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R/V Mirai Cruise Report
MR99-K06

October 13 - November 20, 1999
Tropical Ocean Climate Study (TOCS)

Edited by
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Japan Marine Science and Technology Center
(JAMSTEC)

MR99-K06 TRITON/TOCS CRUISE

Oct. 13-Nov. 20, 1999

Sekinehama-Hachinohe-Guam-Guam

Good work!

Contents

1. Introduction

The purpose of this cruise is to observe physical oceanographic conditions in the western tropical Pacific Ocean to achieve a better understanding of air-sea interaction affecting on the ENSO (El Nino/Southern Oscillation) phenomena and its related climate change. The surface layer in the western tropical Pacific Ocean is characterized by high sea surface temperature which plays major role in driving global atmospheric circulation. Especially, El Nino occurs when warm water migrates eastward, and causes short term climate changes in the world dramatically. For example, the western Pacific area has very few rainfall when the "El Nino" occurred, as in 1997-98. This atmospheric and oceanic systems is so complicated, and we still do not have enough knowledge about it. This climate system have the long time scale. To investigate the mechanism, we need precise and detailed data for the long period continuously. Therefore, ocean and atmosphere observing mooring array is effective to obtain such data set. The major mission of this cruise is to deploy TRITON buoys developed at JAMSTEC for the long term measurements of ocean and atmosphere in the western tropical Pacific Ocean. We have successfully deployed during this R/V Mirai cruise, although we must have recovered one TRITON buoy because of unexpected. It is the first step to establish long-term measurements for the TRITON program.

The other purposes of this cruise are,

1)CO2 measurements in the boundary layer by Meteorological Research Institute of Japan,

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

3)Cloud and rainfall measurement by Doppler radar for comparison with TRMM satellite by Meteorological Institute of Japan.

These measurements are also made successfully during this cruise.

2. Summary

2.1 Ship

R/V Mirai
Captain Takaaki Hashimoto
Total 35 crew members

2.2 Cruise code

MR99-K06

2.3 Project name

Tropical Ocean Climate Study

2.4 Undertaking institution

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

2.5 Chief scientist

Kentaro Ando (JAMSTEC)

2.6 Period

October 13 , 1999 – November 20, 1999

2.7 Ports of call

Sekinehama, Japan	(October 13, 1999)
Hachinohe, Japan	(October 14, 1999)
Guam, USA	(October 19-20, 1999)
Guam, USA	(November 19, 1999)

2.8 Research participants

Total 21 scientists and technical stuff participated from 8 different institutions, universities and companies.

2.9 Observation summary

TRITON buoy deployment: 6 sites
TRITON buoy recovery: 2 sites
TRITON buoy repair: 1 sites
ADCP subsurface buoy deployment:
1 site
ADCP subsurface buoy recovery: 1site
CTD(Salinity, Temperature, Depth):
20 casts down to 1000m
XCTD (Salinity, Temperature, Depth):
18 times down to 1000m
Surface meteorology: continuous
Atmospheric sounding: ?? times
ADCP measurements: continuous
Doppler radar measurements: continuous
Surface temperature, salinity measurements by intake method: continuous
Other specially designed observations have been carried out successfully.

2.10 Observed oceanic and atmospheric conditions

This MR99-K06 cruise has been carried out under the still alive La Nina stage after the recovery from historical 1997-1998 El Nino event. The sea surface temperature (SST) along the equator (138E-156E) showed that higher temperature than 29 degree-C was found west of 147E. On the equator of 156E, the SST was lower than 29 and the temperature and salinity vertical section along 156E showed the strong upwelling and mixing in the mixed layer near the equator. The westward current in the surface layer is still strong (around 1.5 knot). The sea surface salinity (SSS) showed low salinity west of about 142E and higher to the east. This shows the fresh water pool is just confined in the far west region, and the atmospheric convection will be developed in the western region near Indonesia. Along the 156E line, the boundary layer atmosphere was rather dry, and the relative humidity sensor installed on the TRITON buoy often showed lower than usual relative humidity. The radio sonde data also shows the dry air in the lower layer. Under these conditions, the atmospheric convection would be suppressed, then SSS would be higher than usual.

3 Cruise Track

(1) Cruise Track (Fig 3-1)

(2) TRITON buoy site (Fig 3-2)

(3) CTD/XCTD casting site (Fig 3-3)

(4) Radiosonde launching site (Fig 3-4)

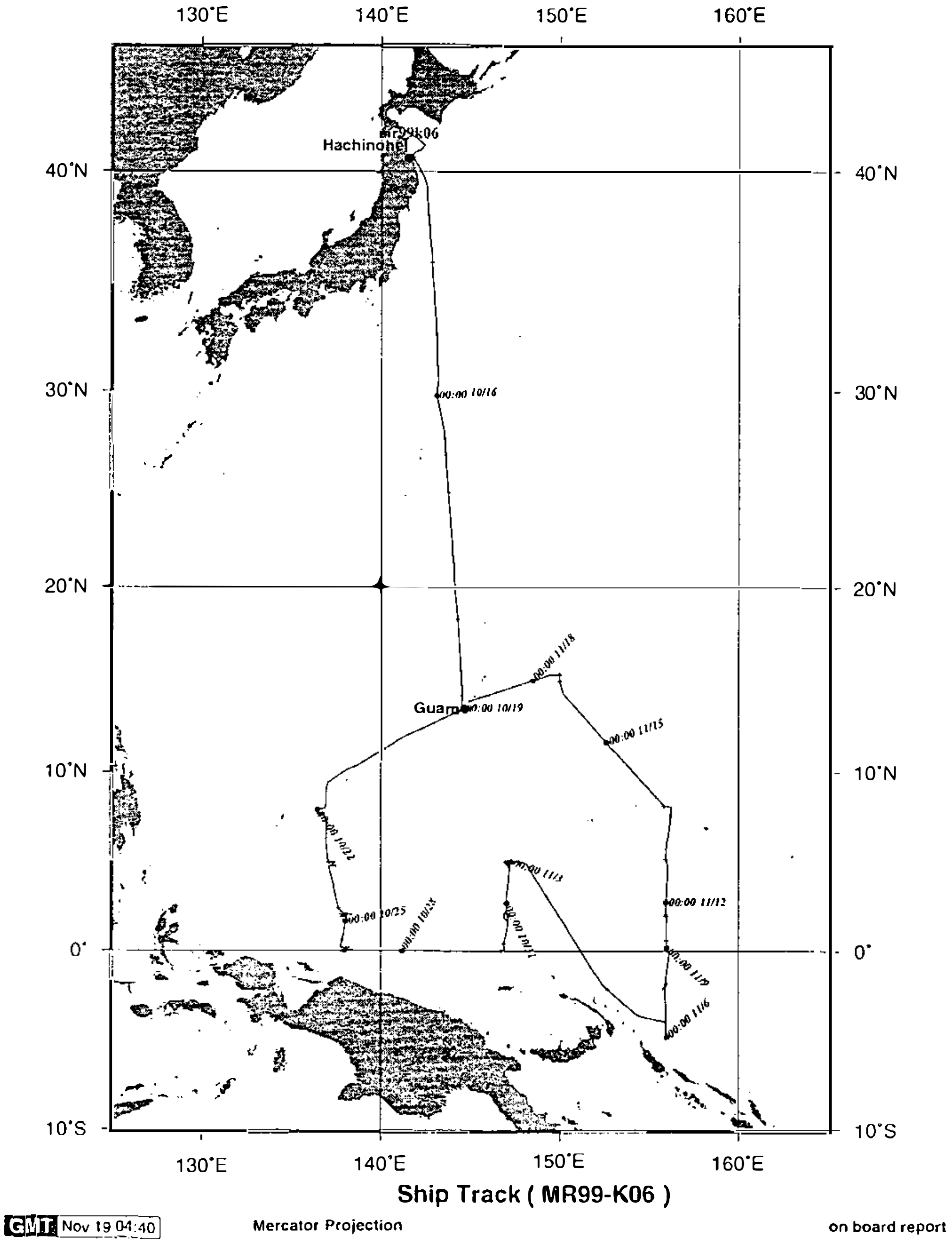
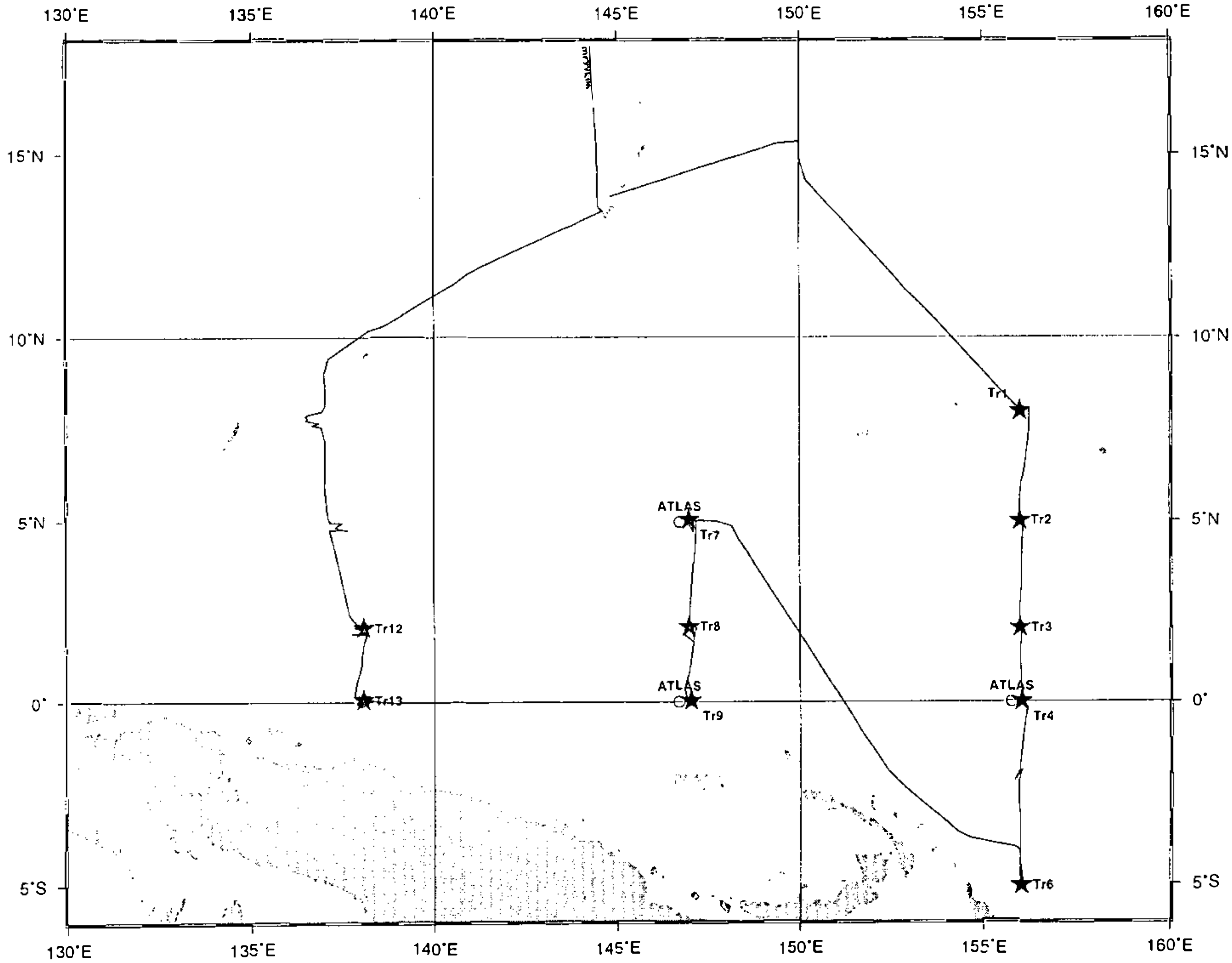
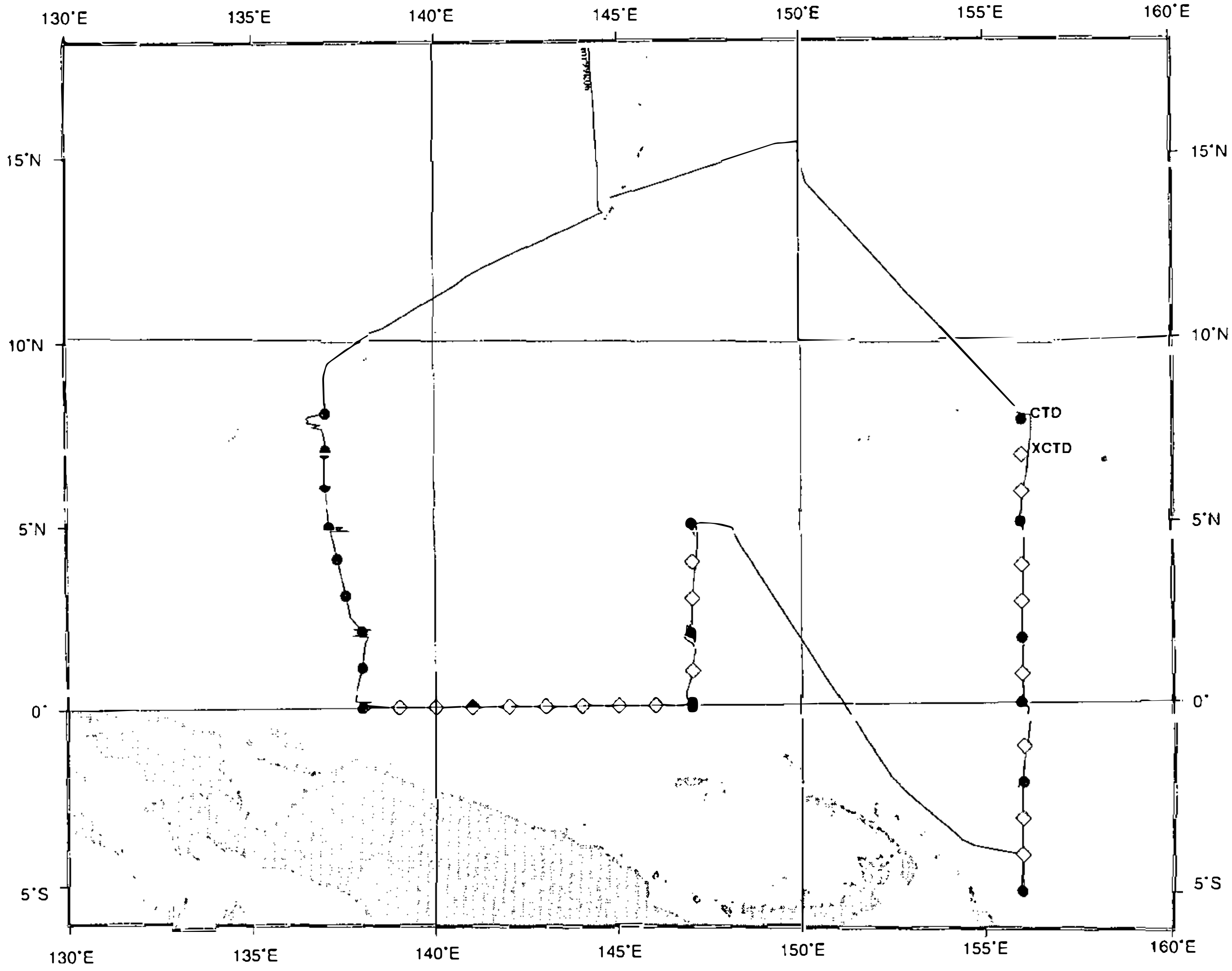

130°E
140°E
150°E
160°E
40°N
30°N
20°N
10°N
0°
10°S
mr99k06
Hachinohe
00:00 10/16
Guam
00:00 10/19
00:00 11/18
00:00 11/15
00:00 10/22
00:00 10/25
00:00 10/28
00:00 11/3
00:00 11/1
00:00 11/12
00:00 11/9
00:00 11/6
Ship Track (MR99-K06)
GMT Nov 19 04:40
Mercator Projection
on board report

Fig 3-1



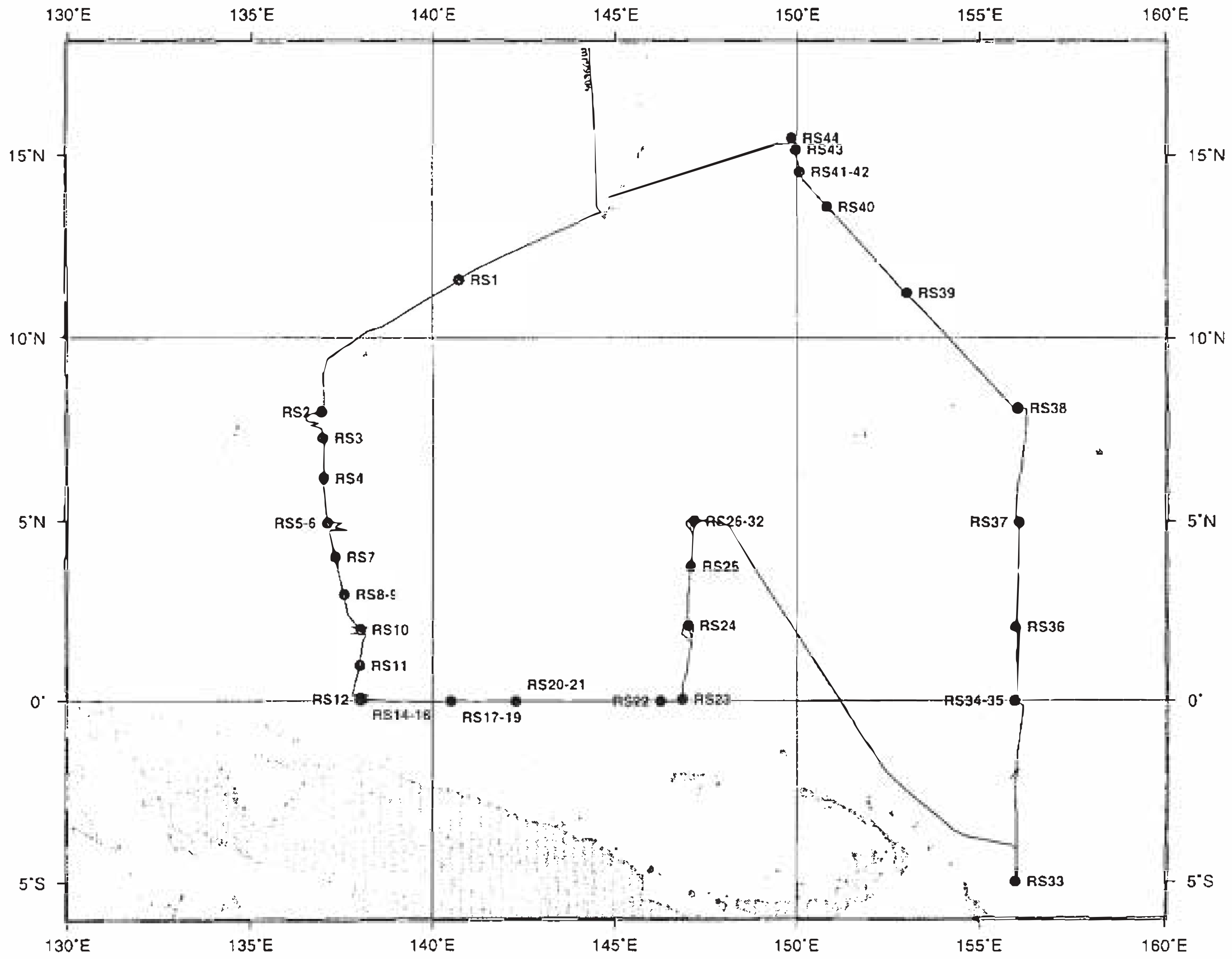
TRITON buoy Site

Fig 3-2



CTD/XCTD casting Site

Fig 3-3



Radio Sonde Launching Site

GMT Nov 19 04:37

Mercator Projection

Fig 3-4

4. Cruise Log

Oct. 13 (Wed.)

16:00 Departure from Sekine-hama (Japan)

Oct. 14 (Th.)

08:00 Arrival at Hachinohe (Japan)
Immigration for going abroad
14:00 Departure from Hachinohe
14:30-15:00 Boat drill
15:00-15:50 Instruction for safety life on Mirai
16:45-17:00 Konpira-san
18:00- All continuous observations start

Oct. 15 (Fri.)

08:30-09:10 Meeting for this cruise
09:00-16:00 TRITON buoy preparation on deck (in Buoy House No.1)

Oct. 16 (Sat.)

09:00-12:30 Test for the large CTD/Rosette system
(24positions with 30 liters Niskin bottle)
13:30-13:45 First test for the small CTD/Carousel system
(12 positions with 12 liters Niskin bottle)
Failed due to disconnection of signal line
15:30-15:50 Second test for the small CTD/Carousel system (succeeded)
16:20-16:40 Test for the large CTD/Carousel system
(24 positions with 30 liters Niskin Bottle)

Oct. 17 (Sun.)

09:00- Preparation for this cruise

Oct. 18 (Mon.)

09:00- Preparation for this cruise
22:00 Ship mean time adjustment (SMT=GMT+10 (JST+1))

Oct 19 (Tue.)

10:00 Arrival at Guam
11:30-12:00 Loading PMEL/NOAA gears

Oct 20 (Wed.)

16:00 Departure from Guam
19:00- Doppler radar observation start

Oct 21 (Th.)

09:30-10:30 Test for Sonde observation (Sonde-1)

Oct. 22 (Fri.)

08:00-08:40 CTD01 (8N, 137E)

09:30 Sonde-2 (7-56.86N, 136-49.50E)
10:30- Seabeam bottom survey around 8N137E for future TRITON deployment
21:30 Sonde-3 (7-21.25N, 136-57.53E)
23:03-23:41 CTD02 (7N, 137E)

Oct. 23 (Sat.)

03:30 Sonde-4 (6-03.36N, 137-01.84E)
03:55-04:45 CTD03 (6N, 137E)
09:02-09:40 CTD04 (5N, 137E)
09:23 Sonde-5 (4-58.00N, 137-05.98E)
10:00-18:18 Seabeam bottom survey around 5N137E
15:30 Sonde-6 (4-49.66N, 137-25.26E)
21:20 Sonde-7 (3-59.71N, 137-19.63E)
21:30 CTD05 (4N, 137-20E)

Oct. 24 (Sun.)

04:05 Sonde-8 (2-59.63N, 137-34.60E)
07:57-08:35 CTD06 (3N, 137-33E)
09:31 Sonde-9 (2-47.70N, 137-35.18E)
12:00-23:00 Seabeam bottom survey around 2N138E

Oct. 25 (Mon.)

08:47-13:03 Deployment of TRITON buoy at 2N138E
09:30 Sonde-10 (2-00.58N, 138-01.81E)
13:36-14:22 CTD07 (2N, 138E)
14:22-18:10 Met. Sensor comparison

Oct. 26 (Tue.)

08:53-09:29 CTD08 (1N, 138E)
09:31 Sonde-11 (1-00.03N, 137-59.79E)
12:54-00:05 Seabeam bottom survey around 0N138E

Oct. 27 (Wed.)

08:33-12:14 Deployment of TRITON buoy at 0N138E
09:33 Sonde-12 (0-03.88N, 137-59.75E)
12:31 Sonde-13 (0-04.58N, 138-02.26E)
13:48-14:33 CTD09 (0N, 138E)
13:50-18:15 Met. Sensor comparison
15:30 Sonde-14 (0-05.52N, 138-00.71E)
18:31 Sonde-15 (0-05.10N, 138-00.46E)
21:32 Sonde-16 (0-00.24S, 138-40.64E)
23:00 XCTD01(0, 139E)

Oct. 28 (Th.)

00:31 Sonde-17 (0-00.26N, 139-20.15E)
03:22 Sonde-18 (0-00.18N, 139-56.31E)
03:51 XCTD02 (0, 140E)
06:31 Sonde-19 (0-00.31N, 140-30.73E)
08:48 XCTD03 (0, 141E)
09:31 Sonde-20 (0-01.46S, 141-06.92E)
13:43 XCTD04 (0, 142E)
15:30 Sonde-21 (0-00.57N, 142-21.62E)
18:36 XCTD05 (0, 143E)
23:07 XCTD06 (0, 144E)

Oct. 29 (Fri.)
03:34 XCTD07 (0, 145E)
08:02 XCTD08 (0, 146E)
09:31 Sonde-22 (0-00.89S, 146-20.73E)
12:00-12:14 Sending Enable and Release commands to the 0N147E ADCP
No response…
14:20-17:52 Deployment of TRITON buoy at 0N147E
18:30-23:15 Met sensor comparison
18:34-19:18 CTD10 (0, 147E)

Oct. 30 (Sat.)
09:00-12:45 Met sensor comparison
09:31 Sonde23 (0-03.13N, 146-50.41E)
12:10-12:45 CTD11 (0, 147E)
13:00-17:14 Recovery of TRITON buoy at 0N147E
21:08 XCTD09 (1N, 147E)

Oct. 31 (Sun.)
00:00-07:15 Seabeam bottom survey around 2N147E
07:54-08:41 CTD12 (2N, 147E)
09:30 Sonde24 (2-11.01N, 146-58.86E)
12:29 XCTD10 (3N, 147E)
15:38 Sonde25 (3-48.76N, 147-04.46E)
16:24 XCTD11 (4N, 147E)
20:00-01:30 Seabeam bottom survey around 5N147E
21:33 Sonde26 (5-02.62N, 147-09.49E)

Nov. 1 (Mon.)
09:36 Sonde27 (4-51.67N, 146-56.26E)
06:40-14:05 Dragging system operation for the recovery of the lower part of the 5N147E TRITON buoy (one recovery buoy and two releasers)

21:31 Sonde28 (4-52.04N, 146-55.62E)
Nov. 2 (Tue.)
07:56-15:05 Dragging system operation
Failed to recover
09:33 Sonde29 (4-51.95N, 146-57.10E)
21:30 Sonde30 (4-59.89N, 146-55.79E)
Nov. 3 (Wed.)
08:42-13:40 Deployment of TRITON buoy at 5N147E
09:31 Sonde31 (5-04.12N, 146-59.78E)
12:57-13:40 CTD13 (5N, 147E)
14:28-18:15 Met sensor comparison
21:31 Sonde32 (5-01.34N, 147-48.64E)
Nov. 4 (Th.)-Nov. 5 (Fri.) cruising to 5S156E. Preparations for buoy deck work on 156E
Nov. 6 (Sat.)
08:04-10:07 Recovery of ATLAS (reverse catenary) at 5S156E
09:36 Sonde33 (5-00.41S, 155-58.45E)
11:00-13:13 Met sensor comparison with TRITON buoy at 5S156E
11:00-11:42 CTD14 (5S156E)
17:20 XCTD12 (4S156E)
21:06 XCTD13 (3S156E)
Nov. 7 (Sun.)
01:00-03:12 Seabeam bottom survey
07:55-10:02 Recovery of ATLAS at 2S156E
10:58-11:43 CTD15 (2S156E)
11:00-14:12 Met sensor comparison
18:18 XCTD14 (1S156E)
21:48-22:27 Seabeam bottom survey around 0 156E
Nov. 8 (Mon.)
07:00-09:00 Recovery of ADCP buoy at 0 156E
09:31 Sonde34 (0-00.24S, 156-02.51E)
10:53-12:06 Deployment of ADCP buoy at 0 156E
12:58-13:05 Sending commands to ATLAS releaser at 0 156E
Nov. 9 (Tue.)
08:34-11:04 Deployment of TRITON buoy at 0 156E
09:31 Sonde35 (0-00.66N, 156-01.88E)
11:05-16:15 Met sensor comparison
12:57-13:39 CTD16 (0, 156E)
20:17 XCTD15 (1N, 156E)

23:30-01:20 Seabeam bottom survey around 2N156E

Nov. 10 (Wed.)

08:33-11:19 Deployment of TRITON buoy at 2N156E
11:20-16:15 Met sensor comparison
12:54-13:39 CTD17 (2N, 156E)

Nov. 11 (Th.)

07:57-08:35 CTD18 (2N, 156E)
08:36-11:52 Recovery of TRITON buoy at 2N156E

Nov. 12 (Fri.)

08:22-10:41 Recovery of ATLAS buoy at 2N156E
14:26 XCTD16 (3N, 156E)
18:16 XCTD17 (4N, 156E)

Nov. 13 (Sat.)

08:21-10:52 Recovery of ATLAS at 5N156E
08:38-15:15 Met sensor comparison
09:30 Sonde37 (4-59.26N, 156-03.42E)
13:01-13:39 Repair of TRITON buoy (replacement of wind sensor)
13:53-14:33 CTD19 (5N, 156E)
20:56 XCTD18 (6N, 156E)

Nov. 14 (Sun.)

00:51 XCTD19 (7N, 156E)
04:00-06:50 Seabeam bottom survey around 8N156E
08:20-11:05 Recovery of ATLAS buoy at 8N156E
08:42-15:10 Met sensor comparison
09:31 Sonde-38 (8-05.08N, 156-01.06E)
12:56-13:41 CTD20 (8N, 156E)
14:36-14:57 CTD test cast down to 500m

Nov. 15 (Mon.)

09:31 Sonde-39 (11-17.70N, 152-55.79E)
21:31 Sonde-40 (13-41.05N, 150-45.38E)

Nov. 16 (Tue.)

09:30 Sonde-41 (14-33.11N, 150-04.35E)
21:33 Sonde-42 (14-29.94N, 150-00.69E)

Nov. 17 (Wed.)

09:31 Sonde-43 (15-15.73N, 149-55.46E)
21:30 Sonde-44 (15-26.81N, 149-50.45E)

Nov. 18 (Th.)

Nov. 19 (Fri.)

09:00 Arrival to pilot station in Guam

After immigration, offloading PMEL gears

Nov. 20 (Sat.)

Disembarkation

5. Participants List

R/V Mirai Scientists and Technical Staff during MR99-K06

Kentaro Ando	Japan Marine Science and Technology Center(JAMSTEC)
Ken Kawano	JAMSTEC
Norifumi Ushijima	JAMSTEC
Masaki Hanyuu	Global Ocean Development Inc. (GODI)
Satoshi Okumura	GODI
Masayuki Fujisaki	Marine Works Japan Ltd.(MWJ)
Nobuharu Komai	MWJ
Hirokatsu Uno	MWJ
Satoshi Ozawa	MWJ
Takeo Matsumoto	MWJ
Fujio Kobayashi	MWJ
Keisuke Wataki	MWJ
Aya Kato	MWJ
Tadahiko Shirato	MWJ
Kentaro Shiraishi	MWJ
Haruya Adati	MWJ
Lant Saroso	Indonesia Navy
Muhammad Ilyas	Bandan Pengkajian dan Penerapan Teknologi(BPPT)
Stephen A. Smith	Pacific Marine Environmental Laboratory(PMEL) 7600
Tetsuo Nakazawa	Meteorological Research Institute (MRI)
Masao Ishii	MRI
Ichiro Matsui	National Institute of Environmental Science
Shigeru Murata	National Electronics corporation (NEC)
Toshikazu Abe	Technosystem Ltd.
Takeharu Yamanaka	Showa optronics Ltd.

6. General Observation

6.1 Meteorological measurement

6.1.1 Surface meteorological observations

(1) Personnel

Tetsuo Nakazawa (MRI)	: Principal Investigator
Masaki Hanyu (GODI)	: Operation Leader
Satoshi Okumura (GODI)	

(2) Objective

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

(3) Measured Parameters

The surface meteorological parameters were observed throughout MR99-K06 cruise from the departure of Sekinehama on 13 October 1999 to the arrival of Guam on 19 November 1999.

Measured parameters are:

Name	Sampling Interval	Acronyms in Table 6.1.1-2
Wind direction	6 sec./10 min. averaged	WD
Wind speed	6 sec./10 min. averaged	WS
Weather	3 hourly	Weather
Pressure (adjusted to the sea surface level)	6 sec./10 min. averaged	P
Air temperature	6 sec./10 min. averaged	T
Dewpoint temperature	6 sec./10 min. averaged	DPT
Relative humidity	6 sec./10 min. averaged	RH
Sea surface temperature	6 sec./10 min. averaged	SST
Rainfall amount	3 hourly (accumulated)	Rain
Significant wave height	3 hourly (20 min. averaged)	Wv. Ht.
Significant wave period	3 hourly (20 min. averaged)	Wv. Pd.

(4) Methods

The meteorological sensors onboard R/V Mirai are listed in Table 6.1.1-1. Surface meteorological data were collected and processed by KOAC-7800 weather data processor and some sensors assembled by Koshin Denki, Japan.

Table 6.1.1-1

Sensors	Type	Maker	Location（Altitude from surface）
Anemometer:	KE-500	Koshin Denki, Japan	Foremast（24m）
Thermometer:	FT	Koshin Denki, Japan	Compass Deck（19m）
Dew point meter:	DW-1	Koshin Denki, Japan	Compass Deck（19m）
Barometer:	F-451	Yokogawa, Japan	Weather observation room, Captain Deck（13m）
Rain gauge:	50202	Young, U.S.A.	Compass Deck（19m）
Optical Rain gauge:	ORG-115DR	SCTI, U.S.A.	Compass Deck（19m）
Radiometer:	MS-801 (short wave) MS-200 (long wave)	Eiko Seiki, Japan	Radar mast (28m)
Wave height meter:	MW-2	Tsurumi-seiki, Japan	Bow

(5) Preliminary Results

Table 6.1.1-2 shows the part of the observation results for the permanent sensors.

We also provide the some weekly time-series of the observational results in Figure 6.1.1-2 to 6.1.1-5, from the week of 17 October to 7 November. We describe a brief summary of the characteristics feature each week below;

- From 17 October to 23 October:

  Mostly calm with occasional showers.

  In this week, from 00Z 19th to 06Z 20th, R/V Mirai was berthing at port of Guam. Before arriving at Guam, the diurnal variation of the air temperature and moisture was weak and became regular after departing from Guam. There were several episodes with abrupt cooling of the air and wind burst (easterlies in most of the cases), which were usually associated with shower events. For example, from 0457Z 21st October, the easterlies enhanced from 4 m/s to 10 m/s, the air temperature from 31 deg-C to 28 deg-C, the humidity from 62 % to 86 % and the rainfall of 2.1 mm in 7 minutes.

  From Z to Z in 20th October, no observation was carried out due to the system maintenance.

- From 24 October to 30 October:

  Most disturbed week in this cruise.

  Daily rainfall in 26 and 27 October was 30.3 mm and 61.7 mm, respectively. Observed by Optical Rain Gauge (See Fig.6.1.1-5). These are the second and the first largest daily precipitation record in this cruise. One hour maximum precipitation was 11.4 mm/hr recorded at 03Z and 04Z 27 October. The ship’s positions were 1N 138E at 00Z 26 October and 0N 138E at 00Z 27 October.

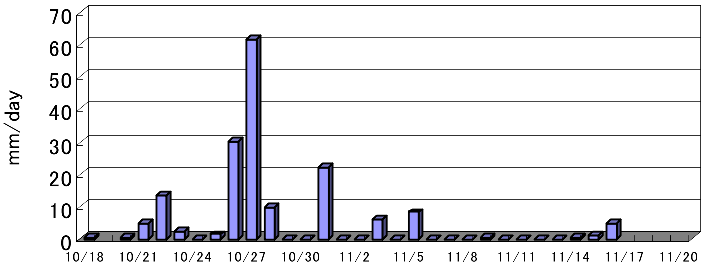
  A cloud cluster started developing at 00Z 26 October around 3N 138E, just several degrees north of R/V Mirai. Another cloud system, located north of New Guinea, was also developed from 15Z 26 October at 2S 136E. These two systems merged into one until 21Z 26 October and further developed in the next day. This system was responsible to bring us rain of more than 60 mm per day.

- From 31 October to 6 November:

  Calm week except for 31 October.

  31 October was the third largest daily rainfall (22.2 mm) day in this cruise. The rapid cooling of the air (29 deg-C to 24 deg-C) and moistening (64 % to 92 %) was evident at 0455Z. At that time the ship was at 2N 147E. The GMS imagery (See Appendix) shows that the cloud system suddenly

Fig. 6.1.1-1 Daily rainfall amount MR99-K06



developed in 03Z at 3N 148E. As the system developed, the system merged to the ITCZ at 10N and the merged cloud belt was located between 5N and 10N.

- From 7 November to 13 November:

Most calm and clear week of this cruise.

Every parameters of the air temperature, wind, solar radiation, relative humidity and rainfall indicate that that this week is the most calm week. Especially the relative humidity did not exceed over 80 %. There were a very few sudden cooling events in this week. The weather map shows that the region was covered by the downward motion by the ridge, which extended from the high pressure system in the mid-latitude.

(6) Data Archive

The dataset with 6 seconds and 10 minutes interval are available in the 3.5” magnetic optical (MO) disk. The dataset will be submitted to the DMO (Data Management Office), JAMSTEC and will be under their control.

Table 6.1.1-2

Time				Position		Weather	WD	WS	P	T	DPT	RH	SST	Rain	Wv.Ht.	Wv.Pd.
UTC		ship		Lat.	Long.		(deg)	(m/s)	(hPa)	(deg.C)	(deg.C)	(%)	(deg.C)	(mm/3h)	(m)	(sec)
13-Oct	9:00	13-Oct	18:00	41-32 N	141-30 E	r	160	10.5	1014.3	17.4	14.4	83	19.3	0.1	1.0	5
	12:00		21:00	41-03 N	142-29 E	r	70	6.6	1013.8	14.9	15.0	100	19.5	6.5	0.9	7
	15:00	14-Oct	0:00	41-01 N	142-28 E	r	80	6.7	1011.7	15.4	14.9	97	19.4	0.3	1.1	7
	18:00		3:00	40-54 N	142-15 E	o	40	2.4	1012.1	15.6	15.1	97	19.2	0.5	1.5	13
	21:00		6:00	40-41 N	141-38 E	o	310	5.6	1012.7	17.3	15.5	89	19.1	0.0	1.5	11
14-Oct	0:00		9:00	40-33 N	141-30 E	bc	80	8.4	1016.6	20.8	17.0	79	25.6	0.0	2.0	14
	3:00		12:00	40-33 N	141-30 E	bc	300	6.5	1015.2	21.0	8.4	45	19.8	0.0	0.2	6
	6:00		15:00	40-33 N	141-45 E	o	300	12.1	1016.3	18.3	10.0	58	20.2	0.0	1.2	8
	9:00		18:00	40-33 N	142-18 E	c	10	10.9	1017.0	16.8	13.0	78	19.8	0.0	1.4	14
	12:00		21:00	39-05 N	142-32 E	bc	30	9.3	1018.8	16.4	12.6	79	18.4	0.0	1.8	20
	15:00	15-Oct	0:00	38-17 N	142-36 E	bc	40	8.2	1018.9	17.5	13.5	77	20.0	0.0	1.6	18
	18:00		3:00	37-30 N	142-40 E	bc	50	7.6	1017.7	18.9	14.3	75	21.7	0.0	1.8	20
	21:00		6:00	36-46 N	142-46 E	r	60	5.6	1017.8	18.9	16.3	85	25.2	5.7	1.6	14
15-Oct	0:00		9:00	36-06 N	142-48 E	o	230	4.6	1015.7	27.2	22.0	73	28.3	0.0	1.3	13
	3:00		12:00	35-22 N	142-51 E	o	120	8.6	1013.7	23.5	18.4	73	25.5	0.0	1.6	10
	6:00		15:00	34-35 N	142-55 E	o	160	5.0	1012.4	24.5	21.9	86	25.7	0.0	1.6	11
	9:00		18:00	33-47 N	142-59 E	bc	260	10.3	1012.6	25.7	21.9	80	26.4	0.0	1.4	11
	12:00		21:00	33-03 N	143-03 E	bc	250	9.1	1013.4	25.7	22.9	85	26.5	0.0	1.8	14
	15:00	16-Oct	0:00	32-19 N	143-06 E	bc	250	9.3	1013.5	26.6	22.5	78	27.7	0.0	1.5	12
	18:00		3:00	32-32 N	143-07 E	bc	260	9.3	1013.6	26.9	22.0	75	27.7	0.0	1.4	12
	21:00		6:00	30-46 N	143-09 E	bc	250	7.0	1014.9	26.8	22.5	77	28.1	0.0	1.3	11
16-Oct	0:00		9:00	23-59 N	143-04 E	bc	120	5.9	1014.3	27.1	23.9	83	28.8	0.0	1.3	9
	3:00		12:00	29-49 N	143-03 E	bc	220	3.0	1014.2	27.9	21.9	70	28.3	0.0	1.1	7
	6:00		15:00	29-24 N	143-09 E	bc	240	2.9	1013.5	27.7	20.8	66	28.7	0.0	1.0	10
	9:00		18:00	28-57 N	143-16 E	bc	230	2.6	1015.0	26.7	20.6	69	28.6	0.0	1.1	10
	12:00		21:00	28-11 N	143-26 E	b	170	1.5	1015.7	27.0	21.7	73	28.2	0.0	0.9	7
	15:00	17-Oct	0:00	27-24 N	143-32 E	bc	100	2.4	1014.8	26.9	22.5	77	28.6	0.0	1.0	9
	18:00		3:00	26-38 N	143-35 E	bc	80	5.6	1013.5	26.9	23.9	84	28.6	0.0	1.0	8
	21:00		6:00	25-52 N	143-39 E	o	110	12.7	1014.3	25.8	23.9	89	28.8	2.6	1.2	6
17-Oct	0:00		9:00	25-05 N	143-42 E	c	120	8.1	1014.0	29.3	25.0	78	29.5	0.0	1.1	8
	3:00		12:00	24-17 N	143-46 E	bc	90	5.2	1013.0	28.2	22.4	71	28.9	0.0	1.1	7
	6:00		15:00	23-28 N	143-49 E	bc	140	3.5	1012.2	28.0	22.7	73	29.4	0.0	1.2	8
	9:00		18:00	22-41 N	143-54 E	bc	140	4.7	1013.3	27.6	23.8	80	29.0	0.0	1.3	9
	12:00		21:00	21-52 N	143-56 E	bc	130	2.6	1014.4	27.6	24.3	83	28.9	0.0	1.1	9
	15:00	18-Oct	0:00	21-04 N	144-01 E	bc	70	2.8	1013.7	27.5	25.2	87	28.8	0.0	1.1	9
	18:00		3:00	20-17 N	144-05 E	bc	90	3.2	1012.1	27.7	25.3	87	29.3	0.0	1.0	8
	21:00		6:00	19-29 N	144-08 E	bc	90	6.2	1013.3	28.0	25.6	87	29.2	0.0	1.0	8
18-Oct	0:00		9:00	18-43 N	144-12 E	bc	110	6.1	1011.1	29.0	24.7	78	29.2	0.0	0.2	9
	3:00		12:00	17-56 N	144-15 E	bc	100	8.5	1011.3	28.8	24.1	76	29.4	0.0	1.4	9
	6:00		15:00	17-12 N	144-18 E	c	100	8.7	1010.5	28.5	25.0	81	29.4	0.0	1.6	10
	9:00		18:00	16-30 N	144-22 E	bc	100	10.1	1011.2	28.5	24.8	81	29.6	0.0	1.7	9
	12:00		21:00	15-48 N	144-24 E	bc	80	9.5	1011.9	28.3	25.0	83	29.3	0.0	1.9	10
	15:00	19-Oct	1:00	15-05 N	144-27 E	c	90	8.6	1011.3	27.8	23.9	79	29.4	0.0	1.8	11
	18:00		4:00	14-23 N	144-29 E	c	70	8.0	1009.5	27.2	25.0	88	29.3	0.0	1.9	12
	21:00		7:00	13-41 N	144-29 E	c	110	10.1	1010.0	27.6	23.9	80	29.2	0.0	1.6	11
19-Oct																
20-Oct																
	9:00		19:00	13-12 N	144-04 E	bc	110	4.5	1009.4	28.3	24.3	79	29.9	0.0	1.5	20
	12:00		22:00	12-53 N	143-20 E	bc	80	3.7	1010.6	28.2	24.6	81	29.8	0.0	1.4	20
	15:00	21-Oct	1:00	12-32 N	142-36 E	bc	100	3.4	1009.2	28.1	24.3	80	29.7	0.0	1.7	20
	18:00		4:00	12-12 N	141-52 E	bc	150	2.3	1008.0	27.5	24.2	82	29.8	0.0	1.4	18
	21:00		7:00	11-52 N	141-08 E	bc	180	1.5	1008.8	27.8	24.1	81	29.7	0.0	1.1	17
21-Oct	0:00		10:00	11-25 N	140-29 E	bc	30	2.9	1012.1	28.8	23.5	73	29.9	0.0	1.0	14
	3:00		13:00	11-01 N	139-47 E	bc	90	2.1	1008.3	30.2	23.5	68	29.9	0.0	1.5	18
	6:00		16:00	10-36 N	139-05 E	c	80	4.6	1007.7	28.9	24.5	77	30.5	2.1	1.5	20
	9:00		19:00	10-12 N	138-23 E	bc	90	0.5	1008.6	28.3	23.2	74	30.3	0.0	1.1	14
	12:00		22:00	9-49 N	137-40 E	bc	320	2.3	1010.4	28.2	23.7	77	30.1	0.0	1.4	19
	15:00	22-Oct	1:00	9-22 N	137-01 E	bc	30	1.8	1010.5	28.2	23.6	76	30.1	0.0	1.0	16
	18:00		4:00	8-34 N	136-59 E	bc	40	2.0	1009.0	28.0	23.4	76	30.1	0.0	1.1	18
	21:00		7:00	8-00 N	136-59 E	bc	20	3.7	1009.8	27.2	23.2	79	29.8	0.0	0.9	8
22-Oct	0:00		10:00	7-54 N	136-42 E	bc	350	1.8	1010.4	27.6	24.0	81	29.9	1.1	0.9	8
	3:00		13:00	7-50 N	136-28 E	bc	90	1.7	1010.0	29.7	23.6	70	30.0	0.0	0.9	9
	6:00		16:00	7-44 N	136-35 E	bc	30	1.7	1007.1	29.4	23.5	71	30.3	0.0	0.9	7
	9:00		19:00	7-37 N	136-38 E	bc	310	0.8	1009.0	28.7	22.7	70	30.2	0.0	0.8	11
	12:00		22:00	7-13 N	136-58 E	bc	270	2.3	1010.8	26.7	22.3	77	30.3	0.0	1.2	15
	15:00	23-Oct	1:00	6-41 N	137-00 E	c	340	1.6	1010.3	27.4	23.9	81	29.9	0.1	1.2	18

Table 6.1.1-2

	18:00		4:00	6-00 N	136-59 E	bc	360	4.2	1008.4	28.1	23.3	75	30.2	0.0	1.3	13
	21:00		7:00	5-28 N	137-03 E	bc	10	5.5	1009.1	27.0	24.2	85	30.0	0.0	1.1	17
23-Oct	0:00		10:00	4-58 N	137-08 E	bc	130	3.3	1009.5	28.6	23.6	74	30.1	0.0	1.2	18
	3:00		13:00	4-54 N	137-27 E	c	360	5.5	1008.8	28.9	23.4	72	30.2	0.0	1.2	13
	6:00		16:00	4-49 N	137-32 E	c	70	4.0	1007.0	27.8	24.3	82	30.3	0.2	1.0	8
	9:00		19:00	4-35 N	137-10 E	c	20	8.5	1008.0	26.3	23.6	85	30.1	0.7	1.2	16
	12:00		22:00	3-59 N	137-20 E	o	50	4.8	1009.3	27.4	23.8	81	29.7	0.0	1.0	8
	15:00	24-Oct	1:00	3-17 N	137-29 E	bc	80	4.0	109.1	27.4	24.2	83	30.0	0.0	1.2	16
	18:00		4:00	2-59 N	137-34 E	c	340	1.3	1007.3	26.2	23.5	85	30.0	0.0	0.9	8
	21:00		7:00	3-00 N	137-38 E	bc	80	0.7	1008.0	27.3	24.7	86	30.0	0.0	0.8	9
24-Oct	0:00		10:00	N/A	N/A	bc	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3:00		13:00	2-07 N	137-59 E	bc	140	4.4	1007.8	29.2	22.9	69	30.2	0.0	0.9	8
	6:00		16:00	2-03 N	137-49 E	bc	170	4.0	1005.9	29.3	23.5	71	30.5	0.0	1.2	16
	9:00		19:00	1-56 N	138-13 E	bc	170	1.7	1006.6	28.1	23.0	74	30.5	0.0	1.2	16
	12:00		22:00	1-51 N	137-59 E	bc	150	4.4	1009.0	28.7	22.7	70	30.2	0.0	0.9	8
	15:00	25-Oct	1:00	2-03 N	138-04 E	bc	170	3.4	1009.0	28.4	22.9	72	30.2	0.0	1.0	9
	18:00		4:00	2-01 N	138-06 E	bc	80	3.9	1007.6	27.5	23.5	79	30.1	0.0	0.8	9
	21:00		7:00	2-02 N	138-05 E	bc	130	3.1	1008.6	28.3	23.7	76	30.0	0.0	0.8	9
25-Oct	0:00		10:00	2-01 N	138-02 E	bc	140	4.0	1010.1	29.0	23.8	73	29.9	0.0	0.9	8
	3:00		13:00	2-04 N	138-02 E	bc	110	3.7	1008.4	32.7	24.4	62	30.2	0.0	0.8	9
	6:00		16:00	2-02 N	138-04 E	bc	130	3.5	1005.9	30.7	23.3	65	30.3	0.0	1.0	9
	9:00		19:00	2-03 N	138-04 E	bc	110	3.2	1006.6	29.1	23.5	72	30.6	0.0	1.0	9
	12:00		22:00	2-01 N	138-04 E	bc	100	5.5	1008.7	28.5	23.7	75	30.3	0.0	0.9	9
	15:00	26-Oct	1:00	2-00 N	138-06 E	bc	80	5.1	1008.6	28.9	23.2	71	30.2	0.0	0.8	9
	18:00		4:00	2-00 N	138-08 E	bc	70	2.9	1007.2	27.6	23.9	80	30.1	0.0	0.8	8
	21:00		7:00	1-28 N	138-03 E	bc	90	3.6	1007.9	27.7	24.7	84	30.0	0.0	1.1	15
26-Oct	0:00		10:00	0-54 N	137-59 E	bc	50	4.7	1009.6	28.0	25.1	84	30.0	0.0	1.0	14
	3:00		13:00	0-09 N	137-47 E	bc	90	5.2	1008.1	29.3	24.5	75	30.3	0.0	1.0	11
	6:00		16:00	0-06 N	138-04 E	bc	50	3.0	1006.0	27.8	23.4	77	30.2	0.0	1.0	17
	9:00		19:00	0-02 N	138-08 E	q	90	6.6	1007.2	27.2	23.9	82	30.1	3.1	0.7	6
	12:00		22:00	0-06 S	137-45 E	bc	90	6.1	1008.8	27.9	24.2	81	29.9	0.0	1.1	14
	15:00	27-Oct	1:00	0-01 N	138-06 E	c	70	6.8	1008.5	28.1	24.1	79	29.9	0.0	1.0	13
	18:00		4:00	0-01 N	137-59 E	c	70	6.6	1007.2	26.1	24.6	91	29.9	0.2	0.9	7
	21:00		7:00	0-03 N	138-01 E	r	130	6.9	1008.6	25.4	22.8	86	29.9	1.1	1.0	8
27-Oct	0:00		10:00	0-03 N	138-00 E	o	100	6.0	1010.4	27.0	23.5	81	29.8	0.0	0.9	6
	3:00		13:00	0-04 N	138-02 E	r	320	1.8	1009.1	24.9	23.7	93	29.8	11.4	1.0	7
	6:00		16:00	0-05 N	138-00 E	o	180	2.4	1007.5	24.9	23.2	90	29.8	6.3	0.8	6
	9:00		19:00	0-05 N	138-05 E	r	280	1.7	1009.0	25.0	23.8	94	29.7	0.0	0.9	6
	12:00		22:00	0-00 N	138-46 E	o	110	4.1	1010.1	25.6	23.0	86	29.7	0.5	0.8	6
	15:00	28-Oct	1:00	0-00 N	139-26 E	o	40	3.6	1008.7	25.7	24.2	91	29.8	0.2	0.8	4
	18:00		4:00	0-00 N	140-01 E	c	190	1.7	1007.2	26.5	23.5	83	29.8	0.0	0.8	4
	21:00		7:00	0-00 N	140-36 E	o	220	3.3	1008.8	26.0	23.8	88	29.9	4.6	0.9	5
28-Oct	0:00		10:00	0-00 N	141-11 E	o	120	6.5	1010.3	26.6	22.9	80	29.7	0.8	1.0	4
	3:00		13:00	0-00 N	141-50 E	o	130	13.6	1008.2	25.5	23.6	90	29.6	7.6	0.9	4
	6:00		16:00	0-00 N	142-26 E	o	140	2.9	1006.7	28.1	22.4	72	29.6	0.0	1.0	5
	9:00		19:00	0-00 N	143-04 E	bc	80	3.5	1007.9	28.2	23.7	77	29.6	0.0	1.0	5
	12:00		22:00	0-00 N	143-45 E	bc	110	4.0	1009.2	28.6	22.5	70	29.6	0.0	0.9	5
	15:00	29-Oct	1:00	0-00 N	144-25 E	bc	130	4.2	1008.6	28.4	23.2	73	29.6	0.0	1.0	5
	18:00		4:00	0-00 N	145-05 E	bc	150	6.3	1007.0	26.4	22.2	78	29.5	0.1	0.9	6
	21:00		7:00	0-00 N	145-46 E	bc	140	3.3	1008.1	27.9	23.6	78	29.6	0.0	0.8	5
29-Oct	0:00		10:00	0-00 N	146-27 E	bc	130	4.6	1009.3	28.9	23.3	72	29.6	0.0	0.9	6
	3:00		13:00	0-00 N	146-57 E	bc	120	6.4	1007.4	29.3	22.2	66	29.7	0.0	0.9	5
	6:00		16:00	0-02 S	146-59 E	bc	120	5.5	1006.8	29.1	21.7	64	29.7	0.0	1.0	6
	9:00		19:00	0-01 S	146-59 E	bc	120	4.6	1008.0	28.3	21.7	67	29.6	0.0	0.9	7
	12:00		22:00	0-02 S	146-59 E	bc	120	5.3	1009.8	27.9	22.5	72	29.5	0.0	0.9	8
	15:00	30-Oct	1:00	0-03 S	146-58 E	bc	90	3.2	1008.1	27.1	22.4	76	29.4	0.0	0.9	9
	18:00		4:00	0-02 S	146-57 E	bc	130	2.6	1007.0	26.3	22.5	80	29.5	0.0	0.8	8
	21:00		7:00	0-01 N	146-56 E	bc	100	2.7	1008.5	27.6	22.2	73	29.5	0.0	0.9	9
30-Oct	0:00		10:00	0-03 N	146-50 E	bc	90	1.8	1009.2	29.0	22.0	66	29.5	0.0	0.9	8
	3:00		13:00	0-04 N	146-50 E	bc	140	2.2	1007.0	29.5	22.0	64	29.8	0.0	0.9	8
	6:00		16:00	0-04 N	146-48 E	bc	120	3.5	1006.2	29.4	22.1	65	29.7	0.0	0.8	9
	9:00		19:00	0-28 N	146-51 E	bc	110	2.4	1007.7	28.1	21.2	66	30.1	0.0	0.9	7
	12:00		22:00	1-13 N	147-01 E	bc	110	2.7	1009.4	28.4	21.2	65	29.9	0.0	0.9	7
	15:00	31-Oct	1:00	1-46 N	146-49 E	bc	100	2.8	1007.8	27.9	21.9	70	29.7	0.0	1.1	13
	18:00		4:00	2-12 N	147-07 E	bc	140	2.5	1006.6	27.6	21.8	71	29.6	0.0	0.9	7
	21:00		7:00	1-55 N	147-05 E	bc	130	3.9	1008.0	28.1	21.9	69	29.5	0.0	0.9	7
31-Oct	0:00		10:00	2-18 N	146-58 E	bc	140	4.2	1008.6	29.1	21.9	65	29.7	0.0	1.0	7
	3:00		13:00	3-07 N	147-00 E	bc	160	4.8	1006.7	30.2	22.3	63	30.2	0.0	1.1	7
	6:00		16:00	3-53 N	147-04 E	r	110	6.7	1006.5	24.6	22.9	91	29.7	9.4	1.3	9
	9:00		19:00	4-36 N	147-09 E	r	100	1.8	1008.5	24.4	23.0	92	30.0	1.6	1.3	7
	12:00		22:00	5-09 N	147-09 E	r	150	3.6	1009.4	25.4	22.7	85	29.8	0.1	1.1	9
	15:00	1-Nov	1:00	4-43 N	146-59 E	o	190	2.9	1008.6	24.4	22.8	91	29.9	0.2	1.4	17
	18:00		4:00	5-02 N	146-57 E	o	180	6.0	1006.5	25.8	22.7	83	29.8	0.0	1.1	8
	21:00		7:00	4-51 N	146-57 E	bc	140	0.9	1008.5	26.7	23.1	81	29.4	0.0	1.1	7
1-Nov	0:00		10:00	4-52 N	146-56 E	bc	230	0.8	1008.9	29.1	23.0	70	29.9	0.0	1.1	7
	3:00		13:00	4-51 N	146-57 E	bc	290	0.2	1007.0	30.3	23.1	66	29.9	0.0	1.1	7
	6:00		16:00	4-51 N	146-55 E	c	260	2.9	1005.9	28.6	22.2	68	30.5	0.0	1.0	7
	9:00		19:00	4-50 N	146-58 E	c	20	1.7	1007.3	28.5	22.6	70	29.9	0.0	1.0	8

Table 6.1.1-2

	12:00		22:00	4-52 N	146-55 E	bc	340	2.9	1008.6	28.7	22.7	70	29.7	0.0	1.2	8
	15:00	2-Nov	1:00	4-51 N	146-55 E	bc	250	1.6	1007.4	27.8	21.3	68	29.9	0.0	1.0	8
	18:00		4:00	4-51 N	146-58 E	bc	90	1.6	1006.0	26.5	22.5	79	29.9	0.0	1.0	8
	21:00		7:00	4-51 N	146-57 E	bc	130	4.0	1007.2	27.7	23.5	78	29.8	0.0	1.0	8
2-Nov	0:00		10:00	4-51 N	146-57 E	bc	160	2.5	1008.3	29.7	23.0	68	30.1	0.0	1.1	8
	3:00		13:00	4-51 N	146-57 E	bc	170	1.7	1006.2	29.2	23.2	70	30.3	0.0	1.2	8
	6:00		16:00	5-01 N	146-56 E	c	240	3.5	1004.9	29.4	21.9	64	30.5	0.0	1.2	9
	9:00		19:00	5-01 N	146-54 E	bc	250	5.1	1006.6	28.7	22.3	68	30.1	0.0	1.1	8
	12:00		22:00	5-04 N	146-55 E	bc	210	4.5	1007.6	28.1	22.7	73	29.9	0.0	1.1	8
	15:00	3-Nov	1:00	5-02 N	146-59 E	bc	170	5.8	1006.1	27.8	22.8	74	29.9	0.0	1.1	8
	18:00		4:00	5-04 N	146-56 E	bc	240	6.0	1005.6	26.8	23.0	80	29.8	0.0	1.0	7
	21:00		7:00	5-04 N	146-56 E	c	260	3.6	1007.3	27.5	23.1	77	29.8	0.0	1.0	8
3-Nov	0:00		10:00	5-03 N	146-59 E	bc	180	6.1	1008.0	29.8	23.1	68	29.9	0.0	1.1	7
	3:00		13:00	5-03 N	146-56 E	bc	170	6.9	1005.5	29.8	23.2	68	30.1	0.0	1.0	7
	6:00		16:00	5-02 N	146-57 E	bc	190	5.4	1004.5	28.5	23.5	74	30.1	0.0	1.0	7
	9:00		19:00	5-01 N	147-08 E	bc	180	5.6	1006.2	28.3	22.7	72	30.0	0.0	1.0	8
	12:00		22:00	5-00 N	147-55 E	bc	170	5.0	1007.6	28.6	21.1	64	29.9	0.0	1.0	7
	15:00	4-Nov	1:00	4-57 N	148-03 E	bc	170	6.4	1006.5	28.4	22.3	70	29.9	0.0	0.9	7
	18:00		4:00	4-25 N	148-22 E	bc	150	4.9	1005.7	28.2	22.0	69	29.9	0.0	1.0	9
	21:00		7:00	3-45 N	148-48 E	bc	130	6.2	1007.3	28.4	22.1	69	29.9	0.0	1.0	9
4-Nov	0:00		10:00	3-05 N	149-13 E	bc	150	5.2	1008.1	29.6	22.3	65	29.8	0.0	0.9	9
	3:00		13:00	2-27 N	149-37 E	bc	140	5.5	1006.3	30.3	22.4	63	29.9	0.0	1.0	7
	6:00		16:00	1-49 N	150-01 E	bc	140	5.4	1006.0	28.7	22.5	69	29.6	0.0	1.1	7
	9:00		19:00	1-11 N	150-25 E	bc	140	4.6	1008.3	28.1	22.5	72	29.4	0.0	1.1	7
	12:00		22:00	0-33 N	150-49 E	bc	130	3.7	1009.9	28.0	22.5	72	29.2	0.0	1.0	8
	15:00	5-Nov	1:00	0-05 S	151-15 E	bc	140	2.6	1008.6	27.9	22.1	71	29.3	0.0	0.9	7
	18:00		4:00	0-44 S	151-38 E	bc	90	4.5	1007.6	27.2	23.3	79	29.1	0.0	0.8	7
	21:00		7:00	1-20 S	152-03 E	bc	70	6.9	1009.8	28.3	23.1	73	29.6	0.0	1.0	8
5-Nov	0:00		10:00	1-58 S	152-27 E	bc	100	5.6	1009.4	28.6	24.2	77	29.6	0.0	1.0	9
	3:00		13:00	2-29 S	153-01 E	bc	120	5.5	1006.7	29.9	23.0	66	29.9	0.0	1.0	8
	6:00		16:00	2-58 S	153-36 E	bc	140	3.9	1005.7	29.7	22.8	67	30.3	0.0	0.9	8
	9:00		19:00	3-27 S	154-10 E	q	120	3.0	1007.9	27.8	24.0	80	30.3	0.0	0.9	10
	12:00		22:00	3-46 S	154-49 E	bc	80	6.0	1009.0	28.4	22.8	72	29.9	0.0	0.9	5
	15:00	6-Nov	1:00	3-55 S	155-32 E	bc	80	4.5	1007.2	28.2	22.6	72	29.9	0.0	1.0	6
	18:00		4:00	4-04 S	155-59 E	bc	90	5.5	1007.2	28.1	21.5	67	29.8	0.0	1.4	11
	21:00		7:00	4-52 S	155-59 E	bc	60	2.8	1009.0	28.9	22.6	69	29.8	0.0	1.3	14
6-Nov	0:00		10:00	5-00 S	155-58 E	bc	50	2.7	1009.1	31.3	22.9	61	29.9	0.0	0.8	8
	3:00		13:00	5-02 S	156-01 E	bc	10	3.1	1006.9	31.2	23.2	62	30.1	0.0	1.0	8
	6:00		16:00	4-20 S	156-00 E	bc	40	1.9	1006.7	29.4	22.3	66	30.6	0.0	0.9	6
	9:00		19:00	3-33 S	155-59 E	bc	60	2.3	1008.8	28.7	21.8	66	30.4	0.0	1.0	7
	12:00		22:00	2-45 S	155-58 E	bc	90	2.2	1009.1	28.1	22.0	70	30.1	0.0	1.0	8
	15:00	7-Nov	1:00	1-57 S	155-55 E	bc	170	0.8	1007.4	27.3	22.0	73	29.7	0.0	1.0	8
	18:00		4:00	2-04 S	155-58 E	bc	250	0.7	1007.3	27.1	22.2	75	29.6	0.0	1.0	8
	21:00		7:00	2-05 S	155-58 E	bc	20	0.5	1009.2	28.6	22.4	69	29.5	0.0	0.8	8
7-Nov	0:00		10:00	2-04 S	156-00 E	bc	160	1.1	1009.8	28.6	22.0	68	29.5	0.0	1.0	9
	3:00		13:00	2-01 S	156-56 E	bc	280	1.5	1007.1	30.2	22.0	62	29.7	0.0	0.8	9
	6:00		16:00	1-36 S	156-00 E	bc	210	3.4	1005.8	29.0	22.4	68	30.0	0.0	1.0	9
	9:00		19:00	0-49 S	156-05 E	bc	180	2.1	1008.4	27.8	22.4	72	28.8	0.0	1.0	9
	12:00		22:00	0-03 S	156-10 E	bc	200	3.2	1009.2	27.3	22.7	76	29.0	0.0	1.0	9
	15:00	8-Nov	1:00	0-00 N	155-59 E	bc	260	3.3	1007.3	27.3	22.4	75	29.0	0.0	1.0	10
	18:00		4:00	0-00 N	155-54 E	bc	30	1.6	1007.4	27.1	22.4	76	29.0	0.0	1.0	10
	21:00		7:00	0-00 N	155-59 E	bc	10	1.2	1009.6	28.5	23.0	72	29.0	0.0	1.0	8
8-Nov	0:00		10:00	0-00 N	156-08 E	bc	330	2.4	1009.9	30.0	23.1	67	29.1	0.0	1.0	7
	3:00		13:00	0-00 N	156-09 E	bc	320	3.9	1007.3	29.9	23.0	67	29.6	0.0	0.9	8
	6:00		16:00	0-00 N	156-01 E	bc	150	1.3	1007.6	28.2	22.3	70	29.2	0.0	0.8	9
	9:00		19:00	0-01 N	156-02 E	bc	90	2.6	1009.5	28.1	22.2	71	29.2	0.0	0.8	9
	12:00		22:00	0-02 N	156-04 E	bc	360	1.3	1010.4	27.6	22.5	74	29.3	0.0	0.9	8
	15:00	9-Nov	1:00	0-03 N	156-01 E	bc	10	3.0	1008.1	27.5	22.4	74	29.1	0.0	0.9	9
	18:00		4:00	0-01 N	156-01 E	bc	40	4.1	1007.8	27.1	22.6	77	29.2	0.0	0.9	9
	21:00		7:00	0-00 N	156-03 E	bc	60	4.6	1009.5	28.6	22.7	71	29.2	0.0	0.9	8
9-Nov	0:00		10:00	0-00 N	156-02 E	bc	80	4.9	1009.9	29.8	22.0	63	29.4	0.0	1.0	8
	3:00		13:00	0-01 N	156-02 E	bc	80	4.8	1006.9	29.9	22.4	64	29.7	0.0	0.9	8
	6:00		16:00	0-00 N	165-01 E	bc	100	5.9	1006.8	29.9	22.1	63	29.7	0.0	1.0	8
	9:00		19:00	0-04 N	156-01 E	bc	100	6.2	1009.2	28.6	22.5	70	29.6	0.0	1.0	8
	12:00		22:00	1-26 N	156-01 E	bc	100	7.7	1010.1	28.4	22.8	72	29.5	0.0	1.1	9
	15:00	10-Nov	1:00	2-02 N	156-07 E	bc	110	6.4	1008.7	28.0	22.9	74	29.4	0.0	1.3	10
	18:00		4:00	2-05 N	155-59 E	bc	110	6.0	1008.5	28.3	22.0	69	29.4	0.0	1.2	9
	21:00		7:00	2-02 N	156-00 E	bc	90	6.6	1010.6	28.8	22.5	69	29.3	0.0	1.2	9
10-Nov	0:00		10:00	2-03 N	155-58 E	bc	120	6.8	1010.4	30.0	22.4	64	29.4	0.0	1.2	9
	3:00		13:00	2-04 N	155-59 E	bc	120	6.2	1008.2	30.3	22.1	61	29.5	0.0	1.2	9
	6:00		16:00	2-04 N	156-00 E	bc	110	6.6	1007.2	29.9	21.6	61	29.5	0.0	1.2	9
	9:00		19:00	1-56 N	156-03 E	bc	110	6.3	1008.9	28.5	22.6	70	29.4	0.0	1.2	9
	12:00		22:00	1-57 N	156-01 E	bc	110	7.3	1009.2	28.1	22.8	73	29.3	0.0	1.2	7
	15:00	11-Nov	1:00	1-52 N	155-59 E	bc	110	5.9	1008.2	27.8	22.7	74	29.3	0.0	1.0	8
	18:00		4:00	1-52 N	155-57 E	bc	110	4.2	1008.8	28.0	21.9	70	29.2	0.0	1.0	8
	21:00		7:00	1-55 N	155-59 E	bc	120	2.7	1010.4	28.6	22.8	71	29.2	0.0	1.2	10
11-Nov	0:00		10:00	1-55 N	155-59 E	bc	140	2.1	1010.5	30.1	23.1	66	29.3	0.0	1.0	7
	3:00		13:00	1-57 N	156-03 E	bc	110	4.6	1008.7	29.2	22.1	65	29.7	0.0	1.0	7

Table 6.1.1-2

	6:00		16:00	1-59 N	155-59 E	bc	110	5.0	1008.1	29.3	22.0	65	29.6	0.0	1.2	10
	9:00		19:00	1-58 N	156-01 E	bc	100	5.1	1010.6	28.6	21.6	66	29.5	0.0	1.0	9
	12:00		22:00	1-58 N	155-56 E	bc	110	5.3	1010.7	28.2	21.4	67	29.3	0.0	1.2	8
	15:00	12-Nov	1:00	1-57 N	155-58 E	bc	110	4.9	1009.2	27.5	22.0	72	29.3	0.0	1.0	8
	18:00		4:00	1-57 N	156-02 E	bc	130	4.6	1008.5	27.3	22.4	74	29.3	0.0	1.0	8
	21:00		7:00	1-59 N	156-00 E	bc	120	3.9	1010.5	28.5	22.3	69	29.3	0.0	0.9	9
12-Nov	0:00		10:00	2-01 N	155-58 E	bc	100	2.4	1010.8	29.0	21.6	64	29.3	0.0	0.9	9
	3:00		13:00	2-37 N	155-59 E	bc	110	4.1	1008.2	29.3	21.7	64	29.8	0.0	1.0	8
	6:00		16:00	3-24 N	156-02 E	bc	100	3.9	1008.1	28.6	21.5	65	29.8	0.0	1.2	9
	9:00		19:00	4-11 N	156-03 E	bc	80	3.7	1010.1	28.3	20.7	63	29.8	0.0	1.4	10
	12:00		22:00	4-56 N	156-04 E	bc	100	4.3	1010.8	27.8	21.2	67	29.7	0.0	1.4	10
	15:00	13-Nov	1:00	4-56 N	156-06 E	bc	100	2.6	1009.8	27.8	20.3	64	29.7	0.0	1.3	8
	18:00		4:00	4-56 N	156-05 E	bc	140	3.9	1009.6	27.5	21.1	68	29.7	0.0	1.4	11
	21:00		7:00	4-58 N	156-04 E	bc	120	3.8	1011.3	28.4	21.1	65	29.6	0.0	1.0	8
13-Nov	0:00		10:00	4-59 N	156-02 E	bc	100	3.9	1011.6	28.8	21.2	64	29.7	0.0	1.0	8
	3:00		13:00	5-01 N	155-58 E	bc	100	4.8	1009.0	29.8	20.7	58	29.8	0.0	1.1	8
	6:00		16:00	5-01 N	155-58 E	bc	100	3.8	1008.0	28.8	21.4	64	29.8	0.0	1.0	8
	9:00		19:00	5-29 N	155-58 E	bc	90	6.0	1009.5	28.2	20.2	62	29.6	0.0	1.1	10
	12:00		22:00	6-15 N	156-04 E	bc	70	4.1	1010.4	28.3	20.2	61	29.5	0.0	1.1	10
	15:00	14-Nov	1:00	7-01 N	156-11 E	bc	60	4.2	1009.4	28.0	22.0	70	29.5	0.0	1.0	10
	18:00		4:00	7-47 N	156-16 E	bc	60	5.5	1008.8	28.1	22.4	71	29.4	0.0	0.9	9
	21:00		7:00	8-05 N	156-00 E	bc	50	6.4	1010.4	28.7	23.7	74	29.4	0.0	1.4	13
14-Nov	0:00		10:00	8-05 N	156-00 E	bc	60	5.3	1010.8	28.5	23.2	73	29.4	0.0	1.1	9
	3:00		13:00	7-57 N	156-01 E	bc	90	3.0	1008.3	30.0	23.2	67	29.7	0.0	1.0	9
	6:00		16:00	7-57 N	156-02 E	bc	50	4.3	1008.1	28.7	23.3	73	29.7	0.0	1.4	10
	9:00		19:00	8-29 N	155-32 E	bc	80	6.4	1009.6	28.4	23.7	76	29.5	0.0	2.0	11
	12:00		22:00	9-04 N	155-00 E	bc	70	5.9	1010.6	28.0	24.5	82	29.3	0.0	1.9	11
	15:00	15-Nov	1:00	9-38 N	154-28 E	bc	80	7.3	1009.9	27.7	24.2	81	29.3	0.0	2.1	10
	18:00		4:00	10-13 N	153-56 E	bc	70	5.0	1009.2	27.7	23.5	78	29.3	0.2	2.2	10
	21:00		7:00	10-49 N	153-23 E	bc	90	4.3	1011.4	28.5	22.7	71	29.1	0.0	2.4	10
15-Nov	0:00		10:00	11-22 N	152-50 E	bc	80	3.8	1012.0	28.9	23.5	73	29.1	0.0	2.5	10
	3:00		13:00	11-58 N	152-18 E	bc	110	3.5	1008.6	28.9	22.6	69	29.6	0.0	2.3	11
	6:00		16:00	12-35 N	151-45 E	bc	130	2.1	1008.8	28.9	23.1	71	29.8	0.0	2.4	11
	9:00		19:00	13-11 N	151-13 E	bc	180	3.2	1010.0	28.4	22.2	69	29.9	0.0	2.9	13
	12:00		22:00	13-46 N	150-04 E	bc	200	2.0	1010.9	27.5	24.4	83	29.5	0.0	2.5	10
	15:00	16-Nov	1:00	14-22 N	150-06 E	bc	90	5.1	1009.9	27.7	23.5	78	29.3	0.9	2.1	10
	18:00		4:00	14-29 N	150-02 E	bc	100	3.0	1010.0	27.0	24.5	86	29.3	0.0	1.7	10
	21:00		7:00	14-31 N	150-04 E	bc	210	1.0	1011.8	27.9	24.1	80	29.3	0.0	1.8	11
16-Nov	0:00		10:00	14-33 N	150-04 E	bc	280	1.9	1012.7	28.8	23.4	73	29.7	0.0	1.9	10
	3:00		13:00	14-38 N	149-56 E	bc	340	2.4	1009.8	29.3	22.8	68	29.8	0.0	2.2	10
	6:00		16:00	14-35 N	150-00 E	bc	310	1.7	1008.7	28.9	22.6	69	30.1	0.0	1.6	10
	9:00		19:00	14-37 N	150-00 E	bc	330	2.5	1010.0	28.3	22.5	71	29.4	0.0	1.5	10
	12:00		22:00	14-29 N	150-00 E	bc	310	3.5	1010.7	27.9	23.1	75	29.5	0.0	1.6	9
	15:00	17-Nov	1:00	14-28 N	149-59 E	bc	310	3.7	1010.2	27.8	22.5	73	29.5	0.0	1.6	9
	18:00		4:00	14-29 N	149-59 E	bc	29	2.7	1009.3	27.9	22.5	73	29.4	0.0	1.5	9
	21:00		7:00	14-37 N	149-59 E	c	180	3.7	1010.2	26.6	24.9	90	29.3	0.0	1.6	8
17-Nov	0:00		10:00	15-20 N	149-59 E	c	120	7.1	1011.0	27.3	24.5	85	29.2	1.2	1.7	7
	3:00		13:00	15-30 N	149-57 E	bc	70	6.6	1008.8	30.1	23.8	69	29.4	0.0	1.8	10
	6:00		16:00	15-29 N	149-54 E	bc	50	7.0	1008.3	28.8	24.1	76	29.3	0.0	1.6	9
	9:00		19:00	15-28 N	149-52 E	bc	50	6.9	1009.5	27.5	23.5	79	29.2	0.0	1.8	9
	12:00		22:00	15-26 N	149-50 E	r	30	10.0	1010.4	26.0	23.9	88	29.2	0.1	1.9	9
	15:00	18-Nov	1:00	15-24 N	149-48 E	bc	60	8.2	1008.7	27.7	23.1	76	29.2	0.2	1.9	9
	18:00		4:00	15-23 N	149-46 E	bc	60	9.0	1007.8	27.5	21.5	70	29.2	0.0	1.9	9
	21:00		7:00	15-20 N	149-31 E	bc	70	6.8	1009.2	27.9	21.9	70	29.2	0.0	2.1	18
18-Nov	0:00		10:00	15-04 N	148-44 E	bc	90	8.4	1010.0	29.3	23.3	70	29.3	0.0	2.5	19

