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R/V Mirai Cruise Report
MR05-03
(Leg 1, Leg 2, and Leg 3)

June 4 – Sep. 5, 2005
Tropical Ocean Climate Group
With the support of
Maritime continent research program (IORGC)

Edited by
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Japan Agency for Marine-Earth Science and Technology
(JAMSTEC)

JAPAN AGENCY FOR MARINE-EARTH SCIENCE AND TECHNOLOGY
No.1
LIFE BOAT

Leg 1

Leg 2

Contents

1. Cruise name and code

Tropical Ocean Climate Study
MR05-03 (Leg 1, Leg 2, and Leg 3)
Ship: R/V MIRAI
Captain: Yujiro Kita

2. Introduction and observation summary

2.1. Introduction

The warm water pool located at the western equatorial Pacific and eastern Indian Oceans has the highest sea surface temperature in the ocean all over the world. Therefore interaction between the ocean and atmosphere in that region becomes important for climate change such as ENSO (El Niño/Southern Oscillation) in the Pacific Ocean and Dipole mode in the Indian Ocean. This cruise is conducted for understanding the process of warm water convergence and divergence, and interaction processes in that region. For that purpose, we carried out deployment and recovery of the TRITON (TRIangle Trans Ocean buoy Network) buoys as the main mission. The TRITON buoys have advantage of analysis for long- term variability in the warm water pool. We also carried out other observations, such as ADCP moorings, CTD measurements and meteorological observation, for understanding the Ocean and atmospheric conditions.

2.2. Overview

2.2.1. Ship

R/V MIRAI
Captain Yujiro Kita
(Captain Masaharu Akamine: for September 04-05)

2.2.2. Cruise code

MR05-03

2.2.3. Project name

Tropical Ocean Climate Study

2.2.4. Undertaking institution

Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
2-15, Natsushima-cho, Yokosuka 237-0061, Japan

2.2.5. Chief Scientist

Leg 1: Kentaro Ando (JAMSTEC)
Leg 2: Hideaki Hase (JAMSTEC)
Leg 3 Shuichi Mori (JAMSTEC)

2.2.6. Period

Leg 1: July 4 th, 2005 (Guam) – July 26 th, 2005 (Darwin)
Leg 2: July 26 th, 2005 (Darwin) – August 25 th, 2005 (Palau)
Leg 3 August 26th, 2005 (Palau) – September 5th, 2005 (Sekinehama)

2.2.7. Research Participants

Total 51 scientists and technical staffs participated from 8 different institutions and companies, including 3 Indonesian scientists and officer during each of Leg 1 and 2.

2.3. Observation summary

TRITON buoy deployment:	8 sites
TRITON buoy recovery:	8 sites
ADCP buoy deployment:	1 site
ADCP buoy recovery	2 sites
CTD including water sampling:	66 casts
XCTD:	92 launches
Radio sonde:	127 launches
Surface meteorology:	continuous
Shipboard ADCP measurement:	continuous
Surface temperature and salinity measurements by intake method	continuous

*** Other specially designed observations have been carried out.

Observed oceanic and atmospheric conditions

Leg 1: Observation in the western tropical Pacific

Oceanic and atmospheric conditions in the tropical Pacific region showed neutral condition and suggested the possible development of La Niña during the next several months. The TAO (Tropical Atmospheric and Ocean)/TRITON array data showed slightly warmer sea surface temperature (SST) in the western end of the warm pool region. Not like the atmospheric and oceanic condition in the last year, according to this high SST distribution westerly winds cannot dominate western end of the warm pool in the Pacific Ocean. Due to this climatological westward shift of convection region, the western region of Pacific warm pool was calm.

Leg 2: Observation in the eastern Indian Ocean

August is in a southwesterly monsoon season in the Indian Ocean. During this cruise period, the SST along 90E observational line exceeded 29 deg-C around the region between 1N and 4S, the highest temperature core in the surface layer shifted to the south of the equator. The low salinity cores in the surface layer appeared in the region of 5N-2N, the equator-1S and 4S-5S, where the values were less than 34.0, 34.5 and 34.5, respectively. The surface current in the equatorial band indicated the eastward. We recovered and deployed two TRITON buoys in the eastern Indian Ocean. The other recovery/deployment operations (ADCP mooring, rawinsonde and ARGO floats etc.) and observation equipments (CTD, shipboard ADCP etc.) were mostly worked without significant problem.

Leg 3: Observation in the western tropical and subtropical Pacific

Oceanic and atmospheric environments with high SST and moist boundary layer are suitable to generate typhoons over the western tropical and subtropical Pacific Ocean in the boreal summer monsoon season. Typhoon Talim (TS0513) was formed at (14.1N, 142.3E) upgraded from Tropical Depression (TD) on August 27 00UTC and passed across our track from August 28 through 29. We encountered strong wind, heavy shower rain, and great waves during the period. Dynamical and thermo dynamical structures of the typhoon were observed successfully with continuous Doppler radar observation, sequential rawinsonde soundings, and other shipboard equipments.

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

3.1. Period

July 4 - September 5, 2005

3.2. Ports of call

Guam, USA	(Departure; July 4, 2005)
Darwin, Australia	(July 26, 2005)
Palau	(August 25-26, 2005)
Kushiro, Japan	(September 2-3, 2005)
Sekinehama, Japan	(September 5, 2005)

3.3. Cruise log

SMT (Ship Mean Time)	UTC	Event
Jul. 04 (Mon.)		
09:00	23:00	Departure from Guam, Japan (SMT = UTC + 10) Start Leg-1 of MR05-03 cruise
09:30	23:30	Safety guidance for participants
11:50	01:50	Launch XCTD XCTD01 (13-00.01N, 144-14.57E)
13:15	03:15	Boat drill
14:00	04:00	Meeting for Leg-1 observation
16:00	06:00	Starting of continuous surface monitoring of surface sea water, and shipboard observations
16:45	06:45	Konpira-san ceremony
17:13	07:13	XCTD02 (11-59.99N, 143-14.16E)
21:34	11:34	XCTD03 (10-59.95N, 142-15.22E)
22:00	12:00	Adjust SMT to JST (=UTC+9)
22:15	13:15	Start Doppler radar operation
Jul. 05 (Tue.)		
02:55	17:55	XCTD04 (9-59.98N, 141-17.00E)
08:14	23:14	XCTD05 (8-59.98N, 140-18.65E)
20:35	11:35	Launch Radio Sonde RS001 (08-01.87N, 137-06.63E)
Jul. 06 (Wed.)		
02:31	17:31	RS002 (7-50.85N, 136-28.88E)
06:44-07:09	21:31-22:09	CTD01-01 (200m)
08:31	23:31	RS003 (07-39.84N, 136-40.80E)
08:35-09:30	23:35-00:30	CTD01-02 (1000m, for comp. to the buoy to recovery)
11:58-12:22	02:58-03:22	CTD01-03 (200m)
12:52-14:52	03:52-05:52	Deployment of TRITON at 8N137E (7-52.52N, 136-27.87E)
14:31	05:31	RS004 (7-52.20N, 136-29.00E)
15:55-16:19	06:55-07:19	CTD01-04 (200m)
16:29-17:19	07:29-08:19	CTD01-05 (1000m, for comp. to deployed buoy)
20:31	11:31	RS005 (7-41.92N, 136-37.95E)
Jul. 07 (Thu.)		
02:31	17:31	RS006 (7-42.44N, 136-35.83E)
06:44-07:04	21:44-22:04	CTD01-06 (200m, 07-40.14N, 136-40.97E)
08:11-11:20	23:11-02:20	Recovery of TRITON at 8N137E

08:24	23:24	RS007 (7-39.52N, 136-41.41E)
12:25-12:48	03:25-03-48	CTD01-07 (200m)
14:30	05:30	RS008 (07-41.46N, 136-36.47E)
15:55-16:17	06:55-07:17	CTD01-08 (200m)
16:18	07:18	XCTD006 (07-40.49N, 136-38.18E)
17:13	08:13	XCTD007 (07-29.95N, 136-40.73E)
19:26	10:26	XCTD008 (06-59.97N, 136-50.57E)
20:32	11:32	RS009 (6-44.33N, 136-53.55E)
21:34	12:34	XCTD009 (06-29.97N, 136-57.09E)
23:42	14:42	XCTD010 (06-00.03N, 137-04.09E)
Jul. 08 (Fri.)		
01:49	16:49	XCTD011 (05-29.03N, 137-11.02E)
02:32	17:32	RS010 (05-20.23N, 137-11.33E)
06:40-07:06	21:40-22:06	CTD02-01 (200m)
08:25-11:18	23:25-02:18	Deployment of TRITON at 5N137E (4-59.98N, 137-18.96E)
08:30	23:30	RS011 (04-56.67N, 137-19.73E)
12:30-12:59	03:30-03:59	CTD02-02 (200m)
13:21-14:15	04:21-05:15	CTD02-03 (1000m, to both buoys of dep. and rec.)
14:30	05:30	RS012 (04-55.74N, 137-18.26E)
15:53-16:17	06:53-07:17	CTD02-04 (200m)
20:30	11:30	RS013 (04-54.96N, 137-18.78E)
Jul. 09 (Sat.)		
02:31	17:31	RS014 (04-52.95N, 137-18.01E)
06:42-07:05	21:42-22:05	CTD02-05 (200m)
08:09-11:52	23:09-02:52	Recovery of TRITON at 5N137E
08:32	23:32	RS015 (04-51.72N, 137-19.52E)
12:55-13:19	03:55-04:19	CTD02-06 (200m)
14:31	05:31	RS016 (04-51.72N, 137-19.52E)
15:54-16:17	06:54-07:17	CTD02-07 (200m)
16:21	07:21	XCTD012 (04-51.58N, 137-18.48E)
17:51	08:51	XCTD013 (04-29.99N, 137-23.71E)
19:50	10:50	XCTD014 (04-00.01N, 137-30.81E)
20:31	11:31	RS017 (03-50.43N, 137-34.54E)
21:51	12:51	XCTD015 (03-30.01N, 137-39.99E)
23:55	14:55	XCTD016 (03-00.00N, 137-48.59E)
Jul. 10 (Sun.)		
01:57	16:57	XCTD017 (02-29.67N, 137-56.97E)
02:31	17:31	RS018 (02-22.21N, 137-59.35E)
06:41-07:05	21:41-22:05	CTD03-01 (200m, 01-59.82N, 138-06.12E)
08:16	23:16	RS019 (01-55.57N, 138-08.29E)
08:19-10:31	23:19-01:31	Deployment of TRITON at 2N138E (01-59.53N, 138-06.46E)
11:55-12:20	02:55-03:20	CTD03-02 (200m, 01-59.53N, 138-06.76E)
12:54-13:45	03:54-04:45	CTD03-03 (1000m, 02-01.88N, 138-04.92E)
14:30	05:30	RS020 (02-03.86N, 138-04.33E)
15:54-16:15	06:54-07:15	CTD03-04 (200m, 02-02.77N, 138-04.05E)
20:32	11:32	RS021 (02-01.41N, 138-04.12E)
Jul.11 (Mon.)		
02:45	17:45	RS022 (02-01.68N, 138-01.76E)

6:40-07:03	21:40-22:03	CTD03-05 (200m, 02-03.20N, 138-04.75E)
08:10-11:59	23:10-02:59	Recovery of TRITON at 2N138E
08:20	23:20	RS023 (02-03.78, 138-04.41E)
12:54-13:22	03:54-04:22	CTD03-06 (200m)
13:42-14:03	04:42-05:03	Repair the TRITON buoy deployed on Jul. 10
14:36	05:36	RS024 (02-01.24N, 138-04.68E)
15:56-16:17	06:56-07:17	CTD03-07 (200m)
16:31	07:31	XCTD018 (01-59.37N, 138-03.38E)
18:35	09:35	XCTD019 (01-29.98N, 138-03.80E)
20:31	11:31	RS025 (01-06.49N, 138-04.92E)
21:10	12:10	XCTD020 (00-59.98N, 138-06.88E)
23:11	14:11	XCTD021 (00-30.00N, 138-06.47E)
Jul. 12 (Tue.)		
02:32	17:32	RS026 (00-06.54N, 138-02.53E)
06:40-07:03	21:40-22:03	CTD04-01 (200m)
08:16	23:16	RS027 (00-01.79N, 138-07.32E)
08:19-10:18	23:19-01:18	Deployment of TRITON at 0-138E (00-04.24N, 138-03.49E)
11:25-11:51	02:25-02:51	CTD04-02 (200m)
12:11-13:01	03:11-04:01	CTD04-03 (1000m, comp. to deployed, 00-03.56N, 138-01.62E)
14:30	05:30	RS028 (00-02.16N, 137-55.14E)
13:52-14:42	04:52-05:42	CTD04-04 (1000m,comp to be recovered,00-02.16N, 137-57.72E)
14:55-15:10	05:55-06:10	Calibration measurement of geo-magnet meter
15:51-16:15	06:51-07:15	CTD04-05 (200m, 00-01.99N, 137-57.72E)
20:30	11:30	RS029 (00-00.65S, 137-54.80E)
Jul.13 (Wed.)		
02:31	17:31	RS030 (00-03.42S, 137-53.54E)
06:40-07:02	21:40-22:02	CTD04-06 (200m, 00-01.57N, 137-55.09E)
08:10-11:08	23:10-02:08	Recovery of TRITON at 0-138E
08:20	23:20	RS031 (00-02.36N, 137-53.11E)
11:53-12:18	02:53-03:18	CTD04-07 (200m)
13:35-15:21	04:35-06:21	Recovery of ADCP mooring
14:30	05:30	RS032 (00-00.06N, 138-02.53E)
15:55-16:15	06:55-07:15	CTD04-08 (200m, 00-00.00S, 137-58.97E)
16:20	07:20	XCTD022 (00-00.03S, 137-58.82E)
20:30	11:30	RS033 (00-43.95N, 137-21.03E)
Jul. 14 (Thu.)		
02:38	17:38	RS034 (01-47.45N, 136-18.11E)
08:38	23:38	RS035 (02-46.47N, 135-17.25E)
14:38	05:38	RS036 (03-45.85N, 134-18.59E)
20:38	11:38	RS037 (04-42.40N, 133-22.40E)
Jul. 15 (Fri.)		
02:38	17:38	RS038 (05-33.98N, 132-30.60E)
08:38	23:38	RS039 (06-25.52N, 131-34.78E)
14:37	05:37	RS040 (07-23.85N, 130-31.73E)
18:00-18:55	09:00-09:55	CTD05-01(1000m,to recovered,8-00.15N,130-00.60E)
20:38	11:38	RS041 (07-59.60N, 129-58.33E)

Jul. 16 (Sat.)

06:40-07:05	21:40-22:05	CTD05-02 (200m, 07-59.34N, 130-00.66E)
08:10-12:02	23:10-03:02	Recovery of TRITON at 8N130E
12:54-13:20	03:54-04:20	CTD05-03 (200m, 07-59.18N, 130-01.86E)
15:53-16:16	06:53-07:16	CTD05-04 (200m, 07-59.60N, 130-01.60E)

Jul. 17 (Sun.)

06:41-07:06	21:40-22:06	CTD05-05 (200m, 07-56.69N, 130-03.97E)
08:13-11:30	23:13-02:30	Deployment of TRITON at 8N130E (07-55.65N, 130-03.88E)
12:23-12:49	03:23-03:49	CTD05-06 (200m, 07-56.29N, 130-04.04E)
13:24-14:14	04:24-05:14	CTD05-07 (1000m, 07-56.28N, 130-03.90E)
15:54-16:15	06:54-07:15	CTD05-08 (200m, 07-59.97N, 130-00.22E)
16:57	07:57	XCTD023 (08-00.56N, 129-58.95E)
18:38	09:38	XCTD024 (07-53.38N, 129-39.98E)
20:20	11:20	XCTD025 (07-46.14N, 129-20.03E)
22:04	13:04	XCTD026 (07-38.52N, 129-00.02E)
23:51	14:51	XCTD027 (07-30.34N, 128-40.15E)

Jul. 18 (Mon.)

02:37	17:37	XCTD028 (07-21.65N, 128-20.00E)
03:18	18:18	XCTD029 (07-15.43N, 127-59.98E)
04:18	19:18	XCTD030 (07-12.62N, 127-49.99E)
04:58	19:58	XCTD031 (07-09.14N, 127-39.98E)
05:49	20:49	XCTD032 (07-05.92N, 127-30.00E)
06:38	21:38	XCTD033 (07-02.67N, 127-19.99E)
07:28	22:28	XCTD034 (06-59.10N, 127-10.00E)
08:17	23:17	XCTD035 (06-55.72N, 126.59.93E)
09:05	00:05	XCTD036 (06-52.96N, 126-50.03E)
09:51	00:51	XCTD037 (06-49.99N, 126-40.05E)
10:46	01:46	XCTD038 (06-40.02N, 126-42.91E)
11:44	02:44	XCTD039 (06-30.02N, 126-50.50E)
12:48	03:48	XCTD040 (06-19.62N, 126-59.40E)
13:51	04:51	XCTD041 (06-10.09N, 127-08.48E)
14:55	05:55	XCTD042 (05-59.98N, 127-16.96E)
15:59	06:59	XCTD043 (05-50.00N, 127-24.76E)
17:02	08:02	XCTD044 (05-40.01N, 127-33.45E)
18:03	09:03	XCTD045 (05-30.01N, 127-41.38E)
19:05	10:05	XCTD046 (05-20.01N, 127-49.19E)
20:09	11:09	XCTD047 (05-10.03N, 127-56.71E)
21:12	12:12	XCTD048 (05-00.14N, 128-04.48E)
22:57	13:57	XCTD049 (04-40.03N, 128-19.89E)

Jul. 19 (Tue.)

00:45	15:45	XCTD050 (04-20.01N, 128-35.36E)
02:31	17:31	XCTD051 (04-00.00N, 128-50.22E)
04:21	19:21	XCTD052 (03-40.00N, 129-05.44E)
06:12	21:12	XCTD053 (03-20.01N, 129-20.31E)
08:06	23:06	XCTD054 (03-00.00N, 129-35.75E)
10:29	01:29	XCTD055 (02-40.01N, 129-50.33E)
12:40	03:40	XCTD056 (02-19.98N, 130-02.31E)
14:18	05:18	XCTD057 (02-03.38N, 130-10.34E)
14:36	05:36	Send Enable command to the buoy for recovery

Jul. 20 (Wed.)		
06:41-07:04	21:41-22:04	CTD06-01 (200m, 02-01.87N, 130-11.46E)
08:04-09:50	23:04-00:50	Recovery of TRITON at 2N130E
10:22-10:44	01:22-01:44	CTD06-02 (200m, 02-02.05N, 130-11.54E)
12:52-13:17	03:52-04:17	CTD06-03 (200m, 02-02.04N, 130-11.76E)
15:55-16:18	06:55-07:18	CTD06-04 (200m, 02-05.06N, 130-15.60E)
Jul.21 (Thu.)		
06:40-07:02	21:40-22:02	CTD06-05 (200m, 01-59.48N, 129-53.97E)
08:09-10:12	23:09-01:12	Deployment of TRITON at 2N130E (01-52.76N, 129-55.99E)
11:54-12:19	02:54-03:19	CTD06-06 (200m, 02-00.26N, 129-55.73E)
13:25-14:54	04:25-05:54	CTD06-07 (2000m, comp to Argo and the buoy, 01-59.34N, 129-55.59E)
15:53-16:15	06:53-07:15	CTD06-08 (200m, 01-59.94N, 129-53.95E)
16:19	07:19	Launching Argo float
Jul. 22 (Fri.)		
06:54-07:17	21:54-22:17	CTD06-09 (200m, 02-02.01N, 130-02.29E)
09:54-10:17	00:54-01:17	CTD06-10 (200m, 02-03.45N, 130-03.21E)
12:59-13:19	03:59-04:19	CTD06-11 (200m, 02-04.25N, 130-04.22E)
15:59-16:14	06:59-07:14	CTD06-12 (200m, 02-03.53N, 130-05.03E)
		Stop all measurements
Jul. 23 (Sat.)		
		Cruising to Darwin
13:00-14:00	04:00-05:00	On-Board Seminar (Ando)
22:00	13:00	Adjust SMT to UTC+9.5hr
Jul. 24 (Sun.)		
		Cruising to Darwin
16:45	07:15	Commemorative Photo at upper deck
Jul. 25 (Mon.)		
		Cruising to Darwin
		Restart continuous measurement
Jul. 26 (Tue.)		
08:30	23:00	Arrival to Darwin, Australia (Leg-1 Finish)
16:40	07:10	Departure from Darwin (SMT = UTC + 9.5)
		Start Leg-2 of MR05-03 cruise
19:36	10:06	Starting of shipboard observations
Jul. 27 (Wed.)		
08:30	23:00	Starting of continuous surface monitoring of surface sea water
09:00	23:30	Safety guidance for participants joining from Leg- 2
09:30	00:00	Safety guidance for Indonesian scientists joining from Leg- 2
10:30	01:00	Meeting for Leg-2 observation
13:15	03:45	Boat drill
16:45	07:15	Konpira-san ceremony
22:00	13:00	Adjust SMT to UTC + 9.0

Jul. 28 (Thu.)		
12:00	03:00	Start Doppler radar operation
22:00	14:00	Adjust SMT to UTC + 8.0
Jul. 29 (Fri.)		
22:00	15:00	Adjust SMT to UTC + 7.0
Jul. 30 (Sat.)		
		Cruise to 5N, 90E
Jul. 31 (Sun.)		
		Cruise to 5N, 90E
Aug. 1 (Mon.)		
		Cruise to 5N, 90E
Aug. 2 (Tue.)		
		Cruise to 5N, 90E
Aug. 3 (Wed.)		
07:33-08:48	00:33-01:48	CTD07 (2000m, 04-59.83N, 090-00.06E), CO2 flux profile observation
11:10	04:10	XCTD058 (04-29.77N, 090-01.00E)
13:30-14:45	06:30-07:45	CTD08 (2000m, 04-00.12N, 090-00.11E), CO2 flux profile observation
17:01	10:01	XCTD059 (03-30.01N, 089-59.96E)
19:08-20:24	12:08-13:24	CTD09 (2000m, 03-00.15N, 090-00.04E)
22:28	15:28	XCTD060 (02-29.99N, 089-59.70E)
Aug. 4 (Thu.)		
00:59-02:14	17:59-19:14	CTD10 (2000m, 02-00.01N, 089-59.96E)
04:19	21:19	XCTD061 (01-29.98N, 089-59.94E)
07:14-08:28	00:14-01:28	CTD11 (2000m, 01-00.09N, 089-59.98E), CO2 flux profile observation
11:30-04:35	04:30-21:35	Survey of sea bottom topography for piston core sampling
Aug. 5 (Fri.)		
06:30	23:30	RS001 (01.181N, 089.395E)
08:10-11:00	01:10-04:00	Piston core sampling P1 (3100m, 01-11.05N, 089-23.57E)
09:25	02:25	RS002 (01.185N, 089.392E)
12:30	05:30	RS003 (01.168N, 089.099E)
14:13-22:33	07:13-15:33	Survey of sea bottom topography for piston core sampling
15:29	08:29	RS004 (01.324N, 088.767E)
18:29	11:29	RS005 (01.642N, 088.847E)
21:29	14:29	RS006 (01.270N, 088.909E)
Aug. 6 (Sat.)		
00:29	17:29	RS007 (01.312N, 088.871E)
03:28	20:28	RS008 (01.314N, 088.885E)
06:29	23:29	RS009 (01.312N, 088.874E)
08:05-11:06	01:05-04:06	Piston core sampling P2

		(3815m, 01-19.13N, 088-52.45E)
09:30	02:30	RS010 (01.318N, 088.874E)
11:15-22:36	04:15-15:36	Survey of sea bottom topography for piston core sampling
12:30	05:30	RS011 (01.278N, 088.684E)
15:28	08:28	RS012 (01.171N, 088.217E)
18:28	11:28	RS013 (01.308N, 088.376E)
21:29	14:29	RS014 (01.166N, 088.515E)
Aug. 7 (Sun.)		
00:29	17:29	RS015 (01.219N, 088.417E)
03:29	20:29	RS016 (01.202N, 088.454E)
06:30	23:30	RS017 (01.216N, 088.433E)
08:06-11:27	01:06-04:27	Piston core sampling P3 (4401m, 01-13.20N, 088-26.00E)
09:29	02:29	RS018 (01.220N, 088.433E)
12:30	05:30	RS019 (01.120N, 088.547E)
15:29	08:29	RS020 (00.720N, 089.095E)
18:28	11:28	RS021 (00.317N, 089.642E)
21:29	14:29	RS022 (00.014N, 090.045E)
Aug. 8 (Mon.)		
00:30	17:30	RS023 (00.018S, 090.066E)
03:30	20:30	RS024 (00.020S, 090.086E)
06:30	23:30	RS025 (00.004N, 090.056E)
06:57-10:00	23:57-03:00	Recovery of ADCP mooring at 90E on the equator
09:31	02:31	RS026 (00.017N, 090.054E)
10:51-12:08	03:51-05:08	CTD12 (2000m, 00-00.13N, 089-59.87E), CO2 flux profile observation
12:29	05:29	RS027 (00.003N, 089.998E)
13:30-14:58	06:30-07:58	Deployment of ADCP mooring at 90E on the equator (4408m, 00-00.38N, 090-03.58E)
15:29	08:29	RS028 (00.019N, 090.054E)
17:51	10:51	XCTD062 (00-30.04S, 090-02.98E)
18:29	11:29	RS029 (00.567S, 090.043E)
20:15	13:15	XCTD063 (00-59.98S, 089-59.87E)
21:29	14:29	RS030 (01.206S, 089.998E)
22:26-02:17	15:26-19:17	CO2 flux cruise observation
Aug. 9 (Tue.)		
00:30	17:30	RS031 (01.549S, 089.978E)
03:30	20:30	RS032 (01.625S, 090.031E)
05:58-07:14	22:58-00:14	CTD13 (2000m, 01-37.69S, 090-02.12E)
07:00	00:00	RS033 (01.627S, 090.035E)
07:59-11:41	00:59-04:41	Recovery of TRITON buoy at 1.5S, 90E
09:30	02:30	RS034 (01.602S, 090.076E)
12:30	05:30	RS035 (01.657S, 089.996E)
13:31-00:25	06:31-17:25	CO2 flux profile and cruise observation
15:29	08:29	RS036 (01.677S, 090.054E)
18:33	11:33	RS037 (01.671S, 090.016E)
21:29	14:29	RS038 (01.635S, 090.069E)
Aug. 10 (Wed.)		
00:30	17:30	RS039 (01.751S, 090.048E)

03:30	20:30	RS040 (01.683S, 089.987E)
06:32	23:32	RS041 (01.657S, 089.997E)
08:07-10:57	01:07-03:57	Deployment of TRITON buoy at 1.5S, 90E (4693m, 01-39.41S, 089-58.84E)
09:29	02:29	RS042 (01.647S, 089.911E)
12:30	05:30	RS043 (01.865S, 089.986E)
14:07-15:22	07:07-08:22	CTD14 (2000m, 02-00.05S, 089-59.84E), CO2 flux profile observation
15:30	08:30	RS044 (01.997S, 089.997E)
17:37	10:37	XCTD064 (02-30.00S, 089-59.77E)
18:29	11:29	RS045 (02.618S, 089.999E)
19:58-21:14	12:58-14:14	CTD15 (2000m, 02-59.91S, 089-59.91E), CO2 flux profile observation
21:23	14:23	Launching Argo float at 3S, 90E (02-59.87S, 090-00.15E)
21:29	14:29	RS046 (02.993S, 090.003E)
23:43	16:43	XCTD065 (03-31.30S, 089-59.55E)
Aug. 11 (Thu.)		
00:30	17:30	RS047 (03.613S, 089.991E)
01:59-03:14	18:59-20:14	CTD16 (2000m, 03-58.13S, 089-56.66E)
03:30	20:30	RS048 (03.962S, 089.943E)
05:46	22:46	XCTD066 (04-29.99S, 089-58.17E)
06:30	23:30	RS049 (04.593S, 089.978E)
08:14-09:27	01:14-02:27	CTD17 (2000m, 04-59.74S, 089-59.93E), CO2 flux profile observation
09:30	02:30	RS050 (04.992S, 089.997E)
11:49	04:49	XCTD067 (05-00.38S, 090-30.02E)
12:30	05:30	RS051 (05.003S, 090.572E)
14:23-15:36	07:23-08:36	CTD18 (2000m, 05-00.12S, 090-59.97E), CO2 flux profile observation
15:30	08:30	RS052 (05.000S, 090.996E)
17:52	10:52	XCTD068 (04-59.64S, 091-30.00E)
18:34	11:34	RS053 (04.996S, 091.569E)
20:01-21:15	13:01-14:15	CTD19 (2000m, 05-00.02S, 091-59.61E)
21:29	14:29	RS054 (04.994S, 091.997E)
23:36	16:36	XCTD069 (04-59.66S, 092-30.00E)
Aug. 12 (Fri.)		
00:26	17:26	RS055 (04.995S, 092.630E)
01:58-03:13	18:58-20:13	CTD20 (2000m, 05-00.02S, 092-59.83E)
03:30	20:30	RS056 (04.998S, 092.995E)
05:34	22:34	XCTD070 (04-59.93S, 093-30.03E)
06:30	23:30	RS057 (05.000S, 093.633E)
08:09-09:20	01:09-02:20	CTD21 (2000m, 05-00.13S, 094-00.07E), CO2 flux profile observation
09:30	02:30	RS058 (05.002S, 094.000E)
11:34	04:34	XCTD071 (05-00.01S, 094-30.00E)
12:30	05:30	RS059 (04.997S, 094.666E)
14:08-15:21	07:08-08:21	CTD22 (2000m, 04-59.55S, 094-58.65E), CO2 flux profile observation
15:29	08:29	RS060 (04.990S, 094.980E)
16:30-01:15	09:30-18:15	CO2 flux profile and cruise observation
18:29	11:29	RS061 (05.084S, 094.990E)

21:29	14:29	RS062 (05.189S, 094.957E)
Aug. 13 (Sat.)		
00:30	17:30	RS063 (05.066S, 094.978E)
03:30	20:30	RS064 (05.057S, 094.940E)
06:30	23:30	RS065 (05.051S, 094.961E)
07:41-11:54	00:41-04:54	Recovery of TRITON buoy at 5S, 95E
09:28	02:28	RS066 (05.031S, 094.969E)
12:29	05:29	RS067 (04.976S, 094.937E)
13:27-23:50	06:27-16:50	CO2 flux profile and cruise observation
15:29	08:29	RS068 (04.968S, 094.989E)
18:29	11:29	RS069 (05.075S, 095.106E)
21:27	14:27	RS070 (05.005S, 094.996E)
Aug. 14 (Sun.)		
00:30	17:30	RS071 (04.974S, 095.092E)
03:30	20:30	RS072 (04.944S, 094.998E)
06:29	23:29	RS073 (04.944S, 094.956E)
08:08-10:53	01:08-03:53	Deployment of TRITON buoy at 5S, 95E (5009m, 04-56.92S, 094-58.40E)
09:28	02:28	RS074 (04.943S, 094.916E)
11:35-16:09	04:35-09:09	CO2 flux profile and cruise observation
12:30	05:30	RS075 (04.969S, 095.073E)
15:35	08:35	RS076 (04.969S, 094.996E)
18:29	11:29	RS077 (05.201S, 095.494E)
20:42	13:42	XCTD072 (05-28.70S, 095-59.99E)
21:29	14:29	RS078 (05.522S, 096.090E)
Aug. 15 (Mon.)		
00:30	17:30	RS079 (05.849S, 096.734E)
01:31	18:31	XCTD073 (05-59.64S, 096-59.98E)
03:29	20:29	RS080 (06.203S, 097.338E)
06:14	23:14	XCTD074 (06-29.64S, 097-59.98E)
11:22	04:22	XCTD075 (06-58.19S, 098-59.98E)
16:23	09:23	XCTD076 (07-28.67S, 099-59.99E)
21:02	14:02	XCTD077 (07-58.55S, 100-59.98E)
Aug. 16 (Tue.)		
01:42	18:42	XCTD078 (08-29.41S, 102-00.00E)
06:15	23:15	XCTD079 (08-59.63S, 103-00.00E)
10:48	03:48	XCTD080 (09-29.73S, 104-00.00E)
15:26	08:26	XCTD081 (09-59.76S, 105-00.02E)
19:36	12:36	XCTD082 (10-02.54S, 106-00.01E)
22:00	14:00	Adjust SMT to UTC + 8.0
Aug. 17 (Wed.)		
00:41	16:41	XCTD083 (10-05.96S, 106-59.99E)
04:39	20:39	XCTD084 (10-08.99S, 108-00.00E)
08:53	00:53	XCTD085 (10-17.10S, 108-59.99E)
13:15	05:15	Launching Argo float at 110E on the track (10-15.14S, 109-59.53E)
13:19	05:19	XCTD086 (10-15.13S, 109-59.82E)
17:39	09:39	XCTD087 (10-17.89S, 111-00.00E)
21:56	13:56	XCTD088 (10-20.03S, 112-00.00E)

22:00	13:00	Adjust SMT to UTC + 9.0
Aug. 18 (Thu.)		
03:29	18:29	Launching Argo float at 113E on the track
03:30	18:30	XCTD089 (10-23.11S, 112-59.87E)
		(10-23.12S, 112-59.75E)
07:56	22:56	XCTD090 (10-25.81S, 114-00.00E)
12:18	03:18	XCTD091 (10-22.79S, 114-59.99E)
16:31	07:31	Launching Argo float at 116E on the track
		(10-14.78S, 115-59.68E)
16:35	07:35	XCTD092 (10-14.76S, 116-00.03E)
Aug. 19 (Fri.)		
10:30	01:30	Stop all observations because entering into the Indonesian water
		Cruise to Palau
Aug. 20 (Sat.)		
		Cruise to Palau
Aug. 21 (Sun.)		
		Cruise to Palau
Aug. 22 (Mon.)		
		Cruise to Palau
14:00	05:00	Restart continuous observations except of sea surface water monitoring
Aug. 23 (Tue.)		
		Cruise to Palau
16:45	07:15	Commemorative Photo at upper deck
Aug. 24 (Wed.)		
		Cruise to Palau
Aug. 25 (Thu.)		
08:50	23:50	Arrival to Palau (Leg-2 Finish)
Aug. 26 (Fri.)		
08:50	23:50	Departure from Palau
		Start Leg-3 of MR05-03 cruise
15:30	06:30	Restarting of continuous observations including Doppler radar and monitoring of surface sea water
16:45	07:15	Konpira-san ceremony
Aug. 27 (Sat)		
		Cruise to Kushiro
14:30	05:30	RS081 (14.417N, 136.014E)
20:30	11:30	RS082 (15.923N, 136.150E)

Aug. 28 (Sun.)		
		Cruise to Kushiro
02:30	17:30	RS083 (17.386N, 136.279E)
08:36	23:36	RS084 (18.847N, 136.529E)
14:25	05:25	RS085 (20.089N, 136.516E)
Aug. 29 (Mon.)		
		Cruise to Kushiro
08:27	23:27	RS086 (23.499N, 136.826E)
Aug. 30 (Tue.)		
		Cruise to Kushiro
21:00	12:00	Stop Doppler radar observation
Aug. 31 (Wed.)		
		Cruise to Kushiro
Sep. 1 (Thu.)		
		Cruise to Kushiro
15:30	06:30	Stop monitoring of surface sea water and sea-beam observation
Sep. 2 (Fri.)		
08:50	23:50	Arrival to Kushiro
Sep. 3 (Sat.)		
		Public exhibition
Sep. 4 (Sun.)		
		Public exhibition
15:50	06:50	Departure from Kushiro
Sep. 5 (Mon.)		
09:00	00:00	Arrival to Sekinehama (Leg-3 Finish) End of MR05-03 cruise

3.4. Cruise track

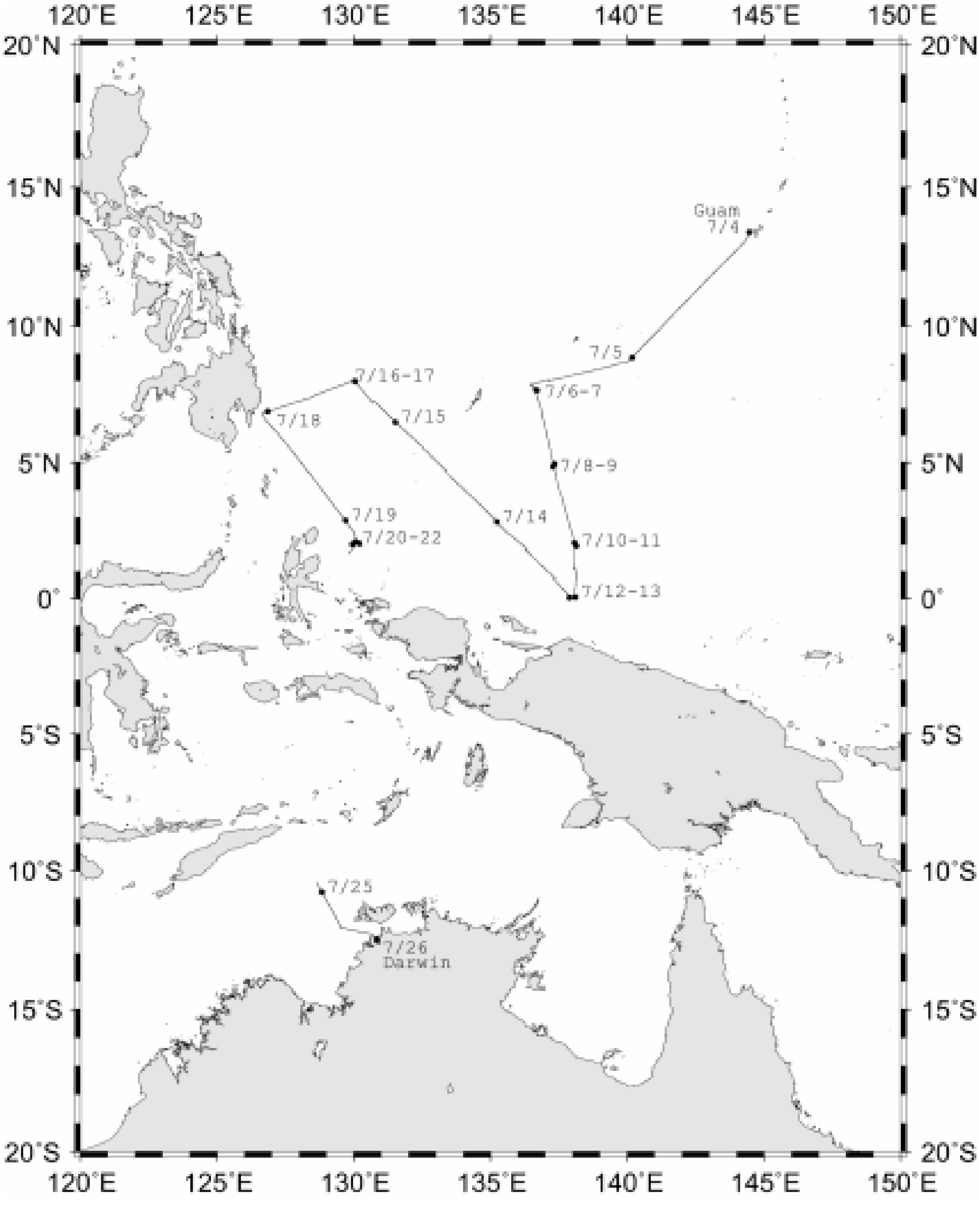

Fig 3.4.1 Cruise track of MR05-03 Leg1

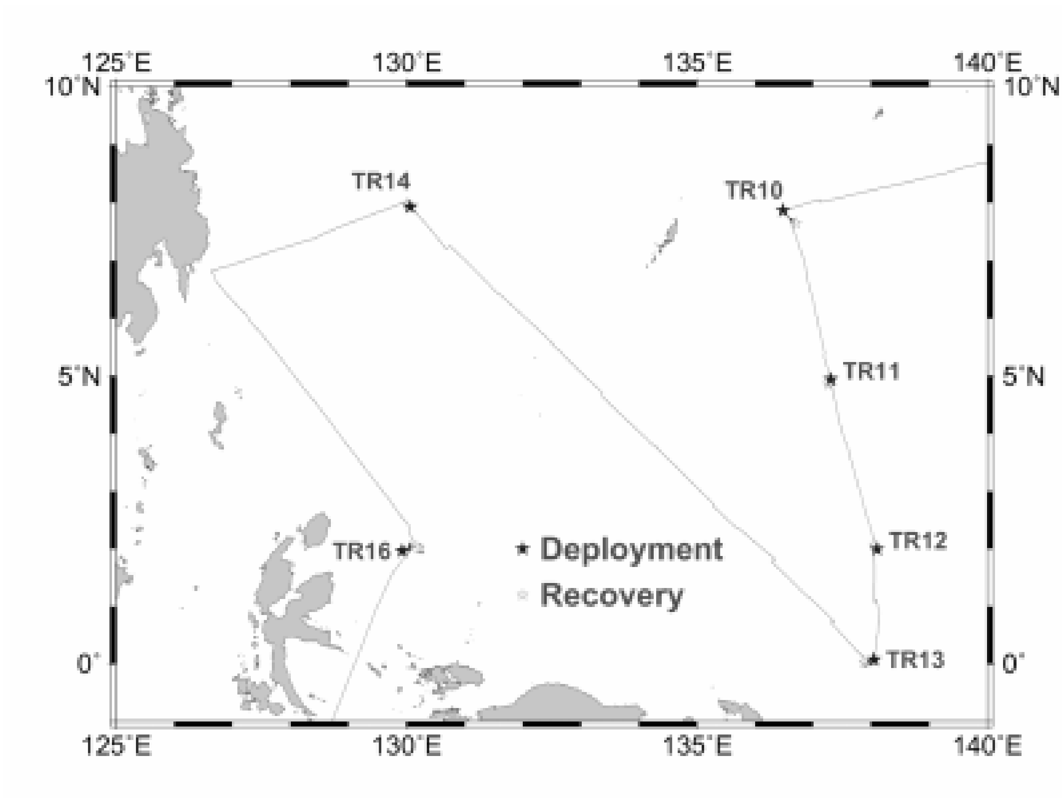

Fig 3.4.2 Deploy/Recovery of TRITON Buoy during MR05-03 Leg1

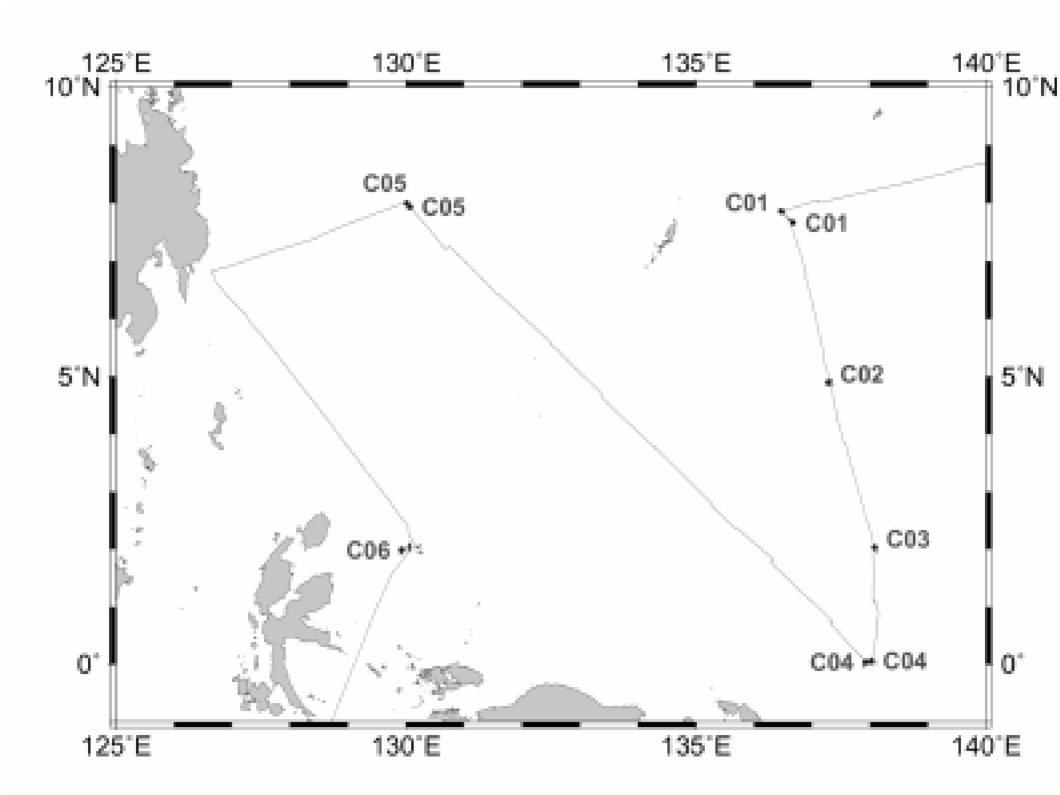

Fig 3.4.3 CTD stations during MR05-03 Leg1

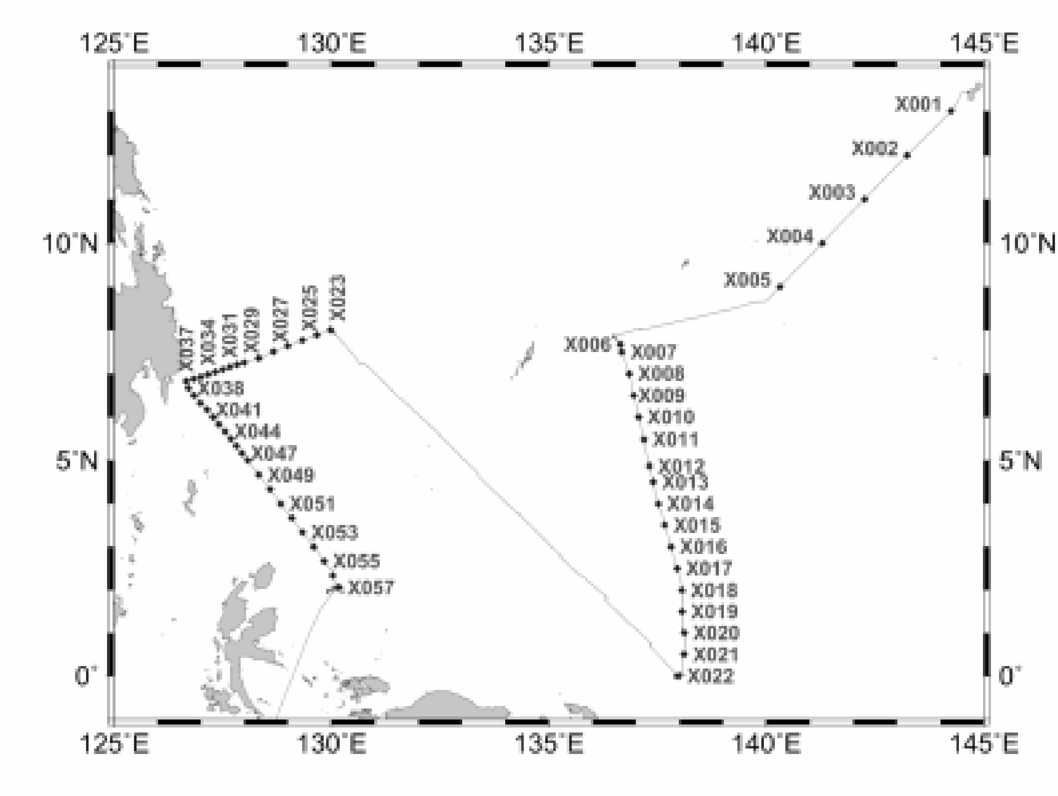

Fig 3.4.4 XCTD stations during MR05-03 Leg1

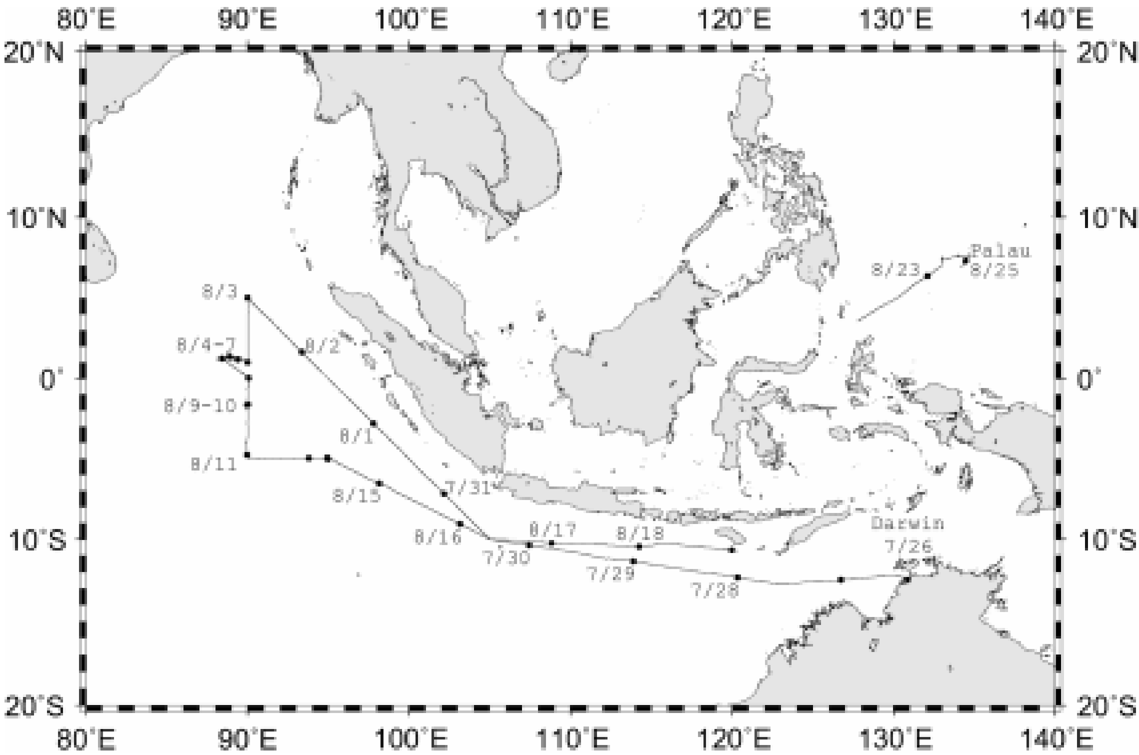

Fig 3.4.5 Cruise track of MR05-03 Leg2

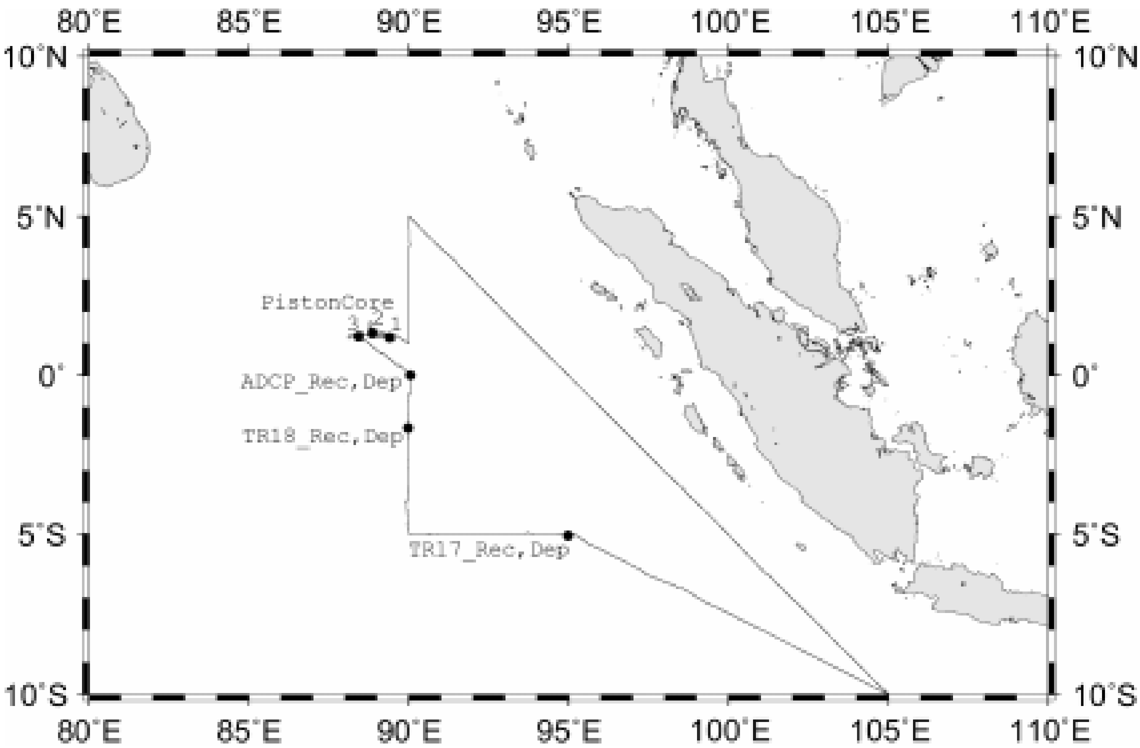

Fig 3.4.6 Deploy/Recovery of TRITON Buoy during MR05-03 Leg2

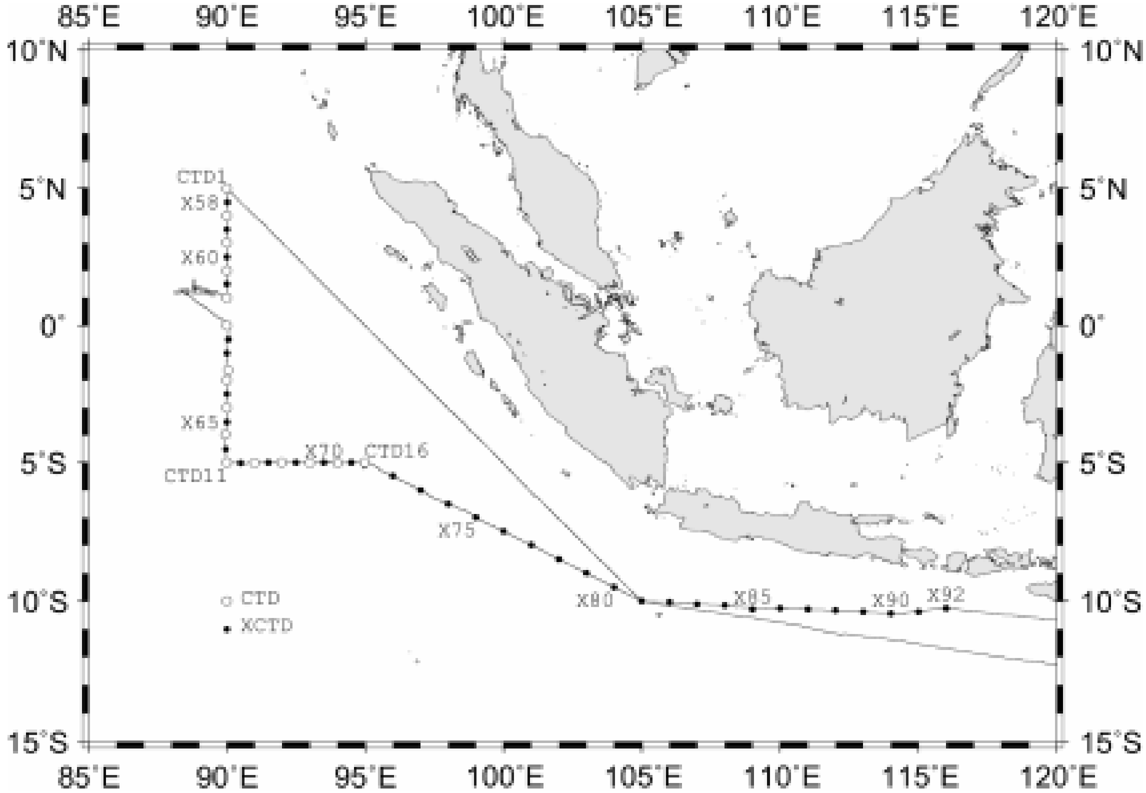

Fig 3.4.7 CTD/XCTD during MR05-03 Leg2

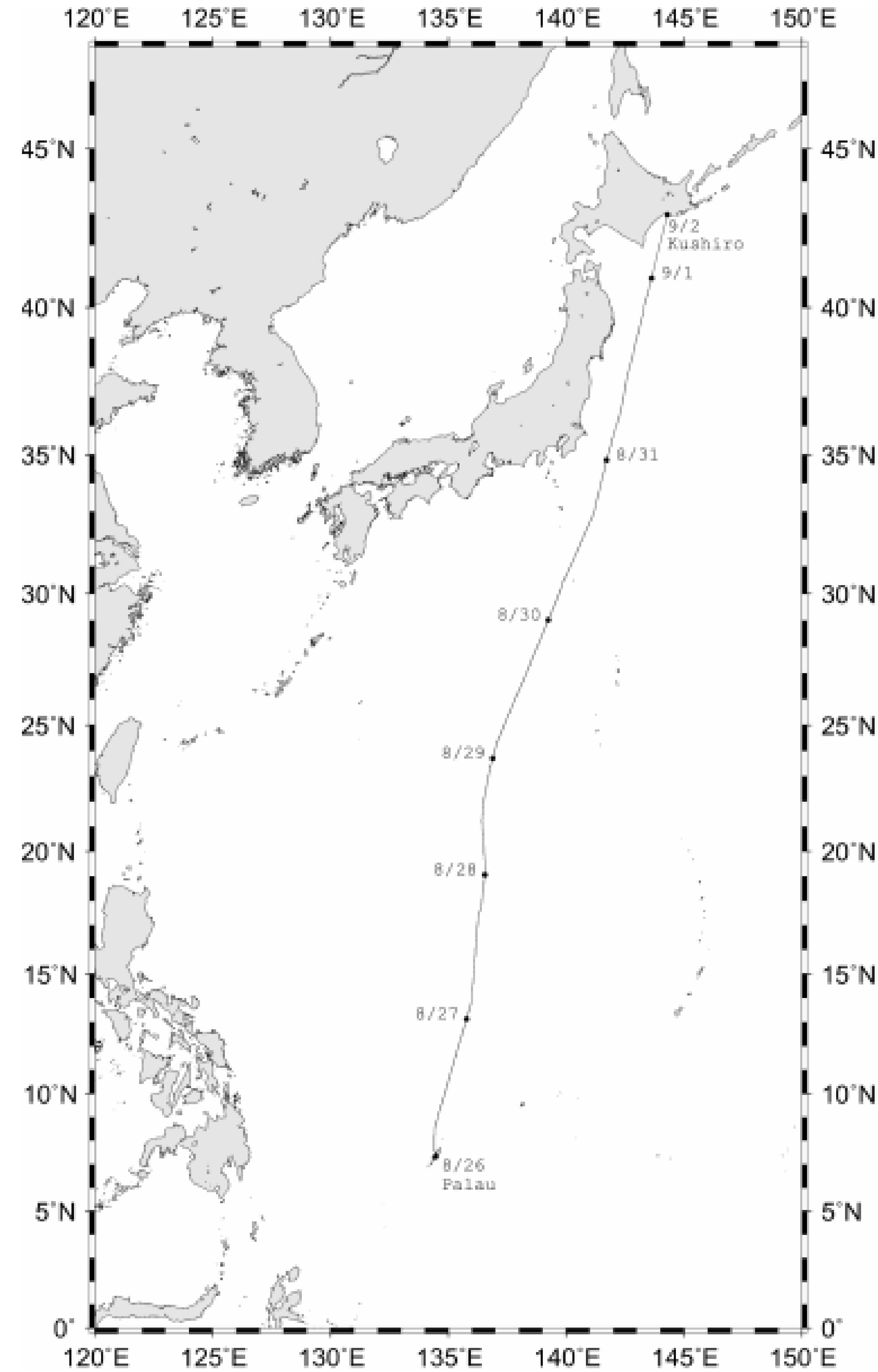

Fig 3.4.8 Cruise track of MR05-03 Leg3

4. Chief scientist

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5. Participants list

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(*: Leg 1, **: Leg 2, ***: Leg 3)

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Tomoyuki Takamori* **	MWJ

Keisuke Matsumoto* ** MWJ

Hiroki Ushiromura* ** MWJ

Shinsuke Toyota* ** MWJ

Nobuhiko Tahara* ** MWJ

Kousuke Okudaira* ** MWJ

Nobuharu Komai** MWJ

Akinori Murata** MWJ

Kentaro Shiraishi** MWJ

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Shinya Okumura**	GODI
Wataru Tokunaga* **	GODI
Norio Nagahama** ***	GODI
Kazuho Yoshida*	GODI

5.2. R/V MIRAI crewmember

Crew List (Leg 1 & Leg2)

Yujiro Kita	Master
Haruhiko Inoue	Chief Officer
Toshio Egawa	1st Officer
Katsunori Minami	2nd Officer
Takeyuki Fukazawa	3rd Officer
Koichi Higashi	Chief Engineer
Shinji Tokunaga	1st Engineer
Takashi Omichi	2nd Engineer
Kenji Ishida	3rd Engineer
Satoshi Okada	Jr. 3rd Engineer
Kazuo Sagawa	Chief Radio Officer
Kenetsu Ishikawa	Boatswain
Yasuyuki Yamamoto	Able seaman
Kenji Yamauchi	Able seaman
Kunihiko Omote	Able seaman
Masami Sugami	Able seaman
Masaru Hamabe	Able seaman
Kazuyoshi Kudo	Able seaman
Tsuyoshi Sato	Able seaman
Nobuhiro Yamamoto	Able seaman
Masashige Okada	Able seaman
Shuji Komata	Able seaman
Yukitoshi Horiuchi	No. 1 Oiler
Toshimi Yoshikawa	Oiler
Yoshihiro Sugimoto	Oiler
Nobuo Boushita	Oiler
Shigeo Yamaguchi	Oiler
Kazumi Yamashita	Oiler
Yasutaka Kurita	Chief Steward
Hatsuji Hiraishi	Cook
Hitoshi Ota	Cook
Kitoshi Sugimoto	Cook
Tatsuya Hamabe	Cook
Kanjyuro Murakami	Cook

Crew List (Leg 3)

Yujiro Kita	Master
Haruhiko Inoue	Chief Officer
Toshio Egawa	1st Officer
Katsunori Minami	2nd Officer
Nobuo Fukaura	3rd Officer
Koichi Higashi	Chief Engineer
Koji Masuno	1st Engineer
Takashi Omichi	2nd Engineer
Kenji Ishida	3rd Engineer
Kazuo Sagawa	Chief Radio Officer
Kenetsu Ishikawa	Boatswain
Yasuyuki Yamamoto	Able seaman
Kenji Yamauchi	Able seaman
Kunihiko Omote	Able seaman
Takeharu Aisaka	Able seaman
Masaru Hamabe	Able seaman
Kazuyoshi Kudo	Able seaman
Tsuyoshi Sato	Able seaman
Nobuhiro Yamamoto	Able seaman
Masashige Okada	Able seaman
Shuji Komata	Able seaman
Yukitoshi Horiuchi	No. 1 Oiler
Toshimi Yoshikawa	Oiler
Yoshihiro Sugimoto	Oiler
Nobuo Boushita	Oiler
Shigeo Yamaguchi	Oiler
Kazumi Yamashita	Oiler
Yasutaka Kurita	Chief Steward
Hatsuji Hiraishi	Cook
Hitoshi Ota	Cook
Kitoshi Sugimoto	Cook
Tatsuya Hamabe	Cook

6. General observation

6.1 Meteorology and atmospheric observation

6.1.1 Surface Meteorological Observation

Kunio Yoneyama	(JAMSTEC)	Principal Investigator (not on-board)
Satoshi Okumura	(Global Ocean Development Inc.,GODI)	-leg1-
Yasutaka Imai	(GODI)	-leg2,3-
Souichiro Sueyoshi	(GODI)	-leg1-
Shinya Okumura	(GODI)	-leg2-
Wataru Tokunaga	(GODI)	-leg1,2-
Kazuho Yoshida	(GODI)	-leg1-
Norio Nagahama	(GODI)	-leg2,3-

(1) Objectives

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

(2) Methods

The surface meteorological parameters were observed throughout the MR05-03 cruise from Guam on 4 July 2005 to Kushiro on 2 September 2005. During this cruise, we used two systems for the surface meteorological observation.

1) MIRAI Surface Meteorological observation (SMET) system
2) Shipboard Oceanographic and Atmospheric Radiation (SOAR) System

1) MIRAI Surface Meteorological observation (SMET) system

Instruments of SMET system are listed in Table 6.1.1-1 and measured parameters are listed in Table 6.1.1-2. Data was collected and processed by KOAC-7800 weather data processor made by Koshin-Denki, Japan. The data set consists of 6-second averaged data.

2) Shipboard Oceanographic and Atmospheric Radiation (SOAR) system

SOAR system designed by BNL (Brookhaven National Laboratory, USA) consists of major three parts.

i) Portable Radiation Package (PRP) designed by BNL – short and long wave downward radiation.
ii) Zeno Meteorological (Zeno/Met) system designed by BNL – wind, air temperature, relative humidity, pressure, and rainfall measurement.
iii) Scientific Computer System (SCS) designed by NOAA (National Oceanic and Atmospheric Administration, USA) – centralized data acquisition and logging of all data sets.

SCS recorded PRP data every 6 seconds, Zeno/Met data every 10 seconds. Instruments and their locations are listed in Table6.1.1-3 and measured parameters are listed in Table 6.1.1-4.

We checked the following three sensors, before and after the cruise for the quality control as post processing.

a) Young Rain gauge (SMET and SOAR)
   Inspecting the linearity of output value from the rain gauge sensor to change input value by adding fixed quantity of test water.
b) Barometer (SMET and SOAR)
   Comparing with the portable barometer value, PTB220CASE, VAISALA.
c) Thermometer (air temperature and relative humidity) (SMET and SOAR)

Comparing with the portable thermometer value, HMP41/45, VAISALA.

(3) Preliminary results

Figures 6.1.1-1 show the time series of the following parameters;

Wind (SOAR)
Air temperature (SOAR)
Relative humidity (SOAR)
Precipitation (SOAR)
Short/long wave radiation (SOAR)
Pressure (SOAR)
Sea surface temperature (SMET)
Significant wave height (SMET)

(4) Data archives

The raw data obtained during this cruise will be submitted to JAMSTEC Data Management Division. Corrected data sets will also be available from K. Yoneyama of JAMSTEC.

(5) Remarks

1. We did not get the data within the territorial waters of the Republic of Indonesia.
2. PIR contains invalid value from 3 August 01:00 to 6 August 03:35, due to the sensor trouble.
3. PRP was stopped from 6 August 01:52 to 03:35, due to the sensor replacement.
4. PRP data input stopped from 22 August 11:11 to 11:55.

