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R/V Mirai Cruise Report
MR25-06

October 16 – November 6, 2025

Tropical Ocean Climate Study (TOCS)

Edited by

Iwao Ueki

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

Contents

1. General information

1.1. Cruise ID

MR25-06

1.2. Name of vessel

R/V Mirai

1.3. Title of cruise

Tropical Ocean Climate Study (TOCS) in the Pacific Ocean:
Comprehensive Ocean-Atmosphere observation in northern edge of the warm pool

1.4. Research area

The western tropical Pacific Ocean

2. Overview and observation summary

2.1. Overview

This cruise is a part of a comprehensive study for short-term climate variability such as ENSO (El Niño/Southern Oscillation), MJO (Madden-Julian Oscillation), and BSISO (Boreal Summer Intraseasonal Oscillation) in the Pacific Ocean. For those phenomena, oceanic and atmospheric processes and air-sea interactions in the warm pool are crucial. Air-sea interactions in the tropical ocean are significantly influenced by atmospheric variability and depend significantly on the structure of the upper ocean, such as the mixed layer isothermal layer, and thermocline, which are closely related to sea surface temperature variability. Particularly in the western tropical Pacific, the presence of Pacific warm pool greatly affects air-sea interactions and the associated atmospheric convective activity. However, observations of the detailed vertical structure of the upper ocean remain limited, and this makes it difficult to understand the various processes involved in the associated air-sea interactions. Considering basin-scale phenomena such as ENSO, clarification of the mechanisms that determine the location and extent of the warm pool is thought to lead to a further understanding of the phenomenon. Thus, we conducted detailed observation for the upper ocean and lower atmosphere by multiplatform; research vessel, moorings, floats, and Wave Gliders and so on.

During the cruise, we replaced a PHSMO (Philippine Sea mooring) and a subsurface ADCP moorings, at 13˚N 137˚E. In addition, a subsurface ADCP mooring at 13.5˚N 137˚E was recovered. We also conducted multiplatform observations using several floats, Wave Gliders, Yo-ko USV (unmanned surface vehicle), and R/V Mirai for upper ocean and lower atmosphere variability. In addition, turbulence microstructure measurements by TurboMAP and MicroALTO, with CTD and LADCP measurements were conducted around Mariana Arc.

Oceanic and atmospheric conditions in the tropical Pacific Ocean showed ENSO-neutral condition after La Niña condition in September. For shorter time scale, there is no significant signals associated with the equatorial waves and MJO in the western Pacific during the cruise. All observations were successfully completed under relatively stable ocean conditions. The replacement of mooring systems, including PHSMO, will enable the acquisition of longer time series, which is expected to be utilized for analyzing climate variability. Furthermore, initial analysis of turbulence observations near the Mariana Arc revealed turbulence diffusion patterns consistent with findings from theoretical and modeling studies. Further analysis will be conducted after cruise.

2.2. Observation summary

Philippine sea mooring (PHSMO) deployment:	1 site
PHSMO recovery:	1 site
ADCP mooring deployment:	1 site
ADCP mooring recovery:	2 sites
Argo float installation:	
APEX float	1 installed
MicroALTO float	1 installed
MOF (Multi-purpose observation float) installation:	2 installed
CTD including water sampling:	8 casts
TurboMAP:	14 casts
Radio sonde:	60 launched
Surface meteorology:	continuous
Shipboard ADCP measurement:	continuous
Geophysics measurement:	continuous
Surface temperature, salinity and dissolved oxygen measurements by intake method	continuous

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

3. Cruise Information

3.1. Period

October 16 – November 06, 2025

3.2. Ports of call

Shimizu, Japan	(Departure: October 16 2025)
Shimizu, Japan	(Arrival: November 6 2025)

3.3. Cruise log

SMT	UTC	Event
October 16th (Thu.) 2025		
09:00	00:00	Departure from Shimizu port
		[Ship Mean Time (SMT)=UTC+9h]
13:15	04:15	Emergency drill
15:00	06:00	Observation Meeting
		Start of surface sea water sampling
		Start of continuous observations
20:30	11:30	Radio Sonde (RS-001)
October 17th (Fri.) 2025		
08:30	23:30 (-1day)	RS-002
20:30	11:30	RS-003
October 18th (Sat.) 2025		
08:30	23:30 (-1day)	RS-004
20:30	11:30	RS-005
October 19th (Sun.) 2025		
08:30	23:30 (-1day)	RS-006
20:30	11:30	RS-007
October 20th (Mon.) 2025		
08:30	17:30 (-1day)	RS-008
14:30	23:30	RS-009
20:05	11:05	CTD cast (ST1M01)
20:48	11:48	RS-010
October 21st (Tue.) 2025		
02:30	17:30 (-1day)	RS-011
08:00 – 10:30	13:00 (-1day) – 01:30	
		Recovery of ADCP mooring
		(13˚ 29.96’N, 137˚ 03.97’E)
08:30	23:30 (-1day)	RS-012
14:12	05:12	CTD cast (ST2M01)
14:30	05:30	RS-013
20:30	11:30	RS-014
October 22nd (Wed.) 2025		
02:30	17:30 (-1day)	RS-015
08:00 – 15:00	23:00 (-1day) – 06:00	
		Deployment of PHSMO
		(13˚ 06.90’N, 136˚ 56.30’E)
08:30	23:30 (-1day)	RS-016

14:30	05:30	RS-017
15:40	06:40	CTD cast (ST2M02)
16:52	07:52	Installation of Yo-ko USV
20:30	11:30	RS-018
October 23rd (Thu.) 2025		
02:30	17:30 (-1day)	RS-019
08:00 – 13:16	23:00 (-1day) – 04:16	Recovery of PHSMO (12˚ 53.61'N, 136˚ 54.31'E)
08:30	23:30 (-1day)	RS-020
13:45	04:45	Installation of Wave Glider
14:30	05:30	RS-021
20:30	11:30	RS-022
October 24th (Fri.) 2025		
02:30	17:30 (-1day)	RS-023
08:00 – 10:21	23:00 (-1day) – 01:21	Recovery of ADCP mooring (12˚ 58.99'N, 137˚ 08.27'E)
08:30	23:30 (-1day)	RS-024
13:00 – 15:51	04:00 (-1day) – 06:51	Deployment of ADCP mooring (12˚ 59.01'N, 137˚ 08.42'E)
14:30	05:30	RS-025
16:10	07:10	Installation of Flux Drifting Buoy
16:15	07:15	Installation of MOFs
16:25	07:25	Cruise to 8˚N 137˚E for capturing surface current system
20:30	11:30	RS-026
October 25th (Sat.) 2025		
02:30	17:30 (-1day)	RS-027
08:30	23:30 (-1day)	RS-028
17:20	08:20	Cruise to 8˚N 135˚E for capturing surface current system
20:30	11:30	RS-029
October 26th (Sun.) 2025		
02:45	17:45 (-1day)	Cruise to 13˚N 135˚E for capturing surface current system
08:30	23:30 (-1day)	RS-030
20:30	11:30	RS-031
October 27th (Mon.) 2025		
04:12	19:12 (-1day)	Arrival at 13˚N 135˚E
08:30	23:30 (-1day)	RS-032
13:00	04:00	Recovery of FDB
13:45	04:45	Pre-test for MicroALTO float
20:30	11:30	RS-033
October 28th (Tue.) 2025		
08:30	23:30 (-1day)	Recovery of Yo-ko USV
08:30	23:30 (-1day)	RS-034
13:50	04:50	Recovery of Wave Glider
16:00	07:00	Cruise to St. 3

20:30	11:30	RS-035
October 29th (Wed.) 2025		
08:30	23:30 (-1day)	RS-036
14:30	05:30	RS-037
20:30	11:30	RS-038
October 30th (Thu.) 2025		
02:30	17:30 (-1day)	RS-039
08:30	23:30 (-1day)	RS-040
09:40	00:40	CTD cast (St. 3: 17˚N 143˚E)
10:30	01:30	TurboMAP (St. 3)
13:05	04:05	Installation of Micro ALTO
13:30	04:30	TurboMAP (St. 3: Recast)
14:30	05:30	RS-041
20:30	11:30	RS-042
October 31st (Fri.) 2025		
02:30	17:30 (-1day)	RS-043
08:05	13:05 (-1 day)	CTD cast (St. 4: 17˚N 142˚E)
08:30	23:30 (-1day)	RS-044
09:00	00:00	TurboMAP (St. 4)
14:30	05:30	RS-045
14:43	05:43	CTD Cast (St. 5: 17˚N 141˚E)
15:30	06:30	TurboMAP (St. 5)
20:30	11:30	RS-046
November 1st (Sat.) 2025		
02:30	17:30 (-1day)	RS-047
08:00	23:00 (-1day)	CTD cast (St. 6: 17˚N 140˚E)
08:30	23:30 (-1day)	RS-048
08:53	23:53 (-1day)	TurboMAP (St.6)
14:30	05:30	RS-049
20:30	11:30	RS-050
November 2nd (Sun.) 2025		
02:30	17:30 (-1day)	RS-051
08:30	23:30 (-1day)	RS-052
20:30	11:30	RS-053
November 3rd (Mon.) 2025		
08:30	23:30 (-1day)	RS-054
18:05	09:05	CTD (St. 7: 28.5˚N 140˚E)
19:30	10:30	Installation of Argo float
20:30	11:30	RS-055
November 4th (Tue.) 2025		
08:30	23:30 (-1day)	RS-056
20:30	11:30	RS-057
November 5th (Wed.) 2025		
		Cruise to Shimizu
November 6th (Thu.) 2025		
09:00	00:00	Arrive at Shimizu

3.4. Cruise track

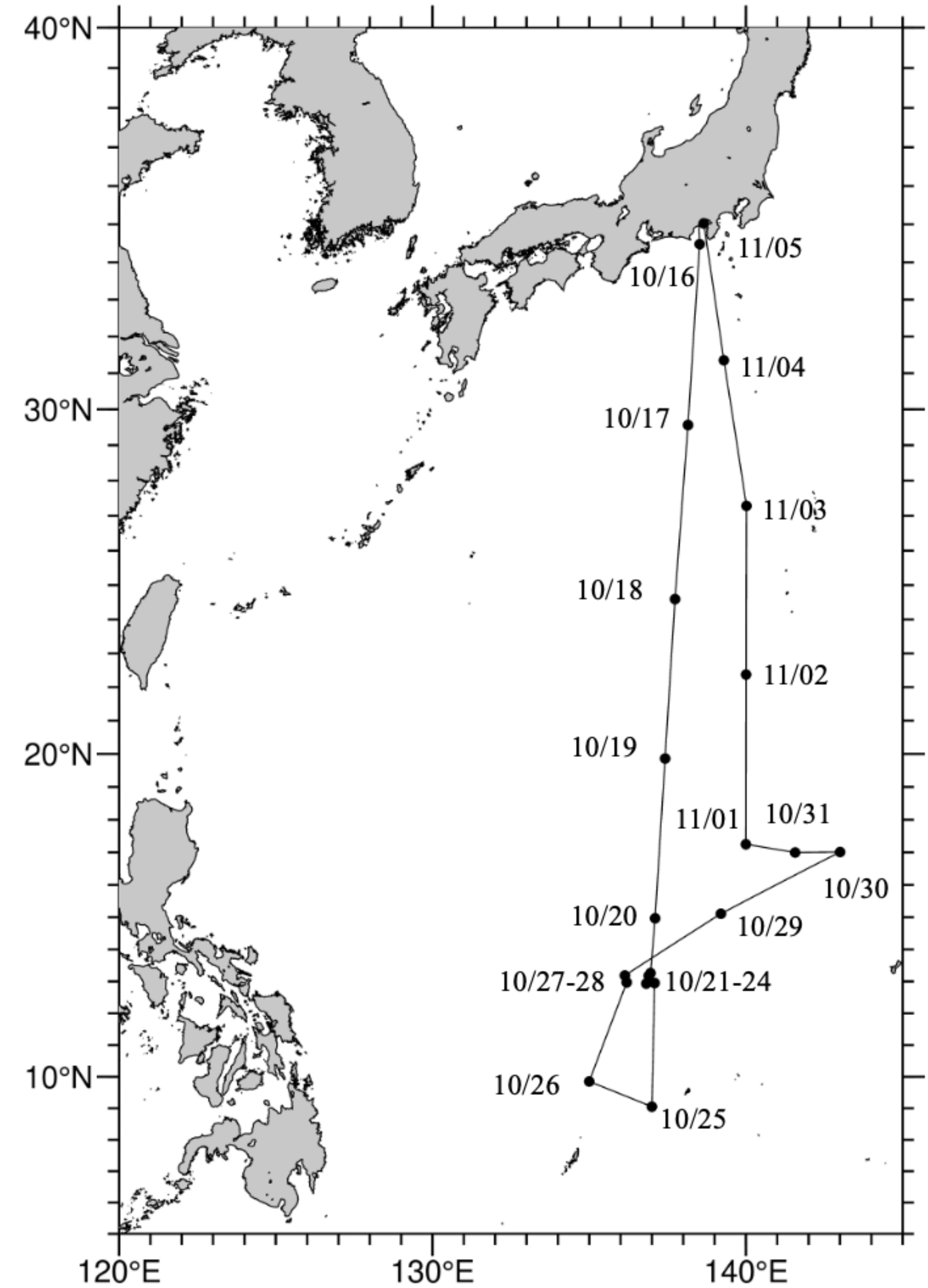

Fig. 3-1 MR25-06 cruise track

4. Research themes and science party

4.1. Chief scientist

Iwao Ueki
Group Leader,
Ocean-Atmosphere Climate Research Group,
Center for Coupled Ocean-Atmosphere Research
Research Institute for Global Change,
JAMSTEC

4.2. Main mission

Comprehensive Ocean-Atmosphere observation in northern edge of the warm pool
Principal Investigator (PI): Iwao Ueki

4.3. Applied missions

Field experiment for Yo-ko USV
PI: Kensuke Watari
Senior Engineer,
Smart Sensing Technology Development Center,
Research Institute for Marine Technology and Engineering,
JAMSTEC

5. Participants list

5.1. R/V Mirai scientists and technical staffs

Name	Affiliation	Occupation
Iwao Ueki	JAMSTEC	Chief Scientist
Akira Nagano	JAMSTEC	Scientist
Ryuichiro Inoue	JAMSTEC	Scientist
Kyoko Taniguchi	JAMSTEC	Technical Staff
Kensuke Watari	JAMSTEC	Engineer
Satoshi Tsubone	JAMSTEC	Engineer
Masahiro Kaku	JAMSTEC	Engineer
Tomoki Takami	Kindai University	Graduate Student
Yutaro Murakami	Nippon Marine Enterprises, Ltd. (NME)	Technical Staff
Satomi Ogawa	NME	Technical Staff
Haruna Yamanaka	NME	Technical Staff
Nobuhiro Fujii	Marine Works Japan Ltd. (MWJ)	Technical Staff
Masaki Yamada	MWJ	Technical Staff
Makito Yokota	MWJ	Technical Staff
Kango Fukuyama	MWJ	Technical Staff
Kai Iwasaki	MWJ	Technical Staff
Misato Kuwahara	MWJ	Technical Staff
Tun Htet Aung	MWJ	Technical Staff
Riho Fujioka	MWJ	Technical Staff
Ko Arihara	MWJ	Technical Staff
Akira Watanabe	MWJ	Technical Staff
Hinata Sato	MWJ	Technical Staff
Makito Yokota	MWJ	Technical Staff

5.2. R/V Mirai crew member

Name		Rank or rating
Masato	Chiba	Master
Haruhiko	Inoue	1st Officer
Hirosada	Matsushita	Chief Officer
Keiji	Kanayama	2nd Officer
Yasuhito	Iida	Jr. 2nd Officer
Masashi	Kanemitsu	3rd Officer
Kazuhiko	Kaneda	Chief Engineer
Yoichi	Yasue	1st Engineer
Tomoya	Koga	2nd Engineer
Atsushi	Idosaka	3rd Engineer
Masanori	Murakami	Chief Radio Operator
Kazuyoshi	Kudo	Boatswain
Tsuyoshi	Sato	Quarter Master
Shuji	Komata	Quarter Master
Hideaki	Tamotsu	Quarter Master
Masaya	Tanikawa	Quarter Master
Yuki	Oishi	Sailor
Ryota	Kume	Sailor
Kazuya	Sumomozawa	Sailor
Iori	Terasaki	Sailor
Ryu	Harada	Sailor
Ryoga	Nakatake	Sailor
Daisuke	Taniguchi	No. 1 Oiler
Makoto	Kozaki	Oiler
Shotaro	Sumitomo	Oiler
Takuya	Watanabe	Oiler
Tsuyoshi	Uchiyama	Oiler
Shodai	Kayaba	Assistant Oiler
Toru	Murakami	Chief Steward
Kenicjі	Okumura	Steward
Masanao	Kunita	Steward
Kina	Abe	Steward
Yuta	Hangai	Steward

6. Misson observations

6.1. Philippine Sea mooring (PHSMO)

(1) Personnel

Iwao Ueki	(JAMSTEC)	Principal investigator
Akira Nagano	(JAMSTEC)	
Tatsuya Fukuda	(JAMSTEC)	Not on board
Yasuhisa Ishihara	(JAMSTEC)	Not on board
Kengo Fukuyama	(MWJ)	Operation Leader
Masaki Yamada	(MWJ)	Technical Leader
Kai Iwasaki	(MWJ)	
Akura Watanabe	(NWJ)	
Ko Arihara	(MWJ)	
Hinata Sato	(MWJ)	
Tun Htet Aung	(MWJ)	

(2) Objectives

In the tropical Pacific where the ocean and atmosphere variations play critical roles in the climate system, upper ocean and lower atmosphere monitoring system using moored buoy has been conducted. On the basis of the knowledge obtained from the buoy array data of the tropical Pacific, we further noticed that, in the Philippine Sea, there are other possible key areas where the variations are responsible for phenomena in the equatorial and Kuroshio regions such as ENSO (Hasegawa and Hanawa, 2007), ENSO-related salinity variation of the sea surface Kuroshio water (Nagano et al., 2014, 2017), and PDO (Nagano et al., 2022). Also, other atmospheric and oceanic disturbances on various timescales such as typhoons, cold surges, seasonal march of the East Asian monsoon, and Madden-Julian Oscillation are present in the Philippine Sea (Nagano et al., 2018). Therefore, to further understand the air-sea interaction in the western North Pacific, JAMSTEC deployed a moored buoy at a site east of the Philippines (nominal 13˚N, 137˚E), corresponding to the northern edge of the western Pacific warm pool, and named PHSMO (Philippine Sea mooring) from December 2016.

This mooring is based on the m-TRITON system, deploying eastern Indian Ocean (Ueki et al., 2010), and K-TRITON buoy, which had been deployed in the Kuroshio Extension region from February 2008 to July 2013 (http://www.jamstec.go.jp/iorgc/ocorp/ktsfg/data/jkeo/index.html). The atmospheric and oceanic data observed by the mooring are publicly available in this web site. In this cruise, the Philippine Sea mooring deployed during the R/V MIRAI MR23-05Leg1 cruise has been recovered, and the new one has been deployed during this cruise.

(3) Measured parameters

PHSMO observed oceanic parameters and meteorological parameters as follow:

Meteorological parameters:

Wind Speed, Direction,
Atmospheric Pressure,
Air Temperature, Relative Humidity,
Shortwave Radiation,
Precipitation.
Longwave Radiation

Oceanic parameters:

Water Temperature and Conductivity at
1m, 10m, 20m, 40m, 60m, 80m, 90m, 100m, 110m, 120m, 180m, 150m, 200m, 300m.

Pressure at

1m, 10m, 40m, 80m, 100m, 120m, 180m, 150m, 300m.

Currents at 1m

Dissolved Oxygen at 80m, 100m, 150m

(3) Instrument

Details of the instruments used on the PHSMO are summarized as follows:

Oceanic sensors

1) CTD and CT

SBE-37 IM MicroCAT

A/D cycles to average:	4
Sampling interval:	600sec.
Measurement range, Temperature:	-5 ～ 35 deg-C
Measurement range, Conductivity:	0 ～ 7 S/m
Measurement range, Pressure:	0 ～ full scale range

2) CRN (Current meter)

Work Horse ADCP

Sensor frequency:	300kHz
Sampling interval:	20min.

Meteorological sensors

1) Precipitation

R.M.YOUNG COMPANY MODEL50202/50203

Sampling interval: 600sec.

2) Atmospheric pressure

PAROSCIENTIFIC.Inc. DIGIQUARTZ FLOATING BAROMETER 6000SERIES

Sampling interval: 600sec.

3) Relative humidity/air temperature, Shortwave radiation, Longwave radiation, Wind speed/direction

JAMSTEC JAMET

Sampling interval: 600sec.

(4) Locations of deployed PHSMO

Nominal location:	13N, 137E
Mooring number (ID):	40506
Number on surface float:	J06
Iridium ID number:	300434067599640
ARGOS backup PTT number:	96773, 29738
Deployed date:	22 Oct. 2025
Exact location:	13°08.45' N, 136°54.43' E
Water depth:	5,327 m

(5) Locations of recovered PHSMO

Nominal location:	13N, 137E
Mooring number (ID):	40505

Number on surface float:	K03
Iridium ID number:	300434060153300
ARGOS backup PTT number:	29698, 27406
Deployed date:	23 Oct. 2025
Recovered date:	1 Jul. 2021
Exact location:	12°56.54' N, 136°25.47' E
Water depth:	5,249 m

*Dates are UTC and represent anchor drop times for deployment and acoustic releaser on deck time for recovery, respectively.

(6) Data archive

Hourly averaged data are transmitted through ARGOS satellite data transmission system in almost real time. The real time data are provided to meteorological organizations via Global Telecommunication System and utilized for daily weather forecast. The data will be also distributed worldwide through Internet from JAMSTEC Web pages (https://www.jamstec.go.jp/ipobs/PhBuoy/). All data will be archived at JAMSTEC Mutsu Institute.

6.2. ADCP subsurface moorings

(1) Personnel

Iwao Ueki	(JAMSTEC)	Principal investigator
Ko Arihara	(MWJ)	Operation Leader
Masaki Yamada	(MWJ)	
Akira Watanabe	(MWJ)	
Hinata Sato	(MWJ)	

(2) Objectives

The purpose of the ADCP (Acoustic Doppler Current Profiler) subsurface mooring is to get knowledge of physical process underlying the dynamics of the northern edge of the Pacific warm pool. We have been observing subsurface currents using ADCP moorings along the equator. In this cruise (MR25-06), we recovered moorings at the two sites of 13N-137E and 13.5N-137E and deployed new moorings at 13N-137E. These moorings also contribute to the multiplatform experiment combined with PHISMO, floats, Wave Gliders, drifting buoys and ship-based observations.

(3) Parameters

Current profiles
Echo intensity
Pressure, Temperature and Conductivity

(4) Method and instrumentation

To acquire current profiles in the subsurface layers above 2000 m, a Workhorse Long Ranger ADCP was installed in a ball buoy as the top float of each mooring. SBE16 (SEACAT CTD) was also installed at the bottom of the ball buoy to acquire depth, temperature and salinity data for correction of current profile data using calculated sound speed. In addition, an RBR duet[3] was installed at the top of the ball buoy of the deployed mooring to acquire detailed depth data. Details of the instruments and their parameters are as follows:

1) ADCP

Work Horse Long Ranger ADCP 75 kHz (Teledyne RD Instruments Inc.)

Distance to first bin:	7.04 m
Pings per ensemble:	27
Time per ping:	6.66 sec.
Number of depth cells:	60
Bin length:	8.00 m
Sampling interval:	3600 sec.

<u>*Recovered ADCP*</u>

・ Serial Number: 24614 (Mooring No. 230709-13N137E)
・ Serial Number: 24620 (Mooring No. 230710-13.5N137E)

<u>*Deployed ADCP*</u>

・ Serial Number: 24625 (Mooring No. 251024-13N137E)

2) CTD/TD

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

Sampling interval: 3600 sec.

<u>*Recovered CTD*</u>

・ Serial Number: 1279 (Mooring No. 230709-13N137E)
・ Serial Number: 1286 (Mooring No. 230710-13.5N137E)

Deployed CTD

- Serial Number: 1280 (Mooring No. 251024-13N137E)

(2) RBR duet[3] T.D (RBR Ltd.)

Sampling interval: 1800 sec.

Deployed TD

- Serial Number: 236571 (Mooring No. 251024-13N137E)

3) Other instruments

(a) Acoustic Release (Teledyne BENTHOS Inc.)

Recovered Acoustic Release

- Serial Number: 632, 666 (Mooring No. 230709-13N137E)
- Serial Number: 693, 667 (Mooring No. 230710-13.5N137E)

Deployed Acoustic Release

- Serial Number: 663, 694 (Mooring No. 251024-13N137E)

(b) Transponder (Teledyne BENTHOS Inc.)

