 mrad
- Detector: PMT (532 nm) , APD (1064 nm)
- Data collection: LeCroy LC574AL
- Measurement range: 0-24 km
- Range resolution: 6 m
- Sampling rate: 10 sec

(5) Preliminary results

Figure 7.3-1 shows a temporal variation of vertical profile. The range-corrected lidar signal at 532 nm is indicated with a color scale. Diurnal variation of boundary layer is not significant as seen in Fig 7.3-1. Low clouds are frequently observed at the top of the planetary boundary layer. Cirrus clouds are also frequently observed in an altitude range of 12 to 17 km.

(6) Data archive

All data will be archived at NIES and TIT, and submitted to JAMSTEC DMO.

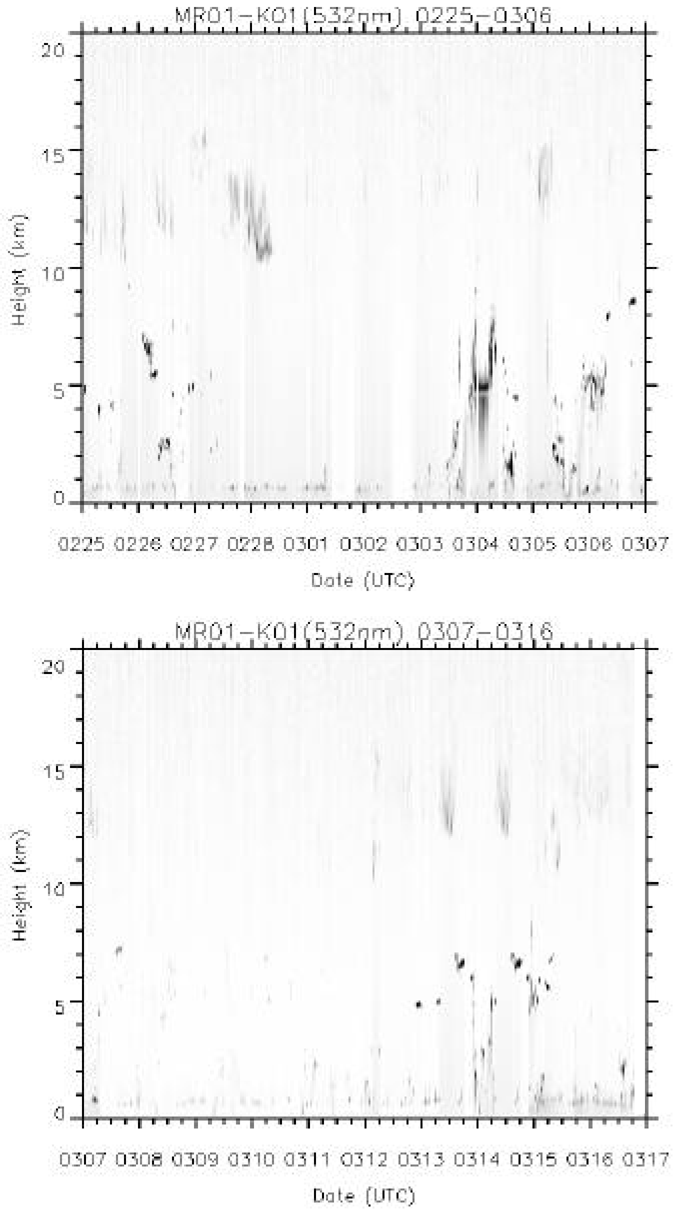


Fig.7.3-1 Temporal variation of range-corrected lidar signal at 532 nm

7.4. Studies on behaviors and climate influence of atmospheric aerosols over the tropical region of the Western Pacific Ocean

Name of research cruise: Observational research over the Tropical Western Pacific Ocean

Observational duration: From 14 February 2001 to 22 March 2001 (37 days)

Area of ocean: Tropical zone of the Western Pacific

Objective theme:

Investigation of horizontal distribution on the concentration and size distribution and optical properties of atmospheric aerosols at the surface and optical thickness of columnar aerosol over the ocean.

Objects:

To clear and solve the problems of horizontal distribution and optical properties of aerosols, some observations were carried out over the northern and tropical region of the Pacific Ocean. Furthermore, collections of the data for calibration and validation to the remote sensing data were performed simultaneously

Summery:

To obtain the data for calibration and validation between remote sensing and surface measurements over the ocean, a series of simultaneous observations has been carried out about optical properties like as scattering and absorption coefficients and radiative properties as optical properties of atmospheric aerosols, the concentration and size distribution of surface aerosols over the tropical and subtropical region of the Western Pacific Ocean for 37days from 14 February 2001 to 22 March 2001. In addition of that, a sky radiometer was examined for to a fully automated ship-borne instrument and improved to the practical usage on same board.

(1) Personnel

On board scientists

Tatsuo Endoh (Institute of Low Temperature Science, Hokkaido University) Associate Professor

Kentaro Ando(JAMSTEC) Chief Research Scientist

Co-workers not on board

Tamio Takamura (Center of environmental remote sensing science, Chiba University) Professor

Sachio Ohta (Engineering environmental resource laboratory, Graduate school of engineering, Hokkaido University) Professor

Teruyuki Nakajima (Center of climate system research, University of Tokyo) Professor

(2) Objects/Introduction

One of the most important objects is the collection of calibration and validation data from the surface (Nakajima et al.1996, 1997 and 1999). It may be considered for the observation over the widely opening of the huge ocean to be desired ideally because of horizontal homogeneity. Furthermore, the back ground values of aerosol concentration are easily obtained over there (Ohta et al.1996, Miura et al. 1997 and Takahashi et al. 1996) and vertical profile of aerosol concentration are obtained by means of extrapolation up to the scale height. It is desired to compare the integrated value of these profile of aerosol concentration with optical thickness observed by the optical and radiative measurement (Hayasaka et al. 1998, Takamura et al.1994). Facing this object, the optical and radiative observations were carried out by the Sky Radiometer providing more precise radiation data as the radiative forcing for global warming.

(3) Measuring parameters

Atmospheric optical thickness, Ångström coefficient of wave length efficiencies,

Direct irradiating intensity of solar, and forward up to back scattering intensity with scattering angles of 2-140degree and seven different wave lengths

GPS provides the position with longitude and latitude and heading direction of the vessel, and azimuth and elevation angle of sun. Horizon sensor provides rolling and pitching angles.

Concentration and size distribution of atmospheric aerosol.

(4) Methods

The instruments used in this work are shown as following in Table-7-4-1.

Sky Radiometer was measuring irradiating intensities of solar radiation through seven different filters with the scanning angle of 2-140 degree. These data will provide finally optical thickness, Ångström exponent and size distribution of atmospheric aerosols with a kind of retrieval method.

Optical Particle Counter was measuring the size of large aerosol particle and counting the number concentration with laser light scattering method and providing the size distribution in 0.3,0.5,1.0,2.0 and 5.0 micron of diameter with real time series display graphically.

(5) Results

Information of data and sample obtained are summarized in Table-7-4-2. The sky radiometer has been going well owing to more calm and silent condition and circumstances about shivering problems provided by the R/V Mirai whose engines are supported by well defined cushions. Therefore, measured values will be expected to be considerably stable and provide good calculated parameters in higher quality. However, some noise waves were found to interfere the 16,13 and 12channel marine bands of VHF from sky radiometer. Fortunately the origin and source were identified by using a VHF wide band receiver and the interference waves were kept by fairly separating from two VHF antennae and decreased to recovery of 100%.

Aerosols size distribution of number concentration have been measured by the Particle Counter and data obtained are displayed in real time by a kind of time series *in situ* with 5stages of size range of 0.3, 0.5, 1.0, 2.0, and 5.0 micron in diameter.

(6)Data archive

This aerosol data by the Particle Counter will be able to be archived soon and anytime. However, the data of other kind of aerosol measurements are not archived so soon and developed, examined , arranged and finally provided as available data after a certain duration. All data will archived at ILTS (Endoh), Hokkaido University, CCSR(Nakajima), University of Tokyo and CeRES(Takamura), Chiba University after the quality check and submitted to JAMSTEC within 3-year.

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Data inventory

Table-7-4-1. Information of obtained data inventory (Method)

Item, No.data	Name	Instrument	Site position
Optical thickness Ångström exponent.	Endoh	Sky Radiometer(Prede,POM-01MK2)	roof of stabilizer
Aerosol Size distribution	Endoh	Particle Counter(Rion,KC-01C)	compass deck(inlet) & environmental research laboratory

Table-7-4-2 Data and Sample inventory

Data/Sample	rate	site	object	name	state	remarks
Sun & Sky Light	1/5min (fine& daytime)	roof of stabilizer	optical thickness Ångström expt.	Endoh	land analysis	2/14'01-3/22'01
Size distribution of aerosols	1/2.5min	compass deck	concentration of aerosols	Endoh	on board	2/14'01-3/22'01

7.5 Atmospheric and oceanic CO_2 measurements

1. Participants

Hisayuki Y. Inoue and *Masao Ishii*
Geochemical Research Department,
Meteorological Research Institute (MRI)

Koichi Goto
Kansai Environmental Engineering Center Co. LTD.

2. Objectives

Carbon dioxide (CO_2), known as a major greenhouse gas, has been increasing in the atmosphere as a result of the anthropogenic emission. Its current concentration is approximately 30% higher than that in the pre-industrial era (280ppm). In order to predict the future atmospheric CO_2 variation due to anthropogenic emission and the potential alteration of the carbon cycle as a result of the climate change, it is necessary to understand the processes which are controlling the fluxes among the global carbon reservoirs, the atmosphere, the terrestrial biosphere and the ocean, as well as to estimate the present CO_2 inventory among these reservoirs.

The eastern and the central equatorial Pacific is now known to act as a significant source of the CO_2 to the atmosphere due primarily to the equatorial upwelling. The western equatorial Pacific, where warm water prevails in the surface layer, also occasionally exhibits a large CO_2 emission from the sea to the atmosphere. Flux of CO_2 from the equatorial Pacific has been reported to show a significant interannual variability that is associated with the ENSO event. However, the temporal and spatial variation in the whole CO_2 system in seawater enough to elucidate its controlling mechanism has not been well documented.

In this cruise, we made concurrent underway measurements of CO_2 concentration in the atmosphere and in surface seawater and total inorganic carbon (TCO_2) in surface seawater. The purpose of these observations is to describe the oceanic CO_2 system in the western equatorial Pacific and to clarify the controlling factors that are responsible for its variation in space and time as well as to investigate the air-sea CO_2 flux in this region.

3. Parameters

(1) CO_2 concentration (χCO_2) in marine boundary air and in the air equilibrated with surface seawater.

(2) Total inorganic carbon (TCO_2) in surface seawater.

4. Methods

(1) Underway measurements of CO_2 concentration in marine boundary air and in the air equilibrated with surface seawater :

We made measurements of the CO_2 concentration (mole fraction of CO_2 in air; χCO_2) in marine boundary air twice every 1.5 hour and that in air equilibrated with the great excess of surface seawater four times every 1.5 hour during the whole cruise using the automated CO_2 measuring system (Nippon ANS Co.). Marine boundary air was taken continuously from the foremast. Seawater was taken continuously from the bottom of ship located ca.5m below the sea level and introduced into the MRI-shower-type equilibrator.

Non-dispersive infrared (NDIR) gas analyzer (BINOS 4) was used as a detector. It was calibrated with four CO_2 reference gases (300, 350, 407, 446 ppm in air, Nippon Sanso Co.) once every 1.5 hour. Concentration of CO_2 will be published on the basis of the WMO X85 mole fraction scale after this cruise. Corrections for the temperature-rise from the bottom of ship to the equilibrator and the drift of CO_2 concentration in reference gases are also to be made. Partial pressure of CO_2 will be calculated from χCO_2 by taking the water vapor pressure and the atmospheric pressure into account.

(2) Underway measurements of total inorganic carbon (TCO_2) in surface seawater :

We made underway measurement of TCO_2 in surface seawater using the automated TCO_2 analyzer(Nippon ANS Co.) equipped with carbon coulometer 5012 (UIC Co.). Seawater was taken continuously from the bottom of ship and a portion of the seawater ($\sim 22 cm^3$) was introduced into the water-jacketed pipette of the analyzer twice every 1.5 hours for analysis. We also analyzed TCO_2 in reference Seawaters prepared in MRI that is traceable to the CRM provided by Dr. A. Dickson in Scripps Institution of Oceanography. The analysis of the reference seawater was made at least once during the each run of the coulometric cathode- and anode-solution.

5. Results

Data analysis will be made soon.

6. Data archive

The original data will be archived at Geochemical Research Department, Meteorological Research Institute. Data will be also submitted to Data Management Office at JAMSTEC within 3 years.

7.6 ADCP subsurface mooring

(1)Personnel

Kentaro Ando	(JAMSTEC): Principal Investigator
Toru Nakamura	(JAMSTEC): Scientist
Hirokatsu Uno	(MWJ): Operation leader
Takeo Matsumoto	(MWJ): Technical staff
Hiroshi Matsunaga	(MWJ): Technical staff
Asako Inoue	(MWJ): Technical staff
Miki Yoshiike	(MWJ): Technical staff
Shigehiko Ohara	(MWJ): Technical staff
Masato Muranaka	(MWJ): Technical staff
Kei Suminaga	(MWJ): Technical staff
Kenichiro Sato	(MWJ): Technical staff
Kaori Akiwaza	(MWJ): Technical staff
Taeko Ohama	(MWJ): Technical staff

(2) Objectives

The purpose is to observe surface and subsurface current variation to understand physical processes in the western equatorial Pacific Ocean from 138E to 165E. The surface and subsurface currents variations are measured by using several ADCP current moorings along the equator. To maintain the current meters array, in this cruise (MR01-K01), we recovered one subsurface ADCP mooring at 00° -156° E and deployed one 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. These are ADCP(Acoustic Doppler Current Profiler) to observe subsurface currents from surface to about 300m depth, and CTD to observe pressure, temperature and salinity at the top of the mooring. Three different types of CTs designed for ARGO float are also installed on mooring line at around 1,800m depth for the validation experiment of ARGO sensors (See details in section 7.2.2). 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 : 12 for Serial Number 1154

16 for Serial Number 1678

Time per ping : 2.00 seconds

Bin length : 8.00 m

Sampling Interval : 3600 seconds

Recovered ADCP

・Serial Number : 1154 (Mooring No.991108-00156E)

Deployed ADCP

・Serial Number : 1678(Mooring No.010228-00156E)

2) CTD

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

Sampling Interval : 1800 seconds

Recovered CTD

・Serial Number : 1285 (Mooring No.991108-00156E)

Deployed CTD

・Serial Number : 1274 (Mooring No.010228-00156E)

3) Other instrument

(a)Acoustic Releaser (BENTHOS,Inc.)

Recovered Acoustic Releaser

・Serial Number :908 (Mooring No.991108-00156E)

・Serial Number :685 (Mooring No.991108-00156E)

Deployed Acoustic Releaser

・Serial Number :954 (Mooring No.010228-00156E)

・Serial Number :663 (Mooring No.010228-00156E)

(b) CTs for ARGO sensor validation experiment (See details in section 7.2.2)

・SBE-37(Sea Bird Electronics Inc.)

・FSI EXCELL(Falmouth Scientific Inc.)

・Tsurumi-Seiki Co.,LTD.