Table 6.1.1-1 Instruments and installations of MIRAI Surface Meteorological observation system

Sensors	Type	Manufacturer	Location (altitude from surface)
Anemometer	KE-500	Koshin Denki, Japan	foremast (24 m)
Tair/RH	HMP45A	Vaisala, Finland	
with 43408 Gill aspirated radiation shield		R.M. Young, USA	compass deck (21 m) starboard side and port side
Thermometer: SST	RFN1-0	Koshin Denki, Japan	4th deck (-1m, inlet -5m)
Barometer	F-451	Yokogawa, Japan	captain deck (13 m) weather observation room
Rain gauge	50202	R. M. Young, USA	compass deck (19 m)
Optical rain gauge	ORG-815DR	Osi, USA	compass deck (19 m)
Radiometer (short wave)	MS-801	Eiko Seiki, Japan	radar mast (28 m)
Radiometer (long wave)	MS-202	Eiko Seiki, Japan	radar mast (28 m)
Wave height meter	MW-2	Tsurumi-seiki, Japan	bow (10 m)

Table 6.1.1-2 Parameters of MIRAI Surface Meteorological observation system

	Parmeter	Units	Remarks
1	Latitude	degree	
2	Longitude	degree	
3	Ship's speed	knot	Mirai log, DS-30 Furuno
4	Ship's heading	degree	Mirai gyro, TG-6000, Tokimec
5	Relative wind speed	m/s	6sec./10min. averaged
6	Relative wind direction	degree	6sec./10min. averaged
7	True wind speed	m/s	6sec./10min. averaged
8	True wind direction	degree	6sec./10min. averaged
9	Barometric pressure	hPa	adjusted to sea surface level 6sec. averaged
10	Air temperature (starboard side)	degC	6sec. averaged
11	Air temperature (port side)	degC	6sec. averaged
12	Dewpoint temperature (starboard side)	degC	6sec. averaged
13	Dewpoint temperature (port side)	degC	6sec. averaged
14	Relative humidity (starboard side)	%	6sec. averaged
15	Relative humidity (port side)	%	6sec. averaged
16	Sea surface temperature	degC	6sec. averaged
17	Rain rate (optical rain gauge)	mm/hr	hourly accumulation
18	Rain rate (capacitive rain gauge)	mm/hr	hourly accumulation
19	Down welling shortwave radiation	W/m^2	6sec. averaged
20	Down welling infra-red radiation	W/m^2	6sec. averaged
21	Significant wave height (bow)	m	hourly
22	Significant wave height (aft)	m	hourly
23	Significant wave period (bow)	second	hourly
24	Significant wave period (aft)	second	hourly

Table 6.1.1-3 Instrument and installation locations of SOAR system

Sensors (*Zeno/Met*)	Type	Manufacturer	Location (altitude from surface)
Anemometer	05106	R.M. Young, USA	foremast (25 m)
Tair/RH	HMP45A	Vaisala, Finland	
with 43408 Gill aspirated radiation shield		R.M. Young, USA	foremast (24 m)
Barometer	61201	R.M. Young, USA	
with 61002 Gill pressure port		R.M. Young, USA	foremast (24 m)
Rain gauge	50202	R. M. Young, USA	foremast (24 m)
Optical rain gauge	ORG-115DA	Osi, USA	foremast (24 m)

Sensors (*PRP*)	Type	Manufacturer	Location (altitude from surface)
Radiometer (short wave)	PSP	Epply Labs, USA	foremast (25 m)
Radiometer (long wave)	PIR	Epply Labs, USA	foremast (25 m)
Fast rotating shadowband radiometer(FRSR)		Yankee, USA	foremast (25 m)

Table 6.1.1-4 Parameters of SOAR system

	Parmeter	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	degC	
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 irradiance	W/m^2	

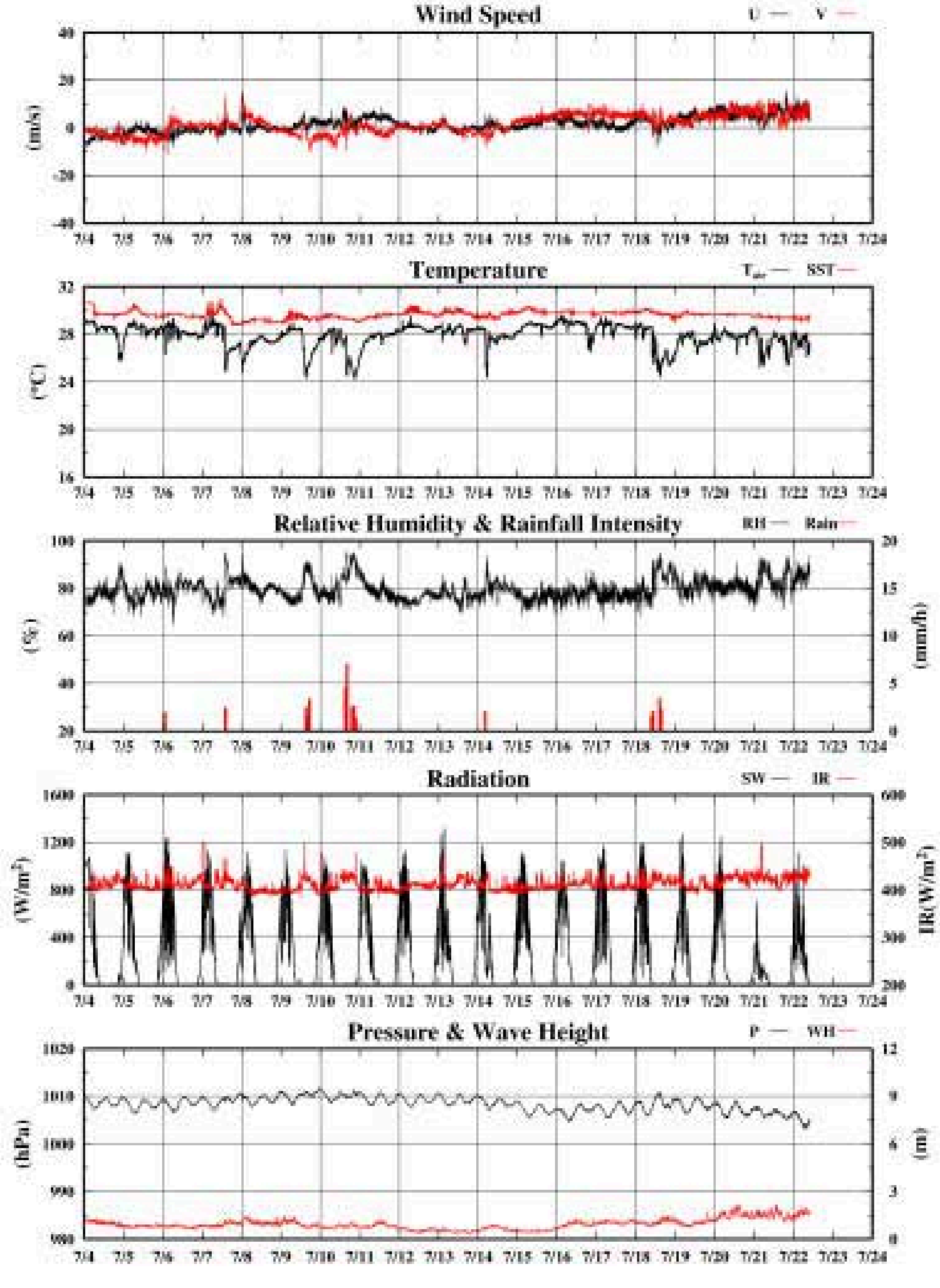


Fig.6.1.1-1 Time series of surface meteorological parameters during the cruise

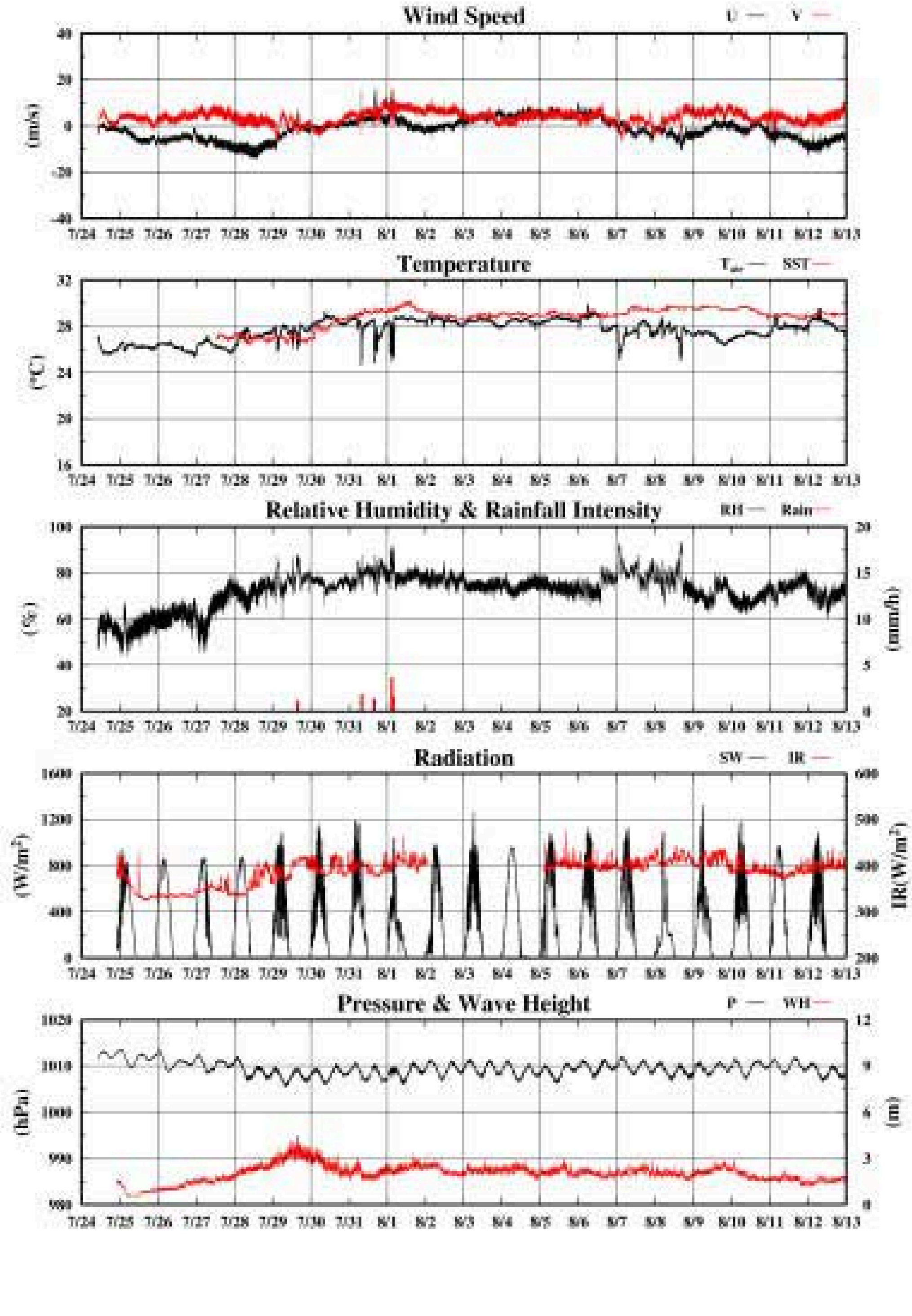


Fig.6.1.1-1 Continued

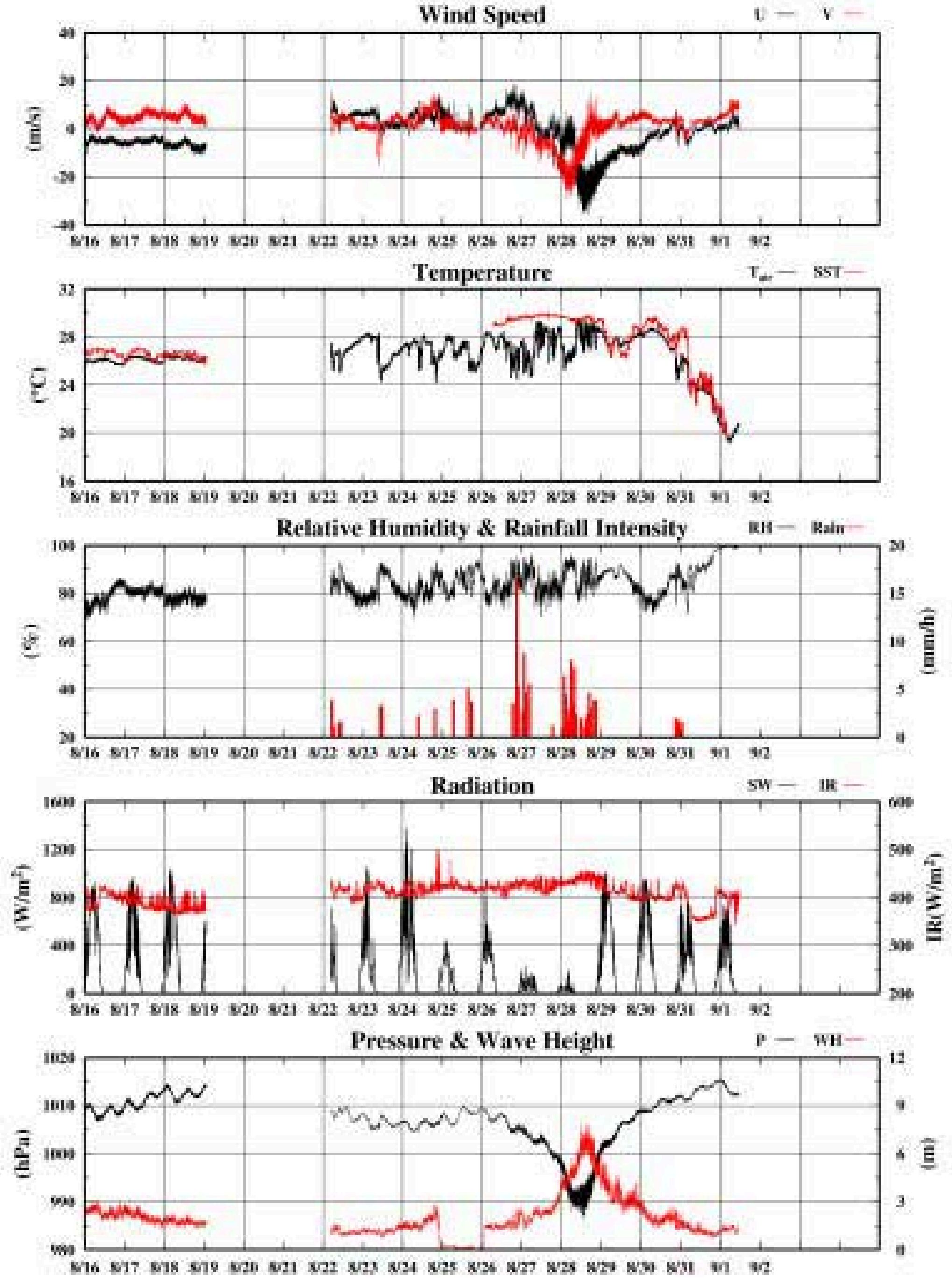


Fig.6.1.1-1 Continued

6.1.2 Ceilometer Observation

Kunio Yoneyama	(JAMSTEC)	Principal Investigator (not on-board)
Satoshi Okumura	(Global Ocean Development Inc.,GODI)	-leg1-
Mikiko Fujita	(JAMSTEC)	-leg1-
Yasutaka Imai	(GODI)	-leg2,3-
Souichiro Sueyoshi	(GODI)	-leg1-
Shinya Okumura	(GODI)	-leg2-
Wataru Tokunaga	(GODI)	-leg1,2-
Kazuho Yoshida	(GODI)	-leg1-
Norio Nagahama	(GODI)	-leg2,3-

(1) Objectives

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

(2) Parameters

1. Cloud base height [m].
2. Backscatter profile, sensitivity and range normalized at 30 m resolution.
3. Estimated cloud amount [oktas] and height [m]; Sky Condition Algorithm.

(3) Methods

We measured cloud base height and backscatter profile using ceilometer (CT-25K, VAISALA, Finland) throughout the MR05-03 cruise from Guam on 4 July 2005 to Kushiro on 2 September 2005.

Major parameters for the measurement configuration are as follows;

Laser source:	Indium Gallium Arsenide (InGaAs) Diode
Transmitting wavelength:	905±5 mm at 25 degC
Transmitting average power:	8.9 mW
Repetition rate:	5.57 kHz
Detector:	Silicon avalanche photodiode (APD) Responsibility at 905 nm: 65 A/W
Measurement range:	0 ~ 7.5 km
Resolution:	50 ft in full range
Sampling rate:	60 sec
Sky Condition	0, 1, 3, 5, 7, 8 oktas (9: Vertical Visibility) (0: Sky Clear, 1:Few, 3:Scattered, 5-7: Broken, 8: Overcast)

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

(4) Preliminary results

The figure 6.1.2-1 show the time series of the first, second and third lowest cloud base height.

(5) Data archives

The raw data obtained during this cruise will be submitted to JAMSTEC Data Management Division.

(6) Remarks

We did not get the data within the territorial waters of the Republic of Indonesia.

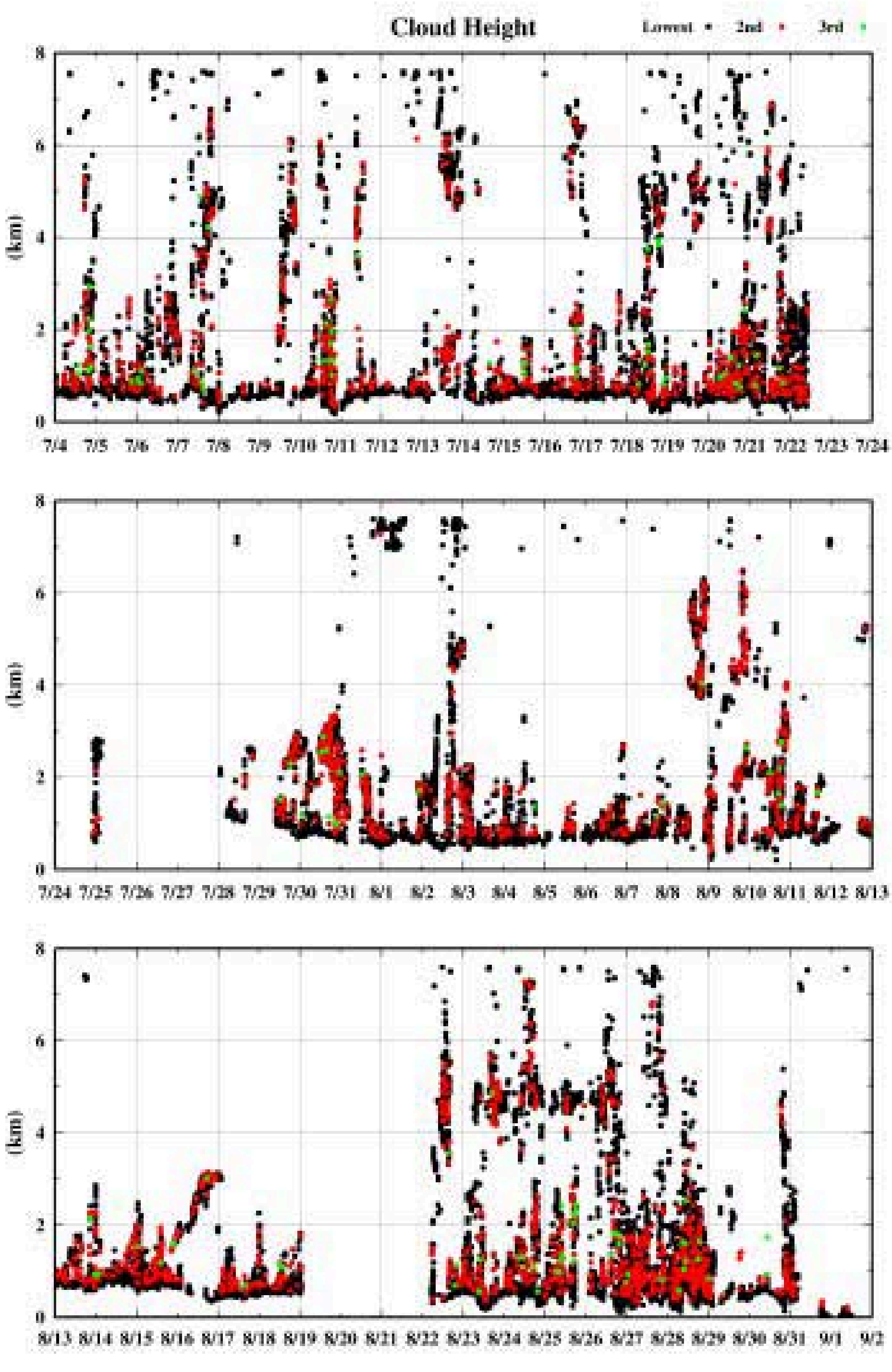


Fig.6.1.2-1 1st, 2nd and 3rd lowest cloud base height during the cruise.

6.2. CTD/XCTD

6.2.1. CTD

Personnel	Kentarou Ando*	(JAMSTEC): Principal Investigator	
	Hideaki Hase**	(JAMSTEC): Principal Investigator	
	Tomoyuki Takamori***	(MWJ)	:Operation leader
	Masaki Moro**	(MWJ)	
	Akinori Murata**	(MWJ)	
	Masanori Enoki*	(MWJ)	
	Shinsuke Toyoda***	(MWJ)	
	Ushiromura Hiroki***	(MWJ)	
	Leg1*, Leg2**, Leg1,2***		

(1) Objective

Investigation of oceanic structure and water sampling.

(2) Overview of the equipment and observation

CTD/Carousel water sampling system (CTD system), which is 12-position Carousel Water Sampler (SBE 32) with SBE 9plus (Sea-Bird Electronics Inc) attached with sensors, was used during this cruise. 12-litter Niskin bottles were used for sampling seawater. The CTD system was deployed from starboard on working deck. During this cruise, 66 CTD observations were carried out (see Table 6.2.1).

(3) List of sensors and equipments

Under water unit:	SBE, Inc., SBE 9plus, S/N 0357
Temperature sensor:	SBE, Inc., SBE 3Plus, S/N 032730
	SBE, Inc., SBE 3Plus, S/N 032453
Conductivity sensor:	SBE, Inc., SBE 04-04/0, S/N 041206
	SBE, Inc., SBE 04-04/0, S/N 041203
Pump:	SBE, Inc., SBE 5T, S/N 052627
	SBE, Inc., SBE 5T, S/N 053118
Deck unit:	SBE, Inc., SBE 11plus, S/N 11P9833-0344
Carousel Water Sampler:	SBE, Inc., SBE 32, S/N 3227443-0391
Water sample bottle:	General Oceanics, Inc., 12-litre Niskin-X

(4) Data processing

The SEASOFT-Win32 (Ver. 5.27b) was used for processing the CTD data. Descriptions and settings of the parameters for the SEASOFT were written as follows.

DATCNV converted the raw data to scan number, pressure, depth, temperatures, conductivities, descent rate. modulo error count and pump status. DATCNV also extracted bottle information where scans were marked with the bottle confirm bit during acquisition. The duration was set to 3.0 seconds, and the offset was set to

0.0 seconds.

ROSSUM created a summary of the bottle data. The bottle position, date, time were output as the first two columns. Salinity, sigma-theta and potential temperatures were averaged over 3.0 seconds.

WILDEDIT marked extreme outliers in the data files. The first pass of WILDEDIT obtained an accurate estimate of the true standard deviation of the data. The data were read in blocks of 1000 scans. Data greater than 10 standard deviations were flagged. The second pass computed a standard deviation over the same 1000 scans excluding the flagged values. Values greater than 20 standard deviations were marked bad. This process was applied to pressure, temperatures and conductivities outputs.

CELLTM used a recursive filter to remove conductivity cell thermal mass effects from the measured conductivity. Typical values used were thermal anomaly amplitude alpha = 0.03 and the time constant 1/beta = 7.0.

FILTER performed a low pass filter on pressure with a time constant of 0.15 seconds. In order to produce zero phase lag (no time shift) the filter runs forward first then backwards.

SECTION selected a time span of data based on scan number in order to reduce a file size. The minimum number was set to be the starting time when the CTD package was beneath the sea-surface after activation of the pump. The maximum number was set to be the end time when the package came up from the surface. (Data to check the CTD pressure drift were prepared before SECTION.)

LOOPEDIT marked scans where the CTD was moving less than the minimum velocity of 0.0 m/s (traveling backwards due to ship roll).

BINAVG averaged the data into 1 dbar pressure bins. The center value of the first bin was set equal to the bin size. The bin minimum and maximum values are the center value plus and minus half the bin size. Scans with pressures greater than the minimum and less than or equal to the maximum were averaged. Scans were interpolated so that a data record exists every dbar.

DERIVE was re-used to compute salinity, potential temperature, and sigma-theta.

SPLIT was used to split data into the down cast and the up cast.

(5) Preliminary Results

Date, time and locations of the CTD casts are listed in Table 6.2.1. Vertical profile of temperature and salinity with pressure are shown in Figure 6.2.1-1 – 66. Figures used secondary sensor results.

(6) Data archive

All raw and processed data files will be submitted to the Data Management Office (DMO) and will be opened to public via “R/V MIRAI Data Web Page” in the JAMSTEC web site.

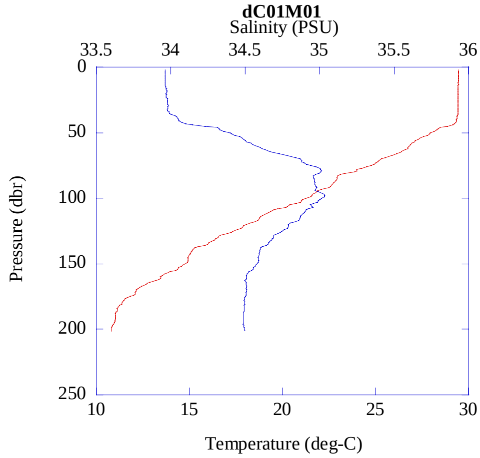


Fig6.2.1-1

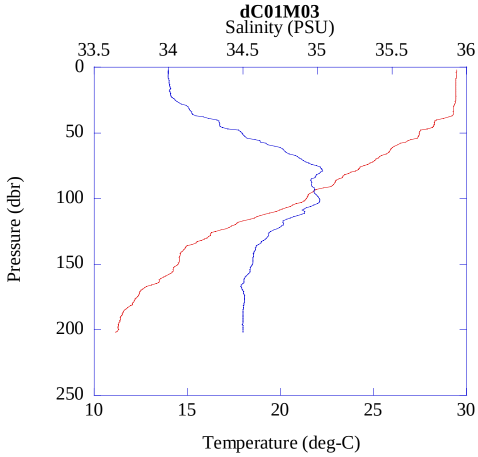


Fig6.2.1-2

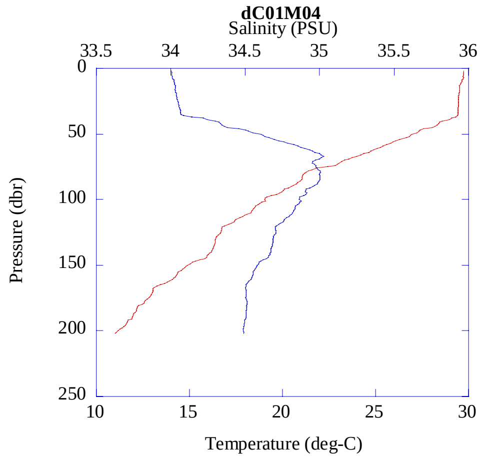


Fig6.2.1-3

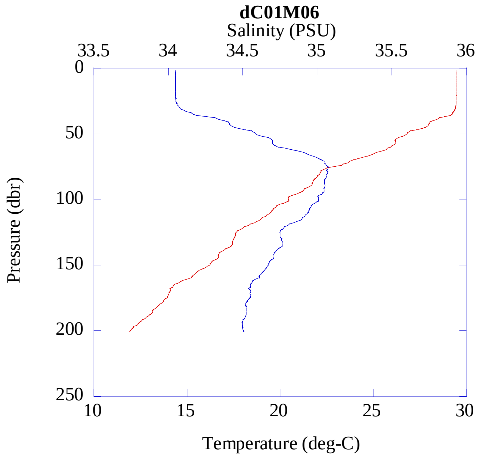


Fig6.2.1-4

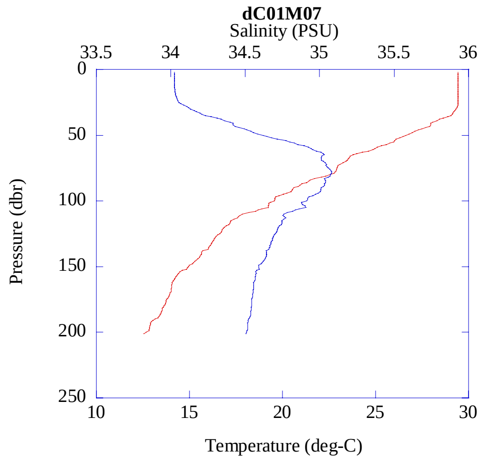


Fig6.2.1-5

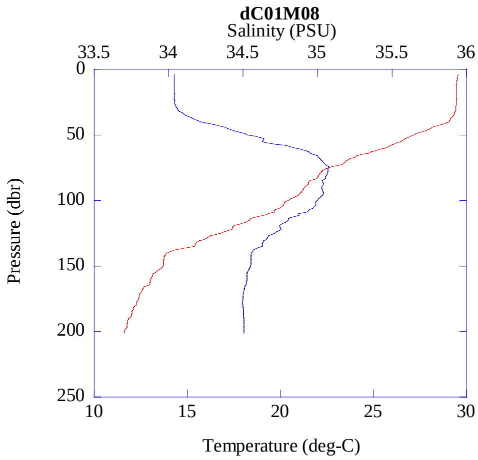


Fig6.2.1-6

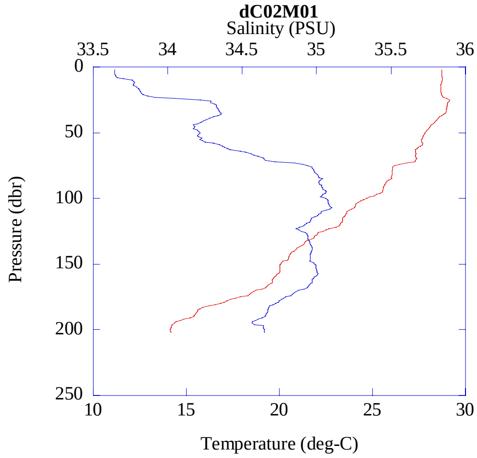


Fig6.2.1-7

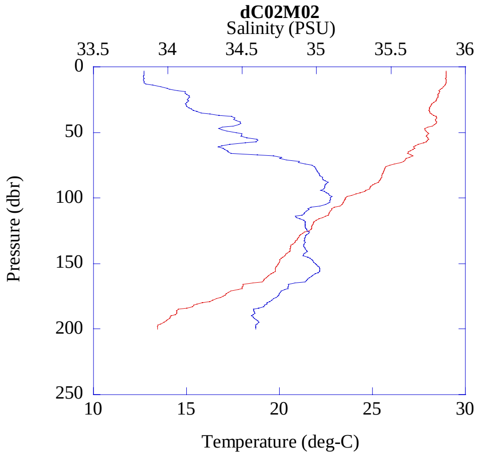


Fig6.2.1-8

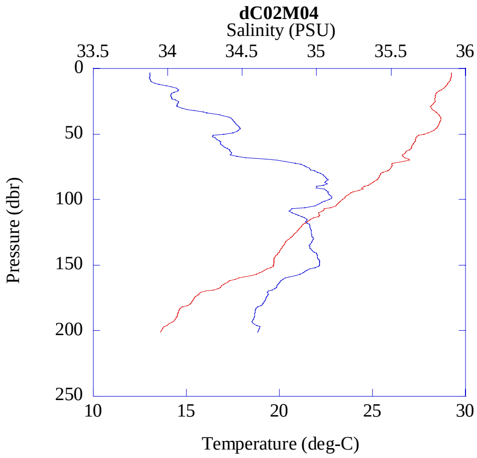


Fig6.2.1-9

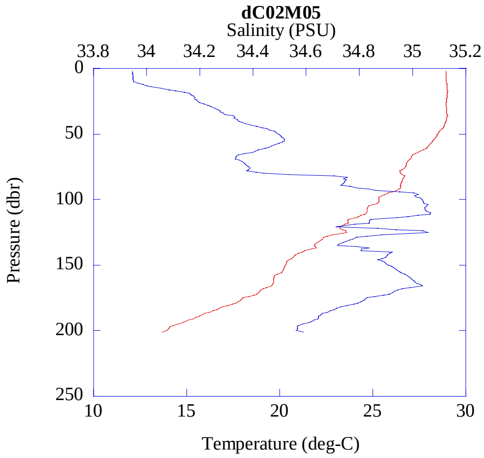


Fig6.2.1-10

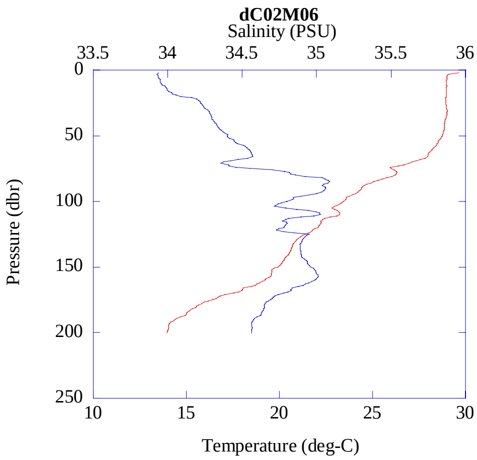


Fig6.2.1-11

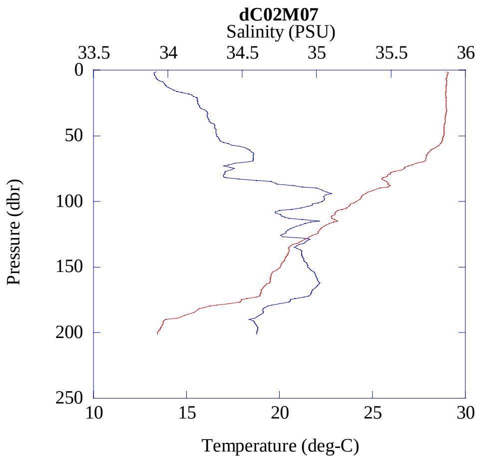


Fig6.2.1-12

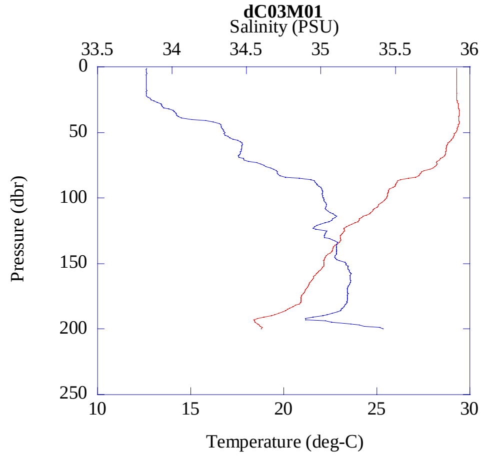


Fig6.2.1-13

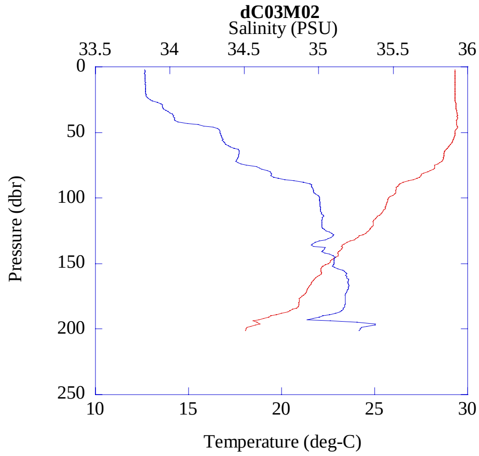
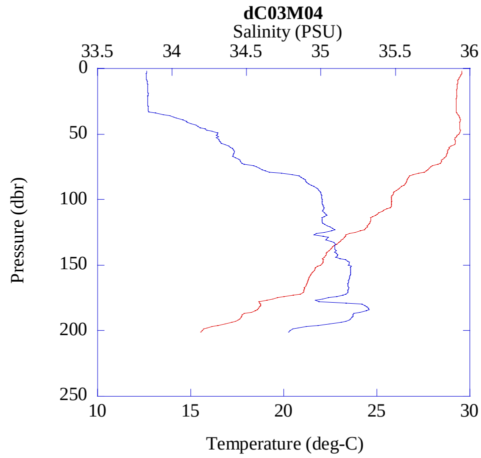


Fig6.2.1-14



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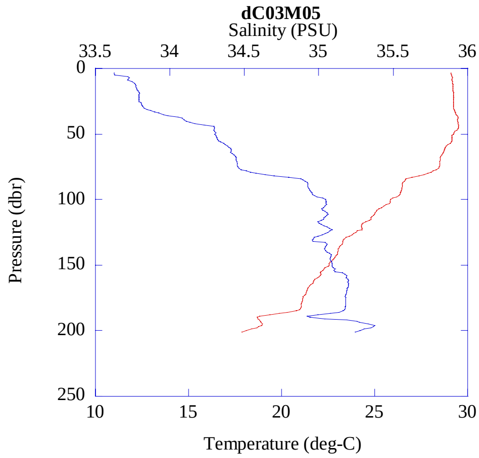


Fig6.2.1-16

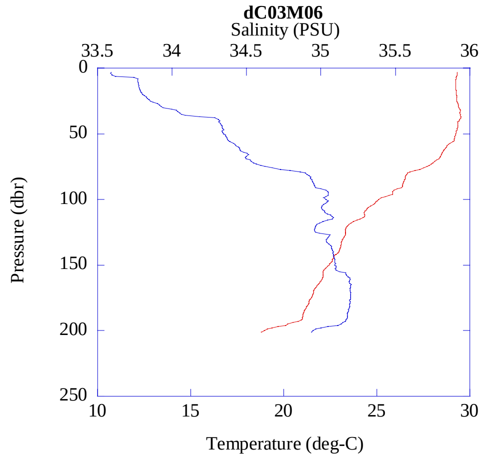


Fig6.2.1-17

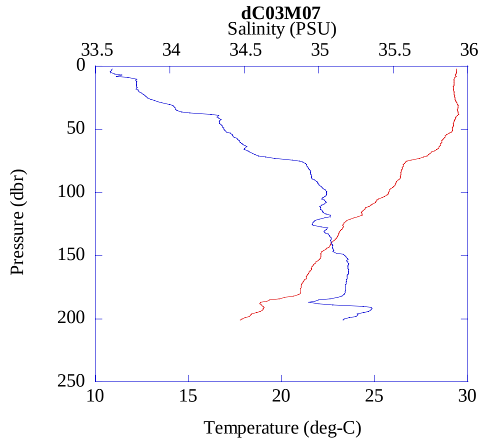


Fig6.2.1-18

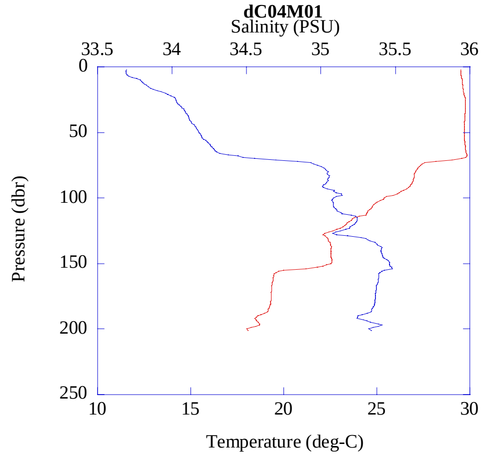
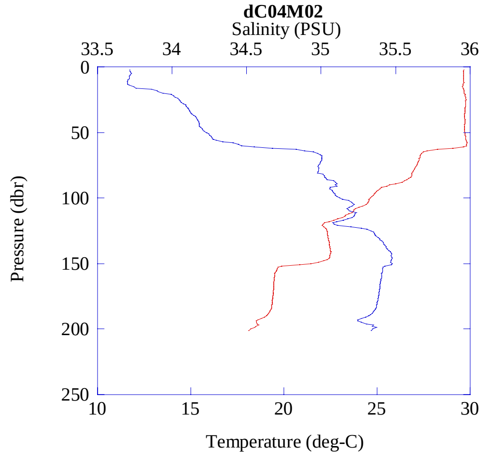


Fig6.2.1-19



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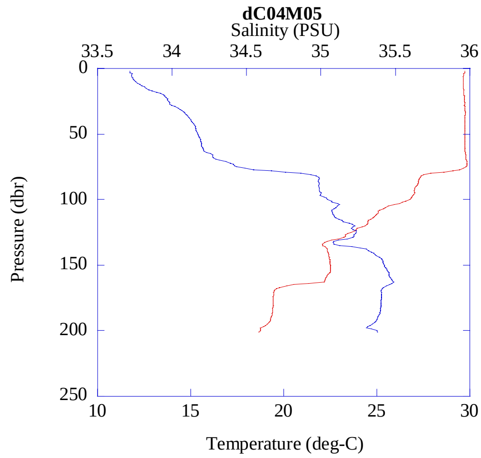


Fig6.2.1-21

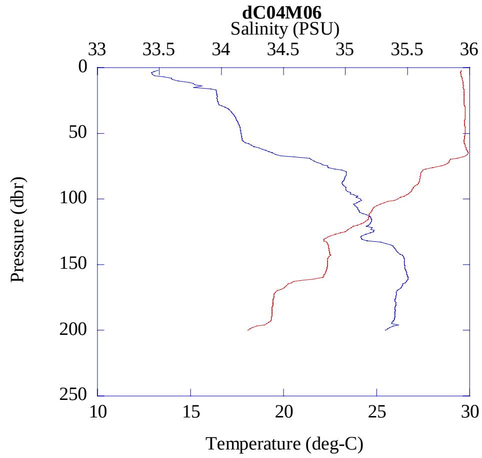


Fig6.2.1-22

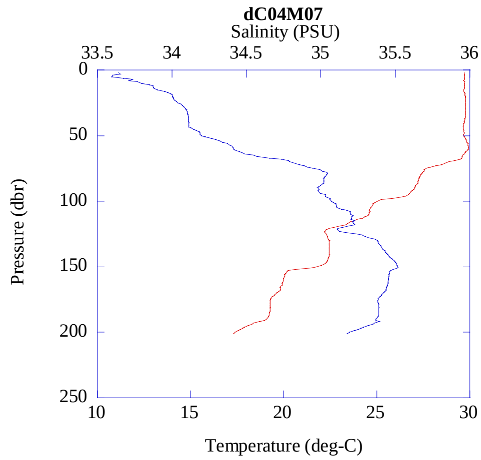


Fig6.2.1-23

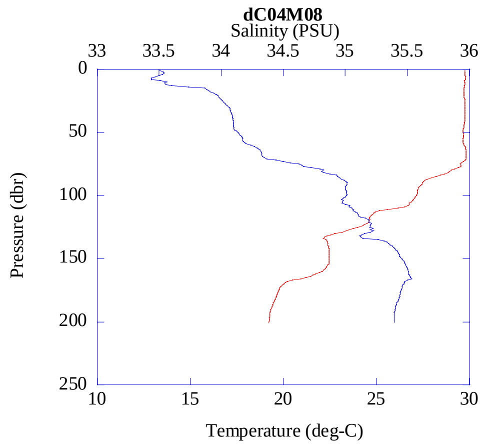


Fig6.2.1-24

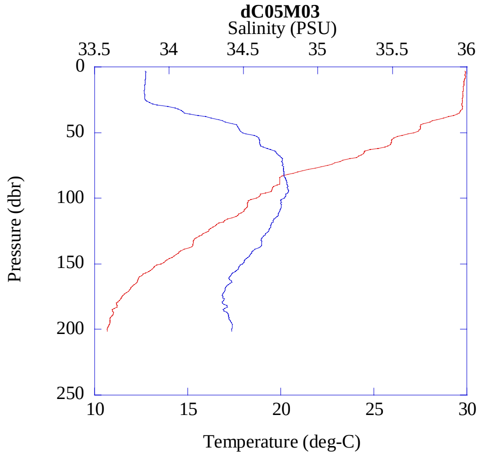


Fig6.2.1-25

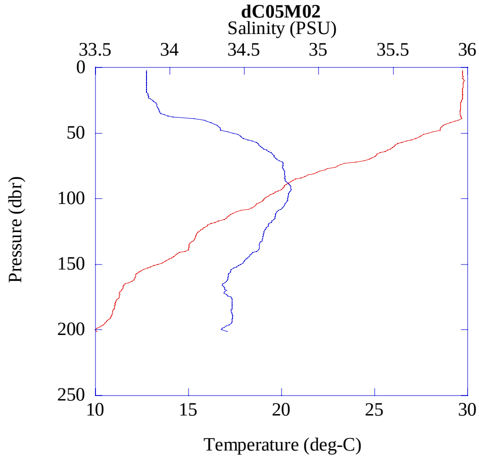
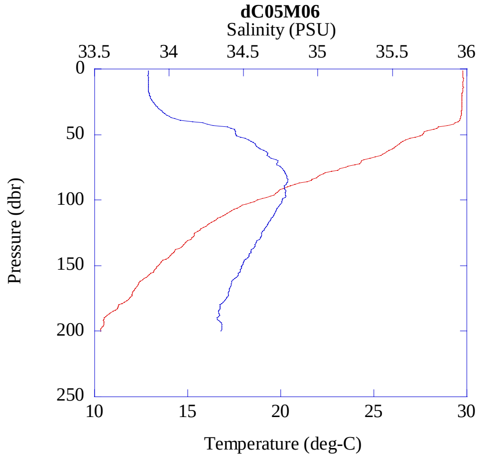


Fig6.2.1-26



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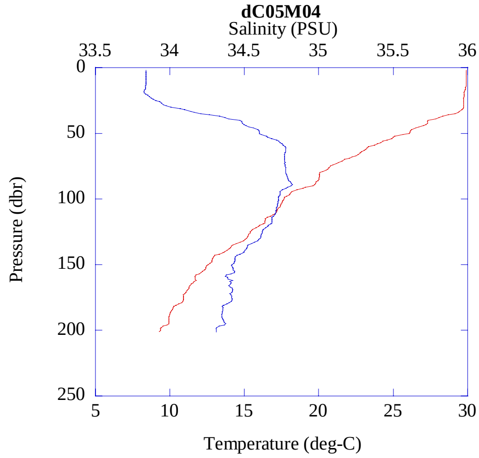


Fig6.2.1-28

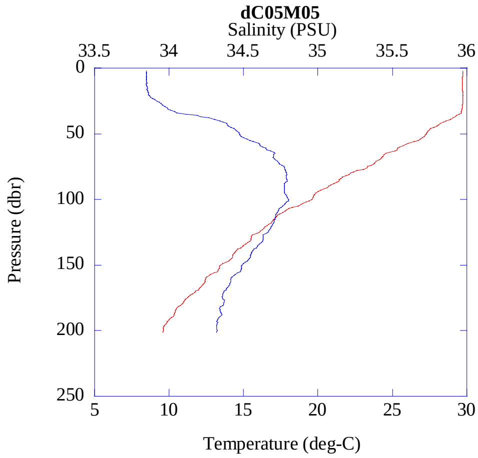


Fig6.2.1-29

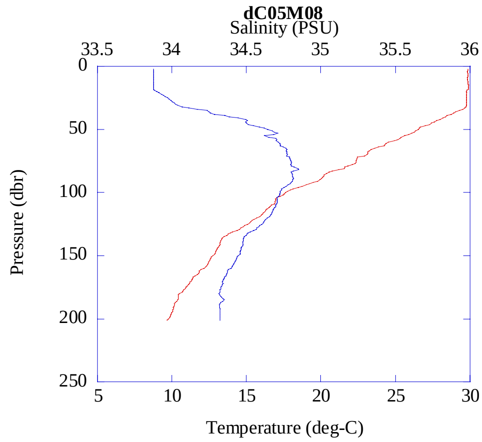


Fig6.2.1-30

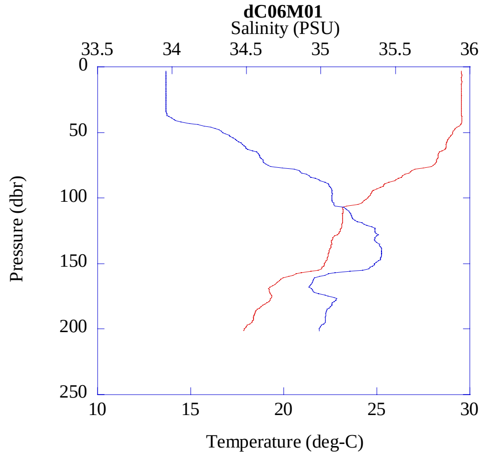
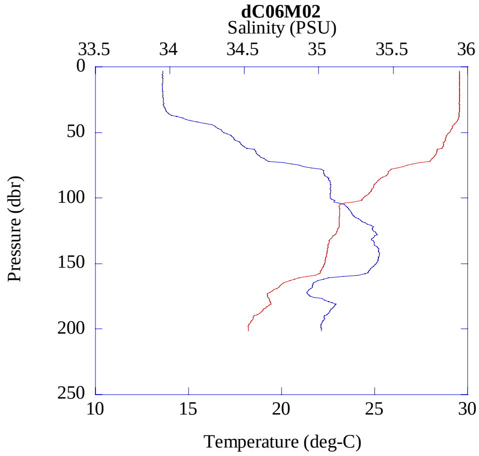


Fig6.2.1-31



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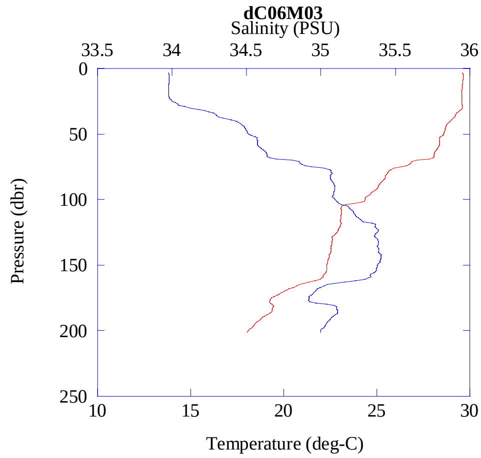

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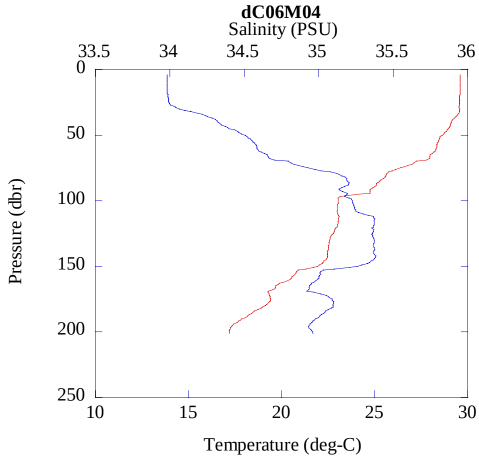

Fig6.2.1-34

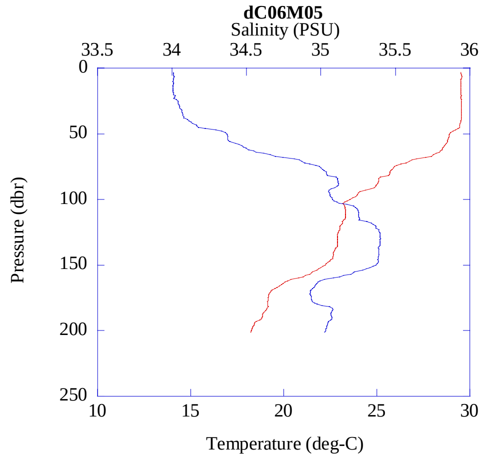

Fig6.2.1-35

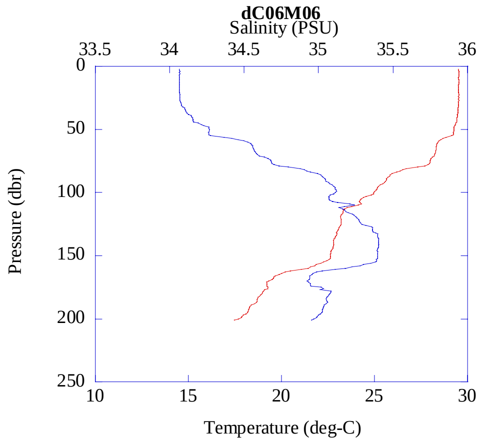

Fig6.2.1-36

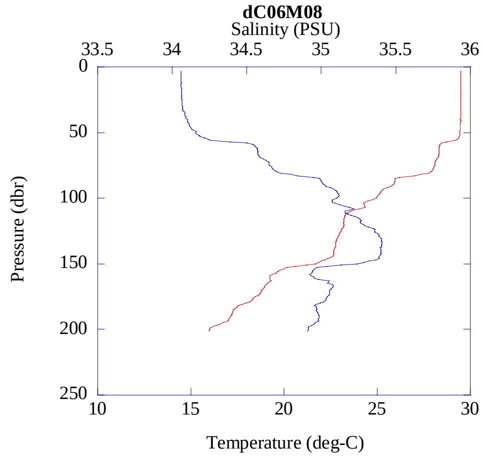

Fig6.2.1-37

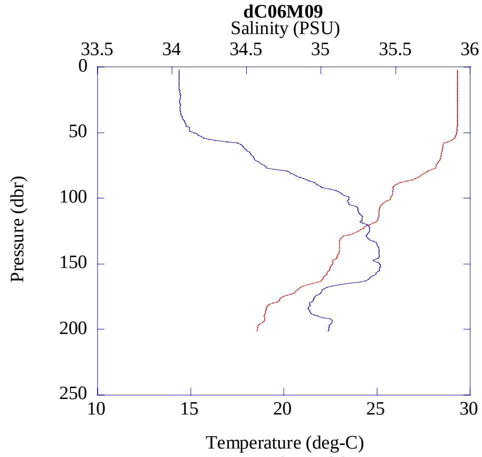

Fig6.2.1-38

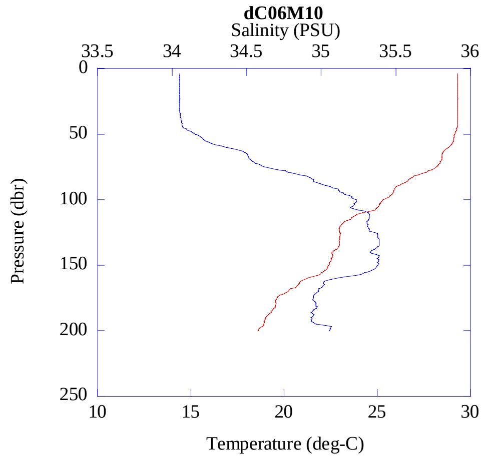

Fig6.2.1-39

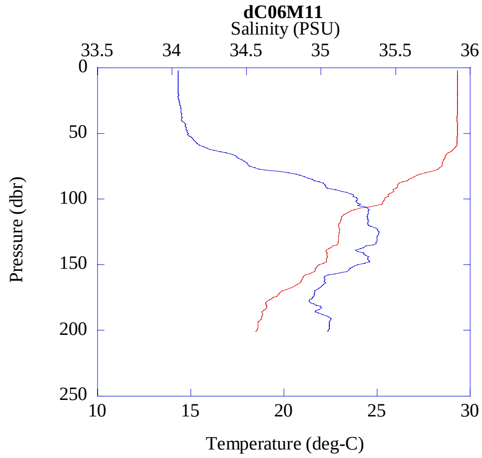

Fig6.2.1-40

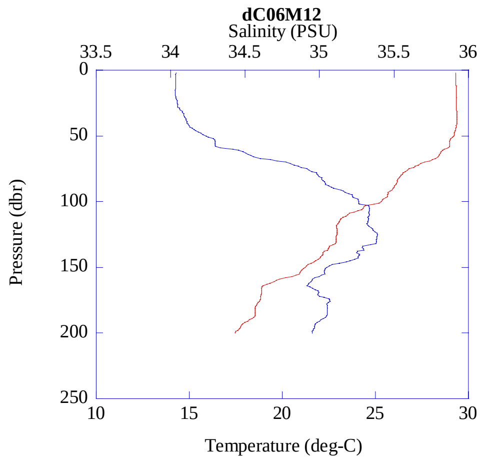

Fig6.2.1-41

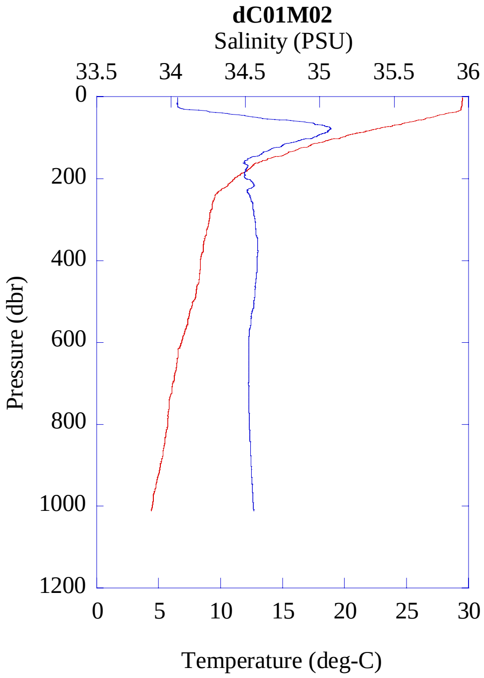

Fig6.2.1-42

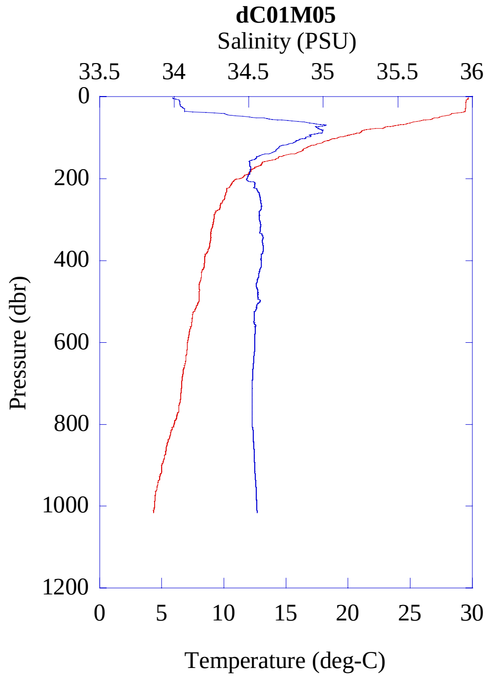

Fig6.2.1-43

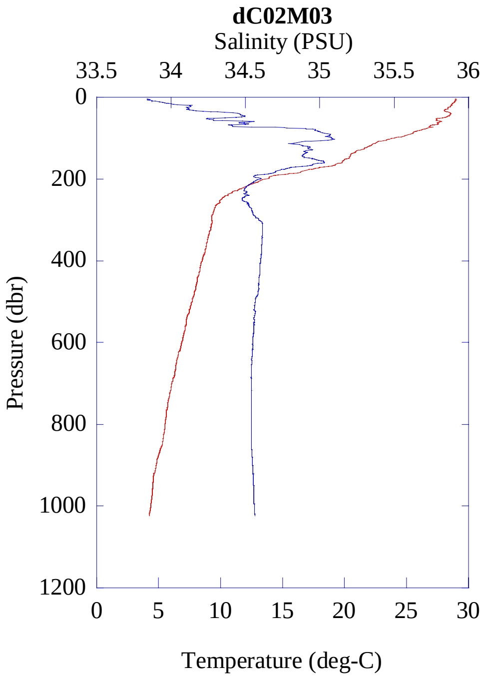

Fig6.2.1-44

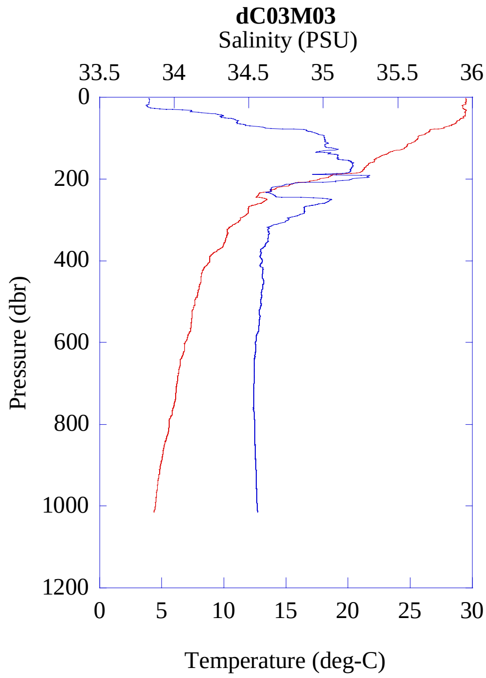

Fig6.2.1-45

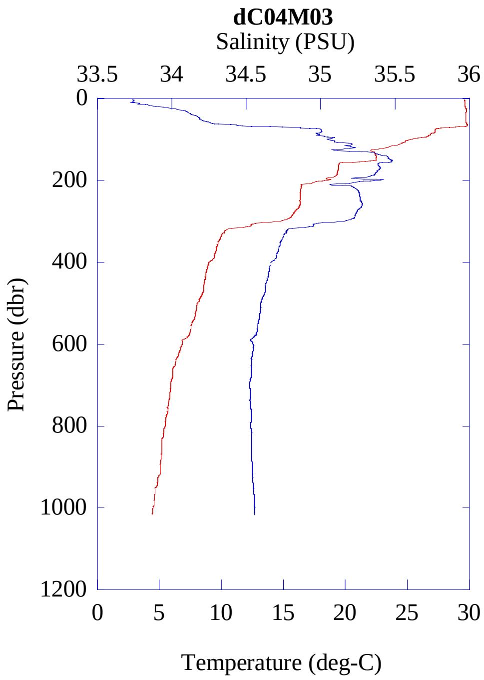

Fig6.2.1-46

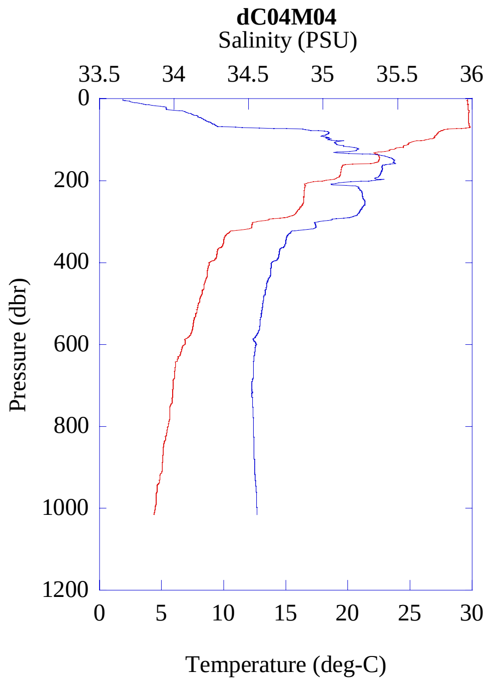

Fig6.2.1-47

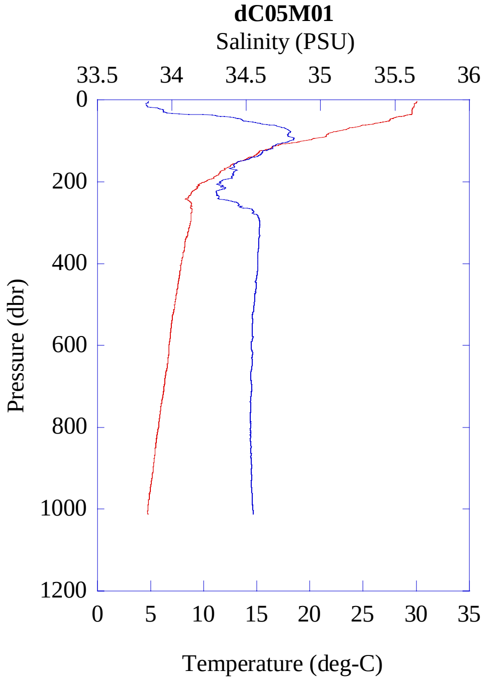

Fig6.2.1-48

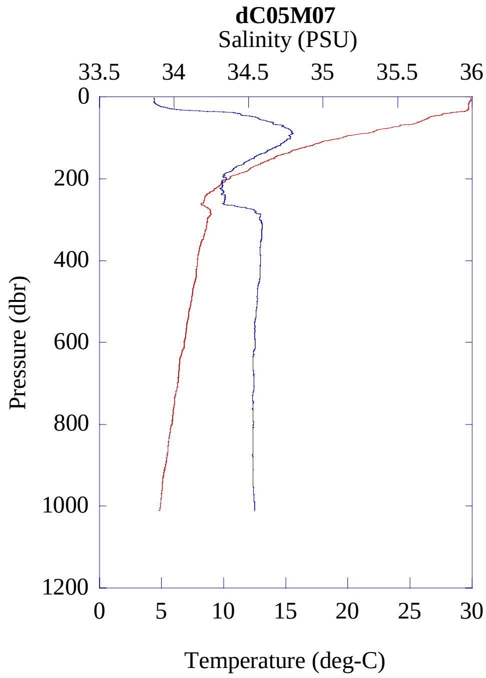

Fig6.2.1-49

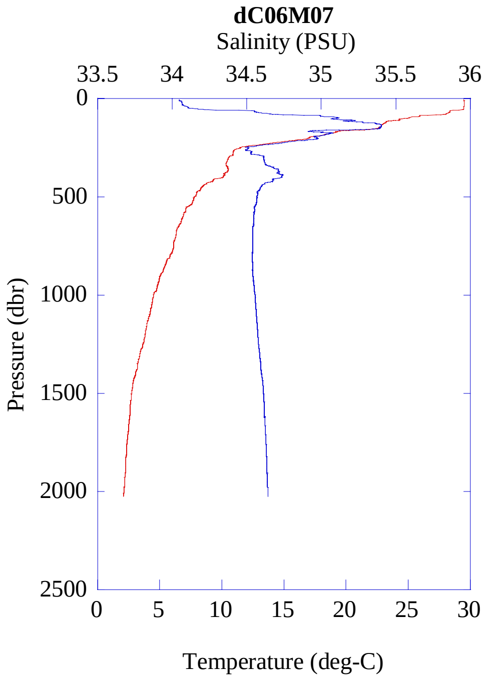

Fig6.2.1-50

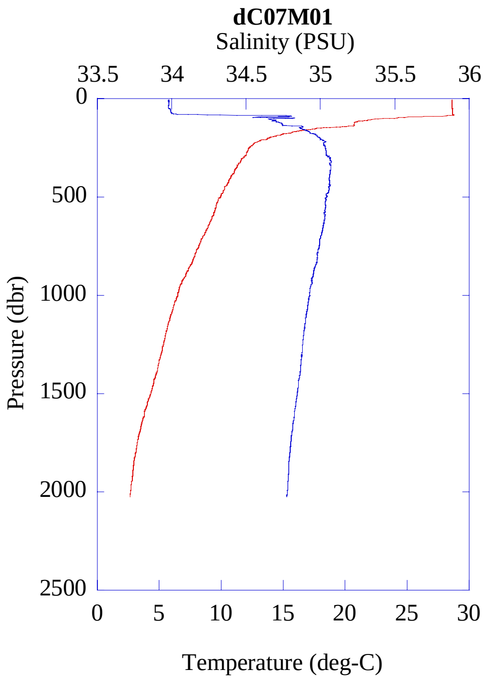

Fig6.2.1-51

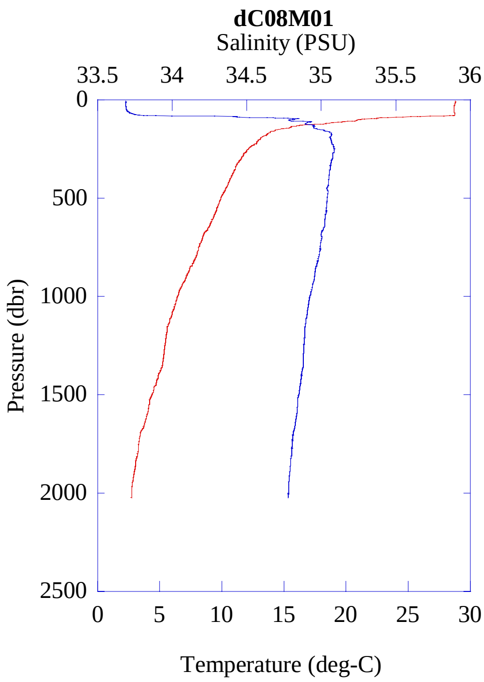

Fig6.2.1-52

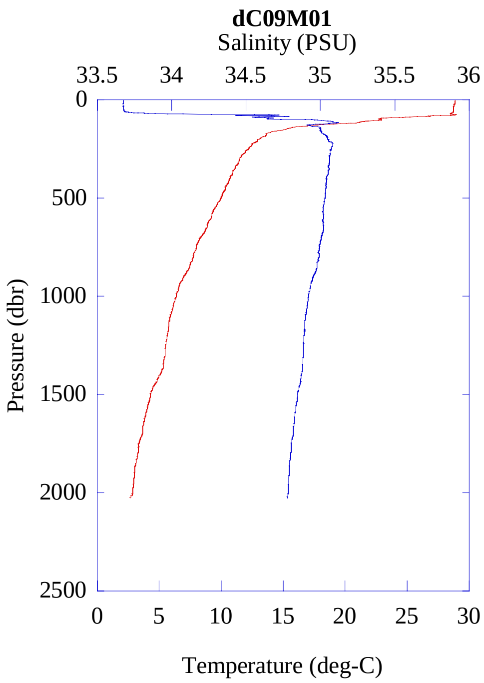

Fig6.2.1-53

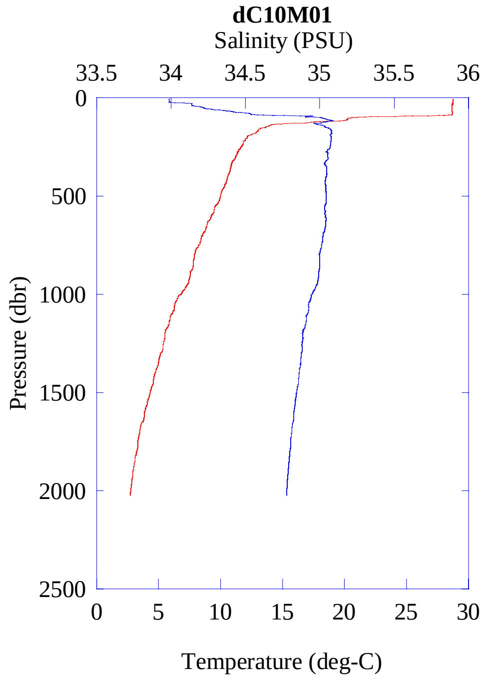

Fig6.2.1-54

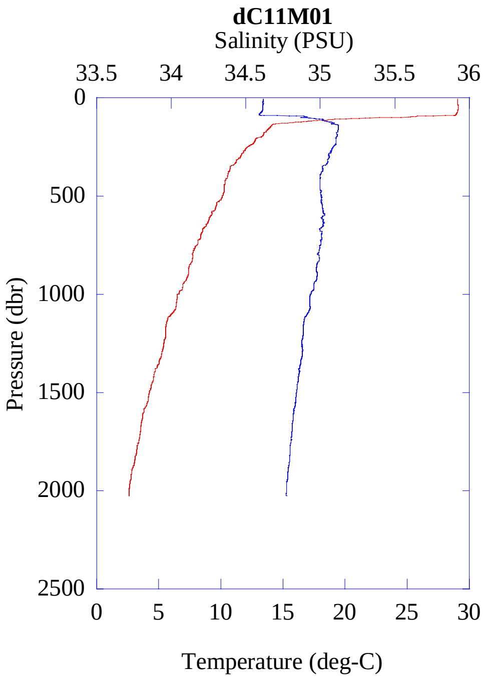

Fig6.2.1-55

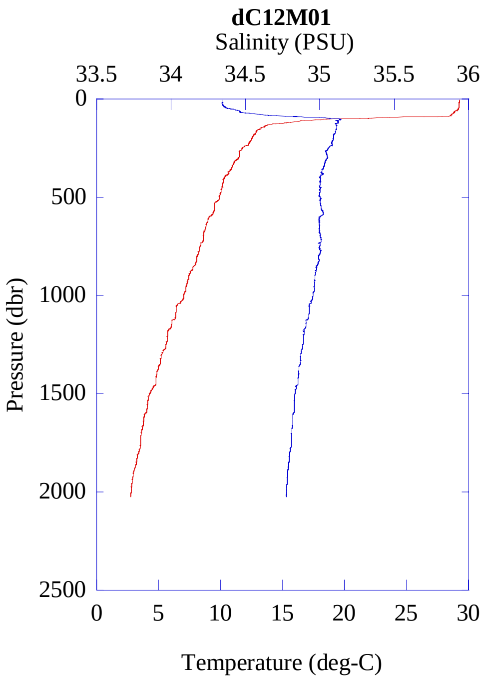

Fig6.2.1-56

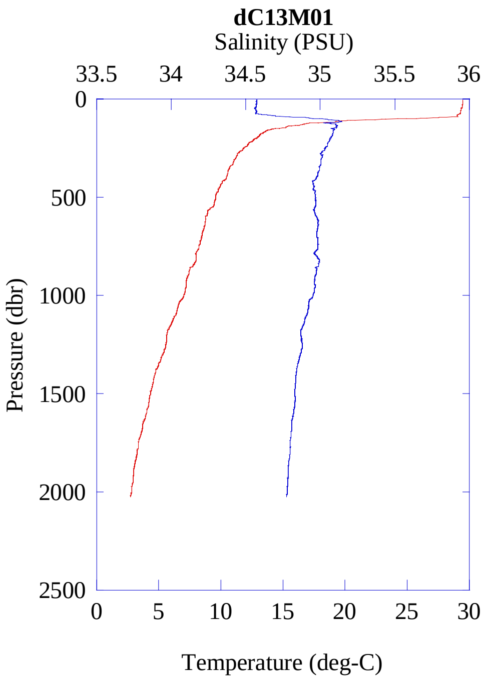

Fig6.2.1-57

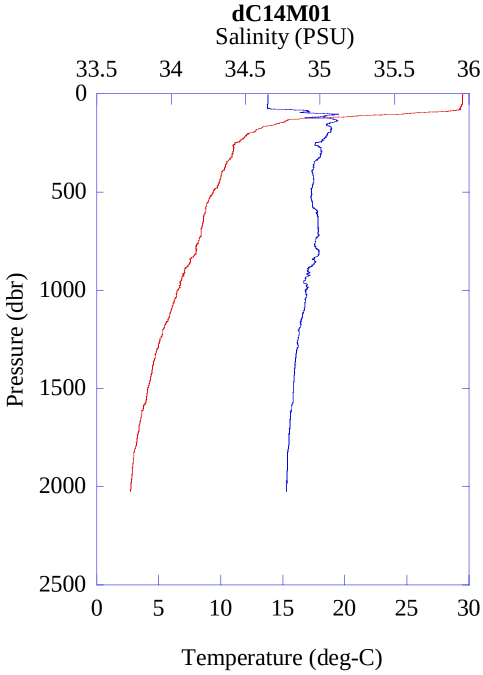

Fig6.2.1-58

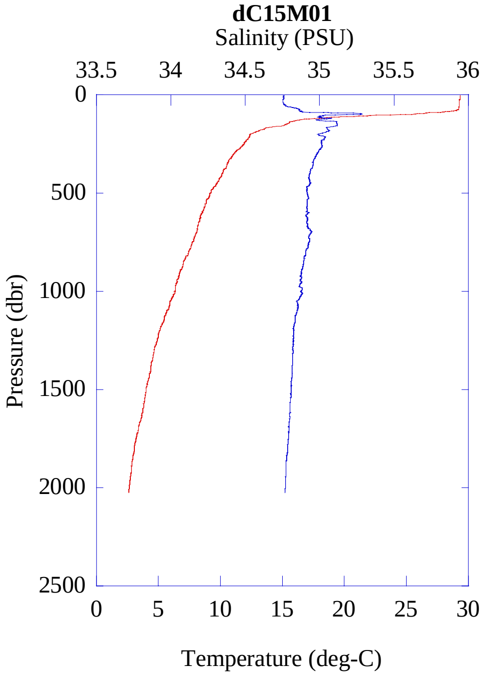

Fig6.2.1-59

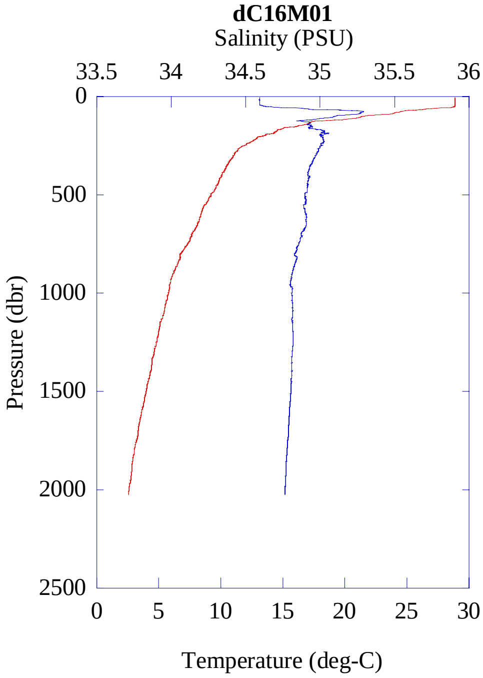

Fig6.2.1-60

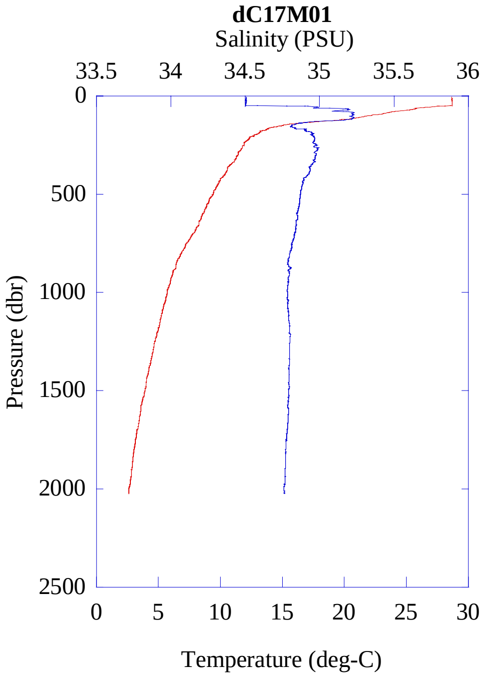

Fig6.2.1-61

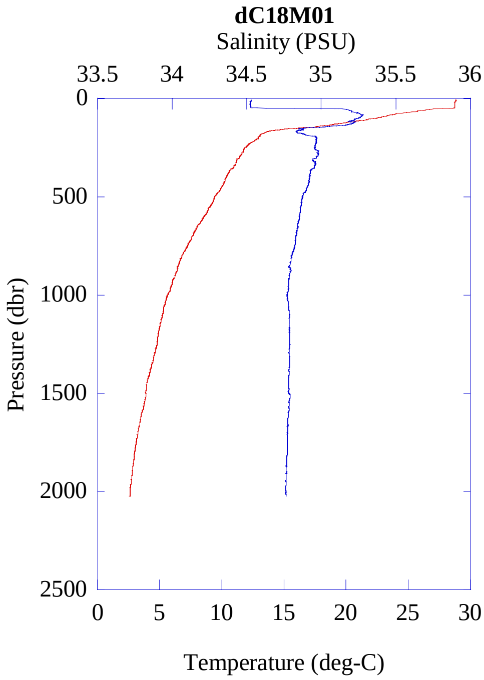

Fig6.2.1-62

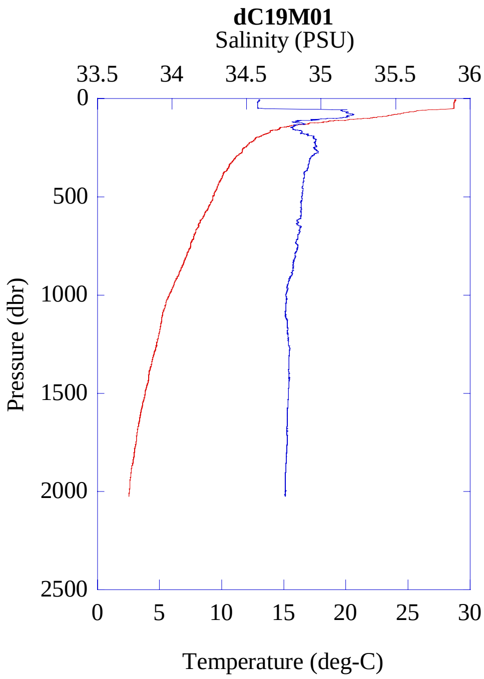

Fig6.2.1-63

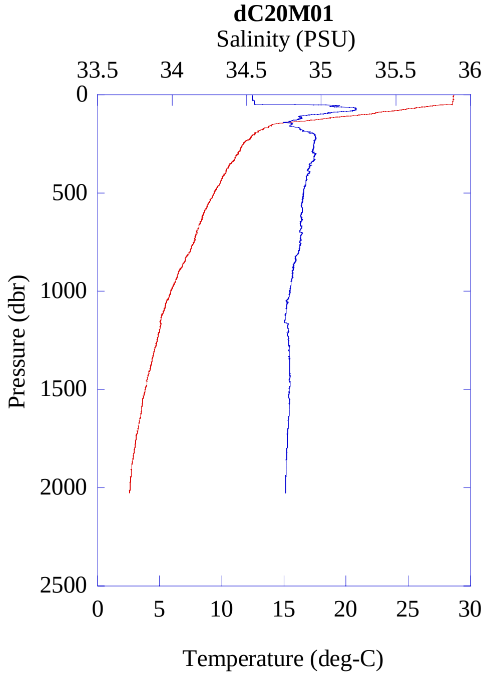

Fig6.2.1-64

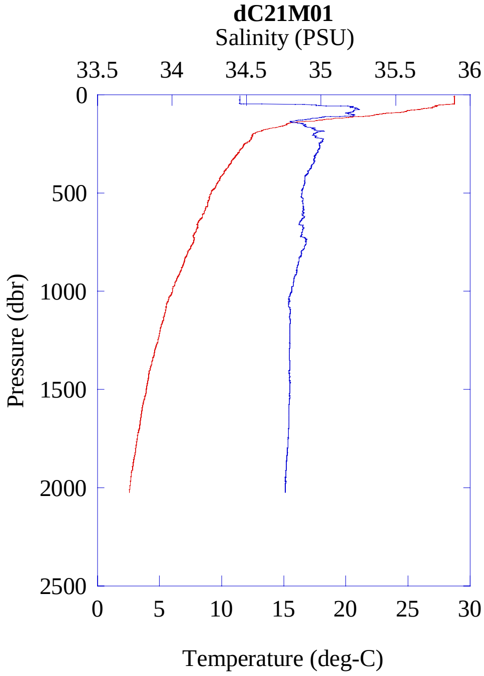

Fig6.2.1-65

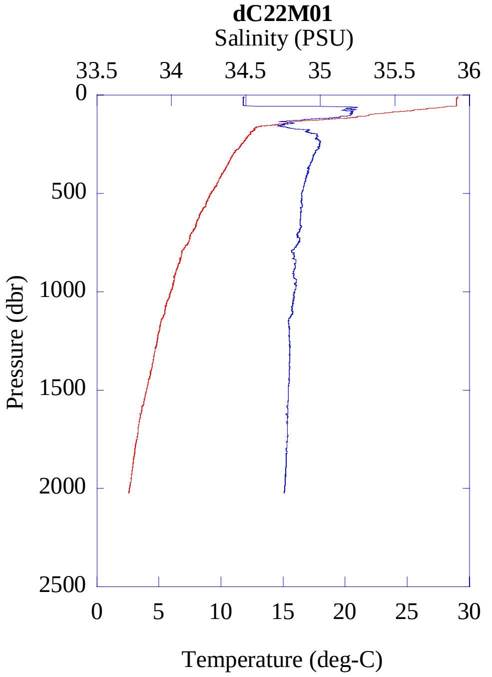
dC22M01
Salinity (PSU)
33.5
34
34.5
35
35.5
36
0
500
1000
1500
2000
2500
Pressure (dbr)
0
5
10
15
20
25
30
Temperature (deg-C)
Fig6.2.1-66

