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R/V Mirai Cruise Report MR04-08 Leg-1

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

R/V Mirai Cruise Report
MR04-08 Leg-1

[Contents]

1. Introduction

Air-sea interaction is a key factor to understand the atmospheric and oceanic phenomena over the tropical western Pacific warm pool region. Since the huge amount of latent heat released from active convections developed over the warm pool drives large-scale meridional (Hadley) and zonal (Walker) circulations, this tropical western Pacific region is often called “heat engine of the globe”.

In order to study the atmospheric convective activities over the warm pool, scientific cruise by using research vessel MIRAI has been conducted since 1999. On the other hand, Institute of Observational Research for Global Change (IORGC; former Frontier Observational Research for Global Change and Ocean Observation and Research Department have been merged from July 2004) of JAMSTEC has deployed meteorological observational sites at Aimeliik and Peleliu in the Republic of Palau since 2001. In particular, two Doppler weather radar systems - one is of IORGC at Aimeliik and the other is of Nagoya University at Peleliu - had been set to observe convective clouds in November 2004. Since the dual Doppler radar obeservation that is a technique to derive three dimensional wind field by combining data obtained from two different sites can produce the fine inner structure of the clouds, the joint intensive observation of the R/V MIRAI and the land sites have been carried out around Palau islands from December 15, 2004 through January 10, 2005.

During the intensive observation period, surface meteorological measurement, atmospheric sounding by radiosonde, CTD casting, and ADCP current measurement as well as Doppler radar observation were carried out as main mission. In addition, turbulent flux measurement, Mie-scattering LIDAR, vertical-pointing cloud radar, wind profiler, SnowWhite-Ozone radiosonde, videosonde, and other many observations were intensively conducted.

This cruise report summarizes the observation items and preliminary results. In the first several sections, basic information such as cruise track, onboard personnel list are described. Details of each observation are stated in Section 5. Many useful information and figures are also attached as Appendices.

2. Cruise Summary

2.1 Ship

Name	Research Vessel MIRAI
L x B x D	128.6m x 19.0m x 13.2m
Gross Tonnage	8,672 tons
Call Sign	JNSR
Home Port	Mutsu, Aomori Prefecture

2.2 Cruise Code

MR04-08 Leg-1

2.3 Project Name

The Study of the Air-Sea Interaction in the Tropics

2.4 Undertaking Institute

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

2.5 Chief Scientist

Kunio YONEYAMA
Institute of Observational Research for Global Change (IORGC) / JAMSTEC

2.6 Periods and Ports of Call

Dec. 12, 2004	departed Chuuk, Federated States of Micronesia
Jan. 12, 2005	arrived at Koror, Republic of Palau

2.7 Observation Summary

5.3 GHz Doppler radar	continuously (1 volume scan=7.5 min)
GPS Radiosonde	217 times
SnowWhite/Ozone sonde	15 times
Videosonde	10 times
Ceilometer	continuously (every 1 min)
Total Sky Imager	continuously (every 5 min)
Surface Meteorology	continuously
CTD	148 times
ADCP	continuously (every 5 min)
Sea surface water monitoring	continuously (every 1 min)
Wind Profiler	continuously
Mie-scattering LIDAR	continuously
95 GHz vertical pointing cloud radar	continuously
23 GHz vertical pointing rain radar	continuously
Infrared thermometer	continuously
Disdrometer	continuously
Rain sampling	occasionally
Ocean colors / solar radiation	occasionally

Turbulent flux	continuously
Gravity / magnetic force / sea bottom depth	continuously in open seas

2.8 Overview

In order to investigate the precipitation mechanism of convective clouds developed over the warm pool region, the stationary observation near Palau islands was carried out from December 15, 2004 through January 10, 2005 (refer to IOP; Intensive Observation Period). The location - about 60km off to the west coast of Palau islands - was chosen to conduct the dual Doppler radar observation by shipboard Doppler radar system and land-based one. In Palau, two Doppler radar systems have been deployed at Aimeliik and Peleliu island by IORGC in collaboration with Nagoya University.

During the first half of IOP, weak westerlies were prevailed in the lower troposphere, while easterlies were dominant in the latter period. In general, observational area had been located under the convectively suppressed condition during the whole IOP except several days in the end of December 2004. Indeed, based on several satellites data and the objective analysis data (not shown here), we confirmed that the dry air masses were frequently intruded into the observational area from northern higher latitudes. As a result, total amount of water vapor (i.e. total precipitable water) sometimes showed tremendously low values (see Fig. 5.1-2(e)).

In the range of the dual observation, only a few organized mesoscale convective systems (MCSs) passed by. Especially, several MCSs and many cumulus were apparently weaken in passing by Palau islands when they moved from east to west. There might give rise to new statistical features for climatology of this area.

2.9 Acknowledgments

We would like to express our sincere thanks to Captain Y. Kita and his crew for their skillful ship operation. In particular, during this cruise, we had to chase the precipitation clouds in a short period. We appreciate their highly understanding to our scientific purpose and their tough work. Thanks are extended to the technical staff of Global Ocean Development Inc. and Marine Works Japan, Co.Ltd. for their continuous support to conduct the various observations.

3. Cruise Track and Log

3.1 Cruise Track

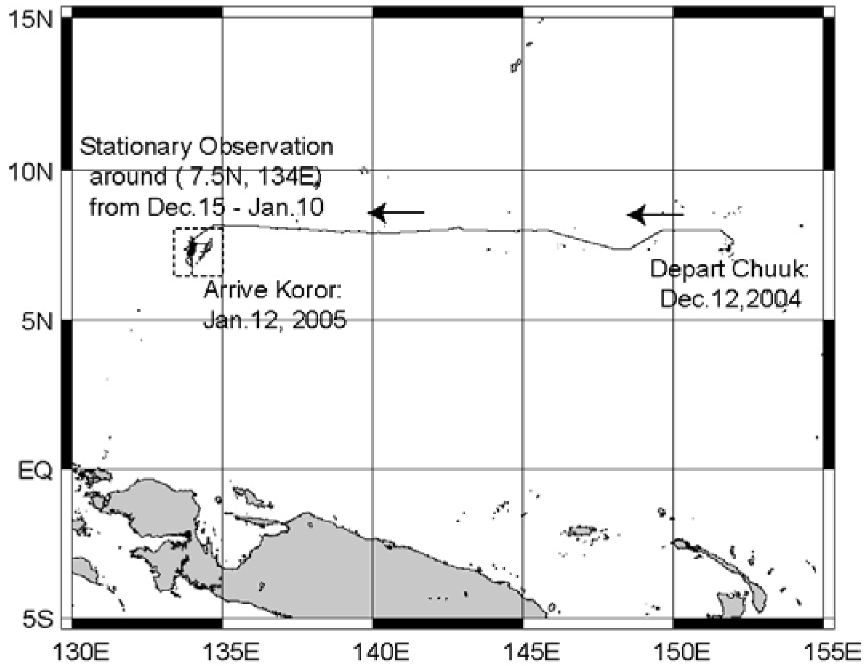

Fig.3.1-1: Cruise Track of MR04-08 leg-1. The dotted square around Palau Islands shows the area of Fig.3.1-2

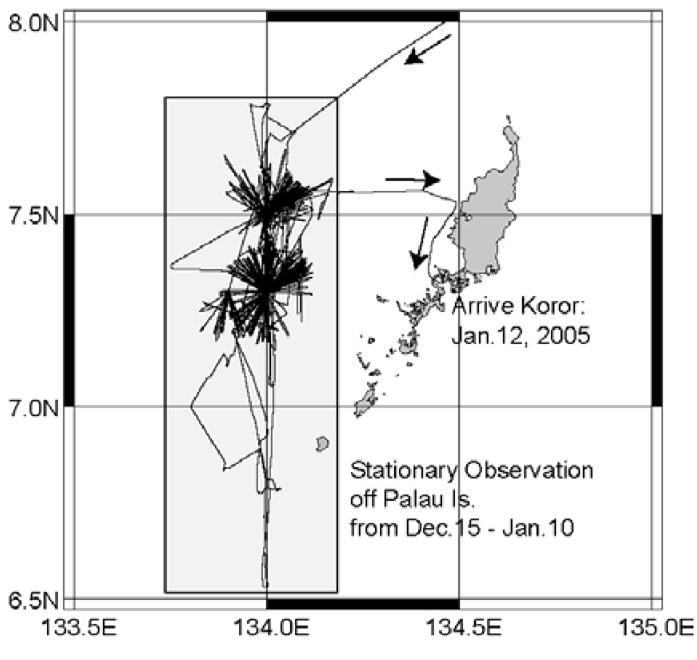

Fig.3.1-2: Cruise Track of MR04-08 leg-1 around Palau Islands. The area corresponds to the dotted square in Fig.3.1-1.

3.2 Cruise Log

Date (LST)	Time (LST)	Time (UTC)		Event
12-Dec	09:00	23:00	(-1d)	depart Chuuk [ship standard time is (UTC+10h)]
	11:30	01:30		start surface water monitoring
	18:00	08:00		start Doppler radar observation
	22:00	13:00		shift ship standard time to (UTC+9h)
13-Dec	14:30	05:30		test-launch of radiosonde
14-Dec	08:30	23:30	(-1d)	start 3-hourly radiosonde observation
	13:43	04:00		test-launch of ozone / water-vapor sonde
15-Dec	09:00	00:00		start Intensive Observation Period (in the eastern sea of Palau Islands)
	11:30	02:30		start 3-hourly CTD profiling
	12:00	03:00		start 3-hourly turbulent flux observation manuever
16-Dec	13:26	04:26		launch ozone / water-vapor sonde
17-Dec	13:33	04:33		launch ozone / water-vapor sonde
18-Dec	13:27	04:27		launch ozone / water-vapor sonde
19-Dec	13:24	04:24		launch ozone / water-vapor sonde
21-Dec	13:27	04:27		launch ozone / water-vapor sonde
23-Dec	16:04	07:04		launch videosonde
24-Dec	01:02	16:02	(-1d)	launch ozone / water-vapor sonde
26-Dec	13:28	04:28		launch ozone / water-vapor sonde
28-Dec	01:37	16:37	(-1d)	launch videosonde
	14:20	05:20		launch ozone / water-vapor sonde
	15:31	18:31		launch videosonde
29-Dec	09:00	00:00		change CTD-profiling interval as 6-hourly

30-Dec	13:29	04:29		launch ozone / water-vapor sonde
	23:32	14:32		launch videosonde
31-Dec	07:25	22:25	(-1d)	launch videosonde
	12:20	03:20		launch videosonde
	18:17	09:17		launch videosonde
01-Jan	13:25	04:25		launch ozone / water-vapor sonde
03-Jan	19:54	09:54		launch ozone / water-vapor sonde
05-Jan	20:17	11:17		launch ozone / water-vapor sonde
07-Jan	09:00	00:00		finish 6-hourly CTD-profiling
09-Jan	07:02	22:02	(-1d)	launch videosonde
10-Jan	08:30	23:30	(-1d)	finish 3-hourly radiosonde observation
	09:09	00:09		launch ozone / water-vapor / video sonde
11-Jan	11:15	02:15		finish Doppler radar observation
	14:00	05:00		finish sea surface water monitoring
12-Jan	09:00	00:00		arrive Koror

4. List of Participants

4.1 On Board Scientists / Technical Staff

Name	Affiliation
YONEYAMA, Kunio	JAMSTEC / IORGC
KATSUMATA, Masaki	JAMSTEC / IORGC
MINATO, Shin-ya	JAMSTEC / IORGC
SHINODA, Taro	HyARC, Nagoya Univ.
ENDOH, Satoshi	HyARC, Nagoya Univ
SUZUKI, Kenji	F. of Agriculture, Yamaguchi Univ.
SHIGENAGA, Yusuke	F. of Agriculture, Yamaguchi Univ.
TESHIBA, Michihiro	RISH, Kyoto Univ.
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INAI, Youichi	EES, Hokkaido Univ.
MATSUI, Ichiro	NIES
OSAWA, Teruo	Kobe Univ.
TANAKA, Kensuke	Kobe Univ.
SANO, Itaru	Kinki Univ.
YAIRO, Sumio	Osaka Univ.
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MAENO, Katsuihisa	GODI
IMAI, Yasutaka	GODI
NAGAHAMA, Norio	GODI
YOSHIDA, Kazuho	GODI
TAKAHASHI, Naoko	MWJ
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MATSUMOTO, Keisuke	MWJ
NOGUCHI, Tomohide	MWJ
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Marine Works Japan Ltd. (MWJ)
1-1-7, Mutsuura, Kanazawa-ward, Yokohama 236-0031 JAPAN

4.2 Ship Crew

KITA, Yujiro	Master
SAKODA, Takahiro	Chief Officer
INOUE, Haruhiko	1st Officer
ISOHI, Takeshi	2nd Officer
FUKAZAWA, Takeyuki	3rd Officer
HIGASHI, Koichi	Chief Engineer
IGATA, Toshiyuki	1st Engineer
MASUNO, Koji	2nd Engineer
OMICHI, Takashi	3rd Engineer
NAKABAYASHI, Shuji	Chief Radio Officer
MORIOKA, Naoto	2nd Radio Officer
ISHIKAWA, Kenetsu	Boatswain
YAMAMOTO, Yasuyuki	Able Seaman
TORAO, Kenichi	Able Seaman
YAMAUCHI, Kenji	Able Seaman
OMOTE, Kunihiko	Able Seaman
OGUNI, Hisao	Able Seaman
SUGAMI, Masami	Able Seaman
SUZUKI, Yukiharu	Able Seaman
SUZUKI, Masaru	Able Seaman
KUDO, Kazuyoshi	Able Seaman
SATO, Tsuyoshi	Able Seaman
KOMATA, Shuji	Able Seaman
HONDA, Sadanori	No.1 Oiler
HORIUCHI, Yukitoshi	Oiler
YOSHIKAWA, Toshimi	Oiler
MATSUO, Toshio	Oiler
BOSHITA, Nobuo	Oiler
TANIGUCHI, Daisuke	Oiler
KURITA, Yasutaka	Chief Steward
HIRAISHI, Hatsuji	Cook
SUGIMOTO, Kitoshi	Cook
TAKESAKO, Ryoji	Cook
SAKAI, Motohisa	Cook
UEMURA, Kozo	Cook
YOSHIZAWA, Hiroyuki	Cook

5. Summary of the Observations

5.1 Atmospheric Sounding by Radiosonde

(1) Personnel

Kunio Yoneyama	(JAMSTEC)	Principal Investigator
Masaki Katsumata	(JAMSTEC)	
Yasutaka Imai	(GODI)	
Kazuho Yoshida	(GODI)	
Katsuhisa Maeno	(GODI)	
Norio Nagahama	(GODI)	
Taro Shinoda	(Nagoya University)	
Satoshi Endoh	(Nagoya University)	
Sumio Yairo	(Osaka University)	

(2) Objective

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

(3) Method

Atmospheric sounding by radiosonde was carried out every 3 hours near Palau islands from December 14, 2004 through January 10, 2005. In total, 217 soundings were carried out (Table 5.1-1). The main system consists of processor (Vaisala, DigiCORA III), GPS antenna (GA20), UHF antenna (RB21), balloon launcher (ASAP), and GPS radiosonde sensor (RS92-SGP).

(4) Preliminary results

Time-height cross sections of equivalent potential temperature, mixing ratio, zonal and meridional wind components are shown in Fig. 5.1-1, respectively. Several basic parameters are calculated from sounding data (Fig. 5.1-2). They include convective available potential energy (CAPE), convective inhibition (CIN), lifted condensation level (LCL), 1000-700 hPa layer-mean zonal and meridional wind components, and total precipitable water (TPW). 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 via 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 5 hPa level datasets are also available from K.Yoneyama of JAMSTEC/IORGC.

Table 5.1-1 Radiosonde launch log.

Time	lon.	lat.	Psfc	Tsfc	RHsfc	WD	Wsd	Max height		Cloud	
YYYYMMDDHH	degE	degN	hPa	degC	%	deg	m/s	hPa	m	Amount/Type	
2004121400	140.25	7.91	1006.4	28.1	79	359	4.2	22.7	25487	7	Sc,Cu
2004121403	139.60	7.94	1005.5	28.1	79	344	4.9	21.6	25818	4	Cu,Sc
2004121406	139.06	7.95	1003.8	28.4	73	331	3.7	21.9	25669	3	Cu,Ci,Sc
2004121409	138.02	8.02	1004.7	28.1	80	6	5.5	23.5	25229	2	Cu
2004121412	137.62	8.06	1006.0	28.1	76	12	3.4	38.4	22177	1	unknown
2004121415	136.86	8.08	1005.4	27.9	81	61	2.0	34.9	22789	2	Cu
2004121418	136.11	8.14	1004.0	27.6	79	210	2.7	34.0	22905	2	unknown
2004121421	135.34	8.16	1004.0	27.6	79	6	0.9	32.8	23194	1	Cu,Sc
2004121500	140.25	7.91	1006.2	28.4	77	101	0.5	344.9	8707	1	Sc,Cu
2004121503	139.60	7.94	1005.5	29.4	72	52	1.0	23.7	25209	6	Cu,Ci
2004121506	134.00	7.57	1003.4	28.9	74	136	0.9	29.4	23821	6	Cu
2004121509	133.90	7.31	1003.8	28.9	72	147	2.3	26.1	24559	4	Cu
2004121512	133.91	7.29	1005.2	28.9	73	172	2.8	30.1	23690	0	-
2004121515	133.90	7.29	1005.5	28.6	76	175	2.0	25.8	24665	1	unknown
2004121518	133.90	7.28	1004.5	28.6	77	185	2.5	26.5	24486	2	Cu
2004121521	133.90	7.30	1005.1	28.1	80	209	2.2	58.9	19622	2	Cu,Cs
2004121600	133.90	7.29	1006.8	28.6	79	185	0.5	22.0	25729	6	Cu,Ci,Sc
2004121603	133.90	7.28	1006.1	28.9	78	215	4.7	27.5	24269	3	Cu,Ci
2004121606	133.90	7.28	1004.3	28.9	78	240	4.5	22.5	25526	2	Cu
2004121609	133.90	7.30	1004.8	28.9	78	249	3.8	31.4	23410	1	Cu,Ci
2004121612	133.99	7.30	1006.7	28.9	78	315	1.5	36.0	22591	2	Cu
2004121615	134.00	7.30	1006.7	28.9	78	307	2.7	30.2	23674	0	-
2004121618	134.00	7.31	1005.4	28.6	77	286	3.7	24.1	25089	0	-
2004121621	133.99	7.29	1005.7	28.1	85	209	0.3	32.8	23162	3	Cu
2004121700	134.00	7.31	1007.2	28.6	77	258	1.5	24.8	24859	2	Cu,Sc,Ac
2004121703	133.98	7.31	1006.5	28.4	81	333	2.1	22.9	25448	7	Cu,Ci,As
2004121706	134.03	7.33	1004.5	29.1	78	183	2.5	51.8	20364	6	As,Cu,Ci
2004121709	134.00	7.30	1004.9	29.1	76	254	3.9	35.5	22658	2	Cu,Ci,Sc
2004121712	134.00	7.29	1006.4	28.9	78	263	2.6	28.5	24040	1	Cu
2004121715	134.00	7.30	1006.3	28.6	81	228	2.0	455.9	6594	0	-
2004121718	134.00	7.29	1004.8	28.6	80	208	1.5	27.6	24250	1	unknown
2004121721	134.00	7.29	1004.9	28.4	83	227	4.2	23.1	25378	2	Cu,Ci
2004121800	134.00	7.29	1007.3	28.9	78	223	3.2	26.2	24575	4	Cu,Ci
2004121803	133.94	7.25	1006.1	28.4	80	241	8.1	21.6	25807	7	Cu,Ci
2004121806	134.01	7.23	1004.2	28.9	78	257	4.9	31.9	23317	6	Cu,As,Ci
2004121809	134.00	7.30	1004.6	29.1	79	243	5.1	33.4	23025	7	Cu,Ci,Cs,Cc
2004121812	134.00	7.30	1006.0	28.9	79	247	5.9	35.3	22708	1	unknown
2004121815	134.00	7.29	1005.8	28.6	81	284	5.0	40.8	21811	4	Cu,Ac
2004121818	134.00	7.30	1004.1	28.6	78	266	4.4	27.5	24245	2	unknown
2004121821	133.99	7.29	1004.6	28.6	79	273	4.7	30.9	23521	4	Cu,Sc
2004121900	133.99	7.30	1006.8	28.4	82	222	3.1	31.3	23483	8	Cu,Ci,Sc,Ns
2004121903	134.01	7.24	1005.7	27.9	79	300	4.9	22.9	25421	5	Cb,Cu,Ci
2004121906	133.84	7.27	1003.8	28.6	80	271	3.3	35.0	22749	8	Cu,Ci
2004121909	134.01	7.21	1004.9	28.6	81	284	4.0	32.7	23167	6	Cu,Cb,Ac,Ci
2004121912	134.00	7.32	1006.9	27.6	80	274	5.5	27.9	24176	4	Cb,Sc,Ac
2004121915	134.00	7.29	1006.4	28.6	80	307	2.3	29.8	23756	4	Cu,Cb,Sc,Ci
2004121918	134.00	7.30	1005.0	28.6	82	336	3.9	25.6	24695	2	unknown
2004121921	134.00	7.31	1005.1	28.9	75	307	4.0	31.7	23356	2	Cu,Ci,Sc
2004122000	133.99	7.31	1007.1	28.9	79	263	2.8	24.4	25036	1	Cu,Ci,Sc
2004122003	133.99	7.31	1006.0	29.1	77	258	3.6	28.8	23967	2	Cu,Ci
2004122006	133.99	7.29	1003.9	28.9	80	243	3.9	34.0	22916	2	Cu,Ci
2004122009	134.00	7.30	1004.4	29.1	78	264	2.8	30.0	23695	7	Cu,Ci
2004122012	134.00	7.30	1006.3	29.1	79	265	4.1	32.6	23194	2	Cu,As

2004122015	134.00	7.30	1006.2	29.1	78	303	3.1	24.6	24990	3	Cu,Cb,Ac
2004122018	134.00	7.30	1004.8	28.9	76	303	3.1	39.3	22029	2	unknown
2004122021	134.00	7.31	1005.2	28.6	79	304	3.4	32.0	23298	6	Cu,Sc,Ci
2004122100	133.99	7.31	1007.4	28.9	79	307	2.3	22.8	25475	6	Cu,Sc,Ci
2004122103	133.99	7.32	1006.0	29.1	76	325	3.1	27.2	24329	5	Cu,Ci,Sc
2004122106	133.99	7.31	1003.5	29.1	76	319	2.7	31.6	23368	4	Cu,Ci
2004122109	134.00	7.30	1004.4	29.1	74	0	1.5	32.9	23128	7	Cu,Ci,Ac
2004122112	134.00	7.31	1006.1	28.6	77	24	4.5	25.5	24734	3	Cu
2004122115	134.00	7.31	1005.5	28.9	78	15	3.8	30.3	23651	3	Cu,Cb,Ci
2004122118	134.00	7.30	1003.5	28.6	77	4	5.2	27.5	24247	0	-
2004122121	134.00	7.31	1004.4	28.6	76	0	3.5	24.8	24901	5	Cu,Sc
2004122200	133.99	7.31	1006.2	26.9	81	70	6.2	28.0	24168	9	Ns,Sc,Cu
2004122203	134.00	7.32	1005.1	29.6	61	31	6.5	25.2	24810	8	Cu,Ns
2004122206	134.00	7.31	1003.4	27.9	78	17	6.3	36.9	22410	8	Cu,Cb,Ns
2004122209	134.00	7.30	1003.8	27.1	83	32	6.8	30.2	23646	9	Cu,Cb,Ac,Ci
2004122212	134.00	7.30	1006.0	27.1	86	17	5.9	30.1	23680	7	As,Ns,Nb
2004122215	133.99	7.30	1005.9	27.9	80	48	2.2	28.9	23959	7	Sc,Cu,Cb,As,Ac
2004122218	134.00	7.30	1004.1	27.9	81	72	3.2	27.0	24352	5	Sc,Cu,As
2004122221	134.00	7.32	1005.0	28.4	76	145	3.8	24.7	24936	9	Cu,Sc,As
2004122300	134.02	7.30	1007.4	28.1	82	125	3.8	24.5	25015	6	Ci,Ac,Cu,Cb
2004122303	134.00	7.30	1006.6	28.6	78	138	2.8	25.4	24786	8	Cb,Cu,As,Ci
2004122306	134.00	7.43	1004.9	28.9	75	189	1.2	111.0	15996	9	Cu,Cb,As
2004122309	133.90	7.64	1005.4	27.9	85	34	2.9	35.7	22618	9	Ac,As,Cu
2004122312	134.00	7.44	1007.1	28.4	78	39	3.6	36.6	22483	10	Ac,As
2004122315	134.00	7.50	1007.5	28.6	76	93	2.5	52.5	20291	-	unknown
2004122318	134.00	7.50	1005.7	28.4	80	75	0.9	31.2	23457	3	Cu,Sc
2004122321	134.00	7.50	1006.8	28.4	80	61	4.4	28.2	24085	2	Cu,Sc,Cb,Ci
2004122400	134.02	7.51	1008.7	28.6	77	85	4.0	34.7	22829	1	Cu,Cb,Sc,Ci
2004122403	134.01	7.50	1008.3	28.9	75	92	5.1	31.4	23451	3	Cu,Cb,Ci
2004122406	134.04	7.47	1006.2	28.9	77	65	6.0	32.9	23115	4	Cu,Cb,Ci,As
2004122409	134.00	7.50	1006.3	28.6	78	53	2.9	30.7	23544	2	Cu,Ci,Ac
2004122412	133.99	7.50	1007.5	28.6	79	65	5.3	28.9	23945	2	Cu,Ci
2004122415	134.00	7.50	1007.3	28.6	76	73	5.6	69.5	18642	1	Cu
2004122418	134.00	7.50	1005.5	28.6	75	72	6.3	36.8	22421	2	Cu
2004122421	134.01	7.51	1005.6	28.6	74	62	8.1	25.2	24801	6	Cu,Sc,As
2004122500	134.05	7.38	1007.1	29.1	75	69	6.6	23.0	25411	6	Cu,Sc
2004122503	134.01	7.31	1006.7	29.1	75	65	4.9	29.4	23837	3	Cu,Ci,As
2004122506	134.08	7.26	1004.7	29.9	68	73	3.2	24.8	24876	3	Cu,Ci,As,Sc,Cc
2004122509	134.09	7.45	1005.1	29.1	75	78	5.3	25.5	24699	5	Cu,Ac,Ci
2004122512	134.09	7.22	1006.6	29.1	77	93	8.1	30.6	23576	7	Cu,Ac
2004122515	134.00	7.30	1006.5	29.1	81	104	3.0	28.2	24081	1	Cu
2004122518	134.00	7.30	1004.8	28.1	83	90	4.7	28.4	24039	8	Cb,Cu
2004122521	134.01	7.31	1004.8	28.4	80	84	6.9	32.2	23236	1	Cu
2004122600	134.01	7.31	1006.7	29.4	76	83	7.4	37.9	22247	2	Cu,Ci
2004122603	134.01	7.31	1006.4	29.6	68	84	7.3	26.5	24492	2	Cu,Ci
2004122606	134.01	7.31	1004.4	29.6	68	90	5.8	200.3	12442	3	Cu,Cb,Ci,Cs
2004122609	134.00	7.50	1004.7	29.4	71	57	8.2	28.3	24035	7	Cu,Ci,Cb
2004122612	134.00	7.45	1006.6	29.1	74	56	8.3	28.7	24004	1	Cu
2004122615	134.01	7.50	1006.6	29.1	74	73	7.3	28.3	24100	2	Cu,Ci
2004122618	134.02	7.35	1004.4	28.6	79	66	10.1	28.1	24121	2	Cu
2004122621	134.00	7.52	1004.5	28.6	79	68	7.4	72.1	18386	8	Cu,Ac,Sc
2004122700	133.99	7.56	1007.1	28.4	73	88	6.7	63.5	19165	5	Cu,Cb,Ac
2004122703	133.99	7.50	1006.0	28.6	79	69	10.1	22.4	25615	5	Cu,As,Ci
2004122706	134.00	7.50	1003.7	29.4	76	65	9.9	24.9	24887	5	Cu,Ci,As
2004122709	134.00	7.50	1004.4	29.1	76	57	11.6	34.5	22809	3	Cu,Ci
2004122712	134.00	7.50	1006.1	29.1	78	55	9.7	32.4	23230	5	Cu,Ci
2004122715	134.03	7.34	1006.2	29.1	80	55	9.7	99.6	16613	5	Cu,Ci
2004122718	134.01	7.08	1004.6	26.9	83	32	6.0	25.7	24706	10	As,Cu

