

NATSUSHIMA Cruise Report
NT12-14

Kuroshio Extension region

11 June 2012 – 19 June 2012

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

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1. Cruise Information

1.1 Cruise number: NT12-14

1.2 Name of vessel: NATSUSHIMA

1.3 Title of the cruise: Investigation of the atmospheric response to the Kuroshio Extension

1.4 Title of proposal: Investigation of the atmospheric response to the Kuroshio Extension

1.5 Cruise period: 11-19 June 2012

1.6 Ports of call: From / To JAMSTEC Wharf

1.7 Research area: Kuroshio Extension Region

1.8 Research map:

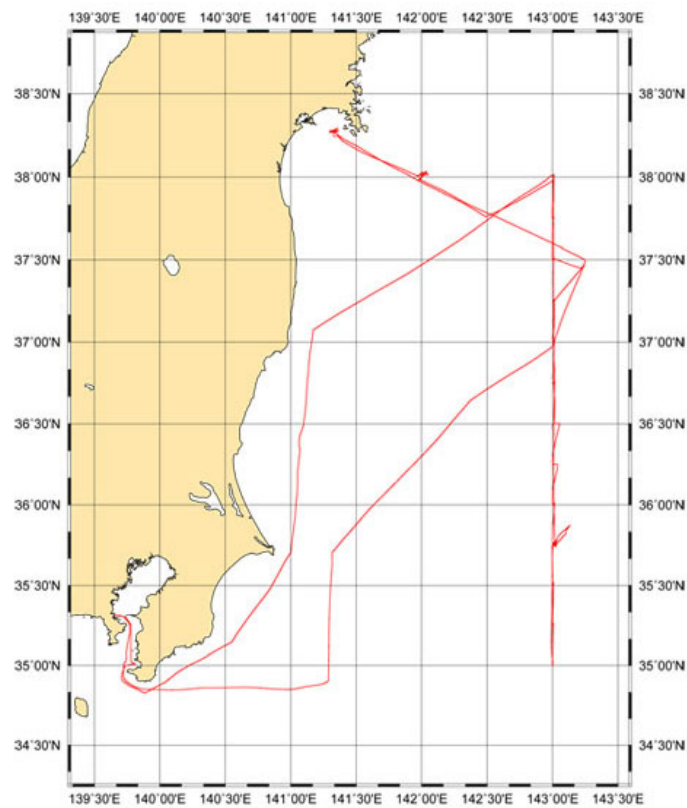


Figure 1. Cruise track of NT12-14 (red line).

2. Researchers

2.1 Chief scientist: Yoshimi Kawai

Ocean-Atmosphere Interaction Research Team
Ocean Climate Change Research Program
Research Institute for Global Change (RIGC)
Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

2.2 Representative of the science party: Yoshimi Kawai

Ocean-Atmosphere Interaction Research Team
Ocean Climate Change Research Program
Research Institute for Global Change (RIGC)
Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

2.3 Science party:

Yoshimi Kawai	RIGC/JAMSTEC
Masami Nonaka	RIGC/JAMSTEC
Vincent Faure	RIGC/JAMSTEC
Qoosaku Moteki	RIGC/JAMSTEC
Bunmei Taguchi	Earth Simulator Center/JAMSTEC
Hideharu Sasaki	Earth Simulator Center/JAMSTEC
Wataru Seta	Tokai University
Akane Kubota	Tokai University
Rina Tajima	Tokai University
Koto Ogata	Mie University
Yuuta Ando	Mie University
Yasumasa Kodama	Hirosaki University
Yukie Wada	Hirosaki University
Fumiaki Ogawa	University of Tokyo
Syun Ohishi	Tohoku University
Yasuharu Seo	Tohoku University
Kazuho Yoshida	Global Ocean Development Inc. (GODI)

2.4 Observation technician:

Takuya Onodera	Nippon Marine Enterprises Ltd. (NME)
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3. Observation

3.1 Purpose and outline

The purpose of this cruise was to investigate the effects of the Kuroshio Extension on the atmospheric boundary layer, atmospheric pressure, clouds, etc. through sea surface heat and momentum flux.

The enormous heat release and the accompanying local minimum of sea level pressure (SLP) over the Kuroshio Extension will contribute to the development and occurrence of extratropical cyclones and play an important role in climate. However, nobody has clarified the processes in which the local minimum of SLP is formed and maintained, and the ones in which the Kuroshio Extension affects precipitation. In this investigation we performed atmospheric observations by using GPS radiosondes, barometer, radiometers, ceilometer, etc. at a fixed point and along a section in the Kuroshio Extension region to examine the effects of the Kuroshio Extension on the atmospheric boundary layer, atmospheric pressure, clouds. We also obtained sea temperature, salinity, and current shear vertical profiles by using expendable (XCTD) and Micro Structure Profiler (MSP), and observed wave height, direction, and period by using a drifting buoy. These data are utilized to investigate the shallowing process of the ocean mixed layer, and the relationship between surface heat/momentum flux and the ocean turbulence. The data obtained in this cruise will be also used for data assimilation, and validation of numerical models.

3.2 Observations and activities

- 1) We performed radiosonde observations every 2 hours and MSP/expendable Current Profiler (XCP) observations every 4 hours at the fixed point (35°45'N, 143°00'E) south of the SST front of the Kuroshio Extension for one day. Wave height, direction, period, etc. were also observed with a drifting buoy around the fixed point for a half day. This buoy was recovered in this cruise.
- 2) We performed radiosonde and XCTD observations every 15' in latitude from 38°N to 35°N along 143°E. The radiosonde and XCTD observations were also done at 37°27'N, 143°14'E twice.
- 3) We observed shortwave and longwave radiations, air temperature, relative humidity, wind speed, wind direction, atmospheric pressure, cloud base height, rain rate, sea surface temperature, and surface current during the cruise.

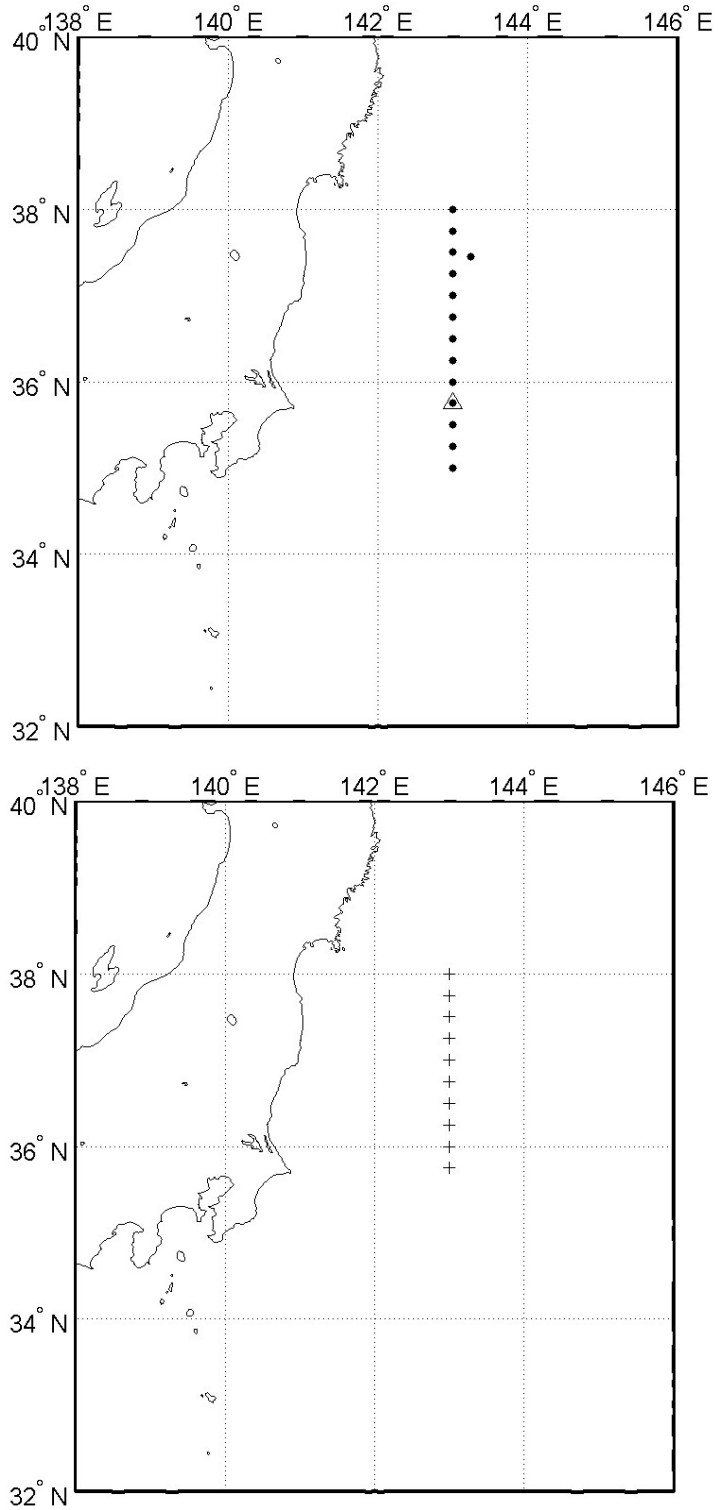


Figure 2. (upper) Locations of the radiosonde/XCTD observations (dot), and the fixed point where MSP, XCP, and drifting-buoy observations were done (triangle). (lower) Locations of the radiosonde observations after the fixed point stay (plus).