Table 6.2.1 CTD Cast table

STNNBR	CASTNO	Date(UTC)	Time(UTC)		Start Position		Depth	WIRE	Max	CTD data	Remarks
		yyyy/mm/dd	Start	End	Latitude	Longitude	(MNB)	OUT	Depth	file name	
C01	01	2005/7/5	21:49	22:05	07-50.53N	136-30.48E	3351	200	-	C01M01	
C01	02	2005/7/5	23:40	0:27	07-39.83N	136-40.77E	3167	1033.5	994.23	C01M02	
C01	03	2005/7/6	3:01	3:20	07-50.21N	136-29.61E	3350	200.8	200.64	C01M03	
C01	04	2005/7/6	7:01	7:16	07-51.39N	136-28.53E	3352	200.8	201.53	C01M04	
C01	05	2005/7/6	7:33	8:15	07-51.80N	136-28.03E	3353	1008.7	1004.85	C01M05	
C01	06	2005/7/6	21:47	22:01	07-39.99N	136-41.04E	3155	199.7	199.46	C01M06	
C01	07	2005/7/7	3:28	3:45	07-40.59N	136-38.37E	2087	199.1	200.68	C01M07	
C01	08	2005/7/7	7:00	7:14	07-40.61N	136-38.35E	2803	198	199.87	C01M08	
C02	01	2005/7/7	21:47	22:02	04-56.54N	137-20.12E	4158	201	200	C02M01	
C02	02	2005/7/8	3:35	3:54	04-54.14N	137-17.24E	4045	202.6	199.02	C02M02	
C02	03	2005/7/8	4:25	5:11	04-54.19N	137-16.97E	4004	1022.5	1001.94	C02M03	
C02	04	2005/7/8	6:59	7:13	04-56.27N	137-19.16E	4160	199.7	199.29	C02M04	
C02	05	2005/7/8	21:46	22:01	04-51.54N	137-17.14E	4141	199.7	199.49	C02M05	
C02	06	2005/7/9	3:59	4:19	04-52.05N	137-18.02E	4062	198.7	198.82	C02M06	
C02	07	2005/7/9	6:58	7:14	04-51.79N	137-17.79E	4112	199.3	199.8	C02M07	
C03	01	2005/7/9	21:46	22:01	01-59.80N	138-06.19E	4327	199.1	198.88	C03M01	
C03	02	2005/7/10	2:59	3:17	01-59.65N	138-06.71E	4327	198.7	199.33	C03M02	
C03	03	2005/7/10	3:57	4:42	02-02.00N	138-04.88E	4293	1010.4	1001.2	C03M03	1*
C03	04	2005/7/10	6:57	7:12	02-02.81N	138-04.09E	4314	199.5	199.79	C03M04	
C03	05	2005/7/10	21:44	21:59	02-03.29N	138-04.75E	4322	198	199.43	C03M05	
C03	06	2005/7/11	3:57	4:15	02-00.75N	138-03.23E	4272	198.2	199.59	C03M06	
C03	07	2005/7/11	6:59	7:14	02-00.25N	138-03.25E	4289	198	199.28	C03M07	
C04	01	2005/7/11	21:44	21:59	00-01.43N	138-00.13E	4165	198.4	199.51	C04M01	
C04	02	2005/7/12	2:30	2:48	00-03.27N	138-00.05E	4232	198.2	199.87	C04M02	
C04	03	2005/7/12	3:14	3:58	00-03.71N	138-01.63E	4178	1010.8	1004.72	C04M03	

Table 6.2.1 CTD Cast table

STNNBR	CASTNO	Date(UTC)	Time(UTC)		Start Position		Depth	WIRE	Max	CTD data	Remarks
		yyyy/mm/dd	Start	End	Latitude	Longitude	(MNB)	OUT	Depth	file name	
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C04	05	2005/7/12	6:56	7:11	00-02.00N	137-57.72E	4284	198.4	199.51	C04M05	
C04	06	2005/7/12	21:44	21:58	00-01.56N	137-55.04E	4325	198.4	198.83	C04M06	
C04	07	2005/7/13	2:57	3:15	00-00.20S	137-59.27E	4001	198.6	199.14	C04M07	
C04	08	2005/7/13	6:58	7:12	00-00.01S	137-58.96E	4019	198.7	198.78	C04M08	
C05	01	2005/7/15	9:06	9:52	08-00.04N	130-00.74E	5605	1002.9	1003	C05M01	
C05	02	2005/7/15	21:46	22:02	07-59.29N	130-00.65E	5717	198	199.58	C05M02	
C05	03	2005/7/16	3:57	4:16	07-59.08N	130-01.91E	5718	197.5	199.37	C05M03	
C05	04	2005/7/16	6:57	7:13	07-59.40N	130-01.72E	5719	198.6	199.71	C05M04	
C05	05	2005/7/16	21:47	22:02	07-56.52N	130-03.96E	5635	-	-	C05M05	
C05	06	2005/7/17	3:28	3:46	07-56.25N	130-04.07E	5629	198.4	200.37	C05M06	
C05	07	2005/7/17	4:27	5:11	07-56.17N	130-03.95E	5623	1004.4	1002.45	C05M07	2*
C05	08	2005/7/17	6:58	7:12	07-59.84N	130-00.31E	5668	198.6	199.92	C05M08	
C06	01	2005/7/19	21:45	22:00	02-01.85N	130-11.43E	4382	199.3	199.61	C06M01	
C06	02	2005/7/20	1:27	1:42	02-01.97N	130-11.48E	4377	197.8	199.64	C06M02	
C06	03	2005/7/20	3:56	4:14	02-02.01N	130-11.73E	4378	197.3	199.73	C06M03	
C06	04	2005/7/20	7:00	7:19	02-04.99N	130-15.52E	4369	197.6	199.67	C06M04	
C06	05	2005/7/20	21:44	21:59	01-59.42N	129-53.94E	4423	198.7	199.76	C06M05	
C06	06	2005/7/21	2:58	3:16	02-00.20N	129-55.67E	4394	198.4	199.15	C06M06	
C06	07	2005/7/21	4:29	5:51	01-59.30N	129-55.56E	4413	2004.4	2000.91	C06M07	
C06	08	2005/7/21	6:57	7:12	01-59.85N	129-53.96E	4418	197.8	199.16	C06M08	
C06	09	2005/7/21	21:59	22:14	02-02.11N	130-02.25E	4405	198.9	199.2	C06M09	
C06	10	2005/7/22	0:59	1:14	02-03.45N	130-03.21E	4404	197.3	198.82	C06M10	
C06	11	2005/7/22	3:59	4:19	02-04.25N	130-04.22E	4400	198.6	199.08	C06M11	
C06	12	2005/7/22	6:59	7:14	02-03.53N	130-05.03E	4390	198.6	198.77	C06M12	

Table 6.2.1 CTD Cast table

STNNBR	CASTNO	Date(UTC)	Time(UTC)		Start Position		Depth	WIRE	Max	CTD data	Remarks
		yyyy/mm/dd	Start	End	Latitude	Longitude	(MNB)	OUT	Depth	file name	
C07	01	2005/8/3	0:33	1:48	04-59.83N	090-00.06E	3408	2008.4	2001.4	C07M01	3*
C08	01	2005/8/3	6:30	7:45	04-00.12N	090-00.11E	2842	2004.9	2001.78	C08M01	4*
C09	01	2005/8/3	12:08	13:24	03-00.15N	090-00.04E	2446	2009.3	2001.6	C09M01	5*
C10	01	2005/8/3	17:59	19:14	02-00.01N	089-59.96E	2645	2003.3	1999.51	C10M01	
C11	01	2005/8/4	0:14	1:28	01-00.09N	089-59.98E	2317	2008	2001.49	C11M01	6*
C12	01	2005/8/8	3:51	5:08	00-00.13N	089-59.89E	4196	2004.2	1999.9	C12M01	7*
C13	01	2005/8/8	22:58	0:14	01-37.69S	090-02.12E	4706	2004.7	2001.11	C13M01	
C14	01	2005/8/10	7:07	8:22	02-00.05S	089-59.84E	4739	2007.8	2001.2	C14M01	
C15	01	2005/8/10	12:58	14:14	02-59.91S	089-59.91E	3331	2010	2000.48	C15M01	
C16	01	2005/8/10	18:59	20:14	03-58.13S	089-56.66E	3054	2014.8	2000.2	C16M01	8*
C17	01	2005/8/11	1:14	2:27	04-59.74S	089-59.93E	5004	2007.3	2001.1	C17M01	9*
C18	01	2005/8/11	7:23	8:36	05-00.12S	090-59.97E	4984	2008	2001.26	C18M01	
C19	01	2005/8/11	13:01	14:15	05-00.02S	091-59.61E	5002	2013.9	2001.3	C19M01	
C20	01	2005/8/11	18:58	20:13	05-00.02S	092-59.80E	4619	2008	2002.2	C20M01	
C21	01	2005/8/12	1:09	2:20	05-00.13S	094-00.07E	4970	2005.1	2000.24	C21M01	
C22	01	2005/8/12	7:08	8:21	04-59.55S	094-58.65E	5014	2003.6	2001.16	C22M01	

1*: Primary are spikes at 206db in Temperature and Salinity(for up cast).

2*: Secondary are spikes at 204db in Temperature and Salinity(for up cast).

3*: Primary are spikes at 877db in Temperature and Salinity(for up cast).

4*: Primary are spikes at 1030db in Temperature and Salinity(for up cast).
Secondary are spikes at 152db in Temperature and Salinity(for up cast).

5*: Primary are spikes at 108db and 75db in Temperature and Salinity(for up cast).

6*: Primary are spikes at 1864db and 1849db in Temperature and Salinity(for up cast).
Secondary are spikes at 156db in Temperature and Salinity(for up cast).

7*: Primary are spikes at 1525db and 78db in Temperature and Salinity(for up cast).

8*: Secondary are spikes at 235db in Temperature and Salinity(for up cast).

9*: Primary are spikes at 940db and 192db in Temperature and Salinity(for up cast).

6.2.2 XCTD

Kentaro Ando (JAMSTEC):	Principal Investigator (Leg1)
Hideaki Hase (JAMSTEC):	Principal Investigator (Leg2)
Satoshi Okumura (Global Ocean Development Inc.)	- Leg1 -
Souichiro Sueyoshi (GODI)	- Leg1 -
Wataru Tokunaga (GODI)	- Leg1,2 -
Kazuho Yoshida (GODI)	- Leg1 -
Yasutaka Imai (GODI)	- Leg2 -
Shinya Okumura (GODI)	- Leg2 -
Norio Nagahama (GODI)	- Leg2 -

(1) Objectives

Investigation of oceanic structure.

(2) Parameters

According 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]	5 [m] or 2% at depth, whichever is greater

(3) 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 and MK 130, Tsurumi-Seiki Co. and was recorded by WinXCTD software (version 1.07) and MK-130L software (version 2.1) made by Tsurumi-Seiki Co..

We dropped 92 probes (X001-X092) by using automatic launcher and hand launcher. The summary of XCTD observation and launching log were shown in Table 6.2.2-1 and Table 6.2.2-2.

(4) Preliminary results

Vertical temperature and salinity sections were shown in the following Fig. 6.2.2-1 to 6.2.2-10.

(5) Data archives

XCTD data obtained in this cruise will be submitted to the JAMSTEC DMD (Data Management Division) and will be available via "R/V MIRAI Data Web Page" in JAMSTEC home page.

Table 6.2.2-1 Summary of XCTD observation and launching log at Leg1

Statio No.	Launch Time (UTC) date	time	Finish time	Launch Potision Latitude	Longitude	Measured Depth [m]	Water Depth [m]	Surface Temp. [deg-C]	Surface Salinity [PSU]	Probe S/N	Remarks *Converter *Launcher
X001	07/04	01:49:37	01:55	13-00.01N	144-14.57E	1034	3902	-	-	04037335	MK-100/Auto
X002	07/04	07:12:59	07:18	11-59.99N	143-14.16E	1035	3323	-	-	04037334	MK-100/Auto
X003	07/04	12:34:09	12:39	10-59.95N	142-15.22E	1034	6767	29.630	33.980	04037333	MK-100/Auto
X004	07/04	17:54:46	18:00	09-59.98N	141-17.00E	1034	3277	29.577	33.964	04037336	MK-100/Auto
X005	07/04	23:14:23	23:19	08-59.98N	140-18.65E	1036	3356	29.610	33.912	04037338	MK-100/Auto
X006	07/07	07:22:58	07:28	07-40.49N	136-38.18E	1035	2787	30.000	34.029	04109687	MK-100/Auto
X007	07/07	08:13:00	08:18	07-29.95N	136-40.73E	1035	2256	29.670	33.908	04037337	MK-100/Auto
X008	07/07	10:25:32	10:31	06-59.97N	136-50.57E	1034	4602	30.150	33.919	04109685	MK-100/Auto
X009	07/07	12:34:05	12:39	06-29.97N	136-57.09E	1034	4481	30.180	33.921	04109683	MK-100/Auto
X010	07/07	14:41:52	14:47	06-00.03N	137-04.09E	1034	4357	29.710	33.851	04109682	MK-100/Auto
X011	07/07	16:49:16	16:54	05-29.03N	137-11.02E	1034	4663	29.390	33.780	04109684	MK-100/Auto
X012	07/09	07:20:33	07:26	04-51.58N	137-18.48E	1034	4151	29.233	33.887	04109688	MK-100/Auto
X013	07/09	08:51:01	08:56	04-29.99N	137-23.71E	1035	4631	29.771	33.872	04109694	MK-100/Auto
X014	07/09	10:49:46	10:55	04-00.01N	137-30.81E	1036	4485	29.670	33.940	04109693	MK-100/Auto
X015	07/09	12:51:29	12:56	03-30.01N	137-39.99E	1035	4599	29.580	33.949	04109693	MK-100/Auto
X016	07/09	14:54:44	15:00	03-00.00N	137-48.59E	1036	4352	29.370	33.772	04109690	MK-100/Auto
X017	07/09	16:57:14	17:02	02-29.67N	137-56.97E	1034	4653	29.170	33.515	04109686	MK-100/Auto
X018	07/11	07:31:16	07:37	01-59.37N	138-03.38E	1128	4256	29.420	33.561	04100045	MK-100/Hand
X019	07/11	09:35:07	09:40	01-29.98N	138-03.80E	1034	4192	29.500	33.754	04100038	MK-100/Auto
X020	07/11	12:09:30	12:15	00-59.98N	138-06.88E	1034	3744	29.480	33.962	04100037	MK-100/Auto
X021	07/11	14:10:52	14:16	00-30.00N	138-06.47E	1034	4027	29.950	33.563	04100093	MK-100/Auto
X022	07/13	07:19:49	07:25	00-00.03S	137-58.83E	1035	4013	29.794	33.409	04100044	MK-100/Auto
X023	07/17	07:57:40	08:03	08-00.56N	129-58.95E	1150	5627	29.920	33.867	04109691	MK-100/Hand
X024	07/17	09:37:37	09:43	07-53.38N	129-39.98E	1035	5224	29.800	33.835	04100043	MK-100/Auto
X025	07/17	11:19:40	11:25	07-46.14N	129-20.03E	1035	5207	29.740	33.854	04100042	MK-100/Auto
X026	07/17	13:04:19	13:09	07-38.52N	129-00.02E	1034	5126	29.769	33.852	04100046	MK-100/Auto
X027	07/17	14:51:03	14:56	07-30.34N	128-40.15E	1034	4911	29.695	33.831	04100041	MK-130/Auto
X028	07/17	16:37:17	16:42	07-21.65N	128-20.00E	1035	5667	29.764	33.806	04100047	MK-130/Auto
X029	07/17	18:18:02	18:23	07-15.43N	127-59.98E	1034	5372	29.787	33.764	04109977	MK-130/Auto
X030	07/17	19:07:39	19:13	07-12.62N	127-49.99E	1035	5793	29.805	33.782	04100048	MK-130/Auto
X031	07/17	19:58:26	20:04	07-09.14N	127-39.98E	1035	6318	29.849	33.929	04100040	MK-130/Auto
X032	07/17	20:48:30	20:54	07-05.92N	127-30.00E	1033	7779	29.800	33.980	04109980	MK-130/Auto
X033	07/17	21:37:49	21:43	07-02.67N	127-19.99E	1033	9651	29.864	34.039	04109974	MK-130/Auto
X034	07/17	22:27:43	22:33	06-59.10N	127-10.00E	1035	7640	29.826	34.050	04109973	MK-130/Auto
X035	07/17	23:16:46	23:22	06-55.72N	126-59.93E	1036	5936	29.764	34.027	04109970	MK-130/Auto
X036	07/18	00:04:58	00:10	06-52.96N	126-50.03E	1084	5171	29.831	34.023	04109976	MK-130/Hand
X037	07/18	00:51:51	00:57	06-49.99N	126-40.05E	1074	2944	29.799	33.990	04109979	MK-130/Hand
X038	07/18	01:45:54	01:51	06-40.02N	126-42.91E	1037	2987	29.826	33.947	04109972	MK-130/Hand
X039	07/18	02:43:43	02:49	06-30.02N	126-50.50E	1036	4402	29.845	34.062	04109951	MK-130/Hand
X040	07/18	03:48:10	03:53	06-19.62N	126-59.40E	1036	4666	29.970	34.033	04109981	MK-130/Auto
X041	07/18	04:51:00	04:56	06-10.09N	127-08.48E	1033	6671	30.023	33.984	04109971	MK-130/Auto
X042	07/18	05:55:40	06:01	05-59.98N	127-16.96E	1035	7261	29.989	33.902	04109978	MK-130/Auto
X043	07/18	06:58:32	07:04	05-50.00N	127-24.76E	1034	7687	30.035	33.693	04109975	MK-130/Auto
X044	07/18	08:01:36	08:07	05-40.01N	127-33.45E	1034	8125	30.047	33.815	04109943	MK-130/Auto
X045	07/18	09:02:37	09:08	05-30.01N	127-41.38E	1033	8992	29.921	33.761	04109942	MK-130/Auto
X046	07/18	10:04:35	10:10	05-20.01N	127-49.19E	1034	8580	29.882	33.790	04109941	MK-130/Auto
X047	07/18	11:07:20	11:07	05-10.03N	127-56.71E	1035	8247	29.775	33.808	04109946	MK-130/Auto
X048	07/18	12:12:11	12:17	05-00.01N	128-04.48E	1034	8472	29.748	33.833	04109950	MK-130/Auto
X049	07/18	13:56:40	14:02	04-40.03N	128-19.89E	1033	6987	29.826	33.708	04109953	MK-130/Auto
X050	07/18	15:44:55	15:55	04-20.01N	128-35.36E	1035	6175	29.565	33.977	04109945	MK-130/Auto
X051	07/18	17:31:27	17:37	04-00.00N	128-50.22E	1035	5810	29.502	33.818	04109955	MK-130/Auto
X052	07/18	19:20:57	19:26	03-40.00N	129-05.44E	1036	4429	29.541	33.954	04109969	MK-130/Auto
X053	07/18	21:12:08	21:17	03-20.01N	129-20.31E	1035	4729	29.522	33.638	04109967	MK-130/Auto
X054	07/18	23:05:55	23:11	03-00.00N	129-35.75E	1034	2261	29.490	33.513	04109968	MK-130/Auto
X055	07/19	01:28:46	01:34	02-40.01N	129-50.33E	1035	2406	29.505	33.691	04109947	MK-130/Auto
X056	07/19	03:39:45	03:45	02-19.98N	130-02.31E	1035	4258	29.439	33.534	04109949	MK-130/Auto
X057	07/19	05:18:20	05:24	02-03.38N	130-10.34E	1035	4375	29.821	33.906	04109944	MK-130/Auto

Table 6.2.2-2 Summary of XCTD observation and launching log at Leg2

Statio No.	Launch Time (UTC) date	time	Finish time	Launch Potision Latitude	Longitude	Measured Depth [m]	Water Depth [m]	Surface Temp. [deg-C]	Surface Salinity [PSU]	Probe S/N	Remarks *Converter *Launcher
X058	2005/08/03	04:10:23	04:15	04-29.78N	090-01.00E	1035	3241	28.637	33.753	04109963	MK-100/Auto
X059	2005/08/03	10:01:16	10:06	03-30.01N	089-59.96E	1035	2462	28.882	33.687	04109957	MK-100/Auto
X060	2005/08/03	15:28:24	15:33	02-29.99N	089-59.71E	1035	2716	28.843	33.710	04109958	MK-100/Auto
X061	2005/08/03	21:19:51	21:25	01-29.98N	089-59.94E	1035	2301	28.816	34.547	04109956	MK-100/Auto
X062	2005/08/08	10:51:56	10:57	00-30.05S	090-02.98E	1035	3088	29.608	34.468	04109960	MK-100/Auto
X063	2005/08/08	13:15:31	13:21	00-59.98S	089-59.87E	1035	3131	29.507	34.482	04109961	MK-100/Auto
X064	2005/08/10	10:37:26	10:42	02-30.00S	089-59.77E	1036	3539	29.450	34.655	04109962	MK-100/Auto
X065	2005/08/10	16:43:14	16:48	03-31.30S	089-59.56E	1036	3570	29.122	34.809	04109965	MK-100/Auto
X066	2005/08/10	22:46:48	22:52	04-30.00S	089-58.18E	1035	4622	28.754	34.498	05022124	MK-100/Auto
X067	2005/08/11	04:49:37	04:55	05-00.38S	090-30.03E	1035	5046	28.700	34.513	05022126	MK-100/Auto
X068	2005/08/11	10:52:40	10:58	04-59.64S	091-30.01E	1046	4988	29.974	34.585	05022125	MK-100/Auto
X069	2005/08/11	16:36:06	16:41	04-59.67S	092-30.00E	1035	5000	28.658	34.575	05022127	MK-100/Auto
X070	2005/08/11	22:34:32	22:40	04-59.93S	093-30.04E	1035	4948	28.656	34.540	05022128	MK-100/Auto
X071	2005/08/12	04:34:23	04:39	05-00.01S	094-30.00E	1036	4981	28.956	34.507	05022129	MK-100/Auto
X072	2005/08/14	13:42:01	13:47	05-28.70S	095-59.99E	1035	4993	28.942	34.276	05022130	MK-100/Auto
X073	2005/08/14	18:31:45	18:37	05-59.64S	096-59.99E	1035	4954	28.524	34.417	05022133	MK-100/Auto
X074	2005/08/14	23:14:46	23:20	06-29.64S	097-59.99E	1035	5434	28.859	34.396	05022132	MK-100/Auto
X075	2005/08/15	04:22:01	04:27	06-58.20S	098-59.99E	1036	5279	28.528	33.851	05022131	MK-100/Auto
X076	2005/08/15	09:23:32	09:29	07-28.68S	100-00.00E	1035	5418	28.439	33.798	05022134	MK-100/Auto
X077	2005/08/15	14:02:15	14:07	07-58.56S	100-59.98E	1035	5507	27.769	33.861	05022135	MK-100/Auto
X078	2005/08/15	18:42:19	18:47	08-29.41S	102-00.00E	1035	5432	27.739	33.730	04109987	MK-100/Auto
X079	2005/08/15	23:15:16	23:20	08-59.63S	103-00.00E	1035	5331	27.045	34.101	04109985	MK-100/Auto
X080	2005/08/16	03:48:10	03:53	09-29.73S	104-00.00E	1035	5495	26.615	34.239	04109989	MK-100/Auto
X081	2005/08/16	08:26:16	08:31	09-59.76S	105-00.02E	1035	4939	26.862	34.143	04109984	MK-100/Auto
X082	2005/08/16	12:36:14	12:41	10-02.55S	106-00.02E	1035	5030	26.623	34.232	04109990	MK-100/Auto
X083	2005/08/16	16:41:05	16:41	10-05.96S	107-00.00E	1035	6139	26.719	34.135	04100031	MK-100/Auto
X084	2005/08/16	20:39:45	20:45	10-08.99S	108-00.00E	1041	6626	26.367	34.164	04109988	MK-100/Auto
X085	2005/08/17	00:53:17	00:58	10-17.10S	109-00.00E	1035	6573	26.110	34.219	04100032	MK-100/Auto
X086	2005/08/17	05:19:33	05:25	10-15.13S	109-59.83E	1035	6928	26.707	34.157	04100034	MK-100/Auto
X087	2005/08/17	09:39:52	09:45	10-17.89S	111-00.00E	1036	4547	26.767	34.147	04100033	MK-100/Auto
X088	2005/08/17	13:56:06	14:01	10-20.03S	112-00.00E	1035	3898	26.501	34.176	04100036	MK-100/Auto
X089	2005/08/17	18:30:35	18:36	10-23.11S	113-00.00E	1035	1880	25.936	34.203	04100035	MK-100/Auto
X090	2005/08/17	22:56:30	23:02	10-25.82S	114-00.02E	1035	2796	26.309	34.098	05022100	MK-100/Auto
X091	2005/08/18	03:18:50	03:24	10-22.80S	114-59.00E	1035	2422	26.511	34.180	05022101	MK-100/Auto
X092	2005/08/18	07:35:04	07:40	10-14.76S	116-00.04E	1035	4375	26.508	34.092	05022102	MK-100/Auto

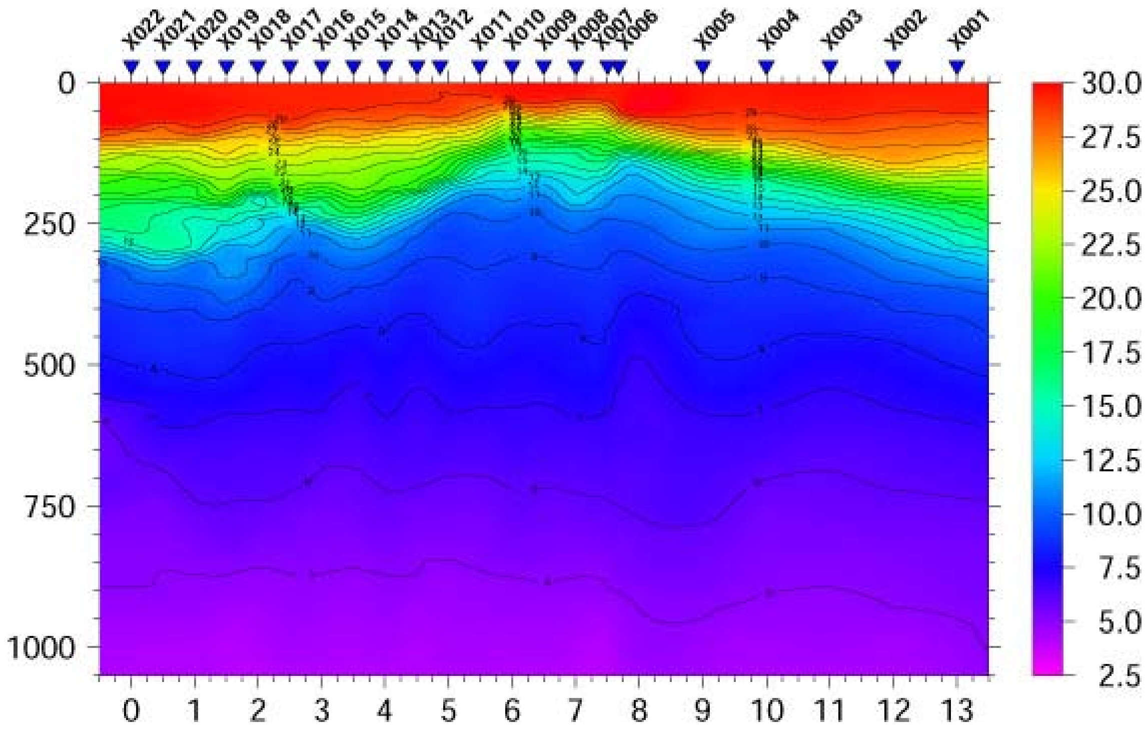

Fig. 6.2.2-1 Temperature along the ship track southward (13N to EQ)

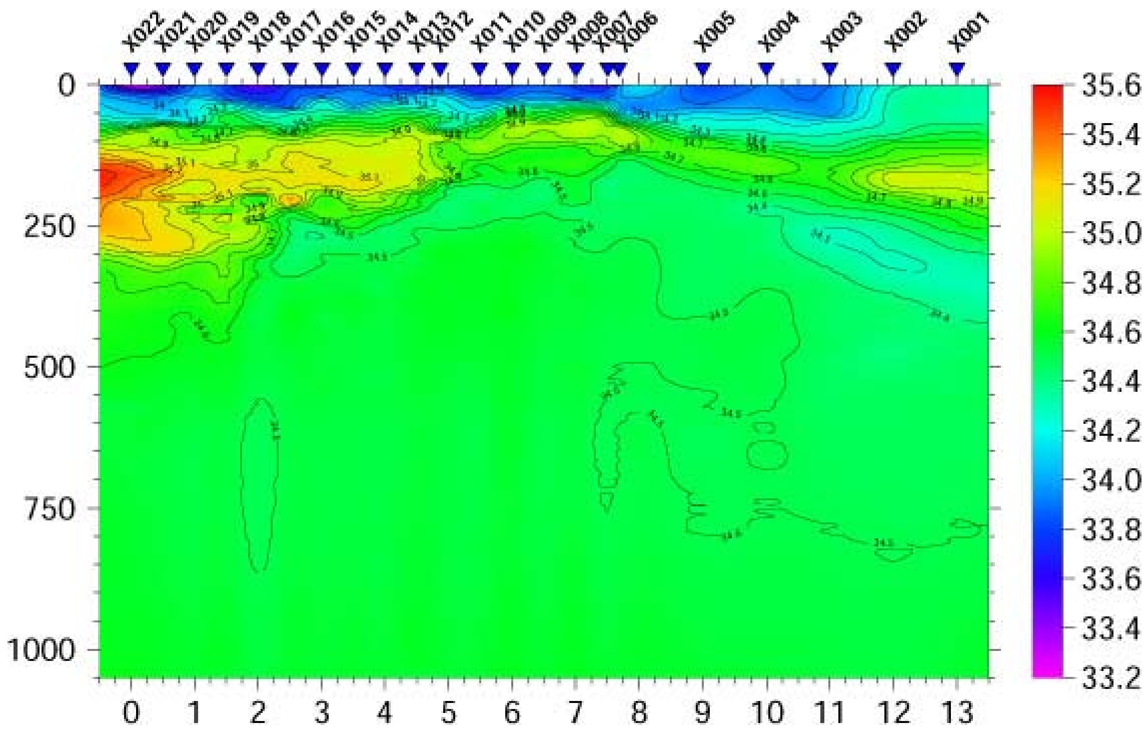

Fig. 6.2.2-2 Salinity along the ship track southward (13N to EQ)

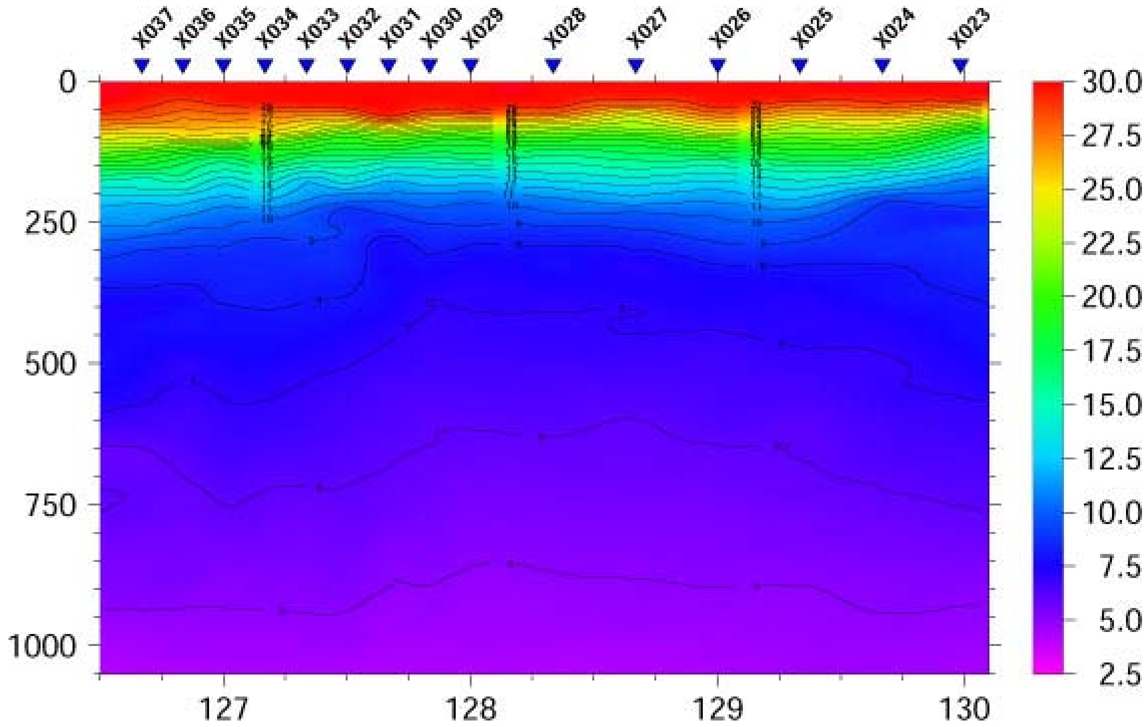

Fig. 6.2.2-3 Temperature along the ship track. (8N-130E to Mindanao Island off)

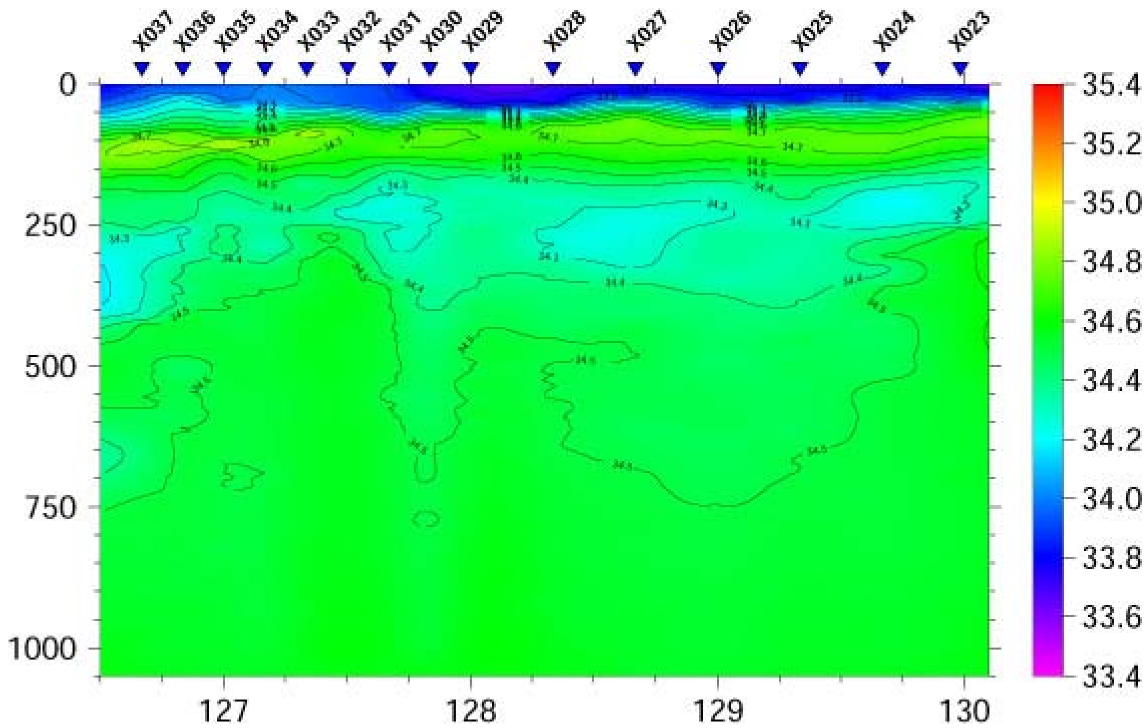

Fig. 6.2.2-4 Salinity along the ship track. (8N-130E to Mindanao Island off)

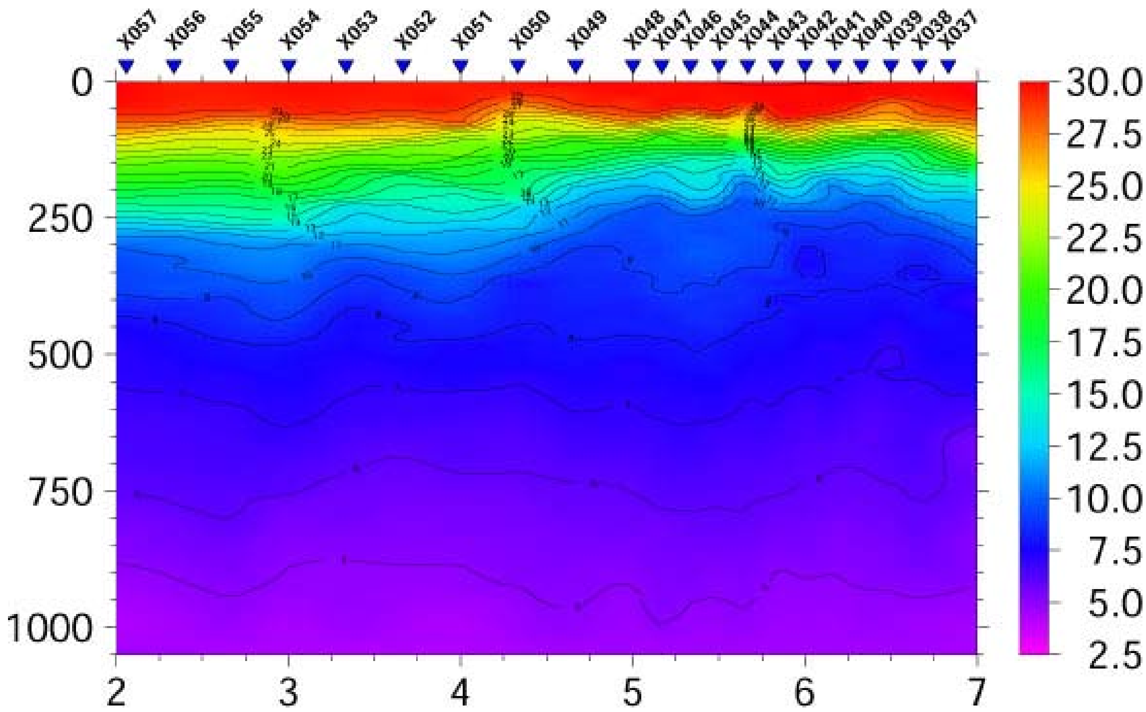

Fig. 6.2.2-5 Temperature along the ship track. (Mindanao Island off to 2N-130E)

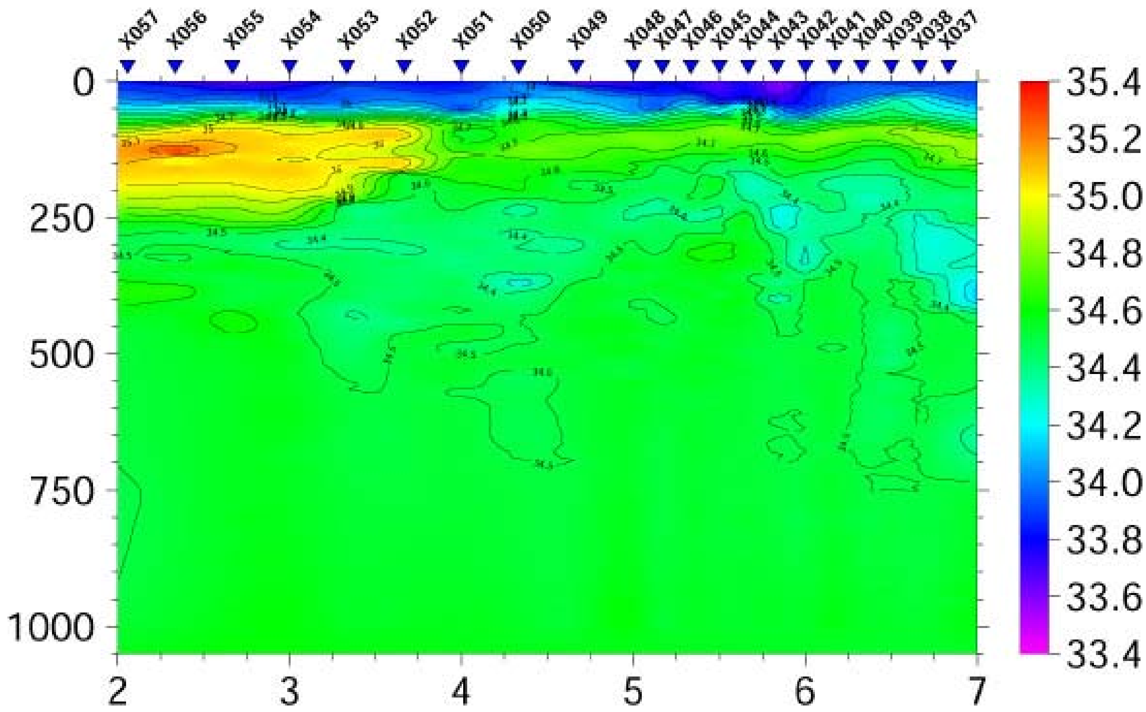

Fig. 6.2.2-6 Salinity along the ship track. (Mindanao Island off to 2N-130E)

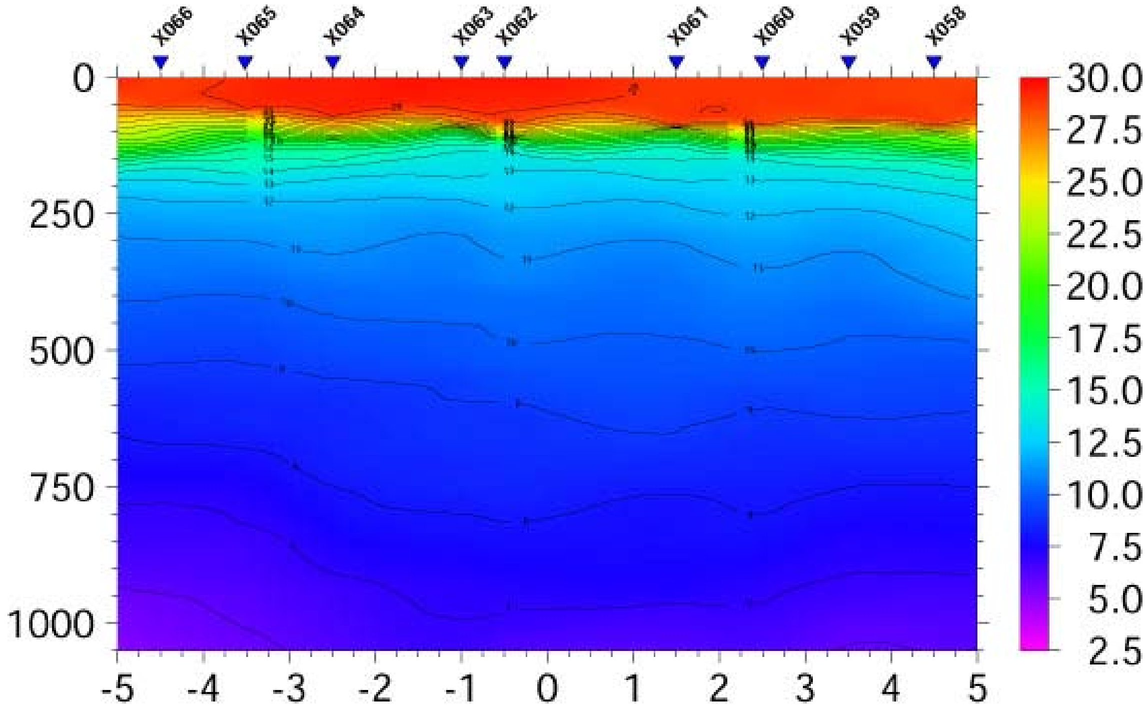

Fig. 6.2.2-7 Temperature along the ship track southward (5N to 5S at 90E)

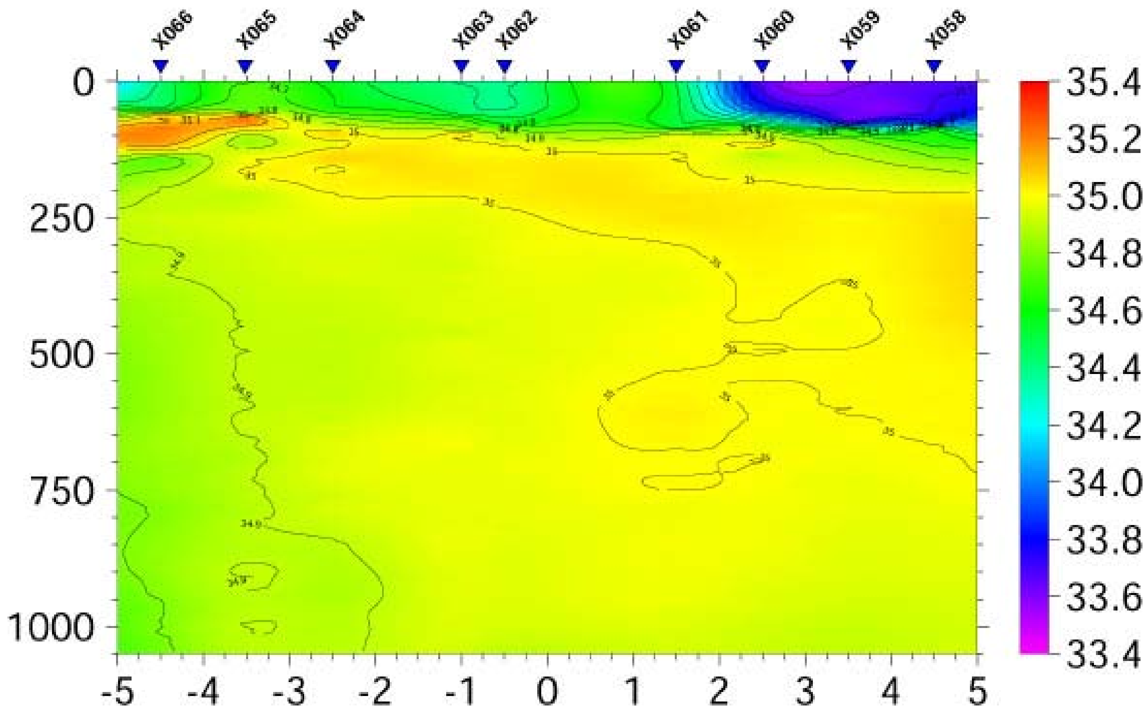

Fig. 6.2.2-8 Salinity along the ship track southward (5N to 5S at 90E)

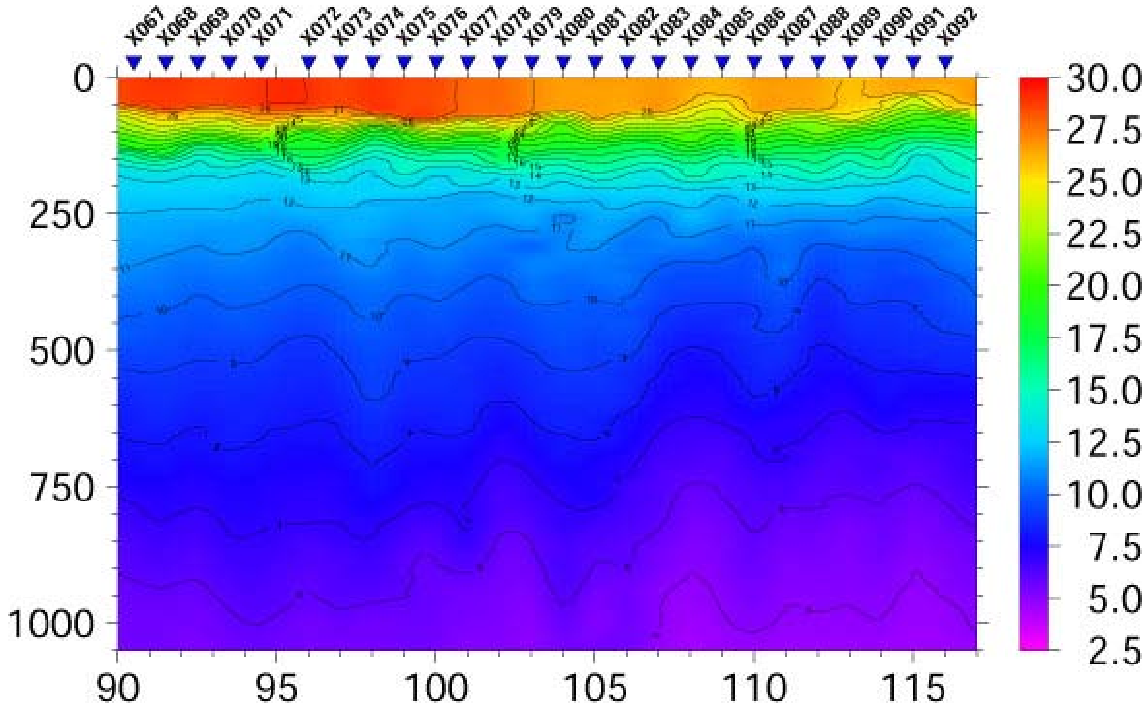

Fig. 6.2.2-9 Temperature along the ship track eastward (5S-90E to 10S-116E)

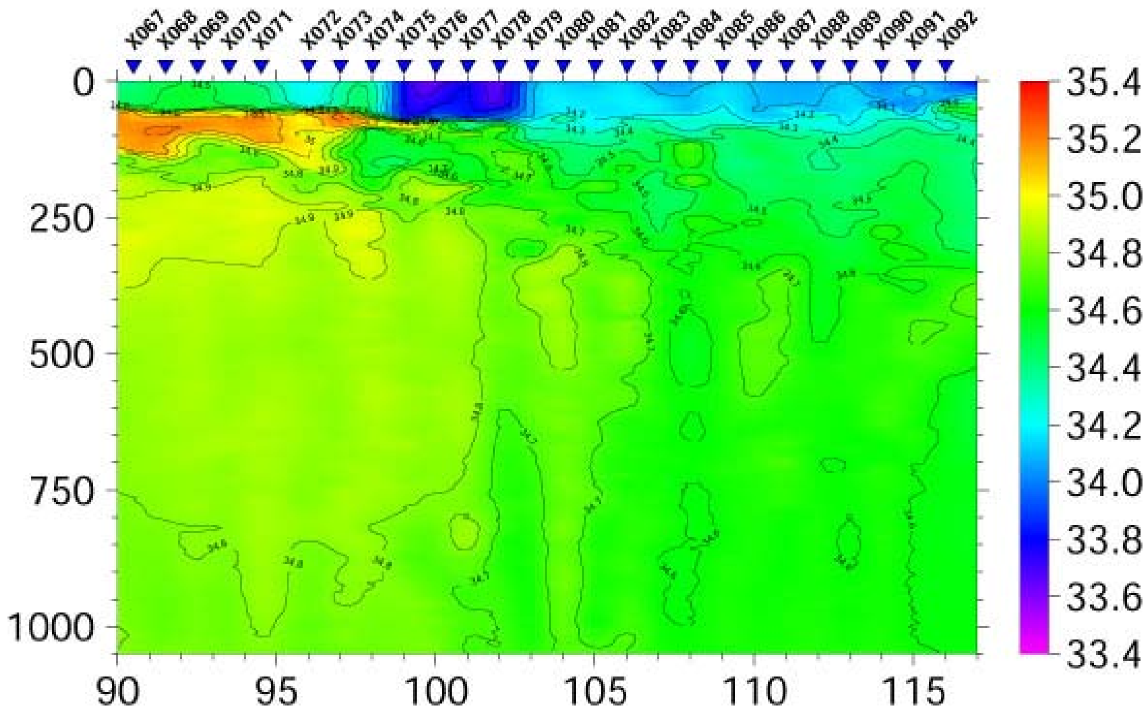

Fig. 6.2.2-10 Salinity along the ship track eastward (5S-90E to 10S-116E)

6.3 Validation of CTD cast data

6.3.1 Salinity measurement of sampled seawater

(1) Personnel

Akinori Murata (MWJ) : Operation Leader

(2) Objective

Bottle salinity was measured in order to compare with CTD salinity.

(3) Instrument and Method

Salinity analysis was carried out on R/V MIRAI during the cruise of MR05-03 using the Guildline AUTOSAL salinometer model 8400B (S/N 62827), with additional peristaltic-type intake pump, manufactured by Ocean Scientific International, Ltd. We also used two Guildline platinum thermometers model 9450. One thermometer monitored an air temperature and the other monitored a bath temperature.

The specifications of AUTOSAL salinometer and thermometer are shown as follows;

Salinometer (Model 8400B "AUTOSAL" ; Guildline Instruments Ltd.)

Measurement Range	:	0.005 to 42 (PSU)
Accuracy	:	Better than ±0.002 (PSU) over 24 hours without restandardization
Maximum Resolution	:	Better than ±0.0002 (PSU) at 35 (PSU)

Thermometer (Model 9540 ; Guildline Instruments Ltd.)

Measurement Range	:	-180 to +240 deg C
Resolution	:	0.001
Limits of error ±deg C	:	0.01 (24 hours @ 23 deg C ±1 deg C)
Repeatability	:	±2 least significant digits

The measurement system was almost same as Aoyama *et al.* (2002). The salinometer was operated in the air-conditioned ship's laboratory 'AUTOSAL ROOM' at a bath temperature of 24 deg C. An ambient temperature varied from approximately 21 deg C to 23 deg C, while a bath temperature is very stable and varied within +/- 0.002 deg C on rare occasion.

The measurement for each sample was done with a double conductivity ratio that is defined as median of 31 times reading of the salinometer. Data collection is started after 5 seconds from set FUNCTION switch to READ then it takes about 10 seconds to collect 31 readings by a personal computer. If the difference between the double conductivity ratio measured for each sample is smaller than 0.00002, the average value of these double conductivity ratio was used to calculate the bottle salinity with the algorithm for practical salinity scale, 1978 (UNESCO, 1981). If this condition isn't satisfied within 5 times in a series of measurement for each sample, we will consider the sample as the bad sample.

(3-1) Standardization

The salinometer was standardized at the beginning of the sequence of measurements using IAPSO standard seawater (SSW). Because of the good stability of the salinometer, standardize of the salinometer was performed only once, the Standardize Dial was adjusted at the time. 9 bottles of SSW were measured in total, and their standard deviation to the catalogue value was 0.0001 (PSU). The value is used for the calibration (linear compensation) of the measured salinity. We added 0.00004 - 0.00005 to the measured double conductivity ratio during station C01-C06, and 0.00002 - 0.00001 during station C07-C22.

The specifications of SSW used in this cruise are shown as follows;

Standard seawater (SSW)

batch : P145
conductivity ratio : 0.99981
salinity : 34.993
preparation date : 15-Jul.-2004

(3-2) Sub-Standard Seawater

We also used sub-standard seawater (SUB) that was sampled and filtered by Millipore filter (pore size of 0.45 m), which was stored in a 20 liters polyethylene container. It was measured every about 20 samples (C01-C06) and 10 samples (C07-C22) in order to check the drift of the salinometer. During the whole measurements, there was no detectable sudden drift of the salinometer.

The specifications of SUB used in this cruise are shown as follows;

Sub standard seawater (SUB)

sampling cruise ID : MR04-05
sampling depth : 2,000db
filtration date : 10-Sep.-2004

(3-3) Salinity Sample Collection

Seawater samples were collected with 12 liter Niskin-X (Non-coating) bottles and EPCS. The salinity sample bottle of the 250ml brown glass bottle was used to collect the sample water. The sample bottle was sealed with a plastic insert thimble and a screw cap. Each bottle was rinsed three times with the sample water, and was filled with sample water to the bottle shoulder. Its cap was also thoroughly rinsed. The bottle was stored more than 24 hours in ‘AUTOSAL ROOM’ before the salinity measurement.

The kind and number of samples are shown as follows;

Table 6.3.1-1 Kind and number of samples

Kind of Samples	Number of Samples
Samples for CTD	115
Samples for EPCS	43
Total	158

(4) Preliminary Results

Difference between bottle-sampling salinity and CTD salinity in 1000m were shown in Fig. 6.3.1-1 and Fig. 6.3.1-2. Refered to Fig. 6.3.1-1 and Fig. 6.3.1-2, We decided to use the CTD salinity data measured secondary sensor. Data of all samples were shown in Table 6.3.1-2. We estimated the precision of this method using 68 pairs of duplicate samples taken from the same pressure but different Niskin bottles, 27 pairs of replicate samples taken by the same Niskin bottle, and compared the salinity of all samples to check the salinity data of CTD. The average and standard deviation of duplicate samples and replicate samples were shown in Table 6.3.1-3, Table 6.3.1-4, respectively.

The average of difference between measurement data and CTD data were 0.0018 (PSU) and the standard deviation was 0.0008 (PSU), and those of duplicate samples were 0.0004 (PSU) and 0.0004 (PSU), and those of replicate samples were 0.0005 (PSU) and 0.0005 (PSU), respectively. The data of Sample bottle 110 was eliminated. Because Niskin bottle No.11 of station C21 was thought to be miss-tripped.

(5) Data Archive

All processed salinity data were submitted to Principal Investigator according to the data management policy of JAMSTEC.