2004122721	134.00	7.50	1005.0	29.1	75	60	11.3	29.8	23779	7	Ci,Cu,Sc
2004122800	134.04	7.38	1007.0	29.1	77	65	9.7	43.6	21419	8	Sc,Ac,Cu,Cc
2004122803	134.08	7.38	1006.7	29.6	75	66	9.7	143.3	14545	8	As,Ac,Cb,Cu
2004122806	134.06	7.49	1004.9	28.6	76	53	13.0	282.2	10150	9	Cu,Cb
2004122809	134.00	7.50	1005.4	27.1	87	20	11.8	30.1	23700	6	Cb,Cu,Ci,As
2004122812	134.00	7.50	1006.5	28.4	82	71	6.6	27.3	24307	1	Cu,As
2004122815	134.01	7.50	1006.8	28.6	83	67	9.5	37.7	22301	4	Cu,Cs,As
2004122818	134.00	7.50	1005.3	28.4	82	69	7.8	34.5	22845	3	Cu,Ci,Sc
2004122821	134.01	7.51	1005.8	28.6	78	69	7.6	23.0	25408	2	Cu,Sc,Ci
2004122900	134.00	7.50	1007.6	29.1	76	62	7.0	23.0	25422	2	Cu,Ci
2004122903	134.07	7.56	1006.6	29.1	77	71	7.5	26.9	24415	3	Cu,Ci
2004122906	134.00	7.50	1004.5	29.1	79	66	9.1	28.5	24012	2	Cu,Ci
2004122909	134.17	7.59	1005.4	28.9	74	69	9.4	27.9	24145	2	Cu,Cb
2004122912	134.02	7.51	1006.7	28.1	80	66	10.3	32.0	23320	5	Ac,Cu,Sc
2004122915	134.00	7.50	1006.8	28.9	80	58	10.2	36.3	22535	6	Cu,Cb
2004122918	134.00	7.51	1005.0	28.6	78	42	11.4	38.2	22199	6	Cu,St
2004122921	134.01	7.52	1005.6	28.9	73	54	10.5	42.7	21509	3	Cu
2004123000	134.02	7.51	1007.1	28.6	78	38	7.4	43.5	21444	2	Cu,Ci
2004123003	134.00	7.50	1006.5	29.4	73	48	10.2	40.8	21836	9	As,Ac,Cu
2004123006	134.02	7.51	1004.7	29.6	73	48	10.6	29.9	23727	3	Ac,Cu
2004123009	134.03	7.52	1005.0	29.1	78	66	10.2	40.2	21911	9	Sc,Cu,Cb,Ci
2004123012	134.03	7.52	1006.5	28.6	78	56	10.8	39.0	22085	-	unknown
2004123015	134.05	7.48	1006.9	29.1	75	69	11.8	532.7	5349	10	Cb
2004123018	134.00	7.49	1004.5	28.6	79	61	10.9	45.4	21144	10	As,Sc
2004123021	134.00	7.50	1005.4	27.1	88	92	9.8	142.4	14575	8	Cb,Cu,Ci
2004123100	133.96	7.78	1008.1	27.1	84	90	8.1	134.3	14949	10	Ns,Cu
2004123103	133.99	7.78	1007.6	26.9	88	70	3.6	261.8	10688	9	Ns,Cu
2004123106	133.96	7.79	1005.5	26.1	88	60	4.3	37.5	22334	9	Ns,Ci,Ac
2004123109	134.11	7.75	1006.4	27.6	84	76	8.4	28.1	24136	-	unknown
2004123112	134.05	7.68	1007.6	27.1	81	95	5.9	31.4	23452	-	unknown
2004123115	134.00	7.30	1007.6	27.4	83	115	2.7	32.4	23253	9	Sc,As,Ac,Cu
2004123118	134.00	7.30	1006.1	26.1	87	217	1.6	29.3	23882	10	Cu
2004123121	134.00	7.28	1006.5	26.9	87	48	2.1	34.8	22798	7	Cu,Cb,Ci,Cc
2005010100	134.00	7.30	1008.9	28.1	82	0	0.2	29.7	23821	3	Cu,Cb,As,Ci
2005010103	134.00	7.30	1008.5	28.1	78	13	3.5	24.3	25085	9	Cu,Cb,Cc,Sc,Ac
2005010106	134.00	7.31	1005.6	27.9	82	344	4.1	26.3	24537	7	Cu,Ac,As
2005010109	134.00	7.33	1006.5	27.9	78	19	2.9	28.7	23968	8	Sc,Cu,Ac
2005010112	134.00	7.32	1007.9	27.9	82	56	4.7	27.6	24242	-	unknown
2005010115	134.02	7.31	1008.1	27.9	81	57	6.8	28.1	24138	6	Cc,Cu,As,As
2005010118	134.00	7.30	1006.2	28.1	72	65	6.3	41.2	21736	6	As,Cu
2005010121	134.00	7.31	1006.6	28.1	80	70	6.6	29.4	23866	4	Cu,Cb,Ci,As
2005010200	134.01	7.30	1008.8	28.4	77	65	6.6	27.9	24215	2	Cu,Cb,Ci,Ac
2005010203	134.01	7.31	1007.5	28.9	74	57	6.3	23.9	25177	3	Cu,Ci,As
2005010206	134.01	7.31	1005.4	28.6	73	41	8.0	35.8	22632	3	Cu,Ci,As,Cs
2005010209	134.02	7.32	1006.5	28.9	72	53	7.6	25.1	24822	2	Cu,Ci,Sc
2005010212	134.02	7.31	1008.0	28.6	74	58	8.1	26.8	24448	0	-
2005010215	134.02	7.31	1008.2	28.4	73	71	7.3	37.2	22411	4	As,Cu
2005010218	134.00	7.30	1006.5	28.1	79	73	8.5	28.0	24179	3	Cu,As
2005010221	134.01	7.31	1006.8	28.1	74	70	8.6	25.1	24859	8	Cu,As,Ci
2005010300	134.02	7.31	1008.5	28.6	77	66	7.8	381.6	7976	2	Cu,As,Ci
2005010303	134.02	7.31	1007.7	29.6	71	78	6.7	26.1	24609	3	Cu,Ci,As
2005010306	134.01	7.30	1005.9	28.1	80	53	6.9	24.5	24964	8	Cu,As,Cs
2005010309	134.03	7.31	1006.7	28.4	79	65	5.7	40.9	21817	8	Ns,Cb,Sc,Cu
2005010312	134.01	7.31	1007.9	28.6	79	79	7.2	32.0	23330	0	-
2005010315	134.02	7.32	1007.5	28.4	80	61	8.1	31.1	23500	1	unknown
2005010318	134.00	7.31	1005.8	28.6	80	65	9.2	31.6	23388	3	Cs,Cu
2005010321	134.01	7.31	1006.5	28.6	79	56	7.9	336.2	8898	8	As,Cu
2005010400	134.01	7.31	1008.4	28.9	77	48	9.7	29.7	23804	3	Cu,Cb,Ci,Cs,As

2005010403	134.03	7.27	1007.6	29.1	76	74	8.8	28.2	24116	8	Cu,As
2005010406	134.00	7.31	1006.0	27.6	72	93	9.6	26.4	24496	8	Ns,Cu
2005010409	134.02	7.28	1006.7	28.6	81	40	7.0	35.4	22676	6	Ci,Cu,Ac
2005010412	134.01	7.31	1008.3	28.6	75	52	8.4	29.7	23766	0	-
2005010415	134.01	7.31	1008.2	28.6	73	49	8.2	33.9	22954	2	unknown
2005010418	134.01	7.31	1006.6	28.4	73	52	9.9	99.8	16589	0+	Cu
2005010421	134.00	7.30	1007.1	28.4	72	42	10.3	33.3	23056	2	Cu,Ci
2005010500	134.01	7.31	1008.9	28.6	69	50	7.3	29.8	23796	0+	Cu,Ci
2005010503	134.01	7.31	1008.0	28.9	72	59	8.8	25.8	24669	1	Cu,Cs,As
2005010506	134.00	7.30	1005.8	28.9	76	33	8.8	29.0	23917	3	Cu,Cs,As
2005010509	134.00	7.31	1006.3	28.1	79	44	9.4	29.6	23790	9	As,Cu,Ci
2005010512	134.00	7.49	1007.1	28.1	80	57	10.6	26.2	24586	0	-
2005010515	134.00	7.49	1006.7	28.4	80	45	10.8	44.6	21292	3	Cu
2005010518	134.00	7.49	1005.4	28.6	78	53	10.9	24.3	25048	3	Sc,As
2005010521	134.00	7.50	1006.1	28.6	72	39	10.3	30.2	23678	2	Cu
2005010600	133.99	7.51	1008.3	28.6	67	40	10.9	29.2	23930	0+	Cu
2005010603	134.02	7.50	1007.0	28.9	62	37	11.3	28.7	24023	1	C,As,Cs
2005010606	134.02	7.53	1005.3	28.9	64	49	8.9	32.0	23305	1	Cu,Cs,As
2005010609	134.01	7.51	1005.7	28.4	72	43	7.3	30.5	23624	3	Sc,Cu,Ci
2005010612	134.01	7.52	1007.3	28.4	77	30	9.5	47.9	20864	0	-
2005010615	133.99	7.52	1007.5	27.4	84	45	7.9	30.4	23657	10	St
2005010618	134.00	7.51	1005.6	27.4	79	60	8.5	27.8	24198	4	St
2005010621	133.99	7.51	1005.8	27.6	79	52	10.2	43.4	21435	8	Cu
2005010700	134.00	7.50	1007.9	27.1	78	16	6.1	21.7	25814	9	Cu,Cb,As
2005010703	133.99	7.52	1006.8	28.6	72	44	8.7	28.2	24151	6	Cs,As,Ac
2005010706	133.99	7.53	1004.7	28.6	73	46	8.7	24.7	24947	3	Cu,As,Ac
2005010709	134.00	7.51	1005.0	28.6	76	40	7.6	34.4	22866	4	Cu,Cb,Cc,Sc
2005010712	134.00	7.53	1006.6	27.4	80	38	6.9	27.0	24441	3	unknown
2005010715	134.00	7.52	1006.1	28.4	78	35	10.1	38.5	22186	1	Cu
2005010718	134.01	7.52	1004.6	28.1	81	38	10.7	33.9	22949	4	Cu,As
2005010721	134.02	7.48	1005.1	28.1	79	37	12.0	30.4	23644	7	Cu,As
2005010800	134.02	6.79	1006.7	27.9	78	33	8.7	272.9	10383	10	Cu,Cb,Ns,As
2005010803	133.92	7.17	1006.0	28.6	73	40	10.8	27.1	24388	6	Cu,Cs,As
2005010806	133.92	7.20	1003.7	28.4	72	27	9.8	28.5	24031	5	Ci,Cs,As,Cu
2005010809	133.92	7.20	1004.2	28.4	67	27	7.9	27.0	24360	2	Ci,Sc,Cu
2005010812	133.92	7.20	1005.7	28.4	71	41	10.0	29.9	23714	10	unknown
2005010815	133.92	7.20	1005.8	28.6	73	30	11.7	31.1	23500	10	unknown
2005010818	133.95	7.03	1004.5	27.9	79	29	7.5	42.1	21612	10	As
2005010821	134.01	6.77	1005.1	26.4	81	44	11.7	455.8	6577	-	unknown
2005010900	133.84	7.06	1007.4	26.4	62	35	5.5	39.5	22029	10	Ns,As
2005010903	133.90	7.11	1006.5	28.4	72	29	9.0	30.7	23600	10	Cu,Ns
2005010906	134.00	7.52	1004.4	28.1	73	51	7.0	30.6	23590	10	Cu,Ac,As
2005010909	134.01	7.52	1005.6	28.1	69	46	8.3	37.6	22307	10	As,Ac,Cu
2005010912	134.01	7.52	1006.7	28.1	71	61	7.3	42.3	21607	10	unknown
2005010915	134.01	7.51	1006.5	28.1	75	57	8.7	46.1	21075	8	As,Cu
2005010918	134.01	7.51	1004.3	27.9	74	36	8.6	38.3	22204	5	As,Cu
2005010921	134.00	7.50	1005.7	28.1	76	55	6.5	33.1	23115	5	Cu
2005011000	134.01	7.52	1008.0	28.4	73	52	7.4	27.6	24274	3	Cu,Cb,Ci,Cc

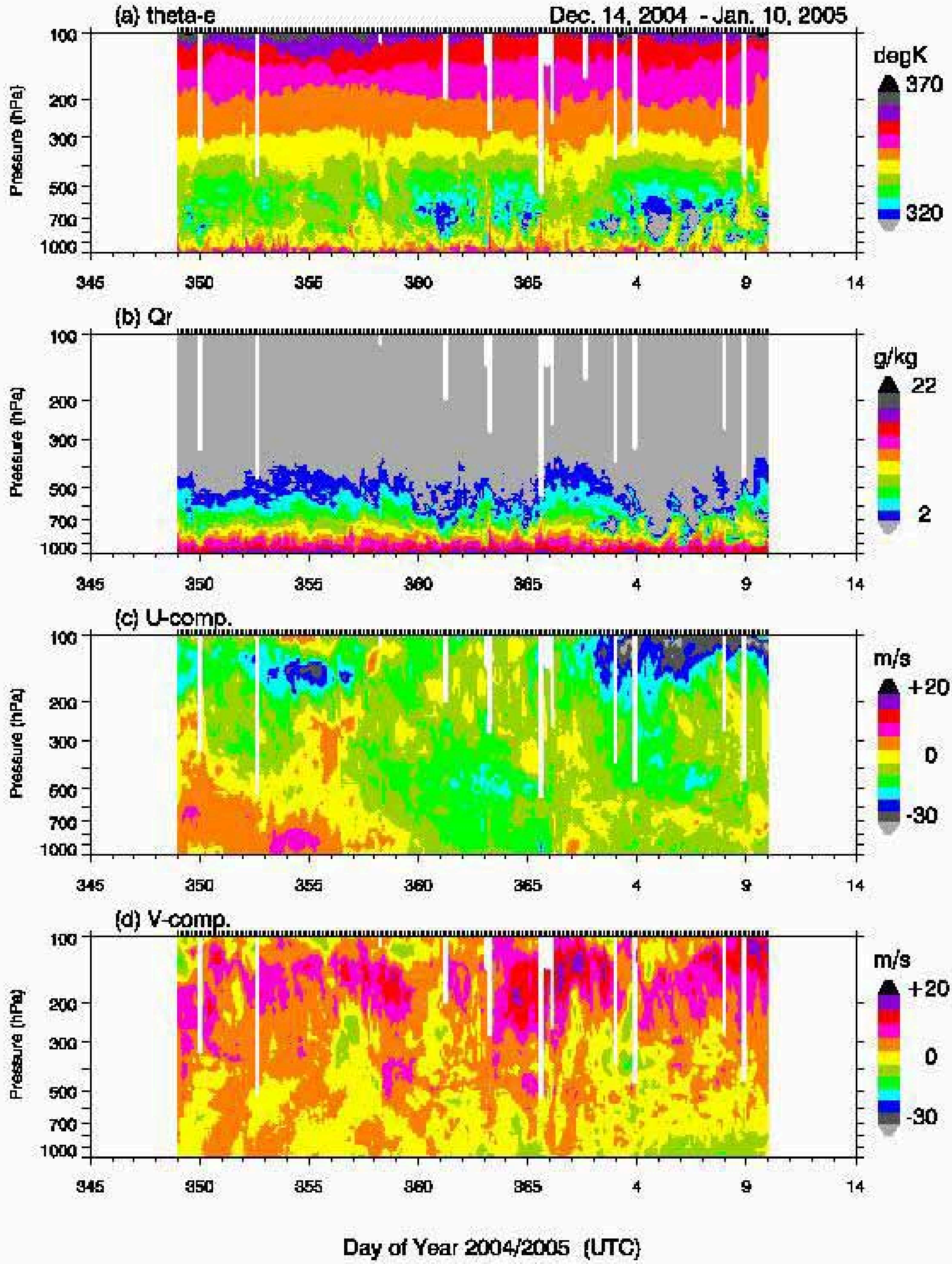

Fig. 5.1-1 Time-height cross sections of (a) equivalent potential temperature (degK), (b) mixing ratio (g/kg), (c) zonal wind component (m/s), and (d) meridional wind component (m/s). DAY349 corresponds to December 14, 2004.

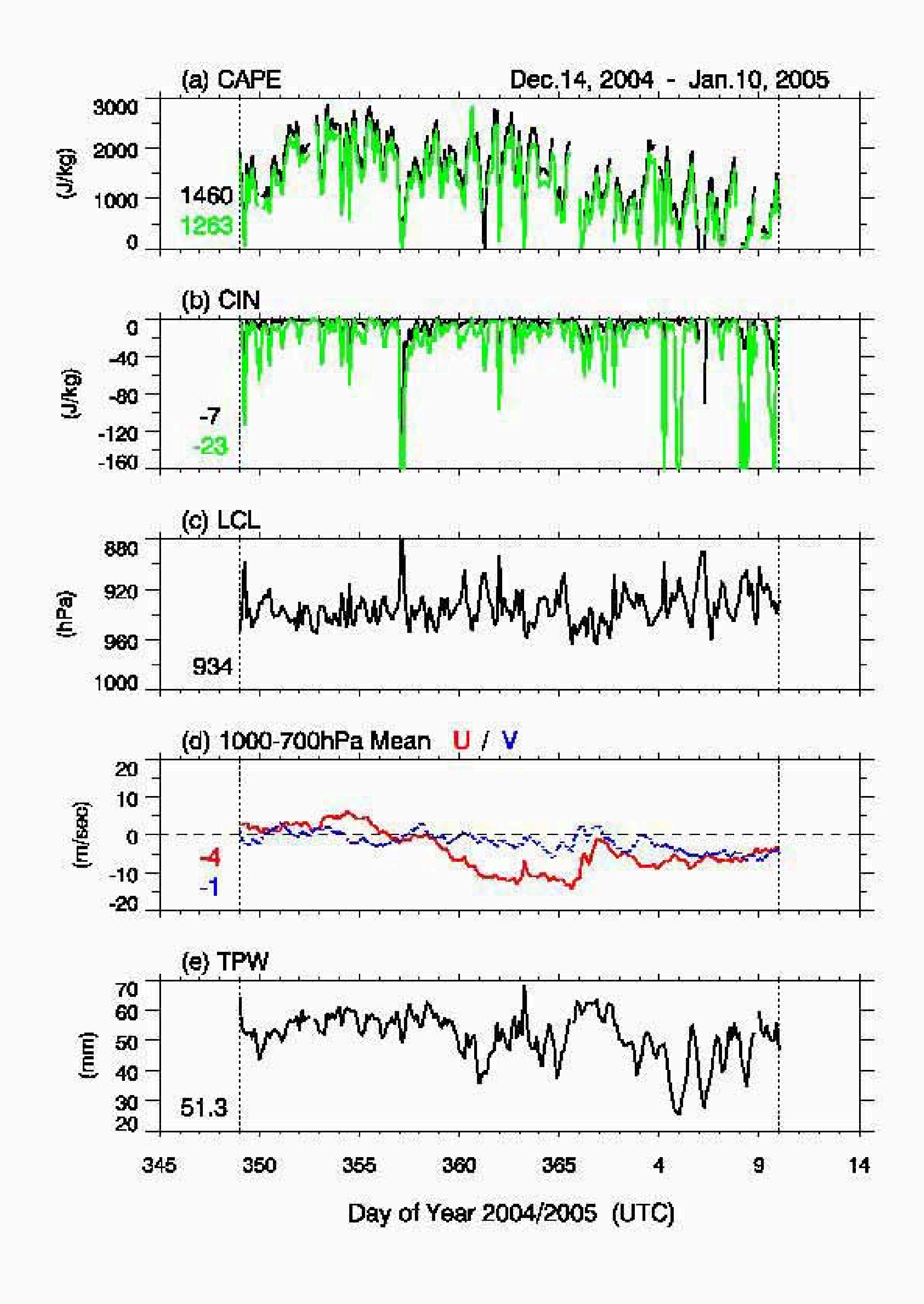

Fig. 5.1-2 Time series of (a) convective available potential energy, (b) convective inhibition, (c) lifted condensation level, and (d) 1000-700 hPa layer-mean zonal (red) and meridional (blue) wind components, and (e) total precipitable water. We calculated CAPE by two ways using virtual temperature (black) and temperature (green). Numbers listed near the left corner are values of 13-day period.

5.2 Wind Profiler

(1) Personnel

Hiroyuki Hashiguchi (RISH, Kyoto University): Principal Investigator (not on board)
Michihiro Teshiba (RISH, Kyoto University): On-board PI

(2) Objective

A wind profiler (Ship-Borne Lower Troposphere Radar: SB-LTR) is installed to observe vertical profiles of air motion and precipitation in the lower troposphere. A GPS navigational sensor and a three-axis angular sensor were deployed to provide necessary adjustments to wind profiles. The objective of this observation is to develop a control software of the SB-LTR, to evaluate its performance, and to investigate convective clouds, cloud clusters etc. over the tropical ocean. Additionally, in this voyage, the antenna size is large related to the previous voyage (MR04-01) in order to gain the radar signal.

(3) Methods

Fig. 5.2-1 shows the overview of the SB-LTR. The hardware specification of the SB-LTR is:

Frequency:	1357.5 MHz
Antenna Size:	4 m x 4 m
Beam Width:	4 degrees
Output Power:	2 kW (Peak power)
GPS Navigation Sensor:	SC-60 (Furuno Electric Co, LTD)
Angular Sensor:	3DM (MicroStrain Inc.).

The observation is performed continuously from December 12, 2004 to January 9, 2005. During the observation, antenna beams were steered to vertical and four oblique directions with the zenith angle of 10 degrees. One cycle for five directions takes about 1 sec. Sub-pulse length is 1 micro sec, which corresponds to the range resolution of 150 m. Since 8-bit pulse compression coding with the IPP of 50 micro sec was used, average output power was about 320 W. Time series data after conducting pulse-decoding and 128 coherent integrations were stored. The data such as roll, pitch, direction and speed of the ship simultaneously obtained were also stored for off-line analysis.