3.3 Instruments

XCTD	XCTD-1 (Tsurumi Seiki)
GPS Radiosonde	RS-06G (sensor), RD-08AC (receiver) (Meisei)
Shortwave radiometer	CM-21 (Kipp&Zone)
Longwave radiometer	CG-4 (Kipp&Zone)
Weather transmitter	WXT520 (Vaisala)
Ceilometer	CL31 (Vaisala)
Micro Structure Profiler	TurboMap (JFE Advantech)
XCP	(Lockheed Martin)
Ultrasonic anemometer	WindMaster II (GILL)
Drifting GPS wave buoy	(Zeni lite buoy)

3.4 Observation results

3.4.1 XCTD measurements

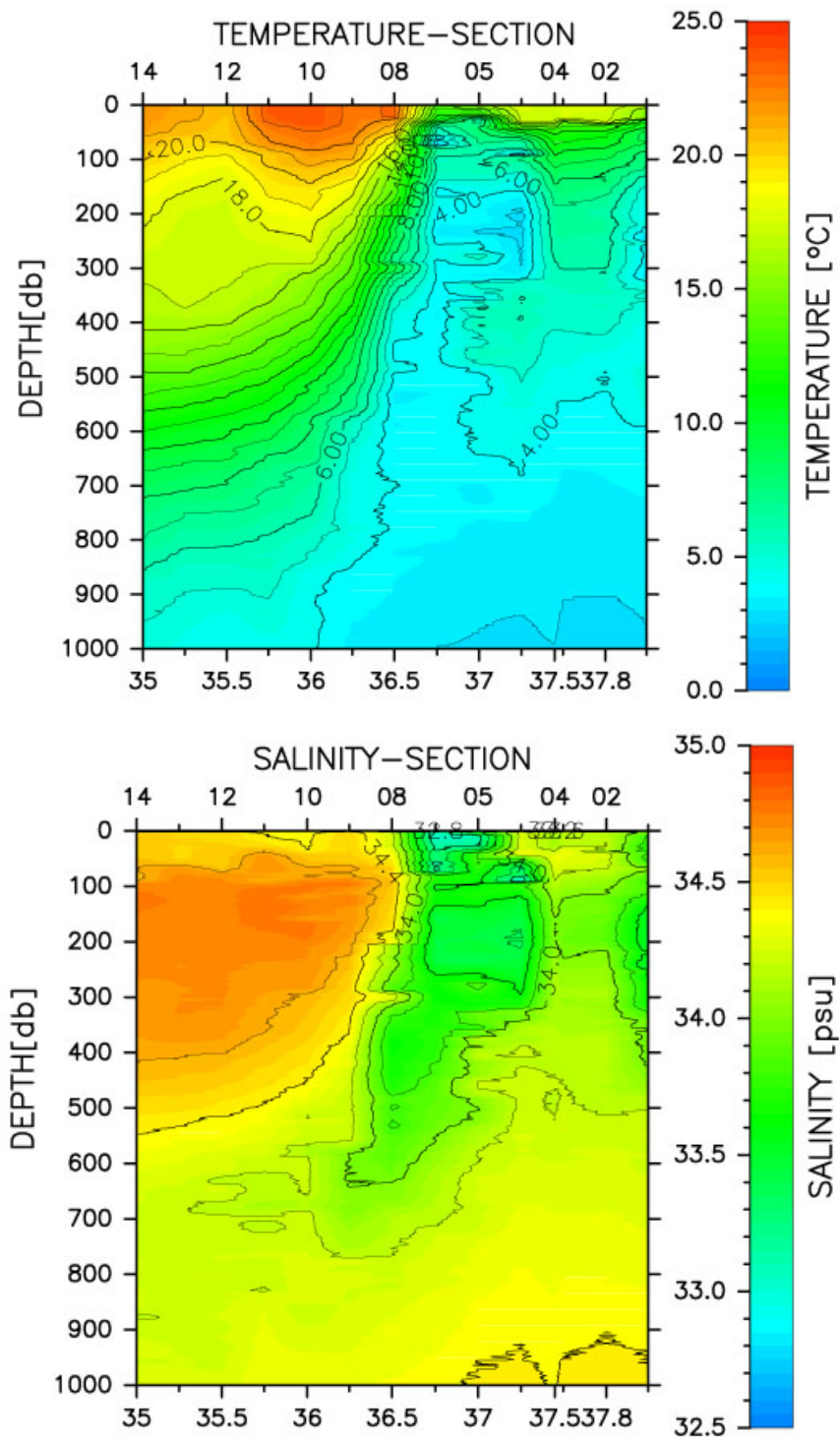


Figure 3. (a) Temperature, (b) salinity, and (c) density along the 143E line.

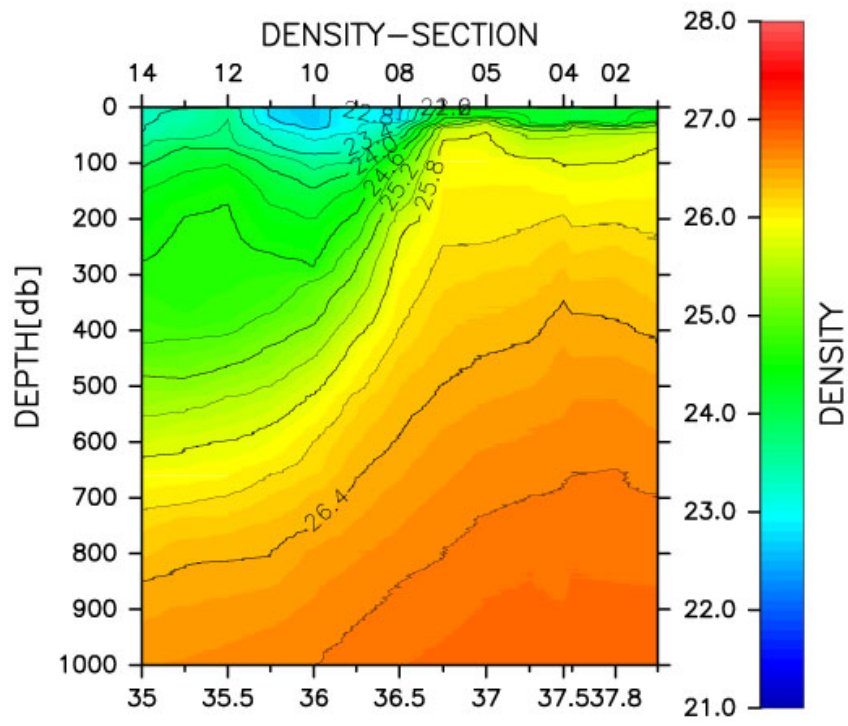


Figure 3. (continued)

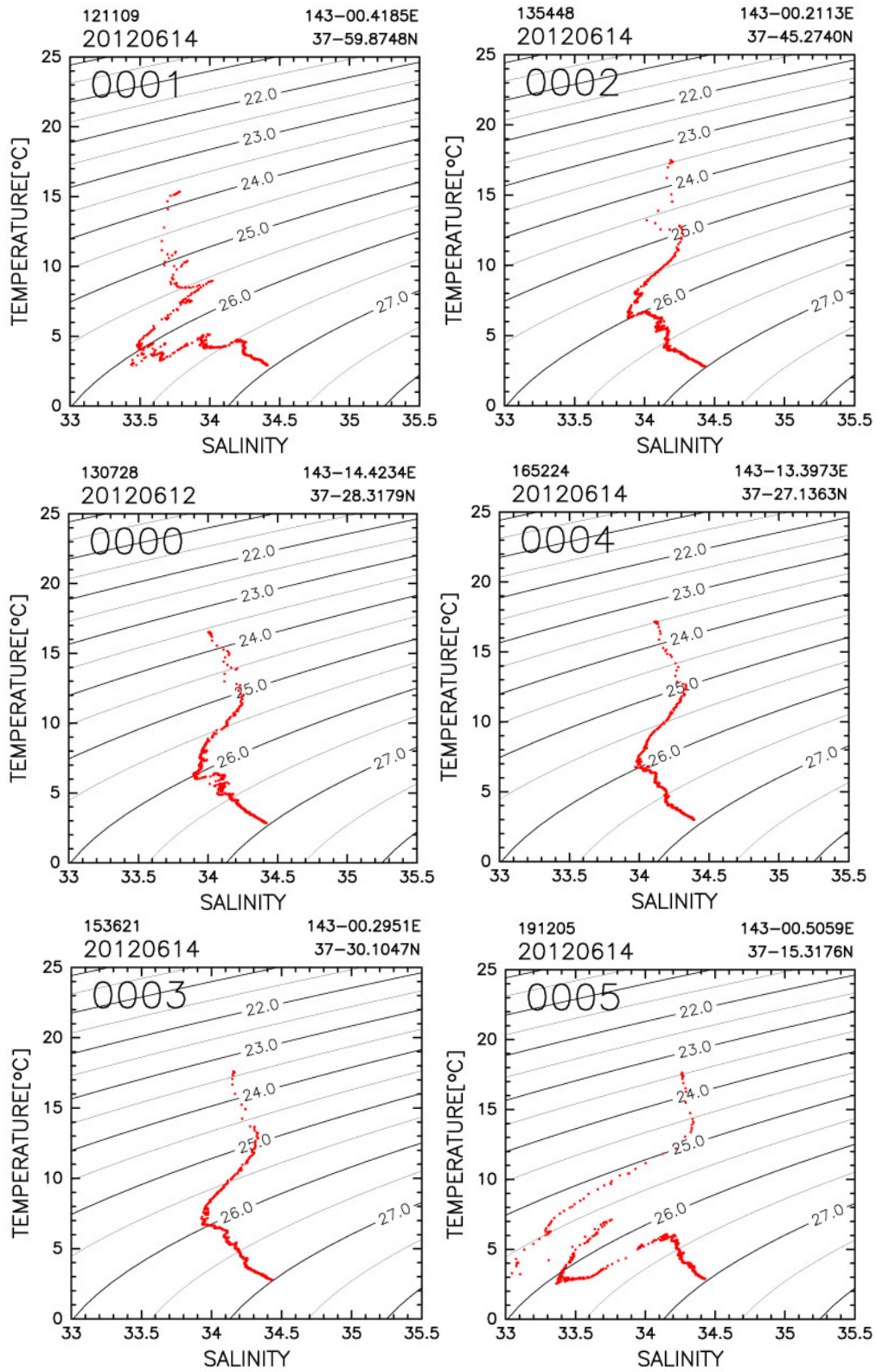


Figure 4. T-S diagrams obtained with XCTDs.