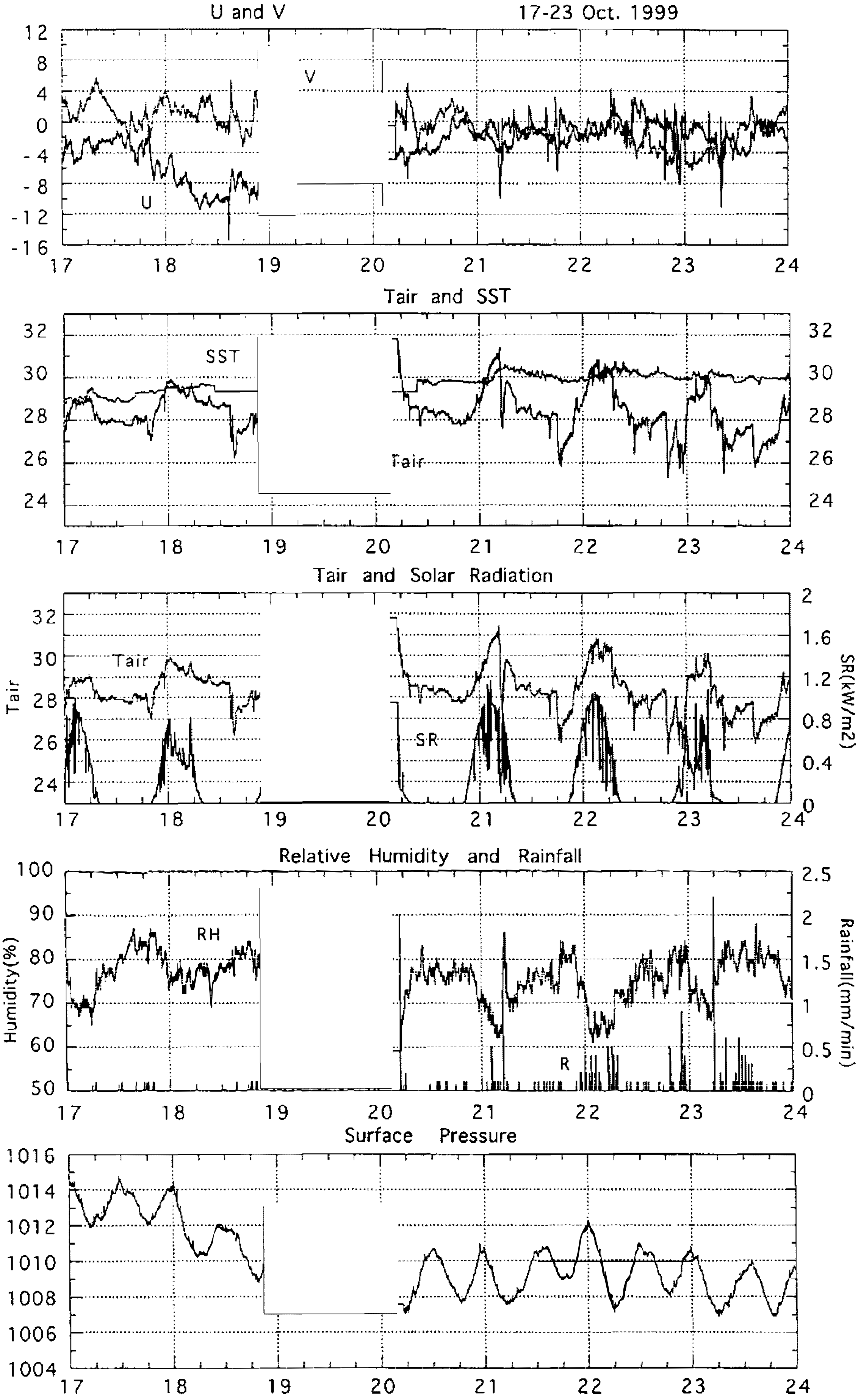


Fig.6.1.1-2 17-23 Oct

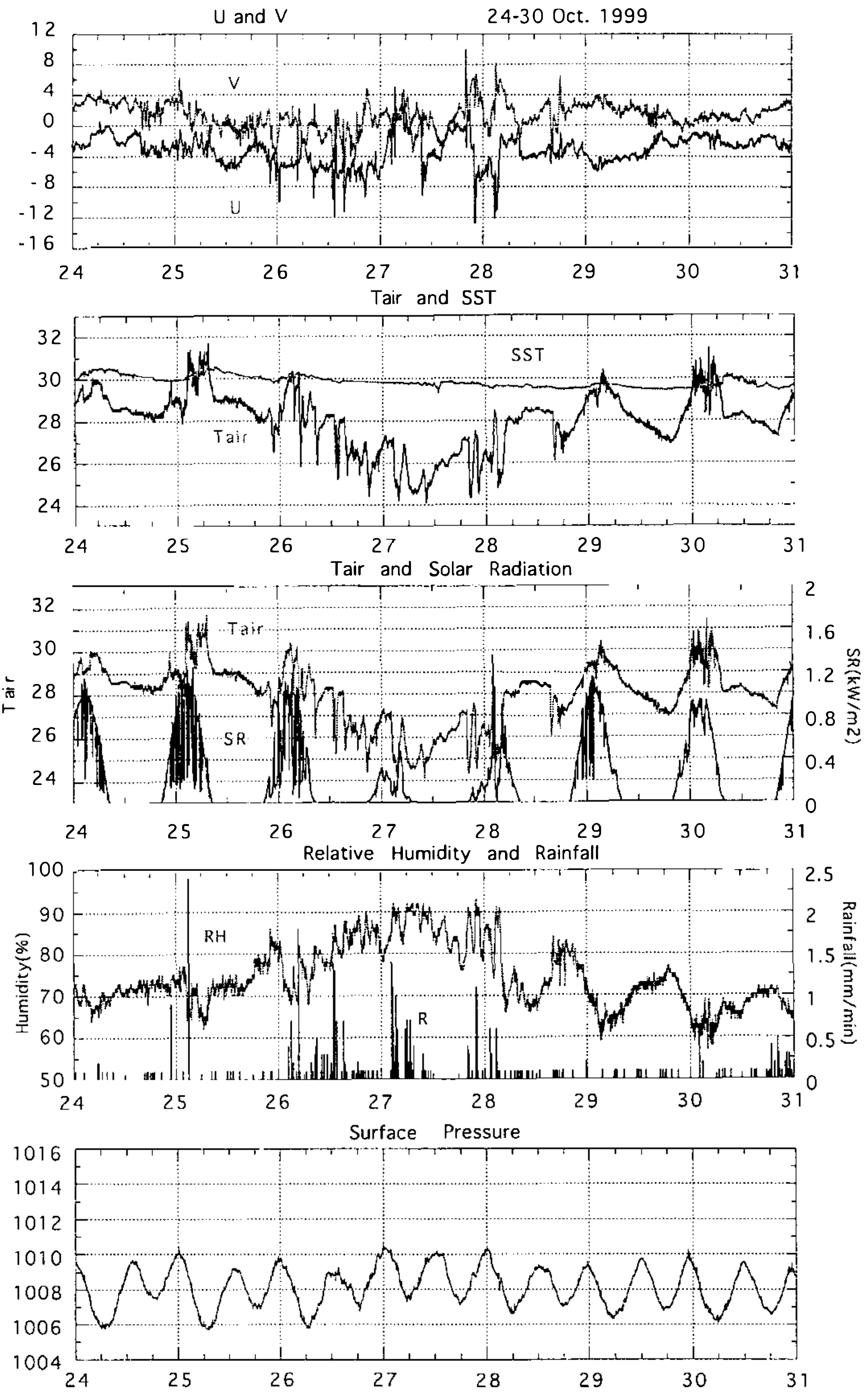


Fig.6.1.1-3 24-30 Oct

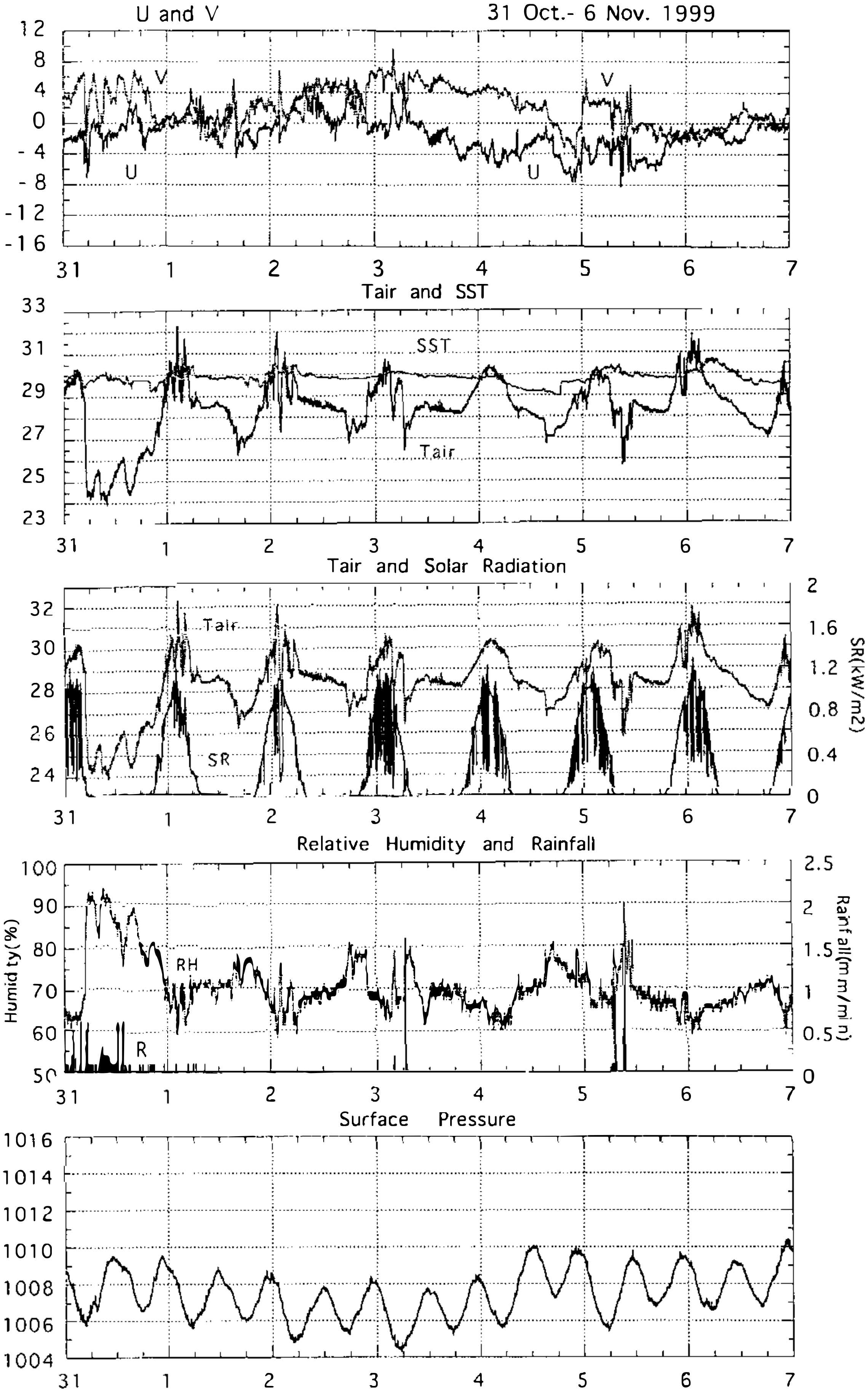


Fig.6.1.1-4 31-6 Nov

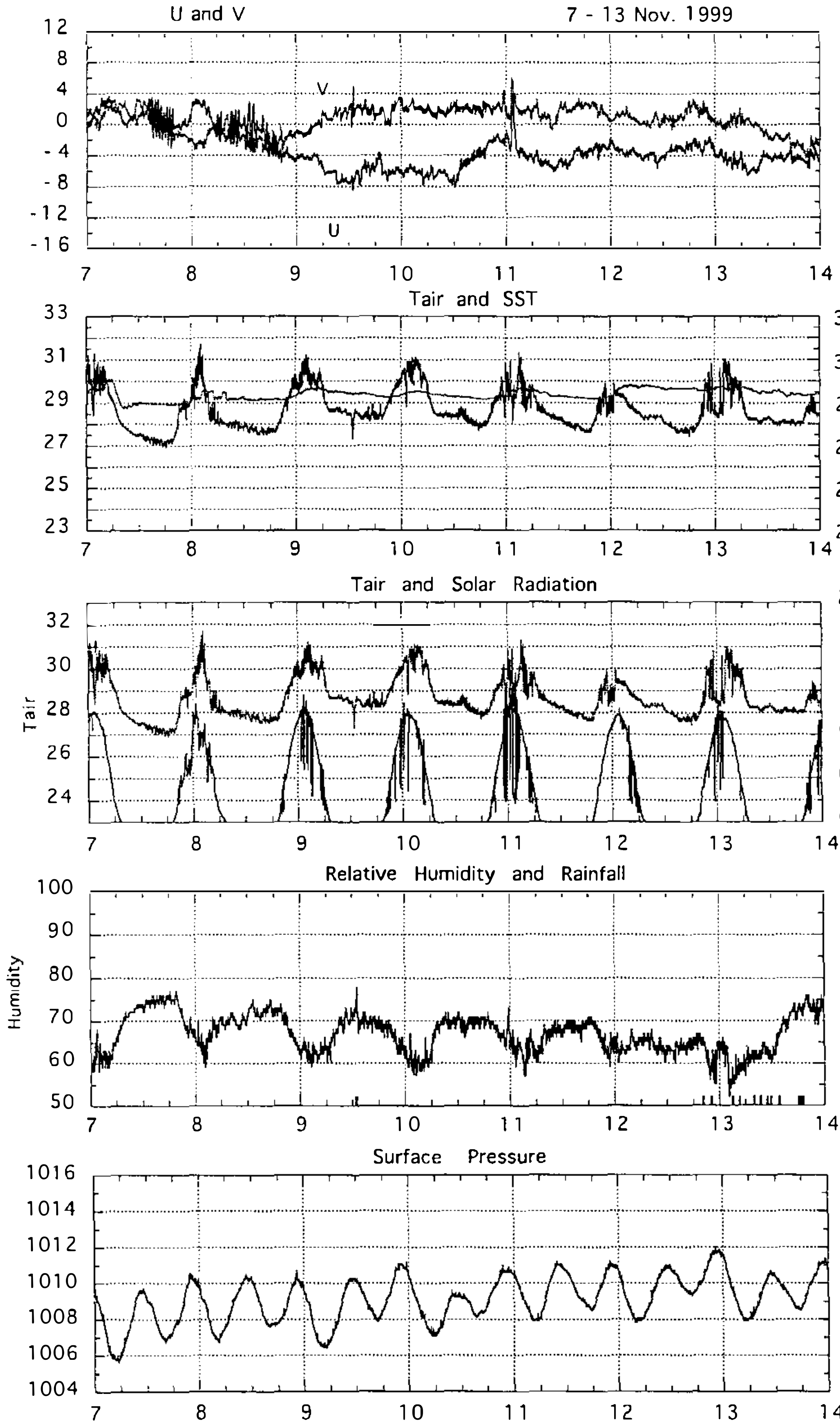


Fig.6.1.1-5 7-13 Nov

6.1.2 Atmospheric Sounding

(1) Personnel

Tetsuo Nakazawa (MRI):	Principal Investigator
Masaki Hanyu (GODI):	Operation Leader
Satoshi Okumura (GODI)	

(2) Objective

Atmospheric soundings are measured using radiosonde.

(3) Measured Parameters

Pressure
Temperature
Relative humidity
Wind speed / direction

(4) Methods

We observed vertical profiles of pressure, temperature, relative humidity and wind speed/direction using VAISALA DigiCORA MW11 semi-automatic radiosonde system and VAISALA RS80-15G radiosonde. The surface data was measured by handy humidity and temperature meter (VAISALA HMI41/45), onboard resonator digital barometer (YOKOGAWA AP-100) and anemometer (KOSHIN KC1570A). From RS-01 to RS-09, we also utilized a VAISALA GC kit which check the 0 % point of relative humidity. After RS-10, we used VAISALA HMI41/45 as GC reference. After calibrating by a VAISALA GC kit, we experienced that a humidity of a radiosonde was always lower than that of the VAISALA HM141/45. As the humidity data at the surface is referred from the referenced data, the moisture at the surface has a positive/wet (sometimes greater than 10%) bias. This tendency can be easily found in the EMAGRAM in the Appendix before RS-09. After RS-10 there was no large bias between the surface reference and the upper sounding data just above the surface.

Table 6.1.2-1 shows radiosonde launch log.

(5) Preliminary results

Profiles of temperature and dew point temperature are plotted on the thermodynamic chart (EMAGRAM) and shown in the Appendix. Wind profile is also shown there.

The disturbed conditions in this cruise was in 27 Oct. and 31 Oct. These two cases were under the convective and stratiform clouds with showers. In 27 Oct. we performed 3-hourly operation from 00Z, 27 Oct. to 00Z, 28 Oct. The difference between air temperature and dew point temperature was small during the period, telling that the radiosonde was inside the precipitating clouds. In 31 Oct. the radiosonde was released every 6 hours from 00Z, 31 Oct. to 12Z, 31 Oct. The distinct difference is found if we compare the vertical moisture profile between 00Z and 06Z. In 00Z the atmosphere was dry up to 300 hPa. However, in 06Z the radiosonde was inside the cloud and the humidity was almost 100% from 950 hPa to 500 hPa.

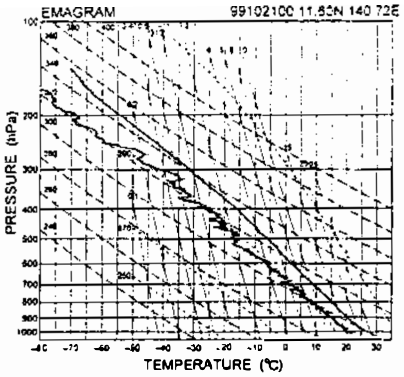
(6) Data archives

All sounding data have been sent to the world through GTS by Japan Meteorological Agency.

Radiosonde data obtained during this cruise will be submitted to the DMO (Data Management Office), JAMSTEC and will be under their control.

Table 6.1.2-1

No.	Time(UTC)				Position				P	T	RH	WD	WS	Max. Altitude		Cloud	Cloud
	YY	MM	DD	HH	Lat.		Long.		(hPa)	(deg-C)	(%)	(deg)	(m/s)	(hPa)	(m)	Amount	Type
1	99	10	21	00	11.60	N	140.72	E	1008.7	28.8	71	46	2.5	141.6	14527	3	Cs,Cu
2	99	10	22	00	7.99	N	136.94	E	1010.1	28.1	76	53	2.8	50.9	20516	5	Cu,Ci
3	99	10	22	12	7.28	N	136.97	E	1009.0	28.1	73	348	2.6	32.2	23379	2	Cu,Sc,Ci
4	99	10	22	18	6.18	N	137.00	E	1006.6	28.1	77	5	3.8	158.8	13864	7	Ci,Cb
5	99	10	23	00	4.97	N	137.10	E	1008.7	27.2	74	84	0.8	52.8	20256	8	Cu,Cb,Ac
6	99	10	23	06	4.83	N	137.30	E	1005.3	29.3	71	35	4.1	75.5	18113	9	Cu,Cb
7	99	10	23	12	4.03	N	137.32	E	1007.2	27.5	79	16	5.2	27.8	24234	8	Cu,Cs,Ci
8	99	10	23	18	2.99	N	137.58	E	1005.4	26.1	85	352	1.3	26.3	24583	2	Cs,Ci
9	99	10	24	00	2.83	N	137.58	E	1007.9	28.4	77	114	2.3	35.6	22705	1	Cb
10	99	10	25	00	2.00	N	138.02	E	1008.1	29.3	72	145	4.4	74.3	18183	3	Cu,Ac
11	99	10	26	00	1.00	N	138.00	E	1008.0	27.6	84	60	5.9	32.2	23369	8	Ns,Cu,Cb
12	99	10	27	00	0.06	N	138.00	E	1008.3	27.6	80	89	7.1	40.2	22066	10	As,Ci
13	99	10	27	03	0.07	N	138.05	E	1007.8	27.2	84	94	1.6	532.8	5358	10	Ns
14	99	10	27	06	0.08	N	138.02	E	1005.6	26.1	87	202	5.0	348.6	8606	10	Ns
15	99	10	27	09	0.08	N	138.01	E	1006.5	24.9	92	307	3.0	70.7	18545	10	Ac
16	99	10	27	12	0.03	N	138.53	E	1008.1	25.8	85	101	4.1	100.0	16553	10	As
17	99	10	27	15	0.00	N	139.25	E	1007.6	26.2	88	50	4.1	36.9	22511	10	As
18	99	10	27	18	0.00	N	139.88	E	1005.9	26.7	84	153	1.2	44.7	21302	3	Ac,Ci,As
19	99	10	27	21	0.00	N	140.50	E	1005.9	24.9	90	212	1.8	177.8	13174	10	Ns,As,Cu
20	99	10	28	00	0.00	N	141.04	E	1008.5	27.1	79	115	7.8	49.8	20697	10	Ns,Sc
21	99	10	28	06	0.00	N	142.27	E	1004.8	28.2	71	134	4.0	47.5	20929	9	As
22	99	10	29	00	0.00	N	146.24	E	1007.5	28.8	73	130	4.6	91.7	17037	4	Cu
23	99	10	30	00	0.06	N	146.84	E	1007.9	28.3	70	95	2.3	35.2	22807	8	Ci
24	99	10	31	00	2.10	N	147.00	E	1007.2	28.2	70	137	4.3	31.0	23598	2	Cu,Ac,Ci
25	99	10	31	06	3.77	N	147.08	E	1004.4	27.9	79	101	6.7	40.8	21856	-	-
26	99	10	31	12	5.01	N	147.16	E	1007.5	26.1	82	157	3.7	58.7	19659	-	-
27	99	11	1	00	4.85	N	146.94	E	1007.2	28.2	70	117	0.6	38.2	22304	2	Ac,Cu,Ci
28	99	11	1	12	4.87	N	146.91	E	1007.0	28.5	70	332	1.1	39.8	22022	-	-
29	99	11	2	00	4.86	N	146.94	E	1006.3	28.5	72	169	2.9	37.2	22450	3	Cb,Ci
30	99	11	2	12	5.00	N	146.92	E	1006.0	28.6	70	214	4.8	47.0	21020	2	Cu
31	99	11	3	00	5.07	N	147.00	E	1006.3	29.3	71	180	6.6	42.3	21645	7	Cu
32	99	11	3	12	5.01	N	147.70	E	1006.0	28.2	66	165	4.6	34.2	22932	-	-
33	99	11	6	00	5.00	N	155.98	E	1007.6	30.4	62	56	2.3	30.1	23735	-	-
34	99	11	8	00	0.00	N	155.95	E	1008.1	28.1	72	338	1.9	35.6	22684	8	As
35	99	11	9	00	0.01	N	156.03	E	1007.9	28.7	68	75	5.1	41.2	21787	1	Cu
36	99	11	10	00	2.07	N	155.97	E	1009.2	29.4	66	119	6.9	32.0	23353	1	Cu
37	99	11	13	00	4.98	N	156.06	E	1009.7	30.5	60	102	2.6	36.9	22493	3	Cu
38	99	11	14	00	8.09	N	156.02	E	1009.5	28.4	77	61	4.7	24.7	24956	2	Cu
39	99	11	15	00	11.24	N	153.01	E	1010.2	28.3	79	62	3.8	30.8	23571	2	Cu
40	99	11	15	12	13.59	N	150.83	E	1009.2	27.8	81	234	1.4	48.1	20854	-	-
41	99	11	16	00	14.55	N	150.08	E	1011.1	29.0	77	249	1.9	49.5	20687	2	Cb,Cu,Cc
42	99	11	16	12	14.50	N	150.01	E	1009.1	28.2	76	329	2.3	38.3	22253	2	Cu
43	99	11	17	00	15.16	N	149.96	E	1009.4	27.4	87	112	7.9	33.0	23146	10	Ns,As
44	99	11	17	12	15.46	N	149.85	E	1008.5	28.1	78	65	9.6	38.8	22151	-	-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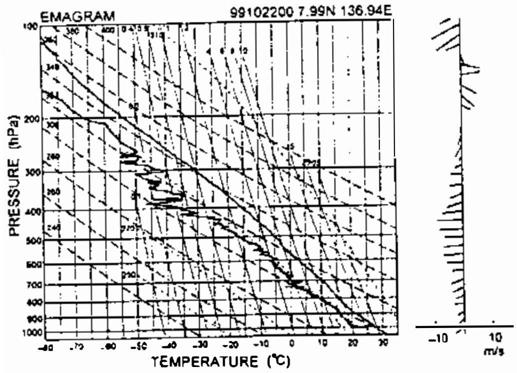
TEMPERATURE (℃)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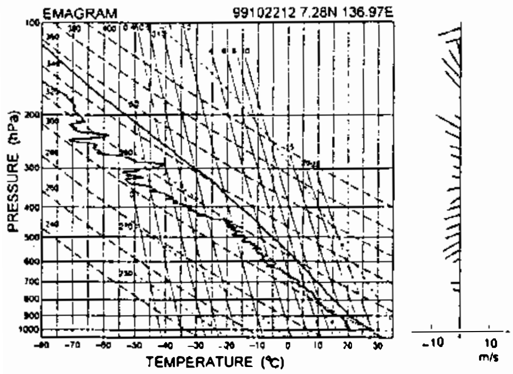
PRESSURE (hPa)
TEMPERATURE (℃)
-10
10
m/s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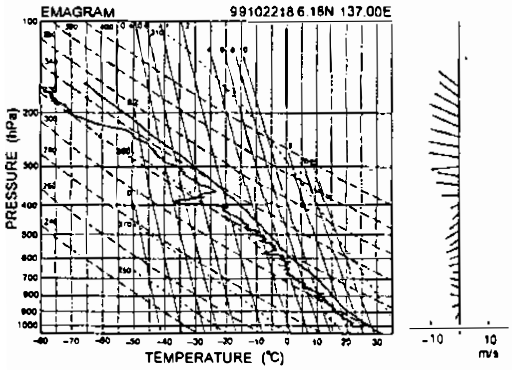
PRESSURE (hPa)
TEMPERATURE (℃)
-10
10
m/s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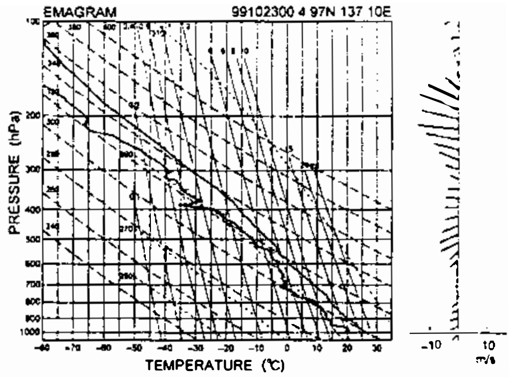
TEMPERATURE (℃)
-10
10
m/s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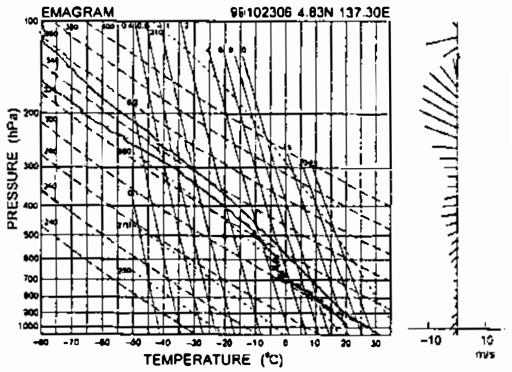
PRESSURE (hPa)
TEMPERATURE (℃)
-10
10
m/s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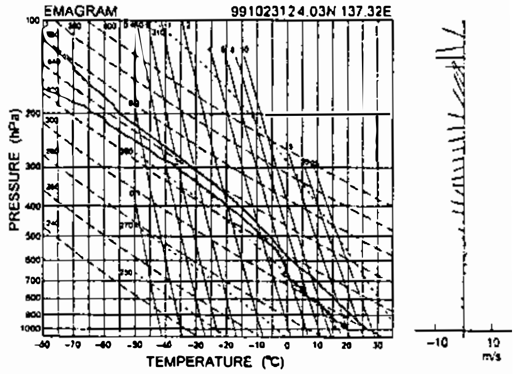
PRESSURE (hPa)
TEMPERATURE (℃)
-10
10
m/s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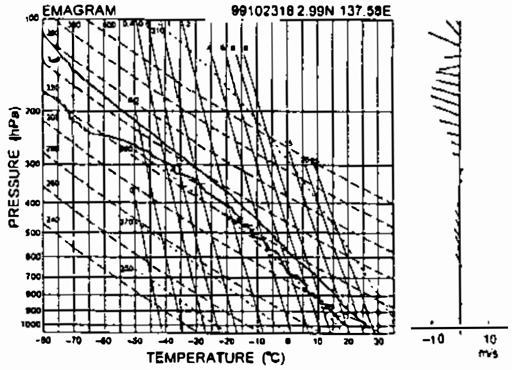
PRESSURE (hPa)
TEMPERATURE (℃)
-10
10
m/s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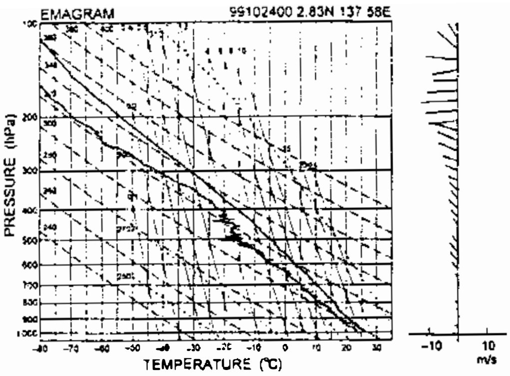
PRESSURE (hPa)
TEMPERATURE (℃)
-10
10
m/s



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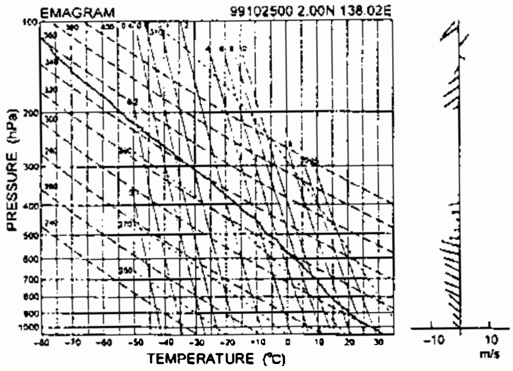

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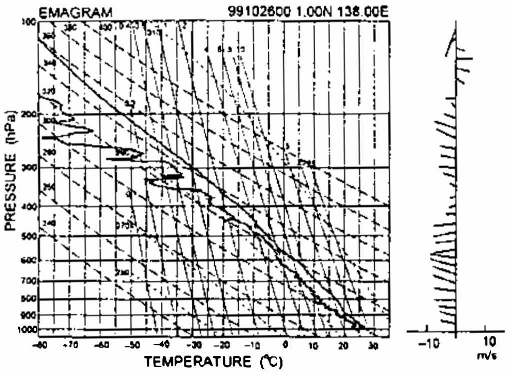

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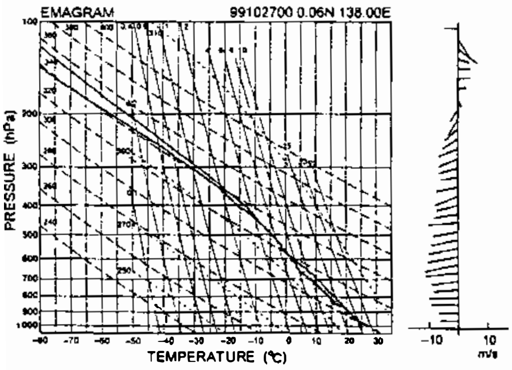

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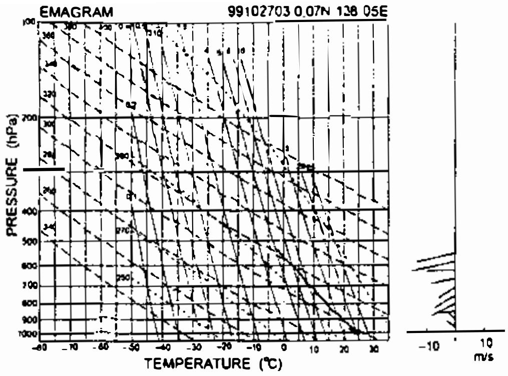

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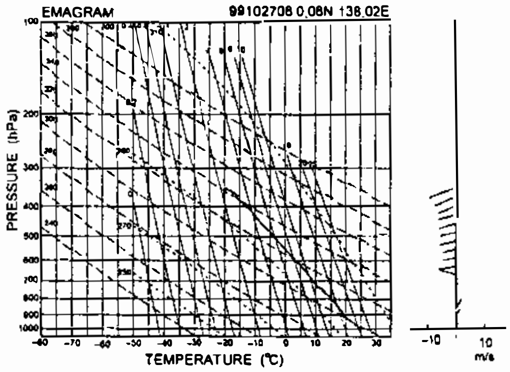

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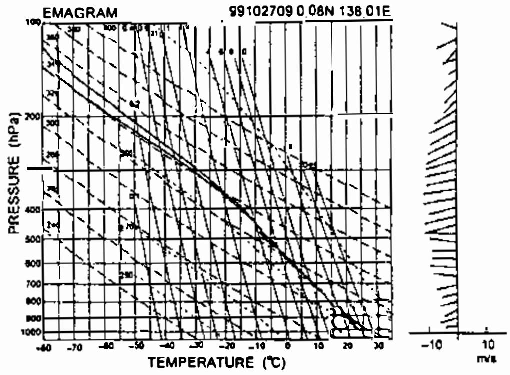

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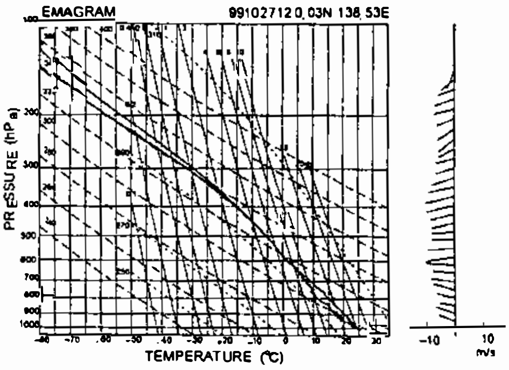

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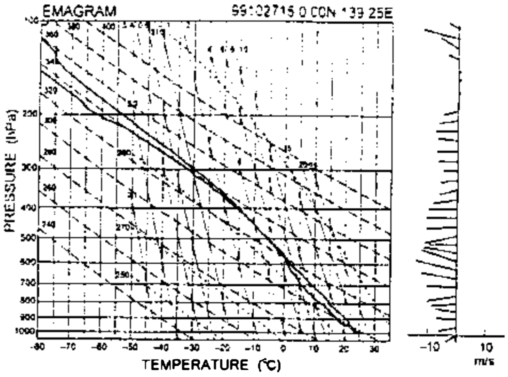
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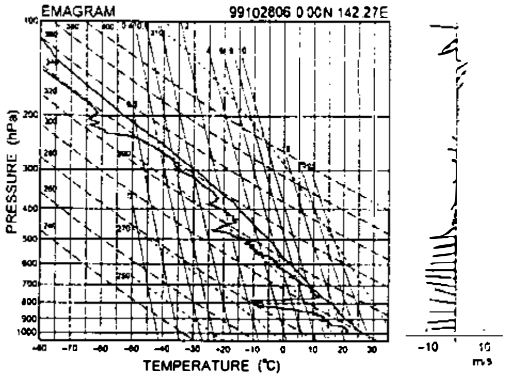
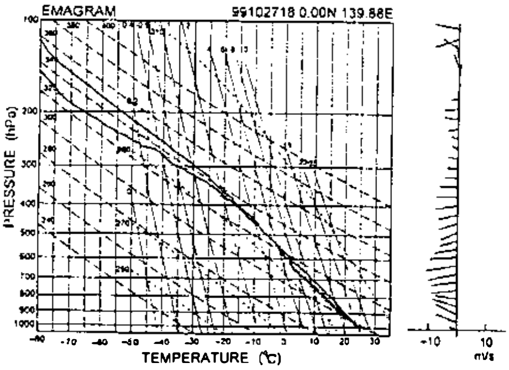
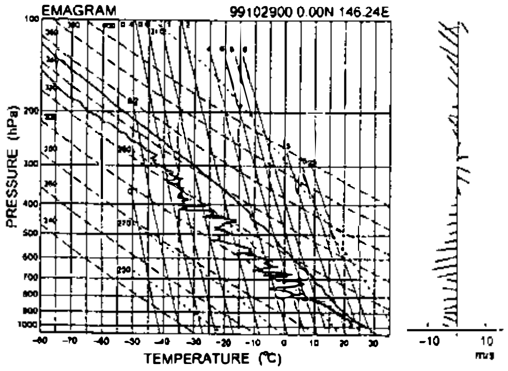
PRESSURE (hPa)
100
200
300
400
500
600
700
800
900
1000
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30
TEMPERATURE (℃)
-10 10
m/s


EMAGRAM
99102806 0.00N 142.27E
PRESSURE (hPa)
100
200
300
400
500
600
700
800
900
1000
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30
TEMPERATURE (℃)
-10 10
m/s

17


EMAGRAM
99102718 0.00N 139.88E
PRESSURE (hPa)
100
200
300
400
500
600
700
800
900
1000
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30
TEMPERATURE (℃)
-10 10
m/s


EMAGRAM
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PRESSURE (hPa)
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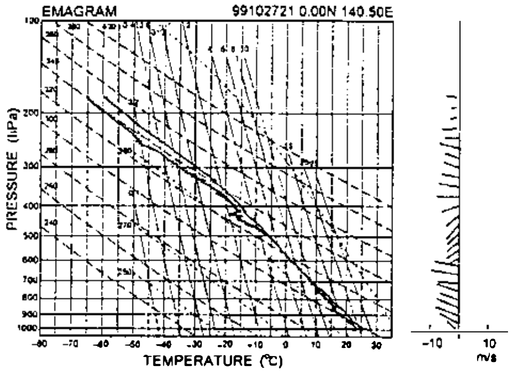
200
300
400
500
600
700
800
900
1000
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30
TEMPERATURE (℃)
-10 10
m/s

18


EMAGRAM
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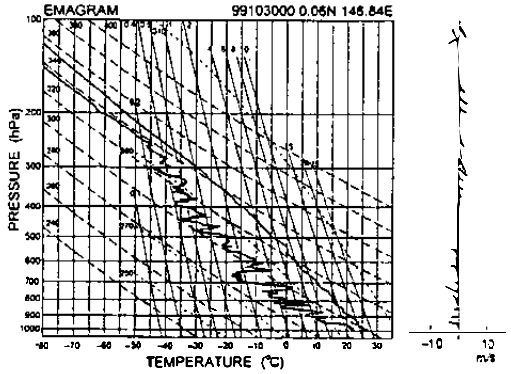
PRESSURE (hPa)
100
200
300
400
500
600
700
800
900
1000
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30
TEMPERATURE (℃)
-10 10
m/s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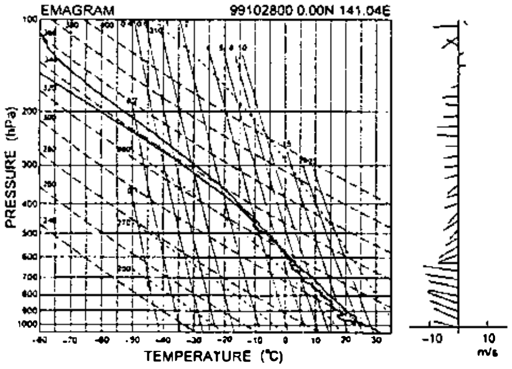
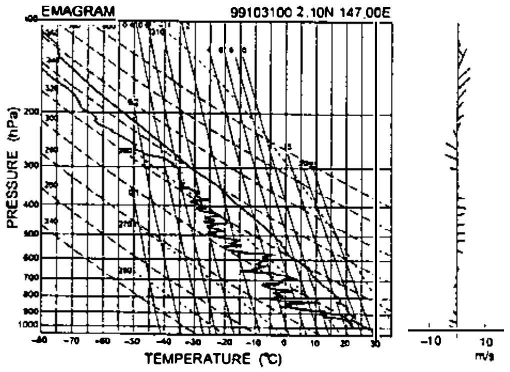
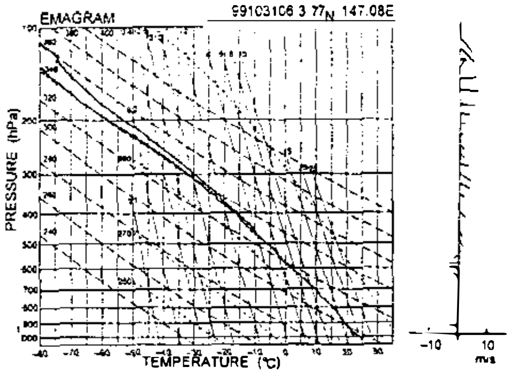
PRESSURE (hPa)
100
200
300
400
500
600
700
800
900
1000
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30
TEMPERATURE (℃)
-10 10
m/s

19


EMAGRAM
99102800 0.00N 141.04E
PRESSURE (hPa)
100
200
300
400
500
600
700
800
900
1000
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30
TEMPERATURE (℃)
-10 10
m/s


EMAGRAM
99103100 2.10N 147.00E
PRESSURE (hPa)
100
200
300
400
500
600
700
800
900
1000
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30
TEMPERATURE (℃)
-10 10
m/s

20


EMAGRAM
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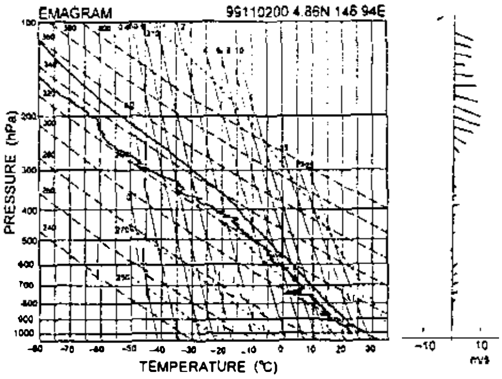
PRESSURE (hPa)
100
200
300
400
500
600
700
800
900
1000
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30
TEMPERATURE (℃)
-10
10
m/s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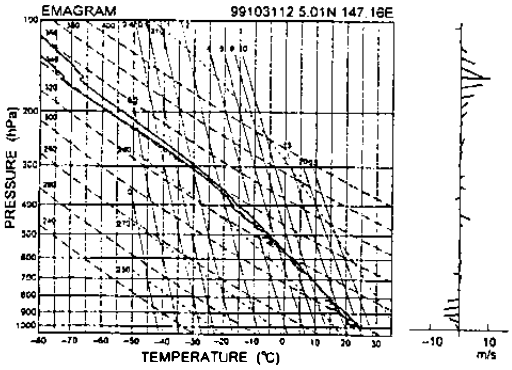
PRESSURE (hPa)
100
200
300
400
500
600
700
800
900
1000
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30
TEMPERATURE (℃)
-10
10
m/s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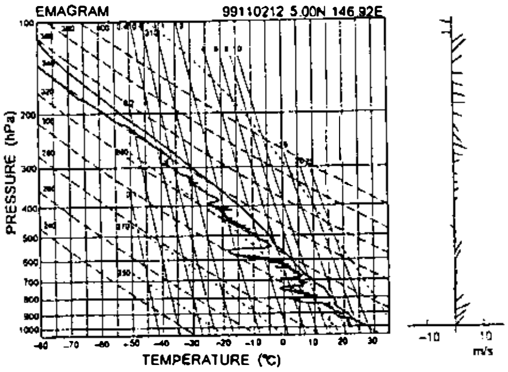
PRESSURE (hPa)
100
200
300
400
500
600
700
800
900
1000
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30
TEMPERATURE (℃)
-10
10
m/s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PRESSURE (hPa)
100
200
300
400
500
600
700
800
900
1000
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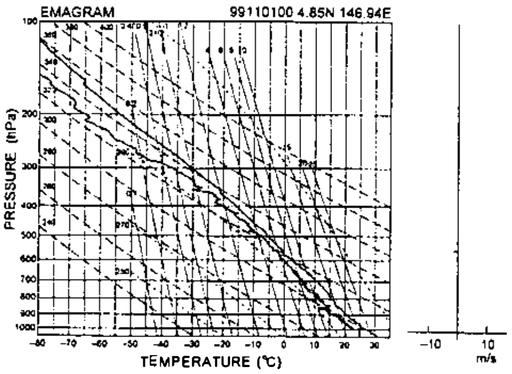
TEMPERATURE (℃)
-10
10
m/s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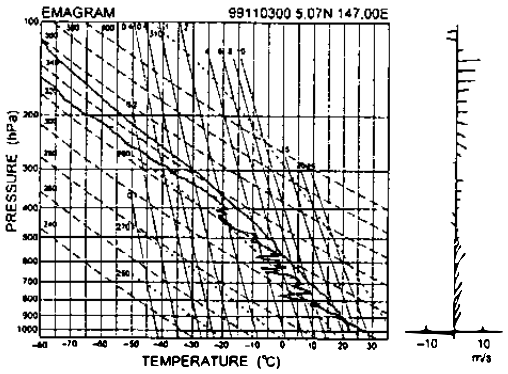
PRESSURE (hPa)
100
200
300
400
500
600
700
800
900
1000
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30
TEMPERATURE (℃)
-10
10
m/s


EMAGRAM
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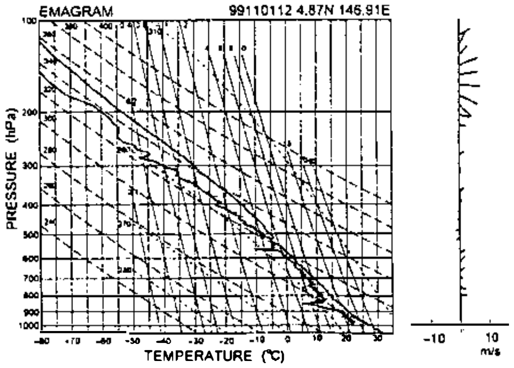
PRESSURE (hPa)
100
200
300
400
500
600
700
800
900
1000
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30
TEMPERATURE (℃)
-10
10
m/s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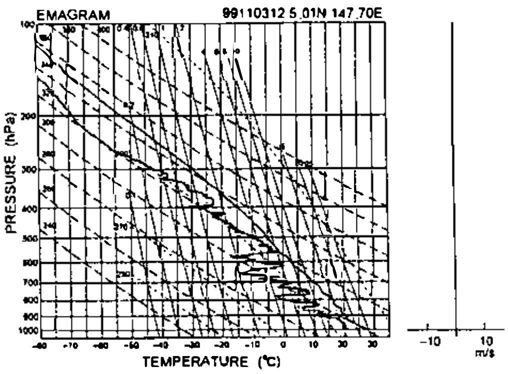
PRESSURE (hPa)
100
200
300
400
500
600
700
800
900
1000
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30
TEMPERATURE (℃)
-10
10
m/s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PRESSURE (hPa)
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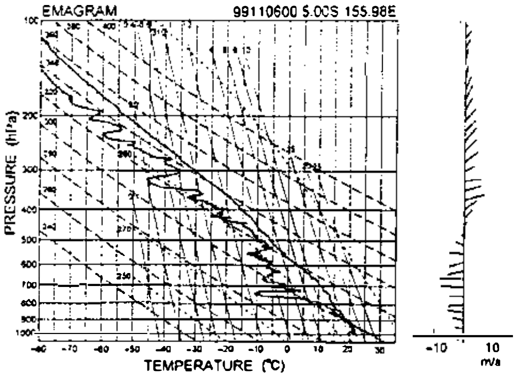
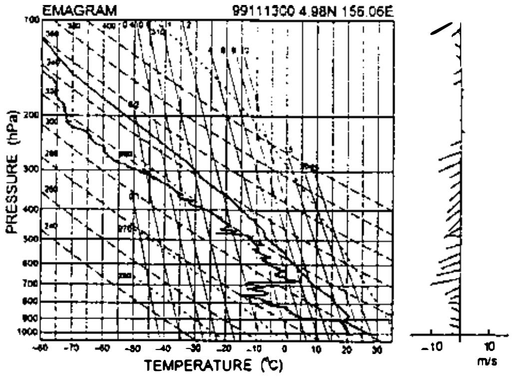
200
300
400
500
600
700
800
900
1000
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30
TEMPERATURE (℃)
-10
10
m/s


EMAGRAM
99110600 5.00S 155.98E
PRESSURE (hPa)
TEMPERATURE (°C)
-10
10
m/s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TEMPERATURE (°C)
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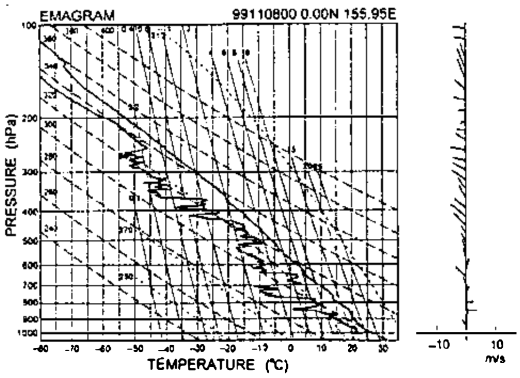
10
m/s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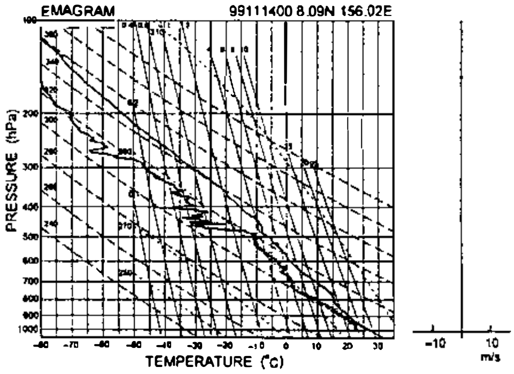
10
m/s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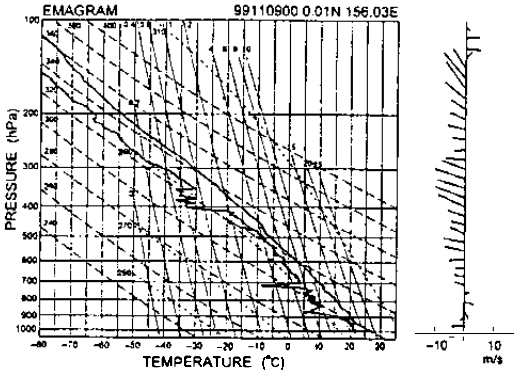
m/s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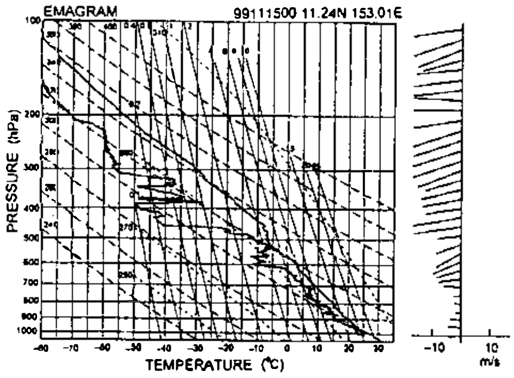
m/s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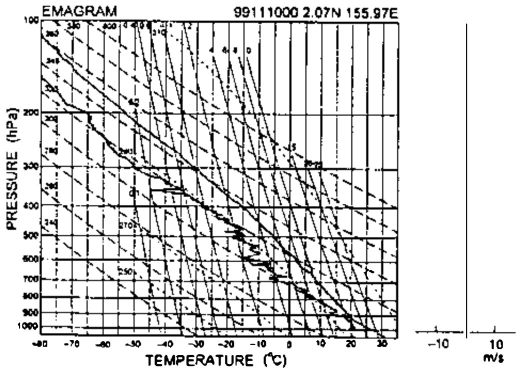
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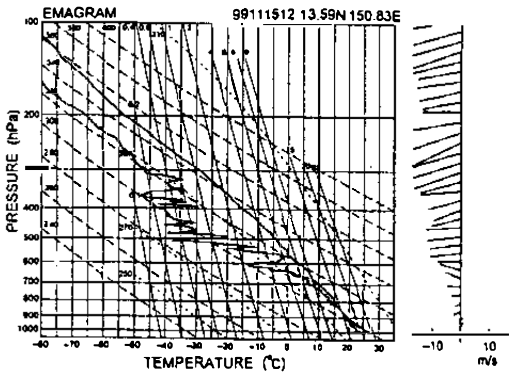
10
m/s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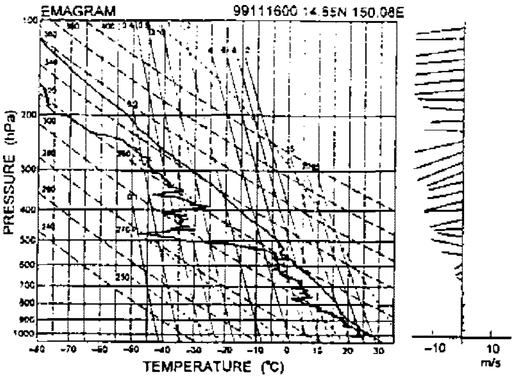
10
m/s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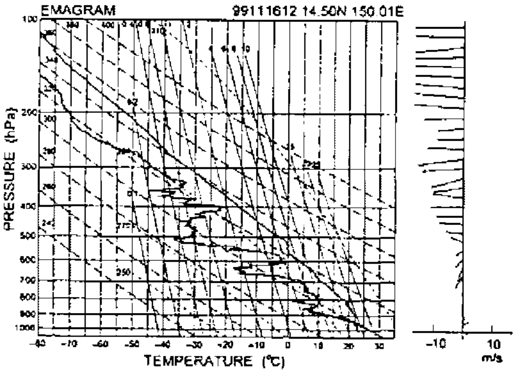
m/s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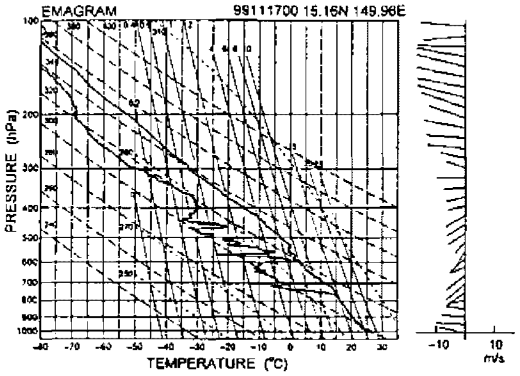
TEMPERATURE (℃)
m/s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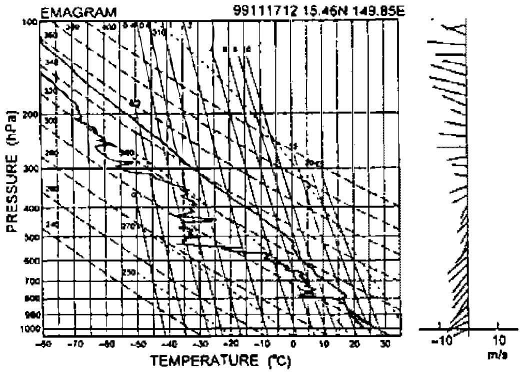
PRESSURE (hPa)
TEMPERATURE (℃)
m/s


EMAGRAM
99111712 15.46N 149.85E
PRESSURE (hPa)
TEMPERATURE (℃)
m/s

6.1.3 Ceilometer

(1) Personnel

Masaki Hanyu (GODI) : Operation Leader
Satoshi Okumura (GODI)

(2) Parameters

(2.1) Cloud base height [m]
(2.2) Backscatter profile, sensitivity and range normalized at 30m resolution

(3) Methods

We measured cloud base height and backscatter profiles using CT-25K (Vaisala, Finland) ceilometer throughout MR99-K06 cruise from the departure of Sekinehama, Japan on 13 October 1999 to the arrival of Guam, U.S.A. on 19 November 1999.

Major parameters for the measurement configuration are as follows;

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

(4) Preliminary results

The results will be public after the analysis.

(5) Data archives

Ceilometer data obtained during this cruise will be submitted to the DMO (Data Management Office), JAMSTEC and will be under their control.

6.2 CTD / XCTD

6.2.1 CTD

(1) Personnel

Masayuki Fujisaki (MWJ) : Operation leader
Nobuharu Komai (MWJ)
Satoshi Ozawa (MWJ)
Fujio Kobayashi (MWJ)
Aya Kato(MWJ)
Keisuke Wataki (MWJ)

(2) Objectives

Investigation of the oceanic (down to 1000m) structure.

(3) Parameters

・Temperature
・Conductivity
・Pressure

(4) Methods

CTD/Carousel Water Sampling Systems were used during this cruise. It was the 12-liters 12-positions Carousel water sampler with Sea-Bird Electronics Inc. CTD (SBE9plus). The sensors attached on CTD were temperature sensor, conductivity sensor, pressure sensor, and altimeter sensor. Salinity was calculated by measurement values of pressure, conductivity and temperature. The CTD/CWS was deployed from starboard on working deck. We kept the descending rate of 1.2 m/s respectively.

The CTD raw data was acquired on real time by using the SEASAVE utility from the SEASOFT software (ver.4.232) provided by SBE and stored on the hard disk of an Windows personal computer. Water samplings were made during up-cast by sending a fire command from the computer. In ordinary cast we sampled water at two layers (500,1000m) to calibrate salinity data. In several casts sea water at 12 layer were sampled for Oceanic Carbon analysis

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

DATCNV:	Converts the binary raw data to output on physical units. Output items are scan number, pressure, temperature, conductivity, salinity, potential temperature, altimeter, descent rate, sigma-t, depth. Simultaneously, this utility selects the CTD data when bottles closed to output on another file.
SECTION:	Remove the unnecessary data.
WILDEDIT:	Obtain an accurate estimate of the true standard deviation of the data. Std deviations for Pass1: 2 Std deviations for Pass2: 10 Points per block: 100
BINAVG:	Calculates the averaged data in every 1 db.
ROSSUM:	Edits the data of water sampled to output a summary file.

SPLIT: Splits the data made by DATCNV into down cast data.

ASCIIOUT: Change into ASCII data.

Specifications of the sensors are listed below.

CTD: SBE 911plus CTD system

Under water unit: CTD 9plus (S/N 09P9833-0280, Sea-Bird Electronics, Inc.).
Calibrated Date: 02.Jan.1997

Temperature sensor: SBE3-04/F Primary Sensor (S/N 031524, Sea-Bird Electronics, Inc.)
Calibrated Date: 08.Sep.1999

Conductivity sensor: SBE4-04/0 Primary Sensor (S/N 041202, Sea-Bird Electronics, Inc.)
Calibrated Date: 08.Sep.1999

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

Carousel water sampler: SBE32 (S/N 329833-0026, S/N Sea-Bird Electronics, Inc.)

(5) Result

See the attached figures. (Fig2.1.6-1)

(6) Trouble

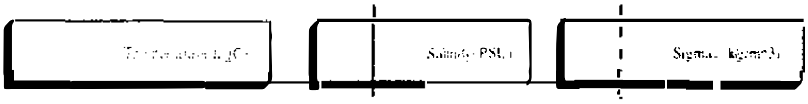
While observing, it was found that No.2 Niskin bottle was miss-tripped from the analysis of oceanic carbon. While investigating in detail, we found the trigger of Carousel water sampler and armored cable seemed to touch each other after command. We hold armored cable tightly to the frame so as not to touch a trigger. The results fo test cast showed the No.2 bottle fired normally.

(7) Data archive

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

Table6.2.1-1 CTD Cast Table

Stn.	Date(UTC)	Time(UTC)		Start Position		Filename	Water Sampling	Remarks
		Start	End	Latitude	Longitude			
0001	10/21/99	21:52	22:35	08-00.08N	136-59.92E	0001S01	○	
0002	10/22/99	13:05	13:40	06-59.99N	137-00.04E	0002S01	○	
0003	10/22/99	17:56	18:44	06-00.06N	136-59.91E	0003S01	○	
0004	10/22/99	23:02	23:40	04-57.89N	137-05.91E	0004S01	○	
0005	10/23/99	11:19	12:16	03-59.99N	137-19.84E	0005S01	○	
0006	10/23/99	21:57	22:34	02-59.94N	137-33.13E	0006S01	○	
0007	10/25/99	03:36	04:21	02-03.75N	138-05.02E	0007S01	○	TRITON 12001 cast
0008	10/25/99	22:53	23:23	00-59.96N	137-59.96E	0008S01	○	
0009	10/27/99	03:48	04:31	00-04.98N	138-02.01E	0009S01	○	TRITON 13001 Cast
0010	10/29/99	08:34	09:16	00-01.51S	147-00.14E	0010S01	○	TRITON 09002 cast
0011	10/30/99	02:10	02:44	00-04.19N	146-49.75E	0011S01	×	TRITON 09001 cast
0012	10/30/99	21:54	22:40	01-59.93N	146-59.94E	0012S01	○	
0013	11/03/99	02:57	03:39	05-03.30N	146-56.70E	0013S01	○	TRITON 07002 Cast
0014	11/06/99	00:59	01:40	05-03.33S	156-02.15E	0014S01	○	TRITON 06001 cast
0015	11/07/99	00:56	01:41	02-01.51S	155-56.69E	0015S01	○	TRITON 05001 cast
0016	11/09/99	02:57	03:38	00-01.67N	156-02.27E	0016S01	○	TRITON 04003 Cast
0017	11/10/99	02:53	03:37	02-04.35N	155-59.72E	0017S01	○	TRITON 03003 Cast
0018	11/10/99	21:56	22:24	01-55.33N	155-59.52E	0018S01	○	TRITON 03002 Cast
0019	11/13/99	03:52	04:32	05-02.08N	155-58.21E	0019S01	○	TRITON 02002 cast
0020	11/13/99	02:55	03:40	07-57.82N	156-01.20E	0020S01	○	TRITON 01002 cast



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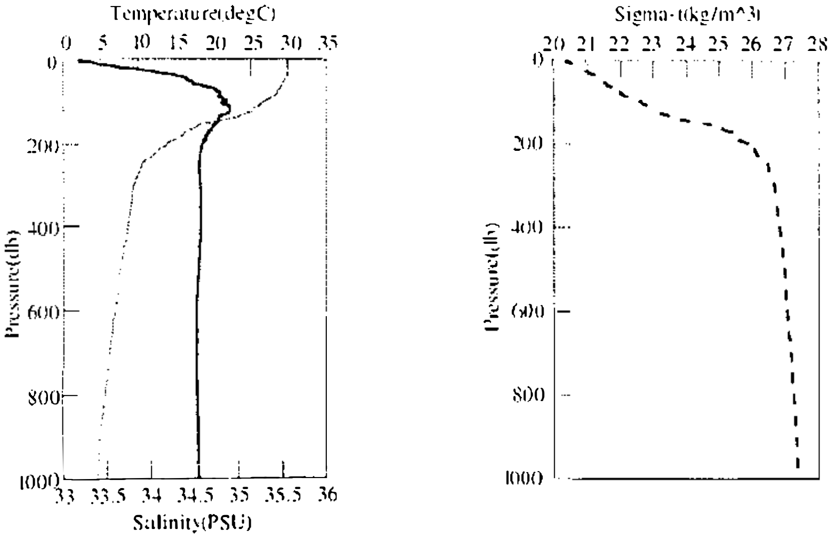

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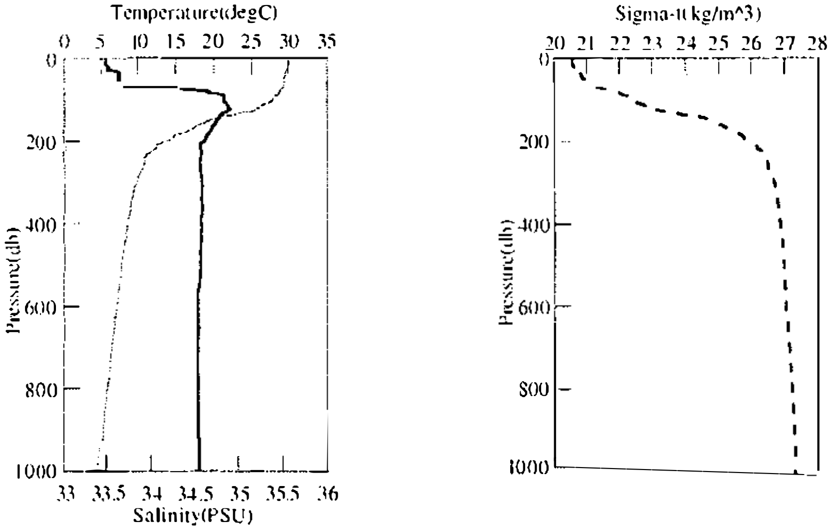

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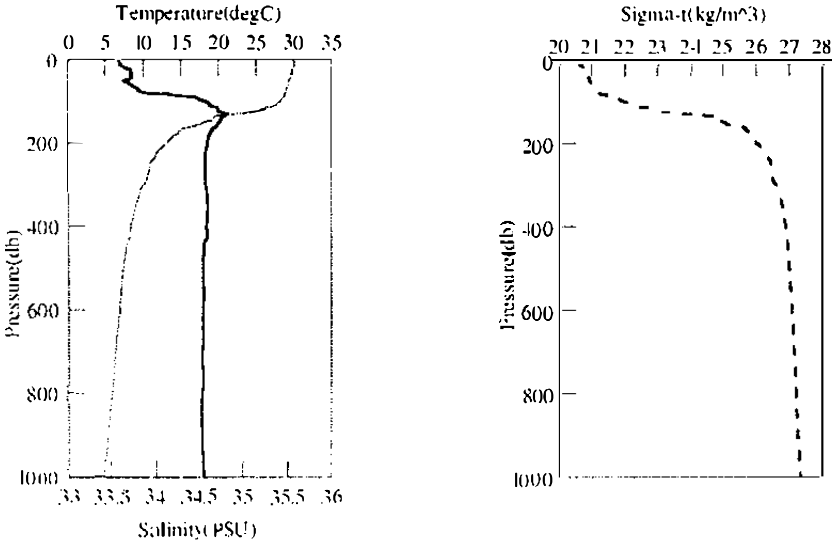
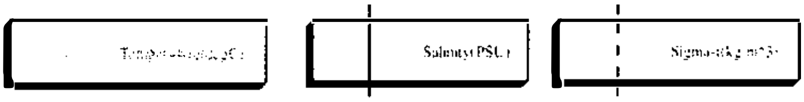


Fig6.2.1 : CTD profile



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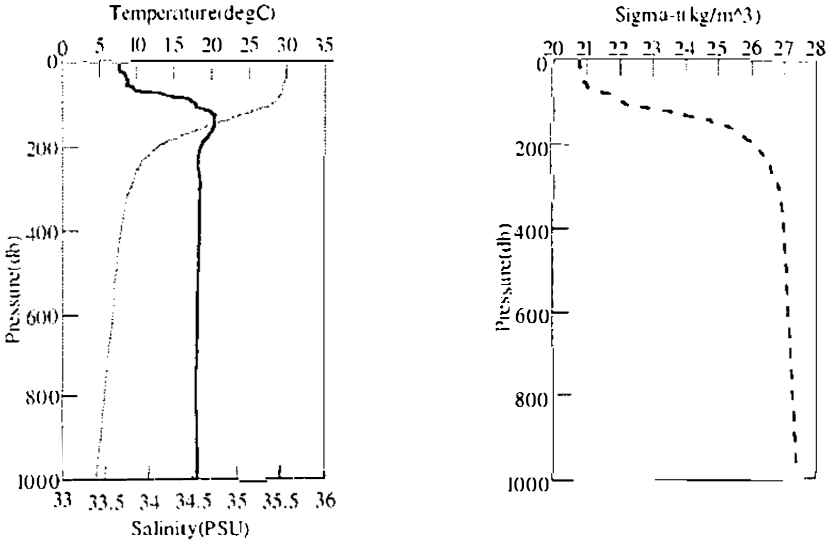

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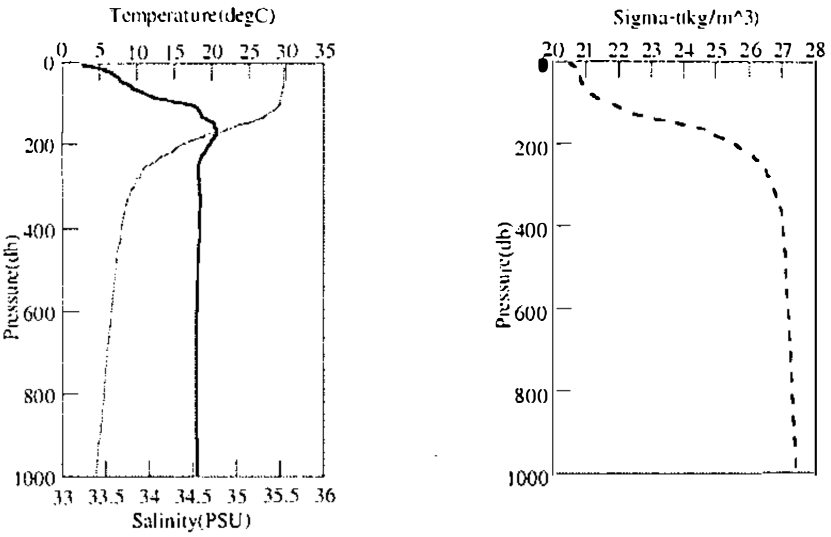

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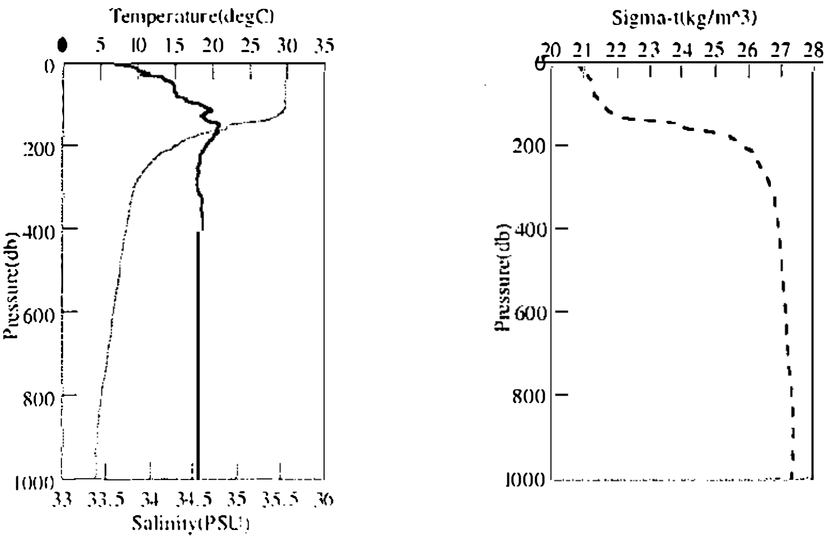
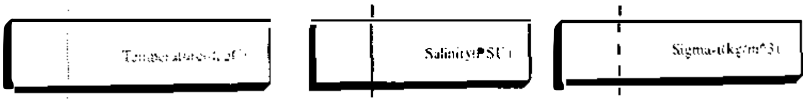


Fig6.2.1 : CTD profile (Continue)



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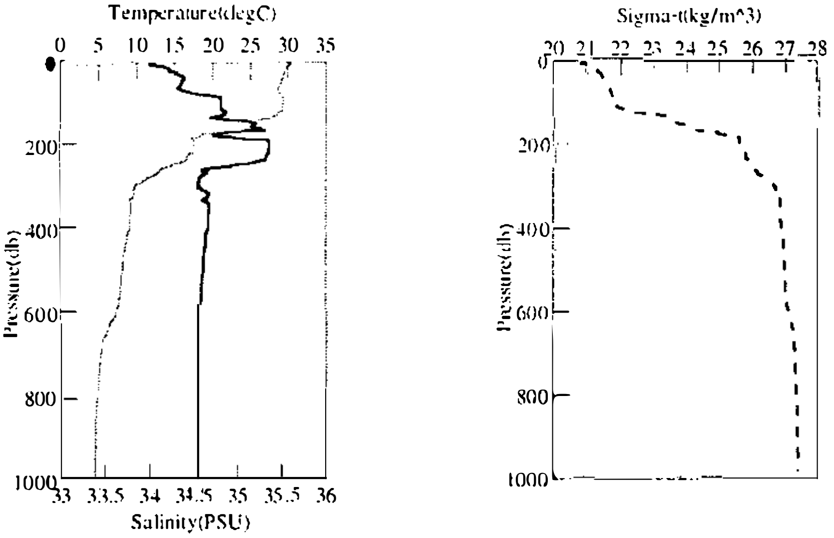

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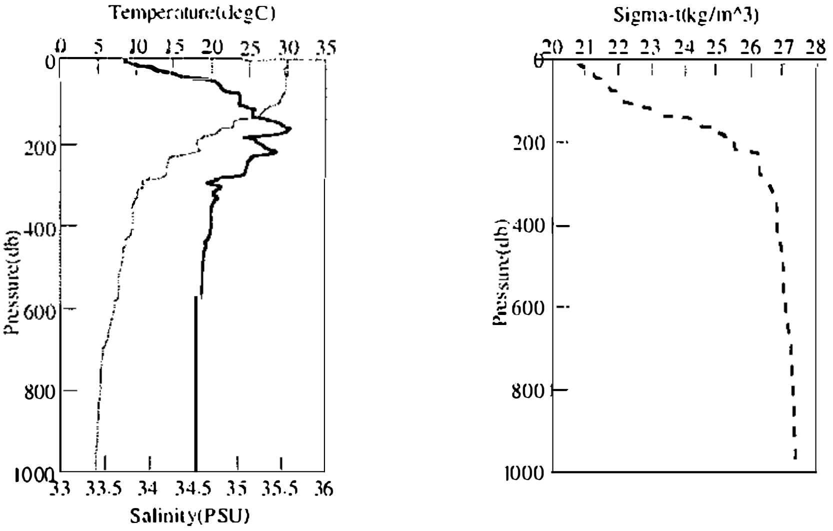