(4) Preliminary Results

The temporal variation of height profiles of Signal to Noise Ratio and three-dimensional wind observed with the SB-LTR in December 30, 2004 are shown in Figs. 5.2-2 and 5.2-3, respectively. In the daytime (LT = UTC + 9), relatively strong echo is observed below 1.5 km height. In the period between 2 and 3 LT, 9 and 11 LT, and 15 and 16 LT, strong downdraft and echo are also observed, which are associated with rainfalls. The heights of the rainfalls, corresponded to the heights of the precipitating clouds, become higher as time passes. Relatively strong echo regions in the height of 3 and 4 km are also higher. Before rainfalls happen, relatively strong (about 0.5 m/s) updrafts are observed in all observational height. Simultaneously, strong easterly wind is observed. Therefore the updrafts go ahead of the rainfalls. The further analyses are future work.

(5) Data Archive

All data will be archived at RISH, Kyoto University (contact Hiroyuki Hashiguchi).

Fig. 5.2-1 Overview of the SB-LTR.

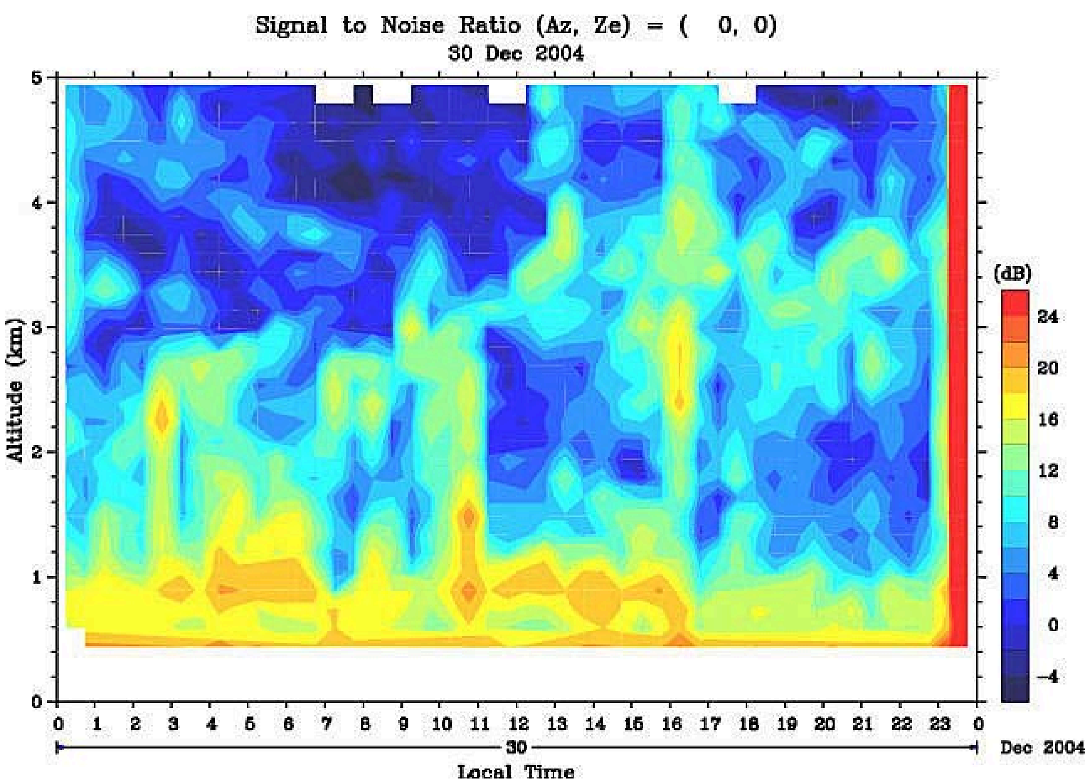

Fig. 5.2-2 Time-height cross-section of signal to noise ratio observed with the SB-LTR in Dec. 30, 2004.

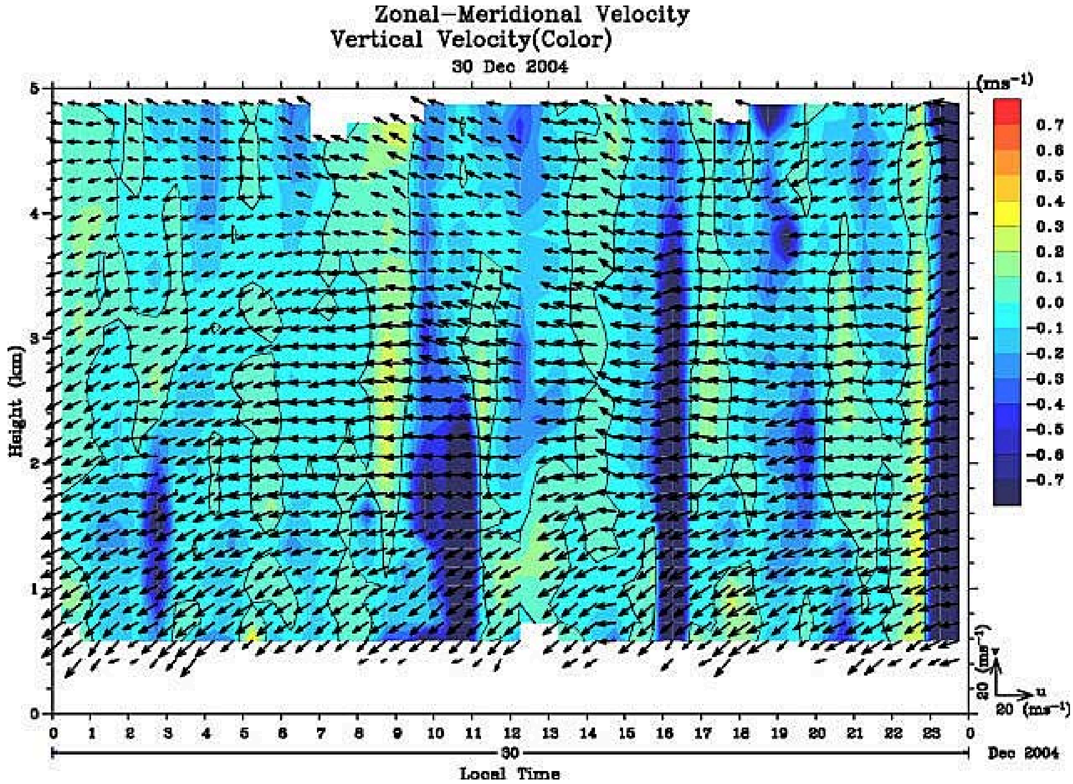

Fig. 5.2-3 Same as Fig. 5.2-2 but for horizontal wind (arrows) and vertical wind component (contour).

5.3 Doppler Radar

(1) Personnel

Masaki KATSUMATA	(JAMSTEC/IORGC):	Principal Investigator
Kunio YONEYAMA	(JAMSTEC/IORGC)	
Taro SHINODA	(HyARC, Nagoya Univ.)	
Satoshi ENDOH	(HyARC, Nagoya Univ.)	
Katsuhisa MAENO	(GODI):	Operation Leader
Norio NAGAHAMA	(GODI)	
Kazuho YOSHIDA	(GODI)	
Yasutaka IMAI	(GODI)	

(2) Objective

The Doppler radar is operated to obtain detailed spatial and temporal distribution of rainfall amount, and structure of precipitating cloud systems. In addition, the latter is retrieved more precisely by combining the data from “Mirai” Doppler radar with land-based two Doppler radars on Palau Islands, using “Dual-Doppler” analyses. 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 12 December 2004 to 11 January 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 1 hour. In addition, RHI (Range Height Indicator) scans were operated to obtain detailed vertical cross sections with Doppler-mode. The Doppler velocity in the volume scan is unfolded automatically by dualPRF unfolding algorithm for the volume scan. The parameters for the above three tasks are listed in Table 5.3-1.

During the intensive observation period, from 15 December 2004 to 10 January 2005, the

(4) Preliminary Results

The temporal variation of the radar-derived precipitating area is shown in Fig.5.3-1. The variation includes various scale phenomena, from large-scale disturbance to the diurnal cycle. The further analyses are future work.

Table 5.3-1: 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, 1.0, 1.8, 2.6, 3.4, 4.2, 5.1, 6.1, 7.3, 8.7, 10.6, 13.1, 16.1, 19.7, 23.8, 28.5, 33.8, 39.5	0.0 to 50.0
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 JAMSTEC/IORGC (contact Masaki Katsumata).

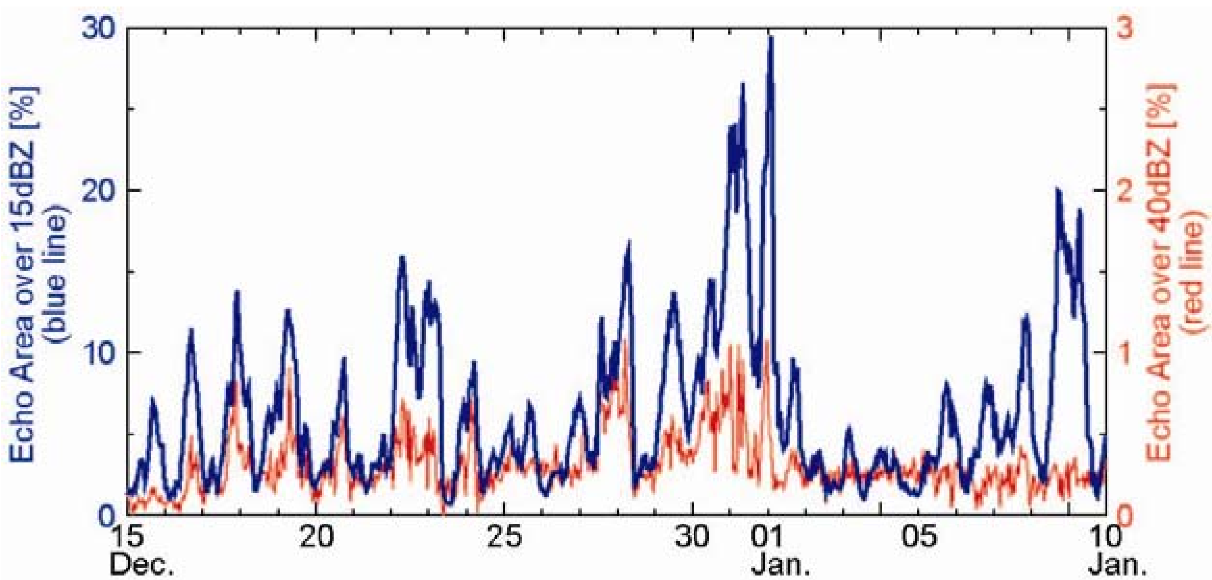

Fig. 5.3-1: Temporal variation of the echo area over 15dBZ (blue) and over 40dBZ (red), obtained by surveillance PPI. The values are the ratios to the radar observation area within the range distance of 200-km from Mirai.

5.4 Micro Rain Radar

(1) Personnel

Masaki KATSUMATA (JAMSTEC/IORGC): Principle Investigator

(2) Objectives

The "mirco rain radar" could obtain vertical profiles of rainfall intensity and fall speed of the raindrops. The objective of this observation is to investigate high-resolution vertical structure of the precipitating clouds, especially above R/V Mirai, where scanning Doppler radar do not cover, while data from vertical-pointing and on-board instruments could be combined.

(3) Methods

The micro rain radar MRR-2 (METEK GmbH) is used for this observation.

The radar is a compact 24 GHz FM-CW-radar for the measurement of profiles of drop size distribution and rain rates, liquid water content and characteristic falling velocity of the raindrops. The transmitter power is 50 mW.

In this observation, the data is obtained every 60 seconds, at every 200-m range gate, from surface to 6000-m height. The observation is performed continuously from 12 December 2004 to 10 January 2005.

(4) Preliminary Results

The data will be analyses after the quality control process after the cruise.

(5) Data Archive

The original data will be archived at JAMSTEC/IORGC (contact Masaki Katsumata) and will be submitted to JAMSTEC DMD.

5.5 Didrometer

5.5.1 Joss-Waldvogel-type Didrometer

(1) Personnel

Taro Shinoda (HyARC, Nagoya Univ.)
Satoshi Endo (HyARC, Nagoya Univ.)

(2) Objectives

The disdrometer can continuously obtain size distribution of raindrops (20 categories) and rainfall intensity in every minute. We can distinguish the type of cloud brought about rainfall events (convective or stratiform clouds) by utilizing the size distribution of raindrops.

(3) Methods

A microphone is installed in the top of the disdrometer. When raindrops hit this microphone, the magnitude and the times of sound are transferred to the size distribution and number of raindrops. There are 20 categories of the size distribution and the sum of raindrops is calculated as the rainfall intensity. The time resolution of these data is one minute.

(4) Preliminary Results

The disdrometer is settled on the top of the Anti-rolling room (Fig. 5.5.1-1). The observation is started on December 11, 2004 when the R/V Mirai anchor at Chuuk and continued to January 10, 2005. There are many intermittent rainfall events during this period. Figure 5.5.1-2 shows a time series of rainfall intensity by every hours and total rainfall amount. Parts of these rainfall events are brought about by showers from shallow convective clouds.

(5) Data Archive

The inventory information of the disdrometer data obtained during this cruise will be submitted to JAMSTEC DMO (Data Management Office). The original data will be archived at and available from Hyrdoshperic Atmospheric Research Center, Nagoya University (contact person is Taro Shinoda).

(6) Remarks

(a) The categories of the size distribution are as follows:

1: 0.313 --- 0.404 mm,
2: 0.405 --- 0.504 mm,
3: 0.505 --- 0.595 mm,
4: 0.596 --- 0.714 mm,
5: 0.715 --- 0.826 mm,
6: 0.827 --- 0.998 mm,
7: 0.999 --- 1.231 mm,
8: 1.232 --- 1.428 mm,
9: 1.429 --- 1.581 mm,
10: 1.582 --- 1.747 mm,
11: 1.748 --- 2.076 mm,
12: 2.077 --- 2.440 mm,
13: 2.441 --- 2.726 mm,

14: 2.727 --- 3.010 mm,
15: 3.011 --- 3.384 mm,
16: 3.385 --- 3.703 mm,
17: 3.704 --- 4.126 mm,
18: 4.127 --- 4.572 mm,
19: 4.573 --- 5.144 mm,
20: larger than 5.145 mm.

(b) The size distribution dataset are sometimes very noisy because of the vibration of the ship or the noise of wind. These noisy data sometimes exist in the small size distribution (category 1 to 6 or 7). Please take care of handling of this data when you use this dataset.

Fig. 5.5.1-1. Disdrometer (a) and on the top of the Anti-rolling room (b).

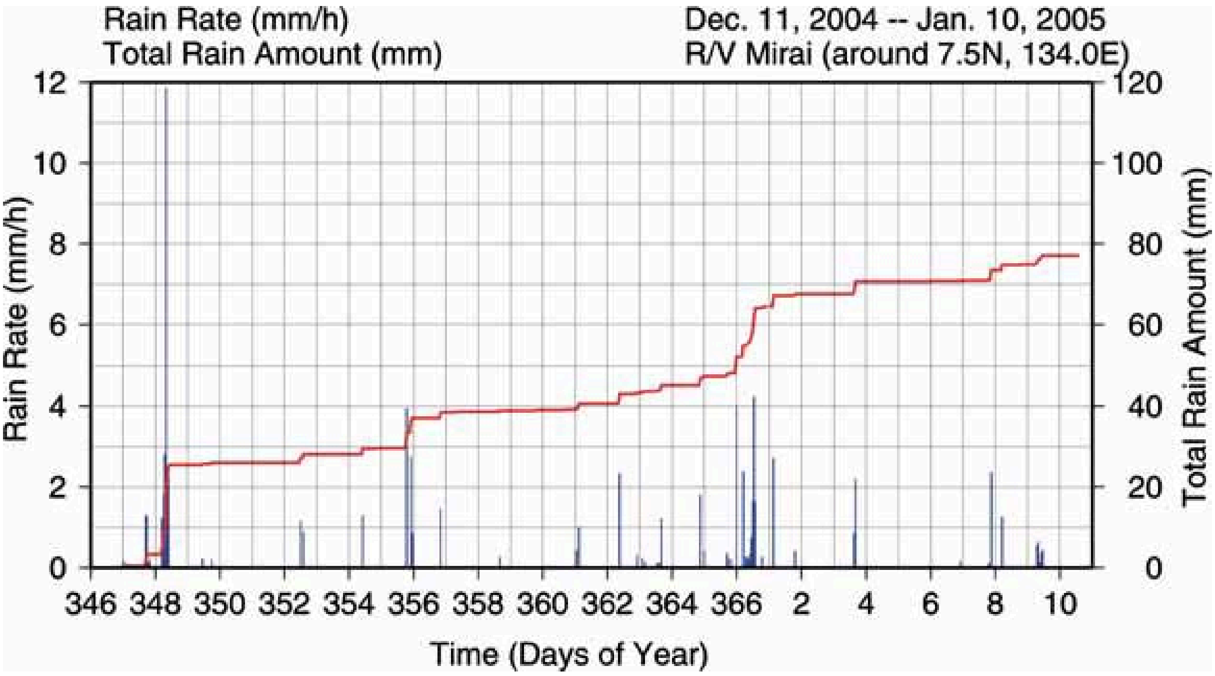

Fig. 5.5.1-2. Time series of rain rate by every hours (blue bar-graph) and total rainfall amount (red line) by disdrometer from December 11, 2004 to January 10, 2005. Date are shown in JST (9 hours ahead of UTC).

5.5.2 Optical Disdrometer

(1) Personnel

Masaki KATSUMATA (JAMSTEC/IORGC)

(2) Objectives

The disdrometer can obtain both size distribution of raindrops and rainfall intensity in every minute. The objective of this observation is to reveal microphysical characteristics of the rainfall, depends on the type, temporal stage, etc. of the precipitating clouds, with combining other instruments (especially scanning Doppler radar and vertical-pointing micro rain radar)

(3) Methods

The “Parsivel” type optical disdrometer (SCINTEC M300) measured blockage of the infrared beam between transmitter and receiver, occurred by the passing of the raindrops. The output product is numbers of raindrops for 32 size classes, from 0.1mm to 20mm in diameter, in every one minutes. The instrument was installed on the top of the anti-rolling system block (Fig.5.5.2-1), and operated continuously from 14 December 2004 to 10 January 2005.

(4) Preliminary Results

The obtained rainrate and cumulative rainfall amount is shown in Fig. 5.5.2-2. The detailed analyses will be done after the data quality control after the cruise.

(5) Data Archive

The original data will be archived at JAMSTEC/IORGC and will be submitted to JAMSTEC DMD.

Fig. 5.5.2-1:
The installed situation of the sensor block. The sensor block is indicated by the red dotted ellipsoid.

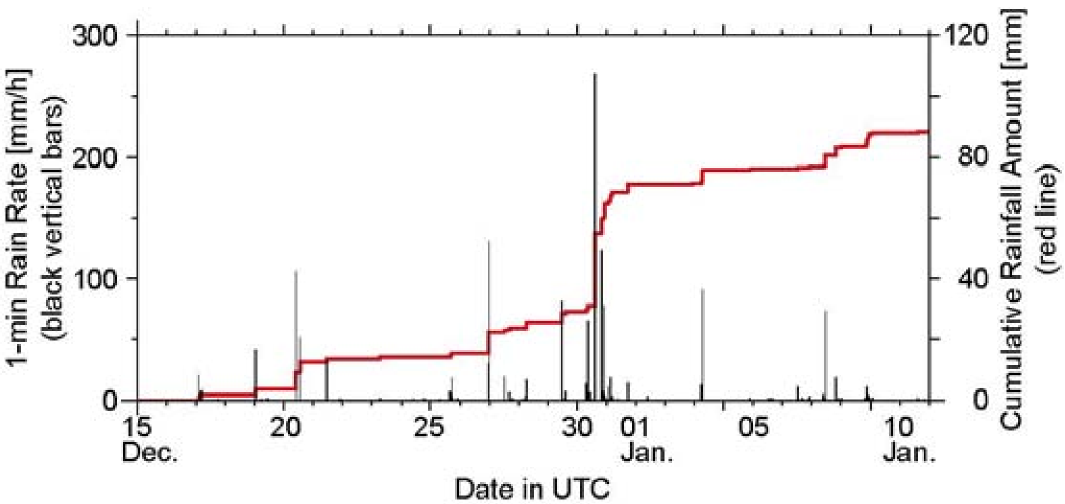

Fig.5.5.2-2: Observed Rain Rate in 1-minute interval (vertical black bar) and cumulative rainfall amount (red line) for IOP (Dec.15 to Jan.11).

5.6 Precipitation/Cloud Videosonde

(1) Personnel

Kenji Suzuki (Yamaguchi University): Principal Investigator
Yusuke Shigenaga (Yamaguchi University)

(2) Objective

Microphysical observations on board using the videosonde system had never been conducted before. This study was the first time to launch videosondes from the vessel. Images of particle obtained from videosondes would give us temporal and spatial distributions of precipitation/cloud particles. The objective of this observation is to investigate the microphysical processes in the tropical maritime cloud developed over the ocean by using videosonde system.

(3) Methods

Precipitation/Cloud videosonde is a balloon-bone radiosonde which images of precipitation/cloud particles are acquired by a CCD camera. Precipitation videosonde system consists of a CCD camera, a video amp, an infrared sensor, a transmitter, batteries, and a control circuit. It also has a stroboscopic illumination, which give us the information of particle size and shape >0.5mm. Cloud videosonde has the transparent film system, which a geared motor winds for 1 second (20mm) every 4 seconds. Cloud particles <1mm fall on the film, and then are captured by the CCD camera. Images of particle are transmitted by the 1680 MHz carrier wave to the receiving system equipped at the navigation deck of the R/V Mirai, and then displayed and recorded. Videosondes are launched with VAISALA radiosonde RS-92, which is described in the session 5.1.

(4) Preliminary Results

5 precipitation videosondes and 4 cloud videosondes were launched into the clouds developed over the R/V Mirai during the observation period of MR04-08 (Table 5.6-1). Images of particle are shown in Figure 5.6-2. In the developing cumulus, large raindrops >3mm were observed. Frozen particles were also observed near and above the freezing level. On the other hand, in the mature cumulonimbus, we observed not only raindrops and frozen particles but also a lot of ice crystals at the upper level. Aggregates were found near the freezing level of the stratiform cloud.

The temporal and spatial distribution of precipitation/cloud particle will be analyzed in the future.

(5) Data Archive

The original data will be archived at and available from Yamaguchi University (contact Kenji Suzuki).

Table 5.6-1: List of videosondes launched during the observation period of MR04-08.

Sonde #	Type	Date	Time (JST)	Remarks
C2	Cloud	Dec. 23, 2004	1603	Stratiform cloud No winding of film, No data
C4	Cloud	Dec. 28, 2004	0138	Small cumulus No winding of film No signal (Tracking mistake)
P4	Precipitation	Dec. 28, 2004	1531	Developing cumulus Large raindrops, ice particles
P2	Precipitation	Dec. 30, 2004	2328	Developing cumulus Strong gust Raindrops & ice particles
C6	Cloud	Dec. 31, 2004	0725	Stratiform cloud Culumn, plate No winding of film after 20min
P6	Precipitation	Dec. 31, 2004	1220	Mature cumulus No gust Raindrops & many ice particles No signal above 12km
P1	Precipitation	Dec. 31, 2004	1816	Dissipating stratiform cloud Aggregates near 0C
C5	Cloud	Jan. 9, 2005	0620	No winding of film Quit the recording at 5min
P5	Precipitation	Jan. 9, 2005	0703	Stratiform cloud Bright band Many ice particles above 0C

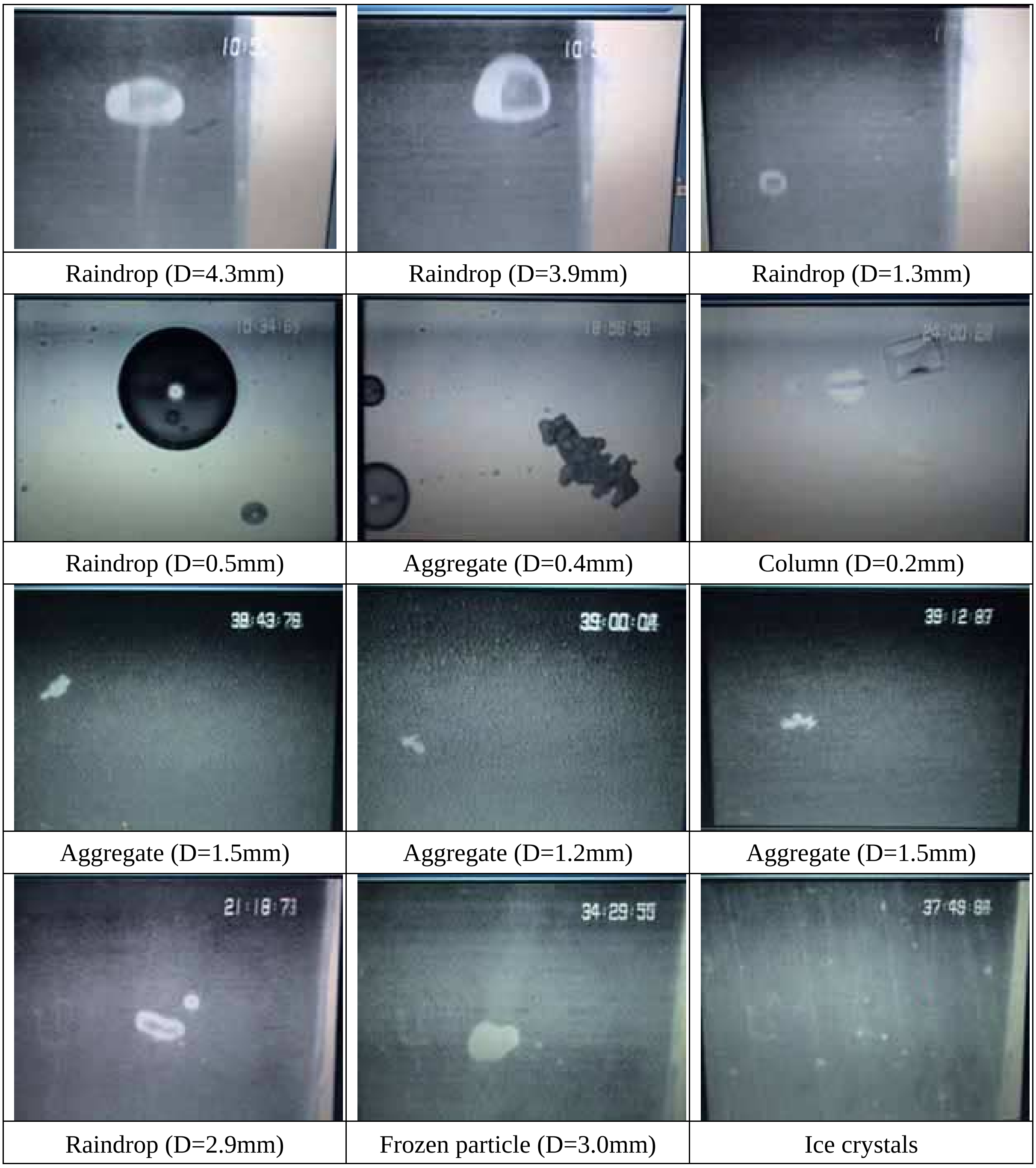

Fig. 5.6-2: Images of precipitation/cloud particles observed during MR04-08.