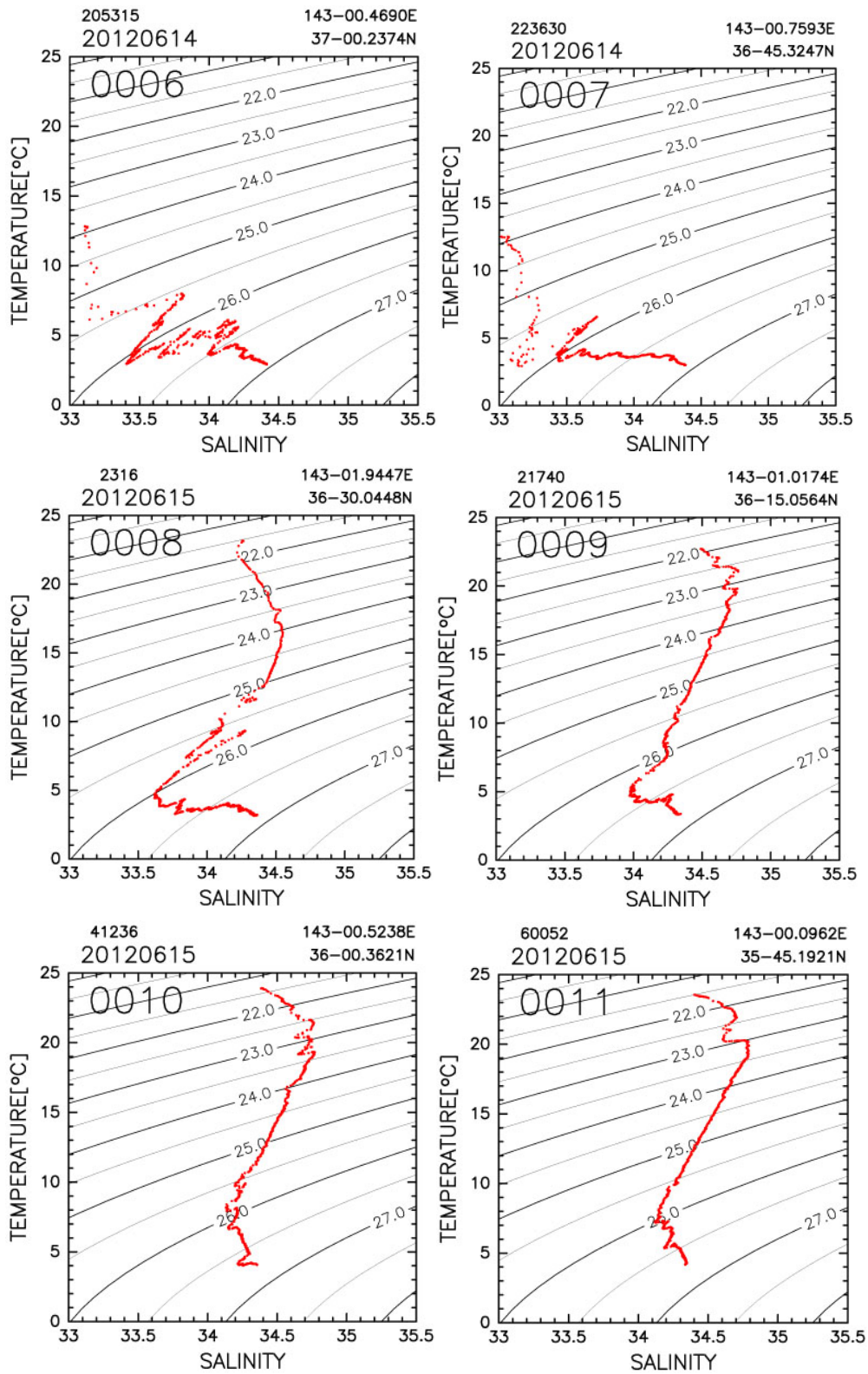


Figure 4 (continued)

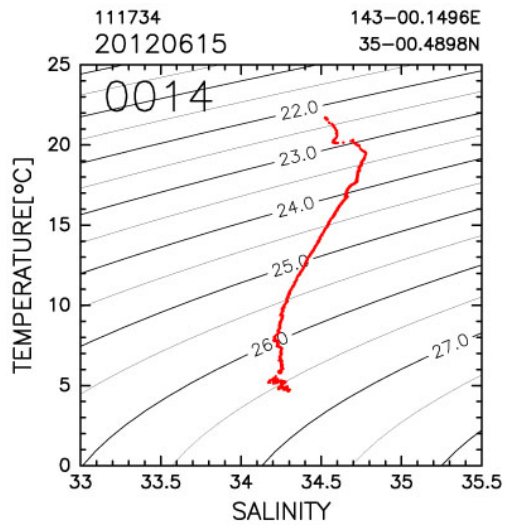
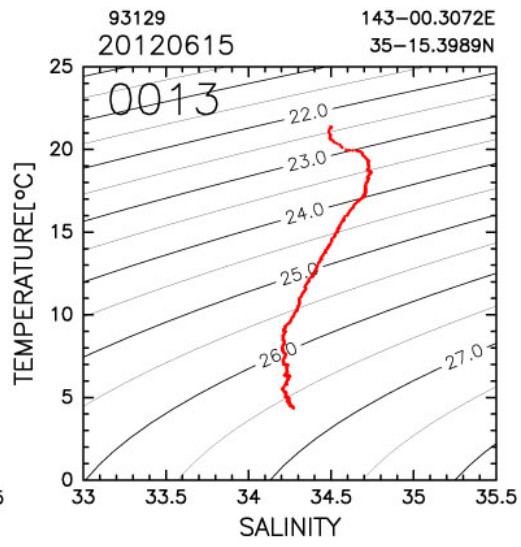
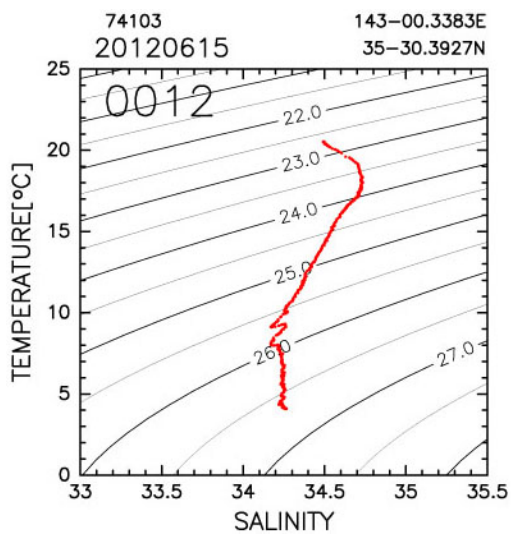


Figure 4 (continued)