(5) Deployment

The ADCP mooring was deployed at 00° -156° E. The ADCP mooring deployed at 00° -156° E was planned to make the ADCP buoy placed at about 300m depth . After we dropped anchor, we monitored depth of the acoustic releaser (Fig.7-6-1). The position of the mooring was shown below.

Result of calibration

・Mooring No.010228-00156E

Date: 28 Feb. 2001 Lat: 00-00.16N Long: 156-07.93E Depth: 1950m

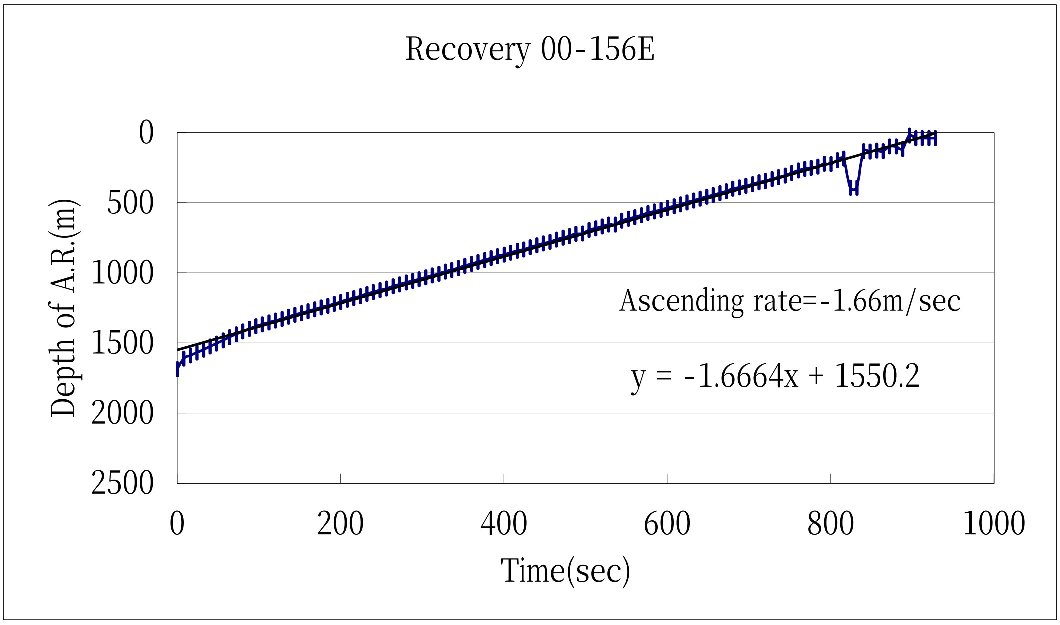
(6) Recovery

We recovered one ADCP mooring which was deployed in Nov.1999 (MR99-K06) on 28 Feb. 2001.We found that Transponder fastened to chain (3.0m) under the ADCP buoy lost. After the recovery, we uploaded ADCP and CTD data into a computer, then raw data were converted into ASCII code. Results were shown in the figures on following pages. Fig.7-6-2 shows CTD pressure, temperature and salinity data. Fig.7-6-3, Fig.7-6-4 ,Fig.7-6-5 and Fig.7-6-6 show the velocity data (eastward and northward component) at 50 m (bin21), 100 m (bin15) ,150 m(bin10) and 200m(bin4) depths.

(7) Data archive

The velocity data will be reconstructed using CTD depth data. The all data will be archived by the member of TOCS project at JAMSTEC after the quality check.

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



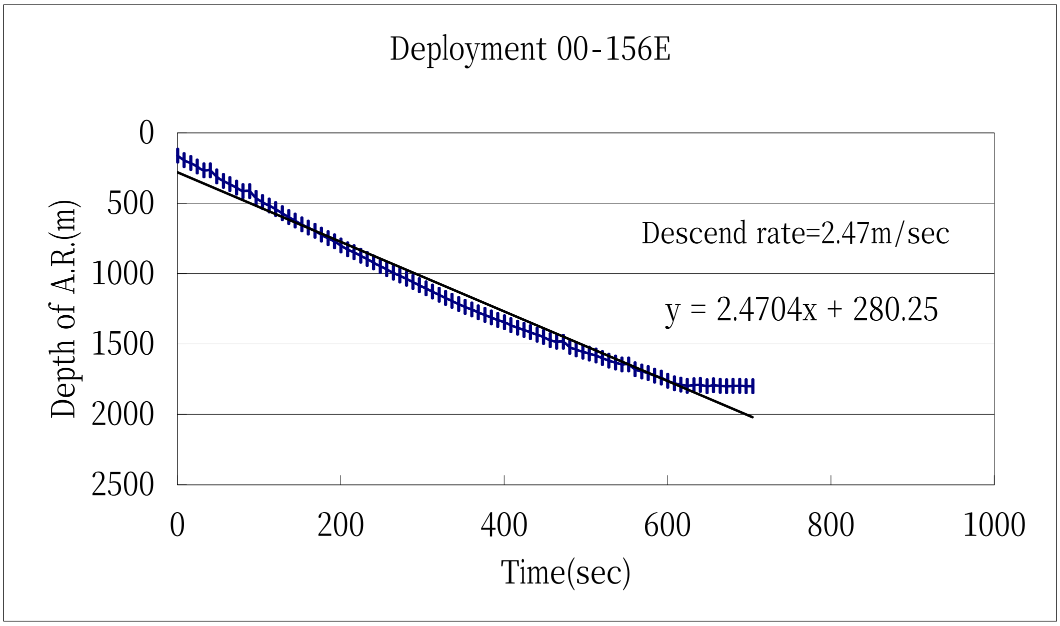
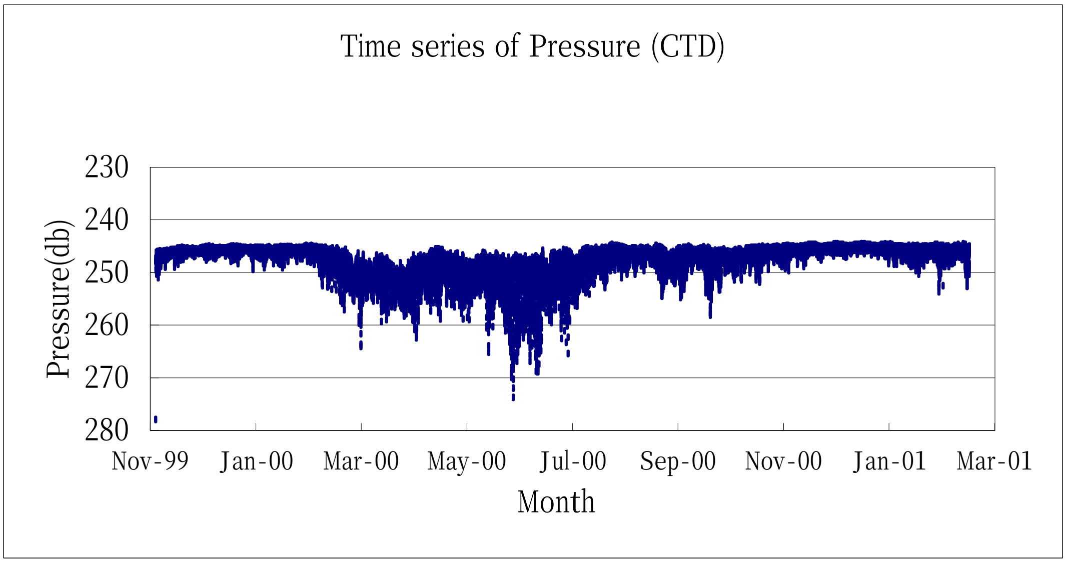
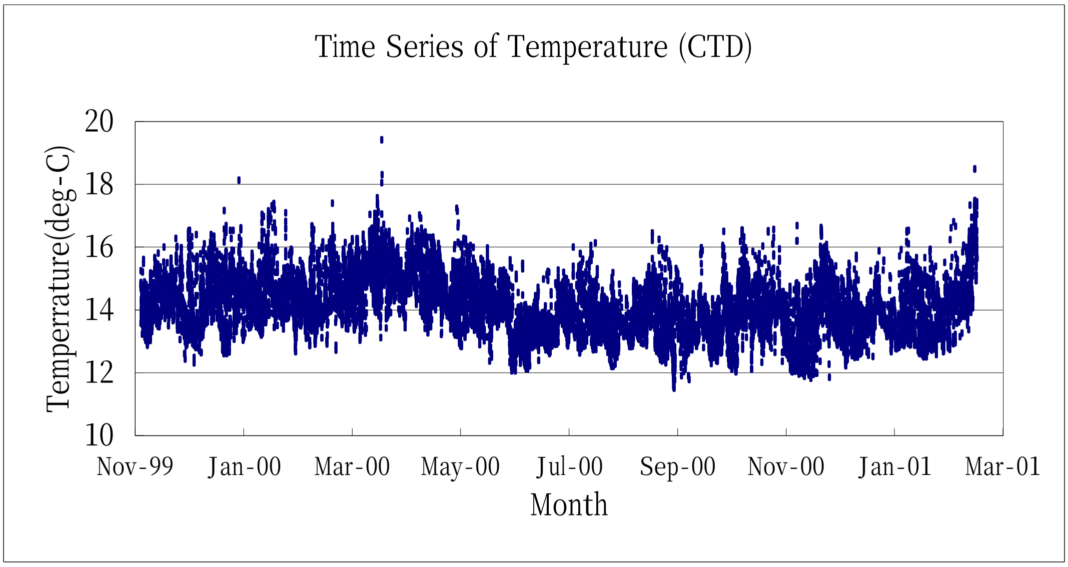


Fig.7-6-1 Acoustic Releaser Depth Monitor
(A.R.:Acoustic Releaser)

(a)



(b)



(c)

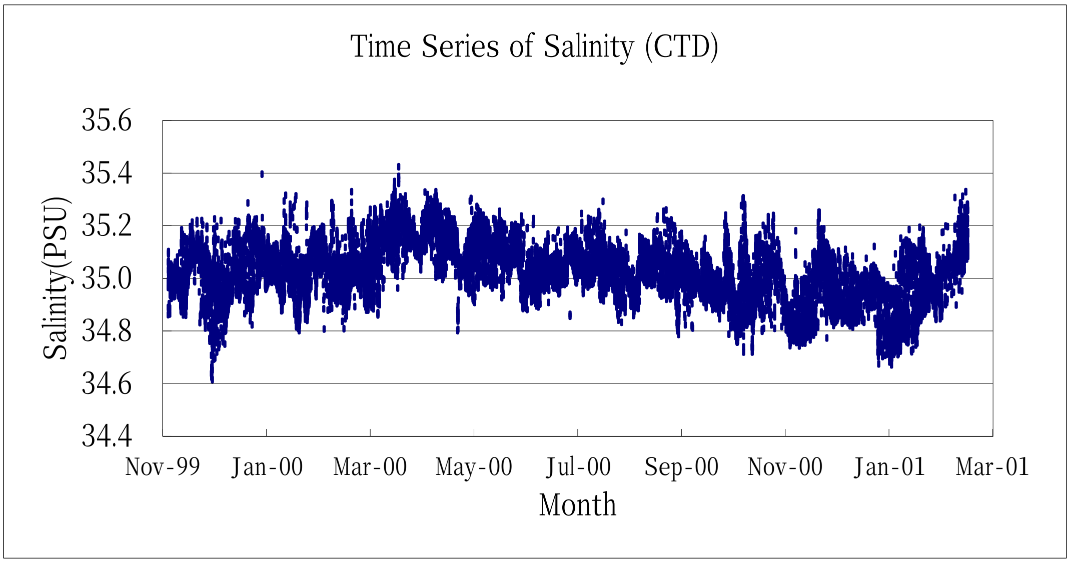
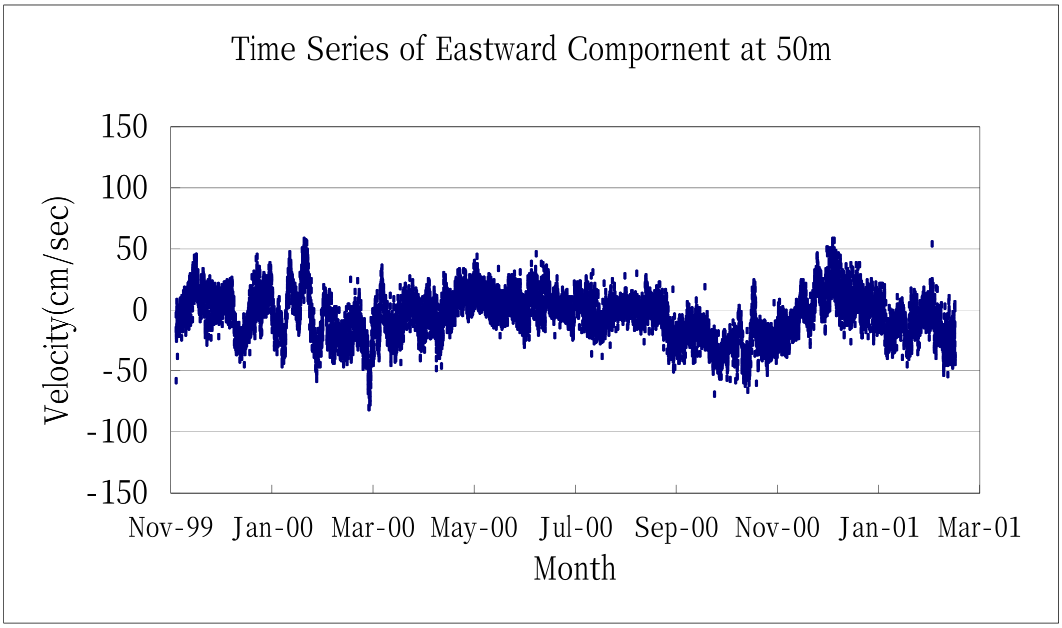


Fig.7-6-2 Time series of (a)pressure,(b)temperature and (c)salinity obtained by CTD from 8 Nov.1999 to 27 Feb.2001