5.7 Mie Scattering Lidar

(1) Personnel

Ichiro Matsui (National Institute for Environmental Studies): On board
Akihide Kamei
Atsushi Shimizu
Nobuo Sugimoto

(2) Objectives

Objectives of the observations in this cruise are

- to study distribution and optical characteristics of marine aerosols using a two-wavelength dual polarization lidar,
- to study distribution of water/ice clouds.

(3) Method

Vertical profiles of aerosols and clouds were measured with a two-wavelength dual polarization lidar. The lidar employs a Nd:YAG laser as a light source which generates the fundamental output at 1064 nm and the second harmonic at 532 nm. Transmitted laser energy is typically 100 mJ per pulse at 1064 nm and 50 mJ per pulse at 532 nm. The pulse repetition rate is 10 Hz. The receiver telescope has a diameter of 35 cm. The receiver has three detection channels to receive the lidar signals at 1064 nm and the parallel and perpendicular polarization components at 532 nm. An analog-mode avalanche photo diode (APD) is used as a detector for 1064 nm, and photomultiplier tubes (PMTs) are used for 532 nm. The detected signals are recorded with a transient recorder and stored on a hard disk with a computer. The lidar system was installed in a 20-ft container with the FM-CW cloud profiling radar of Chiba university. The container has a glass window on the roof, and the lidar was operated continuously regardless of weather. Simultaneously, the observation of the small lidar in a sonde container was also carried out.

(4) Results

Figure 5.7-1 shows the quick-look time-height indications of the range-corrected signal during of this cruise. The lower clouds at 600 m are continuously observed over western Pacific Ocean. Cirrus clouds and Subvisible cirrus clouds are also frequently observed in an altitude range of 10 to 17km.

(5) Data archive

- Raw data
  lidar signal at 532 nm (parallel polarization), lidar signal at 532 nm (perpendicular polarization)
  lidar signal at 1064 nm, temporal resolution 10 sec., vertical resolution 3.75 m
- Processed data
  cloud base height, apparent cloud top height, cloud phase, cloud fraction
  boundary layer height (aerosol layer upper boundary height)
  backscatter coefficient of aerosols, depolarization ratio

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

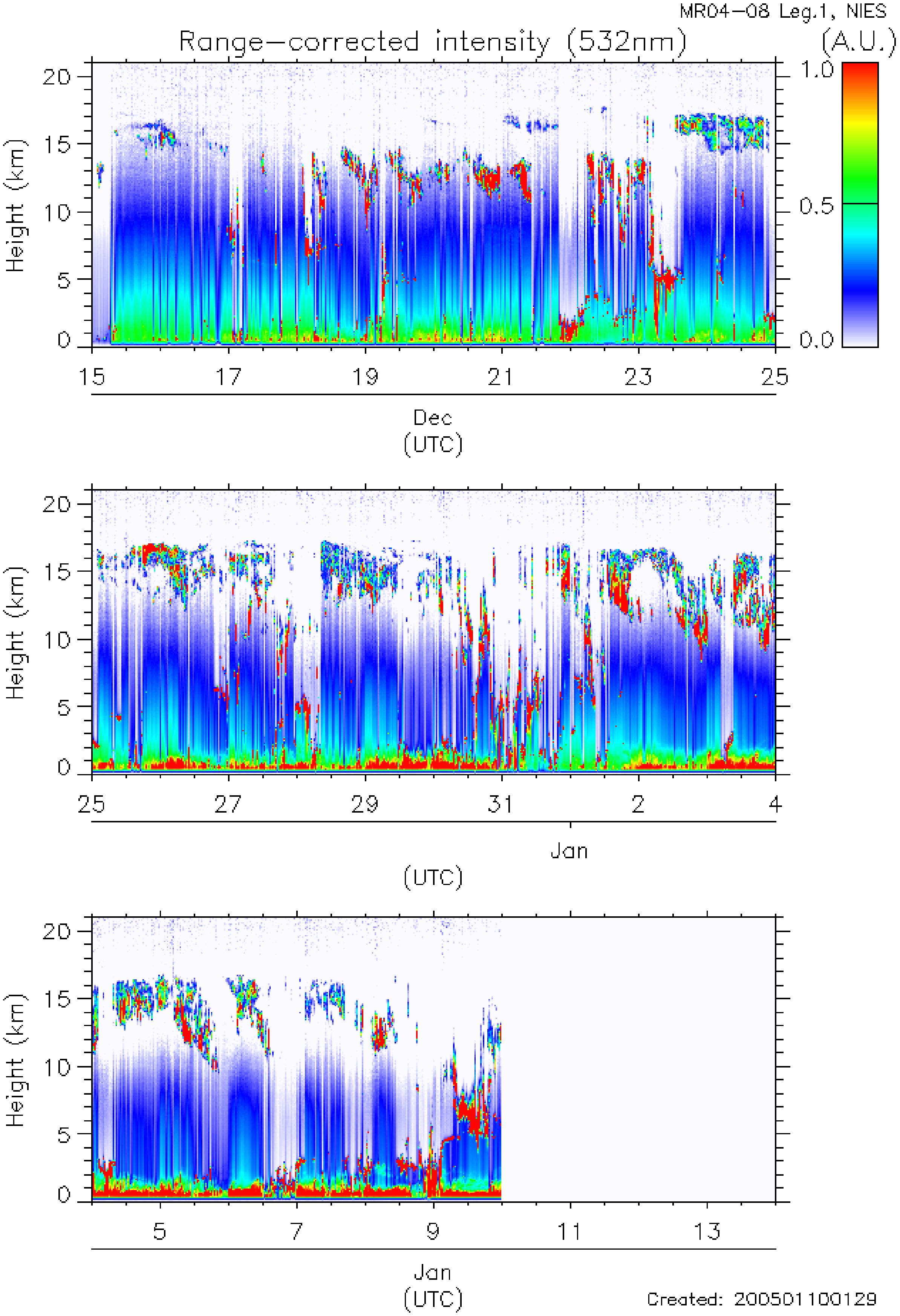

Fig. 5.7-1: Range-corrected signal at 532 nm

5.8 FM-CW 95GHz Radar

(1) Personnel:

Ichiro Matsui (National Institute for Environmental Studies), On board
Toshiaki Takano (Chiba University Associate Professor)
Yohei Kawamura (Chiba University Technical officer)
Ken-ichi Akita (Chiba University Graduate student)
Hiroshi Kubo (Chiba University Graduate student)
Ken-ichi Futaba (Chiba University Undergraduate student)

(2) Objective:

Objectives of the observation during this cruise are to study mechanism of clouds and raining and to study reflection of electromagnetic wave from aerial particles.

(3) Methods:

Vertical profiles of clouds and raining were measured by FM-CW Radar at 95GHz. The Radar use 95 GHz electromagnetic wave on FM-CW (Frequency Modulated Continuous Wave) mode. The advantage of FM-CW mode is using low-power about 500mW and the millimeter-wave at 95 GHz can observe vertical profile with thick clouds.

This system has two parabola antennas of 1m-diameter. The one is transmitter, the other is receiver. The transmitter antenna sends FM-CW waves for right above, the receiver antenna receive the reflection from aerosols in the sky of the FM-CW waves. The received signals are sent to an A/D converter board in an observation PC and are converted digital data. The digital data of the reflection waves were used Fourier transform by FFT program on a processing PC and stored on a hard disk in the processing PC.

(4) Results:

Figure 5.8-1 shows quick-look time-height indications of FM-CW 95GHz signal on this cruise.

(5) Data archive:

The quick-look data is exhibited on Shimakura Laboratory’s http server at Chiba University now.

All data will be archived at Chiba University, and will be submitted to JAMSTEC within 3-years.

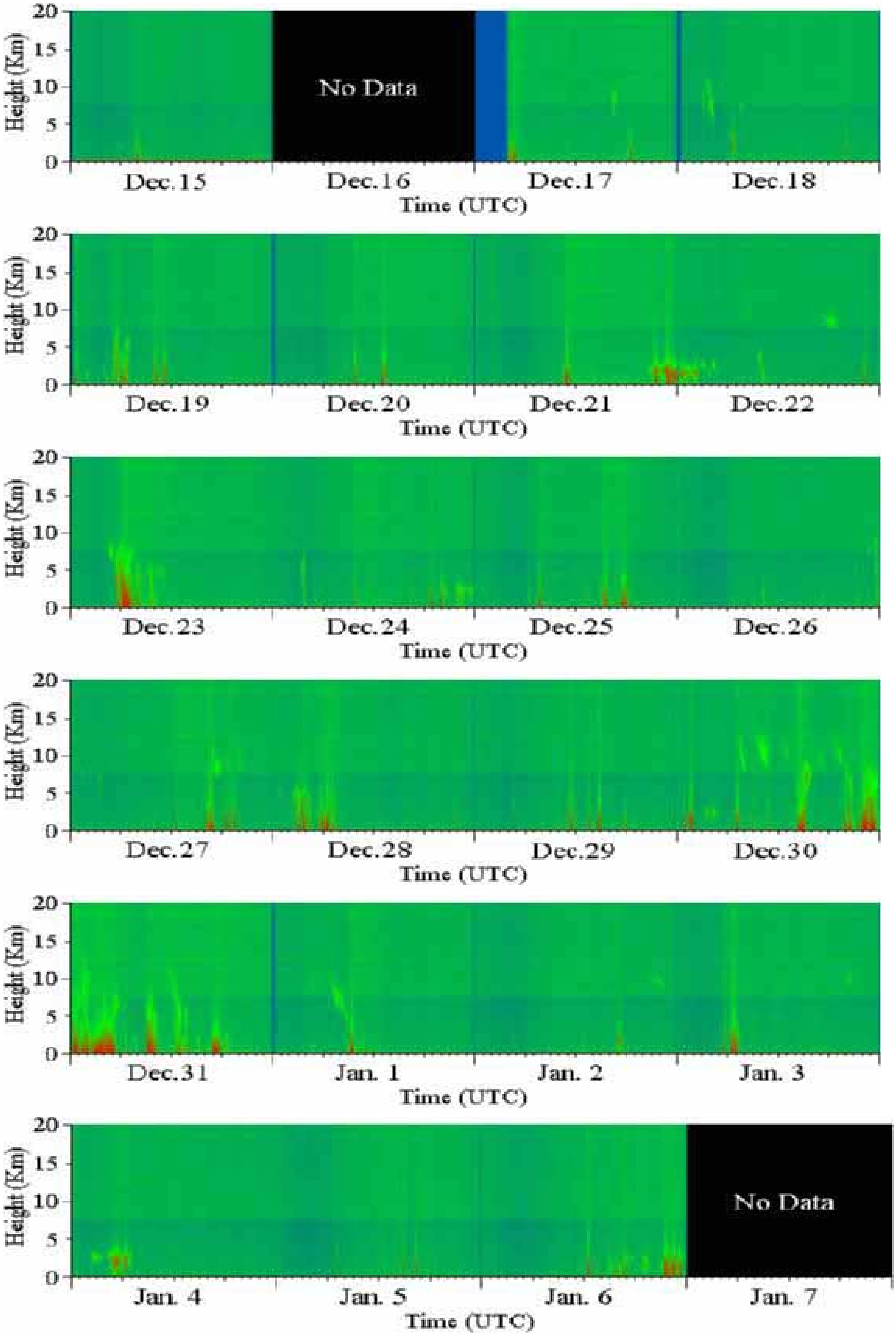

Fig. 5.8-1: Quick-Look Data at FM-CW 95GHz Radar

5.9 Ceilometer

(1) Personnel

Masaki Katsumata	(JAMSTEC): Principal Investigator	
Kunio Yoneyama	(JAMSTEC)	
Taro Shinoda	(HyARC, Nagoya Univ.)	
Satoshi Endoh	(HyARC, Nagoya Univ.)	
Katsuhisa Maeno	(GODI):	Operation Leader
Kazuho Yoshida	(GODI)	
Norio Nagahama	(GODI)	
Yasutaka Imai	(GODI)	

(2) Objective

The information of the cloud base height is important to understand the processes on the exchange of water and energy between the atmospheric boundary layer and the layer above, and horizontal / vertical distribution of the cloud.. As one of the methods to measure them, the ceilometer observation was carried out.

(3) Methods

We measured cloud base height and backscatter profile using CT-25K (VAISALA, Finland) ceilometer throughout MR04-08 Leg1 from the departure of Chuuk on 12 December 2004 to the arrival of Palau on 12 January 2005.

Major parameters for the measurement configuration are as follows;

Laser source:	Indium Gallium Arsenide (InGaAs) Diode
Transmitting wave length:	905±5 nm at 25 deg-C
Transmitting average power:	8.9 mW
Repetition rate:	5.57kHz
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

On the archived dataset, three cloud base height and backscatter profile are recorded with the resolution of 30 m (100 ft.). If the apparent cloud base height could not be determined, vertical visibility and the height of detected highest signal are calculated instead of the cloud base height.

(4) Preliminary results

Fig. 5.9-1 shows the first, second and third lowest cloud base height which the ceilometer detected during the stationary observation. The frequency of the appearance in each height bin is shown in Fig. 5.9-2.

(5) Data archives

Ceilometer data obtained during this cruise will be submitted to and archived by the DMD (Data Management Division) of JAMSTEC.

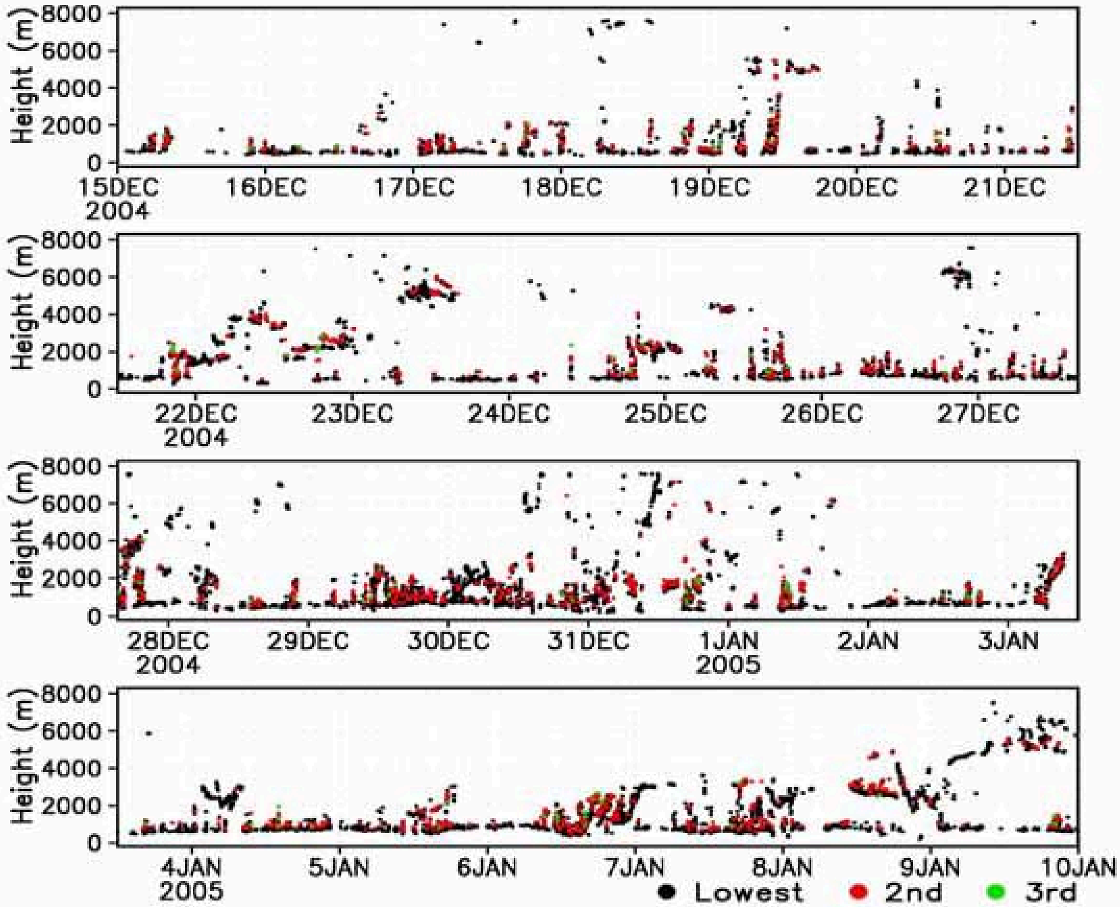

Figure 5.9-1 : 1st, 2nd and 3rd lowest cloud base height during the cruise.

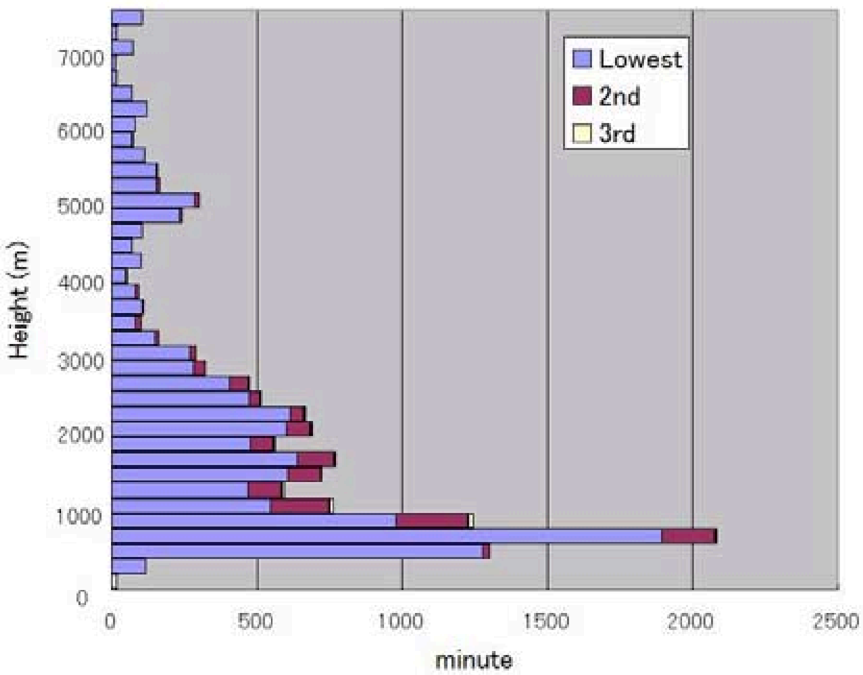

Figure 5.9-2 : Histogram of 1st, 2nd and 3rd lowest cloud base height during the cruise.

5.10 Ozone and Water Vapor Profiling

5.10.1 Ozone and Water Vapor Profiling

(1) Personnel

Masatomo Fujiwara (Hokkaido University): Principal Investigator
Yoichi Inai (Hokkaido University)
Ground supporting members:
Fumio Hasebe (Hokkaido Univ.), Masato Shiotani (Kyoto Univ.),
Noriyuki Nishi (Kyoto Univ.), Atsushi Hamada (Kyoto Univ.), Shin-ya Ogino (Kobe Univ.),
Takashi Shibata (Nagoya Univ.), Holger Voemel (NOAA/Univ. Cororado),
Hisahiro Takashima (Kyoto Univ.)

(2) Objective

The research objective is to investigate the transport and dehydration processes around the tropical tropopause. A total of 15 sets of the EN-SCI electrochemical concentration cell (ECC) ozonesonde, the Meteolabor "Snow White" chilled-mirror dew/frost point hygrometer, and the Vaisala RS80-H radiosonde are flown with meteorological rubber balloons to obtain ozone and water vapor profiles up to the middle stratosphere. The soundings are coordinated as to have "matching" of air mass trajectories with nearby stations where the same type of measurement is being made (Tarawa, Biak, Bandung, and Hanoi). The trajectory forecast is made at Kyoto University, Japan and at Royal Netherlands Meteorological Institute (KNMI).

(3) Methods

The payload consists of the following four parts:

ECC ozonesonde: Standard ozonesonde using potassium iodide solutions
(EN-SCI, Corp., USA)
Snow White hygrometer: Reference-quality chilled-mirror hygrometer
(Meteolabor AG, Switzerland)
RS80-15H: Standard radiosonde with the H-Humicap humidity sensor
(Vaisala Oy, Finland)
TMAX-C board: Interface board for RS80 radiosondes
(TMAX, USA)

The payload is flown with the TA1200 or TX1200 rubber balloon, 160 type parachute, and unwinder (TOTEX, Japan). The Helium gas is used to obtain the buoyancy of about 5 m/s ascent.

The ground receiving system consists of a set of directional and omni-directional antennae, receiver (icom IC-R8500), modem (Kantronics KAM'98), and laptop computer. A special software "STRATO" developed at NOAA is used for calculation, real-time graphics, and data storage. The antennae were installed on the roof of the Aft Wheel House (AWH), and the receiving system together with the ozonesonde preparation system was installed in the AWH.

The following table shows the sounding date and time.

Table 5.10.1-1: Sounding date and time (UTC)

14 Dec. 4:54	15 Dec. 4:33	16 Dec. 4:27	17 Dec. 4:33	18 Dec. 4:27
19 Dec. 4:24	21 Dec. 4:28	23 Dec. 16:02	26 Dec. 4:28	28 Dec. 5:21
30 Dec. 4:30	1 Jan. 4:25	3. Jan. 10:54	5 Jan. 11:17	10 Jan. 0:10 (no ECC)

The balloon inflation was made at the backside of the upper deck where the launch was made or inside the No.1 Mooring Buoy Shed. We used a protection cover for balloon (TOTEX) during the inflation. The frequency range of 404-405 MHz was used for the radiosonde transmitter. We had a small problem of interference by the “Ship Lock” which transmits a pulse of 401.65 MHz with a side band around 404.2 MHz every minute, but there was no data loss by this problem as one of the antennae was installed at the top of the mast and as we changed the radiosonde frequency to an appropriate value.

(4) Preliminary Results

The vertical distributions of temperature, ozone, relative humidities, and the Snow White house-keeping data taken on 26 December are shown in Fig. 5.10.1-1. The “troposphere” where there is a direct influence of cumulus convection is up to about 15.5 km in this case. The region between this 15.5 km level and the cold-point tropopause around 17.5 km is the so-called Tropical Tropopause Layer (TTL) where processes of transport, photochemistry, microphysics, and radiation are actively occurring to determine the initial condition of the stratospheric chemistry. The figure shows a small but distinct ozone minimum at 16.5 km where the simultaneous lidar measurement indicated the existence of a thin cloud layer with the optical characteristics slightly different from the standard upper tropospheric cirrus. Some ozone destruction process previously not reported might have occurred on the special cloud particles.