3.4.2 Radiosonde measurements

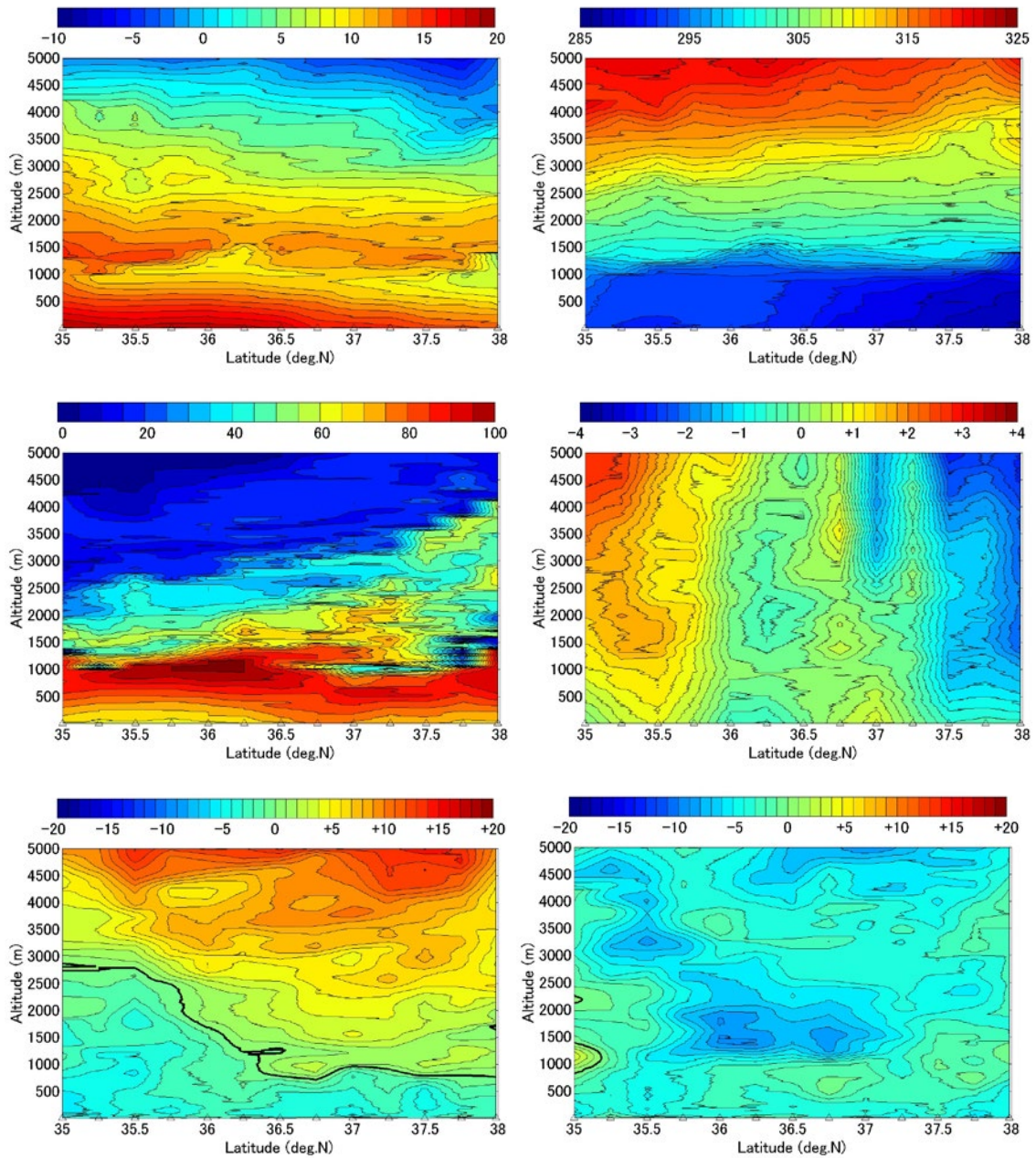


Figure 5. Atmospheric temperature ($^{\circ}\text{C}$, upper left), virtual potential temperature (K , upper right), relative humidity ($\%$, middle left), pressure deviation from average at each level (hPa , middle right), zonal wind speed (m/s , lower left), and meridional wind speed (m/s , lower right) observed from 12:04 on 14 June to 11:12 on 15 June (JST). Positive values show westerly or southerly.

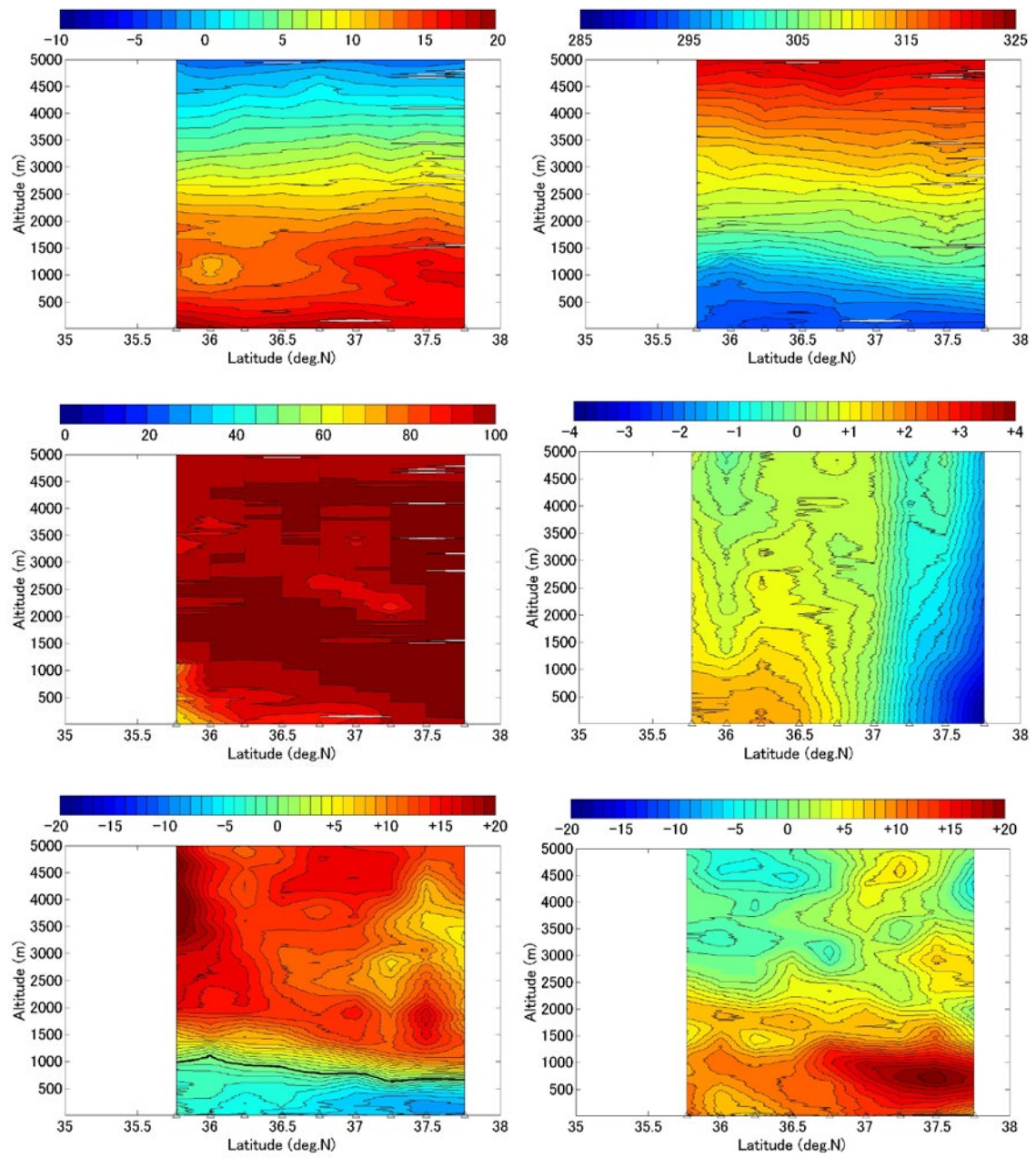


Figure 6. Same as Figure 5, but observed from 16:54 on 16 June to 01:36 on 17 June (JST).