Recovered Transponder

- Serial Number: 67491 (Mooring No. 230709-13N137E)
- Serial Number: 57069 (Mooring No. 230710-13.5N137E)

Deployed Transponder

- Serial Number: 56413 (Mooring No. 251024-13N137E)

(c) ST-400A Xenon Flasher (MetOcean Data Systems)

Recovered Flasher

- Serial Number: Z03-088 (Mooring No. 230709-13N137E)
- Serial Number: A02-066 (Mooring No. 230710-13.5N137E)

(5) Recovery

Two ADCP moorings, which had been deployed on 9 July 2023 at 13°N, 137°E and on 10 July 2023 at 13.5°N, 137°E by *R/V MIRAI* were recovered. The data obtained from the ADCP and CTD were retrieved, and primary check was conducted. The obtained current profiles are presented in Fig. 6.2.-1 as time–depth sections for the zonal and meridional components as a quick look.

*Remarks

After recovery of the Workhorse ADCP (S/N 24620) deployed at 13.5°N, 137°E any ping sound couldn’t be confirmed. During removal of the WH-ADCP from the ball buoy for inspection, a gap was found between the transducer head and the housing, suggesting a possible build-up of internal pressure. Taking appropriate safety measures, was opened and the unit, reaction products formed by the interaction between the lithium battery and seawater were found inside. The internal data could not be retrieved.

Details of the mooring No. 230709-13N137E

Deployed date:	09 Jul. 2023
Recovered date:	23 Oct. 2025
Exact location:	12°58.99' N, 137°08.27' E
Water depth:	5,032 m

Details of the mooring No. 230710-13.5N137E

Deployed date:	10 Jul. 2023
Recovered date:	20 Oct. 2025
Exact location:	13°29.96' N, 137°03.97' E
Water depth:	5,039 m

(6) Deployment

We deployed a new ADCP mooring, which intended to be installed at depth of approximately 2000 m. Following the deployment, we conducted acoustic calibration of mooring positions based on signals from acoustic releases.

Details of the mooring No. 251024-13N137E

Deployed date:	24 Oct. 2025
Exact location:	12°59.01' N, 137°08.42' E
Water depth:	5,023 m
Top buoy depth:	1,997 m

(7) Data archive

The data will be available at the following web page:

https://www.jamstec.go.jp/ipobs/adcp/adcp_data.html

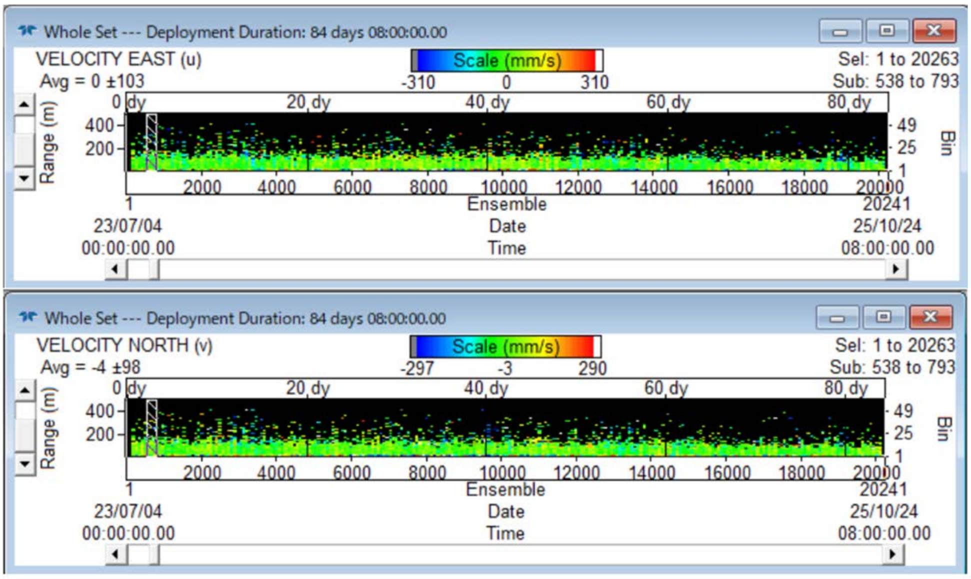

Fig.6.2.-1 Time-depth sections of observed zonal (*top panel*) and meridional (*bottom panel*) current obtained from ADCP mooring at 13N137E.

6.3. Surface drifting buoy (FDB) observation

6.3.1. Air-sea flux observation

(1) Personnel

Iwao Ueki	(JAMSTEC)	Principal investigator
Tatsuya Fukuda	(JAMSTEC)	Not onboard

(2) Objectives

Exchange of momentum, heat, and mass between the ocean and atmosphere is recognized as important processes for atmospheric and oceanic circulation, but observational approaches to capture detailed processes are still insufficient, and understanding those processes through observation is widely required. According to those backgrounds, we have been enhancing our observations to improve our understanding of fundamental processes between the atmosphere and the ocean. As a part of those efforts, we are developing sea surface drifting buoy (FDB) for momentum and heat fluxes. During this cruise, we conducted field experiment for those performances.

(3) Parameters

・Three-dimensional wind speed
・Sonic temperature
・Air temperature/Relative humidity
・Barometric pressure
・Conductivity, Temperature Pressure

(4) Methods

We installed a flux drifting buoy (FDB02) nearby PHISMO site (12˚ 59.28’N, 137˚ 08.00’E) at 24 Oct. 2025 and recovered at 27 Oct. 2025 (Fig. 6. 3. 1 -1). We also installed a 6 meters rope with 11 TD sensors in 0.5 m intervals for observations of temperature profile within near the surface layer. Evaluations of correction schemes for wind speed and acquired fluxes will be done through comparisons with observations by PHISMO, Wave Glider and R/V Mirai.

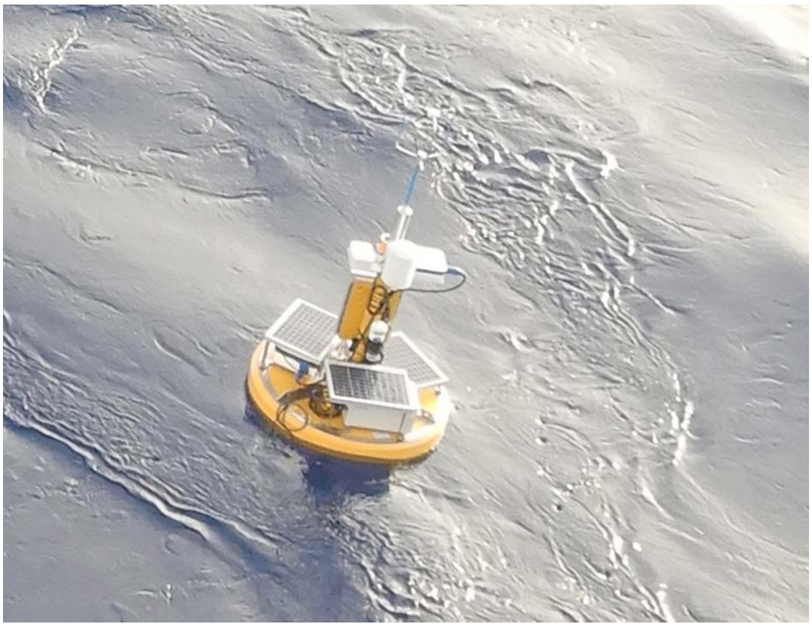

Fig. 6. 3. 1.-1 Installed FDB at 24 Oct. 2025.

(5) Preliminary results

The installed FDB was drifted basically westward with some fluctuation of meridional direction as shown in Fig. 6. 3. 1. -2. Although observation was terminated midway due to battery trouble, the measurements themselves had proceeded smoothly until that time. Observed zonal and meridional wind and derived sensible heat flux (SHF) are shown in Fig. 6. 3. 1. -3. As shown, SHF become large when wind speed and temperature difference between sea surface and air. Evaluation of observation including correction method for pitch and roll of the buoy will be conducted after cruise.

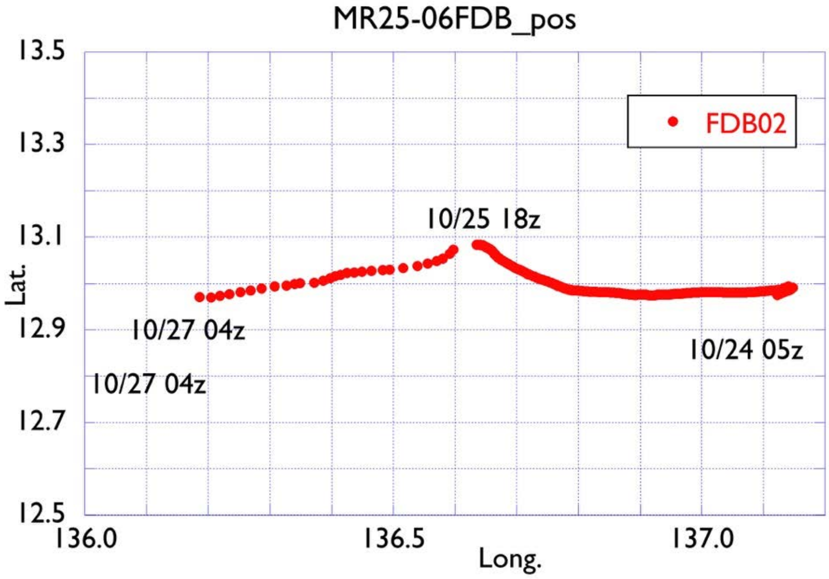

Fig. 6. 3. 1.-2 Location of the FDB from 24 to 27 Oct. 2025.

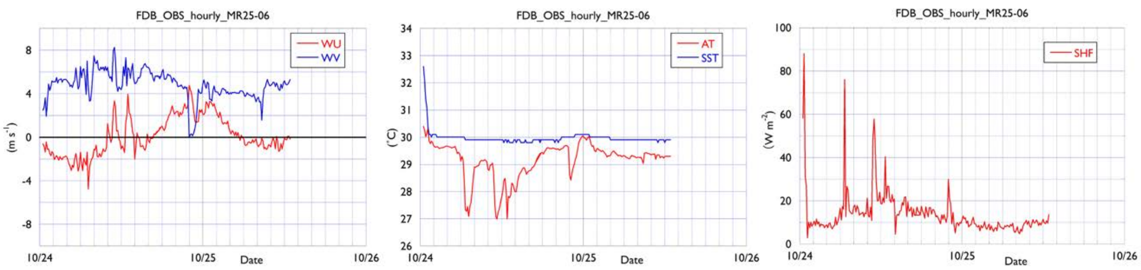

Fig. 6. 3. 1.-3 Time series of zonal (red) and meridional (blue) wind (left) and sensible heat flux based on eddy covariance method observed by FDB.

(6) Data archives

The data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

6.3.2. Installation of Kindai unit

(1) Personnel

Atsutoshi Ikeda	(Kindai University)	Principal investigator (Not onboard)
Tomoki Takami	(Kindai University)	
Iwao Ueki	(JAMSTEC)	

(2) Objectives

Air–sea momentum flux is usually estimated from wind speed and a drag coefficient. The drag coefficient can be influenced by ocean waves. In this cruise, ocean waves were observed in the open sea using a small buoy equipped with two IMUs and a GNSS.

(3) Instruments and methods

A 256 Wh battery pack supplied power to the Raspberry Pi. Two IMU sensors and one GNSS sensor were connected to the Raspberry Pi, and measurements were acquired via a serial communication program. The observation unit is displayed in Fig. 6.3.2.-1The sampling rates were 100 Hz for the IMUs and 10 Hz for the GNSS.

(4) Observation period

Measurement start time: 16:00, 24 October

Measurement duration: 54 hours

(5) Observation point

Deployment position: 13°00' N, 137°10' E

Recovery position: 13°00' N, 136°10' E

Fig. 6. 3. 2.-1 Kindai Unit on the FDB

6.4. Float observation

6.4.1. MicroALTO float

(1) Personnel

Ryuichiro Inoue	(JAMSTEC)	Principal investigator
Shigeki Hosoda	(JAMSTEC)	Not on board
Kanako Sato	(JAMSTEC)	Not on board
Mizue Hirano	(JAMSTEC)	Not on board

(2) Objectives

It has been widely recognized that turbulent mixing is an important mechanism for ocean dynamics and climate processes as well as biogeochemical cycles. Over 20 years of maintaining the Argo observing system, the Argo program has been extended to observe the deep ocean (Deep Argo) as well as biogeochemical cycles (BGC Argo). As a part of the Argo extension, there is an initiative to conduct global turbulence measurements by adding microstructure sensors on profiling floats that is called ArgoMIX but it has not become a part of Argo program. To explore a possibility of microstructure measurements by a profiling float, we deployed one ALTO float with microstructure sensors (microALTO float) during the cruise.

(3) Parameters

・Water temperature
・Salinity
・Pressure
・Vertical gradient of horizontal velocity (vertical shear)
・Vertical gradient of temperature

(4) Instruments

MicroALTO float is an autonomous profiling float and has been developed by MRV system and Rocklands Scientific Inc. (https://www.mrvsys.com/products/microalto). It is based on ALTO float and can equip any combination of two kinds of microstructure sensors (shear probe and fast response thermistor, FP07) and RBRargo CTD sensor. Its length is 1.1m with an antenna length of 0.2m, and it weights 19.5kg. It profiles repeatedly by changing a bladder volume on the bottom and collects data during ascent with a speed of W=0.2~0.25ms^{-1}. Microstructure signals are recorded and internally processed through the Microstructure Analog signal Processor Logger (MAPLe). Shear signals are discarded when the buoyancy pump is turned on while ascending. Band-averaged shear and temperature gradient spectra are sent via the iridium communication with other information such as float positions by GPS and temperature, salinity and depth by the CTD sensor at the sea surface.

(5) Method

We conducted a tethered test before the deployment of float on October 27. In the test, a fishing line (~20m) was attached to a drifting buoy and the float with dummy probes. The float was set to ascent at 10m depth. The float and buoy were recovered by Zodiac after receiving the iridium data on the ship. On October 30, the float was launched and continued measurements without recovering during the cruise. The status of float and its launching information is shown in Table 6.4.1-1 and 6.4.1-2.

Table 6.4.1-1 Specifications of floats

Float Type	microALTO float manufactured by MRV systems
CTD sensor	RBRargo CTD manufactured by RBR
Turbulence sensors	Shear and FP07 manufactured by Rocklands Scientific Inc.
Cycle	every 2 days (approximately 70minutes at the sea surface)
Iridium transmit type	Short burst data (SBD)
Target Parking Pressure	1000 dbar
Sampling layers	0.4~0.5dbar interval from 1100 dbar to surface. CTD sampling frequency is 0.5 Hz and profiling speed is 0.2~0.25m/s.

Table 6.4.2-2 Floats launching positions

Float S/N	Date and Time of Launch (UTC)	Location of Launch		Station
11717	2025/10/30 04:15:09	17°00.10400N	143°00.24562E	St. 3

(6) Data archives

The data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

6.4.2. Argo Float

(1) Personnel

Ryuichiro Inoue	(JAMSTEC)	
Shigeki Hosoda	(JAMSTEC)	Principal investigator (Not onboard)
Kanako Sato	(JAMSTEC)	Not on board
Mizue Hirano	(JAMSTEC)	Not on board

(2) Objectives

The research objective is to clarify the mechanisms of climate and oceanic environment variability, and to understand changes of earth system through estimations of heat and material transports, within the framework of the Argo program. To achieve the objective, one core Argo float was deployed to carry out automatically measurements of long-term temperature and salinity in the North Pacific Ocean. Data accumulated from Argo floats also contribute to improve long-term forecasts of climate changes through data assimilation systems.

(3) Parameters

・Water temperature
・Salinity
・Pressure

(4) Instrumentations and Method

We launched APEX float manufactured by Teledyne. The float is equipped with CTD sensor manufactured by Sea-Bird Electronics Inc. The float drifts at a depth of 1000dbar (called the parking depth) during waiting measurement, then goes upward from a depth of 2000dbar to the sea surface every 1-10 days. During the ascent, physical values are measured following depth table. During surfacing for approximately half an hour, the float sends all measured data to the land via the Iridium RUDICS telecommunication system. The lifetime of float is expected to be about four-eight years. The status of float and its launching information is shown in Table 6.4.2-1 and 6.4.2-2.

Table 6.4.2-1 Specifications of float

Float Type	APEX float manufactured by Teledyne Webb Research.
CTD sensor	SBE41 manufactured by Sea-Bird Electronics Inc.
Cycle	every 2 days (approximately 30minutes at the sea surface)
Iridium transmit type	Router-Based Unrestricted Digital Internetworking Connectivity Solutions (RUDICS)
Target Parking Pressure	1000 dbar
Sampling layers	2dbar interval from 2000 dbar to surface (approximately 1000 levels)

Table 6.4.2-2 Float launching positions

Float S/N	WMO ID	Date and Time	Location		Station
10390	1902462	2025/11/04 21:55:00	28°30.06171N	139°59.91588'E	St. 7

(5) Data archives

The Argo float data will be provided conducting the real-time quality control within 24 hours following the procedure decided by Argo data management team. Then the delayed mode quality control will be conducted within 6 months ~ 1 years, to satisfy their data accuracy for climate research use. Those quality-controlled data are freely available via internet and utilized for not only research but also weather forecasts and any other variable use through internet. Global Data Assembly Center (GDAC: https://usgodae.org/argo/argo.html, https://www.coriolis.eu.org/Observing-the-Ocean/ARGO, https://dataselection.euro-argo.eu/), Global Telecommunication System (GTS).

6.4.3. Multi-purpose Observation Float (MOF)

(1) Personnel

Iwao Ueki	(JAMSTEC)	Principal investigator
Kensuke Watari	(JAMSTEC)	
Masahiro Kaku	(JAMSTEC)	

(2) Objectives

To capture variability of upper ocean temperature and salinity structure.

(3) Instrumentation and methods

MOF is a profiling float, which has a CTD sensor (JES10 Profiler) and can acquire profiles of temperature, salinity until 500 m depth as default. In this experiment, the parking depth and cycle interval of MOFs were 100 m and 24 hours. Specifications of the MOF are listed in Table 6.4.3.

We installed two MOFs (S/N: 19 and 20) at the region of the northern edge of Pacific warm pool, to capture detailed vertical structure of temperature and salinity in the upper layer.

Table 6.4.3 Specifications of the MOF

MOF Design

FEATURES	MOF
Size	910×Φ115
Weight	8.1kg
Sensor	JES10_Profiler
Operating System	Tron
Batt Capacity	Controller:7.8V 14Ah Power:14.4V 30Ah
Communication	Iridium
Depth	500m

(4) Preliminary Results

Two MOFs were installed at 12˚ 59.29'N 137˚ 08.00'E on 24 Oct. 2025 (Fig. 6.4.3). The acquired data will be analyzed to detect mixed and thermocline layers, and used for air-sea interaction study combined with the other observations.

Fig. 6.4.3 Installation of the MOF

(5) Data archives

The data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

6.5. Wave Glider experiment

(1) Personnel

Iwao Ueki	(JAMSTEC)	Principal investigator
Tatsuya Fukuda	(JAMSTEC)	Not onboard
Yasuhisa Ishihara	(JAMSTEC)	Not onboard
Nobuhiro Fujii	(MWJ)	Operation Leader
Makito Yokota	(MWJ)	
Takayuki Hashimukai	(MWJ)	Not onboard
Shino Sakabe	(MWJ)	Not onboard

(2) Background and objectives

According to the recent progress of unmanned surface vehicles we can utilize those platforms for ocean surface fluxes observation. In our case, we use the Wave Glider as platform and developed meteorological and upper ocean sensors based on technologies for sensor developments and operations associated with ocean surface mooring buoys.

In terms of this cruise, our scientific target is to clarify variability of the air-sea interaction on the northern edge of the Pacific warm pool. For that purpose, we installed one Wave Gliders in the region around northern edge of the Pacific warm pool. The air-sea flux observation by the Wave Glider has advantages as described below.

- Almost all essential variables for air-sea heat flux on the single platform can be observed. Relatively small platform reduces biases based on platform itself.
- Each platform can work as a satellite station at a certain point.

We installed a Wave Glider (S/N: SV3-196) at 12˚ 56.68'N, 136˚ 47.02E in the region around northern edge of the Pacific warm pool to capture detailed structure of air-sea variables. The Wave Glider also used for evaluation for eddy covariance method of turbulent fluxes on moving platform. For that purpose, a 3-axis ultra sonic anemometer system was installed on the Wave Glider.

(3) Instrumentation

The Wave Glider is an unmanned ocean surface vehicle, which utilize both wave energy for propulsion and solar power for supporting on-board computing, communications and sensor payloads. It can travel tens of thousands of miles, collect data in the most demanding conditions, and deliver this data in real time. The Wave Glider consists of two-part architecture; surface float and underwater glider with an umbilical cable (Fig. 6. 5 -1).

As payloads, we install three types of meteorological sensor units on the surface float; the Weather Station, Weather Transmitter, and JAMMET. The observed parameters are air temperature, relative humidity, barometric pressure, longwave radiation, shortwave radiation, wind direction, wind speed and rain fall amount. In terms of underwater sensors, temperature and conductivity sensors and ADCP were installed in the surface float and at the underwater glider. The observed variables are ocean current within 120 m depth, temperature, conductivity and pressure at the ocean surface and underwater glider depth (~ 8 m). The acquired data are recorded on the logger system and transmitted to the land station via iridium satellite communication system.

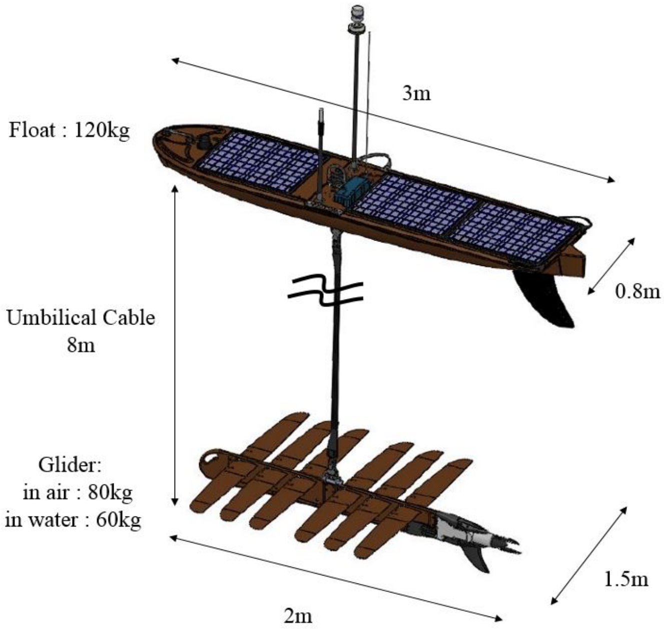

Fig. 6. 5-1 Wave Glider SV3 configuration (from Liquid Robotics Inc.)

(4) Optional sensors

Three axis ultra sonic anemometer system was installed to the rear of the surface float of SV3-196 (Fig. 6.5 -2). The system includes motion sensor and logger in addition to three axis ultra sonic anemometer to conduct wind correction according to motion of the Wave Glider. The system acquired 3-dimensional wind speed, speed of sound, and sonic temperature in every 0.05 sec. The acquired data are recorded on logger.

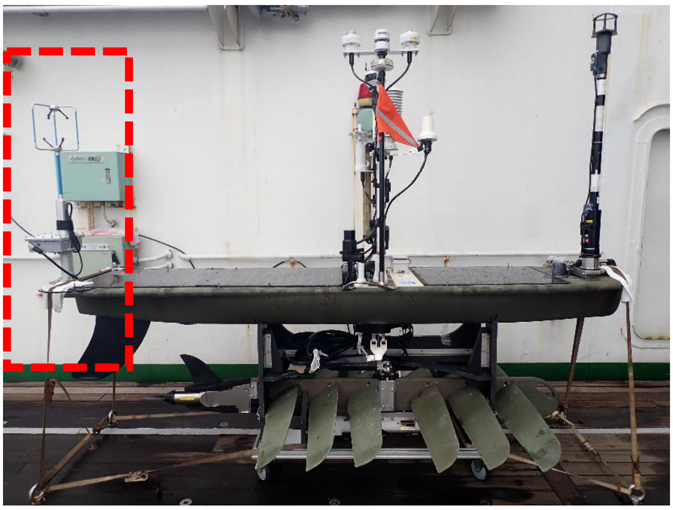

Fig. 6. 5 -2 Three dimensions wind sensor system

(5) Deployment and recovery

The date and time of installation and recovery for the Wave Gliders were listed as below.

S/N: SV3-196

Deployment: 10/23/2025 05:01UTC

Recovery: 10/28/2025 05:11UTC

(6) Mission details

The Wave Glider conducted air-sea flux observation along with FDB and Yo-ko USV from 23 to 28 Oct. 2025. The hourly positions for the Wave Glider are shown in Fig. 6. 5-3.

