

KAIYO Cruise Report

KY13-09



Kuroshio Extension region

28 June 2013 – 12 July 2013

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

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1. Cruise Information

1.1 Cruise ID: KY13-09

1.2 Name of vessel: KAIYO

1.3 Title of the cruise: Research on characteristics of clouds and aerosols over the Kuroshio Extension by simultaneous observations with an aircraft

1.4 Title of the proposal: Research on characteristics of clouds and aerosols over the Kuroshio Extension by simultaneous observations with an aircraft

1.5 Cruise period: 28 June – 12 July 2013

1.6 Ports of call: From / To: Wharf at Yokosuka Works, Sumitomo Heavy Industries

1.7 Research area: Kuroshio Extension Region

1.8 Research map:

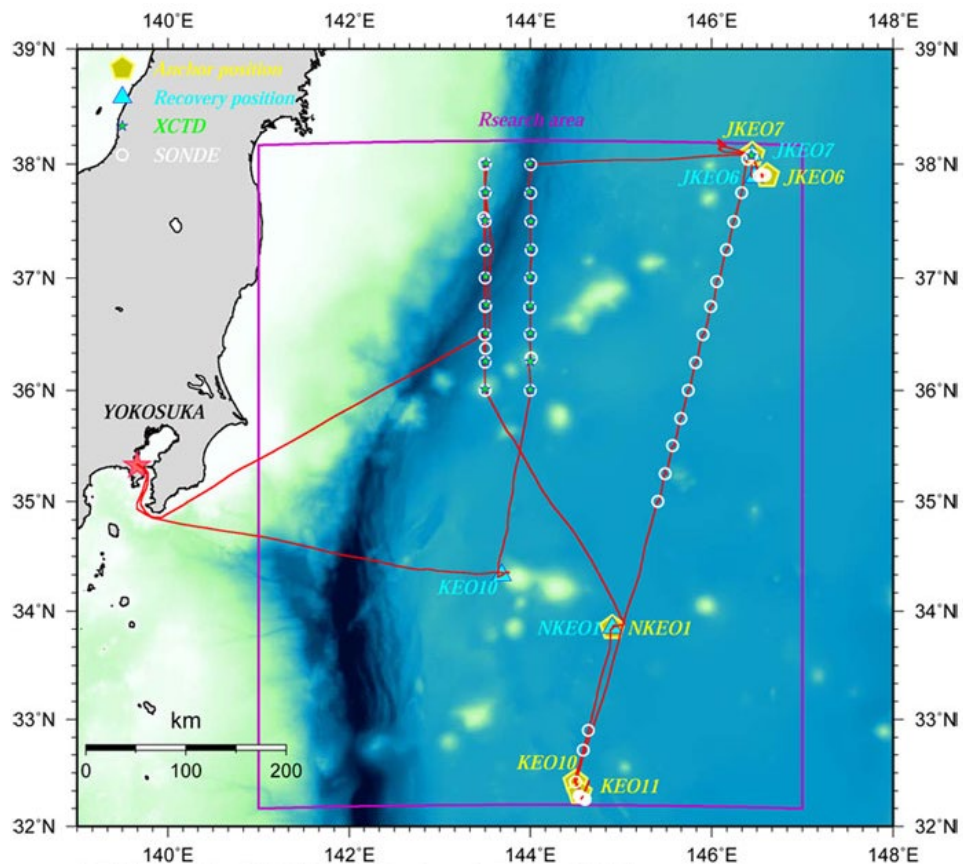


Figure 1. Locations of XCTD (star), GPS radiosonde (circule) observations, and the buoy deployment/recovery operations.

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 RIGC/JAMSTEC

2.3 Science party:

Yoshimi Kawai	RIGC/JAMSTEC
Akira Nagano	RIGC/JAMSTEC
Kyoko Taniguchi	RIGC/JAMSTEC
Hiroshi Ichikawa	RIGC/JAMSTEC
Hiroyuki Tomita	Nagoya University
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Kotaro Murata	Prefecture University of Kumamoto
Satoshi Fukushima	Prefecture University of Kumamoto
Ayumu Miyamoto	University of Tokyo
Mio Terada	Hokkaido University
Yuta Tamaki	Hokkaido University
Keith Ronnholm	University of Washington
David Rivera	University of Washington
Meghan Cronin	Pacific Marine Environmental Laboratory (PMEL)/National Oceanic and Atmospheric Administration (NOAA) (not on board)
Takuji Waseda	RIGC/JAMSTEC (not on board)
Yoshiyuki Nakano	Marine Technology and Engineering Center/JAMSTEC (not on board)
Hisashi Nakamura	University of Tokyo (not on board)
Yutaka Kondo	University of Tokyo (not on board)
Makoto Koike	University of Tokyo (not on board)
Toshiyuki Murayama	Tokyo University of Marine Science and Technology (not on board)
Tadayuki Hayasaka	Tohoku University (not on board)

Daizhou Zhang	Prefecture University of Kumamoto (not on board)
Shoshiro Minobe	Hokkaido University (not on board)

2.4 Observation technicians:

Masayuki Toizumi	Nippon Marine Enterprises Ltd. (NME)
Hirokatsu Uno	Marine Works Japan Ltd. (MWJ)
Akira Watanabe	MWJ
Takatoshi Kiyokawa	MWJ
Tatsuya Tanaka	MWJ
Hiromichi Soejima	MWJ
Yoshiko Ishikawa	MWJ

3. Observation

3.1 Purpose and outline

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

Recent studies have revealed that the structure of the lower atmosphere and clouds change across the sea surface temperature (SST) fronts. Furthermore, the SST fronts may modify the strength of the effect of aerosols on cloud physics, which has recently attracted attention as one of important mechanisms in climate changes. The impacts of the SST fronts on aerosols and cloud physics have not been sufficiently investigated. We investigated the characteristics of aerosols and clouds across the SST front of the Kuroshio Extension by combining SST and atmospheric observations by a ship, and aerosols and clouds observations by an aircraft. Another purpose of the observations was the validation of new satellite data (AMSR2).

3.2 Observations and activities

1) Atmospheric sounding using GPS radiosonde, and aircraft observations

Vertical profiles of air temperature, relative humidity, and wind velocity were observed 66 times in total at 36 sites along the E line, 144°00'E 143°30'E, and at JKEO, KEO, S1, S2 sites, with GPS radiosondes (see Figure 1).

Aircraft observations were performed during 12:11-12:56 on 8 July (takeoff:

11:09, landing: 14:20), and during 11:27-12:18 on 10 July (takeoff: 10:43, landing: 13:26) (all in JST). The aircraft came from/to Sendai airport.

2) Oceanographic survey using XCTD

Vertical profiles of water temperature and salinity up to 1100-m depth were observed at 19 sites along 144°00'E, 143°30'E, and at JKEO site (see Figure 1).

3) Underway marine meteorological measurements on the vessel

We observed shortwave and longwave radiations, air temperature, relative humidity, wind speed, wind direction, atmospheric pressure, rain rate, cloud base height, concentration of aerosol particles, and precipitable water during the cruise. We also photographed the sky on an automatic all-sky camera.

4) Underway oceanic measurements on the vessel

We observed surface temperature and current velocity during the cruise.

5) Sampling of aerosol particles in the lowest atmosphere

Aerosol particles in the air were sampled twice a day with pumps and filters.

6) Recovery and deployment of K-TRITON buoys

K-TRITON buoy has anemometers, thermometers for air temperature, hygrometers, longwave and shortwave radiometers, barometers, a wave gauge, a rain gauge, a pCO₂ sensor, current meters, CTs (water temperature and salinity) and CTDs (water temperature, salinity, and pressure).

We recovered the K-TRITON buoy (JKEO6) which was deployed on 19 June 2012. Another K-TRITON buoy (JKEO7) was deployed on 1 July 2013, but its nylon rope was broken just after the deployment and the buoy was recovered on 3 July 2013. This buoy was not re-deployed in this cruise.

We also recovered the mooring remnant of the K-TRITON buoy deployed at NewKEO (NKEO) site on 7 July 2013. (The wire cable of the buoy was broken on 9 March 2013. The top buoy was recovered on 24 March by R/V Mirai.)

7) Recovery and deployment of KEO buoys (PMEL/NOAA)

KEO buoy has anemometers, thermometers for air temperature, hygrometers, longwave and shortwave radiometers, pCO₂ sensors, rain gauges, barometers, current meters, a pH sensor, Optode, CTs (water temperature and salinity) and CTDs (water temperature, salinity, and pressure).

We deployed the KEO buoy (KEO11) on 5 July 2013. The KEO buoy (KEO10) which was deployed on 4 July 2012 was drifting from 7 June 2013. This

drifting KEO buoy was recovered at 34°21.124' N, 143°45.546'E. Its nylon rope was broken. We recovered the mooring remnant of KEO10 at KEO site on 6 July 2013.

8) Water sampling at JKEO and KEO sites

Bucket water sampling was done before the deployment of K-TRITON buoy at JKEO site. We also sampled water at 5m depth with a Niskin bottle at KEO site and the emergent recovery point of KEO buoy (34°21.124' N, 143°45.546'E).

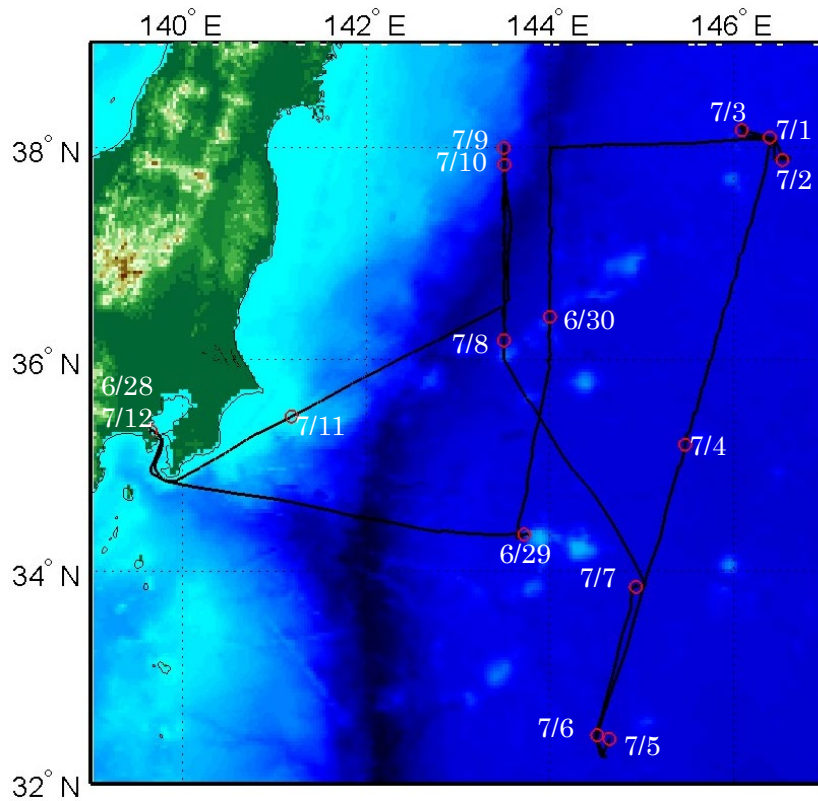


Figure 2. Cruise track with ship position at 0:00 UT (circle) on each day.