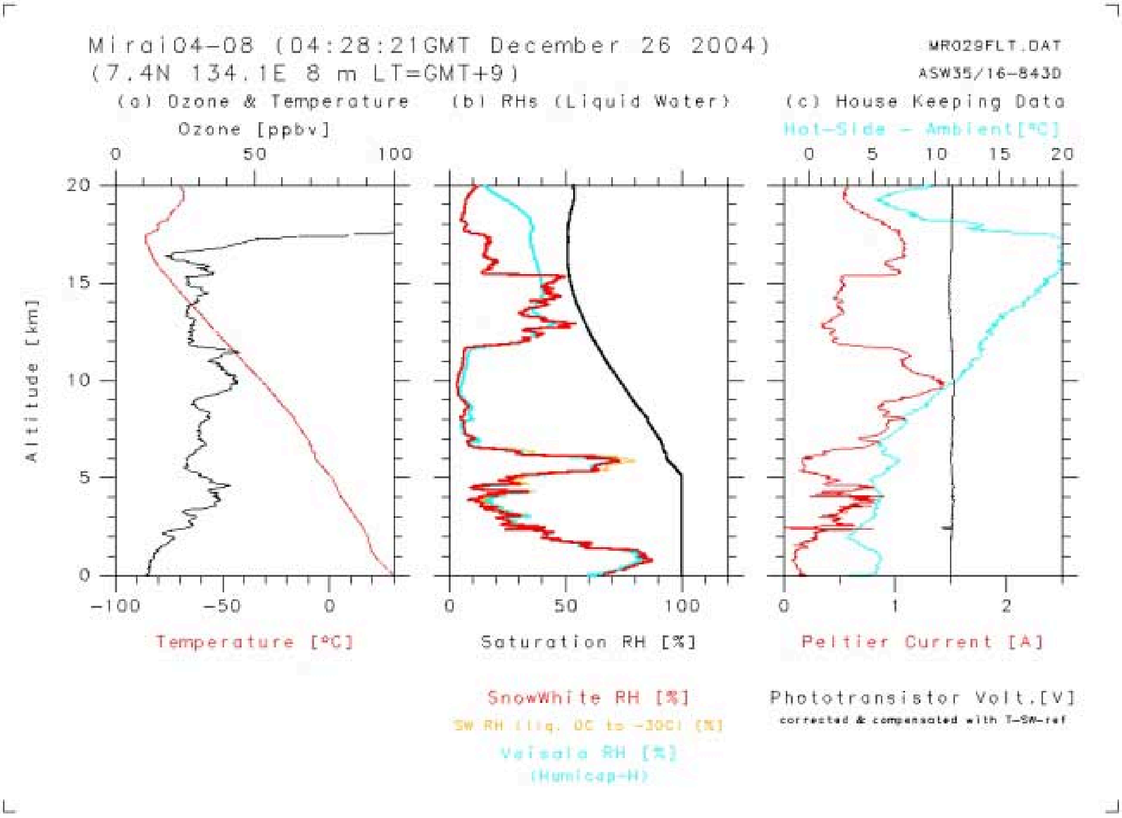

Fig. 5.10.1-1: Vertical profiles of (Left) temperature (red) and ozone mixing ratio (black), (Center) Snow White (SW) relative humidity (RH) with respect to liquid water (red), RS80-H RH (blue), and saturation RH (black), and (Right) SW peltier current (red), SW phototransistor voltage (black), and the temperature difference between the peltier hot side and the air (blue), taken on 26 December at 7.4N, 134.1E.

5.10.2 Chemical Components of the Surface Atmosphere

(1) Personnel

Masatomo Fujiwara (Hokkaido University): Principal Investigator

Ground supporting members: Shungo Kato and Yoshizumi Kajii (Tokyo Metropolitan Univ.)

(2) Objective

The research objective is to investigate the diurnal and day-to-day variation of surface ozone, SO_2, and CO over the tropical Pacific Ocean. The chemical processes in the marine boundary layer may be one of the important controlling factors for the tropopause processes because near-surface air sometimes reaches the upper troposphere in a short time through the convective transport.

(3) Methods

The instruments and measuring principles are as follows:

Ozone: Model 1150 (Dylec, Japan); Ultraviolet absorption method

SO_2: Model 43C (Thermo Electron, Japan); Ultraviolet chemiluminescence method

CO: Model 48C (Thermo Electron, Japan); Near-infrared absorption method

These instruments were installed in the Environmental Research Laboratory where there is a special duct for air intake.

(4) Preliminary Results

It was found that high outside humidities and lower room temperatures due to air conditioner make the ozone sensor unstable. The problem was reduced by installing the wire heater on the inlet tube and wrapping the instrument and the tube by air-cap sheet. All the three species generally showed low and nearly constant concentrations with several spikes due to the ship exhaust. The final data set will be prepared after the cruise.

5.11 Rain Sampling for Stable Isotope Measurement

(1) Personnel

Kimpei Ichiyanagi (JAMSTEC) (Not on board)

(2) Objective

To determine rain water source using a technique of stable isotope analysis

(3) Method

Rainfall water are sampled with plastic caps, then stored in 6cc glass bottles. Stable isotopic composition for hydrogen and ozygen in rain water is determined by the isotope ratio mass spectrometry (IRMS). The IRMS used is Finnigan MAT 252 (Thermo Quest K. K.) with CO2 and H2 equilibrium device.

(4) Preliminary results

During this cruise, we collect 17 samples in total. Table 5.11-1 lists the date and location of rain sampling. 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 5.11-1 Dates and locations to show when and where rain water was sampled.

Sample No.	Date (UTC)	Location (lat/lon)
01	2350Z, December 12, 2004	7-00N, 146-14E
02	0050Z, December 19, 2004	7-15N, 133-58E
03	0039Z, December 20, 2004	7-19N, 133-58E
04	1307Z, December 20, 2004	7-14N, 133-54E
05	1100Z, December 21, 2004	7-20N, 134-01E
06	2100Z, December 21, 2004	7-19N, 134-00E
07	1730Z, December 25, 2004	7-20N, 134-00E
08	0000Z, December 27, 2004	7-34N, 133-56E
09	1127Z, December 29, 2004	7-30N, 134-00E
10	2130Z, December 30, 2004	7-38N, 133-59E
11	0220Z, December 31, 2004	7-47N, 133-59E
12	0530Z, December 31, 2004	7-47N, 133-57E
13	1910Z, December 31, 2004	7-18N, 134-00E
14	0655Z, January 3, 2005	7-20N, 134-04E
15	1110Z, January 7, 2005	7-32N, 134-00E
16	2030Z, January 7, 2005	7-24N, 134-01E
17	2330Z, January 8, 2005	7-06N, 133-52E

5.12 Infrared Radiometer

(1) Personnel

Hajime Okamoto (CAOS, Tohoku University): Principal Investigator (not on board)
Nobuo Sugimoto (National Institute for Environmental Studies)
Ichiro Matsui (National Institute for Environmental Studies) (On board)
Akihide Kamei (National Institute for Environmental Studies)
Toshiaki Takano (Chiba University)

(2) Objective

The infrared radiometer (hereafter IR) is used to derive the temperature of the cloud base. Main objectives are to use study clouds and climate system in tropics by the combination of IR with active sensors such as lidar and 95GHz cloud radar. From these integrated approach, it is expected to extend our knowledge of clouds and climate system. Special emphasis is made to retrieve cloud microphysics in upper part of clouds.

(3) Method

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

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	9.6-10.5um

This is converted to broadband radiance around the wavelength region. This is further combined with the lidar or radar for the retrieval of cloud microphysics such as optical thickness at visible wavelength, effective particle size. The applicability of the retrieval technique of the synergetic use of radar/IR or lidar/IR is so far limited to ice clouds. The microphysics of clouds from hese techniques will be compared with other retrieval technique such as radar/lidar one or radar with multi-parameter.

(4) Data archive

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

5.13 Solar Radiation and Ocean Color

5.13.1 Solar Radiation

(1) Personnel

Katsutoshi Kozai (Kobe-u): Principal Investigator

Itaru Sano (Kinki-u)

(2) Objective

Interaction between atmosphere and ocean is one of key issue for understanding of climate system. However, atmospheric constituents such as aerosols and clouds vary with time and place. The aim of this cruise is to measure the optical properties of aerosols over the western Pacific Ocean by using sun/sky photo-polarimetry. Note that sun photometry potentially plays an important role in the atmospheric correction of remote sensing data, especially for ocean color study.

(3) Method

A portable sun/sky photo-polarimeter PREDE PPM-100P is available for the measurements of the direct solar irradiance and sky polarimetry at the Earth's surface. Measurements are taken at pre-determined discrete multi-wavelengths, i.e., 0.400, 0.443, 0.500, 0.670, 0.870, and 1.020 µm, in order to determine the atmospheric transmittance and the scattering properties of atmospheric constituents. Note that it works only during daylight time.

(4) Preliminary Results

Figures 5.13.1-1 and 5.13.1-2 show aerosol optical thickness (AOT) at wavelengths of 0.500 and 0.870 µm. The AOT values are very low around 0.05 on 15 and 17 December 2004. After low aerosol loading period, the values increase toward the value of 0.1 due to the contamination with very thin cirrus clouds (around 15-17 km tangent height detected by NIES-LIDAR). Then, AOT takes high value except beginning of January. Note that the wavelength tendency between 0.500 and 0.870 µm indicates the coarse mode aerosols.

(5) Data Archive

Quality assured AOT data (equivalent to AERONET Level 2) will be submitted to JAMSTEC DMO. The original data are archived at Department of Informatics, Faculty of Science and Technology, Kinki University (contact to Itaru Sano).

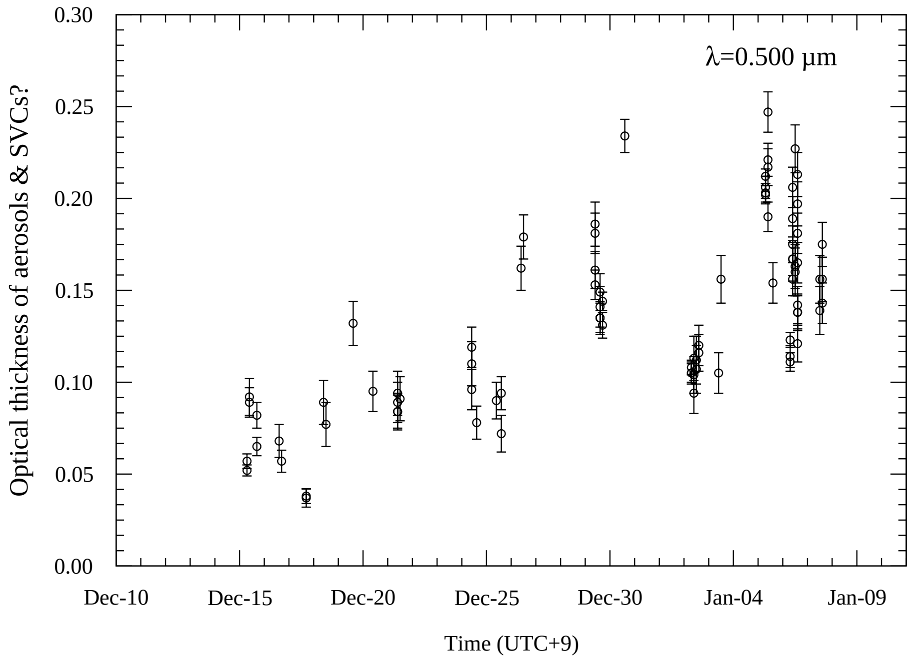

Fig. 5.13.1-1: Temporal variation of aerosol optical thickness (AOT) at a wavelength of 0.500 μm over the western Pacific Ocean (around 7.5°N, 134.0°E) during MR04-08 IOP. Final AOT values will be determined after post-calibration to be held in February 2005. Note that the values of AOT may be contaminated with very thin cirrus clouds (around 15-17 km tangent height).

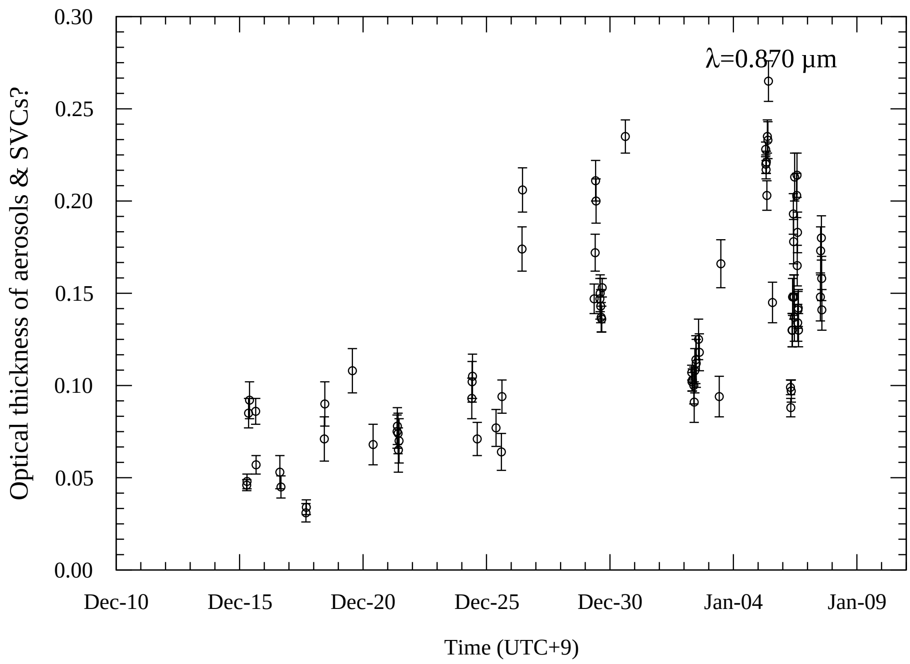

Fig. 5.13.1-2: Same as Fig. 13-1-1 but at a wavelength of 0.870 μm.

5.13.2 Sea Surface Reflectance and Satellite-Derived Ocean Color

(1) Personnel

Itaru Sano (Kinki University): On-board Principle Investigator
Kensuke Tanaka (Kobe University): On-board Investigator
Teruo Ohsawa (Kobe University): Observation assistance
Koji Nishioka(Osaka University): Observation assistance
Katsutoshi Kouzai (Kobe University): Principle Investigator (not on board)

(2) Objective

Radiative energy budget at the surface plays an important role in controlling the global weather and climate. The purpose of the present observation is to observe the reflectance of solar radiation at the ocean surface and to collect ground-truth data for the validation of satellite-derived parameters, particularly, the concentration of Chlorophyll-a.

(3) Method

Spectroradiometer (Geophysical and Environmental Research Corp., GER1500) was used to measure the spectral reflectance of solar radiation at the sea surface. In order to derive the spectral reflectance, the calibrated whiteboard spectral radiance and the upward spectral radiance from the ocean surface are measured. This observation was conducted at the head of the front deck in clear conditions four times a day (10,11,13 and 14LT) when the satellites SEASTAR and NOAA passed over R/V Mirai. In addition, a sea water sampling for measuring the concentration of Chlorophyll-a was performed six times per day (00, 03, 09, 12, 15 and 21LT), in order to compare with the GER- and satellite-derived concentration of Chlorophyll-a. The Specification of GER1500 is shown in Table 5.13.2-1.

Table 5.13.2-1 Spscifications of GER1500.

Spectral Range	350 nm to 1050 nm
Number of Channels	512
Type of Sensor	Silicon Array
Resolution	3 nm FWHM(Full Width Half Maximum)
Integration	5 – 160 ms
Unit Size	6 “wide,3.25” high,10.25”long
	15 cm.wide,8cm.high,26cm.long
Unit Weight	4 lbs.(1.8 kg) maximum
Internal Memory	483 scans maximum
Sighting	483 scans maximum
Power	6 Volt rechargeable nickel hydride battery
Display	LCD, 8digts, 2rows
	Laser and Power LEDs
	Real Time Spectral display with computer
I/Os	COM1, COM2 (RS232 serial ports)
Field of View	Standard(4°Nominal)

The ocean color data is directly received from SeaWiFS/SeaStar satellite. The data will be decrypted and processed based on the SeaDAS processing code after MR04-08 IOP due to the delay of decryption processing. Note that, SeaWiFS data are available until 22 December, because the data distribution policy in the contract between NASA and Orbview company has been changed. The sea surface temperature (MCSST product) derived from AVHRR/NOAA will be used to investigate not only relationship between phytoplankton pigment concentration and sea surface temperature but also structure of ocean surface such as tidal condition, upwelling and so on.

(4) Preliminary Results

The measurements of sea surface reflectance were performed under fine and calm weather conditions during the stationary observation period from Dec 15 2004 to Jan 9 2005. Samples of the sea surface spectral reflectance obtained especially under good conditions are shown in Fig. 5.13.2-1, as a preliminary result. The reflectance at 400 nm, which corresponds to a blue wavelength, exhibits the values of 4.5 - 6.5 % and the convergence is seen in the range longer than 700 nm, which corresponds to the near-infrared wavelength. Theoretically, the reflectance should be zero in the near-infrared wavelengths longer than 550 nm (i.e. solar radiation is completely absorbed). However, non-zero reflectances are found in these wavelengths, and it is indicated that they may be caused by various sea surface condition such as sun glitter, form, and white caps.

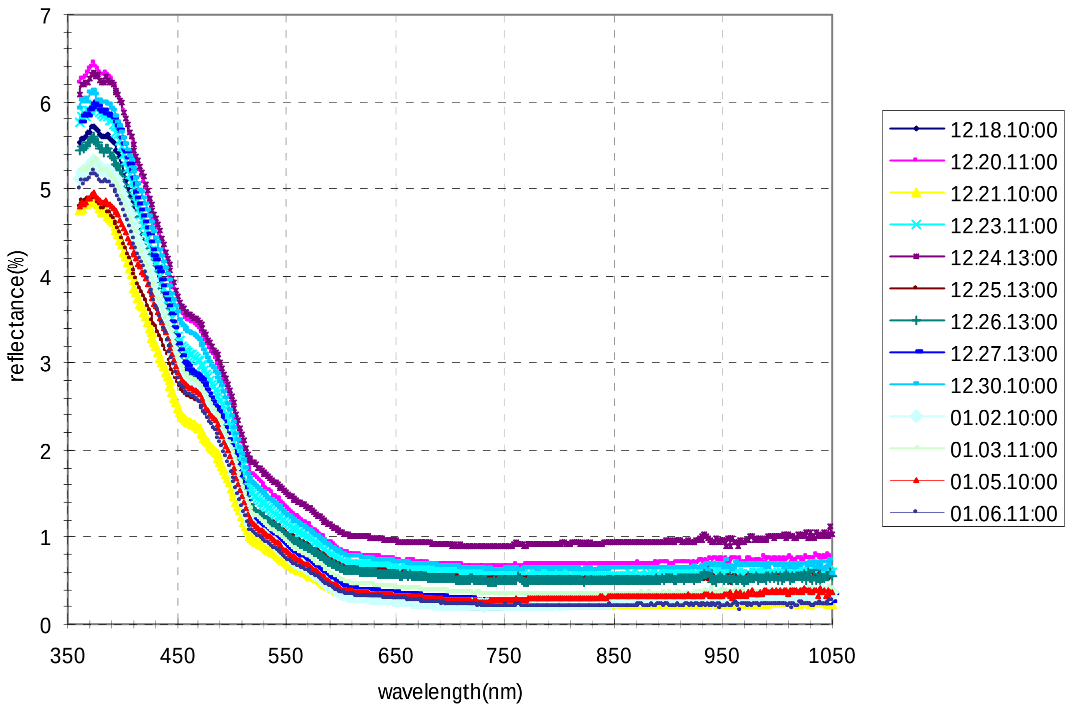

Fig. 5.13.2-1: Sea surface spectral reflectance on some selected days.

(5) Data Archive

Data of sea surface reflectance and Chlorophyll-a obtained in this on-board observation and satellite (SeaWiFS and NOAA) data will be archived at Kobe University, and will be open to public after quality checks and corrections. Interested Scientists should contact Prof. Katsutoshi Kouzai (Faculty of Maritime Scientists, Kobe University). The corrected data and inventory information will be submitted to JAMSTEC Data Management Office.

5.14 Surface Atmospheric Turbulent Fluxes

(1) Personnel

Teruo Ohsawa (Kobe University): On-board Investigator
Koji Nishioka (Osaka University): On-board Investigator
Hiroshi Ishida (Kobe University): On-shore Principal Investigator
Osamu Tsukamoto (Okayama University): On-shore Investigator

(2) Objective

For the understanding of air-sea interaction, accurate measurements of surface energy and water budgets are necessary as well as momentum exchange through the sea surface. In addition, the evaluation of carbon dioxide flux on the sea surface is also indispensable for the study of global warming. In this observation, sea surface turbulent fluxes of momentum, sensible heat, latent heat (water vapor) and carbon dioxide are measured with the eddy correlation method, which is free from any assumptions and is believed to be the most accurate method. The surface fluxes are combined with radiation fluxes and water temperature profiles to derive the sea surface energy and water budgets.

(3) Methods

The turbulent flux measurement system (Fig. 5.14-1) consists of turbulence instruments (Kaijo Co., Ltd.) and ship motion sensors (Kanto Aircraft Instrument Co., Ltd.), which are installed at the top of the foremast. A three-dimensional sonic anemometer-thermometer (Kaijo, DA-600) has been in operation since June of 2000 (MR00-K04), and an infrared hygrometer (LICOR, LI-7500) since May of 2002. The sonic anemometer measures three-dimensional wind components relative to the ship, including apparent wind velocity caused by ship motions. The ship motions are independently measured by three ship motion sensors; 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). LI-7500 is a CO2/H2O sensor that measures turbulent signals of carbon dioxide and water vapor, simultaneously.

The turbulence and ship motion are measured at 10 Hz with a PC-based data logging system (Labview, National Instruments Co., Ltd.). This PC system is connected to the R/V Mirai network system to obtain ship navigation information, which is used to derive absolute wind components. Combining these wind data with the turbulence measurements, turbulent fluxes and their statistics are calculated and displayed on the PC system in a real-time basis. These data are also saved in digital files every 0.1 second for raw data and every 1 minute for statistic data.

(4) Preliminary Results

The measurement of turbulent fluxes was continuously carried out during the stationary observation period, from December 15, 2004 to January 10, 2005. During this period, R/V Mirai ran against wind direction at 5 through 8 knot for one hour at every three hour, in order to remove dynamical and thermal effects of the ship body on the turbulence measurements.

Figs. 5.14-2 and 5.14-3 show the three-hourly turbulent fluxes of sensible heat and latent heat and those of carbon dioxide. Each value is calculated as an average for one hour, excluding apparent errors due to ship motion, precipitation, bird's droppings, etc. The latent heat flux ranges roughly from several 10s to 100 W/m^2, which is typically one order larger than those of the sensible heat flux. The carbon dioxide flux is generally minus several 10s μg/m^2·s, being sometimes less than -100 μg/m^2·s. That is, the flux is mostly negative (downward), and this means that the present ocean area works as a sink of CO_2. These results are similar to those of the previous cruise MR04-01, in which the stationary observation was carried out at (2N, 138.5E) in March, 2004.

(5) Data Archive

All the data obtained in this cruise will be archived at Kobe and Okayama Universities and will be open to public after quality checks and corrections. Interested scientists should contact Prof. Hiroshi Ishida (Kobe University) or Prof. Osamu Tsukamoto (Okayama University). The corrected data and inventory information will be submitted to the JAMSTEC Data Management Office.

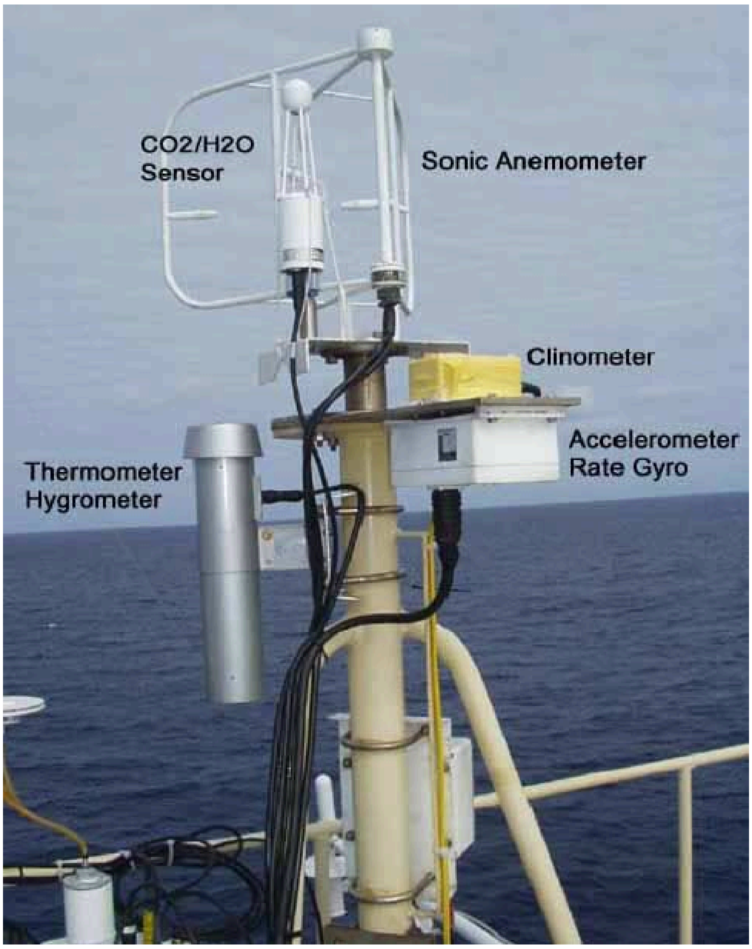

Fig. 5.14-1: The turbulent flux measurement system installed at the top of the foremast.