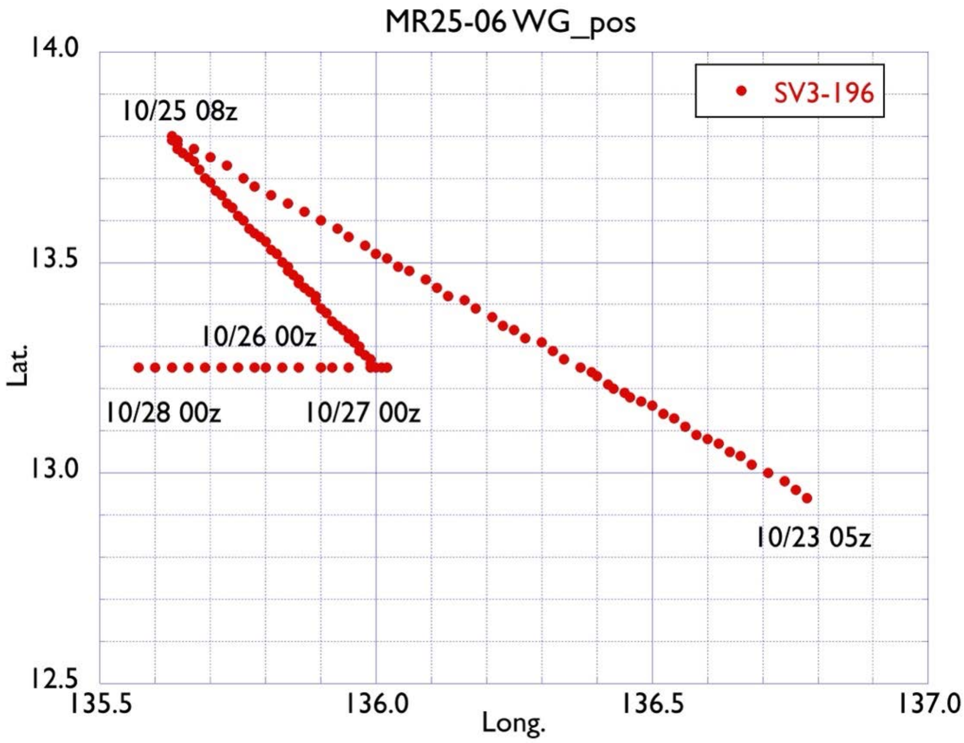

Fig. 6. 5.-3 Cruise track of the Wave Gliders during the mission from 23 to 28 Oct. 2025

(7) Preliminary results

Time series of raw data acquired by the Wave Glider are shown in Fig. 6.5-4. As shown in these figures, measurements of each variable were well conducted. As shown in these figures, measurements of each variable were well conducted. Intercomparison with FDB and Yo-ko USV will be conducted after the cruise.

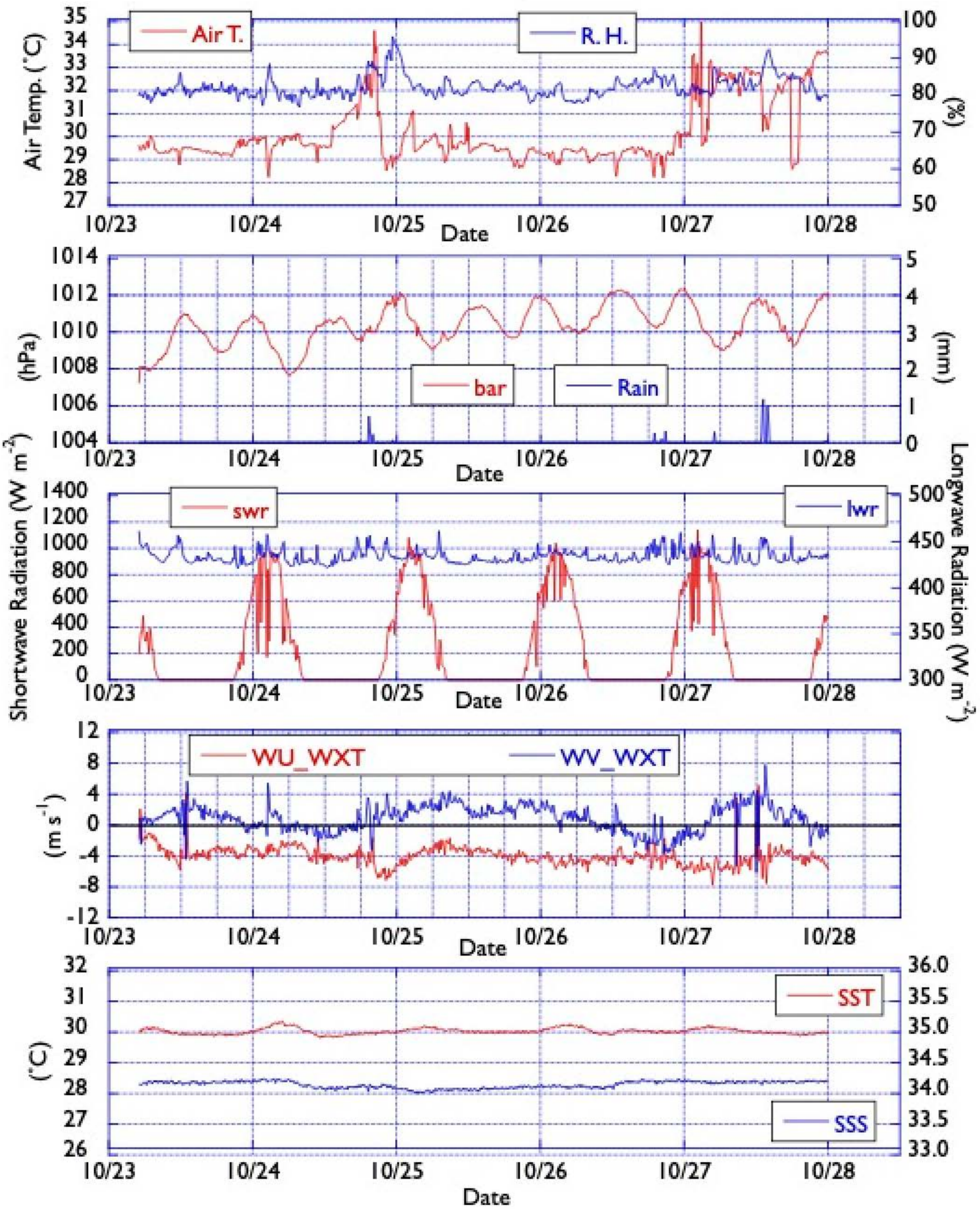

Fig. 6. 5-4 Time series of air temperature and relative humidity at the first row, barometric pressure and precipitation at the second row, shortwave and longwave radiation at the third row, the zonal and meridional wind at the fourth row, and SST, SSS observed by Wave Glider SV3-196.

(5) Data archives

The data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

6.6. Yo-ko USV

(1) Personnel

Kensuke Watari	(JAMSTEC)	Principal investigator
Masaki Katsumata	(JAMSTEC)	Not onboard
Masahiro Kaku	(JAMSTEC)	
Satoshi Tsubone	(JAMSTEC)	
Makito Yokota	(MWJ)	

(2) Objectives

The K-Program Smart Sensing Technology Development Project aims to build an observation network that will mainly complement acoustic propagation and sound source information and improve observation accuracy by using cables to observe the sounds on the seafloor and an offshore platform to measure the environment underwater and at sea. The offshore platform "offshore vehicle" developed in this project is an Uncrewed sailing vessel that is being developed to use wind power to navigate near the target line.

The Uncrewed sailing vessel is an extension of the design of the fixed-point holding platform "VM drone" that has been developed in the Moonshot Project since 2022 and is being developed as a new system with a total length of 3m, with additional batteries, a larger sail, and reduced power consumption of the main unit. This test will be conducted as a confirmation test of the operation of the newly built hull (Fig.1) and will measure the hull's sailing performance and identify problems.

(3) Methods

The prototype uncrewed sailing vessel has the ability to transmit wind direction, speed, temperature, humidity, air pressure, rainfall, and the vessel's status using Iridium communication. The sail angle is adjusted while monitoring wind direction, speed, and vessel inclination, and the vessel is sailed. It is deployed near the KEO observation point and will be retrieved after sailing for a few days. The uncrewed sailing vessel is equipped with two Iridium beacons that transmit position information in case of trouble. In addition, a CTD sensor is built into the weight part of the bottom of the hull, making it possible to measure ocean flux. It is powered by a built-in lithium-ion battery and can operate for about one week.

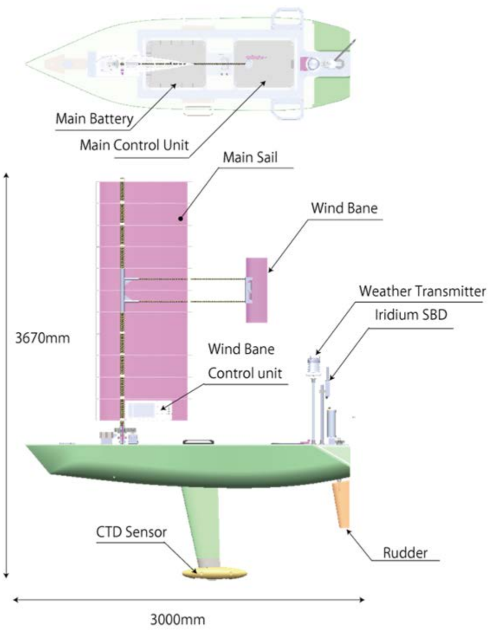

Fig. 6. 6-1 Prototype of Uncrewed sailing vessel

(7) Preliminary results

The unmanned sailing vessel was launched at 8:02 a.m. (UTC) on October 22, 2025, near 13°N and 137°E. It then sailed north through the surrounding waters and was recovered at approximately 8:00 a.m. (UTC) on October 28, near 13.5°N and 135°E. Figure 6-6.4 shows a portion of the vessel's vibration data. During observations, tests were conducted under various conditions, including winds with a maximum instantaneous wind speed exceeding 13 m/s and rainfall. Signs of loosening of screws due to vibration were observed, and some damage occurred. However, the vessel was safely recovered, and vessel and observation data were successfully acquired.

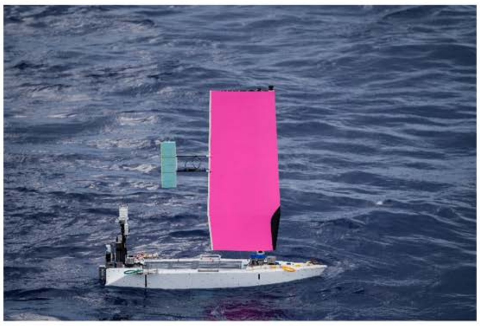

Fig. 6. 6-2 Uncrewed sailing vessel in testing

Fig. 6.6-3 Sunrise seen from the USV

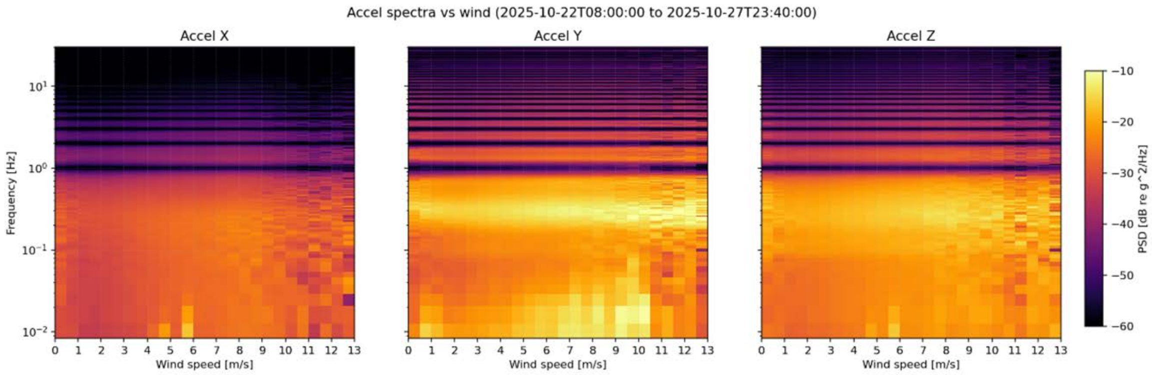

Fig. 6.6-4 Relationship between USV vibration and wind speed

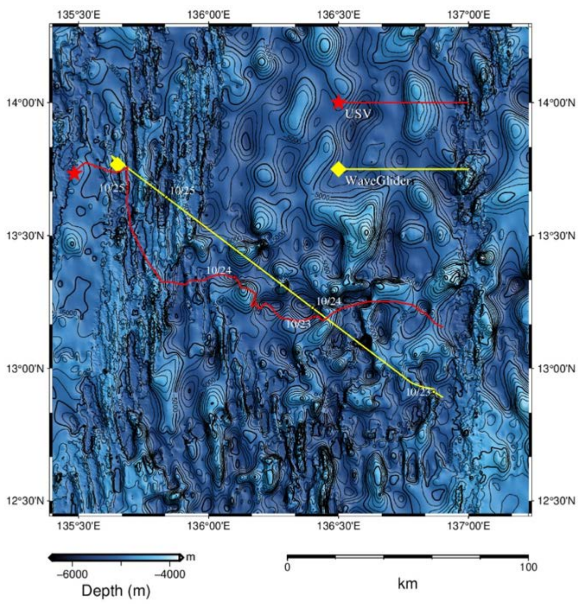

Fig. 6.6-5 Uncrewed Sailing Vessel observation data (Environment)

6.7. CTD observation

(1) Personnel

Iwao Ueki	(JAMSTEC)	Principal investigator
Akira Nagano	(JAMSTEC)	
Tun Htet Aung	(MWJ)	Operation Leader
Riho Fujioka	(MWJ)	
Hinata Sato	(MWJ)	

(2) Objectives

The $CTDO_2$/water sampling measurements were conducted to obtain vertical profiles of seawater properties by sensors and water sampling.

(3) Instrumentations and method

Instruments used in this cruise are as follows:

Winch and cable

Traction winch system (3.0 ton) (Dynacon, Inc., Bryan, Texas, USA)

Armored cable (φ = 9.53 mm) (OCC Corporation, Minato-Mirai, Nishi-ku, Yokohama, Japan)

Compact underwater slip ring swivel (Hanayuu Co., Ltd., Shizuoka, Japan)

Frame

592 kg stainless steel frame for 36-position 12-L water sample bottles

Aluminum rectangular fin (54 × 90 cm) to resist frame’s rotation

Water sampler and sampling bottle

36-position carousel water sampler, SBE 32 (Sea-Bird Scientific, Washington, USA)

Serial no. 3254451-0826

12-L sample bottle, model OTE 110 (Ocean Test Equipment, Inc., Fort Lauderdale, Florida, USA)

(No TEFLON coating, with Viton O-rings)

Deck unit

SBE11plus (Sea-Bird Scientific, Washington, USA)

Serial no. 11P39850-0705

Underwater unit

Pressure sensor, SBE 9plus (Sea-Bird Scientific, Washington, USA)

Serial no. 09P54451-1027（117457） (calibration date: December 06, 2024)

Temperature sensor, SBE 3 (Sea-Bird Scientific, Washington, USA)

Primary, Serial no. 031525 (calibration date: June 14, 2024)

Secondary, Serial no. 03P4418 (calibration date: September 07, 2024)

Conductivity sensor, SBE 4C (Sea-Bird Scientific, Washington, USA)

Primary, Serial no. 043064 (calibration date: January 16, 2025)

Secondary, Serial no. 042854 (calibration date: May 28, 2025)

Dissolved oxygen sensor, Primary, RINKO III (JFE Advantech Co., Ltd., Hyogo, Japan)

Serial no. 0287, Sensing foil no. 163011BA (in situ calibrated on MR25-03 cruise)

Dissolved oxygen sensor, Secondary, SBE 43 (Sea-Bird Scientific, Washington, USA)

Serial no. 430949 (calibration date: December 16, 2023)

Chlorophyll fluorometer (Seapoint Sensors Inc., New Hampshire, USA)

Serial no. 4164, Gain: 30X (0-5 ug/L)

Turbidity meter (Seapoint Sensors Inc., New Hampshire, USA)

Serial no. 14953, Gain setting: 100X (0-25 FTU)

PAR sensor, PAR-Log ICSW (Sea-Bird Scientific, Washington, USA)

Serial no. 1026 (calibration date: July 06, 2015)

Pump, SBE 5T (Sea-Bird Scientific, Washington, USA)

Primary, Serial no. 054595

Secondary, Serial no. 053293

Other additional sensors

Downward looking lowered acoustic Doppler current profiler (LADCP)

Software

Data acquisition software, SEASAVE-Win32, version 7.26.7.121

Data processing software, SBEDataProcessing-Win32, version 7.26.7.129 and some original modules

(4) Data collection and processing

1) Data collection

The CTD system was powered at least 15 minutes in advance of the data acquisition to stabilize the pressure sensor. The data was acquired at least two minutes before and after the CTD cast to collect atmospheric pressure data on the ship's deck.

The CTD package was lowered into the water from the starboard side and held 10 m beneath the surface to activate the pump. After the pump was activated, the package was lifted to the surface and lowered at a rate of 1.0 m/s to 200 m then the package was stopped to operate the heave compensator of the crane. The package was lowered again and at 1.0m/s to the intended maximum depth. The bottle was fired after waiting from the stop for 60 seconds to enhance changing the water between inside and outside of the bottle. At 200m from the surface, the package was stopped to stop the heave compensator of the crane.

2) Data collection problems

During the first cast at station 1, when CTD was lowered to 10m, Bottom Contact Switch (BCS) alarm sounded although BCS was not in use in CTD for this cruise and dummy plus was inserted to the port. CTD was recovered and checked. The dummy plus was replaced with a spare one the CTD was lowered again to 10m and the alarm sounded again. CTD was recovered again, and instead of a dummy plug, 2pin BCS cable was inserted to the port and CTD was lowered again. This time, there was no problem was BCS alarm so the cast was continued as usual.

More detailed information about the irregularities in data (noise, spike or shift, etc.) is recorded in remarks sheet included in data submission.

The definitions of these irregularities are as follows:

noise: not singly but continuously detected outliers.

spike: one-off outlier which is detected after data processing and is oceanographically impossible.

shift: continuous data trend which is deviated from accurate ones.

3) Data processing

The following are the data processing software (SBEDataProcessing-Win32) and original software data processing module sequence and specifications used in reduction of CTD data in this cruise.

(The process in order)

DATCNV converted the raw data to engineering unit data. DATCNV also extracts bottle information where scans were marked with the bottle confirm bit during acquisition. The scan duration to be included in bottle file was set to 3.0 seconds, and the offset was set to 0.0 seconds. The hysteresis and tau correction for the SBE 43 data (voltage) was applied for both profile and bottle information data.

TCORP (original module, version 1.1) corrected the pressure sensitivity of the temperature (SBE3) sensor for both profile and bottle information data (primary sensor only).

RINKOCOR (original module, 1.0) corrected the time-dependent, pressure-induced effect (hysteresis) of the RINKOIII profile data.

RINKOCORROS (original module) corrected the time-dependent, pressure-induced effect (hysteresis) of the RINKOIII bottle information data by using the hysteresis-corrected profile data.

BOTTLESUM created a summary of the bottle data. The data were averaged over 3 seconds.

ALIGNCTD converted the time-sequence of sensor outputs into the pressure sequence to ensure that all calculations were made using measurements from the same parcel of water. For a SBE 9plus CTD with the ducted temperature and conductivity sensors and a 3000-rpm pump, the typical net advance of the conductivity relative to the temperature is 0.073 seconds. So, the SBE 11plus deck unit was set to advance the primary and the secondary conductivity for 1.73 scans (1.75/24 = 0.073 seconds). Oxygen data are also systematically delayed with respect to depth mainly because of the long time constant of the oxygen sensor and of an additional delay from the transit time of water in the pumped plumbing line. This delay was compensated by 4 seconds advancing the SBE 43 oxygen sensor output (voltage) relative to the temperature data. Delay of the RINKOIII data was also compensated by 1 second advancing sensor output (voltage) relative to the temperature data. Delay of the transmissometer data was also compensated by 2 seconds advancing sensor output (voltage) relative to the temperature data.

WILDEDIT marked extreme outliers in the data files. The first pass of WILDEDIT obtained the accurate estimate of the true standard deviation of the data. The data were read in blocks of 1000 scans. Data greater than 10 standard deviations were flagged. The second pass computed a standard deviation over the same 1000 scans excluding the flagged values. Values greater than 20 standard deviations were marked bad. This process was applied to pressure, depth, temperature, conductivity, and SBE 43 output.

CELLTM used a recursive filter to remove conductivity cell thermal mass effects from the measured conductivity. Typical values for SBE 9plus with TC duct and 3000 rpm pump which were 0.03 for thermal anomaly amplitude alpha and 7.0 for the time constant 1/beta were used.

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

WFILTER performed as a median filter to remove spikes in fluorometer and transmissometer data. A median value was determined by 49 scans of the window.

SECTIONU (original module, version 1.1) selected a time span of data based on scan number in order to reduce a file size. The minimum number was set to be the starting time when the CTD package was beneath the sea-surface after activation of the pump. The maximum number was set to be the end time when the depth of the package was 1 dbar below the surface. The minimum and maximum numbers were automatically calculated in the module.

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

DESPIKE (original module, version 1.0) removed spikes of the data. A median and mean absolute deviation was calculated in 1-dbar pressure bins for both down and up cast, excluding the flagged values. Values greater than 4 mean absolute deviations from the median were marked bad for each bin. This process was performed twice for temperature, conductivity and RINKOIII output.

DERIVE was used to compute dissolved oxygen (SBE43), salinity, potential temperature, and sigma-theta.

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

BOTTOMCUT (original module, version 0.1) deleted the deepest pressure bin when the averaged scan number of the deepest bin was smaller than the average scan number of the bin just above.

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

(5) Data archive

The data obtained in this cruise will be submitted to the Data Management Group of JAMSTEC.

Table 6.7.1 MR25-06 CTD cast table

MR25-06 CTD cast table														
Stnnbr	Castno	Date(UTC)	Time(UTC)		BottomPosition		Depth	Wire	HT Above	Max	Max	CTD	Remark
		(mmddyy)	Start	End	Latitude	Longitude	(m)	Out (m)	Bottom (m)	Depth	Pressure	Filename	
ST1	001	102025	11:06	11:44	13-29.96N	136-59.89E	5152.0	992.6	-	992.8	1001.0	ST1M001	
ST2	001	102125	05:12	06:11	12-54.79N	136-50.58E	5219.0	991.5	-	993.8	1002.0	ST2M001	
ST2	002	102225	06:48	07:45	13-09.33N	136-54.16E	5249.0	992.6	-	992.8	1001.0	ST2M002	
ST3	001	103025	00:48	01:27	16-59.97N	143-00.15E	2839.0	994.3	-	992.7	1001.0	ST3M001	
ST4	001	103025	23:09	23:46	16-59.95N	142-00.05E	4503.0	997.6	-	993.6	1002.0	ST4M001	
ST5	001	103125	05:49	06:25	17-00.09N	140-59.99E	4805.0	991.5	-	991.7	1000.0	ST5M001	
ST6	001	103125	23:07	23:44	17-00.04N	139-59.98E	4543.0	995.0	-	993.6	1002.0	ST6M001	
ST7	001	110325	09:13	10:19	28-30.00N	139-59.97E	2321.0	1981.3	-	1978.2	2001.0	ST7M001	

6.8. Water sampling

6.8.1. Salinity

(1) Personnel

Iwao Ueki	(JAMSTEC)	Principal investigator
Akira Nagano	(JAMSTEC)	
Makito Yokota	(MWJ)	Operation Leader
Akira Watanabe	(MWJ)	
Kai Iwasaki	(MWJ)	

(2) Objectives

To calibrate the measurements of salinity collected from CTD casts, and to provide the data for bucket sampling and underway surface water monitoring system.

(3) Instrumentation and methods

1) Sampling

Seawater samples were collected with 12 Liter water sampling bottles and underway surface water monitoring system. The 250 ml brown glass bottles with screw cap were used for collecting the sample water. Each bottle was rinsed 3 times with the sample water and was filled with sample water to the bottle shoulder. Each bottle was stored for more than 24 hours in the laboratory before the salinity measurement.

The numbers of each sampling system are summarized as follows.

Table 6.8.1-1: Number of samples

Sampling system	Number
CTD cast	14
Underway surface water monitoring system	16

2) Instruments and Method

The salinity analysis was carried out on R/V MIRAI during the cruise of MR25-06 using the salinometer (Model 8400B “AUTOSAL”; Guildline Instruments Ltd.: S/N 62556) with an additional peristaltic-type intake pump (Ocean Scientific International, Ltd.). A pair of precision digital thermometers (1502A; FLUKE: S/N B78466 and B81549) were used for monitoring the ambient temperature and the bath temperature of the salinometer.