3.3 Instruments

XCTD	XCTD-1 (Tsurumi Seiki)
GPS Radiosonde	RS-06G (sensor), RD-08AC (receiver) (Meisei)
Thermometer/hygrometer	CVS-HMP-45A (Climatec)
Shortwave radiometer	CM-21, CMP-21 (Kipp&Zonen)
Longwave radiometer	CG-4, CGR-4 (Kipp&Zonen)
Weather multi-sensor	WXT520 (Vaisala)
Ceilometer	CL51 (Vaisala)
Microwave radiometer	MP1500 (Radiometric)
All-sky camera	(Prede)
GPS receiver	Trimble NetR9 (Nicon-Trimble) (for precipitable water measurement)
Optical particle counter	KC-01E (Rion)
Aerosol particle sampler	Cascade Impactors (PIXE International Corp.) PUMP FOR AIR MAS-01 (AS ONE Corp.)
K-TRITON buoy (JKEO6)	JAMSTEC
Anemometer	JAMMET WND-Y85000 (JAMSTEC)
Thermometer/hygrometer	JAMMET HRH-RM103 (JAMSTEC) HOBO U23-001 (Onset)
Shortwave radiometer	ASIMET SW Module (Star Engineering)
Longwave radiometer	ASIMET LW Module (Star Engineering)
Barometer	JAMMET BAR-DP4000 (JAMSTEC)
Weather multi-sensor	WXT520 (Vaisala)
CTD	37-IM, 39-IM, 37-SM (Sea-Bird Electronics)
Current meter	Aquadopp IM400 (Nortek AS)
Water-temperature gauge	HOBO U12-015 (Onset)
pCO ₂ sensor	(JAMSTEC MIO)
Wave gauge	(Zeni lite buoy)
KEO buoy	PMEL/NOAA

3.4 Observation results

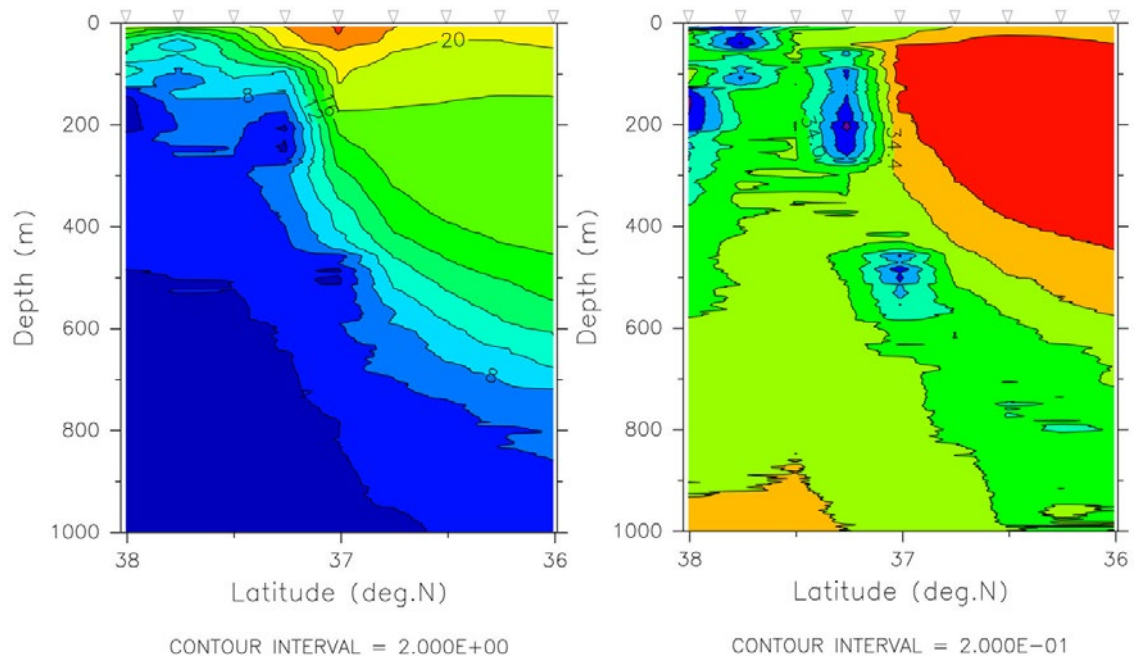


Figure 3. Potential temperature (left) and salinity (right) along 144°00'E on 30 June.

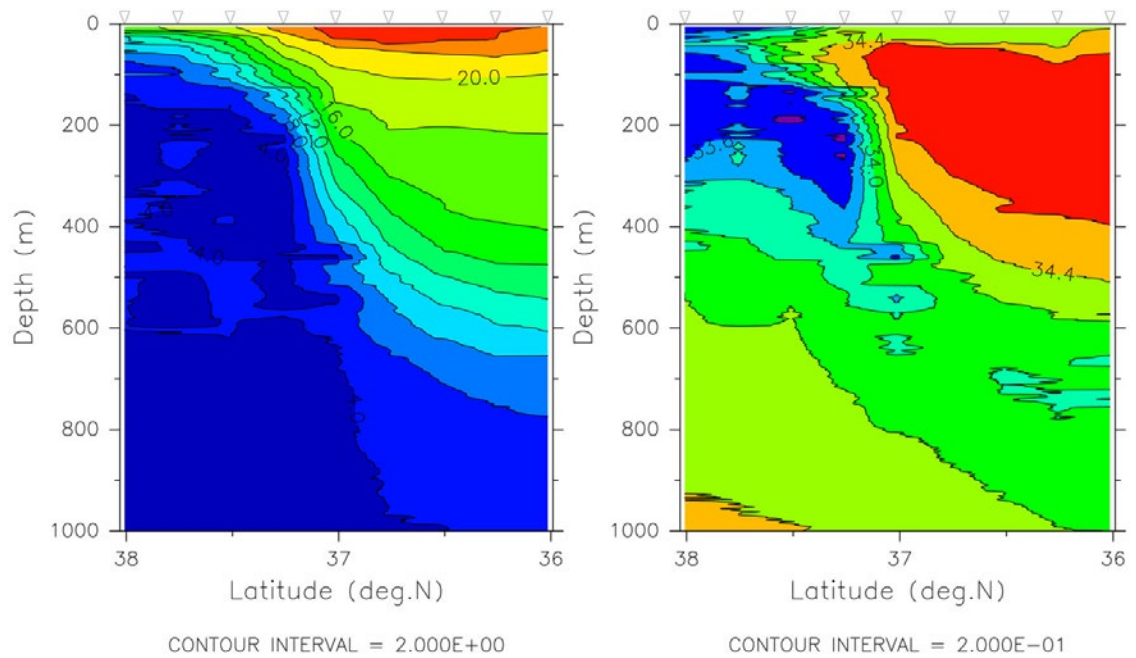


Figure 4. Potential temperature (left) and salinity (right) along 143°30'E on 8 July.

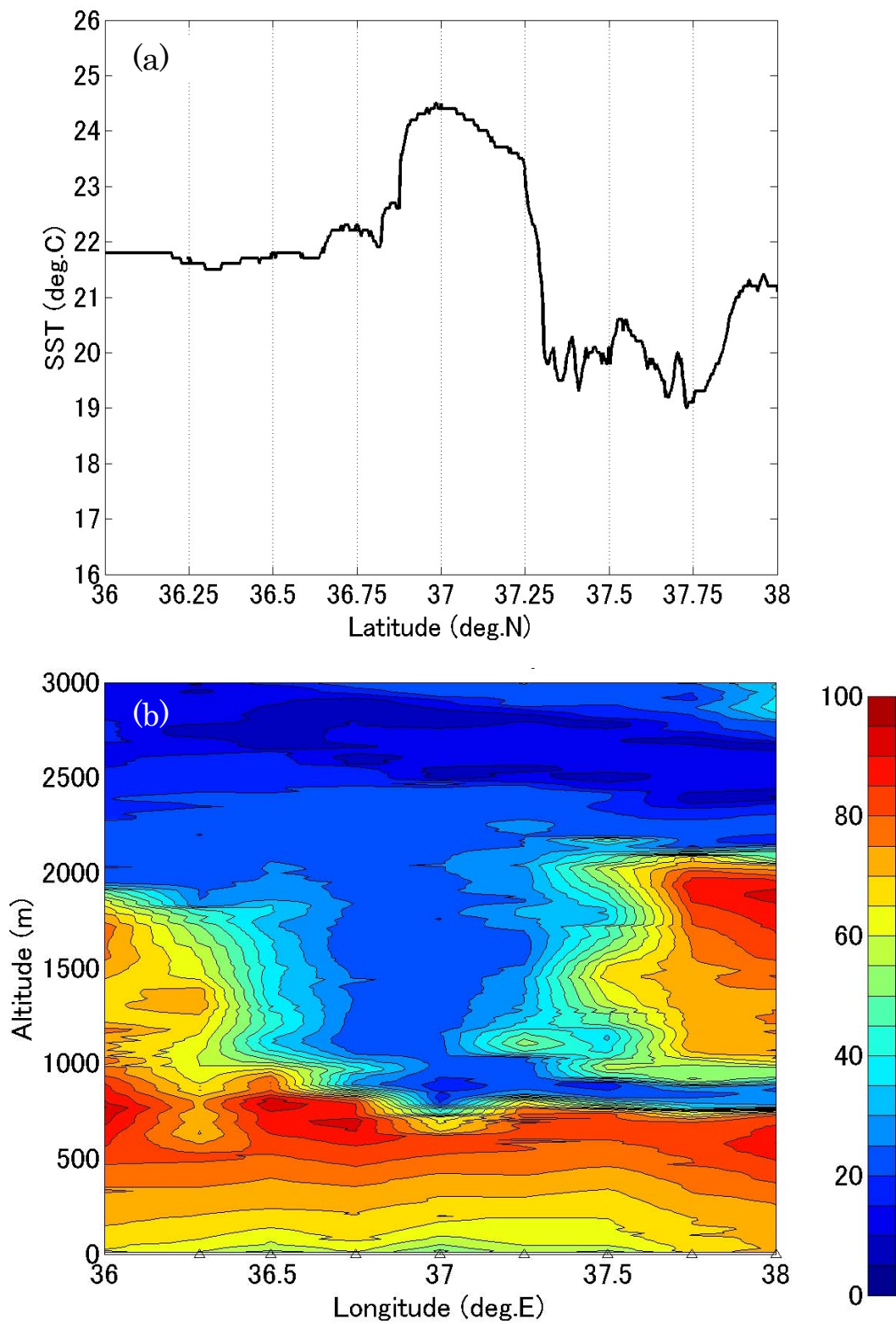


Figure 5. SST (a, °C), relative humidity (b, %), potential virtual temperature (c, K), and wind speed (d, m/s) along 144°00'E on 30 June.