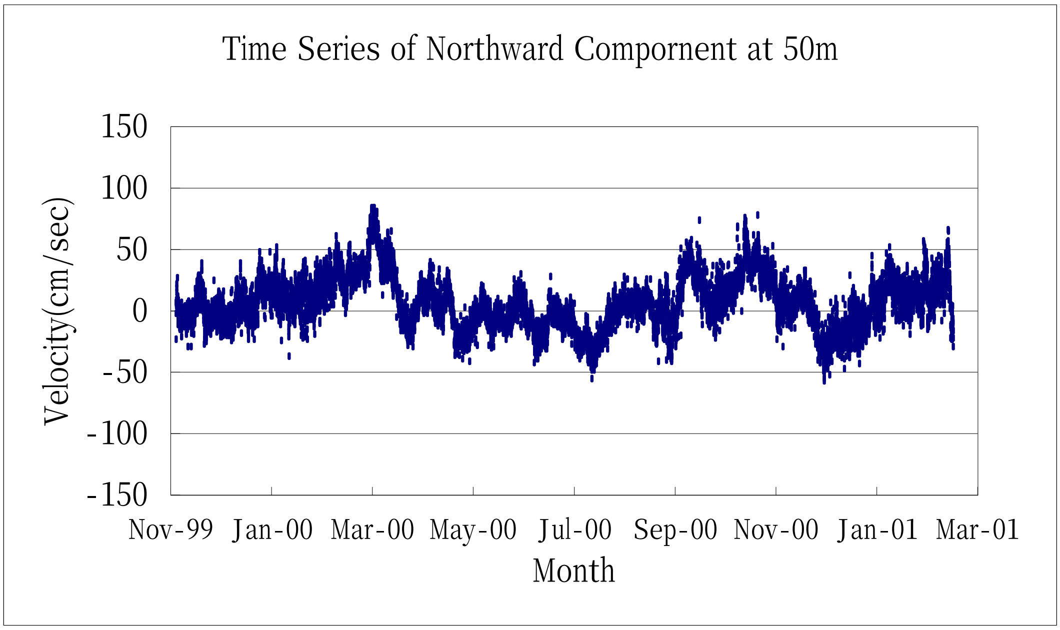
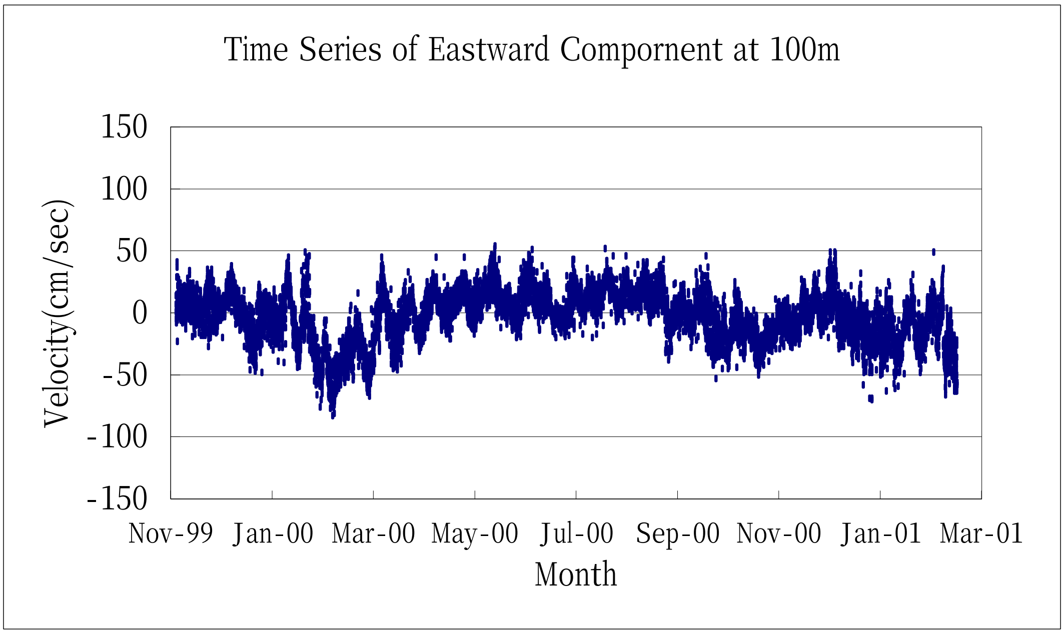


Fig.7-6-3 Time series of 50m depth/bin=21 of eastward and northward from 8 Nov.1999 to 27 Feb.2001



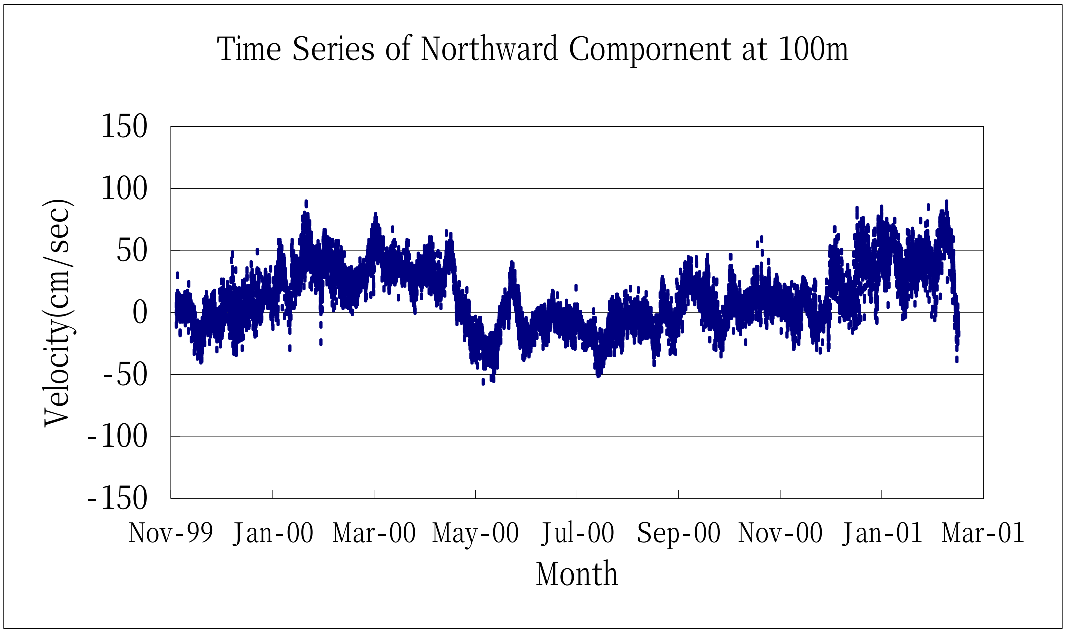
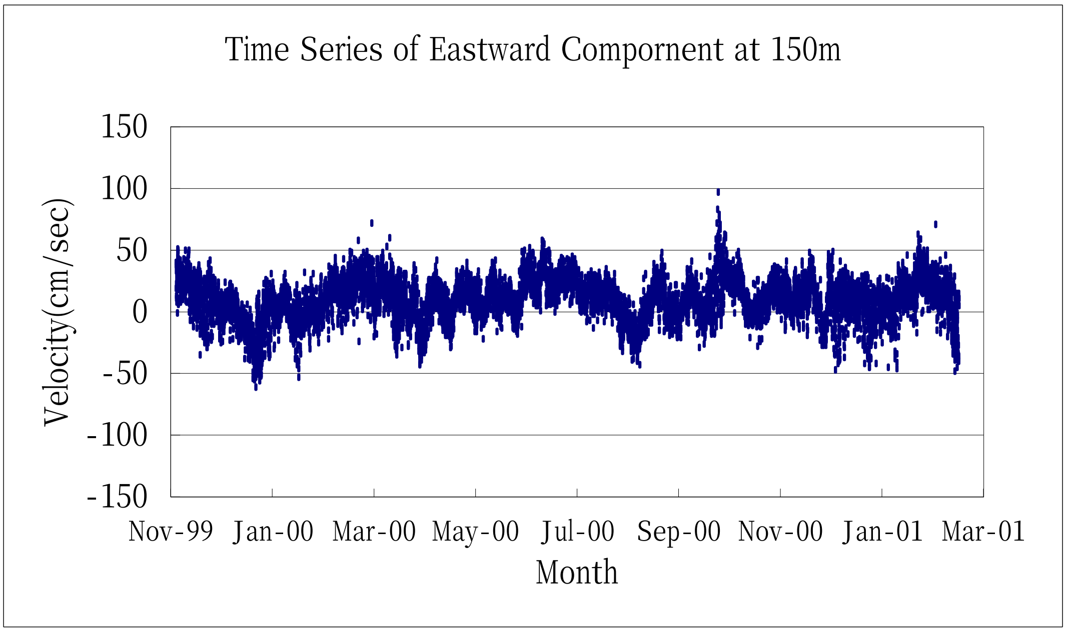


Fig.7-6-4 Time series of 100m depth/bin=15 of eastward and northward from 8 Nov.1999 to 27 Feb.2001



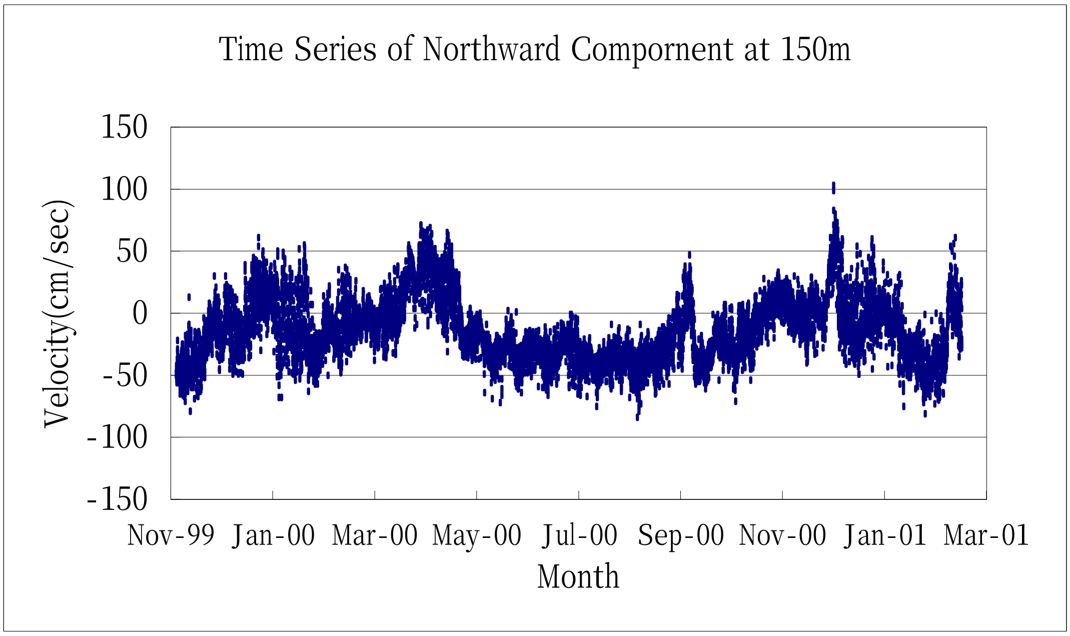
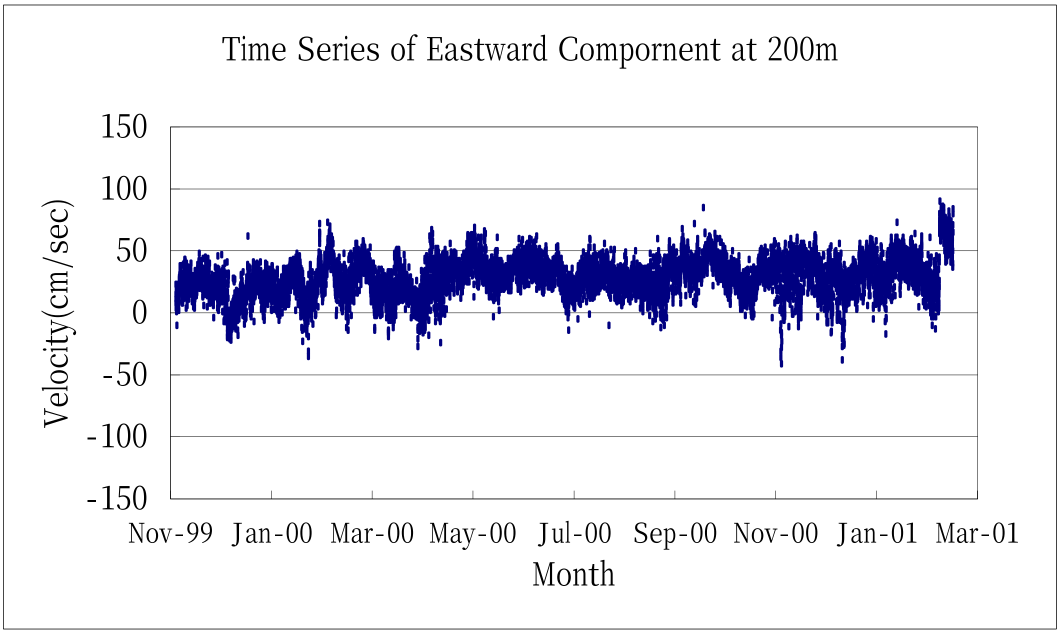


Fig.7-6-5 Time series of 150m depth/bin=10 of eastward and northward from 8 Nov.1999 to 27 Feb.2001



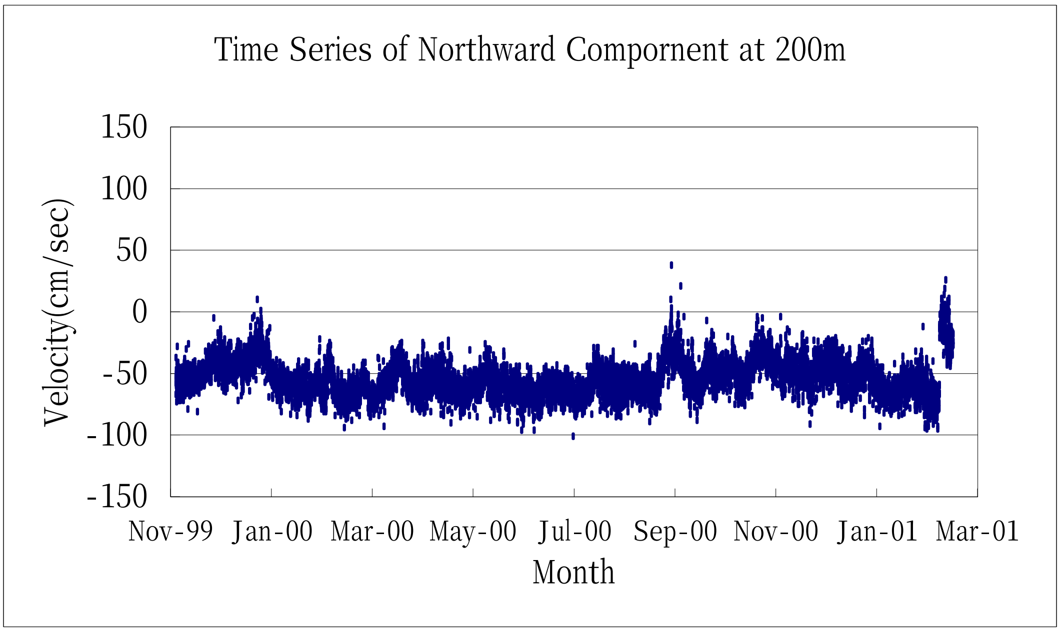


Fig.7-6-6 Time series of 200m depth/bin=4 of eastward and northward from 8 Nov.1999 to 27 Feb.2001

7.7 Ocean Lidar

Takeshi Kawano JAMSTEC, Ocean Research Department
Ai Yasuda, MWJ
Keisuke Wataki, MWJ

1.Objectives

The LIDAR, laser radar, has been developed to detect a horizontal distribution of phytoplankton and a vertical distribution of suspended matters. In order to check the performance of the system and get the required parameters for the system, continuous measurements were made from Guam to Yokosuka.

2.Method

(1) Ocean Lidar

The LIDAR operates a Nd.YAG laser, which emits a green pulse laser in 532 nm through KDP crystal as the second harmonic of Nd.YAG. Detectors in this system detects the laser excited fluorescence from phytoplankton in the surface layer and the light scattered by particles from the depth of about 5O meters. A density of chlorophyll-a is estimated through the empirical equation, obtained by a least square method. A vertical distribution of phytoplankton will be estimated from the logarithm decrement of signal as a function of particles.

(2) Sea truth data

In order to compare the data from Ocean Lidar system, we made an observation as follows.