The specifications of the AUTOSAL salinometer and thermometer are shown as follows:

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

Measurement Range : 0.005 to 42 (PSU)
Accuracy : Better than ±0.002 (PSU) over 24 hours
Maximum Resolution : Better than ±0.0002 (PSU) at 35 (PSU)

Thermometer (1502A: FLUKE)

Measurement Range : 16 to 30 deg C (Full accuracy)
Resolution : 0.001 deg C
Accuracy : 0.006 deg C (0 deg C)

The measurement system was almost the same as Aoyama et al. (2002). The salinometer was operated in the air-conditioned ship's laboratory at a bath temperature of 24 deg C. The ambient temperature varied from approximately 22 to 24 deg C, while the bath temperature was very stable and varied within +/- 0.002 deg C on rare occasion. The measurement for each sample was done with a double conductivity ratio and defined as the median of 34 readings of the salinometer. (Acquisition of the 34 readings took about 11 seconds when the function dial was turned to the 'read' setting) Data were taken after rinsed 5 times with the sample water. The double conductivity ratio of sample was calculated from average value of two measurements. And it was used to calculate the bottle salinity with the algorithm for the practical salinity scale, 1978 (UNESCO, 1981). In the case of the difference between the double conductivity ratio of these two measurements being greater than or equal to 0.00003, continue to be measured up to 3 times. The difference between the double conductivity ratio of these two measurements being smaller than 0.00002 were selected. The measurement was conducted for about 4 hours per day, and the cell was cleaned with neutral detergent after the measurement each day.

(5) Preliminary results

1) Standard Seawater

Standardization control of the salinometer was set to 627. The value of STANDBY was 24+5145 to 5147 and that of ZERO was 0.0±0000. The IAPSO Standard Seawater (SSW) batch P168 was used as the salinity reference standard. The specifications of SSW batch P168 are as follows:

Batch: P168
Conductivity ratio: 0.99993
Salinity: 34.997
Expiry : 1st December. 2026

Three bottles of SSW batch P168 were analyzed before and after the sample measurements. The mean value of the double conductivity ratio obtained during these measurements was 1.99983. Accordingly, the double conductivity ratio was corrected to 1.99986, which is the specified value for SSW batch P168. The resulting standard deviation was 0.00001, corresponding to 0.0002 in practical salinity.

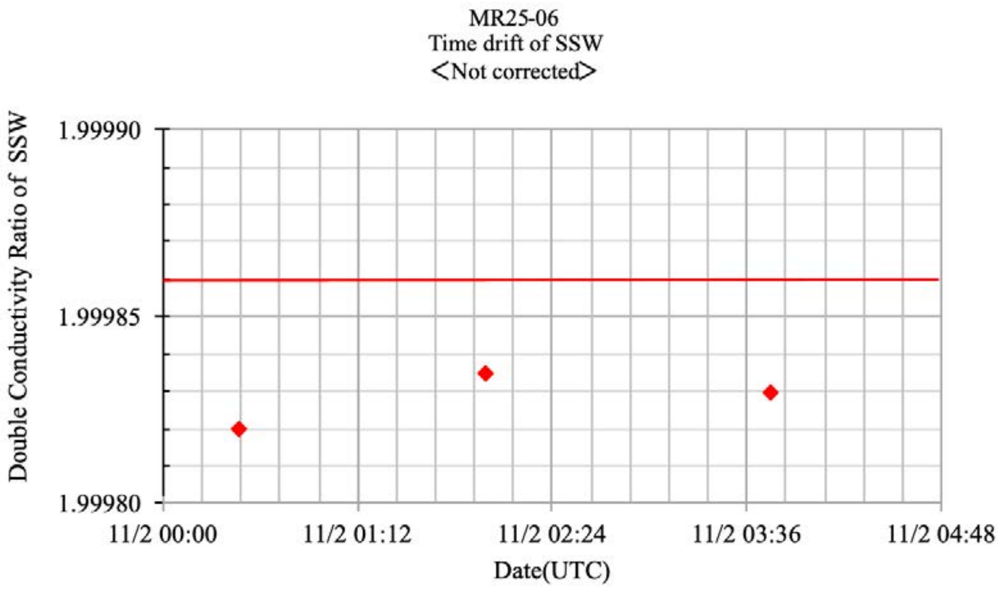

Fig. 6.8.1-1: Time series of double conductivity ratio for the Standard Seawater (before correction)

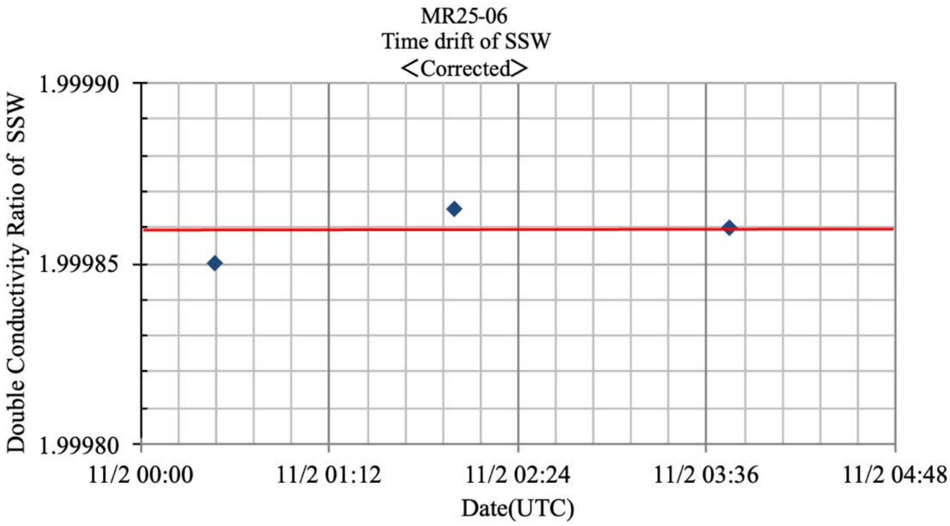

Fig. 6.8.1-2: Time series of double conductivity ratio for the Standard Seawater (after correction)

2) Sub-Standard Seawater

Sub-standard seawater was made from surface sea water filtered by a pore size of 0.45 micrometer and stored in a 20 Liter container made of polyethylene and stirred for at least 24 hours before measuring. It was measured about every 6 samples to check for the possible sudden drifts of the salinometer.

3) Replicate Samples

We estimated the precision of this method using 7 pairs of replicate samples taken from the same water sampling bottle. The average and the standard deviation of absolute difference among 7 pairs of replicate samples were 0.0007 and 0.0006 in salinity, respectively.

(5) Data archives

The data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

(6) References

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

UNESCO (1981): Tenth report of the Joint Panel on Oceanographic Tables and Standards. UNESCO Tech. Papers in Mar. Sci., 36, 25 pp.

6.8.2. Dissolved Oxygen

(1) Personnel

Iwao Ueki	(JAMSTEC)	Principal investigator
Akira Nagano	(JAMSTEC)	
Misato Kuwahara	(MWJ)	Operation Leader

(2) Objectives

Determination of dissolved oxygen in seawater by Winkler titration.

(3) Instruments and Methods

The following procedure is based on Winkler method (Dickson, 1996; Culberson, 1991).

1) Instruments

Burette for sodium thiosulfate and potassium iodate;

Automatic piston burette (APB-510 / APB-610) manufactured by Kyoto Electronics Manufacturing Co., Ltd. / 10 cm^3 of titration vessel

Detector;

Automatic photometric titrator (DOT-15X) manufactured by Kimoto Electric Co., Ltd.

Software;

DOT 15X_Terminal Ver. 1.3.1

2) Reagents

Pickling Reagent I:

Manganese (II) chloride solution (3 mol dm^{-3})

Pickling Reagent II:

Sodium hydroxide (8 mol dm^{-3}) / Sodium iodide solution (4 mol dm^{-3})

Sulfuric acid solution (5 mol dm^{-3})

Sodium thiosulfate (0.025 mol dm^{-3})

Potassium iodate (0.001667 mol dm^{-3})

3) Sampling

Seawater samples were collected with sample bottles attached to the CTD/Carousel Water Sampling System (CTD system). Seawater for oxygen measurement was transferred from the bottle to a volume calibrated flask (ca. 100 cm^3), and two times the volume of the flask overflowed. Temperature was simultaneously measured by q digital thermometer during the overflowing. After transferring the sample, two reagent solutions (Reagent I and II) of 1 cm^3 each were added immediately, and the stopper was inserted carefully into the flask. The sample flask was then shaken vigorously to mix the contents and to disperse the precipitate finely throughout. After the precipitate had settled at least halfway down the flask, the flask was shaken again vigorously to disperse the precipitate. The sample flasks containing pickled samples were stored in a laboratory until they were titrated.

4) Sample measurement

For over two hours after the re-shaking, the pickled samples were measured on board. Sulfuric acid solution with its volume of 1 cm^3 and a magnetic stirrer bar were put into the sample flask, and the sample was stirred. The samples were titrated by a sodium thiosulfate solution whose morality was determined by potassium iodate solution. Temperature of sodium thiosulfate during titration was recorded by a digital thermometer. Dissolved oxygen concentration (μmol kg^{-1}) was calculated by sample temperature during seawater sampling, salinity of the sensor on CTD system, flask volume, and titrated volume of sodium thiosulfate solution without the blank. During this cruise, 1 set of titration apparatus was used.

5) Standardization and determination of the blank

Concentration of sodium thiosulfate titrant was determined by potassium iodate solution. Pure potassium iodate was dried in an oven at 130 ºC, and 1.7835 g of it was dissolved in deionized water and diluted to a final weight of 5 kg in a flask. After 10 cm^3 of the standard potassium iodate solution was added to another flask using a volume-calibrated dispenser, 90 cm^3 of deionized water, 1 cm^3 of sulfuric acid solution, and 1 cm^3 of pickling reagent solution, II and I were added in order. The amount of titrated volume of sodium thiosulfate for this diluted standard potassium iodate solution (usually 5 times measurements average) gave the morality of sodium thiosulfate titrant.

The oxygen in the pickling reagents I (1 cm^3) and II (1 cm^3) was assumed to be 7.6×10^{-8} mol (Murray et al., 1968). The blank due to other than oxygen was determined as follows. First, 1 and 2 cm^3 of the standard potassium iodate solution were added to each flask using a calibrated dispenser. Then 100 cm^3 of deionized water, 1 cm^3 of sulfuric acid solution, 1 cm^3 of pickling II reagent solution, and same volume of pickling I reagent solution were added into the flask in order. The blank was determined by difference between the first (1 cm^3 of potassium iodate) titrated volume of the sodium thiosulfate and the second (2 cm^3 of potassium iodate) one. The titrations were conducted 3 times, and their average was used as the blank value.

(4) Observation log

1) Standardization and determination of the blank

The values of the standardization and the blank for this cruise are summarized in Table 6.8.2-1.

Table 6.8.2-1 Results of the standardization and the blank determination during the cruise

Date (yyyy/mm/dd)	Potassium iodate ID	Sodium thiosulfate ID	DOT-15X (No.9)		Stations
			E.P. (cm^3)	Blank (cm^3)	
2025/10/18	K25C01	T-24O	3.951	-0.002	
2025/10/21	K25C02	T-24O	3.951	0.001	ST2M001, ST2M002

2) Repeatability of sample measurement

Replicate samples were taken at every CTD cast. The standard deviation of the replicate measurement (Dickson et al., 2007) was 0.20 μmol kg^{-1} (n=4).

(5) Data archives

The data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

(6) References

Culberson, C. H. (1991). *Dissolved Oxygen.* WHPO Publication 91-1.

Dickson, A. G. (1996). Determination of dissolved oxygen in sea water by Winkler titration. In *WOCE Operations Manual*, Part 3.1.3 Operations & Methods, WHP Office Report WHPO 91-1.

Dickson, A. G., Sabine, C. L., & Christian, J. R. (Eds.), (2007). *Guide to best practices for ocean CO_2 measurements, PICES Special Publication 3*: North Pacific Marine Science Organization.

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

6.9. LADCP observation

(1) Personnel

Akira Nagano	(JAMSTEC)	Principal investigator
Iwao Ueki	(JAMSTEC)	
Tun Htet Aung	(MWJ)	Operation Leader
Riho Fujioka	(MWJ)	
Hinata Sato	(MWJ)	

(2) Objectives

The objective of the LADCP observation is to obtain current velocity profiles at the northern edge of the Pacific warm pool.

(3) Instruments and Methods

A lowered acoustic doppler current profiler (LADCP) was integrated with the CTD system. The instrument used in this cruise was a Teledyne RD Instruments (San Diego, CA) Workhorse Monitor 300 kHz ADCP (WHM300-I-UG-500, S/N 22899, CPU firmware Ver.50.40).

The instrument was powered by a battery pack during the CTD casts and has 4 downward-looking transducers with 20-degree beam angles, performed direct current measurements below the CTD frame, providing profiles of current velocity. Prior to each cast, the LADCP unit was set to record data internally. After each cast, the internally stored data were uploaded to a computer. By combining measured velocity of seawater with respect to the instrument and shipboard navigation data during a CTD cast, an absolute velocity profile was obtained by using LDEO LADCP processing software (Visbeck 2002; the software is maintained by A. Thunherr and available on GitHUB linked to his website [https://www.ldeo.columbia.edu/~ant/LADCP.html]).

(4) Data collection

In this cruise, data were collected with the following configuration.

Depth cell size (in cm): 800 (For sites/casts ST01M001 and ST02M001: 200)
Number of Depth cells: 25
Pings per ensemble: 1
Time between pings in mm:ss: 00:01.00 (For sites/casts ST01M001 and ST02M001: 00:00.25)
Bandwidth: broad

(5) Preliminary results

By using LDEO LADCP processing software Version IX_15, we obtained the absolute current velocity profiles (Fig. 6.9-1). In addition to the westward flowing North Equatorial Current (Fig. 6.9-1a), current velocity fluctuations with vertical scales of ~50–200 m were observed.

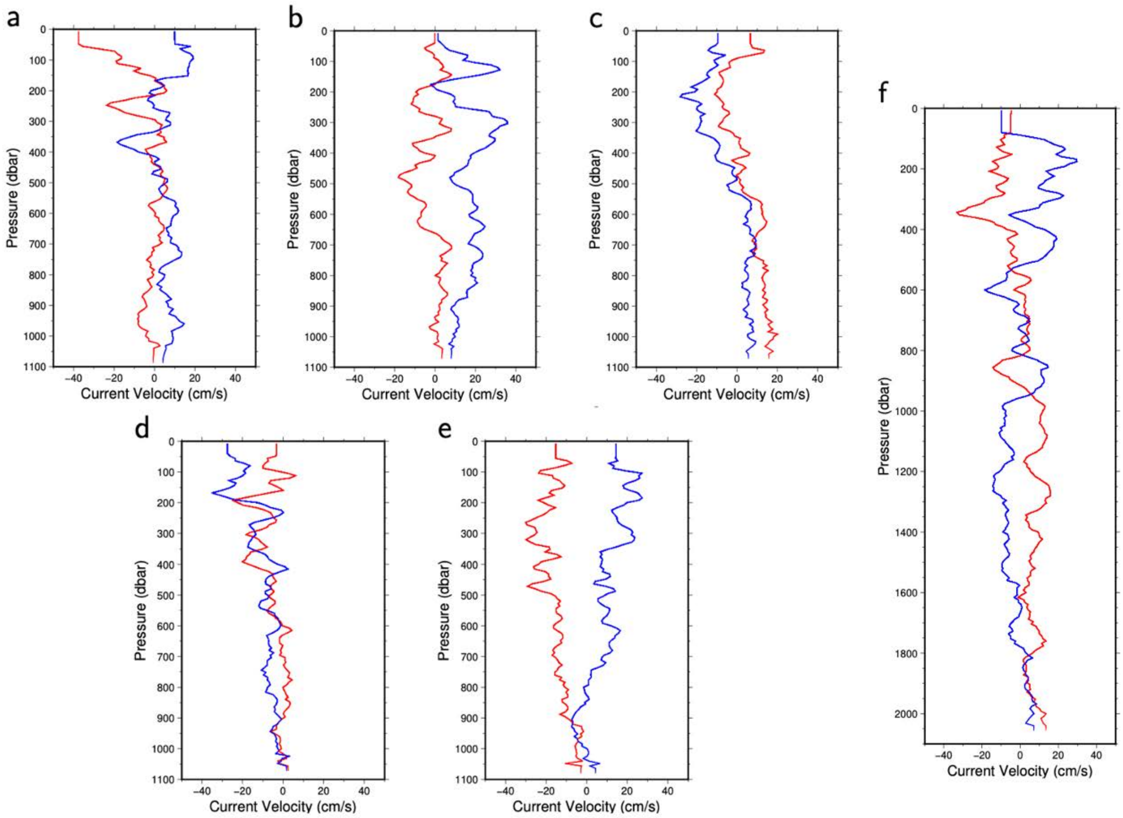

Fig. 6.9-1: Vertical profiles of eastward (red lines) and northward (blue lines) current velocity components at (a) ST2 (PHSMO site), (b–e) ST3, ST4, ST5, ST6 (west of the Mariana Arc), and (f) ST7 (Core Argo float deployment site).

(6) Data archives

The data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

(7) References

Visbeck, M. (2002): Deep velocity profiling using Lowered Acoustic Doppler Current Profilers: Bottom track and inverse solutions. *J. Atmos. Oceanic Technol.*, **19**, 794-807.

6.10. Turbulence microstructure measurements by TurboMAP

(1) Personnel

Iwao Ueki	(JAMSTEC)	Principal investigator
Akira Nagano	(JAMSTEC)	
Ryuichiro Inoue	(JAMSTEC)	
Yutaro Murakami	(NME)	Operation Leader
Satomi Ogawa	(NME)	
Haruna Yamanaka	(NME)	
Masanori Murakami	(NME, Crew)	

(2) Objectives

There are several processes to control turbulent mixing in the upper ocean; temperature/density shear at the bottom of mixed layer, diurnal deep cycle turbulence, shear of the current, effect of waves, and so on. The western tropical Pacific Ocean is characterized by deeper thermocline and thick warm water above it. Heavy precipitation and large amplitude of diurnal cycle based on radiation produce relatively complicated density structure within upper ocean. In addition, the Mariana Arc is known as a significant generation area for internal tides, which propagate to the west. The geometric shape of the arc, which has the radius of ~630 km centered at 17˚N and 139.6˚E. Based on this geometric structure, it is considered that the westward propagating internal tides generated around the Mariana Arc make a focus at its center, then tidal energy, thus turbulent activity will be increased at the focus (Zhao and D'Asaro, 2011). These characters are strongly connected distribution of turbulent mixing. In recent years, it is widely recognized that understanding small-scale turbulent structure is necessary to understand turbulent mixing in the ocean.

According to these backgrounds, we conducted turbulent microstructure measurements in the upper ocean along the 17˚N from 143˚E to 140˚E to obtain vertical shear structure of temperature and horizontal current. We also estimated dissipation rates of turbulent kinematic energy (ε) and temperature variance (χ).

(3) Instrumentation

To measure micro-scale turbulence structure, we use Turbulence Ocean Microstructure Acquisition Profiles (TurboMAP) manufactured by JFE Advantech Co. Ltd. TurboMAP is a free-falling profiler equipped with state-of-the-art sensors for measuring velocity shear ($\partial u/\partial t$, will be converted into $\partial u/\partial z$), temperature gradient ($\partial T/\partial t$, will be converted into $\partial T/\partial z$), fluorescence, turbidity, and hydrographic parameters of conductivity, temperature and pressure. All sensors are mounted on a parabolic nose cone (Fig. 6. 10. -1) that points towards the undisturbed flow. The specifications of the sensors on the TurboMAP are as follows:

Table 6. 10. -1 variables measured with TurboMAP

Variables	Type	Range	Accuracy	Resolution
Shear ($\partial u/\partial t$)	Shear probe	0 ~ 10 s^{-1}	5 %	~ 1 x 10^{-4} s^{-1}
Fast temperature ($\partial T/dt$)	FP07 fast response thermistor	-5 ~ 45 ˚C	1 x 10^{-2} ˚C	< 1 x 10^{-4} ˚C
Slow temperature	Platinum wire thermometer	-5 ~ 45 ˚C	1 x 10^{-2} ˚C	1 x 10^{-3} ˚C
Conductivity	Inductive cell	0 ~ 7 S m^{-1}	1 x 10^{-3} S m^{-1}	2 x 10^{-4} S m^{-1}
Pressure	Semiconductor strain gauge	0 ~ 1000 dbar	2 %FS	1 x 10^{-2} dbar
Acceleration (x, y, z)	Solid-state fixed mass	+/- 2G	1 %FS	5 x 10^{-4} G
Fluorescence	Fluorescence	0 ~ 100 ppb	0.5 ppb	5 x 10^{-3} ppb
Turbidity	Backscatter	0 ~ 100 ppm	1 ppm	5 x 10^{-3} ppm

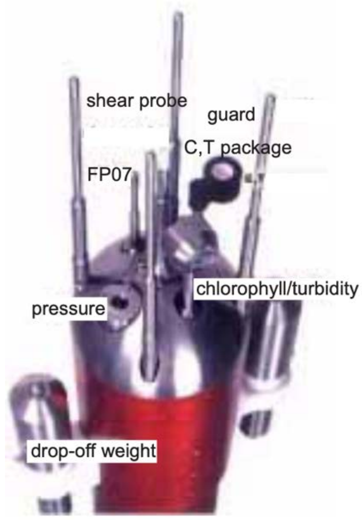

Fig. 6. 10. -1 Sensors on TurboMAP (from TurboMAP brochure/ JFE Advantech Co. Ltd.)

TurboMAP is installed into the ocean with a thin Kevlar rope which is paid out slightly faster than the instrument's sinking velocity. This install technique ensures a free descent of the instrument so that the velocity measurements are not contaminated by vibrations. Data are collected during the downcast at a rate of 512 samples per second.

The length of TurboMAP's pressure case ensures that the low-wavenumber part of the measured turbulence spectrum is not contaminated by the instrument's low-frequency motions. Since the turbulence spectrum begins at a wavenumber of one cpm (one meter wavelength), the length of TurboMAP is two meters.

The following sensors were used for this cruise.

TurboMAP-L:	S/N 34, including CTD, Acceleration, Fluorescence, and Turbidity
Shear Probe #1:	S/N 3248
Shear Probe #2:	S/N 3249
FP07:	S/N 306

(4) Operation and data processing

TurboMAP is installed into the ocean with crane at the starboard side and a special winch, which is mounted on side deck of R/V Mirai (Fig. 6. 10. -2). The winch operator adjusts the drum speed so that the paid-out speed of the rope should be slightly faster than the instrument descending speed. This procedure ensures that the instrument is decoupling from the vessel's motion. After reaching the bottom depth of the observation, the winch is reversed and the instrument is returned to the surface.

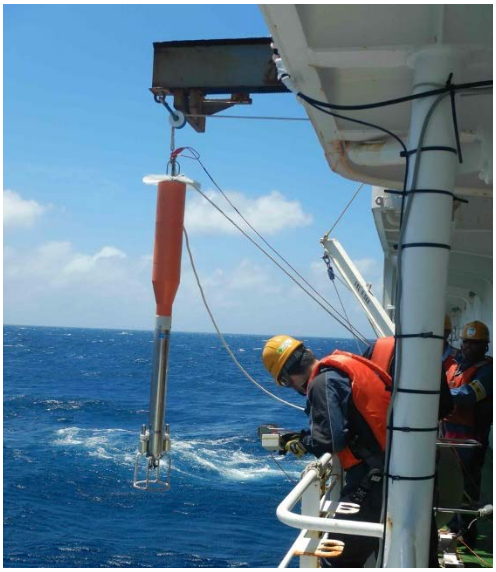

Fig. 6. 10. -2 Operation of TurboMAP on R/V Mirai

The obtained data was monitored and stored in PC on the vessel in real-time. The software “TMtools” (Ver. 3.04D) were used to monitor, record and process the data. We conducted turbulence microstructure measurements in the upper ocean at 4 sites along the 17˚N from 143˚E to 140˚E. The instrument was operated to obtain profiles down to 500 m depth. The 2-3 casts were basically conducted at each site with CTD/LADCP. All of the conducted casts are listed in Table 6. 10. -2.