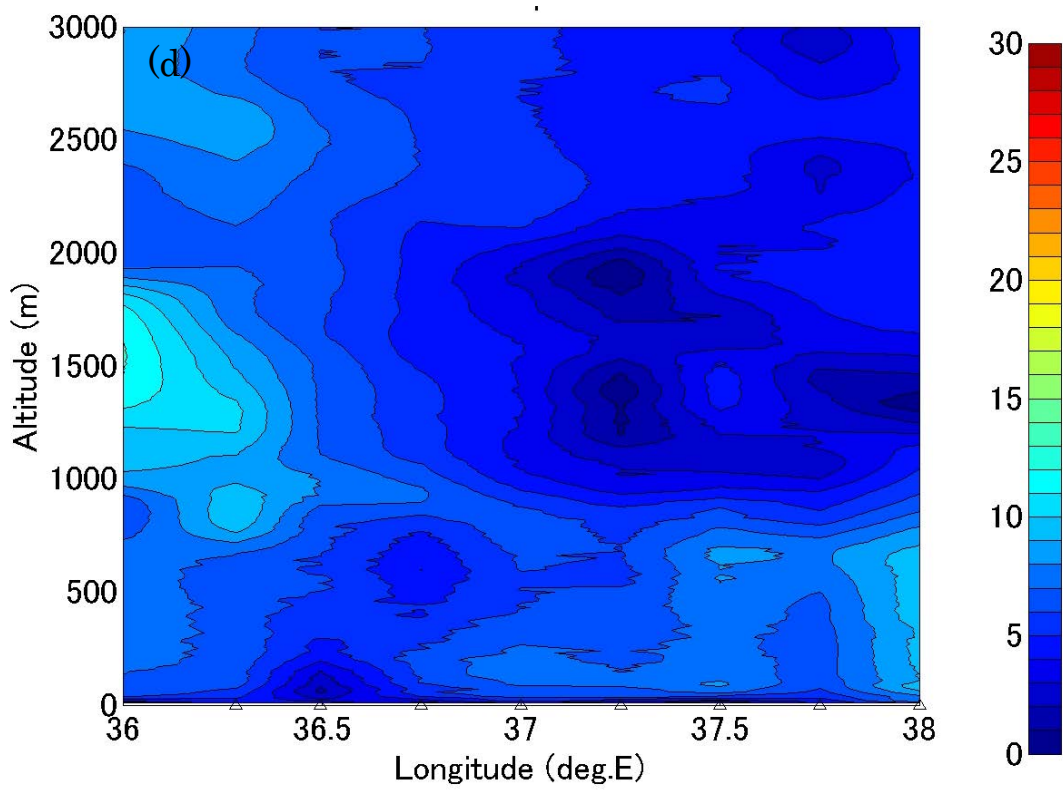
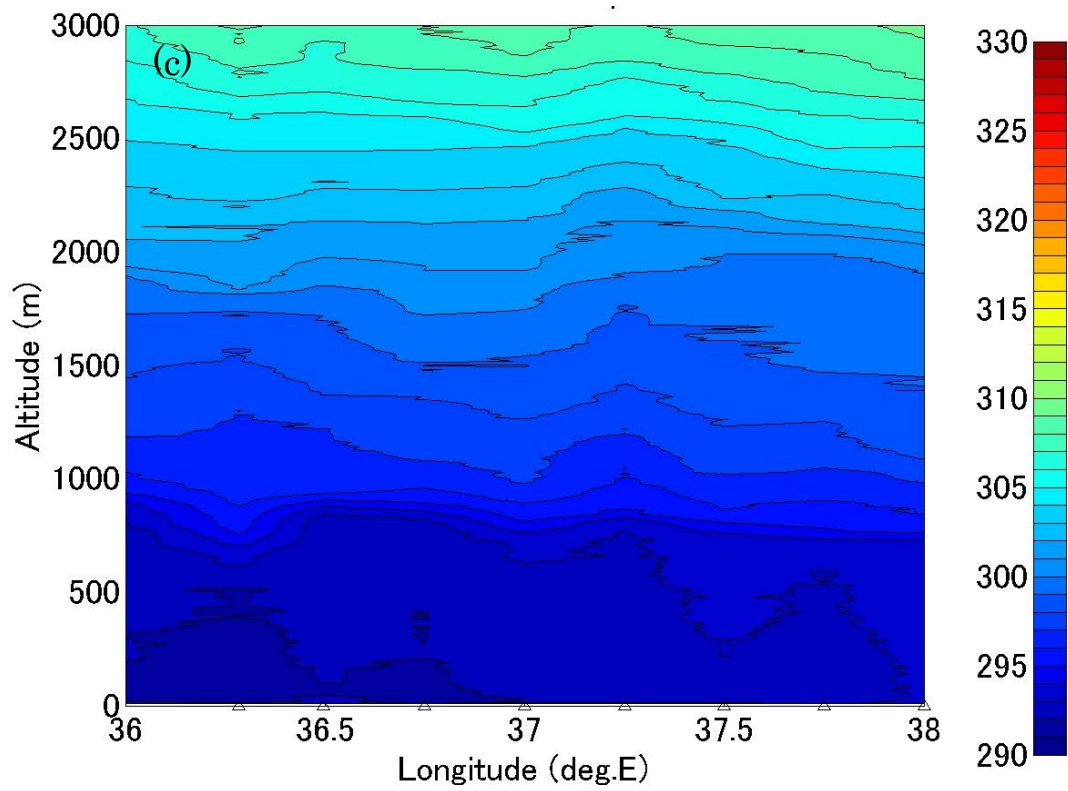


Figure 5 (continued)

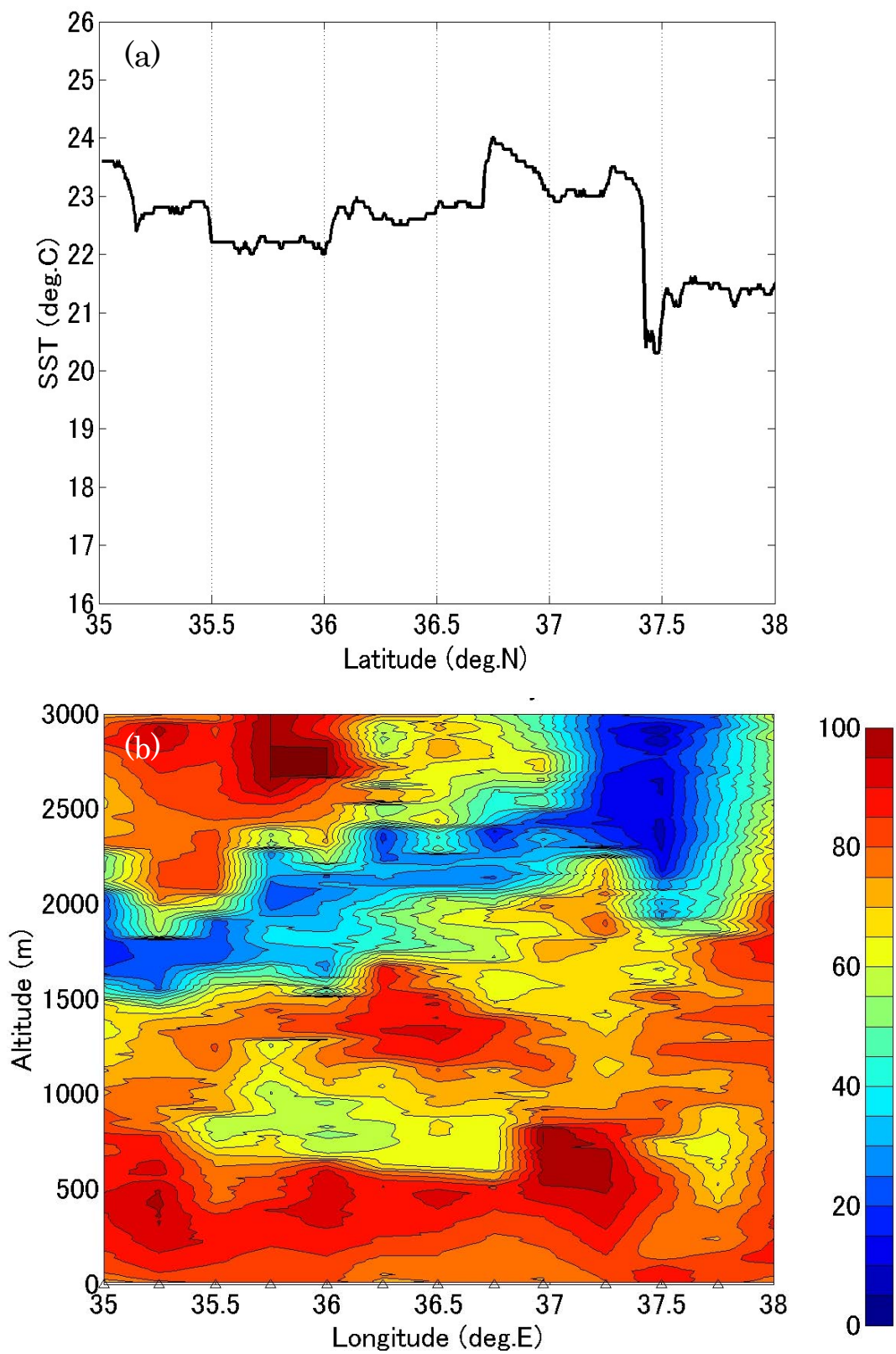


Figure 6. Same as Figure 5, but along the E line on 3 and 4 July.