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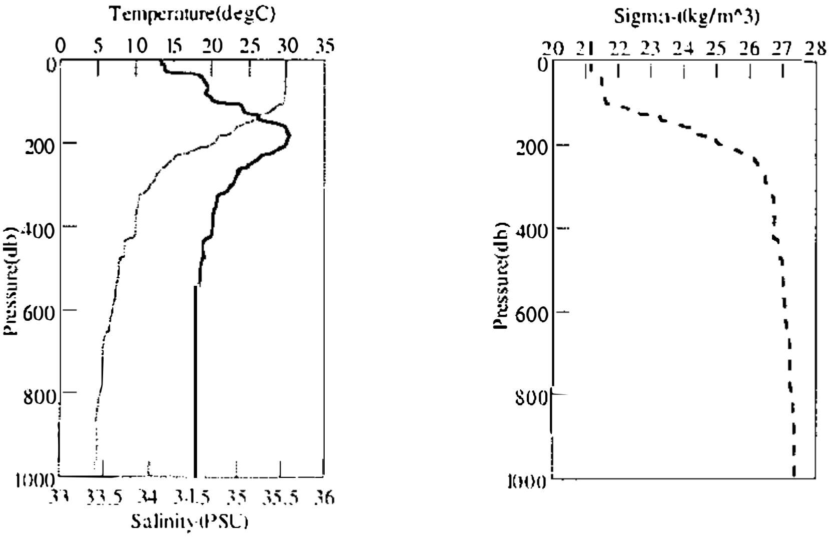
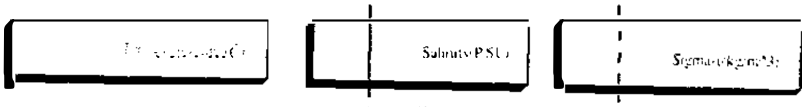


Fig6.2.1 : CTD profile (Continue)



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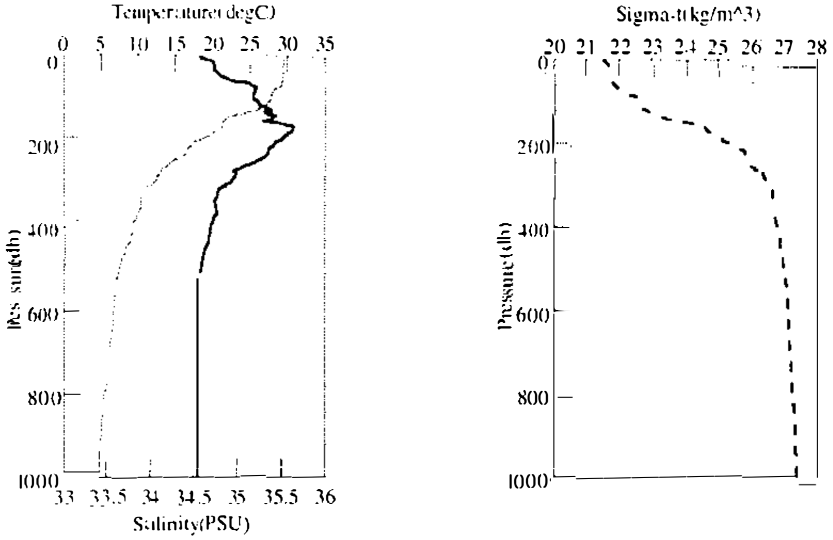

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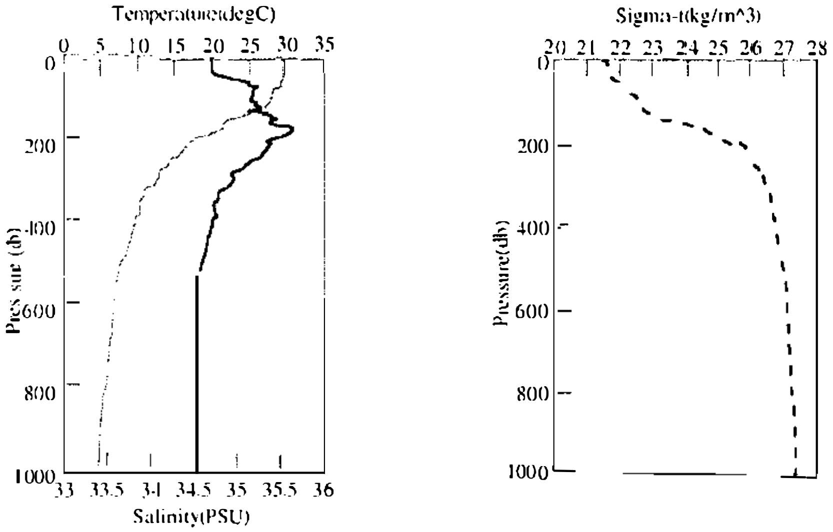

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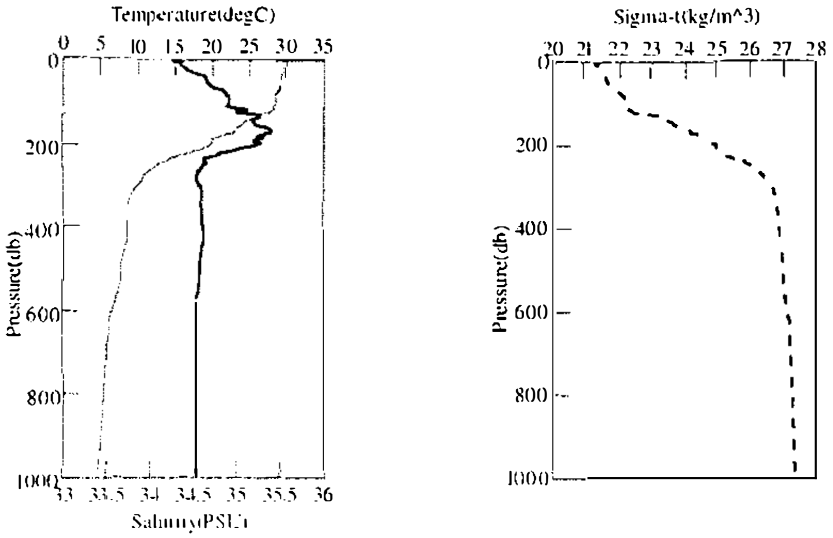
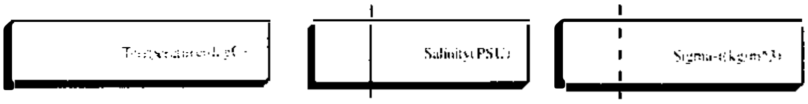


Fig6.2.1 : CTD profile (Continue)



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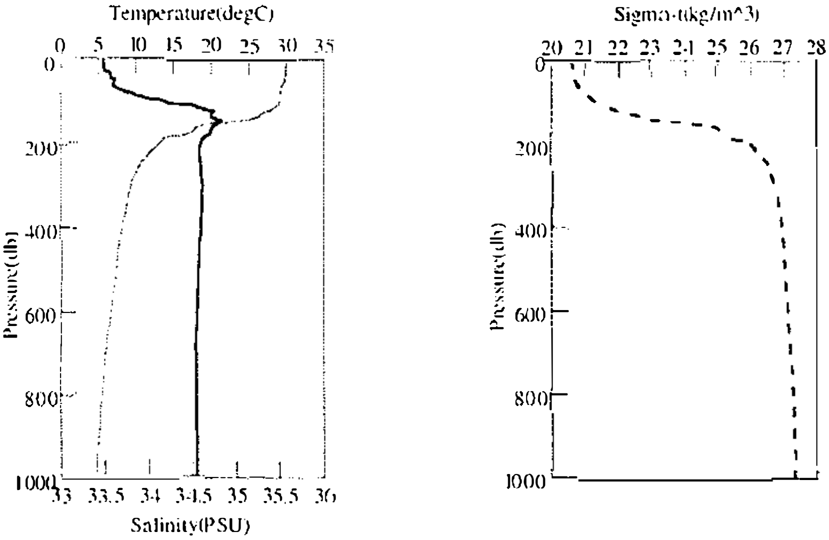

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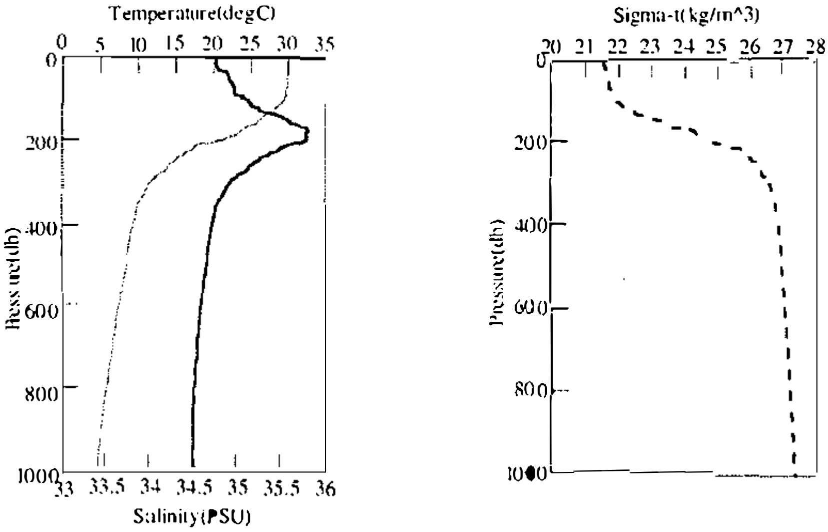

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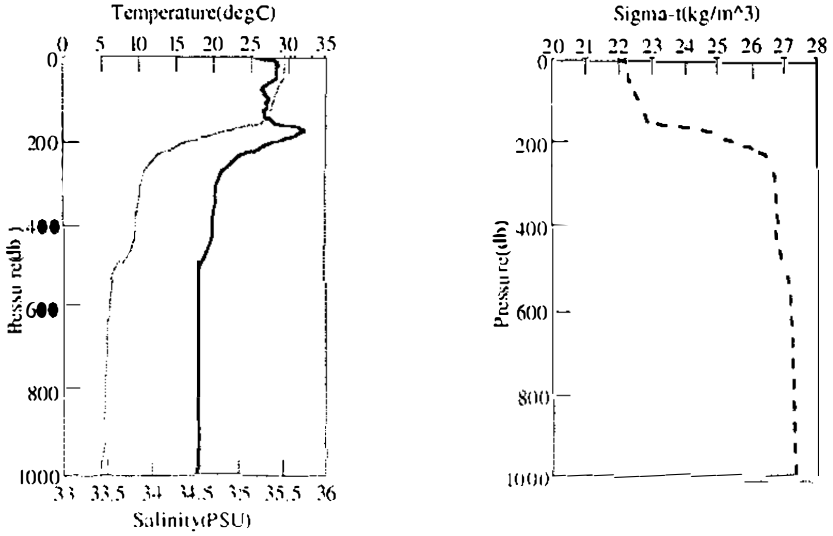
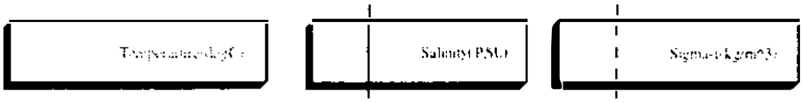


Fig6.2.1 : CTD profile (Continue)



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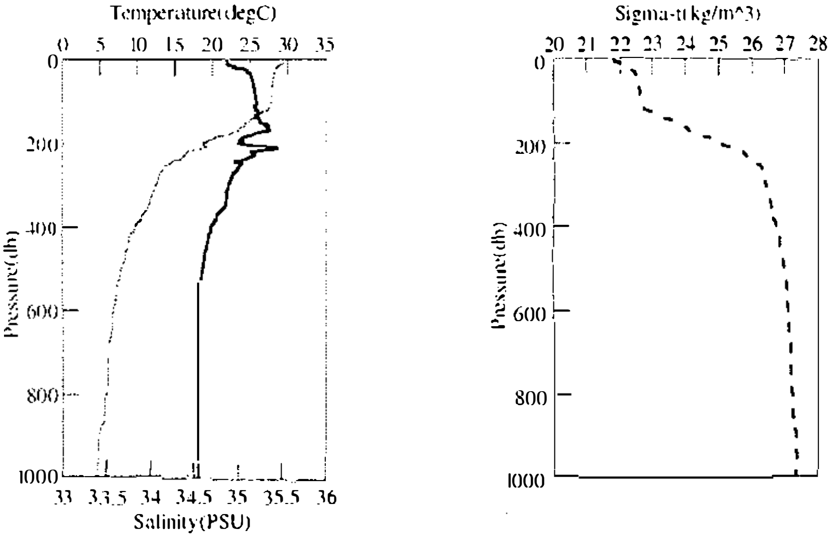

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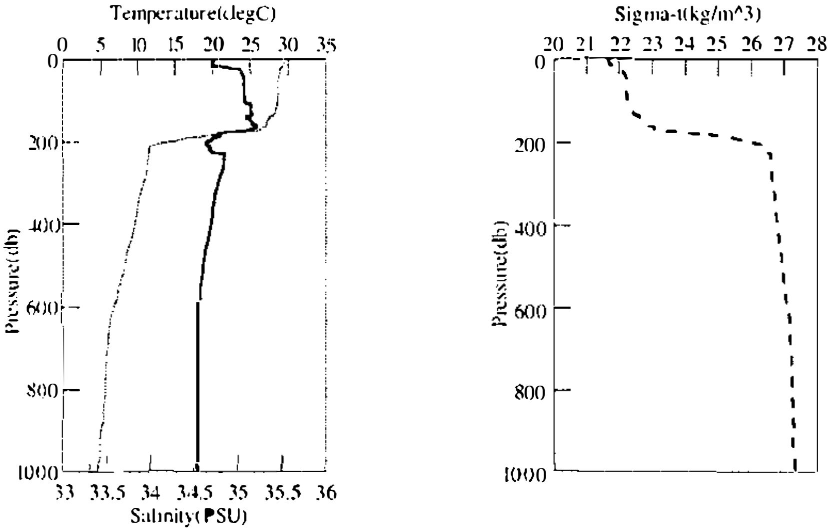

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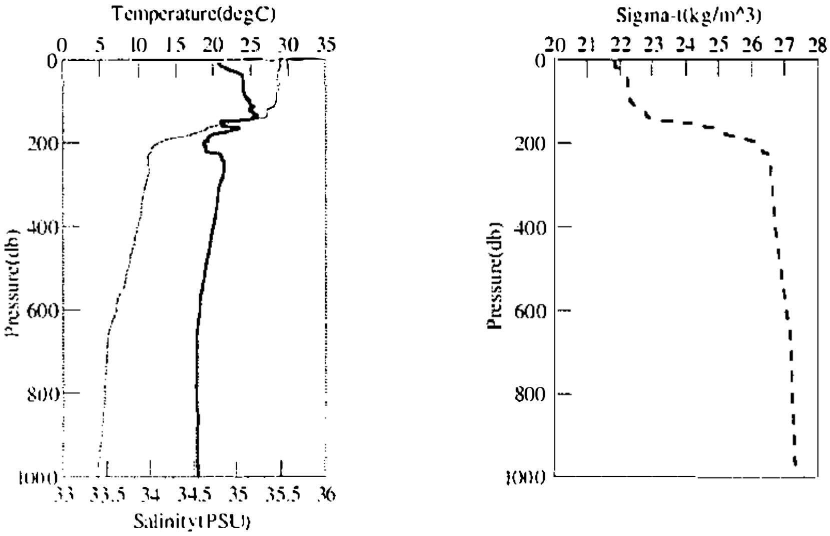
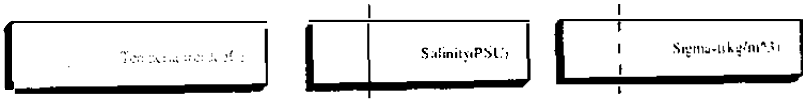


Fig6.2.1 : CTD profile (Continue)



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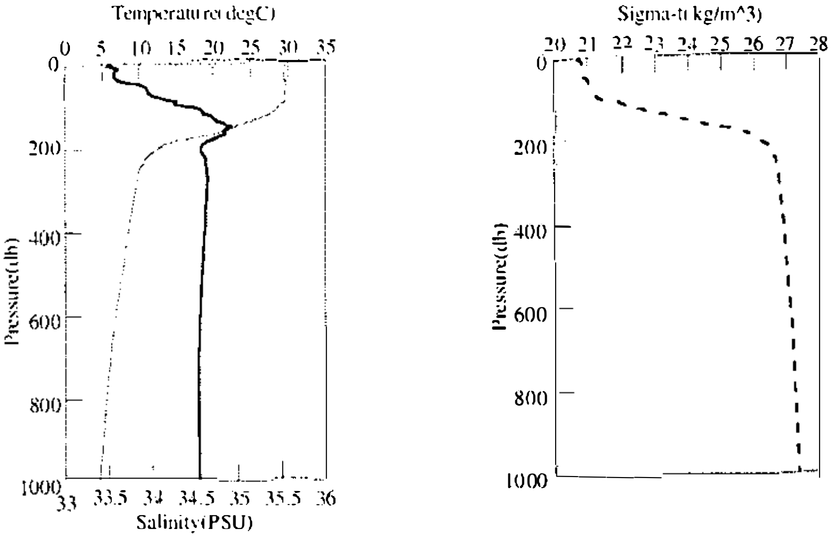

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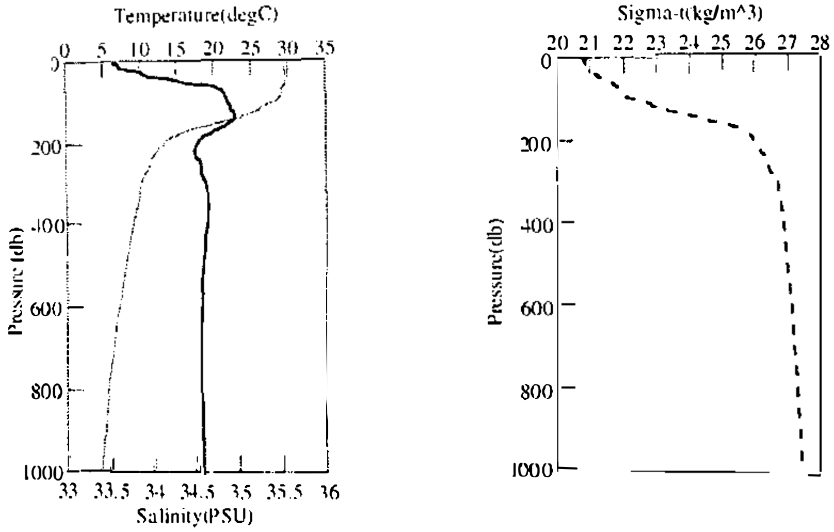


Fig6.2.1 : CTD profile (Continue)

6.2.2 XCTD Observation

(1) Personnel

Kentaro Ando (JAMSTEC): Principal Investigator
Masaki Hanyu (GODI): Operation Leader
Satoshi Okumura (GODI)
Naoto Morioka (Mirai crew)

(2) Parameters

The range and accuracy of parameters measured by the XCTD are as follows;

Parameter	Range	Accuracy
Conductivity	0 – 70 mS/cm	+/- 0.03 mS/cm
Temperature	-2 – 35 deg-C	+/- 0.02 deg-C
Depth	0 – 1000 m	

(3) Methods

We observed the vertical profiles of the sea water measured by XCTD. The signal was converted by MK-100, Tsurumi Seiki and was recorded by WinXCTD software made by Tsurumi Seiki.

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

Table 6.2.2-1 XCTD observation log

Station	Date	Time	Lat	Long	HDG	SPD	SST	SSS	T	RH	WH	WP	WD	WS	CD	CS	MD	Probe S/N
XC01	19991027	1300	0-01.22N	138-59.96E	90	10.9	29.4	33.4	25.9	83	1.1	5.6	82	3.7	257	1.1	1036	99012716
XC02	19991027	1751	0-00.23N	140-00-03E	91	9.5	29.7	34.2	26.4	83	1.1	4.8	159	1.6	280	1.6	1027	99012717
XC03	19991027	2248	0-00.11N	141-00.08E	91	9.5	29.7	34.3	25.8	90	1.2	4.8	130	8.9	265	2.3	1034	99012718
XC04	19991028	0343	0-00.22N	142-00.00E	90	9.6	29.6	34.6	25.4	90	1.4	4.8	138	7.0	269	1.9	1035	99012719
XC05	19991028	0836	0-00.14N	143-00.02E	91	9.4	29.6	34.4	27.8	76	1.3	4.6	51	1.0	260	2.1	914	99012711
XC06	19991028	1734	0-00.09S	143-59.98E	88	10.5	29.5	34.6	26.8	82	1.1	5.6	79	3.5	276	1.6	1032	99012712
XC07	19991028	1307	0-00.09N	144-59.58E	90	10.0	29.6	34.7	28.5	69	1.2	5.3	103	4.0	264	1.9	1035	99012715
XC08	19991028	2156	0-00.04N	146-00.00E	90	10.8	29.5	34.8	28.3	76	0.1	5.5	122	4.7	274	1.2	976	99012710
XC09	19991030	1108	1-00.02N	146-59.93E	14	12.0	29.9	34.7	28.3	66	1.2	7.0	110	2.6	285	1.2	972	99012709
XC10	19991031	0229	3-00.05N	147-00.03E	5	12.5	30.2	34.6	30.2	63	1.2	7.5	151	4.7	4	0.8	870	99012706
XC11	19991031	0624	4-00.04N	147-05.89E	11	11.6	29.8	33.5	24.3	92	1.2	7.5	157	4.5	121	0.6	960	99012707
XC12	19991106	0720	3-59.51S	155-59.96E	4	12.0	30.4	35.0	28.9	65	1.1	6.5	49	1.7	301	0.6	967	99012708
XC13	19991106	1106	3-00.05S	155-58.75E	357	12.5	30.0	35.3	28.4	67	1.1	7.0	109	2.4	290	0.9	1035	99063665
XC14	19991107	0818	1-00.08S	156-04.64E	9	12.4	28.8	35.3	27.9	71	1.1	8.0	185	2.1	273	0.6	1028	99063666
XC15	19991109	1017	1-00.01N	156-00.89E	357	12.1	29.5	34.9	28.6	71	1.2	7.9	104	7.8	271	1.6	960	99063661
XC16	19991112	0426	3-00.01N	156-01.62E	3	12.2	29.8	34.3	28.8	66	1.3	8.5	104	3.7	282	0.6	1035	99063660
XC17	19991112	0816	3-59.98N	156-03.34E	2	12.2	29.8	33.9	28.3	64	1.3	9.0	91	4.1	41	0.1	1009	99063663
XC18	19991113	1056	6-00.01N	156-01.16E	6	12.0	29.5	33.6	28.2	64	1.1	9.8	74	4.1	318	0.6	1036	99063657
XC19	19991113	1451	6-59.99N	156-11.37E	7	12.5	29.6	33.5	27.9	71	1.1	9.7	71	4.5	62	0.8	1035	99063656

Acronyms in Table 6.2.2-1 are as follows;

HDG: Ship’s heading [deg.]
SPD: Ship’s speed [knot]
SST: Sea surface temperature [deg-C]

SSS:	Sea surface salinity [PSU]
T:	Air temperature [deg-C]
RH:	Relative humidity [%]
WH:	Wave height [m]
WP:	Wave period [sec.]
WD:	Wind direction [deg]
WS:	Wind speed [m/s]
CD:	Current direction [deg]
CS:	Current speed [knot]
MD:	Maximum measured depth [m]

(4) Preliminary results

Each profiles are shown in the Appendix. Some contour of XCTD data combined with CTD data are shown in the following figures. Fig 6.2.2-1 and Fig 6.2.2-2 are temperature and salinity plots along 137/138E, Fig 6.2.2-3 and Fig 6.2.2-4 are those along the equator, Fig 6.2.2-5 and Fig 6.2.2-6 are along 147E, and Fig 6.2.2-7 and Fig 6.2.2-8 are along 156E respectively.

(5) Data archives

XCTD data obtained during this cruise will be submitted to the DMO (Data Management Office), JAMSTEC and will be under their control.

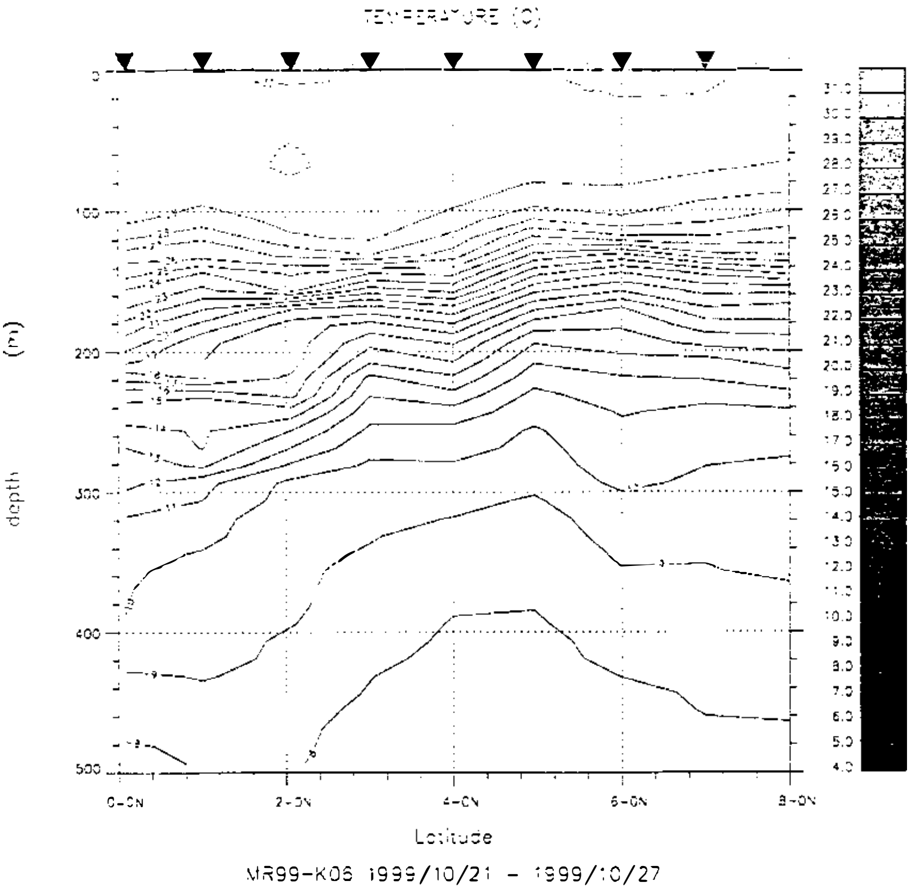


Fig 6.2.2-1 Temperature along 137/138E

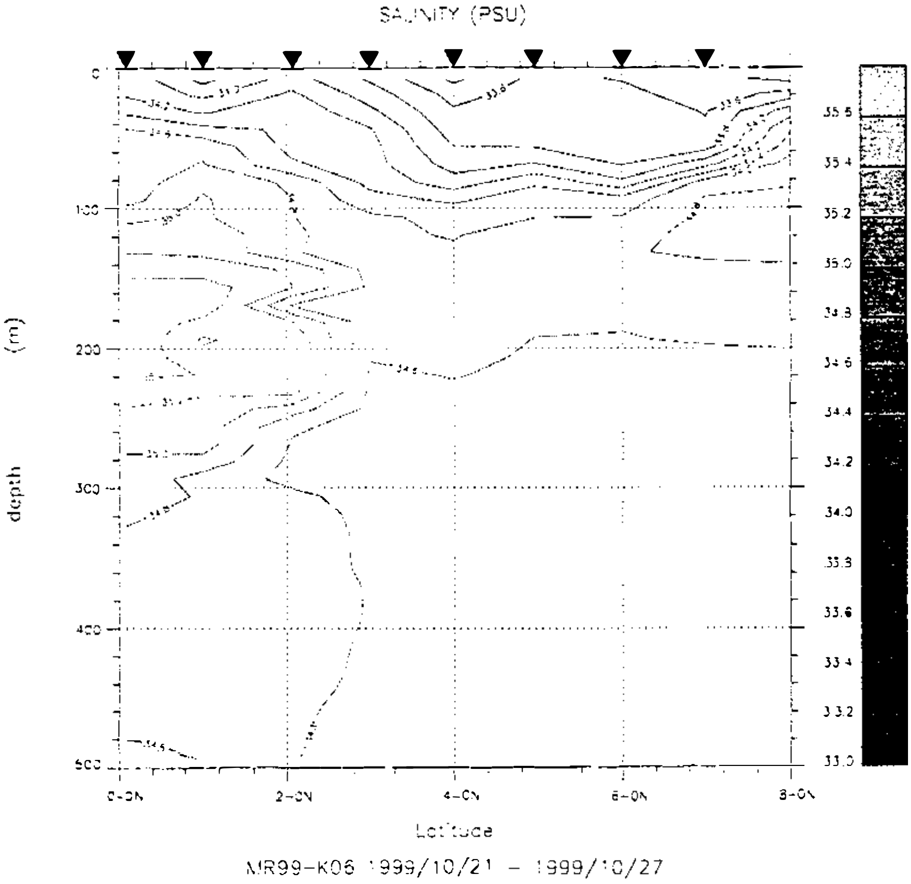


Fig 6.2.2-2 Salinity along 137/138E

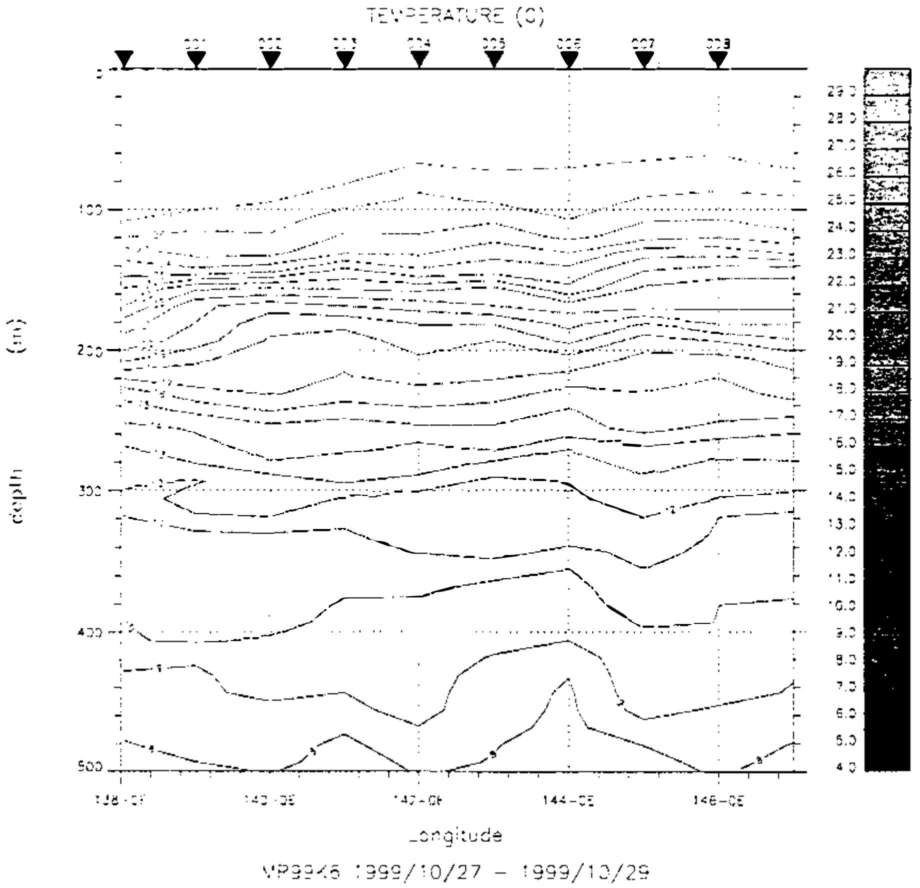


Fig 6.2.2-3 Temperature along Equator

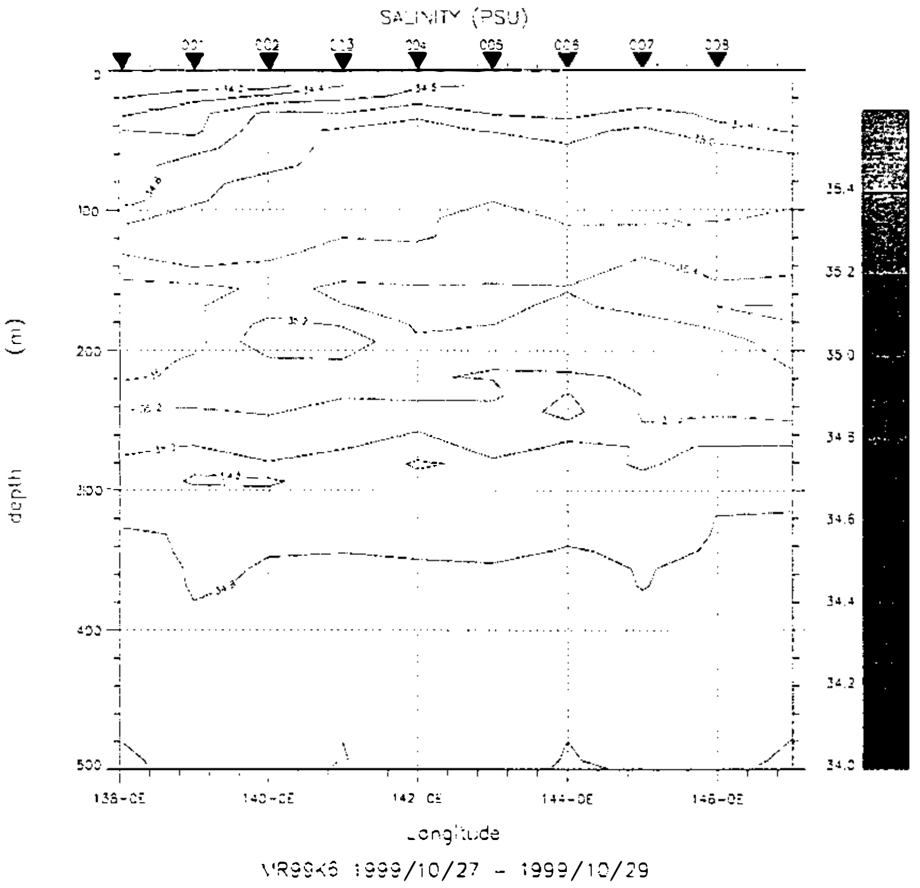
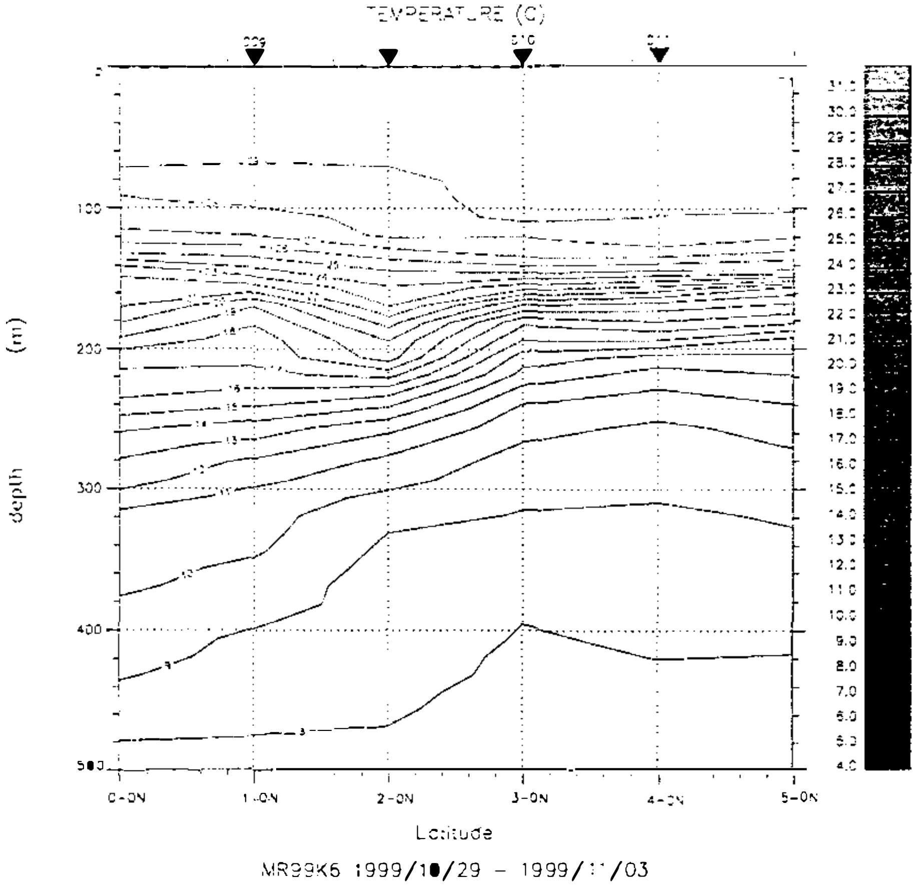


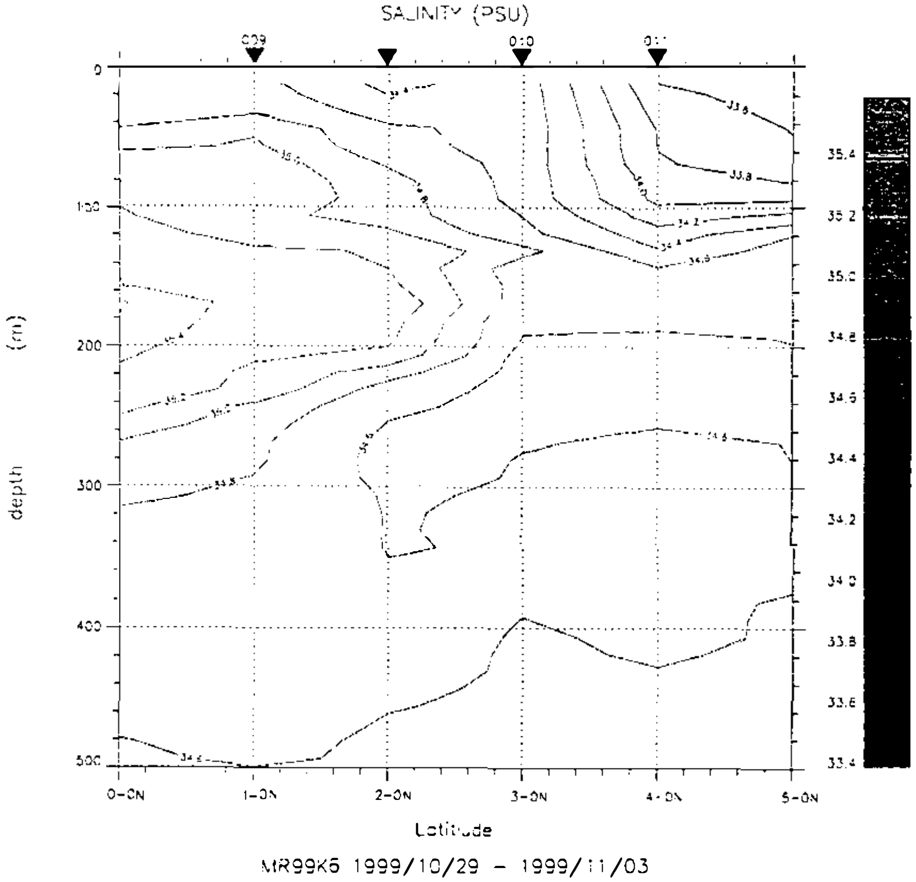
Fig 6.2.2-4 Salinity along Equator



TEMPERATURE (C)

MR99K6 1999/10/29 - 1999/11/03

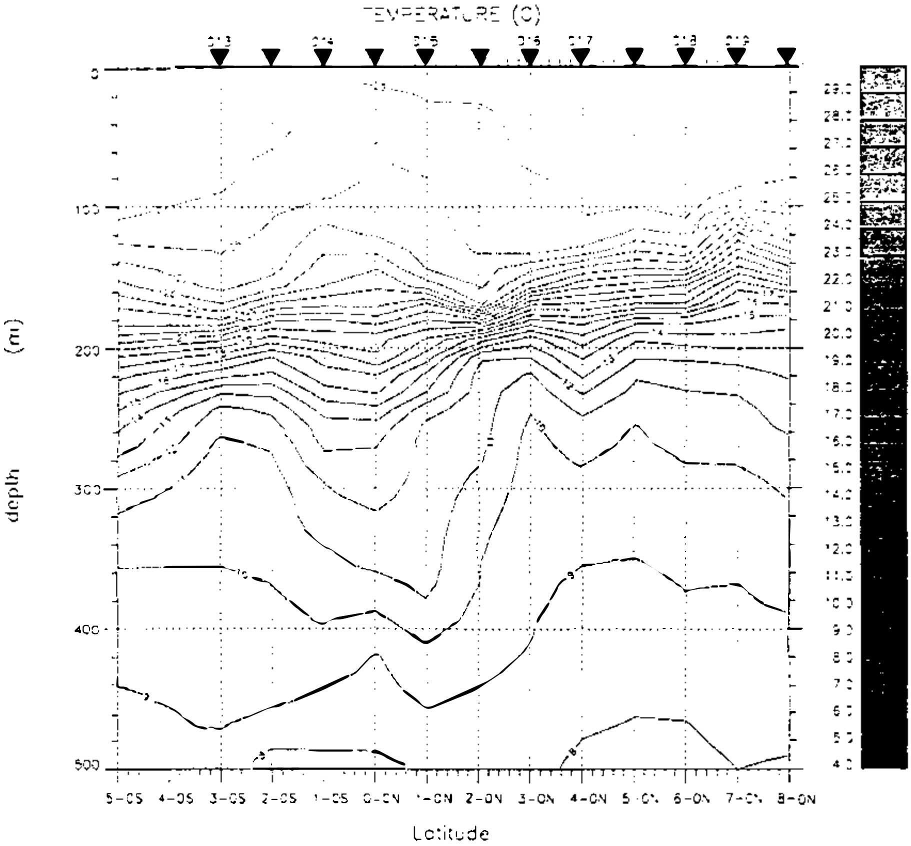
Fig 6.2.2-5 Temperature along 147E



SALINITY (PSU)

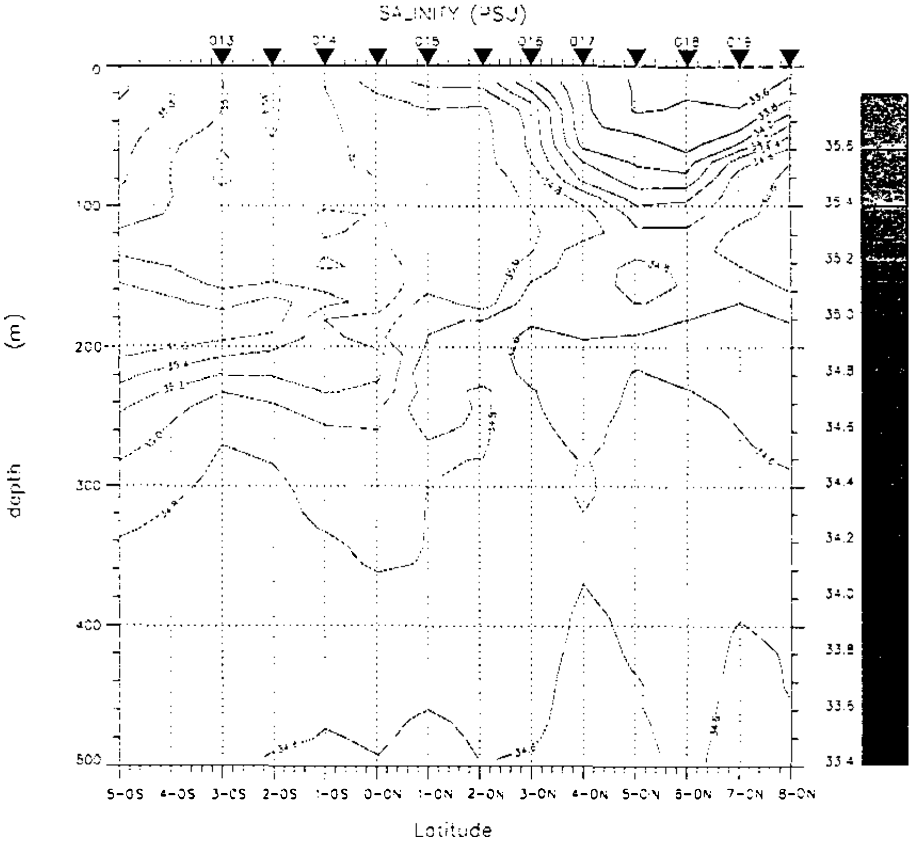
MR99K6 1999/10/29 - 1999/11/03

Fig 6.2.2-6 Salinity along 147E



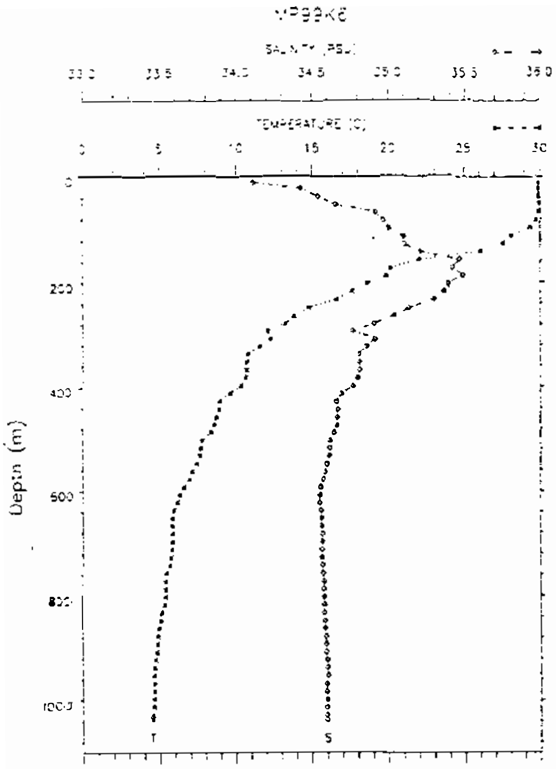
MR99K6 1999/11/06 -- 1999/11/14

Fig 6.2.2-7 Temperature along 156E



MR99K6 1999/11/06 ~ 1999/11/14

Fig 6.2.2-8 Salinity along 156E



1999/10/27 13:00:29

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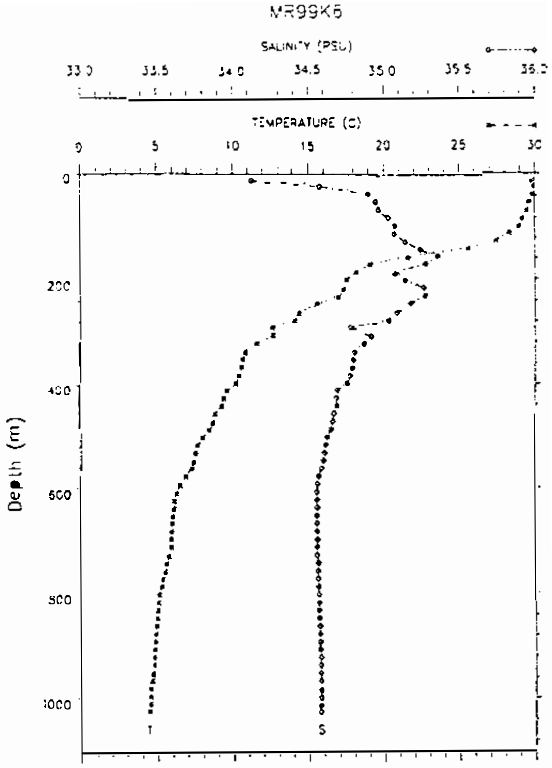
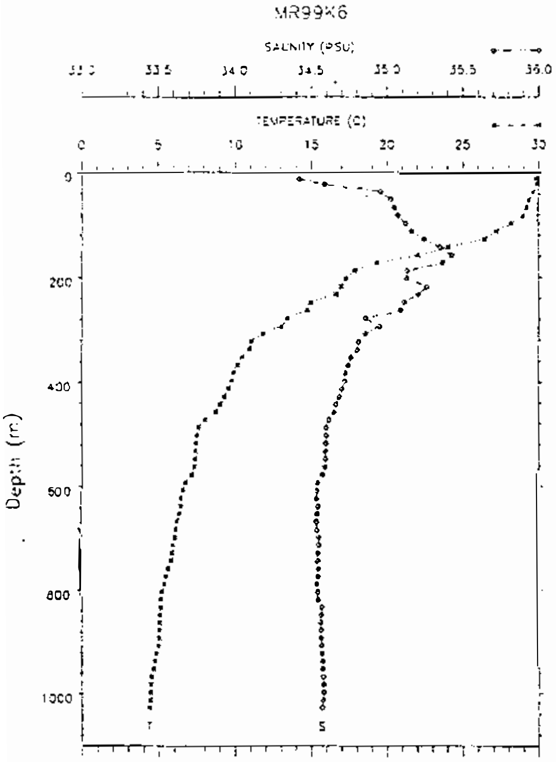


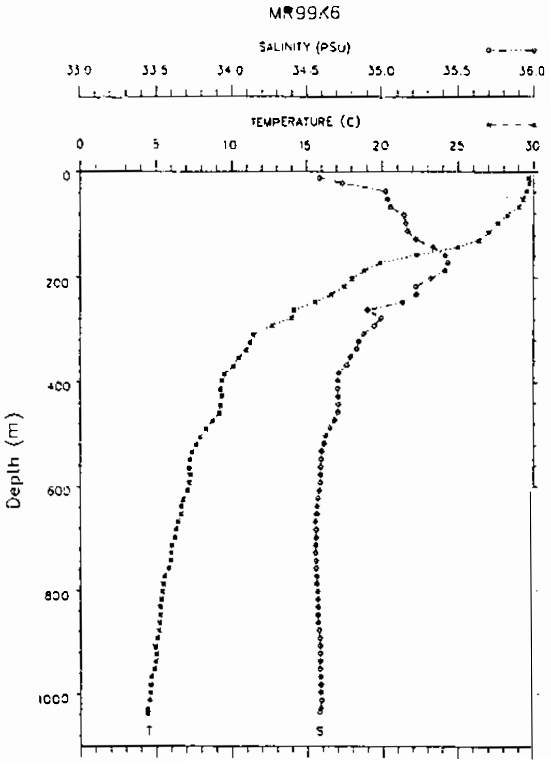
1999/10/27 17:51:24

CAST=002 LAT=0°00'14N LON=140°00'02E



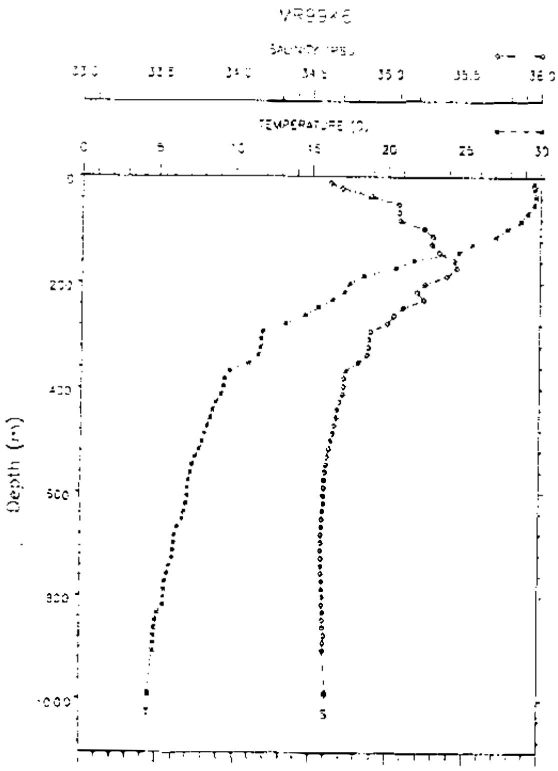
1999/10/27 22:48:19

CAST=003 LAT=0°00'07N LON=141°00'05E



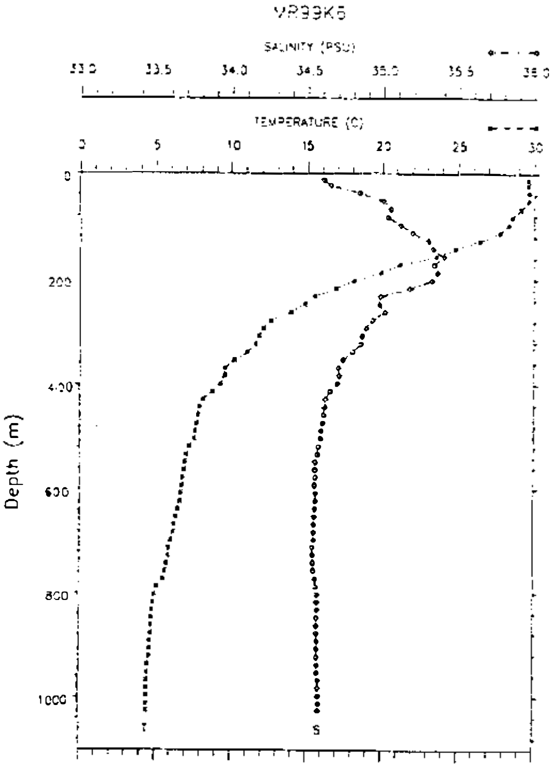
1999/10/28 3:43:30

CAST=004 LAT=0°00'13N LON=142°00'00E



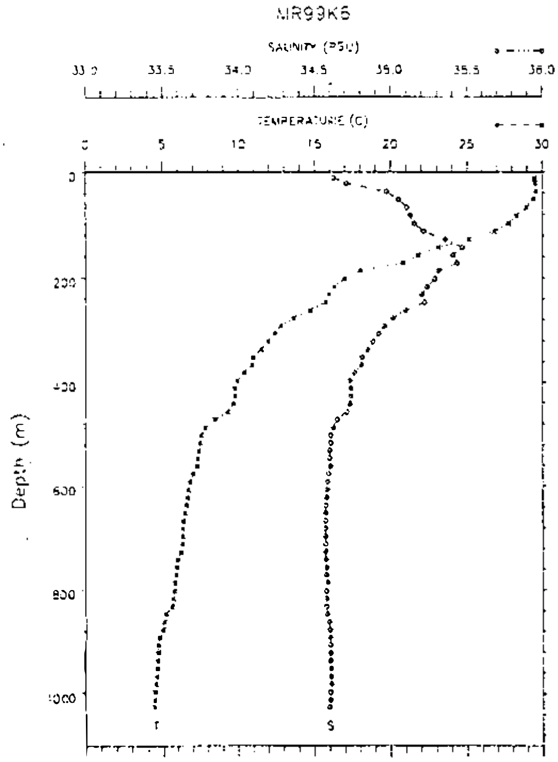
1999/10/28 8:36:30

CAST=005 LAT=0°00'09N LON=143°00'02E



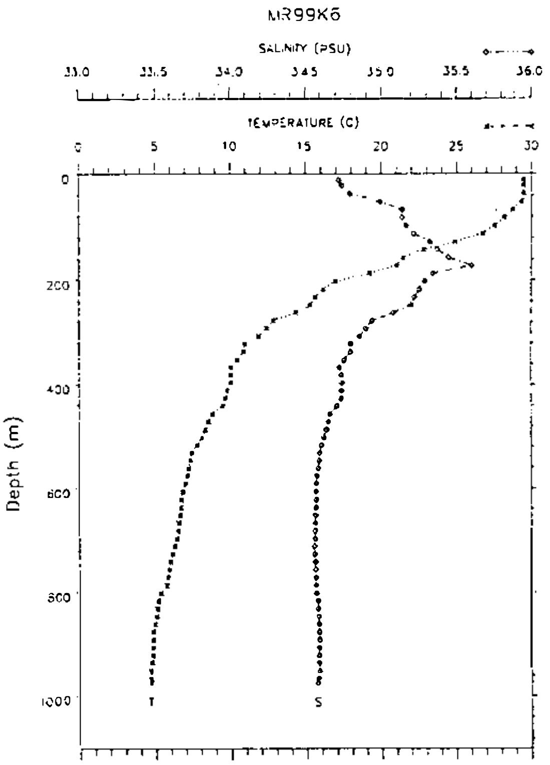
1999/10/28 13:07:23

CAST=006 LAT=0°00'06N LON=143°59'59E



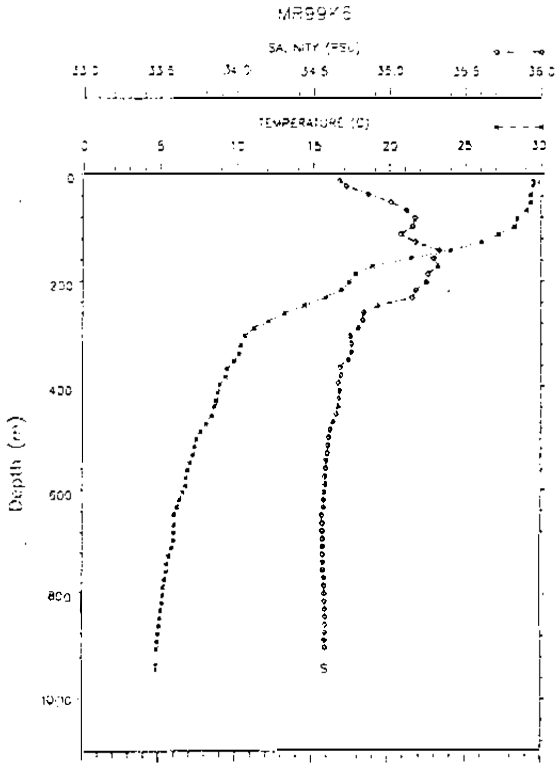
1999/10/28 17:34:51

CAST=007 LAT=0°00'06S LON=144°59'59E



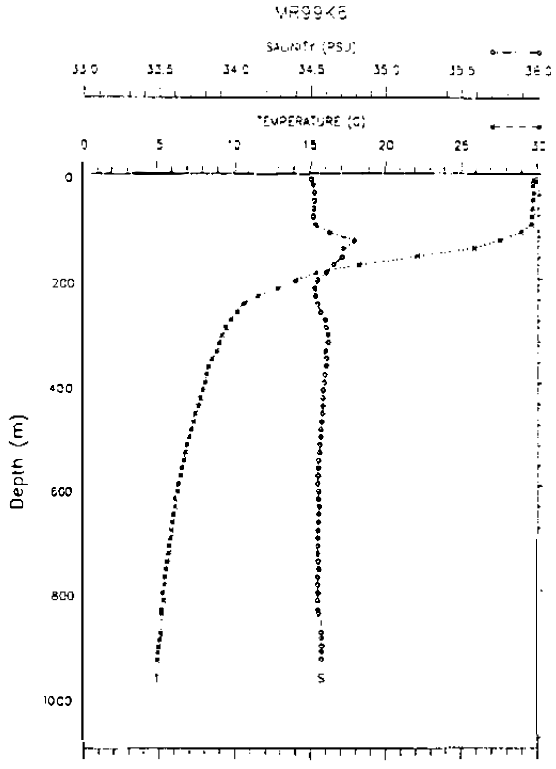
1999/10/28 21:56:53

CAST=008 LAT=0°00'03N LON=145°00'00E



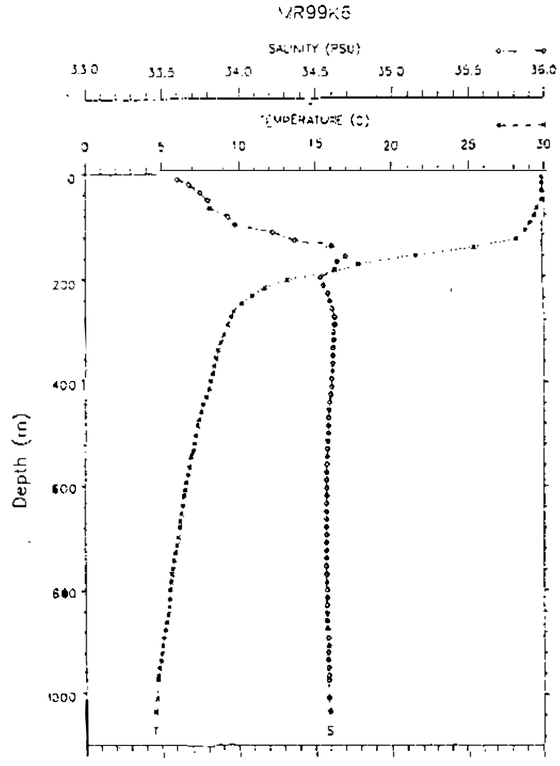
1999/10/30 11:03:11

CAST=009 LAT=1°00'01N LON=146°59'56E



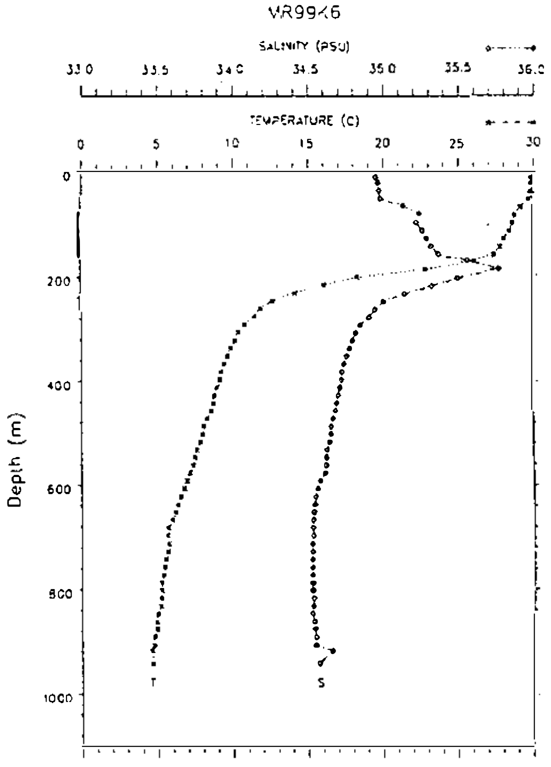
1999/10/31 2:29:34

CAST=010 LAT=3°00'03N LON=147°00'02E



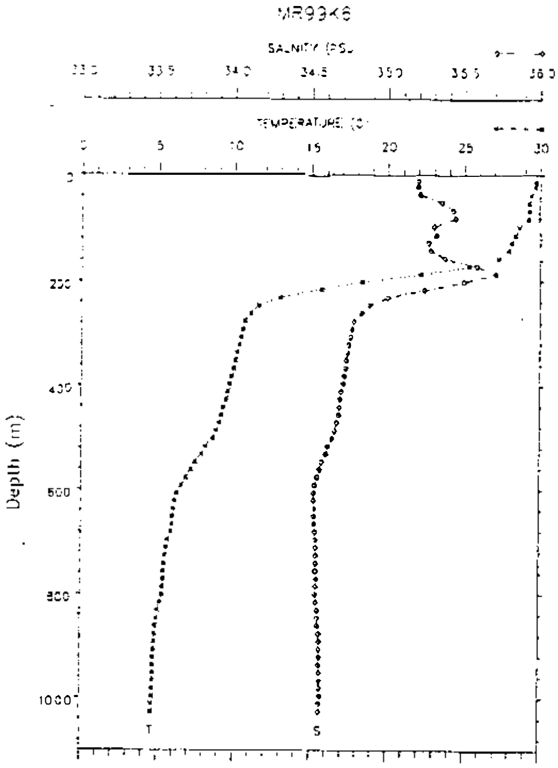
1999/10/31 6:24:26

CAST=011 LAT=4°00'02N LON=147°05'53E



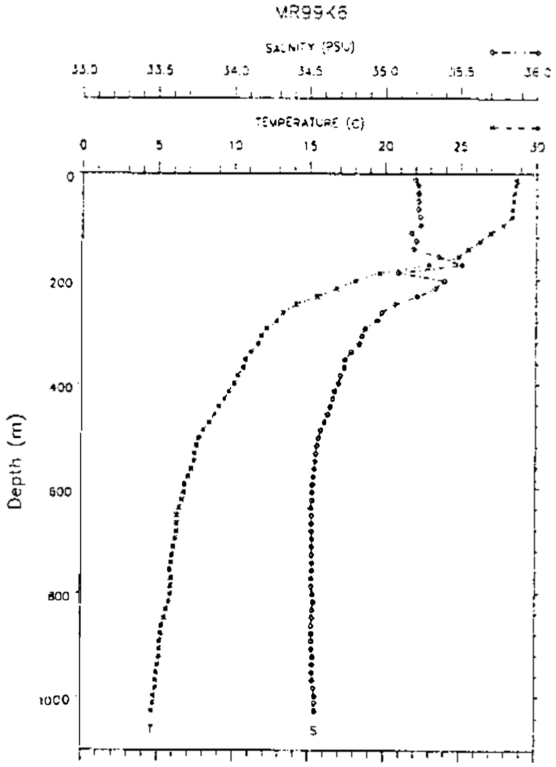
1999/11/06 7:20:55

CAST=012 LAT=3°59'30S LON=155°59'58E



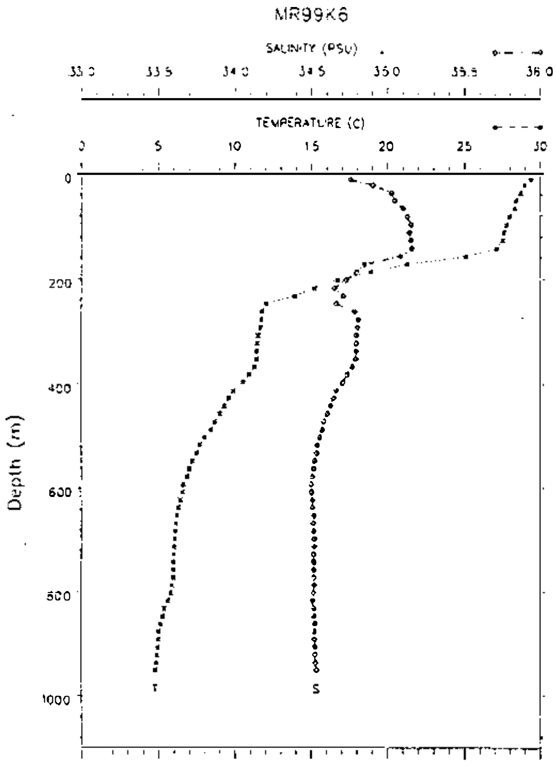
1999/11/06 11:06:40

CAST=013 LAT=3°00'03S LON=155°58'45E



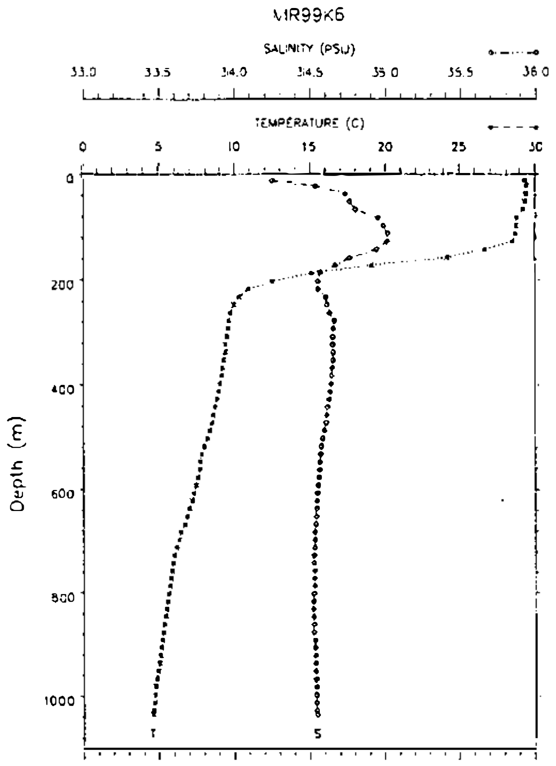
1999/11/07 8:18:15

CAST=014 LAT=1°00'05S LON=156°04'38E



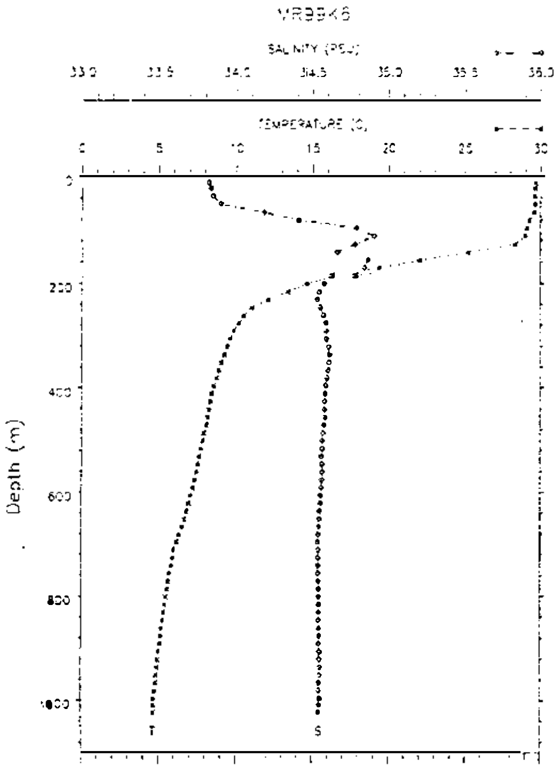
1999/11/09 10:17:23

CAST=015 LAT=1°00'01N LON=156°00'53E



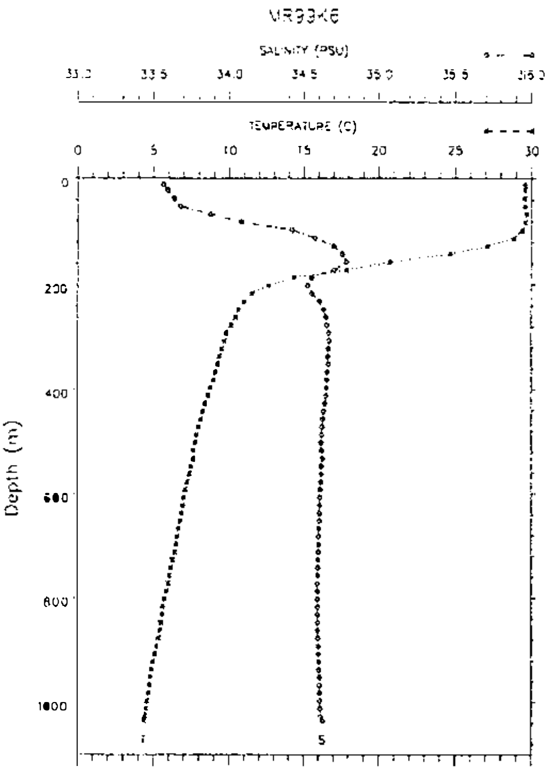
1999/11/12 4:26:18

CAST=016 LAT=3°00'00N LON=156°01'37E



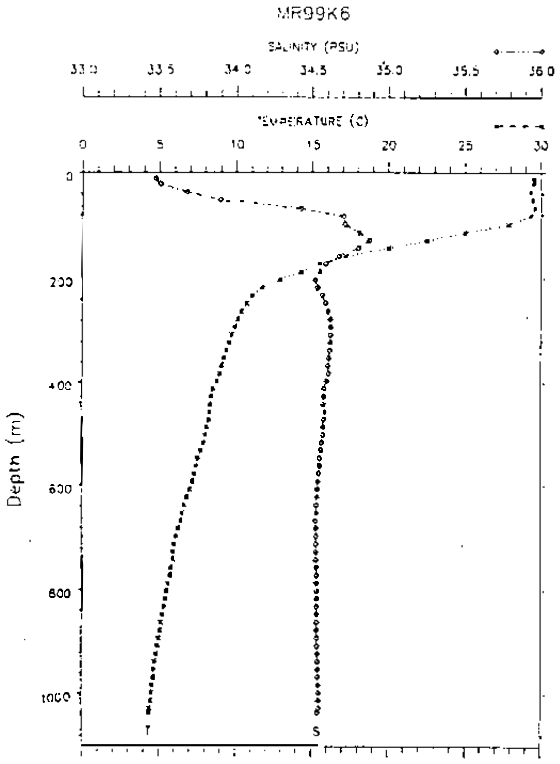
1999/11/12 8:16:23

CAST=017 LAT=3°59'59N LON=156°03'21E



1999/11/13 10:56:56

CAST=018 LAT=6°00'01N LON=156°01'10E



1999/11/13 14:51:16

CAST=019 LAT=6°59'59N LON=156°11'22E

6.2.3. Salinity measurements of sampled seawater for validation of CTD cast data

(1) Personnel

Kentaro Ando (JAMSTEC) : Principal Investigator
Masayuki Fujisaki (MWJ) : Operation Leader
Hirokatsu Uno (MWJ)
Fujio Kobayashi (MWJ)

(2) Objectives

To check the quality of CTD salinity.

(3) Parameters

Salinity of sampled water

(4) Method

Seawater samples were collected with 12 liter Niskin bottles for two layers, 500 m and 1000 m. Samples in the Surface Water Monitoring System in the “Surface Seawater Monitoring Lab. “ were also collected. They were stored in 250 ml Phoenix brown glass bottles. The salinity measurements were carried out using the laboratory salinometer (Model 8400B AUTOSAL; Guildline Instruments Ltd.), which was modified by addition of an Ocean Scientific International peristaltic-type sample intake pump, with a bath temperature 24 deg-C. The instrument was operated in the “AUTOSAL Room” of R/V Mirai. A double conductivity ratio was defined as a median of 31 readings of the salinometer. Data collection was started after 5 seconds and it took about 10 seconds to collect 31 readings by a personal computer. The salinometer standardizations were made with IAPSO Standard Seawater batch P135 (Ocean Scientific International Ltd.) whose conductivity is 0.99992 (salinity 34.9969). Sub-standard seawater was used to check the drift of the Autosal and measured in every 10 samples.

(5) Results

Analysis data of all samples were shown in Table 6.2.3-1. The standard deviation of difference was 0.0025. As the difference of salinity between with CTD and AUTOSAL for No. 2 Niskin bottle was sometimes large (Fig. 6.2.3-1), we excluded the values of No. 2 Niskin bottle. The shadow lines in Table 6.2.3-2 show duplicate samples. These 21 pairs of duplicate samples taken by the same Niskin bottle were analyzed to estimate the precision of this method. The standard deviation of difference in duplicate samples was 0.00062.