Table 6. 10. -2 List of the TurboMAP casts

No.	St.	Date	Latitude	Longitude	Logging Time		Depth [m]	Observation Depth[m]	Wire Length [m]	Note
					Start	Stop				
01	3	2025/10/30	17-00.10N	143-00.18E	01:36	01:55	4904	714	830	miss cast
02	3	2025/10/30	17-00.42N	143-00.18E	02:18	02:49	2842	N/A	730	miss cast
03	3	2025/10/30	17-00.67N	143-00.18E	02:53	03:09	2842	644	750	miss cast
04	3	2025/10/30	17-00.05N	143-00.32E	04:30	04:45	2911	565	640	
05	3	2025/10/30	17-00.32N	143-00.28E	04:56	05:10	2911	527	580	
06	3	2025/10/30	17-00.54N	143-00.25E	05:21	05:35	2911	525	580	
07	4	2025/10/30	16-59.91N	142-00.16E	23:56	00:08	4508	497	630	
08	4	2025/10/31	17-00.08N	142-00.19E	00:21	00:35	4508	525	620	
09	5	2025/10/31	17-00.08N	141-00.06E	06:32	06:46	4805	499	750	
10	5	2025/10/31	17-00.20N	141-00.07E	06:58	07:12	4805	554	880	
11	6	2025/10/31	17-00.15N	139-59.87E	23:53	N/A	4528	N/A	N/A	miss cast
12	6	2025/11/01	17-00.46N	139-59.71E	00:10	00:27	4528	628	790	
13	6	2025/11/01	17-01.06N	139-59.45E	00:47	01:01	4528	571	680	
14	6	2025/11/01	17-01.51N	139-59.22E	01:16	01:31	4528	584	680	

(5) Preliminary results

We got vertical profiles of the turbulent velocity and temperature shear, in addition to those of temperature conductivity at 4 sites. The acquired profiles of turbulent velocity and temperature at each site are shown in Fig. 6. 10.-3. As shown, large values of turbulent velocity shear occur not only near the bottom of the mixed layer but also exhibits a significant peak at a depth of approximately 200–250 m. This lower-layer maximum, within the thermocline, indicates largest value near 140E, suggesting the influence of the Mariana Arc's geometry. The detailed analysis for turbulent mixing will be conducted after cruise.

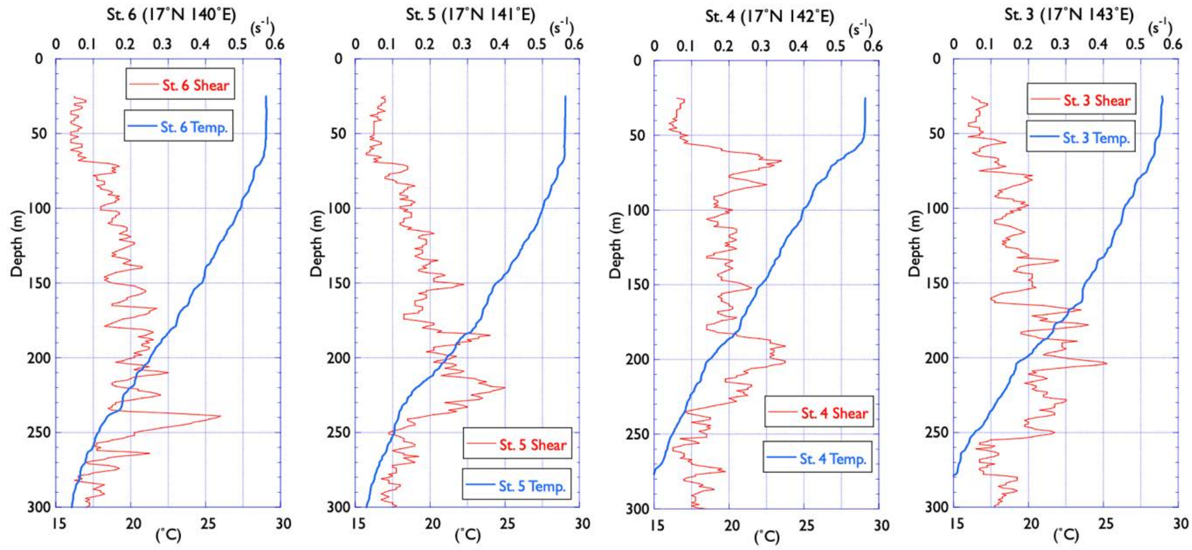

Fig. 6. 10. -3 Observed shear of turbulent velocity at St. 3, 4, 5 and 6.

(6) Data archives

The data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

(7) References

Zhao, Z. and E. D'Asaro (2011): A perfect focus of the internal tide from Mariana Arc. *Geophys. Res. Lett.*, **38**, L14609, doi:10.1029/2011GL047909.

6.11. Radio sonde observation

(1) Personnel

Iwao Ueki	(JAMSTEC)	Principal investigator
Masaki Katsumata	(JAMSTEC)	Not on board
Akira Nagano	(JAMSTEC)	
Kyoko Taniguchi	(JAMSTEC)	
Yutaro Murakami	(NME)	Operation Leader
Satomi Ogawa	(NME)	
Haruna Yamanaka	(NME)	
Masanori Murakami	(NME, Crew)	

(2) Objectives

The objective of this observation is to obtain vertical profiles and temporal variations of air temperature, relative humidity, and wind speed/direction.

(3) Instrumentation and methods

Radiosonde provides atmospheric parameters as ascending the sky with a weather balloon. The obtained data is transmitted via radio to the receiver onboard.

The sensors in this cruise were Vaisala RS-41SGP. The sensor was prepared and calibrated with ground check device (Vaisala RI41) operated by Vaisala MW41 software. For calibration reference, observation value from a barometer (Vaisala PTB-330) near RI41 was applied. The sensor with a balloon (Totex TA-200) was launched from the shipboard balloon launcher. Foremast metrological observations (Section 7.1.1) were referred as the surface condition at launch. After launch, MW41 recorded and processed the sounding data, with a processor (Vaisala SPS-311), GPS antenna (GA20), and UHF antenna (RB21).

(4) Preliminary results

During this cruise, radiosonde observation obtained 57 profiles, as listed in Table 6.10-1. Emagrams of all radiosonde observations are shown in Fig. 6.10-1.

Table 6.10-1: Radiosonde launch log, with surface observations and maximum height.

ID	Date	Launched Location		Surface Observation						Max Height	Cloud at Launch	
	YYYYMMDDHH	Latitude	Longitude	P	T	RH	WD	WS	SST			
		deg	deg	hPa	degC	%	deg	m/s	degC	m	Amount	Type
RS001	2025101612	32.790	138.402	1014.0	27.1	74	231	9.6	25.29	24401	6	Cu
RS002	2025101700	30.353	138.256	1016.6	27.1	74	323	6.2	28.23	25139	3	Cu, As
RS003	2025101712	27.838	138.000	1016.2	27.3	75	83	7.9	28.23	25004	3	Cu
RS004	2025101800	25.378	137.782	1014.9	28.8	77	101	10.5	28.35	24012	4	Cu
RS005	2025101812	22.984	137.636	1012.7	29.2	76	91	12.9	29.41	21727	2	Cu, As
RS006	2025101900	20.636	137.515	1010.7	29.3	76	81	10.4	29.59	24285	6	Cu, As, Ac, Cs
RS007	2025101912	18.269	137.303	1009.1	29.2	80	69	11.0	29.92	18664	3	Cu, As
RS008	2025102000	15.789	137.270	1007.2	29.9	76	67	11.5	29.82	25338	4	Cu, As, Cs, Nb
RS009	2025102006	14.558	137.072	1002.8	29.0	71	70	11.9	29.89	20961	3	Cu, As, Sc
RS010	2025102012	13.499	136.998	1004.6	29.0	83	37	10.3	29.91	25419	4	Cu, As, Nb
RS011	2025102018	13.463	137.027	1003.0	28.6	79	43	8.1	29.91	24101	5	Cu, Nb
RS012	2025102100	13.499	137.062	1005.2	29.3	78	67	8.6	29.93	26784	5	Nb, Cu, As, Ac, Ci
RS013	2025102106	12.913	136.844	1001.4	29.8	79	103	6.4	30.00	24532	7	Cu, St, Sc, As
RS014	2025102112	13.046	136.864	1005.2	29.2	81	105	6.2	29.95	22009	1	Nb, Cu, As
RS015	2025102118	13.100	136.930	1004.2	28.9	81	140	5.5	29.91	24926	6	Nb, As
RS016	2025102200	13.268	136.843	1006.7	29.4	81	160	3.1	29.95	25643	5	Nb, Cu, As, Cs, Ci, Ac
RS017	2025102206	13.118	136.937	1004.2	29.2	78	124	6.8	30.17	25463	7	As, Cu, Sc, St
RS018	2025102212	13.001	136.936	1007.0	29.0	81	79	3.0	29.98	24491	8	unknown
RS019	2025102218	13.022	136.918	1005.4	28.5	83	116	4.6	29.90	25695	7	unknown
RS020	2025102300	12.914	136.857	1007.4	28.5	83	126	5.7	29.87	27391	9	As, Cu, Nb, Ci
RS021	2025102306	12.944	136.783	1006.0	29.0	78	121	3.7	30.14	28099	9	Cu, Sc, St
RS022	2025102312	12.999	137.133	1008.6	29.3	76	110	8.5	29.95	24770	7	As
RS023	2025102318	12.979	137.150	1006.7	29.0	79	92	6.0	29.84	25518	2	Cu
RS024	2025102400	12.981	137.129	1008.7	29.3	83	94	6.3	29.87	18243	4	Ns, Cu, As, Ci
RS025	2025102406	12.973	137.119	1005.5	29.5	77	75	4.6	30.19	27209	8	Cu, Ns, Ci
RS026	2025102412	12.303	137.001	1007.8	27.1	85	69	12.3	30.05	24745	10	Ns
RS027	2025102418	11.079	136.999	1006.6	28.4	85	133	8.5	30.17	17517	10	Nb
RS028	2025102500	9.859	137.001	1008.7	28.8	78	118	7.8	30.16	27795	9	Ns, Cu, Ac, Cc, Ci
RS029	2025102512	8.001	136.404	1007.7	29.6	73	100	6.8	30.32	24174	2	Cu, As, Cs
RS030	2025102600	9.075	135.001	1008.6	29.7	77	89	7.4	30.39	25858	9	Ns, Cu, As, Ci

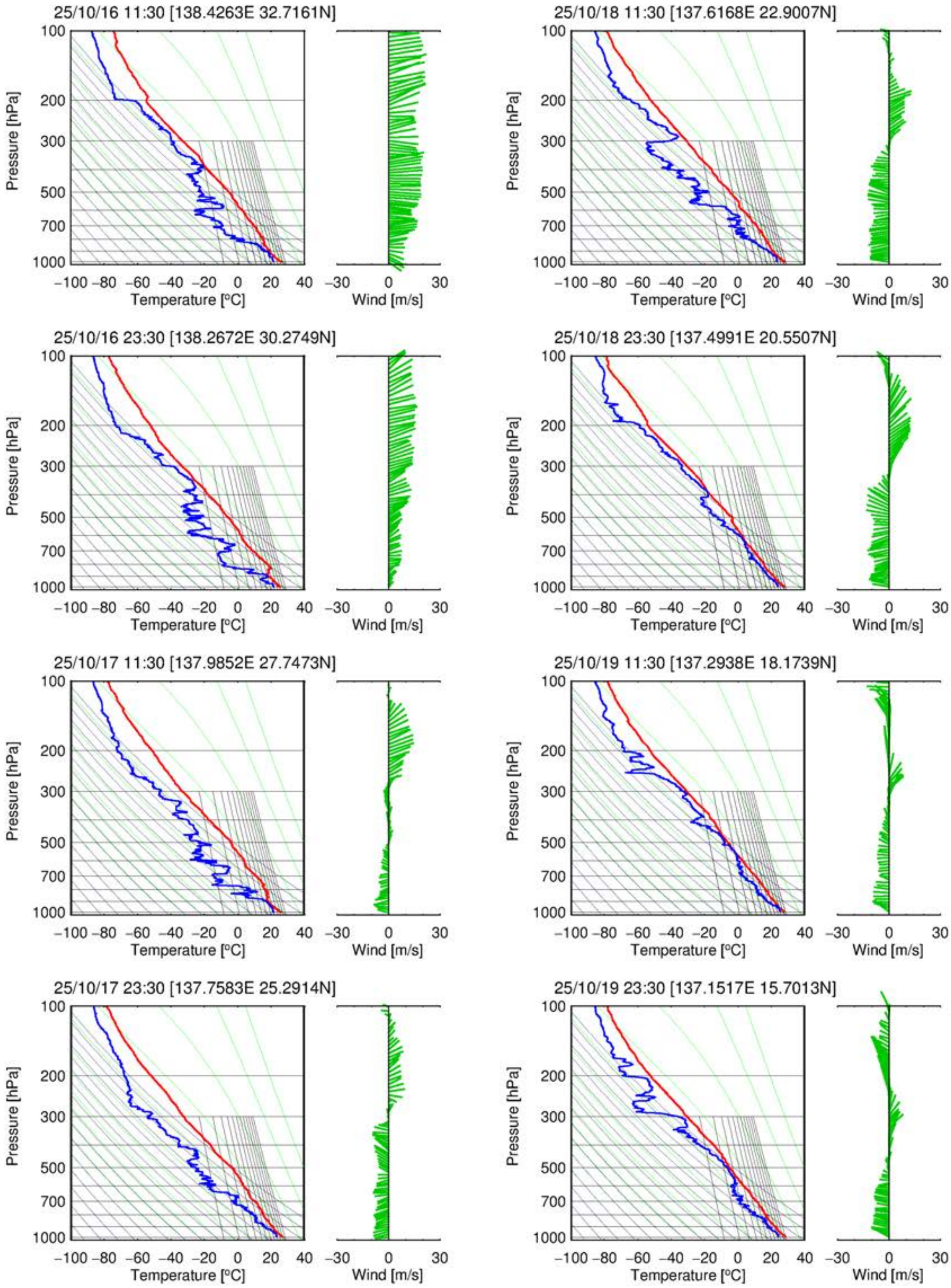

Fig. 6.10-1: Emagrams of radiosonde observations

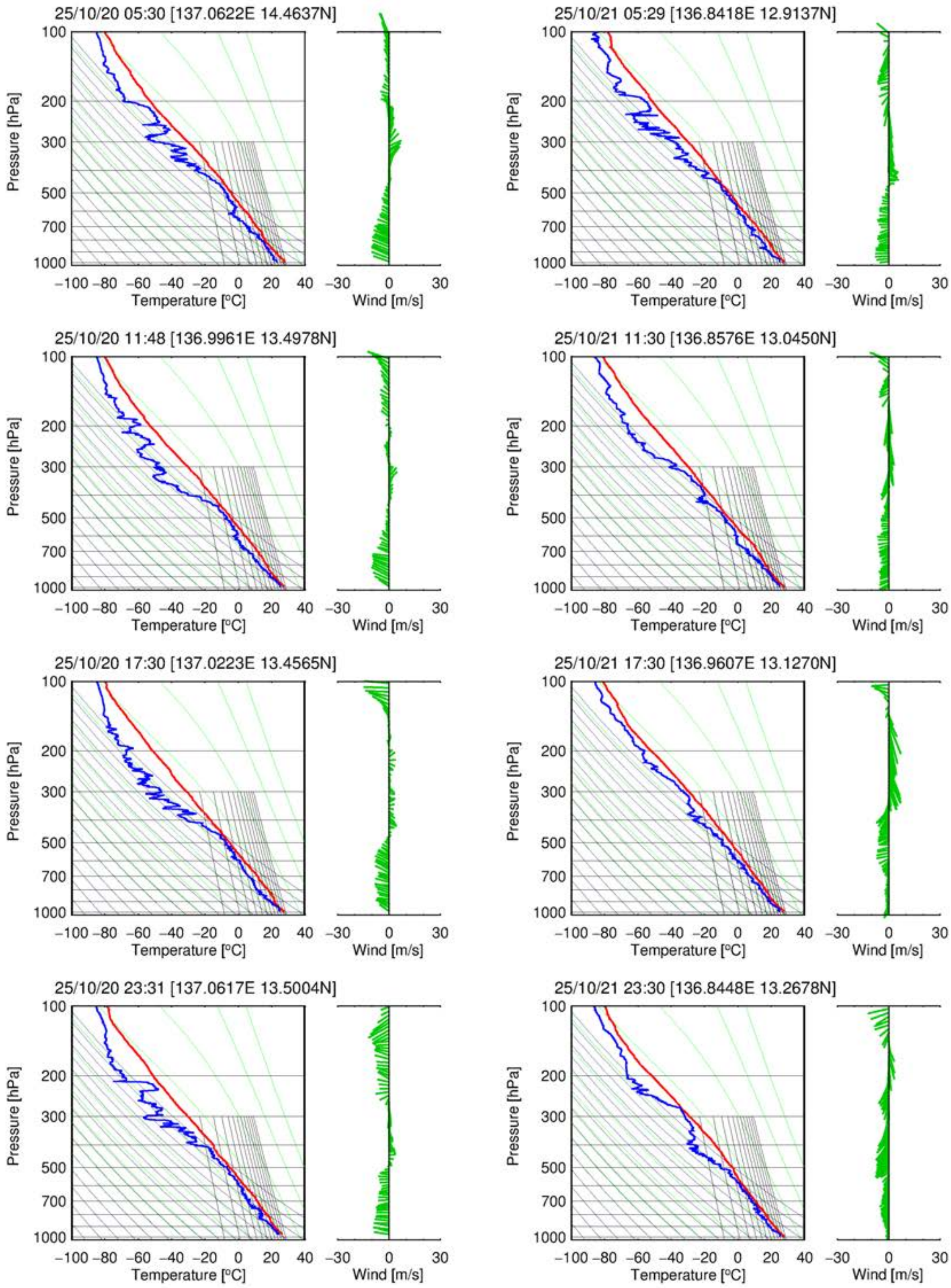

Fig. 6.10-1: Emagrams of radiosonde observations (continued)

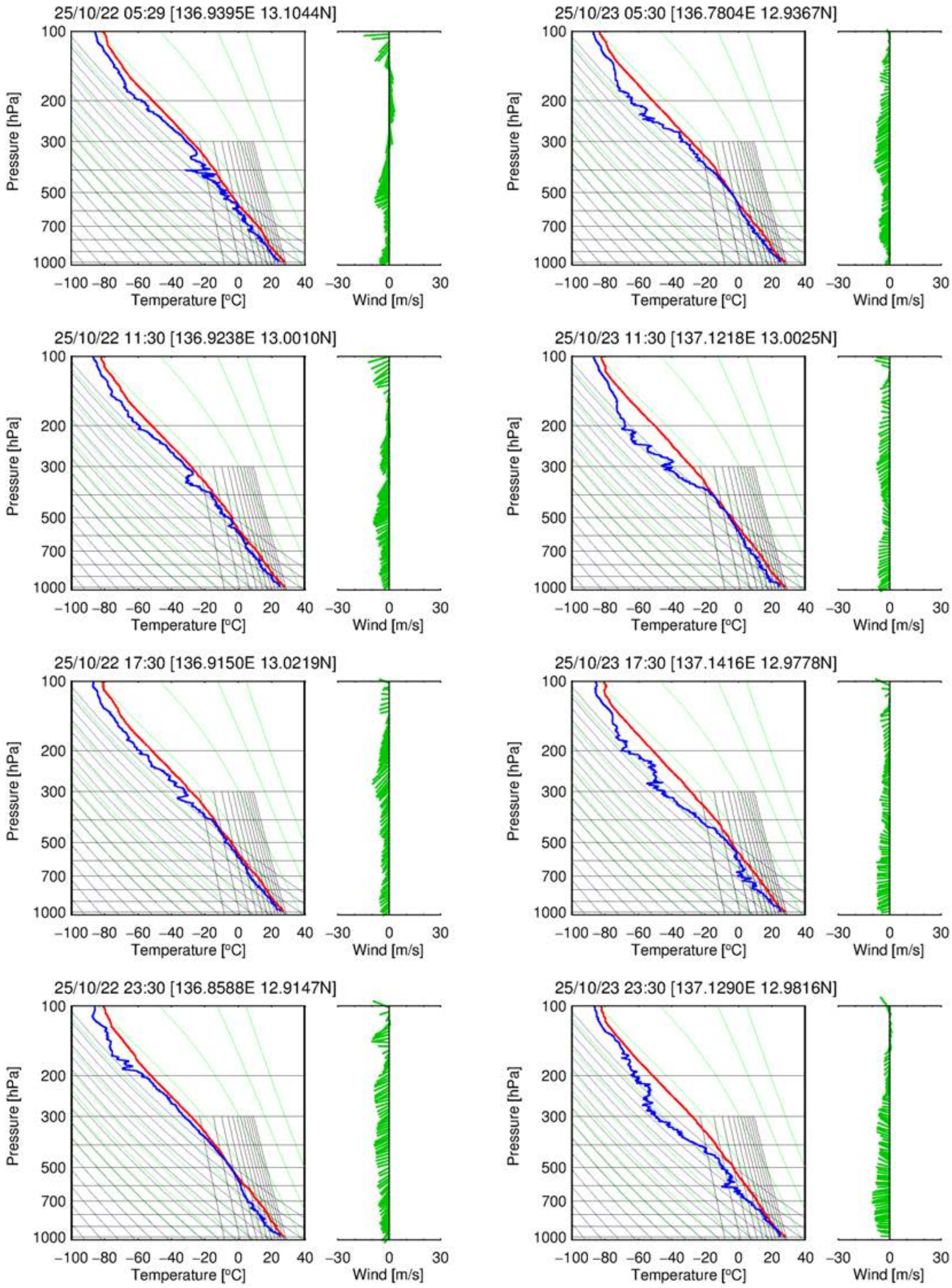

Fig. 6.10-1: Emagrams of radiosonde observations (continued)

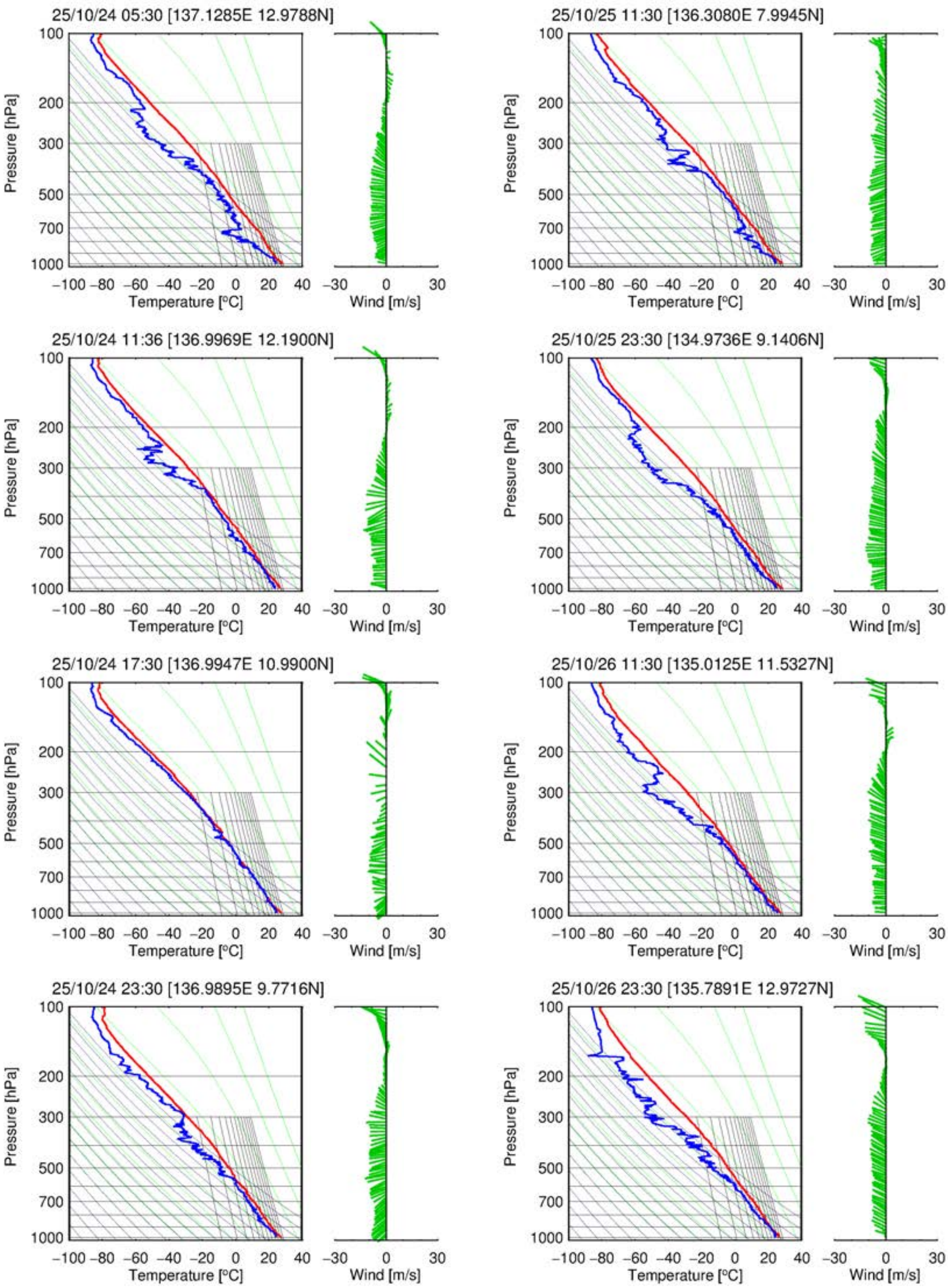

Fig. 6.10-1: Emagrams of radiosonde observations (continued)