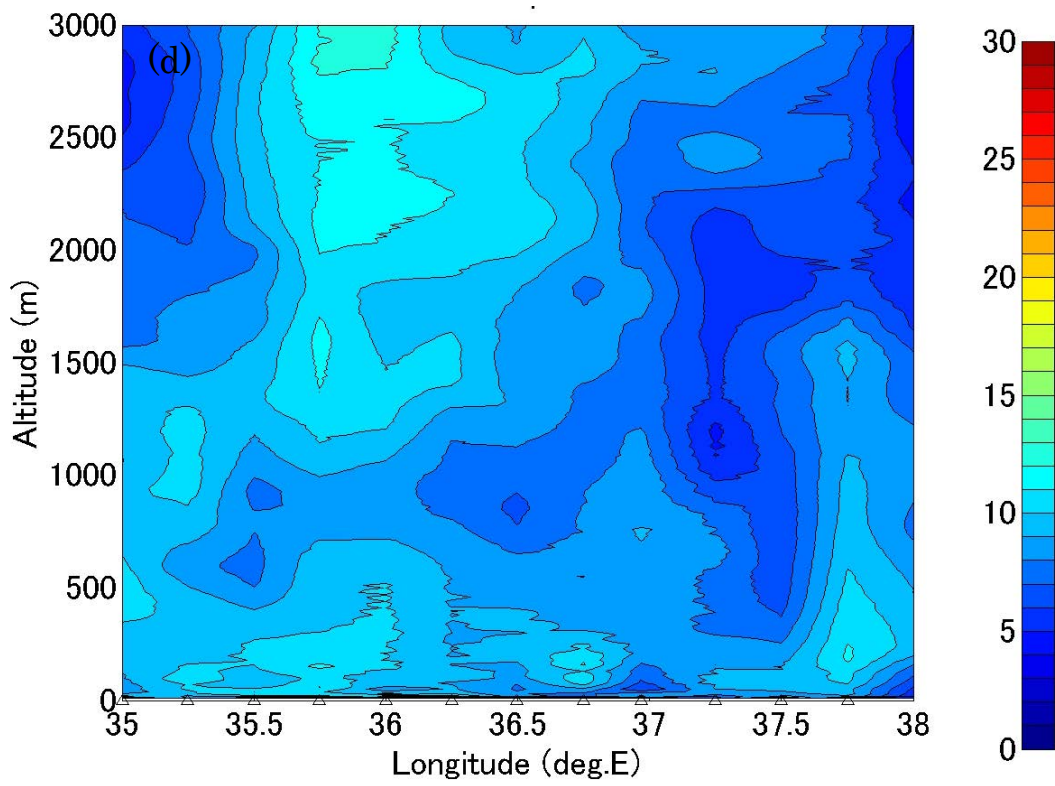
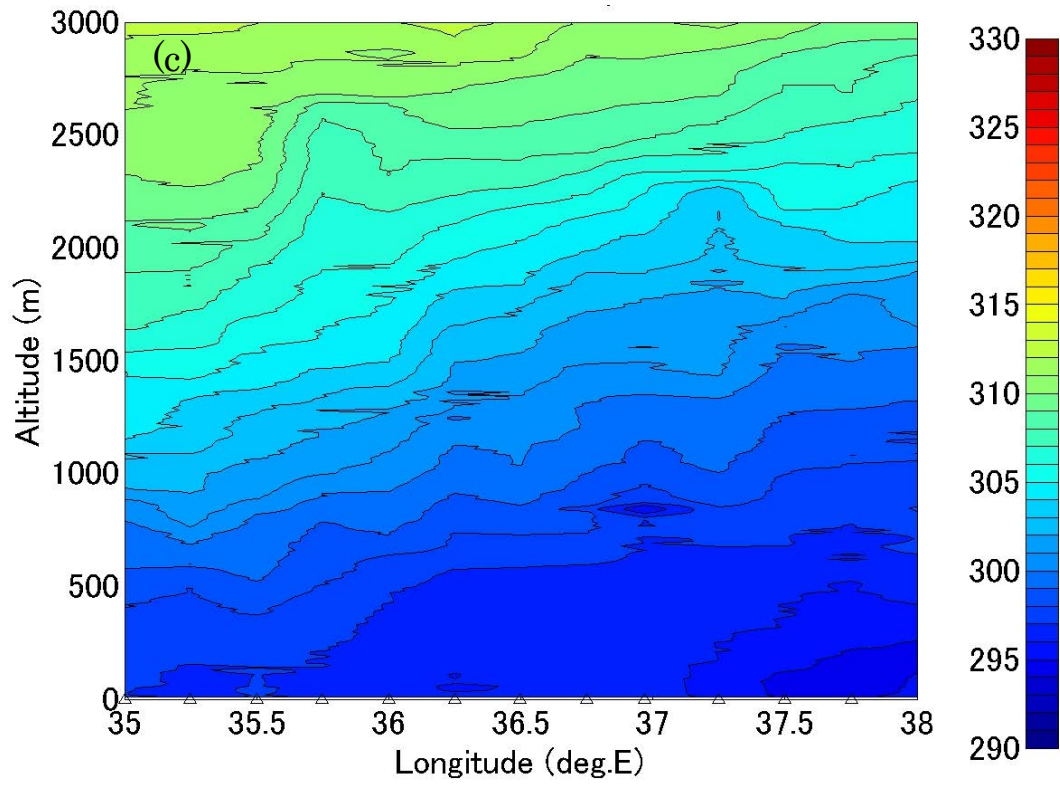


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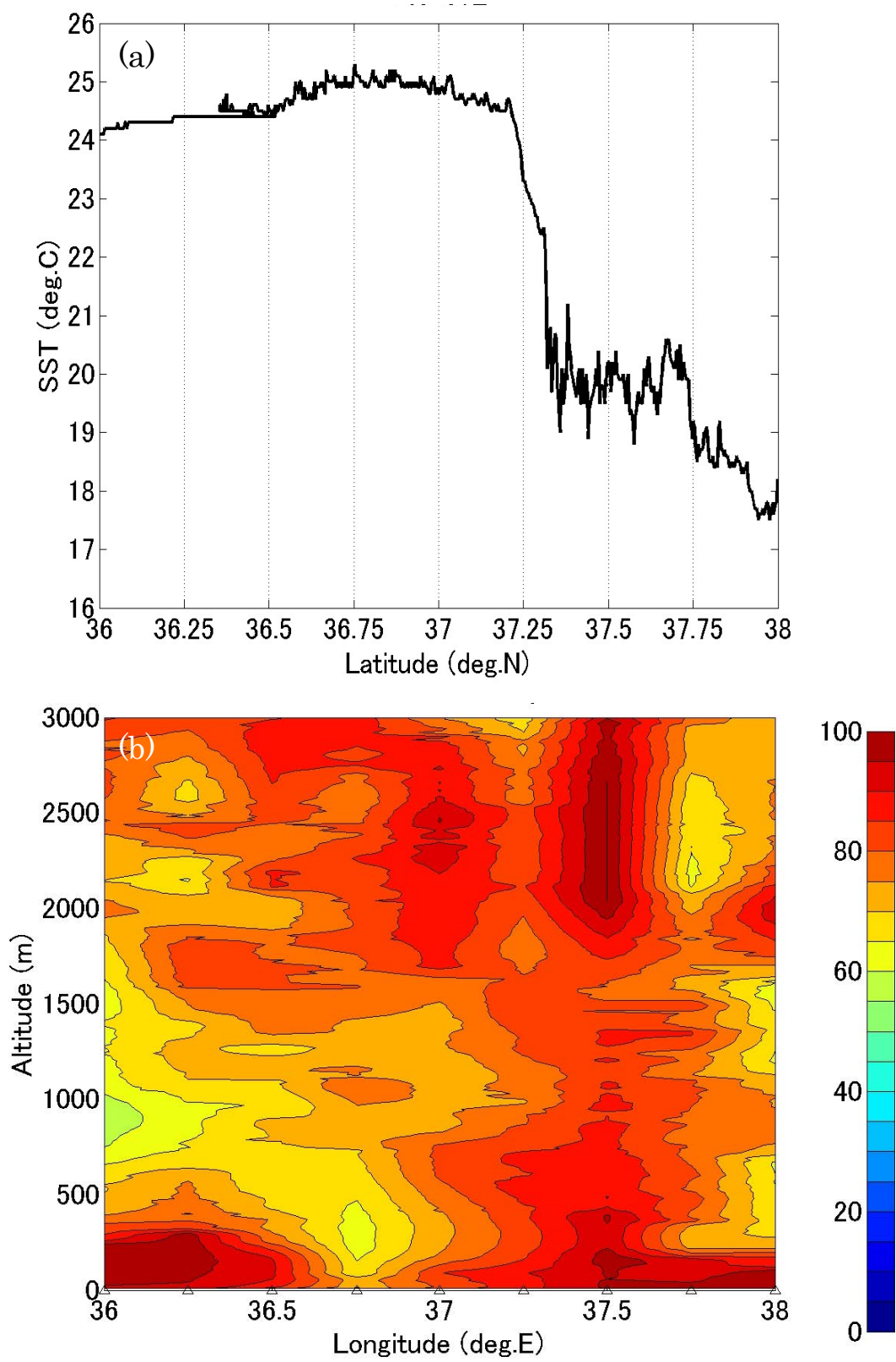


Figure 7. Same as Figure 5, but along 143°30'E on 8 July.

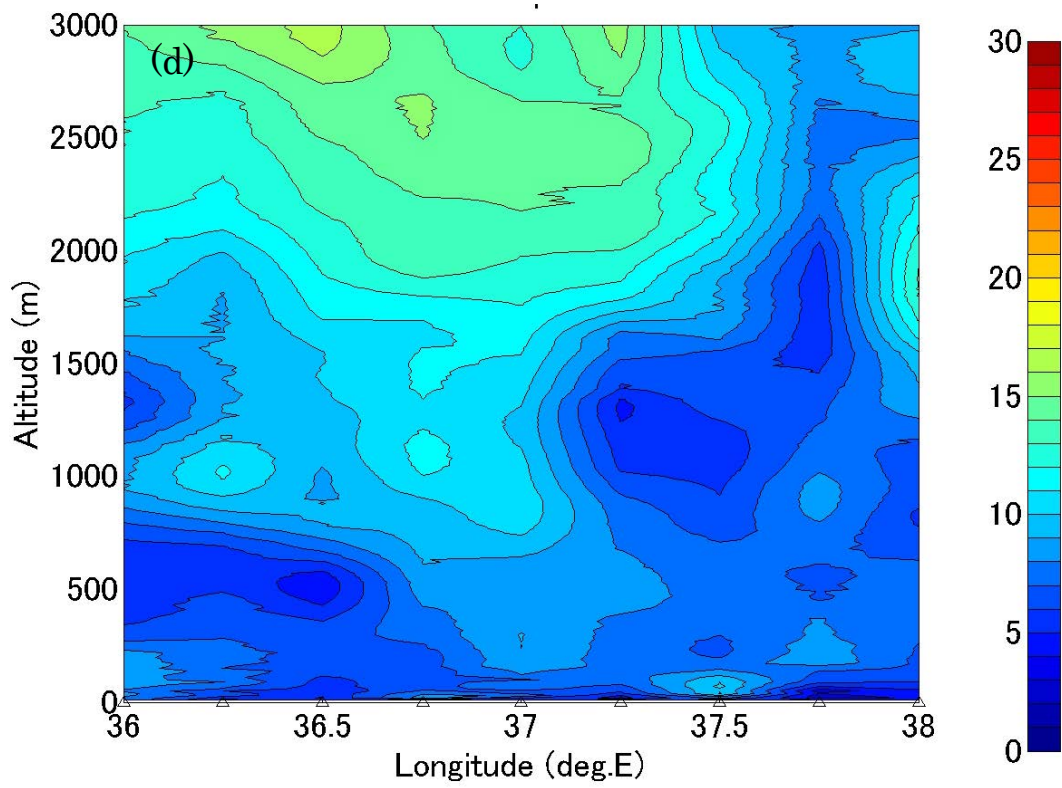
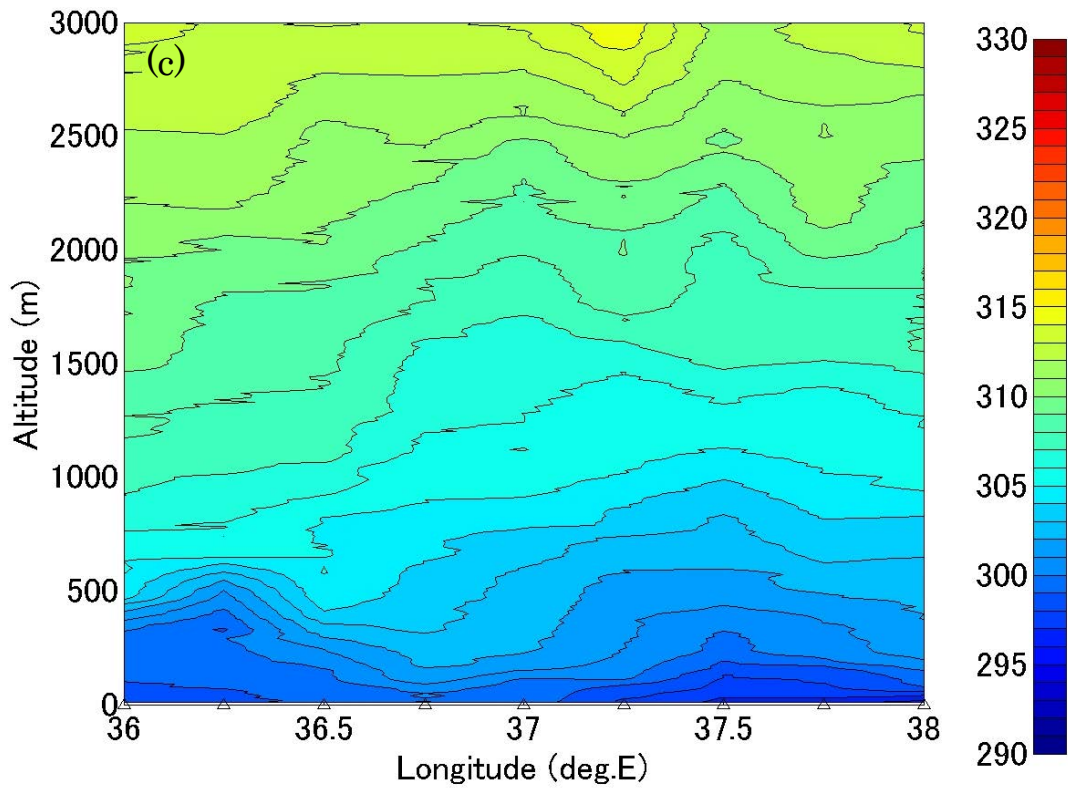


