5.11 Surface meteorological observations

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(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) Methods

Surface meteorological parameters were observed by two systems as follows.

1) MIRAI Surface Meteorological observation (SMet) system

Instruments of SMet system are listed in Table 5.11-1 and measured parameters are listed in Table 5.11-2. Data were collected and processed by KOAC-7800 weather data processor made by Koshin-Denki, Japan. The data set consists of 6 second averaged data.

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

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

a) Portable Radiation Package (PRP) designed by BNL – short and long wave downward radiation.
b) Zeno Meteorological (Zeno/Met) system designed by BNL – wind, air temperature, relative humidity, pressure, and rainfall measurement.
c) “SeaSnake” the floating thermistor designed by BNL – skin sea surface temperature (SSST) measurement.
d) ISAR (Infrared Sea Surface Temperature Autonomous Radiometer) developed by SOES (Southampton Oceanographic Centre) and BNL – SSST 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 PRP data every 6 seconds, Zeno/Met data every 10 seconds and SeaSnake data every 2 seconds. ISAR data was recorded by another PC, every 5 seconds (raw data) and every 10 minutes (averaged data). Instruments and their locations are listed in Table 5.11-3 and measured parameters are listed in Table 5.11-4.

SeaSnake equipped two thermistor probes. Output voltage was converted to SSST by Steinhart-Hart equation with following coefficients led from the calibration data. See (6) Remarks for the deployed period for each sensors.

Sensor	a	b	c
T01-005 Sensor:	7.97710e-04	-2.13236e-04	-6.70279e-08
T01-100 Sensor:	8.10896e-04	-2.11366e-04	-7.29166e-08
T03-005 Sensor:	7.97750e-04	-2.13058e-04	-6.84900e-08
T03-100 Sensor:	8.04777e-04	-2.12133e-04	-7.11043e-08

y = a + b * x + c * x**3,
x = log (1 / ((Vref / V - 1) * R2 - R1))
T = 1 / y - 273.15

Vref = 2500[mV], R1=249000[Ω], R2=1000[Ω]
T: Temperature [degC], V: Sensor output voltage [mV]

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

i. 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.

ii. Barometer (SMet and SOAR)
Comparison with the portable barometer value, PTB220, VAISALA

iii. Thermometer (air temperature and relative humidity) (SMet and SOAR)
Comparison with the portable thermometer value, HMP41/45, VAISALA

iv. SeaSnake SSST
SeaSnake thermistor probe was calibrated by the bath equipped with SBE-3 plus, Sea-Bird Electronics, Inc.

v. ISAR SSST
ISAR sensor (infrared radiometer) was calibrated by CASOTS bath. Reference temperature of the bath was measured by 4-wire thermistor (AS125, GE Sensing).

(4) Preliminary results

Figure 5.11-1 shows time series of the following parameters;
Wind (SMet)
Air temperature and SST (SOAR and SMet)
Relative humidity (SOAR)
Precipitation (SOAR, rain gauge)
Short/long wave radiation (SOAR)
Pressure (SMet)
Sea surface temperature (SMet)
Significant wave height (SMet)

Figure 5.11-2 shows time series of SSST and SST.

(5) Data archives

These meteorological data will be submitted to the Data Management Group (DMG) of JAMSTEC just

after the cruise.

(6) Remarks (Times in UTC)

1) The observation was carried out within following periods,
Leg1: 12:00 25th Sep. 2011 to 00:00 26th Oct. 2011
Leg2: 00:00 29th Oct. 2011 to 03:00 1st Dec. 2011

2) The following periods, SeaSnake SSST data is available.
[T01-005 & T01-100 sensor]
04:53 30th Sep. 2011 to 06:38 24th Oct. 2011
05:09 31st Oct. 2011 to 11:29 13th Nov. 2011
11:35 13th Nov. 2011 to 03:55 14th Nov. 2011
04:46 14th Nov. 2011 to 00:59 15th Nov. 2011
[T03-005 & T03-100 sensor]
01:48 15th Nov. 2011 to 03:55 29th Nov. 2011

3) The following periods, ISAR observation was suspended.
12:00 25th Sep. 2011 to 03:23 26th Sep. 2011
04:03 20th Oct. 2011 to 16:27 20th Oct. 2011

4) The following periods, SOAR wind direction (relative and true) data is not available due to sensor trouble.
05:51 13th Nov. 2011 to 06:33 13th Nov. 2011