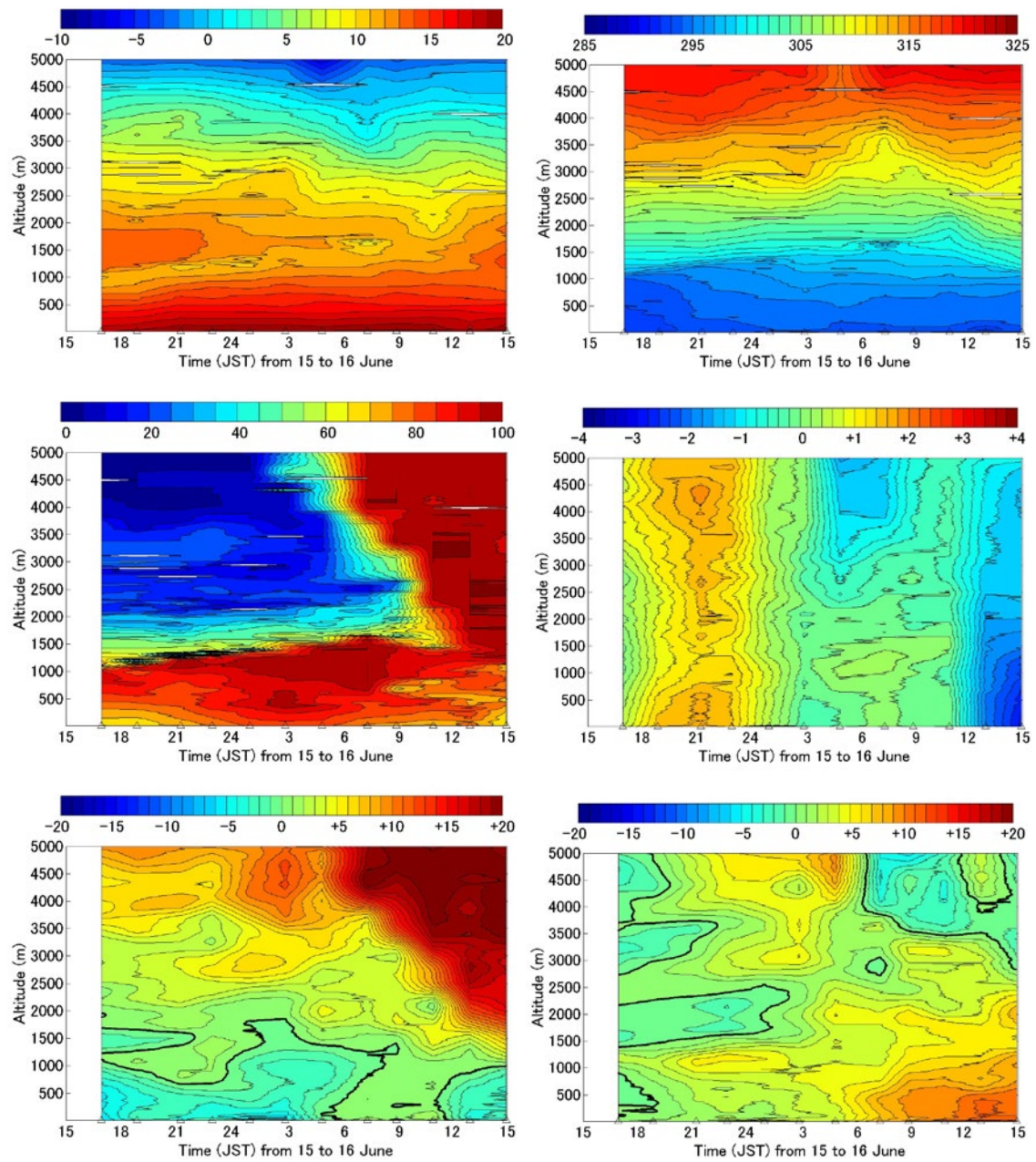


Figure 7. Same as Figure 5, but observed from 16:56 on 15 June to 14:56 on 16 June (JST) at 35°45'N, 143°00'E.

3.4.3 Surface meteorology

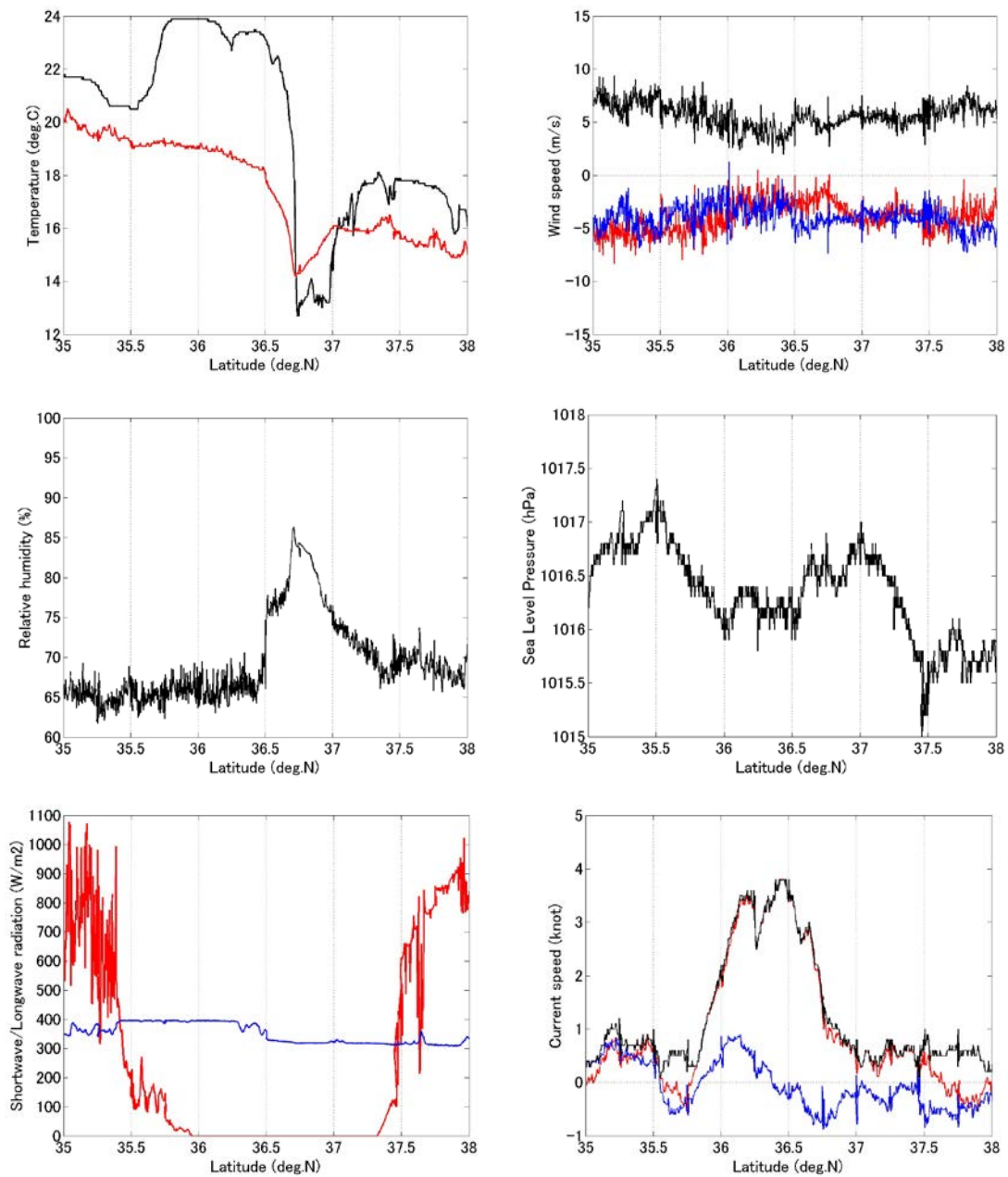


Figure 8. (upper left) Atmospheric temperature (red) and SST (black); (upper right) wind speed (black), meridional component (blue), and zonal component (red); (middle left) relative humidity; (middle right) sea level pressure; (lower left) shortwave (red) and longwave (blue) radiation; (lower right) current speed (black), meridional component (blue), and zonal component (red) observed from 12:04 on 14 June to 11:12 on 15 June (JST). Positive values show westerly or southerly. Note that these data may be corrected later.

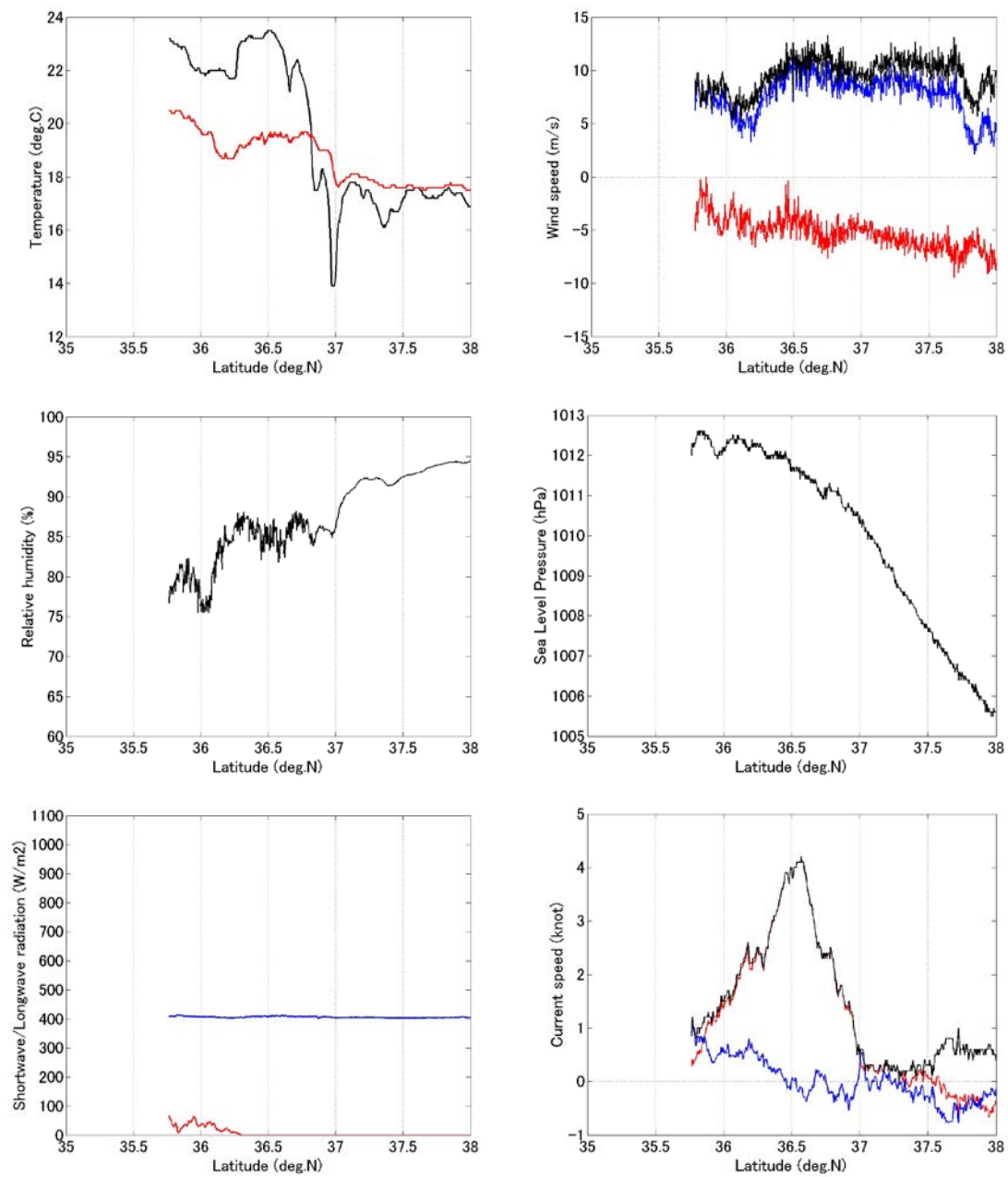


Figure 9. Same as Figure 8, but observed from 16:54 on 16 June to 01:36 on 17 June (JST). Note that these data may be corrected later.