Figure 7 (continued)

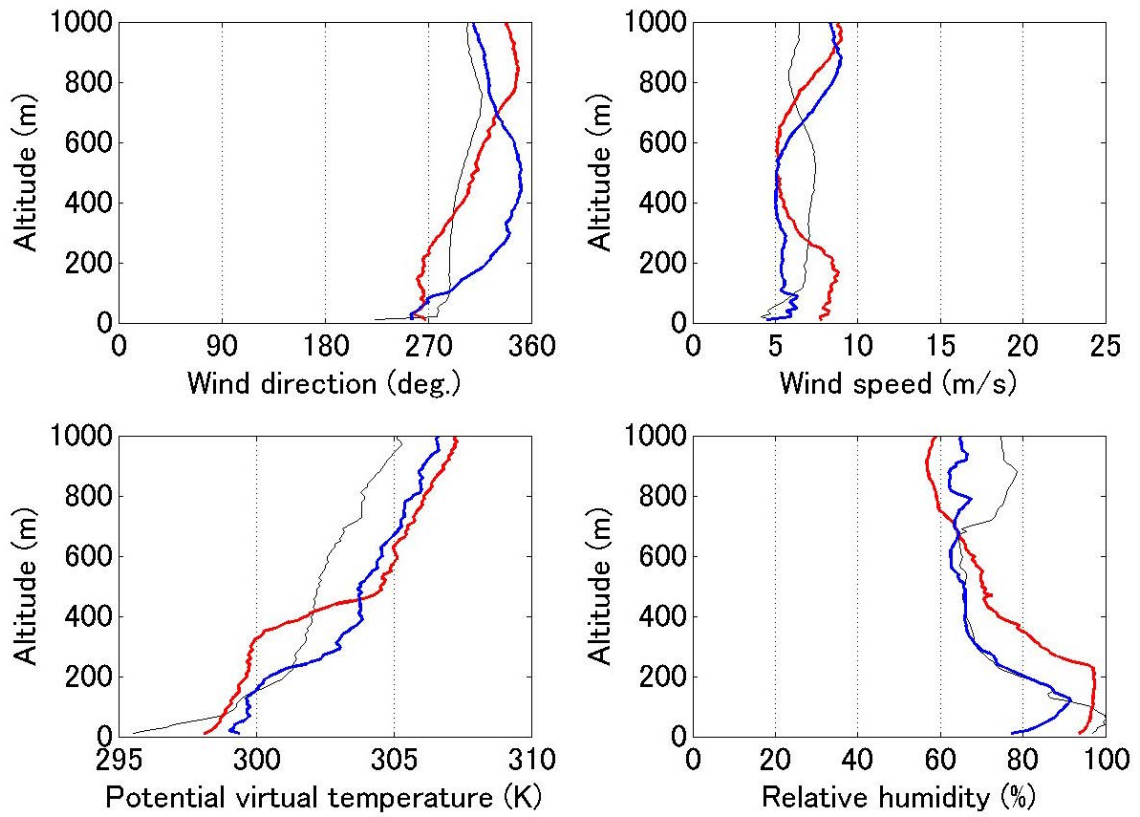


Figure 8. Wind direction (upper left), wind speed (upper right), potential virtual temperature (lower left), and relative humidity (lower right) at 36°00'N (red), 36°23'N (blue), and 38°00'N (black) on 8 July.

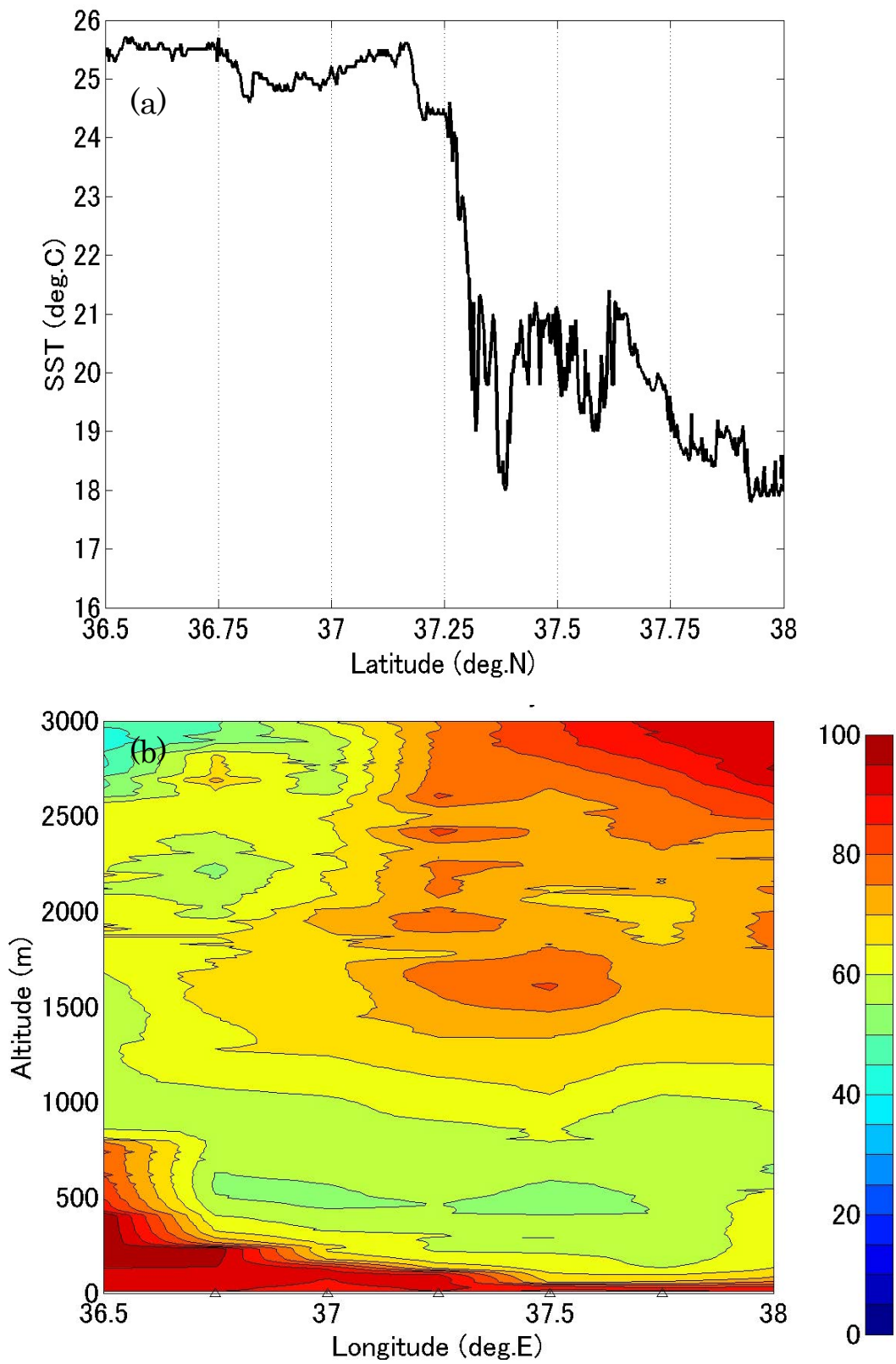


Figure 9. Same as Figure 5, but along 143°30'E on 9 July.