(6) Data archive

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

Table 6.2.3-1 Salinity comparison between CTD and AUTOSAL

Stn.	Niskin No.	Date	Pressure (db)	CTD-Sal. (PSU)	Bottle No.	AUTOSAL-1 (PSU)	AUTOSAL-2 (PSU)	Avg. AUTOSAL (PSU)	Difference (PSU)	Ex. Niskin No.2 (PSU)
0001	1	21 Oct. 1999	1000.513	34.5457	001	34.5435	34.5439	34.5437	0.0020	0.0020
					002	34.5441	34.5439	34.5440	0.0017	0.0017
	2		500.142	34.5447	003	34.5423	34.5427	34.5425	0.0022	
0002	1	22 Oct. 1999	1010.185	34.5454	004	34.5449	34.5445	34.5447	0.0007	0.0007
	6		504.157	34.5601	005	34.5586	34.5590	34.5588	0.0013	0.0013
0003	1		1000.462	34.5445	006	34.5435	34.5431	34.5433	0.0012	0.0012
					007	34.5443	34.5443	34.5443	0.0002	0.0002
	2		500.316	34.5349	008	34.5364	34.5366	34.5365	-0.0016	
0004	1		1008.203	34.5519	009	34.5519	34.5521	34.5520	-0.0001	-0.0001
					010	34.5516	34.5512	34.5514	0.0005	0.0005
	7		504.641	34.5559	011	34.5559	34.5561	34.5560	-0.0001	-0.0001
0005	1	23 Oct. 1999	1000.838	34.5510	012	34.5519	34.5521	34.5520	-0.0010	-0.0010
	2		500.063	34.5536	013	34.5569	34.5571	34.5570	-0.0034	
0006	1		1008.822	34.5538	014	34.5547	34.5543	34.5545	-0.0007	-0.0007
					015	34.5559	34.5555	34.5557	-0.0019	-0.0019
	7		504.283	34.5625	016	34.5616	34.5612	34.5614	0.0011	0.0011
0007	1	25 Oct. 1999	1000.132	34.5509	017	34.5531	34.5527	34.5529	-0.0020	-0.0020
	2		500.131	34.6019	018	34.8064	34.8062	34.8063	-0.2044	
0008	1		1009.625	34.5500	019	34.5516	34.5516	34.5516	-0.0016	-0.0016
					020	34.5519	34.5523	34.5521	-0.0021	-0.0021
	7		504.521	34.5871	021	34.5918	34.5918	34.5918	-0.0047	-0.0047
0009	1	27 Oct. 1999	1000.115	34.5475	022	34.5508	34.5504	34.5506	-0.0031	-0.0031
	2		499.804	34.5888	023	34.5932	34.5930	34.5931	-0.0043	
0010	1	29 Oct. 1999	1000.147	34.5476	024	34.5510	34.5508	34.5509	-0.0033	-0.0033
					025	34.5510	34.5508	34.5509	-0.0033	-0.0033
	2		500.141	34.5769	026	34.5798	34.5802	34.5800	-0.0031	
0011	No Sampling		-	-	-	-	-	-	-	-
0012	1	30 Oct. 1999	1000.323	34.5450	027	34.5484	34.5484	34.5484	-0.0034	-0.0034
	2		500.424	34.5831	028	34.5824	34.5824	34.5824	0.0007	
0013	1	3 Nov. 1999	1001.956	34.5497	030	34.5527	34.5527	34.5527	-0.0030	-0.0030
	2		499.624	34.5667	031	34.5684	34.5682	34.5683	-0.0015	
0014	1	6 Nov. 1999	999.763	34.5234	032	34.5280	34.5278	34.5279	-0.0044	-0.0044
					033	34.5264	34.5264	34.5264	-0.0030	-0.0030
	2		500.128	34.6484	034	34.6496	34.6500	34.6498	-0.0016	
0015	1	7 Nov. 1999	999.971	34.5342	036	34.5380	34.5376	34.5378	-0.0036	-0.0036
					037	34.5388	34.5386	34.5387	-0.0045	-0.0045
	2		499.910	34.6075	038	34.7201	34.7199	34.7200	-0.1125	
0016	1	9 Nov. 1999	1001.050	34.5495	039	34.5527	34.5525	34.5526	-0.0031	-0.0031
	3		499.650	34.5935	040	34.5965	34.5965	34.5965	-0.0030	-0.0030
	2		4.418	34.8862	041	34.8979	34.8981	34.8980	-0.0118	
0017	1	10 Nov. 1999	1000.747	34.5453	042	34.5482	34.5480	34.5481	-0.0028	-0.0028
					043	34.5486	34.5484	34.5485	-0.0032	-0.0032
	3		499.644	34.6010	044	34.6016	34.6014	34.6015	-0.0005	-0.0005
0018	1		499.834	34.6214	049	34.6164	34.6162	34.6163	0.0051	0.0051
					050	34.6160	34.6164	34.6162	0.0052	0.0052
	2		499.899	34.6215	051	34.7756	34.7754	34.7755	-0.1540	
					052	34.7758	34.7756	34.7757	-0.1542	
	3		500.169	34.6219	053	34.6197	34.6193	34.6195	0.0024	0.0024
					054	34.6191	34.6191	34.6191	0.0028	0.0028
	4		499.903	34.6218	055	34.6203	34.6203	34.6203	0.0015	0.0015
					056	34.6205	34.6207	34.6206	0.0012	0.0012
	5		499.647	34.6218	057	34.6221	34.6217	34.6219	-0.0001	-0.0001
					058	34.6217	34.6215	34.6216	0.0002	0.0002
	6		499.914	34.6220	059	34.6213	34.6217	34.6215	0.0005	0.0005
					060	34.6215	34.6217	34.6216	0.0004	0.0004
	7		500.163	34.6219	061	34.6215	34.6215	34.6215	0.0004	0.0004
					062	34.6211	34.6213	34.6212	0.0007	0.0007
	8		500.034	34.6217	063	34.6219	34.6221	34.6220	-0.0003	-0.0003
					064	34.6215	34.6219	34.6217	0.0000	0.0000
	9		499.832	34.6218	065	34.6219	34.6215	34.6217	0.0001	0.0001
					066	34.6217	34.6217	34.6217	0.0001	0.0001
	10		499.848	34.6217	067	34.6221	34.6221	34.6221	-0.0004	-0.0004
					068	34.6221	34.6225	34.6223	-0.0006	-0.0006
	11		500.090	34.6216	069	34.6219	34.6217	34.6218	-0.0002	-0.0002
					070	34.6211	34.6207	34.6209	0.0007	0.0007
	12		499.961	34.6218	071	34.6225	34.6225	34.6225	-0.0007	-0.0007
					072	34.6223	34.6219	34.6221	-0.0003	-0.0003
0019	1	13 Nov. 1999	999.712	34.5514	045	34.5539	34.5537	34.5538	-0.0024	-0.0024
	3		500.504	34.5781	046	34.5794	34.5791	34.5793	-0.0012	-0.0012
	2		10.051	33.5613	047	33.5687	33.5685	33.5686	-0.0073	
0020	1	14 Nov. 1999	1001.298	34.5558	048	34.5586	34.5584	34.5585	-0.0027	-0.0027
	3		499.541	34.5703	049	34.5677	34.5677	34.5677	0.0026	0.0026
	9		100.361	34.8593	051	34.8686	34.8690	34.8688	-0.0095	-0.0095
	2		9.937	33.6100	050	33.6148	33.6146	33.6147	-0.0047	
								Avg. Difference	-0.0097	-0.00076
								S.D.	0.036	0.0025

Note: The shadow lines show the duplicate samples.

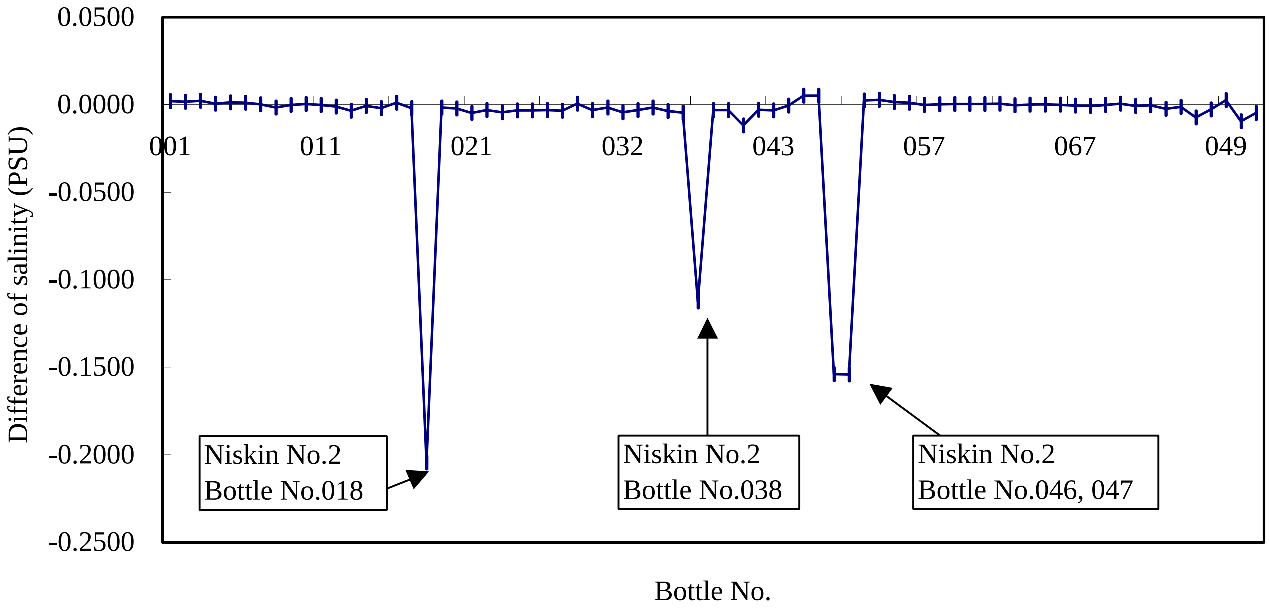


Fig.6.2.3-1 Difference of salinity between CTD and AUTOSAL

Table 6.2.3-2 Salinity comparison between duplicate samples

Stn.	Niskin No.	Date	Pressure (db)	Bottle No.	AUTOSAL-1 (PSU)	AUTOSAL-2 (PSU)	Avg. AUTOSAL (PSU)	Difference (PSU)
0001	1	21 Oct. 1999	1000.513	001	34.5435	34.5439	34.5437	-0.0003
				002	34.5441	34.5439	34.5440	
0003	1	22 Oct. 1999	1000.462	006	34.5435	34.5431	34.5433	-0.0010
				007	34.5443	34.5443	34.5443	
0004	1		1008.203	009	34.5519	34.5521	34.5520	0.0006
				010	34.5516	34.5512	34.5514	
0006	1	23 Oct. 1999	1008.822	014	34.5547	34.5543	34.5545	-0.0012
				015	34.5559	34.5555	34.5557	
0008	1	25 Oct. 1999	1009.625	019	34.5516	34.5516	34.5516	-0.0005
				020	34.5519	34.5523	34.5521	
0010	1	29 Oct. 1999	1000.147	024	34.5510	34.5508	34.5509	0.0000
				025	34.5510	34.5508	34.5509	
0014	1	6 Nov. 1999	999.763	032	34.5280	34.5278	34.5279	0.0015
				033	34.5264	34.5264	34.5264	
0015	1	7 Nov. 1999	999.971	036	34.5380	34.5376	34.5378	-0.0009
				037	34.5388	34.5386	34.5387	
0017	1	10 Nov. 1999	1000.747	042	34.5482	34.5480	34.5481	-0.0004
				043	34.5486	34.5484	34.5485	
0018	1		499.834	049	34.6164	34.6162	34.6163	0.0001
				050	34.6160	34.6164	34.6162	
	2		499.899	051	34.7756	34.7754	34.7755	-0.0002
				052	34.7758	34.7756	34.7757	
	3		500.169	053	34.6197	34.6193	34.6195	0.0004
				054	34.6191	34.6191	34.6191	
	4		499.903	055	34.6203	34.6203	34.6203	-0.0003
				056	34.6205	34.6207	34.6206	
	5		499.647	057	34.6221	34.6217	34.6219	0.0003
				058	34.6217	34.6215	34.6216	
	6		499.914	059	34.6213	34.6217	34.6215	-0.0001
				060	34.6215	34.6217	34.6216	
	7		500.163	061	34.6215	34.6215	34.6215	0.0003
				062	34.6211	34.6213	34.6212	
	8		500.034	063	34.6219	34.6221	34.6220	0.0003
				064	34.6215	34.6219	34.6217	
	9		499.832	065	34.6219	34.6215	34.6217	0.0000
				066	34.6217	34.6217	34.6217	
	10		499.848	067	34.6221	34.6221	34.6221	-0.0002
				068	34.6221	34.6225	34.6223	
	11		500.090	069	34.6219	34.6217	34.6218	0.0009
				070	34.6211	34.6207	34.6209	
	12		499.961	071	34.6225	34.6225	34.6225	0.0004
				072	34.6223	34.6219	34.6221	
							Avg. Difference	-0.000014
							S.D.	0.00062

Note: The shadow lines show the duplicate samples.

6.3 Surface thermosalinograph (TSG) measurement

6.3.1. TSG

(1) Personnel name and affiliation

Kentaro Ando	(JAMSTEC): Principal Investigator
Nobuharu Komai	(MWJ): Operation leader
Keisuke Wataki	(MWJ)

(2) Objectives

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

(3) Parameters

Temperature, salinity, dissolved oxygen, fluorescence, particle size of plankton in the near-surface water.

(4) Methods

The *Continuous Sea Surface Water Monitoring System* (Nippon Kaiyo co., Ltd.) is located in the "*sea surface monitoring laboratory*" on R/V Mirai. It can automatically measure temperature, salinity, dissolved oxygen, fluorescence and particle size of plankton in the near-surface water every 1-minute. Measured data are saved every one-minute together with time and the position of ship, and displayed in the data management PC machine. This system is connected to shipboard LAN-system and provides the acquired data for p-CO_2 measurement system, etc. Geodetic reference system for the positioning was used by WGS 84 at this cruise.

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

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

a-1) Temperature and salinity sensors

SEACAT THERMOSALINOGRAPH
Model: SBE-21, SEA-BIRD ELECTRONICS, INC.
Serial number: 2113117-2641
Measurement range: Temperature -5 to +35 deg-C, Salinity 0 to 6.5 S/m
Accuracy: Temperature 0.01 deg-C/6month, Salinity 0.001 S/m/month
Resolution: Temperature 0.001 deg-C, Salinity 0.0001 S/m
Calibration date: 08-Sep-99 (mounted on 15-Oct-99 in this system)

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

Model: SBE 3S, SEA-BIRD ELECTRONICS, INC.
Serial number: 032607
Measurement range: -5 to +35 deg-C
Initial Accuracy: 0.001 deg-C per year typical
Stability: 0.002 deg-C per year typical
Calibration date: 29-Apr-99 (mounted on 24-Aug-99 in this system)

b) Dissolved oxygen sensor

Model: 2127, Oubisufair Laboratories Japan INC.
Serial number: 31757
Measurement range: 0 to 14 ppm
Accuracy: ±1% at 5 deg-C of correction range
Stability: 1% per month
Calibration date: 15-Oct-99

c) Fluorometer

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

d) Particle size sensor

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

e) Flowmeter

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

(5) Preliminary Result

5-1 Calibration

Temperature sensor

To check the value of the temperature of TSG, we compared the value of the temperature between TSG and CTD (Muller and Schenk, 1991). Temperature of CTD was used both of the pressure at 5 db (about the same depth of the seawater intake) and the average of 4 to 6 db at the each downcast on CTD stations. The result was shown in Table 6.3.1-1 and Figure 6.3.1-1. Average and standard deviation of the difference of temperature (TSG-CTD, temperature of CTD was used by the average of the 4-6 db) was 0.037 and 0.064, respectively. So CTD temperatures at the downcast were not used as reference.

Dissolved Oxygen (D.O.) sensor

D.O. sensor of this system was calibrated just before this cruise. To estimate of accuracy of the sensor, we collected the 14 samples from the course of the system and analyzed by Winkler method. The samples for the titration method were analyzed by Metrohm piston burette of 10ml with Pt Electrode using Whole bottle titration. The standardization and pure water blank determination have been performed before the sample titration. Concentration of D.O. was calculated by equation (8) of WHP Operations and Methods (Culberson, 1991). The amount of D.O. in the reagents was used the value (=0.0027 ml at 21 deg-C) measured at 1995 WOCE cruise.

The results were shown in Table 6.3.1-2 and Figure 6.3.1-2 and 6.3.1-3. D.O. value of the sensor was always higher than the values analyzed by the Winkler method. The Root Mean Squares (R.M.S.) of differences of the value was 0.639 ml/l (one sigma). This value is higher than R.M.S. (0.255 ml/l) at the MR99-K02 cruise. So we wondered if we made a mistake in the procedure of calibration of sensor or the sensor was not in good condition during this cruise. The reason is not unclear.

Fluorometer

In order to calibrate the data of fluorescence from this system, surface seawater samples were collected from the drain of *continuous Dissolved Inorganic Carbon (DIC) measurement system* each day. We cleaned the flow cell of fluorometer at Sekinehama port just before this cruise. We also cleaned the flow cell 7 times (19-Oct-99 at Guam port, 22-Oct-99, 25-Oct-99, 29-Oct-99, 06-Nov-99, 13-Nov-99, and 16-Nov-99) during this cruise. We determined the concentrations of chlorophyll *a* on board. The method of measurement was indicated below.

Sea surface water samples (1L) were filtered through a glass fiber filter at under 20 cmHg pressure. Filters were used Whatman GF/F (glass fiber filter, 25mm diameter).

Chlorophyll *a* on the filters were extracted with 5 ml (16-Oct-99 to 5-Nov-99) or 6 ml (6-Nov-99〜17-Nov-99) of N,N’-Dimethylformamide (DMF) overnight in a dark and -20℃ place.

Fluorescence of extracts were measured by Turner fluorometer (10-AU-005, TURNER DESIGNS). The fluorometer was calibrated against a known concentration of pure chlorophyll *a* standard (Sigma Chemical Company) as determined by the spectrophotometic method (Porra *et al.*, 1989). A half minutes after the each measurement, the extracts were acidified with 1 or 2 drops of 1N HCl and the second measurement was made.

The concentration of chlorophyll *a* was calculated from the following equation:

$$\text{chlorophyll } a \; (mg/L) = Fs \cdot r \cdot (Fo - Fa) \cdot v / V$$

where:

Fs = response factor for sensitivity setting, S (0.22)
r = the before-to-after acidfication ratio of a pure chlorophyll *a* solution (1.75)
Fo = fluorescence of seawater sample before acidification
Fa = fluorescence of seawater sample after acidification
v = extraction volume
V = filtered sample volume

The results were shown in Table 6.3.1-3. We took the 25 duplicate samples (took from the same sample bottle) during this cruise. R.M.S for the samples of 5 ml extraction volume was 0.034 µg/l (one sigma), but for the 6 ml was 0.003 µg/l (one sigma). So 5 ml of extraction volume was not enough volume for the measurements of fluorometer. Therefore we didn’t use the data of 5 ml extraction, which took from 16-Oct-99 to 5-Nov-99 for the calibration and we compared that the fluorescence and concentration of chlorophyll *a* for only 6 ml extraction volume in Figure 6.3.1-4.

5-2 result

Preliminary data in every 10 minutes from Hachinohe to Guam, and along 137E and 138E line, 147E line, 156E line, the equator line (from 138E to 147E), the line form 5N, 147E to 5S, 156E were shown in Figure 6.3.1-5～Figure 6.3.1-10, respectively. They showed the respective trend of temperature, salinity, D.O. and fluorescence distributions on the ship's track. Compared with three lines of 137 and 138E, 147E and 156E, the temperature was getting higher and salinity was getting lower westward. There was a front of salinity at about 3N in both 147E and 156E. At 156E line, Salinity was high (about 35PSU) from 5S to 3N. There was the significant peak of chlorophyll *a* from about 1S to the equator. At the same area, temperature was lower (about 29 deg-C) than other area. We seemed that the equatorial upwelling was caused from about 1S to the equator. In Figure 6.3.1-10, fluorescence peak was found at the same the equatorial area (151-152E). Along the equator line, temperature and salinity were low at 139E.

Compared with February, 1999 of MR99-K02 cruise, at 147E line the temperature and salinity was a little higher in this cruise. In comparison with 156E line, there was a trend which temperature was low and salinity was high at 2S to 4N at February, 1999.

(6) Other remarks

References:

Culberson, C. H. (1991) Dissolved Oxygen, in WHP Operations Methods, Woods Hole, pp.1-15.
Porra R. J., W. A. Thompson and P. E. Kriedemann (1989) Biochem. Biophys. Acta, 975, 384 – 394.

(7) Data archive

All the files of raw data, Microsoft excel files of raw data, excel files divided into each 10minutes data were stored on a magnetic optical disk. All the data will be submitted to the DMO at JAMSTEC.

6.3.2. Salinity measurement for validation of TSG salinity

We sampled almost each day (except with 31-Oct-99) for salinity validation and in situ salinity calibration during this cruise. The samples were taken while on station or from regions with weak horizontal gradients. All salinity samples were drawn from the drain valve of surface water for the *continuous Dissolved Inorganic Carbon (DIC) measurement system*. All samples were analyzed on the Guildline 8400B using standard seawater batch P135 (see section 6.2.3).

We also cleaned the conductivity cell for 5 times (19-Oct-99 at Guam port, 24-Oct-99, 29-Oct-99, 6-Nov-99, and 16-Nov-99) during this cruise. The method of cleaning of the cell was to was the inside of the cell by the 1L fresh water and then wash again by the 250ml distilled water.

To estimate the accuracy of the conductivity, we calculated the conductivity from bottle samples and the conductivity sensor at the same sampling time. We calculated the conductivity at a pressure of 0dbar and at the temperature of the CT sensor. The data were shown in Table 6.3.2-1 and Figure 6.3.2-1 and Figure 6.3.2-2, and the results were shown in Table 6.3.2-2.

Table 6.3.2-2 Precision of Salinity and Conductivity of TSG at MR99-K06

	Sctd-Ssal	Cctd-Csal
Average	0.0039	0.0006
Standard Deviation	0.0076	0.0011
Average of absolute difference	0.0057	0.0008
Standard Deviation of absolute difference	0.0064	0.0009
R.M.S.	0.0060	0.0009
Min	–0.0124	–0.0019
Max	0.0327	0.0049
n	40	40

We calculated the Root Mean Squares (R.M.S.) of difference of salinity and conductivity value for 40 samples. R.M.S. of salinity and conductivity (one sigma) were 0.0060 and 0.0009, respectively. There were 6 samples which difference were over 0.01 PSU at this cruise (Figure 6.3.2-1). We suspected that these differences may be caused by the timing of sampling water and TSG measurement. The final results omitted the six samples were shown in Table 6.3.2-3.

Table 6.3.2-3 Precision of Salinity and Conductivity at TSG omitted 6 samples

	Sctd-Ssal	Cctd-Csal
Average	0.0029	0.0004
Standard Deviation	0.0030	0.0004
Average of absolute difference	0.0035	0.0005
Standard Deviation of absolute difference	0.0022	0.0003
R.M.S.	0.0029	0.0004
Min	–0.0051	–0.0007
Max	0.0084	0.0013
n	34	34

Our final results showed that the validation of salinity of TSG was about 0.006 PSU (two sigma of standard deviation) during this cruise. From our results, it is not clear if washing the conductivity cell reduced the drift of conductivity or not.

Reference:

T. J. Muller and H. -W. Schenk (1991) Near-Surface Temperature, salinity, and Bathmetry Measurements, in WHP Operations Methods, Woods Hole, pp.1-4.

Table 6.3.1-1 Comparison of temperature between CTD and TSG

Stn.	Date&Time of CTD (UTC)	Pressure (db)	Depth (m)	T at 5db (deg-C)	Average of T from 4 to 6db (deg-C)	Date&Time of TSG (UTC)	T of TSG (deg-C)	difference of Temperature	
								TSG-CTD (5db)	TSG-CTD (avg. of 4-6db)
C01	10/21/99 21:54:23	5	4.972	29.8475	29.8311	10/21/99 21:53:58	29.8049	-0.043	-0.026
C02	10/22/99 13:04:06	5	4.972	30.0464	30.0421	10/22/99 13:03:48	30.1172	0.071	0.075
C03	10/22/99 17:56:37	5	4.972	30.1981	30.1962	10/22/99 17:57:02	30.1559	-0.042	-0.040
C04	10/22/99 23:03:31	5	4.972	29.9047	29.9048	10/22/99 23:03:58	29.9055	0.001	0.001
C05	10/23/99 11:29:52	5	4.972	29.7309	29.7354	10/23/99 11:29:51	29.7484	0.017	0.013
C06	10/23/99 21:57:54	5	4.972	29.9084	29.9082	10/23/99 21:57:59	29.9143	0.006	0.006
C07	10/25/99 3:37:20	5	4.972	30.2827	30.3029	10/25/99 3:36:58	30.2996	0.017	-0.003
C08	10/25/99 22:53:34	5	4.972	29.8534	29.8558	10/25/99 22:53:56	29.8353	-0.018	-0.020
C09	10/27/99 3:49:13	5	4.972	29.7809	29.7836	10/27/99 3:48:53	29.8033	0.022	0.020
C10	10/29/99 8:35:18	5	4.972	29.5632	29.5625	10/29/99 8:34:52	29.5765	0.013	0.014
C11	10/30/99 2:11:19	5	4.972	29.5606	29.5479	10/30/99 2:10:54	29.6234	0.063	0.075
C12	10/30/99 21:55:18	5	4.972	29.5100	29.5172	10/30/99 21:54:59	29.5179	0.008	0.001
C13	11/3/99 2:57:33	5	4.972	30.0450	30.0298	11/3/99 2:57:58	30.0336	-0.011	0.004
C14	11/6/99 1:00:08	5	4.972	29.9723	29.9789	11/6/99 1:00:03	30.1296	0.157	0.151
C15	11/7/99 0:58:29	5	4.972	29.5619	29.5676	No data	No data	No data	No data
C16	11/9/99 2:57:24	5	4.972	29.4998	29.4622	11/9/99 2:56:54	29.5891	0.089	0.127
C17	11/10/99 2:54:23	5	4.972	29.4669	29.4766	11/10/99 2:53:56	29.4968	0.030	0.020
C18	11/10/99 21:57:40	5	4.972	29.2097	29.2091	11/10/99 21:57:58	29.2256	0.016	0.016
C19	11/13/99 3:52:38	5	4.972	29.6013	29.6051	11/13/99 3:52:53	29.8041	0.203	0.199
C20	11/14/99 2:56:16	5	4.972	29.5214	29.5242	11/14/99 2:56:54	29.5888	0.067	0.065

Table 6.3.1-2 Comparison of D.O. values between a D.O. sensor of *Sea Surface Monitoring System* and water samples from the system using Winkler method.

Sampling Date and Time (UTC)		Sampling Positon Latitude	Longitude	Salinity (PSU)	T of SBE21 (deg-C)	D.O. sensor	Winkler (ml/l)	difference	Remarks
10/21/99	1:56	11-10.687N	140-02.798E	34.2895	29.9513	5.363	4.436	0.927	took the sample from the system
10/21/99	1:59	11-10.280N	140-02.113E	34.3202	29.9794	5.360	4.435	0.925	took the sample from the system
10/23/99	7:59	04-45.908N	137-13.296E	33.7042	30.0685	5.344	4.480	0.864	took the sample from the system
10/23/99	8:02	04-45.906N	137-12.522E	33.6599	30.0246	5.334	4.468	0.866	took the sample from the system
10/26/99	11:31	00-01.972S	137-48.397E	34.0836	29.9915	5.333	4.493	0.840	took the sample from the system
10/26/99	11:34	00-01.977S	137-47.553E	34.0827	29.9978	5.330	4.489	0.841	took the sample from the system
10/28/99	23:48	00-01.083S	146-24.382E	34.7855	29.5898	5.410	4.484	0.926	took the sample from the system
10/28/99	23:52	00-01.024S	146-25.290E	34.7821	29.5905	5.404	4.501	0.903	took the sample from the system
11/6/99	6:01	04-20.069S	156-00.424E	34.9323	30.5726	5.348	4.445	0.903	took the sample from the system
11/6/99	6:05	04-19.017S	156-00.369E	34.9395	30.6634	5.352	4.433	0.919	took the sample from the system
11/11/99	8:21	01-57.817N	156-02.405E	34.7841	29.4899	5.469	4.502	0.967	took the sample from the system
11/11/99	8:25	01-57.902N	156-02.329E	34.7849	29.4706	5.465	4.508	0.957	took the sample from the system

Table 6.3.1-3 Results of fluorescence and chl.a concentraion for the sea surface samples.

Sampling Date and Time		Sampling Positon		Fluorescence	extraction Vol.	concentraion of chl a (μg/l)			
(UTC)		Latitude	Longitude		(ml)	Sample 1	Sample 2	Avg.	difference
10/16/99	2:10:52	29-49.781N	143-03.326E	0.664	5	0.072	-	0.072	-
10/17/99	4:24:52	23-54.107N	143-47.715E	0.647	5	0.099	-	0.099	-
10/21/99	1:24:54	11-14.922N	140-09.951E	0.660	5	0.039	0.060	0.050	-0.021
10/22/99	3:18:54	07-50.910N	136-33.163E	0.666	5	0.058	0.090	0.074	-0.032
10/23/99	6:38:54	04-45.996N	137-34.887E	0.690	5	0.258	0.157	0.208	0.101
10/24/99	1:33:56	02-15.592N	137-42.167E	0.678	5	0.216	0.122	0.169	0.094
10/25/99	4:12:58	02-03.847N	138-05.197E	0.699	5	0.140	0.092	0.116	0.048
10/26/99	0:29:53	00-46.324N	137-57.461E	0.690	5	0.093	0.066	0.080	0.027
10/27/99	3:16:53	00-04.375N	138-01.749E	0.700	5	0.151	0.097	0.124	0.054
10/28/99	4:07:54	00-00.268N	142-04.864E	0.703	5	0.159	0.105	0.132	0.054
10/29/99	10:05:51	00-01.676S	146-59.497E	0.706	5	0.080	0.073	0.076	0.007
10/30/99	2:27:54	00-04.253N	146-49.639E	0.698	5	0.101	0.077	0.089	0.024
10/31/99	3:14:54	03-11.646N	147-01.074E	0.666	5	0.058	-	0.058	-
11/1/99	2:55:56	04-51.610N	146-57.680E	0.686	5	0.111	0.095	0.103	0.016
11/2/99	4:58:56	04-52.663N	146-57.765E	0.707	5	0.091	0.093	0.092	-0.002
11/3/99	3:04:58	05-03.262N	146-56.767E	0.702	5	0.070	0.089	0.080	-0.019
11/4/99	8:17:57	01-20.885N	150-19.947E	0.740	5	0.078	0.134	0.106	-0.056
11/5/99	9:04:57	03-28.133S	154-11.575E	0.769	5	0.053	-	0.053	-
11/6/99	0:16:04	05-00.971S	155-58.593E	0.741	6	0.057	0.060	0.059	-0.003
11/6/99	12:09:56	02-43.121S	155-57.966E	0.832	6	0.098	0.106	0.102	-0.008
11/7/99	1:28:59	02-01.656S	155-56.713E	0.765	6	0.127	0.122	0.124	0.005
11/7/99	9:07:55	00-47.680S	156-05.974E	0.977	6	0.172	0.182	0.177	-0.010
11/8/99	0:17:54	00-00.111S	156-07.859E	0.708	6	0.141	-	0.141	-
11/9/99	1:35:55	00-01.685N	156-02.019E	0.695	6	0.098	-	0.098	-
11/10/99	3:11:55	02-04.483N	155-59.647E	0.701	6	0.088	-	0.088	-
11/11/99	3:06:55	01-57.142N	156-03.543E	0.698	6	0.081	0.083	0.082	-0.002
11/12/99	1:42:53	02-16.484N	155-57.133E	0.710	6	0.089	0.086	0.088	0.003
11/13/99	3:14:53	05-01.209N	155-58.183E	0.700	6	0.049	0.049	0.049	0.000
11/14/99	3:07:54	07-57.859N	156-01.222E	0.690	6	0.047	-	0.047	-
11/15/99	8:08:52	13-01.165N	151-22.191E	0.700	6	0.039	0.037	0.047	0.002
11/16/99	9:34:56	14-33.449N	150-00.131E	0.705	6	0.042	0.041	0.042	0.001
11/17/99	4:37:51	15-29.705N	149-55.823E	0.716	6	0.056	0.054	0.056	0.002

Table 6.3.2-1 Comparison of salinity between salinity sensor of Sea Surface Monitoring System and samples analyzed by Autosal salinometer.

Sampling Date	Sampling Time	Sampling Position		Tctd	Sctd	Ssal	Sctd-Ssal	Cctd	Csal	Cctd-Csal	Remarks
(UTC)	(UTC)	latitude	longitude	(IPTS-68)	(PSS78)	(PSS78)	(PSS78)	(S/m)	(S/m)	(S/m)	
10/15/99	12:51	32-51.350N	143-04.671E	27.4439	34.0042	33.9867	0.0175	5.4222	5.4198	0.0024	shifting
10/16/99	01:35	29-49.706N	143-03.212E	28.3617	34.4489	34.4430	0.0059	5.5811	5.5802	0.0009	stoppage
10/17/99	01:03	24-48.782N	143-43.764E	29.0874	34.6065	34.5981	0.0084	5.6802	5.6789	0.0013	shifting
10/20/99	12:08	12-52.462N	143-18.170E	29.8929	34.5511	34.5459	0.0052	5.7571	5.7563	0.0008	shifting
10/21/99	01:27	11-14.655N	140-09.504E	29.9113	34.2246	34.2196	0.0050	5.7106	5.7099	0.0007	shifting
10/22/99	13:12	06-59.978N	137-00.089E	30.1482	33.4602	33.4275	0.0327	5.6216	5.6167	0.0049	stoppage
10/23/99	11:38	03-59.853N	137-19.977E	29.7811	33.5861	33.5828	0.0033	5.6025	5.6020	0.0005	stoppage
10/24/99	01:30	02-16.650N	137-41.932E	30.3038	33.9611	33.9595	0.0016	5.7125	5.7122	0.0003	shifting
10/25/99	04:11	02-03.840N	138-05.180E	30.3526	34.0251	34.0201	0.0050	5.7271	5.7264	0.0007	stoppage
10/26/99	00:32	00-45.804N	137-57.273E	30.1317	33.9427	33.9384	0.0043	5.6918	5.6912	0.0006	shifting
10/27/99	03:14	00-04.346N	138-01.798E	29.8469	34.1675	34.146	0.0215	5.6954	5.6923	0.0031	stoppage
10/28/99	04:04	00-00.263N	142-03.982E	29.6341	34.6182	34.6166	0.0016	5.7396	5.7393	0.0003	shifting
10/29/99	04:00	00-02.737S	146-59.227E	29.7537	34.7343	34.7346	-0.0003	5.7694	5.7694	0.0000	shifting
10/29/99	13:58	00-03.215S	146-58.557E	29.5021	34.7278	34.7282	-0.0004	5.7417	5.7418	-0.0001	stoppage
10/30/99	02:26	00-04.246N	146-49.650E	29.6219	34.7085	34.7065	0.0020	5.7516	5.7513	0.0003	stoppage
11/1/99	13:02	04-53.329N	146-57.789E	29.8884	33.377	33.3784	-0.0014	5.5825	5.5827	-0.0002	stoppage
11/2/99	04:56	04-52.637N	146-57.704E	30.1285	33.4587	33.458	0.0007	5.6193	5.6192	0.0001	shifting
11/2/99	21:52	05-04.750N	146-57.100E	29.8316	33.4169	33.4142	0.0027	5.5826	5.5822	0.0004	stoppage
11/3/99	04:18	05-01.280N	146-56.295E	30.1406	33.4626	33.4587	0.0039	5.6212	5.6206	0.0006	stoppage
11/4/99	08:16	01-21.320N	150-19.690E	29.4508	34.6371	34.6359	0.0012	5.7230	5.7228	0.0002	shifting
11/5/99	12:46	03-48.723S	155-00.331E	29.9623	35.0308	35.0431	-0.0123	5.8353	5.8372	-0.0019	shifting
11/6/99	00:14	05-00.838S	155-58.334E	29.8884	34.7637	34.7664	-0.0027	5.7880	5.7884	-0.0004	stoppage
11/6/99	12:12	02-42.579S	155-57.944E	29.7939	35.4459	35.4583	-0.0124	5.8784	5.8802	-0.0018	shifting
11/6/99	23:48	02-05.024S	156-00.824E	29.4835	35.4274	35.4325	-0.0051	5.8422	5.8429	-0.0007	stoppage
11/7/99	02:58	02-02.020S	155-56.409E	29.6661	35.4378	35.4351	0.0027	5.8634	5.8630	0.0004	stoppage
11/8/99	00:07	00-00.058S	156-08.068E	29.0964	34.8875	34.8824	0.0051	5.7220	5.7213	0.0007	shifting
11/9/99	01:35	00-01.693N	156-02.018E	29.5059	34.8784	34.8754	0.0030	5.7642	5.7638	0.0004	stoppage
11/10/99	03:10	02-04.480N	155-59.646E	29.5386	34.7365	34.7345	0.0020	5.7469	5.7466	0.0003	stoppage
11/11/99	03:05	01-57.145N	156-03.602E	29.6974	34.8156	34.8107	0.0049	5.7754	5.7747	0.0007	stoppage
11/12/99	01:34	02-14.006N	155-56.955E	29.6085	34.8209	34.8167	0.0042	5.7667	5.7660	0.0007	shifting
11/13/99	03:13	05-01.209N	155-58.192E	29.8009	33.5810	33.5815	-0.0005	5.6038	5.6038	0.0000	shifting
11/14/99	00:57	08-04.127N	155-59.777E	29.5841	33.6474	33.6459	0.0015	5.5913	5.5911	0.0002	stoppage
11/15/99	02:42	11-55.169N	152-22.302E	29.4469	34.8262	34.8264	-0.0002	5.7503	5.7503	0.0000	stoppage
11/16/99	01:30	14-34.292N	150-03.821E	29.4001	34.8302	34.8178	0.0124	5.7459	5.7441	0.0018	stoppage
11/16/99	16:24	14-28.155N	150-00.072E	29.3763	34.8613	34.8541	0.0072	5.7480	5.7469	0.0011	stoppage
11/17/99	02:22	15-30.787N	149-58.014E	29.3172	34.8398	34.8348	0.0050	5.7385	5.7378	0.0007	stoppage
11/17/99	06:51	15-28.755N	149-53.707E	29.2998	34.8392	34.8326	0.0066	5.7366	5.7356	0.0010	stoppage
11/18/99	02:57	14-50.975N	147-57.397E	29.2638	34.7708	34.764	0.0068	5.7228	5.7218	0.0010	shifting

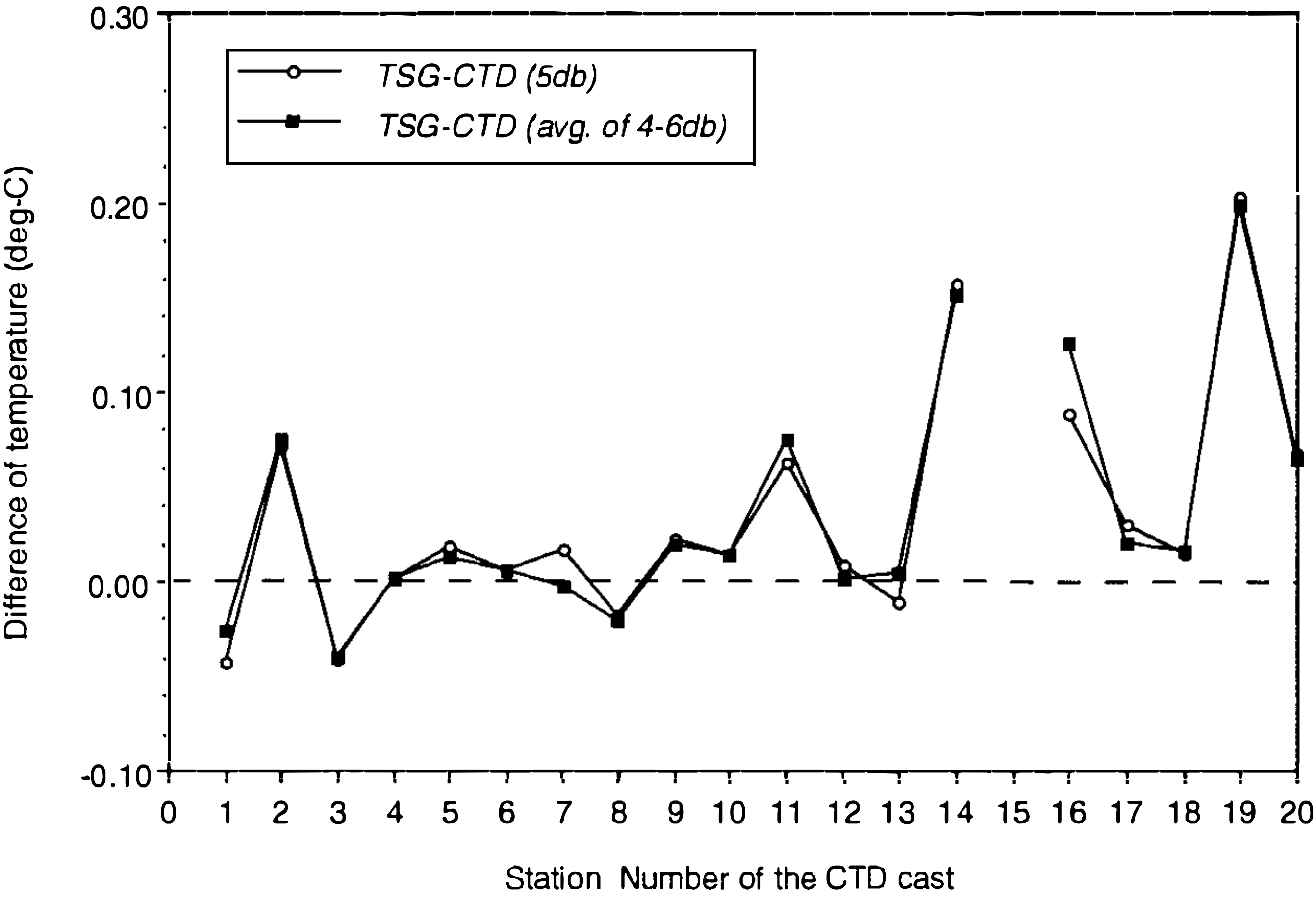


Figure 6.3.1-1 Comparison between the temperature value measured by*Sea Surface Monitoring System* and by CTD at the down cast (CTD temperatures were used at the pressure of 5db and average of 4 to 6db).

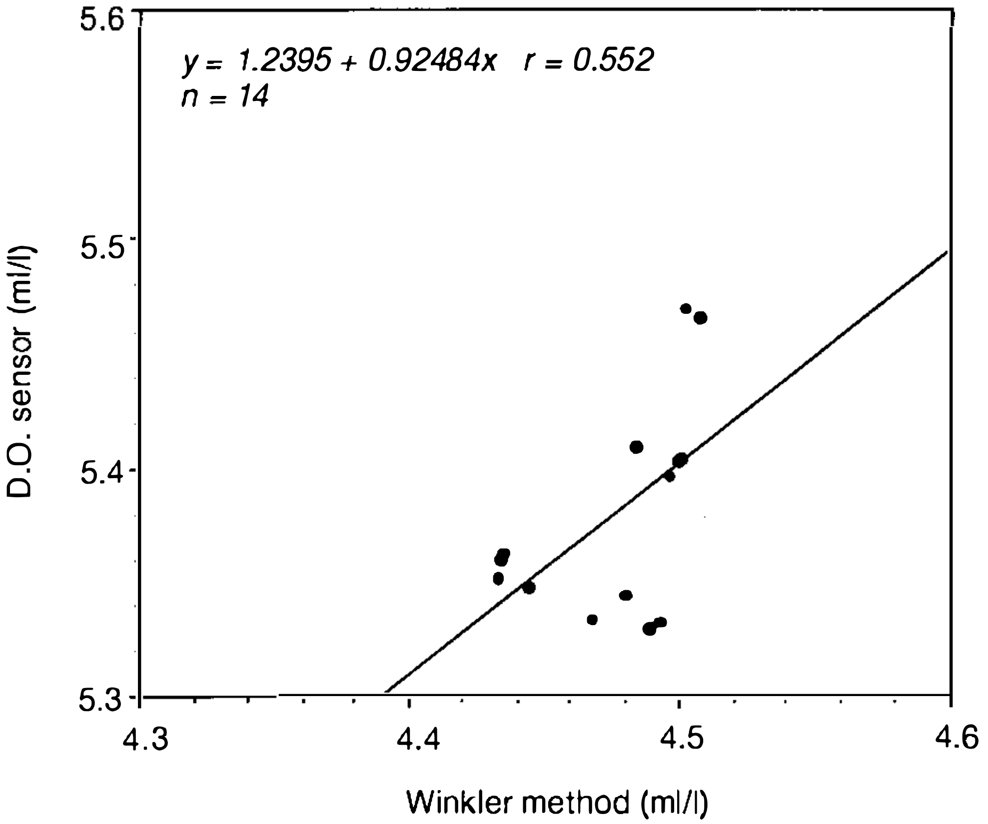


Figure 6.3.1-2 Comparison between the D.O. value measured by D.O. sensor of *Sea Surface Monitoring System* and by the Winkler method for 14 samples during MR99-K06 Cruise.

Note: The value of both axis in this figure were different.

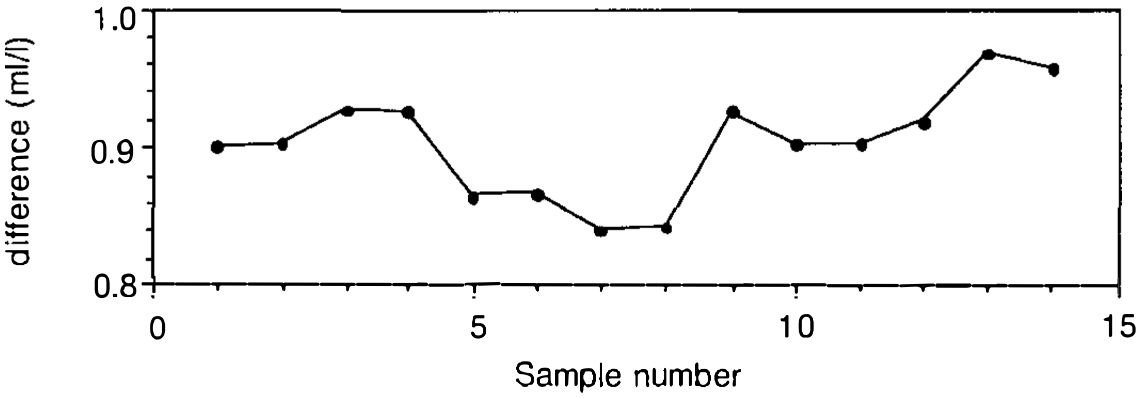


Figure 6.3.1-3 difference of D.O. value between D.O. sensor of *sea Surface Monitoring System* and the Winlkler method during MR99-K06 Cruise.

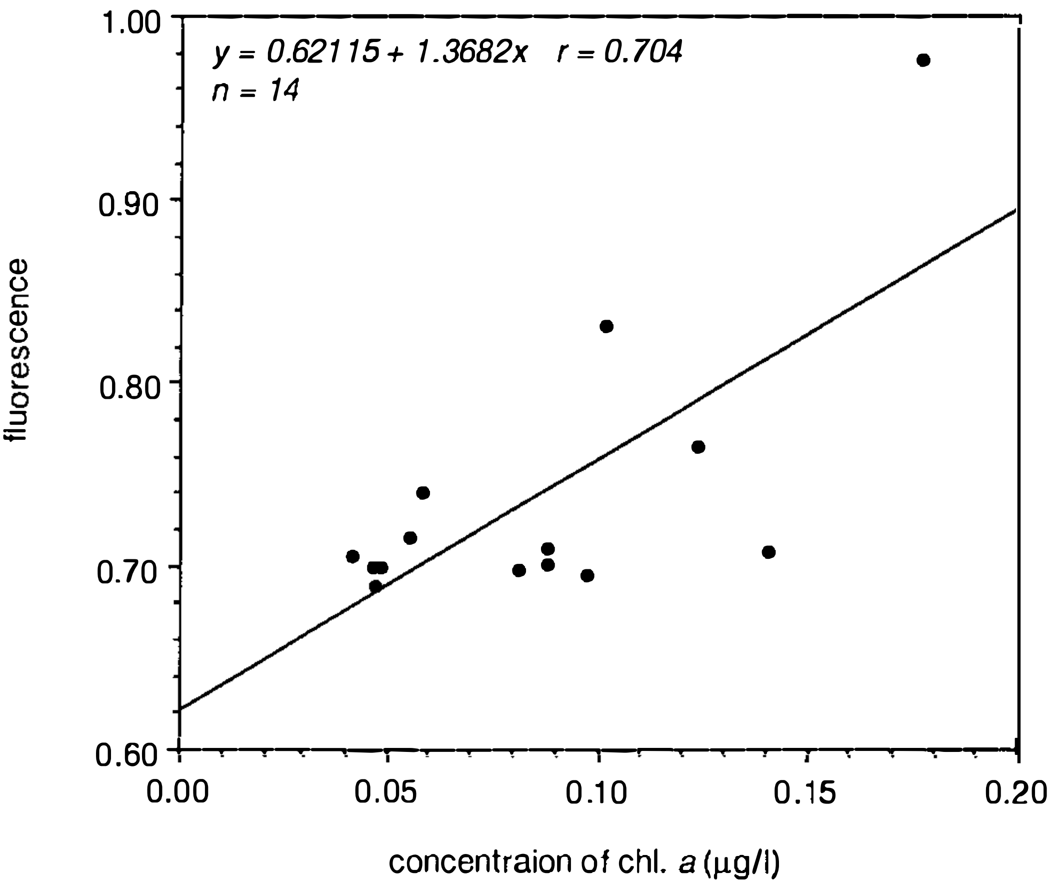


Figure 6.3.1-4 Comparison between the concentraion of chl. *a* and fluorescence of *Sea Surface Monitoring System* for 14 samples during MR99-K06 Cruise.
Note: The samples in this Figure were only 6ml of extraction volume.

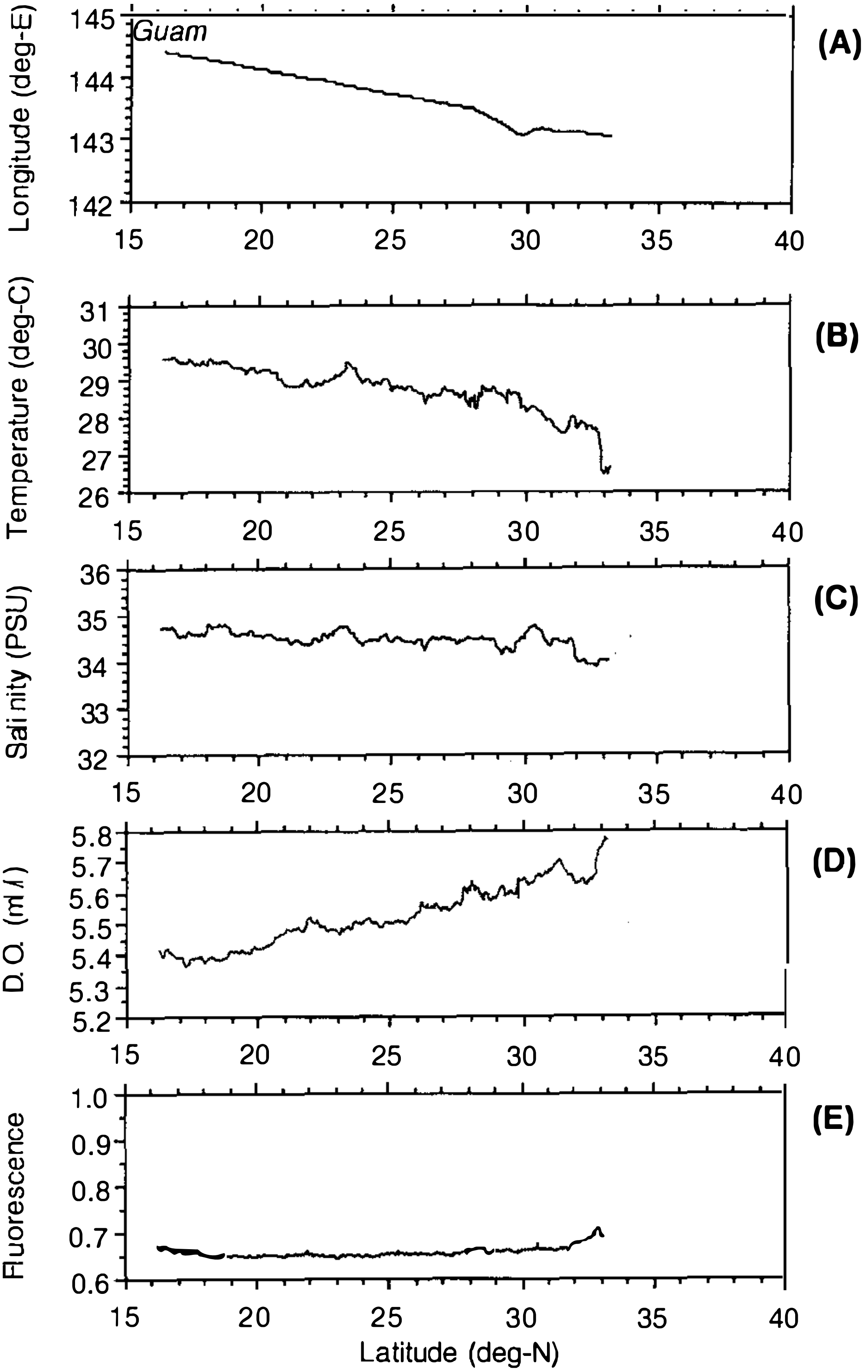


Fig 6.3.1-5 Ship's track (A), temperature (B), salinity (C), D.O. (D) and fluorescence (E) of suface water from Hachinohe to Guam.

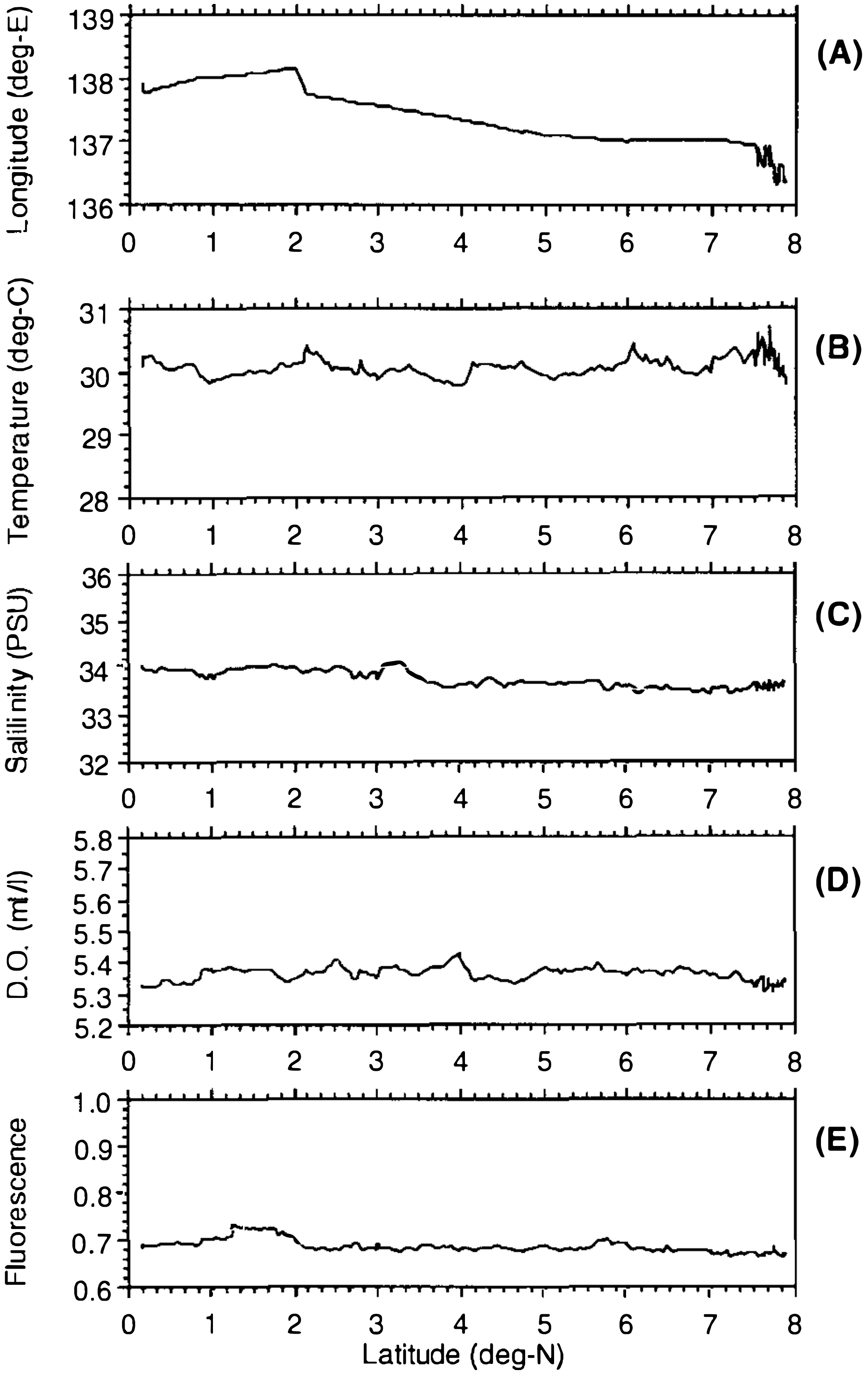


Fig 6.3.1-6 Ship's track (A), temperature (B), salinity (C), D.O. (D) and fluorescence (E) of suface water from 8N to 0N along 137E and 138E line.

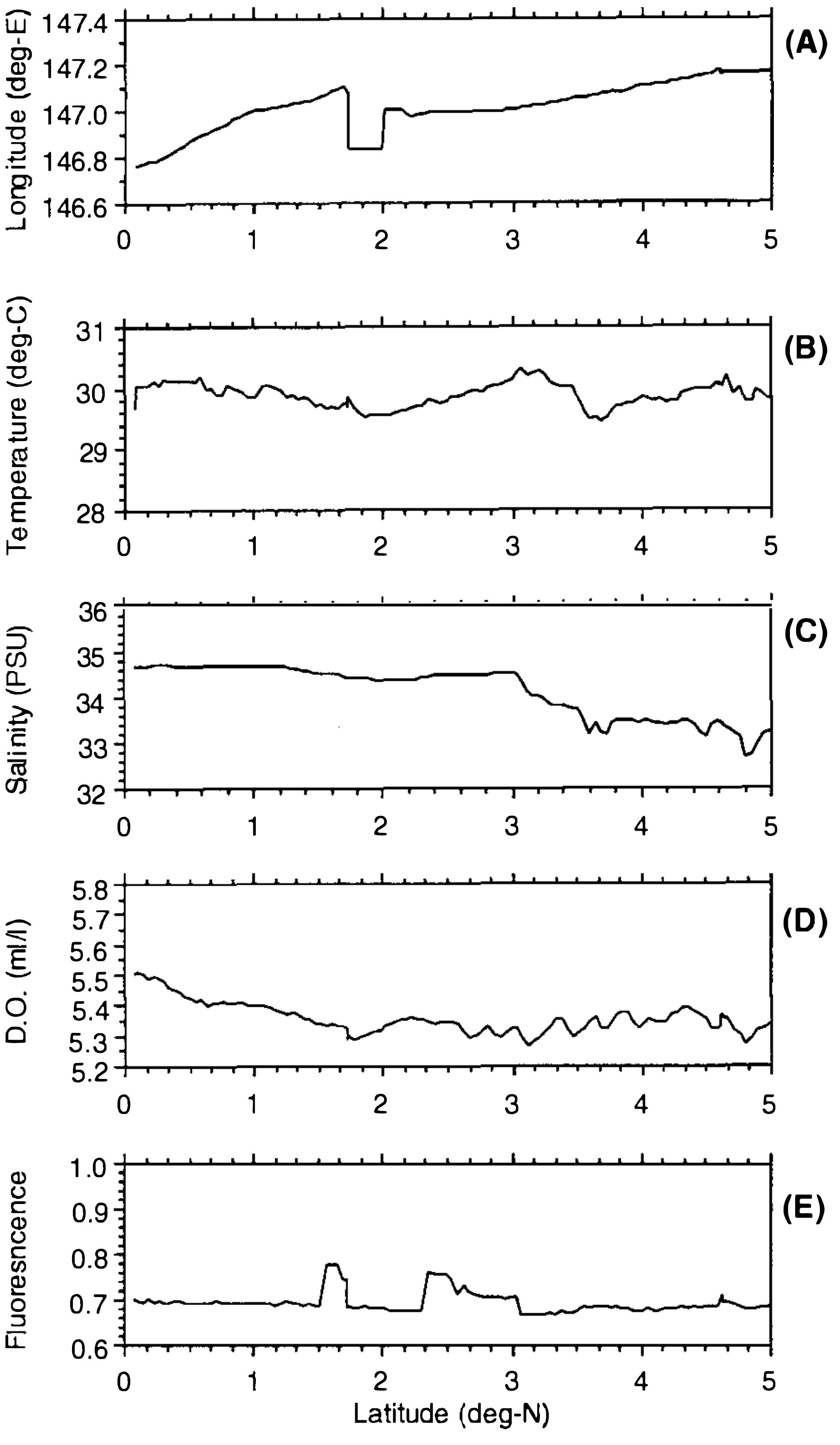


Fig 6.3.1-7 Ship's track (A), temperature (B), salinity (C), D.O. (D) and fluorescence (E) of suface water from 0 to 5N along 147E line.

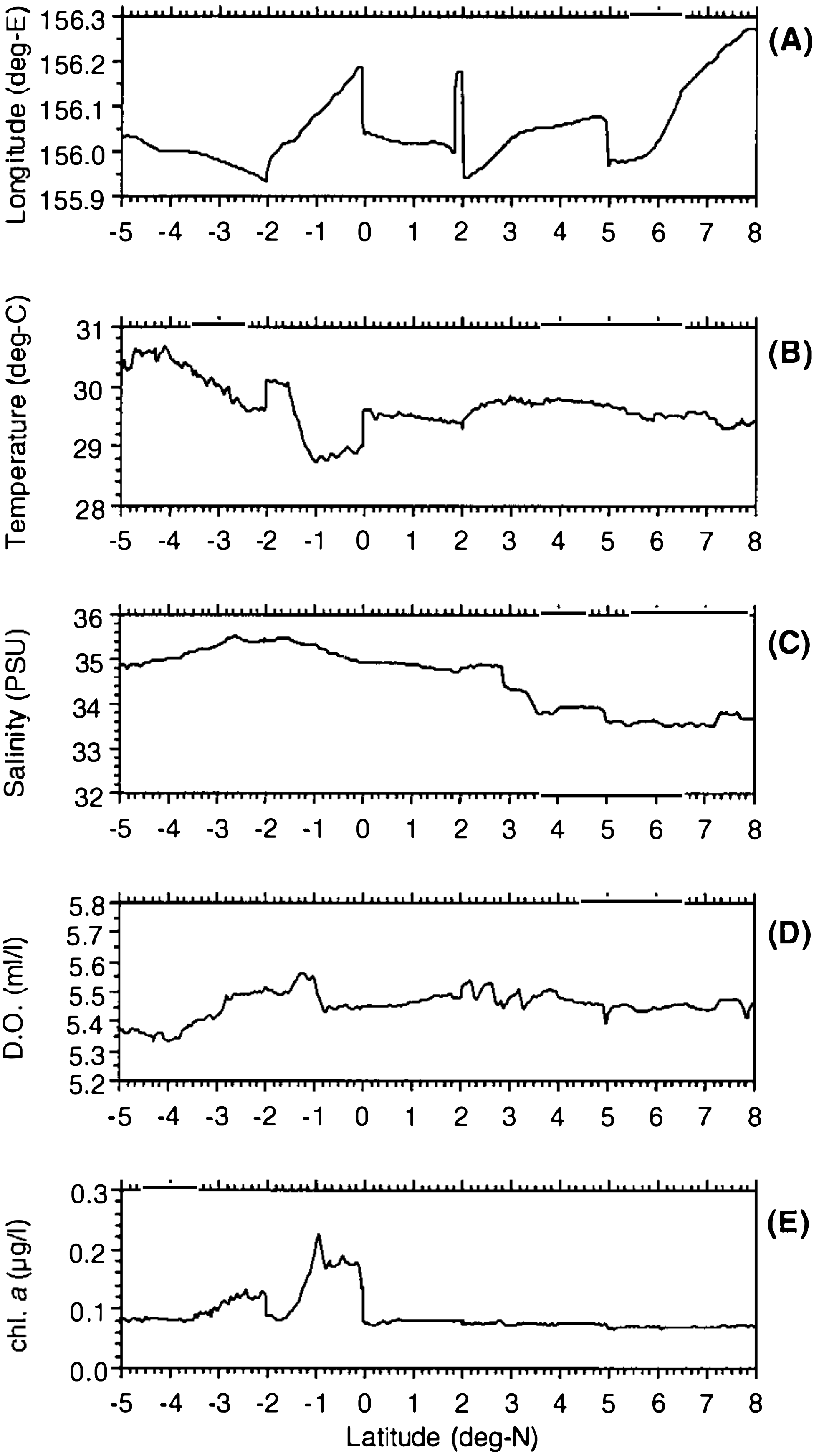


Fig 6.3.1-8 Ship's track (A), temperature (B), salinity (C), D.O. (D) and chl. *a* (E) of suface water from 5S to 8N along 156E line.

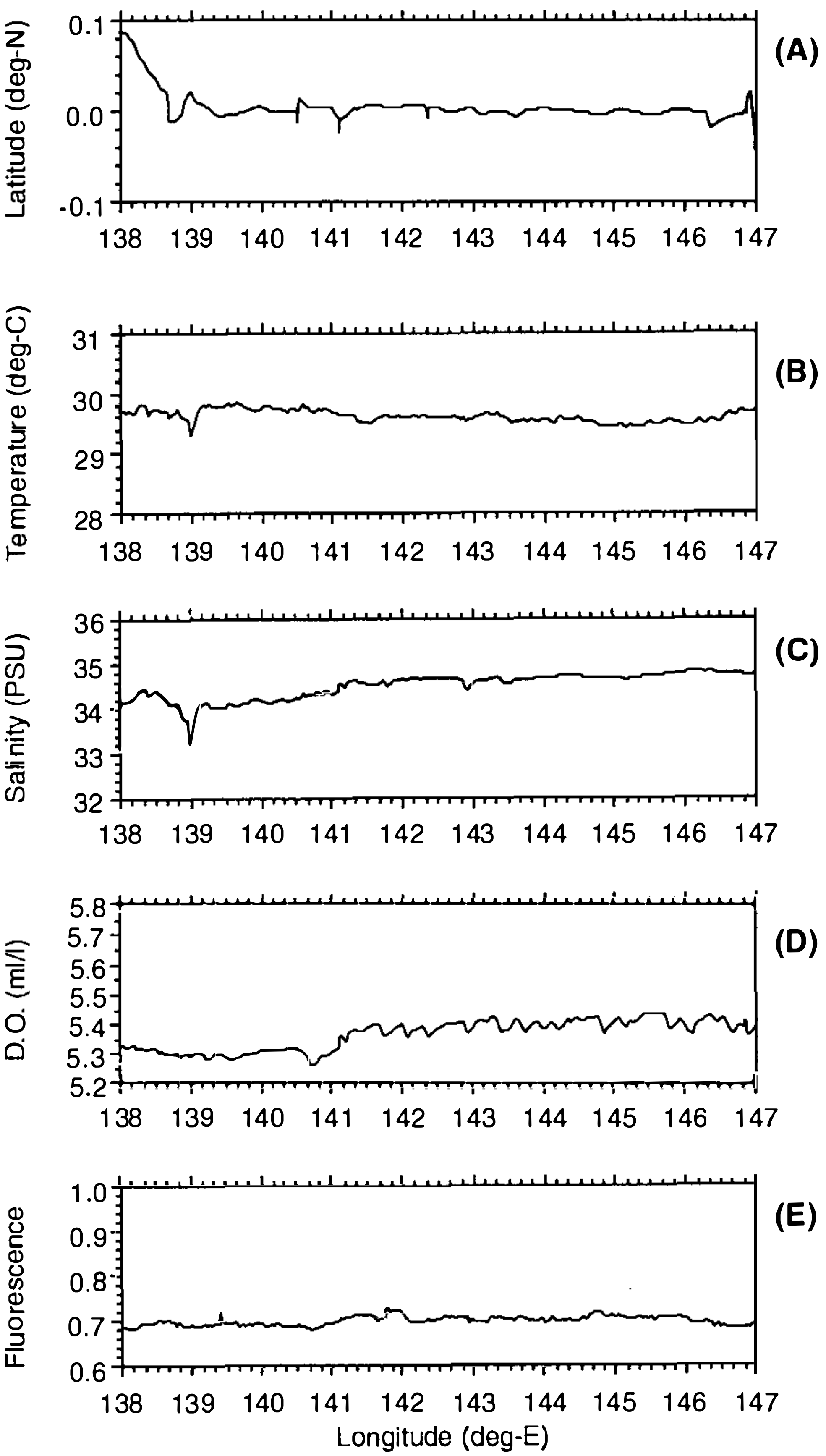


Fig 6.3.1-9 Ship's track (A), temperature (B), salinity (C), D.O. (D) and fluorescence (E) of suface water from 138E to 147E along the equator.

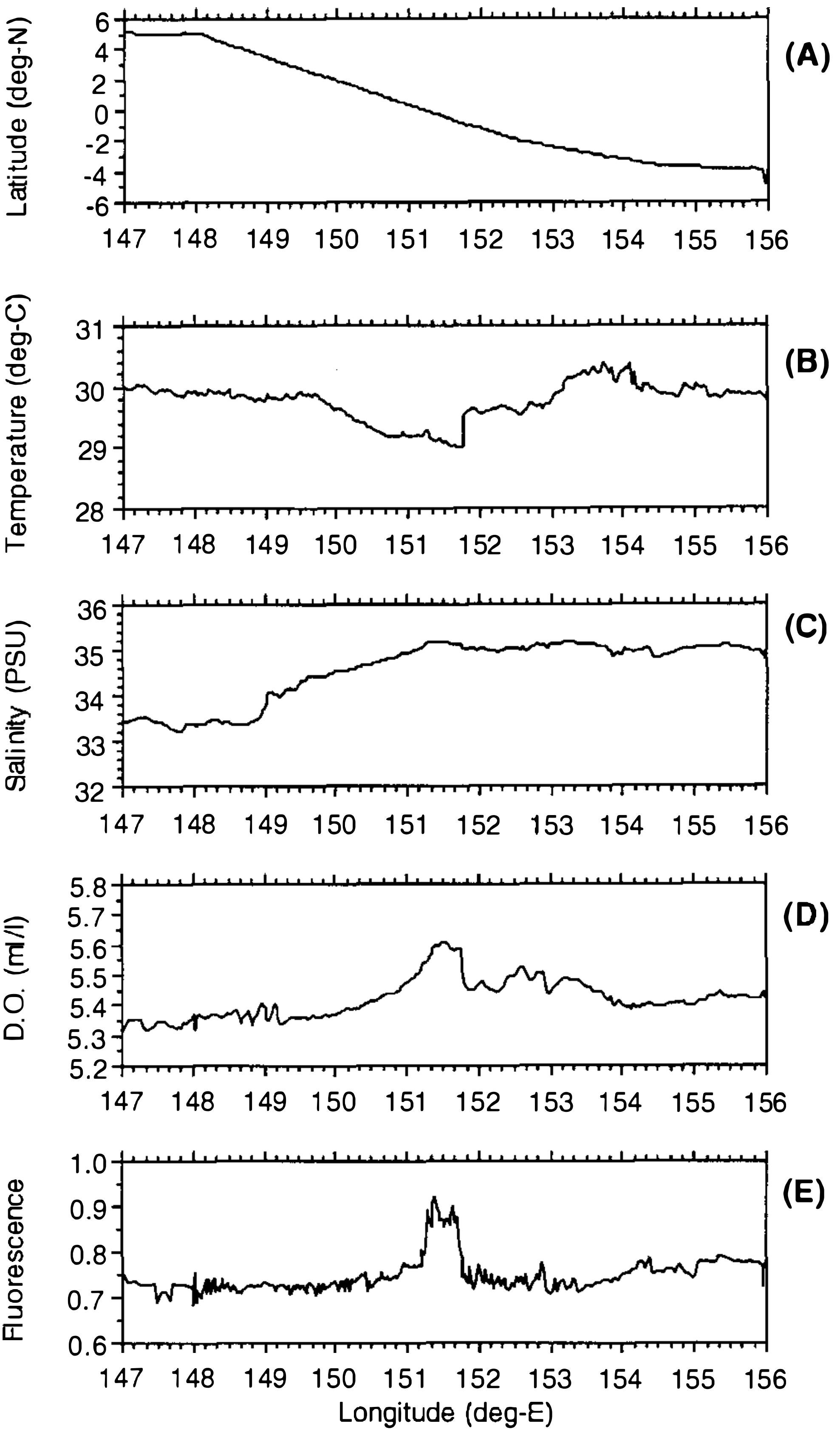


Fig 6.3.1-10 Ship's track (A), temperature (B), salinity (C), D.O. (D) and fluorescence (E) of suface water from 5N, 147E to 5S, 156E.

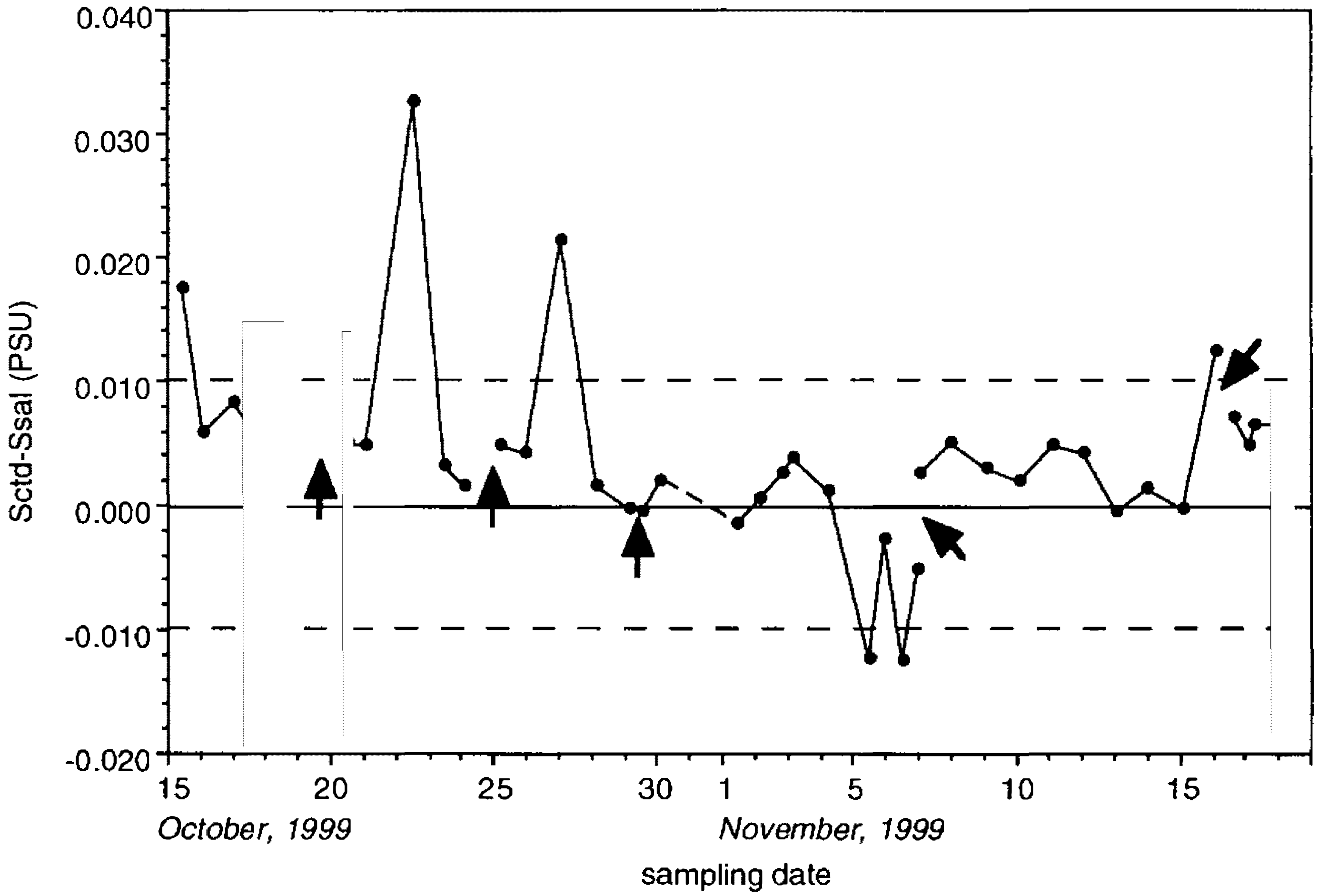


Figure 6.3.2-1 difference between the salinity values measured by TSG (Sctd) of *the Sea Suruface Monitoring System* and by Autosal salinometer (Ssal) for 40 samples.
Arrow denote washing the conductivity sensor.