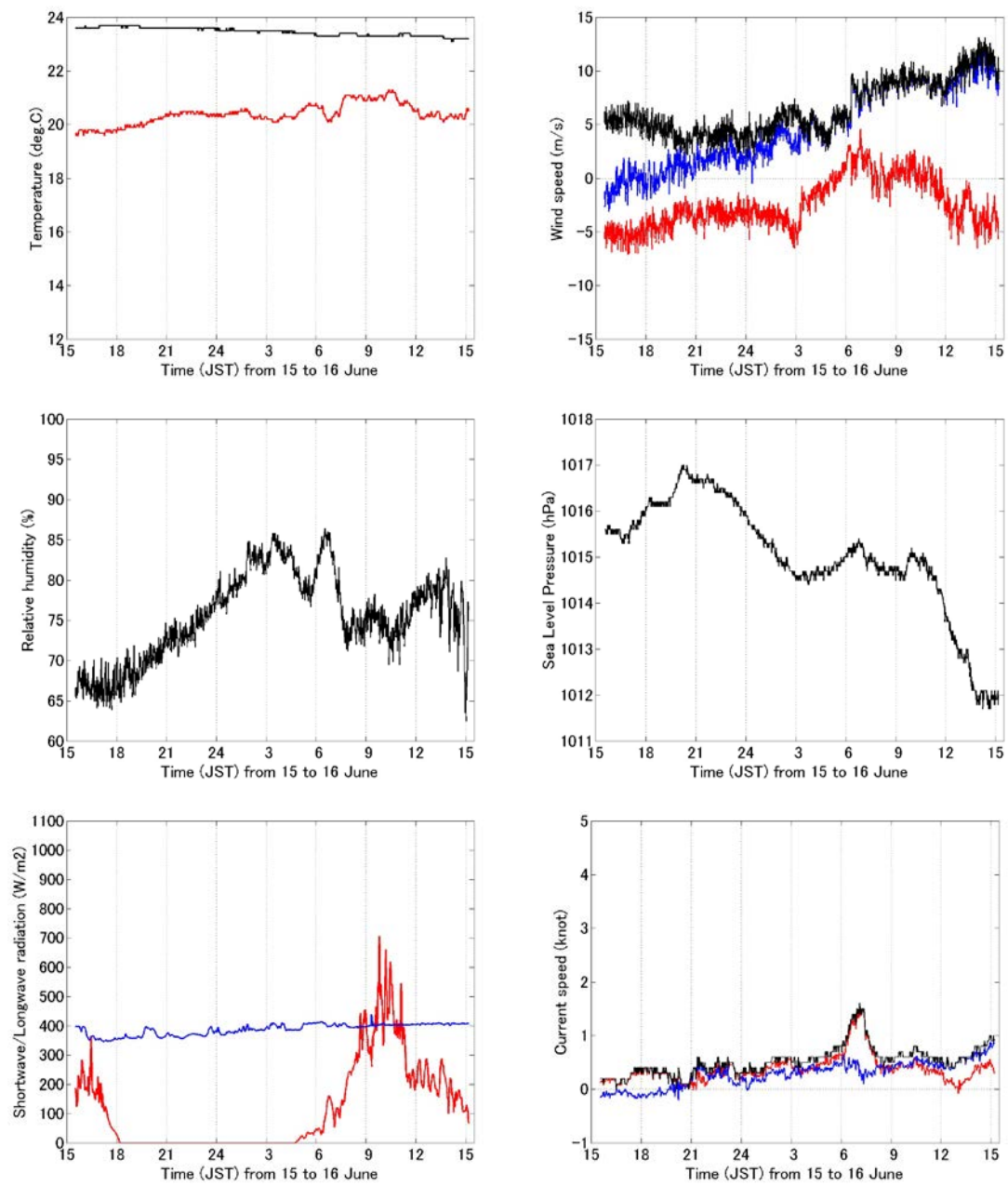


Figure 10. Same as Figure 8, but observed from 16:56 on 15 June to 14:56 on 16 June (JST) at 35°45'N, 143°00'E. Note that these data may be corrected later.

3.4.4 Ocean turbulence

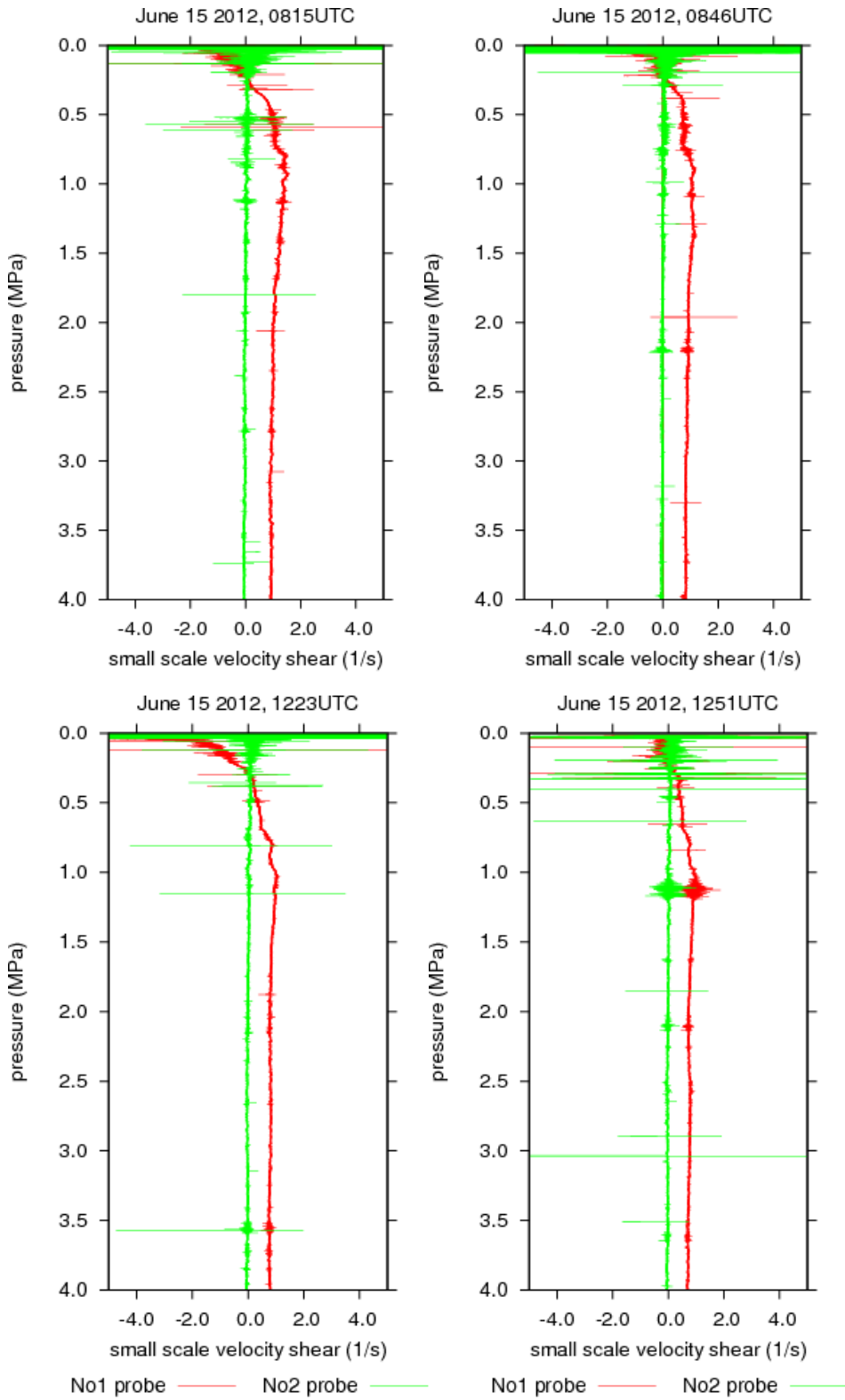


Figure 11. Vertical profiles of current shear measured with TurboMAP.