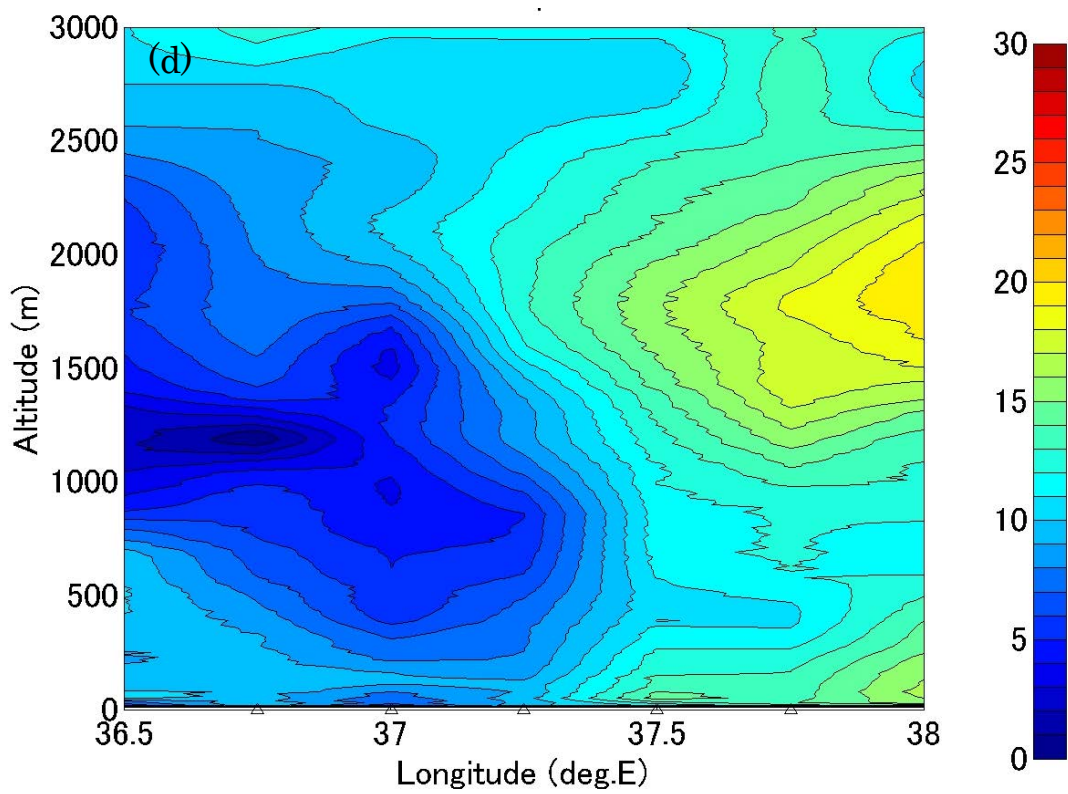
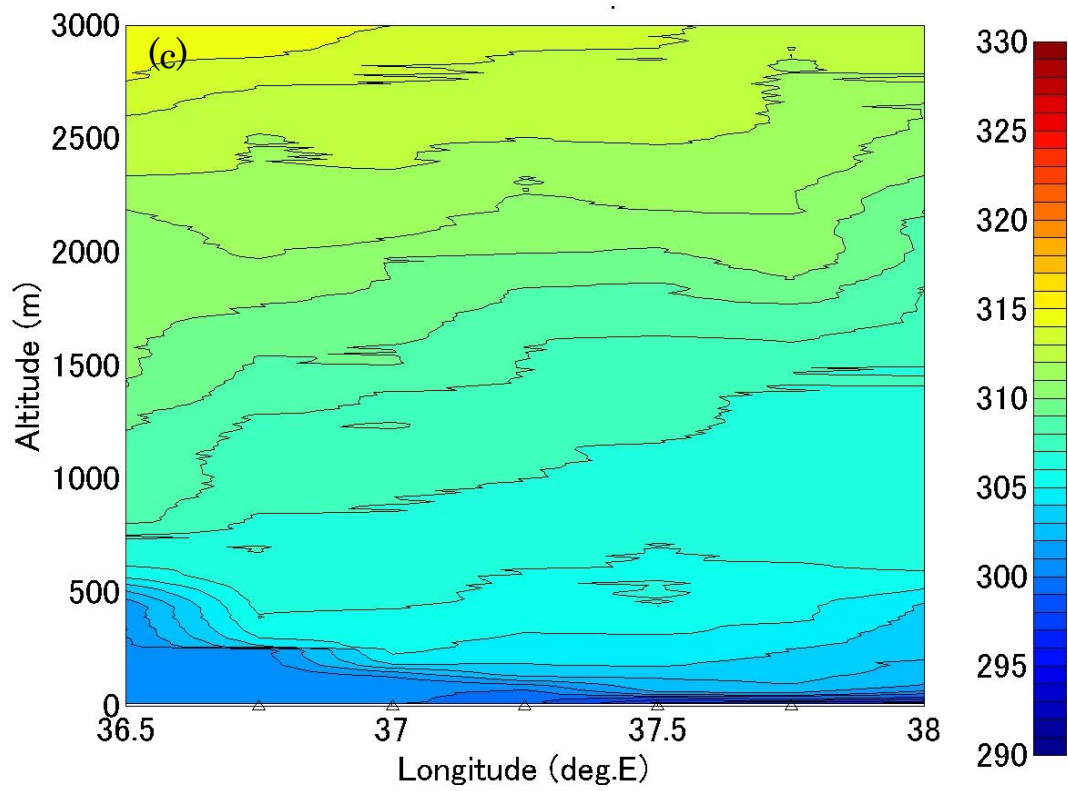


Figure 9 (continued)

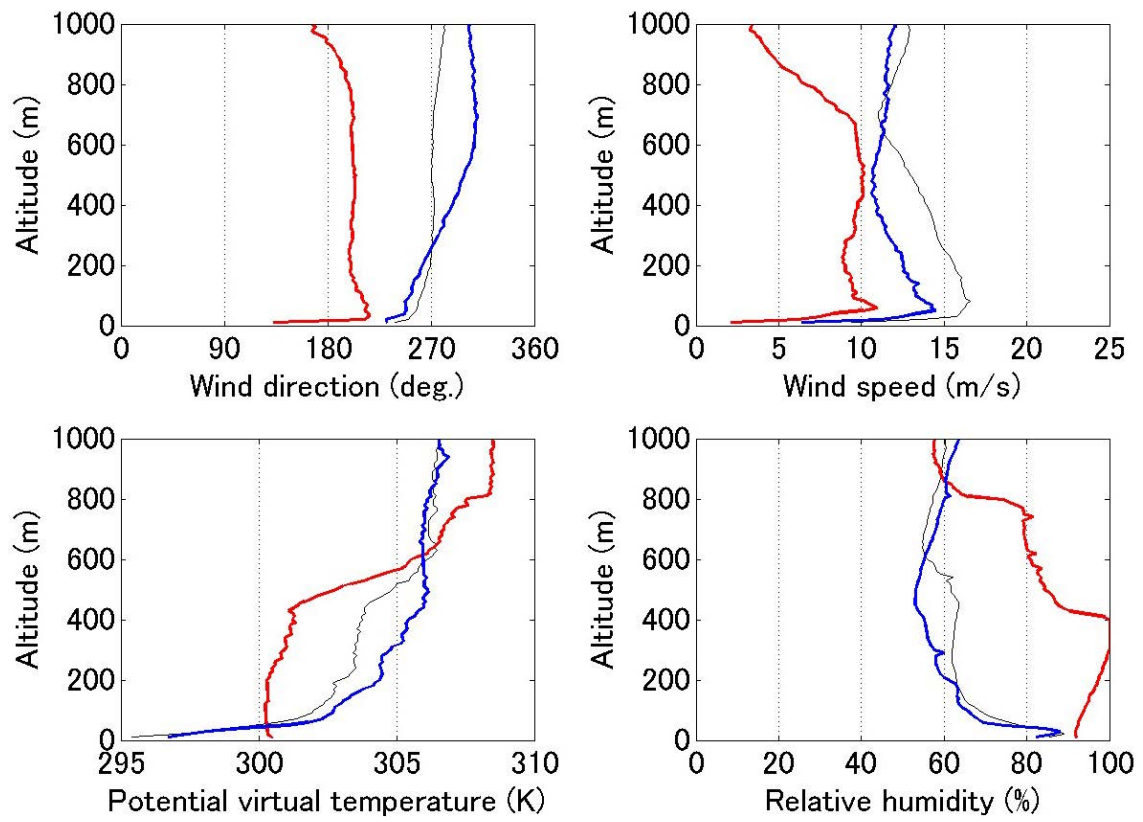


Figure 10. Same as Figure 8, but at 36°30'N (red), 37°30'N (blue), and 38°00'N (black) on 9 July.

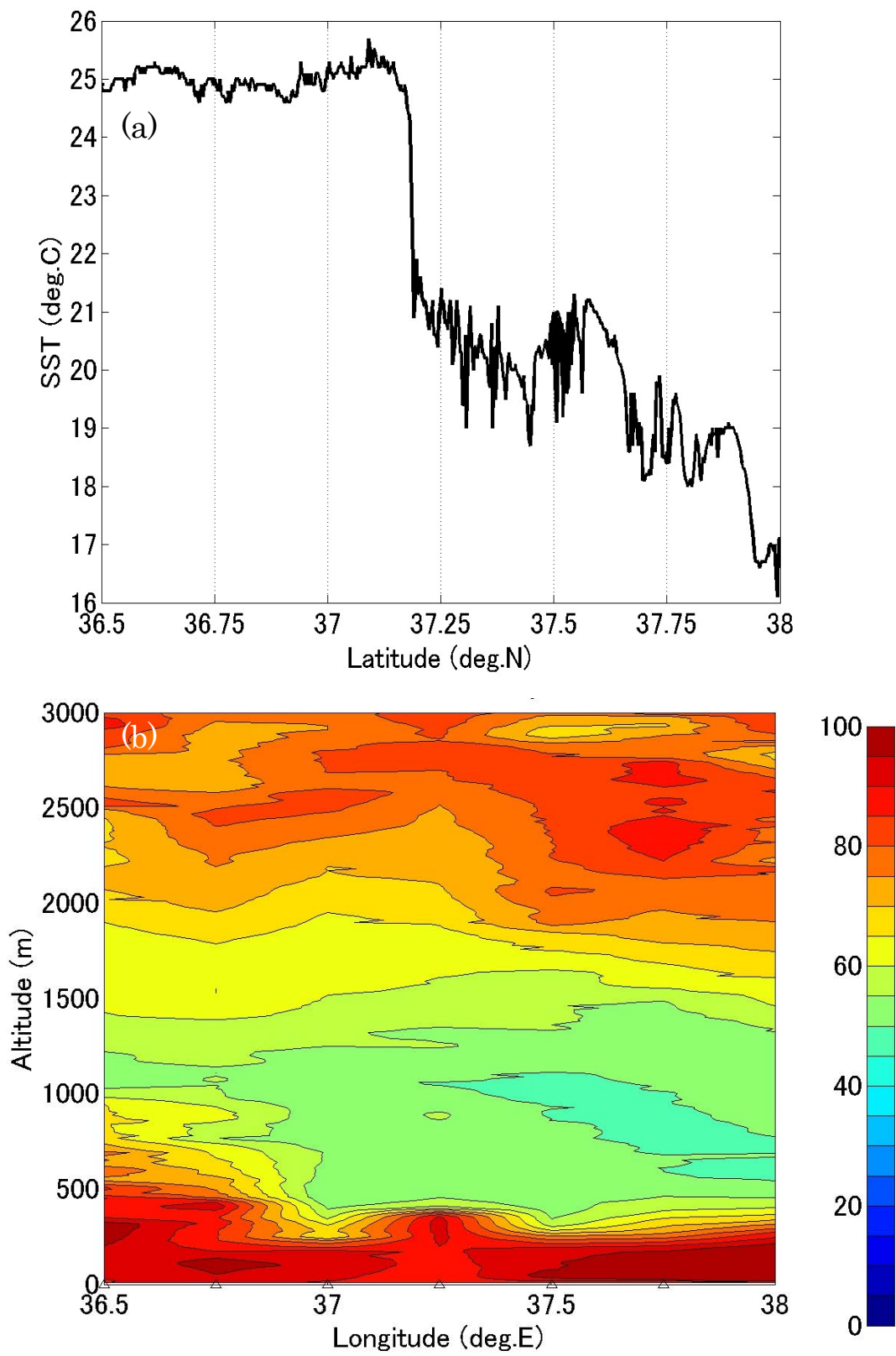


Figure 11. Same as Figure 5, but along 143°30'E on 10 July.