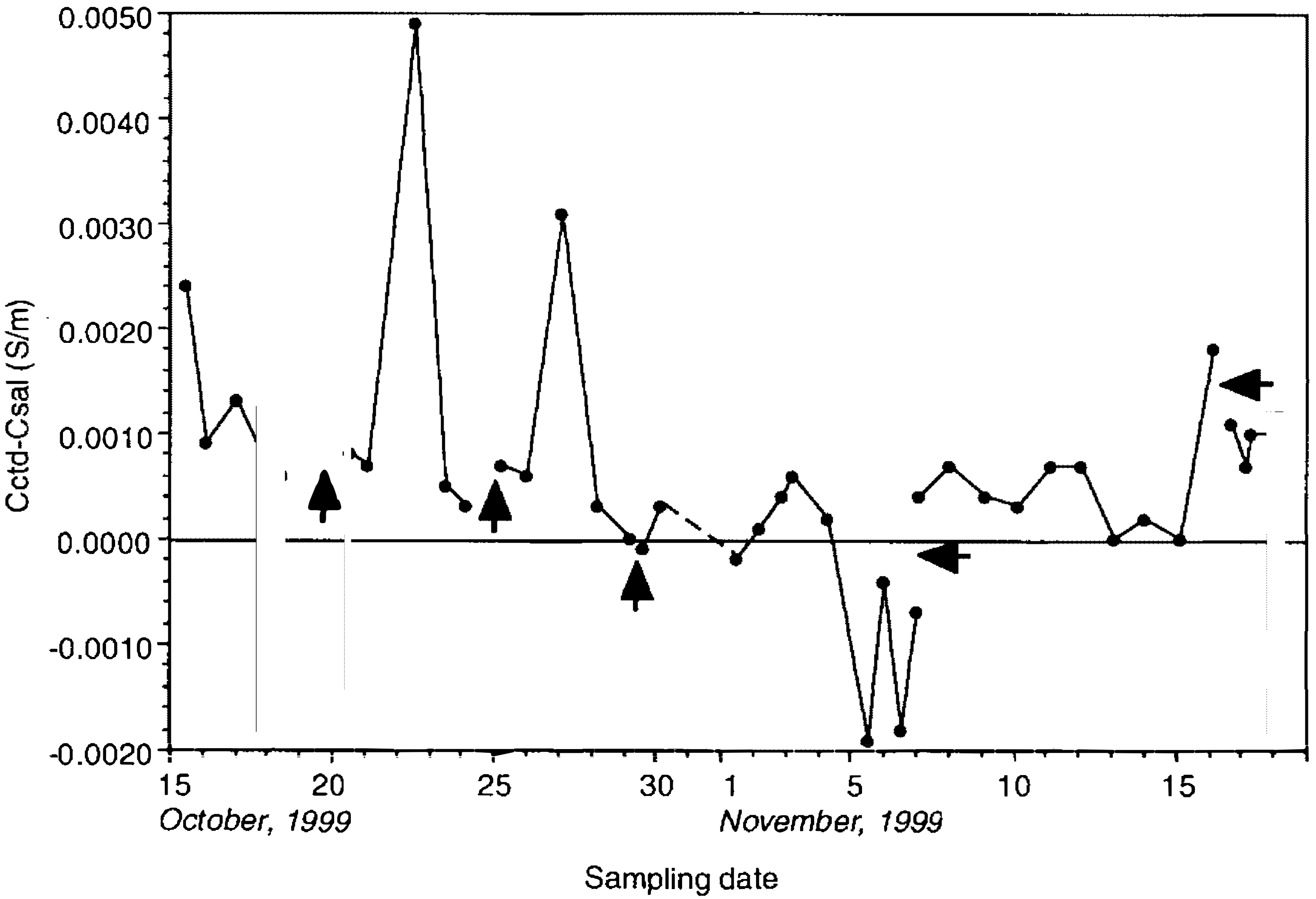


Figure 6.3.2-2 difference between the conductivity values calculated from TSG (Cctd) of *the Sea Suraface Monitoring System* and Autosal salinometer (Csal) for 40 samples.
Arrow denote washing the conductivity sensor.

6.4 Shipboard ADCP

(1) Personnel

Masaki Hanyu	(GODI): Operation Leader
Satoshi Okumura	(GODI)

(2) Parameters

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

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

(3) Methods

We measured current profiles by VM-75 (RD Instruments, Inc. U.S.A.) shipboard ADCP (Acoustic Doppler Current Profiler) throughout MR99-K06 cruise from the departure of Sekinehama, Japan on 13 October 1999 to the day before arrival of Guam, U.S.A. on 18 November 1999.

Major parameters for the measurement configuration are as follows;

Frequency :	75kHz
Average :	every 300 sec
Depth cell length :	1600 cm
No. of depth cells :	40
First depth cell position :	30.9 m
Last depth cell position :	654.9 m
ADCP ensemble time :	32.4 sec
Ping per ADCP raw data :	8

(4) Preliminary results

Two-hourly current vectors of 2-hour running mean averaged data are plotted. (Fig 6.4-1: from Sekinehama to Guam; Fig.6.4-2 and -3: from Guam to Guam). We could not plot whole cruise data in one sheet because of the software limitation.

(5) Data archives

ADCP data obtained in this cruise will be submitted to the DMO (Data Management Office), JAMSTEC and will be under their control.

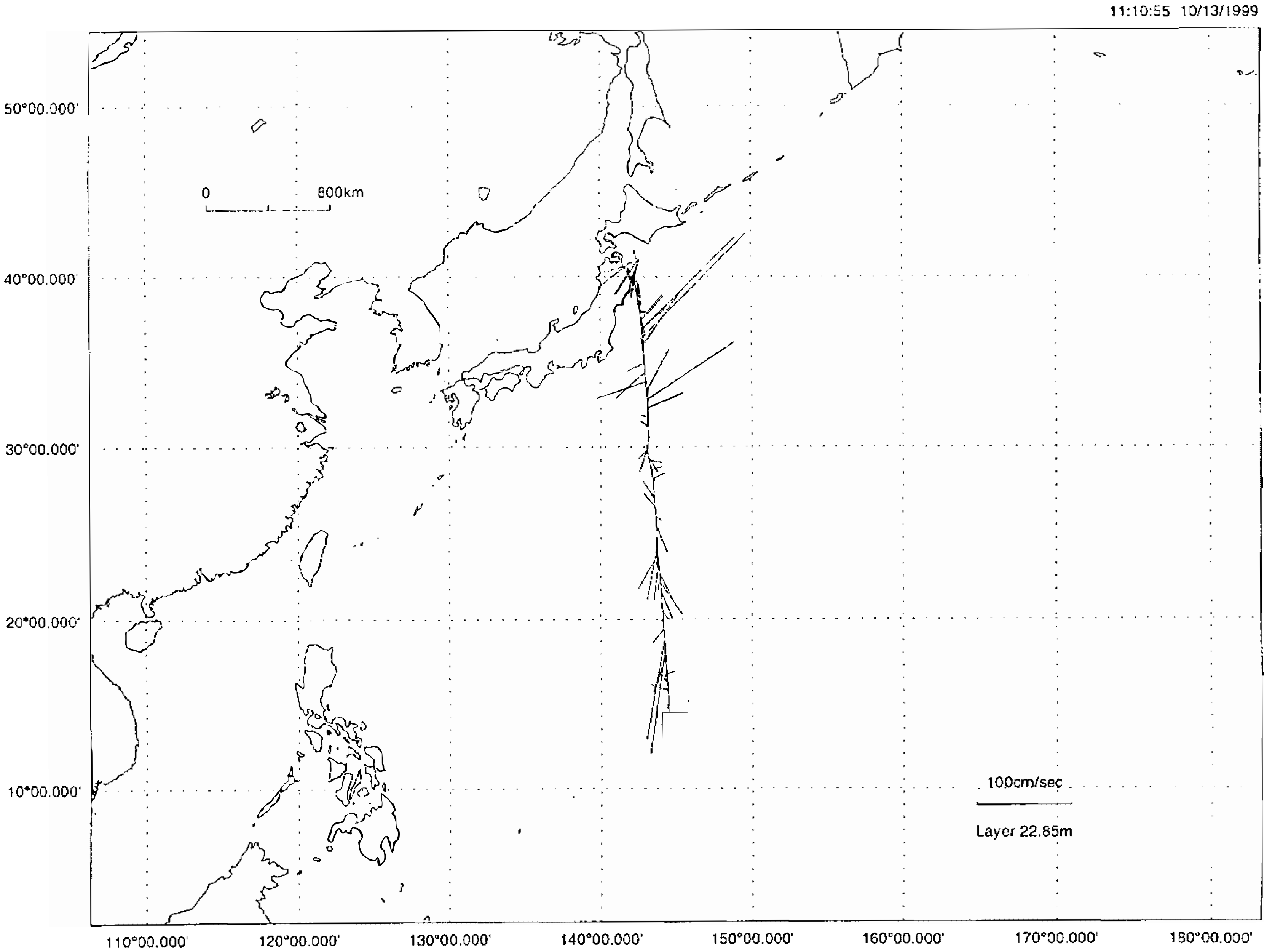

11:10:55 10/13/1999
50°00.000'
40°00.000'
30°00.000'
20°00.000'
10°00.000'
0
800km
100cm/sec
Layer 22.85m
110°00.000'
120°00.000'
130°00.000'
140°00.000'
150°00.000'
160°00.000'
170°00.000'
180°00.000'

Fig 6.4-1

12:47:59 10/20/1999

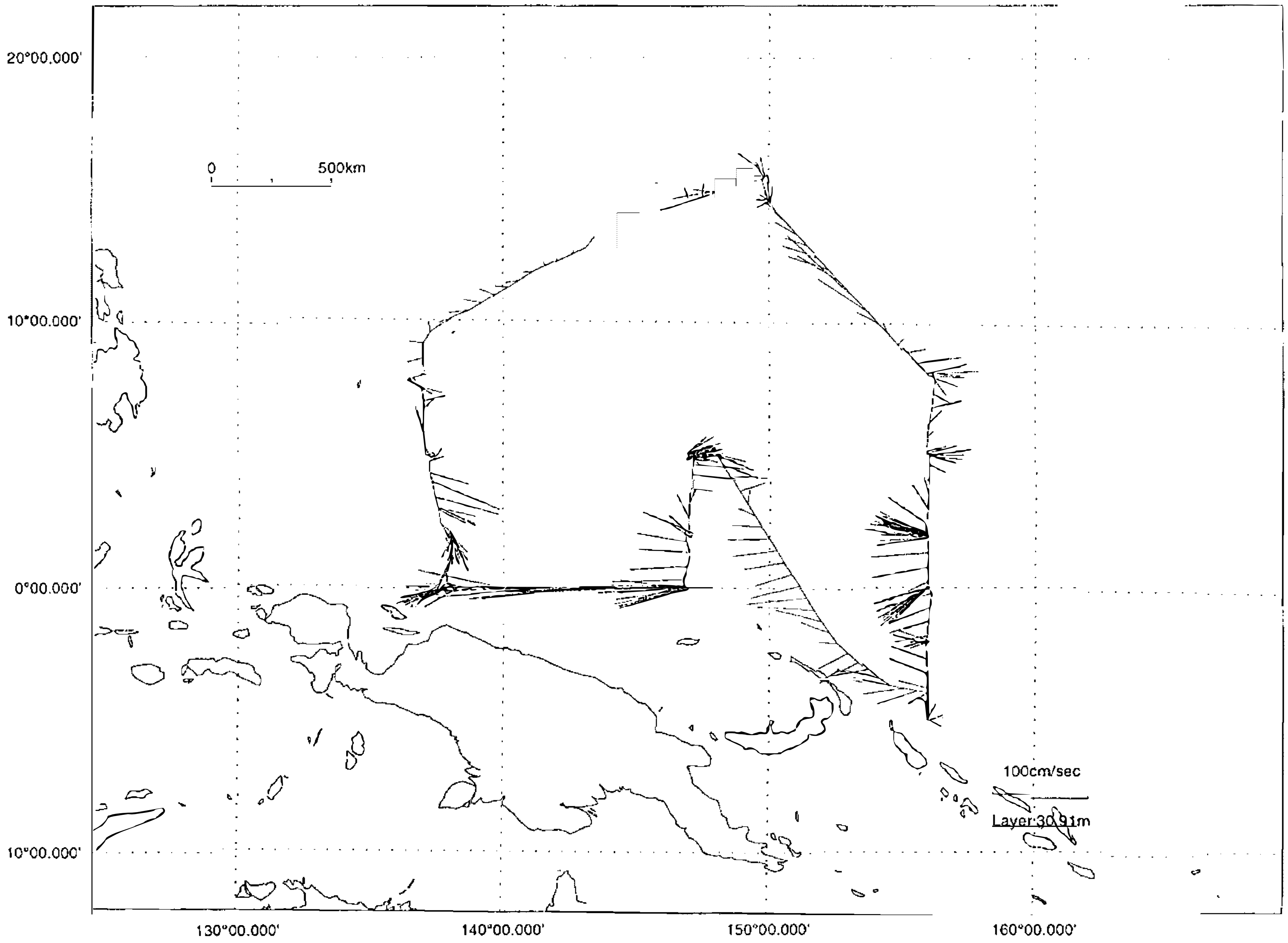


Fig 6.4-2

12:47:59 10/20/1999

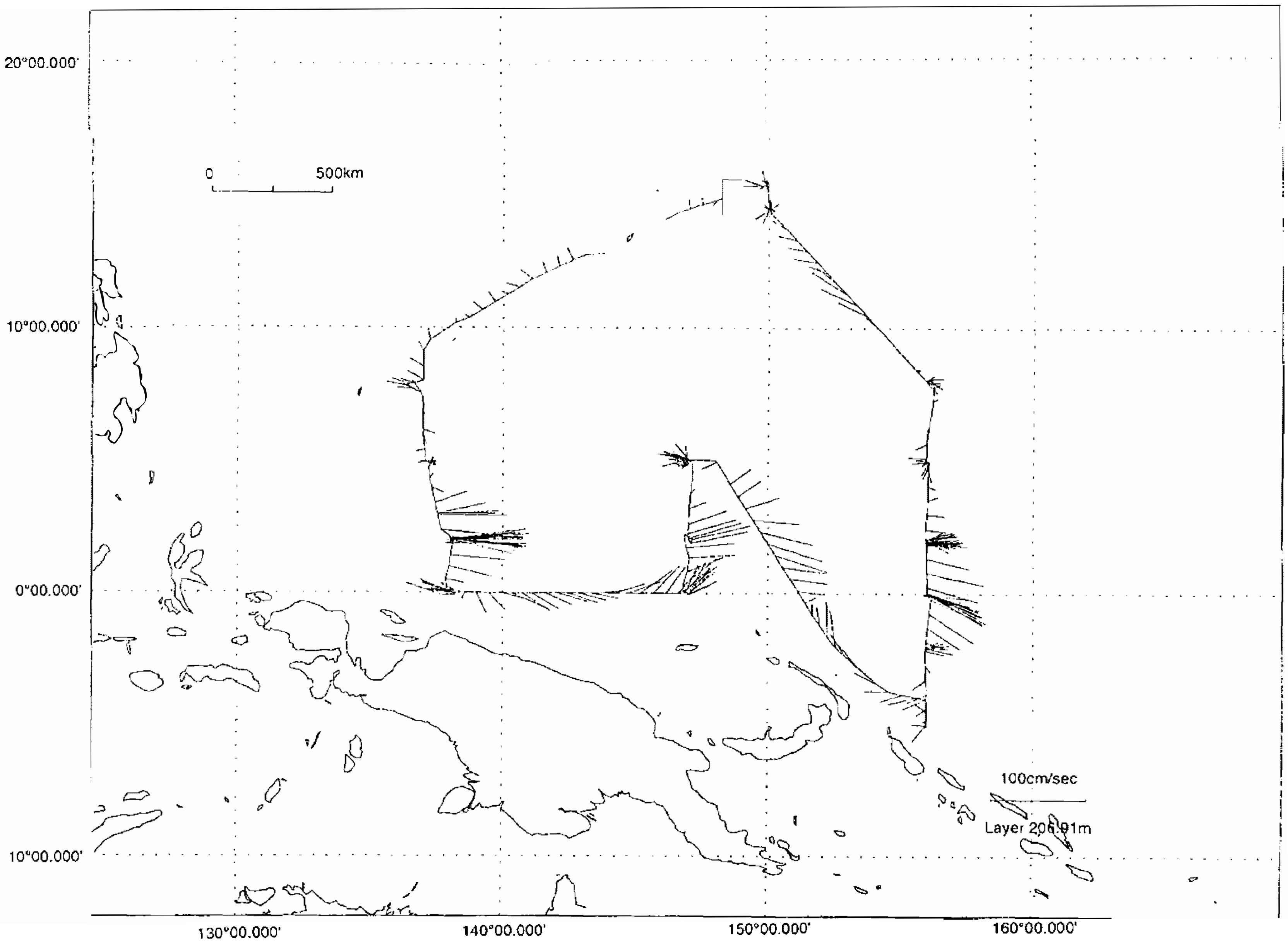


Fig 6.4-3

6.5 Underway geophysics

6.5.1 Sea surface gravity

(1) Personnel

Masaki Hanyu (GODI), Operation leader
Satoshi Okumura(GODI)
Naoto Morioka(Mirai crew)

(2) Method

We measured relative gravity values by LaCoste-Romberg onboard gravity meter S-116 throughout MR99-K06 cruise from the departure of Sekinehama, Japan on 13 October 1999 to the day before arrival of Guam, U.S.A. on 18 November 1999 except Indonesian EEZ.

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

(3) Preliminary results

The absolute gravity values caliculated in comparison with absolute values of reference points at Sekineham and Guam port are shown in Table 6.5.1-1.

(4)Data archives

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

Gravity Variations on each Port of R/V MIRAI, MR99-K06 Cruise

1999.11.20

Station	date	time	G_o	ih	G_c	B-O	G_{abs}	SLH	Draft	G_s
	(JST)		mgal	cm	mgal	mgal	mgal	cm	cm	mgal
Sekinehama JAMSTEC G-Base	1999.10.13	12:53:02	3965.006	44.9	3965.145		**980,368.07**			GODI measured
Sekinehama Port	1999.10.13	12:34:29	3968.644	45.3	3968.784	-3.639	980,371.71			
L & R	1999.10.13	12:30:00	12639.100					275	620	980,372.60
Sekinehama-Guam (L & R)			1844.300							1,843.15
Guam-Guam(L&R)			-1.300							2.08
Sekinehama-Guam-Guam							1,844.96			

Go : Observation Value og Gravity Meter, Gc : Correction of instrumental height, B-O : Gravity Base - Go, Gabs : Absolute G-Values
SLH : Sea Level Height, Gs : Absolute G-Values of Sea Gravity Meter

Table 6.5.1-1

6.5.2 Surface three component magnetometer

(1) Personnel

Masaki Hanyu (GODI), Operation leader
Satoshi Okumura(GODI)

(2) Objective

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

(3) Method

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

(4)Preliminary results

During MR99-K06 cruise, the magnetic force is continuously measured from Sekinehama to Guam except Indonesian EEZ. Data obtained on the sea will be analyzed in near future. The procedure of quality control is mainly to eliminate the effect of ship’s magnetized vector condition.

(5)Data archives

Magnetic force data obtained during this cruise will be submitted to DMO (Data Management Office), JAMSTEC and will be under their control.

6.5.3 Multi narrow beam echo sounding system

(1)Personnel

Masaki Hanyu (GODI), Operation leader
Satoshi Okumura(GODI)
Naoto Morioka(Mirai crew)

(2)Objective

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

(3)Method

We carried out gridding survey for bathymetry mapping around four TRITON bouy deployment sites, 8° N137°E, 5° N137°E, 2°N138° and 0°N138°E, and additional survey at seven area where the bathymetry maps had been created during the previous cruises, MR98-02 and MR99-K01. Each area is approximately 200 n.m. square or less, and depth from 5800m to 1500m. After the gridding survey, the bathymetry data were fed to post processing W/S by ftp command. The post processing system furnished on this MNBES has two high performance W/S Indigo^2 which have "mb-system" software on the basis of the Genetic Mapping Tool (GMT) called SeaView. Consequently, measured data can easily be edited on W/S by automatically or manually to provide gridding data and map images. Finally colored map from A to E size were used to decide to buoy deployment locations.

(4)Results

The bathymetrical contour maps have been utilize for mooring TRITON buoy. The accuracy seems to be enough to deploy the mooring at any depth. It is, of course, required to keep high accuracy that precise correction of sound speed of the target area can be performed based on the temperature profiles of water column. During this cruise, CTD/XCTD casts have done at the deployment sites or very close to the sites, we could use the CTD/XCTD data to derive sound velocity. The newest system has continuously measured the surface water sound velocity in real time, because sound velocity at the hydrophone alley is a very important factor to determine the angle of acoustic ray path which affects the outer beam of wider swath. Unfortunately, the SSV meter had a trouble whole of the cruise, so we input the newest sound velocity data site by site.

(5)Data archives

Bathymetry data obtained during this cruise will be submitted to DMO (Data Management Office), JAMSTEC and will be under their control.

7 Special Observation

7.1 TRITON moorings

7.1.1 TRITON Mooring Operation

(1) Personnel

Yoshifumi Kuroda	(JAMSTEC):	Principal Investigator (not on board)
Kentaro Ando	(JAMSTEC)	
Masayuki Fujisaki	(MWJ):	Operation leader
Norifumi Ushijima	(JAMSTEC):	Leader of meteorological sensor validation
Katsuhiro Uno	(MWJ):	Technical staff
Takeo Matsumoto	(MWJ):	Technical staff
Aya Kato	(MWJ):	Technical staff
Tadahiko Shirato	(MWJ):	Technical staff
Satoshi Ozawa	(MWJ):	Technical staff
Fujio Kobayashi	(MWJ):	Technical staff
Haruya Adachi	(MWJ):	Technical staff
Kentaro Shiraishi	(MWJ):	Technical staff
Nobuharu Komai	(MWJ):	Technical staff
Keisuke Wataki	(MWJ):	Technical staff

(2) Objectives

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

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

The six TRITON buoys have been successfully deployed during this R/V Mirai cruise (MR99-K06),and recovered two TRITON buoys.

(3) Measured parameters

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

Four TRITON buoys will be recovered five month after and replaced by newbuoys,as well as two TRITON buoys will be recovered one year after and replaced by newbuoys. The recovered buoy will be maintained at JAMSTEC Mutsu-Branch where is the mother port of R/V Mirai.

(4) Instrument

1) CTD and CT

SBE-37 IM MicroCAT

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

2) CRN

SonTek Argonaut ADCM

Sensor frequency : 1500kHz
Sampling Interval : 600sec
Average Interval : 120sec

3) Floating Sensor

SCTI ORG-115DX
Precipitation
PARPSCIENTIFIC. Inc. DIGIQUARTZ FLOATING BAROMETER 6000SERIES
Atmospheric pressure
Woods Hole Institution ASIMET
Relative humidity/air temperature
Shortwave radiation
Wind speed/direction

Sampling Interval : 60sec
Data analysis : 600sec averaged

(5) Locations of TRITON Buoys

Six TRITON buoys have been successfully deployed in the EEZs of Federated States of Micronesia,Indonesia and Papua New Guinea using R/V Mirai.

1) TRITON deployed

Nominal location	2N,138E
ID number at JAMSTEC	12001
Number on surface float	T16
ARGOS PTT number	9771
Deployed date	25 .Oct. 1999
Exact location	2 - 03.95N, 138 - 03.78E
Depth	4265 m

Nominal location	0,138E
ID number at JAMSTEC	13001
Number on surface float	T17
ARGOS PTT number	9772

Deployed date	27 .Oct. 1999
Exact location	0 - 00.09N, 138 - 02.92 E
Depth	4216 m

Nominal location	0,147E
ID number at JAMSTEC	09002
Number on surface float	T04
ARGOS PTT number	11826
Deployed date	29 .Oct. 1999
Exact location	0 - 02.19N, 146 - 59.99 E
Depth	4550 m

Nominal location	5N,147E
ID number at JAMSTEC	07002
Number on surface float	T03
ARGOS PTT number	11825
Deployed date	03 .Nov. 1999
Exact location	5 - 02.56N, 146 - 57.07 E
Depth	4265 m

Nominal location	0,156E
ID number at JAMSTEC	04003
Number on surface float	T02
ARGOS PTT number	11824
Deployed date	09 .Nov. 1999
Exact location	0 - 00.98N, 156 - 02.52 E
Depth	1953 m

Nominal location	2N,156E
ID number at JAMSTEC	03003
Number on surface float	T01
ARGOS PTT number	11823
Deployed date	10 .Nov. 1999
Exact location	2 - 03.48N, 156 - 00.03 E
Depth	2597 m

2) TRITON recovered

Nominal location	2N,156E
ID number at JAMSTEC	03002
Number on surface float	T07
ARGOS PTT number	3594
Deployed date	01 .Mar. 1999
Recovered date	11 .Nov. 1999
Exact location	1 - 54.97N, 156 - 00.13 E
Depth	2550 m

Nominal location	0,147E
ID number at JAMSTEC	09001
Number on surface float	T13
ARGOS PTT number	7961
Deployed date	20 .Feb. 1999
Recovered date	30 .Oct. 1999
Exact location	0 - 05.44S, 156 - 01.95E
Depth	4307 m

3) Changed WND Sensor

Nominal location	5N,156E
ID number at JAMSTEC	02002
Number on surface float	T06
ARGOS PTT number	3593
Deployed date	27 .Feb. 1999
Changed Sensor date	14 .Nov. 1999
Change Sensor	Wind speed/direction sensor S/N 316→303
Exact location	5 - 01.15N, 155 - 58.09E

(6) Data archive

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

7.1.2 Intercomparison between shipboard CTD and TRITON data

(1) Personnel

Kentaro Ando(JAMSTEC)
Takeo Matsumoto (MWJ)
Tetsuya Nagahama (MWJ) not on board

(2) Objectives

TRITON CTD data validation.

(3) Measured parameters

- Temperature
- Conductivity
- Pressure

(4) Methods

We used the same CTD system with general CTD observation. We conducted 1 CTD casts at each TRITON buoy site. The cast was performed immediately after the deployment.

(5) Results

The temperature, Conductivity and salinity data from TRITON buoy showed good agreement with CTD data in each comparision.

See the attached figures and tables.(fig.7.1.2-1〜fig.7.1.2-14,table.7.1.2-1〜fig.7.1.2-4)

(6) Data archive

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

Table.7.1.2-1 Difference between TRITON Buoy and CTD

Buoy No.	T16	Position	2N 138E
Observation No.	12001	Comparision Time	3:40(UTC)
Operation	After Deploy		

Pressure(db)	TRITON-CTD		
	Tempareture(℃)	Conductivity(S/m)	Salinity(psu)
1.5	-0.15	-0.003	0.0884
25	****	****	******
50	0.04	0.004	0.0041
75	-0.31	-0.056	-0.1597
100	0.01	0.001	0.0049
125	-0.04	-0.008	-0.0221
150	-0.02	-0.005	-0.0158
200	-0.01	-0.003	-0.0110
250	0.19	0.032	0.1315
300	0.24	0.017	-0.0547
500	0.12	0.012	0.0125
750	0.06	0.006	0.0034

Buoy No.	T17	Position	0 138E
Observation No.	13001	Comparision Time	4:00(UTC)
Operation	After Deploy		

Pressure(db)	TRITON-CTD		
	Tempareture(℃)	Conductivity(S/m)	Salinity(psu)
1.5	-0.16	-0.062	-0.3026
25	0.00	0.001	0.0119
50	-0.01	-0.001	0.0061
75	-0.06	-0.007	0.0011
100	-0.12	0.004	0.1233
125	-0.23	-0.021	0.0282
150	-0.52	-0.047	0.0591
200	-0.61	-0.065	-0.0130
250	0.04	0.182	1.6610
300	0.16	0.015	0.0066
500	0.01	0.000	-0.0080
750	-0.01	0.000	0.0112

Buoy No.	T04	Position	0 147E
Observation No.	09002	Comparision Time	8:40(UTC)
Operation	After Deploy		

Pressure(db)	TRITON-CTD		
	Tempareture(℃)	Conductivity(S/m)	Salinity(psu)
1.5	0.00	0.022	0.1606
25	-0.02	-0.004	-0.0097
50	-0.01	-0.002	-0.0005
75	-0.57	-0.062	-0.0014
100	-0.09	-0.007	0.0218
125	-0.18	-0.014	0.0416
150	-0.02	-0.006	-0.0269
200	-0.05	-0.013	-0.0599
250	0.63	0.063	0.0131
300	0.51	0.000	-0.4667
500	0.25	0.024	0.0195
750	0.00	-0.001	-0.0055

*** :not transmit

Table.7.1.2-2 Difference between TRITON Buoy and CTD

Buoy No.	T13	Position	0 147E
Observation No.	09001	Comparision Time	3:00(UTC)
Operation	Before Recovery		

Pressure(db)	TRITON-CTD		
	Tempareture(℃)	Conductivity(S/m)	Salinity(psu)
1.5	0.27	0.032	0.0296
25	-0.02	-0.004	-0.0026
50	0.04	-0.012	-0.1060
75	0.55	0.060	0.0181
100	0.00	0.004	0.0283
125	-0.48	-0.057	-0.0425
150	-0.23	-0.028	-0.0266
200	-0.14	-0.017	-0.0232
250	-0.09	-0.011	-0.0206
300	0.04	0.003	-0.0047
500	0.13	0.011	-0.0126
750	0.02	0.001	-0.0078

Buoy No.	T03	Position	5N 147E
Observation No.	07002	Comparision Time	3:20(UTC)
Operation	After Deploy		

Pressure(db)	TRITON-CTD		
	Tempareture(℃)	Conductivity(S/m)	Salinity(psu)
1.5	0.08	0.009	0.0153
25	0.01	0.002	0.0126
50	-0.05	-0.012	-0.0421
75	0.01	-0.006	-0.0413
100	-0.05	-0.023	-0.1156
125	-0.31	-0.032	0.0077
150	-0.51	-0.050	0.0237
200	-0.35	-0.037	-0.0289
250	-0.04	-0.006	-0.0141
300	-0.02	-0.002	-0.0007
500	0.02	0.001	-0.0081
750	-0.03	-0.003	-0.0051

Buoy No.	T10	Position	5S 156E
Observation No.	06001	Comparision Time	2:00(UTC)
Operation	During Visit		

Pressure(db)	TRITON-CTD		
	Tempareture(℃)	Conductivity(S/m)	Salinity(psu)
1.5	0.16	0.018	0.0136
25	-0.01	0.015	0.1170
50	0.01	0.007	0.0473
75	-0.06	-0.002	0.0364
100	0.00	0.005	0.0417
125	-0.15	-0.008	0.0601
150	0.52	0.049	-0.0431
200	2.32	0.247	0.0423
250	1.25	0.139	0.1424
300	0.33	0.035	0.0337
500	0.00	0.000	-0.0002
750	0.07	0.008	0.0169

Table.7.1.2-3 Difference between TRITON Buoy and CTD

Buoy No.	T09	Position	2S 156E
Observation No.	05001	Comparision Time	2:00(UTC)
Operation	During Visit		

Pressure(db)	TRITON-CTD		
	Tempareture(℃)	Conductivity(S/m)	Salinity(psu)
1.5	0.60	0.094	0.2092
25	-0.05	-0.003	0.0176
50	-0.09	-0.016	-0.0400
75	-0.09	-0.017	-0.0511
100	-0.19	-0.021	0.0062
125	-0.12	-0.011	0.0172
150	-0.11	-0.009	0.0245
200	-1.01	-0.116	-0.1247
250	0.02	-0.001	-0.0242
300	0.02	0.002	0.0047
500	-0.09	-0.009	-0.0056
750	-0.05	-0.005	-0.0020

Buoy No.	T02	Position	0 156E
Observation No.	04003	Comparision Time	3:00(UTC)
Operation	After Deploy		

Pressure(db)	TRITON-CTD		
	Tempareture(℃)	Conductivity(S/m)	Salinity(psu)
1.5	0.09	0.010	0.0092
25	-0.17	-0.018	0.0048
50	-0.02	-0.003	-0.0034
75	-0.01	-0.004	-0.0132
100	-0.02	-0.003	0.0010
125	0.02	-0.001	-0.0182
150	0.23	0.021	-0.0253
200	0.09	0.016	0.0665
250	-0.40	-0.043	-0.0298
300	-0.03	-0.004	-0.0142
500	-0.03	-0.006	-0.0264
750	0.00	0.000	0.0023

Buoy No.	T01	Position	2N 156E
Observation No.	03003	Comparision Time	3:00(UTC)
Operation	After Deploy		

Pressure(db)	TRITON-CTD		
	Tempareture(℃)	Conductivity(S/m)	Salinity(psu)
1.5	-0.04	-0.004	0.0071
25	-0.03	-0.005	-0.0064
50	-0.02	-0.002	0.0073
75	-0.01	-0.001	0.0069
100	0.01	0.001	0.0037
125	0.01	0.000	-0.0007
150	-0.02	-0.004	-0.0037
200	0.14	0.006	-0.0680
250	0.01	0.001	0.0005
300	-0.01	-0.002	-0.0077
500	0.06	0.005	-0.0022
750	-0.02	-0.002	0.0018

Table.7.1.2-4 Difference between TRITON Buoy and CTD

Buoy No.	T07	Position	2N 156E
Observation No.	03002	Comparision Time	22:00(UTC)
Operation	Before Recovery		

Pressure(db)	TRITON-CTD		
	Tempareture(℃)	Conductivity(S/m)	Salinity(psu)
1.5	0.00	-0.009	-0.0562
25	0.00	0.001	0.0117
50	0.00	0.001	0.0113
75	-0.01	-0.003	-0.0086
100	0.00	0.002	0.0169
125	0.02	0.007	0.0446
150	0.74	0.104	0.2098
200	0.54	0.053	0.0073
250	-0.01	-0.002	-0.0098
300	-0.08	-0.009	-0.0081
500	-0.24	-0.024	-0.0150
750	-0.05	-0.005	-0.0005

Buoy No.	T06	Position	5N 156E
Observation No.	02002	Comparision Time	4:00(UTC)
Operation	During Visit		

Pressure(db)	TRITON-CTD		
	Tempareture(℃)	Conductivity(S/m)	Salinity(psu)
1.5	0.17	0.022	0.0391
25	0.00	0.007	0.0512
50	-0.04	0.003	0.0497
75	0.02	0.003	0.0091
100	-0.03	0.005	0.0590
125	-0.40	-0.040	0.0240
150	-0.48	-0.051	-0.0061
200	0.24	0.021	-0.0204
250	0.32	0.028	-0.0214
300	0.05	0.003	-0.0103
500	-0.08	-0.008	-0.0080
750	0.08	0.007	-0.0029

Buoy No.	T05	Position	8N 156E
Observation No.	01002	Comparision Time	3:00(UTC)
Operation	During visit		

Pressure(db)	TRITON-CTD		
	Tempareture(℃)	Conductivity(S/m)	Salinity(psu)
1.5	0.20	0.026	0.0431
25	0.02	0.014	0.0868
50	-0.07	0.015	0.1581
75	-0.11	-0.005	0.0500
100	0.02	0.006	0.0372
125	-0.29	-0.031	-0.0035
150	****	****	******
200	-0.05	-0.008	-0.0217
250	-0.01	-0.002	-0.0074
300	0.06	0.006	0.0012
500	0.03	0.002	-0.0056
750	0.14	0.012	-0.0062