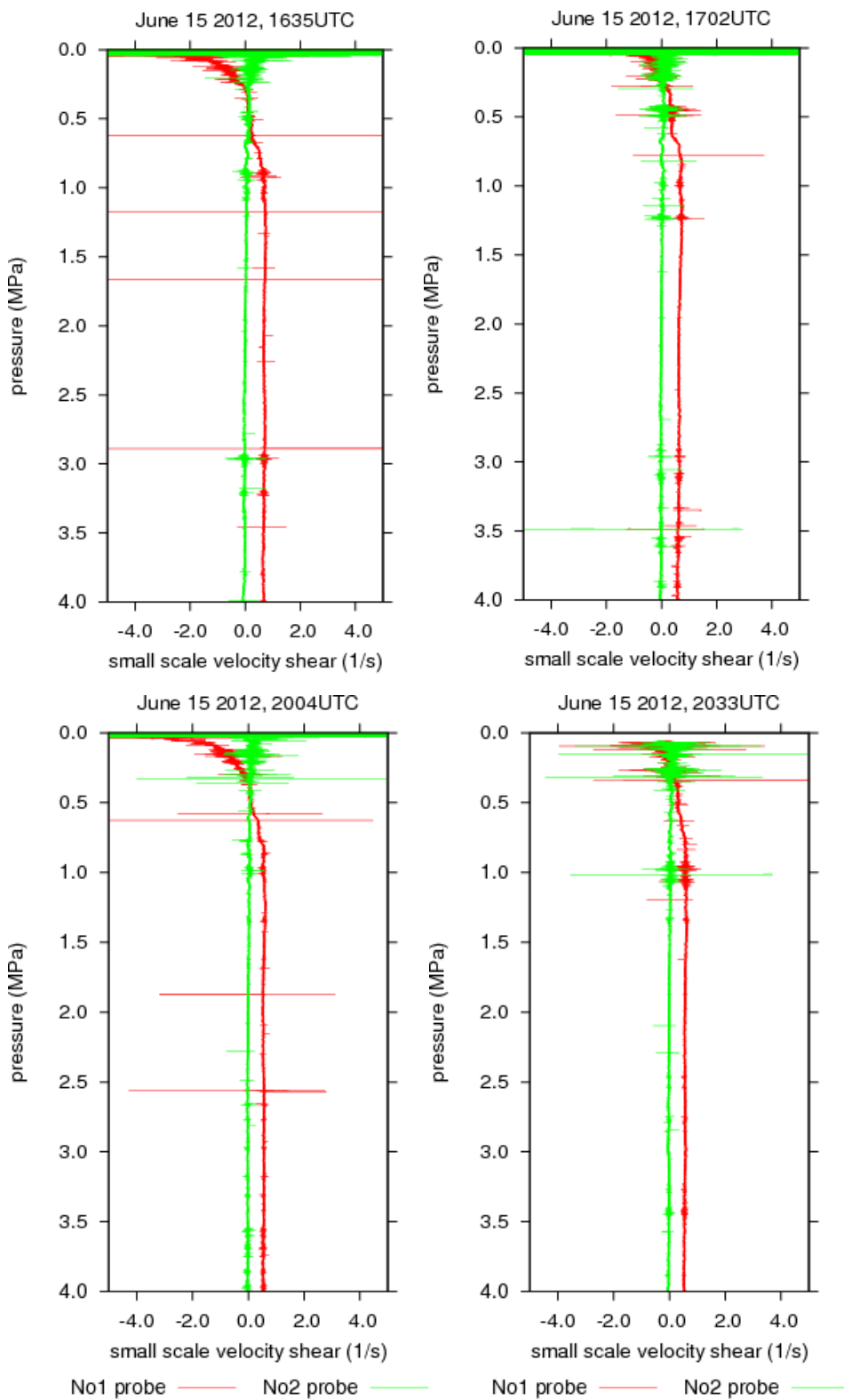


Figure 11 (continued)

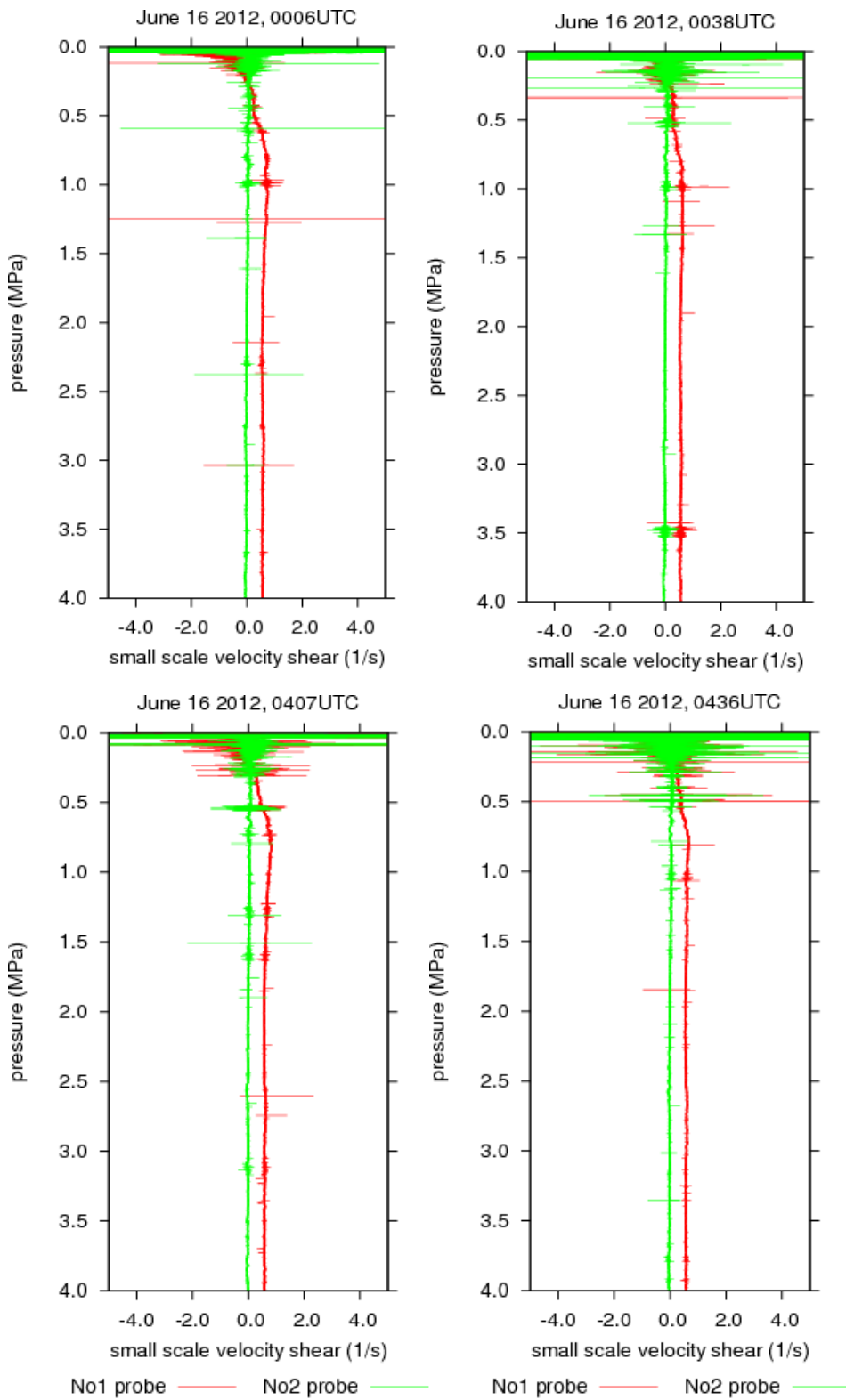


Figure 11 (continued)

3.5 Cruise log

Date	Time		Event
	(JST)	(UTC)	
11 Jun.	09:00	00:00	Japan Standard Time is (UTC+9h) Departed from JAMSTEC Wharf.
12 Jun.	12:37	03:37	Radiosondes and XCTD at 37°27'N, 143°14'E
	13:15	04:15	Commenced shifting to Kinkasan South ward
	19:00	10:00	Arrived off Kinkasan
13 Jun.	06:30	21:30 (-1d)	Commenced proceeding to off Ishinomaki
	10:00	01:00	Arrived off Ishinomaki and commenced drifting
14 Jun.	03:00	18:00 (-1d)	Commenced proceeding to research area
	12:04	03:04	Started the radiosonde/XCTD observations along 143°E from 38°N
15 Jun.	16:52	07:52	Radiosonde and XCTD at 37°27'N, 143°14'E
	11:12	02:12	Finished the radiosonde/XCTD observations along 143°E at 35°N
	15:15	06:15	Arrived at the fixed point (35°45'N, 143°00'E)
	16:56	07:56	Started the radiosonde/MSP observations at the fixed point
16 Jun.	18:42	09:42	Released the drifting buoy
	06:59	21:59 (-1d)	Recovered the drifting buoy
	15:02	06:02	Departed from the fixed point for the across-front observations
17 Jun.	03:00	18:00 (-1d)	Finished the radiosonde observations along 143°E at 38°N, and departed for Yokosuka
18 Jun.	10:00	01:00	Arrived at Tateyama Bay
	13:15	04:15	Departed from Tateyama Bay
	16:05	07:05	Arrived at JAMSTEC Wharf
19 Jun.	09:00	00:00	Finished unloading

3.6 Detailed information on research points

	St.	Date and time (JST)	Latitude	Longitude	Serial Number	Observation	Memo
1	X01	2012/06/12 12:48	37°25.4720'	143°13.0393'	101154	Sonde 1	Max 19718m
1	X01	2012/06/12	37°27.1834'	143°13.9013'	101151	Sonde 2	Max 17543m