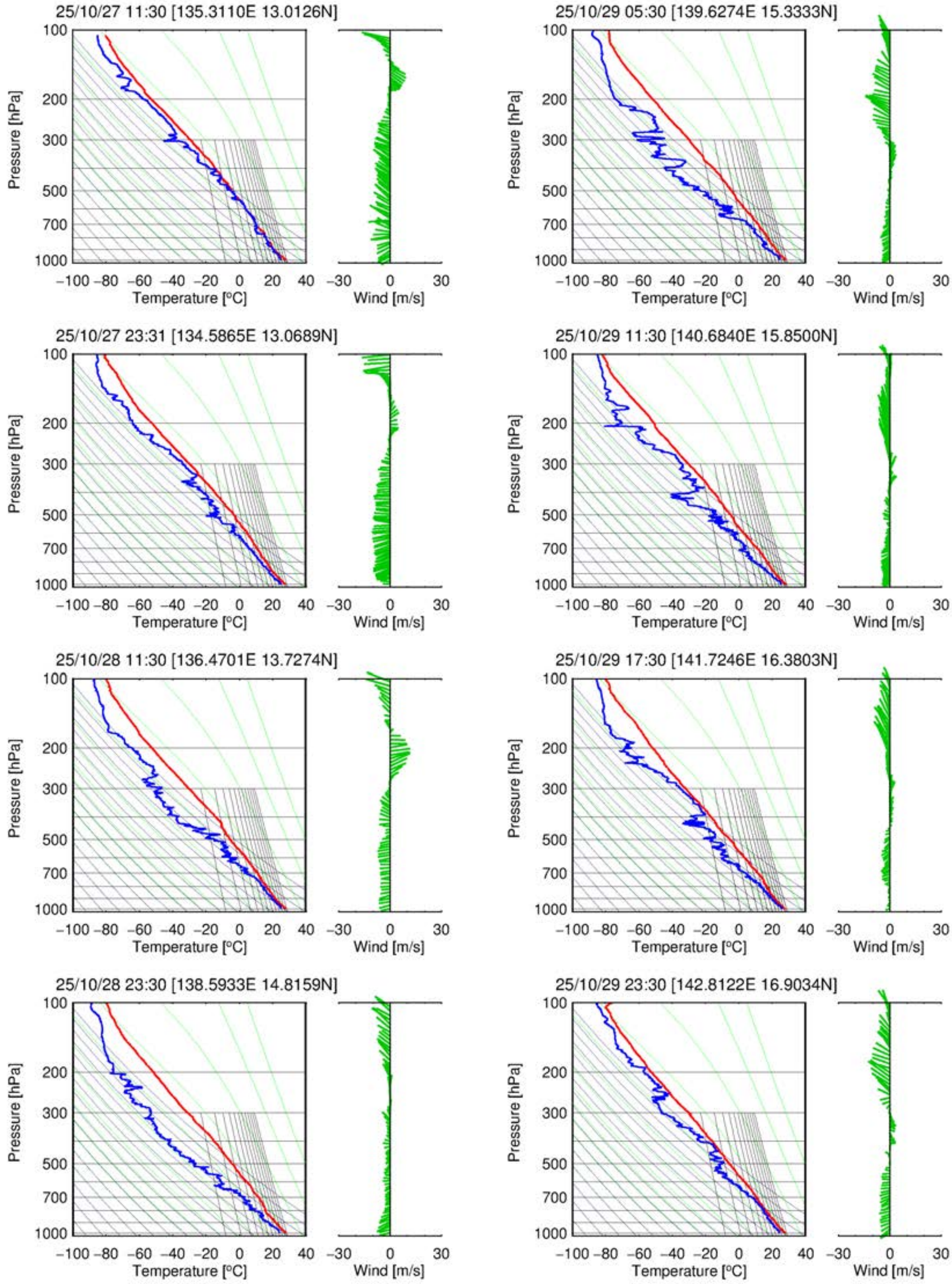

Fig. 6.10-1: Emagrams of radiosonde observations (continued)

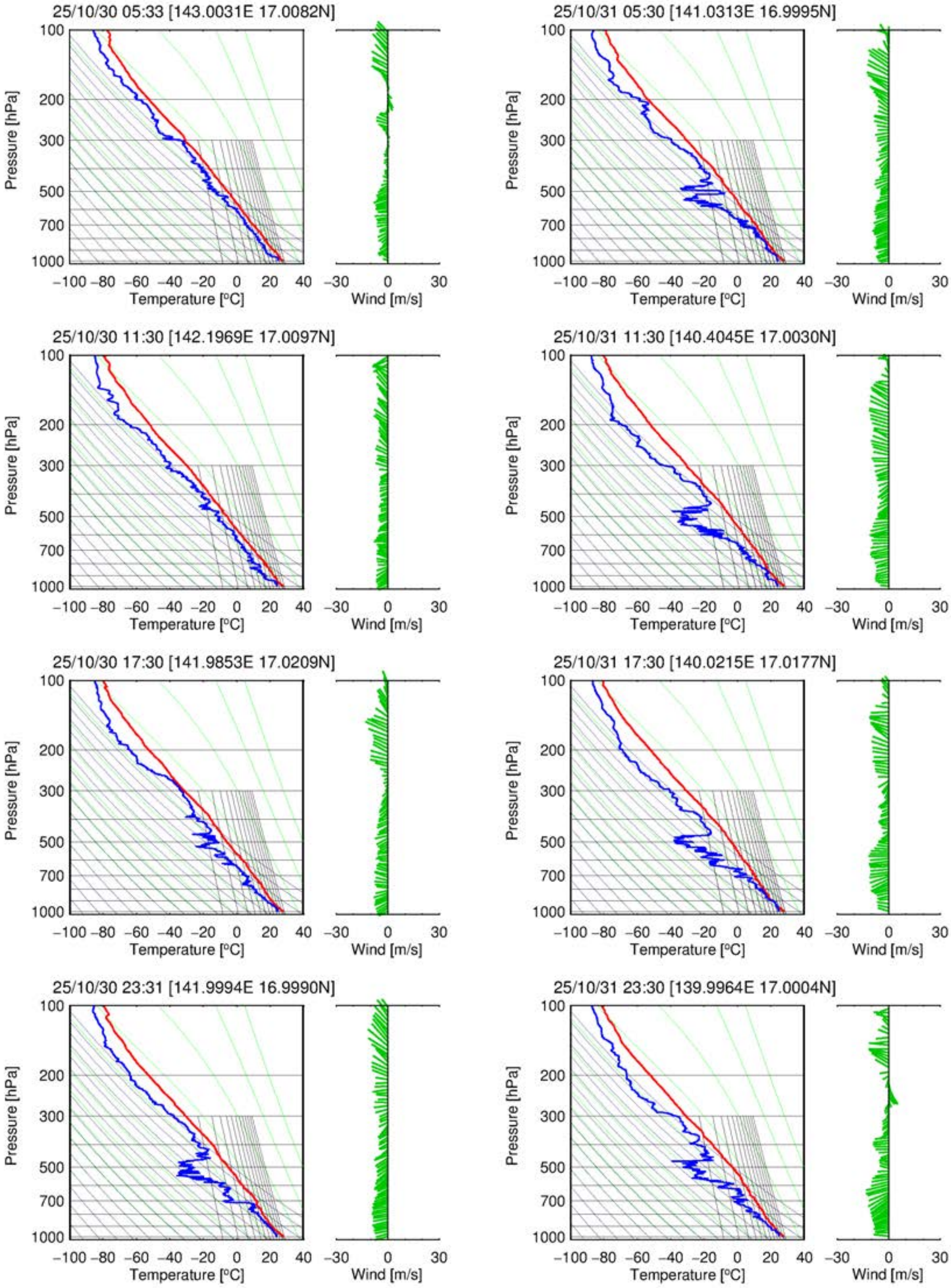

Fig. 6.10-1: Emagrams of radiosonde observations (continued)

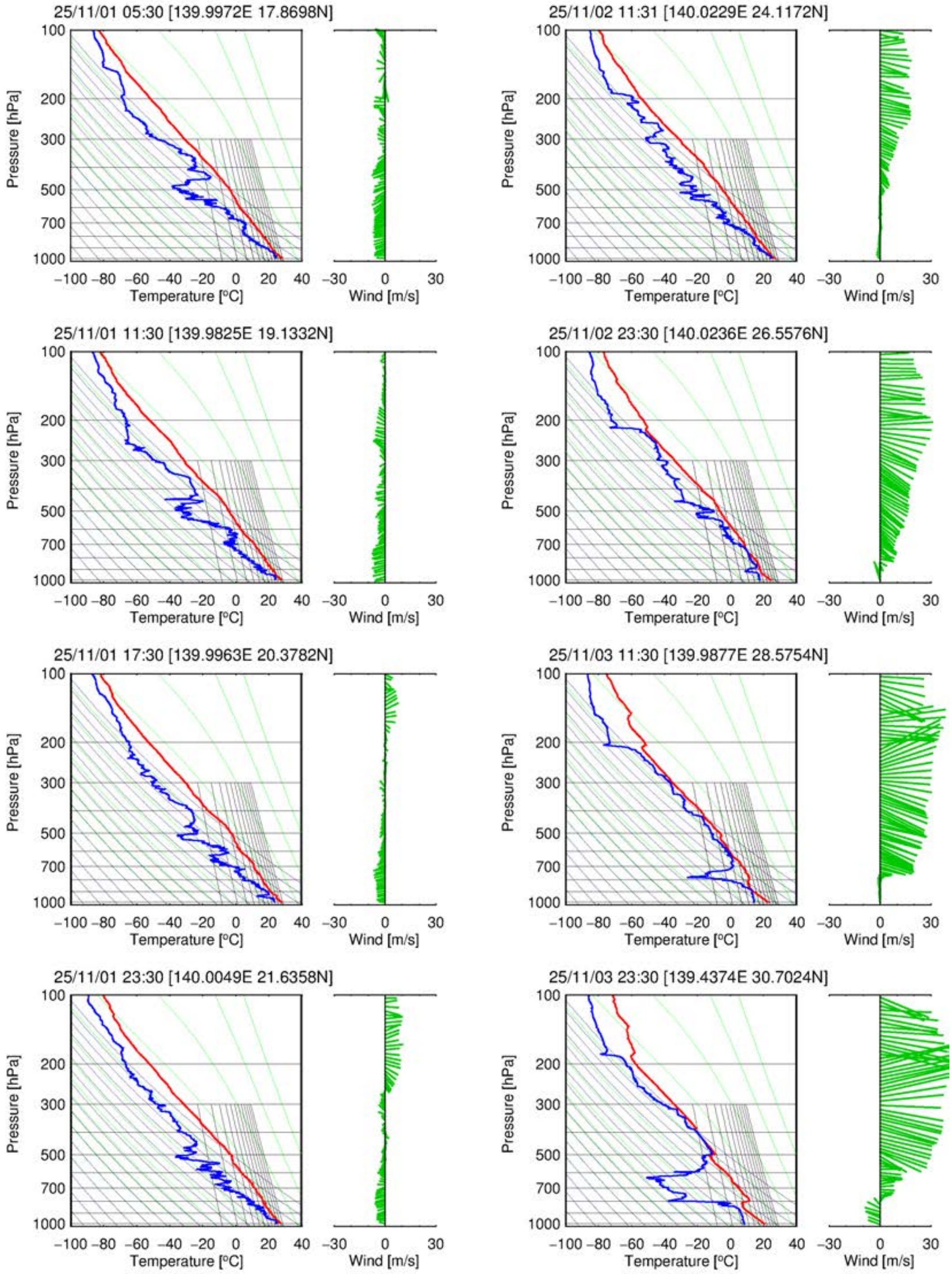

Fig. 6.10-1: Emagrams of radiosonde observations (continued)

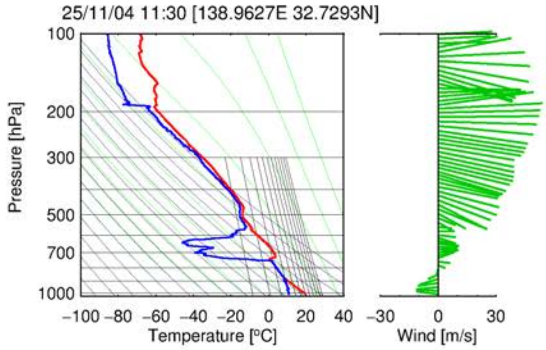

Fig. 6.10-1: Emagrams of radiosonde observations (continued)

(5) Data archives

The data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

6. 12. Microwave radiometer and whole sky camera observations

(1) Personnel

Masaki Katsumata	(JAMSTEC)	Principal investigator, Not on board
Akira KUWANO-YOSHIDA	(Kyoto Univ.)	Not on board
Masahiro MINOWA	(Furuno Electric Co., Ltd.)	Not on board

(2) Objectives

To retrieve the integrated and vertical profile of water vapor.

(3) Instrumentation and methods

The microwave radiometer (hereafter MWR; manufactured by Furuno Electric Co., Ltd.) is used. The MWR received natural microwave within the angle of 20 deg. from zenith. The MWR observes at the frequencies around 22 GHz, to retrieve the column integrated water vapor (or precipitable water), and the vertical profile of the water vapor. The observation was made approximately every 20 seconds except when periodic auto-calibration was on-going (once in several minutes). The rain sensor is equipped to identify the period of rainfall.

In addition to the MWR, the whole sky camera was installed beside the MWR. This is to monitor cloud cover, which also affects the microwave signals. The camera obtained the whole-sky image every 2 minutes.

All instruments were installed at the top of the roof of aft wheelhouse, as in Fig. 6.11-1. The data was continuously obtained all through the cruise period.

Fig. 6.11-1: Outlook of the instruments installed at the roof of the aft wheelhouse; the microwave radiometer for the air temperature (right), microwave radiometer for the water vapor (middle), and the whole-sky camera (left).

(4) Preliminary results

The data has been obtained all through the cruise. Further analyses will be carried out after the cruise.

(5) Data archive

The data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

(6) Acknowledgment

The observation was supported by the JSPS KAKENHI Grant 23H00519. Nippon Marine Enterprise Ltd. kindly supported the operation.

6.13. Mie / Raman Lidar Observation

(1) Personnel

Iwao Ueki	(JAMSTEC)	Principal investigator
Masaki Katsumata	(JAMSTEC)	Not on board
Kyoko Taniguchi	(JAMSTEC)	Operation Leader
Yutaro Murakami	(NME)	
Satomi Ogawa	(NME)	
Haruna Yamanaka	(NME)	

(2) Objectives

The objective of this observation is to capture the vertical distribution of clouds, aerosols, and water vapor in high spatio-temporal resolution.

(3) Observed variables

355nm Mie scattering signal
532nm Mie scattering signal
1064nm Mie scattering signal
387nm Raman nitrogen scattering signal (nighttime only)
408nm Raman water vapor scattering signal (nighttime only)
607nm Raman nitrogen scattering signal (nighttime only)
660nm Raman water vapor scattering signal (nighttime only)

(4) Instrumentation and methods

The Mirai Lidar system transmits a 10-Hz pulse laser in three wavelengths: 1064nm, 532nm, 355nm. For cloud and aerosol observation, the system detects Mie scattering at these wavelengths. The separate detections of polarization components at 532 nm and 355 nm obtain additional characteristics of the targets. The system also detects Raman water vapor signals at 660 nm and 408nm, Raman nitrogen signals at 607 nm and 387nm at nighttime. Based on the signal ratio of Raman water vapor to Raman nitrogen, the system offers water vapor mixing ratio profiles.

(5) Observation period

16 October 2025 to 5 November 2025 UTC

(6) Preliminary results

The lidar system observed the lower atmosphere throughout the cruise. All data will be reviewed after the cruise to maintain data quality.

(7) Data archives

The data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

6.14. Water vapor and wind coherent lidar

(1) Personnel

Masaki Katsumata	(JAMSTEC)	Not on board
Tetsu Sakai	(Meteorological Research Institute, Japan Meteorological Agency)	Not on board
Satoru Yoshida	(MRI-JMA)	Not on board
Tomohiro Nagai	(MRI-JMA)	Not on board
Takuya Kawabata	(MRI-JMA)	Not on board
Eisuke Haraguchi	(Mitsubishi Electric Co.)	Not on board
Takahiro Suzuki	(Mitsubishi Electric Co.)	Not on board
Satoi Kobayashi	(Mitsubishi Electric Co.)	Not on board

(2) Objectives

To retrieve the vertical profile of the water vapor amount and horizontal / vertical wind for the lower troposphere.

(3) Instrumentation and methods

The “ship-based water vapor and wind coherent lidar” used in this study is capable of retrieving the vertical profile of the water vapor amount by differential absorption between two wavelengths on and off the water vapor absorption band (which is generally called as the DIAL [Differential Absorption Lidar]), as well as the vertical profile of the wind by Doppler shift of the backscattered signal simultaneously.

The lidar was developed particularly for the ship-based observation, by referring to the original system as in Imaki et al. (2020) utilizing an eye-safe laser at 1.53 µm. The lidar for this study was installed inside the 10-feet sea container, which was settled at the stern of the upper deck. See Fig. 6.13-1 for the installation.

The system sequentially observes four directions with 90 degrees separations in azimuth (i.e. 0, 90, 180, 270 from a particular horizontal direction). A zenith angle of 11.5 degrees is set for all four directions. Combining wind speed along these four directions enables to retrieve the three-dimensional wind vector including horizontal and vertical wind. Note that all the angles are relative to the lidar system, to be required to correct ship motions in post-processing. The data of ship motions / attitudes were monitored and recorded separately for post-processing. The vertical profile of the water vapor is retrieved to integrate the data (from all four directions, or from particular direction(s)) for certain period.

During the cruise, observations at each direction were usually performed for 2 seconds followed by an interval of 0.5 seconds. The range resolution along each direction is set to 76.7 meters to set the vertical resolution of 75 meters with zenith angle of the four observation directions Observations were made continuously through the cruise, with some intermittent pauses by the experimental and technical reasons. Through the observation period, the window at the roof of the container to transmit the laser beam and receive the backscatter signal was cleaned by the blower beside to continuously blow / dry the water drops on the window, and by cleaning by hand once per day for the dirt by the sea salt etc.

The obtained data will be converted to the vertical profile of the horizontal wind vector and vertical wind speed, as well as to the vertical profile of the water vapor amount. The temporal resolutions of these parameters will be examined after the cruise to achieve the best combination of data quality and temporal resolution.

Fig. 6.13-1: Photographs of the ship-based water vapor and wind coherent lidar system. (Left) The lidar system inside the sea container. (Right) Sea container with the lidar system (circled in red) at the stern of the R/V Mirai.

(4) Preliminary results

All datasets will be analyzed and examined after the cruise.

(5) Data archives

The data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

(6) Acknowledgment

We deeply indebted to board scientists (especially Dr. Iwao Ueki, Ms. Kyoko Taniguchi and Dr. Akira Nagano) for daily works to maintain the lidar system. Nippon Marine Enterprise Ltd. kindly supported the installation and operation. The observation was supported by the JSPS KAKENHI Grant 22H00250.

6.15. Aerosol optical characteristics measured by Shipborne Sky radiometer

(1) Personnel

Kazuma Aoki	(University of Toyama)	Not on board
Yutaro Murakami	(NME)	
Satomi Ogawa	(NME)	
Haruna Yamanaka	(NME)	

(2) Objectives

Objective of this observation is to study distribution and optical characteristics of marine aerosols by using a ship-borne sky radiometer (POM-01 MK-III: PREDE Co. Ltd., Japan). Furthermore, collections of the data for calibration and validation to the remote sensing data were performed simultaneously.

(3) Instrumentation and methods

1) Sky radiometer measurement

The sky radiometer measures the direct solar irradiance and the solar aureole radiance distribution with seven interference filters (0.315, 0.4, 0.5, 0.675, 0.87, 0.94, and 1.02 μm). Analysis of these data was performed by SKYRAD.pack version 4.2 developed by Nakajima et al. 1996 and 2020.

2) Parameters

- Aerosol optical thickness at five wavelengths (400, 500, 675, 870 and 1020 nm)
- Ångström exponent
- Single scattering albedo at five wavelengths
- Size distribution of volume (0.01 μm – 20 μm)
- # GPS provides the position with longitude and latitude and heading direction of the vessel, and azimuth and elevation angle of the sun. Horizon sensor provides rolling and pitching angles.

(4) Data archives

Aerosol optical data are to be archived at University of Toyama (K.Aoki, SKYNET/SKY: http://skyrad.sci.u-toyama.ac.jp/sobs/) after the quality check and will be submitted to JAMSTEC.

(5) References

Nakajima,T., G.Tonna, R.Rao, P.Boi, Y.Kaufman and B.Holben (1996) Use of sky brightness measurements from ground for remote sensing of particulate polydispersions, Appl. Opt., 35, 2672–2686, https://doi.org/10.1364/AO.35.002672.

Aoki. K., T.Takemura, K.Kawamoto, and T.Hayasaka (2013), Aerosol climatology over Japan site measured by ground-based sky radiometer, AIP Conf. Proc. 1531, 284-287 (2013); doi: 10.1063/1.4804762.

Nakajima,T., Campanelli,M., Che,H., Estellés,V., Irie,H., Kim,S.-W., Kim,J., Liu,D., Nishizawa,T., Pandithurai,G., Soni,V.K., Thana,B., Tugjsurn,N.-U., Aoki,K., Hashimoto,M., Higurashi,A., Kazadzis,S., Khatri,P., Kouremeti,N., Kudo,R., Marenco,F., Momoi,M., Ningombam,S. S., Ryder,C.L., and Uchiyama,A.(2020) An overview and issues of the sky radiometer technology and SKYNET, Atmos. Meas. Tech., 13, 4195–4218, 2020, https://doi.org/10.5194/amt-13-4195-2020.

6.16. Atmospheric gas observations over the western Pacific Ocean

(1) Personnel

Fumikazu Taketani	(JAMSTEC)	Not on board
Yugo Kanaya	(JAMSTEC)	Not on board
Hisahiro Takashima	(Fukuoka Univ./JAMSTEC)	Not on board

(2) Objectives

To investigate roles of gas and aerosols in the marine atmosphere in relation to climate change.

(3) Instrumentation and methods

Ambient air was continuously sampled on the compass deck and drawn through ~20m long Teflon tubes connected to a nondispersive infrared (NDIR) CO analyzer (Model 48i-TLE, Thermo Fisher Scientific) and a UV photometric ozone analyzer (model 205, 2B Technologies), located in the environmental research room. The data will be used for characterizing air mass origins.

(4) Data archives

The data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

(5) Acknowledgments

We thank the crew of the R/V Mirai, the staff of Nippon Marine Enterprises, Ltd., and Dr. Iwao Ueki, for their support with observations throughout the cruise.

7. General observations
7.1. Meteorological observations
7.1.1. Surface meteorological observation
(1) Personnel

Iwao Ueki	(JAMSTEC)	Principal investigator
Yutaro Murakami	(NME)	Operation Leader
Satomi Ogawa	(NME)	
Haruna Yamanaka	(NME)	
Masanori Murakami	(NME, Crew)	

(2) Objectives

Surface meteorological parameters are observed as a basic dataset of the meteorology. These parameters provide the temporal variation of the meteorological condition surrounding the ship.

(3) Instrumentation and methods

Surface meteorological parameters were observed throughout the MR25-06 cruise. During this cruise, we used two systems for the observation.

1) MIRAI Surface Meteorological observation (SMet) system

Instruments of SMet system are listed in Table 7.1.1-1 and measured parameters are listed in Table 7.1.1-2. Data were collected and processed by KOAC-7800 weather data processor made by Koshin-Denki, Japan. The data set consists of 6 seconds averaged data.

2) Shipboard Oceanographic and Atmospheric Radiation (SOAR) measurement system

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

a) Analog meteorological data sampling with CR1000 logger manufactured by Campbell Scientific, Inc., U.S.A – wind, pressure, and rainfall (by a capacitive rain gauge (CRG)) measurement.

b) Digital meteorological data sampling from individual sensors －air temperature, relative humidity and rainfall (by optical rain gauge (ORG)) measurement.

c) Radiation data sampling with CR1000X logger manufactured by Campbell Scientific, Inc., Radiometers designed by Hukseflux Thermal Sensors B.V., Netherlands. – short and long wave downward radiation measurement.

d) Photosynthetically Available Radiation (PAR) and Ultraviolet Irradiance (UV) sensor manufactured by Biospherical Instruments Inc., USA. – PAR and UV measurement

e) Scientific Computer System (SCS) developed by NOAA (National Oceanic and Atmospheric Administration, USA) – centralized data acquisition and logging of all data sets.