(6) Reference

・Aoyama, M., T. Joyce, T. Kawano and Y. Takatsuki: Standard seawater comparison up to P129. *Deep-Sea Research*, I, Vol. 49, 1103～1114, 2002

・UNESCO: Tenth report of the Joint Panel on Oceanographic Tables and Standards. *UNESCO Technical Papers in Marine Science*, 36, 25 pp., 1981

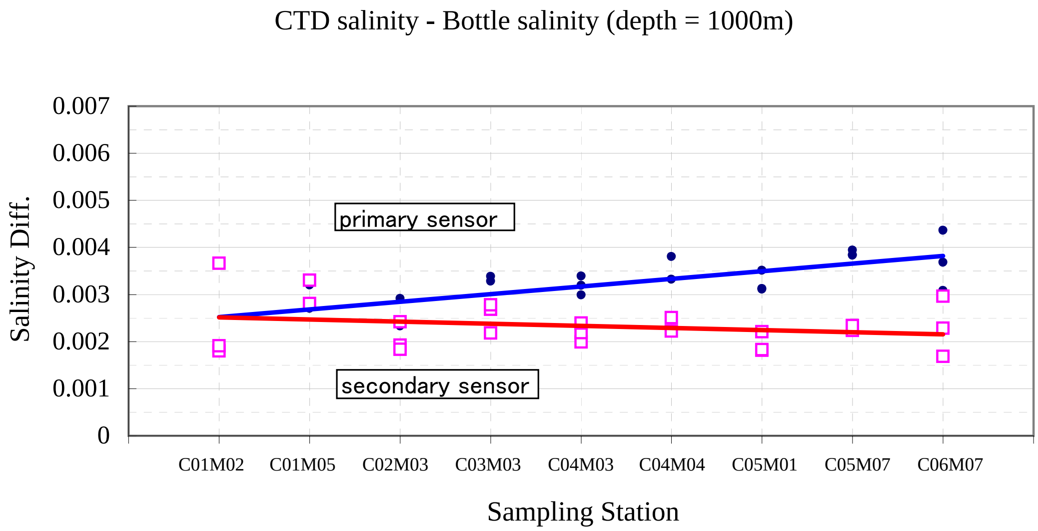

Fig. 6.3.1-1 Difference between bottle sampling salinity and CTD salinity. (C01-C06)

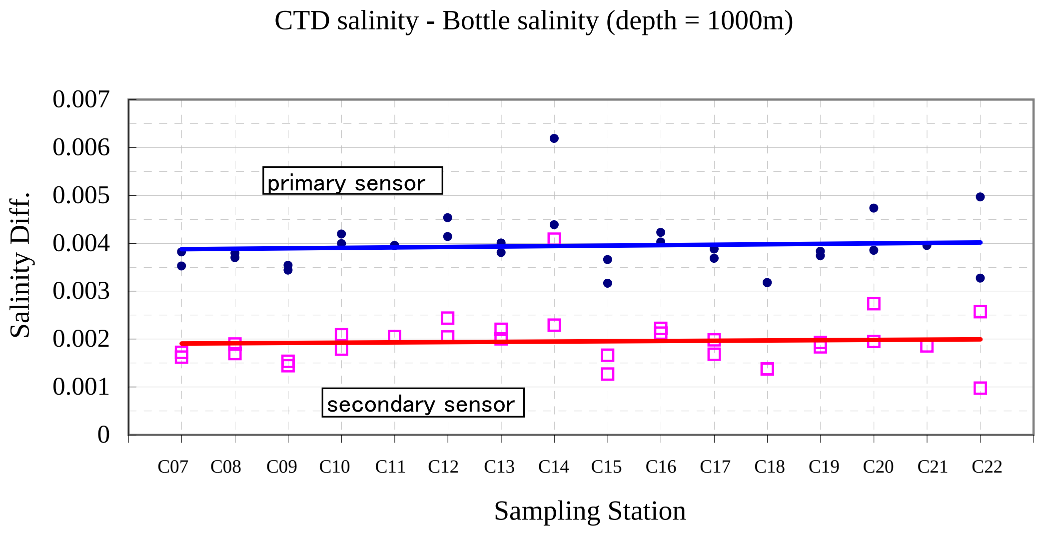

Fig. 6.3.1-2 Difference between bottle sampling salinity and CTD salinity. (C07-C22)

Table 6.3.1-2 Difference between bottle-sampling salinity and CTD salinity

Station	Cast	Sample Bottle	Salinity (PSS-78)	Niskin Bottle No.	CTD Pressure (db)	CTD salinity (PSS-78)	**Salinity Diff. CTD-Salinity**
C01	02	0001	34.5515	1	1006.5	34.5552	**0.0037**
	02	0002	34.5534	1	1006.5	34.5552	**0.0018**
	02	0003	34.5534	2	1006.1	34.5553	**0.0019**
	05	0004	-	1	1011.3	34.5557	**-**
	05	0005	34.5529	1	1011.3	34.5557	**0.0028**
	05	0006	34.5524	3	1012.2	34.5557	**0.0033**
C02	03	0007	34.5587	1	1009.8	34.5606	**0.0019**
	03	0008	34.5582	1	1009.8	34.5606	**0.0024**
	03	0009	34.5588	2	1010.7	34.5606	**0.0018**
C03	03	0010	34.5559	1	1008.4	34.5581	**0.0022**
	03	0011	34.5554	1	1008.4	34.5581	**0.0027**
	03	0012	34.5553	2	1008.8	34.5581	**0.0028**
C04	03	0013	34.5555	1	1010.9	34.5575	**0.0020**
	03	0014	34.5553	1	1010.9	34.5575	**0.0022**
	03	0015	34.5552	2	1011.4	34.5576	**0.0024**
	04	0016	34.5557	1	1011.3	34.5582	**0.0025**
	04	0017	-	1	1011.3	34.5582	**-**
	04	0018	34.5561	2	1011.6	34.5583	**0.0022**
C05	01	0019	34.5445	1	1009.9	34.5463	**0.0018**
	01	0020	34.5441	1	1009.9	34.5463	**0.0022**
	01	0021	34.5446	2	1010.2	34.5464	**0.0018**
	07	0022	34.5393	1	1009.6	34.5415	**0.0022**
	07	0023	34.5392	1	1009.6	34.5415	**0.0023**
	07	0024	34.5390	2	1009.7	34.5413	**0.0023**
C06	07	0025	34.6405	1	2021.2	34.6434	**0.0029**
	07	0026	34.6390	1	2021.2	34.6434	**0.0044**
	07	0027	34.6410	2	2021.4	34.6434	**0.0024**
	07	0028	34.6136	14	1513.7	34.6166	**0.0030**
	07	0029	34.6123	14	1513.7	34.6166	**0.0043**
	07	0030	34.6136	15	1513.8	34.6165	**0.0029**
	07	0031	34.5562	23	1008.2	34.5579	**0.0017**
	07	0032	34.5549	23	1008.2	34.5579	**0.0030**
	07	0033	34.5555	24	1008.2	34.5578	**0.0023**
C07	01	0034	34.7760	1	2021.5	34.7766	**0.0006**
	01	0035	34.7750	1	2021.5	34.7766	**0.0016**
	01	0036	34.7745	2	2022.1	34.7765	**0.0020**
	01	0037	34.9227	10	1008.8	34.9244	**0.0017**
	01	0038	34.9225	11	1007.7	34.9241	**0.0016**
C08	01	0039	34.7781	1	2021.3	34.7792	**0.0011**
	01	0040	34.7784	1	2021.3	34.7792	**0.0008**
	01	0041	34.7784	2	2021.0	34.7794	**0.0010**
	01	0042	34.9214	10	1008.3	34.9233	**0.0019**
	01	0043	34.9216	11	1009.2	34.9233	**0.0017**
C09	01	0044	34.7772	1	2022.6	34.7777	**0.0005**
	01	0045	34.7765	1	2022.6	34.7777	**0.0012**
	01	0046	34.7769	2	2022.3	34.7780	**0.0011**
	01	0047	34.9188	10	1009.1	34.9202	**0.0014**
	01	0048	34.9187	11	1008.9	34.9202	**0.0015**
C10	01	0049	34.7764	1	2020.4	34.7774	**0.0010**
	01	0050	34.7762	1	2020.4	34.7774	**0.0012**
	01	0051	34.7762	2	2021.1	34.7773	**0.0011**
	01	0052	34.9404	10	1009.1	34.9425	**0.0021**
	01	0053	34.9406	11	1009.3	34.9424	**0.0018**
C11	01	0054	34.7723	1	2023.5	34.7734	**0.0011**
	01	0055	34.7723	1	2023.5	34.7734	**0.0011**
	01	0056	34.7720	2	2023.9	34.7733	**0.0013**
	01	0057	34.9325	10	1009.2	34.9346	**0.0021**
	01	0058	34.9327	11	1010.2	34.9347	**0.0020**
C12	01	0059	34.7756	1	2020.8	34.7763	**0.0007**

	01	0060	34.7750	1	2020.8	34.7763	**0.0013**
	01	0061	34.7760	2	2021.0	34.7764	**0.0004**
	01	0062	34.9505	10	1008.0	34.9529	**0.0024**
	01	0063	34.9509	11	1008.1	34.9529	**0.0020**
C13	01	0064	34.7748	1	2021.8	34.7763	**0.0015**
	01	0065	34.7747	1	2021.8	34.7763	**0.0016**
	01	0066	34.7749	3	2021.4	34.7764	**0.0015**
	01	0067	34.9489	10	1007.5	34.9509	**0.0020**
	01	0068	34.9493	11	1007.6	34.9515	**0.0022**
C14	01	0069	34.7732	1	2021.6	34.7742	**0.0010**
	01	0070	34.7729	1	2021.6	34.7742	**0.0013**
	01	0071	34.7727	2	2021.5	34.7744	**0.0017**
	01	0072	34.9004	10	1009.4	34.9045	**0.0041**
	01	0073	34.9006	11	1008.4	34.9029	**0.0023**
C15	01	0074	34.7682	1	2021.9	34.7692	**0.0010**
	01	0075	34.7676	1	2021.9	34.7692	**0.0016**
	01	0076	34.7683	2	2021.3	34.7693	**0.0010**
	01	0077	34.8084	10	1515.3	34.8105	**0.0021**
	01	0078	34.8086	11	1515.0	34.8105	**0.0019**
	01	0079	34.8820	13	1007.8	34.8833	**0.0013**
	01	0080	34.8817	14	1008.5	34.8834	**0.0017**
C16	01	0081	34.7639	1	2020.6	34.7647	**0.0008**
	01	0082	34.7638	1	2020.6	34.7647	**0.0009**
	01	0083	34.7633	2	2020.6	34.7647	**0.0014**
	01	0084	34.8095	10	1011.5	34.8117	**0.0022**
	01	0085	34.8095	11	1010.6	34.8116	**0.0021**
C17	01	0086	34.7622	1	2022.0	34.7629	**0.0007**
	01	0087	34.7618	1	2022.0	34.7629	**0.0011**
	01	0088	34.7620	2	2021.7	34.7630	**0.0010**
	01	0089	34.7840	10	1007.5	34.7860	**0.0020**
	01	0090	34.7842	11	1008.3	34.7859	**0.0017**
C18	01	0091	34.7632	1	2022.3	34.7640	**0.0008**
	01	0092	34.7630	1	2022.3	34.7640	**0.0010**
	01	0093	34.7627	2	2022.4	34.7641	**0.0014**
	01	0094	34.7729	10	1007.5	34.7743	**0.0014**
	01	0095	34.7731	11	1008.6	34.7745	**0.0014**
C19	01	0096	34.7583	1	2021.2	34.7603	**0.0020**
	01	0097	34.7585	1	2021.2	34.7603	**0.0018**
	01	0098	34.7588	2	2021.4	34.7604	**0.0016**
	01	0099	34.7652	10	1008.8	34.7670	**0.0018**
	01	0100	34.7651	11	1009.1	34.7670	**0.0019**
C20	01	0101	34.7602	1	2021.6	34.7613	**0.0011**
	01	0102	34.7597	1	2021.6	34.7613	**0.0016**
	01	0103	34.7602	2	2022.2	34.7613	**0.0011**
	01	0104	34.7897	10	1008.4	34.7916	**0.0019**
	01	0105	34.7889	11	1008.1	34.7916	**0.0027**
C21	01	0106	34.7600	1	2021.9	34.7617	**0.0017**
	01	0107	34.7598	1	2021.9	34.7617	**0.0019**
	01	0108	34.7607	2	2021.9	34.7618	**0.0011**
	01	0109	34.7962	10	1007.6	34.7981	**0.0019**
	01	0110	34.8714	11	1006.2	34.7977	**-**
C22	01	0111	34.7581	1	2021.6	34.7589	**0.0008**
	01	0112	34.7583	1	2021.6	34.7589	**0.0006**
	01	0113	34.7581	2	2021.7	34.7589	**0.0008**
	01	0114	34.8213	10	1008.4	34.8223	**0.0010**
	01	0115	34.8211	11	1008.5	34.8237	**0.0026**

Bad Sample		**Average**	**0.0018**
miss-tripped		**Stdev**	**0.0008**

Table 6.3.1-3 Difference of duplicate samples

Station	Cast	Niskin Bottle	CTD Pressure (db)	CTD Salinity (PSS-78)	Sample Bottle	Salinity (PSS-78)	Salinity Diff. CTD-Salinity	Niskin Bottle	CTD Pressure (db)	CTD Salinity (PSS-78)	Sample Bottle	Salinity1 (PSS-78)	Salinity Diff. CTD-Salinity	**Duplicate DIFF. SAL-SAL1**
C01	2	1	1006.5	34.5552	0001	34.5515	0.0037	2	1006.1	34.5553	0003	34.5534	0.0019	**0.0018**
	2	1	1006.5	34.5552	0002	34.5534	0.0018	2	1006.1	34.5553	0003	34.5534	0.0019	**0.0001**
	5	1	1011.3	34.5556	0004	-	-	2	1012.2	34.5556	0006	34.5524	0.0032	-
	5	1	1011.3	34.5556	0005	34.5529	0.0027	2	1012.2	34.5556	0006	34.5524	0.0032	**0.0005**
C02	3	1	1009.8	34.5611	0007	34.5587	0.0024	2	1010.7	34.5611	0009	34.5588	0.0023	**0.0001**
	3	1	1009.8	34.5611	0008	34.5582	0.0029	2	1010.7	34.5611	0009	34.5588	0.0023	**0.0006**
C03	3	1	1008.4	34.5585	0010	34.5559	0.0026	2	1011.4	34.5586	0012	34.5553	0.0033	**0.0007**
	3	1	1008.4	34.5595	0011	34.5554	0.0041	2	1011.6	34.5594	0012	34.5553	0.0041	**0.0000**
C04	3	1	1010.9	34.5585	0013	34.5555	0.0030	2	1011.4	34.5586	0015	34.5552	0.0034	**0.0004**
	3	1	1010.9	34.5585	0014	34.5553	0.0032	2	1011.4	34.5586	0015	34.5552	0.0034	**0.0002**
	4	1	1011.3	34.5595	0016	34.5557	0.0038	2	1011.6	34.5594	0018	34.5561	0.0033	**0.0005**
	4	1	1011.3	34.5595	0017	-	-	2	1011.6	34.5594	0018	34.5561	0.0033	-
C05	1	1	1009.9	34.5476	0019	34.5445	0.0031	2	1010.2	34.5477	0021	34.5446	0.0031	**0.0000**
	1	1	1009.9	34.5476	0020	34.5441	0.0035	2	1010.2	34.5477	0021	34.5446	0.0031	**0.0004**
	7	1	1009.6	34.5431	0022	34.5393	0.0038	2	1009.7	34.5428	0024	34.5390	0.0038	**0.0000**
	7	1	1009.6	34.5431	0023	34.5392	0.0039	2	1009.7	34.5428	0024	34.5390	0.0038	**0.0001**
C06	7	1	2021.2	34.6445	0025	34.6405	0.0040	2	2021.4	34.6446	0027	34.6410	0.0036	**0.0004**
	7	1	2021.2	34.6445	0026	34.6390	0.0055	2	2021.4	34.6446	0027	34.6410	0.0036	**0.0019**
	7	14	1513.7	34.6178	0028	34.6136	0.0042	15	1513.8	34.6178	0030	34.6136	0.0042	**0.0000**
	7	14	1513.7	34.6178	0029	34.6123	0.0055	15	1513.8	34.6178	0030	34.6136	0.0042	**0.0013**
	7	23	1008.2	34.5593	0031	34.5562	0.0031	24	1008.2	34.5592	0033	34.5555	0.0037	**0.0006**
	7	23	1008.2	34.5593	0032	34.5549	0.0044	24	1008.2	34.5592	0033	34.5555	0.0037	**0.0007**
C07	1	1	2021.5	34.7766	0034	34.7760	0.0006	2	2022.1	34.7765	0036	34.7745	0.0020	**0.0014**
	1	1	2021.5	34.7766	0035	34.7750	0.0016	2	2022.1	34.7765	0036	34.7745	0.0020	**0.0004**
	1	10	1008.8	34.9244	0037	34.9227	0.0017	11	1007.7	34.9241	0038	34.9225	0.0016	**0.0001**
C08	1	1	2021.3	34.7792	0039	34.7781	0.0011	2	2021.0	34.7794	0041	34.7784	0.0010	**0.0001**
	1	1	2021.3	34.7792	0040	34.7784	0.0008	2	2021.0	34.7794	0041	34.7784	0.0010	**0.0002**
	1	10	1008.3	34.9233	0042	34.9214	0.0019	11	1009.2	34.9233	0043	34.9216	0.0017	**0.0002**
C09	1	1	2022.6	34.7777	0044	34.7772	0.0005	2	2022.3	34.7780	0046	34.7765	0.0015	**0.0010**
	1	1	2022.6	34.7777	0045	34.7765	0.0012	2	2022.3	34.7780	0046	34.7765	0.0015	**0.0003**
	1	10	1009.1	34.9202	0047	34.9188	0.0014	11	1008.9	34.9202	0048	34.9187	0.0015	**0.0001**
C10	1	1	2020.4	34.7774	0049	34.7764	0.0010	2	2021.1	34.7773	0051	34.7762	0.0011	**0.0001**
	1	1	2020.4	34.7774	0050	34.7762	0.0012	2	2021.1	34.7773	0051	34.7762	0.0011	**0.0001**
	1	10	1009.1	34.9425	0052	34.9404	0.0021	11	1009.3	34.9424	0053	34.9406	0.0018	**0.0003**
C11	1	1	2023.5	34.7734	0054	34.7723	0.0011	2	2023.9	34.7733	0056	34.7723	0.0010	**0.0001**
	1	1	2023.5	34.7734	0055	34.7723	0.0011	2	2023.9	34.7733	0056	34.7723	0.0010	**0.0001**
	1	10	1009.2	34.9346	0057	34.9325	0.0021	11	1010.2	34.9347	0058	34.9327	0.0020	**0.0000**
C12	1	1	2020.8	34.7763	0059	34.7756	0.0007	2	2021.0	34.7764	0061	34.7750	0.0014	**0.0007**
	1	1	2020.8	34.7763	0060	34.7750	0.0013	2	2021.0	34.7764	0061	34.7750	0.0014	**0.0001**

	1	10	1008.0	34.9529	0062	34.9505	0.0024	11	1008.1	34.9529	0063	34.9509	0.0020	**0.0004**
C13	1	1	2021.8	34.7763	0064	34.7748	0.0015	3	2021.4	34.7764	0066	34.7747	0.0017	**0.0002**
	1	1	2021.8	34.7763	0065	34.7747	0.0016	3	2021.4	34.7764	0066	34.7747	0.0017	**0.0001**
	1	10	1007.5	34.9509	0067	34.9489	0.0020	11	1007.6	34.9515	0068	34.9493	0.0022	**0.0002**
C14	1	1	2021.6	34.7742	0069	34.7732	0.0010	2	2021.5	34.7744	0071	34.7727	0.0017	**0.0007**
	1	1	2021.6	34.7742	0070	34.7729	0.0013	2	2021.5	34.7744	0071	34.7727	0.0017	**0.0004**
	1	10	1009.4	34.9045	0072	34.9004	0.0041	11	1008.4	34.9029	0073	34.9006	0.0023	**0.0018**
C15	1	1	2021.9	34.7692	0074	34.7682	0.0010	2	2021.3	34.7693	0076	34.7683	0.0010	**0.0000**
	1	1	2021.9	34.7692	0075	34.7676	0.0016	2	2021.3	34.7693	0076	34.7683	0.0010	**0.0006**
	1	10	1515.3	34.8105	0077	34.8084	0.0021	11	1515.0	34.8105	0078	34.8086	0.0019	**0.0002**
	1	14	1007.8	34.8833	0079	34.8820	0.0013	15	1008.5	34.8834	0080	34.8817	0.0017	**0.0004**
C16	1	1	2020.6	34.7647	0081	34.7639	0.0008	2	2020.6	34.7647	0083	34.7633	0.0014	**0.0006**
	1	1	2020.6	34.7647	0082	34.7638	0.0009	2	2020.6	34.7647	0083	34.7633	0.0014	**0.0005**
	1	10	1011.5	34.8117	0084	34.8095	0.0022	11	1010.6	34.8116	0085	34.8095	0.0021	**0.0001**
C17	1	1	2022.0	34.7629	0086	34.7622	0.0007	2	2021.7	34.7630	0088	34.7620	0.0010	**0.0003**
	1	1	2022.0	34.7629	0087	34.7618	0.0011	2	2021.7	34.7630	0088	34.7620	0.0010	**0.0001**
	1	10	1007.5	34.7860	0089	34.7840	0.0020	11	1008.3	34.7859	0090	34.7842	0.0017	**0.0003**
C18	1	1	2022.3	34.7640	0091	34.7632	0.0008	2	2022.4	34.7641	0093	34.7627	0.0014	**0.0006**
	1	1	2022.3	34.7640	0092	34.7630	0.0010	2	2022.4	34.7641	0093	34.7627	0.0014	**0.0004**
	1	10	1007.5	34.7743	0094	34.7729	0.0014	11	1008.6	34.7745	0095	34.7731	0.0014	**0.0000**
C19	1	1	2021.2	34.7603	0096	34.7583	0.0020	2	2021.4	34.7604	0098	34.7585	0.0019	**0.0001**
	1	1	2021.2	34.7603	0097	34.7585	0.0018	2	2021.4	34.7604	0098	34.7585	0.0019	**0.0001**
	1	10	1008.8	34.7670	0099	34.7652	0.0018	11	1009.1	34.7670	0100	34.7651	0.0019	**0.0001**
C20	1	1	2021.6	34.7613	0101	34.7602	0.0011	2	2022.2	34.7613	0103	34.7602	0.0011	**0.0000**
	1	1	2021.6	34.7613	0102	34.7597	0.0016	2	2022.2	34.7613	0103	34.7602	0.0011	**0.0005**
	1	10	1008.4	34.7916	0104	34.7897	0.0019	11	1008.1	34.7916	0105	34.7889	0.0027	**0.0008**
C21	1	1	2021.9	34.7617	0106	34.7600	0.0017	2	2021.9	34.7618	0108	34.7607	0.0011	**0.0006**
	1	1	2021.9	34.7617	0107	34.7598	0.0019	2	2021.9	34.7618	0108	34.7607	0.0011	**0.0008**
	1	10	1007.6	34.7981	0109	34.7962	0.0019	11	1006.2	34.7618	0110	34.8714	-0.1096	-
C22	1	1	2021.6	34.7589	0111	34.7581	0.0008	2	2021.7	34.7589	0113	34.7581	0.0008	**0.0000**
	1	1	2021.6	34.7589	0112	34.7583	0.0006	2	2021.7	34.7589	0113	34.7581	0.0008	**0.0002**
	1	10	1008.4	34.8223	0114	34.8213	0.0010	11	1008.5	34.8237	0115	34.8211	0.0026	**0.0016**

Bad Sample		**Average**	**0.0004**
miss-tripped		**Stdev.**	**0.0004**

Table 6.3.1-4 Difference of replicate samples

Station	Cast	Niskin Bottle	CTDPressure (db)	Sample Bottle	Salinity (PSS-78)	Sample Bottle	Salinity1 (PSS-78)	**Replicate Diff.** Sal-Sal1
C01	2	1	1006.5	0001	34.5515	0002	34.5534	0.0019
	5	1	1011.3	0004	-	0005	34.5529	–
C02	3	1	1009.8	0007	34.5587	0008	34.5582	0.0005
C03	3	1	1008.4	0010	34.5559	0011	34.5554	0.0005
C04	3	1	1010.9	0013	34.5555	0014	34.5553	0.0002
	4	1	1011.3	0016	34.5557	0017	–	–
C05	1	1	1009.9	0019	34.5445	0020	34.5441	0.0004
	7	1	1009.6	0022	34.5393	0023	34.5392	0.0001
C06	7	1	2021.2	0025	34.6405	0026	34.6390	0.0015
	7	14	1513.7	0028	34.6136	0029	34.6123	0.0013
	7	23	1008.2	0031	34.5562	0032	34.5549	0.0013
C07	1	1	2021.5	0034	34.7760	0035	34.7750	0.0010
C08	1	1	2021.3	0039	34.7781	0040	34.7784	0.0003
C09	1	1	2022.6	0044	34.7772	0045	34.7765	0.0007
C10	1	1	2020.4	0049	34.7764	0050	34.7762	0.0002
C11	1	1	2023.5	0054	34.7723	0055	34.7723	0.0000
C12	1	1	2020.8	0059	34.7756	0060	34.7750	0.0006
C13	1	1	2021.8	0064	34.7748	0065	34.7747	0.0001
C14	1	1	2021.6	0069	34.7732	0070	34.7729	0.0003
C15	1	1	2021.9	0074	34.7682	0075	34.7676	0.0006
C16	1	1	2020.6	0081	34.7639	0082	34.7638	0.0001
C17	1	1	2022.0	0086	34.7622	0087	34.7618	0.0004
C18	1	1	2022.3	0091	34.7632	0092	34.7630	0.0002
C19	1	1	2021.2	0096	34.7583	0097	34.7585	0.0002
C20	1	1	2021.6	0101	34.7602	0102	34.7597	0.0005
C21	1	1	2021.9	0106	34.7600	0107	34.7598	0.0002
C22	1	1	2021.6	0111	34.7581	0112	34.7583	0.0002

Bad Sample

Average	0.0005
Stdev.	0.0005

6.4 Continuous monitoring of surface seawater

6.4.1 EPCS

(1) Personnel

Leg1

Kentaro ANDOU(JAMSTEC)

Masanori ENOKI (Marine Works Japan Co. Ltd.)

Leg2

Hideki HASE(JAMSTEC)

Masaki MORO (Marine Works Japan Co. Ltd.)

(2) Objective

To measure temperature, salinity, dissolved and fluorescence of near-sea surface water.

(3) Methods

The *Continuous Sea Surface Water Monitoring System* (Nippon Kaiyo Co. Ltd.) has six kind of sensors and can automatically measure salinity, temperature, dissolved oxygen, fluorescence and particle size of plankton in near-sea surface water continuously, every 1-minute. This system is located in the "*sea surface monitoring laboratory*" on R/V MIRAI. This system is connected to shipboard LAN-system. Measured data is stored in a hard disk of PC every 1-minute together with time and position of ship, and displayed in the data management PC machine.

Near-surface water was continuously pumped up to the laboratory and flowed into the *Continuous Sea Surface Water Monitoring System* through a vinyl-chloride pipe. The flow rate for the system is controlled by several valves and was 12L/min except with fluorometer (about 0.3L/min). The flow rate is measured with two flow meters.

Specifications of each sensor in this system are listed below.

a) Temperature and Salinity sensor

SEACAT THERMOSALINOGRAPH

Model:	SBE-21, SEA-BIRD ELECTRONICS, INC.	
Serial number:	2118859-2641	
Measurement range:	Temperature -5 to +35℃,	Salinity0 to 6.5 S m-1
Accuracy:	Temperature 0.01 ℃ 6month-1,	Salinity0.001 S m-1 month-1
Resolution:	Temperatures 0.001℃,	Salinity0.0001 S m-1

b) Bottom of ship thermometer

Model:	SBE 3S, SEA-BIRD ELECTRONICS, INC.
Serial number:	032175
Measurement range:	-5 to +35℃
Resolution:	±0.001℃

Stability: 0.002 ℃ year-1

c) Dissolved oxygen sensor

Model: 2127A, Huch Ultra Analytics Japan INC.
Serial number: 47477
Measurement range: 0 to 14 ppm
Accuracy: ±1% at 5 ℃ of correction range
Stability: 1% month-1

d) Fluorometer

Model: 10-AU-005, TURNER DESIGNS
Serial number: 5562 FRXX
Detection limit: 5 ppt or less for chlorophyl a
Stability: 0.5% month-1 of full scale

e) Particle Size sensor

Model: P-05, Nippon Kaiyo LTD.
Serial number: P5024
Measurement range: 0.02681 mmt to 6.666 mm
Accuracy: ±10% of range
Reproducibility: ±5%
Stability: 5% week-1

f) Flow meter

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

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

Leg.1: 04-july.-'05 09:00 to 25-July.-'05 06:01
Leg.2:

We stopped measurement in 22-july.-'05 09:00 to 24-July.-'05 22:59

(4) Preliminary Results

Figure6.4.1-1 shows the contour line of the temperature, salinity and fluorescence for Leg.1, respectively. Figure 6.4.1-2 shows the contour line of the temperature and the salinity for Leg. 2.

(5) Date archive

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

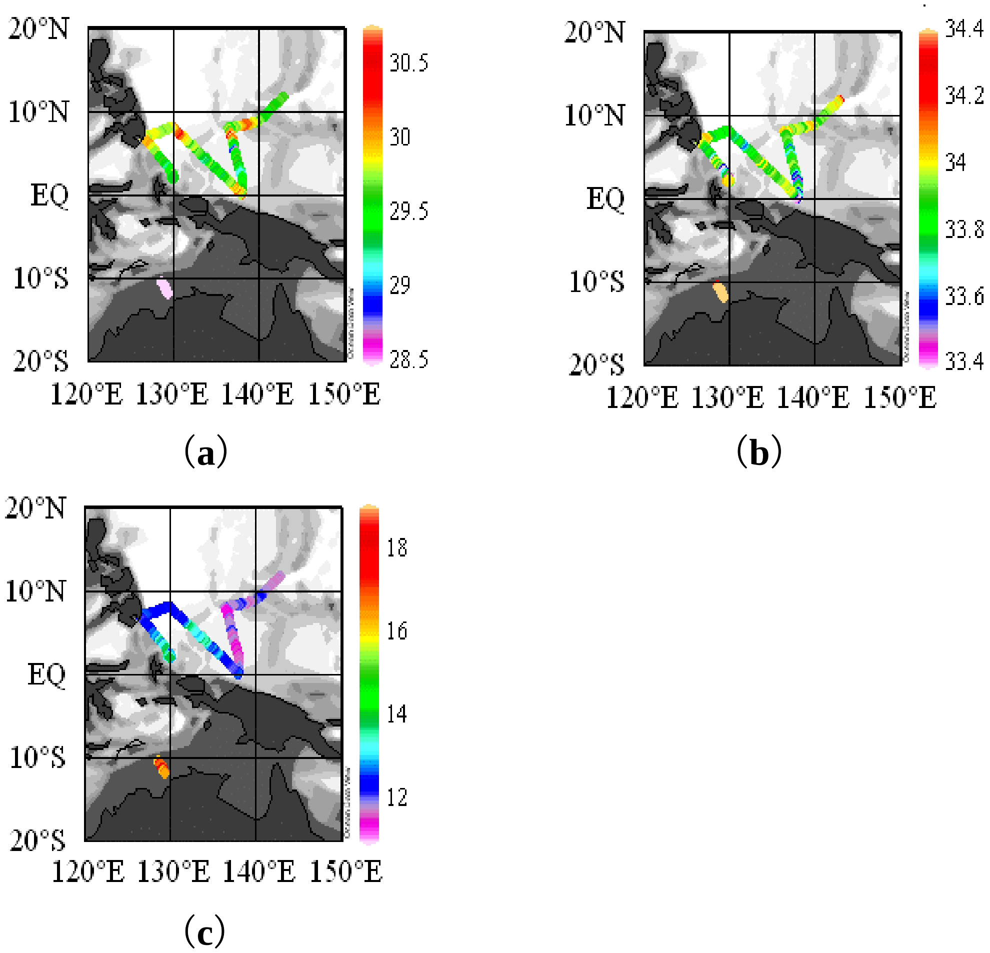

Fig. 6.4.1-1 Contour line of temperature(a), salinity(b), and fluorescence(c) in sea surface water(Leg1).

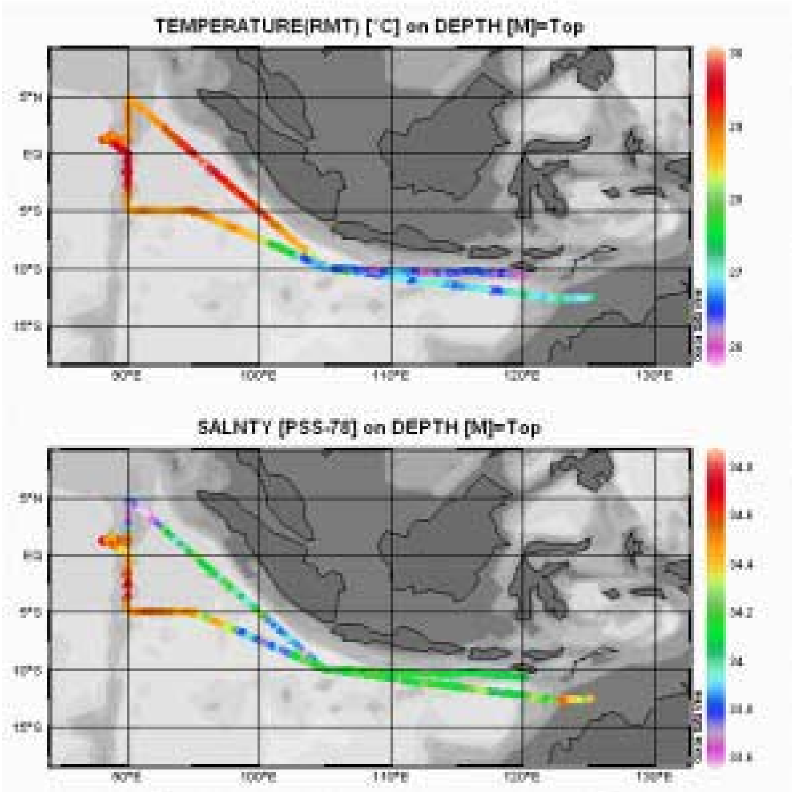

Fig. 6.4.1-2　Contour line of temperature and salinity in sea surface water (Leg2).

6.4.2 Partial Pressure of CO_2 (pCO_2) Measurement

(1) Personnel

Masaki MORO (MWJ)

(2) Objective

Since the global warming is becoming an issue world-widely, studies on the green house gas such as CO_2 are drawing high attention. Because the ocean plays an important roll in buffering the increase of atmospheric CO_2, studies on the exchange of CO_2 between the atmosphere and the sea becomes highly important. When CO_2 dissolves in water, chemical reaction takes place and CO_2 alters its appearance into several species. Unfortunately, the concentrations of the individual species of CO_2 system in solution cannot be measured directly. There are, however, four parameters that could be measured; alkalinity, total dissolved inorganic carbon (TDIC), pH and pCO_2. When more than two of the four parameters are measured, the concentration of CO_2 system in the water could be estimated (DOE, 1994). We here report on board measurements of pCO_2 in the Indian Ocean that was analyzed during MR05-03Leg2 cruise.

(3) Measured Parameters

Partial pressure of CO_2 in the atmosphere and surface seawater

(4) Apparatus and performance

Concentrations of CO_2 in the atmosphere and the sea surface were measured continuously during the cruise using an automated system with a non-dispersive infrared (NDIR) analyzer (BINOS^{TM}). One cycle for the automated system ran for one and a half hour. In one cycle, standard gasses, marine air and air in a headspace of an equilibrator were analyzed subsequently. The concentrations of the standard gases were 201.3, 289.9, 340, 392 and 442 ppm.

The marine air taken from the bow was introduced into the NDIR by passing through a mass flow controller, which controlled the air flow rate at about 0.5 L/min, a cooling unit, a Perma-pure dryer (GL Sciences Inc.) and a desiccant holder containing $Mg(ClO_4)_2$.

A fixed volume of the marine air taken from the bow was equilibrated with a stream of seawater that flowed at a rate of 5-6L/min in the equilibrator. The air in the equilibrator was circulated with a pump at 0.7-0.8L/min in a closed loop passing through two cooling units, a Perma-pure dryer (GL Science Inc.) and a desiccant holder containing $Mg(ClO_4)_2$.

(5) Preliminary results

Figure 6.4.2-1 is showing the results of measuring the CO_2 concentration (xCO_2) of ambient air samples and the seawater samples.

(6) Notification

On the 30th of July, the ship crew had been re-painting the bow at around 4:20-4:50 (UTC) as part of the maintenance of the ship. This could have been a possible source of the disturbance in the results of ambient air samples.

(7) Data Archive

All data was submitted to JAMSTEC Data Management Office (DMO) and is currently under its control.

(8) Reference

DOE (1994), *Handbook of methods for the analysis of the various parameters of the carbon dioxide system in sea water*; version 2, A. G. Dickson & C. Goyet, Eds., ORNS/CDIAC-74.

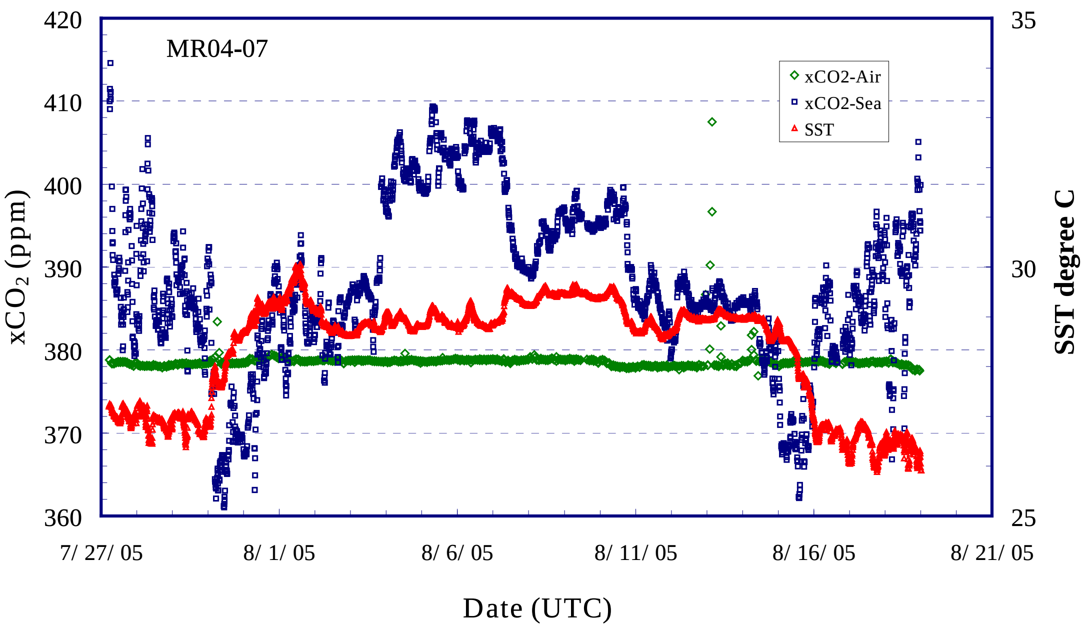

Figure 6.4.2.-1 Concentrations of CO_2 (xCO_2) in atmosphere (green) and surface seawater (blue), and SST (red) that was analyzed in the Indian Ocean during MR05-03Leg2 cruise.

6.5 Shipboard ADCP

(1) Personnel

Kentaro Ando	(JAMSTEC):	Principal Investigator	- leg1 -
Hideaki Hase	(JAMSTEC)	Principal Investigator	- leg2 -
Satoshi Okumura	(Global Ocean Development Inc.)		- leg1 -
Yasutaka Imai	(GODI)		- leg2,3 -
Souichiro Sueyoshi	(GODI)		- leg1 -
Shinya Okumura	(GODI)		- leg2 -
Wataru Tokunaga	(GODI)		- leg1,2 -
Norio Nagahama	(GODI)		- leg2,3 -
Kazuho Yoshida	(GODI)		- leg1 -

(2) Parameters

Current velocity of each depth cell [cm/s]
Echo intensity of each depth cell [dB]

(3) Methods

Continuous upper ocean current measurement along ship's track were made using hull-mounted Acoustic Doppler Current Profiler, RD Instruments VM-75 system installed on the centerline and approximately 28 m aft from the bow. The firmware version was 5.59 and the data acquisition software was VmDas Ver.1.3. For most of its operation, the instrument was configured for water-tracking mode recording each ping as the raw data in 16 m (bin size) x 40 bins (bin number) from 24.74 m to 648.74 m. Bottom-tracking mode, interleaved bottom-ping with water-ping, was made in shallower water region to get the calibration data for evaluating transducer misalignment angle. Raw data was recorded in beam coordinate, and then converted to earth coordinate using ship's heading data from ship's main gyrocompass, Tokimec TG-6000. The position fix data from ship's navigation system was also recorded in NMEA0183 format and merged with ensemble data in the VmDas.

The system performed well throughout the cruise. The profile range always reached 655 m under calm weather. Also, 60 seconds and 300 seconds average data were recorded as short-term average (STA) and long-term average (LTA) data.

The system consists of following components;

1. a 75 kHz Broadband (coded-pulse) profiler with 4-beam Doppler sonar operating at 75 KHz (RD Instruments, USA), mounted with beams pointing 30 degrees from the vertical and 45 degrees azimuth from the keel;
2. the Ship's main gyro compass (Tokimec, Japan), continuously providing ship's heading measurements to the ADCP;
3. a GPS navigation receiver (Leica MX9400) providing position fixes;
4. a personal computer running data acquisition software. The clock of the logging PC is adjusted to GPS time every 5 minutes.

(4) Preliminary results

Horizontal velocity along the ship's track is presented in figure 6.5.1 (Leg1), 6.5.2 (Leg2) and 6.5.3(Leg3). In vertical direction, the data are averaged at layers bounded on the depths of 31, 65, and 100m with the center average scheme of CODAS (Common Oceanographic Data Acquisition System) software.

(5) Data archives

These data obtained in this cruise will be submitted to the JAMSTEC DMD (Data

Management Division), and will be opened to the public via “R/V Mirai Data Web Page” in JAMSTEC home page.

(6) Remarks

We did not correct the data following period;

1. From 3 Jul 2005 22:45 UTC to 4 Jul 2005 00:28 UTC, due to territorial waters of USA GUAM.
2. From 22 Jul 2005 10:00 UTC to 24 Jul 2005 22:04 UTC, due to territorial waters of Indonesia..
3. From 25 Jul 2005 06:25 UTC to 27 Jul 2005 10:06 UTC, due to territorial waters of Australia.
4. From 19 Aug 2005 01:30 UTC to 22 Aug 2005 05:00 UTC, due to territorial waters of Indonesia.
5. From 24 Aug 2005 00:00 UTC to 26 Aug 2005 06:30 UTC, due to territorial waters of Palau.

Table 6.5.1 Major parameters

Bottom-Track Commands	
BP000	-------------------- Ping per Ensemble
BP001	-------------------- Ping per Ensemble
Environmental Sensor Commands	
EA = +00000	-------------------- Heading Alignment (1/100 deg)
EB = +00000	-------------------- Heading Bias (1/100 deg)
ED = 00065	-------------------- Transducer Depth (0-65535dm)
EF = +0001	-------------------- Pitch/Roll Division/Multiplier (pos/neg) [1/99-99]
EH = 00000	-------------------- Heading (1/100 deg)
ES = 35	-------------------- Salinity (0-40 pp thousand)
EX = 00000	-------------------- Coord Transform (Xform; Type; Tilts; 3Bm; Map)
EZ = 1020001	-------------------- Sensor Source(C; D; H; P; R; S; T)
Timing Commands	
TE = 00000200	-------------------- Time per Ensemble (hrs; min; sec; sec/100)
TP = 000200	-------------------- Time per Ping (min: sec; sec/100)
Water Track Commands	
WA = 255	-------------------- False Target Threshold (Max) (0-255 counts)
WB = 1	-------------------- Mode 1 Bandwidth Control (0=Wid, 1=Med, 2=Nar)
WC = 064	-------------------- Low Correlation Threshold (0-255)
WD = 111111111	-------------------- Data Out (V; C; A; PG; St; Vsum; Vsum^2; #G; P0)
WE = 5000	-------------------- Error Velocity Threshold (0-5000 mm/s)
WF = 0800	-------------------- Blank After Transmit (cm)
WG = 001	-------------------- Percent Good Minimum (0-100%)
WM = 1	-------------------- Profiling Mode (1-8)
WN = 040	-------------------- Number of Depth Cells (1-128)
WP = 00001	-------------------- Pings per Ensemble (0-100%)
WS = 1600	-------------------- Depth Cell Size (cm)
WV = 999	-------------------- Mode 1 Ambiguity Velocity (cm/s radial)

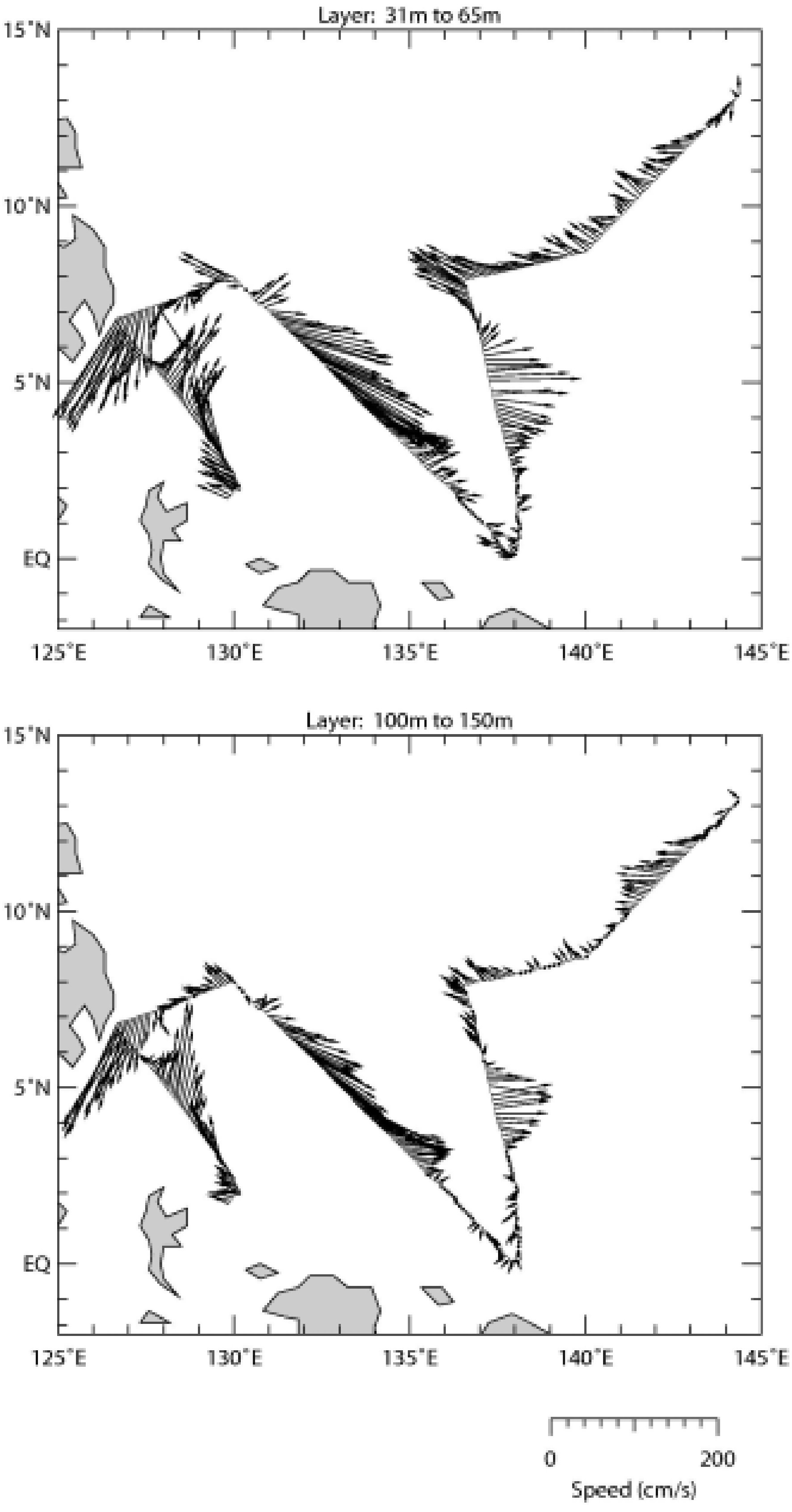

Fig 6.5.1 Horizontal Velocity along Track (Leg1)

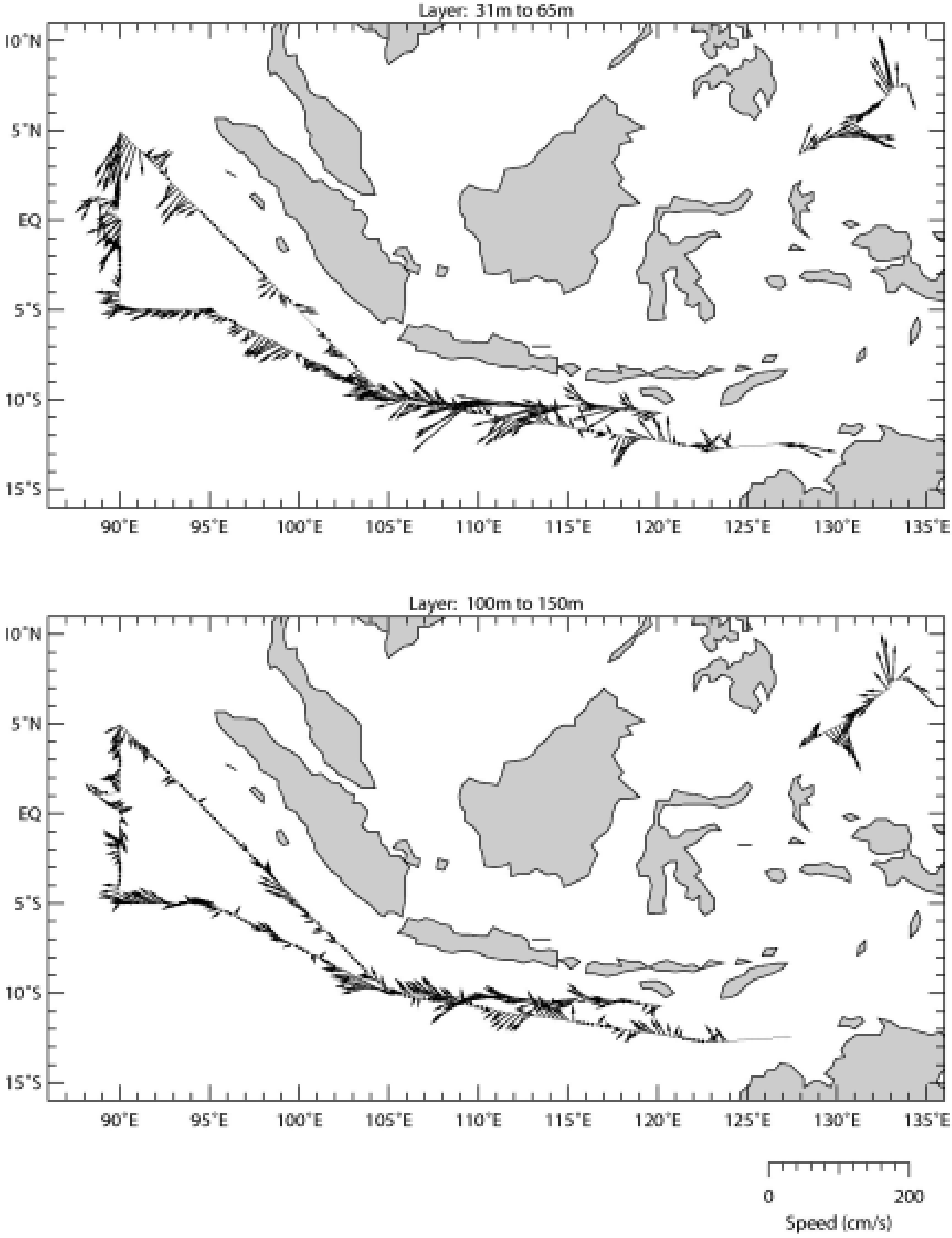

Fig 6.5.2 Horizontal Velocity along Track (Leg2)

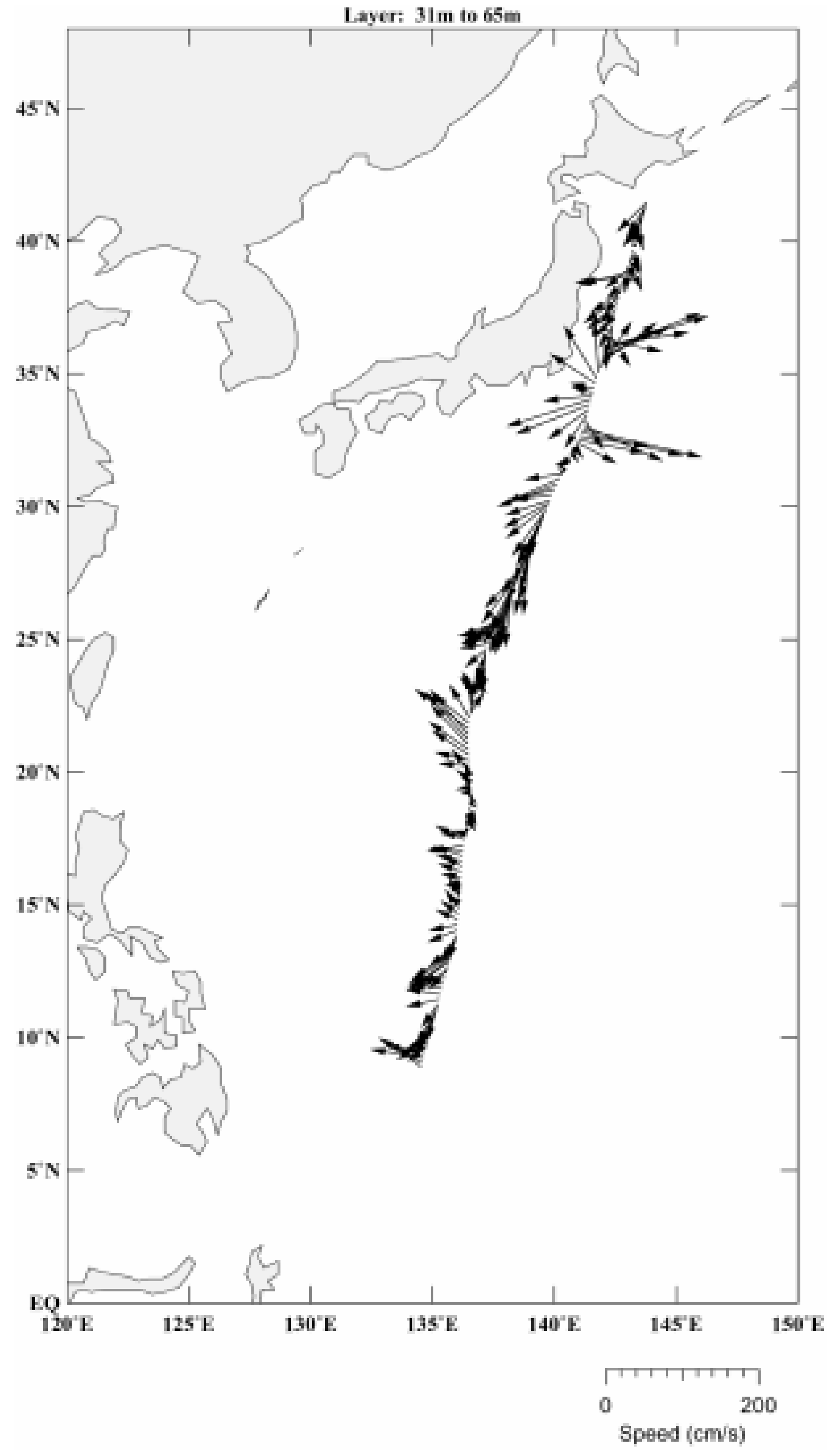

Fig 6.5.3 Horizontal Velocity along Track (Leg3)

6.6 Underway geophysics

6.6.1 Sea Surface Gravity

Takeshi Matsumoto (University of the Ryukyus)	Principal Investigator (Not on-board)
Satoshi Okumura (Global Ocean Development Inc.)	- Leg1 -
Souitchiro Sueyoshi (GODI)	- Leg1 -
Wataru Tokunaga (GODI)	- Leg1, 2 -
Kazuho Yoshida (GODI)	- Leg1 -
Yasutaka Imai (GODI)	- Leg2, 3 -
Shin'ya Okumura (GODI)	- Leg2 -
Norio Nagahama (GODI)	- Leg2, 3 -

(1) Introduction

The distribution of local gravity is an important parameter in geophysics and geodesy. We collected gravity data at the sea surface during the MR05-03 cruise from Guam, USA on 4th July 2005 to Kushiro, Japan on 2nd September 2005, and called at ports Darwin, Australia on 26th July, Koror, Palau on 25th August.

(2) Parameters

Relative Gravity [CU: Counter Unit]
[mGal] = (coef1: 0.9946) * [CU]

(3) Data Acquisition

We have measured relative gravity using LaCoste and Romberg air-sea gravity meter S-116 (LaCoste and Romberg Gravity Meters, Inc.) during this cruise. To convert the relative gravity to absolute one, we measured gravity using portable gravity meter (Scintrex gravity meter CG-3M and CG-5), at Sekinehama Port, Kushiro Port and Darwin Port as reference points.

(4) Preliminary Results

Absolute gravity shown in Table 6.6.1-1

Table 6.6.1-1

No.	Date	U.T.C.	Port	Absolute Gravity [mGal]	Sea Level [cm]	Draft [cm]	Gravity at Sensor *1 [mGal]	L&R *2 Gravity [mGal]
----	May/25	03:30	Sekinehama	980371.85	316	622	980372.95	12726.88
#01	July/3	00:36	Guam	unknown	212	645	-------------	10853.86
#02	July/26	01:53	Darwin	978302.30	371	622	979742.30	10642.09
#03	Aug/25	02:40	Koror	unknown	103	605	-------------	10647.12
#04	Sep/2	03:02	Kushiro	980592.93	200	600	980593.68	12940.43

*1: Gravity at Sensor = Absolute Gravity + Sea Level*0.3086/100 + (Draft-530)/100*0.0431
*2: LaCoste and Romberg air-sea gravity meter S-116

(5) Data Archives

Gravity data obtained during this cruise will be submitted to the JAMSTEC Data Management Division, and archived there.

(6) Remarks

We did not sample the data in the territorial waters of USA, Republic of Indonesia, Australia and Republic of Palau.

Data acquisitions term;

1. 4th July 2005 00:28UTC - 22nd July 2005 10:03UTC
2. 26th July 2005 10:03UTC - 19th August 2005 01:40UTC
3. 22nd August 2005 05:00UTC - 24th August 2005 00:00UTC
4. 26th August 2005 06:30UTC - 2nd September 2005 00:00UTC.

6.6.2 Sea Surface Three-Component Magnetic Field

Takeshi Matsumoto	(University of the Ryukyus) (Not on-board)	:Principal investigator
Satoshi Okumura	(Global Ocean Development Inc.)	- Leg1 -
Souichiro Sueyoshi	(GODI)	- Leg1 -
Kazuho Yoshida	(GODI)	- Leg1 -
Wataru Tokunaga	(GODI)	- Leg1, 2 -
Yasutaka Imai	(GODI)	- Leg2, 3 -
Shinya Okumura	(GODI)	- Leg2 -
Norio Nagahama	(GODI)	- Leg2, 3 -

(1) Introduction

Measurement of magnetic force on the sea is required for the geophysical investigations of marine magnetic anomaly caused by magnetization in upper crustal structure. We measured geomagnetic field using a three-component magnetometer during the MR05-K03 cruise from Guam, USA on 4 July 2005 to Kushiro, Japan on 2 September 2005.

(2) Parameters

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

(3) Method of Data Acquisition

A sensor of three-component fluxgate magnetometer is set on the top of foremast. Sampling is controlled by 1pps (pulse per second) standard clock of GPS signals. Navigation information, 8 Hz three-component of magnetic force, and VRU (Vertical Reference Unit) data are recorded every one second.

For calibration of the ship's magnetic effect, we made a running like a "figure-eight" turn (a pair of clockwise and anti-clockwise rotation). This calibration carried out as below.

12 July 2005, 05:55 to 06:16 about at 00-02N, 137-56E
16 July 2005, 04:30 to 04:52 about at 07-59N, 130-01E
2 August 2005, 18:47 to 19:07 about at 05-00N, 90-00E
13 August 2005, 17:32 to 17:53 about at 04-57S, 95-01E

(4) Preliminary Results

The results will be published after primary processing.

(5) Data Archives

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

(6) Remarks

We did not sample the data around Guam Island and the territorial waters of USA, within the territorial waters of the Republic of Indonesia and Australia.

6.6.3 Swath Bathymetry

Takeshi Matsumoto (University of the Ryukyus)	Principal Investigator (Not on-board)
Satoshi Okumura (Global Ocean Development Inc.)	- Leg1 -
Souitchiro Sueyoshi (GODI)	- Leg1 -
Wataru Tokunaga (GODI)	- Leg1, 2 -
Kazuho Yoshida (GODI)	- Leg1 -
Yasutaka Imai (GODI)	- Leg2, 3 -
Shinya Okumura (GODI)	- Leg2 -
Norio Nagahama (GODI)	- Leg2, 3 -

(1) Introduction

R/V MIRAI is equipped with a Multi Narrow Beam Echo Sounding system (MNBES), SEABEAM 2112.004 (SeaBeam Instruments Inc.). Sub Bottom Profiler (SBP) is an add-on option to the “SEABEAM 2100”. SBP subsystem collects vertical sediments information.

The major objective of MNBES is site survey. So we gathered necessary bathymetric and sub-sediment information around the core sampling point. And also, the other objective is collecting continuous bathymetric data along ship’s track to make a contribution to geological and geophysical investigations and global datasets.

In addition, we need to estimate the depth at the location of deployment of TRITON buoys and ADCP mooring buoys in order to design these mooring systems.

(2) Data Acquisition

The “SEABEAM 2100” on R/V MIRAI was used for bathymetry mapping during the this cruise from Guam, USA on 4th July 2005 to Kushiro, Japan on 2nd September 2005, and called at ports Darwin, Australia on 26th July and Koror, Republic of Palau on 25th to 26th August, except for the territorial waters of these countries.

To get accurate sound velocity of water column for ray-path correction of acoustic multibeam, we used Surface Sound Velocimeter (SSV) data at the surface (6.2m) sound velocity, and the others depth sound velocity calculated temperature and salinity profiles from CTD and XCTD data by the equation in Mackenzie (1981) during the cruise.

Table 6.6.3-1 listed system configuration and performance of SEABEAM 2112.004 system and SBP subsystem.

Table 6.6.3-1 System configuration and performance

SEABEAM 2112.004 (12kHz system)

Frequency:	12 kHz
Transmit beam width:	2 degree
Transmit power:	20 kW
Transmit pulse length:	3 to 20 msec.
Depth range:	100 to 11,000 m
Beam spacing:	1 degree athwart ship
Swath width:	150 degree (max) 120 degree to 4,500 m 100 degree to 6,000 m 90 degree to 11,000 m
Depth accuracy:	Within < 0.5% of depth or +/-1m, whichever is greater, over the entire swath. (Nadir beam has greater accuracy; typically within < 0.2% of depth or +/-1m, whichever is greater)

Sub-Bottom Profiler (4kHz system)

Frequency:	4 kHz
Transmit beam width:	5 degree
Sweep:	5 to 100 msec
Depth Penetration:	As much as 75 m (varies with bottom composition)
Resolution of sediments:	Under most condition within < tens-of-centimeters range (dependent upon depth and sediment type)

(3) Preliminary Results

The results will be published after primary processing.

(4) Data Archives

Bathymetric data obtained during this cruise will be submitted to the JAMSTEC Data Management Division, and archived there.

6.7 Satellite image acquisition

6.7.1 NOAA/HRPT

Kentaro Ando (JAMSTEC):	Principal Investigator (Leg1)
Hideaki Hase (JAMSTEC):	Principal Investigator (Leg2)
Syuichi Mori (JAMSTEC):	Principal Investigator (Leg3)
Satoshi Okumura (Global Ocean Development Inc.)	- Leg1 -
Souichiro Sueyoshi (GODI)	- Leg1 -
Wataru Tokunaga (GODI)	- Leg1, 2 -
Kazuho Yoshida (GODI)	- Leg1 -
Yasutaka Imai (GODI)	- Leg2, 3 -
Shinya Okumura (GODI)	- Leg2 -
Norio Nagahama (GODI)	- Leg2, 3 -

(1) Objectives

It is our objectives to collect data of sea surface temperature in a high spatial resolution mode from the Advance Very High Resolution Radiometer (AVHRR) on the NOAA polar orbiting satellites and to build a time and depth resolved primary productivity model.

(2) Method

We receive the down link High Resolution Picture Transmission (HRPT) signal from NOAA satellites by the same way as the signal of OrbView-2. We processed the HRPT signal with the in-flight calibration and computed the sea surface temperature by the Multi-Channel Sea Surface Temperature (MCSST) method. A daily composite map of MCSST data is processed for each day on the R/V MIRAI for the area, where the R/V MIRAI located.

We received and processed NOAA data throughout MR05-03 cruise from the departure of Guam, USA on 4th July 2005 to the arrival at Kushiro, Japan on 2nd September 2005.

The sea surface temperature data will be applied for the time and depth resolved primary productivity model to determine a temperature field for the model.

(3) Preliminary results

Fig. 6-7-1, Fig. 6-7-2 and Fig.6-7-3 showed sea surface temperature about western tropical Pacific Ocean and eastern Indian Ocean. There were composite maps of MCSST data during the cruise.

(4) Data archives

The raw data obtained during this cruise will be submitted to JAMSTEC Data Management Division and will be under their control.

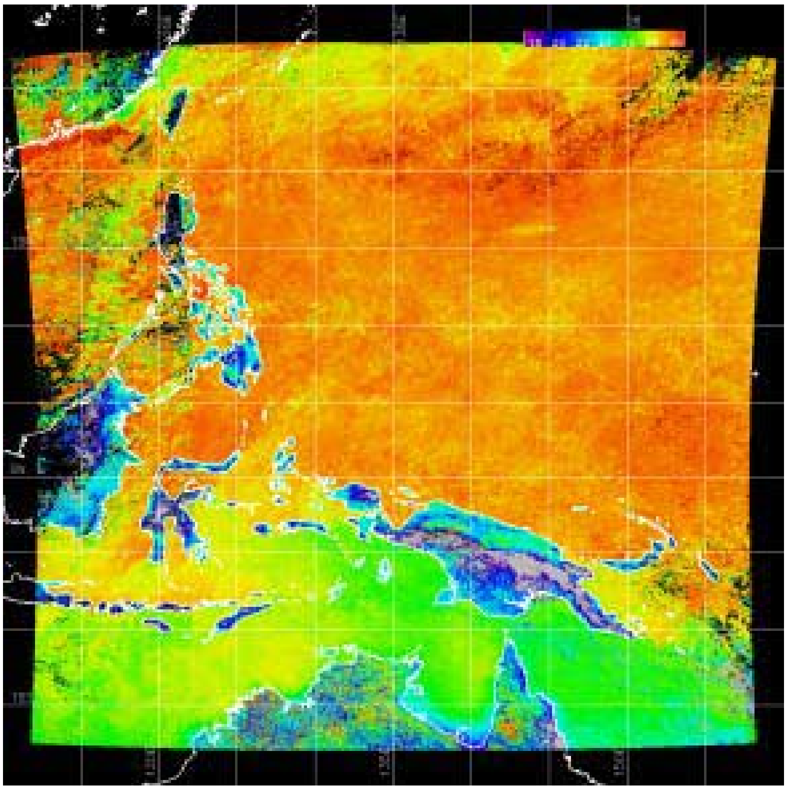

Fig. 6-7-1　MCSST composite image, from 3rd July to 25th July 2005.

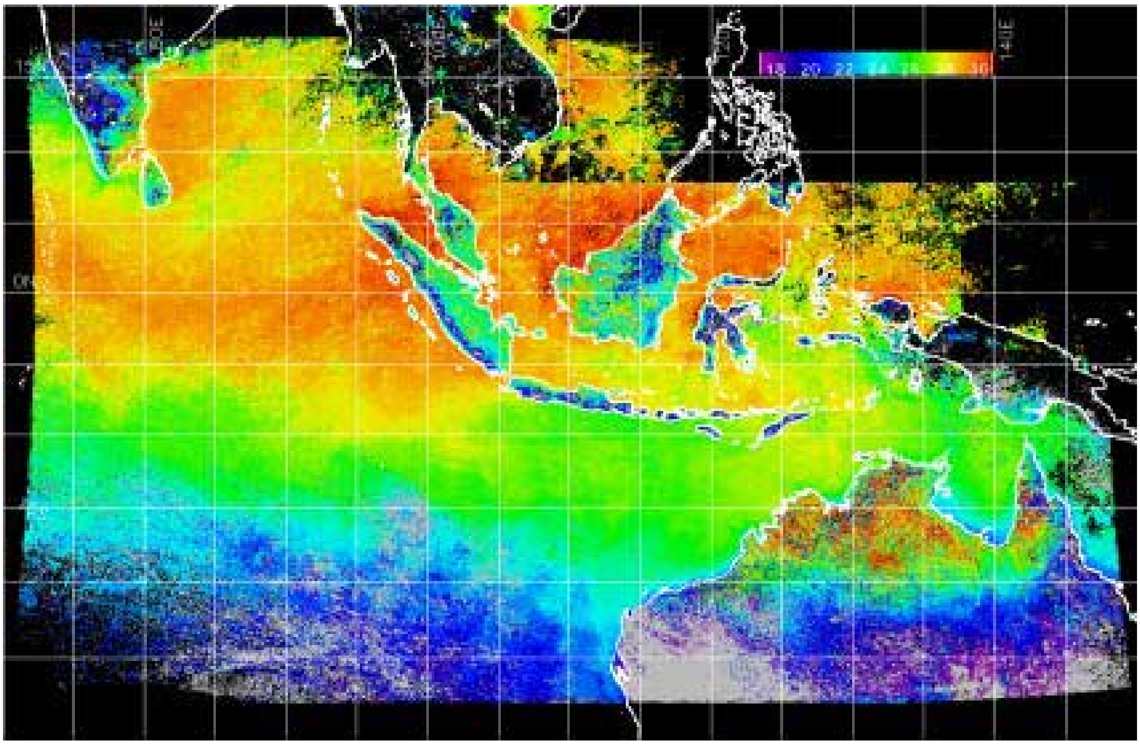

Fig. 6-7-2　MCSST composite image, from 26th July to 19th August 2005.

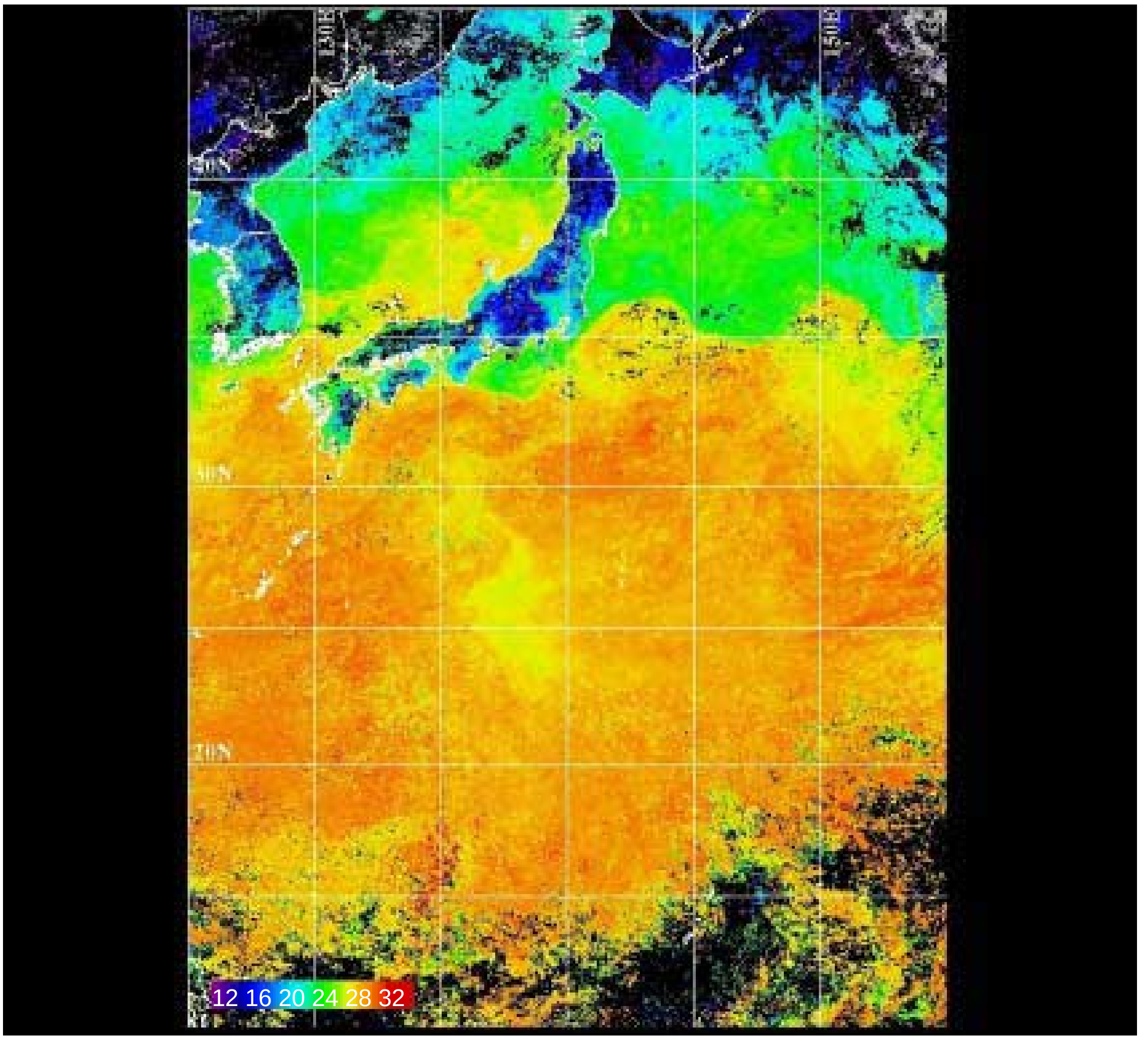

Fig. 6-7-3　MCSST composite image, from 25th August to 1st September 2005.

7 Special Observation

7.1 TRITON moorings

7.1.1 TRITON mooring operation

(1) Personnel

Kentaro Ando[※1]	(JAMSTEC): Principal Investigator
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Masaki Yamada[※3]	(MWJ): Technical Staff
Hiroki Ushiromura[※2]	(MWJ): Technical Staff
Shinsuke Toyoda[※2]	(MWJ): Technical Staff
Nobuhiko Tahara[※2]	(MWJ): Technical Staff
Kousuke Okudaira[※2]	(MWJ): Technical Staff

※1 on board Leg1 ※2 on board Leg1&Leg2 ※3 on board Leg2

(2) Objectives

The large-scale air-sea interaction over the warmest sea surface temperature region in the western tropical Pacific Ocean called warm pool that 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. Therefore, long term data sets of temperature, salinity, currents and meteorological elements have been required at fixed locations. 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).

Eight TRITON buoys have been successfully recovered during this R/V MIRAI cruise (MR05-03 Leg1&Leg2).

(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 deg-C

Measurement range, Conductivity : 0～+7 S/m

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

R.M.YOUNG COMPANY MODEL50202/50203

Atmospheric pressure

PAROPSCIENTIFIC.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 deployment

Nominal location	8N, 137E
ID number at JAMSTEC	10005
Number on surface float	T02
ARGOS PTT number	07883
ARGOS backup PTT number	29692
Deployed date	06 Jul. 2005
Exact location	07 52.21N, 136 29.12E
Depth	3348 m

Nominal location	5N, 137E
ID number at JAMSTEC	11005
Number on surface float	T03
ARGOS PTT number	28868
ARGOS backup PTT number	29694

Deployed date	08 Jul. 2005
Exact location	04 57.04N, 137 19.00E
Depth	4139 m
Option sensors	One Precipitation sensor on the tower
	CT at 175 m : S/N 0658

Nominal location	2N, 138E
ID number at JAMSTEC	12007
Number on surface float	T13
ARGOS PTT number	09427
ARGOS backup PTT number	29695
Deployed date	10 Jul. 2005
Exact location	01 - 59.77N, 138 - 06.18E
Depth	4322 m
Option sensors	CT at 175 m : S/N 1036

Nominal location	EQ, 138E
ID number at JAMSTEC	13007
Number on surface float	T20
ARGOS PTT number	None
ARGOS backup PTT number	24232, 29696
Deployed date	12 Jul. 2005
Exact location	00 04.43N, 138 03.13E
Depth	4211 m
Option sensors	CT at 175m : S/N 0509

Nominal location	8N, 130E
ID number at JAMSTEC	14004
Number on surface float	T22
ARGOS PTT number	23470
ARGOS backup PTT number	29697
Deployed date	17 Jul. 2005
Exact location	07 - 55.65N, 130 - 03.88E
Depth	5636 m

Nominal location	2N, 130E
ID number at JAMSTEC	16005
Number on surface float	T23
ARGOS PTT number	None
ARGOS backup PTT number	13065, 29698
Deployed date	21 Jul. 2005
Exact location	01 - 57.76N, 129 - 55.99E
Depth	4425 m
Option sensors	CT at 175m : S/N 0511

Nominal location	5S, 95E
ID number at JAMSTEC	17004
Number on surface float	T24
ARGOS PTT number	20384
ARGOS backup PTT number	24233
Deployed date	14 Aug. 2005
Exact location	04 - 56.92S, 94 - 58.40 E
Depth	5009 m

Nominal location	1.5S, 90E
ID number at JAMSTEC	18005
Number on surface float	T25
ARGOS PTT number	20439
ARGOS backup PTT number	24240
Deployed date	10 Aug. 2005
Exact location	01 - 39.42S, 89 - 58.85 E
Depth	4693 m
Option sensors	One Precipitation sensor on the tower

(6) TRITON recovered

Nominal location	8N, 137E
ID number at JAMSTEC	10004
Number on surface float	T08
ARGOS PTT number	03595
ARGOS backup PTT number	24239
Deployed date	13 Jun. 2004
Recovered date	07 Jul. 2005
Exact location	07 38.95N, 136 41.92E
Depth	3166 m

Nominal location	5N, 137E
ID number at JAMSTEC	11004
Number on surface float	T09
ARGOS PTT number	03779
ARGOS backup PTT number	24241
Deployed date	21 Jun. 2004
Recovered date	09 Jul. 2005
Exact location	04 51.60N, 137 15.62 E
Depth	4096 m
Option sensors	Precipitation sensor (capacitive type) on the tower CT at 175m : S/N 0567

Nominal location	2N, 138E
ID number at JAMSTEC	12006
Number on surface float	T10
ARGOS PTT number	09792

ARGOS backup PTT number	24242
Deployed date	16 Jun. 2004
Recovered date	11 Jul. 2005
Exact location	02 - 04.02N, 138 03.74 E
Depth	4325 m
Option sensors	Precipitation sensor (capacitive type) on the tower CT at 175m : S/N 0547

Nominal location	EQ, 138E
ID number at JAMSTEC	13006
Number on surface float	T11
ARGOS PTT number	None
ARGOS backup PTT number	24243, 24244
Deployed date	18 Jun. 2004
Recovered date	13 Jul. 2005
Exact location	00 - 02.03N, 137 52.90 E
Depth	4384 m

Nominal location	8N, 130E
ID number at JAMSTEC	14003
Number on surface float	T12
ARGOS PTT number	07960
ARGOS backup PTT number	24246
Deployed date	24 Jul. 2004
Recovered date	16 Jul. 2005
Exact location	07 - 58.83N, 130 - 02.10 E
Depth	5722 m

Nominal location	2N, 130E
ID number at JAMSTEC	16004
Number on surface float	T18
ARGOS PTT number	03593
ARGOS backup PTT number	13067
Deployed date	25 Jul. 2004
Recovered date	20 Jul. 2005
Exact location	02 01.69N, 130 11.39 E
Depth	4372 m
Option sensors	CT at 175m : S/N 1045

Nominal location	5S, 95E
ID number at JAMSTEC	17003
Number on surface float	T28
ARGOS PTT number	03781
ARGOS backup PTT number	07878
Deployed date	09 Jul. 2004
Recovered date	13 Aug.2005
Exact location	05 - 02.21S, 94 - 58.58 E

Depth	5013m
Nominal location	1.5S, 90E
ID number at JAMSTEC	18004
Number on surface float	T27
ARGOS PTT number	20434
ARGOS backup PTT number	13066
Deployed date	12 Jul. 2004
Recovered date	09 Aug.2005
Exact location	01 - 36.17S, 90 - 04.49 E
Depth	4715m

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

(6) Details of deployed

We had deployed nine TRITON buoys, described them details in the list.