Table 5.11-1: Instruments and installation locations of MIRAI Surface Meteorological observation system

Sensors	Type	Manufacturer	Location (altitude from surface)
Anemometer	KE-500	Koshin Denki, Japan	foremast (24 m)
Tair/RH	HMP45A	Vaisala, Finland with	
43408 Gill aspirated radiation shield		R.M. Young, USA	compass deck (21 m)
			starboard side and port side
Thermometer: SST	RFN1-0	Koshin Denki, Japan	4th deck (-1m, inlet -5m)
Barometer	Model-370	Setra System, USA	captain deck (13 m)
			weather observation room
Rain gauge	50202	R. M. Young, USA	compass deck (19 m)
Optical rain gauge	ORG-815DR	Osi, USA	compass deck (19 m)
Radiometer (short wave)	MS-802	Eiko Seiki, Japan	radar mast (28 m)
Radiometer (long wave)	MS-202	Eiko Seiki, Japan	radar mast (28 m)
Wave height meter	MW-2	Tsurumi-seiki, Japan	bow (10 m)

Table 5.11-2: Parameters of MIRAI Surface Meteorological observation system

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

Table 5.11-3: Instruments and installation locations of SOAR system

Sensors (Zeno/Met)	Type	Manufacturer	Location (altitude from surface)
Anemometer	05106	R.M. Young, USA	foremast (25 m)
Tair/RH	HMP45A	Vaisala, Finland	
with 43408 Gill aspirated radiation shield			
		R.M. Young, USA	foremast (23 m)
Barometer	61202V	R.M. Young, USA	
with 61002 Gill pressure port		R.M. Young, USA	foremast (23 m)
Rain gauge	50202	R.M. Young, USA	foremast (24 m)
Optical rain gauge	ORG-815DA	Osi, USA	foremast (24 m)

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

Sensors (SeaSnake)	Type	Manufacturer	Location (altitude from surface)
Thermistor	107	Campbell Scientific, USA	bow, 5m extension (0 m)

Sensors (ISAR)	Manufacturer	Location (altitude from surface)
ISAR	RMR, USA	foremast (24 m)

Table 5.11-4: 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 Rain rate (optical rain gauge)	mm/hr	
11 Precipitation (capacitive rain gauge)	mm	reset at 50 mm
12 Down welling shortwave radiation	W/m^2	
13 Down welling infra-red radiation	W/m^2	
14 Defuse irradiance	W/m^2	
15 “SeaSnake” raw data	mV	
16 SSST (SeaSnake)	degC	
17 SSST (ISAR)	degC	