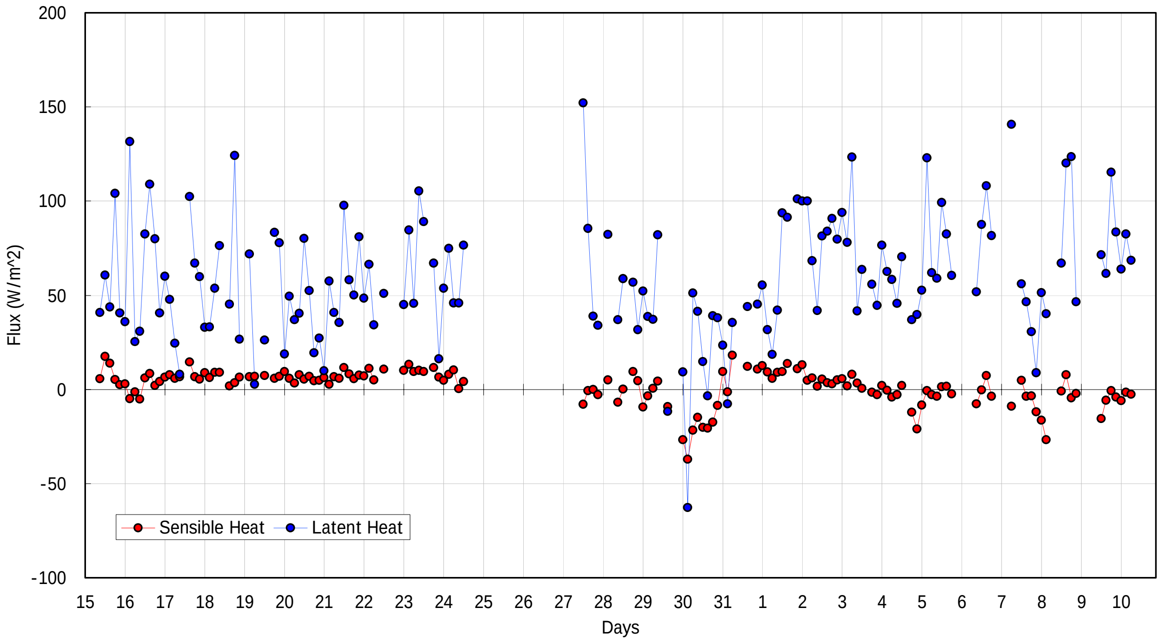

Fig. 5.14-2: Time series of three-hourly sensible and latent heat fluxes during the stationary observation period.

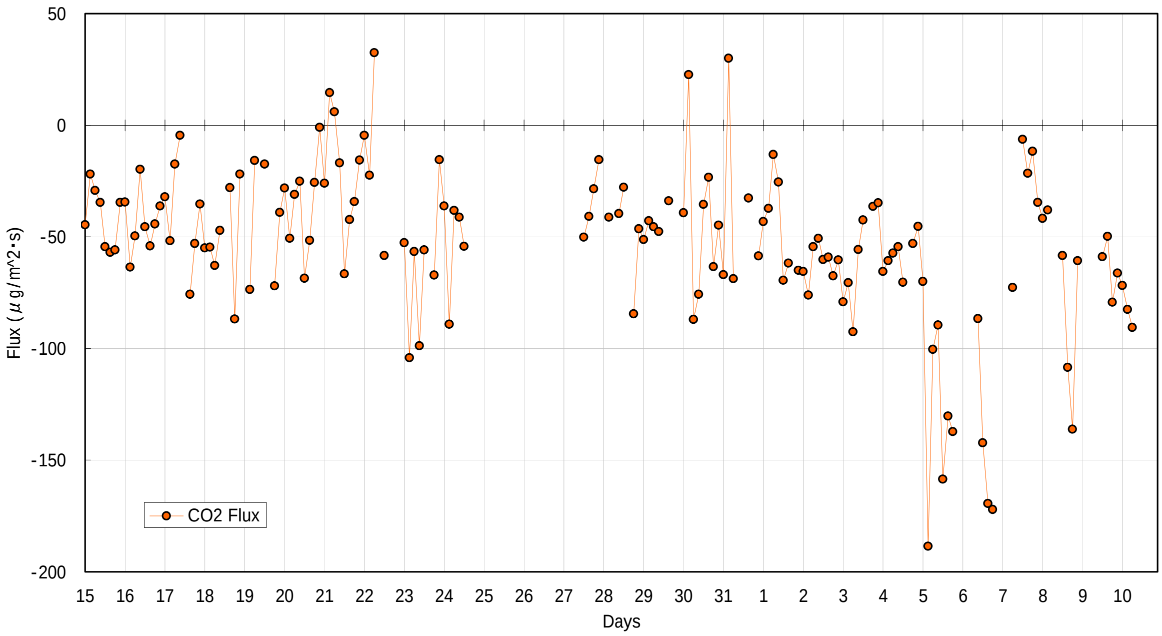

Fig. 5.14-3: Time series of three-hourly CO2 fluxes during the stationary observation period.

5.15 Surface Meteorological Observation

(1) Personnel

Kunio Yoneyama	(JAMSTEC):	Principal Investigator
Masaki Katsumata	(JAMSTEC)	
Katsuhisa Maeno	(GODI):	Operation Leader
Yasutaka Imai	(GODI)	
Norio Nagahama	(GODI)	
Kazuho Yoshida	(GODI)	

(2) Objective

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

(3) Methods

The surface meteorological parameters were observed throughout MR04-08 leg1 cruise from the departure of Chuuk on 12 December 2004 to the arrival of Palau on 12 January 2005.

At this cruise, we used 3 systems for the surface meteorological observation.

1. Mirai meteorological observation system
2. Shipboard Oceanographic and Atmospheric Radiation (SOAR) system
3. Skin Sea Surface Temperature (SSST)

(3-1) Mirai meteorological observation system

Instruments of Mirai meteorological system (SMET) are listed in Table 5.15-1 and measured parameters are listed in Table 5.15-2. Data was collected and processed by KOAC-7800 weather data processor made by Koshin Denki, Japan. The data set has 6-second averaged.

Table 5.15-1: Instruments and their installation locations of Mirai meteorological system

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

Table 5.15-2: Parameters of Mirai 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 (fore)	m	hourly
22	Significant wave height (aft)	m	hourly
23	Significant wave period	second	hourly
24	Significant wave period	second	hourly

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

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

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

SCS recorded PRP data every 6 seconds, Zeno/met data every 10 seconds. Instruments and their locations are listed in Table 5.15-3 and measured parameters are listed in Table 5.15-4

Table 5.15-3: Instruments and their installation locations of SOAR system

Sensors	Type	Manufacturer	Location (altitude from surface)
Zeno/Met			
Anemometer	05106	R.M. Young, USA	foremast (25m)
Tair/RH	HMP45A	Vaisala, Finland	foremast (24m)
	with 43408 Gill aspirated radiation shield (R.M. Young)		
Barometer	61201	R.M. Young, USA	foremast (24m)
	with 61002 Gill pressure port (R.M. Young)		
Rain gauge	50202	R. M. Young, USA	foremast (24m)
Optical rain gauge	ORG-815DA	Osi, USA	foremast (24m)
PRP			
Radiometer (short wave)	PSP	Eppley, USA	foremast (25m)
Radiometer (long wave)	PIR	Eppley, USA	foremast (25m)
Fast rotating shadowband radiometer		Yankee, USA	foremast (25m)

Table 5.15-4: 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 50mm
12	Down welling shortwave radiation	W/m^2	
13	Down welling infra-red radiation	W/m^2	
14	Defuse irradiance	W/m^2	

(3-3) Skin Sea Surface Temperature (SSST)

To measure the skin sea surface temperature (SSST), the SeaSnake designed by BNL was installed at the bow (5m extention). In this cruise, the SeaSnake was improved using two thermistor (107 Campbell, USA). We converted sensor output voltages to SSST by using the linier equation leaded by the calibration data. Each coefficient is like below.

	a	b
Sensor1:	11.3775	-56.2644
Sensor2:	11.2723	-56.4440

$T = a * v + b$, T: Temperature [degC], v: Sensor output voltage [mV]

(4) Preliminary results

Figure 5.15-1 show the time series of the following parameters during the stationary observation period, from 15 December 2004 to 10 January 2005; Wind (SOAR), air temperature (SOAR), sea surface temperature (from EPCS), relative humidity (SOAR), precipitation (SOAR), short/long wave radiation (SOAR), pressure (SOAR). 30 minutes accumulated precipitation data from SOAR optical rain gauge was converted to the rainfall intensity. Other figures show the uncorrected data. Figure 5.15-2 shows the time series of SSST compared to SST (from EPCS). In this figure the uncorrected data was plotted.

(5) Data archives

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

(6) Remarks

(a) SSST observation started at 0200UTC December 15 and finished at 0615UTC December 26.
(b) SSST observation was suspended from 0420UTC to 0725UTC December 23.

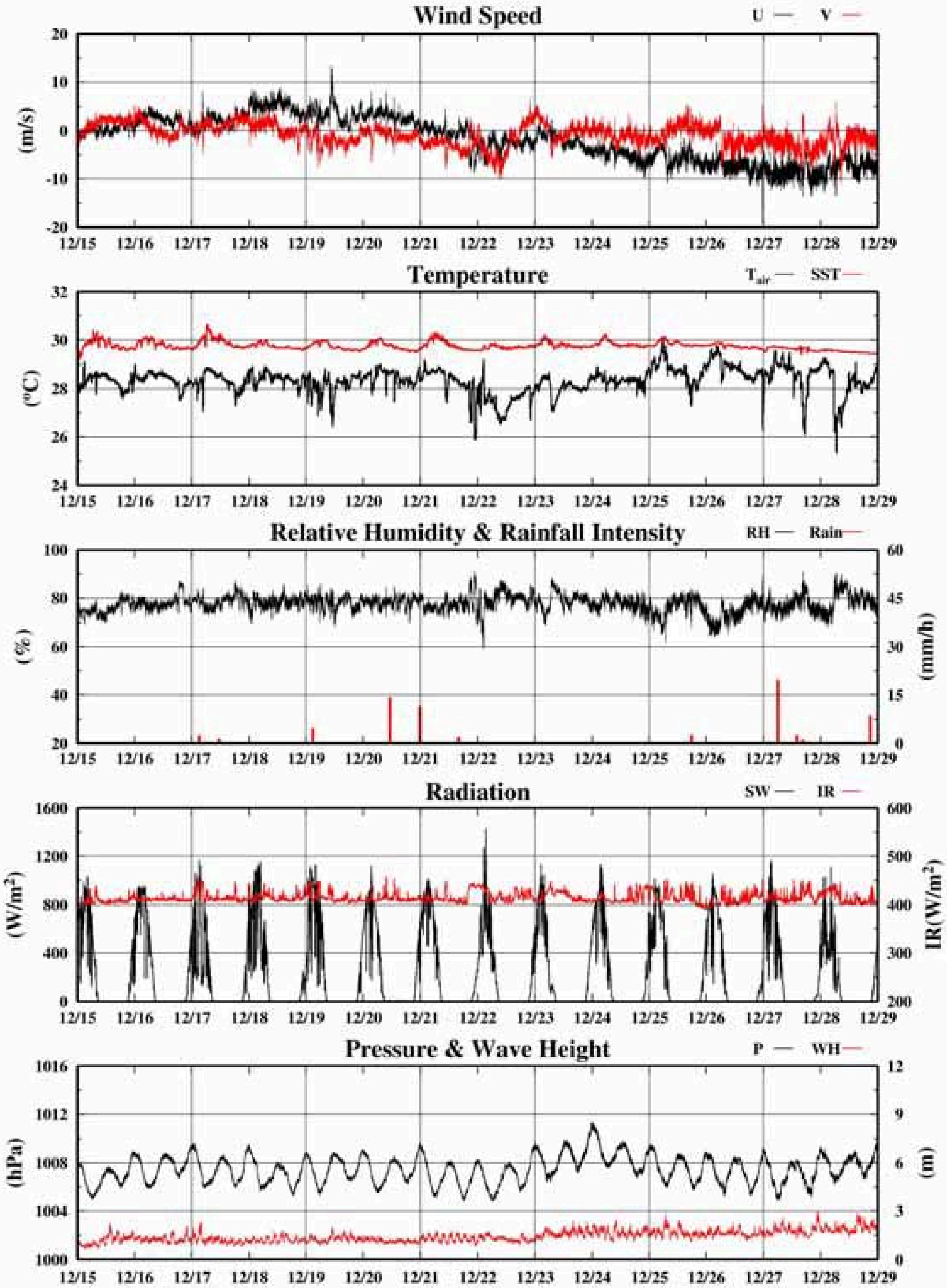

Figure 5.15-1: Time series of surface meteorological parameters during the stationary observation.

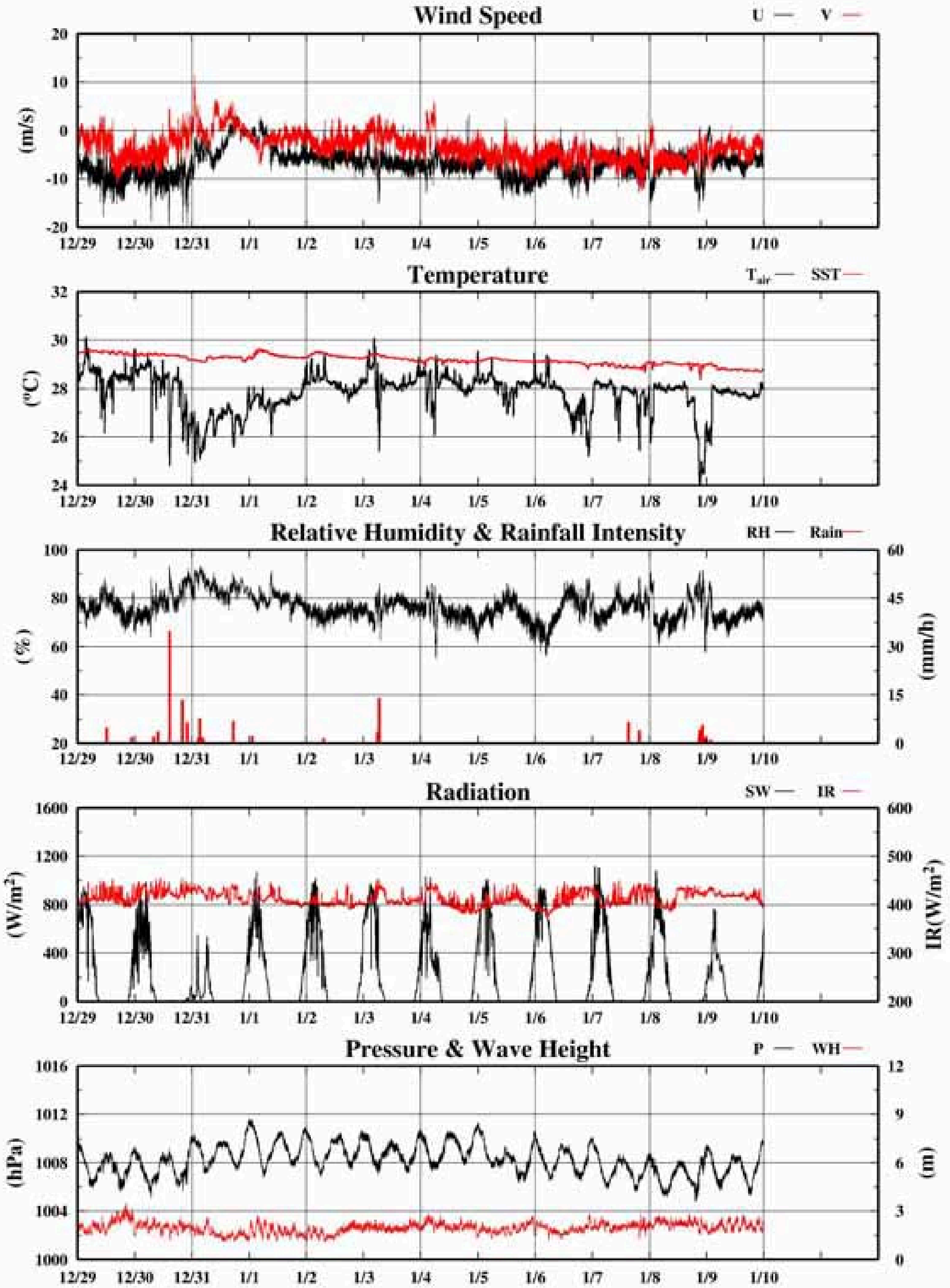

Figure 5.15-1: (continued)

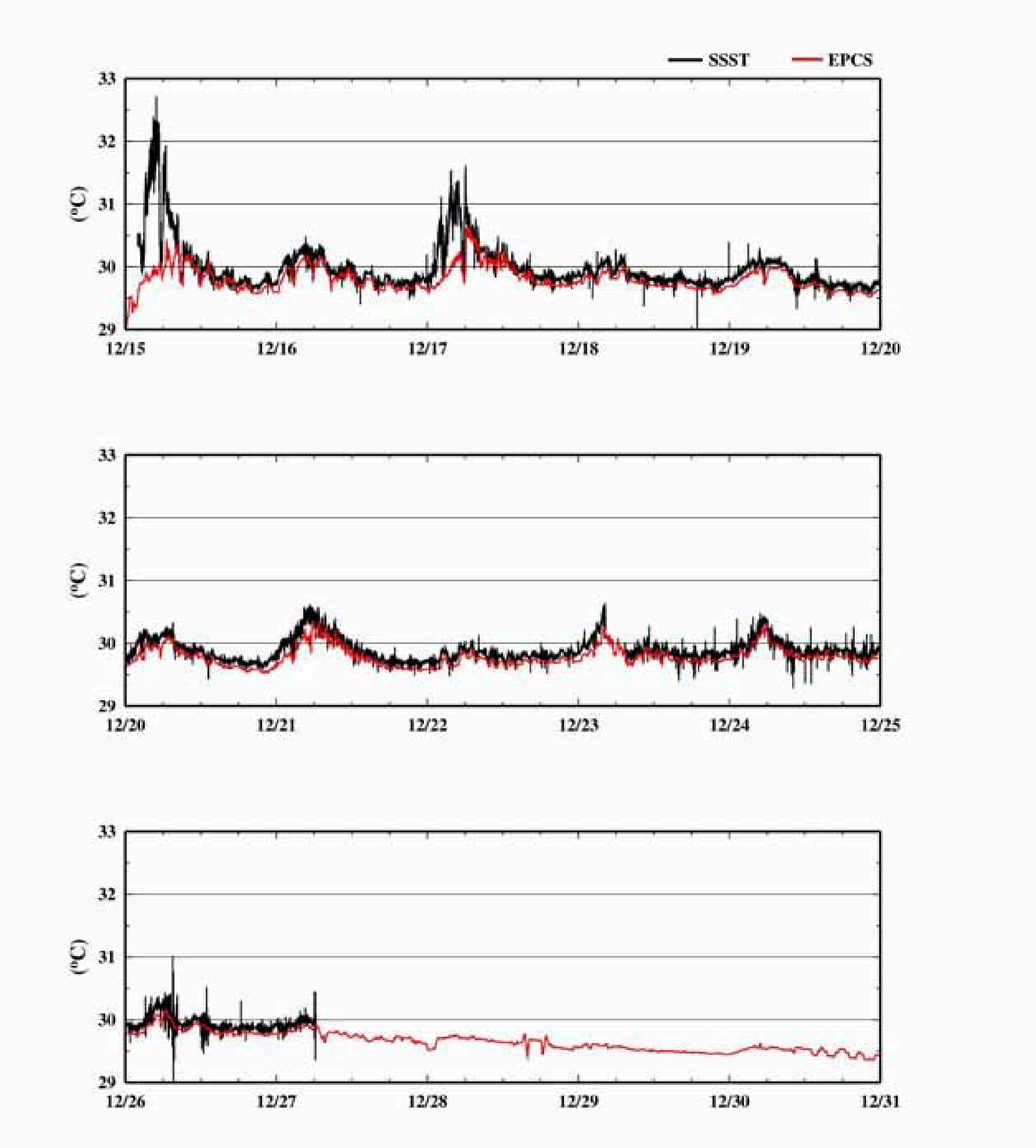

Figure 5.15-2: Time series of sea surface temperature

5.16 Sea Surface Water Monitoring

(1) Personnel

Kunio YONEYAMA (JAMSTEC)
Shinichiro YOKOGAWA (Marine Works Japan Co. Ltd.)
Takuhei SHIOZAKI (Marine Works Japan Co. Ltd.)

(2) Objective

To measure temperature, salinity, dissolved oxygen, 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.

Specification of the each sensor in this system of 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 degC,	Salinity	0 to 6.5 S m-1
Accuracy:	Temperature	0.01 degC 6month-1,	Salinity	0.001 S m-1 month-1
Resolution:	Temperatures	0.001 degC,	Salinity	0.0001 S m-1

b) Bottom of ship thermometer

Model:	SBE 3S, SEA-BIRD ELECTRONICS, INC.
Serial number:	032175
Measurement range:	-5 to +35 degC
Resolution:	±0.001 degC
Stability:	0.002 degC 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 degC 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.

12-Dec.-2005 05:59 to 11-Jan.-2005 00:01

(4) Preliminary Result

Every 10 minutes data are plotted for the period of Dec.12 to Jan. 11 (fig. 5.16-1). This figure showed the respective trend of temperature, salinity, dissolved oxygen and fluorescence distributions.

(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.

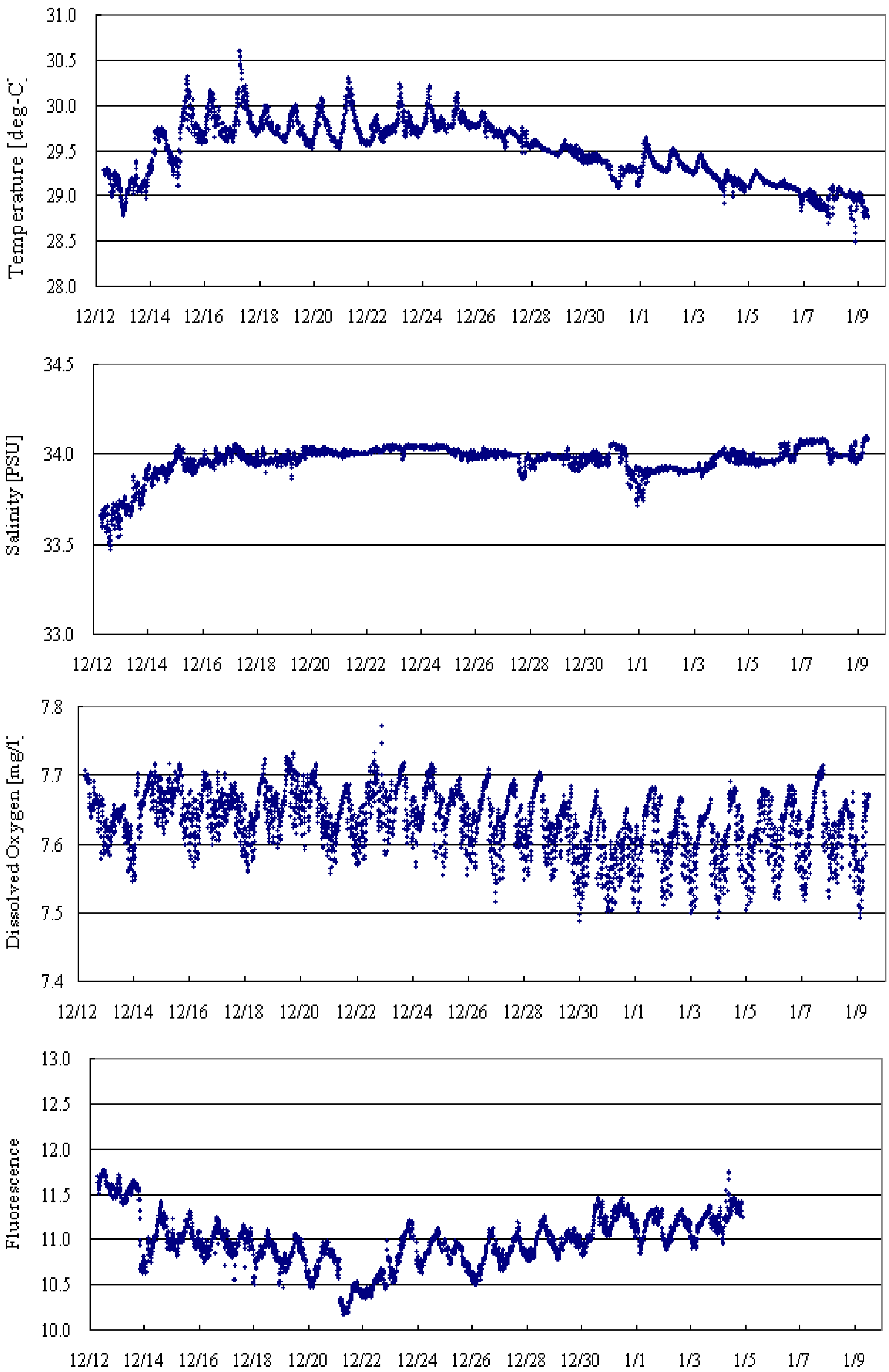

Fig. 5.16-1. Observed variation of the sea surface water on temperature (top panel), salinity (2nd), dissolved oxygen (3rd) and fluorescence (bottom).

5.17 Oceanic Profiles

5.17.1 CTDO-Sampler

(1) Personnel

Kunio Yoneyama	(JAMSTEC):	Principal Investigator
Naoko Takahashi	(MWJ):	Operation leader
Shinichiro Yokogawa	(MWJ)	
Fuma Matsunaga	(MWJ)	
Tomohide Noguchi	(MWJ)	
Keisuke Matsumoto	(MWJ)	
Takuhei Shiozaki	(MWJ)	
Masako Hori	(MWJ)	
Takehiro Shibuya	(MWJ)	

(2) Objective

Investigation of oceanic structure and its time variation by measuring vertical profiles of temperature and salinity.

(3) Methods

(3-1) Overview of the equipment

The CTD system, SBE 911plus system (Sea-Bird Electronics, Inc., USA), is a real time data system with the CTD data transmitted from a SBE 9plus underwater unit via a conducting cable to the SBE 11plus deck unit. The SBE 11plus deck unit is a rack-mountable interface which supplies DC power to the underwater unit, decodes the serial data stream, formats the data under microprocessor control, and passes the data to a companion computer. The serial data from the underwater unit is sent to the deck unit in RS-232 NRZ format using a 34560 Hz carrier-modulated differential-phase-shift-keying (DPSK) telemetry link. The deck unit decodes the serial data and sends them to a personal computer (Hewlett Packard Vectra VL, Intel(r) Celeron(tm), Microsoft Windows98 2nd edition) to display, at the same time, to storage in a disk file using SBE SEASOFT software.