Deployed TRITON buoys

Observation No.	Location.	Details.
10005	8N137E	Deploy with full spec.
11005	5N137E	Deploy with full spec and one optional precipitation sensor and one optional CT senseor.
12007	2N138E	Deploy with full spec and one optional CT sensor.
13007	EQ138E	Deploy with ten CT sensor, two CTD sensor, one current meter
14004	8N130E	Deploy with ten CT sensor, two CTD sensor, and one current meter.
16005	2N130E	Deploy with ten CT sensor, two CTD sensor, one current meter
17004	5S95E	Deploy with WND,HRH,optical precipitation sensor on the tower and ten CT sensor, two CTD sensor, one current
18005	1.5S90E	Deploy with full spec and one optional precipitation sensor.

(7) Data archive

Hourly averaged data are transmitted through ARGOS satellite data transmission system in almost 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 The JAMSTEC Mutsu Institute.

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

7.1.2 Inter-comparison between shipboard CTD and TRITON data

(1) Personnel

Kentaro Ando※1	(JAMSTEC): Principal Investigator
Hideaki Hase※3	(JAMSTEC): Principal Investigator
Takeo Matsumoto※1	(JAMSTEC): Technical Leader
Hiroshi Matsunaga ※1	(MWJ): Operation Leader
Keisuke Matsumoto※2	(MWJ): Technical staff

※1 on board Leg1 ※2 on board Leg1&Leg2 ※3 on board Leg2

(2) Objectives

TRITON CTD data validation

(3) Measured parameters

- Temperature
- Conductivity
- Pressure

(4) Methods

TRITON buoy underwater sensors are equipped along a wire cable of the buoy below sea surface. We used the same CTD (SBE 9/11Plus) system with general CTD observation (See section 5) on R/V MIRAI for this intercomparison. We conducted 1 CTD cast at each TRITON buoy site before recovery, conducted 1 CTD cast at each TRITON buoy site after deployment. The cast was performed immediately after the deployment and before recovery. R/V MIRAI was kept the distance from the TRITON buoy within about 2 nm.

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

As our temperature sensors are expected to be more stable than conductivity sensors, conductivity data and salinity data are selected at the same value of temperature data. Then, we calculate difference of salinity from conductivity between the shipboard CTD data on R/V MIRAI and the TRITON buoy data for each deployment and recovery of buoys.

Compared site

Observation No.	Latitude	Longitude	Condition
10005	8N	137E	After Deployment
11005	5N	137E	After Deployment
12007	2N	138E	After Deployment
14004	8N	130E	After Deployment
17004	5S	95E	After Deployment
18005	1.5S	90E	After Deployment
10004	8N	137E	Before Recover
11004	5N	137E	Before Recover
17003	5S	95E	Before Recover
18004	1.5S	90E	Before Recover

(5) Results

Most of temperature, conductivity and salinity data from TRITON buoy showed good agreement with CTD cast data in T-S diagrams. See the Figures 7.1.2-1(a)(b).

To evaluate the performance of the conductivity sensors on TRITON buoy, the data from had deployed buoy and shipboard CTD data at the same location were analyzed.

The estimations were calculated as deployed buoy data minus shipboard CTD data. The salinity differences are from –0.212 to 0.125 for all depths. Below 300db, salinity differences are from –0.050 to 0.015 (See the Figures 7.1.2-2 (a) and Table 7.1.2-1 (a)). The absolute average of all salinity differences was 0.024 with absolute standard deviation of 0.035.

The estimations were calculated as recovered buoy data minus shipboard CTD (9Plus) data. The salinity differences are from –0.344 to 0.186 for all depths. Below 300db, salinity differences are from –0.080 to 0.019 (See the Figures 7.1.2-2(b) and Table 7.1.2-1 (b)). The absolute average of salinity differences was 0.051 with absolute standard deviation of 0.070.

The estimations of time-drift were calculated as recovered buoy data minus deployed buoy data. The difference of salinity over 1 year had the variation ranging from –0.107 to 0.180, for all depths. Below 300db, the difference of salinity over 1 year had the variation ranging from –0.025 to 0.015 (See the figures 7.1.2-2(c)). The absolute average of salinity differences was 0.048 with absolute standard deviation of 0.048.

(6) Data archive

All raw and processed CTD data files were copied on 3.5 inch magnetic optical disks and submitted to JAMSTEC TOCS group of the Ocean Observation and Research Department. All original data will be stored at JAMSTEC Mutsu brunch. (See section 5)

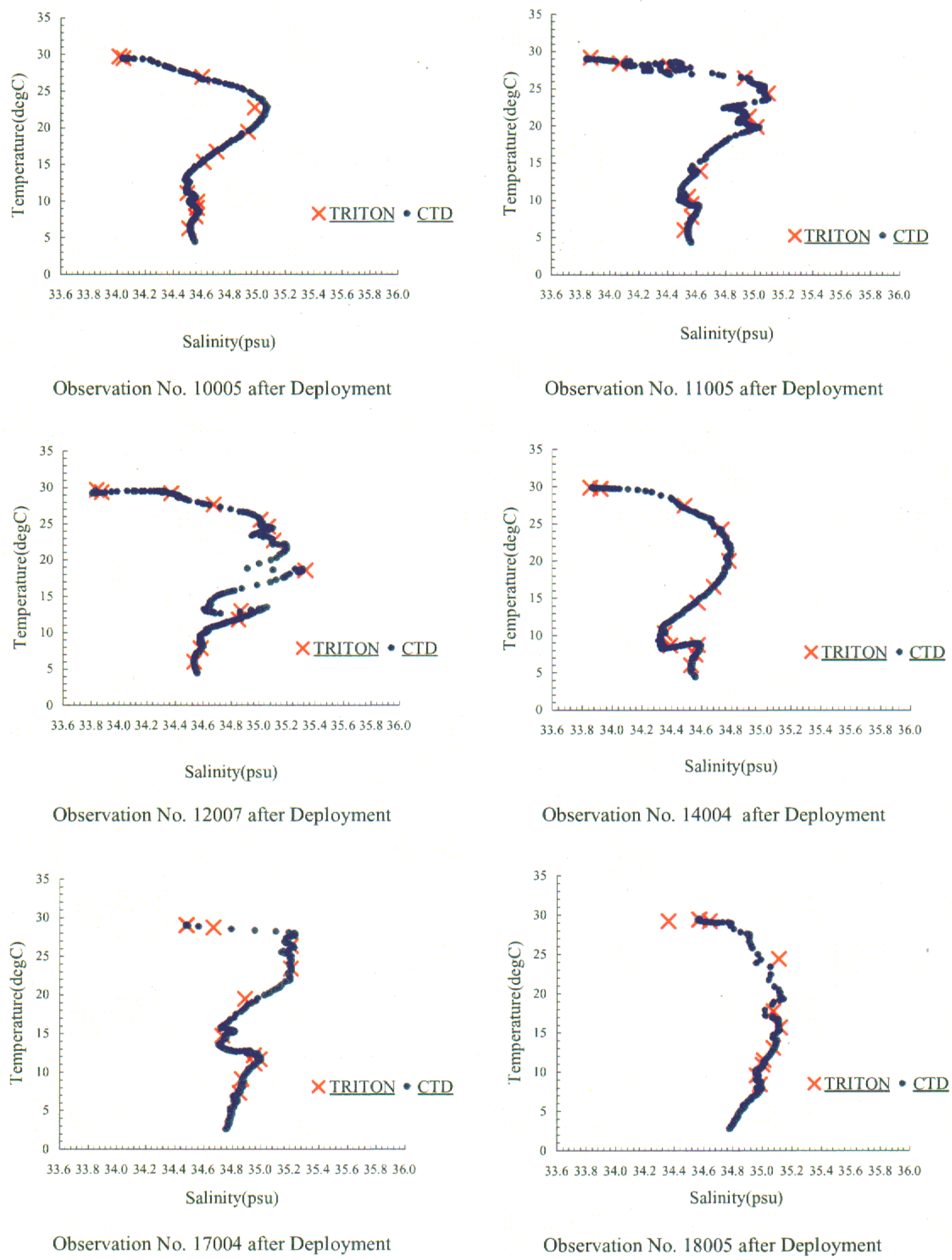
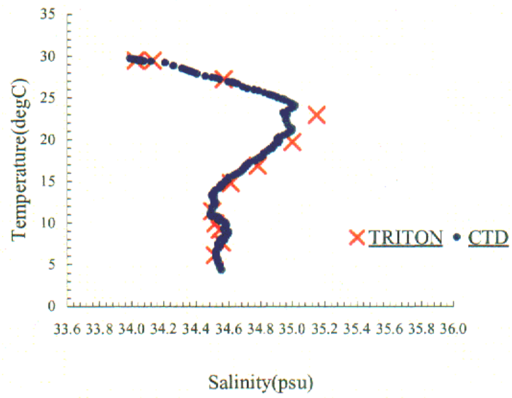
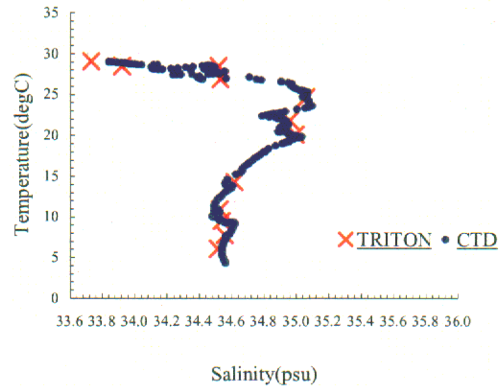


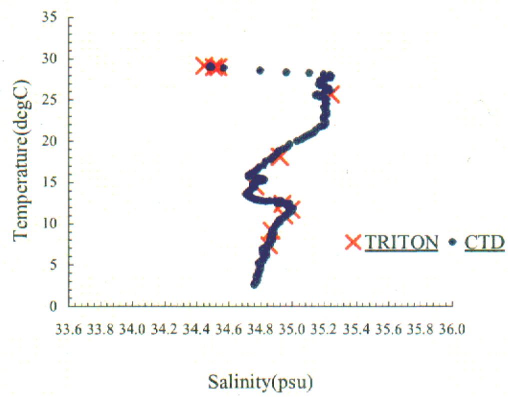
Fig.7.1.2.-1(a) T-S diagram of TRITON buoys data and shipboard CTD data



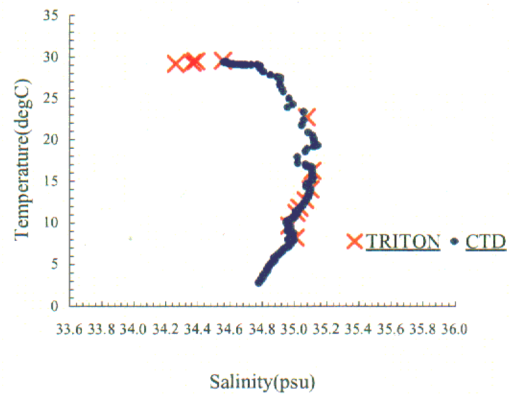
Observation No. 10004 before Recovery



Observation No. 11004 before Recovery



Observation No. 17003 Before Recovery



Observation No. 18004Before Recovery

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

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

Observation No.	Pressure (db)	Temperature (degC)	Conductivety (S/m)	Salinity (psu)
10005	1.5	0.20	0.015	-0.026
10005	25.0	0.00	0.000	0.002
10005	50.0	0.07	0.009	0.019
10005	75.0	-0.05	-0.018	-0.089
10005	100.0	-0.13	-0.014	-0.005
10005	125.0	-0.01	0.000	0.007
10005	150.0	-0.01	-0.001	0.002
10005	200.0	0.01	-0.002	-0.019
10005	250.0	0.28	0.031	0.048
10005	293.3	-0.01	0.000	0.006
10005	500.0	-0.01	-0.001	-0.001
10005	730.9	0.42	0.038	-0.011
11005	1.5	0.15	0.019	0.028
11005	25.0	0.00	-0.006	-0.036
11005	50.0	-0.09	-0.012	-0.019
11005	75.0	0.02	-0.002	-0.018
11005	100.0	0.00	0.003	0.025
11005	125.0	0.03	0.004	0.014
11005	150.0	0.00	-0.003	-0.012
11005	200.0	-0.01	0.003	0.033
11005	250.0	0.12	0.015	0.035
11005	286.4	0.17	0.010	-0.050
11005	500.0	0.00	0.000	-0.005
11005	705.8	0.21	0.017	-0.024
12007	1.5	0.12	0.013	0.007
12007	25.0	0.01	-0.003	-0.027
12007	50.0	0.01	0.002	0.011
12007	75.0	0.04	0.008	0.031
12007	100.0	0.01	0.001	0.002
12007	125.0	0.02	0.003	0.014
12007	150.0	-0.03	-0.002	0.010
12007	200.0	-0.01	0.004	0.037
12007	250.0	0.01	-0.013	-0.124
12007	299.9	0.02	0.004	0.015
12007	500.0	0.00	0.000	-0.003
12007	747.8	0.00	0.000	0.004
14004	1.5	0.00	-0.004	-0.015
14004	25.0	0.00	-0.002	-0.009
14004	50.0	0.04	0.008	0.027
14004	75.0	-0.03	-0.002	0.009
14004	100.0	0.08	0.009	0.006
14004	125.0	-0.04	-0.004	-0.003
14004	150.0	0.00	0.002	0.018
14004	200.0	-0.01	-0.002	-0.005
14004	250.0	0.04	0.008	0.047
14004	299.3	-0.01	-0.001	-0.004
14004	500.0	0.00	0.000	-0.001
14004	741.6	0.00	-0.001	-0.004

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

Observation No.	Pressure (db)	Temperature (degC)	Conductivety (S/m)	Salinity (psu)
17004	1.5	-0.03	-0.003	0.003
17004	25.0	0.04	0.005	0.003
17004	50.0	-0.11	0.003	0.104
17004	75.0	0.01	-0.001	-0.015
17004	100.0	0.36	0.039	0.004
17004	125.0	-0.10	-0.021	-0.087
17004	150.0	0.00	-0.001	-0.015
17004	200.0	0.01	-0.002	-0.023
17004	250.0	0.00	0.000	-0.002
17004	299.6	0.00	-0.001	-0.011
17004	500.0	0.00	-0.001	-0.004
17004	746.8	0.01	0.000	0.001
18005	1.5	-0.22	-0.056	-0.212
18005	25.0	0.00	-0.001	-0.001
18005	50.0	0.00	0.002	0.009
18005	75.0	0.02	0.011	0.060
18005	100.0	0.17	0.034	0.125
18005	125.0	-0.15	-0.008	0.058
18005	150.0	0.36	0.037	0.009
18005	200.0	0.13	0.013	-0.003
18005	250.0	-0.09	-0.011	-0.013
18005	299.4	-0.10	-0.011	-0.009
18005	500.0	0.00	-0.001	-0.011
18005	722.2	0.13	0.011	-0.006

Bad data (red-highlighted cells: 17004 100.0 temperature; 18005 1.5 conductivity and salinity; 18005 150.0 temperature)

Table 7.1.2.-1(b) Data differences between TRITON buoys data and ship board CTD data before recovery

Observation No.	Pressure (db)	Temperature (degC)	Conductivety (S/m)	Salinity (psu)
10004	1.5	0.00	-0.006	-0.027
10004	25.0	0.00	0.009	0.066
10004	50.0	-0.03	-0.001	0.024
10004	75.0	0.02	0.026	0.186
10004	100.0	0.08	0.019	0.086
10004	125.0	-0.02	0.007	0.074
10004	150.0	0.02	0.007	0.044
10004	200.0	0.02	0.003	0.004
10004	250.0	-0.01	-0.007	-0.062
10004	298.1	0.00	-0.003	-0.029
10004	500.0	-0.15	-0.014	0.004
10004	742.8	-0.27	-0.026	-0.010
11004	1.5	0.05	-0.012	-0.113
11004	25.0	0.01	-0.029	-0.199
11004	50.0	0.01	0.004	0.027
11004	75.0	-0.02	0.014	0.118
11004	100.0	-0.01	0.001	0.022
11004	125.0	-0.02	0.001	0.026
11004	150.0	-0.05	0.000	0.045
11004	200.0	-0.03	0.003	0.049
11004	250.0	0.26	0.025	-0.002
11004	287.3	0.18	0.008	-0.080
11004	500.0	0.00	-0.001	-0.016
11004	709.5	0.28	0.023	-0.028
17003	1.5	0.05	-0.001	-0.041
17003	25.0	0.00	0.007	0.052
17003	50.0	0.00	0.001	0.011
17003	75.0	0.00	0.011	0.082
17003	100.0			
17003	125.0	0.08	0.013	0.043
17003	150.0	-0.02	0.000	0.011
17003	200.0	0.00	-0.005	-0.045
17003	250.0	0.00	0.000	-0.002
17003	308.8	0.00	0.000	-0.011
17003	500.0	0.00	-0.001	-0.005
17003	750.1	0.00	0.000	-0.001
18004	1.5	0.01	-0.028	-0.189
18004	25.0	0.03	0.001	-0.019
18004	50.0	0.00	-0.032	-0.211
18004	75.0	0.02	-0.048	-0.344
18004	100.0	0.27	0.030	0.017
18004	125.0	-0.05	-0.005	-0.002
18004	150.0	-0.02	-0.002	-0.002
18004	200.0	0.01	0.000	-0.007
18004	250.0	0.00	-0.001	-0.004
18004	306.9	0.00	0.000	-0.003
18004	500.0	0.07	0.006	-0.004
18004	755.2	0.00	0.002	0.019

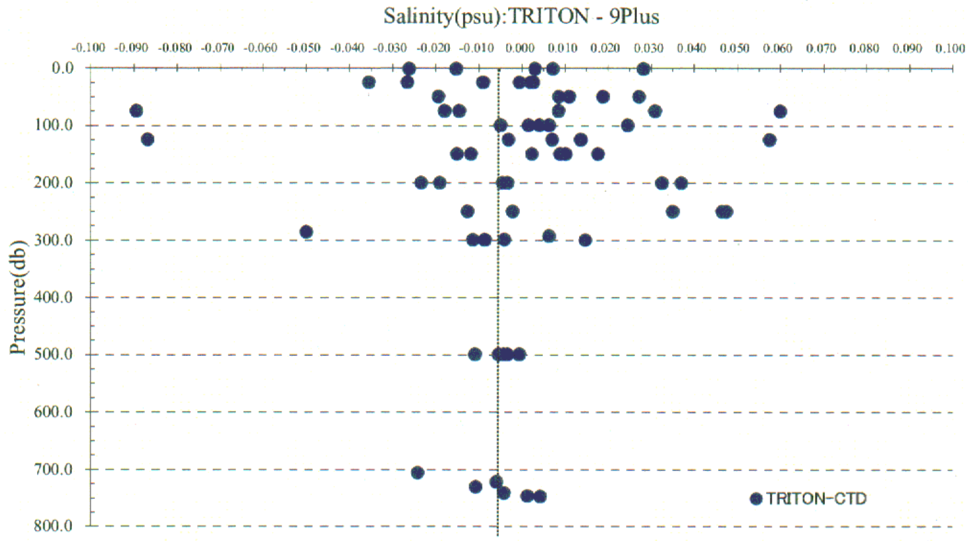


Fig.7.1.2.-2 (a) Salinity differences between TRITON buoys data and shipboard CTD data after deployment

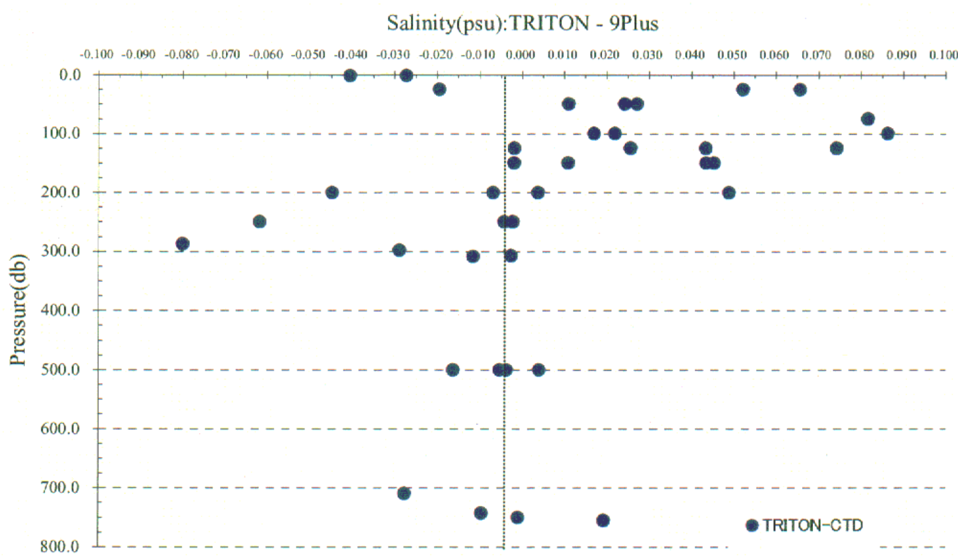


Fig.7.1.2.-2 (b) Salinity differences between TRITON buoys data and shipboard CTD data before recovery

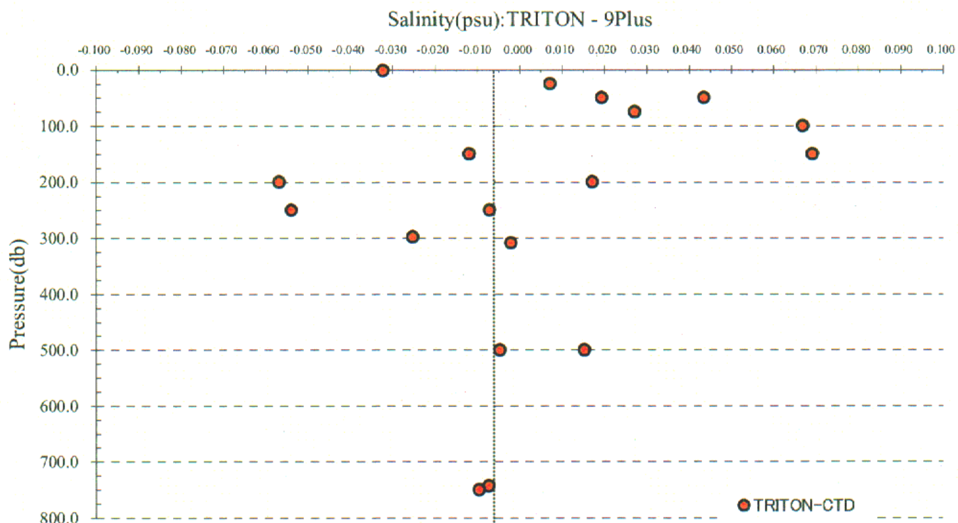


Fig.7.1.2.-2 (c) Salinity differences between deployment data and recovery data for 1year
Observation No.10,17

7.2 ADCP subsurface mooring

(1) Personnel

Kentaro Ando	(JAMSTEC): Principal Investigator (Leg.1)
Hideaki Hase	(JAMSTEC): Principal Investigator (Leg.2)
Mari Sakai	(JAMSTEC): Technical staff (Leg.2)
Hiroshi Matsunaga	(MWJ): Operation leader (Leg.1)
Nobuharu Komai	(MWJ): Operation leader (Leg.2)
Masaki Taguchi	(MWJ): Technical staff (Leg.1)
Tetsuya Nagahama	(MWJ): Technical staff (Leg.1)
Kei Suminaga	(MWJ): Technical staff (Leg.1)
Kentaro Shiraishi	(MWJ): Technical staff (Leg.2)
Masaki Furuhata	(MWJ): Technical staff (Leg.2)
Tomoyuki Takamori	(MWJ): Technical staff (Leg.1-2)
Masaki Moro	(MWJ): Technical staff (leg.2)
Keisuke Matsumoto	(MWJ): Technical staff (Leg.1-2)
Takatoshi Kiyokawa	(MWJ): Technical staff (Leg.1)
Masanori Enoki	(MWJ): Technical staff (Leg.1)
Tetsuharu Iino	(MWJ): Technical staff (Leg.1)
Akinori Murata	(MWJ): Technical staff (Leg.2)
Masaki Yamada	(MWJ): Technical staff (Leg.2)
Shinsuke Toyoda	(MWJ): Technical staff (Leg.1-2)
Hiroki Ushiromura	(MWJ): Technical staff (Leg.1-2)
Kosuke Okudaira	(MWJ): Technical staff (Leg.1-2)
Nobuhiko Tahara	(MWJ): Technical staff (Leg.1-2)

(2) Objectives

The purpose is to get the knowledge of physical process in the western equatorial Pacific Ocean. We have been observing subsurface currents using ADCP moorings along the equator. In this cruise (MR05-03), we recovered two subsurface ADCP mooring at Eq-138E/Eq-90E and deployed one ADCP moorings at Eq-90E.

(3) Parameters

- Current profiles
- Echo intensity
- Pressure, Temperature and Conductivity

(4) Methods

Two instruments are mounted at the top float of the mooring. One is ADCP(Acoustic Doppler Current Profiler) to observe upper ocean layer currents from subsurface to 320m and 400m depth. The other is CTD to observe pressure, temperature and salinity for correction of sound speed and depth variability. Details of the instruments and their parameters are as follows:

1) ADCP

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

Distance to first bin : 8 m
Pings per ensemble : 16
Time per ping : 2.00 seconds
Bin length : 8.00 m
Sampling Interval : 3600 seconds

Recovered ADCP

・Serial Number : 1678(Mooring No.040619-00138E)

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

Distance to first bin : 7.04 m

Pings per ensemble : 27

Time per ping : 6.66 seconds

Bin length : 8.00 m

Sampling Interval : 3600 seconds

Recovered ADCP

・Serial Number : 1248(Mooring No.040713-0090E)

Deployed ADCP

・Serial Number : 1645(Mooring No.050808-0090E)

2) CTD

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

Sampling Interval : 1800 seconds

Recovered CTD

・Serial Number : 1286 (Mooring No.040619-00138E)

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

Sampling Interval : 1800 seconds

Recovered CTD

・Serial Number : 1388 (Mooring No.040713-0090E)

Deployed CTD

・Serial Number : 1775 (Mooring No.050808-0090E)

3) Other instrument

(a) Acoustic Releaser (BENTHOS,Inc.)

Recovered Acoustic Releaser

・Serial Number :844 (Mooring No.040619-00138E)

・Serial Number :636 (Mooring No.040619-00138E)

・Serial Number :1104 (Mooring No.040713-0090E)

・Serial Number :937 (Mooring No.040713-0090E)

Deployed Acoustic Releaser

・Serial Number :960 (Mooring No.050808-0090E)

・Serial Number :961 (Mooring No.050808-0090E)

(b) Transponder (BENTHOS,Inc.)

Recovered Transponder

・Serial Number : 67489 (Mooring No.040619-00138E)

Deployed Transponder

・Serial Number : 67492 (Mooring No.050808-0090E)

(5) Deployment

The ADCP mooring deployed at Eq-90E was planned to play the ADCP at about 400m depth. After we dropped the anchor, we monitored the depth of the acoustic releaser.

The position of the mooring No.040713-0090E

Date: 13 Jul. 2004 Lat: 00-00.39N Long: 90-03.58E Depth: 4408m

(6) Recovery

We recovered two ADCP moorings. One was deployed on 19 Jun.2003 (MR04-03), the other was deployed on 13 Jul. 2003 (MR04-03). After the recovery, we uploaded ADCP and CTD data into a computer, then raw data were converted into ASCII code.

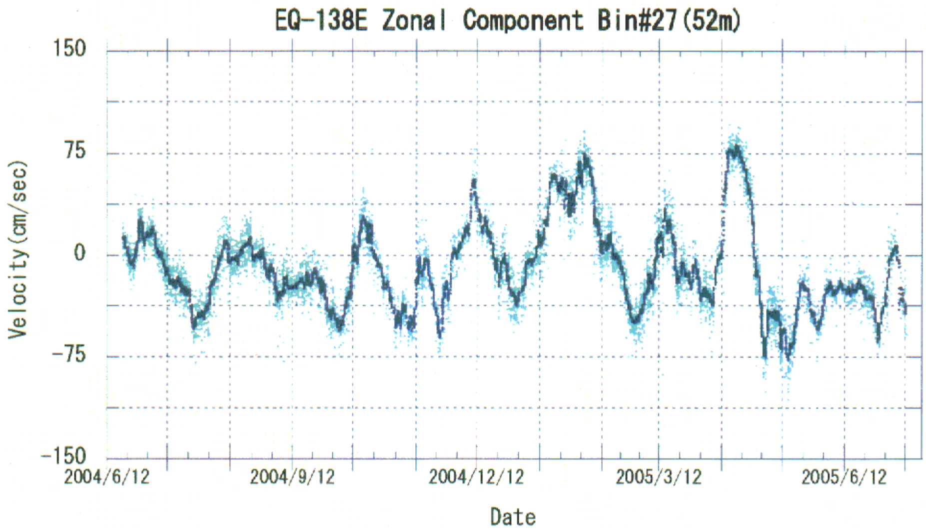
Results were shown in the figures in the following pages. Fig.7-2-1～Fig.7-2-3 show the ADCP velocity data (zonal and meridional component) at bin# 27, bin# 21, bin# 1(Eq-138E).

Fig.7-2-4 shows CTD pressure, temperature and salinity data (Eq-138E). Fig.7-2-5 ～ Fig.7-2-7 show the ADCP velocity data (zonal and meridional component) at bin# 42, bin# 36, bin# 30 (Eq-90E). Fig.7-2-8 shows CTD pressure temperature and salinity data (Eq-90E).

(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.

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



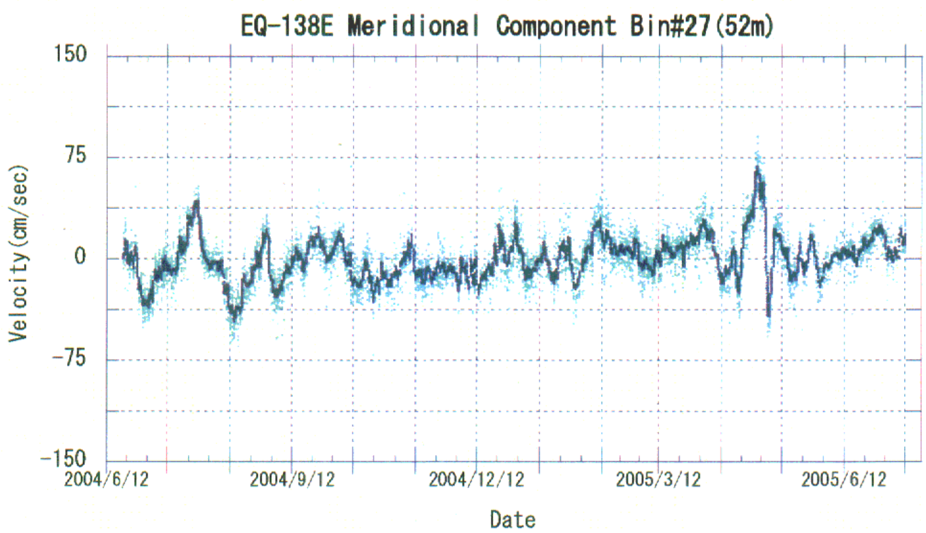
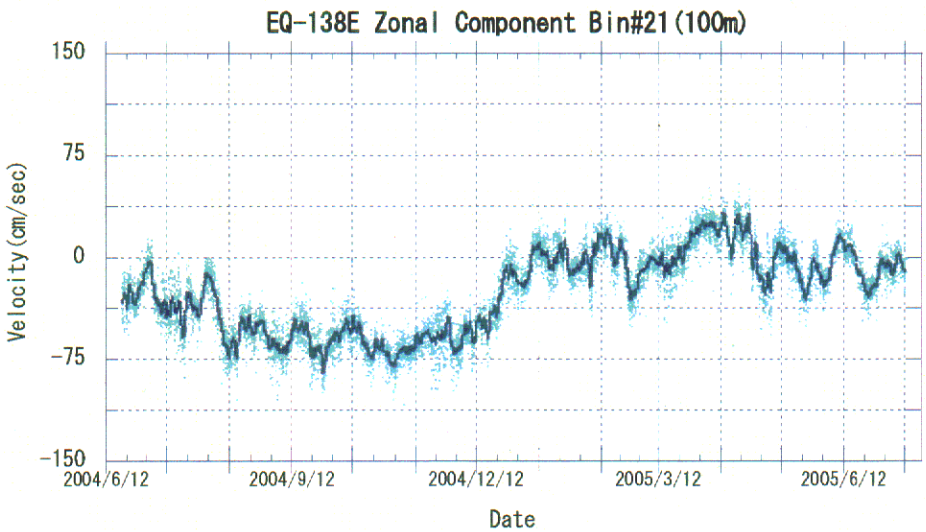


Fig.7-2-1 Time Series of zonal and meridional velocities of EQ-138E mooring at bin# 27 (2004/6/19-2005/7/13)



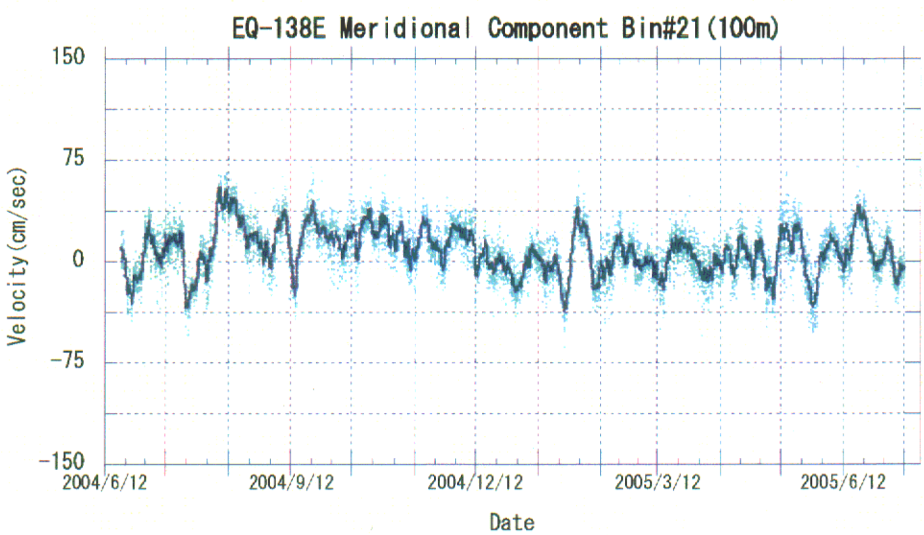
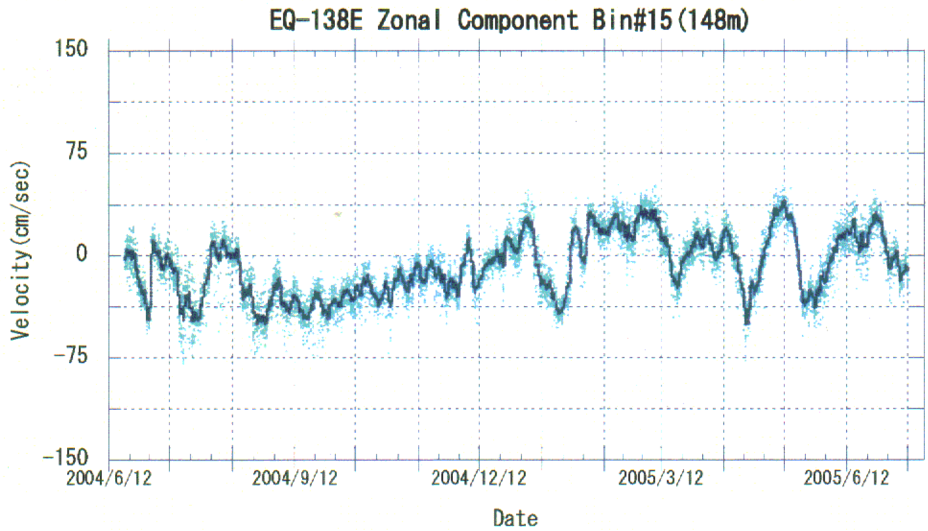


Fig.7-2-2 Time Series of zonal and meridional velocities of EQ-138E mooring at bin# 21
(2004/6/19-2005/7/13)



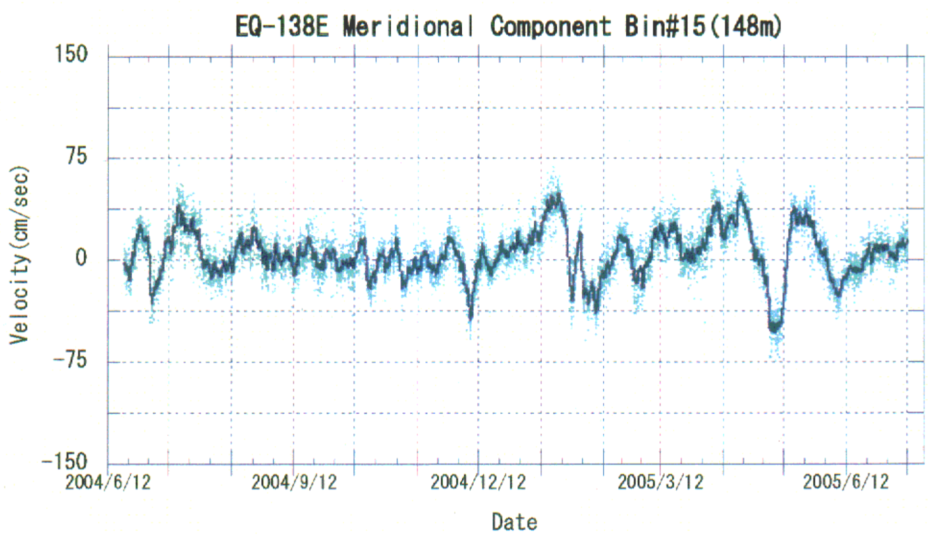


Fig.7-2-3 Time Series of zonal and meridional velocities of EQ-138E mooring at bin# 15
(2004/6/19-2005/7/13)

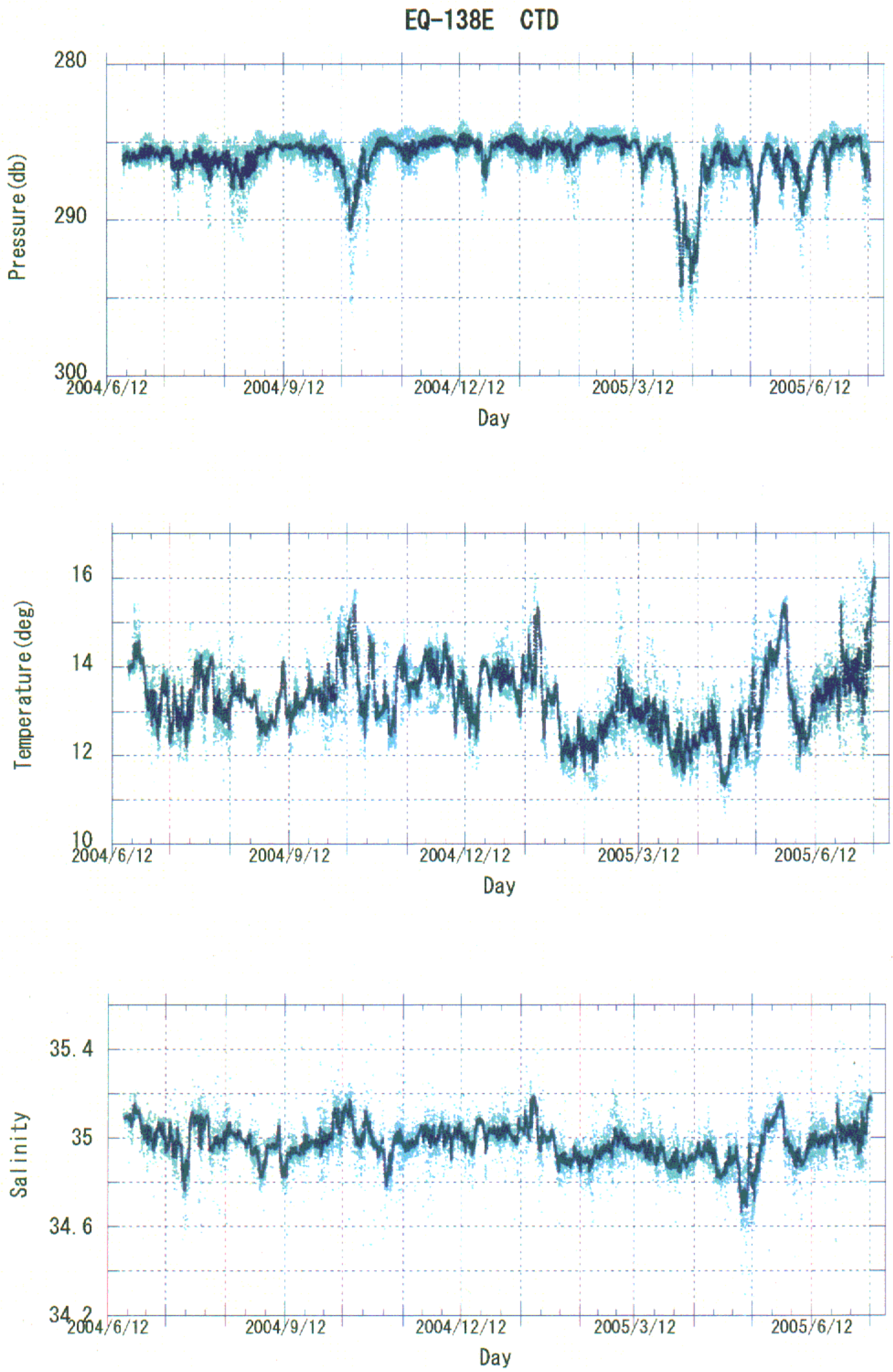
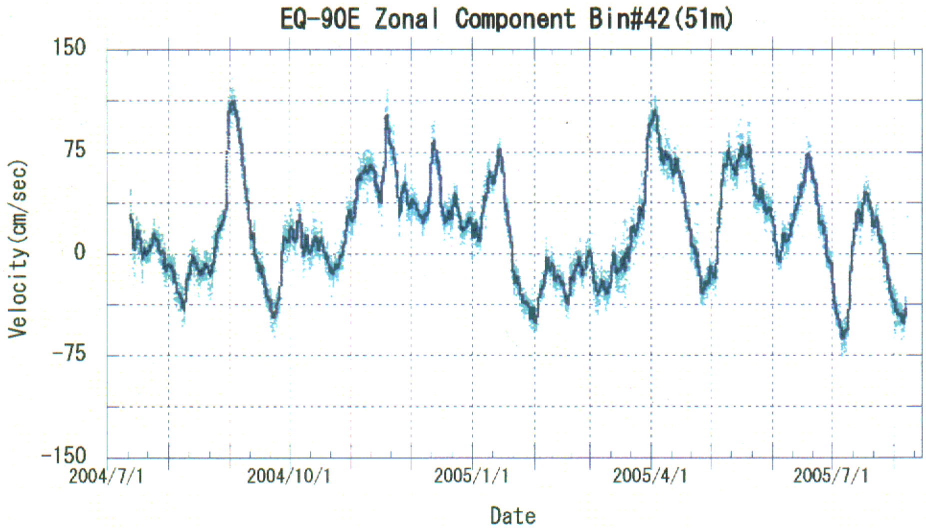


Fig.7-2-4 Time Series of pressure, temperature, salinity of obtained with CTD of EQ-138E mooring (2004/6/19-2005/7/13)



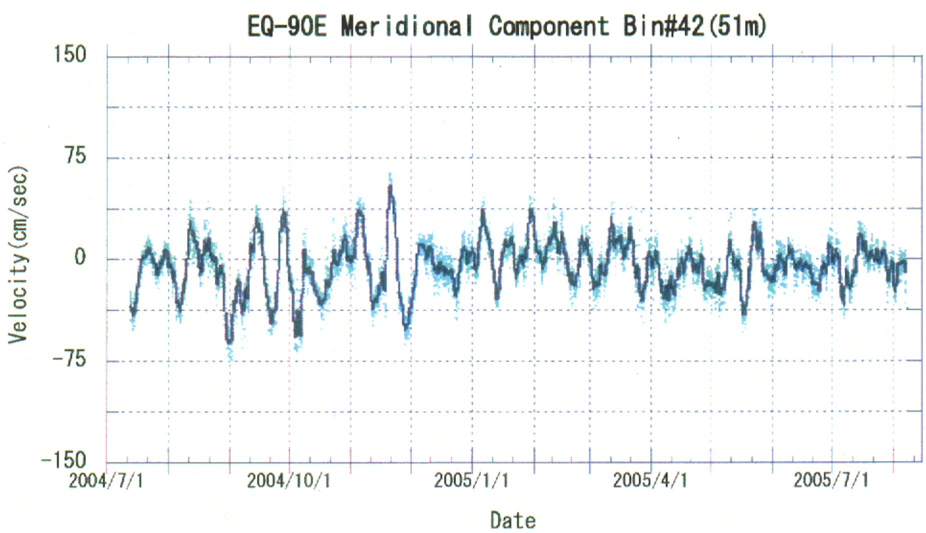
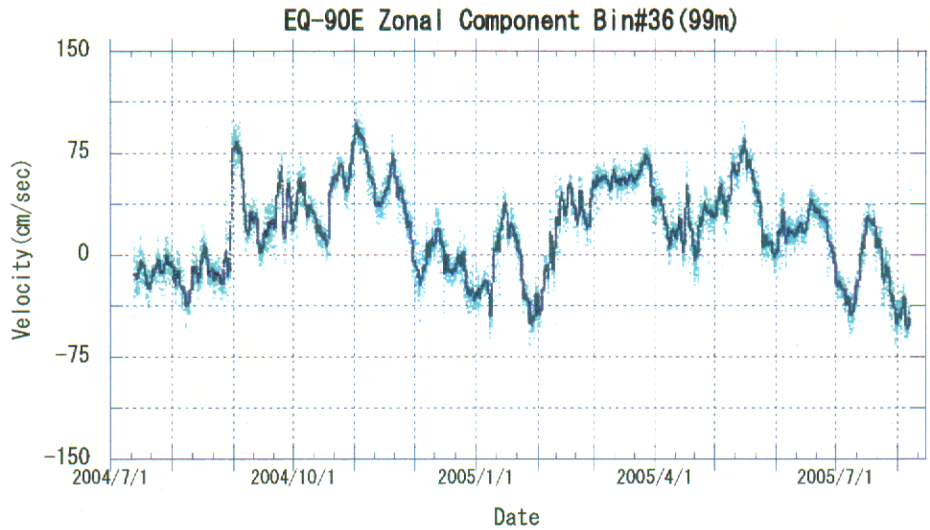


Fig.7-2-5 Time Series of zonal and meridional velocities of EQ-90E mooring at bin# 42 (2004/7/13-2005/8/8)



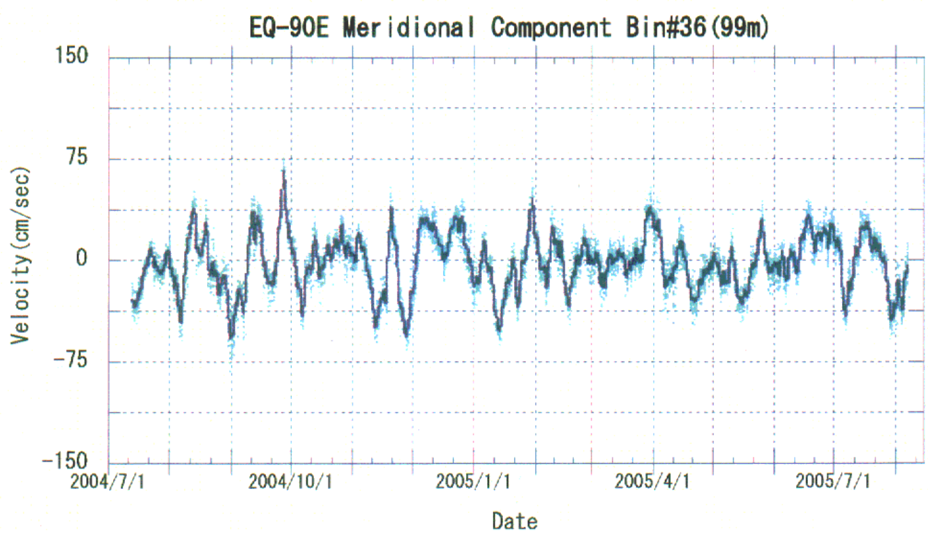
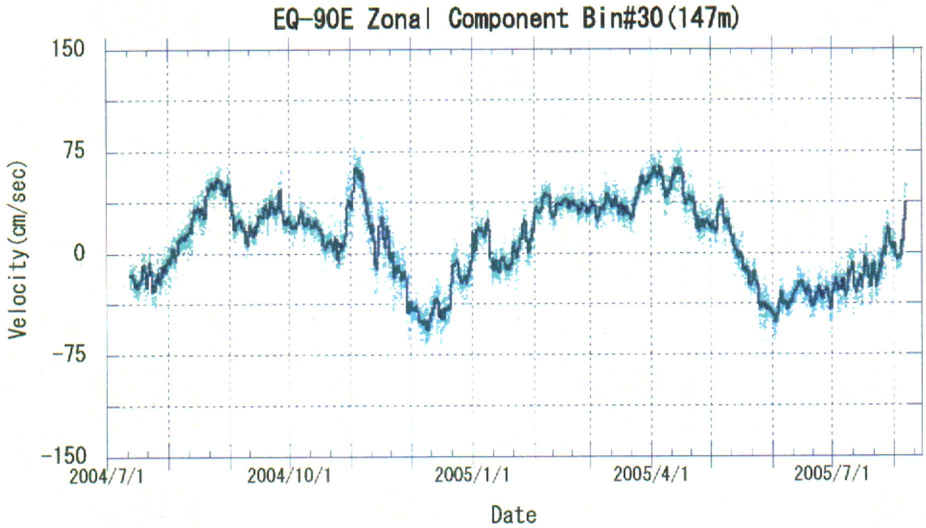


Fig.7-2-6 Time Series of zonal and meridional velocities of EQ-90E mooring at bin# 36 (2004/7/13-2005/8/8)



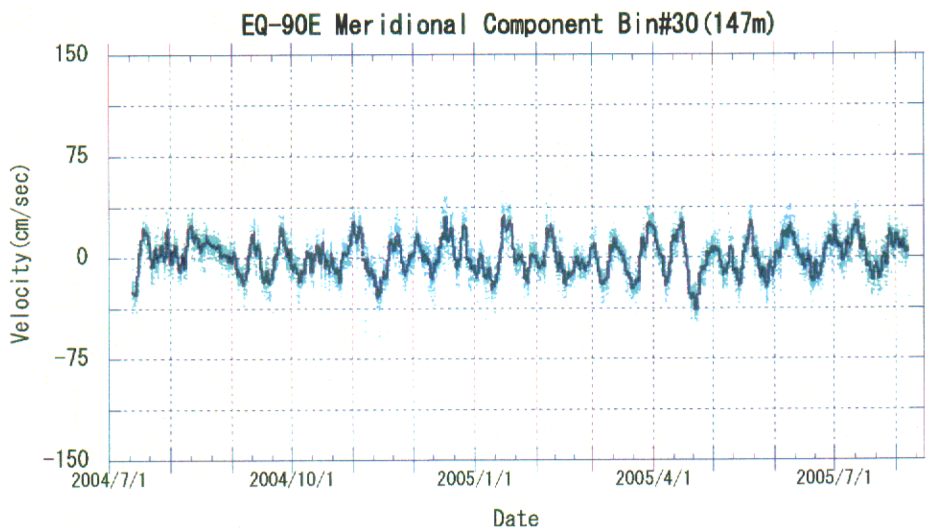


Fig.7-2-7 Time Series of zonal and meridional velocities of EQ-90E mooring at bin# 30 (2004/7/13-2005/8/8)

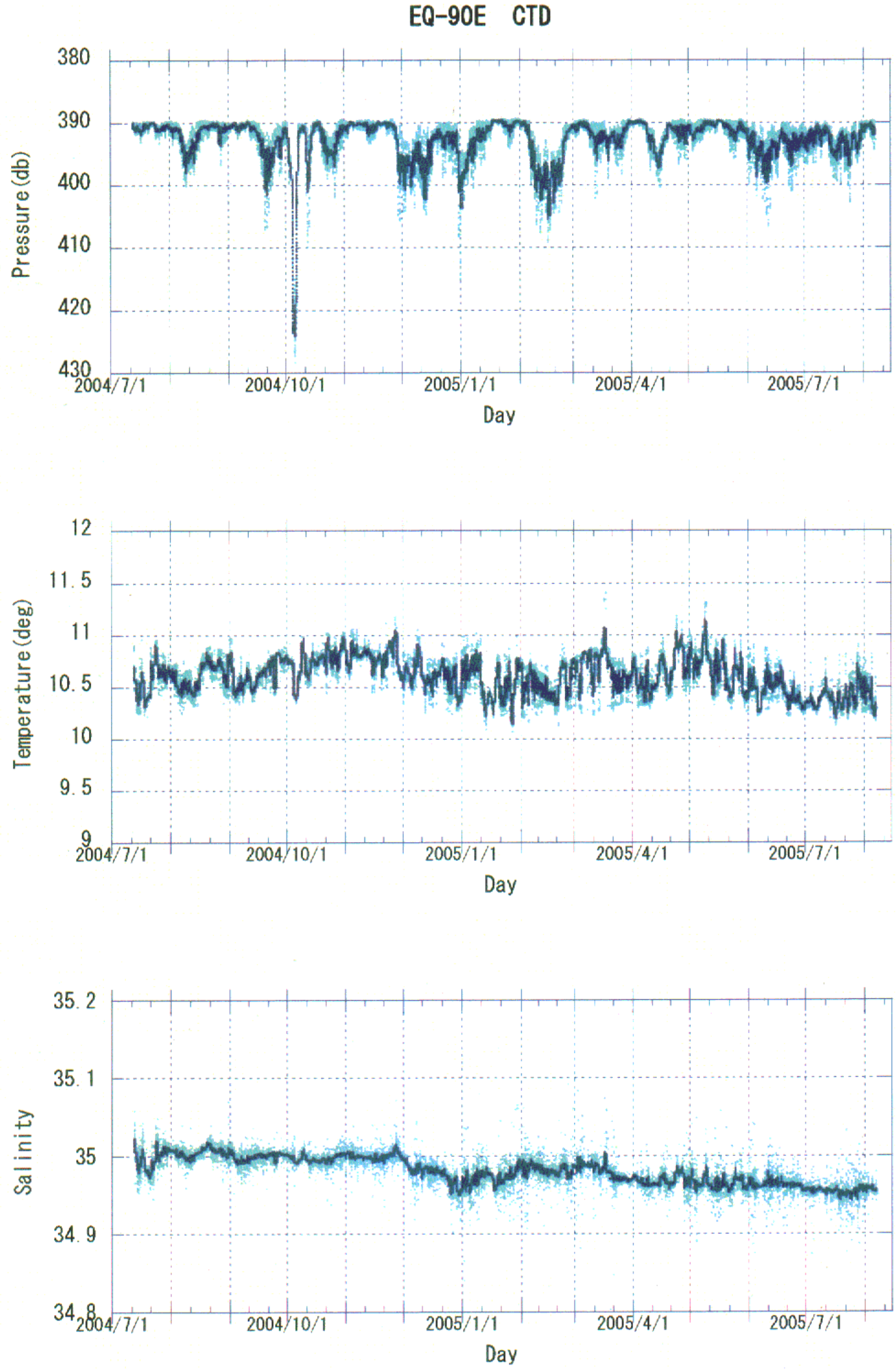


Fig.7-2-8 Time Series of pressure, temperature, salinity of obtained with CTD of EQ-90E mooring (2004/7/13-2005/8/8)

7.3 Shallow Water CTD and Fluorescence Observation

(1) Personnel

Naoki Nakatani (Osaka Prefecture University): Principal Investigator

Kana Kuroda (Osaka Prefecture University)

Daichi Hamamiya (Osaka Prefecture University)

Atsuko Nakajima (Osaka Prefecture University)

(2) Objectives

In order to clarify the primary production in the ocean, it is very important to know a vertical concentration of phytoplankton. We carried out the shallow water observation to understand the temporal and spatial variations of environment with biological production in the euphotic layer.

(3) Methods

We observed vertical profiles of temperature, conductivity, fluorescence, turbidity, and light intensity by sensor units from surface to 200 m depth every 0.1 sec. The Conductivity Temperature Depth profiler with fluorescence sensor (Compact-CTD ASTD687, S/N 33, Alec Electronics Co. Ltd.) and the light intensity sensor (Compact-LW ALW-CMP, S/N 33, Alec Electronics Co. Ltd.) were attached to CTD/water sampler which is equipped on board of the vessel. Descending and ascending rate were kept about 0.5 m/s respectively. Salinity was calculated from observed pressure, conductivity and temperature. The log data is shown in Table 7.3.1. Light intensity was not observed at morning cast after 16th July because it's value is very small. Instead we observed fluorescence at morning cast using another sensor (Compact-CL ACLW-CMP, S/N 36, Alec Electronics Co. Ltd.) because of cross check for fluorescence sensor. The water samplings at four layers were carried out on the cast before and after the noon because of calibration for fluorescence. Fluorescence was recorded as the raw data (N value: 0 to 65520), and we will calibrate the fluorescence data using the chlorophyll-a pigment data which was analyzed by MWJ.

Accuracy of the sensors is as follows;

Depth : ±0.3 %FS

Temperature :±0.02 ℃

Conductivity : ±0.05 mS/cm

Fluorescence : ±1.0 %FS

Light intensity : ±4.0 %FS

Turbidity : ±2.0 %FS

(4) Preliminary Results

Figure 7.3.1 shows the oceanic profiles at 8N 137E. Mixed layer depth was almost 40m. But the maximum depth of phytoplankton was about 60-70 m under the mixed layer depth. Phytoplankton formed the sharp shape at top of vertical distribution. Figure 7.3.2 shows the profiles at 5N 137E. The large gradients of density were not observed. The maximum layer of phytoplankton was located about shallower 40-60m. We could see that the strong light intensity urged the phytoplankton to spring. The results at 2N 138E are showed by Fig. 7.3.3. The large gradients layer of density existed at 75m and the maximum layer of phytoplankton was located in this position. The phytoplankton increased by light but the amount of growth was not large. Figure 7.3.4 suggests the results at 0N 138E. The high-density gradient existed at from 60 to 80m and moved up and down. The phytoplankton formed the maximum layer in this position and decreased gradually under the maximum layer. Figure 7.3.5 shows the results at 8N 130E. Though the mixed layer depth was almost at 40m, the maximum layer depth of phytoplankton moved between 60m and 80m. These tendency was similar to 8N 138E. Last figures (Fig. 7.3.6) show the profiles of 2N 130E. The high-density gradient repeated occurrence and disappearance because the distribution of density changed widely. Therefore the shape of phytoplankton distribution was fluctuated. After 21 July, fluorescence decreased in mixing layer as light intensity became weak.

(5) Data Archives

The raw data will be submitted to the DMO of JAMSTEC. And the data will have a quality check in Osaka Prefecture University, and will be distributed to the public later.

Table 7.3.1 Shallow Water CTD Cast Table

CAST No.	File name *.raw	Lat.	Long.	Date[LST] LST=UTC+9h	Start Time	End Time	Water Sampling	Note
1	0706CTD_0001 0706Li_0001	07-50.53N	136-30.50E	06.Jul.2005	6:47	7:06	none	
2	0706CTD_0002 0706Li_0002	07-50.20N	136-29.63E	06.Jul.2005	11:59	12:21	30,50,70,90m	
3	0706CTD_0003 0706Li_0003	07-51.40N	136-28.51E	06.Jul.2005	15:59	16:17	none	
4	0707CTD_0001 0707Li_0001	07-39.99N	136-41.40E	07.Jul.2005	6:45	7:01	none	
5	0707CTD_0002 0707Li_0002	07-40.57N	136-38.39E	07.Jul.2005	12:27	12:45	30,50,70,90m	
6	0707CTD_0003 0707Li_0003	07-40.11N	136-38.35E	07.Jul.2005	15:58	16:14	none	
7	0708CTD_0001 0708Li_0001	04-56.00N	137-19.10E	08.Jul.2005	6:44	7:02	none	
8	0708CTD_0002 0708Li_0002	04-54.16N	137-17.29E	08.Jul.2005	12:33	12:55	40,50,60,80m	
9	0708CTD_0003 0708Li_0003	04-56.23N	137-19.10E	08.Jul.2005	15:57	16:13	none	
10	0709CTD_0001 0709Li_0001	04-51.54N	137-17.39E	09.Jul.2005	6:43	7:01	none	
11	0709CTD_0002 0709Li_0002	04-52.50N	137-18.20E	09.Jul.2005	12:57	13:19	40,50,60,80m	
12	0709CTD_0003 0709Li_0003	04-51.78N	137-17.75E	09.Jul.2005	15:56	16:13	none	
13	0710CTD_0001 0710Li_0001	01-59.80N	138-06.19E	10.Jul.2005	6:43	7:01	none	
14	0710CTD_0002 0710Li_0002	01-59.65N	138-06.71E	10.Jul.2005	11:57	12:17	50,60,70,90m	
15	0710CTD_0003 0710Li_0003	02-02.81N	138-04.90E	10.Jul.2005	15:56	16:12	none	
16	0711CTD_0001 0711Li_0001	02-03.30N	138-04.76E	11.Jul.2005	6:42	6:59	none	
17	0711CTD_0002 0711Li_0002	02-00.77N	138-03.23E	11.Jul.2005	12:55	13:15	50,60,70,90m	
18	0711CTD_0003 0711Li_0003	02-00.25N	138-03.25E	11.Jul.2005	15:57	16:14	none	
19	0712CTD_0001 0712Li_0001	00-01.44N	138-00.12E	12.Jul.2005	6:42	6:59	none	
20	0712CTD_0002 0712Li_0002	00-03.25N	138-00.20E	12.Jul.2005	11:28	11:48	60,70,80,90m	
21	0712CTD_0003 0712Li_0003	00-02.00N	137-57.71E	12.Jul.2005	15:54	16:11	none	
22	0713CTD_0001 0713Li_0001	00-01.56N	137-55.40E	13.Jul.2005	6:41	6:58	none	
23	0713CTD_0002 0713Li_0002	00-02.20S	137-59.27E	13.Jul.2005	11:55	12:15	50,60,70,80m	
24	0713CTD_0003 0713Li_0003	00-00.10N	137-58.96E	13.Jul.2005	15:57	16:13	none	
25	0716CTD_0001 0716Ch_0001	07-59.26N	130-00.65E	16.Jul.2005	6:42	7:02	none	light intensity was not observed
26	0716CTD_0002 0716Li_0002	07-59.60N	130-01.92E	16.Jul.2005	12:55	13:15	60,70,80,90m	
27	0716CTD_0003 0716Li_0003	07-59.38N	130-01.72E	16.Jul.2005	15:50	16:12	none	
28	0717CTD_0001 0717Ch_0001	07-56.50N	130-03.93E	17.Jul.2005	6:43	7:02	none	light intensity was not observed
29	0717CTD_0002 0717Li_0002	07-56.24N	130-04.06E	17.Jul.2005	12:25	12:46	60,70,80,90m	
30	0717CTD_0003 0717Li_0003	07-59.83N	130-00.32E	17.Jul.2005	15:55	16:11	none	

Table 7.3.1 Shallow Water CTD Cast Table (continue)

CAST No.	File name *.raw	Lat.	Long.	Date[LST] LST=UTC+9h	Start Time	End Time	Water Sampling	Note
31	0720CTD_0001 0720Ch_0001	02-01.77N	130-11.40E	20.Jul.2005	6:43	7:00	none	light intensity was not observed
32	0720CTD_0002 0720Li_0002	02-01.97N	130-11.48E	20.Jul.2005	10:25	10:41	none	
33	0720CTD_0003 0720Li_0003	02-02.01N	130-11.72E	20.Jul.2005	12:54	13:14	50,60,70,80m	
34	0720CTD_0004 0720Li_0004	02-04.98N	130-15.49E	20.Jul.2005	15:56	16:15	none	
35	0721CTD_0001 0721Ch_0001	01-59.34N	129-53.90E	21.Jul.2005	6:41	6:59	none	light intensity was not observed
36	0721CTD_0002 0721Li_0002	02-00.17N	129-55.64E	21.Jul.2005	11:56	12:16	50,60,70,80m	
37	0721CTD_0003 0721Li_0003	01-59.85N	129-53.95E	21.Jul.2005	15:54	16:12	none	
38	0722CTD_0001 0722Ch_0001	02-02.07N	130-02.22E	22.Jul.2005	6:56	7:14	none	light intensity was not observed
39	0722CTD_0002 0722Li_0002	02-03.44N	130-03.19E	22.Jul.2005	9:56	10:14	none	
40	0722CTD_0003 0722Li_0003	02-04.25N	130-04.22E	22.Jul.2005	12:57	13:19	50,60,70,80m	
41	0722CTD_0004 0722Li_0004	02-03.53N	130-05.00E	22.Jul.2005	15:55	16:14	none	