SCS recorded wind, pressure, rainfall, air temperature, relative humidity, radiation, and PAR data. SCS composed event data (JamMet) from these data and ship's navigation data every 6 seconds. Instruments and their locations are listed in Table 7.1.1-3 and measured parameters are listed in Table 7.1.1-4.

3) Quality control

For the quality control as post processing, we checked the following sensors, before and after the cruise.

a) Young rain gauge (SMet and SOAR)

Inspect of the linearity of output value from the rain gauge sensor to change input value by adding fixed quantity of test water.

b) Barometer (SMet and SOAR)
Comparison with the portable barometer value, PTB330, VAISALA.
c) Thermometer (air temperature and relative humidity) (SMet and SOAR)
Comparison with the portable thermometer value, HM70, VAISALA.

(4) Preliminary results

Figure 7.1.1-1 shows the time series of the following parameters; Wind (SMet), Air temperature (SMet), Relative humidity (SMet), Precipitation (SOAR, CRG), Short/long wave radiation (SOAR), Sea level pressure (SMet), Sea surface temperature (SMet), Significant wave height (SMet).

Table 7.1.1-1: Instruments and installation locations of MIRAI Surface Meteorological observation system

Sensors	Type	Manufacturer	Location (altitude from surface)
Anemometer	KS-5900	Koshin Denki, Japan	Foremast (25 m)
T/RH	HMP155	VAISALA, Finland	Compass deck (21 m)
with aspirated radiation shield	43408 Gill	R.M. Young, U.S.A.	starboard and port side
Thermometer: SST	RFN2-0	Koshin Denki, Japan	4th deck (-1 m, inlet -5 m) Bow thruster room
Barometer	Model-370	Setra System, U.S.A.	Captain deck (13 m) Weather observation room
Capacitive rain gauge	50202	R. M. Young, U.S.A.	Compass deck (19 m)
Optical rain gauge	ORG-815DS	Optical Scientific Inc., U.S.A.	Compass deck (19 m)
Radiometer (short wave)	MS-802	Eko Seiki, Japan	Radar mast (28 m)
Radiometer (long wave)	MS-202	Eko Seiki, Japan	Radar mast (28 m)
Wave height meter	WM-2	Tsurumi-seiki, Japan	Bow (10 m) Stern (8 m)

Table 7.1.1-2: Parameters of MIRAI Surface Meteorological observation system

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

Table 7.1.1-3: Instruments and installation locations of SOAR system

Sensors (Meteorological)	Type	Manufacturer	Location *
Anemometer	05106	R.M. Young, USA	Foremast (25 m)
Barometer	PTB210	VAISALA, Finland	Foremast (23 m)
with pressure port	61002 Gill	R.M. Young, USA	
Rain gauge	50202	R.M. Young, USA	Foremast (24 m)
Tair/RH	HMP155	VAISALA, Finland	Foremast (23 m)
with aspirated radiation shield	43408 Gill	R.M. Young, USA	
Optical rain gauge	ORG-815DR	Optical Scientific Inc., U.S.A.	Foremast (24 m)

Sensors (Radiation)	Type	Manufacturer	Location *
Radiometer (short wave)	SR20	Hukseflux Thermal Sensors B.V., Netherlands	Foremast (25 m)
Radiometer (long wave)	IR20	Hukseflux Thermal Sensors B.V., Netherlands	Foremast (25 m)

Sensor (PAR&UV)	Type	Manufacturer	Location *
PAR&UV sensor	PUV-510	Biospherical Instruments Inc., USA	Navigation deck (18 m)

Table 7.1.1-4: Parameters of SOAR system

Parameter	Units	Remarks
1 Latitude	degree	
2 Longitude	degree	
3 SOG	knot	
4 COG	degree	
5 Relative wind speed	m/s	
6 Relative wind direction	degree	
7 Barometric pressure	hPa	
8 Air temperature	degC	
9 Relative humidity	%	
10 Precipitation intensity (optical rain gauge)	mm/hr	
11 Precipitation (capacitive rain gauge)	mm/hr	reset at 50 mm
12 Down welling shortwave radiation	W/m^2	
13 Down welling infrared radiation	W/m^2	
14 PAR	$microE/cm^2/sec$	
15 UV 305 nm	$microW/cm^2/nm$	
16 UV 320 nm	$microW/cm^2/nm$	
17 UV 340 nm	$microW/cm^2/nm$	
18 UV 380 nm	$microW/cm^2/nm$	

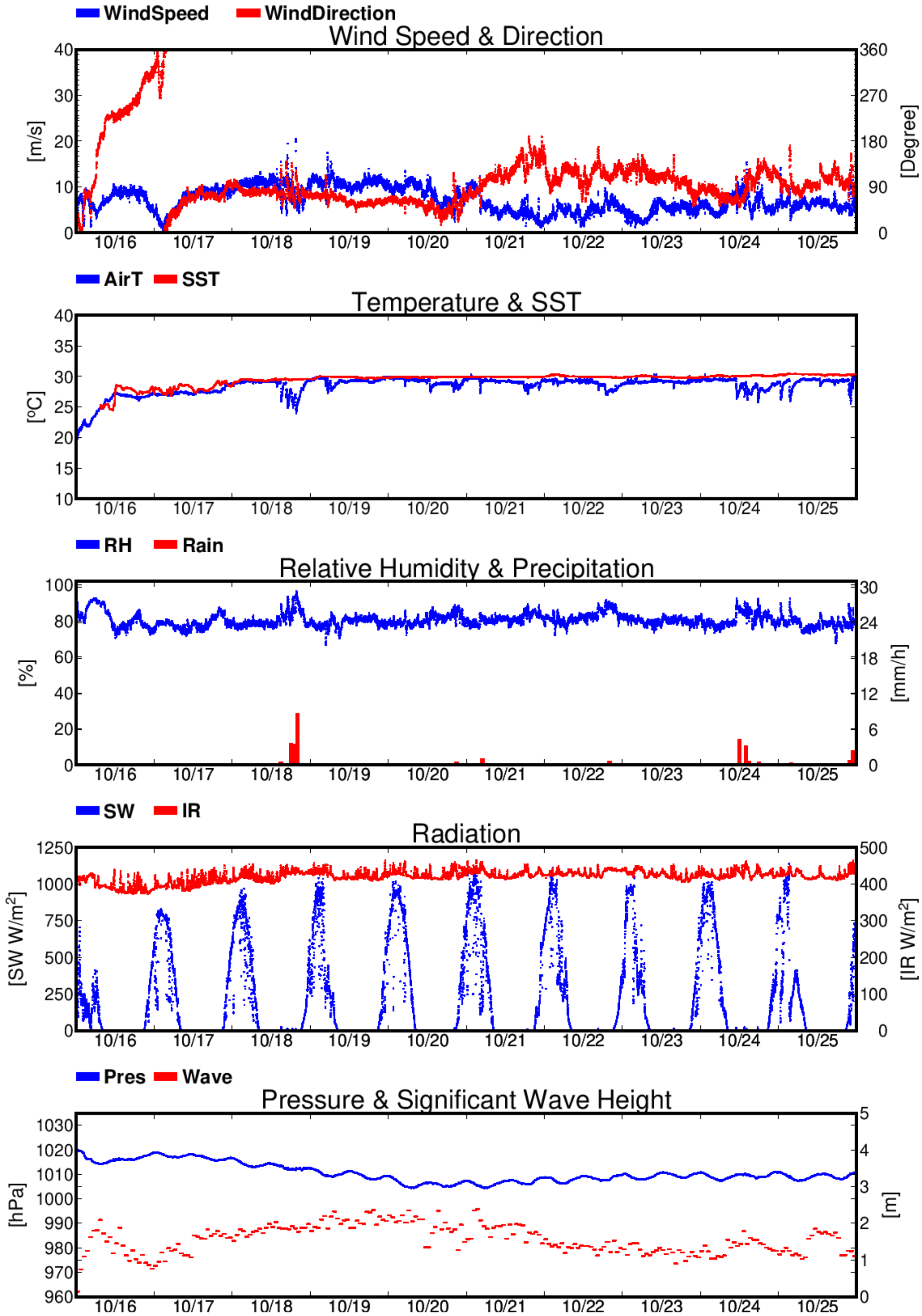

Fig. 7.1.1-1: Time series of surface meteorological parameters during this cruise

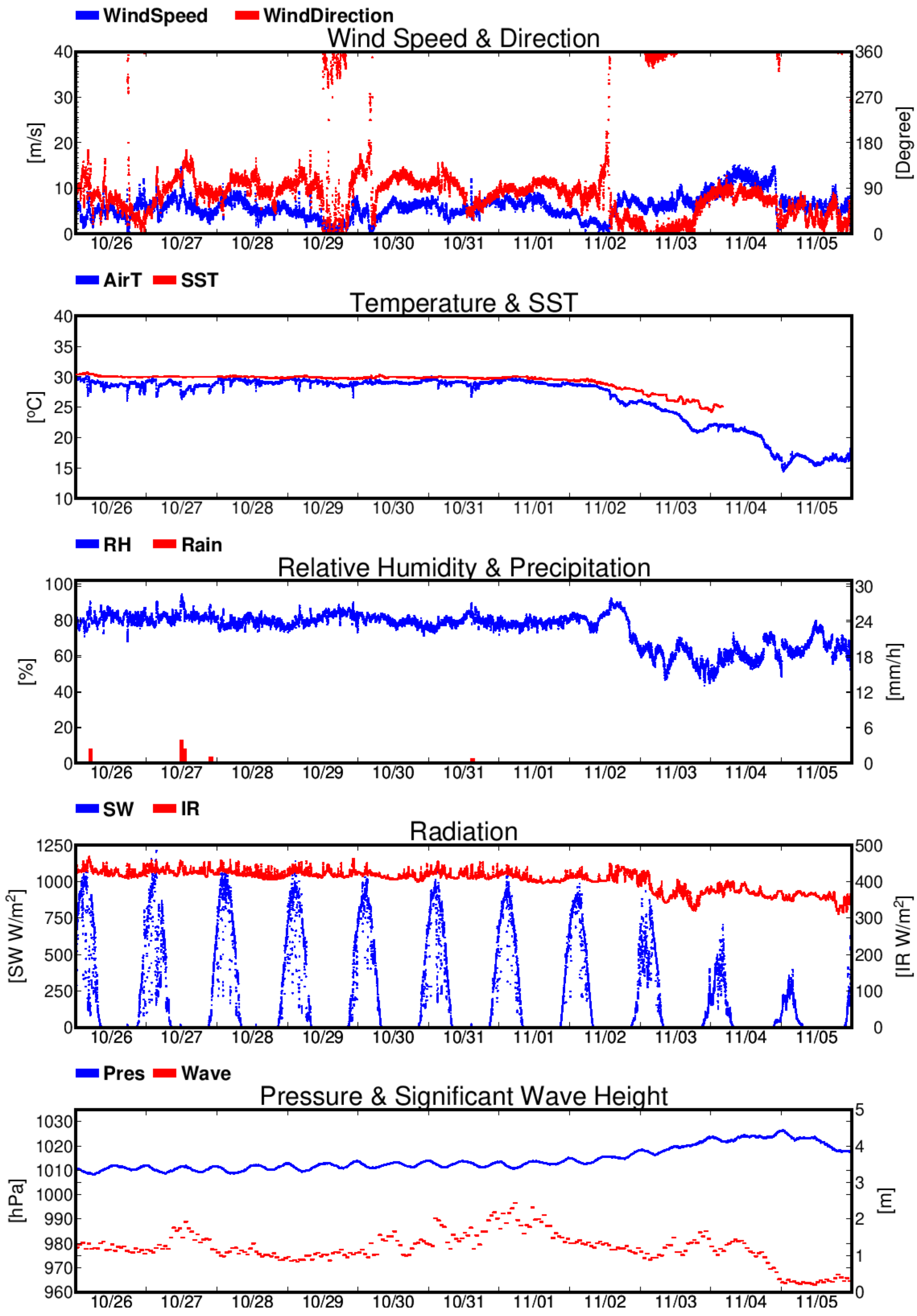

Fig. 7.1.1-1 (Continued)

(5) Data archives

The data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

(6) Remarks

1. The following periods, SST data of SMET was available.
   07:28UTC 16 Oct. 2025 – 00:06UTC 04 Nov. 2025

2. The following time, increasing of SMet capacitive rain gauge data were invalid.
   19:01UTC 03 Nov. 2025
   23:53UTC 03 Nov. 2025
   11:39UTC 04 Nov. 2025
   18:55UTC 04 Nov. 2025
   23:45UTC 04 Nov. 2025
   21:35UTC 05 Nov. 2025
   23:00UTC 05 Nov. 2025

3. The following periods, SOAR wind direction and wind speed data were doubtful due to birds perching on the foremast.
   about 11:20UTC 28 Oct. 2025 - 20:10UTC 28 Oct. 2025
   about 10:50UTC 29 Oct. 2025 - 20:00UTC 29 Oct. 2025
   about 15:15UTC 31 Oct. 2025 - 20:00UTC 31 Oct. 2025
   about 11:35UTC 01 Nov. 2025 - 20:15UTC 01 Nov. 2025

7.1.2. Ceilometer

(1) Personnel

Iwao Ueki	(JAMSTEC)	Principal investigator
Yutaro Murakami	(NME)	Operation Leader
Satomi Ogawa	(NME)	
Haruna Yamanaka	(NME)	
Masanori Murakami	(NME, Crew)	

(2) Objectives

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

(3) Instrumentation and methods

We measured cloud base height and backscatter profile using ceilometer (CL51, VAISALA, Finland) throughout the MR25-06 cruise. Table 7.1.2-1 shows major parameters for the measurement configuration.

On the archive dataset, the following parameters are recorded with the resolution of 10 m (33 ft).

1) Cloud base height [m].
2) Backscatter profile, sensitivity and range normalized at 10 m resolution.
3) Estimated cloud amount [octas] and height [m]; Sky Condition Algorithm.

Table 7.1.2-1: Major parameters for the measurement configuration

Laser source	Indium Gallium Arsenide (InGaAs) Diode Laser
Transmitting center wavelength	910±10 nm at 25 degC
Transmitting average power	19.5 mW
Repetition rate	6.5 kHz
Detector	Silicon avalanche photodiode (APD)
Measurement range	0 ~ 15 km
	0 ~ 13 km (Cloud detection)
Resolution	10 meter in full range
Sampling rate	36 sec
Sky Condition	0, 1, 3, 5, 7, 8 octas (9: Vertical Visibility)
	(0: Sky Clear, 1: Few, 3: Scattered, 5-7: Broken,
	8: Overcast)

(4) Preliminary results

The time series plot of the lowest, second and third cloud base height during this cruise are shown in Fig.7.1.2-1.

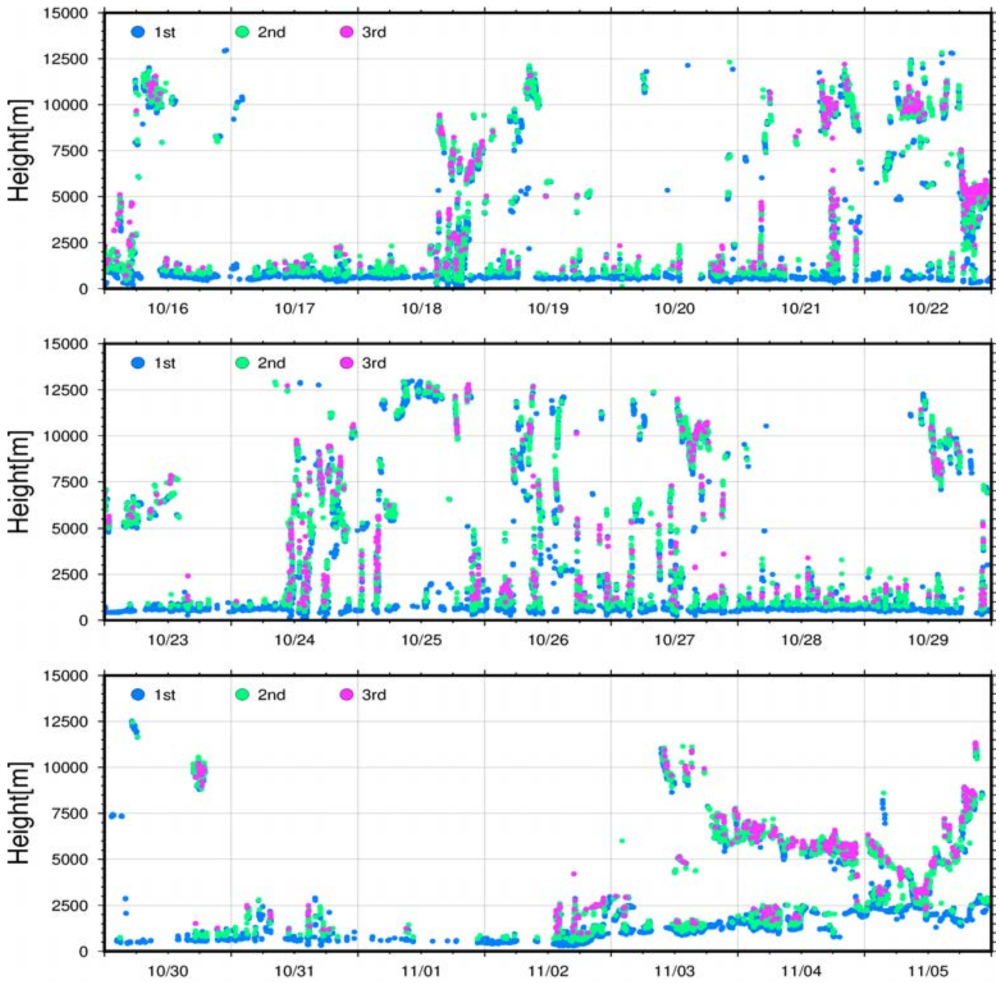

Fig. 7.1.2-1: First (Blue), 2nd (Green) and 3rd (Pink) lowest cloud base height during this cruise

(5) Data archives

The data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

(6) Remarks

Window Cleaning

02:05UTC 20 Oct. 2025

01:45UTC 27 Oct. 2025

01:47UTC 03 Nov. 2025

7.2. Ocean observations

7.2.1. Shipboard ADCP

(1) Personnel

Iwao Ueki	(JAMSTEC)	Principal investigator
Yutaro Murakami	(NME)	Operation Leader
Satomi Ogawa	(NME)	
Haruna Yamanaka	(NME)	
Masanori Murakami	(NME, Crew)	

(2) Objectives

To obtain continuous measurement data of the current profile along the ship's track.

(3) Instrumentation and methods

Upper ocean current measurements were made in this cruise, using the hull-mounted Acoustic Doppler Current Profiler (ADCP) system. For most of its operation, the instrument was configured for water-tracking mode. Bottom-tracking mode, interleaved bottom-ping with water-ping, was made to get the calibration data for evaluating transducer misalignment angle in the shallow water. The system consists of following components;

1) R/V MIRAI has installed the Ocean Surveyor for vessel-mount ADCP (frequency 76.8 kHz; Teledyne RD Instruments, USA). It has a phased-array transducer with single ceramic assembly and creates 4 acoustic beams electronically. We mounted the transducer head rotated to a ship-relative angle of 45 degrees azimuth from the keel.
2) For heading source, we use ship's gyro compass (Tokyo Keiki, Japan), continuously providing heading to the ADCP system directory. Additionally, we have Inertial Navigation System (Phins, iXblue, France) which provide high-precision heading, attitude information, pitch and roll. They are stored in ".N2R" data files with a time stamp.
3) Differential GNSS system (StarPack-D, Fugro, Netherlands) providing precise ship's position.
4) We used VmDas software version 1.50.19 (TRDI) for data acquisition.
5) To synchronize time stamp of ping with computer time, the clock of the logging computer is adjusted to GNSS time server continuously by the application software.
6) Fresh water is charged in the sea chest to prevent bio fouling at transducer face.
7) The sound velocity at the transducer does affect the vertical bin mapping and vertical velocity measurement, and that is calculated from temperature, salinity (constant value; 35.0 PSU) and depth (6.5 m; transducer depth) by equation in Medwin (1975).

Data was configured for "8 m" layer intervals starting about 23 m below sea surface, and recorded every ping as raw ensemble data (.ENR). Additionally, 30 seconds averaged data were recorded as short-term average (.STA) and 300 seconds averaged data were recorded as long-term average (.LTA), respectively.

(4) Parameters

Major parameters for the measurement, Direct Command, are shown in Table 7.2.1-1

Table 7.2.1-1: Major parameters

Bottom-Track Commands

BP = 001 Pings per Ensemble (almost less than 1,300m depth)

Environmental Sensor Commands

EA = 04500 Heading Alignment (1/100 deg)

ED = 00065 Transducer Depth (0 - 65535 dm)

EF = +001 Pitch/Roll Divisor/Multiplier (pos/neg) [1/99 - 99]

EH = 00000 Heading (1/100 deg)

ES = 35 Salinity (0-40 pp thousand)

EX = 00000 Coordinate Transform (Xform:Type; Tilts; 3Bm; Map)

EZ = 10200010 Sensor Source (C; D; H; P; R; S; T; U)

C (1): Sound velocity calculates using ED, ES, ET (temp.)

D (0): Manual ED

H (2): External synchro

P (0), R (0): Manual EP, ER (0 degree)

S (0): Manual ES

T (1): Internal transducer sensor

U (0): Manual EU

EV = 0 Heading Bias (1/100 deg)

Water-Track Commands

WA = 255 False Target Threshold (Max) (0-255 count)

WC = 120 Low Correlation Threshold (0-255)

WD = 111 100 000 Data Out (V; C; A; PG; St; Vsum; Vsum^2; #G; P0)

WE = 1000 Error Velocity Threshold (0-5000 mm/s)

WF = 0800 Blank After Transmit (cm)

WN = 100 Number of depth cells (1-128)

WP = 00001 Pings per Ensemble (0-16384)

WS = 800 Depth Cell Size (cm)

WV = 0390 Mode 1 Ambiguity Velocity (cm/s radial)

(5) Preliminary results

The horizontal velocity distributions along the ship's track are shown in Fig.7.2.1-1. In vertical direction, the data are averaged from 39 to 55 m. We conducted ADCP profile surveys along the 2 longitude of 137° E and 135° E meridians during this cruise. Figure 7.2.1-2 shows latitude-depth cross sections along them.