- Photosynthetic parameters

We made an P-I curve measurement in every 8 hours using a surface seawater. The bottles were spiked with 0.2 mmoles/mL of $NaH^{13}CO_3$ solution, and incubated for 3 hours at temperature-controlled bath in a laboratory. The light intensity was shown in table 1. Samples were filtered immediately after the incubation and the filters were kept to freeze till analyse of this cruise. After that, filters were dried on the oven of 45 degree C.

Table. 1 Light Intensity of P-I measurements

Bottle No.	Light Intensity (uE/cm^2/sec)
1	1100
2	500
3	250
4	145
5	70
6	28
7	22
8	12

- Attenuation Coefficient

In order to measure the attenuation coefficients, we made a cast down to 100m of Hi-Star at 5 station. The casts were carried out at 1300LT from March 18th to 21st, and 1000LT on March 22nd.

- FRRF

In order to measure the photochemical quenching, we made a continuous measurement of FRRF, Fast Repetition Rate Fluorometer.

- PAR

In order to measure the photosynthetical available radiation, we made a continuous measurement using a PUV by Biospherical Instruments during the cruise.

All the data and samples will be analyzed after the cruise.

8 Ship Operations during General and Special Observation

8.1 Ship's movement at engine stopped

(1) Personnel

Captain Masaharu Akamine, Master of R/V " MIRAI "
And Ship's Crew

(2) Objectives

It is very important to find an influence of an external force such as a wind and a current for handling the ship in the engine stopped and the low speed required while ship is engaged in the development/recovery of the mooring buoy and CTD operation, etc.
It is easy to find the quantity of the current force by a Doppler sonar device but it is difficult to find directly the quantity of influence on ship's body by the wind force owing to a characteristic of the ship in a fluid.
Accordingly, a approximate formula is given to study of a relation between the ship's movement and the wind force by making ship drift actually.
A measurement is carried out to meet the needs of the approximate formula.

(3) Observation parameters

・The ship's position, course, speed
・Directions of the wind and the current, velocities of the wind and the current

(4) Methods

(4.1) Measurement of the actual ship-movement

A measurement of the ship-movement in stopped engine condition was done in real-time by the radio navigation device. The measurement includes a direction and a velocity of the ship-movement under external forces each second for 4 hours in case of the wind blowing to her starboard-side and for 1 hour in case of the wind blowing to her port-side.

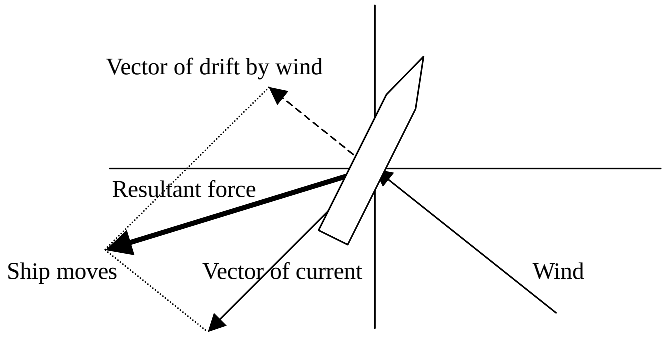
Fig 8.1-1 and Fig 8.1-2 show an example of the ship's movement under engine stopped.

(4.2) Measurement of the wind and the current

The direction and the speed of the wind were measured by KOAC-7800 weather data processor and sensors assembled by Koshin Denki.

The direction and the speed of the current were continuously measured by a Doppler sonar installed at the bottom of the ship that FURUNO Electric Co., Ltd. Japan produced.

The vector resultant force was calculated by the wind/the current data according to the following vector diagram. In case the current was found, the component of its force was excluded from the resultant force of the ship.



(4.3) Drifting coefficient

In case the ship receives the wind by the state that stopped the engine, the ship has leeway by her speed that the wind pressure and the resistance of water balanced each other out.

Assuming that the ship drifts to the lee side while receiving constant wind her right side, a following formula is given.

$$1/2 \cdot \rho a \cdot Cya \cdot Va^2 \cdot B = 1/2 \cdot \rho w \cdot Cyw \cdot Vw^2 \cdot L \cdot d$$

$$Vw = \sqrt{\frac{\rho a}{\rho w}} \sqrt{\frac{Cya}{Cyw}} \cdot \sqrt{\frac{B}{L \cdot d}} \cdot Va = \mathbf{k} \cdot \sqrt{\frac{B}{L \cdot d}} \cdot Va$$

where, ρa: density of air (0.124kgsec^2/m^4)

Cya: wind resistance

Va: Velocity of wind

B: lateral surface of projection (m^2)

ρw: density of water (104.5kgsec^2/m^4)

Cyw: fluid resistance

Vw: velocity of water

L: length between perpendiculars (m)

d: draught of ship (m)

k: drifting coefficient

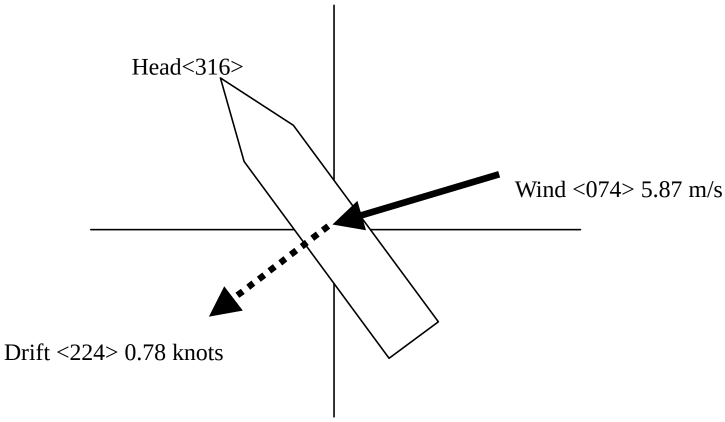
(5) Results

The measurements on the quantity of the ship drifted to the wind force are shown in Fig 8.1-3, Fig 8.1-4, Fig8.1-5 and Fig8.1-6 and the conclusion is shown as follows.

(5.1) In case of the wind blowing to her starboard-side

Propellers were clutched out and the current was nil.

The measurement was done using data in the state that the ship was stable from 2230 UTC 28th Feb.2001 to 0130 UTC 1st Mar. 2001.



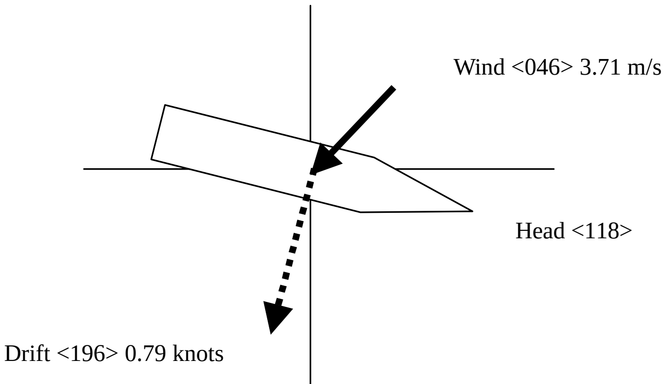
The ship drifted at the angle of 150 degrees from the direction of the wind.

The angles between the direction of the wind and the ship's longitudinal center line were 118 degrees.

(5.2) In case of the wind blowing to her port-side

Propellers were clutched out and the current of <299> 1.05 knots were excluded.

The measurement was done utilizing in the state that the ship was stable from 0155 UTC 5th Mar.2001 to 0240 UTC 5th Mar. 2001.



The ship drifted at the angle of 150 degrees from the direction of the wind.

The angles between the wind direction/ the ship's longitudinal center line were 108 degrees.

(5.3) Drift coefficient

A drift coefficient is found by substituting figures in (5.2) for the approximate formula as shown in (4.3).

The above- mentioned figures in (5.2) are adopted because of the current being nil.

$$Vw = k \cdot \sqrt{\frac{B}{L \cdot d}} \cdot Va$$

Where, Vw = 0.78 knots, B = 1713 cm^2, d = 6.00 m, Va = 5.87 m/s

$$0.78 \text{ knots} = k \cdot \sqrt{\frac{1713\, m^2}{116\, m \ x\ 6\, m}} \cdot 5.87 \text{ x } 3600/1852 \text{ knots}$$

Drift coefficient k = 0.0436

A report of Dr. Akira Iwai, "SOSENRON" issued in 1977, shows the drift coefficient is 0.041 if the approximate formula in (4.3) for k is resolved as Cya/Cyw has generally the value of 1.40. The drift coefficient of the ship is bigger than one of the general ship because the projection surface of the ship is large as compared with the general ship.

According to investigation of this time, the result shows that the ship takes afterward movement due to a reversed thrust in case propellers clutched out. We have to consider this matter if engine stopped.

(5.4) Drift angle

As for the drift angle, it was the proper result that the ship did not drifts to the right opposite direction of the wind blowing and that it had one constant angle due to a difference of power to act on the hull.

So it is necessary to adjust an angle of maximum 30 degrees from the right opposite direction where the wind blows to in case the vector calculation in (4.2) is done.

(6) Data archive

All data will be archived on board.

(7) Remarks

In this time, a standard for the ship drifting was found through the actual measurement. The standard is not quite finished yet.

It is necessary to collect data through the ship takes an active part in her research works after this in order to bring it close to realty more.

Fig 8.2-1 Ship's Movement at engine stopped

Tracking

(In case of the wind blowing to the ship's starboard side)
2200 UTC 28th Feb.2001 ~ 0200 UTC 1st Mar.2001
00-06.14N, 156-12.36E ~ 00-04.04N, 156-10.37E
Wave height: 1.4m Weather: bc

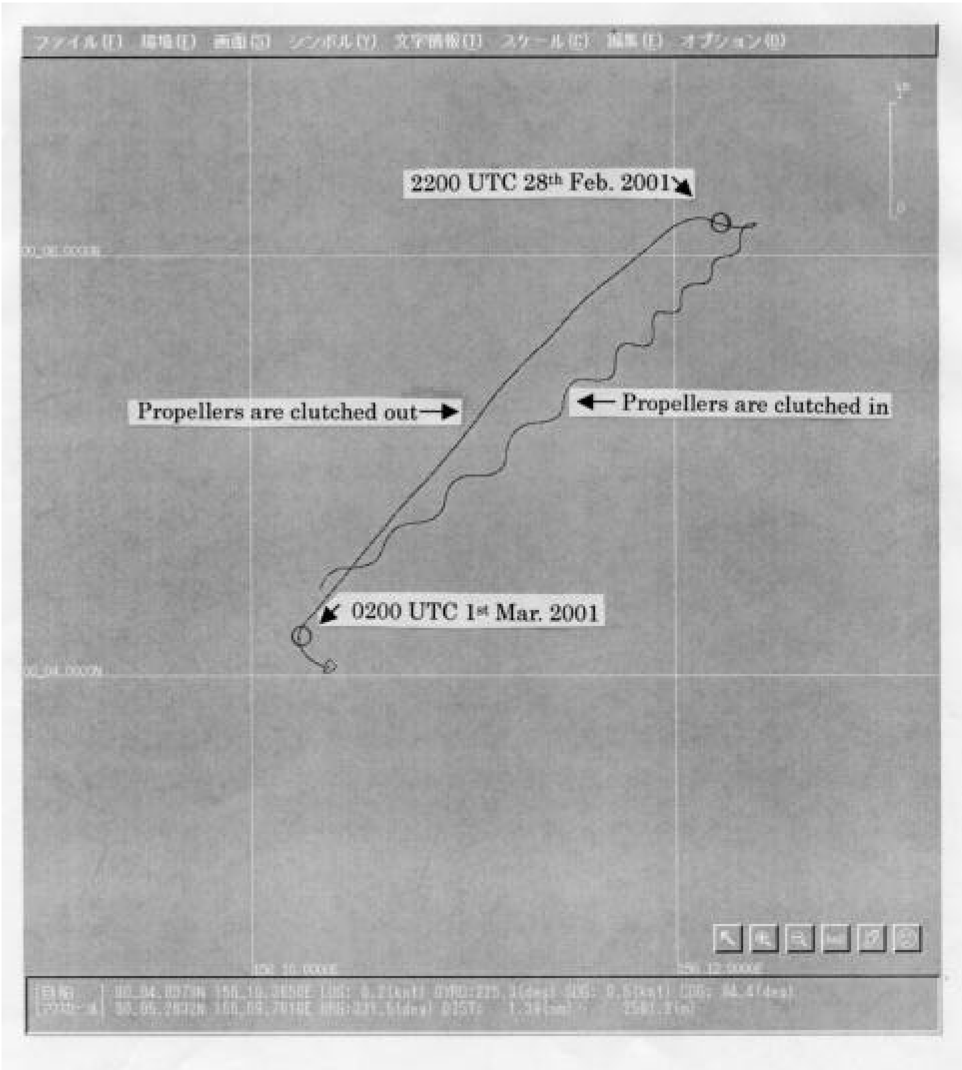
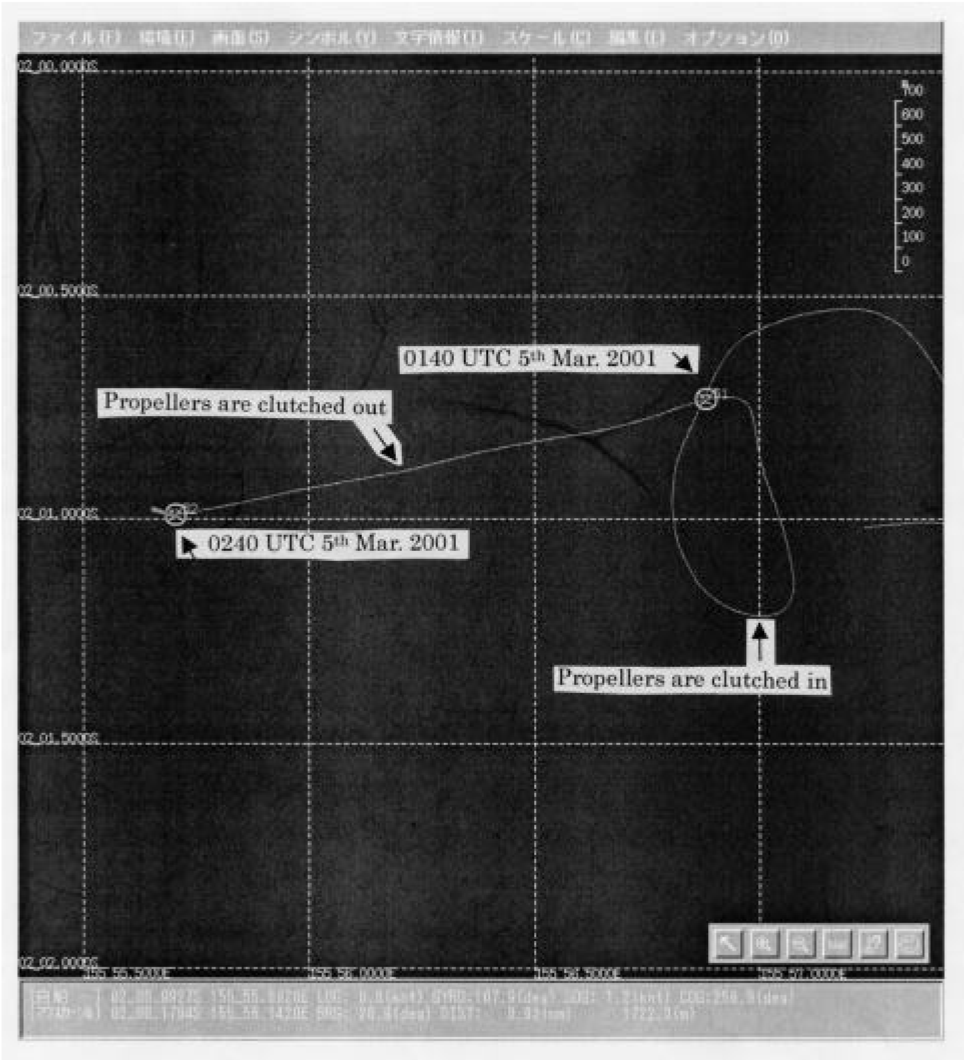