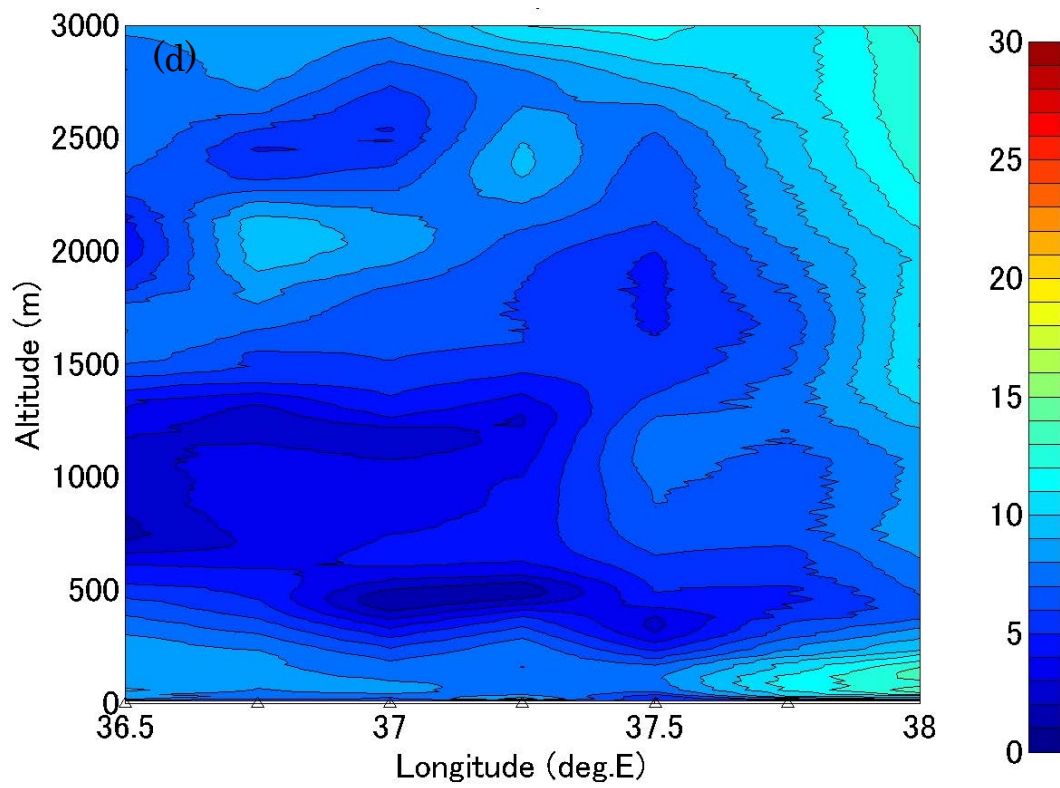
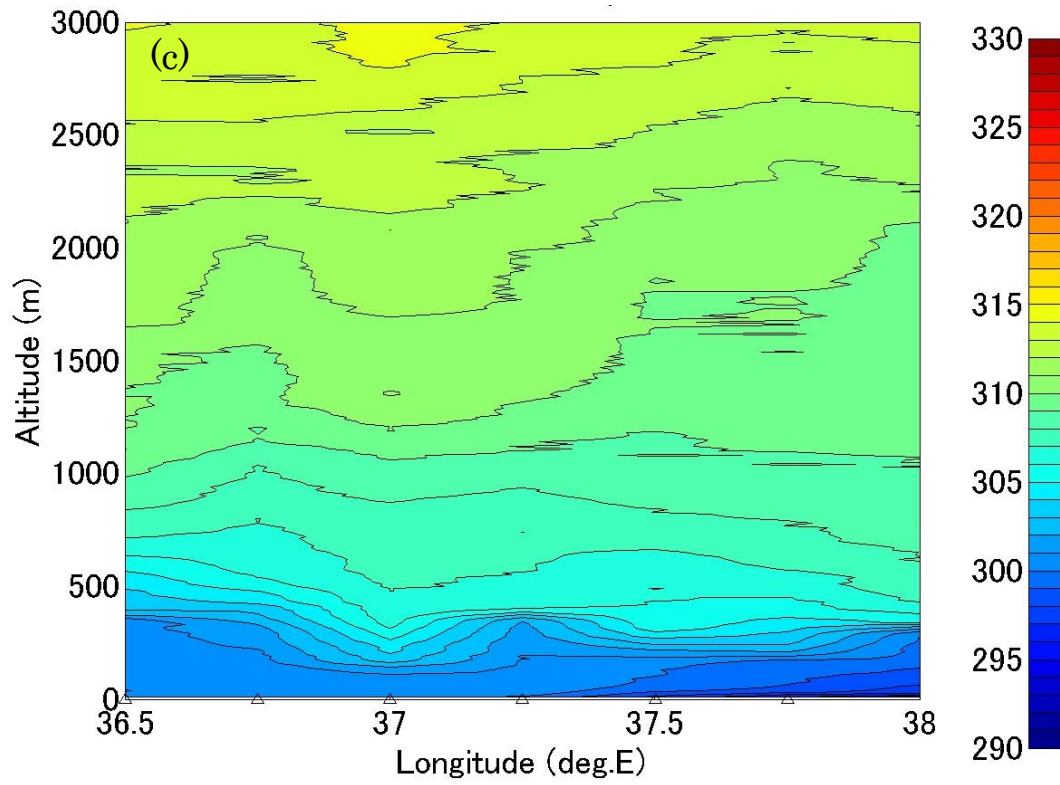


Figure 11 (continued)

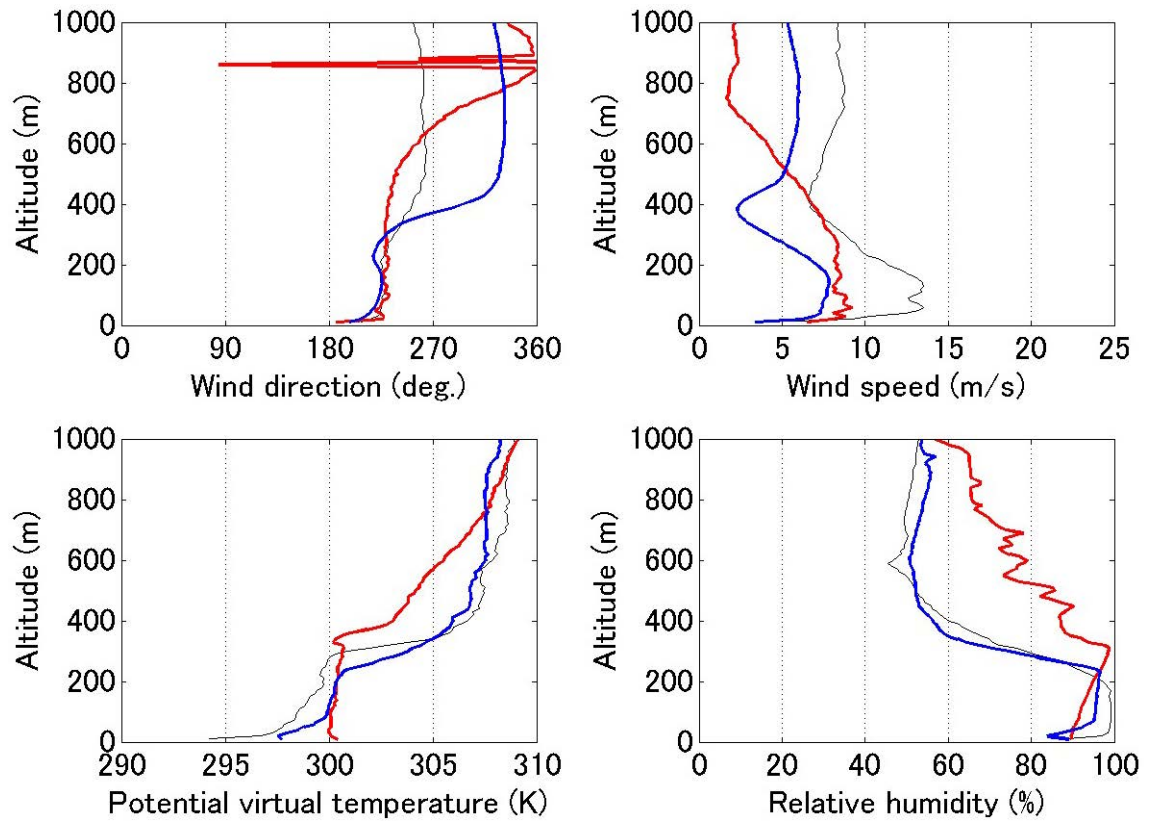


Figure 12. Same as Figure 8, but at 36°30'N (red), 37°32'N (blue), and 38°00'N (black) on 10 July.

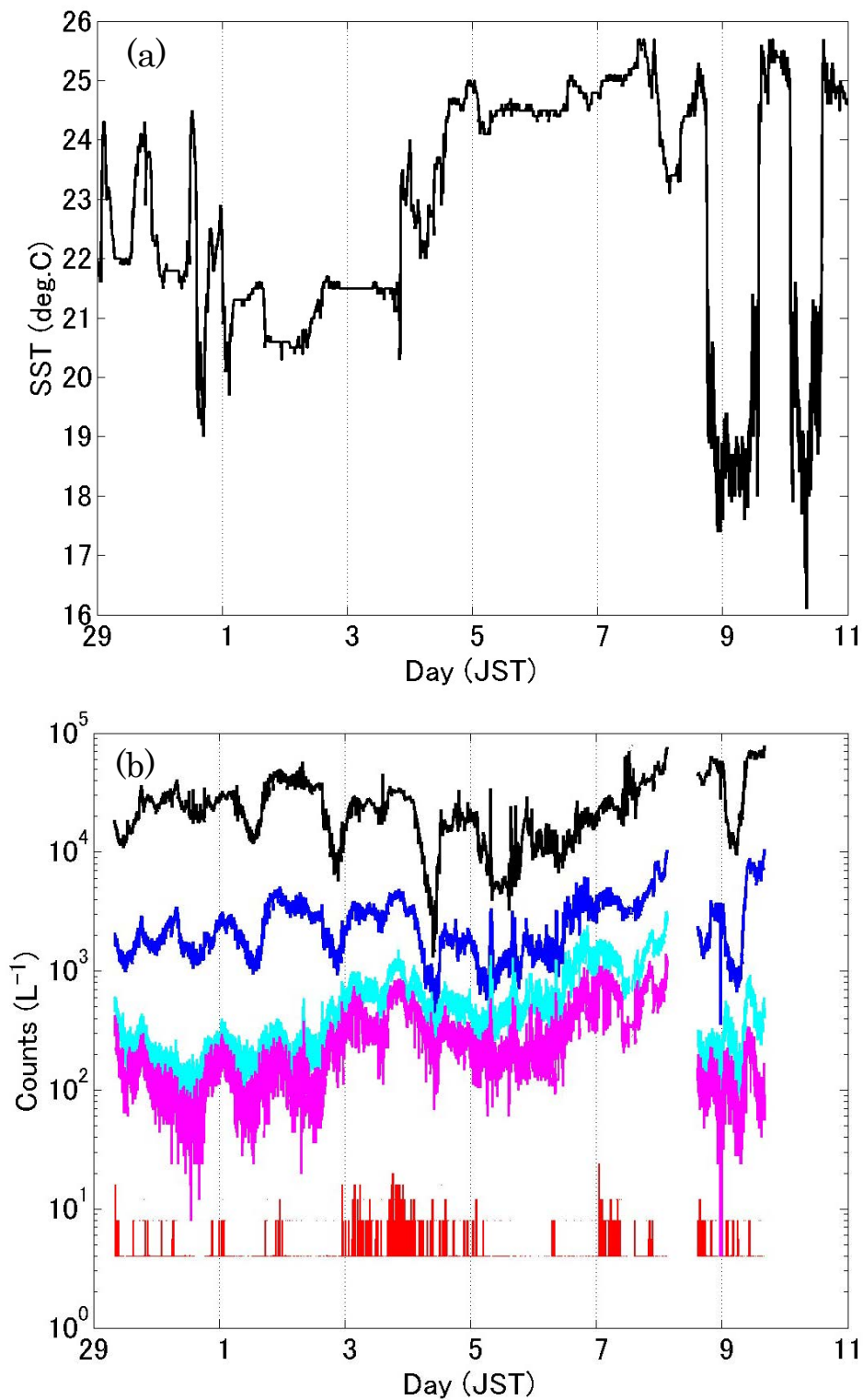


Figure 13. SST (a, °C) and counts of aerosol particles (b). Black, blue, cyan, pink, and red lines represent 0.3-0.5 μm , 0.5-1 μm , 1-2 μm , 2-5 μm , and more than 5 μm of particle size, respectively. Data with the “High Concentration” error are not shown.