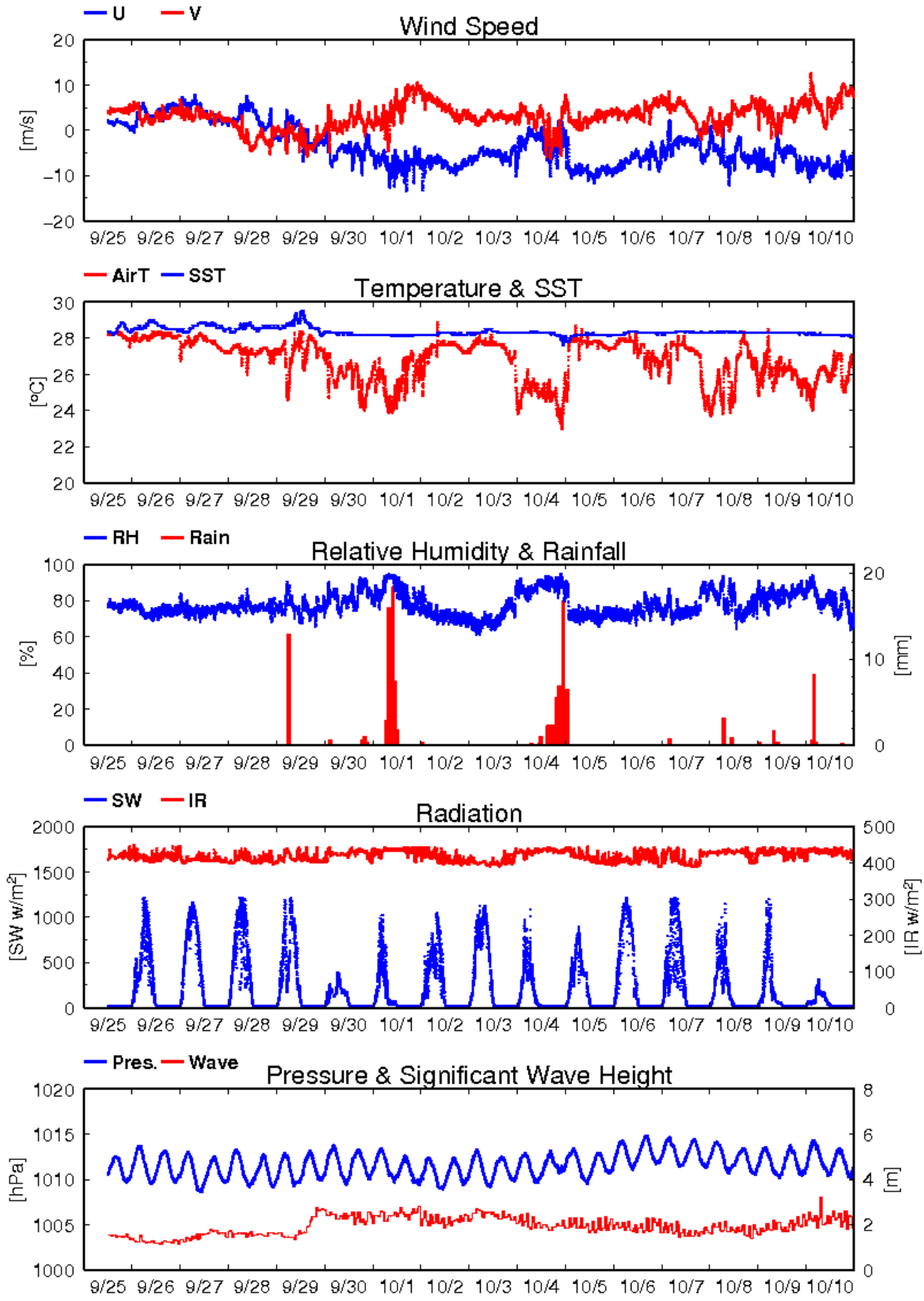


Fig. 5.11-1: Time series of surface meteorological parameters during the cruise.