Fig 8.2-2 Ship's Movement at engine stopped

Tracking

(In case of the wind blowing to the ship's port side)
0140 UTC 5th Mar.2001 ~ 0240 UTC 5st Mar.2001
02-00.73N, 156-56.88E ~ 02-01.00N, 156-55.70E
Wave height: 1.8m Weather: bc



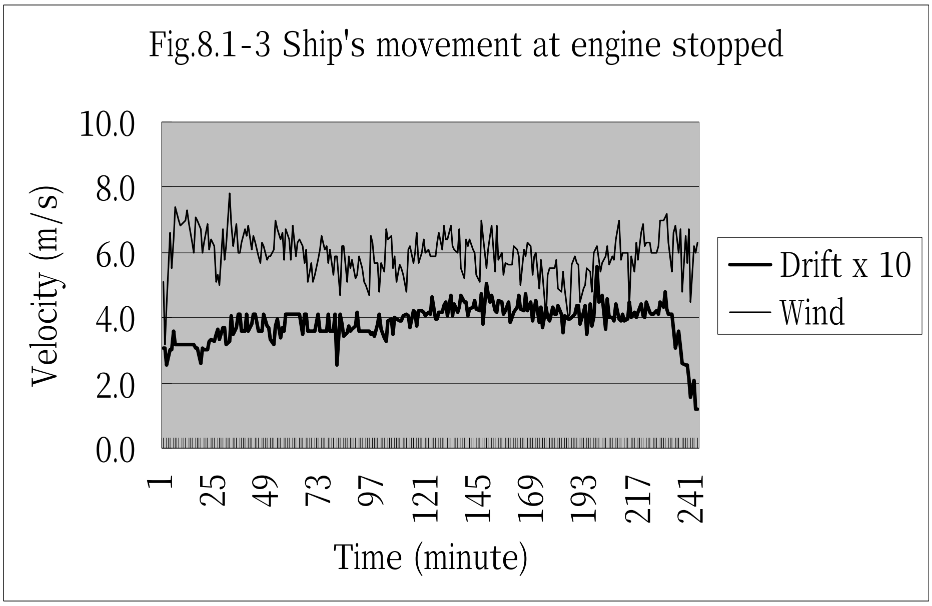


Fig.8.1-3 Ship's movement at engine stopped
10.0
8.0
6.0
4.0
2.0
0.0
Velocity (m/s)
1
25
49
73
97
121
145
169
193
217
241
Time (minute)
Drift x 10
Wind

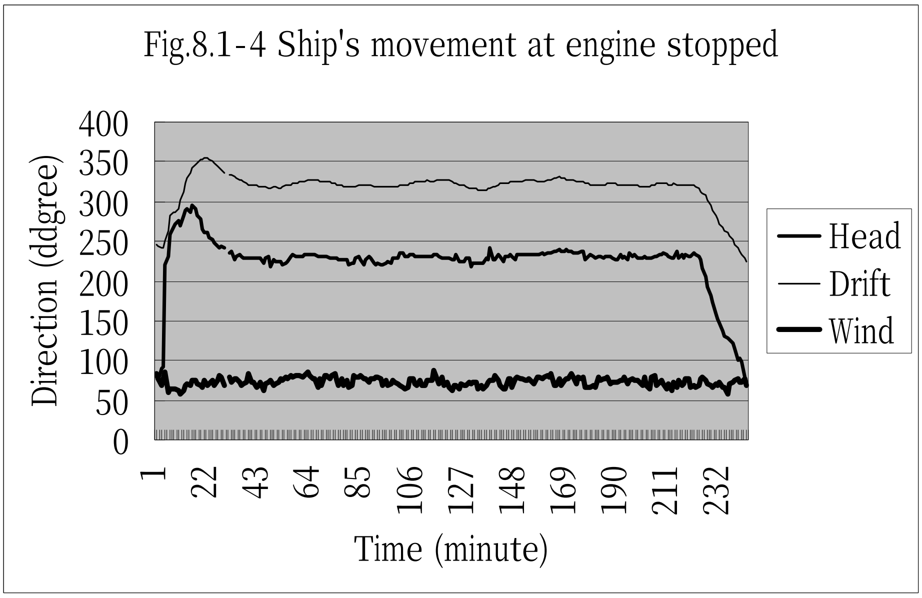


Fig.8.1-4 Ship's movement at engine stopped
400
350
300
250
200
150
100
50
0
Direction (ddgree)
1
22
43
64
85
106
127
148
169
190
211
232
Time (minute)
Head
Drift
Wind

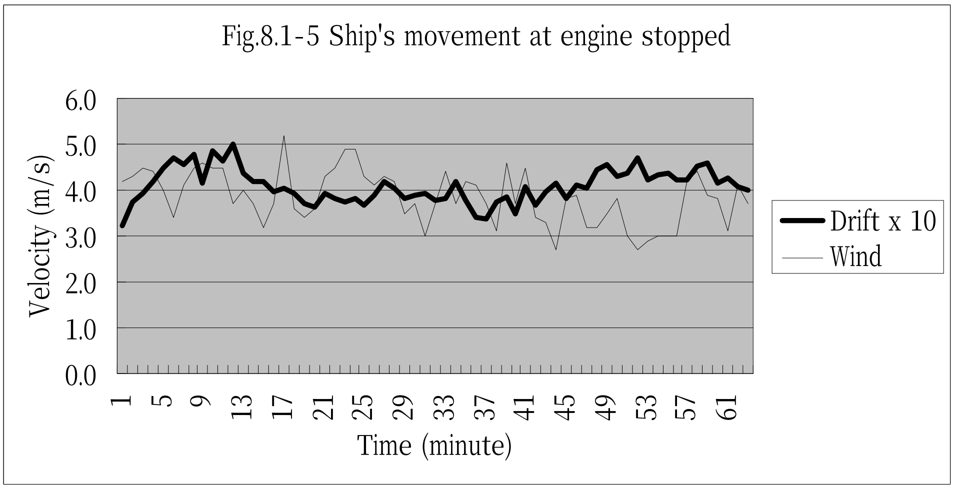


Fig.8.1-5 Ship's movement at engine stopped
Velocity (m/s)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1
5
9
13
17
21
25
29
33
37
41
45
49
53
57
61
Time (minute)
Drift x 10
Wind

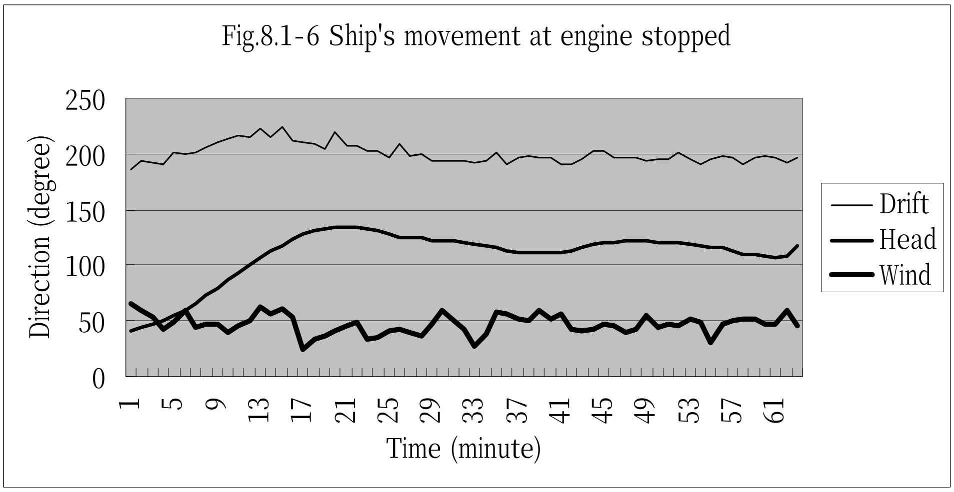


Fig.8.1-6 Ship's movement at engine stopped
Direction (degree)
250
200
150
100
50
0
1
5
9
13
17
21
25
29
33
37
41
45
49
53
57
61
Time (minute)
Drift
Head
Wind

8.2 Ship's Handling for Deployment TRITON buoys and ADCP mooring system

(1) Personnel

Captain Masaharu Akamine, Master of R/V " MIRAI "
And Ship's Crew

(2) Objectives

It is necessary for a ship's maneuvering to find a necessary distance for deploying a TRITON buoy/an ADCP mooring systems in order to make her move to a site in required depth.
An approximation and a standard are led as a parameter by a course of a ship, a speed, working hours and a distance between position of a sinker dropped and that of the sinker arrived at the bottom of the sea with a purpose in order to investigate the necessary distance.

(3) Observation parameters

- Ship's position, course, speed
- Directions of the wind and the current, velocities of the wind and the current
- Vectors of the wind and the current, the resultant force
- Working hours
- Position of sinker

(4) Methods

(4.1) Measurement of the actual ship-movement

Measurement of the ship-movement at engine stopped was executed by a set-drift before the deployment TRITON buoy in order to make in advance a comparison between reality and expectation. A direction and a velocity of the ship-movement in the external force influence was measured by a radio navigation device " Sains" assembled by Sena Co., Ltd. Japan and a Doppler sonar "DS-30" assembled by FURUNO Electric Co., Ltd. Japan.

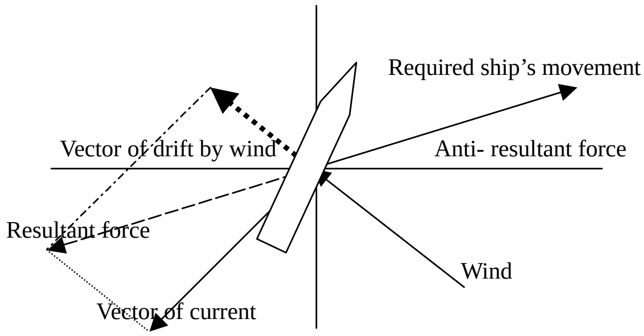
A report as indicated in 8.1 shows an example of the ship's movement at engine stopped.

(4.2) Measurement of the wind and the current

The wind direction and speed were measured by KOAC-7800 weather data processor and sensors assembled by Koshin Denki.

The current direction and speed were continuously measured by a Doppler sonar “DS-30” installed at the bottom of the ship.

The vector resultant force was calculated by the wind and the current data in real-time according to the following vector diagram. The wind was transformed into the vector of the drift using an approximate formula given by some hydrodynamic tests. An example is shown in the report 8.1



(4.3) Ship’s speed

According to the results measured in MR00-K02, the ship’s speed was set up so as to keep her speed on 2 ~ 3 knots at ship’s through-the-water during the nylon ropes being let out and to keep her speed on 1 ~ 2 knots at ship’s through-the-water during the cable being paid out and the recovery buoys/releasers/sinker being connected in order to avoid the occurrence of their kink accident and to maintain a safety of the works. An average speed through all work around 2 knots at ship’s through-the-water became one aim.

(4.4) Ship’s course

The ship’s course was expected by the vector calculation of the wind-drift and the current as indicated in (4.2), making reference to the data of the set-drift carried out before the deploying operation of the TRITON buoys/the ADCP mooring systems.

If there is a great difference between the direction of the wind and that of the current, the selection of her course shall be attached importance to a bigger one of the vector value and shall be in need of the direction of depth contour in the bathymetric map.

(4.4) Working hours for the deployment TRITON buoy/ADCP mooring systems

The time that the ship needed for each work was investigated taking data in MR00-K02 into account.

(4.5) Decision of position of sinker

The position of the sinker was fixed with a radio navigation device, an acoustic navigation device and the ship's radars.

The radio navigation device: "Sains" assembled by Sena Co., Ltd. Japan.

The acoustic navigation device: "SSBL processor (13kHz)" assembled by Oki Denki.

The ship's radar: "JMA9000 X band" and "JMA 9000 S band " assembled by JRC Ltd.

"MM950 X & S band" assembled by Consilium Selesmar, Italy.

(5) Results

(5.1) Ship's speed

The results are shown in Table 8.2-1 and 8.2-2.

By the results of this time, the average speed of the deploy buoy works was around 2 knot at ship's through-the-water with all the buoy works from TRITON buoy No.1 to No.8.

(5.2) Ship's course

The results are shown in Table 8.2-2.

The ship's course was adjusted so that the ship could cope with the external force influence to change variously, leading the wire cable and the nylon ropes right astern.

By the results of this time, about the course of the ship, a big difference is not recognized between expectation and the reality.

(5.3) Working hours

The results are shown in Table 8.2-1.

Except time paying out the nylon ropes, the times that the ship needed for each work show to be fixed nearly.

When show the average time that spent on each work, the results are as follows.

The time that spent in paying out a wire cable	1 hour 12 minutes
The time that spent in connecting recovery buoys, releasers and a sinker	14 minutes
Total	1 hour 26 minutes

Length of total nylon ropes divided by Y is the time that spent in paying out nylon ropes

Y = 0.6472 x Length of total nylon ropes + 1503 (by recurrence type to lead from the results shown in Fig. 8.2- 1)

(5.4) Sinker's position

The difference between position of **the sinker dropped** and that of **the sinker arrived at the sea bottom** were shown in Table 8.2-3. In the result, the distance between two points was about 15 % of depth of the water. An approximate formula is given with these past records in

Table 8.2-3. This different distance was added to the necessary distance for the deployment of TRITON buoy in order to bring the sinker up on the site in the required depth.

Table 8.2-3 was shown that the direction from position of **the sinker dropped** to that of **the sinker arrived at the sea bottom** was nearly the same course as the ship was finally towing the sinker in all cases.

In case of the ADCP mooring system, position of the sinker was fixed at a point that the sinker had been dropped because weight of the sinker for the whole system was heavy as compared with the TRITON buoy.

(5.5) Distance for Deployment TRITON buoy

All of the ship's movement for the deploying operation of the buoy was in existence within required limits of each operation as stated above.

An approximate formula for the distance of the deployment TRITON buoy is derived from the actual data indicated in Table 8.2-1, Table 8.2-3 and Fig. 8.2-1.

It is shown as follows:

$$D = (U1 - Vw) \times k1 + (U2 - Vw) \times L / k2 + S$$

Where,

D: Distance of the deployment TRITON buoy, not included distance for towing the sinker. (Unit: mile)

U1: The average speed in the ship's through-the-water while the cable being paid out, the recovery buoys and the releasers being set, and the sinker being stood by except the sinker being towed. (Unit: knot)

1~2 knots is given by the past records as indicated in (4.3).

U2: The average speed in the ship's through-the-water while the nylon ropes being paid out. (Unit: knot)

2~3 knots is given by the past records as indicated in (4.3).

Vw: The average quantity of the current influences a forward movement of the ship. (Unit: knot)

The value is calculated by a formula to multiple a cosine of an angle A in the current's speed.