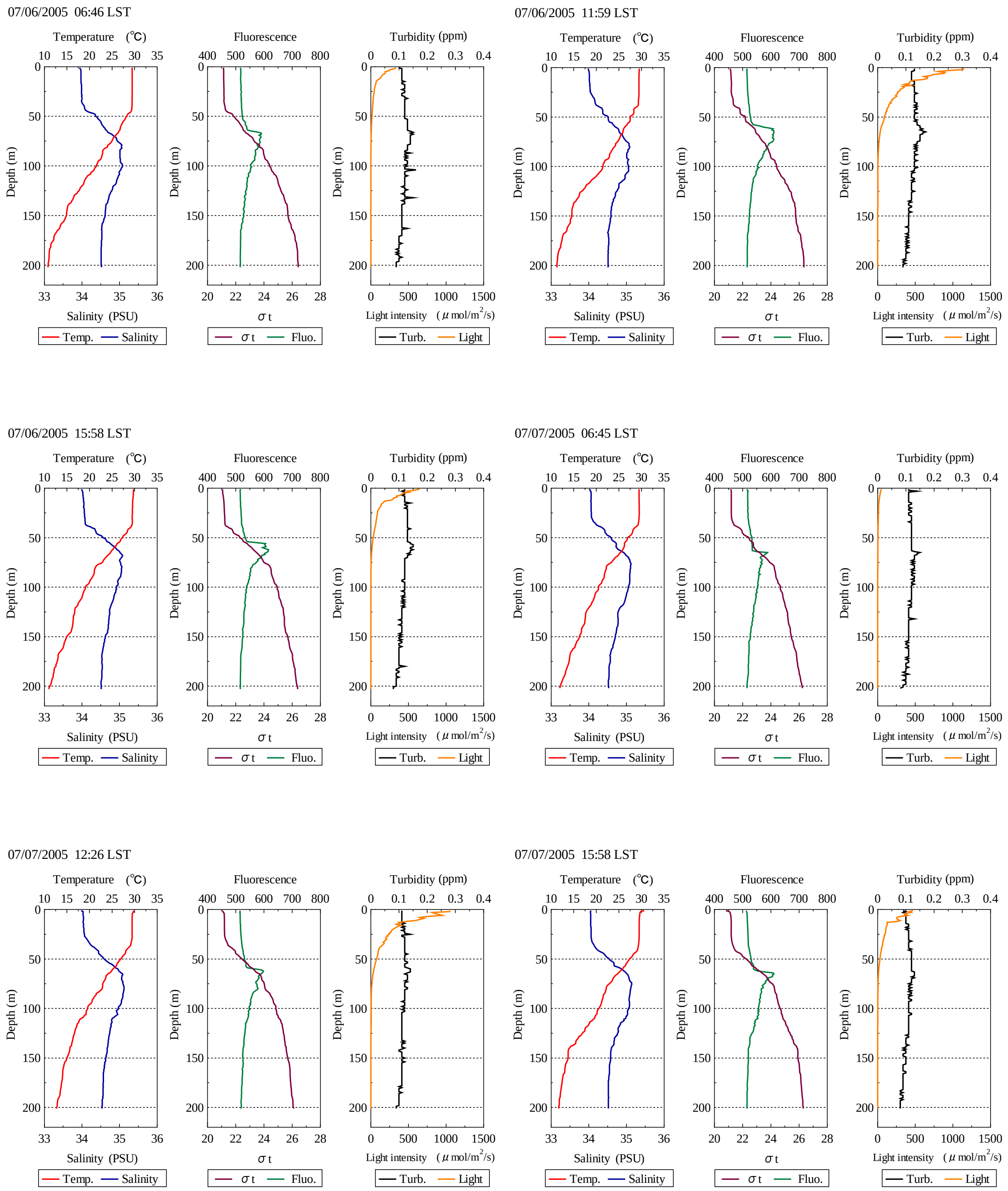


Fig.7.3.1 Oceanic profiles at 137E, 8N

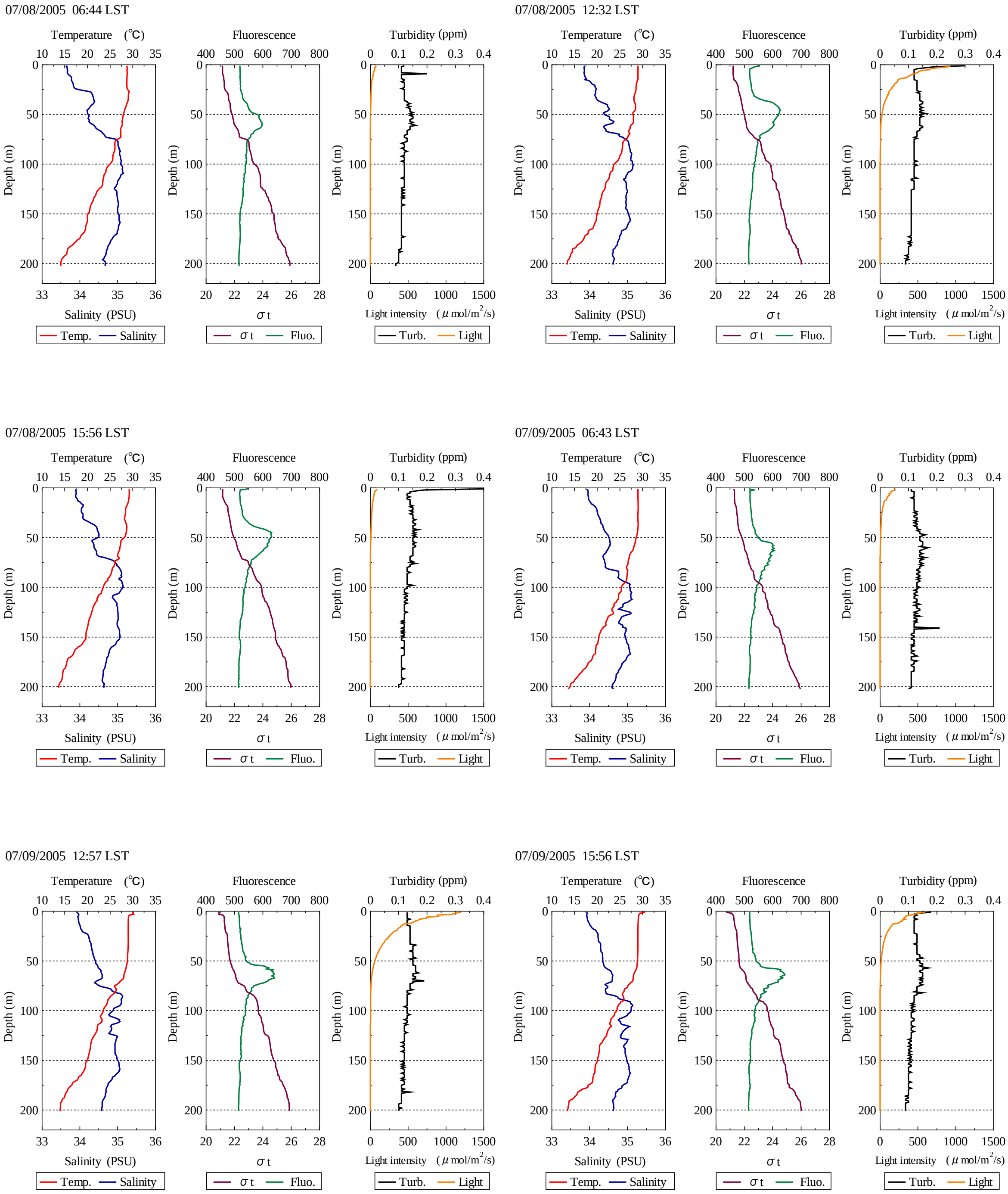


Fig.7.3.2 Oceanic profiles at 137E, 5N

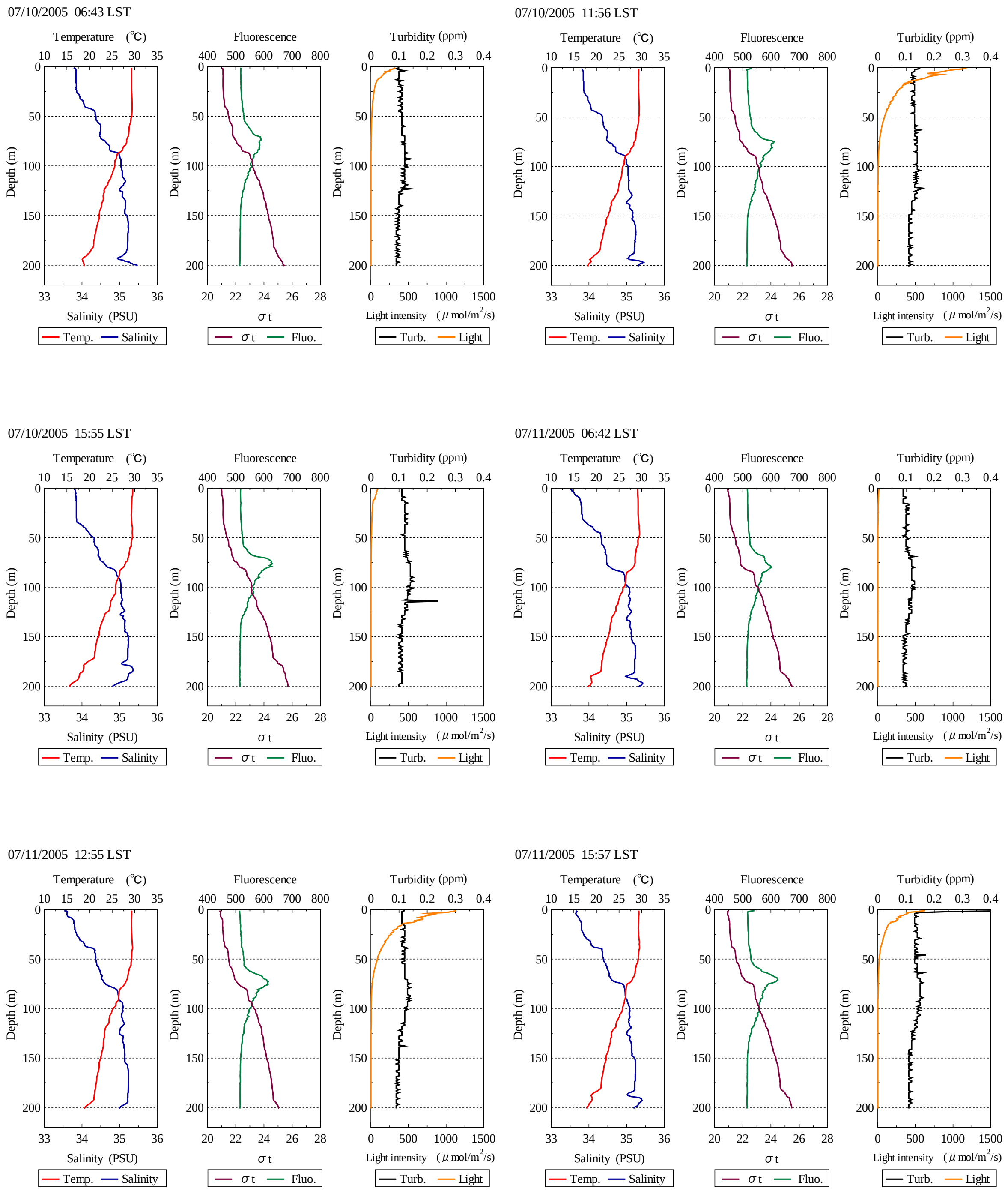


Fig.7.3.3 Oceanic profiles at 138E, 2N

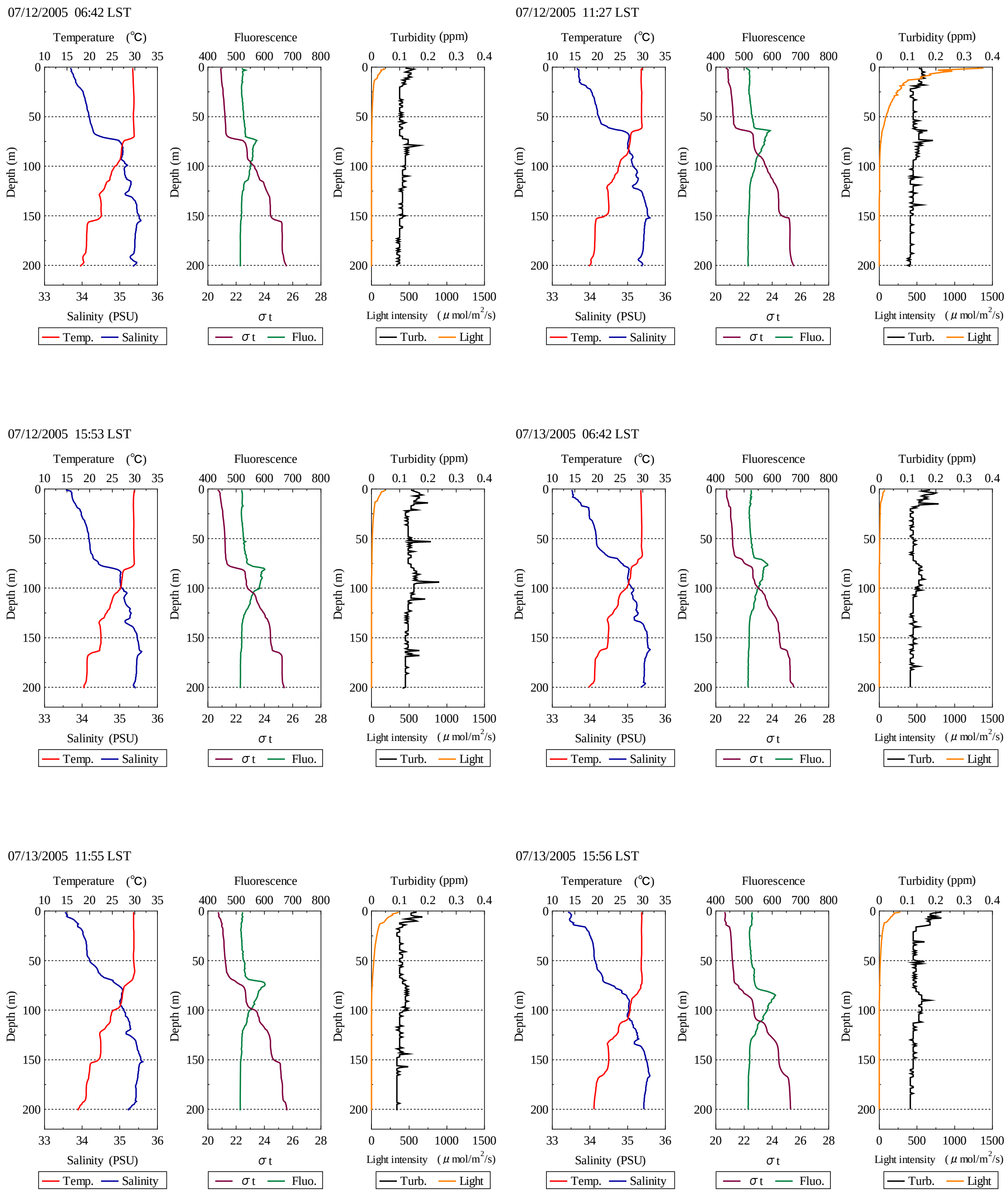


Fig.7.3.4 Oceanic profiles at 138E, 0N

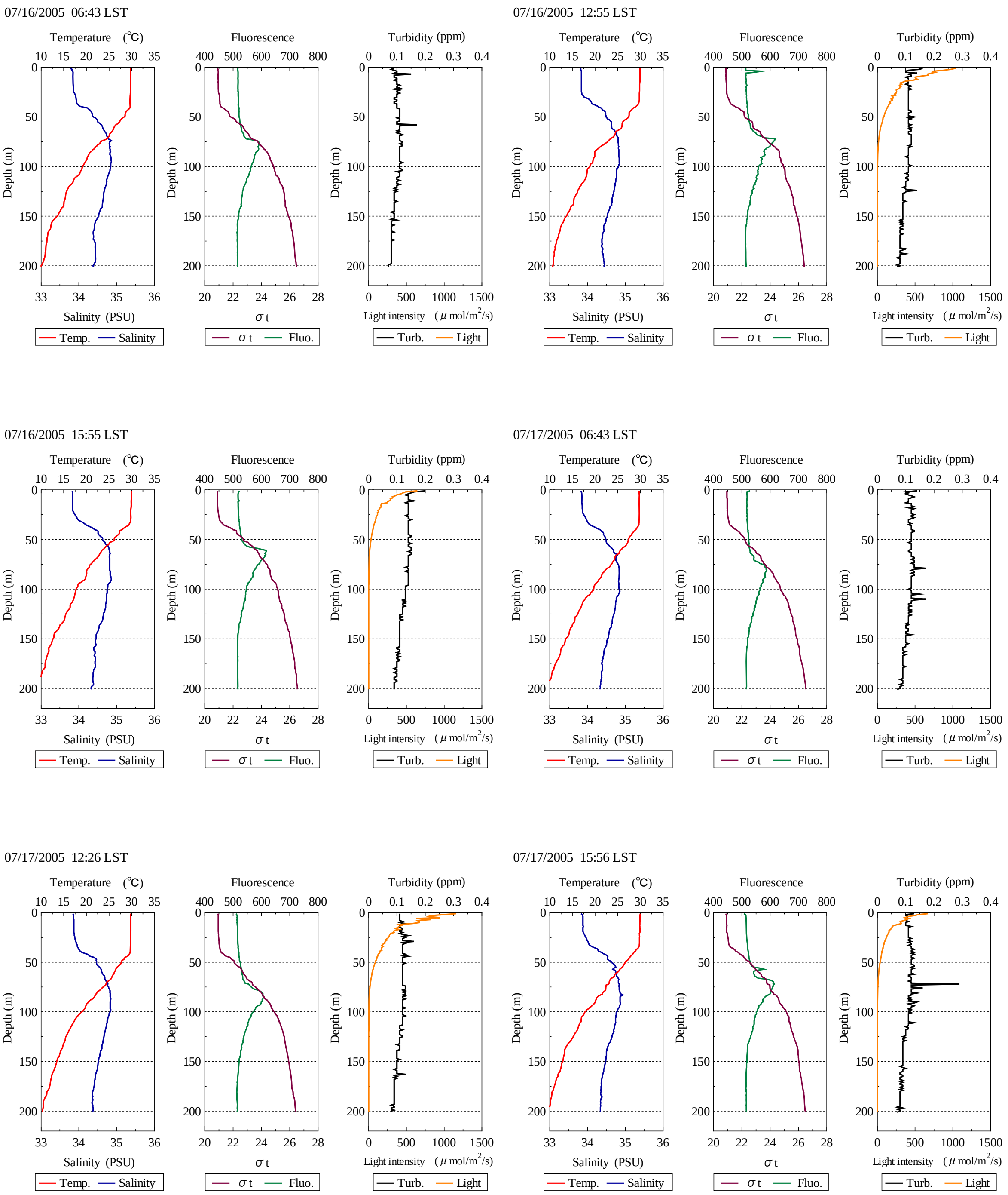


Fig.7.3.5 Oceanic profiles at 130E, 8N

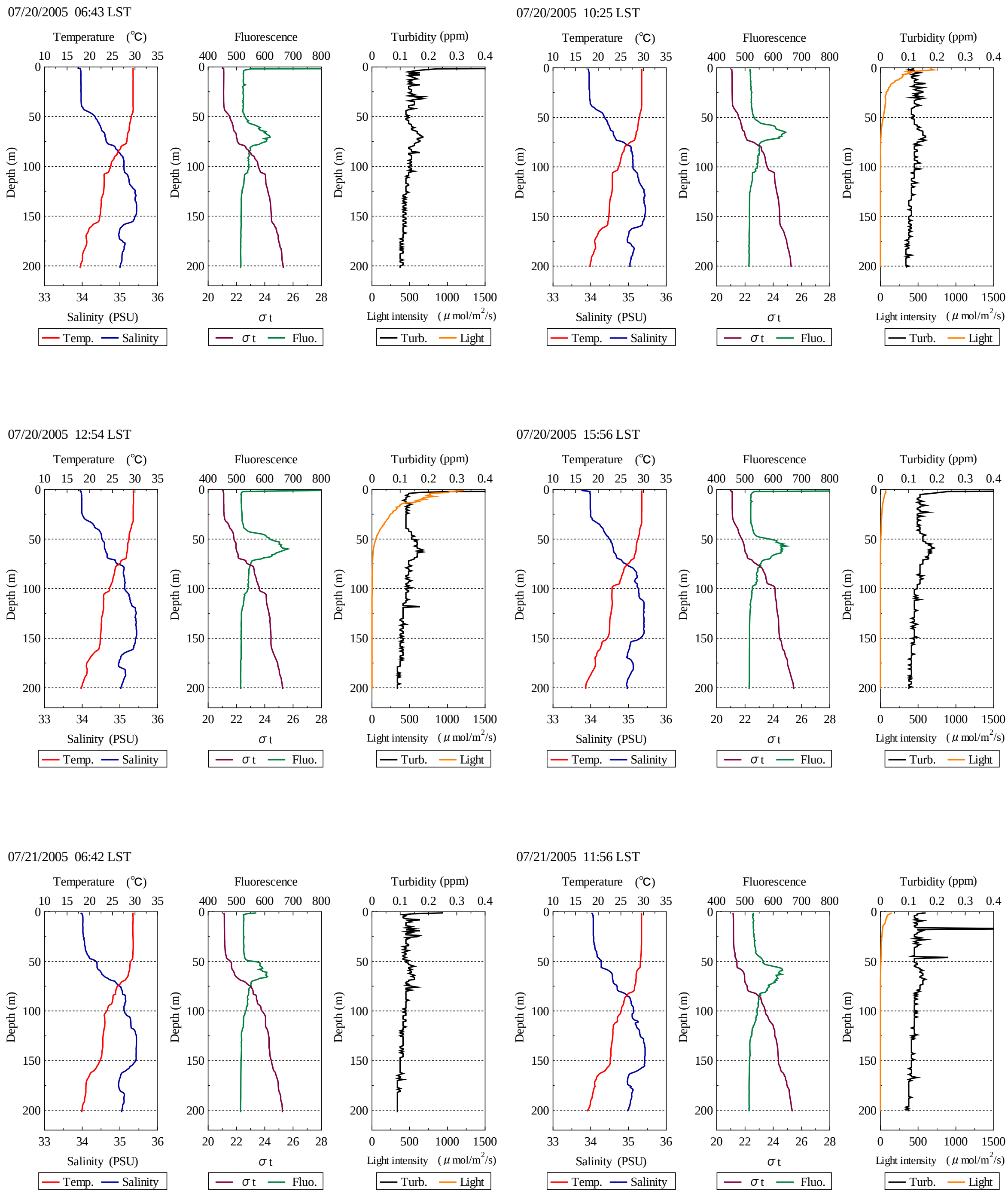
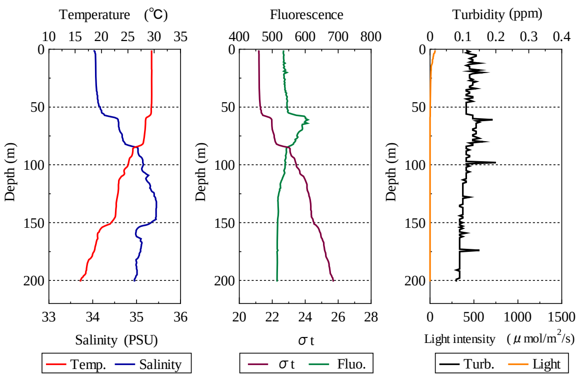
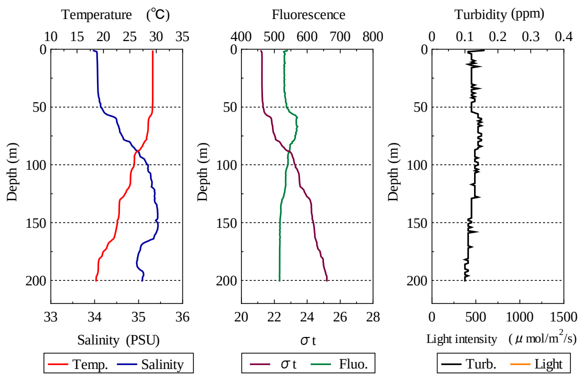


Fig.7.3.6 Oceanic profiles at 130E, 2N

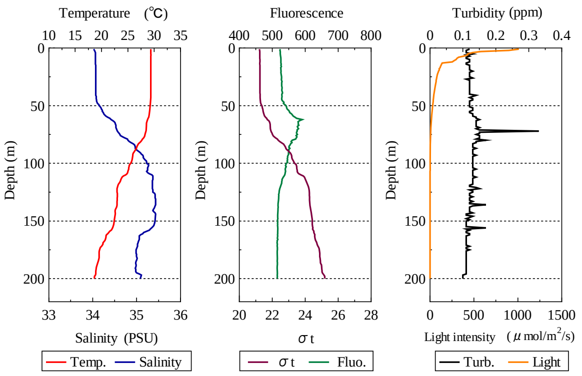
07/21/2005 15:55 LST



07/22/2005 06:56 LST



07/22/2005 9:56 LST



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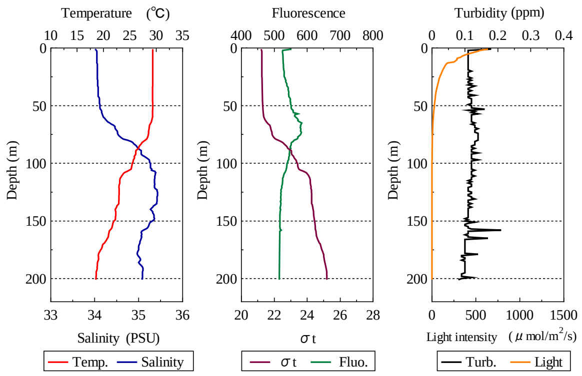


07/22/2005 15:56 LST

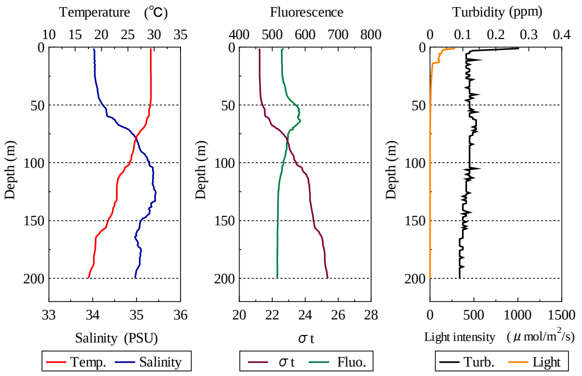


Fig.7.3.6 Oceanic profiles at 130E, 2N (continue)

7.4 Argo profiling float deployment

(1) Personnel

Nobue Shikama	(FORSGC): Principal Investigator (not on board)	
Hiromiti Ueno	(JAMSTEC)	not on board
Mizue Hirano	(JAMSTEC)	not on board
Masaki Taguchi*	(MWJ)	
Tomoyuki Takamori**	(MWJ)	
Hiroki Ushiromura**	(MWJ)	
Shinsuke Toyoda**	(MWJ)	

Leg1* Leg1&Leg2**

(2) Objectives

The objective of deployment is to clarify the structure and temporal/spatial variability of water masses in the subtropical Indian Ocean such as the South Pacific Eastern Subtropical Mode Water.

The profiling floats launched in this cruise obtain vertical profiles of temperature and salinity automatically every ten days. The data from the floats will enable us to understand the phenomenon mentioned above with time/spatial scales much smaller than those in the previous studies.

(3) Parameters

・water temperature, salinity, and pressure

(4) Methods

1) Profiling float deployment

We launched 2 APEX floats of JAMSTEC and 1 APEX float and 2 PROVOR floats of CSIRO. These floats equip an SBE41 CTD sensor manufactured by Sea-Bird Electronics Inc.

The floats usually drift at a depth of 2000 or 1500 dbar (called the parking depth), rising up to the sea surface every ten days by increasing their volume and thus changing the buoyancy. During the ascent, they measure temperature, salinity, and pressure. They stay at the sea surface for approximately nine hours, transmitting their positions and the CTD data to the land via the ARGOS system, and then return to the parking depth by decreasing volume. The status of floats and their launches are shown in Table 7.4-1.

(5) Data archive

All data acquired by the JAMSTEC floats through the ARGOS system is stored at JAMSTEC. The real-time data are provided to meteorological organizations via Global Telecommunication System (GTS) and utilized for analysis and forecasts of sea conditions.

Table 7.4-1 Status of floats and their launches

APEX

Float Type	APEX floats manufactured by Webb Research Ltd.
CTD sensor	SBE41 manufactured by Sea-Bird Electronics Inc.
Cycle	10 days (approximately 9 hours at the sea surface)
ARGOS transmit interval	30 sec
Target Parking Pressure	1500 or 2000 dbar

PROVOR

Float Type	PROVOR floats manufactured by METOCEAN Data Systems Ltd.
CTD sensor	SBE41 manufactured by Sea-Bird Electronics Inc.
Cycle	10 days
Target Parking Pressure	2000 dbar

Launches

Owner	Type	S/N	ARGOS PTT ID	Date and Time of Reset (UTC)	Date and Time of Launch (UTC)	Location of Launch
JAMSTEC	APEX	1583	23776	06:22, Jul. 21	07:19, Jul. 21	02-00.13 N, 129-54.11 E
JAMSTEC	APEX	1614	23808	13:09,Aug.10	14:25,Aug.10	02-59.87 S, 090-00.15 E
CSIRO	APEX	1923	53204	04:01,Aug.17	05:15,Aug.17	10-15.15 S, 109-59.53 E
CSIRO	PROVOR	122	34239	17:11,Aug.17	18:29,Aug.17	10-23.12 S, 112-59.75 E
CSIRO	PROVOR	123	34889	07:12,Aug.18	07:32,Aug.18	10-14.78 S, 115-59.68 E

7.5 Doppler radar and radio sonde observation

7.5.1 Doppler Radar

7.5.1-1 Observation in Leg1

(1) Personnel

Ryuichi Shirooka	(JAMSTEC) Principal Investigator (not on board)
Masaaki Katsumata	(JAMSTEC)
Kunio Yoneyama	(JAMSTEC)
Mikiko Fujita	(JAMSTEC) On-board Investigator
Satoshi Okumura	(GODI)
Souichiro Sueyoshi	(GODI) Operation Leader
Wataru Tokunaga	(GODI)
Kazuho Yoshida	(GODI)

(2) Objective

The Doppler radar is operated to obtain spatial and temporal distribution of rainfall amount, and structure of precipitating cloud systems. The objective of this observation is to investigate the mechanism, role and impact of the precipitating systems in the climate system.

(3) Methods

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

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

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

The observation is performed continuously from 5 July to 23 July 2005. During the observation, the “volume scan” (consists of PPIs for 18 elevations) with Doppler-mode (160-km range for reflectivity and Doppler velocity) had been obtained every 7.5 minutes. The “Surveillance” PPI at one elevation with Intensity-mode (300-km range for reflectivity) had been obtained every one hour. The parameters for the above three tasks are listed in Table 7.5.1-1.

(4) Preliminary Results

The temporal variation of the radar-derived precipitating area is shown in Fig.7.5.1-1. As shown, the radar detected widespread echo area, accompanied by MJO convectively active period. Diurnal variation with the afternoon peak is also implied. The further analyses are future work.

Table 7.5.1-1: Parameters for each task.

	Surveillance PPI	Volume Scan	RHI
Pulse Width	2 [microsec]	0.5 [microsec]	
Scan Speed	18 [deg./sec.]		Automatically determined
PRF	260 [Hz]	900 / 720 [Hz] (Dual PRF)	900 [Hz]
Sweep Integration	32 samples		
Ray Spacing	1.0 [deg.]		0.2 [deg.]
Bin Spacing	250 [m]	125 [m]	
Elevations	0.5	0.5, 1.2, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.1, 11.3, 12.8, 14.6, 16.6, 18.9, 21.6, 25.0, 29.0, 34.0, 40.0	0.0 to 60.0
Azimuths	Full Circle		Optional
Range	300 [km]	160 [km]	

(5) Data Archive

The inventory information of the Doppler radar data will be submitted to JAMSTEC DMD. The original data will be archived at and available from Ocean Observation and Research Department of JAMSTEC.

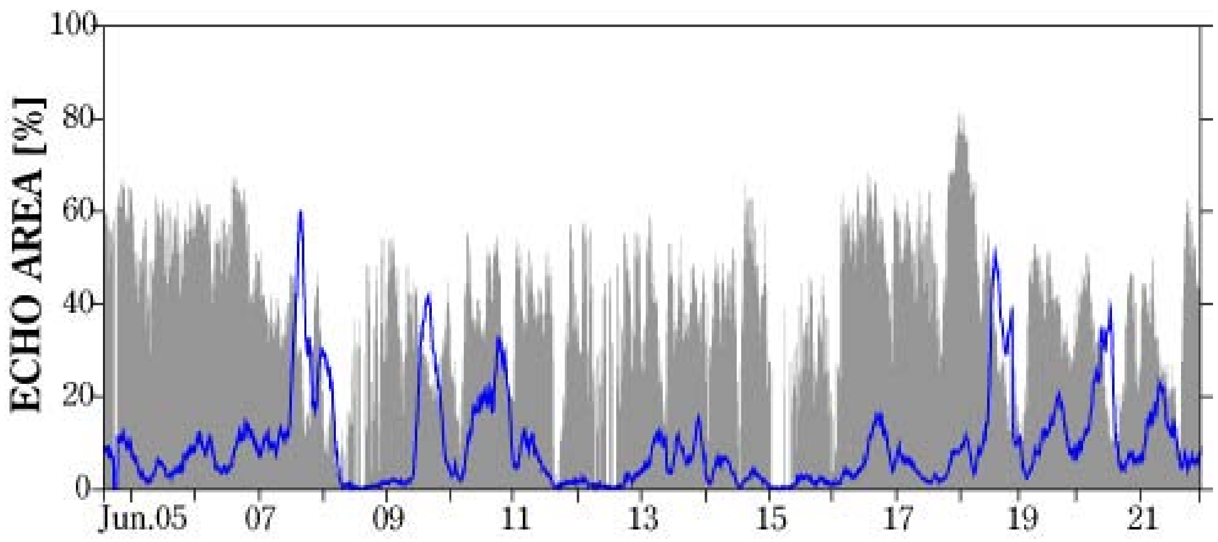


Fig. 7.5.1-1: Temporal variation of the echo area over 15dBZ obtained by surveillance PPI. The values are the ratios to the radar observation area within the range distance of 300-km (blue line). The ratio of echo area with convective cloud out of all cloud was showed by the gray bar (Tokay and Short, 1996).

7.5.1-2 Observation in Legs 2 and 3

(1) Personnel

Shuichi Mori	(JAMSTEC): Principal Investigator
Yasutaka Imai	(GODI): Legs 2 and 3
Wataru Tokunaga	(GODI): Leg 2
Shin-Ya Okumura	(GODI): Leg 2
Norio Nagahama	(GODI): Legs 2 and 3

(2) Objective

The objective of Doppler radar observation is to understand precipitating convective systems in the eastern Indian Ocean during boreal summer monsoon season in Leg 2 by obtaining both spatial and temporal distributions of rainfall amount and property, and structures of the precipitating convective system. Those in a typhoon over the western Pacific Ocean are investigated in Leg 3, too.

(3) Methods

The hardware specification of the shipboard Doppler radar and its calibration procedure are same as those in MR05-03 Leg 1.

The observation is performed continuously from July 28 through August 24, 2005 (except for July 29 23:50UTC – July 30 23:30UTC, August 15 21:00UTC – August 17 01:20UTC, and August 19 01:30UTC – August 22 05:00UTC) in Leg 2, and from August 26 through August 31, 2005 in Leg3.

During the observation, the programmed "tasks" are repeated every 10 minutes. One cycle consists of one "volume scan" (consists of PPIs for 21 elevations) with Doppler-mode (160 km range for reflectivity and Doppler velocity), one-elevation "surveillance" PPI with Intensity-mode (300 km range for reflectivity). In the interval of the cycles, RHI (Range Height Indicator) scans were operated to obtain detailed vertical cross sections with Doppler-mode. The Doppler velocity is unfolded automatically by dual PRF unfolding algorithm. The parameters for the above three tasks are listed in Table 7.5.1-2-1.

(4) Preliminary results

Continuous observation of Doppler radar has been carried out successfully without any trouble during this period. Results show pretty clear condition during the cruise and organized radar echoes were derived only for a few days in Leg 2. Major disturbances were observed on August 27-29 in Leg 3 over the western Pacific Ocean where a typhoon (TS0513, Talim) passed across the vessel as shown in Figs. 7.5.1-2-1 and 7.5.1-2-2. Detailed analyses with other obtained data are in future work after the quality check.

(5) Data archive

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

Table 7.5-1-2-1

	Surveillance PPI	Volume Scan	RHI
Pulse Width	2 [microsec.]	0.5 [microsec.]	
Scan Speed	18 [deg./sec.]		Automatically determined
PRF	260 [Hz]	900/720 [Hz]	
Sweep Integration	32 samples		
Ray Spacing	1.0 [deg.]		0.2 [deg.]
Bin Spacing	250 [m]	125 [m]	
Elevations	0.5	0.5, 1.2, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.1, 11.3, 12.8, 14.6, 16.6, 18.9, 21.6, 25.0, 29.0, 34.0, 40.0	0.0 to 65.0
Azimuths	Full Circle		Optional
Range	300 km	160 [km]	

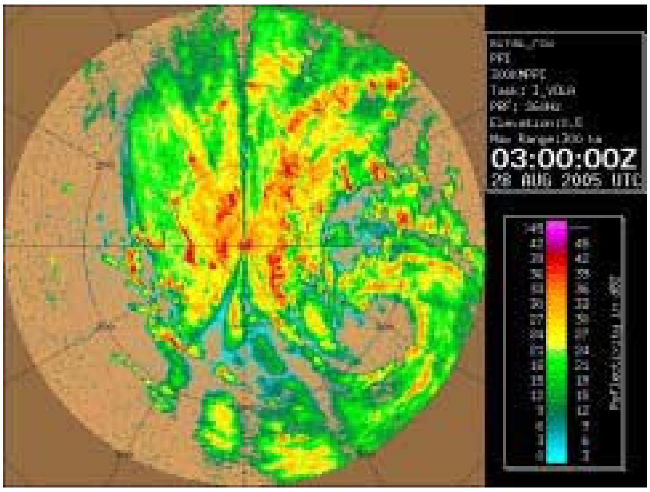


Fig. 7.5.1-2-1 Radar reflectivity field obtained with surveillance (intensity-mode) PPI at 03UTC on August 28, 2005. An eye of TS0513 (Talim) is located at 200 km SSE from R/V Mirai. Horizontal range is 300km centered from the radar.

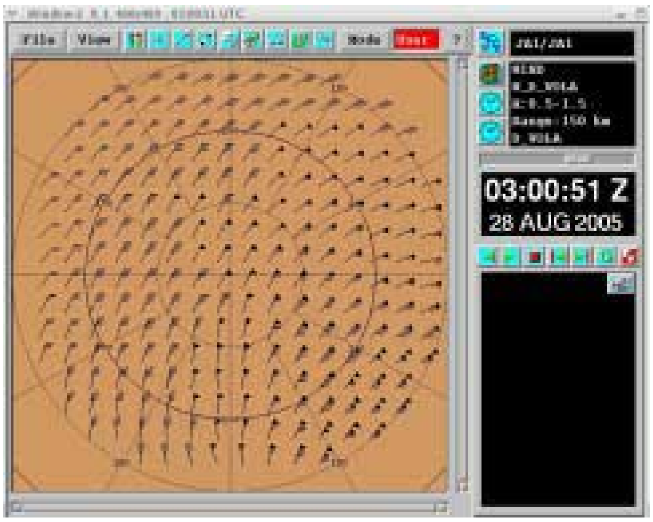


Fig. 7.5.1-2-2 Horizontal wind field at 3km above MSL calculated by VVP technique at 03UTC on August 28, 2003. Horizontal range is 150km centered from the radar.

7.5.2 Radio sonde Observation

7.5.2-1 Observation in Leg1

(1) Personnel

Ryuichi Shirooka	(JAMSTEC) Principal Investigator (not on board)
Kunio Yoneyama	(JAMSTEC)
Mikiko Fujita	(JAMSTEC) On-board Investigator
Satoshi Okumura	(GODI)
Souichiro Sueyoshi	(GODI)
Wataru Tokunaga	(GODI)
Kazuho Yoshida	(GODI)

(2) Objective

Atmospheric soundings of temperature, humidity, and wind speed/direction.

(3) Method

Atmospheric sounding by radiosonde was carried out every 6 hours around the Western Pacific Ocean from July 5 through July15, 2005. In total, 41 soundings were carried out (Table 7.5.2-1). The main system consists of processor (Vaisala, DigiCORA MW11), GPS antenna (GA20), UHF antenna (RB21), balloon launcher (ASAP), and GPS radiosonde sensor (RS90 and RS80-15GH).

(4) Preliminary results

Time-height cross sections of equivalent potential temperature, mixing ratio, zonal and meridional wind components are shown in Fig.x.1.1-1, respectively. Several basic parameters are calculated from sounding data (Fig. 7.5.2-1). In Appendix-C, vertical profiles of temperature and dew point temperature on the thermodynamic chart with wind profiles are also attached.

(5) Data archive

Data were sent to the world meteorological community by Global Telecommunication System through the Japan Meteorological Agency, immediately after the each observation. Raw data is recorded as ASCII format every 2 seconds during ascent. These raw datasets will be submitted to JAMSTEC Data Management Office. Corrected and projected onto every 5hPa level datasets are available from K.Yoneyama of JAMSTEC.

Table 5.1.1-1 Radiosonde launch log during the stationary observation.

Date	Lat.	Long.	Surface Conditions					Max Altitude		Cloud	
YYYYMMDDHH	degE	degN	hPa	degC	%	deg	m/s	hPa	m	Amount	Type
05070512	137.174	8.0227	1007.7	28.2	79	9	2.5	40.0	22,007	1	Cu
05070518	136.498	7.8439	1006.2	28.5	78	15	4.9	30.4	23,725	1	Cu
05070600	133.636	7.7037	1007.8	28.9	78	31	4.9	25.6	24,816	4	Cu,Cb,Ci
05070606	136.477	7.8728	1005.9	29.0	78	100	3.7	23.1	25,475	9	Cu,Ac
05070612	136.647	7.7015	1007.8	28.3	81	108	2.1	35.9	22,682	1	Cu
05070618	136.609	7.7191	1007.0	28.1	82	95	6.9	48.1	20,870	3	Cu,As
05070700	136.692	7.6578	1007.9	28.0	83	128	3.7	38.4	22,278	9	Cu,Sc
05070706	136.614	7.6932	1006.2	28.9	76	123	3.2	43.8	21,423	7	Cu,Cb,Ci
05070712	136.890	6.8058	1008.0	28.8	75	158	2.6	30.2	23,787	1	Cu
05070718	137.201	5.3925	1007.9	26.8	85	215	1.6	35.1	22,819	9	Cu,As
05070800	137.330	4.9441	1009.2	27.2	82	156	7.3	26.0	24,716	9	Cu,Cb,Cs
05070806	137.291	4.9104	1006.7	28.1	79	150	6.9	33.0	23,183	6	Cu,Cb,Ac,As,Cc
05070812	137.341	4.9122	1008.5	27.9	77	166	3.1	29.1	24,018	0	-
05070818	137.301	4.8827	1007.5	27.4	82	83	1.0	33.3	23,161	1	Cu
05070900	137.282	4.8608	1009.4	27.8	79	18	0.9	32.5	23,309	4	Cu,As
05070906	137.312	4.8692	1007.5	29.2	74	25	1.6	27.2	24,416	3	Cu,Ci
05070912	137.537	3.9107	1009.1	28.5	79	332	4.0	31.6	23,478	2	Cu
05070918	137.966	2.4450	1009.0	25.5	89	344	8.0	604.1	4,357	10	As
05071000	138.142	1.9211	1010.1	27.7	75	302	2.7	25.9	24,745	4	Cu,As
05071006	138.072	2.0641	1007.8	28.4	75	331	5.9	30.5	23,672	4	Cu,As,Ci
05071012	138.046	1.9986	1009.0	28.3	77	333	4.4	32.2	23,373	5	Unknown
05071018	138.031	2.0279	1008.7	26.3	86	167	3.1	52.8	20,321	10	Unknown
05071100	138.075	2.0628	1009.5	26.0	87	251	3.7	26.0	24,728	9	St,Cu,As
05071106	138.094	2.0120	1007.1	27.9	80	270	4.7	26.2	24,604	2	Cu,Cb
05071112	138.059	1.0881	1009.4	28.2	78	297	4.5	36.8	22,511	2	Cu,Sc
05071118	138.041	0.0983	1007.0	28.1	79	304	6.0	30.8	23,597	4	Cu
05071200	138.121	0.0250	1008.9	28.5	75	230	1.5	22.8	25,563	3	Cu,Ci,Cs
05071206	137.920	0.0357	1006.9	29.0	74	245	0.6	30.4	23,003	9	Cu,Cb,Sc,As
05071212	137.919	-0.0027	1008.8	28.8	74	63	1.1	33.7	23,049	7	As,Cs
05071218	137.892	-0.0530	1007.6	28.3	80	100	2.0	41.1	21,819	3	Cu,Sc
05071300	137.885	0.0410	1009.1	28.7	76	187	1.8	26.7	24,545	4	Cu,Ci,Cs
05071306	138.036	-0.0098	1006.8	28.3	78	236	0.5	116.2	15,711	9	Cu,As,Ac,Ci
05071312	137.332	0.6910	1009.0	28.7	75	44	2.3	27.0	24,441	9	Cu,Sc,As
05071318	136.323	1.7415	1007.5	28.4	77	19	1.0	34.5	22,897	4	Cu,As
05071400	135.307	2.7258	1008.7	28.8	77	4	2.2	28.1	24,166	4	Cu,Cb,Ac,As,Ci
05071406	134.304	3.7617	1007.0	24.5	90	152	1.1	27.0	24,371	10	Cb,As
05071412	133.380	4.6419	1008.0	27.4	85	230	3.0	29.8	23,843	1	Cu
05071418	132.526	5.5418	1007.0	27.8	83	343	0.1	33.3	23,146	3	Cu
05071500	131.646	6.3849	1007.9	28.4	78	205	3.5	24.6	24,985	4	Cu,Ci
05071506	130.585	7.3263	1005.0	29.0	73	197	3.2	23.3	25,316	5	Cu,As
05071512	129.996	7.9940	1006.3	28.9	78	212	5.7	33.1	23,185	6	Cu,Sc,Ns,Cs

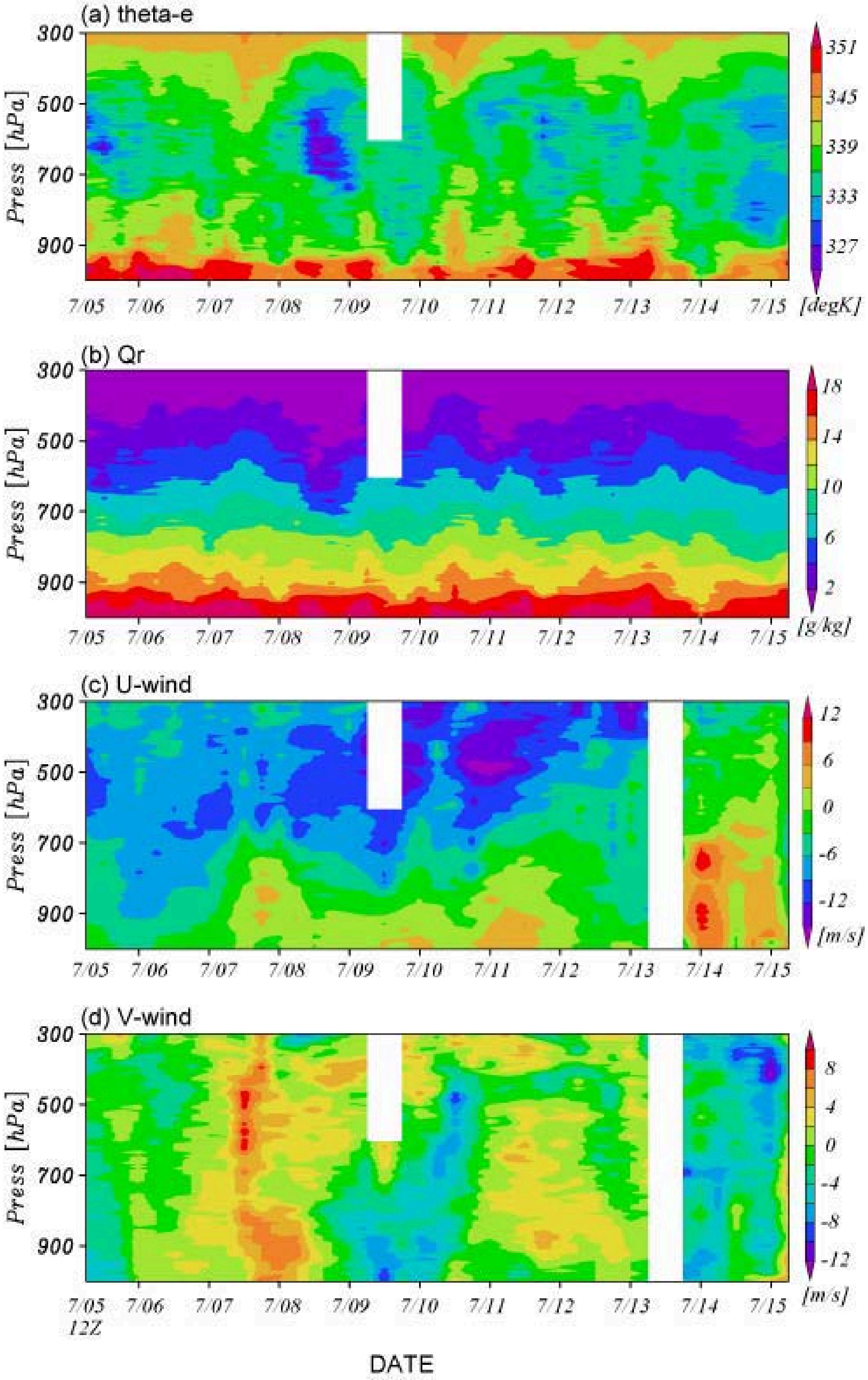
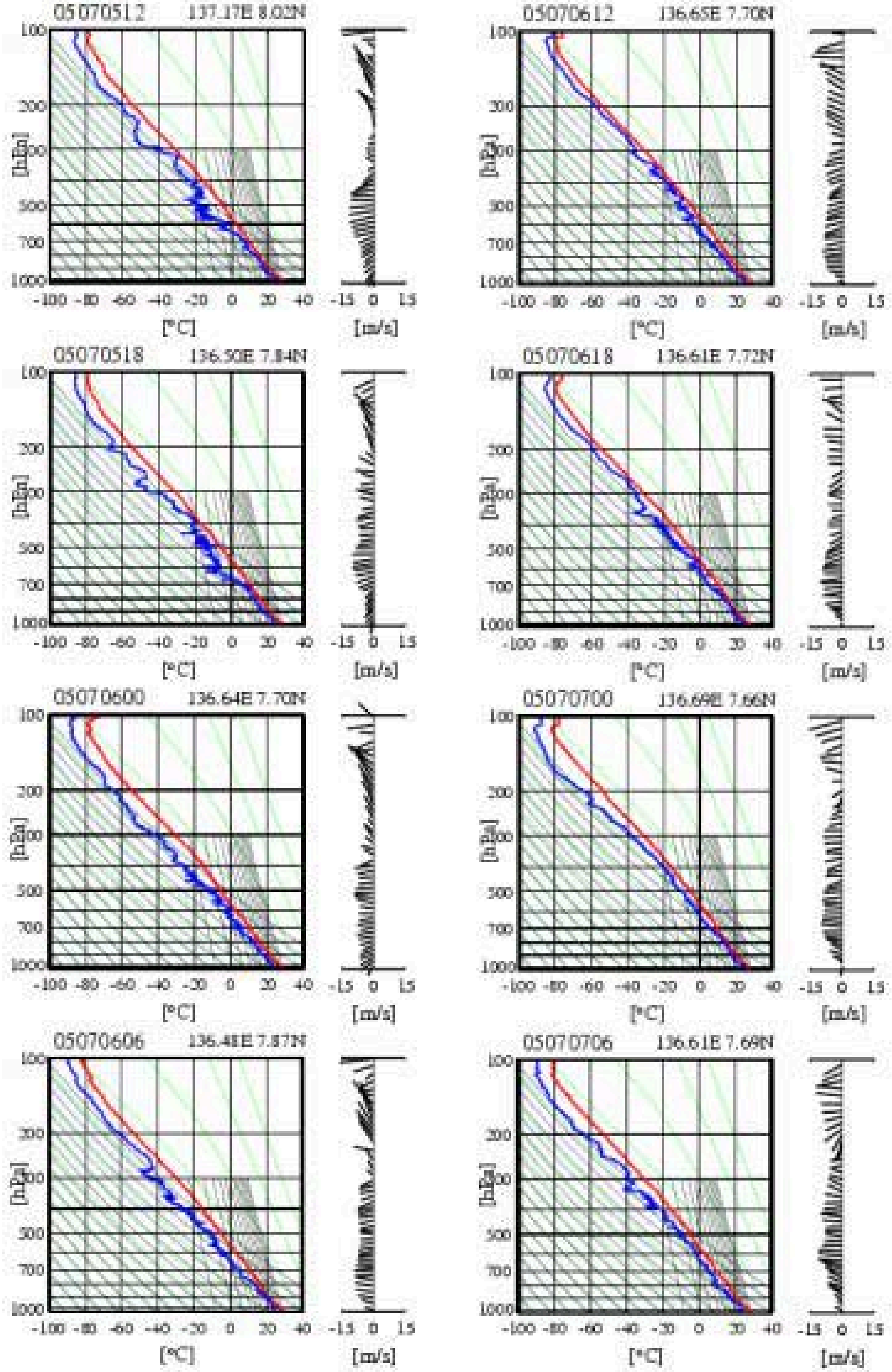
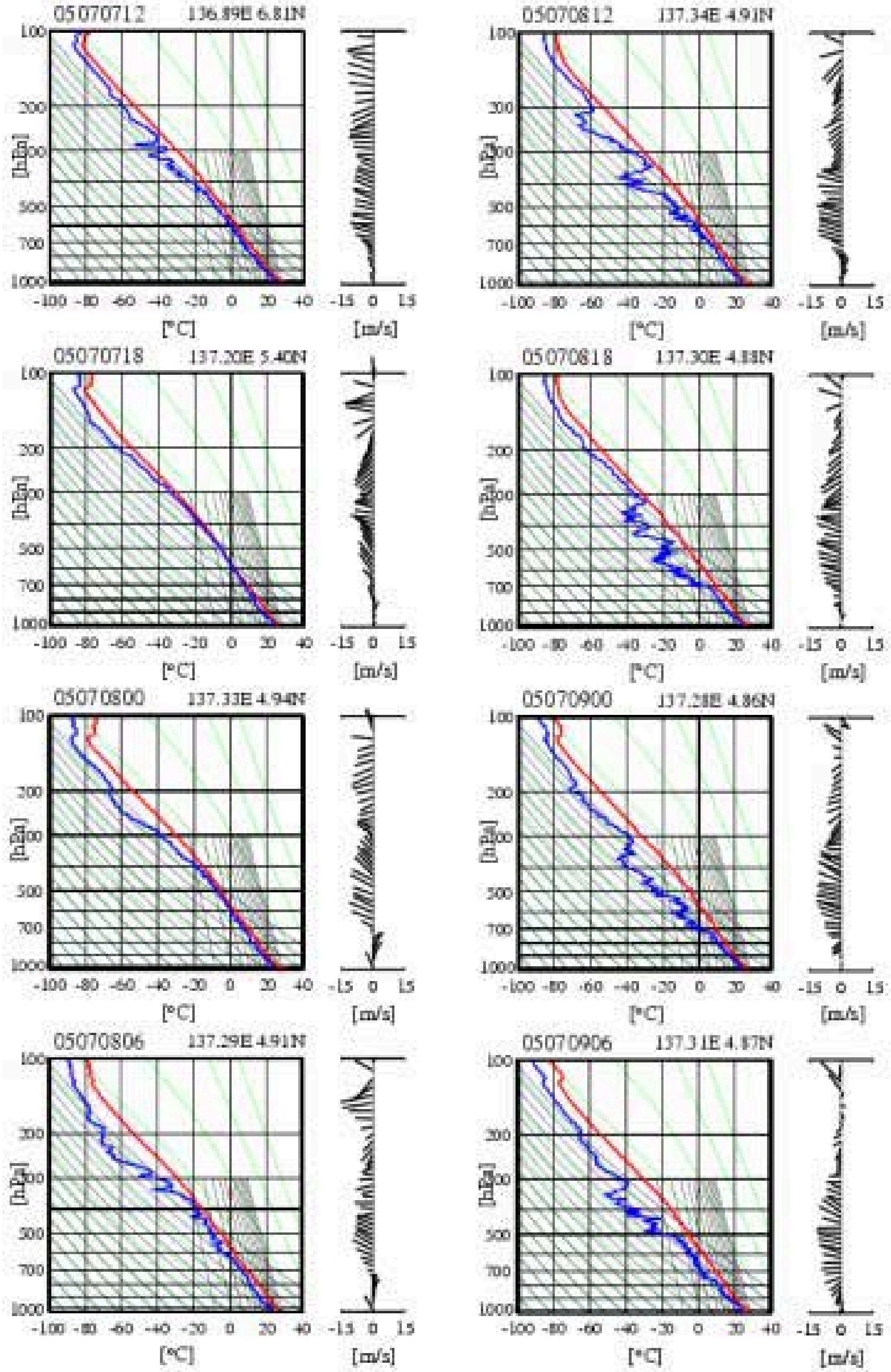
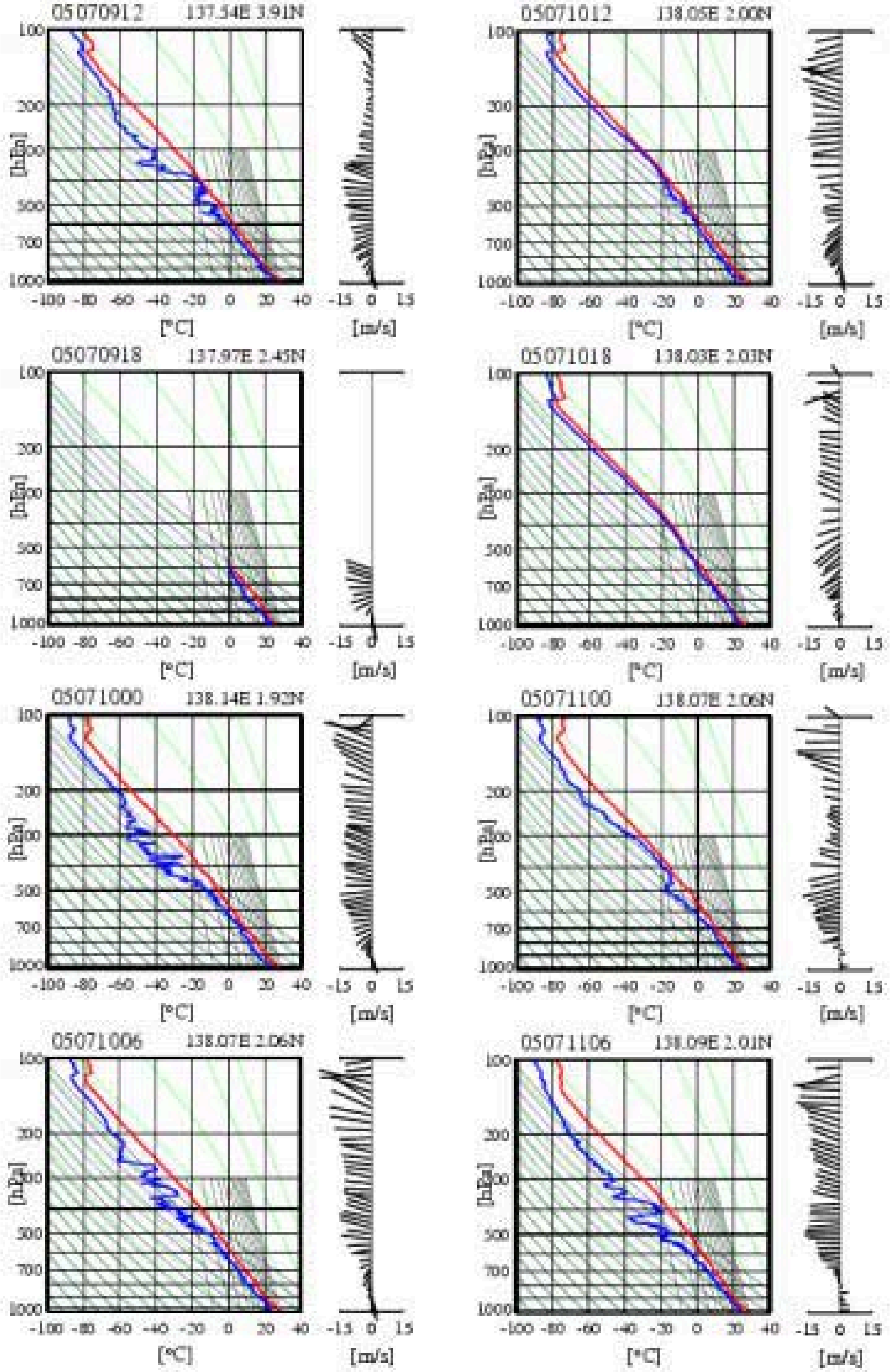
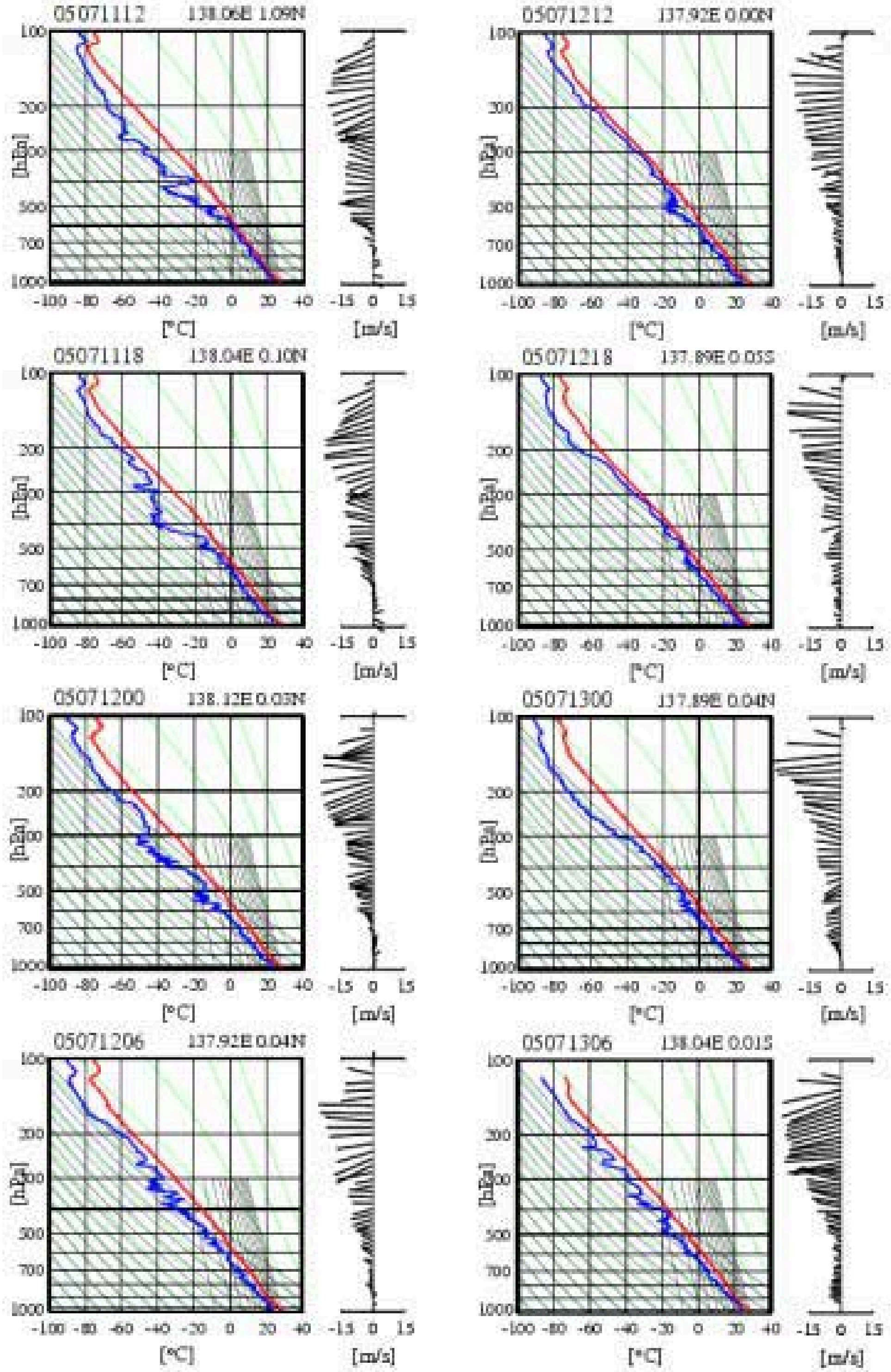


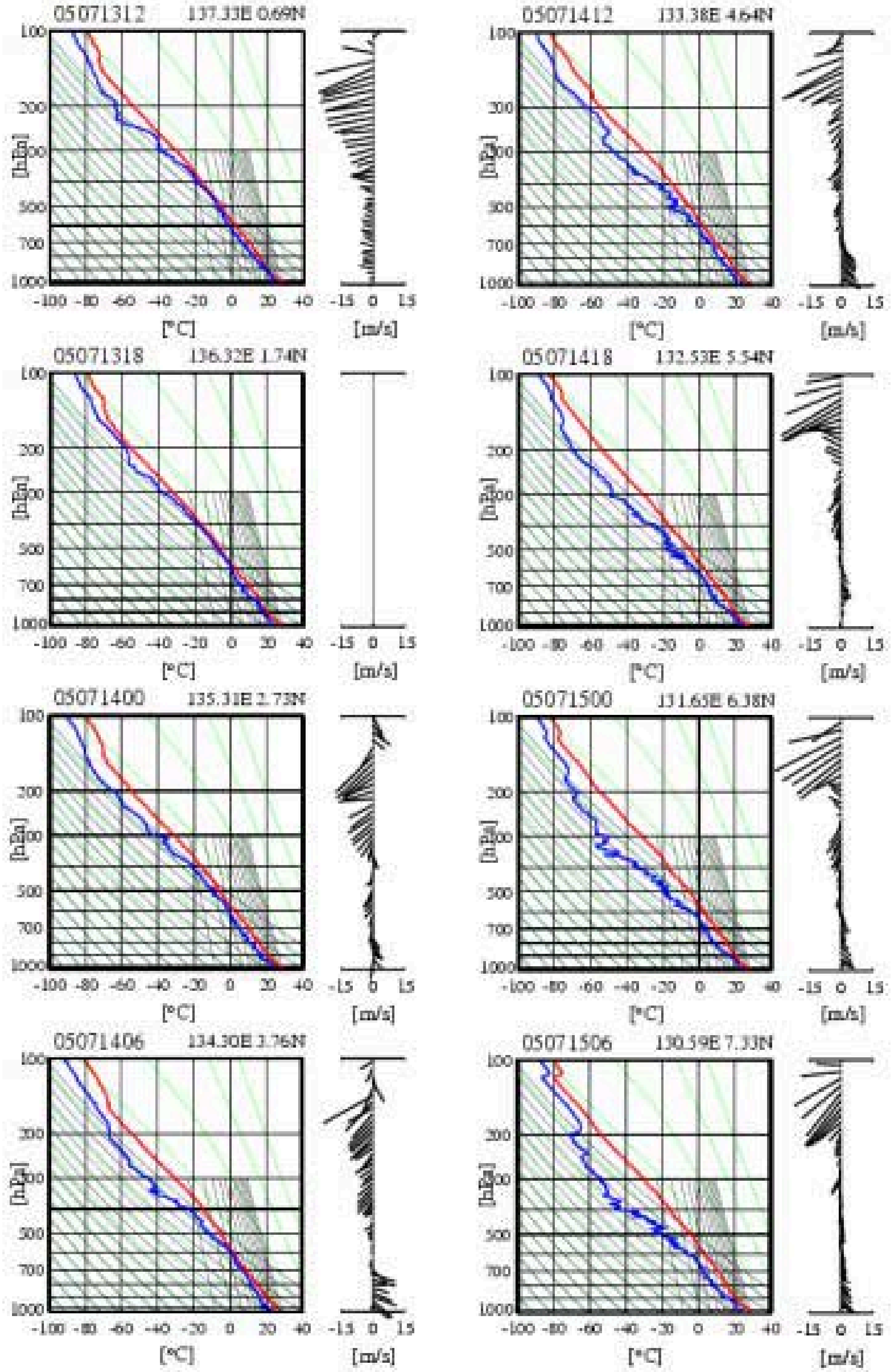
Fig. x.1.1-1 Time-height cross sections of (a) equivalent potential temperature (degK), (b) mixing ratio (g/kg), (c) zonal wind component (m/s), and (d) meridional wind component (m/s).

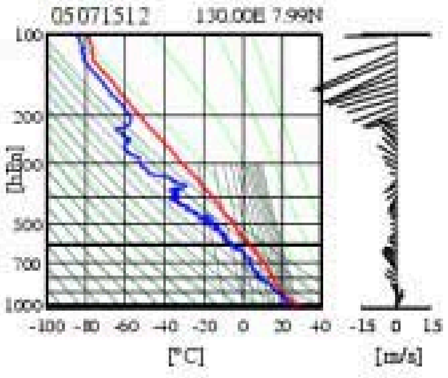

05070512 137.17E 8.02N
05070612 136.65E 7.70N
05070518 136.50E 7.84N
05070618 136.61E 7.72N
05070600 136.64E 7.70N
05070700 136.69E 7.66N
05070606 136.48E 7.87N
05070706 136.61E 7.69N
[hPa]
100
200
300
500
700
1000
-100 -80 -60 -40 -20 0 20 40
[°C]
-15 0 15
[m/s]


05070712 136.89E 6.81N
05070812 137.34E 4.91N
05070718 137.20E 5.40N
05070818 137.30E 4.88N
05070800 137.33E 4.94N
05070900 137.28E 4.86N
05070806 137.29E 4.91N
05070906 137.31E 4.87N
[hPa]
[°C]
[m/s]


05070912 137.54E 3.91N
05071012 138.05E 2.00N
05070918 137.97E 2.45N
05071018 138.03E 2.03N
05071000 138.14E 1.92N
05071100 138.07E 2.06N
05071006 138.07E 2.06N
05071106 138.09E 2.01N
[hPa]
[°C]
[m/s]


05071112 138.06E 1.09N
05071212 137.92E 0.00N
05071118 138.04E 0.10N
05071218 137.89E 0.05S
05071200 138.12E 0.03N
05071300 137.89E 0.04N
05071206 137.92E 0.04N
05071306 138.04E 0.01S
[hPa]
100
200
300
500
700
1000
-100 -80 -60 -40 -20 0 20 40
[°C]
-15 0 15
[m/s]


05071312 137.33E 0.69N
05071412 133.38E 4.64N
05071318 136.32E 1.74N
05071418 132.53E 5.54N
05071400 135.31E 2.73N
05071500 131.65E 6.38N
05071406 134.30E 3.76N
05071506 130.59E 7.33N
[hPa]
[°C]
[m/s]



05071512
130.00E 7.99N
100
200
300
500
700
1000
[hPa]
-100 -80 -60 -40 -20 0 20 40
[°C]
-15 0 15
[m/s]

7.5.2-2 Observation in Legs 2 and 3

(1) Personnel

Shuichi Mori	(JAMSTEC): Principal Investigator
Yasutaka Imai	(GODI): Legs 2 and 3
Wataru Tokunaga	(GODI): Leg 2
Shin-Ya Okumura	(GODI): Leg 2
Norio Nagahama	(GODI): Legs 2 and 3

(2) Objective

The objective of rawinsonde observation is to understand precipitating convective systems in the eastern Indian Ocean during boreal summer monsoon season in Leg 2 by using atmospheric environmental profiles of pressure, temperature, relative humidity, wind direction, and wind speed. Those in a typhoon over the western Pacific Ocean are investigated in Leg 3, too.

(3) Method

Atmospheric soundings by using rawinsonde were carried out every 3 hours from 00UTC August 05 through 21UTC August 14 along the cruise track over the eastern Indian Ocean in Leg 2, and , and every 6 hours from 06UTC August 27 through 00UTC August 29 over the western Pacific Ocean in Leg 3. Table 7.5.2-2-1 shows the summary of 86 launches in total. The observation system consists of receiver/processor (Vaisala DigiCORA Ⅲ MW21), GPS antenna (GA20), UHF telemetry antenna (RB20), balloon launcher (ASAP), 200g balloons (Totex TA-200), and GPS rawinsonde transmitters Vaisala RS92-SGP (RS80-15G) in Leg 2 (Leg 3). The transmitters were calibrated before launch with ground check kits of Vaisala GC25 (GC23) in Leg 2 (Leg3).

(4) Preliminary results

The cruise track with launching positions in Legs 2 and 3 is shown in 7.5.2-2-1. Time-height cross sections of equivalent potential temperature, specific humidity, zonal and meridional wind components in Leg 2 are shown in Fig. 7.5.2-2-2. Vertical profiles of temperature, dew-point temperature are plotted on the thermodynamic chart with wind profiles in Fig7.5.2-2-3. Detailed analyses with other obtained data are in future work after the quality check.

(5) Data archive

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

Table 7.5.2-2-1 Rawinsonde launch log during the MR05-03 Leg 2.