		13:00					
1	X01	2012/06/12 13:07	37°28.3429'	143°14.4338'	10121094	XCTD 1	Max 1100m
2	E01	2012/06/14 12:04	37°59.2201'	143°00.4221'	101152	Sonde 3	Max 19090m
2	E01	2012/06/14 12:11	37°59.8780'	143°00.4181'	10121095	XCTD 2	Max 1100m
3	E02	2012/06/14 13:46	37°44.9605'	143°00.1288'	101153	Sonde 4	Max 17898m
3	E02	2012/06/14 13:54	37°45.2778'	143°00.2124'	10121096	XCTD 3	Max 1100m
4	E03	2012/06/14 15:28	37°29.8383'	143°00.1397'	101155	Sonde 5	Max 16970m
4	E03	2012/06/14 15:36	37°30.1056'	143°00.2940'	10121097	XCTD 4	Max 1100m
5	X01	2012/06/14 16:52	37°27.1370'	143°13.3983'	10121098	XCTD 5	Max 1100m
5	X01	2012/06/14 17:17	37°27.8289'	143°14.5326'	101156	Sonde 6	Max 16045m
6	E04	2012/06/14 19:04	37°14.9704'	143°00.3809'	101158	Sonde 7	Max 16136m
6	E04	2012/06/14 19:12	37°15.3168'	143°00.5060'	11063960	XCTD 6	Max 1100m
7	E05	2012/06/14 20:47	37°00.0096'	143°00.2625'	101159	Sonde 8	Max 16789m
7	E05	2012/06/14 20:53	37°00.2387'	143°00.4696'	11063961	XCTD 7	Max 1100m
8	E06	2012/06/14 22:28	36°44.9550'	143°00.3091'	101160	Sonde 9	Max 16861m
8	E06	2012/06/14 22:36	36°45.3240'	143°00.7590'	11063962	XCTD 8	Max 1100m
9	E07	2012/06/15 00:17	36°29.9448'	143°01.2738'	101161	Sonde 10	Max 17477m
9	E07	2012/06/15 00:23	36°30.0447'	143°01.9486'	11063963	XCTD 9	Max 1095.9m

10	E08	2012/06/15 02:11	36°14.8782'	143°00.3250'	101162	Sonde 11	Max 16584m
10	E08	2012/06/15 02:17	36°15.0568'	143°01.0152'	11063964	XCTD 10	Max 1100m
11	E09	2012/06/15 04:07	36°00.0420'	143°00.2424'	101163	Sonde 12	Max 15435m
11	E09	2012/06/15 04:12	36°00.3630'	143°00.5251'	11063965	XCTD 11	Max 1100m
12	E10	2012/06/15 05:54	35°44.9108'	143°00.0250'	101164	Sonde 13	Max 15719m
12	E10	2012/06/15 06:00	35°45.1928'	143°00.0967'	11063966	XCTD 12	Max 1100m
13	E11	2012/06/15 07:35	35°30.0884'	143°00.2026'	101165	Sonde 14	Max 16904m
13	E11	2012/06/15 07:41	35°30.3939'	143°00.3379'	11063967	XCTD 13	Max 1100m
14	E12	2012/06/15 09:25	35°15.0372'	143°00.1759'	101166	Sonde 15	Max 18035m
14	E12	2012/06/15 09:31	35°15.3988'	143°00.3076'	11063968	XCTD 14	Max 1100m
15	E13	2012/06/15 11:12	35°00.1953'	143°00.1482'	101167	Sonde 16	Max 17403m
15	E13	2012/06/15 11:17	35°00.4899'	143°00.1493'	11063969	XCTD 15	Max 1100m
16	E10	2012/06/15 16:56	35°45.0207'	143°00.5159'	101168	Sonde 17	Max 15095m Fixed point
16	E10	2012/06/15 17:14	35°45.3603'	143°01.3847'	—	MSP 1	Max 467m
16	E10	2012/06/15 17:45	35°45.4042'	143°01.0788'	—	MSP 2	Max 461m
16	E10	2012/06/15 18:36	35°45.4956'	143°00.7013'	10091063	XCP 1	Data not good
17	E10	2012/06/15 18:42	35°45.5778'	143°00.6916'	—	Release buoy	
18	E10	2012/06/15 18:52	35°45.8916'	143°00.7714'	101169	Sonde 18	Max 15518m

18	E10	2012/06/15 18:59	35°45.9854'	143°00.7758'	—	Bucket 1	23.7°C
19	E10	2012/06/15 20:57	35°45.0196'	143°01.3144'	101170	Sonde	Temp. error retry
19	E10	2012/06/15 21:14	35°45.1467'	143°01.2378'	101171	Sonde 19	Max 17630m
19	E10	2012/06/15 21:22	35°45.1858'	143°01.1705'	—	MSP 3	Max 465m
19	E10	2012/06/15 21:50	35°45.3396'	143°00.9598'	—	MSP 4	Max 458m
19	E10	2012/06/15 22:30	35°45.6739'	143°00.7427'	10111004	XCP 2	Failure
20	E10	2012/06/15 22:57	35°46.0384'	143°00.7627'	101173	Sonde 20	Max 16797m
20	E10	2012/06/15 23:03	35°46.0912'	143°00.7443'	—	Bucket 2	23.5°C
21	E10	2012/06/16 01:00	35°44.8883'	143°01.4661'	101174	Sonde 21	Max 16060m
21	E10	2012/06/16 01:06	35°44.9413'	143°01.4287'	—	MSP	Max 156m Strong tension retry
21	E10	2012/06/16 01:26	35°44.9413'	143°01.4287'	—	MSP	Weight lost retry
21	E10	2012/06/16 01:34	35°45.1984'	143°01.3003'	—	MSP 5	Max 460m
21	E10	2012/06/16 02:01	35°45.4943'	143°01.1949'	—	MSP 6	Max 453m
22	E10	2012/06/16 02:56	35°45.3545'	143°01.2932'	101175	Sonde 22	Max 16240m
22	E10	2012/06/16 03:02	35°45.2354'	143°01.4390'	—	Bucket 3	23.5°C
23	E10	2012/06/16 04:55	35°45.6483'	143°01.6169'	101176	Sonde 23	Max 17133m
23	E10	2012/06/16 05:03	35°45.7553'	143°01.6405'	—	MSP 7	Max 449m
23	E10	2012/06/16	35°46.1945'	143°01.6868'	—	MSP 8	Max 442m

		05:32					
24	E10	2012/06/16 06:59	35°52.3576'	143°08.0076'	—	Recover buoy	
25	E10	2012/06/16 07:24	35°49.7515'	143°06.3240'	101178	Sonde 24	Max 11936m
25	E10	2012/06/16 08:12	35°44.9625'	143°01.2303'	—	Bucket 4	23.4°C
26	E10	2012/06/16 08:58	35°44.9140'	143°01.1085'	101177	Sonde 25	Max 17363m
26	E10	2012/06/16 09:05	35°45.0312'	143°01.2510'	—	MSP 9	Max 430m
26	E10	2012/06/16 09:35	35°45.9194'	143°01.5338'	—	MSP	Strong tension at the surface retry
26	E10	2012/06/16 09:37	35°45.9194'	143°01.5338'	—	MSP 10	Max 419m
27	E10	2012/06/16 10:58	35°45.4578'	143°01.5781'	101180	Sonde 26	Max 17738m
27	E10	2012/06/16 11:02	35°45.4377'	143°01.6990'	—	Bucket 5	23.4°C
28	E10	2012/06/16 12:58	35°44.5144'	143°01.1179'	101181	Sonde 27	Max 16653m
28	E10	2012/06/16 13:07	35°44.6167'	143°01.1843'	—	MSP 11	Max 423m
28	E10	2012/06/16 13:35	35°45.5391'	143°01.3052'	—	MSP 12	Max 421m
29	E10	2012/06/16 14:56	35°46.0842'	143°01.2482'	101182	Sonde 28	Max 16966m
29	E10	2012/06/16 15:03	35°46.0290'	143°01.2129'	—	Bucket 6	23.3°C
30	E09	2012/06/16 16:21	36°00.1528'	143°00.6444'	101183	Sonde 29	Max 15915m
31	E08	2012/06/16 17:32	36°14.3009'	143°00.4814'	101184	Sonde 30	Max 17246m
32	E07	2012/06/16 18:54	36°29.7748'	143°00.5697'	101185	Sonde 31	Max 16155m

33	E06	2012/06/16 20:19	36°45.3423'	143°00.7257'	101186	Sonde 32	Max 14628m
34	E05	2012/06/16 21:39	37°00.3423'	143°00.5644'	101187	Sonde 33	Max 16473m
35	E04	2012/06/16 22:53	37°14.7166'	143°00.4757'	101189	Sonde 34	Max 15546m
36	E03	2012/06/17 00:10	37°29.3580'	143°00.9421'	101190	Sonde 35	Max 14667m
37	E02	2012/06/17 01:36	37°45.2784'	143°00.3904'	101192	Sonde 36	Max 16153m
38	E01	2012/06/17 02:55	37°59.2099'	143°00.6072'	101193	Sonde	Data recording failure

3.7 About data

Some of the data obtained in this cruise will be corrected after the cruise.

4. Notice on using

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

This report may not be corrected even if changes on contents (i.e. taxonomic classifications) may be found after its publication. This report may also be changed without notice. Data on this cruise report may be raw or unprocessed. If you are going to use or refer to the data written on this report, please ask the Chief Scientist for latest information.

Users of data or results on this cruise report are requested to submit their results to the Data Management Group of JAMSTEC.

Acknowledgements

We would like to express our sincere thanks to Captain H. Tanaka and his crew for their skillful operation.