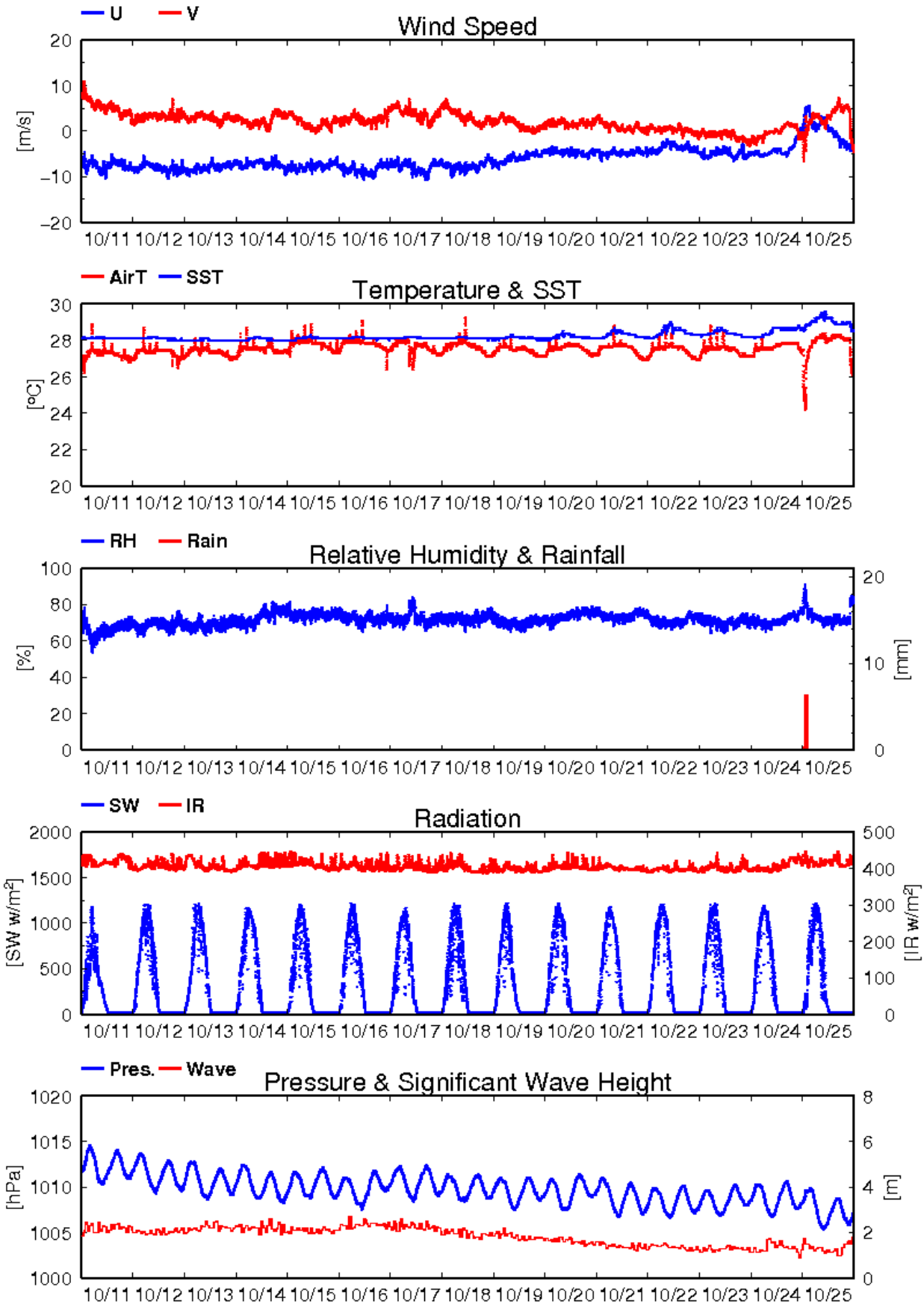
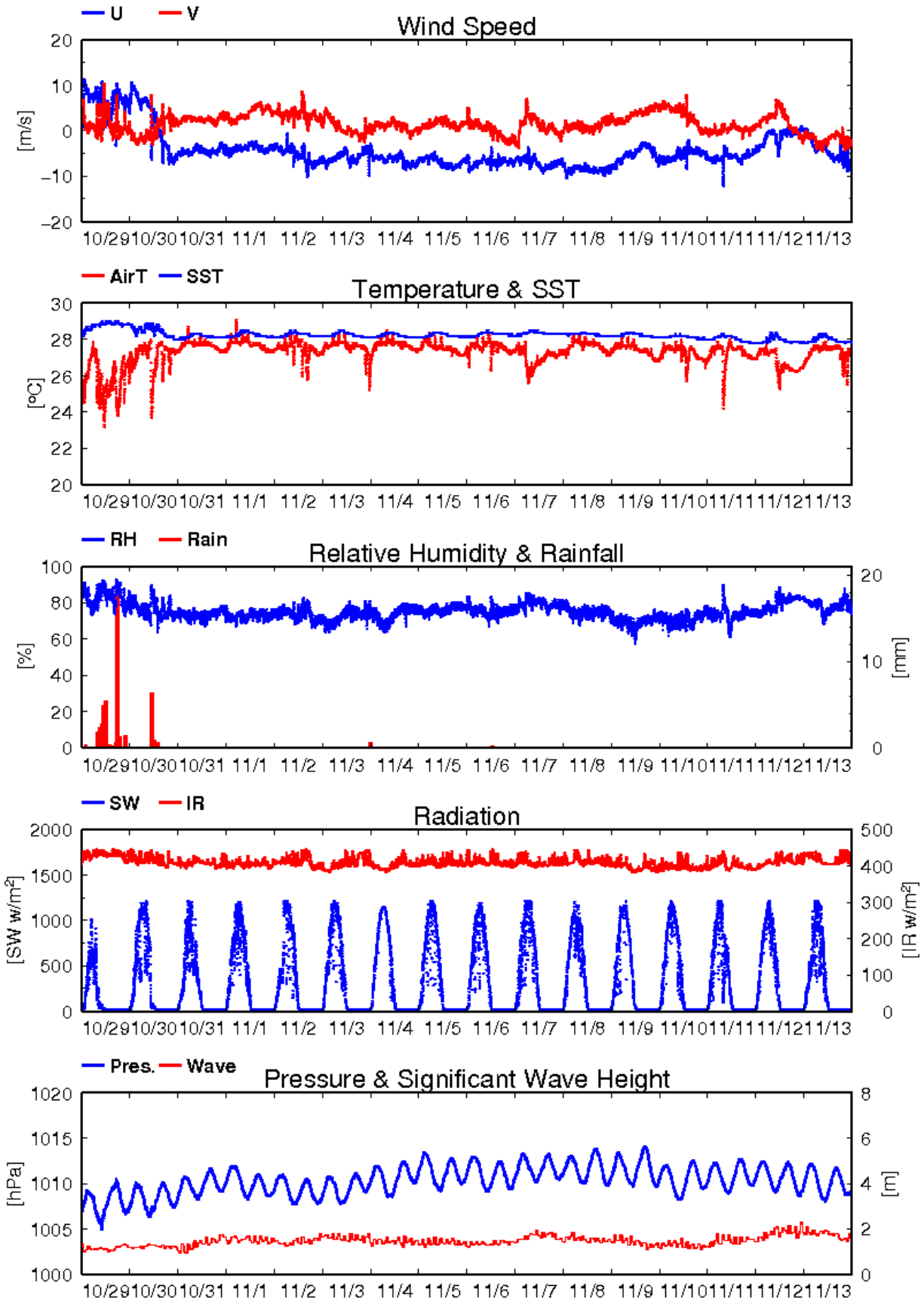