No.	DATE &TIME	Position		Surface Data					Maximum Altitude		Cloud Amount & type	
		Lon. E	Lat. N	P	T	RH	WD	WS				
	YY MM DD HH	(deg.)	(deg.)	(hPa)	(℃)	(%)	(deg.)	(m/s)	(hPa)	(gpm)		
RS-001	05 08 05 00	89.3950	1.1810	1007. 8	28.1	81	196	5.2	29.0	24,0 42	4	Cu,Ac
RS-002	05 08 05 03	89.3921	1.1851	1009. 8	28.5	75	213	3.5	25.0	25,0 00	3	Cu,Ci
RS-003	05 08 05 06	89.0990	1.1687	1009. 4	28.7	76	212	4.9	29.7	23,9 09	2	Ac,Cu
RS-004	05 08 05 09	88.7677	1.3250	1007. 2	28.9	75	216	4.8	30.1	23,7 92	2	Cu,Ci
RS-005	05 08 05 12	88.8479	1.6424	1006. 9	28.7	74	230	5.7	27.2	24,3 98	3	Sc,Cu,Ci
RS-006	05 08 05 15	88.9099	1.2707	1009. 4	28.5	73	217	5.8	27.3	24,4 12	0	–
RS-007	05 08 05 18	88.8711	1.3127	1009. 4	28.5	77	224	6.8	32.0	23,3 83	0	–
RS-008	05 08 05 21	88.8859	1.3147	1007. 4	28.1	76	254	5.6	33.5	23,0 90	0	–
RS-009	05 08 06 00	88.8742	1.3123	1007. 2	28.1	77	250	5.5	28.5	24,1 16	4	Sc,Ci
RS-010	05 08 06 03	88.8740	1.3189	1009. 6	28.5	76	212	4.1	26.0	24,7 32	5	Sc,Ci
RS-011	05 08 06 06	88.6840	1.2787	1008. 9	28.7	73	252	5.3	25.2	24,8 93	5	Cu,Ci
RS-012	05 08 06 09	88.2173	1.1714	1006. 2	28.8	71	239	4.4	27.8	24,2 42	5	Cu,Ci
RS-013	05 08 06 12	88.3764	1.3081	1006. 1	28.5	75	233	6.6	77.4	18,0 59	8	As,Cu,Ci
RS-014	05 08 06 15	88.5150	1.1663	1008. 0	28.7	76	238	7.0	38.2	22,2 98	0	–
RS-015	05 08 06 18	88.4178	1.2192	1008. 8	28.5	76	226	7.5	30.7	23,6 64	0	–
RS-016	05 08 06 21	88.4541	1.2022	1007. 0	28.3	79	227	6.4	27.7	24,2 95	0	–
RS-017	05 08 07 00	88.4333	1.2163	1007. 0	28.3	79	226	6.4	28.3	24,1 59	7	Cu,Ci
RS-018	05 08 07 03	88.4333	1.2201	1008. 5	28.4	78	226	6.2	55.9	19,9 94	4	Ci,Cu
RS-019	05 08 07 06	88.5740	1.1203	1007. 7	28.9	75	215	8.0	23.9	25,2 32	8	Cu,Ci
RS-020	05 08 07 09	89.0957	0.7205	1006. 0	28.9	75	213	5.8	28.8	24,0 54	4	Cu,Sc
RS-021	05 08 07 12	89.6428	0.3175	1005. 7	29.0	76	225	7.2	34.5	22,9 27	2	Cu,Ci
RS-022	05 08 07 15	90.0458	0.0147	1008. 6	28.7	74	225	5.9	27.1	24,4 57	0	–
RS-023	05 08 07 18	90.0666	0.0186	1009.1	28.7	74	216	5.7	28.8	24, 068	–	Unknown
RS-024	05 08 07 21	90.0862	0.0206	1008.0	28.6	72	219	5.2	30.0	23, 811	–	Unknown
RS-025	05 08 08 00	90.0561	0.0042	1008. 3	28.5	76	226	5.8	26.1	24,6 55	–	Unknown
RS-026	05 08 08 03	90.0543	0.0179	1009. 9	29.5	72	232	7.4	29.6	23,8 85	2	Ci
RS-027	05 08 08 06	89.9981	0.0036	1008. 5	29.5	75	217	7.0	25.8	24,7 51	1	Cu
RS-028	05 08 08 09	90.0548	0.0198	1006. 9	29.9	71	207	5.1	26.5	24,5 36	3	Cu
RS-029	05 08 08 12	90.0439	0.5675	1007.9	29.1	74	221	7.3	30.2	23, 757	5	Cu
RS-030	05 08 08 15	89.9988	1.2063	1009.7	27.9	81	201	7.3	23.2	25, 440	–	Unknown
RS-031	05 08 08 18	89.9782	1.5491	1009.8	27.6	81	227	3.3	28.1	24, 219	–	Unknown
RS-032	05 08 08 21	90.0316	1.6258	1008.2	27.9	79	217	2.8	28.2	24, 154	–	Unknown
RS-033	05 08 09 00	90.0357	−1.6280	1008.6	28.1	78	255	1.4	26.3	24,605	9	Ac,Cu

No.	DATE &TIME YY MM DD HH	Lon. E (deg.)	Lat. N (deg.)	P (hPa)	T (℃)	RH (%)	WD (deg.)	WS (m/s)	Maximum Altitude (hPa)	Maximum Altitude (gpm)	Cloud Amount	Cloud type
RS-034	05 08 09 03	90.0767	−1.6027	1010.5	26.0	86	342	2.8	22.4	25,676	8	Cu,Ci,Cb
RS-035	05 08 09 06	89.9960	−1.6570	1009.5	28.5	77	112	2.0	28.6	24,110	10	Cu,As,Ac
RS-036	05 08 09 09	90.0542	−1.6779	1007.8	27.6	83	166	4.5	27.5	24,338	10	As,Cu,Cb
RS-037	05 08 09 12	90.0163	−1.6715	1007.5	27.8	84	126	4.7	82.1	17,707	8	Sc,Ac
RS-038	05 08 09 15	90.0698	−1.6356	1009.3	28.3	77	135	4.4	33.6	23,084	−	Unknown
RS-039	05 08 09 18	90.0481	−1.7513	1010.0	28.5	75	134	2.9	30.2	23,765	−	Unknown
RS-040	05 08 09 21	89.9877	−1.6833	1007.9	28.1	79	109	4.0	41.6	21,749	−	Unknown
RS-041	05 08 10 00	89.9972	−1.6570	1007.8	27.3	81	27	5.0	27.3	24,371	7	Cu,Ci
RS-042	05 08 10 03	89.9116	−1.6478	1009.4	28.1	77	91	1.1	25.5	24,828	10	Cu,Cs,Ac,Cb
RS-043	05 08 10 06	89.9867	−1.8658	1007.8	27.7	69	144	2.6	25.1	24,897	4	Cu,Cb,Sc,Ac,Ci
RS-044	05 08 10 09	89.9971	−1.9977	1006.7	28.3	77	130	4.7	30.1	23,713	9	Sc,Ac,Cu,Ci
RS-045	05 08 10 12	89.9995	−2.6187	1006.6	27.8	77	135	5.6	29.0	23,987	6	Sc,Ac,Cb
RS-046	05 08 10 15	90.0033	−2.9938	1008.7	27.2	85	140	9.0	27.8	24,269	−	Unknown
RS-047	05 08 10 18	89.9917	−3.6135	1008.0	28.0	76	127	8.3	30.3	23,720	−	Unknown
RS-048	05 08 10 21	89.9433	−3.9621	1007.1	27.7	75	147	9.4	26.7	24,490	−	Unknown
RS-049	05 08 11 00	89.9787	−4.5940	1006.8	27.3	77	155	9.6	26.4	24,571	4	Cu,Ci
RS-050	05 08 11 03	89.9973	−4.9930	1009.1	27.5	70	141	7.2	29.7	23,865	8	Ci,Cu,Sc
RS-051	05 08 11 06	90.5729	−5.0038	1008.3	27.4	71	144	8.0	25.2	24,884	7	Cu,Ci
RS-052	05 08 11 09	90.9964	−5.0001	1006.8	27.8	67	153	6.1	24.8	24,978	5	Cs,Ci,Cu
RS-053	05 08 11 12	91.5690	−4.9970	1007.6	27.4	69	182	4.1	31.4	23,500	9	Cs,Cu
RS-054	05 08 11 15	91.9973	−4.9942	1009.1	27.3	76	176	6.9	32.8	23,233	−	Unknown
RS-055	05 08 11 18	92.6308	−4.9955	1009.3	26.8	73	187	7.1	28.2	24,152	−	Unknown
RS-056	05 08 11 21	92.9959	−4.9983	1008.2	26.5	78	164	4.2	38.5	22,205	−	Unknown
RS-057	05 08 12 00	93.6333	−5.0007	1008.6	26.9	72	193	5.4	38.8	22,167	3	Cu,Ci
RS-058	05 08 12 03	94.0008	−5.0029	1010.4	27.1	68	157	4.3	30.4	23,721	5	Cu,Ci
RS-059	05 08 12 06	94.6660	−4.9975	1008.5	27.4	66	162	5.5	34.1	22,985	6	Ci,Cs
RS-060	05 08 12 09	94.9801	−4.9910	1006.1	27.6	68	150	7.0	34.1	22,985	8	Cs,Ci
RS-061	05 08 12 12	94.9902	−5.0849	1007.8	27.5	68	156	4.2	34.1	23,006	5	Ci,As
RS-062	05 08 12 15	94.9576	−5.1890	1009.6	27.4	67	172	2.3	31.6	23,500	−	Unknown
RS-063	05 08 12 18	94.9786	−5.0062	1010.0	27.3	70	217	2.9	37.5	22,415	−	Unknown
RS-064	05 08 12 21	94.9409	−5.0576	1008.5	27.2	71	166	5.1	37.2	22,444	−	Unknown
RS-065	05 08 13 00	94.9617	−5.0513	1008.4	27.3	73	138	3.8	54.9	20,080	4	Cu,Ci
RS-066	05 08 13 03	94.9691	−5.0319	1010.2	27.9	72	129	5.9	22.2	25,728	4	Cu,Ci
RS-067	05 08 13 06	94.9373	−4.9766	1008.9	28.5	73	138	4.7	26.5	24,616	7	Cu,Ci

No.	DATE & TIME YY MM DD HH	Lon. E (deg.)	Lat. N (deg.)	P (hPa)	T (℃)	RH (%)	WD (deg.)	WS (m/s)	Maximum (hPa)	Altitude (gpm)	Cloud Amount	type
RS-068	05 08 13 09	94.9897	4.9687	1007.1	28.1	75	140	5.3	34.2	22,959	4	Cu,Ci
RS-069	05 08 13 12	95.1065	5.0754	1007.9	28.0	76	144	5.4	33.0	23,215	6	Sc,Ci
RS-070	05 08 13 15	94.9964	5.0059	1010.3	28.1	75	117	6.2	29.9	23,856	3	Sc
RS-071	05 08 13 18	95.0923	4.9743	1010.3	28.0	76	105	6.1	958.7	482	–	Unknown
RS-072	05 08 13 21	94.9981	4.9442	1008.3	28.0	80	88	6.5	41.3	21,799	–	Unknown
RS-073	05 08 14 00	94.9567	4.9450	1008.2	28.2	78	94	10.0	31.3	23,499	6	Cu,Cs
RS-074	05 08 14 03	94.9163	4.9439	1009.4	28.6	71	109	10.0	56.9	19,876	6	Cu,Ci
RS-075	05 08 14 06	95.0735	4.9697	1008.4	28.7	69	101	10.0	24.3	25,089	4	Ci,Cu
RS-076	05 08 14 09	94.9969	4.9699	1005.8	28.7	72	100	9.4	22.9	25,474	3	Ci,Cu
RS-077	05 08 14 12	95.4947	5.2019	1006.6	28.3	71	112	8.4	32.4	23,286	9	Ci,Sc,Cs
RS-078	05 08 14 15	96.0901	5.5227	1008.5	28.2	72	107	6.8	37.9	22,336	–	Sc
RS-079	05 08 14 18	96.7349	5.8495	1008.4	27.8	72	111	7.1	34.8	22,881	–	Unknown
RS-080	05 08 14 21	97.3384	6.2031	1007.1	27.7	75	134	6.8	41.5	21,755	–	Unknown
RS-081	05 08 27 06	14.411	136.014	1002.4	25.1	98	275	10.3	272.0	10,366	10	Cu
RS-082	05 08 27 12	15.923	136.150	1002.9	26.7	87	250	4.4	47.7	21,027	–	–
RS-083	05 08 27 18	17.386	136.279	999.7	27.4	86	353	3.4	60.3	19,542	–	–
RS-084	05 08 28 00	18.847	136.529	997.4	28.1	86	21	16.6	385.0	7,826	–	–
RS-085	05 08 28 06	20.086	136.516	992.6	26.0	96	6	20.5	504.8	6,468	–	–
RS-086	05 08 29 00	23.499	136.825	1000.0	28.6	88	102	13.8	26.8	24,792	–	–

(a)

(b)

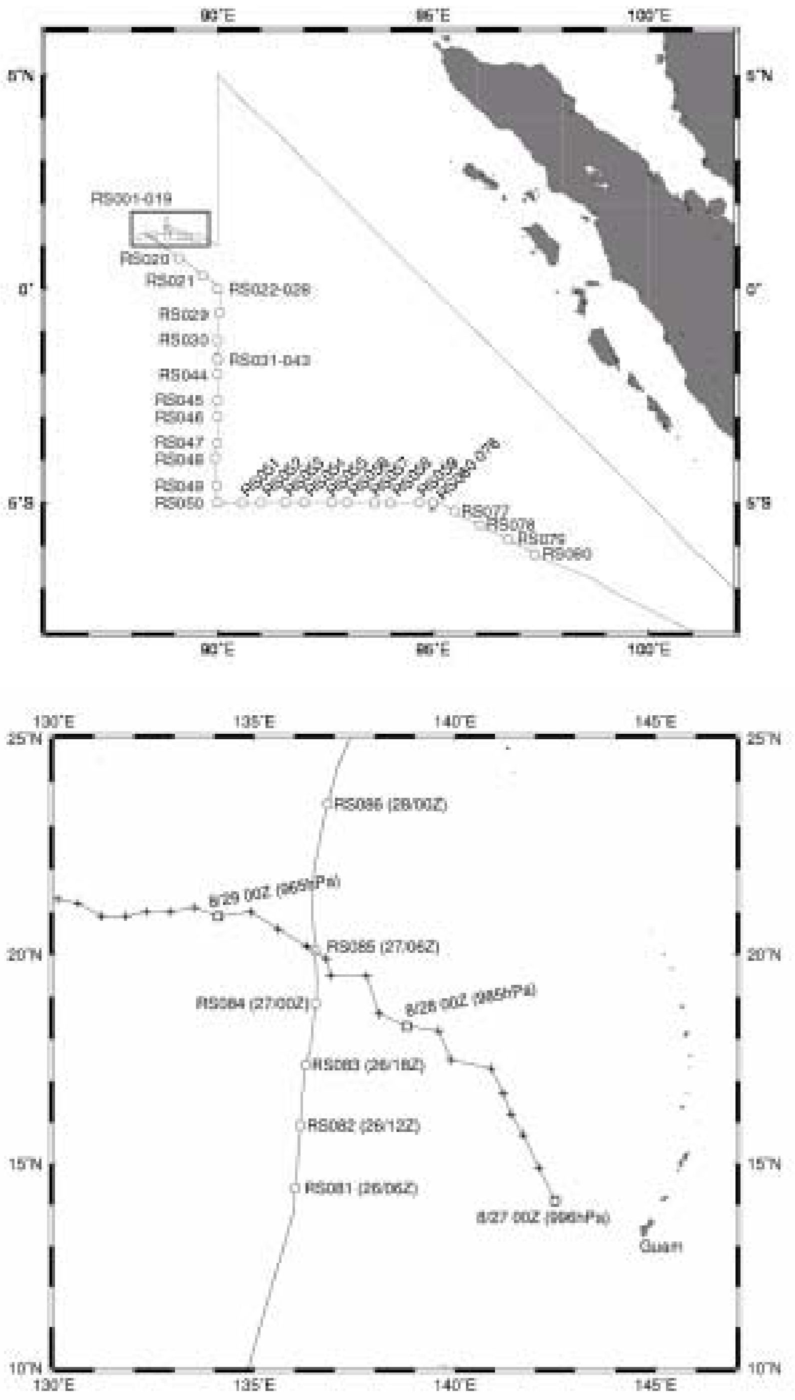


Fig. 7.5.2-2-1 Sounding positions and cruise track over the eastern Indian Ocean in Leg 2 (a) and the western Pacific Ocean in Leg 3 (b). RS-XXX show sequential sounding number. The other line with cross mark in (b) shows the track of typhoon TS0513 (Talim).

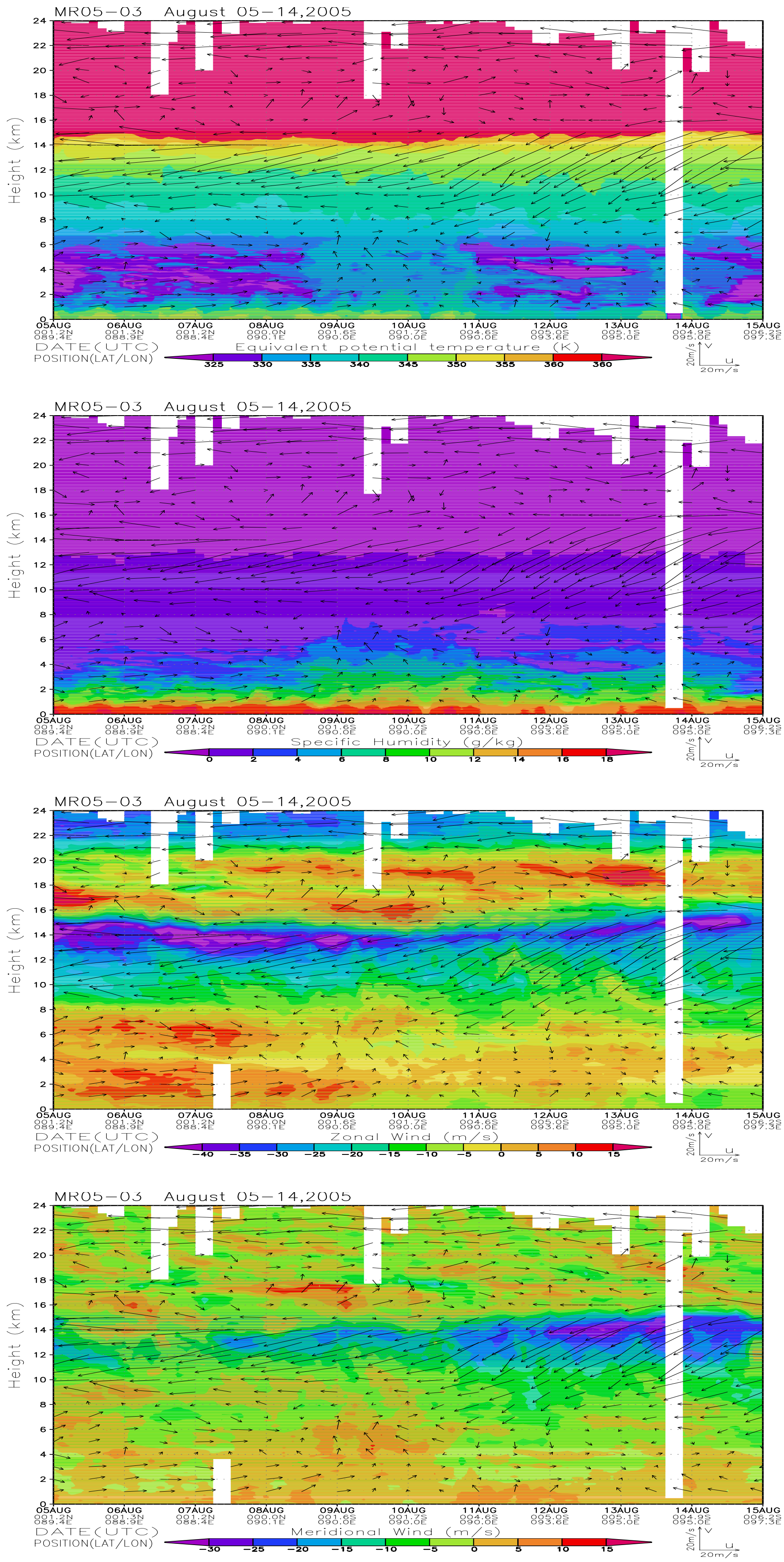


Fig. 7.5.2-2-2 Time-height cross sections of equivalent potential temperature (deg K), specific humidity (g/kg), zonal wind (m/s), and meridional wind components (m/s).

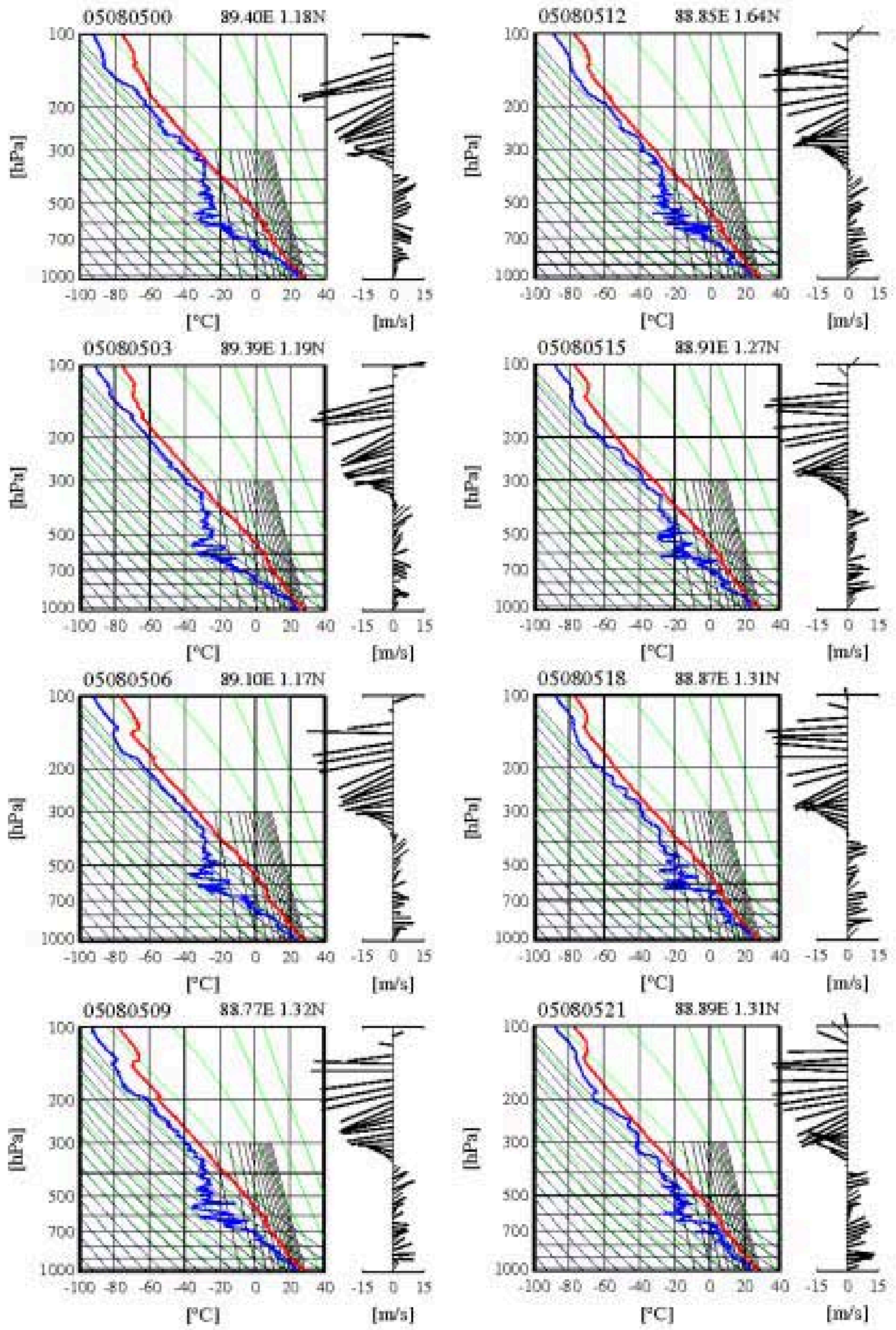


Fig. 7.5.2-2-3 Vertical profiles of temperature (red line) and dew-point temperature (blue line) are described on emagrams. Wind direction and speed are indicated by vectors on the each panel.

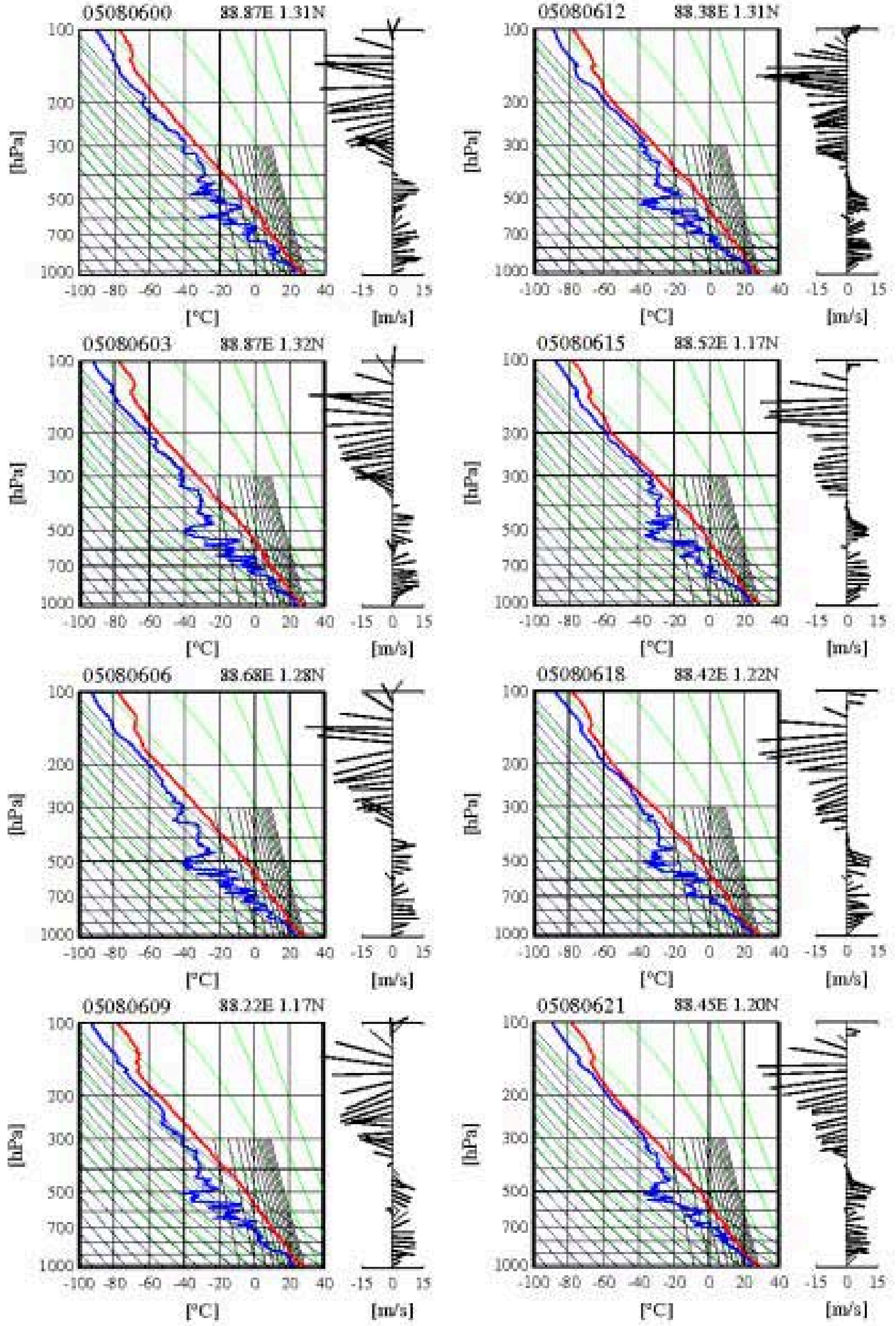


Fig. 7.5.2-2-3 (continued)

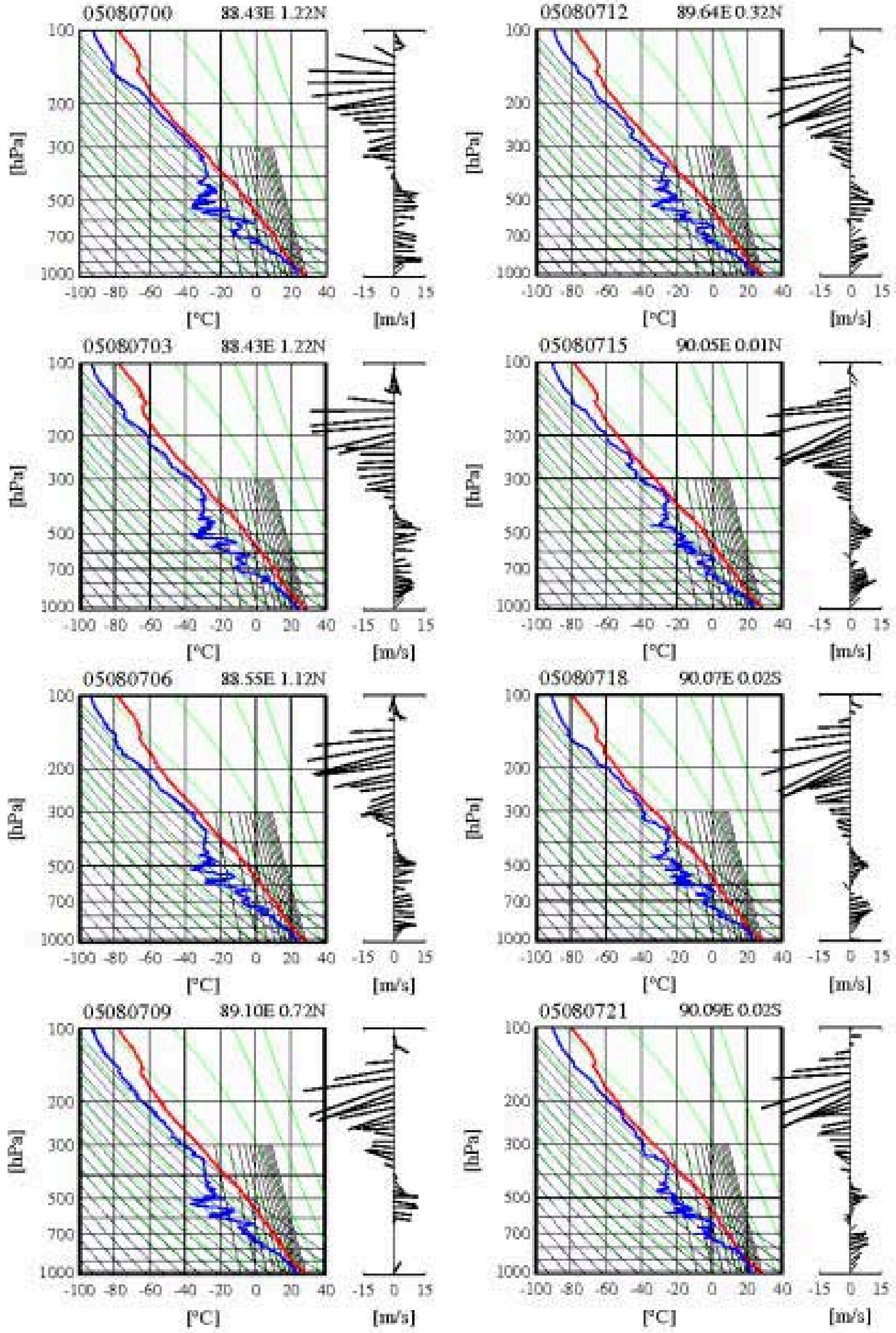


Fig. 7.5.2-2-3 (continued)

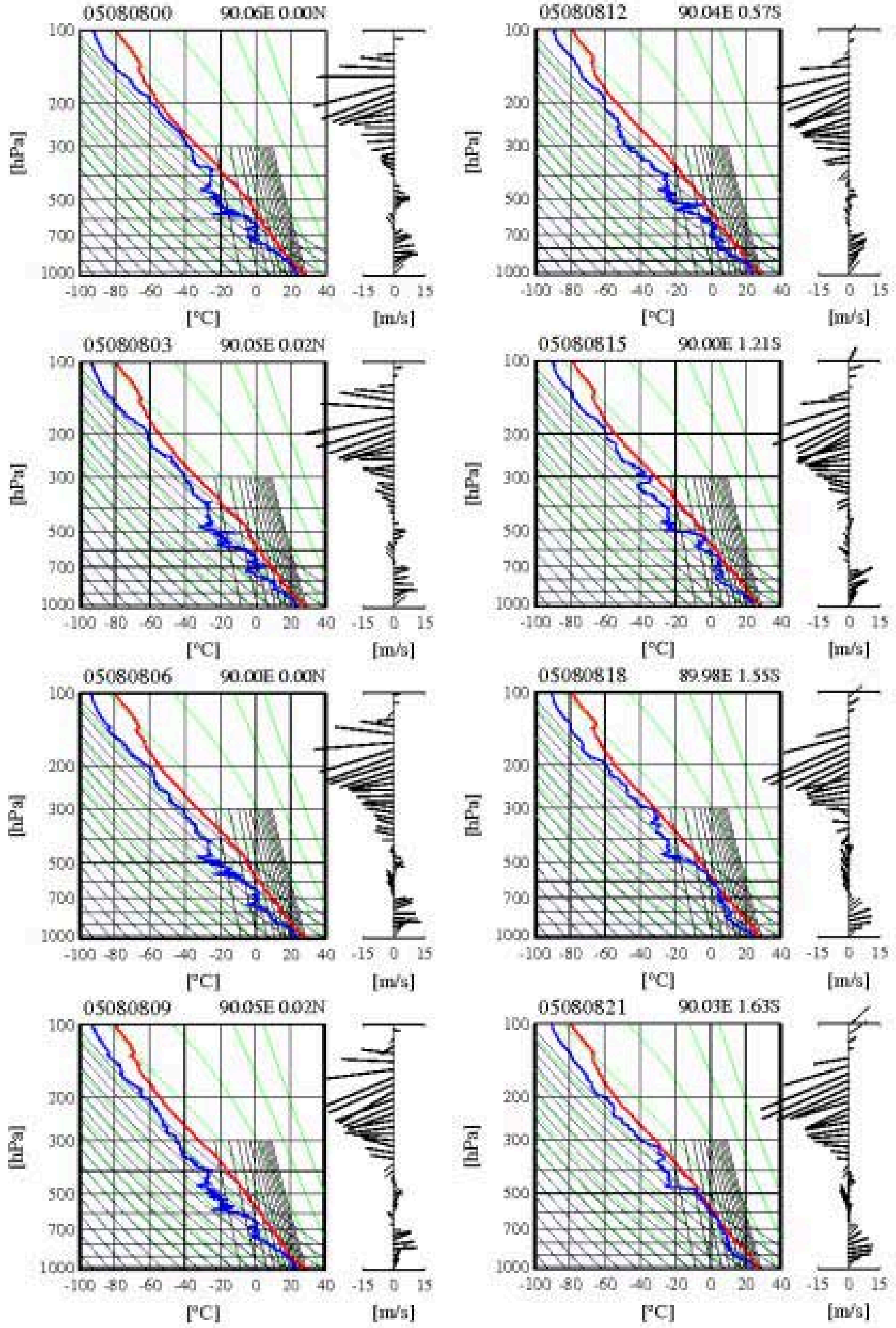


Fig. 7.5.2-2-3 (continued)

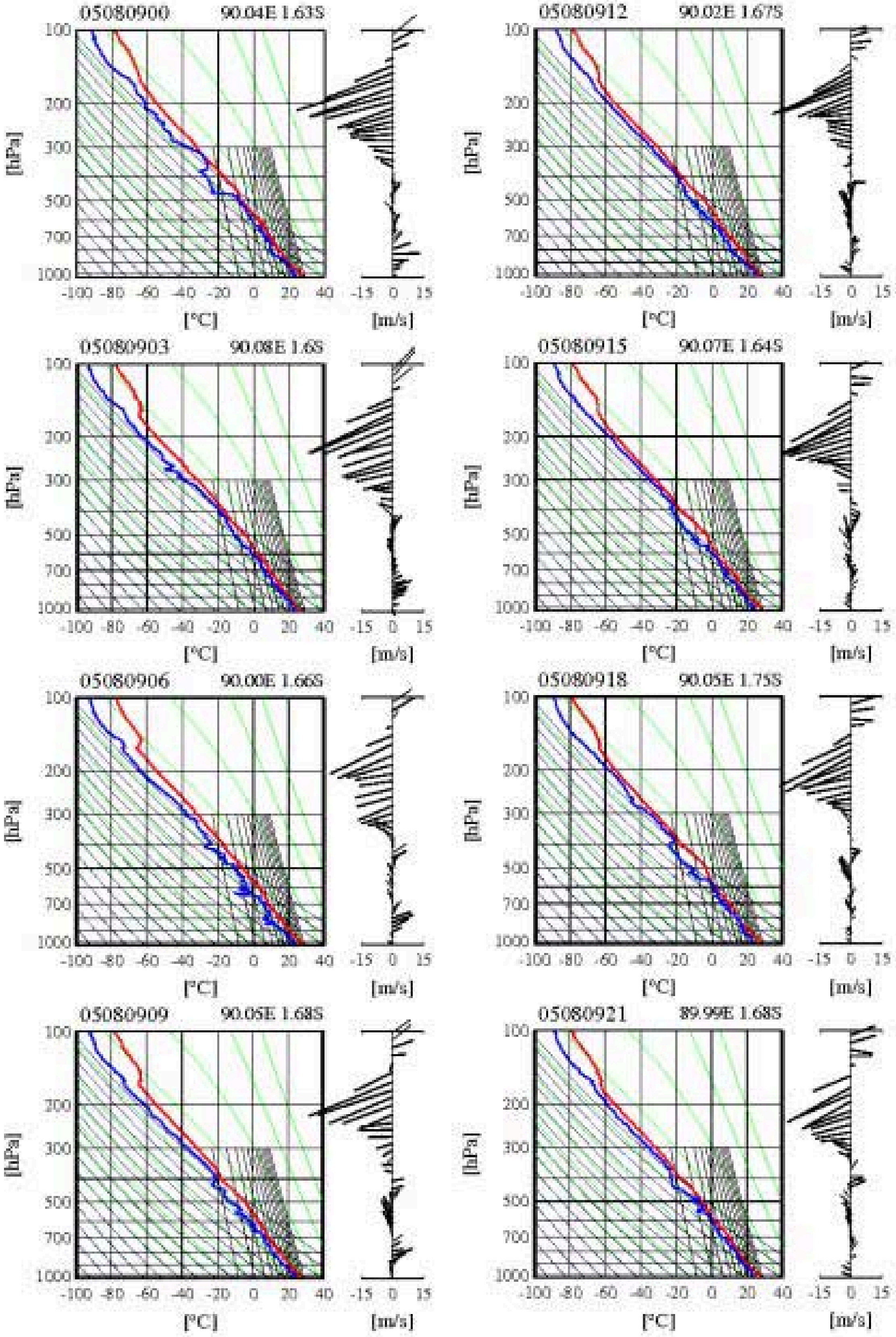


Fig. 7.5.2-2-3 (continued)

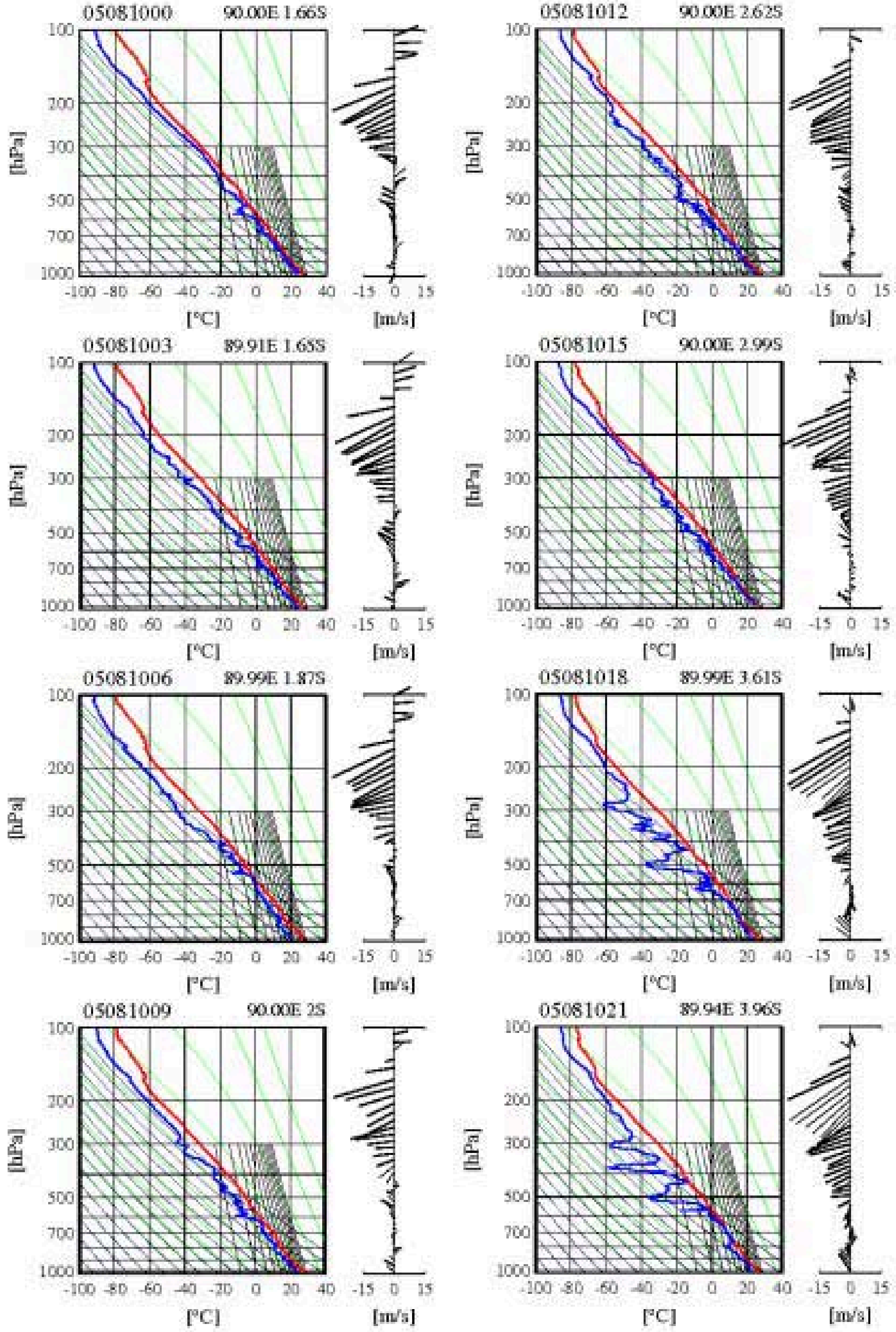


Fig. 7.5.2-2-3 (continued)

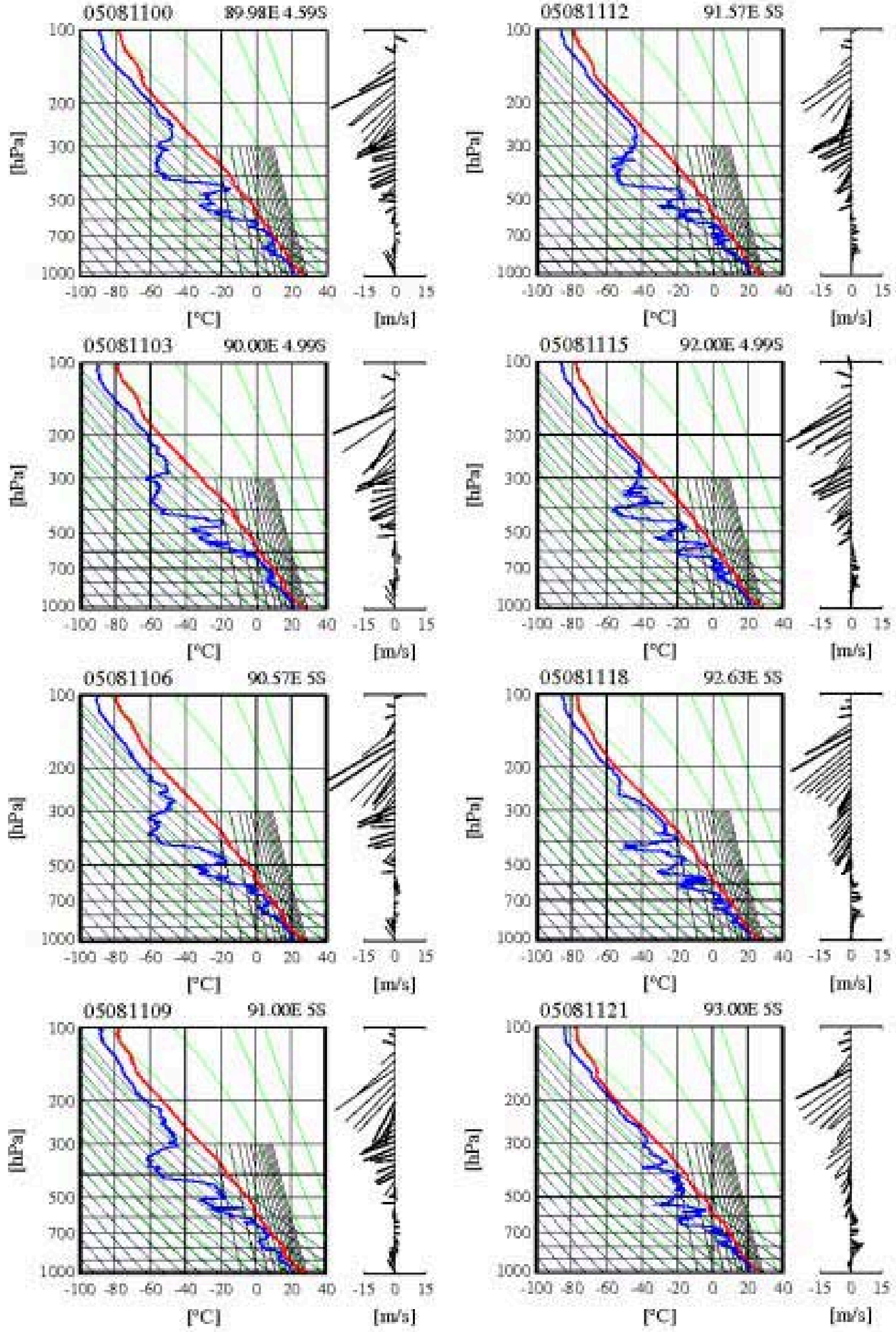


Fig. 7.5.2-2-3 (continued)

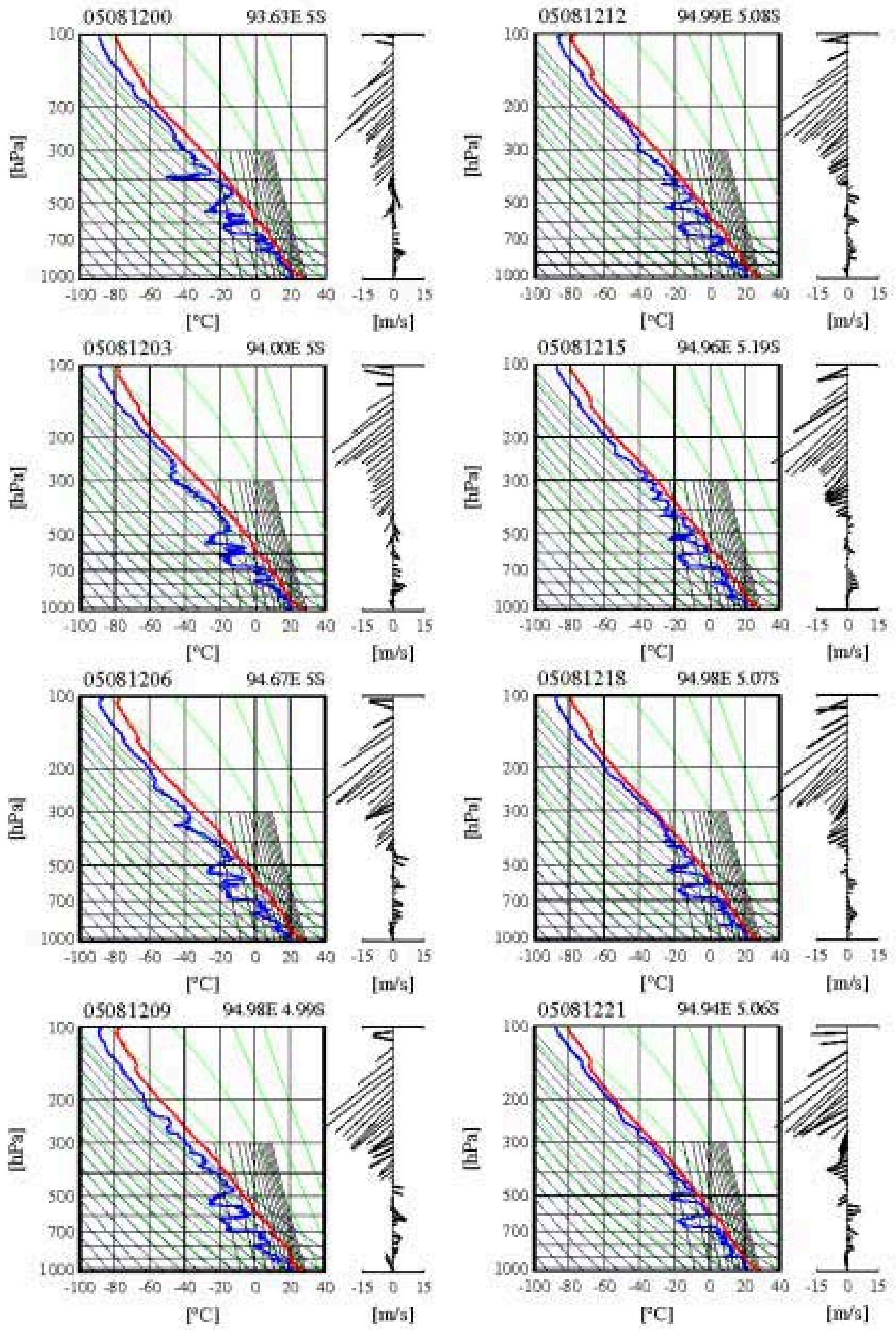


Fig. 7.5.2-2-3 (continued)

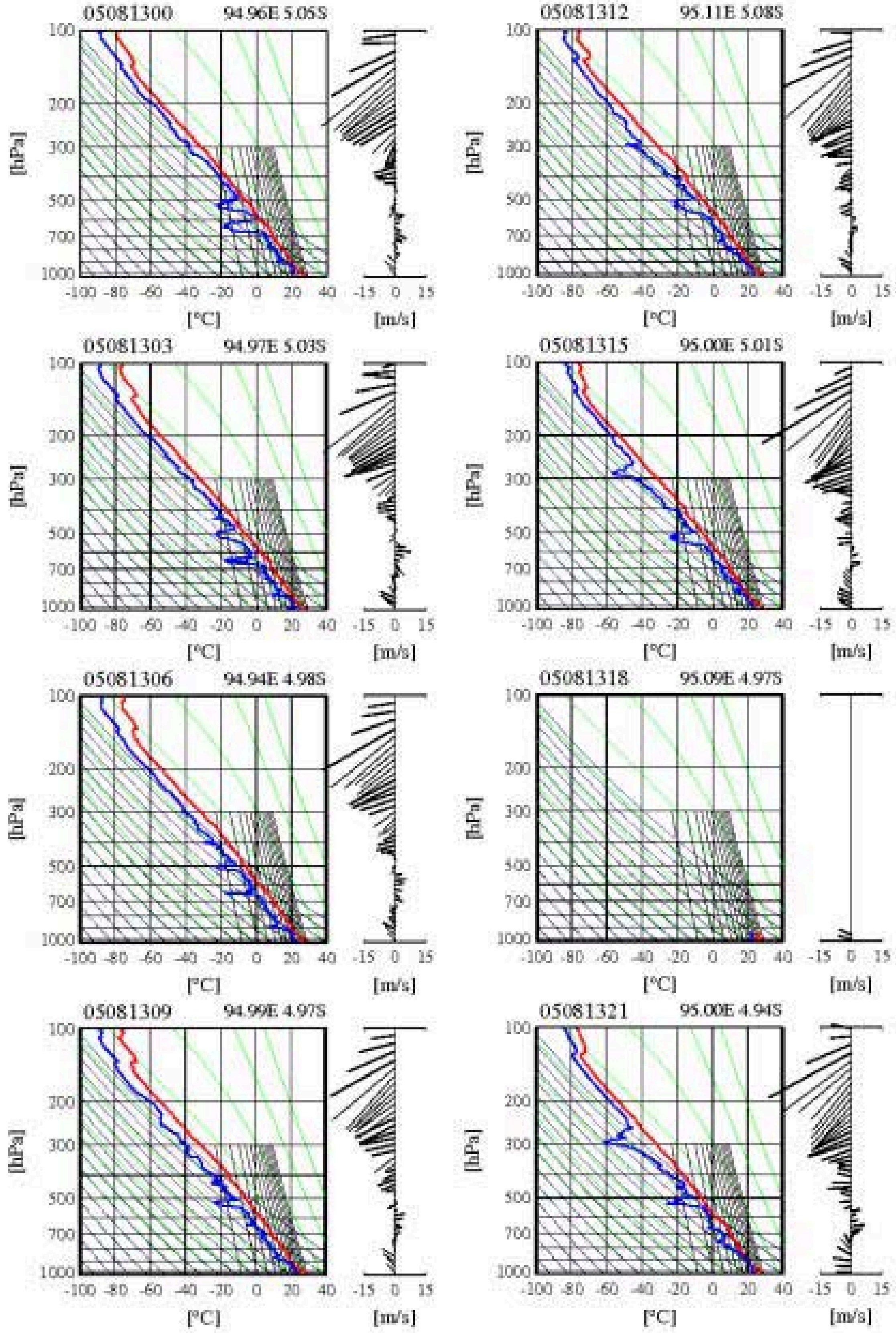


Fig. 7.5.2-2-3 (continued)

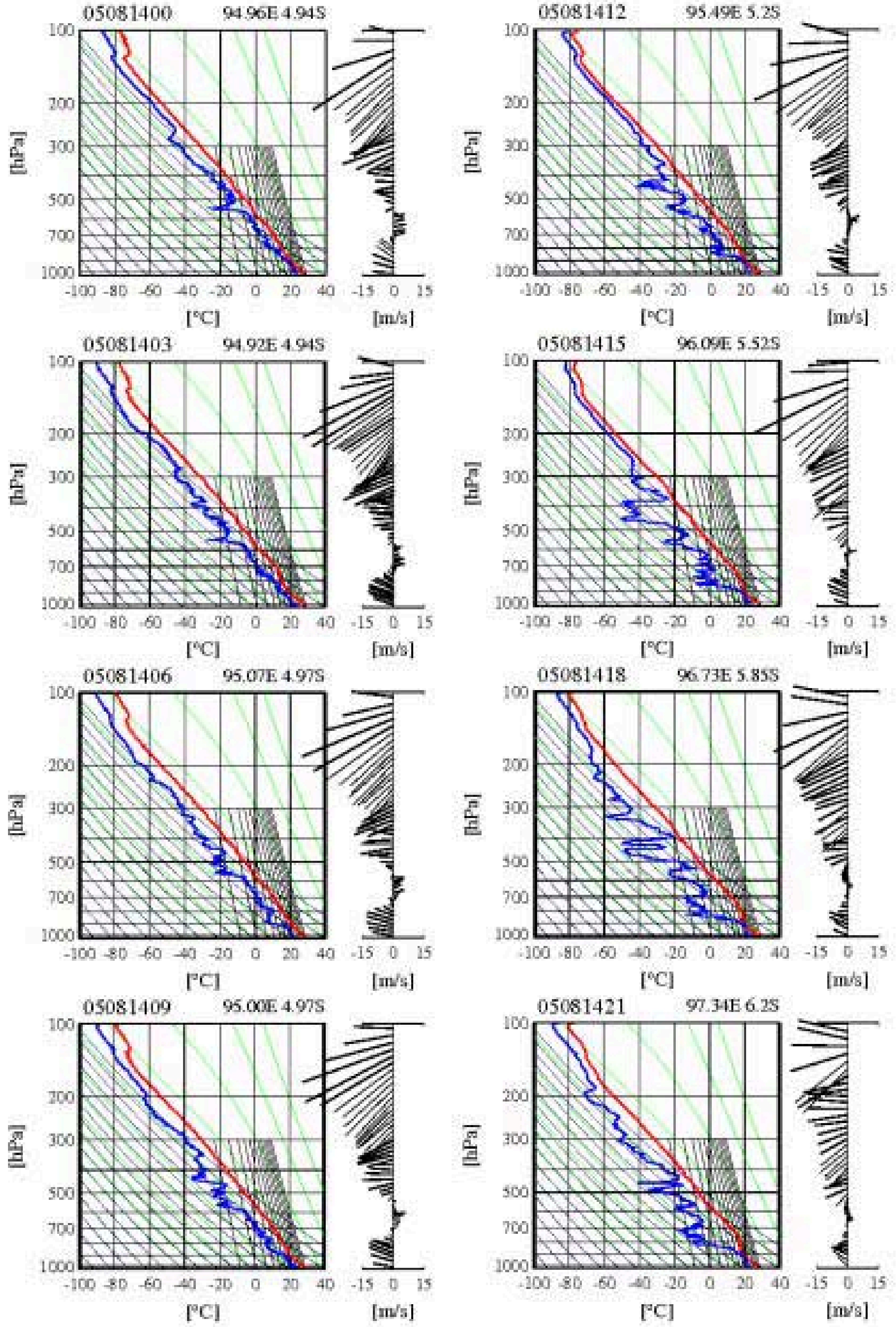


Fig. 7.5.2-2-3 (continued)

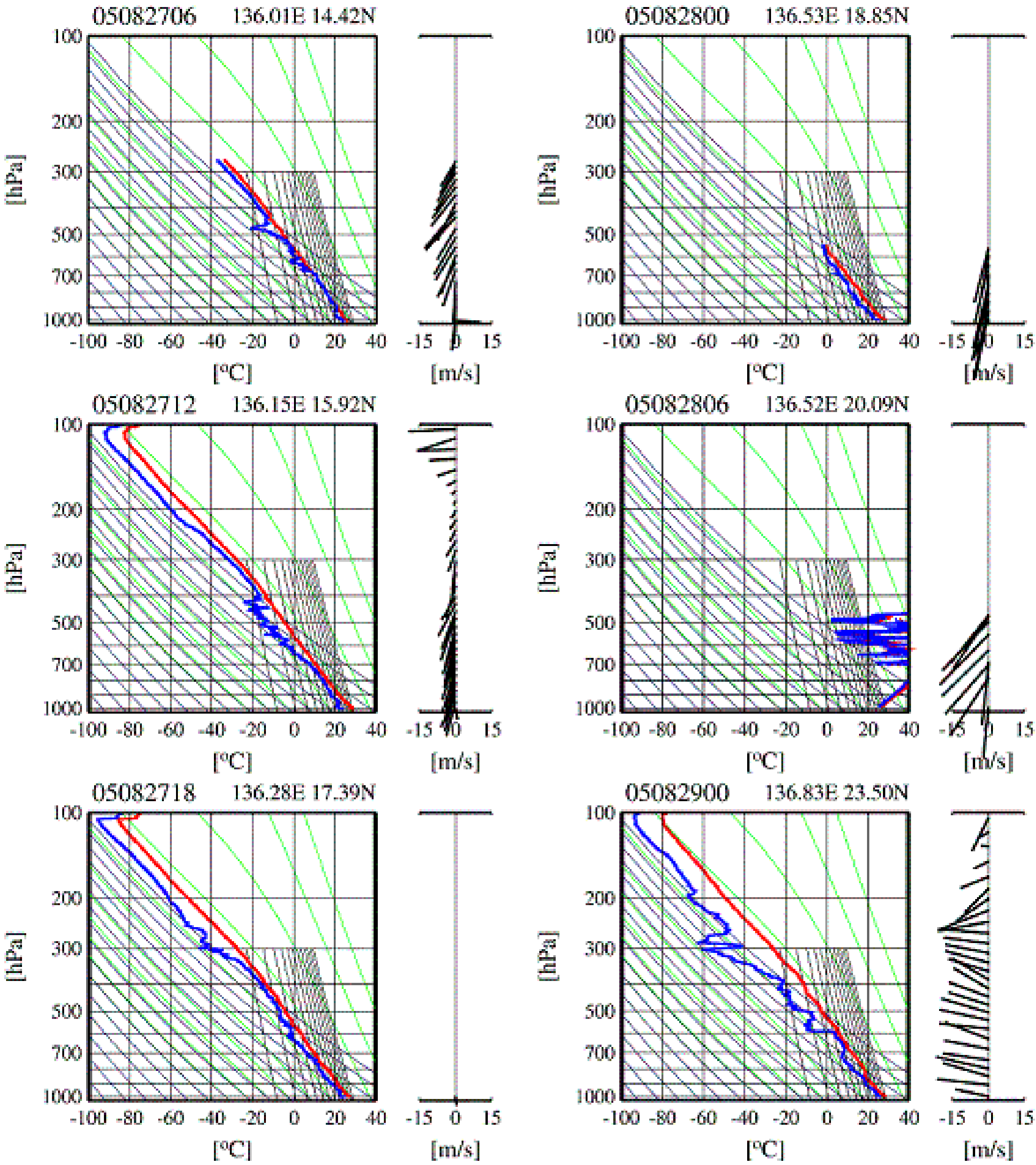


Fig. 7.5.2-2-3 (continued)

7.5.3 Observation of Rainfall Drop Size Distribution in Leg 2 and 3

(1) Personnel

Shuichi Mori	(JAMSTEC): Principal Investigator
Yasutaka Imai	(GODI): Legs 2 and 3
Wataru Tokunaga	(GODI): Leg 2
Shin-Ya Okumura	(GODI): Leg 2
Norio Nagahama	(GODI): Legs 2 and 3

(2) Objective

Rainfall Drop Size Distribution (DSD) data is obtained to study rainfall characteristics, that vary with its originated precipitating cloud system, i.e., clouds type (convective and stratiform) and development stage of precipitating clouds system (developing, mature, and dissipating). Both temporal and spatial variations of DSD characteristics are also interested over the western Indian Ocean during boreal summer monsoon season in Leg 2. Those in a typhoon over the western Pacific Ocean are investigated in Leg 3, too.

(3) Method

An optical type disdrometer (Parsivel M300) and a Micro-Rain Radar (MRR2) were installed on the navigation and captain decks, respectively, as shown in Fig. 7.5.3-1. The range of drop diameters that can be measured by the M300 spans from 0.1 mm to 20 mm every 1 minute. The DSD data are collected then recorded every one minute with 32 drop size classes. The MRR2 obtains vertical profile of DSD up to 6000 m with resolutions of 1 minute and 200 m.

(4) Preliminary results

Continuous observation of DSD has been carried without significant trouble through Legs 2 and 3. The detailed analyses with other obtained datasets are in future work after the quality check.

(5) Data archive

Original samples will be preserved at Institute of Observational Research for Global Change (IORGC)/JAMSTEC. Both inventory information and analyzed dataset will be submitted to JAMSTEC Data Management Office (DMO).

Fig. 7.5.3-1
Look of the Persivel M300 (left panel) and MRR-2 (right panel) sensors installed on the vessel.

7.6 Lidar observations of clouds and aerosols

(1) Personnel

Nobuo Sugimoto, Ichiro Matsui, Atsushi Shimizu and Akihide Kamei (National Institute for Environmental Studies, not on board), operation was supported by GODI.

(2) Objectives

Objectives of the observations in this cruise is to study distribution and optical characteristics of ice/water clouds and marine aerosols using a two-wavelength lidar.

(3) Measured parameters

- Vertical profiles of backscattering coefficient at 532 nm
- Vertical profiles of backscattering coefficient at 1064 nm

(4) Method

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

(5) Results

Data obtained in this cruise has not been analyzed.

(6) Data archive

- raw data

lidar signal at 532 nm

lidar signal at 1064 nm

temporal resolution 15 min.

vertical resolution 6 m.

data period : Leg.1 July 4, 2005 – July 22, 2005, Leg.2 July 24, 2005 – August 23, 2005,
Leg.3 August 26, 2005 – September 2, 2005

- processed data

  cloud base height, apparent cloud top height

  cloud fraction

  boundary layer height (aerosol layer upper boundary height)

  backscatter coefficient of aerosols

7.7 Rain Sampling for Stable Isotopes

(1) Personnel

Kimpei Ichiyanagi (JAMSTEC) (Not on board)

(2) Objective

To determine the spatial distribution of isotopic composition of rainfall on the Ocean

(3) Method

Rainfall samples are collected in 6cc glass bottle with plastic cap. Isotopic compositions for hydrogen and oxygen in rainfall are determined by the Isotope Ratio Mass Spectrometry (IRMS).

(4) Preliminary results

During this cruise, we collected 26 samples in total. Table 7.7-1 lists the date and location of rainfall samples. Analysis will be done after the cruise.

(5) Data archive

Original samples will be analyzed by IORGC. Inventory and analyzed digital data will be submitted to JAMSTEC Data Management Office.

Table 7.7-1 Dates and locations to show when and where rain water were sampled.

Sample No.	Date (UTC)	Location (lat/lon)	Rain (mm)
033	01:45, July 6	07-50.10N, 136-29.46E	3.3
034	04:10, July 6	07-52.75N, 136-27.60E	1.3
035	22:56, July 7	04-56.04N, 137-19.72E	4.0
036	21:50, July 9	01-59.82N, 138-06.10E	5.2
037	22:15, July 10	02-03.70N, 138-04.52E	14.7
038	07:22, July 14	04-02.50N, 134-00.00E	18.0
039	22:56, July 15	07-59.40N, 130-01.33E	9.4
040	22:45, July 18	03-03.23N, 129-33.24E	
041	22:05, July 20	01-59.72N, 129-53.89E	0.7
042	01:55, July 21	01-58.00N, 129-56.44E	0.1
043	11:00, July 21	02-01.53N, 130-02.53E	2.9
044	09:16, July 22	01-46.48N, 129-54.60E	1.0
045	23:19, July 31	02-56.53N, 097-54.46E	1.6
046	07:58, August 2	03-06.50N, 091-53.97E	4.0
047	04:38, August 3	04-23.16N, 090-00.84E	4.5
048	02:09, August 9	01-36.15S, 090-04.65E	2.3
049	05:27, August 22	03-37.35N, 127-51.82E	6.0

050	23:15, August 22	06-17.41N, 131-57.21E	2.0
051	21:28, August 22	07-39.29N, 134-00.77E	12.0
052	00:13, August 27	13-09.90N, 135-47.01E	12.0
053	06:00, August 27	14-35.08N, 136-02.71E	28.0
054	10:42, August 27	15-46.17N, 136-08.45E	6.0
055	22:30, August 28	23-23.47N, 136-47.71E	70.0
056	22:17, August 30	34-21.26N, 141-35.53E	3.0
057	23:02, August 30	34-33.40N, 141-38.93E	3.0
058	09:12, August 31	37-13.99N, 142-29.35E	1.0

7.8 Horizontal distribution and optical properties of aerosols

1. Personnel

Tatsuo ENDOH (Tottori University of Environmental Studies, Professor) not on board

Co-workers not on board:
Sachio OHTA (Engineering environmental resource laboratory, Graduate school of engineering, Hokkaido University) Professor
Tamio TAKAMURA (Center of environmental remote sensing science, Chiba University) Professor
Teruyuki NAKAJIMA (Center of climate system research, University of Tokyo) Professor
Nobuo SUGIMOTO (National Institute for Environmental Studies, Japan) Chief Research Scientist

2. Objectives

2. 1. 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.

2. 2. Objects:

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

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 mean of 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-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, single scattering albado 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-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 TUES (Endoh),Tottori University of Environmental Studies, 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-1. Information of obtained data inventory (Method)

===

Item, No.data	Name	Instrument	Site position
Optical thickness, Ångström exponent and Aerosol Size distribution.	Endoh	Sky Radiometer(Prede,POM-01MK2)	roof of stabilizer

Table-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	06/07’05-03/09’05

7.9 Eddy Correlation Measurement of CO_2 flux

7.9.1 Eddy Correlation Measurements by Open-Path and Closed-Path CO_2/H_2O Gas Analyzers

(1) Personnel

Fumiyoshi Kondo (Okayama University)
Toru Iwata (Okayama University)
Chikako Watanabe (Okayama University)

On-shore Scientists: Osamu Tsukamoto (Okayama University): Principal Investigator
Hiroshi Ishida (Kobe University)
Kunio Yoneyama (JAMSTEC)

(2) Objective

The ocean is main sink of anthropogenic CO_2. Therefore understanding of CO_2 flux processes and mechanisms across the air-sea interface is an important topic. Eddy covariance method is the only direct measurement of air-sea CO_2 flux. Then this method has little assumption (constant flux layer and steady state), and may evaluate small spatial and temporal CO_2 flux as compared with mass balance methods. For these reasons, we hope that this method investigates processes and mechanisms that control air-sea CO_2 flux.

(3) Method

The measurement system of eddy covariance method consists of turbulence instruments and ship motion sensors. These sensors are installed at the top of the foremast. Ordinarily, the turbulence instruments are a three-dimensional sonic anemometer-thermometer (Kaijo, DA-600) and a CO_2/H_2O gas analyzer (Li-cor, LI-7500). LI-7500 is an open-path CO_2/H_2O gas analyzer that measures directly turbulent fluctuations of carbon dioxide and water vapor in the air. In this cruise, two closed-path CO_2/H_2O gas analyzers (Li-cor, LI-7500 and LI-7000) are installed at the top of the foremast (LI-7500 modification type with calibration tube) and in the Boatswain room (LI-7000), respectively. Sample air intakes provide near the three-dimensional sonic anemometer-thermometer. Sample airs are drawn to each gas analyzers with Teflon tubes and diaphragm pumps.

The sonic anemometer measures three-dimensional wind components relative to the ship including apparent wind velocity due to ship motion. The ship motions are measured by ship motion sensors. These sensors are a two-axis inclinometer (Applied Geomechanics, MD-900-T), a three-axis accelerometer (Applied Signal Inc., QA-700-020), and a three-axis rate gyro (Systron Donner, QRS-0050-100).

These turbulence and ship motion signals are sampled at 10 Hz by a PC-based data logging system (Labview, National Instruments Co., Ltd.). This PC system is connected to the Mirai network system to obtain ship speed and heading data that are used to derive absolute wind components relative to the ground. Combining these wind data with the turbulence measurements, turbulent fluxes and statistics are calculated in a real-time basis and displayed on the PC.

(4) Data Archive

All the data obtained during this cruise are archived at Okayama University, and will be open to public after quality checks and corrections. The corrected data and inventory information will be submitted to JAMSTEC Data Management Office.

Fig.7.9-1 Installation of the turbulence measurements sensors at the top of the foremast.

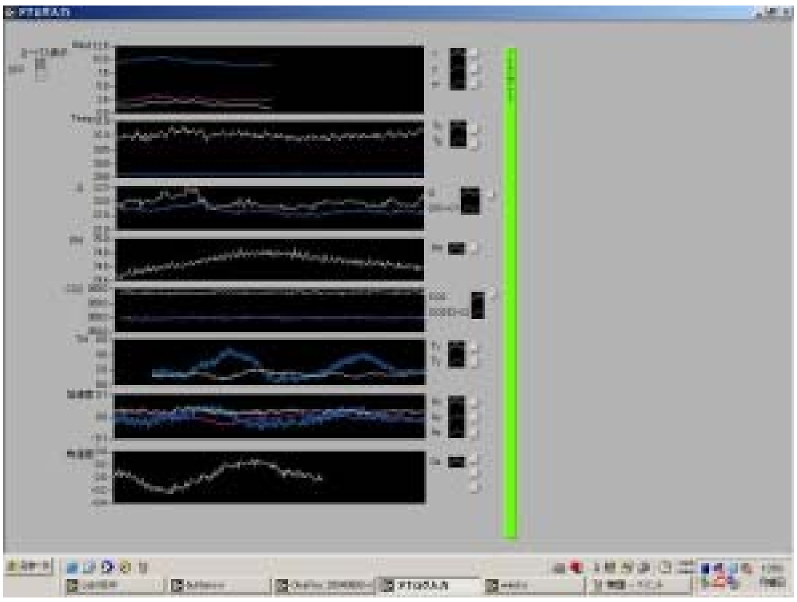

Fig.7.9-2 PC-based real time logging and monitoring system using LabVIEW software.

7.9.2 CO_2 profile measurement

(1) Personnel

Toru IWATA (Okayama University): Principal Investigator
Chikako Watanabe (Okayama University)
Fumiyoshi KONDO (Okayama University)
On-shore scientists: Osamu TSUKAMOTO (Okayama University)

(2) Objective

The aerodynamic gradient technique has been used to estimate CO_2 fluxes over the land surface by some micrometeorologists. In order to estimate CO_2 flux by this technique, the profile of CO_2 concentration in the surface boundary layer must be measured and the eddy diffusivity correctly evaluated.

(3) Methods

The CO_2 content at four levels in the surface atmosphere (20, 110, 280 and 790cm above the sea surface) was measured with a non-dispersive infrared (NDIR) gas analyzer (Licor Co., LI-6252) to estimate the CO_2 fluxes by the aerodynamic gradient technique. Air samples drawn from four levels were alternately introduced into the measuring cell of the NDIR every 150 second by the electrical switch at the rate of 0.12-0.14 L/min (Fig.7.9-3). Sample air was pre-dried by passing through a fiber drier. The calibration of NDIR was made every three days using other standard gas concentrations of CO_2. Data was logged at 1Hz by a laptop PC and statistically analyzed for 60 seconds every 150 second.

Air is sampled by using “Albedo boom” at the head of the ship with 6x9 vinyl hose sustained by a 8m carbon rod (Fig.7.9-4). A water-repellent filter was attached to the end of hoses. Sample airs at the four levels are introduced to the laboratory with 4x6 teflon hose(65m). They are extended every CTD casting operations and flux cruise observations. Summary of surface CO_2 profile measurements is shown in Table 7.9-1

(4) Preliminary Results

Figure 7.9-5 shows an example of the CO_2 profile measured during the flux cruise run at 5S, 95E. The profile may present semilogarithmic fit and the difference of CO_2 concentration between surface and 8m height is about 0.6 μatm.

(5) Future plan and Data Archives

All the data obtained during this cruise are archived at Okayama University, and will be open to public after quality checks and corrections. Interested scientists should contact Dr. Toru Iwata at Okayama University. The corrected data and inventory information will be submitted to JAMSTEC Data Management Office.

Table.7.9-1 List of surface CO_2 profile measurements.

Pt.Name	Location	DATE	DOY	Time(LST)	Duration	Profile
Static-01	5.0N,90E	Aug-05	215	7:20- 9:00	1:40	(NoData)
Static-02	4.0N,90E	Aug-05	215	13:20-14:50	1:30	
Static-03	1.0N,90E	Aug-05	216	7:05- 8:30	1:25	
Static-04	EQ,90E	Aug-05	220	11:10-12:15	1:05	
Run-111	1.5S,90E	Aug-05	220	22:27-22:57	0:30	(NoObs.)
Run-112	1.5S,90E	Aug-05	220	23:28-23:58	0:30	(NoObs.)
Run-113	1.5S,90E	Aug-05	221	0:38- 1:10	0:30	(NoObs.)
Run-114	1.5S,90E	Aug-05	221	1:46- 2:17	0:30	(NoObs.)
Run-121	1.5S,90E	Aug-05	221	13:31-14:01	0:30	(NoObs.)
Run-122	1.5S,90E	Aug-05	221	14:36-15:06	0:30	
Run-123	1.5S,90E	Aug-05	221	15:39-16:09	0:30	
Run-124	1.5S,90E	Aug-05	221	16:45-17:15	0:30	
Run-131	1.5S,90E	Aug-05	221	17:52-18:52	1:00	
Run-132	1.5S,90E	Aug-05	221	20:02-21:02	1:00	
Run-133	1.5S,90E	Aug-05	221	21:40-22:40	1:00	
Run-134	1.5S,90E	Aug-05	221	23:24-24:25	1:00	
Static-05	2.0S,90E	Aug-05	222	14:00-15:40	1:40	
Static-06	5.0S,90E	Aug-05	223	8:05- 9:30	1:25	
Static-07	5.0S,91E	Aug-05	223	14:15-15:25	1:10	
Static-08	5.0S,94E	Aug-05	224	8:00- 9:30	1:30	
Static-09	5.0S,95E	Aug-05	224	14:00-15:30	1:30	
Run-211	1.5S,95E	Aug-05	224	16:30-17:30	1:00	
Run-212	1.5S,95E	Aug-05	224	18:30-19:30	1:00	
Run-213	1.5S,95E	Aug-05	224	20:20-21:20	1:00	
Run-214	1.5S,95E	Aug-05	224	22:20-23:20	1:00	
Run-215	1.5S,95E	Aug-05	225	0:15- 1:15	1:00	
Run-221	1.5S,95E	Aug-05	225	13:27-14:27	1:00	
Run-222	1.5S,95E	Aug-05	225	15:12-16:12	1:00	
Run-223	1.5S,95E	Aug-05	225	17:05-18:05	1:00	
Run-231	1.5S,95E	Aug-05	225	19:05-20:05	1:00	
Run-232	1.5S,95E	Aug-05	225	21:00-22:00	1:00	
Run-233	1.5S,95E	Aug-05	225	22:50-23:50	1:00	
Run-241	1.5S,95E	Aug-05	226	11:35-12:35	1:00	
Run-242	1.5S,95E	Aug-05	226	13:20-14:20	1:00	
Run-243	1.5S,95E	Aug-05	226	15:09-16:09	1:00	

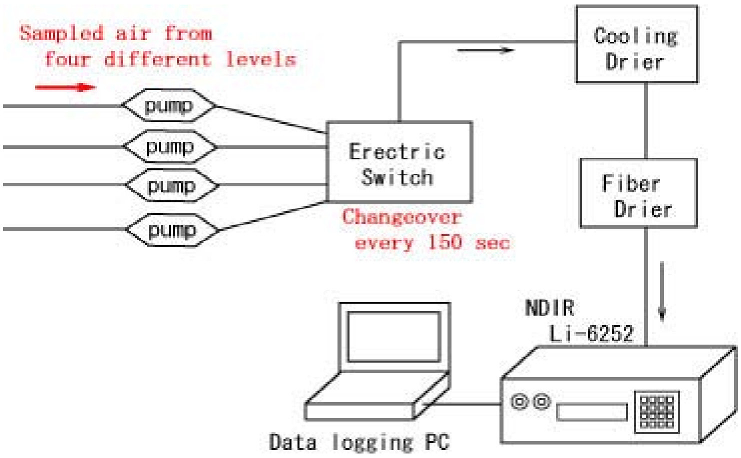

Fig.7.9-3 CO_2 profile measurement system.