*** :not transmit

Lat.2N Long.138E
Date 99/10/25 Time 03:40(UTC) After Deploy

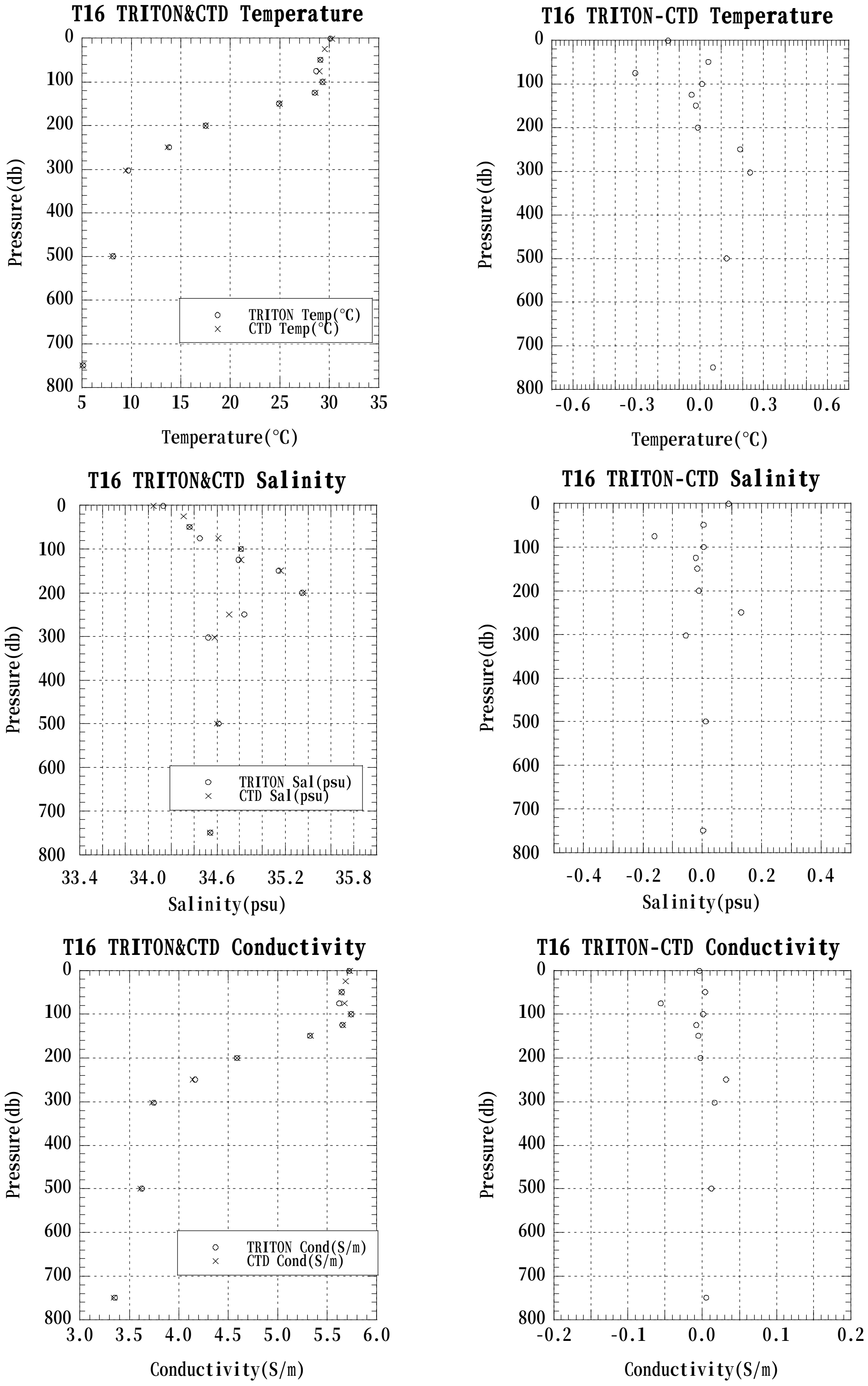


fig.7.1.2-1 Compare TRITON with CTD

Lat.EQ Long.138E
Date 99/10/27 Time 04:00(UTC) After Deploy

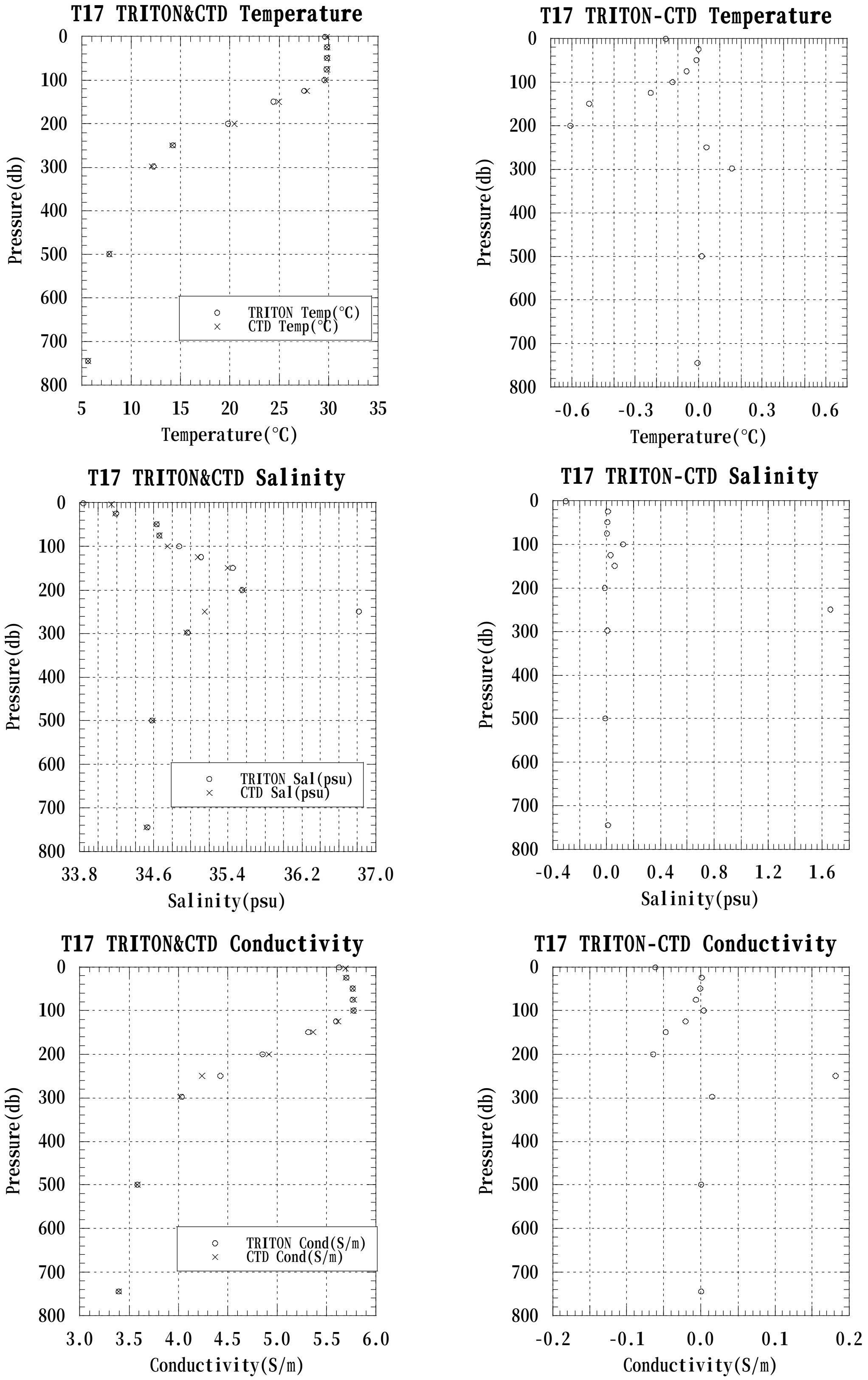


fig.7.1.2-2 Compare TRITON with CTD

Lat.EQ Long.147E
Date 99/10/29 Time 08:40(UTC) After Deploy

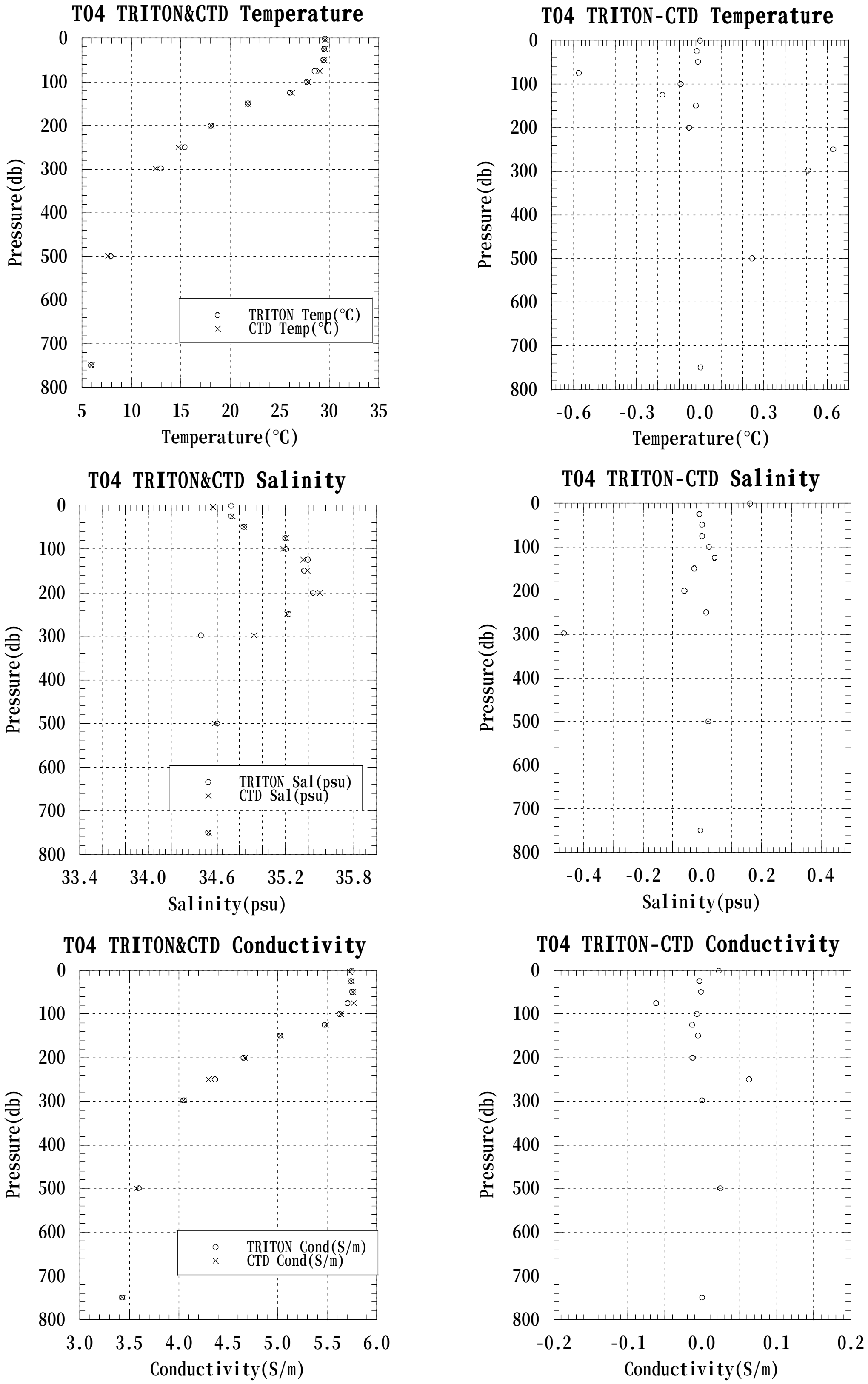


fig.7.1.2-3 Compare TRITON with CTD

Lat.EQ Long.147E
Date 99/10/30 Time 03:00(UTC:Hourly average) Before Recovery

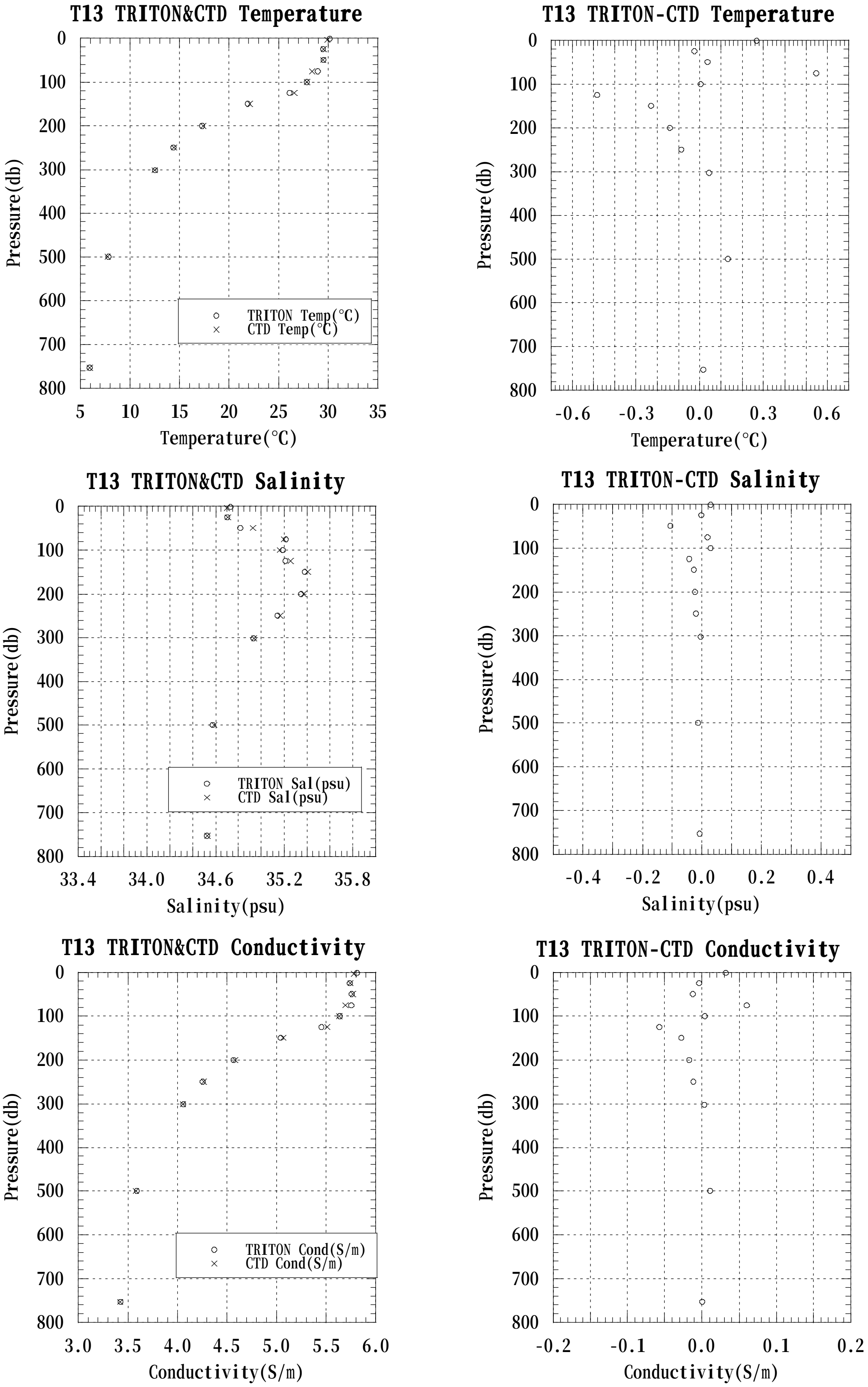


fig.7.1.2-4 Compare TRITON with CTD

Lat.5N Long.147E
Date 99/11/03 Time 03:20(UTC) After Deploy

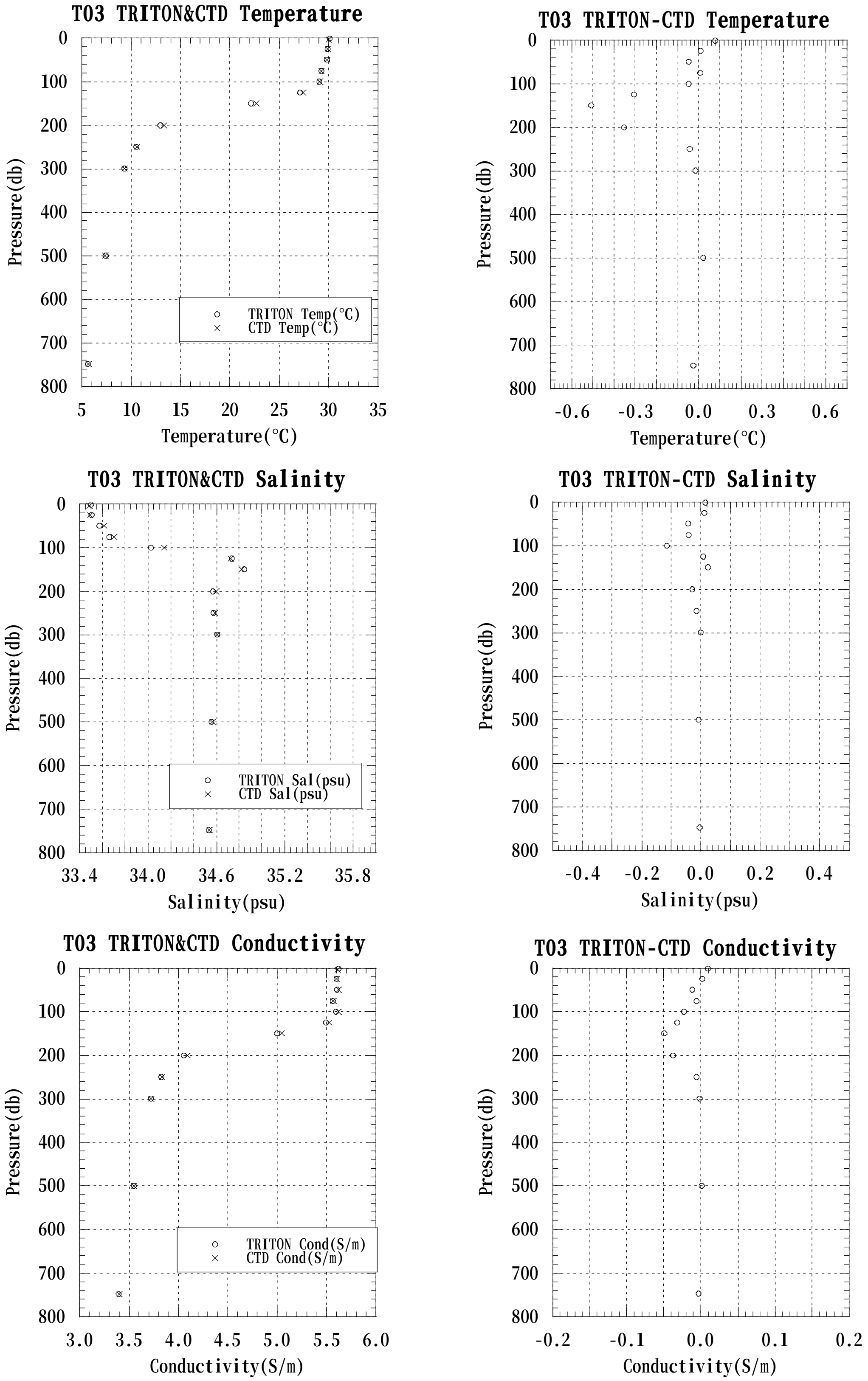


fig.7.1.2-5 Compare TRITON with CTD

Lat.5S Long.156E
Date 99/11/6Time 02:00(UTC:Hourly average) During Visit

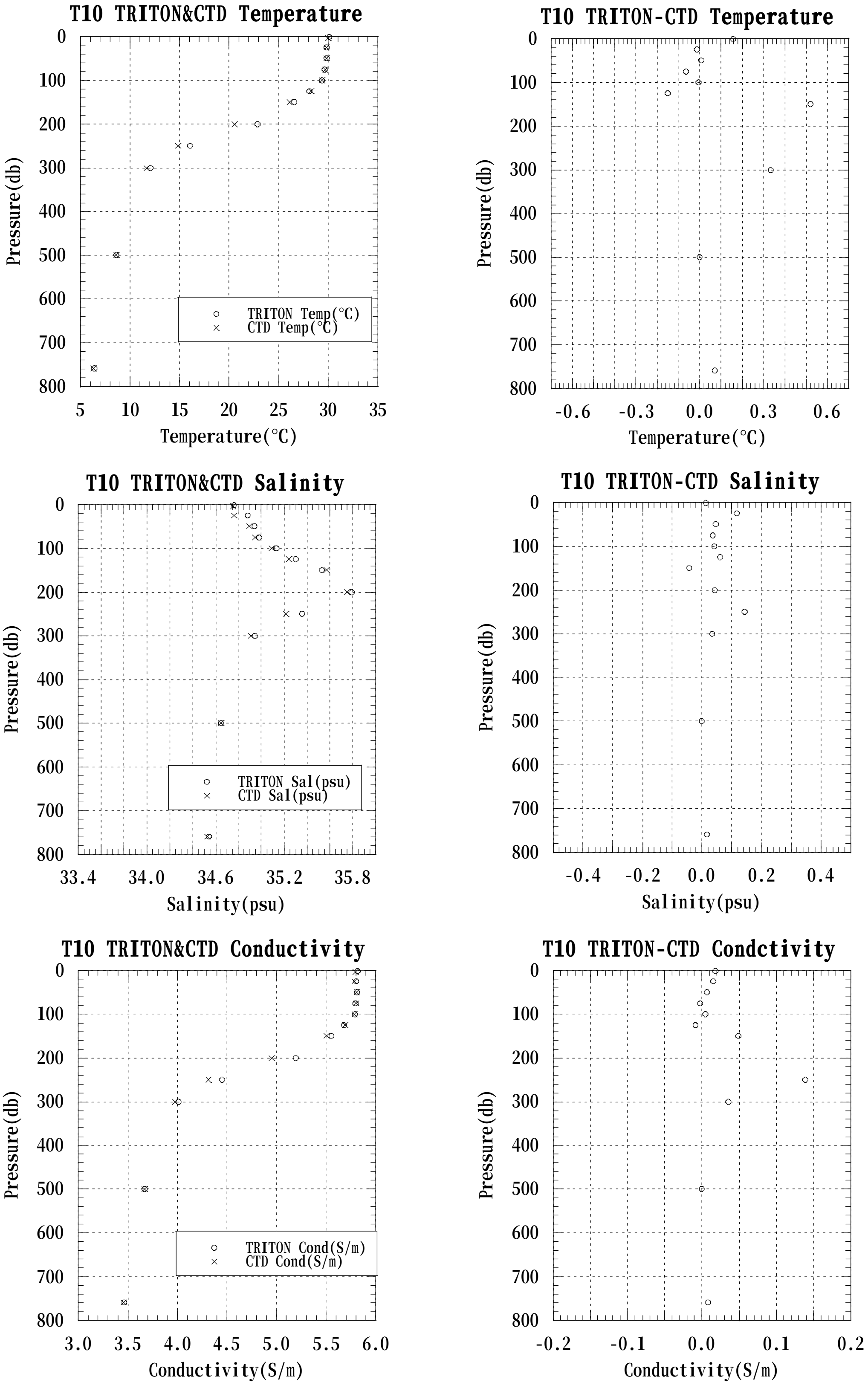


fig.7.1.2-6 Compare TRITON with CTD

Lat.2S Long.156E
Date 99/11/7Time 02:00(UTC:Hourly average) During Visit

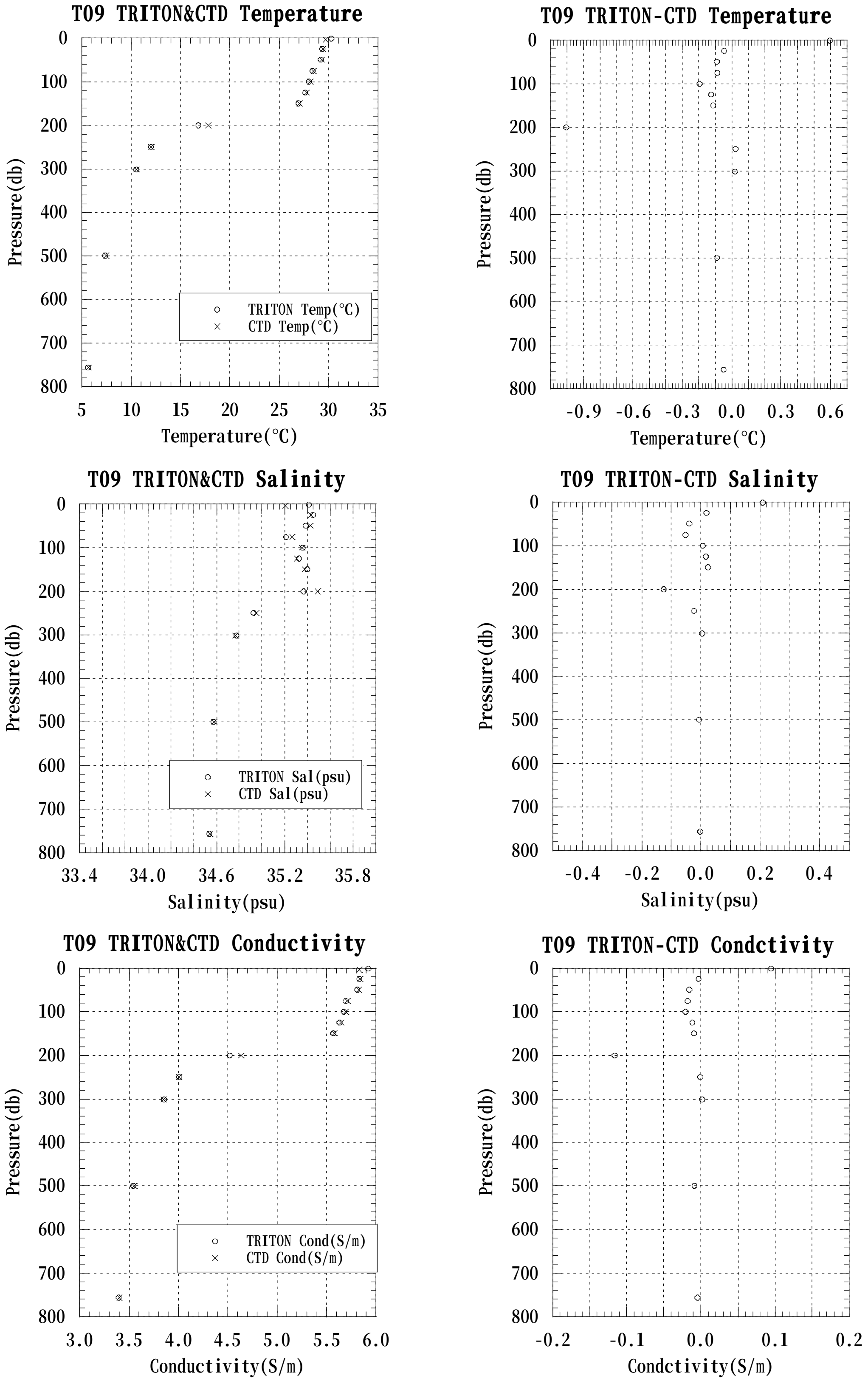


fig.7.1.2-7 Compare TRITON with CTD

Lat.EQ Long.156E
Date 99/11/09 Time 03:00(UTC) After Deploy

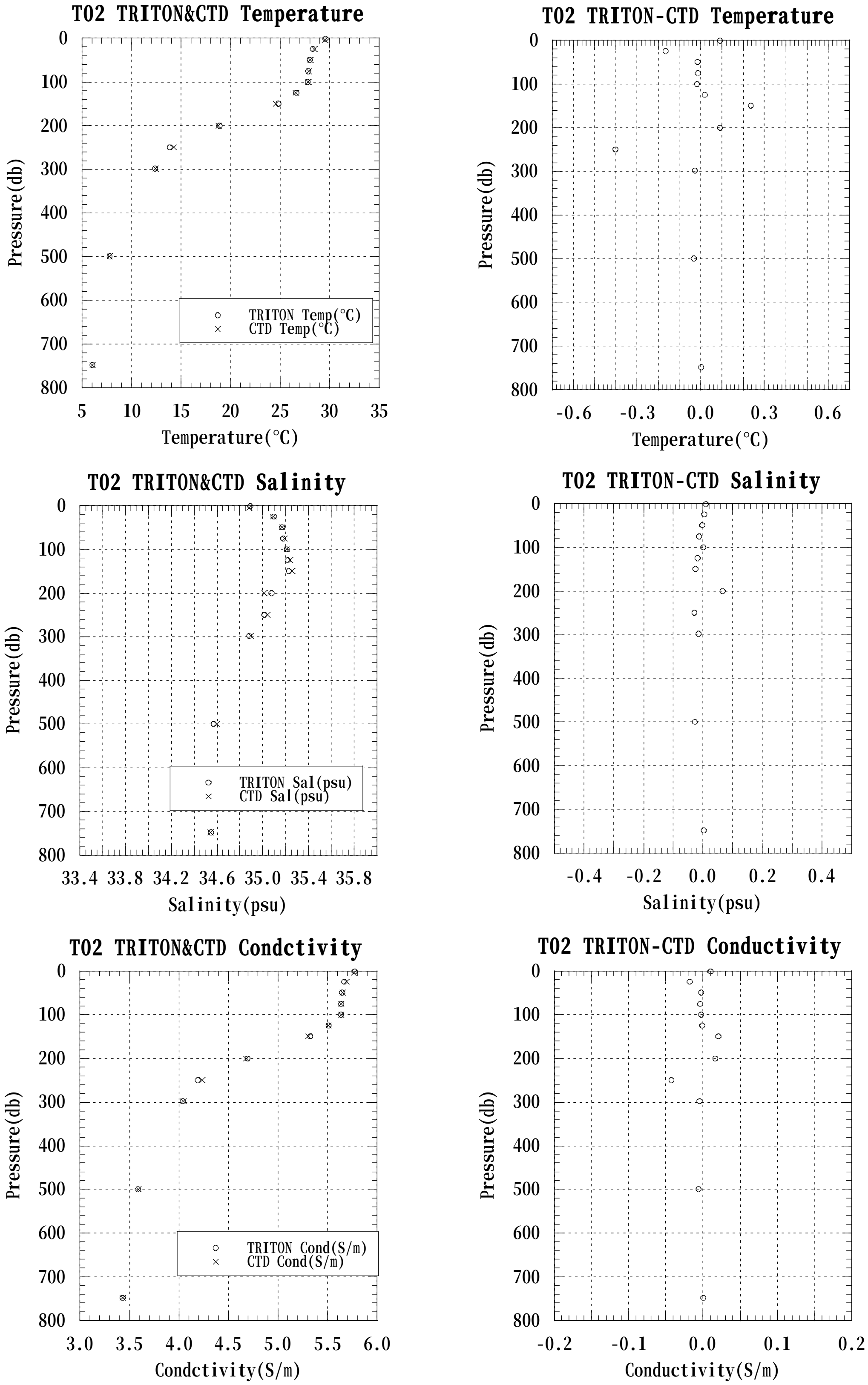


fig.7.1.2-8 Compare TRITON with CTD

Lat.2N Long.156E
Date 99/11/10 Time 03:00(UTC) After Deploy

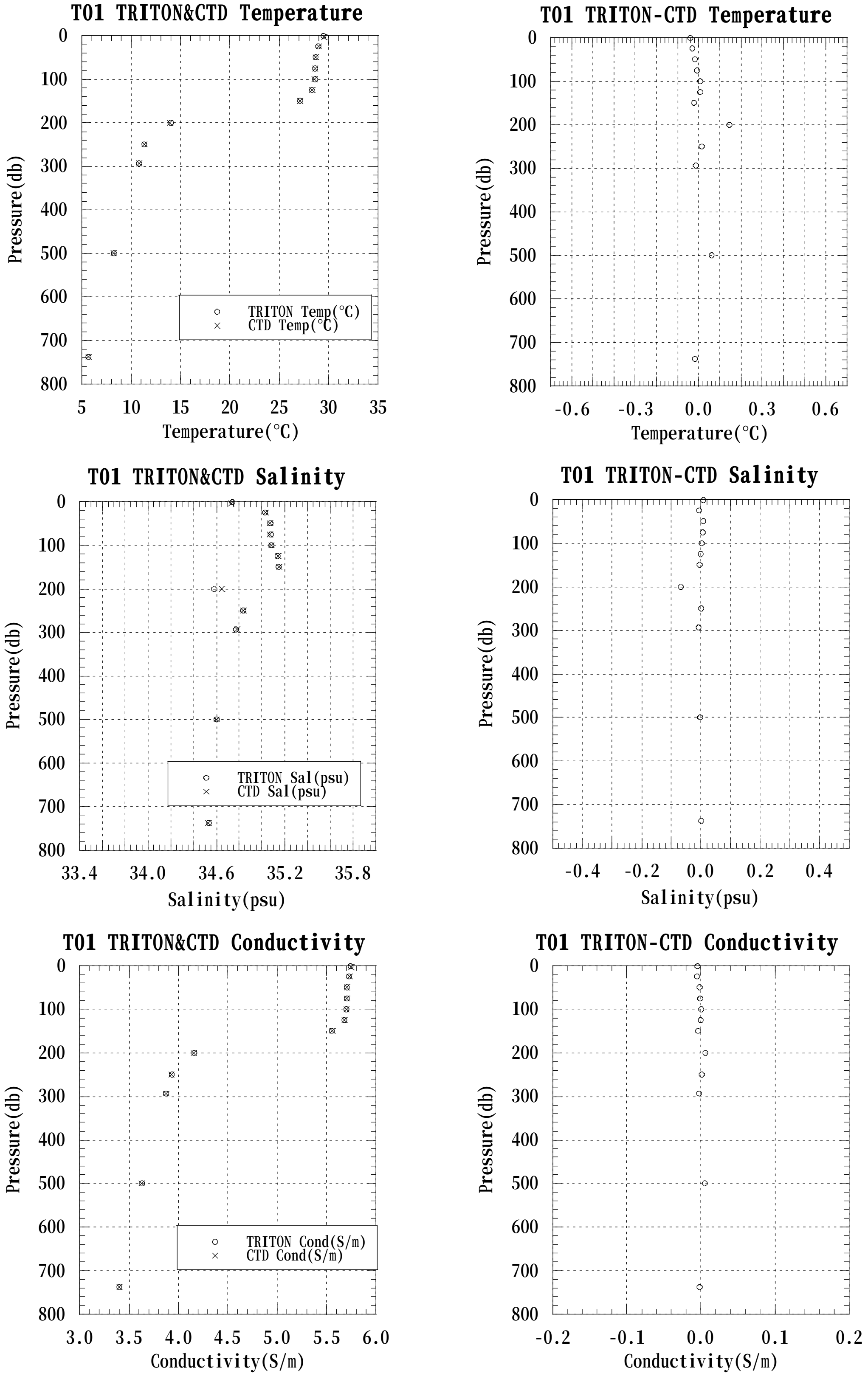


fig.7.1.2-9 Comparision TRITON with CTD

Lat.2N Long.156E
Date 99/11/10Time 22:00(UTC:Hourly average) Before Recovery

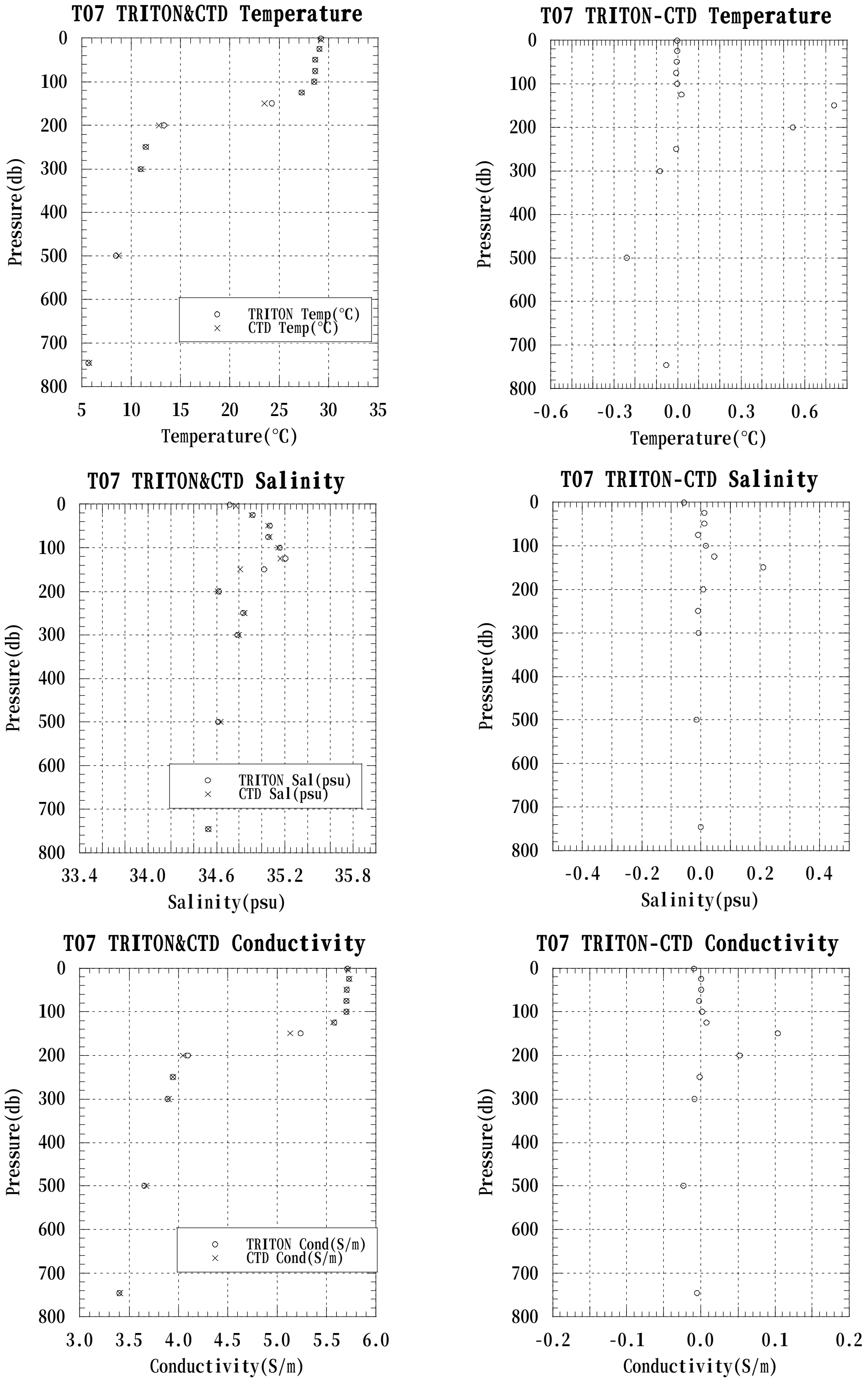


fig.7.1.2-10 Compare TRITON with CTD

Lat.5N Long.156E
Date 99/11/13Time 04:00(UTC:Hourly average) During Visit

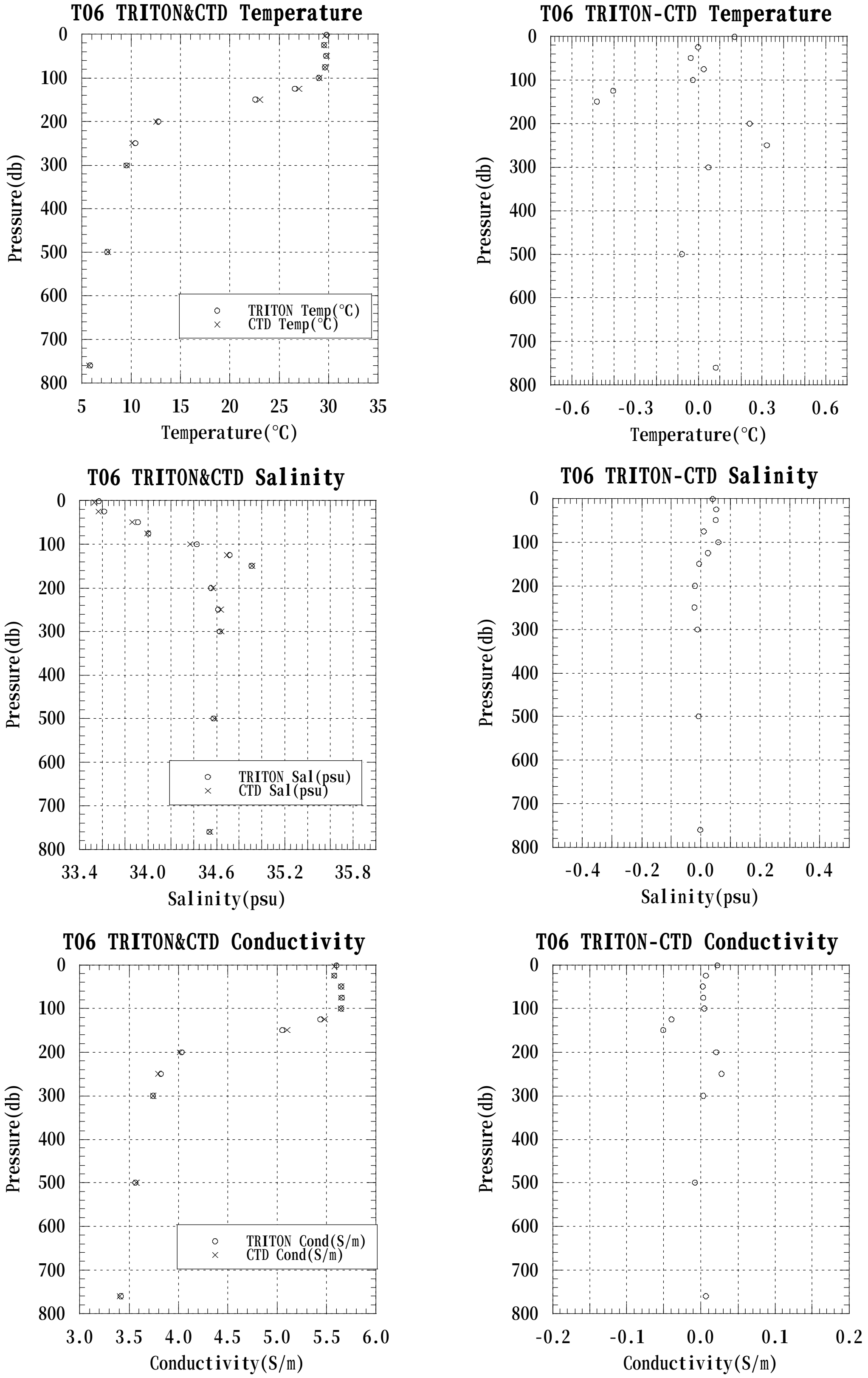


fig.7.1.2-11 Compare TRITON with CTD

Lat.8N Long.156E
Date 99/11/14 Time 03:00(UTC:Hourly average) During Visit

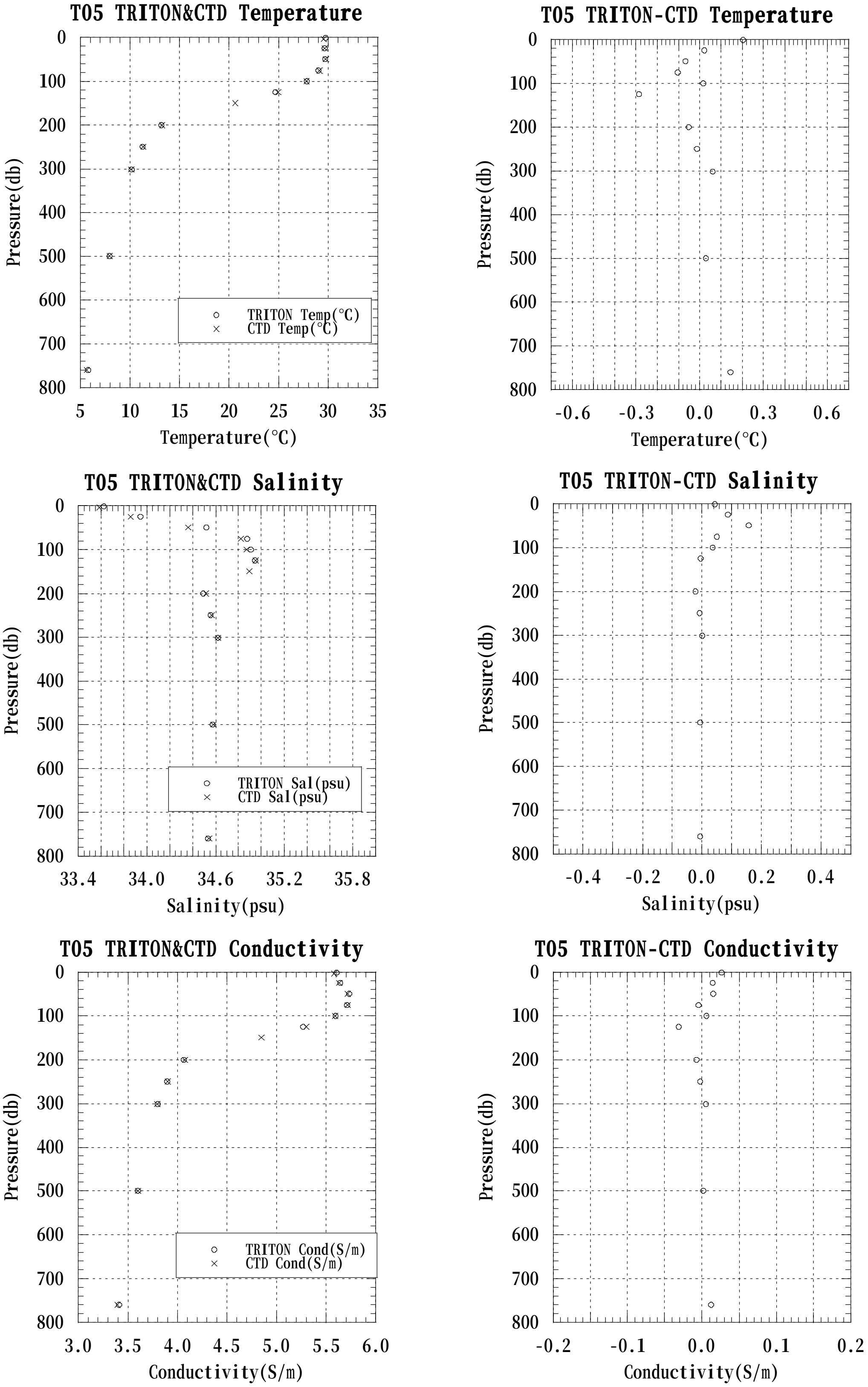


fig.7.1.2-12 Compare TRITON with CTD

T-S Diagram

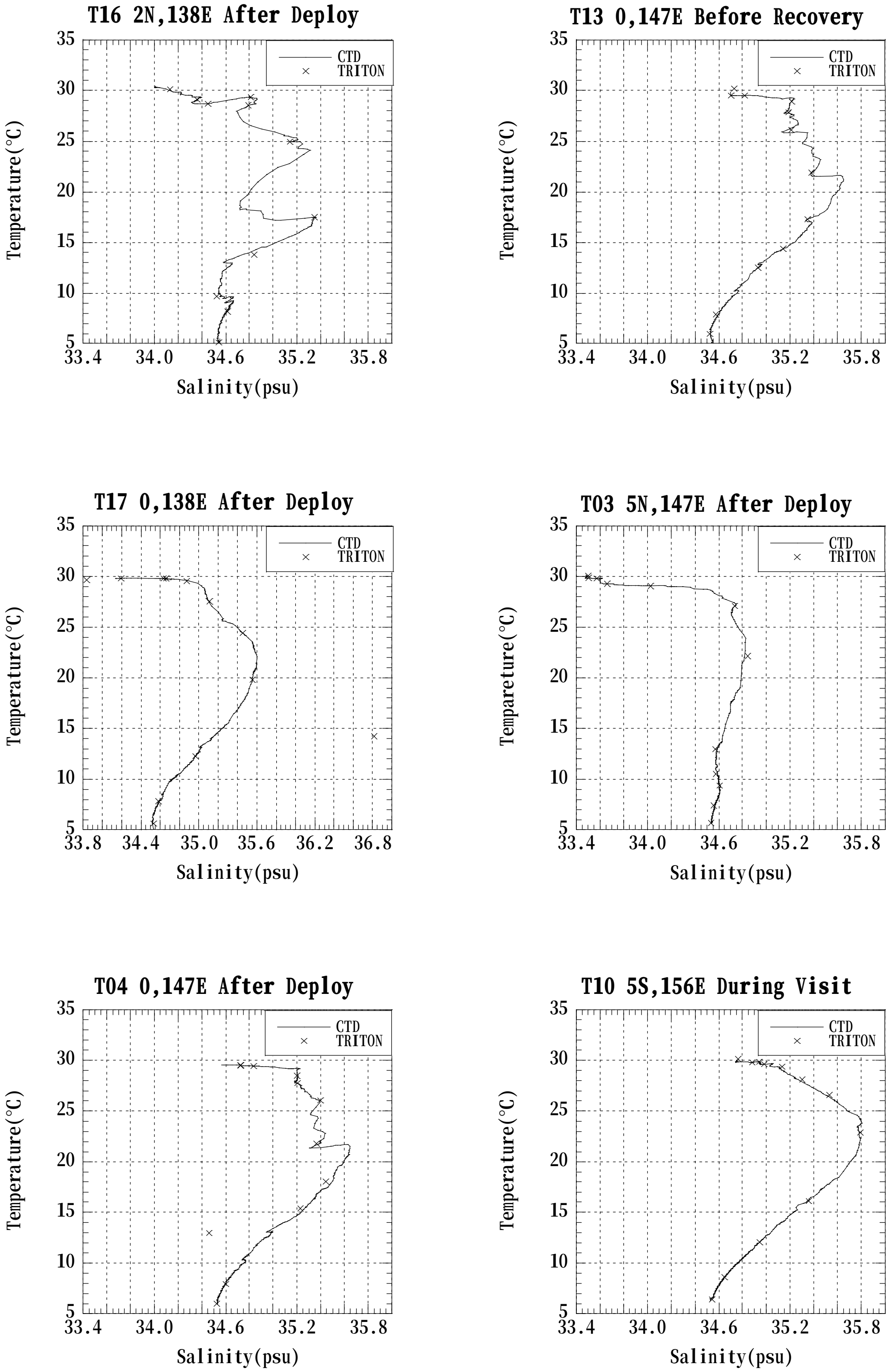
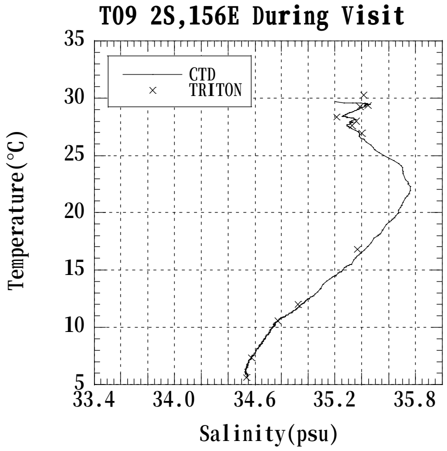
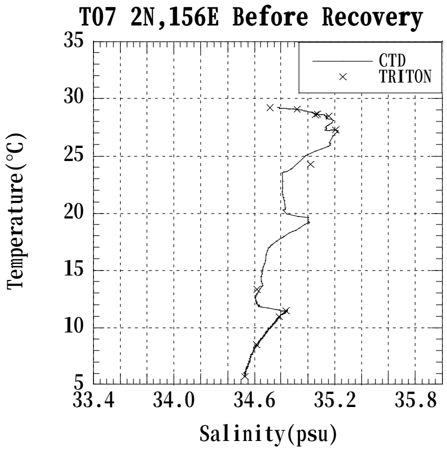
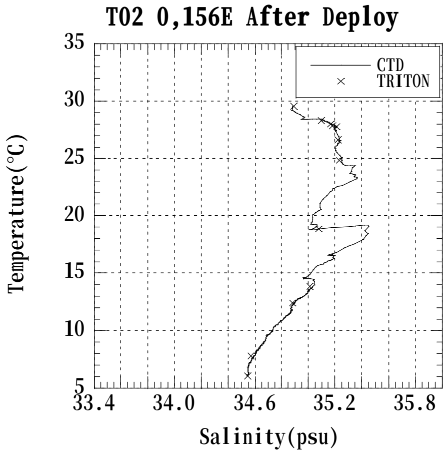


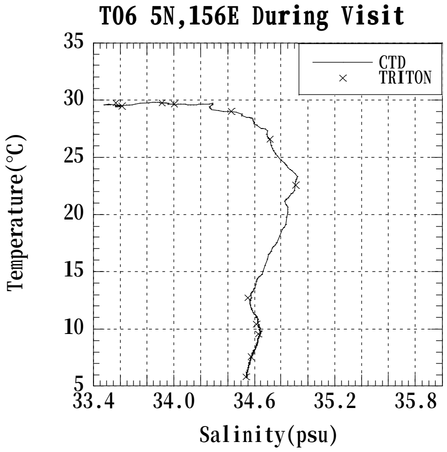
fig.7.1.2-13 Comparision TRITON with CTD

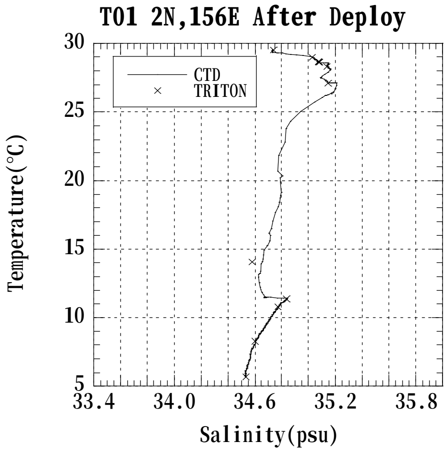
T-S Diagram


T09 2S,156E During Visit


T07 2N,156E Before Recovery


T02 0,156E After Deploy


T06 5N,156E During Visit


T01 2N,156E After Deploy

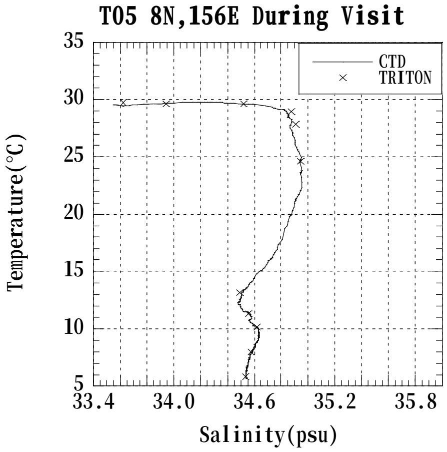

T05 8N,156E During Visit

fig.7.1.2-14 Comparision TRITON with CTD

7.1.3 Inter-comparison of surface meteorological data and current data between TRITON buoy and R/V Mirai

(1) Personnel

Norifumi Ushijima (JAMSTEC): Principal Investigator.
Masaki Hanyu (GOJI): Shipboard measurements.
Hirokatsu Uno (MWJ): Assembling meteorological sensors on albedo boom at the bow .

(2) Objectives

Data of TRITON buoys is expected to improve the prediction of El Nino and daily weather forecast. For that purpose, it is important to provide qualified data. The shipboard meteorological observation in this report aims to obtain the data for TRITON buoy data validation. During this R/V Mirai cruise (MR99-K06), shipboard meteorological measurements were carried out for a few hours after each deployment , before recovery and during mooring of TRITON buoy.

(3) Measured parameters

TRITON buoy:	wind speed, wind direction, air temperature, relative humidity, solar radiation, atmospheric pressure, current speed, current direction.
R/V Mirai :	wind speed, wind direction, air temperature, relative humidity, solar radiation , atmospheric pressure, current speed, current direction.

(4) Methods

Location, sampling interval and data analysis are as follows.

TRITON buoy:	•sampling interval	10min. (without precipitation) continuous (precipitation)
	•data analysis	hourly averaged (without precipitation) 1-hour total precipitation (precipitation)
Mirai : (automatic obs.)	•location	albedo boom at the bow (wind vane/anemometer, thermometer, hygrometer, pyranometer) Weather observation room on the captain deck (resonator digital barometer) Top of the fore mast (wind vane/anemometer) Compass deck (thermometer, hygrometer) Top of the main mast (pyrometer) Roof top on the anti rolling system room, which is as almost same as compass deck level (rain gauge) bottom of the ship (Doppler sonar)
	•sampling interval	1 min.
	•data analysis	hourly averaged hourly total precipitation (precipitation)

(5) Results

Results of this observation are as follows. The following tables are all data and the following figures are results of from TRITON T01 to TRITON No.17.

	Observation No.	Buoy No.	Location	table	figure
TRITON	12001	T16	2N-138E	Table 7.1.3-1	Figure 7.1.3-1a to 7.1.3-1h
TRITON	13001	T17	0N-138E	Table 7.1.3-2	Figure 7.1.3-2a to 7.1.3-2f
TRITON	09002	T04	0N-147E	Table 7.1.3-3	Figure 7.1.3-3a to 7.1.3-3h
TRITON	09001	T13	0N-147E	Table 7.1.3-4	Figure 7.1.3-4a to 7.1.3-4f
TRITON	07002	T03	5N-147E	Table 7.1.3-5	Figure 7.1.3-5a to 7.1.3-5h
TRITON	06001	T10	5S-156E	Table 7.1.3-6	Figure 7.1.3-6a to 7.1.3-6f
TRITON	05001	T09	2S-156E	Table 7.1.3-7	Figure 7.1.3-7a to 7.1.3-7f
TRITON	04003	T02	0N-156E	Table 7.1.3-8	Figure 7.1.3-8a to 7.1.3-8h
TRITON	03003	T01	2N-156E	Table 7.1.3-9	Figure 7.1.3-9a to 7.1.3-9h
TRITON	02002	T06	5N-156E	Table 7.1.3-10	Figure 7.1.3-10a to 7.1.3-10h
TRITON	01002	T05	8N-156E	Table 7.1.3-11	Figure 7.1.3-11a to 7.1.3-11h

・wind speed

The height of wind vane on TRITON buoy was different from that at the albedo boom of R/V Mirai (TRITON buoy: 3.5m, albedo boom: 10.0m, above the sea surface). So, wind speed obtained at the albedo boom was generally larger than at TRITON buoy.

During 2-3 hours observations, R/V Mirai were to keep her head against to the wind in the condition of almost drifting, and also to keep the distance from the position of the TRITON buoy within 2 sea miles.

In most cases, averaged difference was from 0.2 to 0.3 m/s between TRITON and the albedo boom data.

For verification of the data at albedo boom, we compared the wind speed at foremast of R/V Mirai and albedo. They showed almost the same wind speed tendancy.

・wind direction

In most cases, averaged difference was from 10 to 20 degrees between TRITON and the albedo boom data.

For verification of the data at albedo boom, we compared the wind direction at foremast of R/V Mirai and albedo. They showed almost the same wind direction.

・Air temperature and relative humidity

The height of thermometer and hygrometer on the TRITON buoy was different from that of thermometer and hygrometer at albedo boom (TRITON buoy: 2.2m, albedo boom: 9.8m, above the sea surface). So, air temperature and relative humidity at albedo boom were generally lower than those on TRITON buoy.

The air temperature and relative humidity on TRITON buoy showed similar time change at albedo boom. The temperature differences between TRITON and albedo data were about 0.2-0.3 degree C. There was a case of which albedo temperature was a little higher than TRITON temperature, when the wind weakened and the time was in the middle of the daytime. It may be caused by ship heating. Generally, the temperature change was small.

In most case, the relative humidity on TRITON was about 2-8% higher than that at albedo boom.

There was a case of which albedo humidity was a little higher than TRITON humidity, when the wind weakened and the time was in the middle of the daytime. It may be caused by ship heating. Generally, the humidity was also small.

- solar radiation

Solar radiation on TRITON buoy showed almost same value comparing with that at albedo boom except in the rainy periods or cloudy periods when the measurements may be affected by small scale cloud movement.

- atmospheric pressure

The height of resonator digital barometer on TRITON buoy was different from the height of resonator digital barometer on R/V Mirai (TRITON buoy: 2.0m, captain deck: 13.4m, above the sea surface). Then the observed pressure on R/V Mirai was adjusted to the pressure at mean sea level. As a result of correction to mean sea level, the pressure on TRITON buoy showed almost same value.

- current speed and current direction

Current speed and current direction data obtained from TRITON at 10m depth and Doppler sonar at 8 m depth on R/V Mirai were hourly averaged. The differences were 0.2 to 0.5 knots between the data on TRITON buoy and on R/V Mirai .

(6) Data archive

All data will be archived at JAMSTEC Data Management Office.

(7) Remarks

We will plan the following analysis.

- We will calculate momentum, sensible heat and latent heat flux and roughness to check data of wind speed, air temperature and relative humidity exactly.

Table 7.1.3-1 Comparison of data observed at TRITON T16 (12001:2N138E) against data observed at Mirai

Time (UTC)	Wind Speed (m/sec)		Wind Direction (deg)		Air Temperature (℃)		Relative Humidity (%)		Solar Radiation (W/m･m)		Atmospheric Pressure (hPa)		Current Speed (konts)		Current Direction (deg)	
	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai
1999/10/24 23:00	4.3		286		29.1		76.4		919.6		1009.8					
1999/10/25 0:00	3.5		319		29.3		73.1		1012.4		1009.2		1.1		198	
1999/10/25 1:00	2.7		309		28.3		79.9		150.7		1009.6	1010.0	1.2	0.6	196	166
1999/10/25 2:00	2.6		270		28.9		77.5		799.8		1008.7	1009.5	1.3	0.5	178	164
1999/10/25 3:00	2.1		280		29.3		74.7		985.2		1008.3	1008.7	0.6	0.6	178	176
1999/10/25 4:00	2.8	3.9	293	266	29.2	28.7	75.1	78.1	758.8	949.3	1007.6	1007.7	0.4	0.6	178	177
1999/10/25 5:00	2.4	2.4	270	280	29.1	28.7	76.9	77.9	793.3	468.0	1006.7	1006.8	0.5	0.6	180	184
1999/10/25 6:00	2.9	3.1	294	319	29.4	29.1	73.6	74.5	599.1	528.5	1006.0	1006.0	0.5	0.6	179	189
1999/10/25 7:00	3	3.0	287	317	29.5	29.3	72.3	71.7	408.7	444.6	1005.8	1005.9	0.5	0.6	186	196
1999/10/25 8:00	2.6	3.0	261	279	29.0	29.1	75.7	75.3	80.5	226.1	1005.9	1005.9	0.5	0.5	177	201
1999/10/25 9:00	2.4	2.0	250	229	29.1	28.8	77.3	76.3	10.6	22.6	1006.2	1006.2	0.4	0.4	172	203
1999/10/25 10:00	3.4		256		29.3		73.6		0.2		1007.2	1007.1	0.3	0.4	195	210
1999/10/25 11:00	3.9		250		29.4		74.4		0.0		1007.9	1007.9	0.3	0.4	240	207
1999/10/25 12:00	4.2		259		29.4		73.9		0.1		1008.4	1008.4	0.2	0.5	232	194
1999/10/25 13:00	4.2		259		29.4		74.9		0.1		1008.9	1008.9	0.2	0.5	197	198
99/10/25 14:00	3.8		256		29.4		74.9		0.1		1009.1	1009.1	0.3	0.5	181	186
99/10/25 15:00	3.9		244		29.4		75.3		0.1		1008.9	1008.9	0.3	0.4	213	211
99/10/25 16:00	3.2		236		29.2		74.9		0.0		1008.2	1008.3	0.4	0.4	216	212
99/10/25 17:00	2.7		257		29.1		74.0		0.1		1007.6	1007.6	0.4	0.5	217	228
99/10/25 18:00	2.0		267		29.0		75.3		0.1		1007.2	1007.2	0.4	0.5	219	227
99/10/25 19:00												1007.1		0.5		215
Average for 4H	2.7	2.9	278.0	298.6	29.3	29.0	74.6	74.8	470.4	416.8	1006.1	1006.1	0.5	0.6	180.2	192.3
Standard deviation	0.3	0.3	15.2	22.4	0.2	0.3	2.1	2.6	303.7	131.9	0.4	0.4	0.0	0.0	3.9	7.7
△for TRITON&MIRAI		-5.0%		-7%		0.8%		-0.3%		12.9%		0.0%		-14.2%		-6.3%

Table 7.1.3-2 Comparison of data observed at TRITON T17 (13001:0N138E) against data observed at Mirai

Time (UTC)	Wind Speed (m/sec)		Wind Direction (deg)		Air Temperature (℃)		Relative Humidity (%)		Solar Radiation (W/m・m)		Atmospheric Pressure (hPa)		Current Speed (konts)		Current Direction (deg)	
	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai
1999/10/26 19:00	0		0		-20.0		0.0		0.0		850.0					
1999/10/26 20:00	0		0		-20.0		0.0		0.0		850.0					
1999/10/26 21:00	4.2		279		26.4		85.9		23.0		1007.9		1.1		239	
1999/10/26 22:00	3.1	4.3	268	266	26.4	26.2	87.6	87.3	35.1	39.6	1008.1	1008.8	0.9	1.0	279	247
1999/10/26 23:00	3.6	5.2	257	273	27.0	26.7	84.5	84.2	124.1	59.9	1010.0	1009.7	0.6	1.0	276	245
1999/10/27 0:00	6.2	6.8	264	267	27.6	27.2	79.5	83.0	288.3	161.6	1010.6	1010.0	1.7	1.1	259	247
1999/10/27 1:00	4.8	6.3	267	284	27.6	27.4	80.9	80.1	211.3	160.9	1010.4	1010.3	0.9	1.1	257	248
1999/10/27 2:00	3.7	3.8	274	298	27.2	27.3	85.7	82.3	223.6	161.1	1009.9	1010.1	4.1	1.2	262	248
1999/10/27 3:00	0.7	2.4	315	286	25.6	26.5	92.2	87.4	171.9	111.6	1009.5	1009.6	1.2	1.3	251	252
1999/10/27 4:00	1.6	2.1	0	338	26.1	24.9	88.3	91.5	595.8	138.1	1008.4	1008.9	1.2	1.4	248	252
1999/10/27 5:00	1.7	1.7	3	26	26.8	26.1	86.6	87.2	294.7	394.8	1008.0	1008.0	1.2	1.4	248	252
1999/10/27 6:00	4.1	3.5	6	22	26.0	25.8	90.4	89.1	83.1	65.4	1007.6	1007.5	1.1	1.3	246	249
1999/10/27 7:00	1.2	3.1	335	359	25.4	25.1	92.4	92.3	33.6	30.7	1007.9	1007.7	0.9	1.1	244	240
1999/10/27 8:00	2.1	2.4	164	190	25.4	25.1	89.8	90.7	12.3	11.2	1008.3	1008.1	0.8	1.0	239	238
1999/10/27 9:00	1.9		128	134	26.0		89.2		2.8		1008.7	1008.5	0.9	1.0	245	247
Average for 4H	2.2	2.6	86.0	186.4	26.1	25.5	89.4	90.0	251.8	157.2	1008.0	1008.0	1.1	1.3	247	248
Standard deviation	1.3	0.8	166.0	187.5	0.6	0.6	2.5	2.3	255.8	164.6	0.3	0.6	0.2	0.1	2	6
△for TRITON&MIRAI		-17.1%		-53.9%		2.3%		-0.7%		60.1%		0.0%		-14.8%		-0.7%

Table 7.1.3-3 Comparison of data observed at TRITON T04 (09002:0N147E) against data observed at Mirai

Time (UTC)	Wind Speed (m/sec)		Wind Direction (deg)		Air Temperature (℃)		Relative Humidity (%)		Solar Radiation (W/m･m)		Atmospheric Pressure (hPa)		Current Speed (konts)		Current Direction (deg)	
	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai
1999/10/29 1:00	0.0		0		-20.0		0.0		0.0		850.0					
1999/10/29 2:00	1.2		325		29.4		57.2		114.7		1006.3					
1999/10/29 3:00	1.2		325		29.4		57.2		114.7		1006.3	1007.7	1.0	1.6	110	265
1999/10/29 4:00	5.9		307		28.7		64.2		540.9		1005.7	1007.2	0.0	1.6		265
1999/10/29 5:00	5.2		274		28.5		63.6		434.0		1006.5	1006.6	1.5	1.8	327	264
1999/10/29 6:00	5.2		279		28.4		64.2		247.2		1006.7	1006.4	1.6	1.7	293	262
1999/10/29 7:00	4.5		270		28.4		61.7		144.3		1007.0	1006.7	1.4	1.7	280	265
1999/10/29 8:00	5.0		265		28.0		65.7		0.7		1007.4	1006.9	1.8	1.6	170	264
1999/10/29 9:00	4.7	4.2	283	293	28.1	28.5	66.5	69.6	0.0	0.5	1008.0	1007.5	1.7	1.6	168	262
1999/10/29 10:00	5.0	4.4	272	295	28.0	28.5	65.2	70.5	0.0	0.6	1008.7	1008.3	1.6	1.6	168	256
1999/10/29 11:00	4.7	4.3	272	307	28.0	28.3	67.3	72.2	0.0	0.5	1009.0	1008.9	1.7	1.7	164	256
1999/10/29 12:00	4.8	4.5	271	302	28.0	28.3	68.0	72.9	0.0	0.7	1009.6	1009.6	1.6	1.7	166	258
1999/10/29 13:00	4.5	4.4	270	293	27.8	28.1	69.2	74.1	0.0	0.5	1009.6	1009.6	1.6	1.5	163	260
1999/10/29 14:00	4.1	3.1	272	292	27.7	28.0	68.3	73.9	0.0	0.4	1009.0	1009.1	1.6	1.6	164	258
1999/10/29 15:00	2.8	1.7	267	286	27.6	27.9	68.2	74.7	0.0	0.3	1008.4	1008.5	1.6	1.5	166	259
99/10/29 16:00	1.9	1.2	273	289	27.5	27.7	67.9	74.5	0.0	0.5	1007.6	1007.7	1.6	1.7	166	265
99/10/29 17:00	1.7	1.5	283	285	27.3	27.6	69.7	74.8	0.0	0.9	1007.1	1007.1	1.7	1.8	169	268
99/10/29 18:00	2.3	2.6	272	288	27.2	27.5	69.8	74.3	0.0	1.0	1006.9	1006.9	1.7	1.7	167	268
99/10/29 19:00	2.7	2.1	270	292	27.1	27.4	70.4	76.5	0.0	0.8	1007.0	1007.0	1.7	1.7	168	269
99/10/29 20:00	3.0	4.7	268	285	27.2	27.5	70.3	76.0	2.2	1.9	1007.5	1007.4	1.6	1.6	165	265
99/10/29 21:00	2.9	4.4	254	227	27.6	27.6	67.5	74.7	109.5	84.8	1008.2	1008.1	1.5	1.4	165	260
Average for 4H	4.7	4.4	273.6	298	28.0	28.3	67.2	71.9	0.0	0.6	1009.0	1008.8	1.6	1.6	166	258
Standard deviation	0.2	0.1	5.3	6	0.1	0.1	1.5	1.8	0.0	0.1	0.7	0.9	0.0	0.1	2	3
△for TRITON&MIRAI		8.7%		-8.2%		-1.2%		-6.5%		-100.0%		0.0%		1.7%		-35.8%

Table 7.1.3-4 Comparison of data observed at TRITON T13 (09001:0N147E) against data observed at Mirai

Time (UTC)	Wind Speed (m/sec)		Wind Direction (deg)		Air Temperature (℃)		Relative Humidity (%)		Solar Radiation (W/m・m)		Atmospheric Pressure (hPa)		Current Speed (konts)		Current Direction (deg)	
	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai
1999/10/29 13:00	4.7	4.4	295	293	28.4	28.1	74.2	74.1	0	0.5	1009.6					
1999/10/29 14:00	3.9	3.1	292	292	28.3	28.0	73.6	73.9	0	0.4	1009.0					
1999/10/29 15:00	3.1	1.7	294	286	28.1	27.9	73.6	74.7	0	0.3	1008.4					
1999/10/29 16:00	2.3	1.2	297	289	27.9	27.7	74.0	74.5	0	0.5	1007.6					
1999/10/29 17:00	1.8	1.5	310	285	27.8	27.6	73.8	74.8	0	0.9	1007.1	1007.1		1.8		268
1999/10/29 18:00	1.7	2.6	301	288	27.7	27.5	72.3	74.3	0	1.0	1006.8	1006.9		1.7		268
1999/10/29 19:00	2.5	2.1	311	292	27.7	27.4	74.2	76.5	0	0.8	1007.0	1007.0		1.7		269
1999/10/29 20:00	2.9	4.7	296	285	27.7	27.5	75.6	76.0	2.2	1.9	1007.5	1007.4		1.6		265
1999/10/29 21:00	2.7	4.4	282	227	27.8	27.6	74.3	74.7	98.2	84.8	1008.2	1008.1		1.4		260
1999/10/29 22:00	2.2	3.5	277	172	28.1	27.9	72.9	73.4	212.7	224.4	1009.1	1008.9		1.4		257
1999/10/29 23:00	2.5	2.2	270	262	28.1	28.0	71.3	72.6	433.9	335.5	1009.7	1009.6		1.4		250
1999/10/30 0:00	2.4	2.3	274	281	28.2	28.1	69.9	71.4	542	459.7	1009.5	1009.6		1.3		246
1999/10/30 1:00	1.9	1.8	266	258	28.2	28.2	69.6	70.0	797.5	773.4	1009.0	1009.1		1.3		253
1999/10/30 2:00	1.8	1.7	288	269	28.2	28.1	69.7	70.4	840.5	798.5	1008.1	1008.2		1.4		259
1999/10/30 3:00	2	2.6	296	286	28.2	28.1	70.3	70.4	816.6	832.5	1007.2	1007.3		1.6		266
99/10/30 4:00	0.1	2.1	270	294	28.2	28.1	70.3	71.1	0.3	795.8	1006.8	1006.9		1.6		267
Average for 4H	2.1	2.1	278.8	271	28.2	28.1	70.2	70.9	686.1	639.9	1008.7	1008.8		1.4		255
Standard deviation	0.3	0.4	12.7	12	0.0	0.1	0.7	1.1	185.5	226.5	1.0	1.0		0.1		8
△for TRITON&MIRAI		0.8%		2.8%		0.3%		-1.1%		7.2%		0.0%		-100.0%		-100.0%

Table 7.1.3-5 Comparison of data observed at TRITON T03 (07002:5N147E) against data observed at Mirai

Time (UTC)	Wind Speed (m/sec)		Wind Direction (deg)		Air Temperature (℃)		Relative Humidity (%)		Solar Radiation (W/m・m)		Atmospheric Pressure (hPa)		Current Speed (konts)		Current Direction (deg)	
	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai
1999/11/2 19:00	0		0		-20.0		0.0		0.0		850.0					
1999/11/2 20:00	0		0		-20.0		0.0		0.0		850.0					
1999/11/2 21:00	1.2		80		28.2		76.8		111.1		1006.7	1006.9	0.5	0.4	43	68
1999/11/2 22:00	4.7		327		28.8		71.4		231.4		1006.8	1007.5	0.3	0.8	113	64
1999/11/2 23:00	4.7		7		29.1		71.3		702.9		1008.2	1008.0	1.1	0.8	83	67
1999/11/3 0:00	4.7		15		29.0		71.6		401.6		1008.0	1008.0	1.3	0.7	76	66
1999/11/3 1:00	5.5		13		29.1		73.2		959.3		1007.6	1007.7	0.9	0.8	77	70
1999/11/3 2:00	6		18		28.6		75.9		812.5		1006.7	1006.9	3.8	0.7	69	66
1999/11/3 3:00	5.6		350		29.0		72.4		759.8		1005.8	1006.0	0.8	0.7	71	72
1999/11/3 4:00	6.2	6.3	23	16.6	28.5	28.3	76.8	74.9	951.5	417.7	1005.2	1005.2	0.7	0.6	51	72
1999/11/3 5:00	5.6	7.1	9	17.7	28.6	27.9	73.2	74.5	669.5	645.3	1004.6	1004.6	0.8	0.5	67	77
1999/11/3 6:00	4.7	4.7	354	5.2	28.8	28.2	74.1	74.2	499.6	457.3	1004.6	1004.5	0.6	0.6	65	74
1999/11/3 7:00	5.3	5.2	10	33.3	28.4	27.3	75.2	79.1	220.8	147.9	1005.0	1004.8	0.5	0.4	66	85
1999/11/3 8:00	4.8	4.1	7	16.8	28.4	27.6	76.8	79.6	35.2	42.2	1005.4	1005.2	0.5	0.5	68	75
Average for 4H	5.3	5.5	80.6	18	28.5	27.9	75.2	76.5	475.3	342.1	1005.0	1004.9	0.6	0.5	63	77
Standard deviation	0.6	1.2	153.0	10	0.2	0.4	1.6	2.7	361.8	244.2	0.4	0.3	0.1	0.1	7	5
△for TRITON&MIRAI		-3.1%		349.5%		2.4%		-1.6%		39.0%		0.0%		15.3%		-17.4%

Table 7.1.3-6 Comparison of data observed at TRITON T10 (06001:5S156E) against data observed at Mirai

Time	Wind Speed		Wind Direction		Air Temperature		Relative Humidity		Solar Radiation		Atmospheric Pressure		Current Speed		Current Direction	
(UTC)	(m/sec)		(deg)		(℃)		(%)		(W/m・m)		(hPa)		(konts)		(deg)	
	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai
1999/11/5 10:00	2		299		28.4		77.4		0.0		1008.9					
1999/11/5 11:00	3.7		290		28.1		81.5		0.0		1009.4					
1999/11/5 12:00	3.6		266		27.7		80.6		0.0		1009.4					
1999/11/5 13:00	3.4		285		28.3		77.5		0.0		1009.0					
1999/11/5 14:00	2.8		265		28.3		78.2		0.0		1008.2					
1999/11/5 15:00	2.9		256		28.2		78.7		0.0		1007.4					
1999/11/5 16:00	2.8		240		28.3		77.7		0.0		1006.9					
1999/11/5 17:00	3.7		219		28.7		73.1		0.0		1006.7					
1999/11/5 18:00	4.2		226		28.7		71.5		0.0		1006.7					
1999/11/5 19:00	3.8		211		28.7		70.8		0.0		1007.4					
1999/11/5 20:00	3.7		214		28.8		69.7		59.4		1007.8					
1999/11/5 21:00	2.6		225		29.2		68.7		282.6		1008.8					
1999/11/5 22:00	2.2		212		29.2		70.1		489.2		1009.3					
1999/11/5 23:00	2.4		223		29.2		69.3		677.9		1009.5	1009.4		0.3		120
1999/11/6 0:00	2.1		223		29.2		70.6		749.3		1009.4	1009.3		0.4		103
1999/11/6 1:00	1.5	3.8	203	240	29.2	29.2	71.3	70.4	961.4	729.1	1009.0	1008.9		0.5		112
1999/11/6 2:00	1.9	2.0	214	208	29.2	29.0	71.2	71.6	753.4	939.5	1008.3	1008.4		0.3		80
1999/11/6 3:00	2.3	2.6	199	205	29.3	29.0	71.6	71.8	754.2	761.2	1007.3	1007.3		0.2		70
1999/11/6 4:00		7.5		186		29.2		69.9		851.2		1006.9		0.2		97
99/11/6 5:00												1006.8		0.4		281
Average for 4H	1.9	2.8	205.3	217.6	29.2	29.1	71.4	71.3	823.0	809.9	1008.2	1008.2		0.3		87.2
Standard deviation	0.4	0.9	7.8	19.1	0.1	0.1	0.2	0.8	119.9	113.4	0.9	0.8		0.2		22.0
△for TRITON&MIRAI		-31.6%		-5.6%		0.5%		0.1%		1.6%		0.0%				

Table 7.1.3-7 Comparison of data observed at TRITON T09 (05001:2S156E) against data observed at Mirai

Time (UTC)	Wind Speed (m/sec)		Wind Direction (deg)		Air Temperature (℃)		Relative Humidity (%)		Solar Radiation (W/m・m)		Atmospheric Pressure (hPa)		Current Speed (konts)		Current Direction (deg)	
	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai
1999/11/6 3:00	1.9		291		28.5		68.0		955.7		1007.8					
1999/11/6 4:00	1.7		283		28.6		67.9		748.6		1007.2	1006.9		0.2		97
1999/11/6 5:00	2.4		286		28.7		67.7		599.9		1006.8	1006.8		0.4		281
1999/11/6 6:00	2.5		306		28.8		68.0		340.0		1006.8	1006.6		0.5		292
1999/11/6 7:00	2.2		305		28.8		68.8		150.2		1007.2	1006.9		0.8		287
1999/11/6 8:00	2.4		299		28.5		71.0		3.4		1008.0	1007.6		0.8		293
1999/11/6 9:00	2.9		320		28.5		71.3		0.0		1008.6	1008.3		0.9		295
1999/11/6 10:00	2.2		307		28.5		72.1		0.0		1008.9	1008.8		1.0		300
1999/11/6 11:00	2.5		331		28.4		70.6		0.0		1009.1	1009.1		1.1		287
1999/11/6 12:00	2.5		329		28.4		71.6		0.0		1009.1	1009.0		1.0		305
1999/11/6 13:00	2.2		327		28.3		72.6		0.0		1008.8	1008.8		0.8		310
1999/11/6 14:00	1.8		323		28.1		72.9		0.0		1008.2	1008.2		0.8		295
1999/11/6 15:00	1		338		28.0		73.1		0.0		1007.6	1007.6		1.0		295
1999/11/6 16:00	0.4		346		27.8		72.7		0.0		1007.2	1007.2		1.0		279
1999/11/6 17:00	0		0		27.7		73.3		0.0		1006.8	1006.9		0.8		260
1999/11/6 18:00	0.3		71		27.6		73.7		0.1		1007.1	1007.0		0.7		292
99/11/6 19:00	0.2		90		27.6		73.6		0.2		1007.8	1007.7		0.6		294
99/11/6 20:00	0.2		63		28.0		71.8		59.4		1008.3	1008.2		0.5		281
99/11/6 21:00	0.2		0		28.6		69.8		174.9		1008.9	1008.7		0.5		275
99/11/6 22:00	0.8		270		28.5		70.6		386.7		1009.8	1009.6		0.5		253
99/11/6 23:00	0.9		302		28.4		70.6		572.0		1010.1	1010.1		0.4		245
99/11/7 0:00	1.3		324		28.4		70.7		809.2		1009.9	1009.9		0.4		240
99/11/7 1:00	1.0	3.1	338	34	28.5	28.0	71.1	70.2	951.3	958.1	1009.3	1009.3		0.5		244
99/11/7 2:00	1.4	1.7	8	33	28.4	28.3	71.4	69.9	963.6	949.2	1008.4	1008.4		0.4		247
99/11/7 3:00	2.1	2.1	59	72	28.6	28.4	71.3	69.9	896.4	861.3	1007.4	1007.5		0.6		230
99/11/7 4:00	2.6	2.9	41	63	28.8	28.5	71.3	68.9	741.5	722.2	1006.3	1006.3		0.6		233
Average for 4H	2.0	2.2	36.0	56.0	28.6	28.4	71.3	69.6	867.2	844.2	1007.4	1007.4		0.5		236.7
Standard deviation	0.6	0.6	25.9	20.1	0.2	0.1	0.1	0.5	113.9	114.5	1.1	1.1		0.1		8.7
△for TRITON&MIRAI		-8.6%		-35.8%		0.7%		2.5%		2.7%		0.0%		-100.0%		-100.0%

Table 7.1.3-8 Comparison of data observed at TRITON T02 (04003:0N156E) against data observed at Mirai

Time (UTC)	Wind Speed (m/sec)		Wind Direction (deg)		Air Temperature (℃)		Relative Humidity (%)		Solar Radiation (W/m･m)		Atmospheric Pressure (hPa)		Current Speed (konts)		Current Direction (deg)	
	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai
1999/11/8 19:00	0		0		-20.0		0.0		0.0		850.0					
1999/11/8 20:00	0.7		180		29.5		65.3		397.5		1008.9					
1999/11/8 21:00	0.7		180		29.5		65.3		397.5		1008.9		1.1		344	
1999/11/8 22:00	2.3		244		28.6		70.2		43.7		1009.1		0.4		0	
1999/11/8 23:00	4.6	4.8	248	236	28.5	28.2	71.8	72.4	777.7	55.4	1010.2		1.2		19	
1999/11/9 0:00	4.9	5.3	257	233	28.5	28.3	69.4	71.7	923.4	58.2	1009.7		1.5		311	
1999/11/9 1:00	4.9	4.9	246	246	27.9	28.4	73.7	70.3	1025.6	207.2	1009.1	1009.3	3.9	1.2	287	234
1999/11/9 2:00	5.4	4.2	250	247	28.5	28.3	70.8	72.7	872.1	986.8	1007.9	1008.4	1.4	1.1	264	240
1999/11/9 3:00	5.2	4.4	255	249	28.6	28.3	70.7	71.8	952.1	917.0	1007.0	1007.3	1.4	1.1	258	236
1999/11/9 4:00	3.7	4.0	262	256	28.7	28.4	69.6	70.7	772.0	836.9	1006.5	1006.7	1.5	1.0	264	237
1999/11/9 5:00	4.1	3.8	268	261	28.7	28.5	69.1	70.0	640.9	490.2	1006.6	1006.5	1.5	1.1	261	236
1999/11/9 6:00	5.1	4.9	268	279	28.8	28.6	70.7	71.8	392.2	433.3	1006.8	1006.6	1.5	1.2	259	233
1999/11/9 7:00												1007.0		1.1		237
Average for 4H	4.7	4.3	260.6	258.1	28.7	28.4	70.2	71.4	725.9	732.9	1007.0	1007.1	1.4	1.1	261.2	236.2
Standard deviation	0.8	0.4	8.0	12.8	0.1	0.1	0.8	1.0	219.8	253.9	0.6	0.8	0.1	0.0	3.0	2.3
△for TRITON&MIRAI		9.9%		1.0%		0.8%		-1.7%		-1.0%		0.0%		30.0%		10.6%

Table 7.1.3-9 Comparison of data observed at TRITON T01 (03003:2N156E) against data observed at Mirai

Time (UTC)	Wind Speed (m/sec)		Wind Direction (deg)		Air Temperature (°C)		Relative Humidity (%)		Solar Radiation (W/m・m)		Atmospheric Pressure (hPa)		Current Speed (konts)		Current Direction (deg)	
	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai
1999/11/9 19:00	0		0		-20.0		0.0		0.0		850.0	1008.7		1.3		291
1999/11/9 20:00	5.3		268		29.4		70.4		424.0		1009.9	1009.3		1.4		299
1999/11/9 21:00	5.3		268		29.4		70.4		424.0		1009.9	1010.0	1.0	1.1	32	296
1999/11/9 22:00	1.1		315		29.7		68.2		598.2		1009.9	1010.8	0.6	1.2	251	294
1999/11/9 23:00	5.6		267		29.2		71.9		751.9		1010.9	1011.0	0.0	1.2		290
1999/11/10 0:00	6.9		273		29.1		73.4		919.7		1010.6	1010.8	1.6	1.2	288	289
1999/11/10 1:00	6.8	6.3	272	267	27.8	28.8	80.8	68.9	910.5	65.5	1009.7	1010.1	3.8	1.1	293	285
1999/11/10 2:00	6.2	5.6	272	289	29.0	28.7	73.6	68.1	927.7	843.5	1009.1	1009.3	1.4	1.1	276	284
1999/11/10 3:00	6.5	5.8	275	303	29.1	28.7	74.0	67.8	896.2	909.4	1008.2	1008.5	1.4	1.1	285	286
1999/11/10 4:00	6.9	6.0	268	297	29.1	28.7	74.6	68.8	742.7	806.1	1007.8	1008.0	1.6	1.0	277	284
1999/11/10 5:00	6.6	6.4	268	297	29.1	28.7	74.0	69.1	529.9	610.0	1007.4	1007.4	1.5	1.0	282	283
1999/11/10 6:00	6.8	6.4	270	293	29.3	28.8	72.6	67.6	385.3	422.1	1007.3	1007.2	1.7	1.2	281	290
1999/11/10 7:00	6.4		268		29.1		74.8		132.7			1007.3	1.8	1.4	283	287
1999/11/10 8:00												1007.7		1.4		291
1999/11/10 9:00												1008.5		1.3		289
1999/11/10 10:00												1009.0		1.3		292
Average for 4H	6.7	6.1	270.3	297.7	29.2	28.7	73.8	68.3	638.5	686.9	1007.7	1007.8	1.6	1.1	281.5	286.0
Standard deviation	0.2	0.3	3.3	4.0	0.1	0.0	0.8	0.7	226.0	215.8	0.4	0.6	0.1	0.1	3.1	2.8
△for TRITON&MIRAI		9.0%		-9.2%		1.4%		8.0%		-7.0%		0.0%		43.7%		-1.6%

Table 7.1.3-10 Comparison of data observed at TRITON T06 (02002:5N156E) against data observed at Mirai

Time (UTC)	Wind Speed (m/sec)		Wind Direction (deg)		Air Temperature (℃)		Relative Humidity (%)		Solar Radiation (W/m･m)		Atmospheric Pressure (hPa)		Current Speed (konts)		Current Direction (deg)	
	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai
1999/11/12 23:00	2.3	1.1	2	288	28.8	29.2	63.9	62.1	625.8	760.1	1011.8	1011.7	0.5	0.7	98	128
1999/11/13 0:00	2.1	1.6	346	274	28.8	29.0	66.3	63.9	703.3	829.5	1011.6	1011.7	0.3	0.6	71	111
1999/11/13 1:00	3	2.3	319	266	28.7	28.8	66.8	65.2	865.1	922.1	1011.0	1011.2	0.3	0.6	72	110
1999/11/13 2:00	3.2	1.7	315	246	28.6	28.7	66.4	65.8	921.9	900.5	1010.1	1010.2	0.3	0.4	69	104
1999/11/13 3:00	4.2	4.2	320	270	28.6	28.2	66.4	64.4	865.1	893.4	1009.4	1009.4	0.3	0.5	72	91
1999/11/13 4:00	3.5	4.4	278	271	28.6	28.2	68.0	65.1	687.7	786.7	1008.6	1008.7	0.3	0.6	83	87
1999/11/13 5:00	4.4	4.3	286	287	28.6	28.2	68.0	65.5	457.5	605.2	1008.1	1008.1	0.5	0.6	68	86
1999/11/13 6:00	4.1	4.4	286	293	28.7	28.2	67.7	65.9	294.5	379.2	1008.1	1008.0	0.5	0.7	62	86
1999/11/13 7:00	4.3		276		28.6		66.9		97.3		1008.3	1008.2	0.5	0.8	53	92
1999/11/13 8:00												1008.5		0.8		90
Average for 4H	3.7	2.9	317.5	257.7	28.6	28.5	66.4	65.1	893.5	897.0	1009.8	1009.8	0.3	0.5	70.7	97.2
Standard deviation	0.7	1.8	3.5	17.0	0.0	0.3	0.0	1.0	40.2	5.0	0.5	0.6	0.0	0.1	2.2	9.2
△for TRITON&MIRAI		25.9%		23.2%		0.4%		2.0%		-0.4%		0.0%		-31.0%		-27.2%
Average for 4H	4.0	4.3	283.3	283.6	28.6	28.2	67.9	65.5	479.9	590.4	1008.3	1008.3	0.4	0.6	71.1	86.3
Standard deviation	0.5	0.0	4.6	11.6	0.1	0.0	0.2	0.4	197.6	204.2	0.3	0.4	0.1	0.0	10.8	0.7
△for TRITON&MIRAI		-8.0%		-0.1%		1.4%		3.6%		-18.7%		0.0%		-30.8%		-17.6%

Table 7.1.3-11 Comparison of data observed at TRITON T05 (01002:8N156E) against data observed at Mirai

Time (UTC)	Wind Speed (m/sec)		Wind Direction (deg)		Air Temperature (℃)		Relative Humidity (%)		Solar Radiation (W/m･m)		Atmospheric Pressure (hPa)		Current Speed (konts)		Current Direction (deg)	
	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai	TRITON	Mirai
1999/11/13 10:00	2.3		252		28.7		74.2		0.0		1010.6		0.2		51	
1999/11/13 11:00	3.1		251		28.6		75.3		0.0		1010.7		0.4		73	
1999/11/13 12:00	3.1		259		28.5		76.1		0.0		1010.6		0.3		63	
1999/11/13 13:00	2.2		234		28.4		76.1		0.0		1010.4		0.4		70	
1999/11/13 14:00	2.8		235		28.4		76.8		0.0		1010.0		0.3		89	
1999/11/13 15:00	2.7		217		28.4		76.7		0.1		1009.8		0.3		87	
1999/11/13 16:00	4.2		225		28.5		75.5		0.0		1009.2		0.4		84	
1999/11/13 17:00	4.1		224		28.4		74.5		0.0		1008.8		0.3		93	
1999/11/13 18:00	4		214		28.4		75.6		0.0		1008.8		0.3		109	
1999/11/13 19:00	3.9		234		28.4		75.2		0.0		1009.2		0.4		95	
1999/11/13 20:00	4.2		225		28.5		76.5		29.6		1009.7		0.3		107	
1999/11/13 21:00	3.8		246		28.9		74.5		224.3		1010.3		0.2		47	
1999/11/13 22:00	4		240		28.7		75.9		269.1		1010.8		0.5		20	
1999/11/13 23:00	4.3		241		28.9		76.3		664.0		1011.2	1011.1	0.4	0.7	14	67
1999/11/14 0:00	3.8	2.8	240	230	28.9	29.1	75.9	73.1	668.2	739.4	1011.0	1011.1	0.3	0.9	75	70
1999/11/14 1:00	3.4	1.9	228	232	28.9	29.4	76.8	72.2	829.7	850.7	1010.2	1010.4	0.4	1.1	109	92
99/11/14 2:00	3.5	6.2	214	261	28.5	28.3	77.6	75.9	702.5	703.1	1009.5	1009.6	0.4	0.9	99	98
99/11/14 3:00	2.9	2.8	246	243	28.9	28.5	76.6	76.7	743.4	896.3	1008.6	1008.7	0.4	0.6	109	94
99/11/14 4:00	4	3.9	254	248	28.9	28.6	77.1	76.8	587.6	595.9	1008.0	1008.0	0.5	0.7	85	86
99/11/14 5:00	3.6	4.0	212	227	28.5	28.1	79.3	79.1	315.7	429.5	1007.8	1007.8	0.5	0.9	85	98
99/11/14 6:00	3.8	4.0	231	217	28.6	28.5	77.3	76.0	260.6	281.6	1008.1	1007.9	0.6	0.8	79	67
99/11/14 7:00												1008.2		0.8		72
Average for 4H	3.6	3.7	235.8	233.5	28.7	28.4	77.6	77.2	476.8	550.8	1008.1	1008.1	0.5	0.8	89.4	86.1
Standard deviation	0.5	0.6	18.5	14.5	0.2	0.2	1.2	1.4	228.1	263.7	0.3	0.4	0.1	0.1	13.1	13.8
△for TRITON&MIRAI		-2.7%		1.0%		1.1%		0.5%		-13.4%		0.0%		-36.1%		3.9%

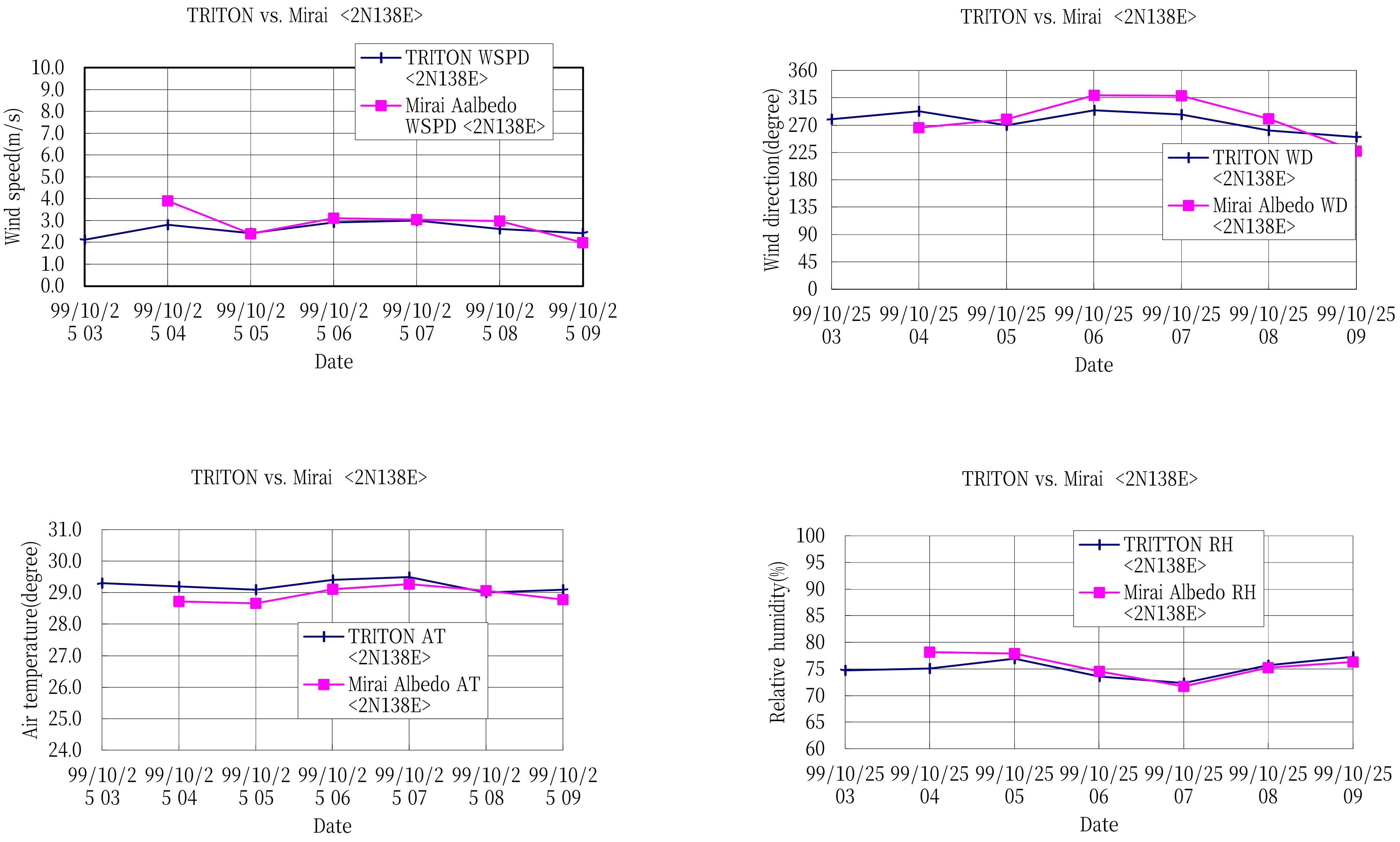


Fig.7.1.3-1a～1d　Time series of wind speed, wind direction,air temperature and relative humidity at TRITON T16(12001) and Mirai

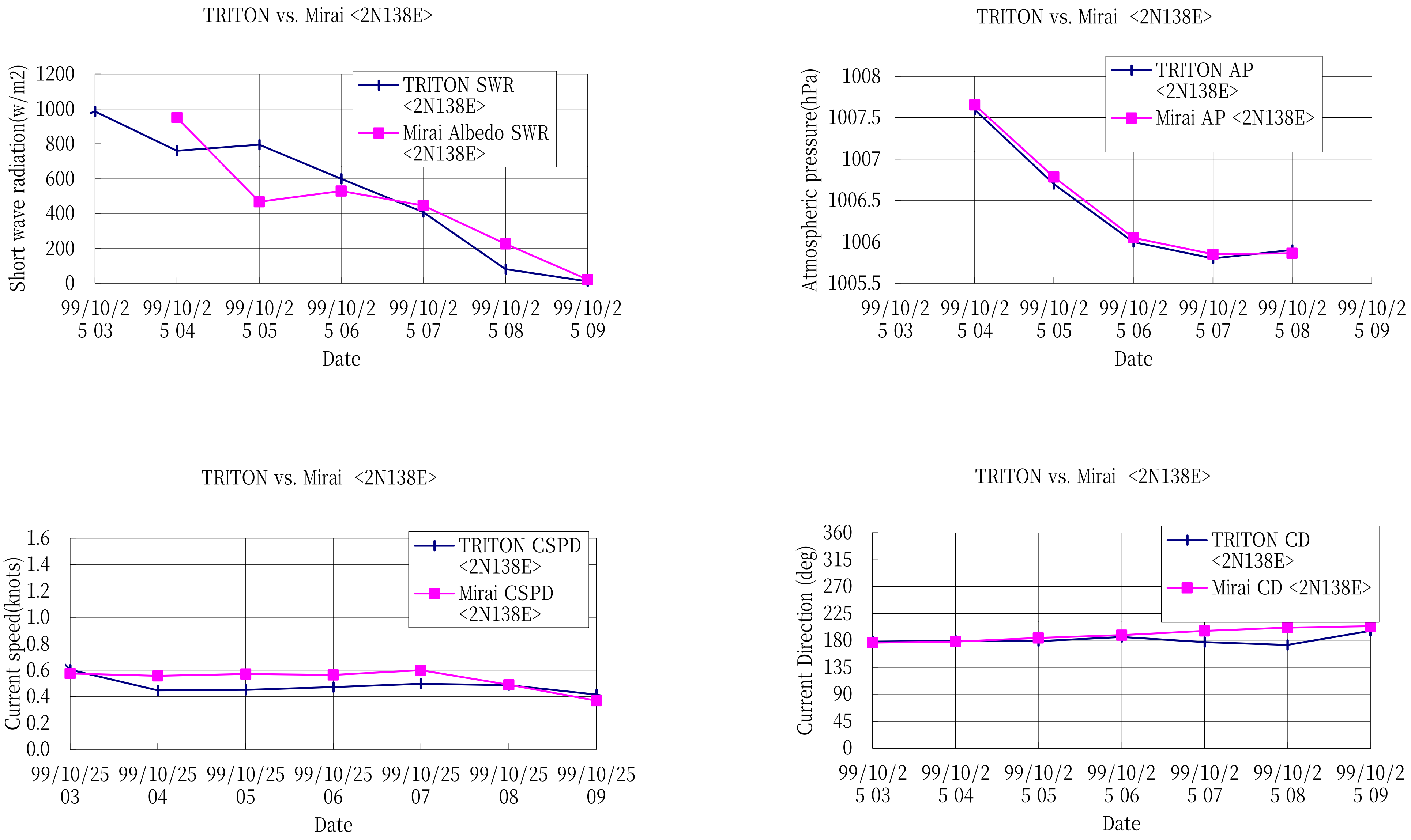


Fig.7.1.3-1e～1h　Time series of solar radiation,atmospheric pressure,current speed & direction at TRITON T16(12001) and Mirai

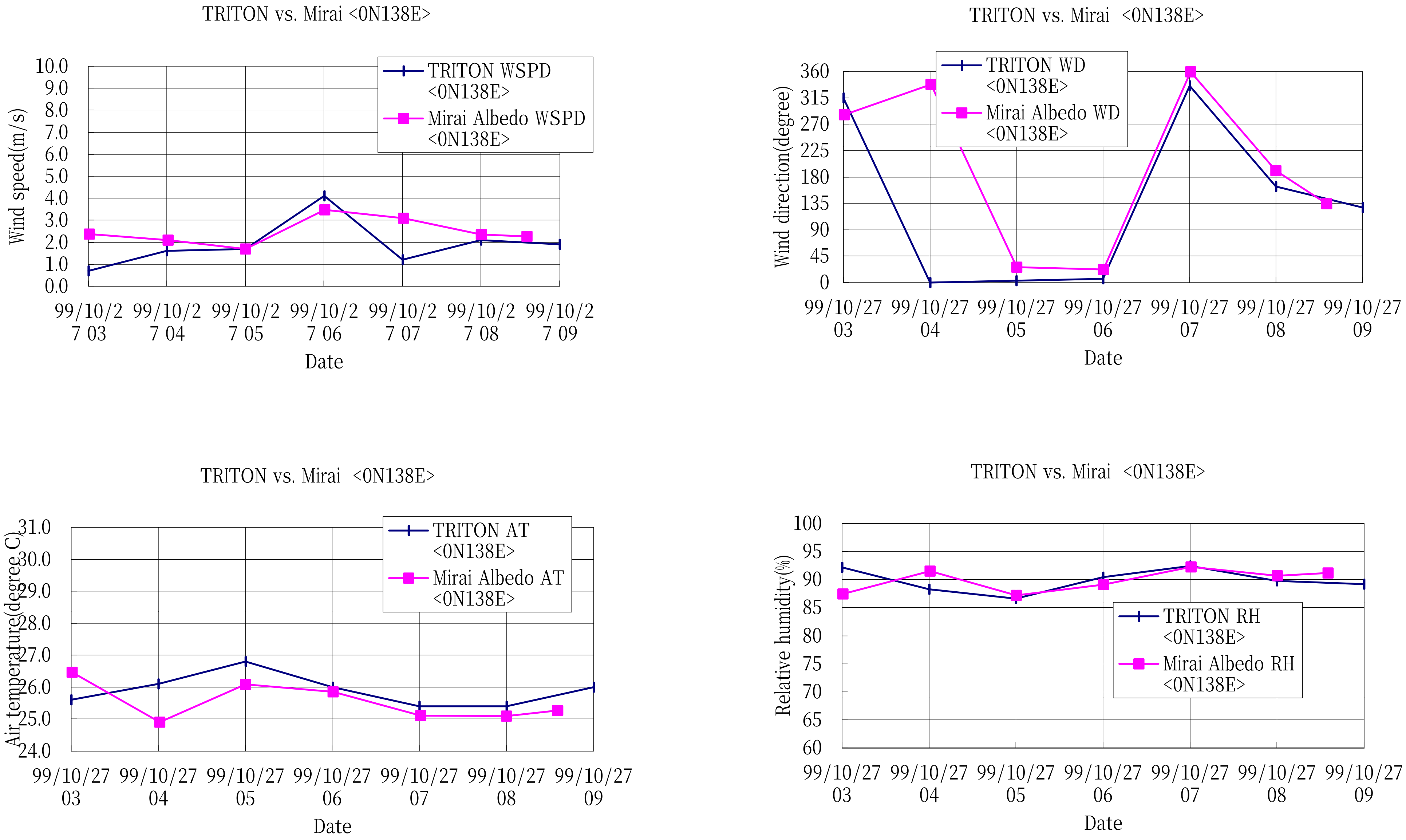


Fig.7.1.3-2a～2d Time series of wind speed, wind direction,air temperature and relative humidity at TRITON T17(13001) and Mirai

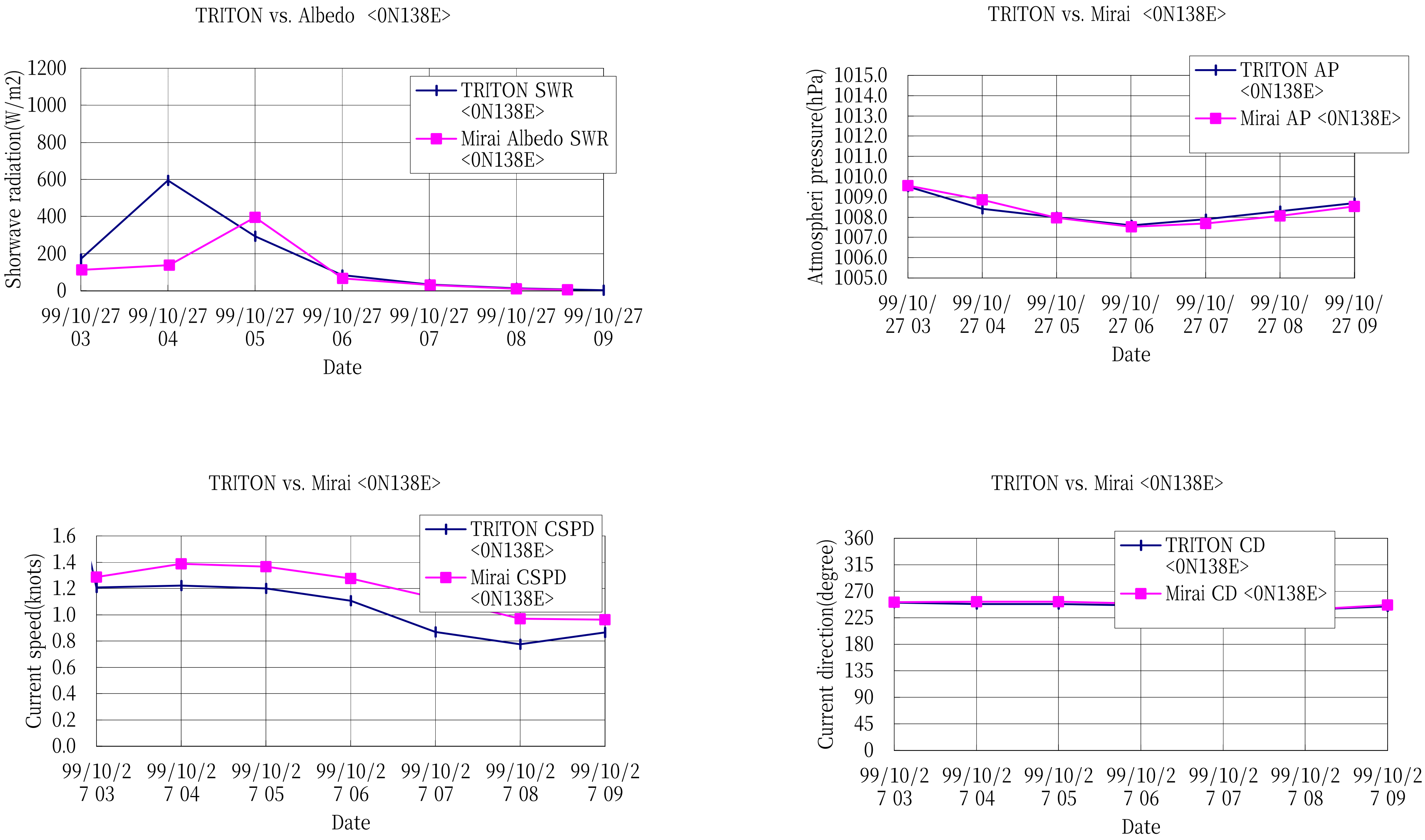


Fig.7.1.3-2e～2h Time series of solar radiation,atmospheric pressure,current speed & direction at TRITON T17(13001) and Mirai

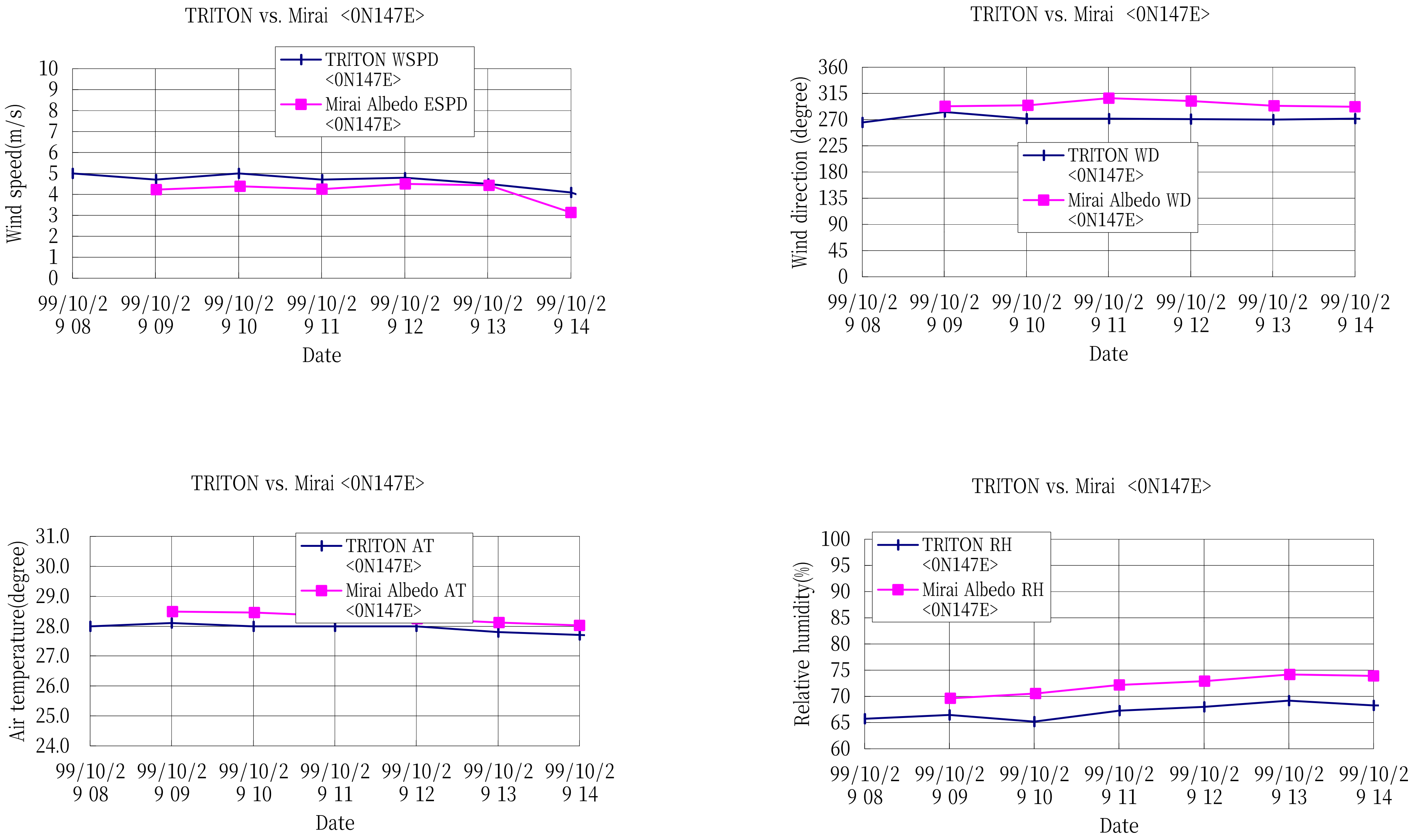


Fig.7.1.3-3a～3d　Time series of wind speed, wind direction,air temperature and relative humidity at TRITON T04(09002) and Mirai