Fig. 5.11-1 (Continued)



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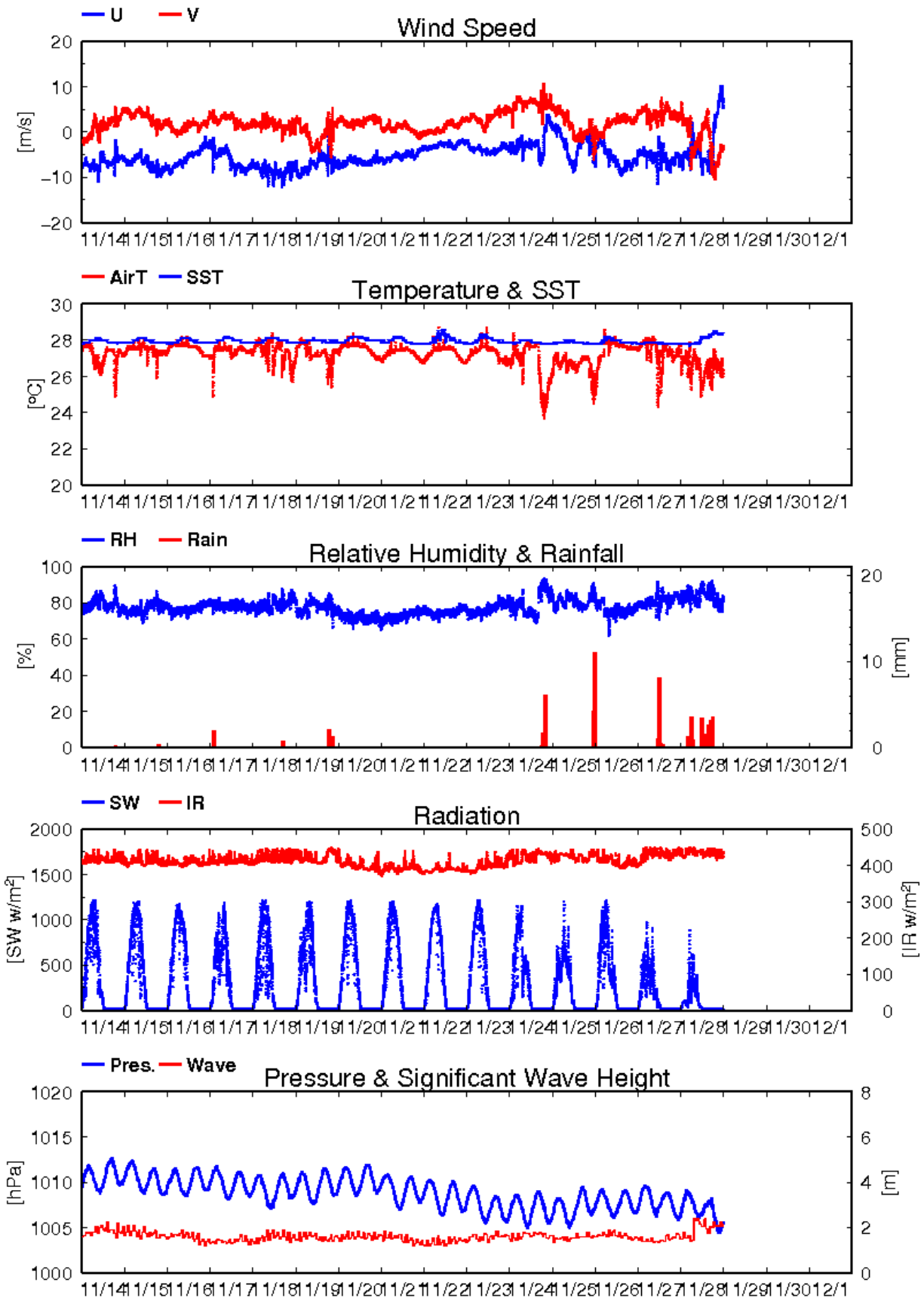