The SBE 911pus system acquires data from primary, secondary and auxiliary sensors in the form of binary numbers corresponding to the frequency or voltage outputs from those sensors at 24 samples per second. The calculations required to convert from raw data to engineering units of the parameters are performed by the SBE SEASOFT in real-time. The same calculations can be carried out after the observation using data stored in a disk file.

The SBE 911plus system controls the 12-position SBE 32 Carousel Water Sampler. The Carousel accepts 12-litre water sample bottles. Bottles were fired through the RS-232C modem connector on the back of the SBE 11plus deck unit while acquiring real time data. The 12-litre Niskin-X water sample bottle (General Oceanics, Inc., USA) is equipped externally with two stainless steel springs. The external springs are ideal for applications such as the trace metal analysis because the inside of the sampler is free from contaminants from springs.

(3-2) Details of sensors

The system used in this cruise is summarized as follows (see Figure 6.9.1):

Under water unit:

SBE, Inc., SBE 9plus, S/N 0280

Temperature sensor:

SBE, Inc., SBE 3Plus, S/N 03P2730 (primary)

SBE, Inc., SBE 03-04/F, S/N 031524 (secondary)

Conductivity sensor:

SBE, Inc., SBE 04C, S/N 042435 (primary)

SBE, Inc., SBE 04-04/0, S/N 041203 (secondary)

Oxygen sensor:

SBE, Inc., SBE 43, S/N 430205 (primary)

Pump:

SBE, Inc., SBE 5T, S/N 053293 (primary)

SBE, Inc., SBE 5T, S/N 052627 (secondary)

Deck unit:

SBE, Inc., SBE 11plus, S/N 11P8010-0308

Carousel Water Sampler:

SBE, Inc., SBE 32, S/N 3222295-0171

Water sample bottle:

General Oceanics, Inc., 12-litre Niskin-X

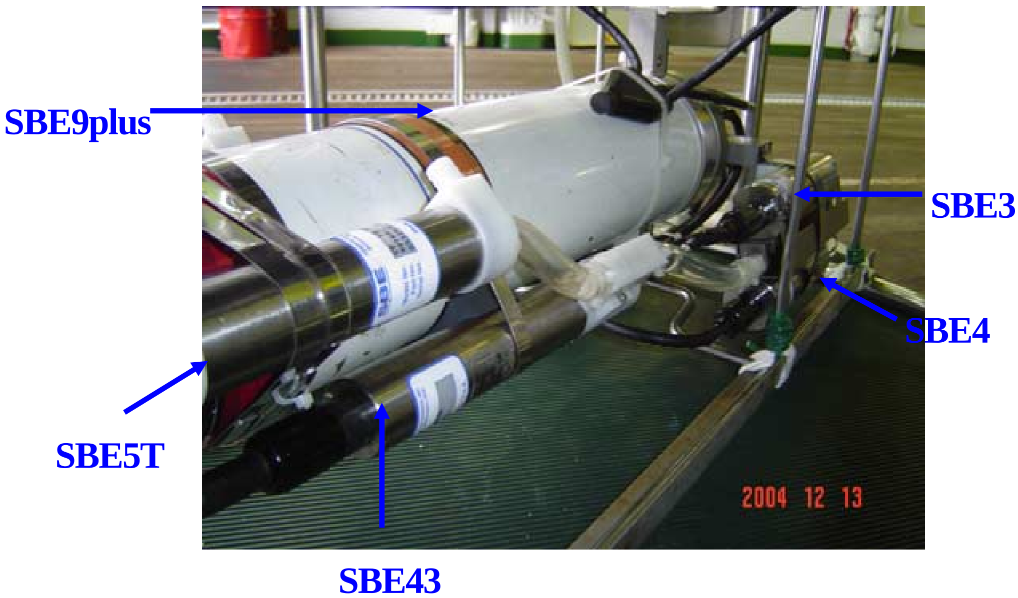

Figure 5.17.1-1: CTD systems

(3-3) Data collection and processing

(3-3-1) Data collection

CTD measurements were made using a SBE 9plus CTD equipped with two pumped temperature-conductivity (TC) sensors. The TC pairs were monitored to check drift and shifts by examining the differences between the two pairs. The SBE 9plus CTD (sampling rate of 24 Hz) was mounted horizontally in a 12-position carousel frame. The Auxiliary sensor included dissolved oxygen sensor.

In this cruise CTD lowered until 500m or 1,000m. The package was lowered into the water from the starboard side and held 10 m beneath the surface for about one minute in order to activate the pump. After the pump was activated the package was lifted to the surface and lowered at a rate of 1.0 m/s to 200 m then the package was stopped in order to change the right of the winch operating from the deck to the after wheelhouse. The package was lowered again at a rate of 1.0-1.2 m/s to the bottom. For the up cast, the package was lifted at a rate of 1.0-1.2 m/s. At 200 m from the surface, the package was stopped in order to change the right of winch operating from the deck to the after wheelhouse.

The SBE 11plus deck unit received the data signal from the CTD. Digitized data were forwarded to a personal computer running the SEASAVE module of the SEASOFT acquisition and processing software, version 5.27b.

(3-3-2) Data processing

The following are the SEASOFT-Win32 (Ver. 5.27b) processing module sequence and specifications used in the reduction of CTD data in this cruise. At the CTD cast until 1,000m the bottles were fired for salinity samples, so all of the following data processing variables were used. At the CTD cast until 500m the bottles were not fired, so the following data processing variables except RUSSUM were used.

DATCNV converted the raw data to scan number, pressure, depth, temperatures, conductivities, oxygen voltage, and descent rate. 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. Scan number, pressure, depth, temperatures, conductivities and oxygen voltage were averaged over 3.0 seconds.

ALIGNCTD converted the time-sequence of oxygen sensor outputs into the pressure sequence to ensure that all calculations were made using measurements from the same parcel of water. For a SBE 9plus CTD with the ducted temperature and conductivity sensors and a 3000 rpm pump, the typical net advance of the conductivity relative to the temperature is 0.073 seconds. So, the SBE 11plus deck unit was set to advance the primary conductivity for 1.73 scans (1.75/24 = 0.073 seconds). The secondary conductivity for 1.73 scans advance in ALIGNCTD. Oxygen data are also systematically delayed with respect to depth mainly because of the long time constant of the oxygen sensor and of an additional delay from the transit time of water in the pumped plumbing line. This delay was compensated by 4 seconds advancing oxygen sensor output (oxygen voltage) relative to the pressure.

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, conductivities and oxygen voltage 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).

DERIVE was used to compute oxygen.

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.

(3-3-3) Data collection problems

From station 1 to station 2 S/N 031524 was used for primary temperature sensor, S/N 032730 was used for secondary temperature sensor, S/N 041203 was used for primary conductivity sensor, S/N 042435 was used for secondary conductivity sensor. After station 2 (third station) S/N 032730 was used for primary temperature sensor, S/N 031524 was used for secondary temperature sensor, S/N 042435 was used for primary conductivity sensor, S/N 041203 was used for secondary conductivity sensor because of sensor trouble. Data of station 1 , 2 and 86 cannot use because of sensor trouble.

(4) Preliminary Results

Date, time and locations of the CTD casts are listed in cast table (See Table 6.9.1- 4). In total 148 CTD casts were carried out. Vertical section of temperature, salinity, dissolved oxygen are shown from Figure 6.9.2 to6.9.4. The result of temperature of surface seawater is shown in table 6.9.5 and figure 6.9.5.

These results are used Uncorrected CTD data.

(5) Further calibration

The CTD salinity will be calibrated using in-situ salinity data.

(6) Data archive

All raw and processed CTD data files are submitted to Jamstec Data Management Office (DMO) and will be under their control.

Table 5.17.1-1: CTD Cast table

CASTNO	Date(UTC)	Time(UTC)		Start Position		Depth	WIRE	Max	Max	CTD data
	yyyy/mm/dd	Start	End	Latitude	Longitude		OUT	Depth	Pressure	file name
003	2004/12/15	8:41	9:03	07-17.87N	133-54.03E	3245.0	497.4	499.3	500.2	08S003
004	2004/12/15	11:37	11:56	07-17.82E	133-54.07E	3238.0	498.7	496.8	500.2	08S004
005	2004/12/15	14:35	14:54	07-17.89N	133-53.85E	3263.0	497.9	497.2	500.8	08S005
006	2004/12/15	17:33	17:53	07-17.68N	133-53.84E	3259.0	497.9	498.0	501.5	08S006
007	2004/12/15	20:35	20:55	07-18.01N	133-53.84E	3271.0	495.6	497.6	501.0	08S007
008	2004/12/15-16	23:32	0:25	07-17.98N	133-53.90E	3265.0	-	993.0	1001.0	08S008
009	2004/12/16	2:36	2:55	07-17.78N	133-53.96E	3248.0	496.1	496.7	499.8	08S009
010	2004/12/16	5:34	5:53	07-17.86N	133-53.98E	3248.0	496.8	497.6	501.0	08S010
011	2004/12/16	8:38	8:58	07-17.97N	133-54.03E	3252.0	496.8	497.4	500.4	08S011
012	2004/12/16	11:36	11:55	07-18.03N	134-00.13E	2860.0	496.5	496.6	499.9	08S012
013	2004/12/16	14:36	15:04	07-18.01N	134-00.01E	2852.0	497.2	496.2	500.3	08S013
014	2004/12/16	17:37	17:58	07-17.91N	133-59.84E	2834.0	497.6	497.2	499.5	08S014
015	2004/12/16	20:32	20:54	07-17.93N	133-59.96E	2842.0	497.0	497.2	500.3	08S015
016	2004/12/16-17	23:34	0:13	07-17.99N	133-59.92E	2845.0	995.0	1000.2	993.9	08S016
017	2004/12/17	2:33	2:51	07-17.98N	134-00.05E	2856.0	497.0	497.0	500.4	08S017
018	2004/12/17	5:32	5:50	07-18.05N	134-00.18E	2864.0	497.8	496.6	500.0	08S018
019	2004/12/17	8:36	8:56	07-18.04N	134-00.06E	2856.0	496.8	496.6	500.5	08S019
020	2004/12/17	11:35	11:53	07-18.05N	134-00.17E	2863.0	496.8	496.7	500.3	08S020
021	2004/12/17	14:33	14:53	07-17.88N	134-00.06E	2858.0	496.8	497.1	500.4	08S021
022	2004/12/17	17:32	17:52	07-17.70N	133-59.98E	2854.0	501.1	497.6	501.0	08S022
023	2004/12/17	20:36	20:56	07-17.90N	133-59.85E	2843.0	496.7	496.6	500.2	08S023
024	2004/12/17-18	23:32	0:10	07-17.87N	133-59.92E	2840.0	994.5	992.8	1000.6	08S024
025	2004/12/18	2:35	2:55	07-16.28N	133-56.42E	3191.0	496.1	497.1	500.8	08S025
026	2004/12/18	5:31	5:49	07-15.82N	134-00.35E	2877.0	497.6	496.9	500.3	08S026
027	2004/12/18	8:37	8:58	07-17.84N	134-00.05E	2855.0	498.9	497.5	500.8	08S027
028	2004/12/18	11:34	11:53	07-17.95N	133-59.99E	2847.0	496.8	497.1	500.1	08S028
029	2004/12/18	14:34	14:54	07-18.00N	134-00.11E	2856.0	497.9	496.8	500.3	08S029
030	2004/12/18	17:36	17:55	07-18.03N	134-00.00E	2852.0	495.2	496.1	500.0	08S030
031	2004/12/18	20:34	20:55	07-17.90N	133-59.89E	2837.0	499.6	496.7	501.0	08S031
032	2004/12/18-19	23:33	0:13	07-17.82N	133-59.69E	2832.0	995.4	992.8	1000.8	08S032
033	2004/12/19	2:35	2:55	07-14.65N	134-01.02E	2890.0	496.5	496.9	500.3	08S033
034	2004/12/19	5:33	5:52	07-16.27N	133-50.18E	3466.0	495.7	496.3	500.3	08S034
035	2004/12/19	8:38	8:58	07-12.61N	134-00.56E	2913.0	498.3	496.6	500.3	08S035
036	2004/12/19	11:33	11:53	07-19.49N	133-59.59E	2930.0	496.7	497.1	500.0	08S036
037	2004/12/19	14:33	14:53	07-17.97N	134-00.00E	2850.0	497.0	497.0	500.2	08S037
038	2004/12/19	17:37	17:56	07-18.04N	134-00.04E	2859.0	495.4	496.7	500.5	08S038
039	2004/12/19	20:34	20:57	07-17.98N	133.59.94E	2844.0	496.8	496.8	499.9	08S039
040	2004/12/19-20	23:31	0:13	07-18.00N	133-59.99E	2851.0	995.2	993.3	1001.1	08S040
041	2004/12/20	2:33	2:55	07-18.02N	134-00.01E	2854.0	538.8	539.0	542.6	08S041
042	2004/12/20	5:32	5:50	07-17.87N	134-00.05E	2857.0	500.7	497.1	500.2	08S042
043	2004/12/20	8:37	8:58	07-17.76N	134-00.20E	2859.0	497.4	496.2	500.6	08S043
044	2004/12/20	11:33	11:53	07-17.91N	134-00.00E	2850.0	496.3	496.9	500.1	08S044
045	2004/12/20	14:33	14:53	07-17.92N	133-59.92E	2841.0	495.9	497.0	500.7	08S045

CASTNO	Date(UTC)	Time(UTC)		Start Position		Depth	WIRE	Max	Max	CTD data
	yyyy/mm/dd	Start	End	Latitude	Longitude		OUT	Depth	Pressure	file name
046	2004/12/20	17:39	17:57	07-18.04N	134-00.07E	2857.0	498.1	497.7	500.1	08S046
047	2004/12/20	20:33	20:52	07-17.91N	133-59.89E	2840.0	497.9	497.7	499.1	08S047
048	2004/12/20-21	23:33	0:12	07-18.12N	133-59.94E	2863.0	993.9	992.2	1000.6	08S048
049	2004/12/21	2:33	2:52	07-18.15N	134-00.01E	2856.0	507.5	508.0	511.4	08S049
050	2004/12/21	5:33	5:51	07-17.96N	133-59.99E	2852.0	496.7	497.5	500.6	08S050
051	2004/12/21	8:36	8:56	07-17.94N	134-00.20E	2860.0	496.7	496.8	500.1	08S051
052	2004/12/21	11:34	11:53	07-17.84N	134-00.04E	2852.0	496.8	497.5	500.5	08S052
053	2004/12/21	14:33	14:53	07-18.02N	133-59.93E	2842.0	497.0	497.2	500.1	08S053
054	2004/12/21	17:33	17:51	07-18.16N	134-00.01E	2856.0	497.0	497.3	500.8	08S054
055	2004/12/21	20:34	20:53	07-18.09N	134-00.19E	2866.0	499.8	497.7	500.8	08S055
056	2004/12/21-22	23:33	0:14	07-18.14N	133-59.95E	2849.0	998.1	992.8	1000.7	08S056
057	2004/12/22	2:35	2:53	07-18.29N	134-00.63E	2918.0	497.4	497.2	500.7	08S057
058	2004/12/22	5:34	5:51	07-18.13N	133-59.84E	2841.0	492.8	497.3	500.3	08S058
059	2004/12/22	8:35	8:54	07-18.06N	134-00.03E	2858.0	496.1	497.0	500.3	08S059
060	2004/12/22	11:34	11:53	07-17.90N	134-00.03E	2850.0	496.8	497.2	500.8	08S060
061	2004/12/22	14:34	14:52	07-18.06N	133-59.97E	2843.0	500.0	497.0	500.4	08S061
062	2004/12/22	17:33	17:51	07-18.06N	134-00.02E	2853.0	497.8	497.2	500.6	08S062
063	2004/12/22	20:33	20:52	07-17.94N	134-00.03E	2853.0	497.9	497.5	501.6	08S063
064	2004/12/22-23	23:33	0:13	07-18.06N	134-00.07E	2856.0	996.1	993.0	1000.6	08S064
065	2004/12/23	2:35	2:56	07-18.08N	134-00.06E	2859.0	499.0	497.5	500.8	08S065
066	2004/12/23	5:28	5:46	07-27.47N	133-59.98E	3747.0	498.1	495.9	500.5	08S066
067	2004/12/23	8:35	8:54	07-38.16N	133-53.71E	4321.0	497.4	497.6	500.7	08S067
068	2004/12/23	11:34	11:52	07-30.02N	134-00.09E	3869.0	496.1	496.8	500.1	08S068
069	2004/12/23	14:34	14:52	07-30.09N	133-59.98E	3869.0	496.7	497.3	500.1	08S069
070	2004/12/23	17:33	17:51	07-30.14N	133-59.91E	3880.0	497.6	496.5	500.3	08S070
071	2004/12/23	20:35	20:55	07-30.03N	134-00.15E	3858.0	497.4	497.1	500.1	08S071
072	2004/12/23-24	23:31	0:10	07-30.06N	134-00.20E	3855.0	998.9	992.2	1000.2	08S072
073	2004/12/24	2:34	2:53	07-30.00N	134-00.27E	3852.0	497.0	497.0	500.1	08S073
074	2004/12/24	5:34	5:52	07-27.81N	134-02.45E	3465.0	495.3	497.7	500.6	08S074
075	2004/12/24	8:35	8:54	07-29.64N	133-59.91E	3859.0	498.3	496.6	500.0	08S075
076	2004/12/24	11:34	11:53	07-29.78N	133-59.84E	3864.0	497.2	497.0	500.8	08S076
077	2004/12/24	14:33	14:52	07-30.04N	133-59.83E	3878.0	499.2	497.8	500.7	08S077
078	2004/12/24	17:34	17:52	07-29.91N	133-59.88E	3866.0	496.7	496.7	500.1	08S078
079	2004/12/24	20:33	20:52	07-29.93N	133-59.94E	3864.0	497.8	496.9	500.7	08S079
080	2004/12/24-25	23:39	0:21	07-22.93N	134-03.05E	3158.0	994.6	993.5	1001.1	08S080
081	2004/12/25	2:35	2:54	07-17.99N	134-00.15E	2862.0	496.8	497.1	500.5	08S081
082	2004/12/25	5:35	5:53	07-14.54N	134-04.89E	2630.0	496.7	497.0	500.6	08S082
083	2004/12/25	8:35	8:54	07-26.88N	134-05.24E	2342.0	498.9	497.4	500.3	08S083
084	2004/12/25	11:33	11:53	07-13.24N	134-05.42E	2512.0	496.5	497.2	500.1	08S084
085	2004/12/25	14:34	14:54	07-18.09N	133-59.94E	2843.0	496.7	497.0	500.7	08S085
087	2004/12/25	20:32	20:52	07-18.02N	133-59.97E	2845.0	496.7	497.2	500.3	08S087
088	2004/12/25-26	23:31	0:12	07-18.12N	134-00.11E	2861.0	995.6	993.4	1000.9	08S088
089	2004/12/26	2:34	2:56	07-17.97N	134-00.09E	2859.0	529.8	530.0	534.2	08S089
090	2004/12/26	5:34	5:53	07-18.24N	134-00.02E	2856.0	498.1	497.1	500.3	08S090
091	2004/12/26	8:35	8:56	07-29.94N	134-00.00E	3861.0	496.3	496.8	500.4	08S091

CASTNO	Date(UTC)	Time(UTC)		Start Position		Depth	WIRE	Max	Max	CTD data
	yyyy/mm/dd	Start	End	Latitude	Longitude		OUT	Depth	Pressure	file name
092	2004/12/26	11:33	11:54	07-29.95N	133-59.94E	3864.0	498.1	498.0	500.9	08S092
093	2004/12/26	14:34	14:54	07-29.98N	134-00.10E	3860.0	497.4	497.1	500.7	08S093
094	2004/12/26	17:33	17:51	07-19.98N	134-00.87E	3071.0	496.7	496.8	500.3	08S094
095	2004/12/26	20:33	20:54	07-29.98N	133-59.96E	3867.0	497.2	497.7	500.9	08S095
096	2004/12/27	0:25	1:06	07-33.14N	133-53.94E	4121.0	993.7	992.2	1000.2	08S096
097	2004/12/27	2:34	2:54	07-29.97N	133-59.92E	3868.0	535.3	534.2	538.1	08S097
098	2004/12/27	5:35	5:54	07-30.02N	134-00.00E	3868.0	496.5	497.4	500.4	08S098
099	2004/12/27	8:35	8:54	07-30.00N	133-59.88E	3873.0	496.5	497.4	500.7	08S099
100	2004/12/27	11:35	11:53	07-30.00N	134-00.02E	3861.0	496.5	496.7	500.6	08S100
101	2004/12/27	14:37	14:55	07-18.66N	134-00.96E	2988.0	497.0	497.4	500.3	08S101
102	2004/12/27	17:33	17:51	07-04.69N	134-00.64E	2690.0	496.3	496.9	500.4	08S102
103	2004/12/27	20:37	20:56	07-29.63N	133-59.67E	3884.0	498.9	497.2	500.5	08S103
104	2004/12/27-28	23:36	0:17	07-20.16N	134-02.40E	2944.0	994.6	993.8	1001.2	08S104
105	2004/12/28	2:22	2:40	07-21.54N	134-04.46E	2661.0	496.8	497.0	500.3	08S105
106	2004/12/28	5:34	5:51	07-29.98N	134-03.74E	2993.0	496.7	496.9	500.8	08S106
107	2004/12/28	8:39	8:58	07-29.68N	134-00.03E	3853.0	496.3	497.1	500.1	08S107
108	2004/12/28	11:36	11:56	07-29.95N	133-59.85E	3867.0	497.0	497.4	501.0	08S108
109	2004/12/28	14:33	14:52	07-29.96N	134-00.05E	3863.0	496.8	497.1	500.7	08S109
110	2004/12/28	17:33	17:50	07-29.81N	134-00.03E	3862.0	495.7	496.7	500.5	08S110
111	2004/12/28	20:30	20:49	07-29.94N	134-00.01E	3862.0	497.0	497.5	500.9	08S111
112	2004/12/28-29	23:42	0:25	07-29.88N	133-59.84E	3869.0	995.2	993.8	1001.2	08S112
113	2004/12/29	5:32	5:51	07-29.95N	133-59.99E	3862.0	495.7	497.0	500.1	08S113
114	2004/12/29	12:00	12:22	07-29.47N	134-00.38E	3816.0	498.5	497.0	500.9	08S114
115	2004/12/29	17:45	18:03	07-29.57N	133-59.62E	3878.0	495.7	497.7	500.6	08S115
116	2004/12/29-30	23:33	0:14	07-30.01N	134-00.03E	3867.0	994.6	992.5	1000.4	08S116
117	2004/12/30	5:36	5:54	07-29.82N	134-00.27E	3832.0	497.2	496.1	500.7	08S117
118	2004/12/30	11:39	12:00	07-29.75N	133-59.77E	3873.0	496.5	497.2	500.4	08S118
119	2004/12/30	17:53	18:11	07-28.89N	133-59.79E	3832.0	494.8	497.2	500.3	08S119
120	2004/12/30-31	23:34	0:15	07-46.97N	133-59.65E	4401.0	994.5	992.8	1000.9	08S120
121	2004/12/31	5:34	5:52	07-47.06N	133-57.45E	4416.0	496.1	497.7	500.2	08S121
122	2004/12/31	11:32	11:53	07-40.69N	134-03.18E	4281.0	496.5	496.5	500.5	08S122
123	2004/12/31	17:32	17:52	07-18.00N	133-59.90E	2840.0	495.9	497.1	500.1	08S123
124	2004/12/31-2005/1/1	23:34	0:14	07-17.79N	134-00.05E	2859.0	994.8	994.0	1000.4	08S124
125	2005/1/1	5:34	5:53	07-17.99N	134-00.21E	2860.0	496.7	497.8	500.2	08S125
126	2005/1/1	11:30	11:51	07-18.00N	133-59.94E	2847.0	497.4	496.9	500.4	08S126
127	2005/1/1	17:33	17:52	07-17.93N	133-59.93E	2844.0	497.0	496.8	500.4	08S127
128	2005/1/1-2	23:34	0:15	07-17.86N	133-59.86E	2836.0	996.3	992.9	1000.3	08S128
129	2005/1/2	5:33	5:51	07-17.76N	134-00.05E	2856.0	496.3	497.2	500.5	08S129
130	2005/1/2	11:33	11:54	07-17.57N	133-59.99E	2856.0	498.5	497.4	500.9	08S130
131	2005/1/2	17:33	17:51	07-17.79N	133-59.89E	2844.0	497.0	497.1	500.7	08S131
132	2005/1/2-3	23:33	0:14	07-17.76N	134-00.03E	2856.0	995.4	992.8	1000.0	08S132
133	2005/1/3	5:31	5:50	07-17.64N	134-00.14E	2861.0	495.9	497.3	500.2	08S133
134	2005/1/3	11:31	11:51	07-17.92N	133-59.82E	2833.0	497.0	496.8	500.7	08S134
135	2005/1/3	17:33	17:52	07-18.04N	133-59.98E	2847.0	496.1	497.3	500.7	08S135
136	2005/1/3-4	23:34	0:14	07-17.89N	133-59.95E	2584.0	994.1	991.4	1000.3	08S136
137	2005/1/4	5:32	5:50	07-18.04N	133-59.98E	2848.0	496.3	496.3	500.8	08S137