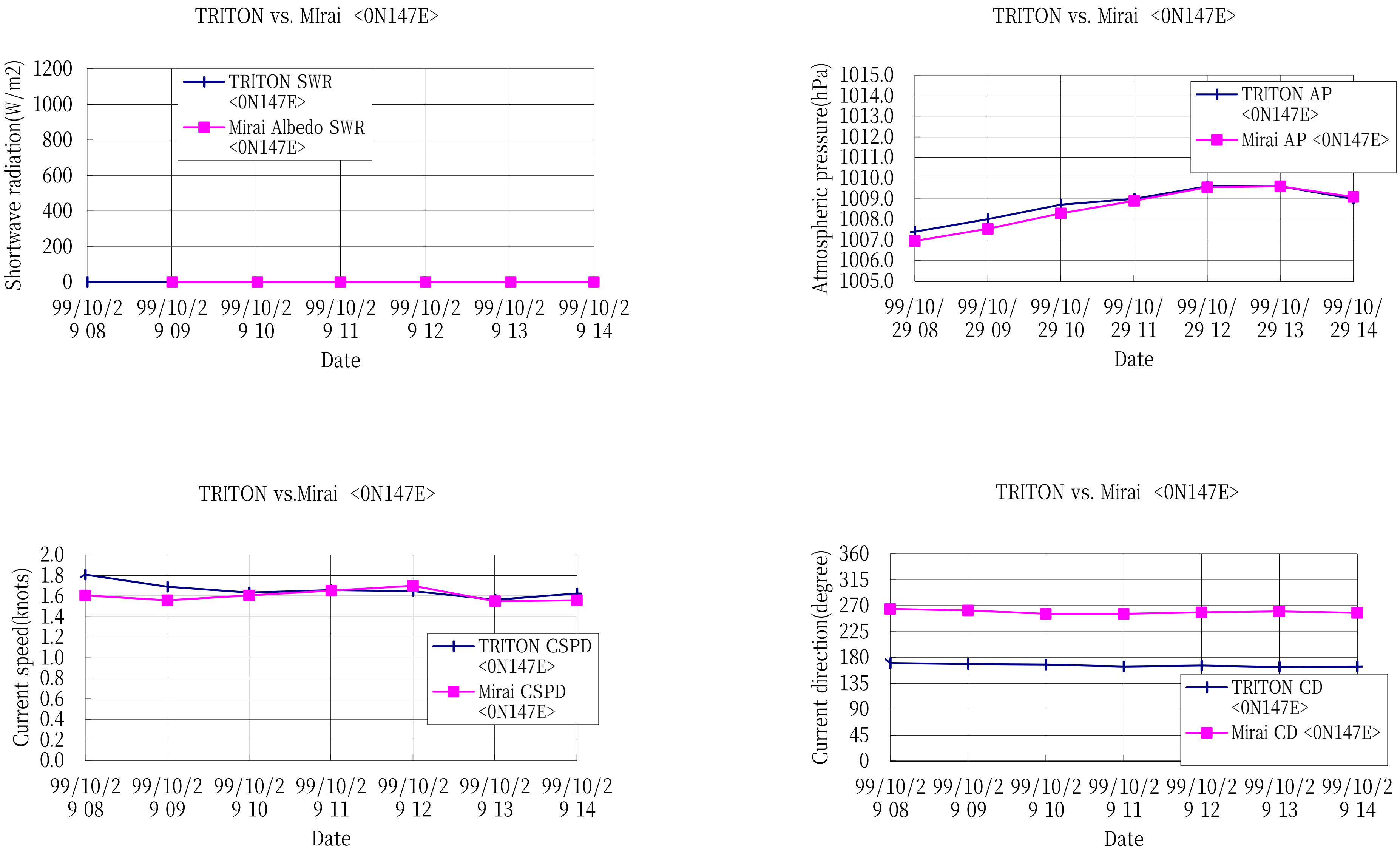


Fig.7.1.3-3e～3h Time series of solar radiation,atmospheric pressure,current speed & direction at TRITON T04(09002) and Mirai

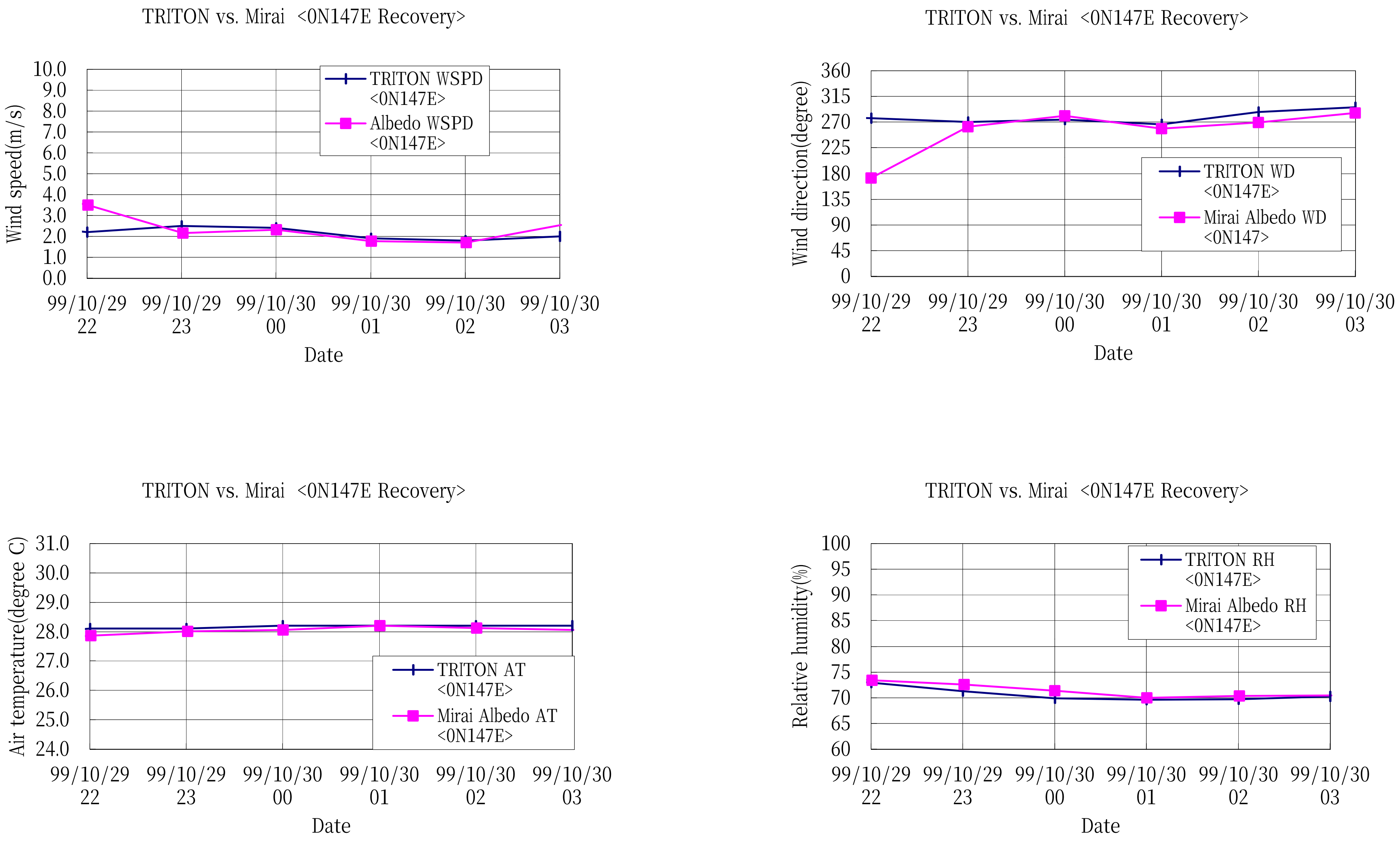
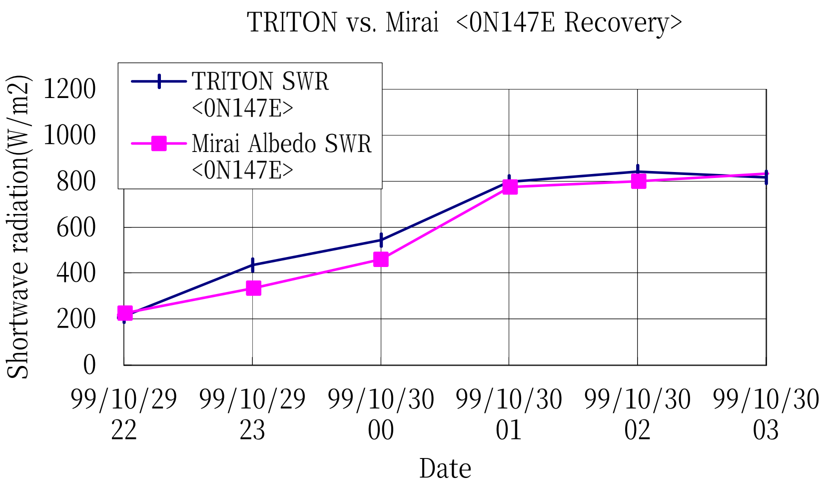


Fig.7.1.3-4a～4d Time series of wind speed, wind direction,air temperature and relative humidity at TRITON T13(09001) and Mirai



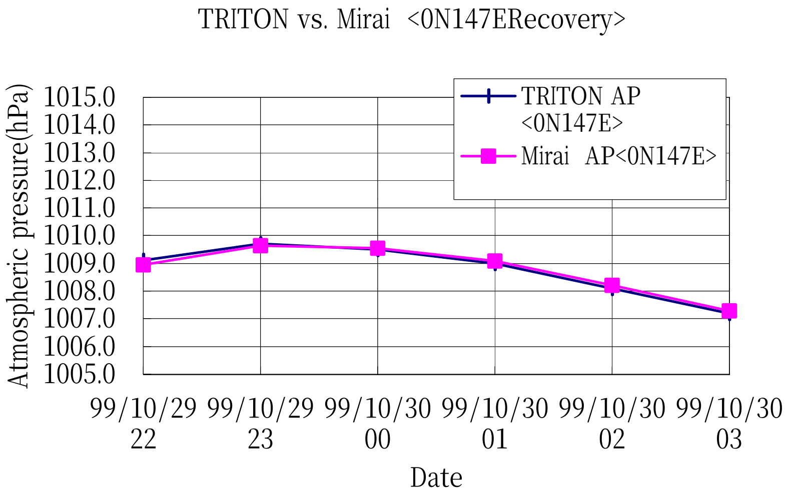


Fig.7.1.3-4e～4f Time series of solar radiation,atmospheric pressure at TRITON T13(09001) and Mirai

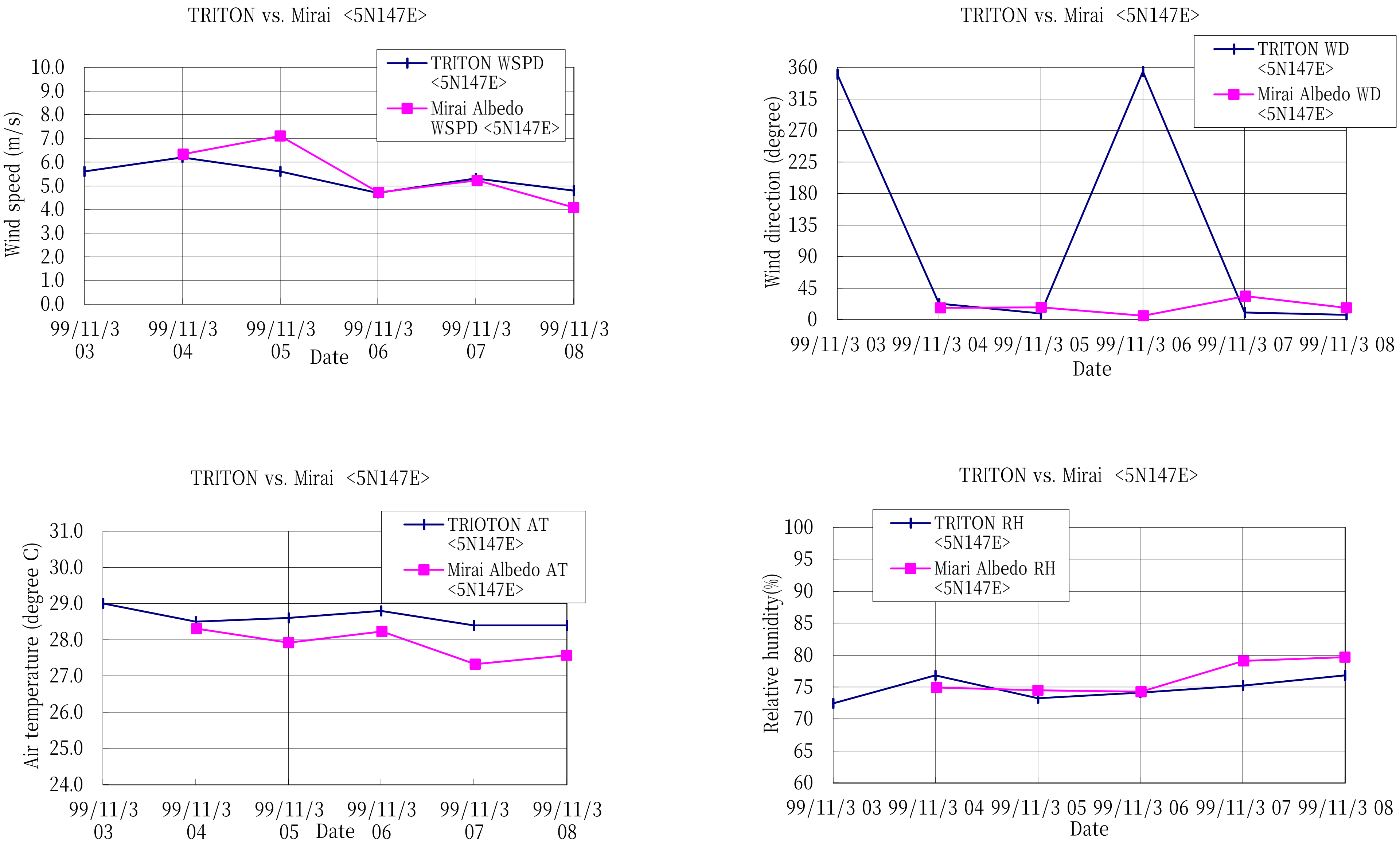


Fig.7.1.3-5a～5d　Time series of wind speed, wind direction,air temperature and relative humidity at TRITON T03(07002) and Mirai

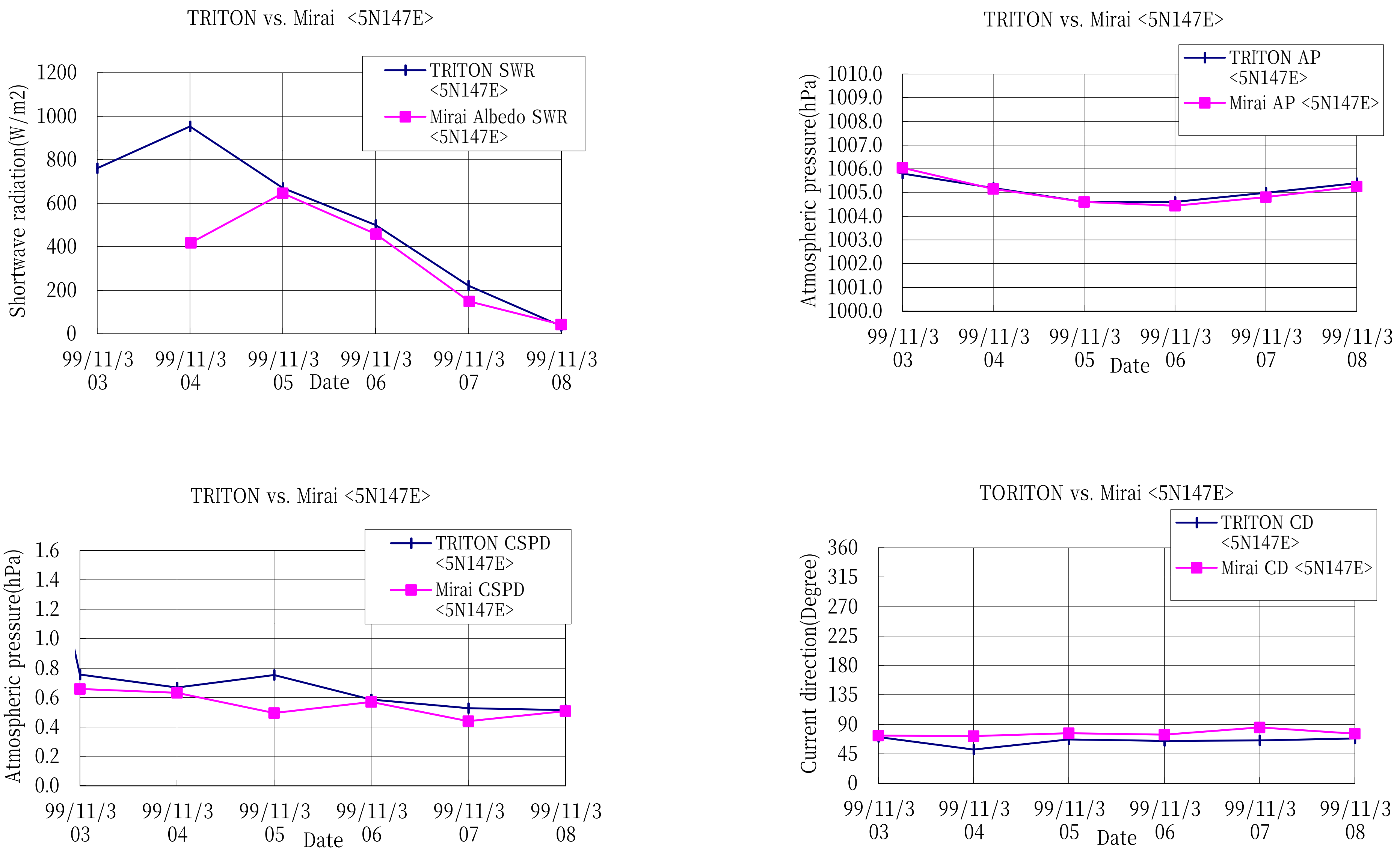


Fig.7.1.3-5e～5h　Time series of solar radiation,atmospheric pressure,current speed & direction at TRITON T03(07002) and Mirai

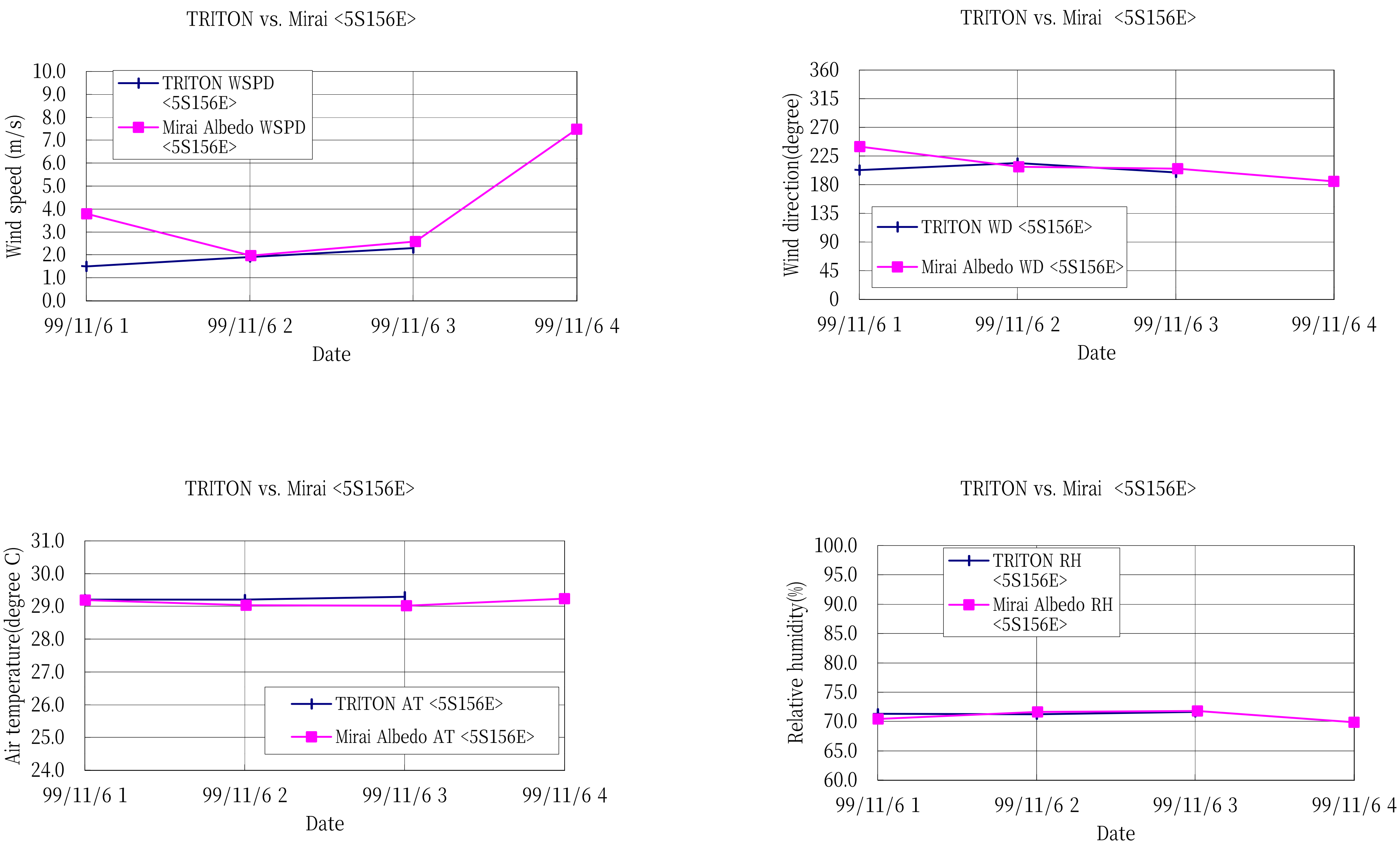


Fig.7.1.3-6a～6d　Time series of wind speed, wind direction,air temperature and relative humidity at TRITON T10(06001) and Mirai

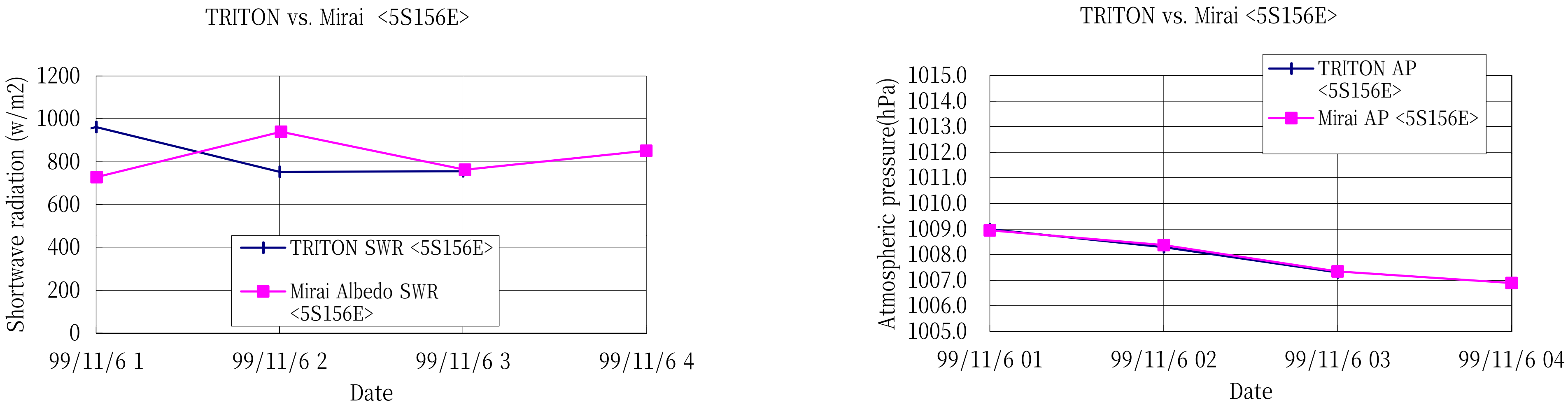


Fig.7.1.3-6e～6f　Time series of solar radiation,atmospheric pressure at TRITON T10(06001) and Mirai

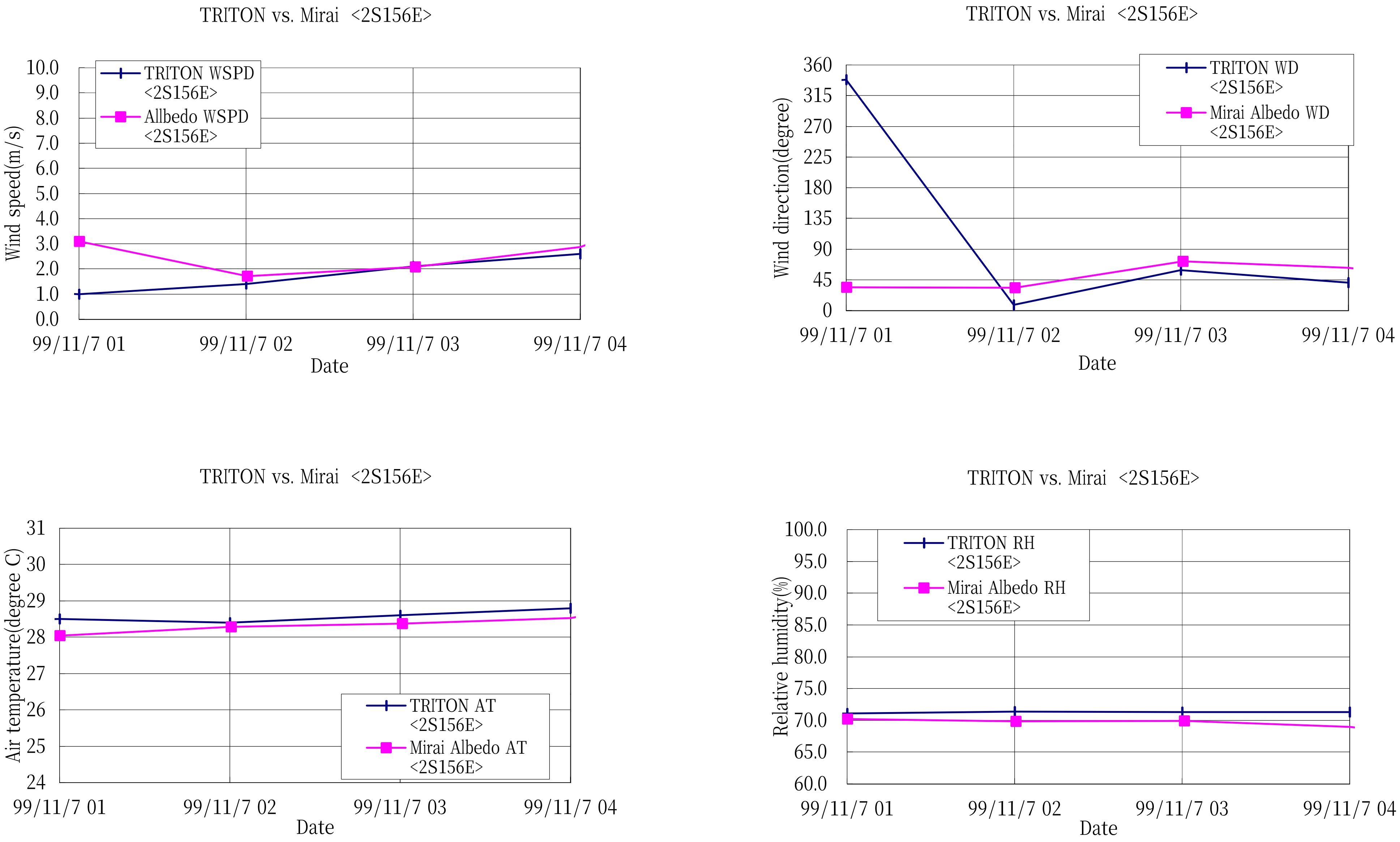


Fig.7.1.3-7a～7d　Time series of wind speed, wind direction,air temperature and relative humidity at TRITON T09(05001) and Mirai

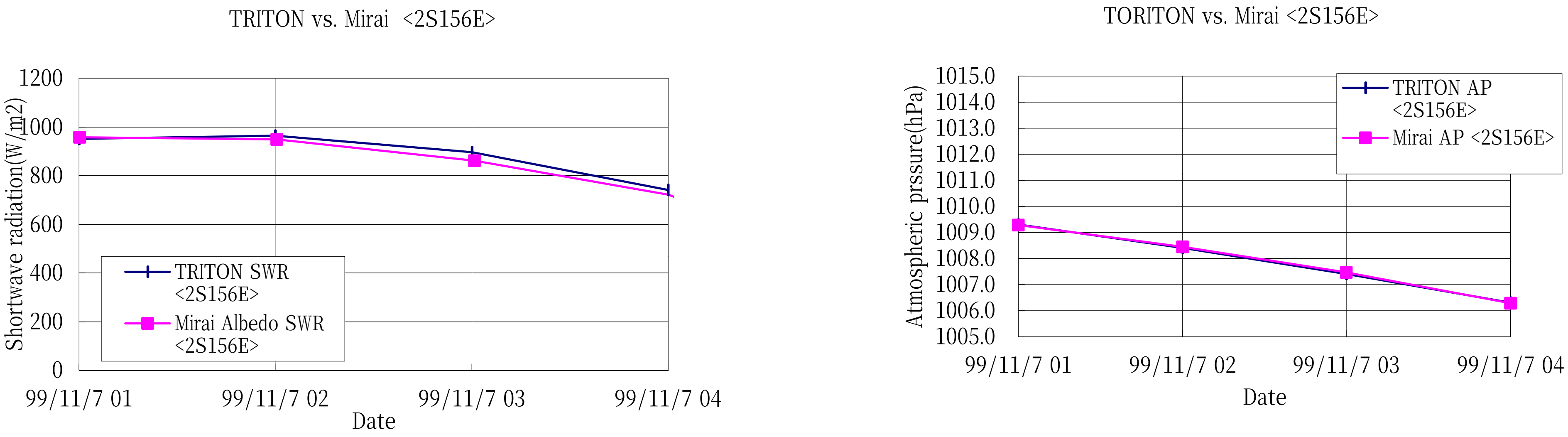


Fig.7.1.3-7e～7f Time series of solar radiation,atmospheric pressure at TRITON T09(05001) and Mirai

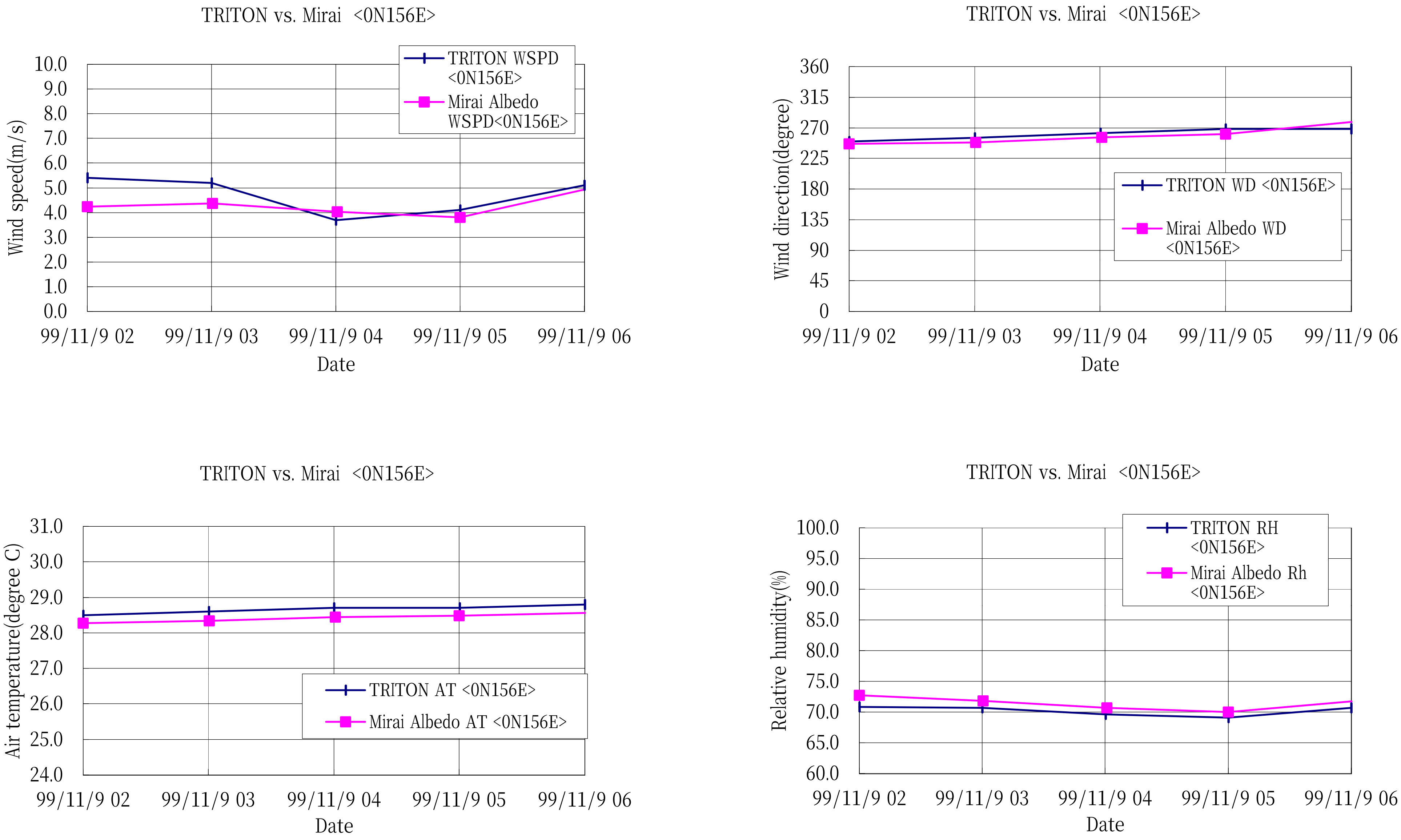


Fig.7.1.3-8a～8d　Time series of wind speed, wind direction,air temperature and relative humidity at TRITON T02(04003) and Mirai

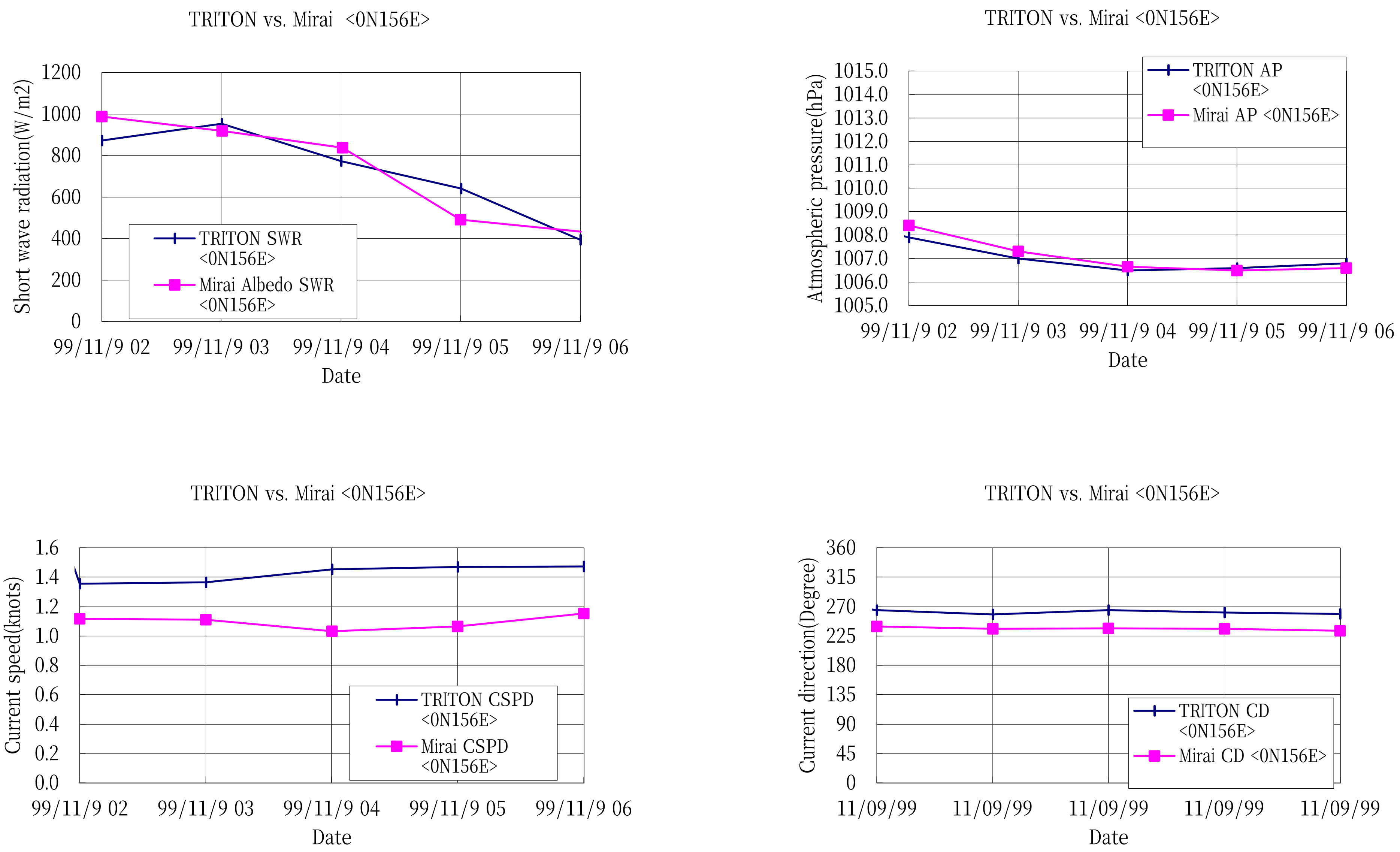


Fig.7.1.3-8e～8h　Time series of solar radiation,atmospheric pressure,current speed & direction at TRITON T03(04003) and Mirai

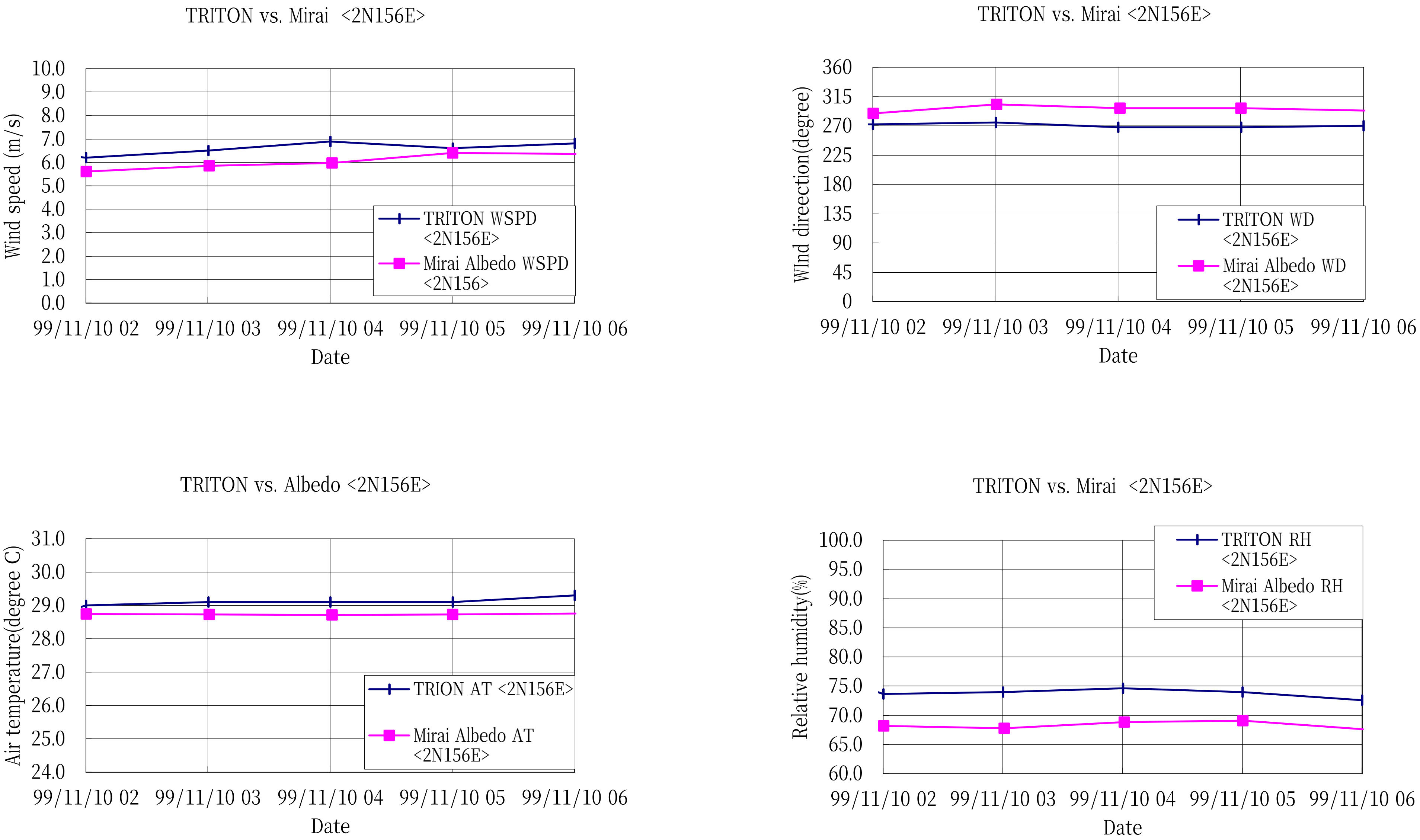


Fig.7.1.3-9a～9d Time series of wind speed, wind direction,air temperature and relative humidity at TRITON T01(03003) and Mirai

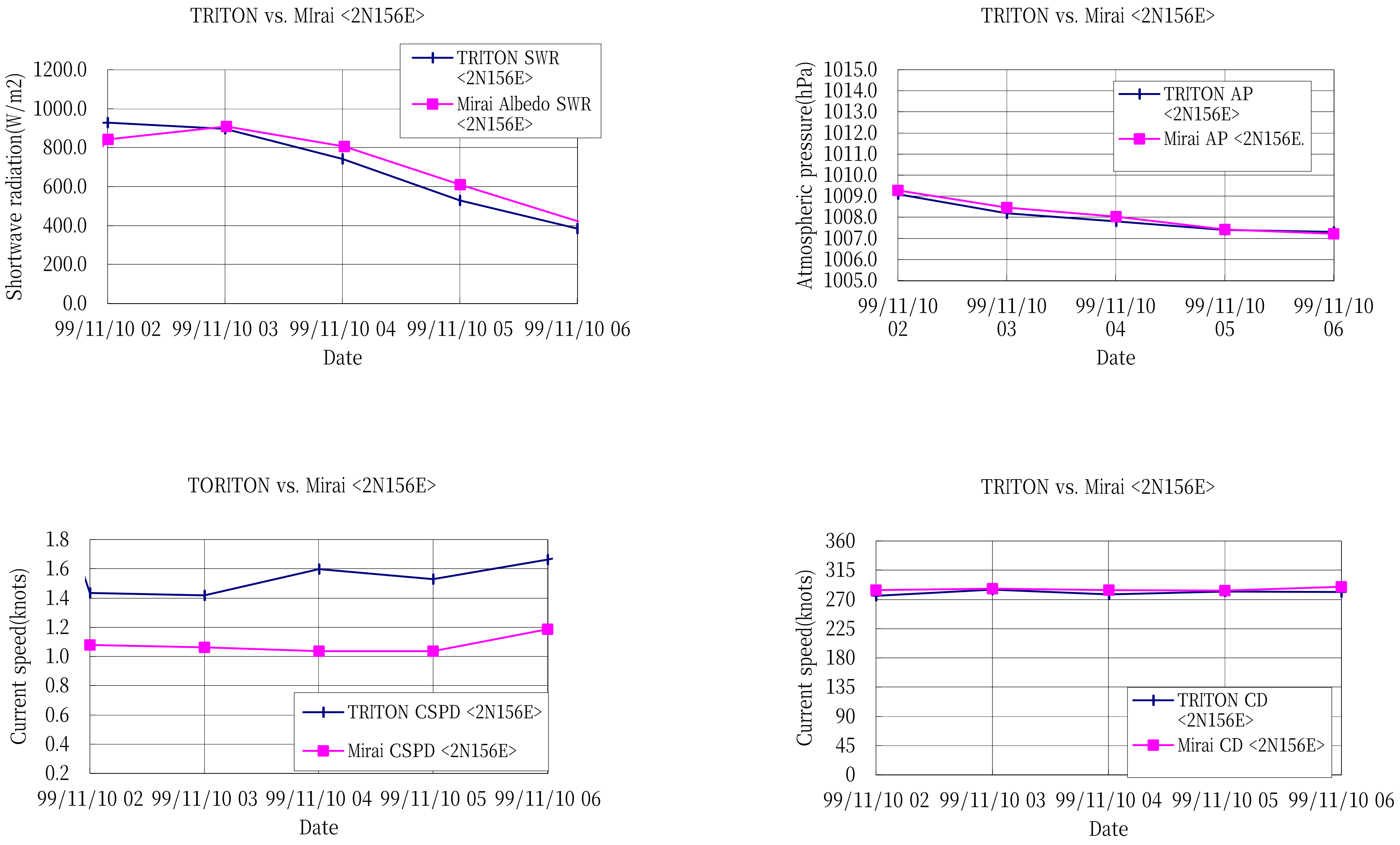


Fig.7.1.3-9e～9h Time series of solar radiation,atmospheric pressure,current speed & direction at TRITON T01(03003) and Mirai

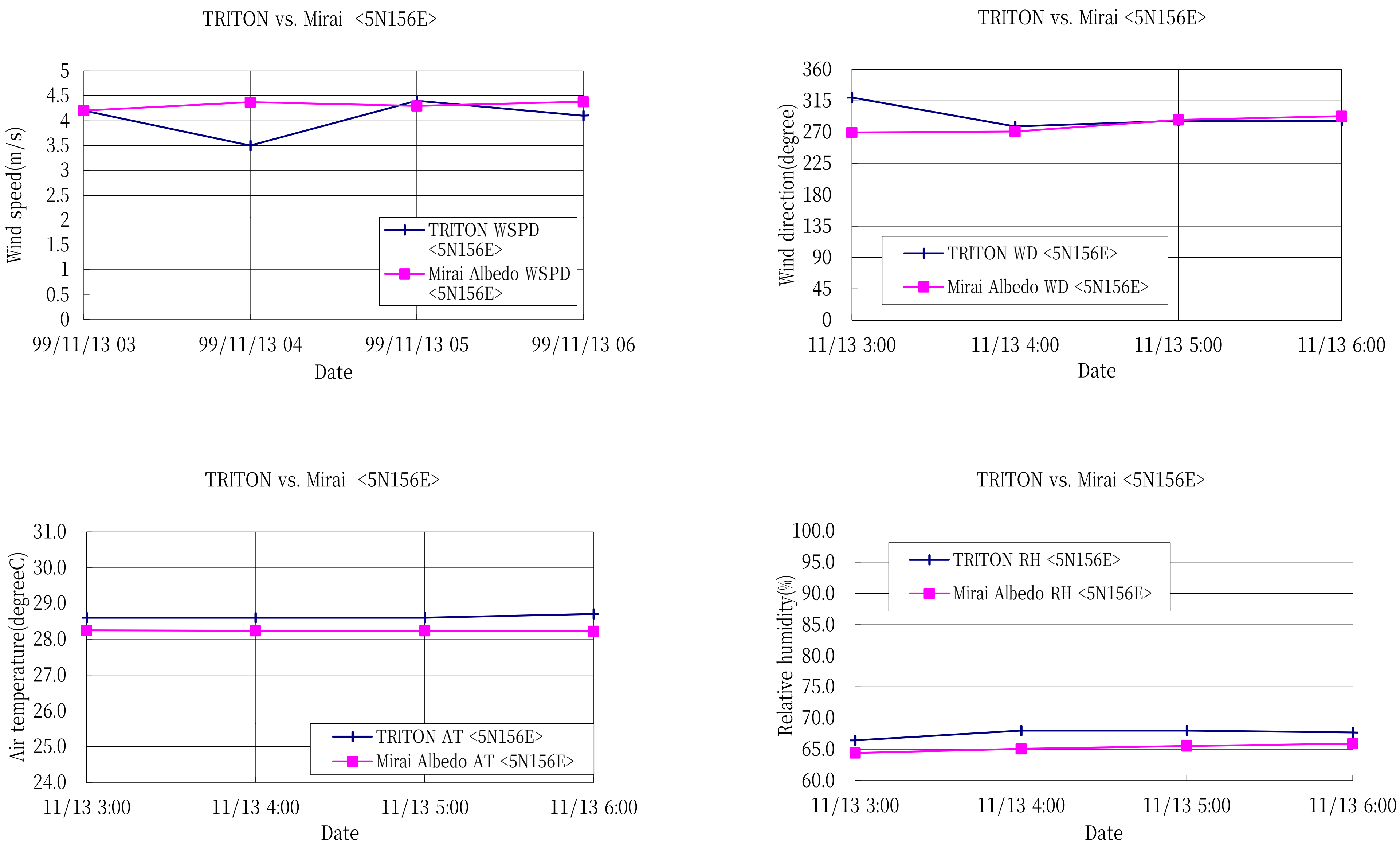


Fig.7.1.3-10a～10d　Time series of wind speed, wind direction,air temperature and relative humidity at TRITON T06(02002) and Mirai

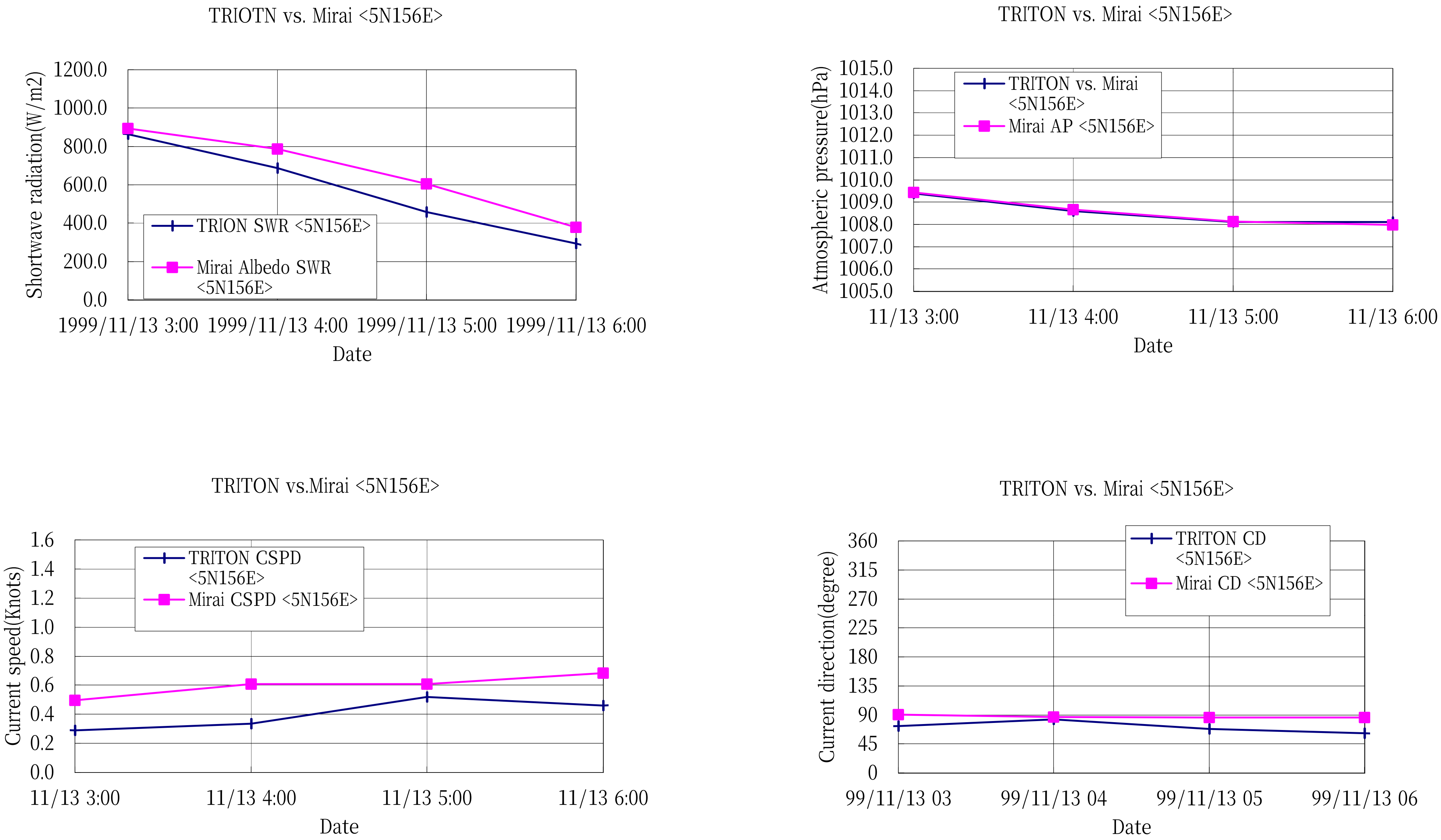


Fig.7.1.3-10e～10h　Time series of solar radiation,atmospheric pressure,current speed & direction at TRITON T06(02002) and Mirai

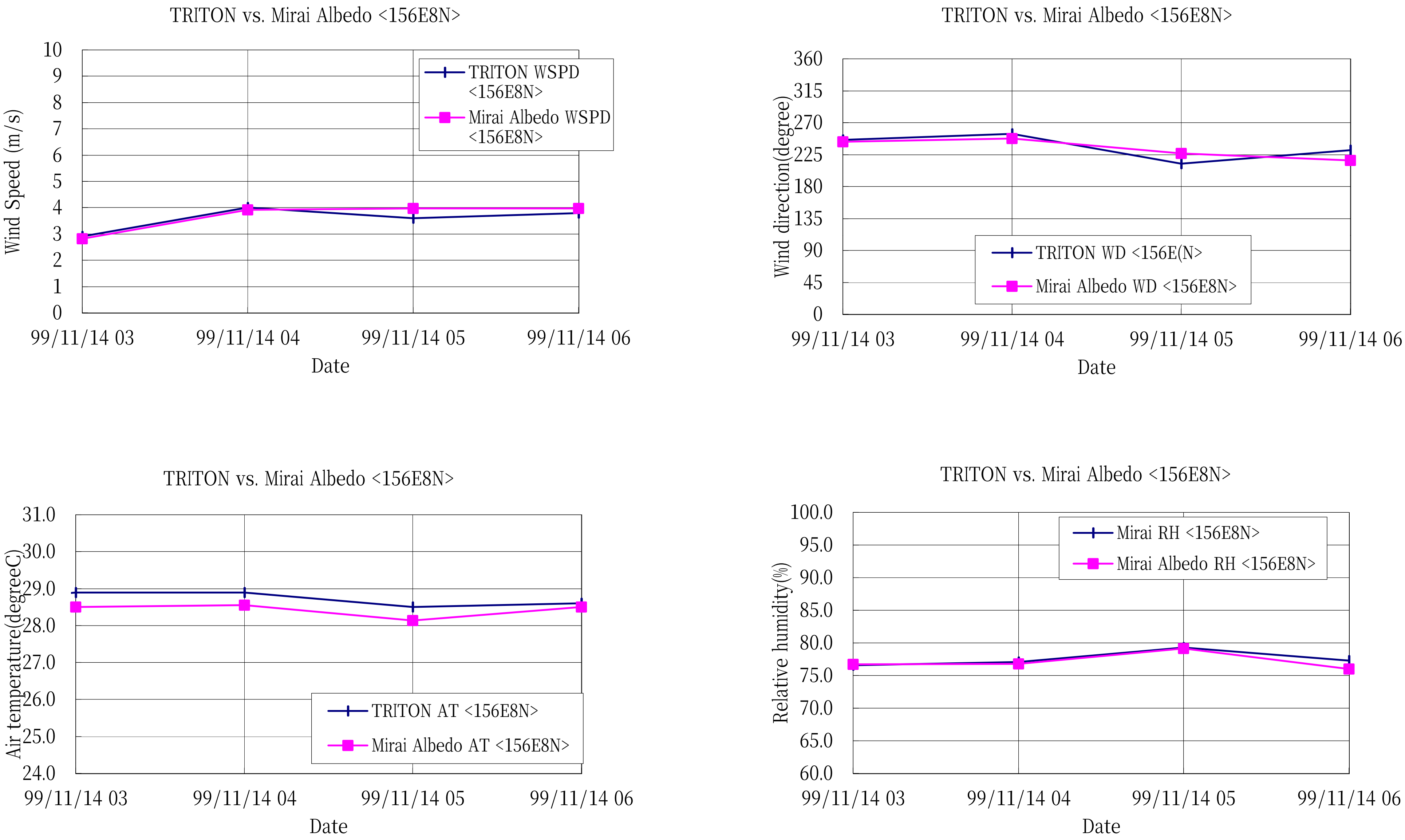


Fig.7.1.3-11a～11d　Time series of wind speed, wind direction,air temperature and relative humidity at TRITON T05(01002) and Mirai

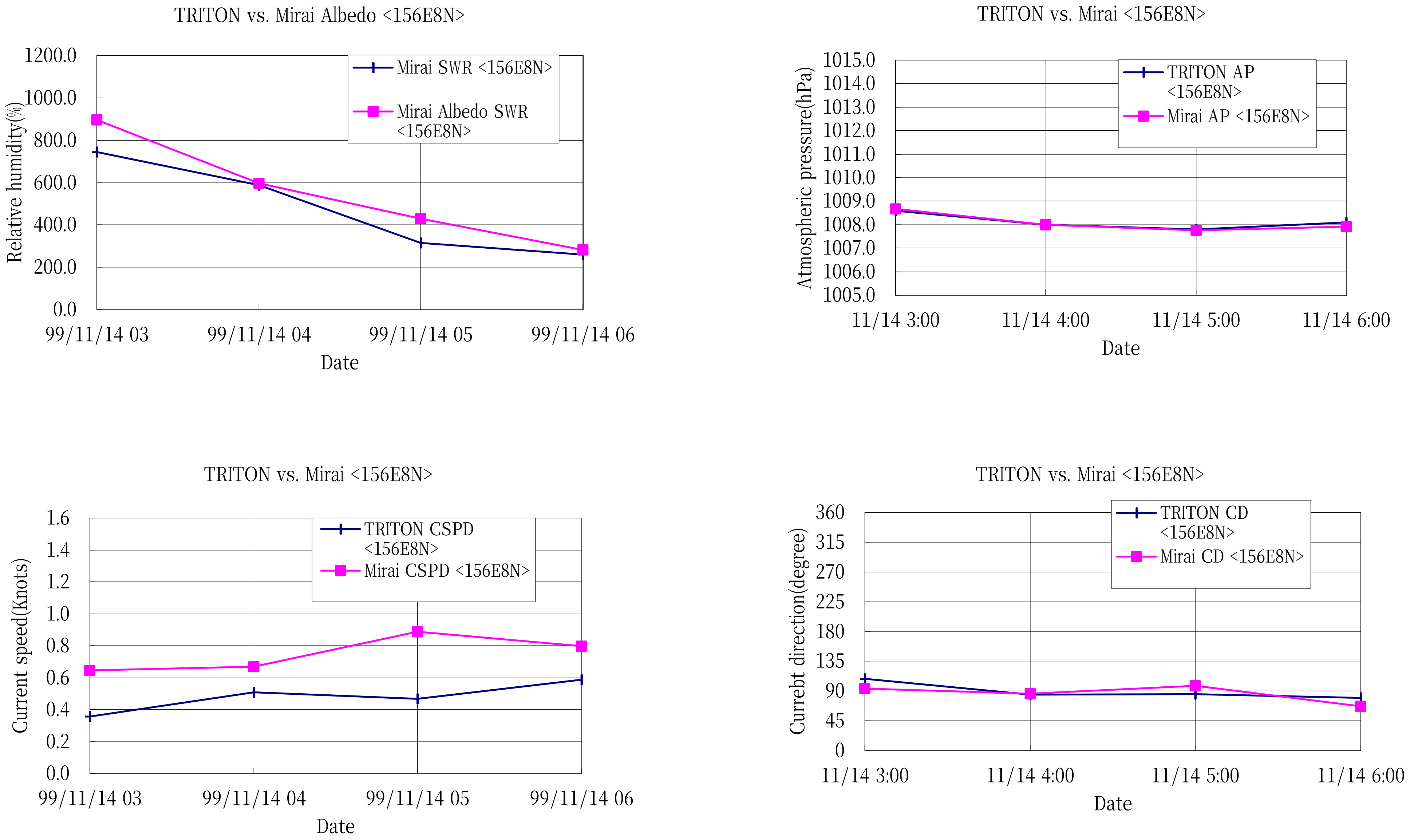


Fig.7.1.3-11e～11h　Time series of solar radiation,atmospheric pressure,current speed & direction at TRITON T05(01002) and Mirai

7.2 Doppler radar observation

(1) Personnel

Tetsuo Nakazawa (MRI)	: Principal Investigator
Masaki Hanyu (GODI)	: Operation Leader
Satoshi Okumura (GODI)	

(2) Objective

The Doppler radar is operated to obtain spatial and temporal distribution of rainfall amount, and structure of precipitating cloud systems.

In this cruise we made synchronized observations with the TRMM (Tropical Rainfall Measurement Mission) satellite. The TRMM satellite has several remote sensing rainfall measuring sensors, such as precipitation radar and visible infrared radiometer and microwave radiometer. The objective of the synchronized observation with TRMM satellite is to validate the satellite rainfall measurement by comparing with Doppler radar data obtained by R/V Mirai.

(4) Parameters

Spatial and temporal distribution of two parameters, radar reflectivity and Doppler velocity, are obtained for 100km radius and 7.5 minute intervals by 17-elevations volume scan.. The horizontal radar reflectivity fields are also obtained for 200 km radius and 7.5 minute intervals by one elevation (0.7 degrees) PPI (Plan Position Indicator) scan.

(4) Methods

The hardware specification of this shipborne Doppler radar (RC-52B, made by Mitsubishi Electric Co. Ltd., Japan) are;

Frequency:	5290MHz
Beam Width:	better than 1.5 degrees
Output Power:	250 kW (PEP)
Signal Processor:	RVP-6 (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 for once par a day, and (4) transmitting pulse width and (5) receiver linearity for twice, at the beginning and at the end of this cruise.

On the operation, on the other hand, the programmed “tasks” are repeated every 7.5 minutes. One cycle consists of one volume scan (consists of PPIs for 17 elevations) with Doppler-mode (100-km range for reflectivity, Doppler velocity), one-elevation PPI with Intensity-mode (200-km range for reflectivity). Occasionally we operated RHI (Range Height Indicator) scan with Doppler-mode.

The parameters for the above three tasks are shown in Table 7.2-1.

Table 7.2-1: Parameters for each tasks

	Intensity-mode PPI	Volumu Scan	RHI
Pulse Width	2 [us]	0.5 [us]	
Scan Speed	18 [deg./sec.]		automatically determined
PRF	260 [Hz]	900 / 720 [Hz]	
Sweep Integration	32 samples		
Ray Spacing	about 1.0 [deg.]		0.2 [deg.]
Bin Spacing	250 [m]	125 [m]	
Elevations	0.7	0.7, 1.4, 2.1, 3.0, 4.0, 5.0, 6.0, 7.1, 8.2, 9.5, 11.0, 12.5, 14.5, 17.0, 20.0, 24.0, 30.0	0.0 to 84.0
Azimuths	Full Circle		Optional
Filters	Speckle filter for Z	Speckle filter for Z Dual-PRF velocity unfolding	
Gain Control	Fixed		

(5) Preliminary Results

The synchronized observations with the TRMM satellite were performed in 16 cases during the cruise, summarized in Table 7.2-2. Out of 16 cases there were 7 cases with rain, 9 cases with no rain. Out of 7 rain cases there were 3 convective/stratiform rain cases, other 3 cases for scattered cumulus and 1 case for squall line/vortex type. The horizontal radar maps with the TRMM satellite orbits of these 7 rain cases were presented in from Fig. 7.2-1 to Fig. 7.2-7.

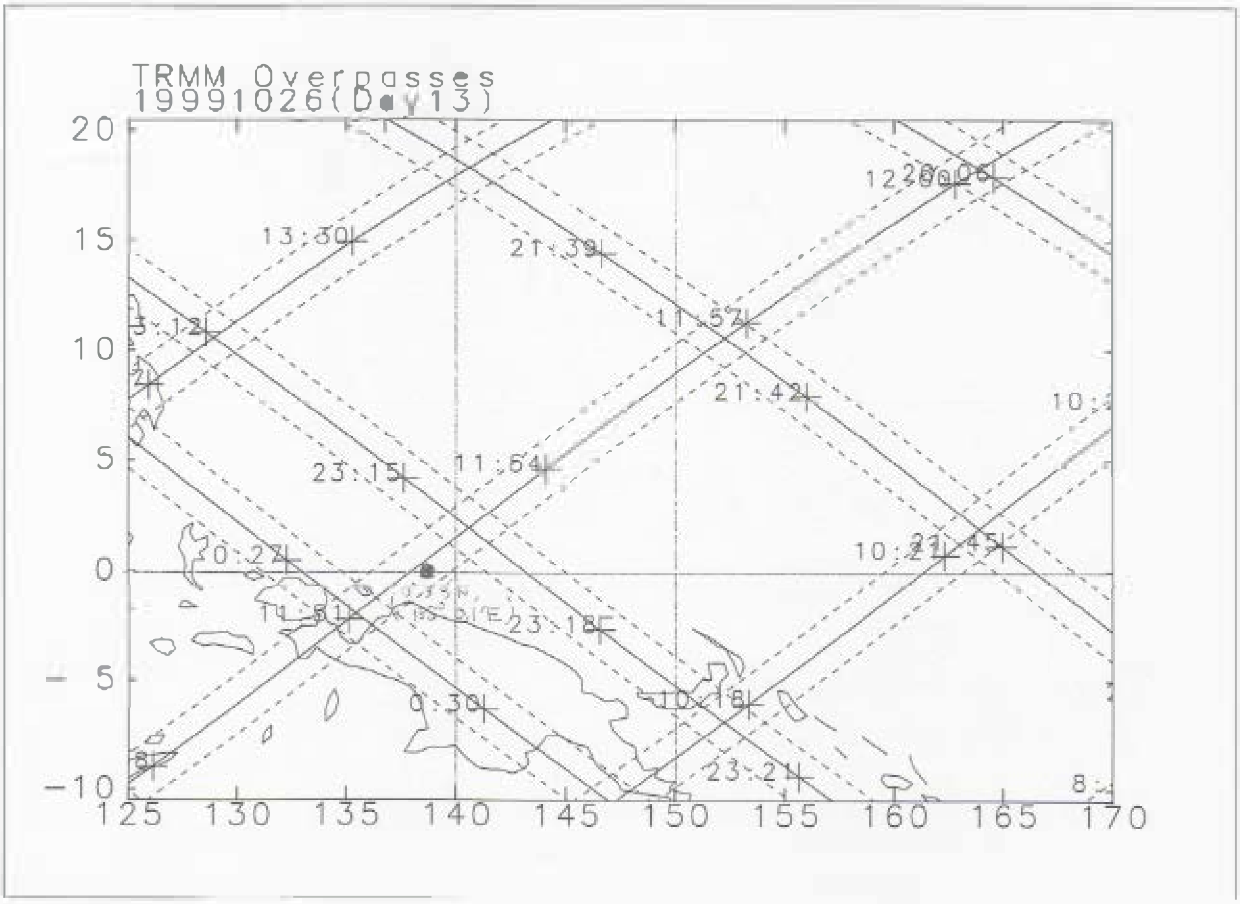
Table 7.2-2 Synchronized observation with the TRMM satellite

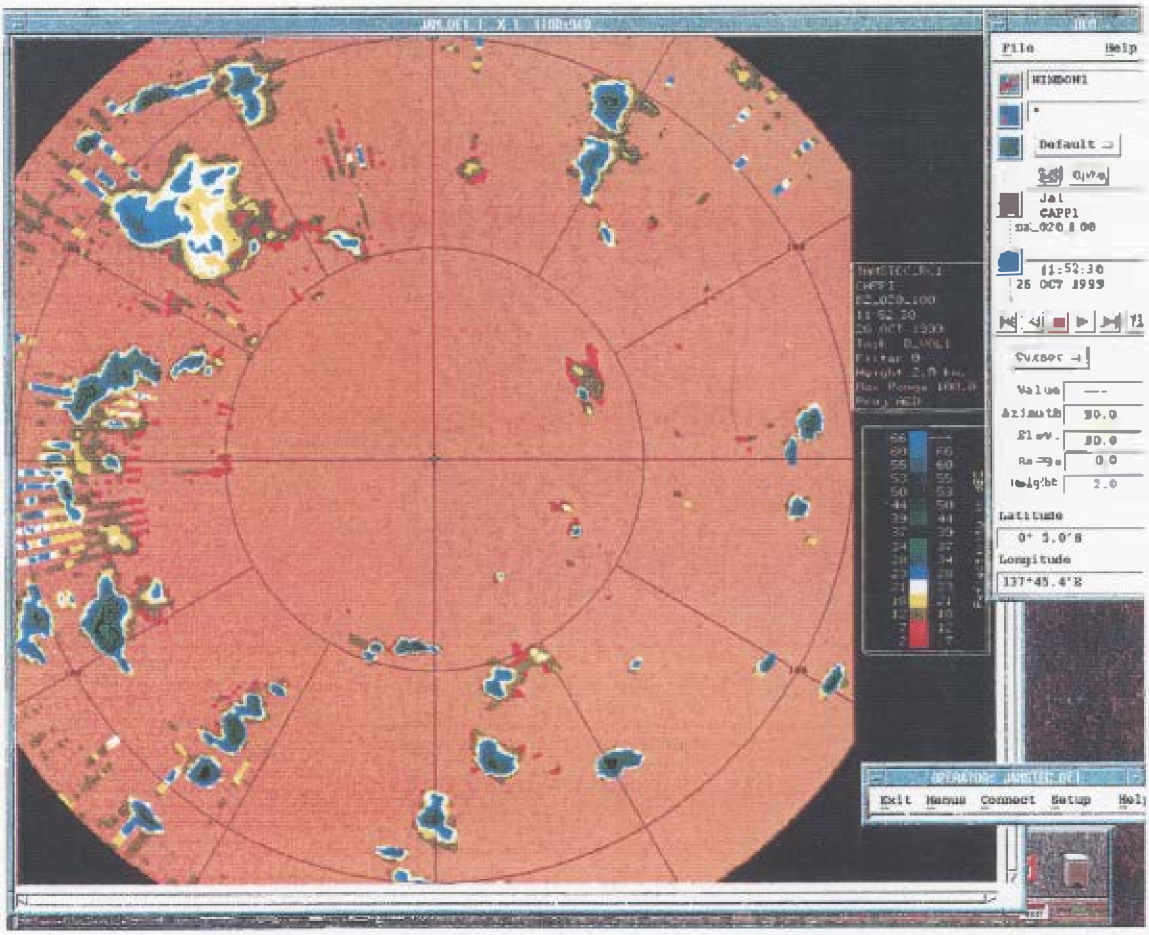
Observation time	Latitude	Longitude	Matching with TRMM	Cloud type
26 Oct. 11:52Z	0N	138E	PR	Scattered
26 Oct. 23:15Z	0N	138E	TMI	Convective/stratiform
29 Oct. 09:53Z	0N	147E	PR	No cloud
31 Oct. 09:05Z	2N	147E	TMI	Convective/stratiform
31 Oct. 20:27Z	2N	147E	PR	Stratiform
02 Nov. 08:17Z	5N	147E	PR	Scattered
03 Nov. 18:26Z	5N	148E	PR	No cloud
05 Nov. 17:40Z	4S	156E	PR	No cloud
08 Nov. 04:16Z	0N	156E	TMI	No cloud
08 Nov. 15:39Z	0N	156E	TMI	Mostly clear
10 Nov. 03:27Z	2N	156E	TMI	No cloud
10 Nov. 14:50Z	2N	156E	TMI	No cloud
13 Nov. 12:49Z	5N	156E	PR	Mostly clear
14 Nov. 01:51Z	8N	156E	PR	Scattered
16 Nov. 10:46Z	14.5N	150E	PR	No cloud
17 Nov. 01:27Z	15.5N	150E	PR	Squall line

PR: Precipitation Radar, TMI: TRMM Microwave Imager

(6) Data Archive

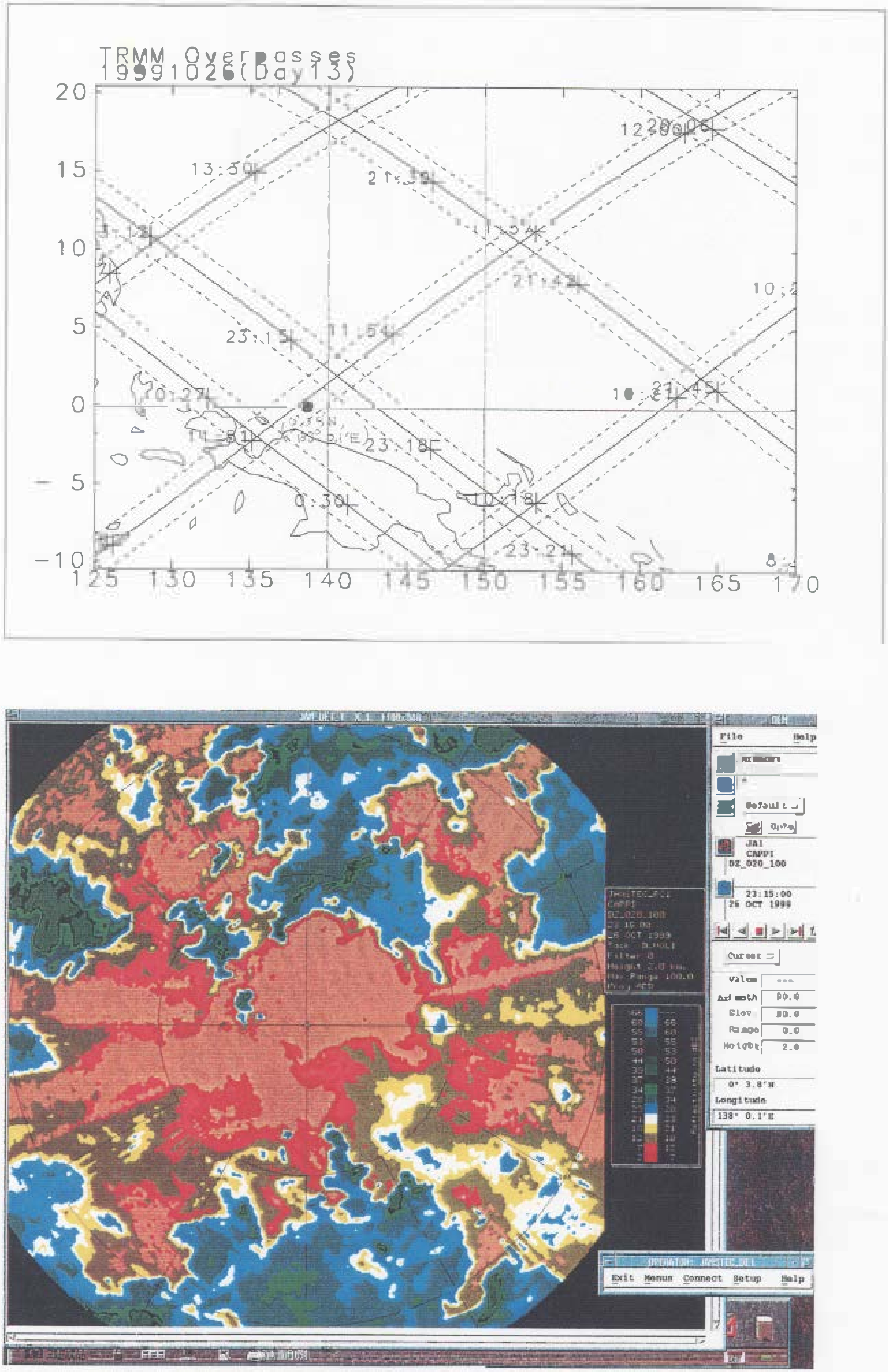
The inventory information of the Doppler radar data obtained in this cruise will be submitted to the DMO (Data Management Office) of JAMSTEC. The original data will be archived at Ocean Research Department of JAMSTEC.