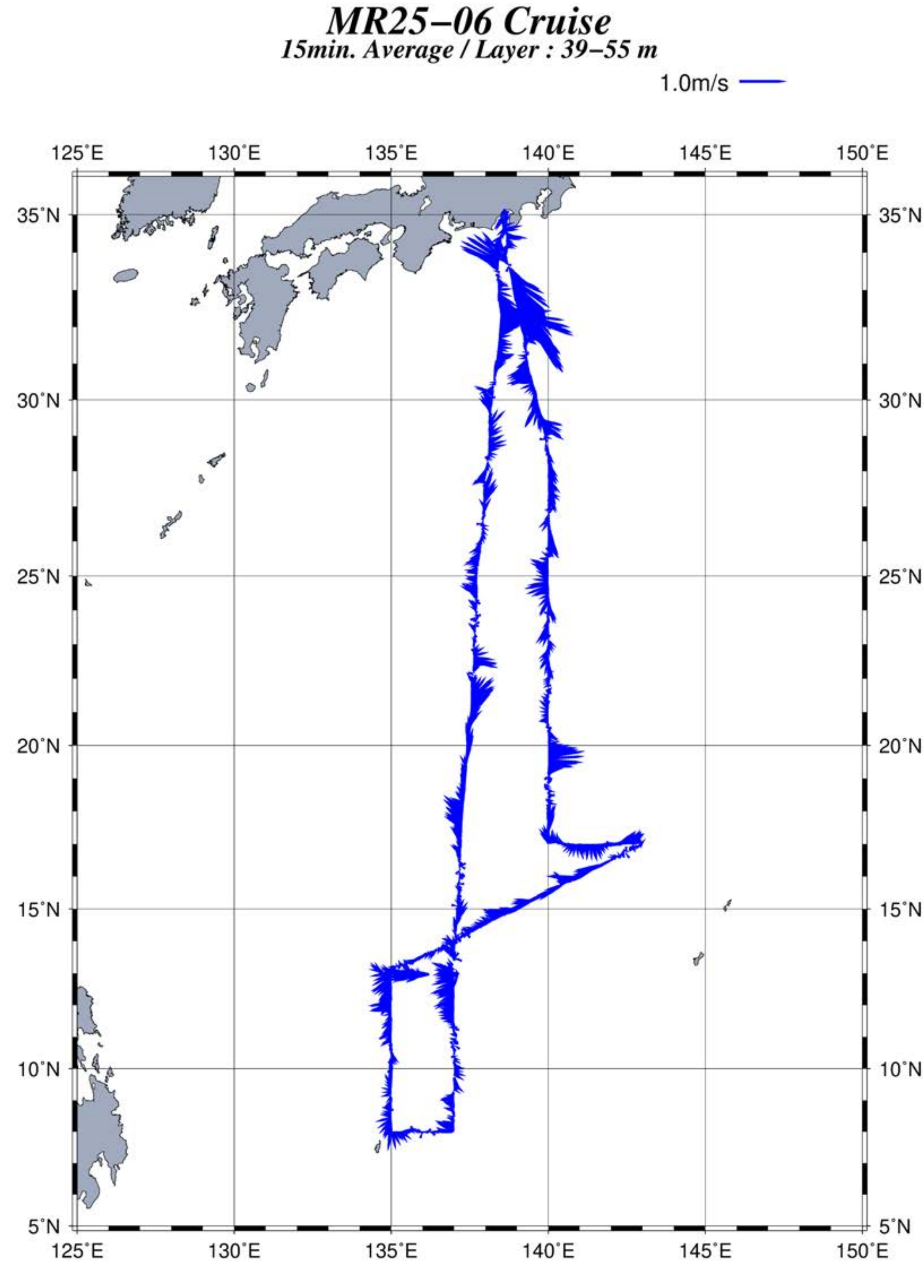

Fig. 7.2.1-1: Horizontal Velocity along the ship’s track

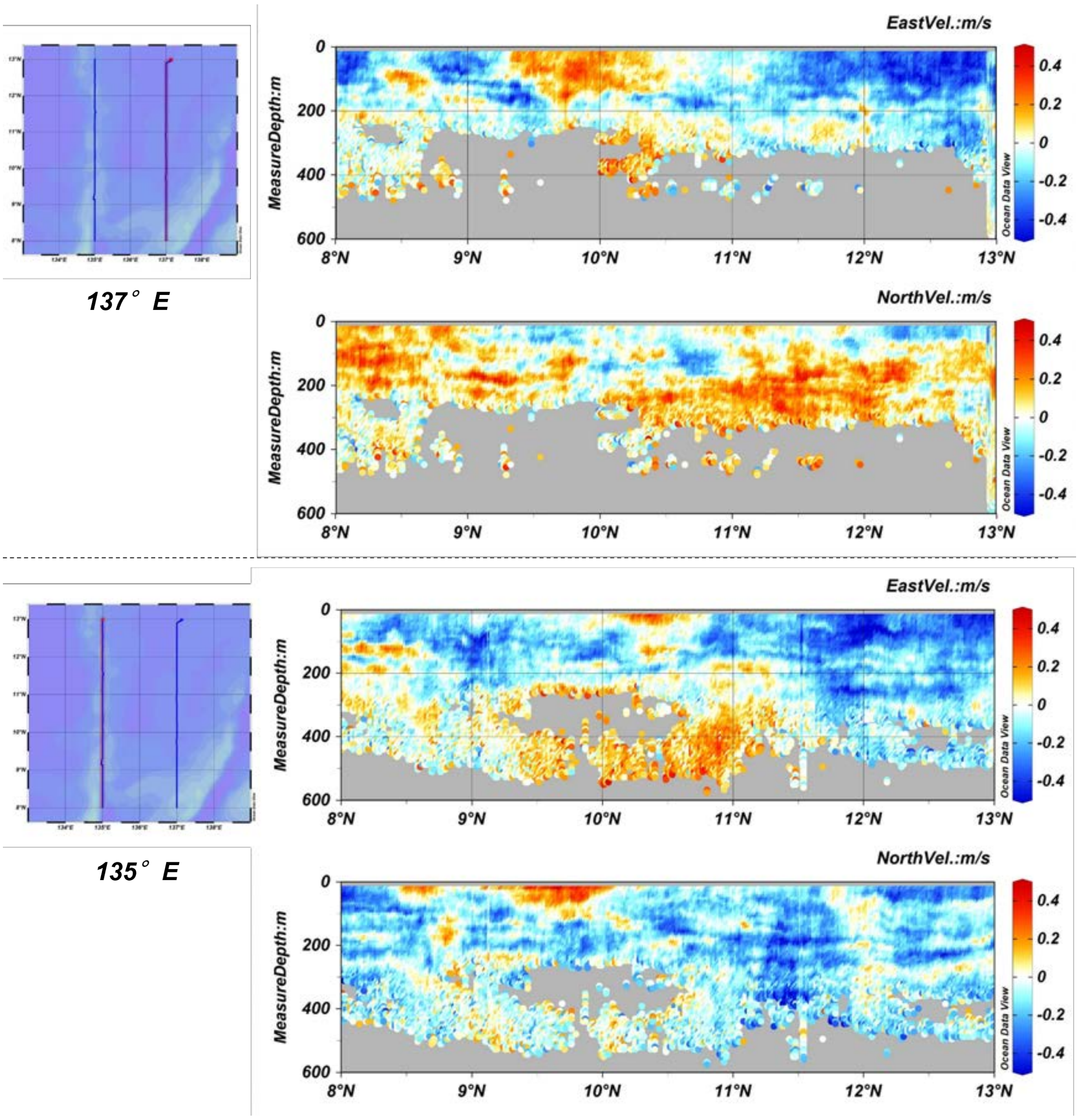

Fig. 7.2.1-2: Latitude-depth cross sections along the 137° E and 135° E meridians

(6) Data archives

The data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

7.2.2. Underway surface water monitoring

(1) Personnel

Iwao Ueki	(JAMSTEC)	Principal investigator
Riho Fujioka	(MWJ)	Operation Leader
Nobuhiro Fujii	(MWJ)	
Tun Htet Aung	(MWJ)	

(2) Objectives

To obtain temperature, salinity, dissolved oxygen, fluorescence, turbidity and total dissolved gas pressure data continuously in near-sea surface water.

(3) Observation variables

Temperature
Salinity
Dissolved oxygen
Fluorescence
Turbidity
Total dissolved gas pressure

(4) Instrumentation and methods

The Continuous Sea Surface Water Monitoring System (Marine Works Japan Co. Ltd.) is equipped with five sensors and automatically measures temperature, salinity, dissolved oxygen, fluorescence, turbidity and total dissolved gas pressure in near-sea surface water at one-miniute intervals. This system is installed in the "Sea Surface Monitoring Laboratory" and connected to the shipboard LAN-system. The measured data, along with the time and ship location, were stored on a data management PC. Seawater was continuously pumped into the laboratory from an intake placed approximately 4.5 m below the sea surface and flowed into the system through a vinyl-chloride pipe. The flow rate of the surface seawater was maintained at 10 dm^3 min^{-1}.

1) Instruments

a) Sensors

Temperature and Conductivity Sensor

Model:	SBE-45, SEA-BIRD ELECTRONICS, INC.
Serial number:	4563325-0362
Measurement range:	Temperature -5 ºC - +35 ºC
	Conductivity 0 S m^{-1} - 7 S m^{-1}
Initial accuracy:	Temperature 0.002 ºC
	Conductivity 0.0003 S m^{-1}

Typical stability (per month):	Temperature 0.0002 ºC
	Conductivity 0.0003 S m^{-1}
Resolution:	Temperature 0.0001 ºC
	Conductivity 0.00001 S m^{-1}

Bottom of ship thermometer

Model:	SBE 38, SEA-BIRD ELECTRONICS, INC.
Serial number:	38-1299
Measurement range:	-5 ºC - +35 ºC
Initial accuracy:	±0.001 ºC
Typical stability (per 6 month):	0.001 ºC
Resolution:	0.00025 ºC

Dissolved oxygen sensor

Model:	RINKO II, JFE ADVANTECH CO. LTD.
Serial number:	0077
Measuring range:	0 mg L^{-1} - 20 mg L^{-1}
Resolution:	0.001 mg L^{-1} - 0.004 mg L^{-1} (25 ºC)
Accuracy:	Saturation ± 2 % F.S. (non-linear) (1 atm, 25 ºC)

Fluorescence & Turbidity sensor

Model:	C3, TURNER DESIGNS
Serial number:	2300707
Measuring range:	Chlorophyll in vivo 0 μg L^{-1} – 500 μg L^{-1}
Minimum Detection Limit:	Chlorophyll in vivo 0.03 μg L^{-1}
Measuring range:	Turbidity 0 NTU - 1500 NTU
Minimum Detection Limit:	Turbidity 0.05 NTU

Total dissolved gas pressure sensor

Model:	Mini TDGP, PRO OCEANUS SYSTEM, INC
Serial number:	45-450-31
Temperature range:	-2 ºC - +50 ºC
Resolution:	0.002% (full scale)
Accuracy:	0.1 % (Temperature Compensated)

b) Software

Seamoni Ver.1.2.0.0

(5) Observation log

Periods of measurement, maintenance, and problems during this cruise are listed in Table 7.2.2-1.

Table 7.2.2-1 Events list of the Sea surface water monitoring during MR25-06

System Date [UTC]	System Time [UTC]	Events
2025/10/16	08:30:00	All the measurements started, and data was available.
2025/10/19	22:59:00 to 23:00:00	Flow adjustment.
2025/10/25	04:09:00 to 04:21:00	Filter Cleaning
2025/11/04	00:06:00	All the measurements stopped.

(6) Preliminary results

We collected surface water samples from this system once a day to compare sensor data with discreate bottle measurement of dissolved oxygen and salinity. The results are shown in fig. 7.2.2-1. All the salinity samples were analyzed by the Model 8400B “AUTOSAL” (Guildline Instruments Ltd., see 6.8.1) and dissolve oxygen samples were analyzed by the Winkler method (see 6.8.2).

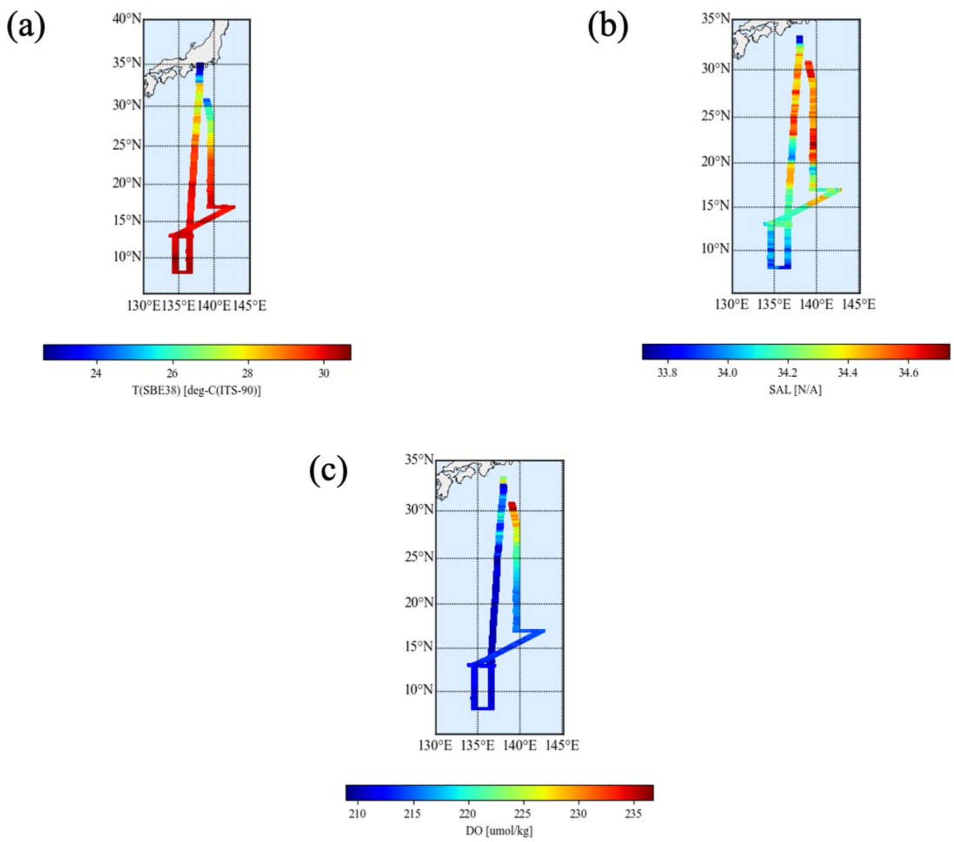

Fig. 7.2.2-1 Spatial and temporal distribution of (a) temperature, (b) salinity, and (c) dissolved oxygen

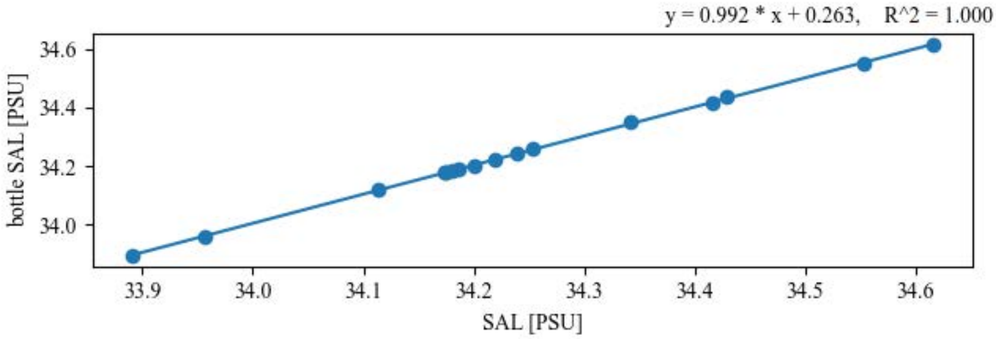

Fig. 7.2.2-2-1 Correlation of salinity between sensor data and bottle data

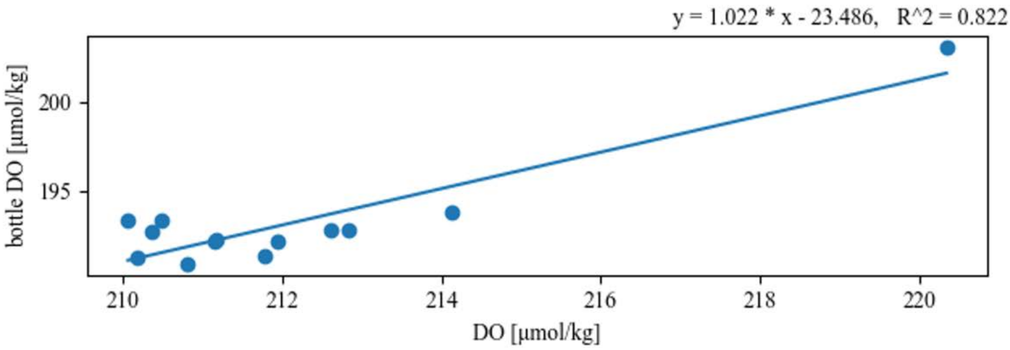

Fig. 7.2.2-2-2 Correlation of dissolved oxygen between sensor data and bottle data

(7) Data archives

The data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

7.3. Geophysical surveys

7.3.1. Sea surface gravity

(1) Personnel

Iwao Ueki	(JAMSTEC)	Principal investigator
Yutaro Murakami	(NME)	Operation Leader
Satomi Ogawa	(NME)	
Haruna Yamanaka	(NME)	
Masanori Murakami	(NME, Crew)	

(2) Objectives

The local gravity is an important parameter in geophysics and geodesy. We collected gravity data at the sea surface.

(3) Instrumentation and methods

We measured relative gravity using LaCoste and Romberg air-sea gravity meter S-116 (Micro-G LaCoste, LLC) during this cruise. Parameters of gravity meter are as follows:

Relative Gravity [CU: Counter Unit]

[mGal] = (coef1: 0.9946) * [CU]

(4) Preliminary results

The observed absolute gravities were shown in Table. 7.3.1-1.

Table 7.3.1-1: Absolute gravity table

No.	Date m/d	UTC hh:mm	Port	Absolute Gravity [mGal]	Sea Level [cm]	Ship Draft [cm]	Gravity at Sensor *1 [mGal]	S-116 Gravity [mGal]
#1	10/15	02:13	Shimizu	979728.98	198	648	979729.85	11998.93
#2	11/06	23:48	Shimizu	979728.98	167	613	979729.68	11999.78

*1: Gravity at Sensor = Absolute Gravity + Sea Level*0.3086/100 + (Draft-530)/100*0.2222

(5) Data archives

The data obtained during this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

(6) Remarks

1. The following period, data acquisition of sea depth was suspended due to sending acoustic command of ANS system.

   21:32UTC 20 Oct. 2025 - 22:54UTC 20 Oct. 2025

   05:51UTC 22 Oct. 2025 - 06:01UTC 22 Oct. 2025

   21:24UTC 22 Oct. 2025 - 22:06UTC 22 Oct. 2025

   21:23UTC 23 Oct. 2025 - 22:36UTC 23 Oct. 2025

   06:51UTC 24 Oct. 2025 - 07:00UTC 24 Oct. 2025

2. The following period, data acquisition of sea depth was suspended due to operating of TurboMAP.

   01:29UTC 30 Oct. 2025 - 03:25UTC 30 Oct. 2025

   04:22UTC 30 Oct. 2025 - 05:52UTC 30 Oct. 2025

   23:46UTC 30 Oct. 2025 - 00:47UTC 31 Oct. 2025

   06:24UTC 31 Oct. 2025 - 07:34UTC 31 Oct. 2025

   23:44UTC 31 Oct. 2025 - 01:51UTC 01 Nov. 2025

7.3.2. Sea surface three component magnetic field

(1) Personnel

Iwao Ueki	(JAMSTEC)	Principal investigator
Yutaro Murakami	(NME)	Operation Leader
Satomi Ogawa	(NME)	
Haruna Yamanaka	(NME)	
Masanori Murakami	(NME, Crew)	

(2) Objectives

Measurement of magnetic force on the sea is required for the geophysical investigations of marine magnetic anomaly caused by magnetization in upper crustal structure. We measured geomagnetic field using a three-component magnetometer during this cruise.

(3) Instrumentation and methods

A shipboard three-component magnetometer system (Tierra Tecnica SFG2018) is equipped on-board R/V MIRAI. Three-axes flux-gate sensors with ring-cored coils are fixed on the fore mast. Outputs from the sensors are digitized by a 20-bit A/D converter (1 nT/LSB), and sampled at 8 times per second. Ship's heading, pitch, and roll are measured by the Inertial Navigation System (INS, PHINS). Ship's position and speed data are taken from LAN every second.

Principle of ship-board geomagnetic vector measurement

The relation between a magnetic-field vector observed on-board, ***Hob***, (in the ship's fixed coordinate system) and the geomagnetic field vector, ***F***, (in the Earth's fixed coordinate system) is expressed as:

$$\boldsymbol{Hob} = \boldsymbol{A} * \boldsymbol{R} * \boldsymbol{P} * \boldsymbol{Y} * \boldsymbol{F} + \boldsymbol{Hp} \qquad \text{(a)}$$

where, ***R***, ***P*** and ***Y*** are the matrices of rotation due to roll, pitch and heading of a ship, respectively. ***A*** is a 3 x 3 matrix which represents magnetic susceptibility of the ship, and ***Hp*** is a magnetic field vector produced by a permanent magnetic moment of the ship's body. Rearrangement of Eq. (a) makes

$$\boldsymbol{B} * \boldsymbol{Hob} + \boldsymbol{Hbp} = \boldsymbol{R} * \boldsymbol{P} * \boldsymbol{Y} * \boldsymbol{F} \qquad \text{(b)}$$

where $\boldsymbol{B} = \boldsymbol{A}^{-1}$, and $\boldsymbol{Hbp} = -\boldsymbol{B} * \boldsymbol{Hp}$. The magnetic field, ***F***, can be obtained by measuring ***R***, ***P***, ***Y*** and ***Hob***, if ***B*** and ***Hbp*** are known. Twelve constants in ***B*** and ***Hbp*** can be determined by measuring variation of Hob with ***R***, ***P*** and ***Y*** at a place where the geomagnetic field, ***F***, is known.

(4) Data archives

The processed data will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

(5) Remarks

1. The following periods, we made a “figure-eight” turn (a pair of clockwise and anti-clockwise rotation) for calibration of the ship’s magnetic effect.

    11:56UTC 20 Oct. 2025 - 12:17UTC 20 Oct. 2025 around 13-30N, 137-00E

    10:39UTC 03 Nov. 2025 - 11:03UTC 03 Nov. 2025 around 28-31N, 140-00E

2. The following period, data acquisition of sea depth was suspended due to sending acoustic command of ANS system.

    21:32UTC 20 Oct. 2025 - 22:54UTC 20 Oct. 2025

    05:51UTC 22 Oct. 2025 - 06:01UTC 22 Oct. 2025

    21:24UTC 22 Oct. 2025 - 22:06UTC 22 Oct. 2025

    21:23UTC 23 Oct. 2025 - 22:36UTC 23 Oct. 2025

    06:51UTC 24 Oct. 2025 - 07:00UTC 24 Oct. 2025

3. The following period, data acquisition of sea depth was suspended due to operating of TurboMAP.

    01:29UTC 30 Oct. 2025 - 03:25UTC 30 Oct. 2025

    04:22UTC 30 Oct. 2025 - 05:52UTC 30 Oct. 2025

    23:46UTC 30 Oct. 2025 - 00:47UTC 31 Oct. 2025

    06:24UTC 31 Oct. 2025 - 07:34UTC 31 Oct. 2025

    23:44UTC 31 Oct. 2025 - 01:51UTC 01 Nov. 2025

7.3.3. Swath bathymetry

(1) Personnel

Iwao Ueki	(JAMSTEC)	Principal investigator
Yutaro Murakami	(NME)	Operation Leader
Satomi Ogawa	(NME)	
Haruna Yamanaka	(NME)	
Masanori Murakami	(NME, Crew)	

(2) Objectives

R/V MIRAI is equipped with a Multi narrow Beam Echo Sounding system (MBES), SEABEAM 3012 Model (L3 Communications ELAC Nautik). The objective of MBES is collecting continuous bathymetric data along ship's track to make a contribution to geological and geophysical investigations and global datasets.

(3) Instrumentation and methods

The "SEABEAM 3012 Model" on R/V MIRAI was used for bathymetry mapping during this cruise. To get accurate sound velocity of water column for ray-path correction of acoustic multibeam system, we used data from a Surface Sound Velocimeter (SSV) to measure the sea-surface sound velocity at a depth of 6.62 m. Sound velocity profiles for deeper layers were calculated from temperature and salinity profiles obtained from CTD, and Argo float data using the equation of Del Grosso (1974) during the cruise. Table 7.3.3-1 shows system configuration and performance of SEABEAM 3012 system.

Table 7.3.3-1: SEABEAM 3012 System configuration and performance

Frequency:	12 kHz
Transmit beam width:	2.0 degree
Transmit power:	4 kW
Transmit pulse length:	2 to 20 msec
Receive beam width:	1.6 degree
Depth range:	50 to 11,000 m
Beam spacing:	Equi-Angle
Number of beams:	301 beams
Swath width:	60 to 150 degrees (max)
Depth accuracy:	< 1 % of water depth (average across the swath)

(4) Data archives

The processed data will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via Data Research System for Whole Cruise Information in JAMSTEC (DARWIN) in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

(5) Remarks

1. The following period, data acquisition of sea depth was suspended due to sending acoustic command of ANS system.

21:32UTC 20 Oct. 2025 - 22:54UTC 20 Oct. 2025
05:51UTC 22 Oct. 2025 - 06:01UTC 22 Oct. 2025
21:24UTC 22 Oct. 2025 - 22:06UTC 22 Oct. 2025
21:23UTC 23 Oct. 2025 - 22:36UTC 23 Oct. 2025
06:51UTC 24 Oct. 2025 - 07:00UTC 24 Oct. 2025

2. The following period, data acquisition of sea depth was suspended due to operating of TurboMAP.

01:29UTC 30 Oct. 2025 - 03:25UTC 30 Oct. 2025
04:22UTC 30 Oct. 2025 - 05:52UTC 30 Oct. 2025
23:46UTC 30 Oct. 2025 - 00:47UTC 31 Oct. 2025
06:24UTC 31 Oct. 2025 - 07:34UTC 31 Oct. 2025
23:44UTC 31 Oct. 2025 - 01:51UTC 01 Nov. 2025

8. Acknowledgement

First of all, I would like to express great thank to Captain Chiba and all of the crew of R/V MIRAI. The all of observation activities were conducted under the cooperation with marine technicians of MWJ and NME. Their efforts were crucially important for our scientific activities. I hope all of scientists joining this cruise will acquire fruitful results. We would like to express our sincere appreciation to the Governments of the United States, the Federated States of Micronesia for allowing us to conduct observations in the areas under their jurisdictions. Finally, I appreciate all of people, who have been involved this cruise.

9. Notice on using

This cruise report is a preliminary documentation as of the end of cruise.

This report is not necessarily corrected even if there is any inaccurate description (i.e. taxonomic classifications). This report is subject to be revised without notice. Some data on this report may be raw or unprocessed. If you are going to use or refer the data on this report, it is recommended to ask the Chief Scientist for latest status.

Users of information on this report are requested to submit Publication Report to JAMSTEC.

https://www.godac.jamstec.go.jp/darwin/en/note.html#report

E-mail: submit-rv-cruise@jamstec.go.jp