Where, A= the angle that the ship's course line intersects the direction line of the current.

L: Length of all the nylon ropes except that of the nylon ropes between the recovery buoys. (Unit: meter)

k1: All the working hours for the cable being paid out, the recovery buoys and the releasers being set, and the sinker being stood by except the sinker being towed. (Unit: hour)

(k1=1hour and 26 minutes is transformed to 1.43 by the decimal system. This value is given from the past records in Table 8.2-1)

k2: The average length of the nylon ropes paid out per hour. (Unit: meter)

(k2=0.6472 x length of all nylon ropes + 1503. This value is given by a regression through the data shown in Fig. 8.2-1)

S: The distance between position of the sinker dropped and that of the sinker arrived at the bottom of the sea. (Unit: meter)

(The distance between two points=0.1089 x the required depth + 127.3)

This value is given by the approximate formula as indicated in Table 8.2-3.

(6) Data archive

All data will be archived on board.

(7) Remarks

As for it beginning to have been led an approximation and a standard by the results, there is big significance. But this is not a complete thing. We will want to get rid of expectation and difference with the reality by accumulating the results.

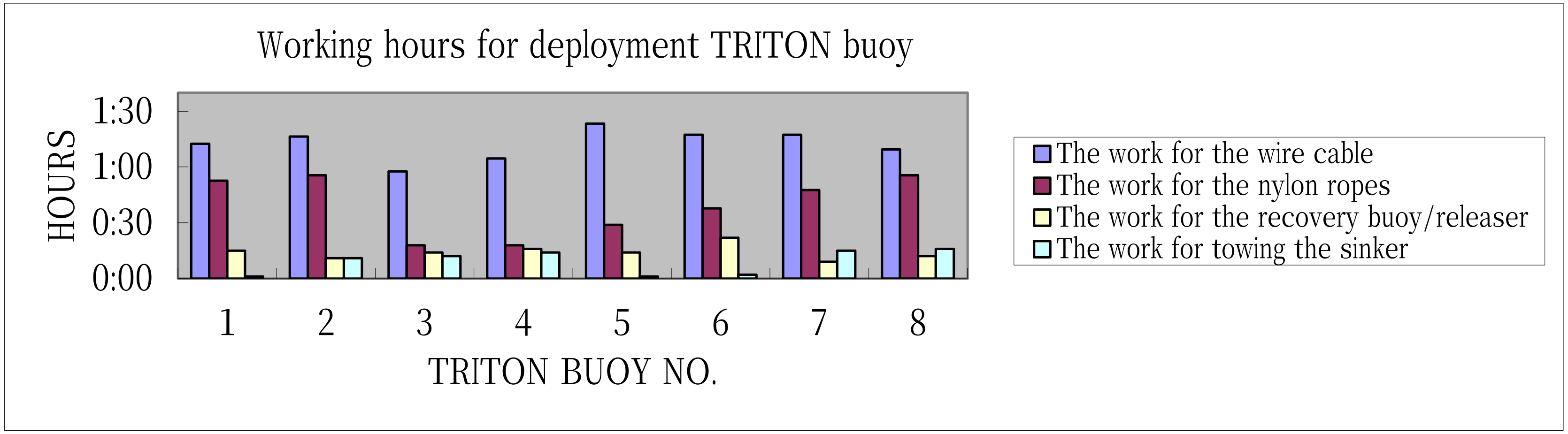
Table 8.2-1 SUMMARY OF WORKING TIME FOR DEPLOYMENT TRITON BUOY AND ADCP MOORING SYSTEM DURING MR01-K01

TRITON No.	8	7	6	5	4	3	2	1		ADCP
Location	2N,147E	5N,147E	5S,156E	2S,156E	0,156E	2N,156E	5N,156E	8N,156E		0,156E
Works Dat	14-Mar	15-Mar	7-Mar	5-Mar	2-Mar	26-Feb	24-Feb	22-Feb		28-Feb
Com'ced	9:21	8:51	8:53	8:53	8:51	8:49	13:20	9:35		13:02
Buoy into sea	9:30	9:00	9:02	9:02	9:02	9:00	13:24	9:35		13:04
Set 250m Sensor	9:46	9:22	9:18	9:17	10:05	9:54	13:50	9:56		0:00
Set 300m Sensor	9:48	9:25	9:21	9:21	10:11	9:57	13:53	9:59		0:00
Set 500m Sensor	9:56	9:32	9:26	9:30	10:22	10:07	13:59	10:07		0:00
Set 750m Sensor	10:08	9:41	9:35	9:40	10:29	10:17	14:09	10:20		0:00
Pay out Nylon Rope	10:34	10:08	9:51	9:58	11:00	10:44	14:38	10:45		13:15
Set Recovery Buoy	10:50	10:24	10:04	10:13	11:22	11:17	14:56	11:01		13:42
Set Recovery Buoy	10:59	10:31	10:13	10:23	11:32	11:27	15:02	11:08		0:00
Pay out Nylon Rope	11:00	10:32	10:14	10:24	11:35	11:28	15:03	11:09		13:47
Set Releaser	11:37	11:12	10:19	10:27	11:42	11:33	15:33	11:49		13:47
S/B sinker	11:42	11:15	10:23	10:32	11:43	11:44	15:35	11:53		13:48
Let go sinker	11:43	11:26	10:35	10:46	11:44	11:46	15:50	12:09	Average	13:54
H for cable	1:13	1:17	0:58	1:05	1:24	1:18	1:18	1:10	**1:12**	0:13
o for ropes	0:53	0:56	0:18	0:18	0:29	0:38	0:48	0:56	**0:39**	0:27
u for releaser	0:15	0:11	0:14	0:16	0:14	0:22	0:09	0:12	**0:14**	0:06
r for sinker in tow	0:01	0:11	0:12	0:14	0:01	0:02	0:15	0:16	**0:09**	0:06
Total	2:22	2:35	1:42	1:53	2:08	2:20	2:30	2:34	2:15	0:52
Length of all ropes(m	**3435**	**3205**	**455**	**699**	**956**	**1551**	**2501**	**3170**	1,997	**1229**
Length of ropes(m/h	**3,889**	**3,434**	**1,517**	**2,330**	**1,978**	**2,449**	**3,126**	**3,396**	3,033	**2,731**
D for cable (mile)	1.13	1.24	1.81	1	3.78	1.54	1.49	1.75	2.29	0.43
I for ropes (mile)	1.72	1.53	0.54	0.47	0.93	1.2	1.2	2.46	1.68	1.31
s for releaser (mile)	0.27	0.27	0.37	0.32	0.38	0.43	0.12	0.17	0.39	0.14
t for sinker (mile)	0.01	0.2	0.43	0.29	0.01	0.02	0.55	0.65	0.36	0.17
Total (mile)	3.13	3.24	3.15	2.08	5.1	3.19	3.36	5.03	4.71	2.05
S for cable (knot)	0.9	1.0	1.9	0.9	2.7	1.2	1.1	1.5	1.87	2.0
p for ropes (knot)	1.9	1.6	1.8	1.6	1.9	1.9	1.5	2.6	2.5	2.9
ee for releaser(knot)	1.1	1.5	1.6	1.2	1.6	1.2	0.8	0.9	1.6	1.4
d for sinker (knot)	0.6	1.1	2.1	1.2	0.6	0.6	2.2	2.4	2.4	1.7
Average speed (knot	1.3	1.3	1.9	1.1	2.4	1.4	1.3	2.0	2.1	2.4

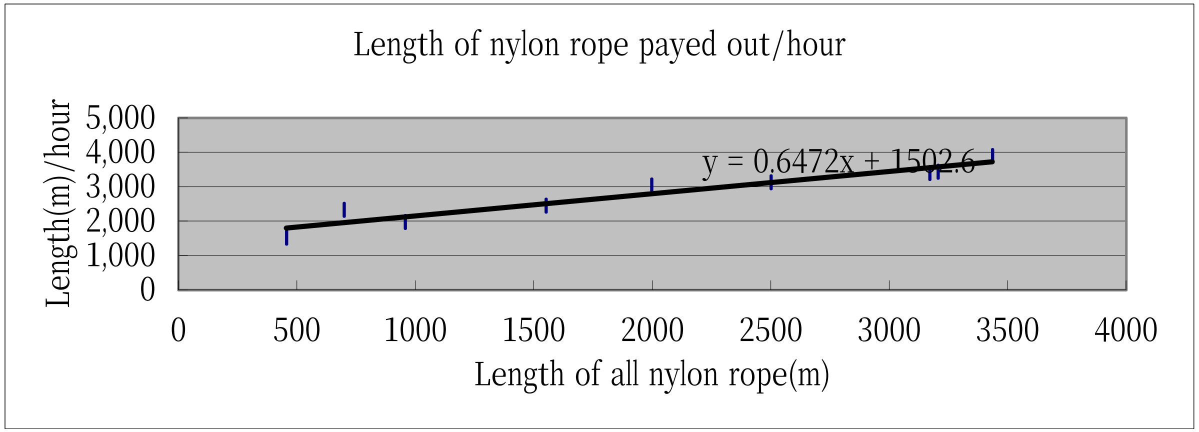
Remarks: As for TRITON #3, Hours for cable exclude extra times of 37 minutes for cheking sensors after TRITON buoy deployed.
As for TRITON #4, Hours for cable exclude 45 minutes consumed in surplus for installing the fairing

Fig. 8.2-1 SUMMARY OF WORKING TIME FOR DEPLOYMENT TRITON BUOY ON MR01-K01

The time spent in each work except the work for paying out the nylon ropes is nearly fixed as shown in the following chart.



As for the work for the nylon ropes, a following regression formula is derived from the relation between the lenghth of all the nylon ropes and that of the nylon ropes paid out per hour.



length of the nylon ropes sent out/hour = 0.6472 x length of all the nylon ropes + 1503
(unit: meter)

Table 8.2-2 SUMMARY OF SHIP'S HANDLING FOR DEPLOYING TRITON BUOY DURING MR01-K01

			Course			Speed			Deploy dist			Wind		Current		Vector				Required	Working
No.	Location	Date	Exp.	Act.	Diff.	Exp.	Act.	Diff.	Exp.	Act.	Diff.	Direct.	Velocity	Direct.	Velocity	Direct.	speed	C.Co.	C.C.F.	Depth(Actual)	hours
1	8N,156E	22-Feb	125	125	0	1.8	1.9	-0.1	4.2	4.4	-0.1	85	10	315	0.2	4	1.5	108	-0.2	4850(4847)	2:18
2	5N,156E	24-Feb	225	225	0	1.1	1.2	-0.2	2.4	2.8	-0.4	60	6	85	1.2	46	0.5	294	-0.9	3600(3608)	2:15
3	2N,156E	26-Feb	70	70	0	1.7	1.1	0.6	3.4	3.2	0.2	80	7	270	0.3	4	1.2	78	-0.3	2575(2577)	2:55
4	0,156E	2-Mar	45	45	0	1.8	1.7	0.0	4.7	5	-0.3	75	5	170	0.4	-25	0.9	35	-0.2	1950(1953)	2:52
5	2S,156E	5-Mar	80	82	-2	1.1	1.0	0.1	1.7	1.7	0.0	40	6.5	295	1.1	31	1.7	91	-0.9	1750(1755)	1:39
6	5S,156E	7-Mar	350	352	-2	1.8	1.7	0.1	2.7	2.6	0.1	340	1.5	100	0.5	-48	0.6	297	-0.2	1510(1520)	1:30
7	5N,147E	15-Mar	90	92	-2	1.6	1.3	0.3	3.7	3	0.7	70	8.0	285	0.4	9	1.0	90	-0.4	4275(4287)	2:24
8	2N,147E	14-Mar	90	90	0	1.4	1.3	0.1	3.3	3.1	0.2	300	1.3	300	0.7	-18	0.6	117	-0.6	4490(4495)	2:21
Unit			deg.	deg.	deg.	knot	knot	knot	mile	mile	mile	deg.	m/s	deg.	Knot	deg.	knot	deg.	knot	meter	Hours

Remarks: Vector means the resultant force of the wind-drift and the current. Exp.=Expectation, Act.=Actual, Diff.=difference, The working hours means the actual hours for all the work except the work for towing the sinker, Dist.=Distance, Direct.=Direction, C.CO=Calculation Course, deg.=degree. C.C.F.=Component of current force.The course is shown on the course made good basis and the speed is on her over the grand basis.
As for TRITON #3, the working hours include extra times of 37 minutes for checking sensors which is installed right below of the buoy.
As for TRITON #4, the working hours include additional time for 45 minutes to install fairings to the cable and 1.5 miles are added to deploy distance.
As for TRITON #7, the deploy distance shortened than expection as the mooring point was changed on the way.

An approximation for finding the value of the necessary distance for deploying the TRITON buoy

Length of all the nylon ropes ? (unit:meter)	3170	Speed is given by the" C.C.F "value in the above table?	-0.2
Neccesary distance for deploying a buoy (unit:mile)	**4.2**	Estimated average log speed for deploying a bouy (unit:knot)	1.8

The above mentioned value in square brackets is one for location 8N,156E as an example.

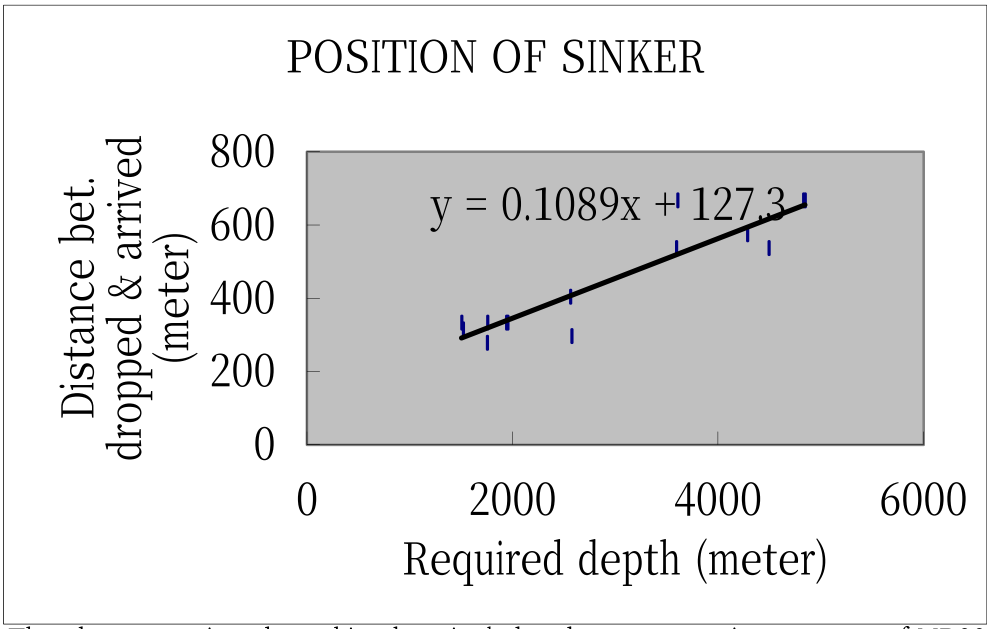
Table 8.2-3 DIFFERENCES BETWEEN A POSITION OF THE SINKER DROPPED AND THAT OF THE SINKER ARRIVED AT THE BED OF THE SEA DURING MR01-K01

Buoy No.	position		Depth (meter)	Distance (meter)	Direction (degree)	Ratio to depth
	Let go sinker	Fixed				
8	2-06.05N 146-57.23E	2-06.04N 146-56.94E	4495	537	268 <090>	12%
7	4-58.75N 147-01.34E	4-58.70N 147-01.03E	4287	574	261 <080>	13%
6	5-01.80S 156-01.45E	5-01.95S 156-01.53E	1520	315	153 <340>	21%
5	2-01.01S 155-57.40E	2-01.02S 155-57.25E	1755	278	266 <090>	16%
4	0-01.20N 156-02.69E	0-01.08N 156-02.56E	1953	333	227 <045>	17%
3	2-02.35N 156-01.30E	2-02.32N 156-01.14E	2577	296	260 <070>	11%
2	5-01.16N 155-57.96E	5-01.33N 155-58.25E	3608	667	54 <225>	18%
1	7-59.21N 156-00.77E	7-59.41N 156-00.47E	4847	667	304 <130>	14%
ADCP	0-00.49N 156-07.97E	0-00.17N 156-07.93E	1952	74	240 <070>	4%

<>final course

According to the following chart, a regression formula is derived from a relation between a position of the sinker dropped and that of the sinker arrived at the sea bottom.