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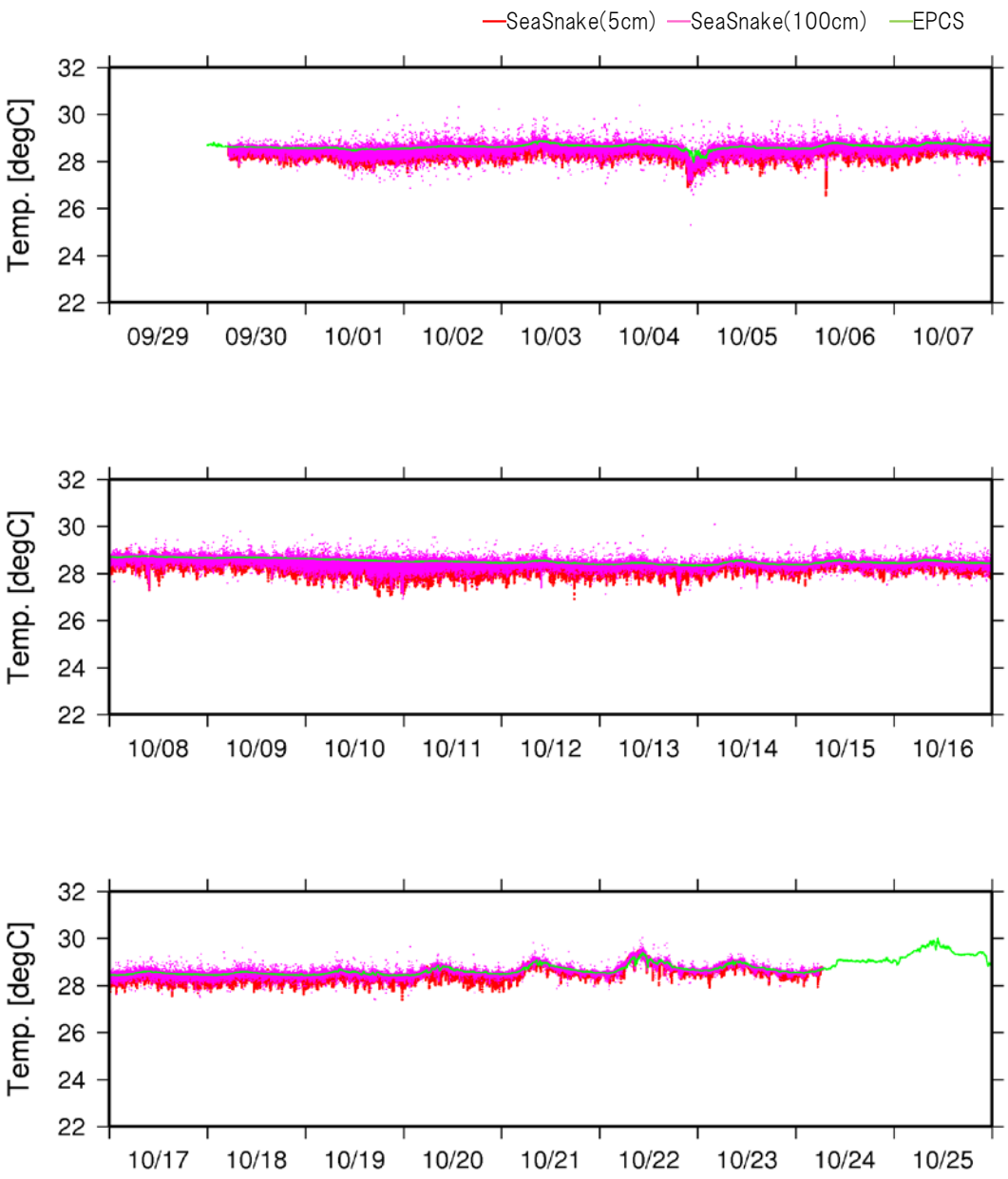

Fig. 5.11-2: Time series of Skin Sea Surface Temperature(SSST, red and purple) and Sea Surface Temperature (EPCS, green) during the cruise.