CASTNO	Date(UTC)	Time(UTC)		Start Position		Depth	WIRE	Max	Max	CTD data
	yyyy/mm/dd	Start	End	Latitude	Longitude		OUT	Depth	Pressure	file name
138	2005/1/4	11:33	11:54	07-17.92N	134-00.16E	2858.0	497.8	497.3	500.9	08S138
139	2005/1/4	17:33	17:51	07-18.02N	133-59.97E	2847.0	495.6	495.8	500.1	08S139
140	2005/1/4-5	23:34	0:14	07-17.98N	134-00.05E	2857.0	996.3	993.6	1001.6	08S140
141	2005/1/5	5:33	5:53	07-17.9N	134-00.04E	2856.0	496.3	497.2	500.2	08S141
142	2005/1/5	11:32	11:52	07-29.28N	133-59.5E	3871.0	497.6	497.4	500.4	08S142
143	2005/1/5	17:36	17:58	07-29.37N	133-59.94E	3831.0	496.1	496.9	500.3	08S143
144	2005/1/5-6	23:37	0:19	07-29.34N	134-00.03E	3833.0	994.5	993.0	1000.6	08S144
145	2005/1/6	5:35	5:56	07-29.82N	133-59.95E	3859.0	495.4	497.1	500.0	08S145
146	2005/1/6	11:30	11:50	07-29.93N	134-00.07E	3856.0	497.2	497.4	500.7	08S146
147	2005/1/6	17:37	17:58	07-29.39N	133-59.48E	3876.0	495.2	497.0	500.1	08S147
148	2005/1/6-7	23:33	0:23	07-29.98N	134-00.04E	3862.0	994.6	992.7	1000.6	08S148

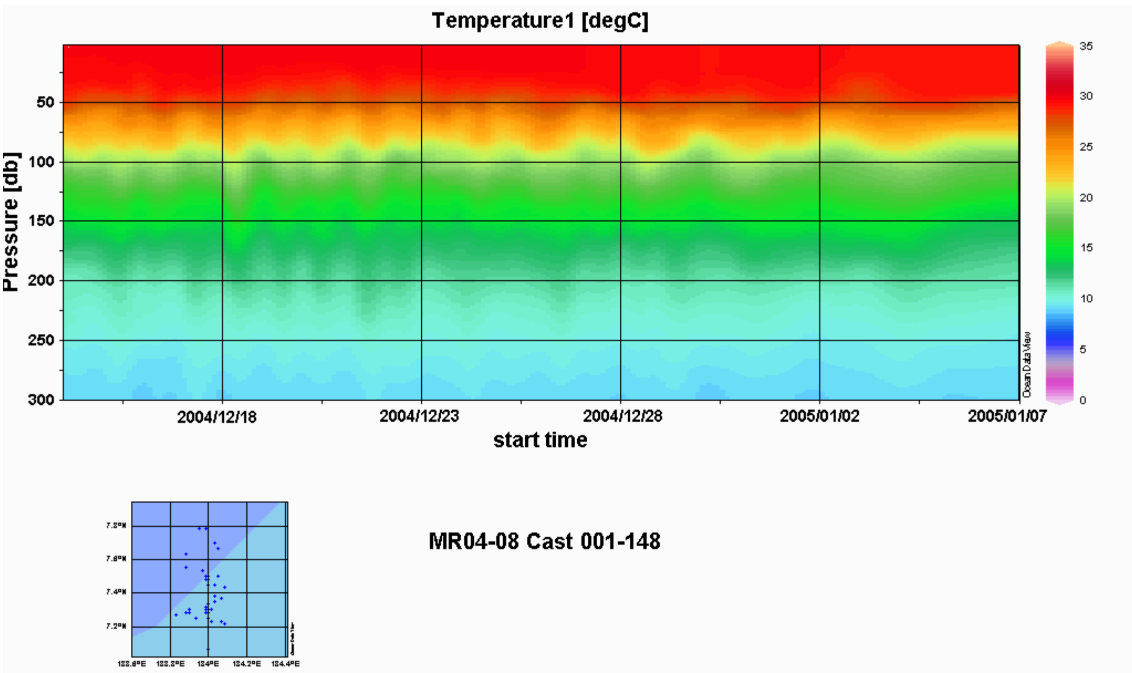

Figure 5.17.1-2: Time-depth cross section of temperature.

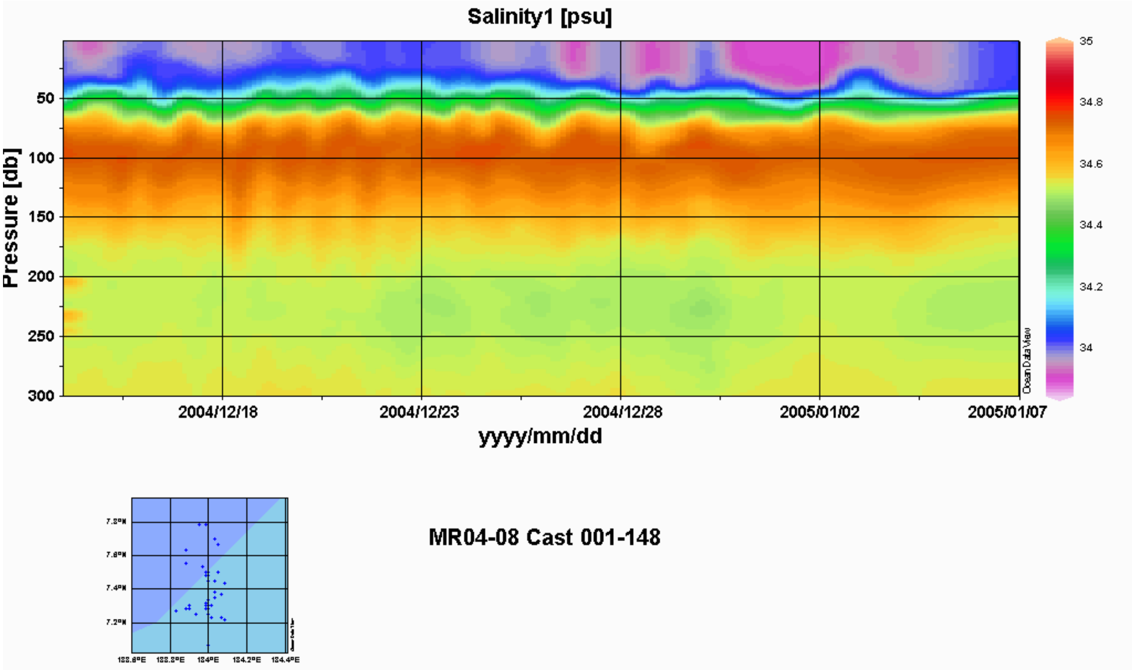

Figure 5.17.1-3:Time-depth cross section of salinity

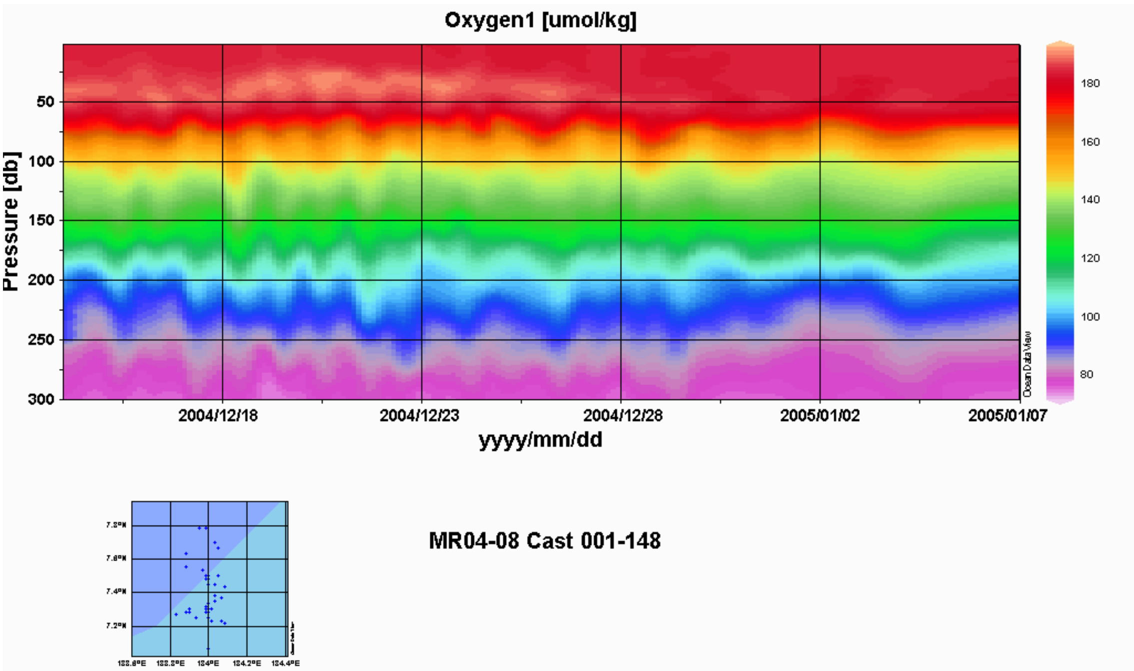

Figure 5.17.1-4: Time-depth cross section of dissolved oxygen.

Table 5.17.1-2: Temperature of surface seawater.

Cast No.	Date(UTC)	Temperature(deg-C)	Remarks
024	2004/12/18	29.7	
032	2004/12/19	29.6	
040	2004/12/20	29.6	
048	2004/12/21	29.7	
056	2004/12/22	29.4	
064	2004/12/23	29.6	
072	2004/12/24	29.7	
080	2004/12/25	29.8	
088	2004/12/26	29.7	
096	2004/12/27	29.5	
104	2004/12/28	29.5	
112	2004/12/29	-	No data
116	2004/12/30	29.3	
120	2004/12/31	29.0	
124	2005/1/1	29.3	
128	2005/1/2	29.2	
132	2005/1/3	29.1	
136	2005/1/4	29.1	
140	2005/1/5	29.0	
144	2005/1/6	28.9	
148	2005/1/7	28.8	

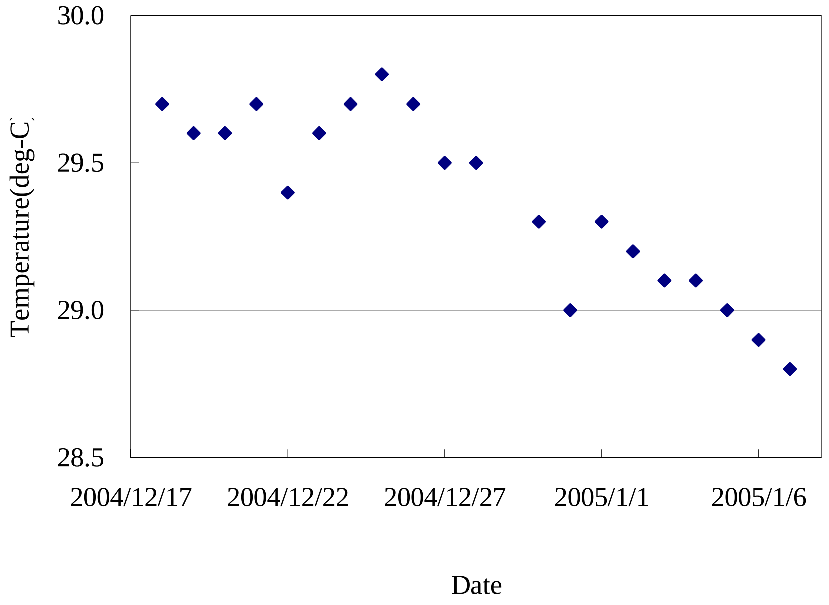

Figure 5.17.1-5: Temporal variation of the temperature of surface seawater

5.17.2 Salinity Measurement.

(1) Personnel

Naoko Takahashi (MWJ) Operation Leader
Tomohide Noguchi (MWJ)

(2) Objective

1. To measure salinity of the samples obtained by CTD casts, bucket sampling, and EPCS.
2. To identify salinity of CTD through comparing that of CTD with that of samples.

(3) Instrument and Method

The salinity analysis was carried out on R/V MIRAI during the cruise of MR04-08 (Leg1) using the salinometer (Model 8400B “AUTOSAL”; Guildline Instruments Ltd.: S/N 62556) with additional peristaltic-type intake pump (Ocean Scientific International, Ltd.). Two precision digital thermometers (Model 9540; Guildline Instruments Ltd.: S/N 62525 and 66528) were used. One thermometer monitored an ambient 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.* (2003). 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 23.0 deg C to 23.9 deg C, while a bath temperature is very stable and varied within +/- 0.002 deg C on rare occasion.

The measurement values were determined as median of 31 times reading of the salinometer. Data collection was started in 15 seconds after filling sample to the cell and it took about 10 seconds to collect 31 readings by a personal computer. In case the difference between the measurement values of this two fillings is smaller than 0.00002, the average value of them was used to calculate the bottle salinity with the algorithm for practical salinity scale, 1978 (UNESCO, 1981).

(3-1) Standardization

AUTOSAL model 8400B was standardized at the beginning of the sequence of measurements using IAPSO standard seawater (SSW). SSW salinity changes equivalent to less than 0.001 after 3 years storage on catalogue.

This standardization was done by adjusting the value on the display of AUTOSAL to the double conductivity ratio that is a double-fold value of conductivity ratio indicated the label of SSW bottles. In this cruise, standardization of the AUTOSAL was performed twice. SSW was used 13 bottles in total.

Sub-standard seawater (SUB) was sampled and filtered by Millipore filter (pore size: 0.45μm), which was stored in a 20 liters polyethylene container. It was measured every about 6 samples in order to check the drift of the AUTOSAL.

The specifications of SSW and SUB used in this cruise are shown as follows,

Standard seawater (SSW)

Batch : P144
conductivity ratio : 0.99987
salinity : 34.995
preparation date : 23-Sep.-2003

Sub standard seawater (SUB)

sampling cruise ID : MR03-K01
sampling position : 5N,165E
sampling depth : 2,000dbar

(3-2) Salinity Sample Collection

Seawater samples were collected with 12 liter Niskin-X (Non-coating for Teflon) bottle, bucket, and the EPCS. The salinity sample bottle of the 250ml brown grass bottle with screw cap was used to collect the sample water. 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 5.17.2-1 Kind and number of samples

Kind of Samples	Number of Samples
Samples for CTD	101
Samples for EPCS	16
Total	117

(4) Preliminary Results

(4-1) Replicate and Duplicate Samples

24 pairs of replicate samples were collected from the same bottle to identify accuracy of measurement for raw seawater. 25 bottles of duplicate samples were collected from the different bottles in the same depth to check leak of water bottle, misfire, and miss-trip of CTD with water sampling system. The average and standard deviation of the absolute difference between each pair of replicate or duplicate samples were obtained. The results of replicate and duplicate samples are shown as Table 5.17.2-2. The frequency distribution for replicate samples is shown as Fig. 5.17.2-1. All replicates and duplicates made from the water sampled deeper 500db.

Table 5.17.2-2 Results of replicate and duplicate samples

Kind of Samples	Number of Samples	Average	Standard deviation
Replicate	24 pairs	0.00022	0.00018
Duplicate	25 bottle	0.00041	0.00028

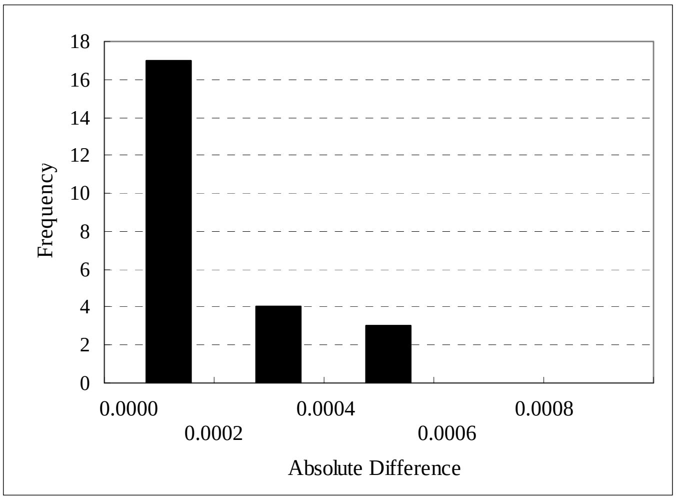

Fig. 5.17.2-1 Frequency distribution for replicate samples

According to these results, measurement and water sampling were done correctly.

(4-2) Comparison between CTD data and Salinity measurement data

The average and standard deviation of difference between measurement data and CTD data is shown as Table 5.17.2-3.(except bad samples)

Table 5.17.2-3 Results of replicate and duplicate samples

Kind of samples	Number of samples	Average	Standard deviation
Primary sensor (all data)	78	-0.0034	0.0020
Secondary sensor (all data)	78	-0.0022	0.0020
Primary sensor (>500db)	62	-0.0034	0.0009
Secondary sensor (>500db)	62	-0.0023	0.0007

According to these results, CTD data were considered reasonable and proper.

(5) Data Archive

The data of salinity sample will be submitted to the DMO at 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 Tech. Papers in Mar. Sci., 36, 25 pp., 19

5.18 Shipboard ADCP

(1) Personnel

Kunio Yoneyama	(JAMSTEC): Principal Investigator
Katsuhisa Maeno	(GODI): Operation Leader
Yasutaka Imai	(GODI)
Norio Nagahama	(GODI)
Kazuho Yoshida	(GODI)

(2) Methods

Upper ocean current measurements were made throughout MR04-08 Leg1 cruise (Departure from Chuuk on 12 December 2004 to the arrival at Palau on 12 January 2005), using the hull-mounted Acoustic Doppler Current Profiler (ADCP) system that is permanently installed on the R/V Mirai. The system consists of following components;

1) a 75 kHz Broadband (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) an IBM-compatible personal computer running data acquisition software (VmDas version 1.3 ; RD Instruments, USA). The clock of the logging PC are adjusted to GPS time every 10 minutes.

The ADCP was configured for 16-m processing bin, a 8-m blanking interval. The sound speed is calculated from temperature (thermistor near the transducer head), salinity (constant value; 35.0 psu) and depth (6.5 m; transducer depth) by equation in Medwin (1975). 40 velocity measurements were made at 16-m intervals starting 31-m below the surface. Every ping was recorded as raw ensemble data (.ENR). Also, 60 seconds and 300 seconds average data were recorded as short term average (.STA) and long term average (.LTA) data., respectively. Major parameters for the measurement (Direct Command) are as follows:

Bottom-Track Commands

BP = 001 Pings per Ensemble

Environmental Sensor Commands

EA = +00000	Heading Alignment (1/100 deg)
EB = +00000	Heading Bias (1/100 deg)
ED = 00065	Transducer Depth (0 - 65535 dm)
EF = +0001	Pitch/Roll Divisor/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)
	C(1): Sound velocity calculate using ED, ES, ET(temp.)
	D(0): Manual ED
	H(2): External synchro

	P(0), R(0): Manual EP, ER (0 degree)
	S(0): Manual ES
	T(1): Internal transducer sensor

Timing Commands

TE = 00:00:02.00	Time per Ensemble (hrs:min:sec.sec/100)
TP = 00:02.00	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 = 111 111 111	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%)
WI = 0	Clip Data Past Bottom (0=OFF,1=ON)
WJ = 1	Rcvr Gain Select (0=Low,1=High)
WM = 1	Profiling Mode (1-8)
WN = 040	Number of depth cells (1-128)
WP = 00001	Pings per Ensemble (0-16384)
WS = 1600	Depth Cell Size (cm)
WT = 000	Transmit Length (cm) [0 = Bin Length]
WV = 999	Mode 1 Ambiguity Velocity (cm/s radial)

The periods of bottom track mode and water mode track are as follows;

Bottom Track : from the departure to 00:23 UTC 12 December 2004

Water Track : from 00:25 UTC 12 December 2004 to the arrival

(3) Preliminary results

Fig. 5.18-1 shows time series of water current profile (northward and eastward) during the stationary observation. The data was long term average data (300-seconds average).

(4) Data archive

These data obtained in this cruise will be submitted to the DMD (Data Management Division) of JAMSTEC, and will be opened to the public via “R/V Mirai Data Web Page” in JAMSTEC home page.

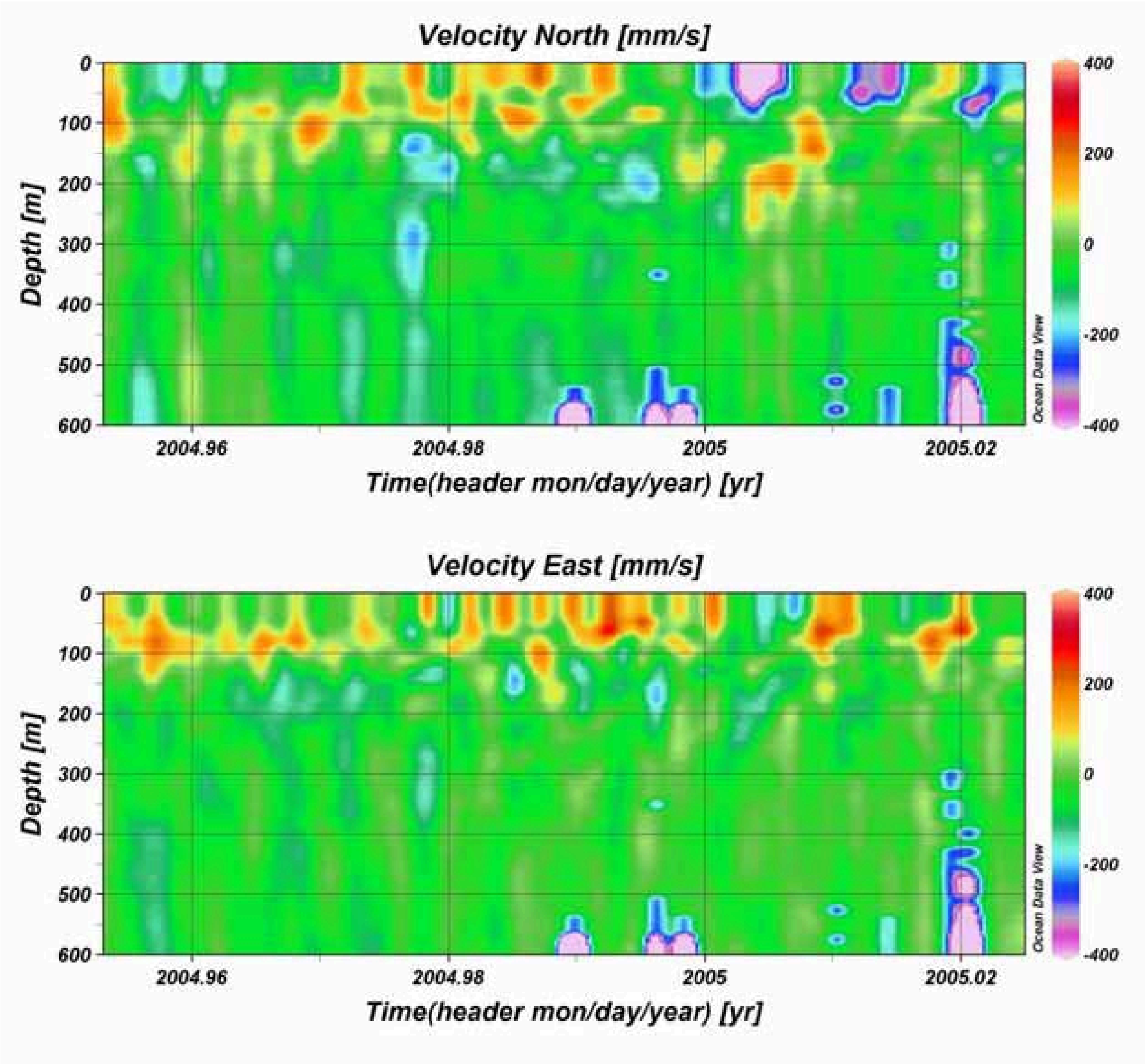

Fig.5.18-1: Time-depth cross section of the horizontal current velocity, northward (upper) and eastward (lower). The shading represents absolute current speed.

5.19 Underway Geophysics

(1) Personnel

Toshiya Fujiwara (JAMSTEC) Principal investigator (not on board)
Katsuhisa Maeno (Global Ocean Development Inc.)
Yasutaka Imai (GODI)
Norio Nagahama (GODI)
Kazuho Yoshida (GODI)

(2) Objective

The spatial and temporal variation of parameters as / below the sea bottom are basic data for the many fields of geophysics. During this cruise, we observed gravity, magnetic force and sea bottom depth.

(3) Method

We measured relative gravity value by S116 onboard gravity meter (LaCoste-Romberg, USA), magnetic force by SFG-1214 three axes fluxgate magnetometer (Tierra technica, Japan) on the top of foremast at 8Hz sampling ratio and sea bottom depth by SeaBeam2112.004 (SeaBeam, Inc., USA) 12kHz multi-narrow beam echo sounding system.

To obtain absolute gravity value, we usually measure relative value by portable gravity meter (Scintrex gravity meter CG-3M) at comparable points. Three components magnetic force was sampled at 1 sec controlled by the 1 pps standard clock of GPS signal. Navigation information, 8Hz three components magnetic force and vertical reference unit data were recorded at every 1 sec. At SeaBeam system, to get accurate sounding velocity of water column for ray-path correction of acoustic multibeam, we used temperature and salinity profiles from CTD data calculated sound velocity by equation in Mackenzei (1981).

All of there observations were carried out from the departure of Chuuk on 12 December 2004 to the arrival of Palau on 12 January 2005.

(4) Preliminary Results

The results will be public after the analyses in future.

(5) Data Archives

The dataset obtained during this cruise will be submitted to the JAMSTEC Data Management Office, and archived there.