X = the required depth, Y = the necessary distance when the sinker is dropped.



The above mentioned graphic chart includes data at a previous voyage of MR00-K02.

8.3 Ship's Handling for Recovery TRITON buoy / ADCP mooring systems

(1) Personnel

Captain Masaharu Akamine, Master of R/V " MIRAI "
And Ship's Crew

(2) Objectives

To find how to make a ship approach a TRITON buoy and an ADCP float drifting on the sea after their mooring lines were release from a sinker at the bottom of the sea and to obtain data on working hours for the recovery of the TRITON buoy/the ADCP mooring systems in order to be helpful to us in doing a next work.

(3) Observation parameters

- Ship's position, course, speed
- Directions of the wind and the current, velocities of the wind and the current

(4) Methods

(4.1) Measurement of the actual ship-movement

Measurement of the ship-movement at coming close to the buoy and float was carried out in a radio navigation device assembled by Sena Co., Ltd. Japan.

(4.2) Measurement of the wind and the current

The wind direction and speed were measured by KOAC-7800 weather data processor and sensors assembled by Koshin Denki.

The current direction and speed were continuously measured by a Doppler sonar installed at the bottom of the ship. The Doppler sonar is assembled by FURUNO Electric Co., Ltd.

(5) Results

(5.1) How to approach the buoy/the float

The results are illustrated in Fig.8.3-1 ~ Fig.8.3-7 and the following matters are pointed out.

(a) The mooring system drifted according to a big power between the wind and the flow after the recovery-buoys and the ADCP float that are one part of a system surfaced on the sea. When power of the wind or the flow is small, the mooring system floats in a group as well not to establish a course. In this case, the ship tows it in the wind or upstream after having connected a handling rope which sent from the ship to the TRITON buoy or the ADCP float which there is first of the mooring system to prevent from getting entangled in buoys, floats, mooring ropes each other. An example is shown in Fig.8.3-6.

(b) The ship was handled so as to take her position in the lee side or the down stream to the mooring system according to a basic manner. In this time, it was comparatively easy to handle the ship because the course of the current was the same as the direction of the wind each case. If there is nothing of a great difference between the wind and the current, the ship shall be in need of the direction of a handling small buoy connected with the TRITON buoy or the ADCP float. Namely the ship shall approach it at right angles as much as possible to the direction that a handling small buoy flows.

(5.2) Working hours for recovery the buoy/ADCP mooring systems

The result is shown in Table 8.3- **1** and the following matters are pointed out.

(a) The time consumed on each work in recovery of all the TRITON buoys was nearly constant except the working time for the recovery of the nylon ropes that have different lengths.

(b) As for the time when the recovery buoys surface on the sea, there was not a big difference all.

(c) A lot of fishing line got entangled in the wire cables of TRITON buoy No.1, No.2, No.3, and No.6.

(d) The working time of the boat was controlled by the timing that a release signal is sent from the acoustic navigation device installed in the bottom of the ship.

(e) In case of the recovery of the ADCP mooring system, the working boat was lowered after surfacing of glass balls had been confirmed.

(f) The ship recovered most TRITON buoy mooring systems while receiving wind aback. This was much better than others, judging from the ship’s handling.

(6) Data archive

All data will be archived on board.

(7) Remarks

The results are very much beneficial when we work in future. The results will be accumulated in this sense.

Fig. 8.3-1 FIGURE OF RECOVERY BUOY

Triton buoy number: 1 (8N, 156E)

Date: 23rd Feb.2001

Wind: <100> 10.0 m/s, Current: <025> 0.3 knot

Swell: ENE, Wave height: 2.2 m, Weather: Overcast

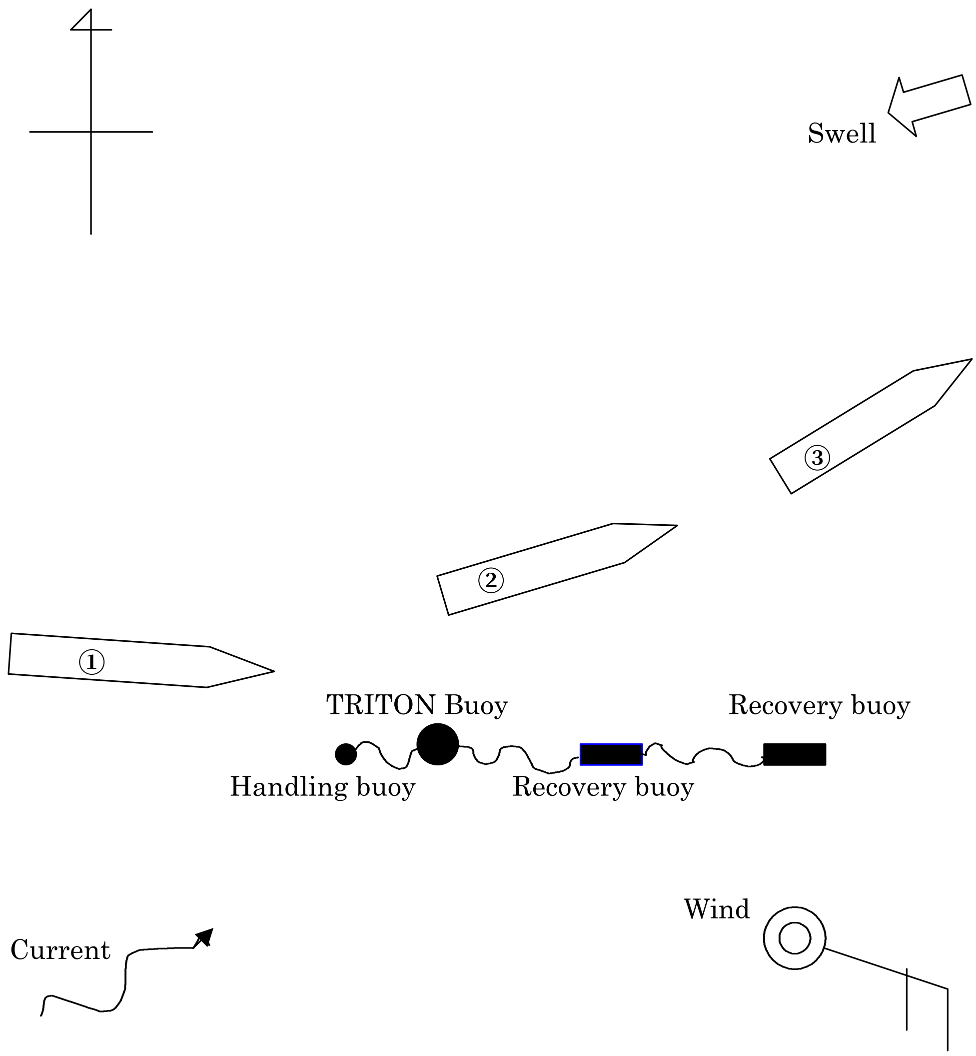


Fig.8.3-2　FIGURE OF RECOVERY BUOY

Triton buoy number: 2　(5N, 156E)

Date: 25th Feb.2001

Wind: <045> 8.0 m/s, Current: <045> 0.8 knot

Swell: NE, Wave height: 2.3 m, Weather: bc

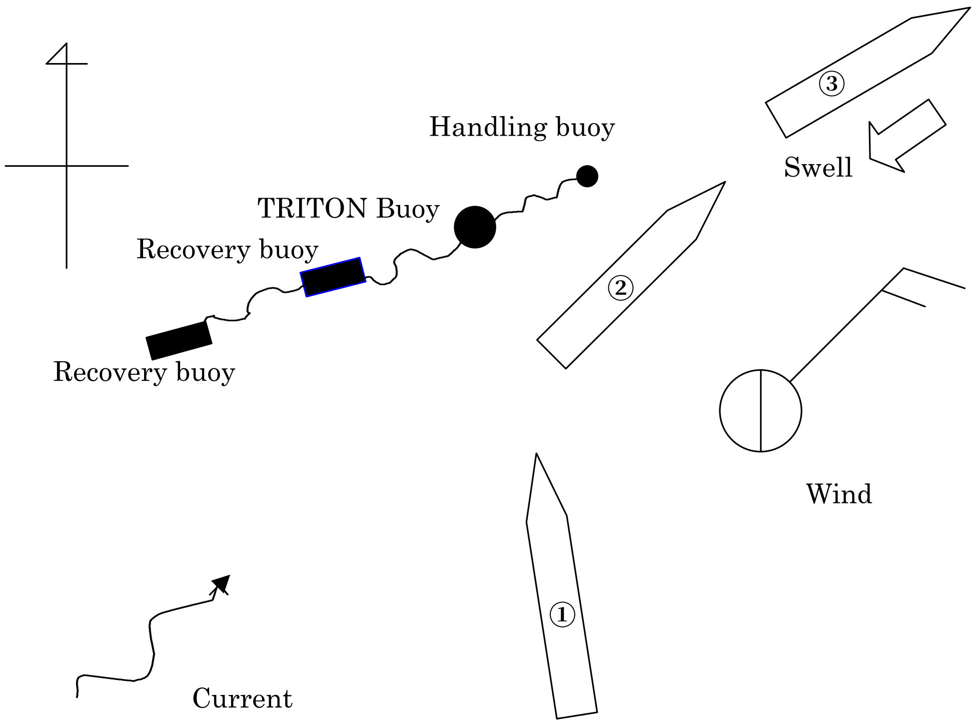


Fig.8.3-3 FIGURE OF RECOVERY BUOY

Triton buoy number: 3 (2N, 156E)

Date: 27th Feb.2001

Wind: <075> 2.4 m/s, Current: <260> 0.4 knot

Swell: ENE, Wave height: 1.4 m, Weather: bc

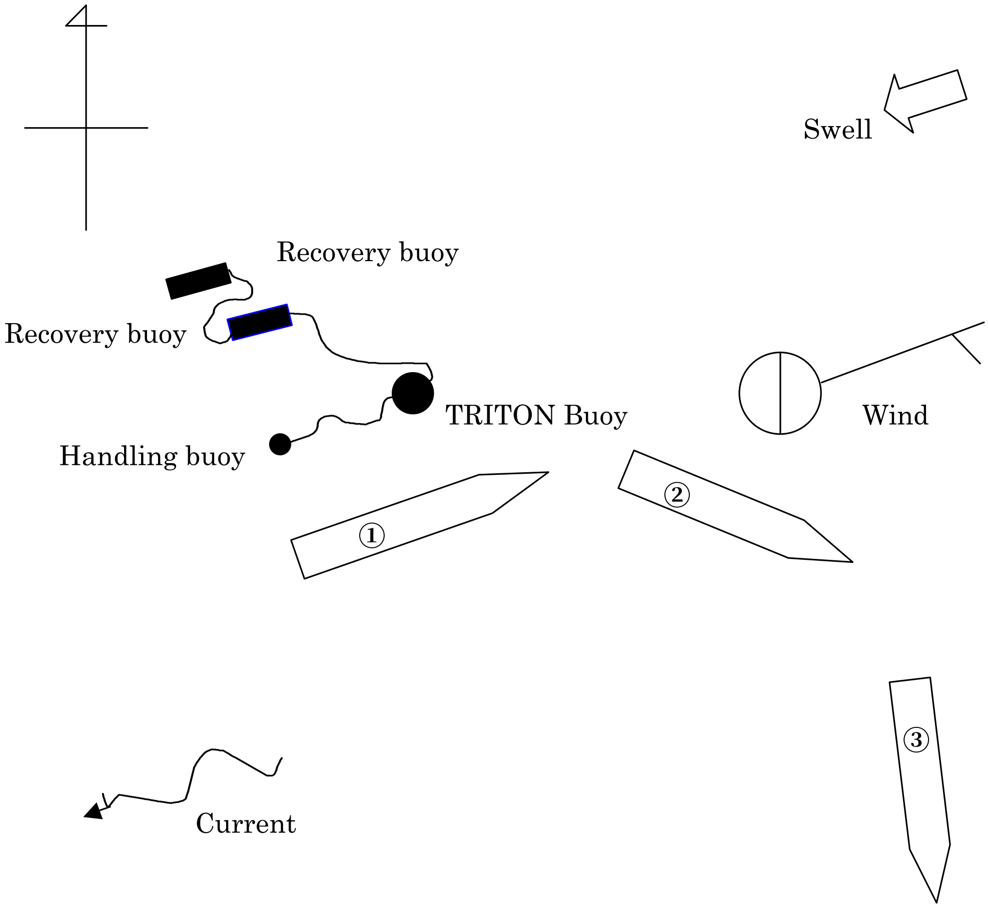


Fig.8.3-5 FIGURE OF RECOVERY BUOY

Triton buoy number: 4 (0, 156E)