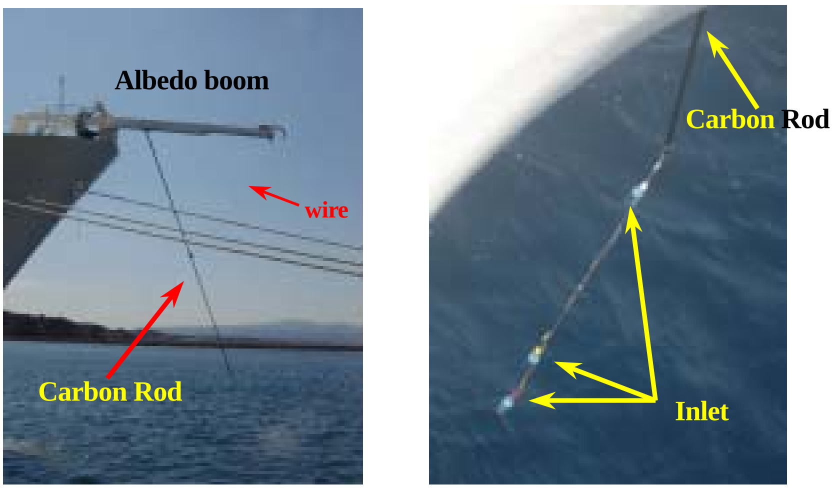

Fig.7.9-4 Albedo boom with carbon rod (left panel) and lower three inlets of sample gas at the end of the carbon rod (right panel).

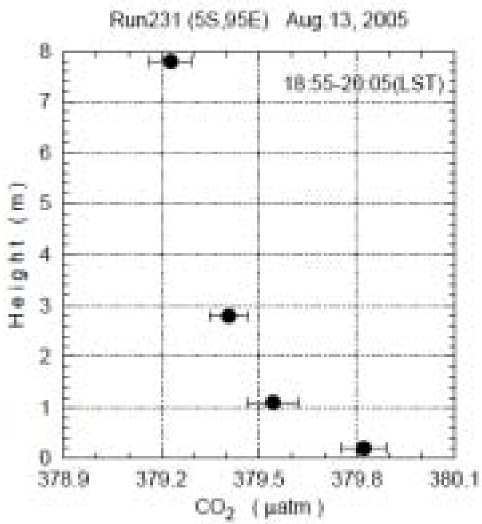

Fig.7.9-5 An example of Vertical profile of CO_2 during the flux cruise at 5S, 95E.

7.10 Piston core sampling

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Toshiya Kanamatsu (IFREE, JAMSTEC)
Yusuke Suganuma (GSJ, AIST)
Yusuke Sato (MWJ)
Kazuhiro Yoshida (MWJ)
Yuko Sagawa (MWJ)
Yasushi Hashimoto (MWJ)

Objective

The purpose of the coring program in the equatorial Indian Ocean is to obtain sediments for a paleomagnetic study. The main purposes of the paleomagnetic study are as follows.

(1) In the West Caroline Basin, western equatorial Pacific, a component of ~100 kyr quasi-period was found in relative paleointensity and inclination variations (Yamazaki and Oda, 2002; 2005). This periodicity is close to that of the orbital eccentricity, which suggests orbital modulation of the geomagnetic field. Also, an intriguing correlation between inclination and paleointensity variations was found, and to explain this, a model connecting dipole-field intensity fluctuations and an inclination anomaly caused by a persistent quadrupole component has been proposed (Yamazaki and Oda, 2002; 2004). Large inclination anomalies occur in low latitudes of the Indian Ocean based on time-averaged field models (e.g. Hatakeyama and Kono, 2002), and thus it is expected that the paleointensity-inclination correlation should be observed there, if our model is correct. An objective is to confirm this idea.

(2) The main criticism for sedimentary paleointensity studies, in particular for the orbital modulation hypothesis, is the possibility that artificial variations caused by paleoclimatically induced lithological changes may contaminate relative paleointensity records. To evaluate this, it is necessary to compare paleointensity records from various sediment lithologies. In particular, glacial-interglacial variations of carbonate production/preservation in the Indian Ocean sediments could be opposite in phase compared with the Pacific Ocean sediments. Thus the aim of the study is to compare rock-magnetic, paleomagnetic, and sedimentological characteristics of the Indian Ocean sediments with our previous results from the West Caroline Basin in the Pacific.

We planned to take sediment cores from different water depths. One reason is to evaluate the effect of differences in carbonate contents on relative paleointensity estimation. Another reason is age estimation of sediments. Empirically, excellent paleomagnetic records are expected for sediments from water depths of ~4000m or deeper. However, sediments of such large water depths are difficult to be dated by oxygen isotopes because most carbonates are dissolved. We thus planned to date sediment cores taken from the depths enough shallower than the carbonate compensation depth (CCD), and estimate ages of the cores from deeper sites by inter-core correlation using magnetic susceptibility.

Site survey

Coring sites are located on the Ninety-east ridge (Figure 7.10-1), which is considered to have formed by an interaction between a fracture zone and a hotspot. A site survey was carried out in order to find locations suitable for sediment coring. Swath bathymetry and sub-bottom profiling (SBP) were conducted using the SeaBeam 2112 multi-narrow-beam echo sounder equipped on R/V Mirai. Based on water depths, topography, and sedimentary sequences on the SBP records, the sites were selected so as to avoid coring abnormal sediments like slumping and turbidites. Topography around each coring sites and SBP records during coring are shown in Figures 7.10-2 through 7.10-4. Topography of this area is characterized by lineaments of E-W or ESE-WNW directions. They are close to the direction of magnetic lineations of seafloor spreading origin to the west of this area.

Coring method, results, and handling procedure of cores

A piston corer system used in this cruise consists of a long aluminum barrel with polycarbonate liner tube. The outline of this piston corer system is shown in Figures 7.10-5 and 7.10-6. The total weight of the system is approximately 1.3 ton. The length of the core barrel was 15m for PC01 and PC02, and 20m for PC03. We used a small multiple corer ("Ashura") for a trigger. For PC01 and PC02, we used inner liners: polycarbonate liner tubes (Inner type) of 5 m long and 74mm inside diameter. For PC03, we didn't use inner liners (Outer type). A compass with inclinometer was attached above the weight of the corer to examine performance of the corer.

When we starts lowering the piston corer system, a speed of wire out is set to be 0.2 m/s., and then gradually increased to the maximum of 1.2 m/s. The piston corer is stopped at a depth about 100 m above the sea floor for 3-5 minutes to reduce any pendulum motion of the system. After the system is stabilized, the wire is stored out at a speed of 0.2 m/s., and we carefully watch a tension meter. When the piston corer touches the bottom, wire tension abruptly decreases by the loss of the piston corer weight. Immediately after confirmation that the corer hit the bottom, wire out is stopped and rewinding of the wire is started at a dead slow speed (~0.2m/s.), until the tension gauge indicates that the corer is lifted off the bottom. After leaving the bottom, winch wire is wound in at the maximum speed.

Results of the coring is summarized in Table 7.10-1. The inner tube of the piston corer filled with sediments was cut into 1m lengths for each section using a handy cutter. The sections were longitudinally split into a working and an archive halves by a splitting devise with a stainless steel wire.

On board, we carried out visual core description, taking photographs, color reflectance measurement, measurements of magnetic susceptibility, gamma-ray density, and P-wave velocity using a multi-senor core logger, and sub-sampling using plastic cubes of 7 cm^3 each. Samples for soft X-ray photo were taken from Core PC03. Handling procedure of the cores is shown in Figure 7.10-7.

Visual core description and photograph

Photographs of the three sediment cores obtained are presented in Figures 7.10-8 through 7.10-10. Visual core descriptions of the cores are attached as Appendix 7.10.1. Brief descriptions of each core are as follows.

Core PC01 is composed of foraminifera and nannofossil carbonate ooze, which contains several mottles and rarely visible bioturbation throughout the core. The color of the sediments is generally light yellow to grayish yellow. A volcanic ash layer is recognized at 0 -12 cm of the section 13. This volcanic ash layer represents normal grading with light gray to grayish-yellow color.

Core PC02 is characterized by intercalation of nannofossil carbonate ooze, foraminifera and nannofossil calcareous ooze, and minor clay rich sediments. The nannofossil carbonate ooze and foraminifera and nannofossil calcareous ooze generally present grayish yellow or dull yellow color, and rarely light bluish gray color, especially in the deeper part of the core. The clay rich sediments mainly occur in the deeper part of the core with grayish white or bluish gray color. The sediments of PC02 is mottled relatively heavier than PC01. A thin volcanic ash layer occurs at 88.5-90 cm of the section 10, which exhibits gray color.

Core PC03 is dominated by clay to silty clay with minor amount of nannofossil. The sediments of PC03 is frequently mottled and bioturbated throughout the core, and laminated in the deeper part of the core. The color of sediments is mainly light gray or grayish in the upper part, and olive gray or gray in the lower part of the core. Volcanic ash layers are recognized at 79 - 95 cm of the section 3, 76 - 80 cm of the section 9, and 62 - 84 cm of the section 12.

A suit of volcanic ash layers was found from all cores, which is certainly originated from the Toba caldera in Sumatra Island. The volcanic ash layers found from top 1.0 - 1.4 m of each core are most likely to be correlated to the youngest Toba eruption. The youngest Toba eruption has been dated at 73-75 ka by K-Ar and Ar-Ar methods (Ninkovich et al.,1978; Chesner et al., 1991). Other volcanic ash layers, found from the deeper part of the PC03, are most likely to be originated from older Toba eruptions. Based on the depths of the core, the volcanic ashes at 76-80 cm of the section 9 and 62 – 84 cm of the section 12 can be correlated to the volcanic ash C and D of Dehn et al. (1991), respectively.

On the basis of these correlations, ages of each ash are estimated to be 0.512 – 0.538 Ma and 0.731-0.750 Ma by the oxygen-isotope dating (Dehn et al., 1991).

Muli-sensor core logging and color reflectance

Physical properties on PC and PL cores were measured by onboard GEOTEK multisensor core logger (MSCL). Gamma-ray density (GD), magnetic susceptibility (MS), P-wave velocity were measured on PC01, PC02, PL01, PL02, and PL03. P-wave velocity was not but GD and MS were measured on PC03. All measurements were performed at 2 cm intervals. Color reflectance was measured using the Minolta Photospectrometer CM-2002. The color of the working halves was measured on every 2-cm through crystal clear polyethylene wrap. The color reflectance data are displayed as the color parameters of L*, a*, and b* (L*: black and white, a*: red and green, b*: yellow and blue). The results are summarized in Figures 7.10-11 through 7.10-14.

<u>PC01</u>

MSCL data in the interval of 0-14.5 cm are invalid due to incomplete sediment fill. One ash layer is included at 111 cmbsf (the top of Section 13). A broad peak in the MS profile corresponds to this ash layer. GD in this interval reveals slightly smaller value.

L* value drops at the horizon of ash layer (111 cm), it also decreases in the middle of section 14. The a* reveals high at the top section (Section 12). It decreases gradually with depth.

<u>PC02</u>

MSCL data in the interval of 0-40 cmbsf are invalid due to due to incomplete sediment fill. A thin ash layer (1.5 cm) is included near the bottom of Section 10. This may be correlated to the broad MS peak in the interval between 80 cmbsf and 90 cmbsf.

L* value drops broadly at the horizon including the ash layer near the bottom of Section 10. High values of a* and b* are recognized through Sections 10 to the middle of Section12. Both values show a sudden decrease at the middle of Section 12. They change to fairly constant low values.

<u>PC03</u>

A sharp MS peak is correlated to ash layers in the interval of 79-95 cmbsf (the lower Section 3). No clear peak in MS is recognized for the ash in the intervals of 701.5-704.5 cmbsf (76 - 80 cm of the section 9). A prominent high GD appears in the indurate interval accompanied ash layers at 996.5 cmbsf-1018.5 cmbsf (62 - 84 cm of the section 12). A small peak of MS is recognized at the layer.

Figure 7.10-15 shows enlarged MS profiles for three cores. MS sharp peaks, at 111 cmbsf of PC01, 87 cmbsf of PC02, and 134 cmbsf of PC03, are considered to be arisen from the same volcanic ash, and a fluctuation pattern below this horizon in cores is supposedly correlated with each other.

Fluctuation in L* value through all sections is recognized. It also drops at the ash layers (79-95 cm, Section 3, 62 - 84 cm of the section 12). High value of a* and b* occur through Sections 2 to the middle of Section 10. Below this level, both values show fairly constant low values.

Table 7-10.1 Summary of Piston coring

Core No.	Date and Time	Latitude (N)	Longitude (E)	Depth (m)	Core length (m)*	Lithology
PC01	2005.8.5 09:41	1-11.0126	89-23.5837	3,101	4.09	foraminifera and nannofossil carbonate ooze
PC02	2005.8.6 09:42	1-19.1495	88-52.4365	3,813	5.96	nannofossil ~ foraminifera and nannofossil calcareous ooze/ clay
PC03	2005.8.7 09:53	1-13.2484	88-25.9536	4,406	10.18	clay ~ silty clay

*excluded flow-in

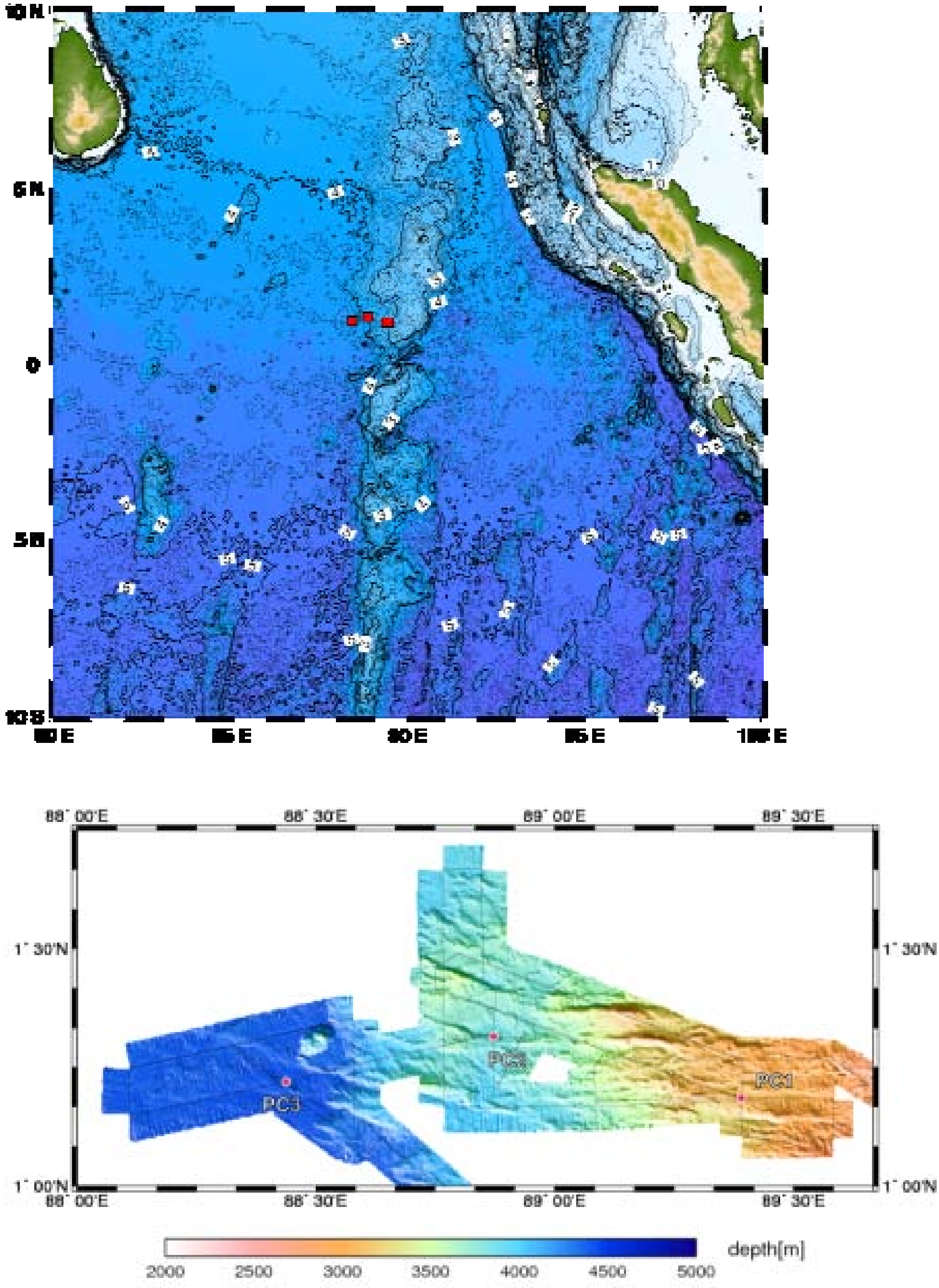


Figure 7.10-1 Index map of coring sites.

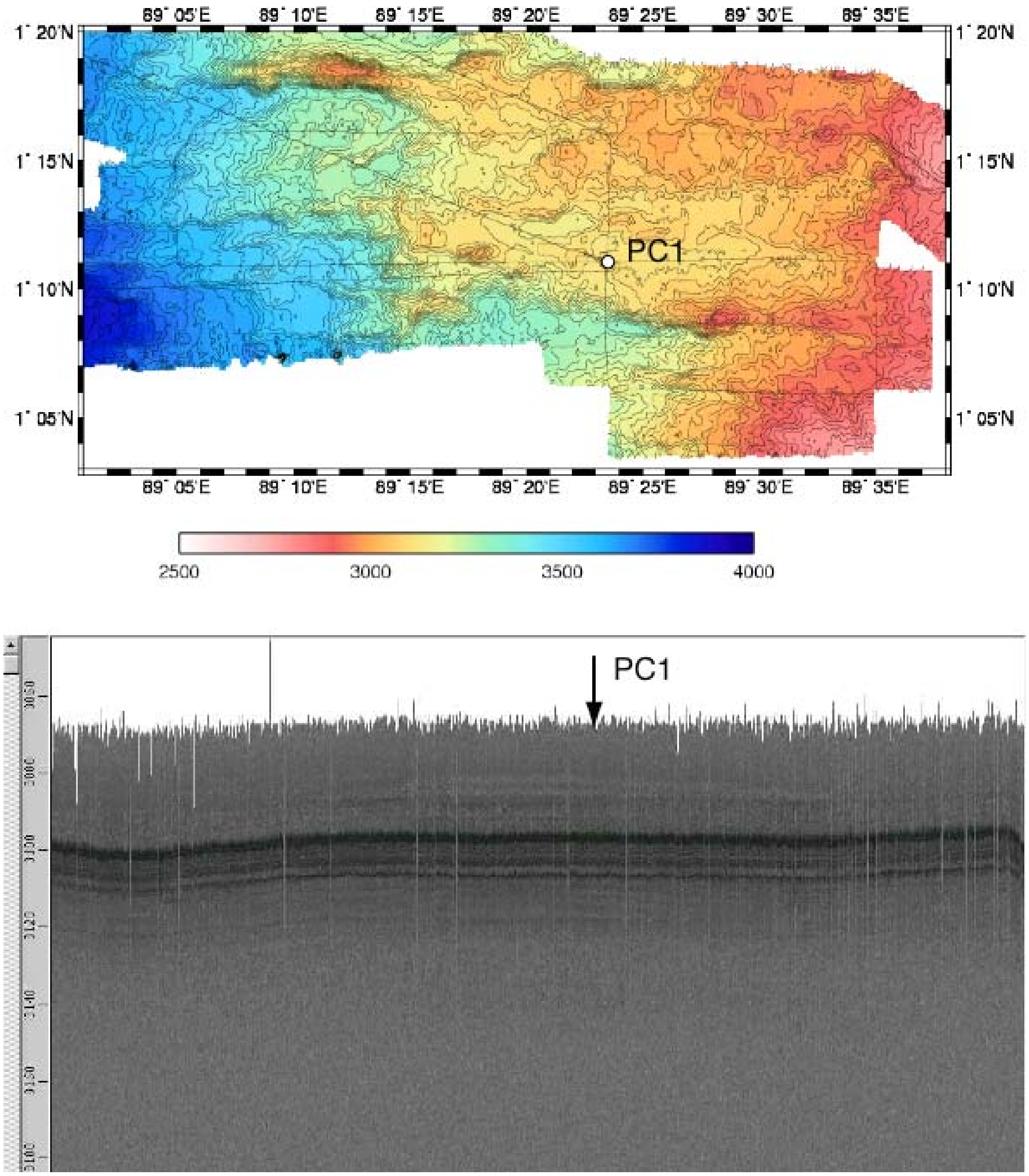


Figure 7.10-2 Topography around the site of core MR0503-PC01 (top), and record of sub-bottom profiler at the coring site (bottom).

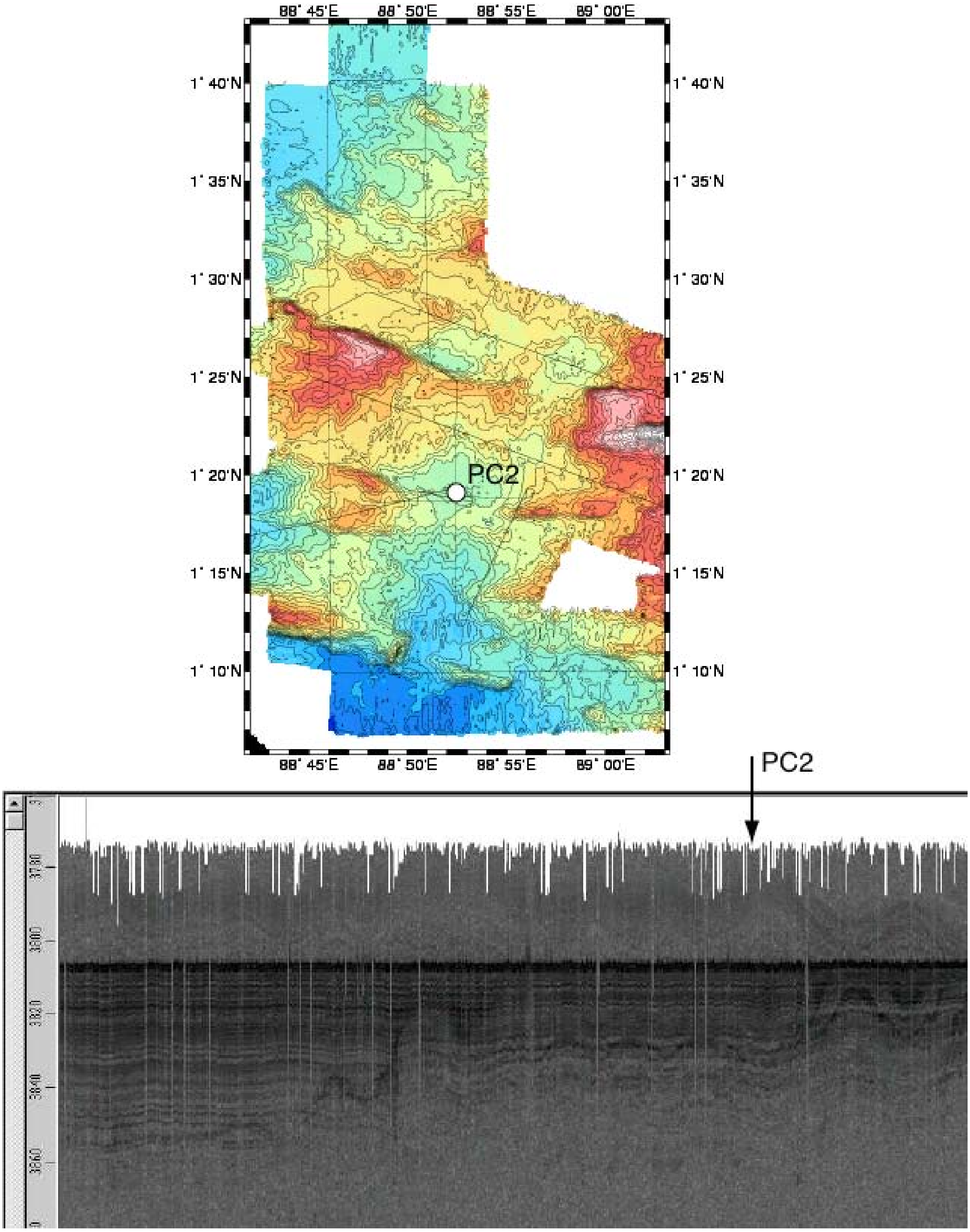


Figure 7.10-3 Topography around the site of core MR0503-PC02 (top), and record of sub-bottom profiler at the coring site (bottom).

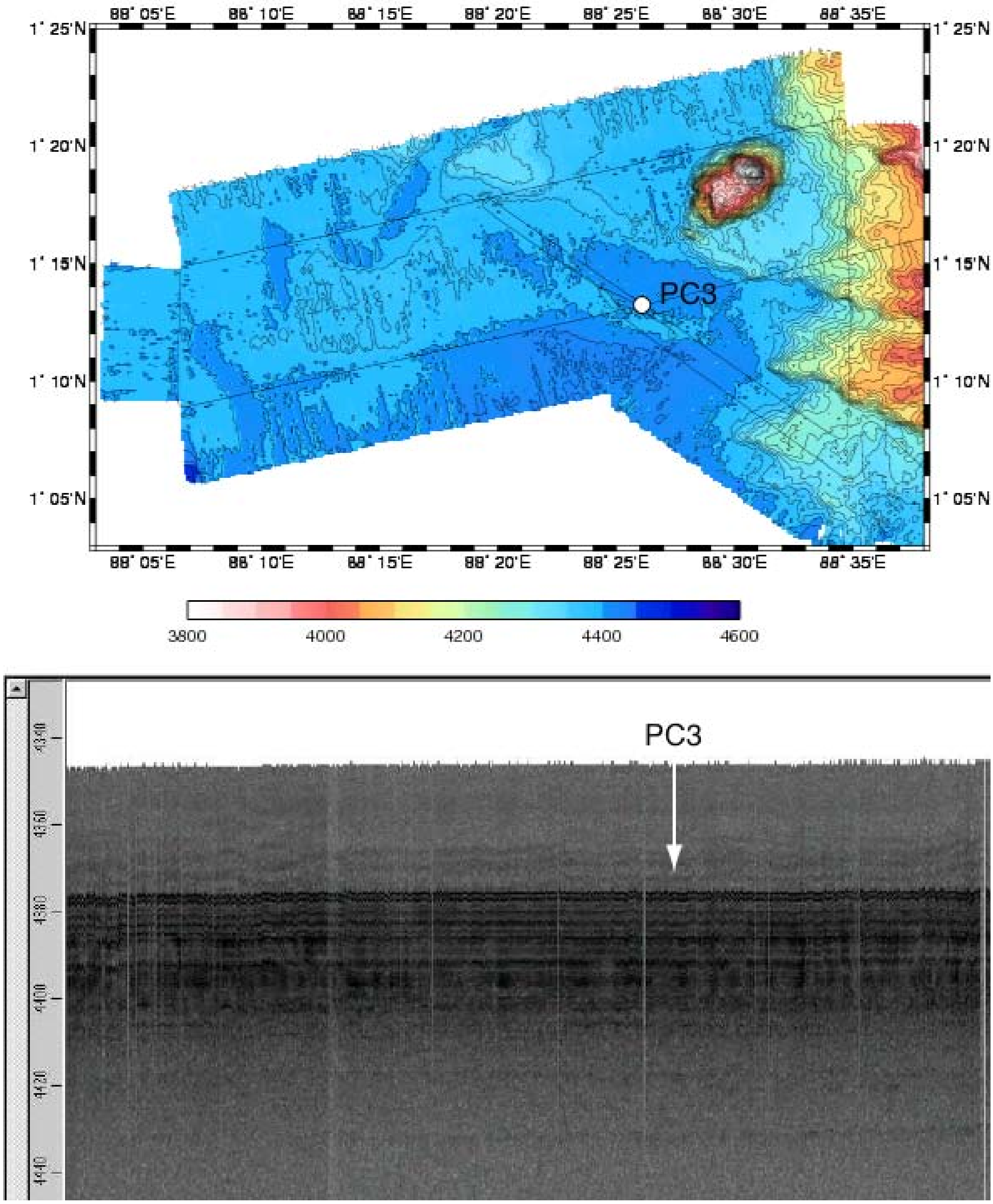
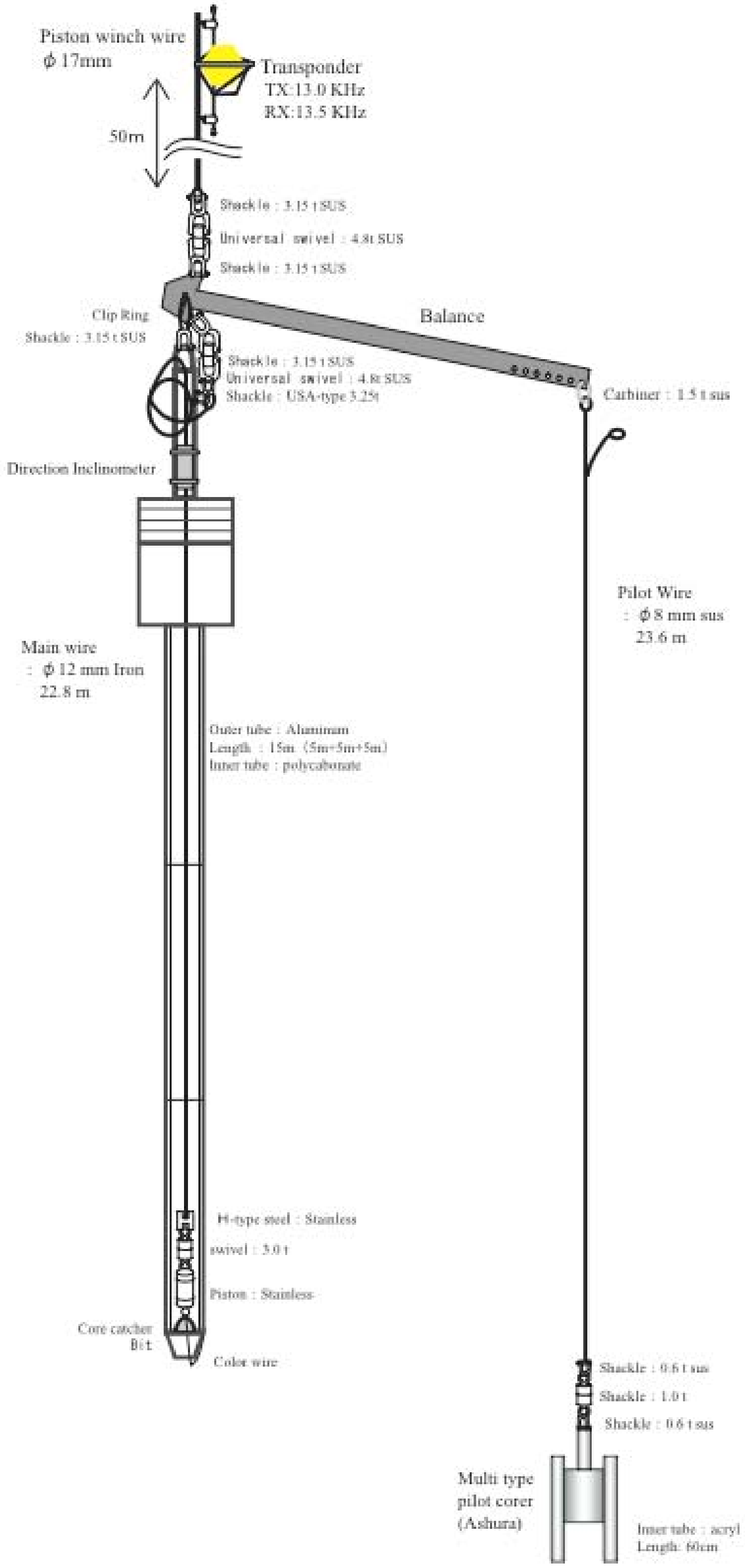


Figure 7.10-4 Topography around the site of core MR0503-PC03 (top), and record of sub-bottom profiler at the coring site (bottom).



Piston corer system (PC-01,02)

Figure 7.10-5 Piston corer system with 15m-long core barrel.

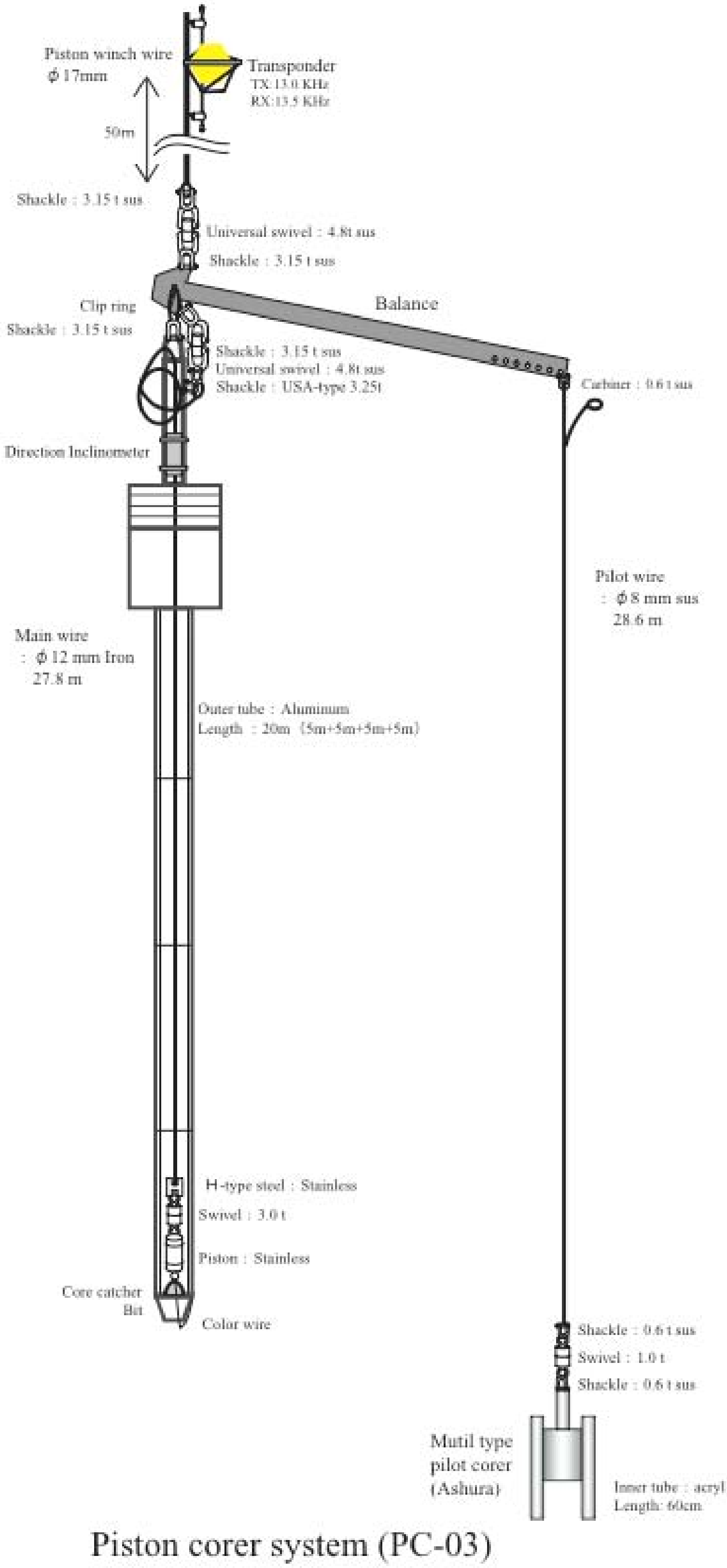


Figure 7.10-6 Piston corer system with 20m-long core barrel.

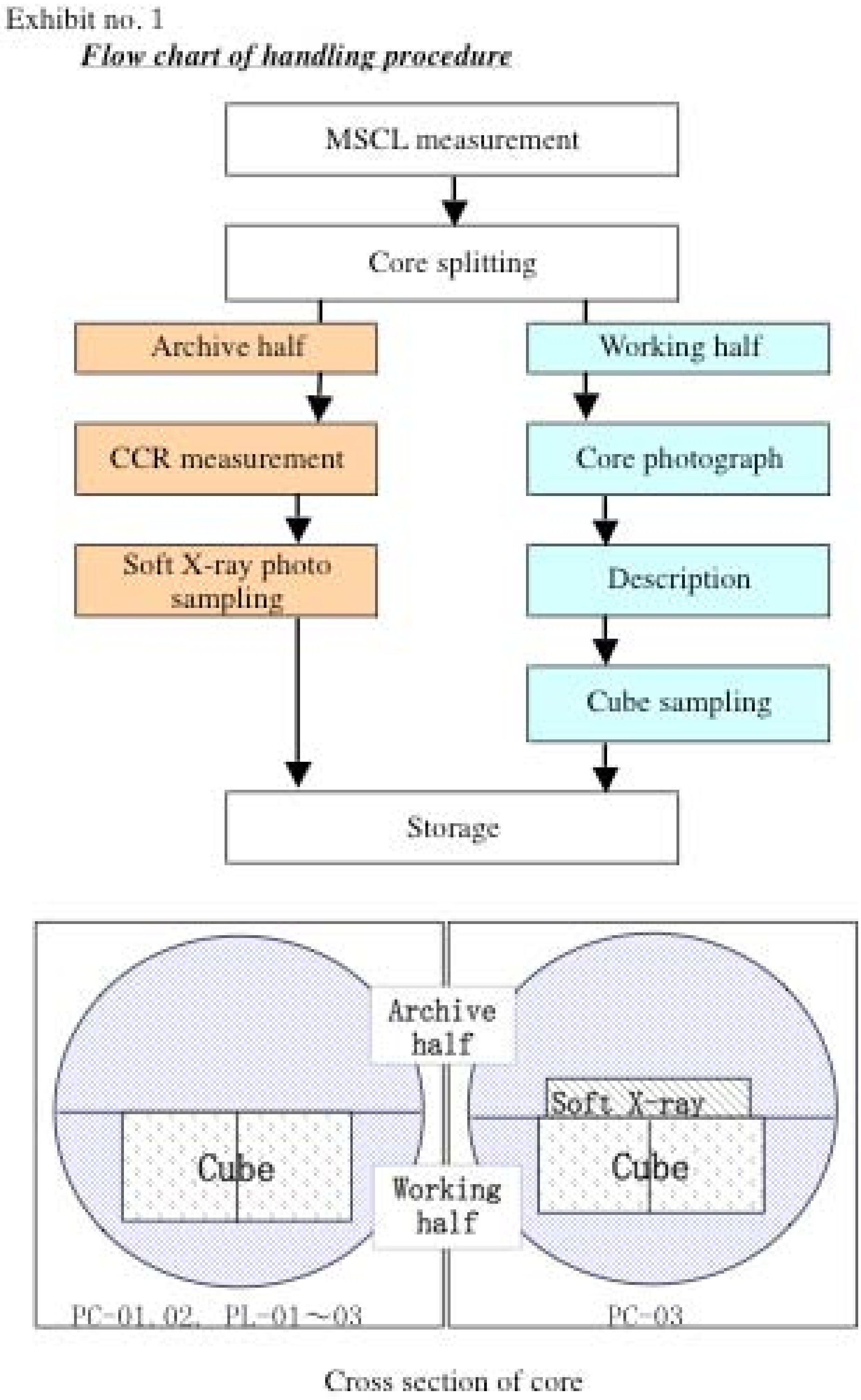


Figure 7.10-7 Handling procedure of cores.

Figure 7-10.8 Photograph of core MR0503-PC01.

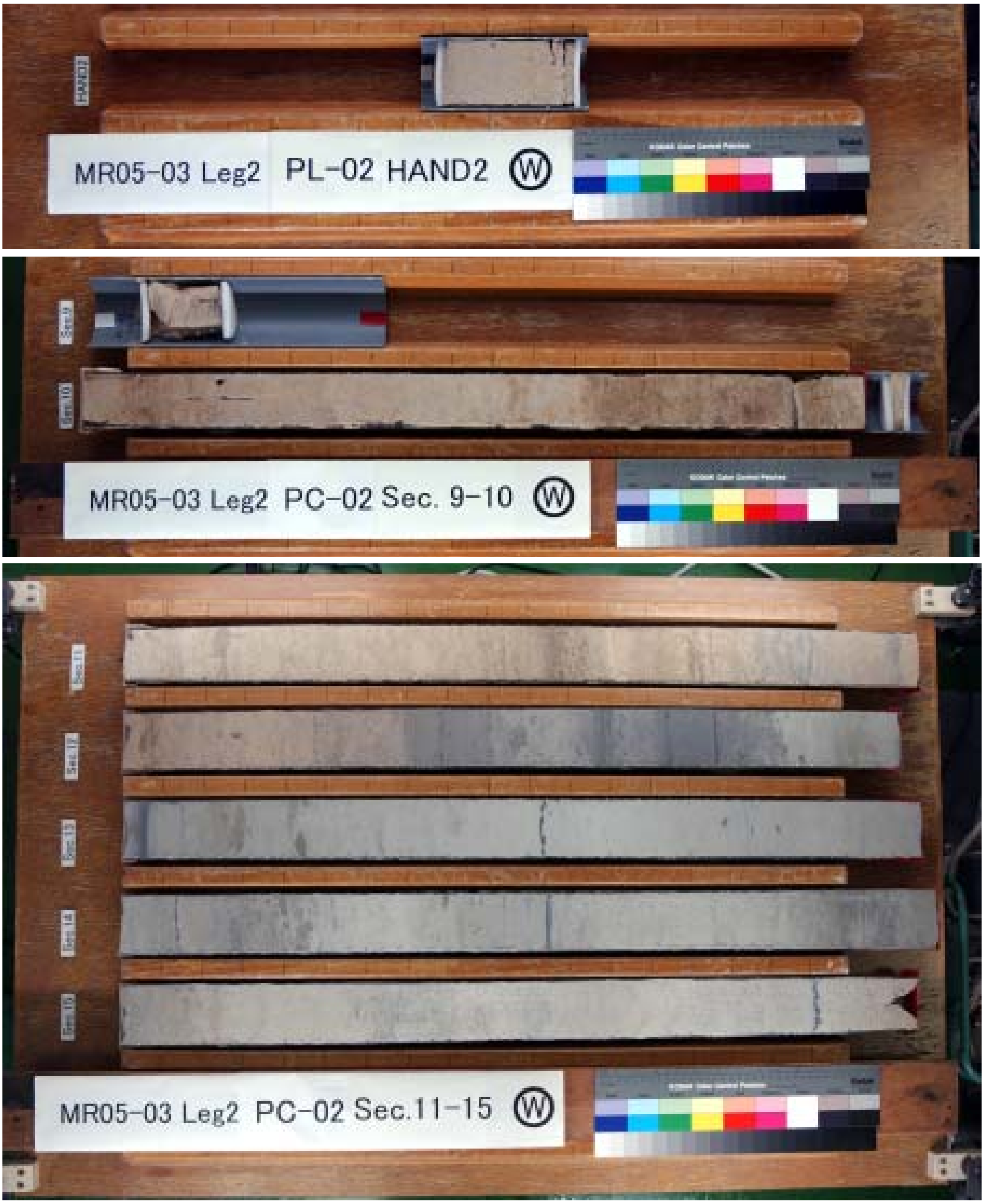


Figure 7.10-9. Photograph of core MR0503-PC02.

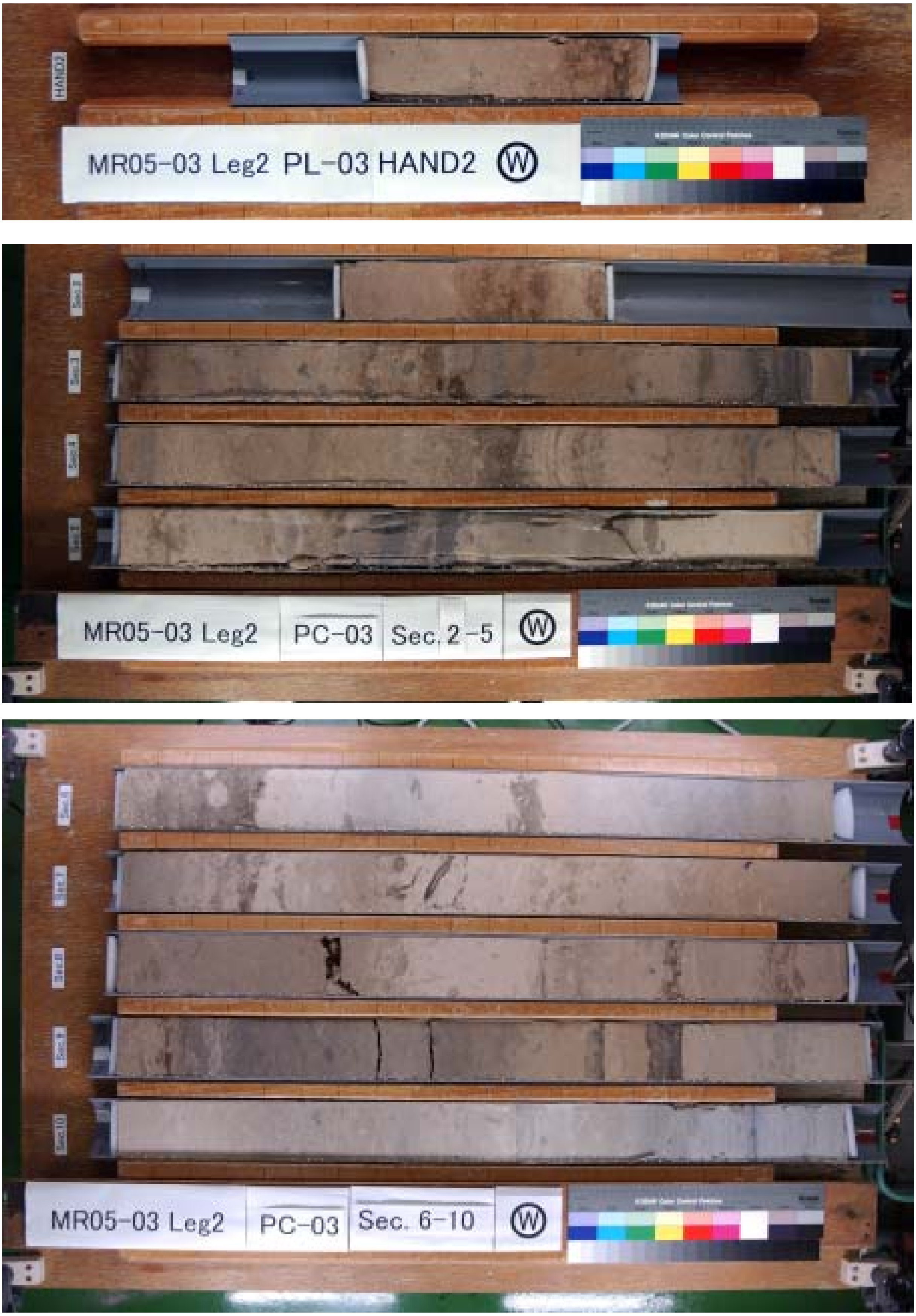


Figure 7.10-10 Photograph of core MR0503-PC03 sections 2 through 10, and PL03.

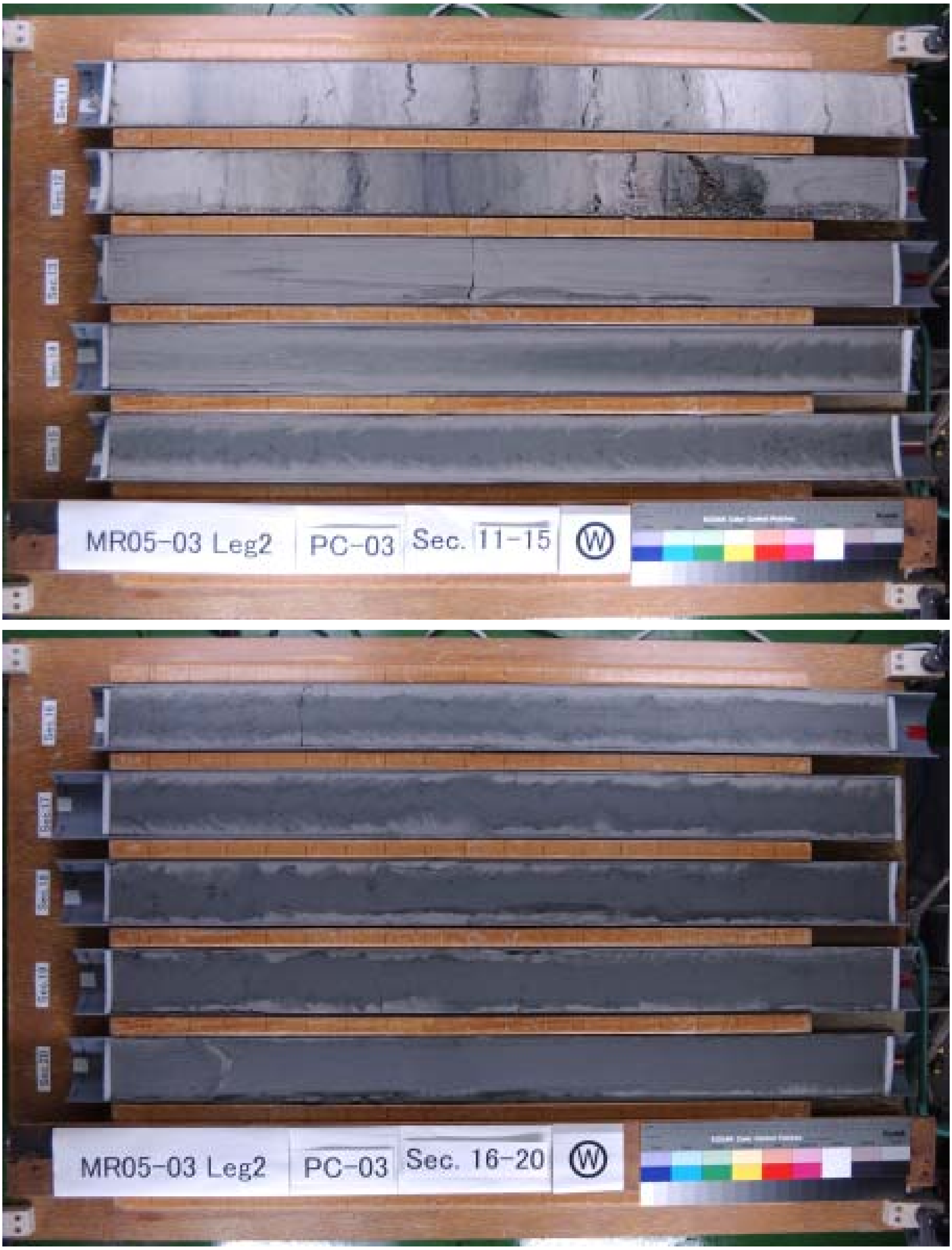


Figure 7.10-10 (cont'd) Photograph of MR0503-PC03, sections 11 through 20.

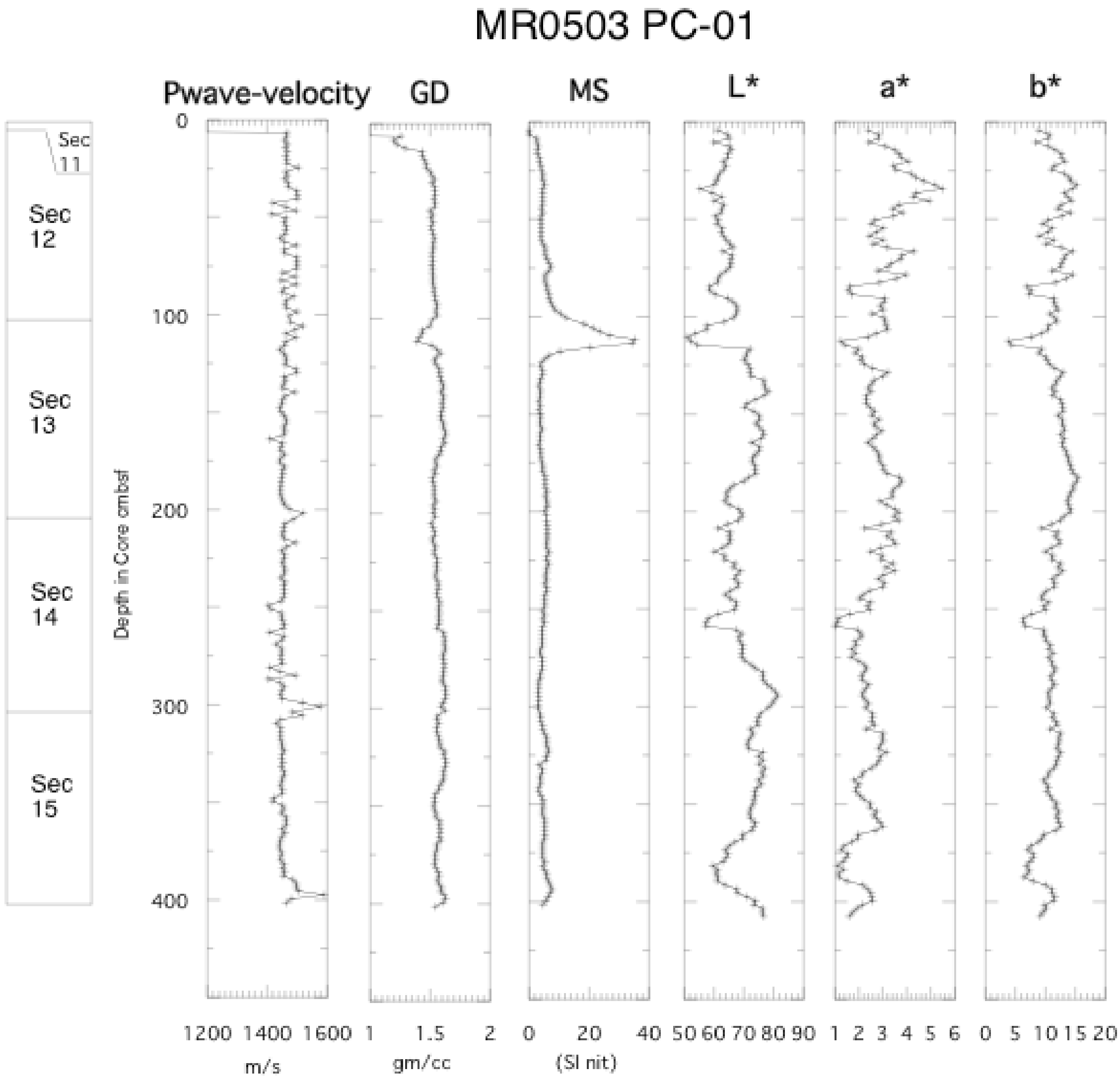


Figure 7.10-11 Physical properties (P-wave velocity, gamma-ray density, and magnetic susceptibility) and color reflectance (L*, a*, b*) of MR0503-PC01.

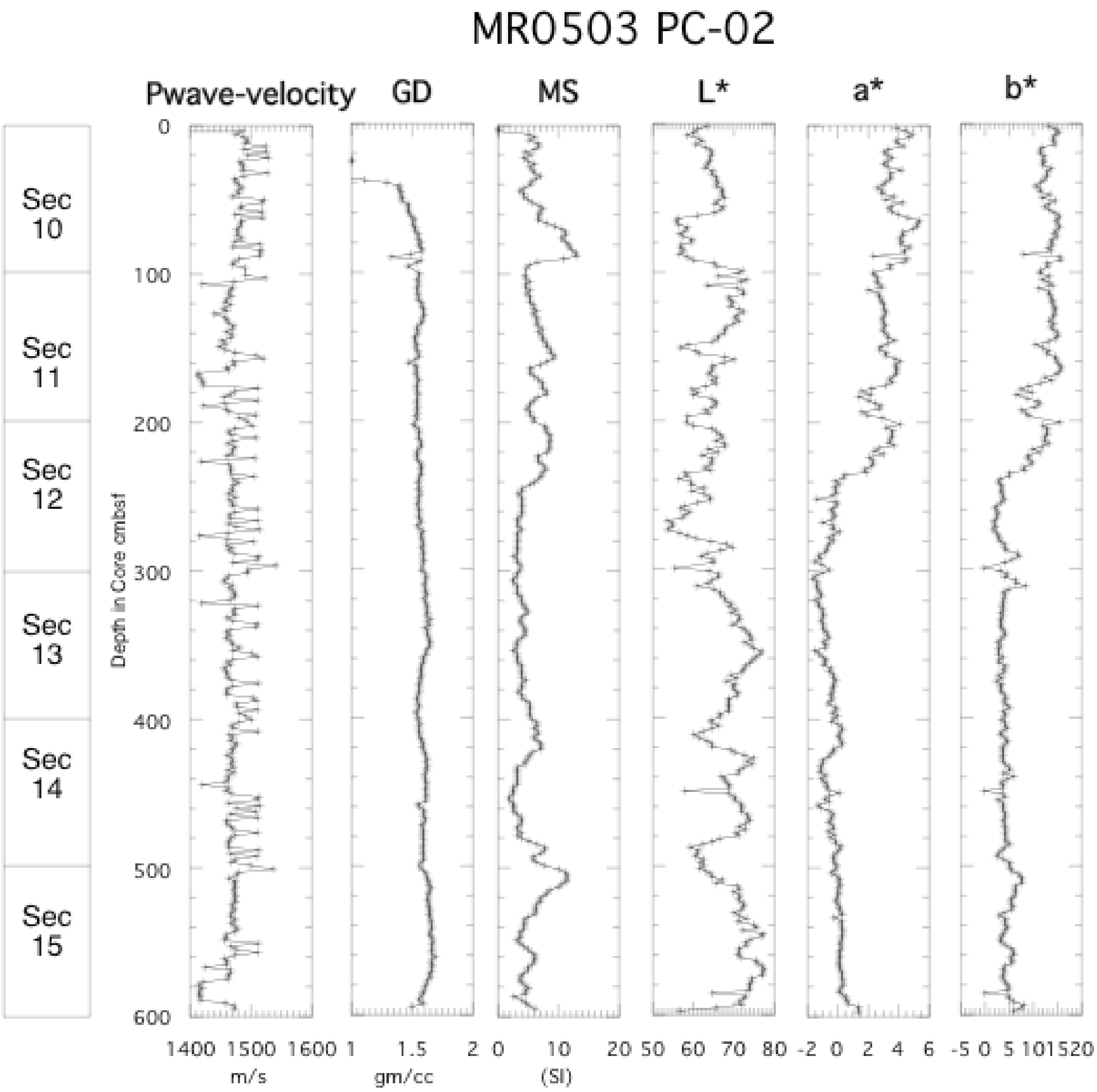


Figure 7.10-12: Physical properties (P-wave velocity, gamma-ray density, and magnetic susceptibility) and color reflectance (L*, a*, b*) of MR0503-PC02.

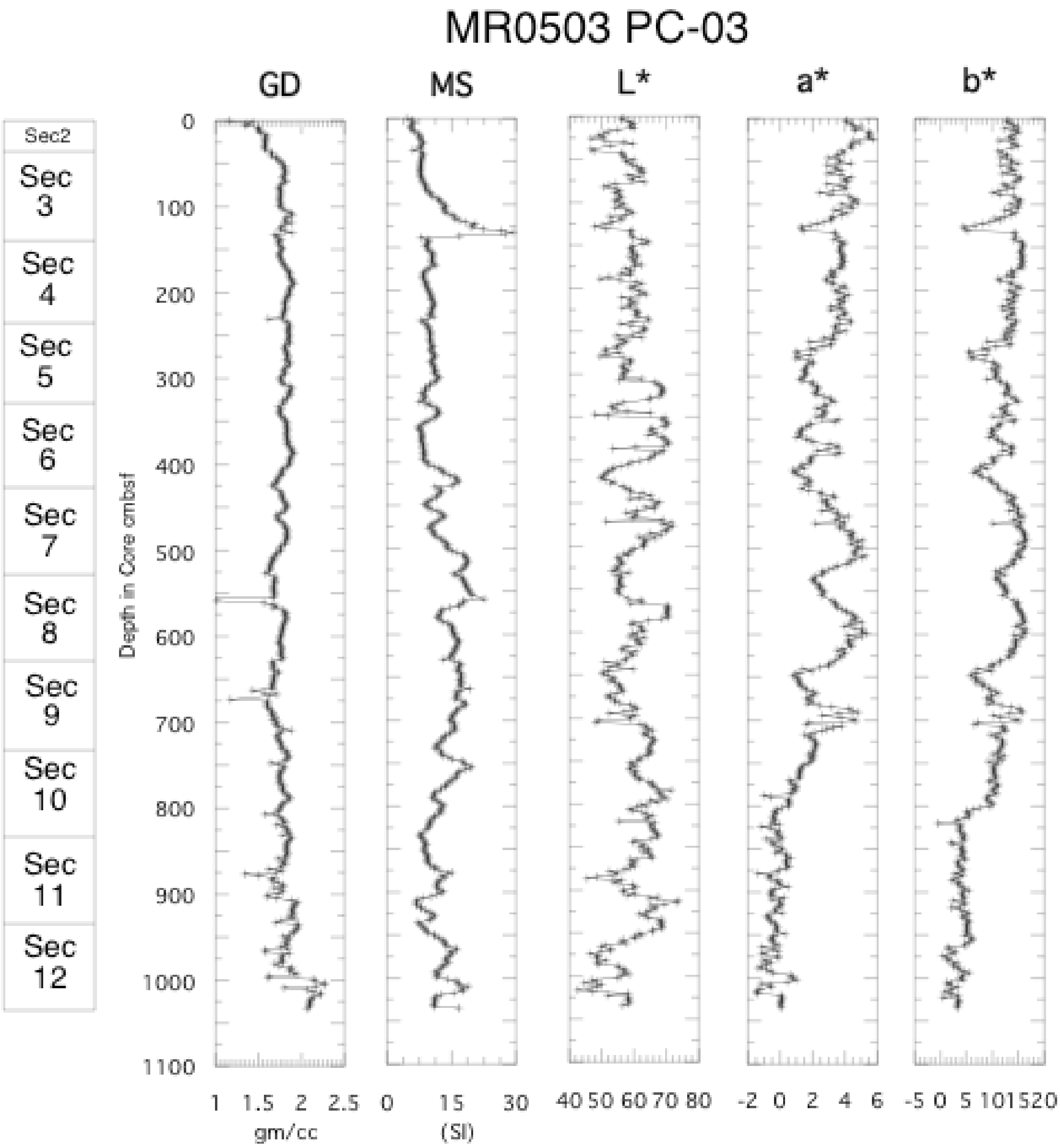


Figure 7.10-13: Physical properties (gamma-ray density, and magnetic susceptibility) and color reflectance (L*, a*, b*) of MR0503-PC03.

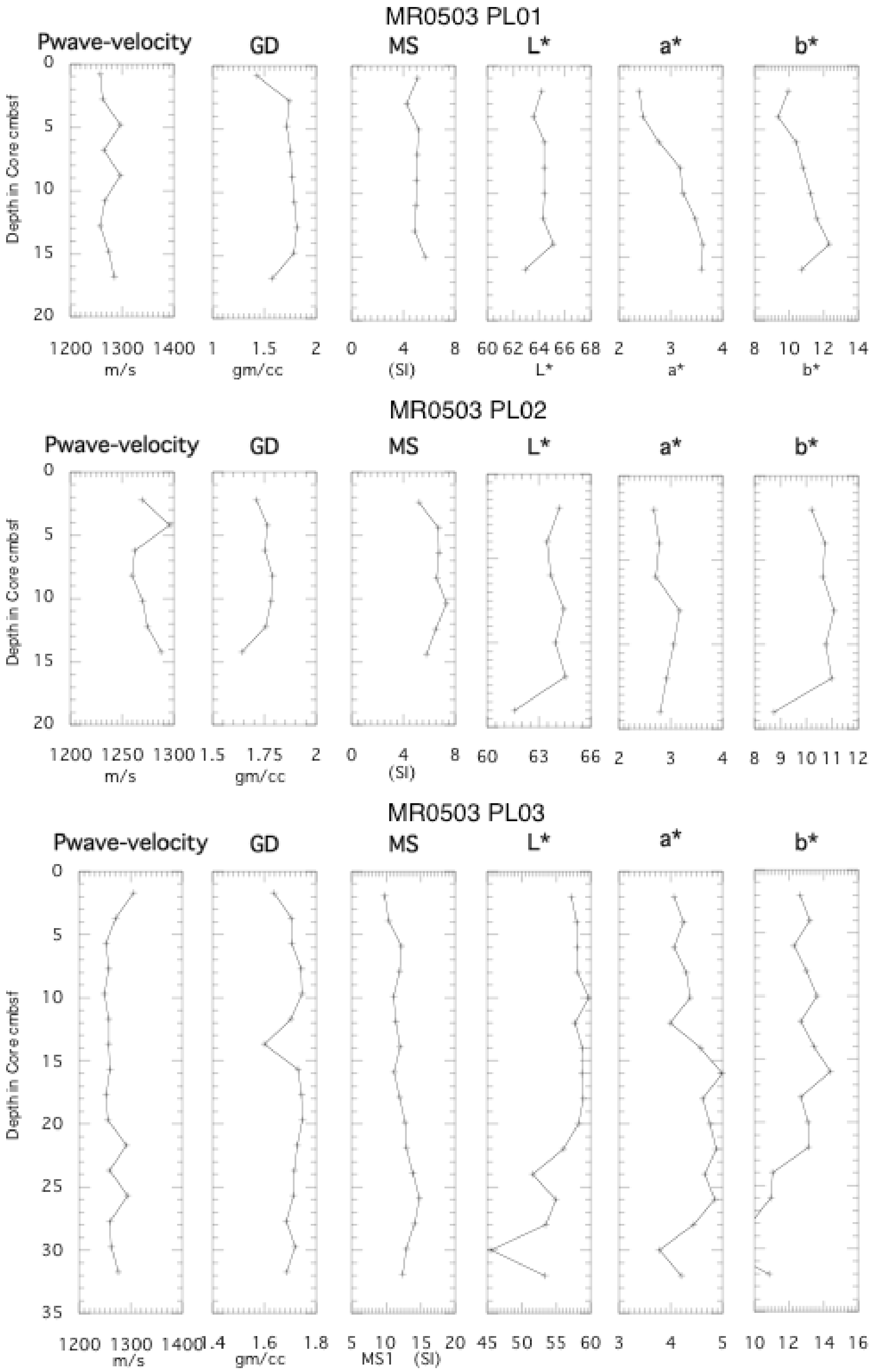


Figure 7.10-14 Physical properties (P-wave velocity, gamma-ray density, and magnetic susceptibility) and color reflectance (L*, a*, b*) of MR0503-PL01, PL02, and PL03.

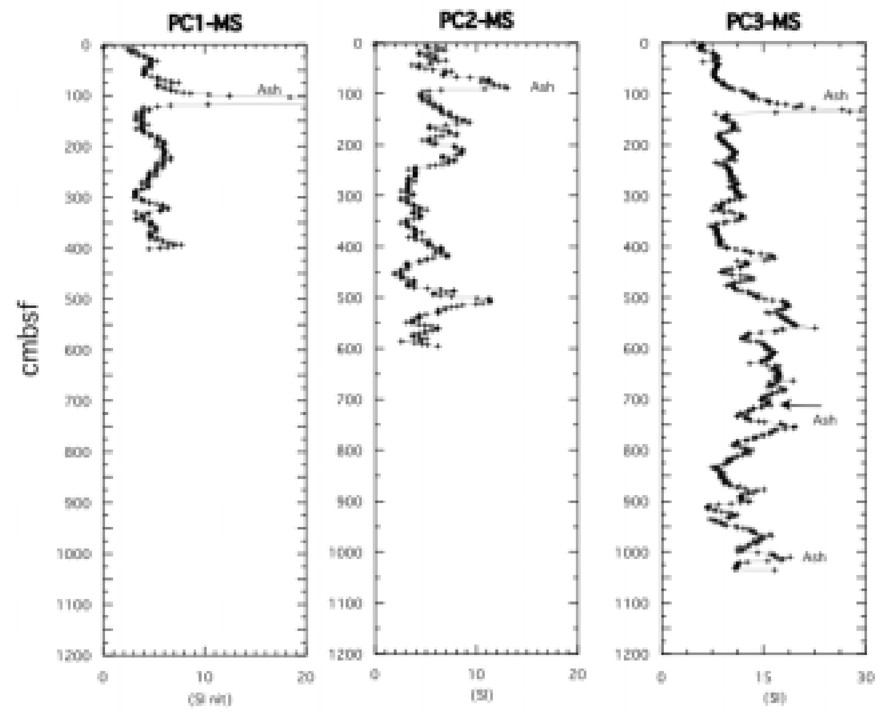


Figure 7.10-15 Correlation of magnetic susceptibility profiles for PC01, PC02, and PC03.

7.11 Observation of clouds by infrared radiometer

(1) Personnel

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(2) Objective

The infrared radiometer (hereafter IR) is used to derive the temperature of the cloud base. Main objectives are to study distribution of high clouds and its relation to the climate system by the combination of IR with lidar operated by National Institute for Environmental Studies. From these integrated approach, it is expected to extend our knowledge of clouds and climate system. We also attempted to retrieve cloud microphysics in upper part of clouds.

(3) Method

IR instrument directly provides broadband infrared temperature (9.6-10.5mm).

General specifications of IR system (KT 19II, HEITRONICS)

Temperature range	-100 to 100^{o}C
Accuracy	0.5 ^{o}C
Mode	24hours
Time resolution	1 min.
Field of view	Less than 1^{o} (will be estimated later)
Spectral region	9.6-10.5 m

The measured temperature is converted to broadband radiance around the wavelength region. This is further combined with the lidar for the retrieval of cloud microphysics such as optical thickness at visible wavelength. The applicability of the retrieval technique of the synergetic use lidar/IR is so far limited to ice clouds.

(4) Data archive

Data period is May 24 to Sep.1 in 2005 but there are no observational data for the following dates, July 1,2,23 and 25 and August 19, 20 and 24.

The measured temperature for May 25 and August 16 are shown in Figs.1a and b, respectively. And the data for the whole cruise period is shown in Fig.2

Fig. 1 (a) The measured temperature by IRT in May 25 and (b) in August 16.

Fig. 2 The same as Fig.1 but for the whole observation period.

The data archive server is set inside Tohoku University and the original as well as corrected data and the results of the analyses will be available from us.