Value ---
Azimuth 90.0
Elev. 90.0
Range 0.0
Height 2.0
Latitude 0° 3.0'S
Longitude 137°45.4'E

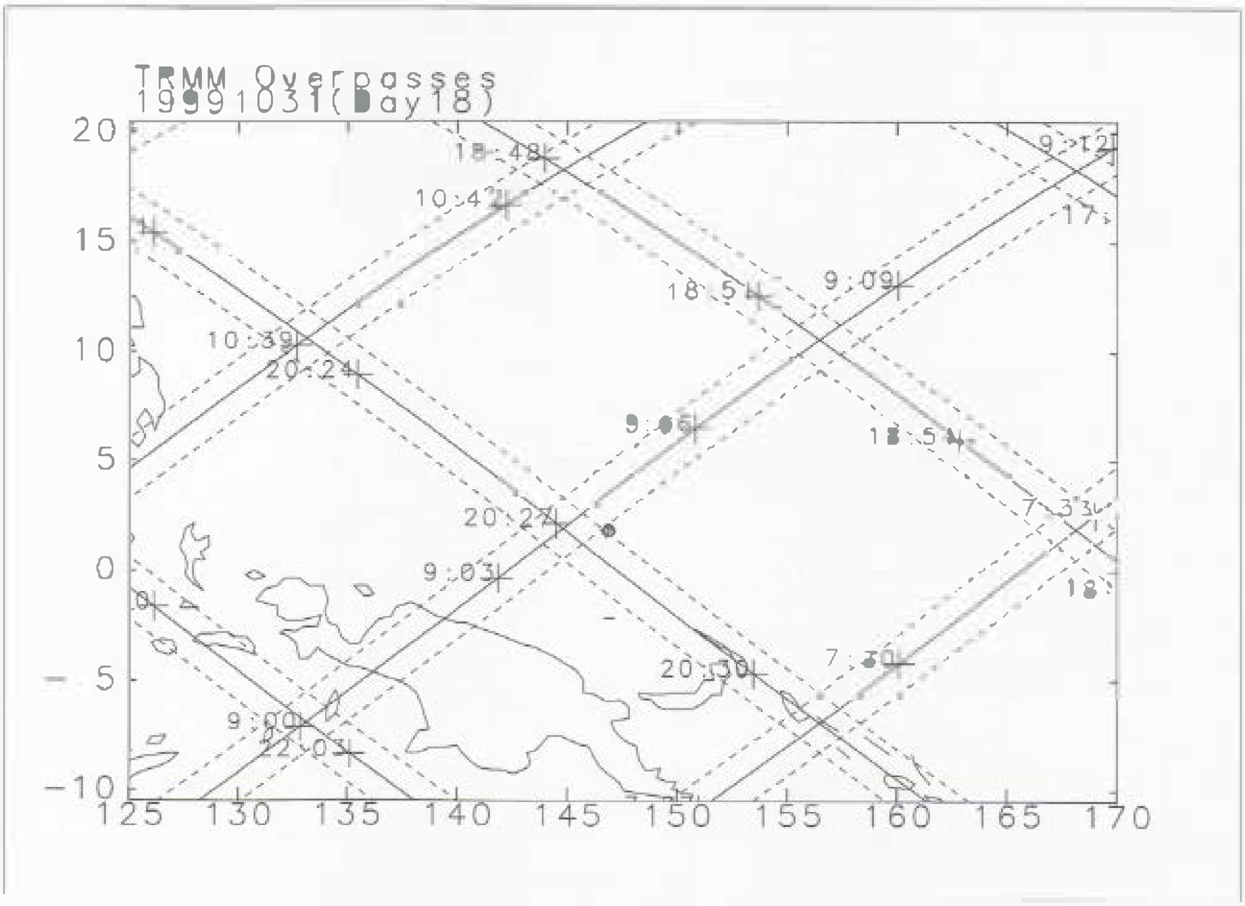
Fig.7.2-1

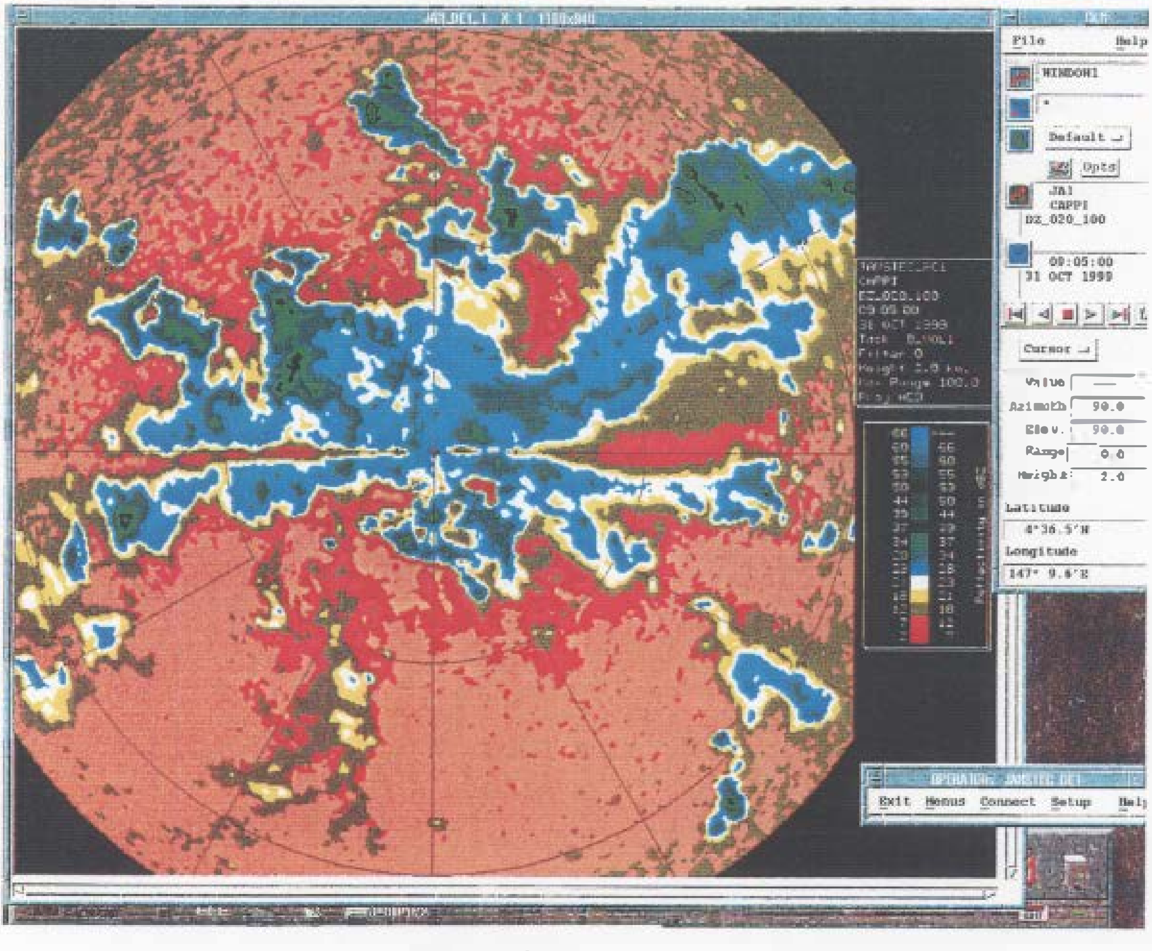


23:15:00
26 OCT 1999

Value ---
Azimuth 90.0
Elev 90.0
Range 0.0
Height 2.0
Latitude 0° 3.8'N
Longitude 138° 0.1'E

Fig.7.2-2





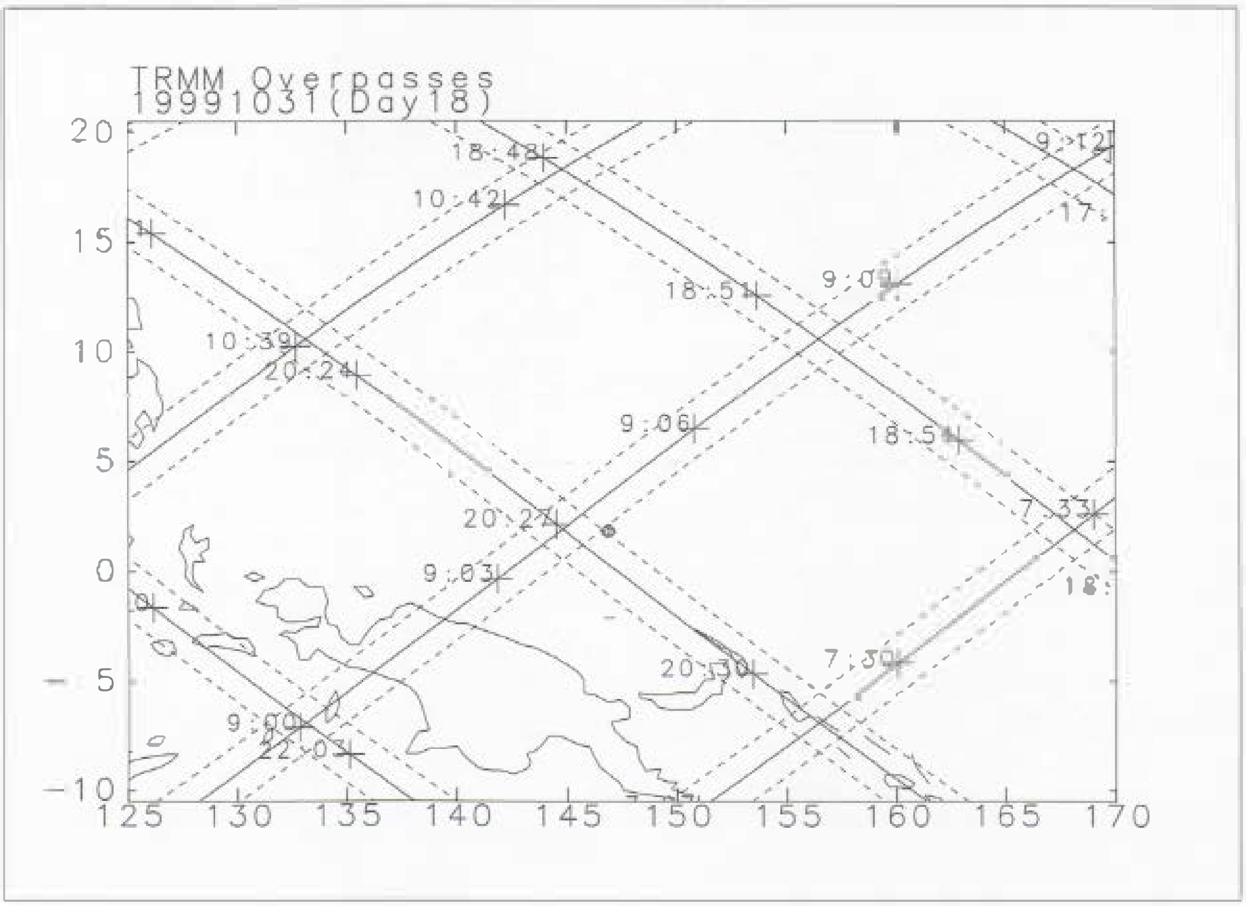
JA1
CAPPI
DZ_020_100

09:05:00
31 OCT 1999

Value —
Azimuth 90.0
Elev. 90.0
Range 0.0
Height 2.0

Latitude
4°36.5'N
Longitude
147° 9.6'E

Fig.7.2-3


TRMM Overpasses
19991031(Day18)
20
15
10
5
0
−5
−10
125
130
135
140
145
150
155
160
165
170
18:48
10:42
18:51
9:09
10:39
20:24
9:06
18:54
20:27
9:03
7:33
20:30
7:30
9:00
22:03
9:12
17:
18:

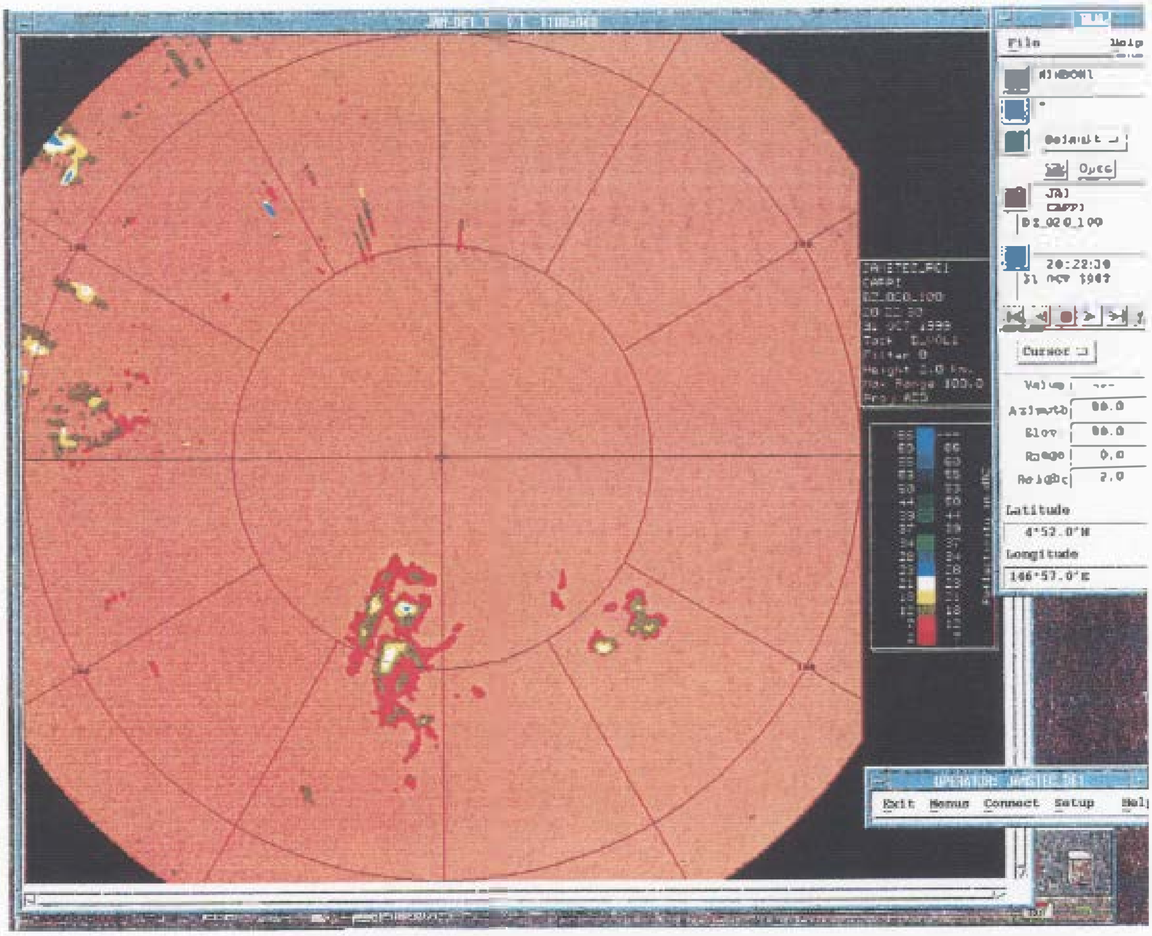
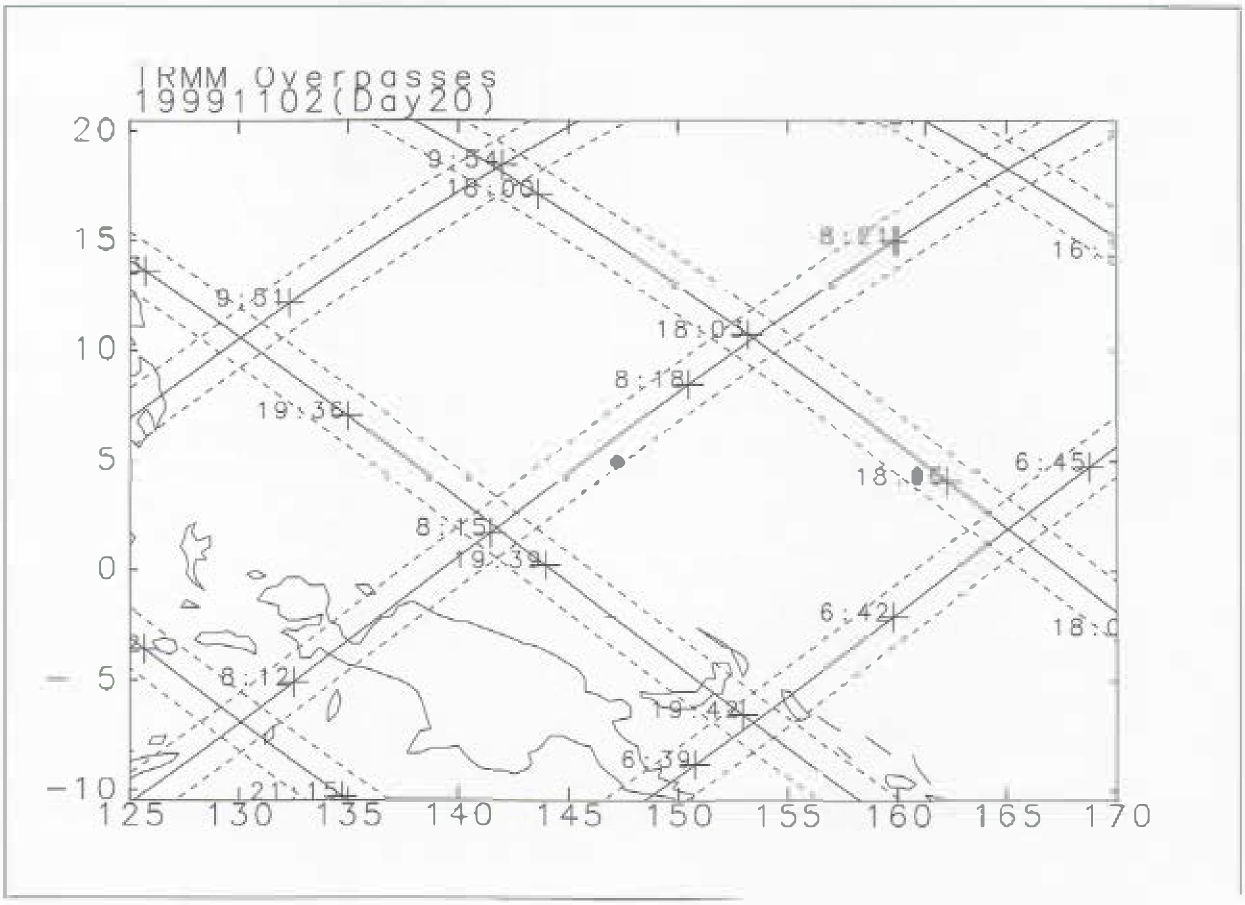
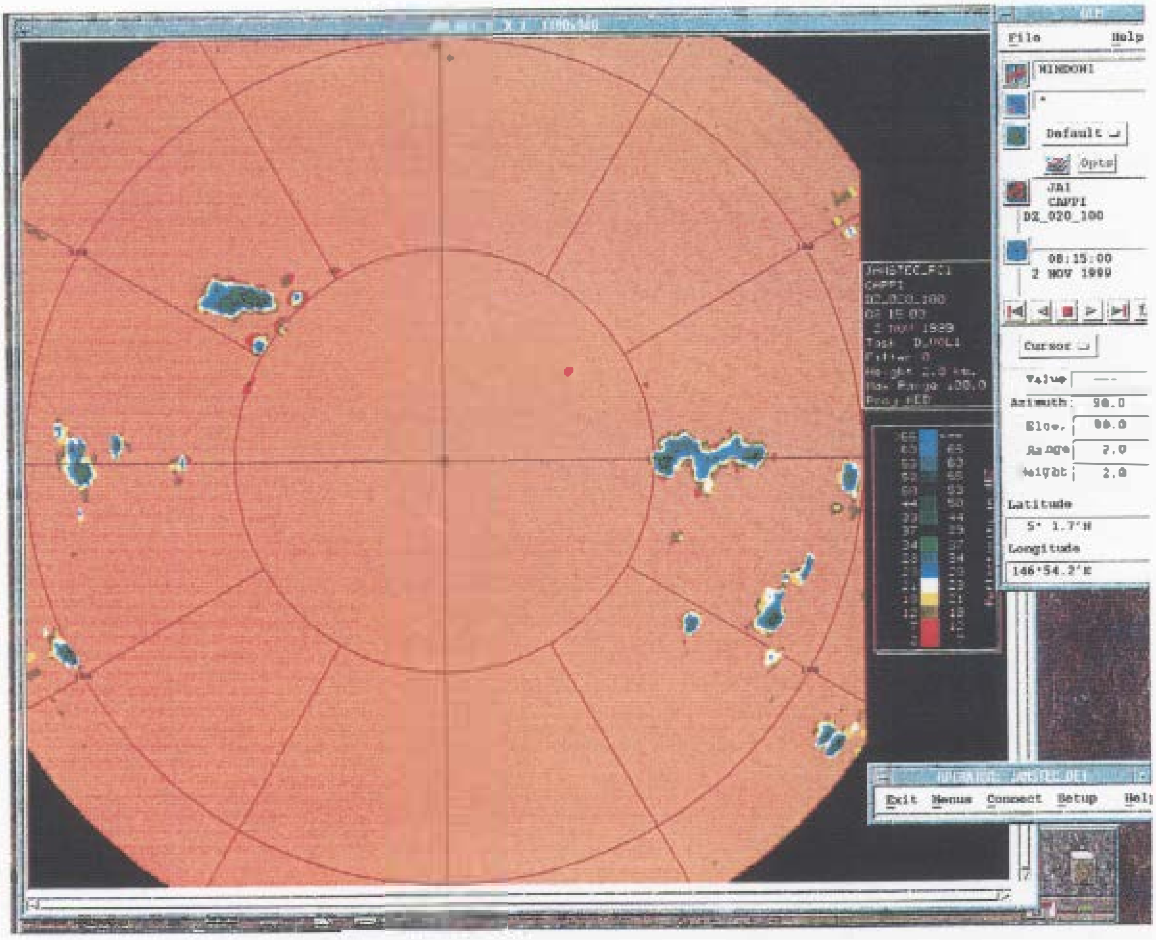

File
Help
Opec
CAPPI
02_020_100
20:22:30
31 OCT 1999
Filter 0
Height 2.0 km.
Max Range 100.0
Cursor
Value
Azimuth
00.0
Elev
00.0
Range
0.0
Height
2.0
Latitude
4°52.0'N
Longitude
146°57.0'E
Exit
Menus
Connect
Setup

Fig.7.2-4



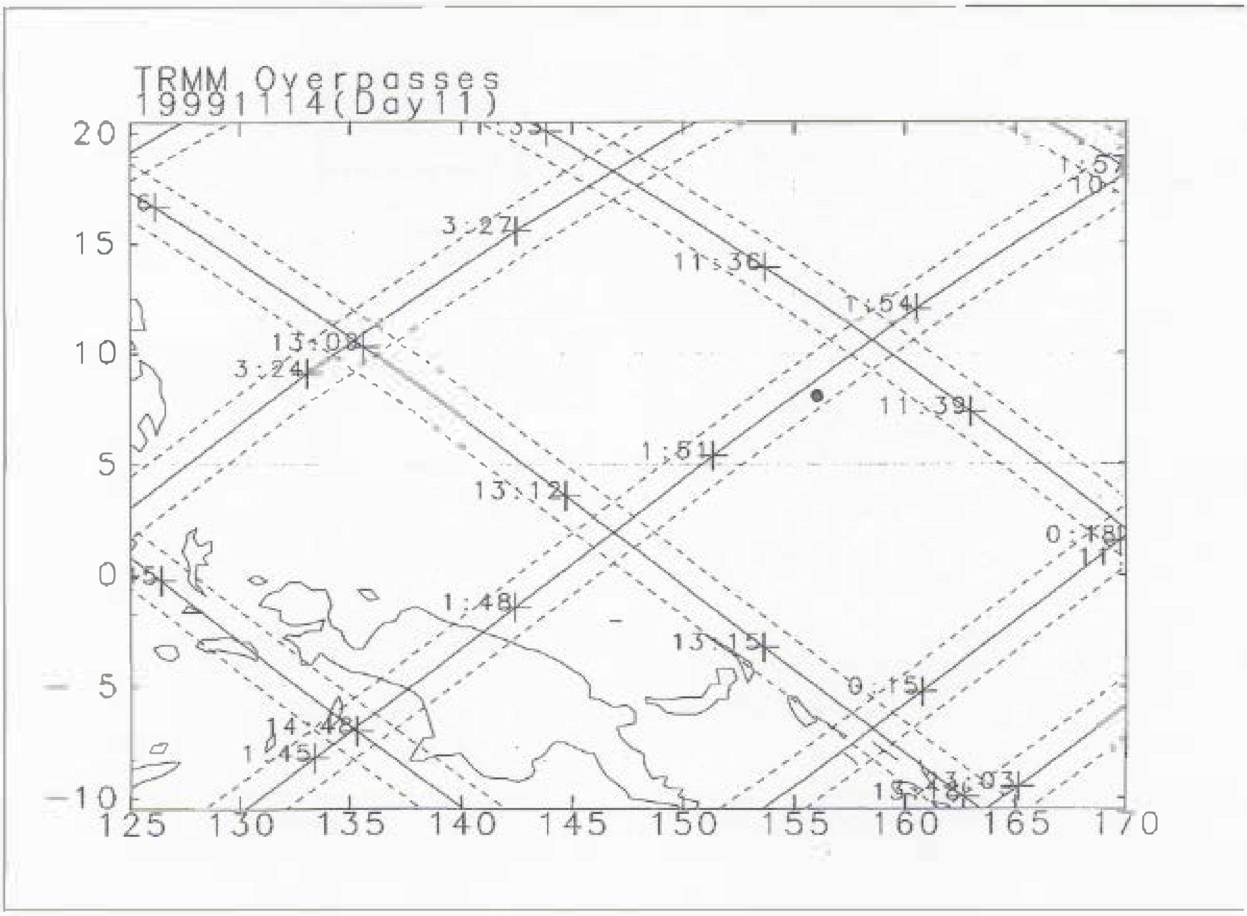


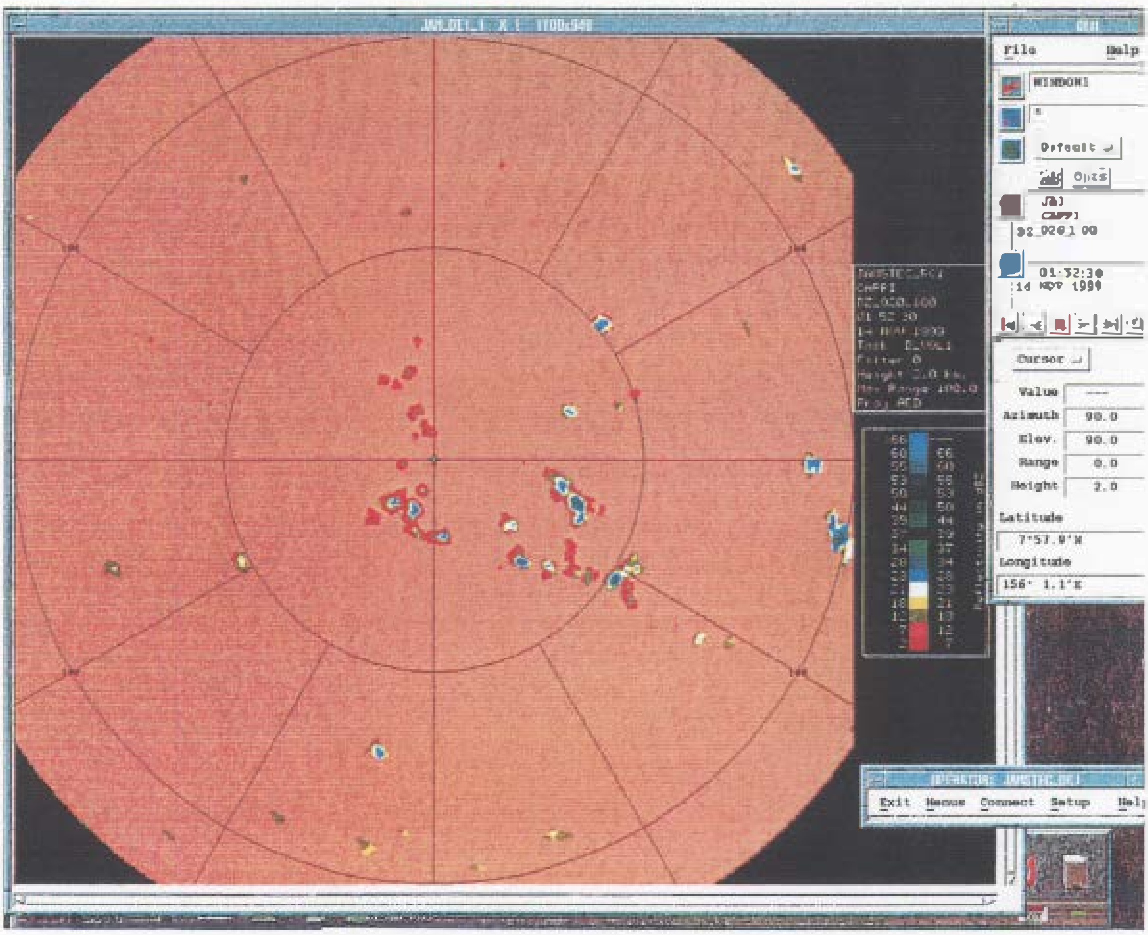
JA1
CAPPI
DZ_020_100

08:15:00
2 NOV 1999

Value ---
Azimuth: 90.0
Elev. 90.0
Range 2.0
Height 2.0
Latitude
5° 1.7'N
Longitude
146°54.2'E

Fig.7.2-5





Value ----

Azimuth 90.0

Elev. 90.0

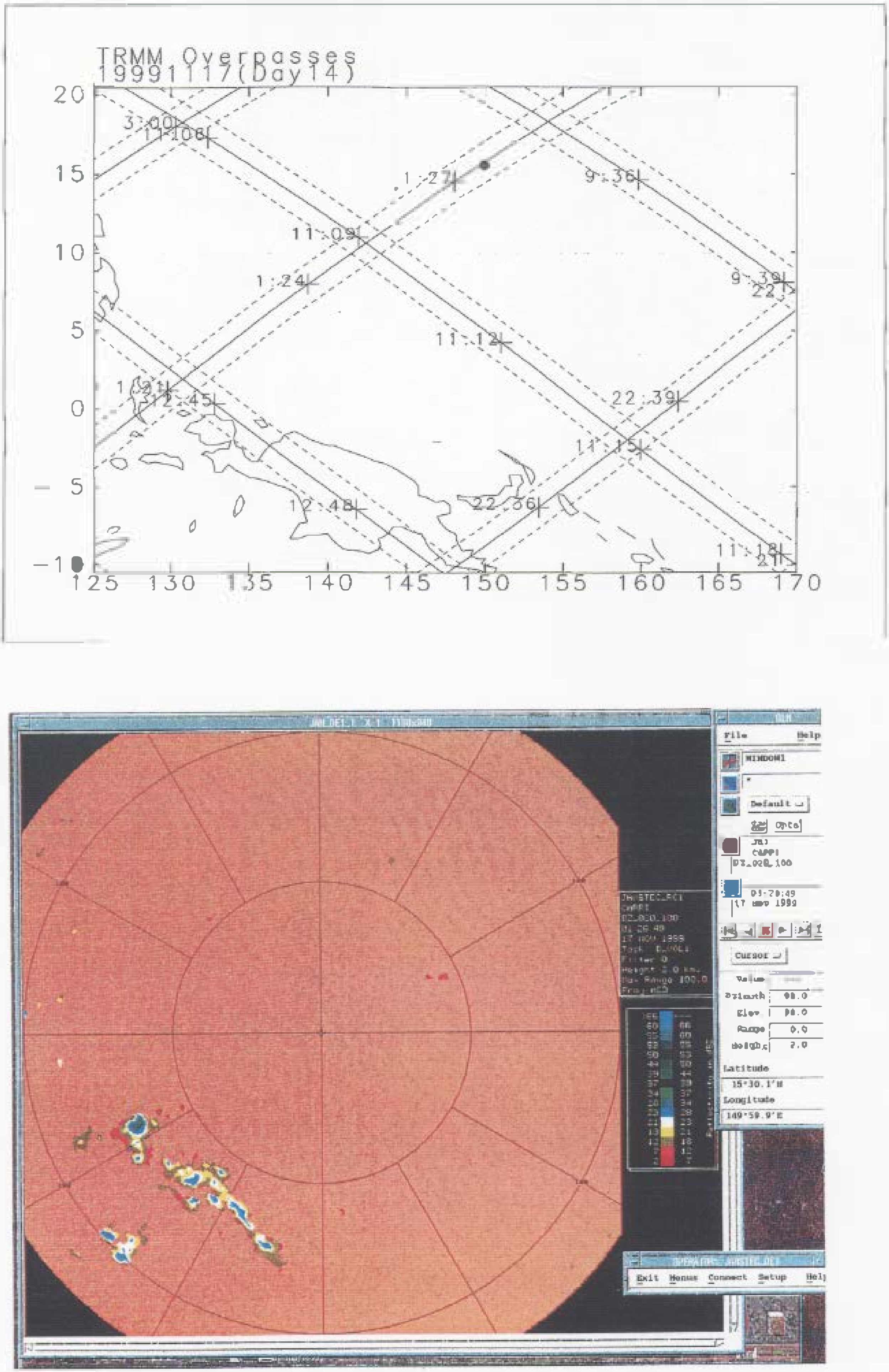
Range 0.0

Height 2.0

Latitude 7°57.9'N

Longitude 156° 1.1'E

Fig.7.2-6



Latitude
15°30.1'N
Longitude
149°58.9'E

Fig.7.2-7

7.3. Atmospheric and oceanic CO_2 measurements

(1) Personnel

Masao Ishii*, Hisayuki Y. Inoue, and Shu Saito
Geochemical Research Department, Meteorological Research Institute

* on board personnel

(2) Objectives

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

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

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

(3) Parameters

(a) CO_2 concentration (xCO_2) in marine boundary air and in the air equilibrated with surface seawater.

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

(c) Total inorganic carbon (TCO_2) in the water column above the depth of 1000 m.

(d) pH (total hydrogen ion scale) in the water column above the depth of 1000 m.

(4) Methods

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

We made measurements of the CO_2 concentration (mole fraction of CO_2 in air; xCO_2) in marine boundary air twice every 1.5 hour and that in the air equilibrated with the great excess of surface seawater four times every 1.5 hour during the whole cruise using the automated CO_2 measuring system (Nippon ANS Co.). Marine boundary air was taken continuously from the foremast. Seawater was taken continuously from the seachest located ca.5 m below the sea level and introduced into the MRI-shower-type equilibrator. Non-dispersive infrared (NDIR) gas analyzer (BINOS 4) was used as a detector. It was calibrated with four CO_2 reference gases (306ppm, 356ppm, 405ppm, 456ppm in air, Nippon Sanso Co.) once every 1.5 hour. Concentration of CO_2 will be published on the basis of the WMO X85 mole fraction scale after the cruise. Corrections for the temperature-rise from the seachest to the equilibrator and the drift of CO_2 concentration in reference gases are also to be made. Partial pressure of CO_2 will be calculated from xCO_2 by taking the water vapor pressure and the atmospheric pressure into account.

(b) Underway measurement of total inorganic carbon (TCO_2) in surface seawater:

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

(c)(d) Measurement of TCO_2 and pH (total hydrogen ion scale) in the water column:

Discrete samples for TCO_2 and pH analyses were taken from Niskin bottles on CTD/carousel sampler at the total of 14 hydrographic stations:

stn.1 (8N,137E), stn.3 (6N, 137E), stn.5 (4N, 137-20E), stn.7 (2N, 138E), stn.9 (0, 138E),
stn.10 (0, 147E), stn.11 (2N, 147E), stn.12 (5N, 147E), stn.13 (5S, 156E), stn.14 (2S, 156E),
stn.15 (0,156E), stn.16 (2N, 156E), stn.17 (5N,156E), stn.18(8N, 156E).

Nominal depths of the sampling were 10m, 25m, 50m, 75m, 100m, 125m, 150m, 200m, 300m, 400m, 500m, 1000m.

Samples for TCO_2 analysis were collected in 250cm^3 borosilicate glass bottles (Sibata) with ground-glass stopcock lubricated with Apiezon L grease, and were poisoned with 0.2 cm^3 of saturated $HgCl_2$ solution. Duplicate samples were routinely taken from the depths of 1000m and 10m or 25m. TCO_2 was determined by coulometry at 20 deg-C using a automated TCO_2 sampling system (MRI-Nippon ANS) equipped with carbon coulometer 5012 (UIC Co.). It was standardized using a suite of Na_2CO_3 solution and the reference seawater prepared in MRI that is traceable to the CRM provided by Dr. A. Dickson in Scripps Institution of Oceanography. The analysis of the reference seawater was made twice during the each run of the coulometric cathode- and anode-solutions. All samples were analyzed within 8 h after the CTD/carousel arrived on deck. A correction for the addition of $HgCl_2$ solution is to be made.

Samples for pH analysis were collected in 500cm^3 borosilicate glass bottles (Sibata) with ground-glass stopcock lubricated with Apiezon L grease, and were poisoned with 0.4 cm^3 of saturated $HgCl_2$ solution. Duplicate samples were routinely taken from the depths of 500m and 25m or 50m. pH was measured by spectrophotometry at 25.0 deg-C after adding a dye m-cresol purple using a MRI-Nippon ANS automated system equipped with spectrophotometer Cary 50 (Varian, Co). The analysis of the reference seawater was made once at the end of each run of the system. All samples were analyzed within 8 h after the CTD/carousel arrived on deck. Corrections for the addition of $HgCl_2$ solution and m-cresol purple solution are to be made.

(5) Results

Data analyses will be made soon.

(6) Data archive

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

7.4. Lidar observation

(1)Personnel name and affiliation (* indicates on board personnel)

Ichiro Matsui (NIES)*
Nobuo Sugimoto (NIES)
Isao Tamamushi (TIT)
Kazuhiro Asai (TIT)

(2)Objectives

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

(3)Parameters

Aerosols:	Density distribution, Backscatter coefficient, Depolarization, Optical depth.
Clouds:	Height of cloud bottom, Backscatter coefficient, Depolarization, Optical depth.

(4)Method

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

Laser: Big Sky Laser CFR-200
  Output power: 532nm 50mJ/Pulse, 1064nm 100mJ/pulse
  Repetiton rate: 10Hz Beam div.: 0.5mrad
Receiver: Schmidt cassegrainian
  Diameter: 280mm Field of view: 1mrad
Detector: PMT(532nm) , APD(1064nm)
Data collection: LeCroy LC574AL
  Measurement range: 0-24km Range resolution: 6m
  Sampling rate: 10sec

(5)Results

Figure 1 shows a temporal variation of vertical profile. The range-corrected lidar signal at 532 nm is indicated with a gray scale. Diurnal variation of boundary layer is not significant as seen in Fig.1. Low clouds are frequently observed at the top of the planetary boundary layer. Cirrus clouds are also frequently observed in an altitude range of 10 to 15 km.

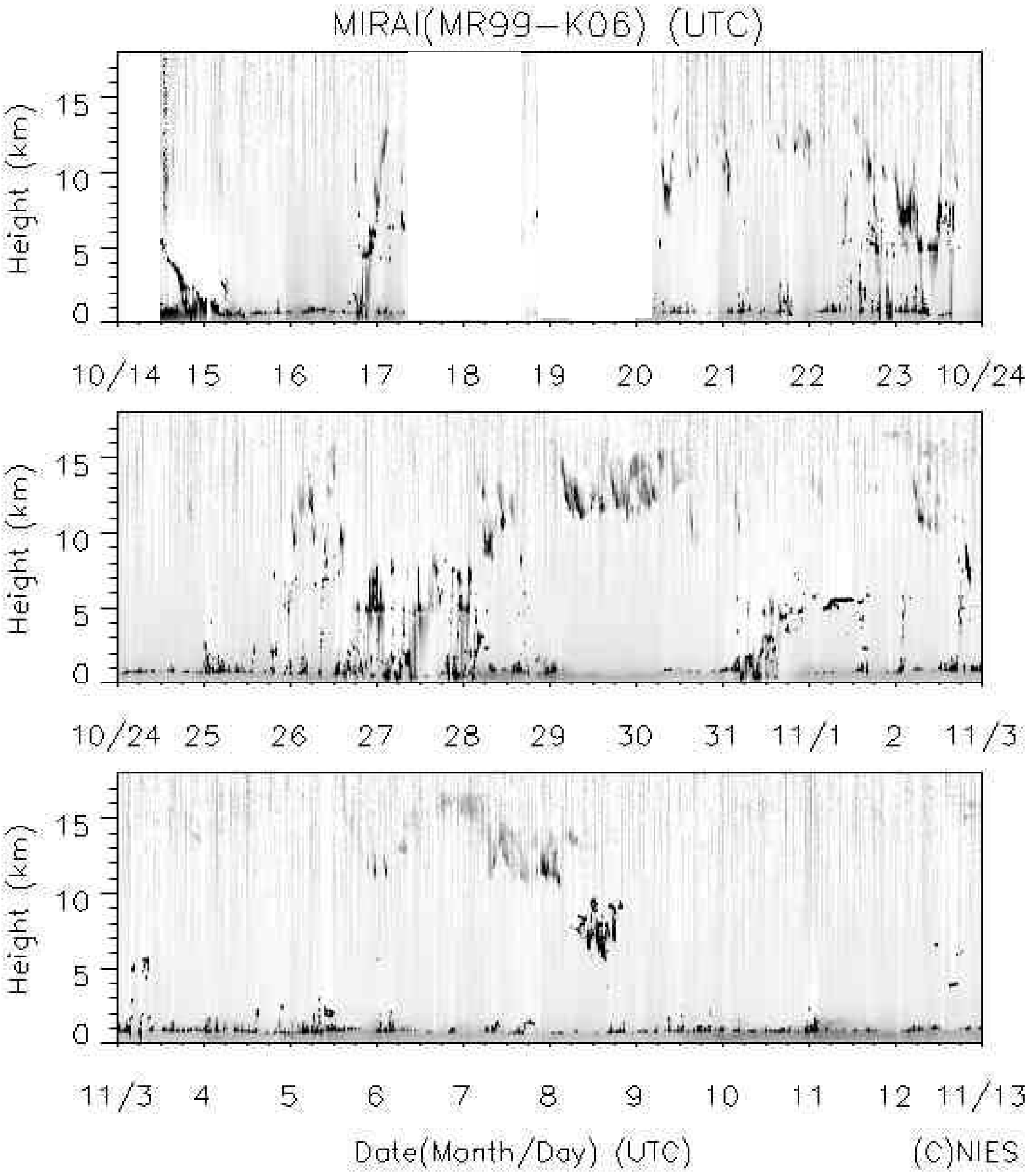


Fig.1 Temporal variation of range-corrected lidar signal at 532 nm.

(6) Data archive

All data will be archived at NIES and TIT.

7.5 ADCP subsurface mooring

(1) Personnel

Masayuki Fujisaki	(MWJ): Operation Leader
Nobuharu Komai	(MWJ): Technical Staff
Hirokatsu Uno	(MWJ): Technical Staff
Satoshi Ozawa	(MWJ): Technical Staff
Takeo Matsumoto	(MWJ): Technical Staff
Fujio Kobayashi	(MWJ): Technical Staff
Aya Kato	(MWJ): Technical Staff
Keisuke Wataki	(MWJ): Technical Staff
Tadahiko Shirato	(MWJ): Technical Staff
Haruya Adachi	(MWJ): Technical Staff
Kentaro Shiraishi	(MWJ): Technical Staff
Kentaro Ando	(JAMSTEC): Principal investigator
Yoshifumi Kuroda	(JAMSTEC): not onboard
Yuji Kashino	(JAMSTEC): not onboard

(2) Objectives

The purpose is to get the knowledge of upper ocean circulation in the western equatorial pacific. In this cruise (MR99-K06), we recovered and deployed one ADCP subsurface moorings at Eq.-156E.

(3) Parameters

- Current profiles
- Echo intensity
- Temperature and Conductivity

(4) Instruments

1) ADCP

RDI BB-ADCP

Distance to first bin: 8m
Pings per ensemble: 16 (Recovered ADCP), 12 (Deployed ADCP)
Time per ping: 2.00s
Bin length: 8.00m
Sampling Interval: 3600s

Recovered ADCP

- Serial Number : 1150 (Mooring No. 980825-00156E)

Deployed ADCP

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

2) CTD

SBE-16

Sampling Interval: 1800s

Recovered CTD

- Serial Number : 1284 (Mooring No. 980825-00156E)

Deployed CTD

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

(5) Deployment

One ADCP subsurface mooring was deployed at Eq.-156E. The mooring was designed to moor the ADCP at about 270m. After we dropped the anchor, we monitored depth of the acoustic releaser. The descending rate was about 2.1m/sec. Each position of the mooring was showed below.

Results of calibration

- Mooring No.991108-00156E

  Latte: 0° 00.04N   Long: 156° 07.58E

(6) Recovery

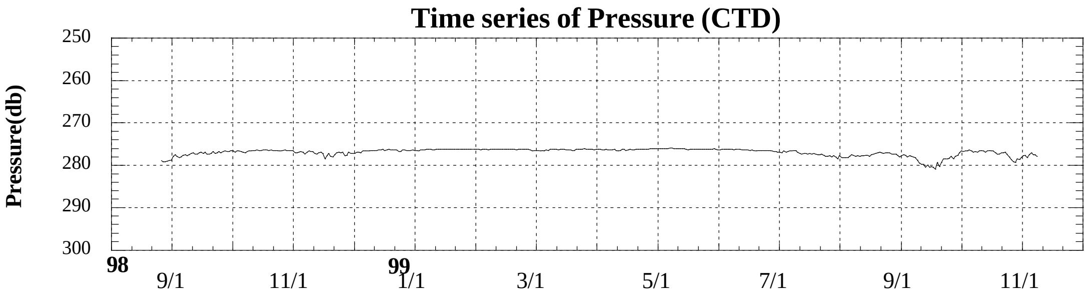
We recovered one ADCP moorings at Eq.-156E, which was deployed on Aug.1998 (KY98-10). We monitored depth of acoustic releaser after we released the anchor.

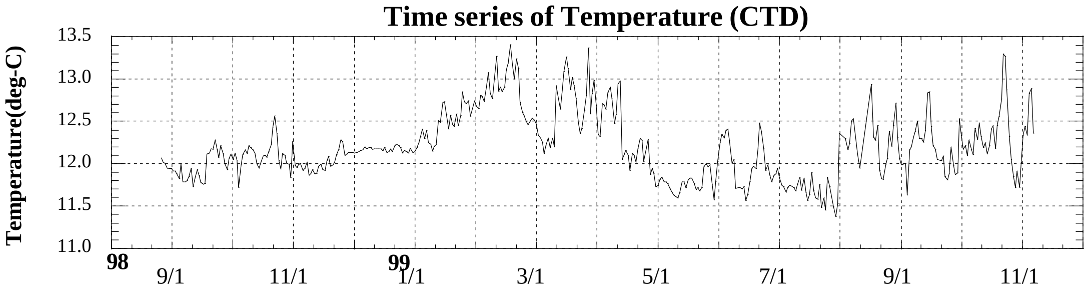
After the recovery, we uploaded ADCP and CTD data into a computer, and then raw data were converted into ASCII code. Results were shown in the figures on following pages. Fig.7.5-1 shows timeseries of CTD depth, temperature, and salinity. Figure7.5-2, 3 shows the velocity data (eastward and northward component) at 50m (29bins), 100m (22bins), 150m (16bins), and 200m (10bins) depth.

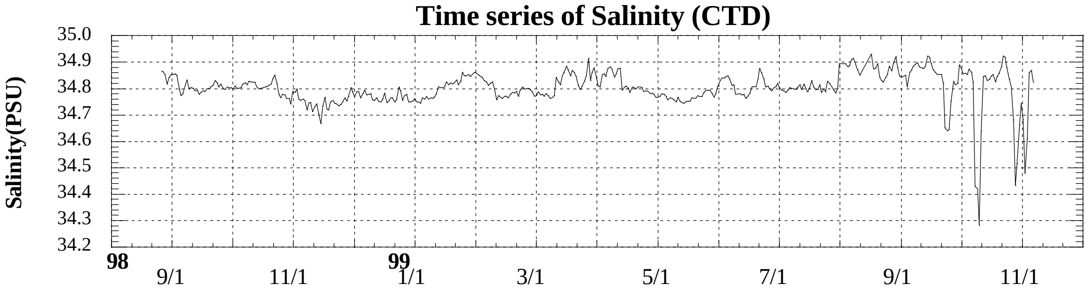
(7) Data archive

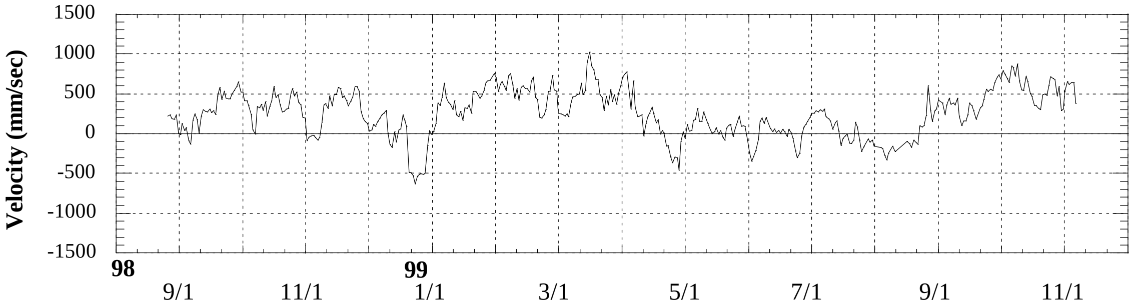
The data will be created using CTD depth data. The data will be archived by member of TOCS project at JAMSTEC. The data at Eq.-156E will be submitted to TAO project office as a component of TAO current meter array after the quality check.

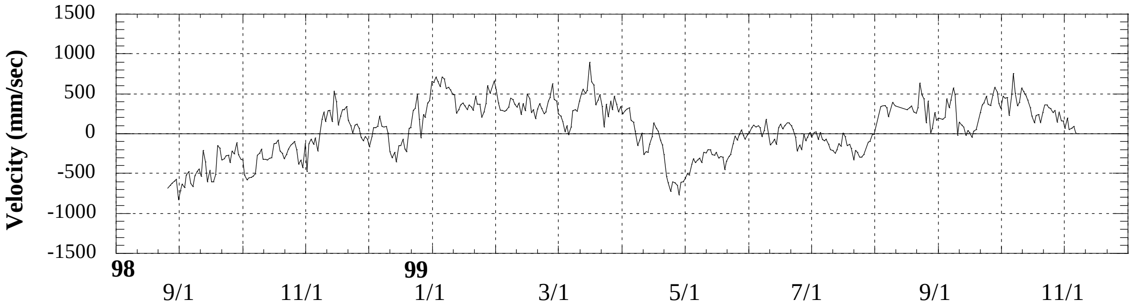
All data will be submitted to DMO at JAMSTEC within 3 years after each recovery.

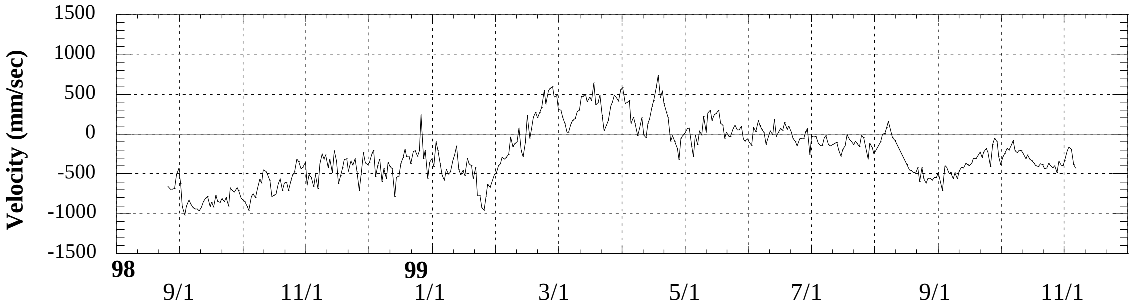

Time series of Pressure (CTD)
Pressure(db)
250
260
270
280
290
300
98
9/1
11/1
99
1/1
3/1
5/1
7/1
9/1
11/1

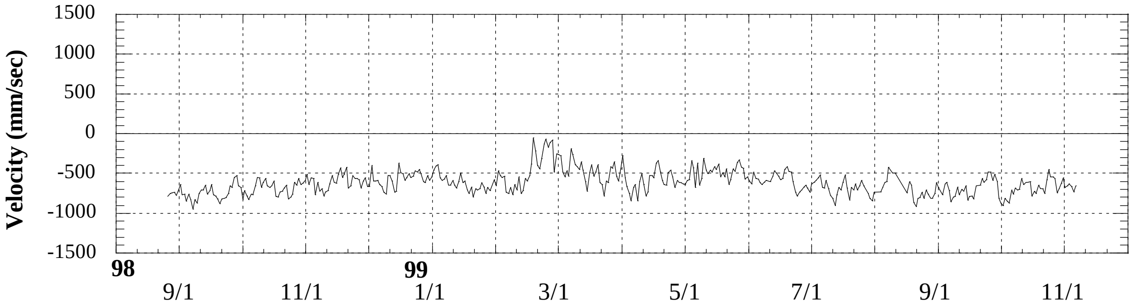

Time series of Temperature (CTD)
Temperature(deg-C)
13.5
13.0
12.5
12.0
11.5
11.0
98
9/1
11/1
99
1/1
3/1
5/1
7/1
9/1
11/1


Time series of Salinity (CTD)
Salinity(PSU)
35.0
34.9
34.8
34.7
34.6
34.5
34.4
34.3
34.2
98
9/1
11/1
99
1/1
3/1
5/1
7/1
9/1
11/1

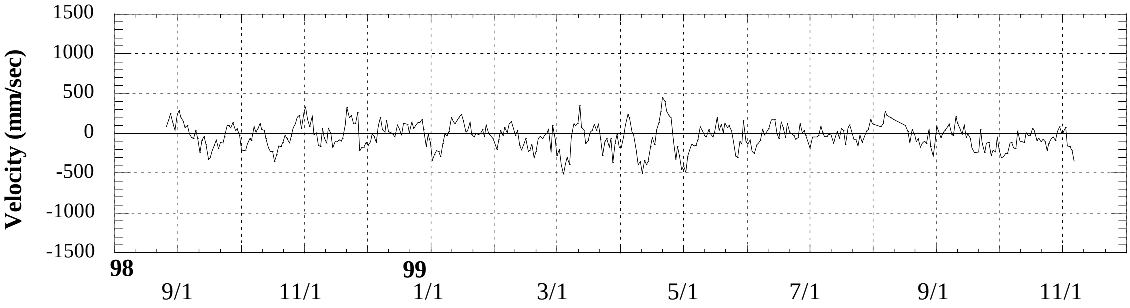

Time Series of Eastward Compornent at 50m


Time Series of Eastward Compornent at 100m

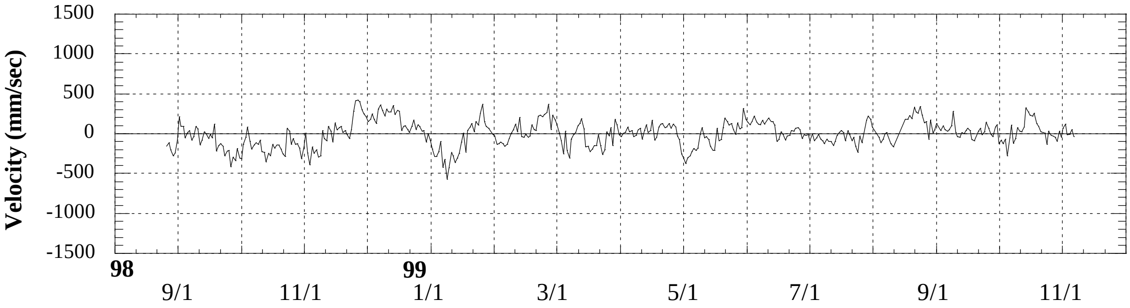

Time Series of Eastward Compornent at 150m


Time Series of Eastward Compornent at 200m

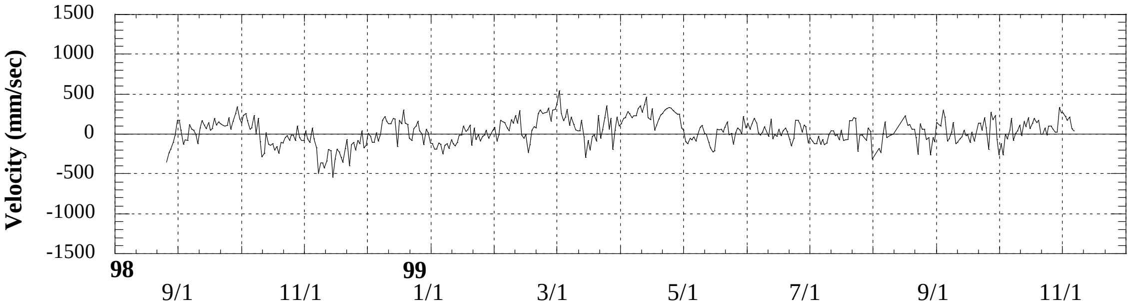
Time Series of Northward Compornent at 50m



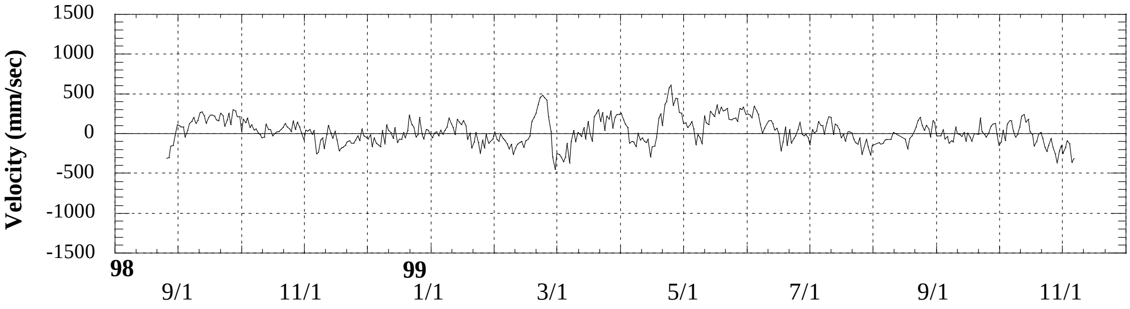
Time Series of Northward Compornent at 100m



Time Series of Northward Compornent at 150m



Time Series of Northward Compornent at 200m



DEPLOYMENT & RECOVERY

MOORING No. 980825 - 00156E

PROJECT	TOCS	TIME	UTC
AREA	Western Pacific	RECORDER (D)	T. Shimbiki
POSITION	0 156°E	(R)	A. Kato

DEPTH 1956m

PERIOD 25. Aug. 98 ~ NAVIGATION SYSTEM : WGS 84

No.of DAYS

LENGTH : m DEPTH of BUOY : m BUOYANCY : kg

ACOUSTIC RELEASER

TYPE	Benthos (Upper)	TYPE	Benthos (Lower)
S/N	662	S/N	692
RECEIVE F.	13.0 kHz	RECEIVE F.	13.0 kHz
TRANSMIT F.	13.5 kHz	TRANSMIT F.	14.0 kHz
ENABLE C.	B	ENABLE C.	E
RELEASE C.	A	RELEASE C.	D
BATTERY	2 years.	BATTERY	2years
TEST on DECK		TEST on DECK	

DEPLOYMENT

DATE 25 Aug. 98 SHIP KAIYO CRUISE No. KY9810

WEATHER bc CONDITIONS 0.8m - 9sec DIR. of WIND 100° VEL. of WIND 2 m/sec

DEPTH 1961 m DEPTH of A.R. 1803 m DESCEND. RATE 2.5 m/s

POS. of STRT 0° 00.021 N 155 ° 59.034 E HOR.RANGE m

POS. of DEP. 0° 00.053 N 156 ° 00.163 E SINKER 23 :07 DISAPPEAR 23 : 14

POS. of MOORING 0 ° 00.003 N 156 ° 00.126 E LANDING 23 : 19

AirPが
[illegible]
流して等

着底

NOTE

アンカー上 Nylon 125 → 100m 変更
全没 2314 (UTC)
着底 2319
Depth 1961m

	TIME	S/R	DEPTH
S	23:07		377
S	23:11		553
B	23:13		943
L	23:16		1425
	23:19		1803

2.15 m/s
3.25 m/s
2.68
2.1
2.5

RECOVERY

DATE 7. Nov. 99 SHIP MIRAI CRUISE No. MR99-k06

WEATHER bc CONDITIONS 1m DIR. of WIND 216° VEL. of WIND 2.3 m/sec

START of RELEASE 20 : 59 FINISH of RELEASE 20 : 59 (1回目)

POS. of DISCOVERY 0 ° 00.42S 155° 29.23E (Time 21 : 01)

DIRECTION ° DISTANCE m ASCENDING RATE m/s

NOTE

21:01 ブイ発見
21:15 ガラス玉発見
21:55 作業艇 着水
22:04 ロープ取り付け
22:07 ひきよせ索巻き取り開始
22:14 ADCP 水切り.

Upper A.R. 作動確認 OK.
11/8 3:12

	TIME	S/R	DEPTH
S	21:00	2538	1532 m
S	:02	2560	1320 m
B	:03	2536	1161 m
L	:07	2308	648 m
	:08	2303	482 m

TIME RECORD

MOORING NO. 980825 - 00156E

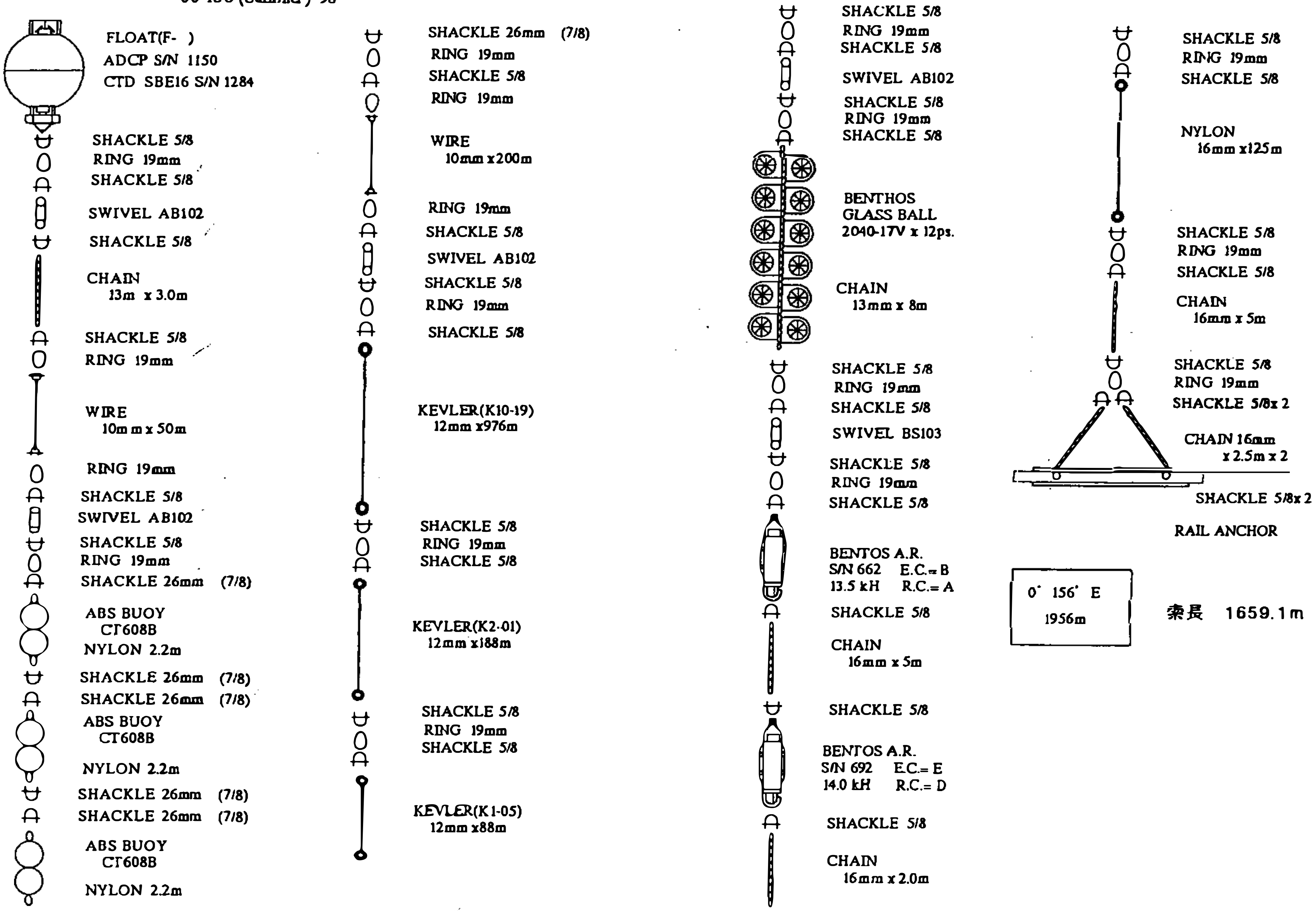
		DEPLOYMENT		RECOVERY (Date: ~~8~~7.Nov.99)	
		START : 22:26 FINISH : 23:07		START : 22:07 FINISH : 22:59	
ITEM	S/N etc.	TIME	MEMO	TIME	MEMO
ADCP	ADCP 1150 CTD 1784	22:28		22:17	水切り 22:14.
WIRE	50m	22:28		22:19 - 22:22	
ABS BUOY	2	22:31		22:14	
〃	2	22:31		〃	
〃	2	22:32		〃	
WIRE	200m	22:32～22:39		22:26 - 22:33	
KEVLER	976m	22:39～22:50	K10+9	22:33 - 22:48	
〃	188 m	22:50～22:55	K2-01	22:48 - 22:52	
〃	88 m	22:55～23:00	K1-05	22:52 - 22:54	
GLASS BALL	12	23:00～23:01		22:59	
BENTOS A.R.	S/N 662	23:01		22:59	
〃	692	23:01		22:58	
NYLON	125m	23:01～23:06	100m八超		
RAIL ANCHOR	1.8t	23:07			

23'14 全没 (降り700m)
23:19 着底
1961m 水深

21:55 作業艇着水
22:04 ロープ取りつけ
22:07 ひきよせ索巻き取り開始
22:14 ADCP 水切り.

99. 秋 みらい回収

00-156 (Summer) '98



75-8

DEPLOYMENT & RECOVERY

MOORING No. 991108 - 00156E

PROJECT	TOCS	TIME	UTC
AREA	Western Pacific	RECORDER (D)	A. Kato
POSITION	0 , 156 E	(R)	

DEPTH 1950 m

PERIOD NAVIGATION SYSTEM : WGS 84

No.of DAYS

LENGTH : m DEPTH of BUOY : m BUOYANCY : kg

ACOUSTIC RELEASER

TYPE	Benthos (Upper)	TYPE	Benthos (lower)
S/N	908	S/N	685
RECEIVE F.	11.0 kHz	RECEIVE F.	13.0 kHz
TRANSMIT F.	14.5 kHz	TRANSMIT F.	14.5 kHz
ENABLE C.	A	ENABLE C.	C
RELEASE C.	D	RELEASE C.	G
BATTERY	1 year	BATTERY	1 year
TEST on DECK	8, Nov, 99	TEST on DECK	8, Nov, 99

DEPLOYMENT

DATE 8, Nov, 99 SHIP MIRAI CRUISE No. MR99--K06

WEATHER bc CONDITIONS 1m DIR. of WIND 316° VEL. of WIND 3.3 m/sec.

DEPTH 1950 m DEPTH of A.R. 1712 m DESCEND. RATE m/s BUOY 0 : 54

POS. of STRT 0° 00.55S 156° 06.46E. HOR.RANGE m

POS. of DEP. 0° 00.04 N 156° 07.65E SINKER 1 : 47 DISAPPEAR. :

POS. of MOORING 0° 00.04 N 156° 07.58E LANDING 2 : 00

NOTE

トラポン 270 m

その後、反応なし。

SSBL	TIME	S / R	DEPTH
S	1 : 52		700
S	1 : 53		800
B	1 : 54		1000
L	1 : 57		1500
	2 : 00		1712

RECOVERY

DATE SHIP CRUISE No.

WEATHER CONDITIONS DIR. of WIND VEL. of WIND

START of RELEASE : FINISH of RELEASE :

POS. of DISCOVERY ° ° ASCENDING RATE m/s

DIRECTION ° DISTANCE m

NOTE

SSBL	TIME	S / R	DEPTH
S			
S			
B			
L			

TIME RECORD

No. 991108-M156E

	DEPLOYMENT		RECOVERY	
	DATE	8. Nov. 99		
	START	0:53		
	FINISH	1:47		

ITEM	S/N	etc	TIME	MEMO	TIME	MEMO
APCP	ADCP 1154 CTD 1285		0:54			
TRANSPONDER	57039		0:54			
WIRE		ø10×50m	0:54-0:58			
ABS BUOY	2		0:58			
"	"		"			
"	"		"			
WIRE		ø10×200m	0:58-1:03			
KEVLER	K10-01 490	ø12×490m	1:03-1:10			
"	K10-01 2/2 433	ø12×433m	1:10-1:17			
"	K2-06	ø12×187m	1:17-1:20			
"	K1-01	ø12×87m	1:20-1:23			
GLASS BALL	12 pc.		1:27			
U Benthos A.R.	908		1:27			
L Benthos A.R	~~560~~ 685		1:27			
NYLON		ø16×170m	1:27-1:32			
RAIL ANCHOR	1.8 ton		1:47			

- TRANSPONDER : ADCP下の3mチェーンに取りつけ。

SN. 57039

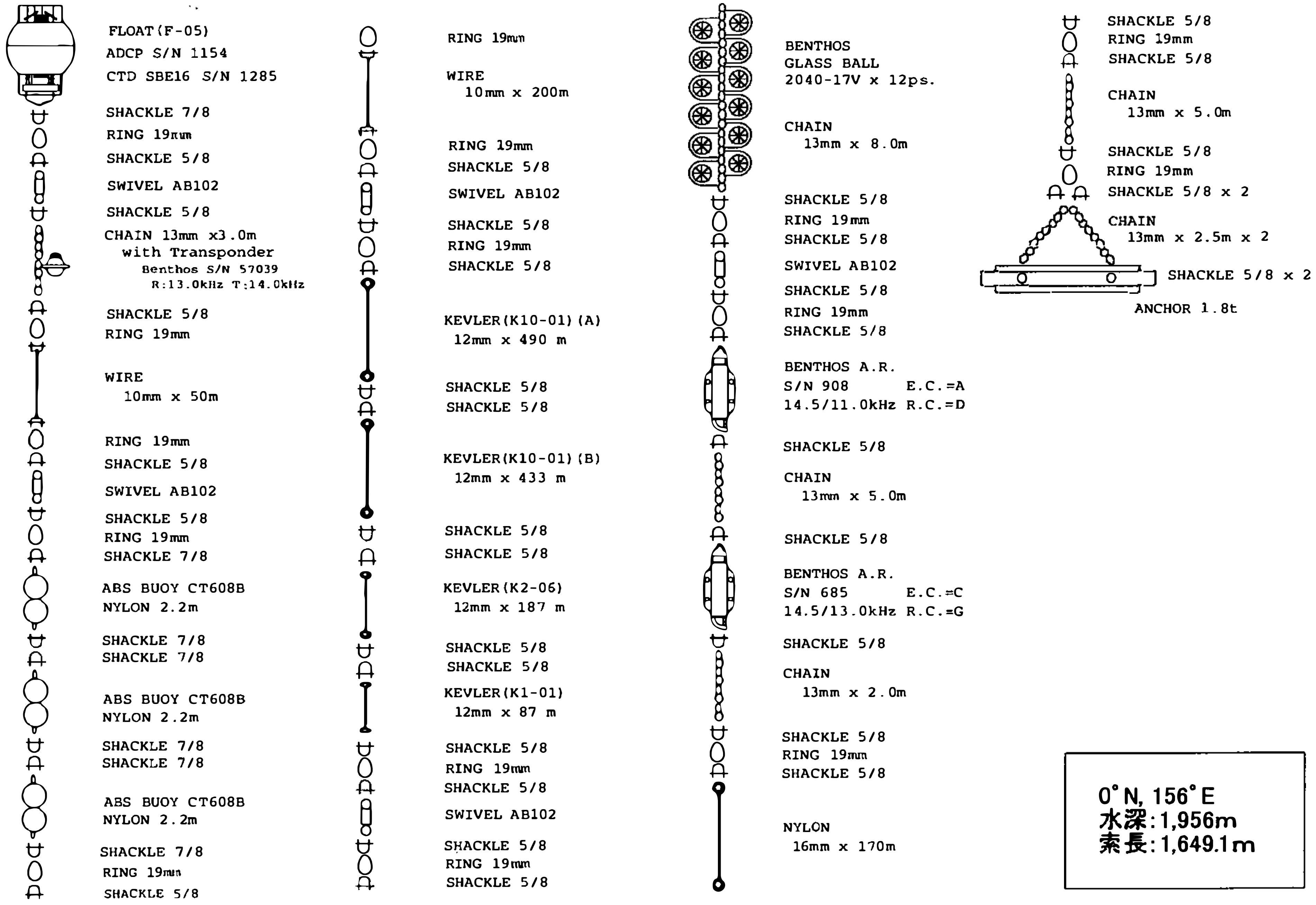
Receive 13.0 kHz

Transmit 14.0 kHz

着底 2:00

トラポン深度 270m

その後反応なし。



0°N, 156°E
水深:1,956m
索長:1,649.1m

7.6. TAO/ATLAS mooring

(1) Ship: R/V MIRAI (JAMSTEC)

(2) Cruise Dates: Oct.20, to Nov.19,1999

(3) Personnel: Steve Smith (PMEL)

(4) Port: Guam to Guam

(5) Operation summary: (Recover Only) 5 atlas buoys on 156E

(6) Pre-cruise import

The Mirai arrived at the Coast Guard base at 0900 Oct. 19. I had arrived at 0800 and met up with Chief John Howk our main contact in Guam. After the ship arrived Chief Howk called the freight agent and the 20ft container arrived with in 45min. It was quickly unloaded with the help of the ships crew and the forklift provided by the coast guard. The crew had all the gear stowed and secured on the ship in a vary short time. The ship sailed on time Oct. 20, at 1600.

(7) Moorings:

5s 156E Reverse Catenary
Release fired 21:53 (GMT) Time on deck 0:05
Depth 1551m

2s 156E Standard Atlas
Release fired 21:57 (GMT) Time on deck 0:00
Depth 1756m

0 156E Next Generation
Buoy adrift no recovery

2n 156E Standard Atlas
Release fired 22:25 (GMT) Time on deck 0:40
Depth 2600m

5n 156E Standard Atlas
Release fired 22:23 (GMT) Time on Deck 0:50
Depth 3606m

8n 156E Standard Atlas
Release fired 22:23 (GMT) Time on deck 1:04
Depth 4915m

(8) Mooring Operations:

All five buoy recoveries went smoothly. All sensors were recovered except for 2n and 8n. The 2n wind sensor had been broken off with other evidence that it had been visited by a fishing vessel. The 8n buoy was deployed in January ‘98 and has been in the water for 22 months. It stopped transmitting the 22nd of January ‘99. It was spotted 24 Feb. and the wind sensor and mast were missing. After recovery, it was discovered that water had entered the tube and destroyed the batteries and circuit boards. There was plenty of evidence that a fishing vessel had spent some time there. Between the professional ship handling of the officers and the dedication and experienced crews, the recoveries of the TAO moorings were a success. I would like to thank all of the officers and crews of the Mirai for all their help in the recoveries of the Atlas buoys along 156E.