Date: 3rd Mar.2001

Wind: <060> 5.0 m/s, Current: <265> 0.8 knot

Swell: ENE, Wave height: 1.7 m, Weather: bc

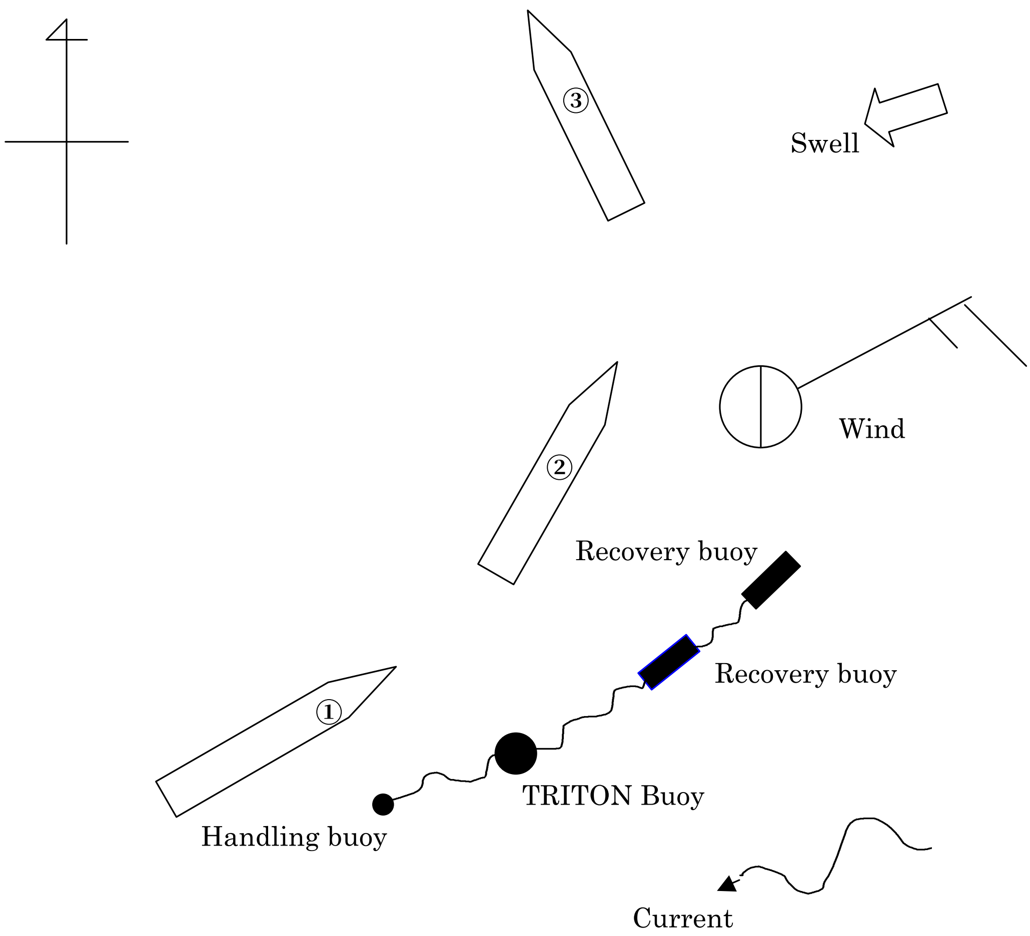


Fig.8.3-5　FIGURE OF RECOVERY BUOY

Triton buoy number: 5　(2S, 156E)

Date: 6th Mar.2001

Wind: <180> 5.0 m/s, Current: <290> 1.1 knot

Swell: ENE, Wave height: 1.8 m, Weather: o & r

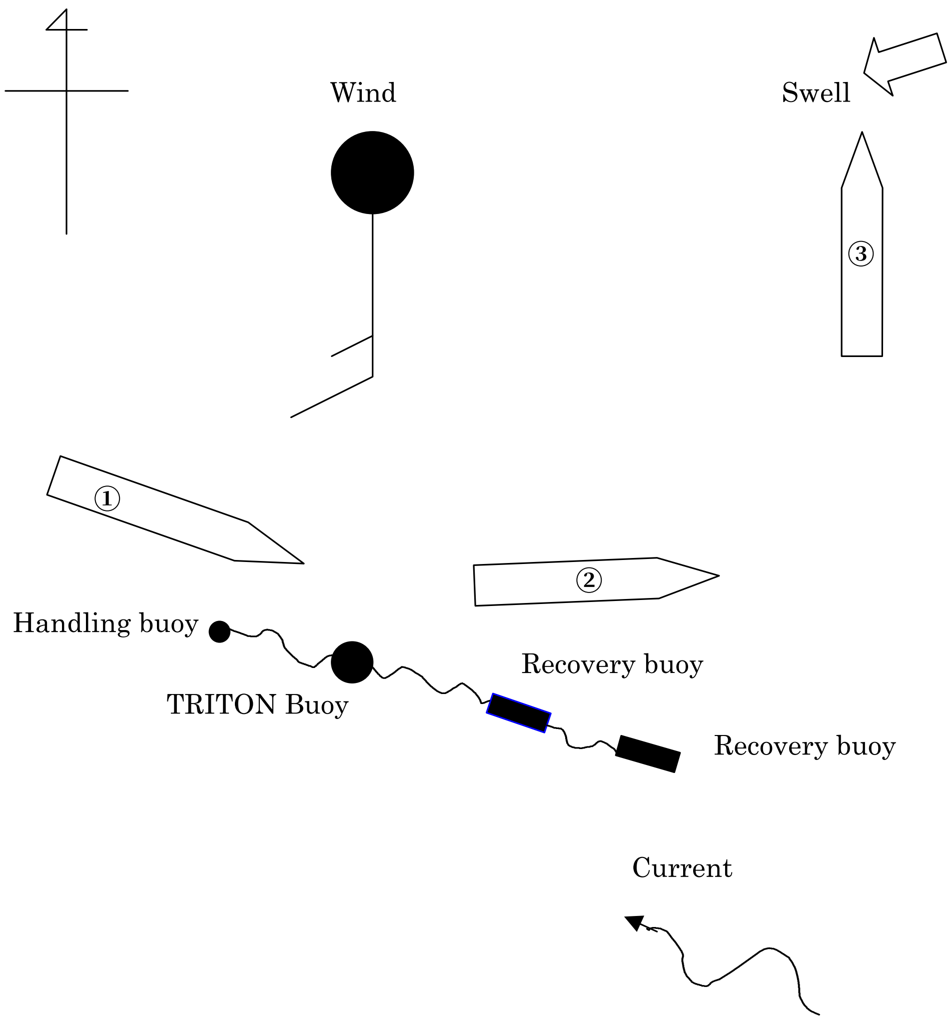


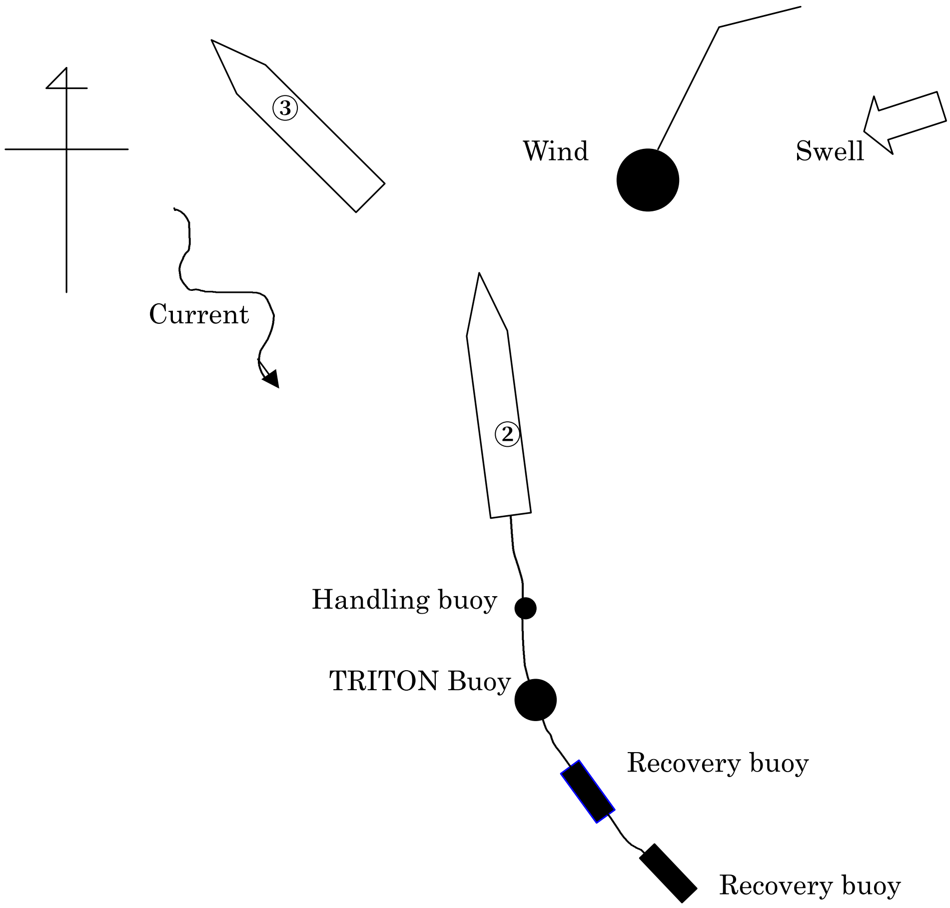
Fig.8.3-6 FIGURE OF RECOVERY BUOY

Triton buoy number: 6 (5S, 156E)

Date: 8th Mar.2001

Wind: <010> 3.6 m/s, Current: <140> 0.3 knot

Swell: ENE, Wave height: 1.7 m, Weather: o & s



Because there was hardly the wind and the current, the recovery buoys surfaced in a group.
The recovery work began after having towed the TRITON buoy mooring system.

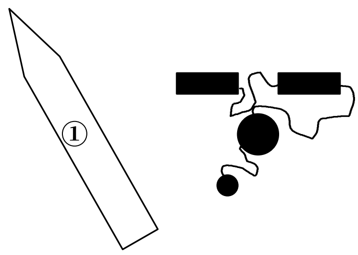


Fig.8.3-7 FIGURE OF RECOVERY ADCP

Location: 0, 156E

Date: 28th Feb.2001

Wind: <080> 4.0 m/s, Current: <010> 0.1 knot

Swell: ENE, Wave height: 1.3 m, Weather: bc

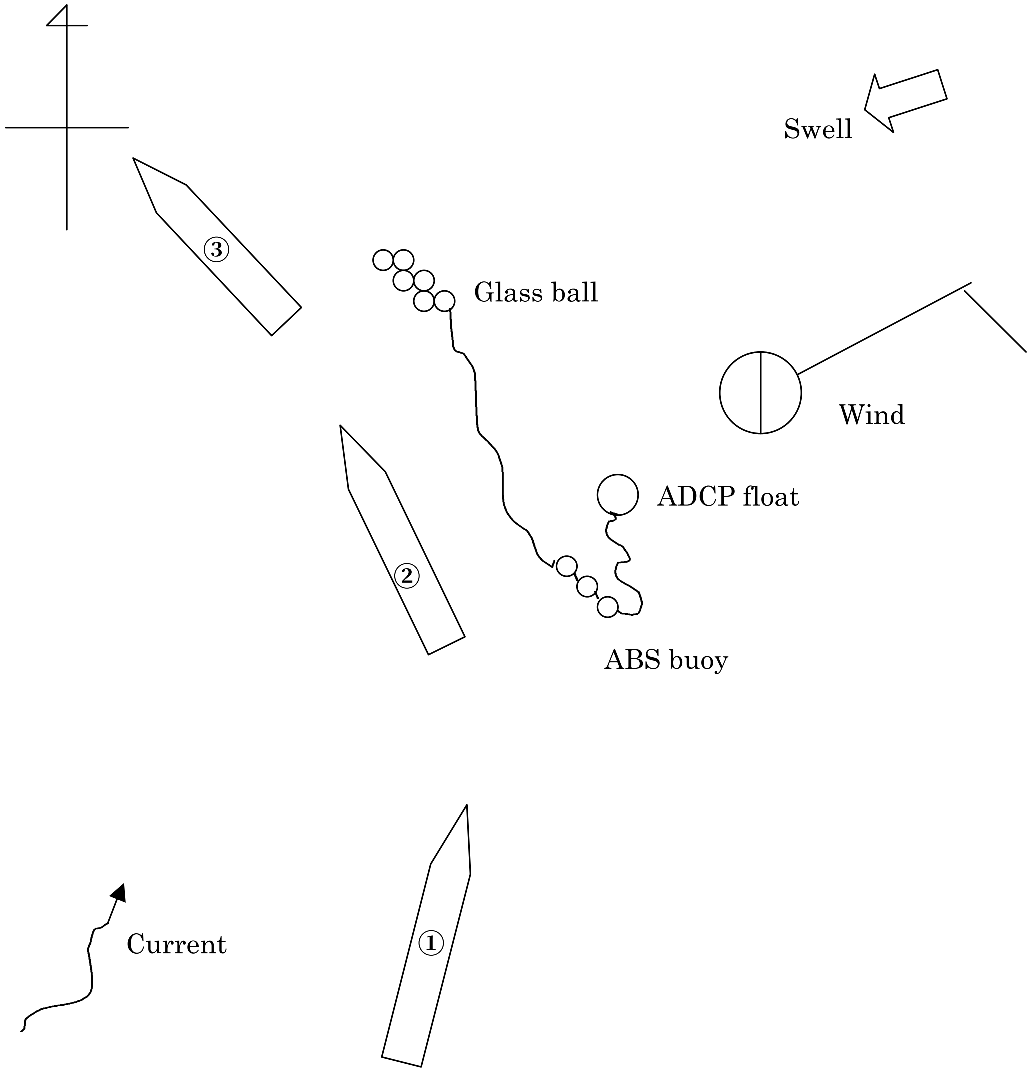


Table 8.3-1 RECOVERY OF TRITON BUOY/ADCP DURING VOYAGE MR01-K01

TRITON NUMBER		1	2	3	4	5	6	ADCP
	Location	8N, 156E	5N, 156E	2N, 156E	0, 156E	2S, 156E	5S, 156E	0, 156E
	Date	23-Feb	25-Feb	27-Feb	3-Mar	3-Mar	8-Mar	28-Feb
Length of buoy system(m)		4850	3600	2575	1950	1750	1510	1639
Com'ced work		7:55	7:59	7:55	7:51	7:52	7:55	7:55
Sent working-boat		7:57	8:04	7:58	8:01	7:54	7:56	8:21
Released from sinker		8:33	8:32	8:13	8:18	8:09	8:08	8:00
Recovery buoy surfaced		8:46	8:43	8:33	8:31	8:19	8:17	8:16
Sling rope connected with buoy		9:00	8:53	8:49	8:41	8:29	8:27	8:26
Picked up the boat		9:06	8:56	8:52	8:45	8:35	8:33	8:31
Winded up buoy		9:23	9:09	9:05	8:56	8:45	8:43	8:36
Recovery of cable		9:30	9:15	9:12	9:02	8:50	8:48	8:40
Recovery of rope		10:28	10:17	9:56	9:47	9:30	9:29	8:44
Recovery of releaser		11:48	11:19	10:44	10:25	10:05	10:00	9:15
Finished the work		11:50	11:21	10:45	10:27	10:06	10:01	9:18
Total working hours		3:55	3:22	2:50	2:36	2:14	2:06	1:23

Time consumed

	1	2	3	4	5	6	Average	ADCP
* in rising of recovery buoy	0:13	0:11	0:20	0:13	0:10	0:09	0:12	0:16
in working of boat (included *)	1:11	0:57	0:57	0:54	0:43	0:38	0:53	0:36
in recovery of TRITON buoy	0:24	0:19	0:20	0:17	0:15	0:15	0:18	0:05
in recovery of cable	0:58	1:02	0:44	0:45	0:40	0:41	0:48	0:08
in recovery of ropes	1:22	1:04	0:49	0:40	0:36	0:32	0:50	0:34
Total working hours	3:55	3:22	2:50	2:36	2:14	2:06	2:50	1:23
Remarks	Fishing line	Fishing line	Fishing line			Fishing line		

TRITON NUMBER	1	2	3	4	5	6	ADCP
Approaching course (deg)	95	45	75	50	100	320	345
Course of recovery (deg)	330	85	230	260	0	270	320
Wind direction (deg)	100	45	75	60	180	10	80
Wind velocity (m/s)	10	8	2.4	5	5	3.6	4
Current direction (deg)	25	45	260	265	290	140	9
Current velocity (knot)	0.3	0.8	0.4	0.8	1.1	0.3	0.1
Swell direction	ENE	NE	ENE	ENE	ENE	ENE	ENE
Wave height (m)	2.2	2.3	1.4	1.7	1.8	1.7	1.3