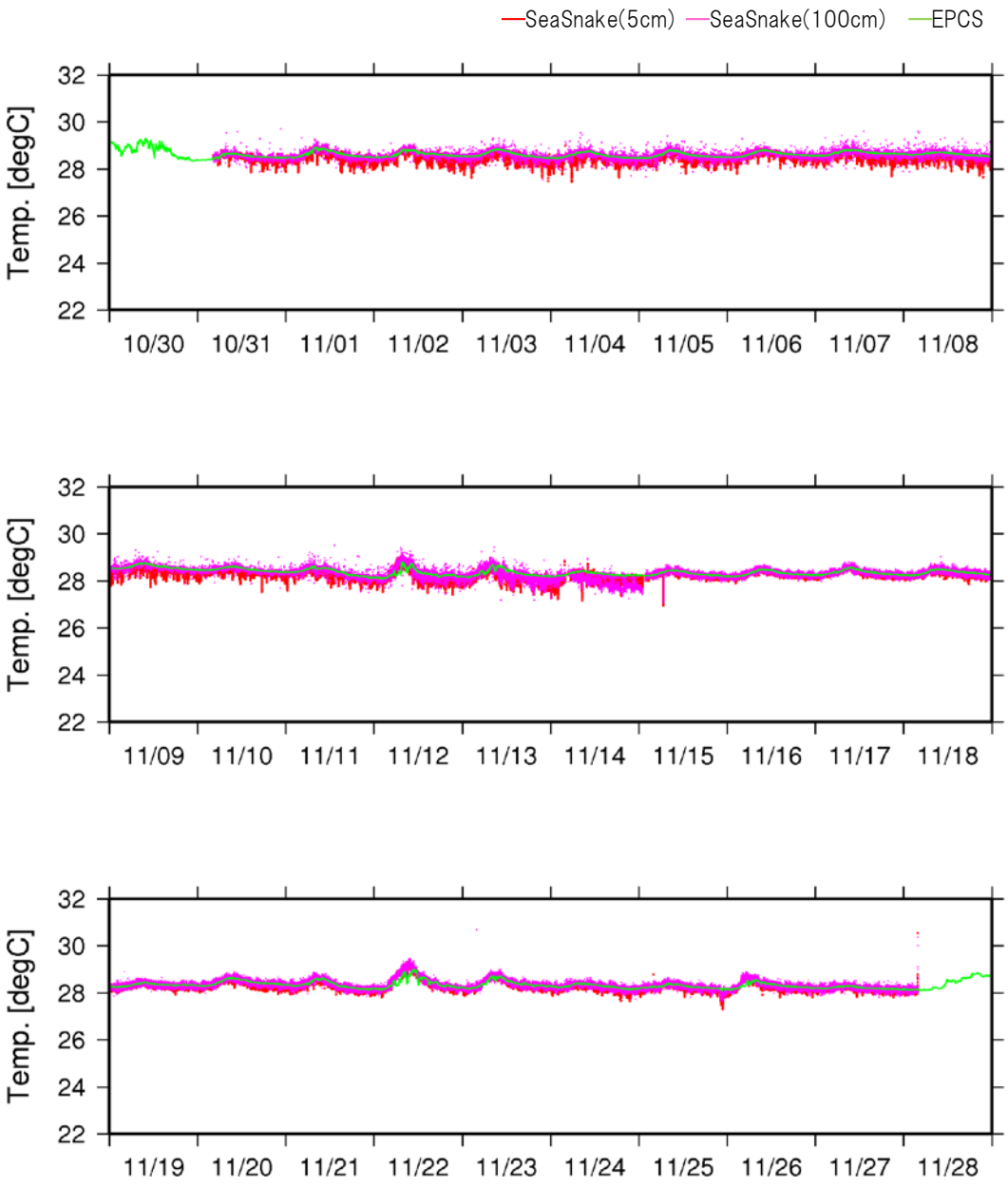

Fig. 5.11-2 (Continued)