3.5 Cruise log

Date	Time		Event
	(JST)	(UTC)	
28 Jun.	09:00	00:00	Japan Standard Time is (UTC+9h) Depart from Sumitomo Wharf
29 Jun.	07:00	22:00 (-1d)	Water sampling with a Niskin bottle near the drifting KEO buoy
	07:54	22:54 (-1d)	Start drifting KEO buoy recovery (KEO10)
	12:38	03:38	Finish drifting part recovery
30 Jun.	06:01	21:01 (-1d)	Start radiosonde and XCTD observations along 144°00'E from 36°00'N
1 Jul.	06:30	21:30 (-1d)	Water sampling with a bucket at JKEO site
	07:50	22:50 (-1d)	Start K-TRITON buoy deployment (JKEO7)
	13:53	04:53	Anchor release
	14:21	05:21	Anchor landing
	14:50	05:50	Confirm the acoustic releasers response
2 Jul.	07:37	22:37 (-1d)	Send the release code (JKEO6)
	07:59	22:59 (-1d)	Start K-TRITON buoy recovery
	13:50	04:50	Finish recovery
	15:30	06:30	Check the acoustic releasers and confirm the K-TRITON buoy (JKEO7) was drifting
	16:53	07:53	Catch up the drifting K-TRITON buoy (JKEO7)
3 Jul.	05:52	20:52 (-1d)	Start drifting K-TRITON buoy recovery (JKEO7)
	10:31	01:31	Finish drifting part recovery
	12:51	03:51	Send the release code (JKEO7)
	14:02	05:02	Find the glass balls on the surface
	14:21	05:21	Start mooring remnant recovery
	16:08	07:08	Finish mooring remnant recovery
	16:52	07:52	Start radiosonde observations along the E line
5 Jul.	08:20	23:20 (-1d)	Start KEO buoy deployment (KEO11)
	13:54	04:53	Anchor release
	14:47	05:47	Start triangulation
	16:05	07:05	Water sampling with a Niskin bottle at KEO site, and start measuring the depth with the multi-beam
6 Jul.	07:00	22:00 (-1d)	Send the release code (KEO10)

7 Jul.	08:32	23:32 (-1d)	Find the glass balls on the surface
	09:05	23:08 (-1d)	Start mooring remnant recovery
	10:59	01:59	Finish mooring remnant recovery
	03:29	18:29 (-1d)	Send the release code (NKEO1)
	08:13	23:13 (-1d)	Find the glass balls on the surface
8 Jul.	08:15	23:15 (-1d)	Start mooring remnant recovery
	14:37	05:37 (-1d)	Finish mooring remnant recovery
	07:56	22:56 (-1d)	Start radiosonde and XCTD observations along 143°50'E
9 Jul.	09:13	0:13	Start radiosonde observations along 143°50'E
10 Jul.	08:02	23:02 (-1d)	Start radiosonde observations along 143°50'E
10 Jul.	18:56	09:56	Last radiosonde observation in this cruise
12 Jul.	09:00	00:00	Arrive at Sumitomo Wharf

3.6 Research information

	Station	Date and time (JST)	Latitude	Longitude	Serial Number	Operation	Memo
1	KEO_E	2013/06/29 07:00	34°21.124'	143°45.546'	-	Water sampling	5m depth, Niskin
2	KEO_E	2013/06/29 07:54	34°21.004'	143°43.660'	KEO10	Start recovery	Drifting top buoy
2	KEO_E	2013/06/29 12:38	34°19.172'	143°39.679'	KEO10	End nylon	Nylon rope was broken
3	W01	2013/06/30 06:01	35°59.96'	143°59.88'	202582	Sonde 1	
3	W01	2013/06/30 06:11	36°00.36'	144°00.01'	11063972	XCTD 1	
4	W02	-	-	-	202583	Sonde 2	Failure
4	W02	2013/06/30 07:58	36°15.42'	143°59.87'	11063973	XCTD 2	
4	W02	2013/06/30 08:14	36°17.45'	144°00.40'	202581	Sonde 2	
5	W03	2013/06/30 09:35	36°30.11'	143°59.96'	202584	Sonde 3	
5	W03	2013/06/30 09:44	36°30.47'	143°59.82'	11074191	XCTD 3	

6	W04	2013/06/30 11:02	36°44.46'	143°59.72'	202588	Sonde 4	
6	W04	2013/06/30 11:09	36°45.36'	144°00.06'	11074194	XCTD 4	
7	W05	2013/06/30 12:31	37°00.05'	144°00.29'	202587	Sonde 5	
7	W05	2013/06/30 12:38	37°00.80'	143°59.68'	11074193	XCTD 5	
8	W06	2013/06/30 13:58	37°14.99'	144°00.55'	202592	Sonde 6	
8	W06	2013/06/30 14:03	37°15.70'	143°59.85'	11074192	XCTD 6	
9	W07	2013/06/30 15:24	37°29.99'	144°00.11'	202591	Sonde 7	
9	W07	2013/06/30 15:27	37°30.12'	144°00.13'	11074197	XCTD 7	
10	W08	2013/06/30 16:50	37°44.82'	144°00.37'	202586	Sonde 8	
10	W08	2013/06/30 16:55	37°45.67'	143°59.45'	11074196	XCTD 8	
11	W09	2013/06/30 18:21	37°59.86'	144°00.38'	202585	Sonde 9	
11	W09	2013/06/30 18:24	38°00.37'	143°59.77'	11074195	XCTD 9	
12	JKEO	-	-	-	202590	Sonde 10	Failure
12	JKEO	2012/07/01 06:11	38°04.73'	146°26.16'	202596	Sonde 10	
12	JKEO	2012/07/01 06:18	38°04.75'	146°26.09'	11074200	XCTD 10	
13	JKEO	2012/07/01 06:30	38°04.850'	146°26.167'	-	Water sampling	Bucket
14	JKEO	2012/07/01 07:50	38°05.978'	146°21.487'	JKEO7	Start deployment	
14	JKEO	2012/07/01 13:53	38°05.051'	146°26.900'	JKEO7	Anchor release	

14	JKEO	2012/07/01 14:21	38°05.049'	146°26.873'	JKEO7	Anchor landing	
15	JKEO	2012/07/01 15:06	38°04.73'	146°26.38'	202593	Sonde 11	
16	JKEO	2012/07/01 18:06	37°54.28'	146°35.34'	202595	Sonde 12	
17	JKEO	2012/07/01 21:03	37°54.78'	146°33.60'	202600	Sonde 13	
18	JKEO	2012/07/01 23:59	37°54.14'	146°34.84'	202589	Sonde 14	
19	JKEO	2012/07/02 01:29	37°54.03'	146°32.84'	202599	Sonde 15	
20	JKEO	2012/07/02 02:59	37°53.75'	146°31.43'	202598	Sonde 16	
21	JKEO	2012/07/02 05:59	37°54.41'	146°32.85'	202597	Sonde 17	
22	JKEO	2012/07/02 07:37	37°54.045'	146°36.366'	JKEO6	Release code	
22	JKEO	2012/07/02 07:50	37°54.063'	146°35.972'	JKEO6	Start recovery	
22	JKEO	2012/07/02 13:50	37°53.452'	146°26.853'	JKEO6	End acoustic releasers	
23	JKEO	2012/07/03 05:52	38°11.079'	146°04.075'	JKEO7	Start recovery	Drifting top buoy
23	JKEO	2012/07/03 10:31	38°09.915'	146°05.250'	JKEO7	End nylon	Nylon rope was broken
24	JKEO	2012/07/03 12:51	38°04.974'	146°26.533'	JKEO7	Release code	
24	JKEO	2012/07/03 14:21	38°04.715'	146°26.462'	JKEO7	Start recovery	Mooring remnant
24	JKEO	2012/07/03 16:08	38°05.647'	146°25.746'	JKEO7	End nylon	
25	JKEO	-	-	-	101228	Sonde 18	Failure
25	JKEO	2013/07/03 16:52	38°02.79'	146°23.81'	202594	Sonde 18	Touch the water

26	E12	2013/07/03 18:35	37°45.07'	146°19.87'	201141	Sonde 19	
27	E11	2013/07/03 20:02	37°29.88'	146°14.56'	201142	Sonde 20	
28	E10	2013/07/03 21:22	37°14.96'	146°09.69'	201144	Sonde 21	
29	E9	-	-	-	101230	Sonde 22	Failure
29	E9	-	-	-	201145	Sonde 22	Failure
29	E9	2013/07/03 23:03	36°58.04'	146°03.22'	201146	Sonde 22	
30	E8	2013/07/04 00:10	36°45.01'	145°59.52'	201143	Sonde 23	
31	E7	2013/07/04 01:30	36°29.85'	145°54.27'	201147	Sonde 24	
32	E6	2013/07/04 02:41	36°14.96'	145°49.48'	201148	Sonde 25	
33	E5	2013/07/04 04:07	35°59.95'	145°44.49'	201149	Sonde 26	
34	E4	2013/07/04 05:33	35°44.94'	145°39.63'	201150	Sonde 27	
35	E3	2013/07/04 07:01	35°30.13'	145°34.17'	202269	Sonde 28	
36	E2	2013/07/04 08:40	35°14.89'	145°29.38'	202268	Sonde 29	
37	E1	2013/07/04 10:09	35°00.03'	145°24.42'	202270	Sonde 30	
38	KEO	2012/07/05 08:20	32°25.457'	144°38.929'	KEO11	Start deployment	
38	KEO	2012/07/05 13:54	32°15.413'	144°34.126'	KEO11	Anchor release	
38	KEO	2012/07/05 14:51	32°14.903'	144°33.817'	KEO11	Triangulatio n 1	
38	KEO	2012/07/05 15:12	32°14.820'	144°34.933'	KEO11	Triangulatio n 2	
38	KEO	2012/07/05	32°15.880'	144°35.451'	KEO11	Triangulatio	

		15:30				n 3	
39	KEO	2013/07/05 16:05	32°16.370'	144°34.929'	-	Water sampling	5m depth, Niskin
40	KEO	2013/07/05 18:01	32°15.64'	144°35.38'	202271	Sonde 31	
41	KEO	2013/07/05 19:28	32°15.99'	144°34.27'	202273	Sonde 32	
42	KEO	2013/07/05 21:00	32°16.48'	144°32.97'	202274	Sonde 33	
43	KEO	2013/07/05 22:30	32°17.00'	144°32.21'	202275	Sonde 34	
44	KEO	2013/07/05 23:59	32°15.10'	144°36.14'	202276	Sonde 35	
45	KEO	2013/07/06 01:29	32°15.79'	144°34.89'	202277	Sonde 36	
46	KEO	2013/07/06 02:58	32°16.11'	144°33.76'	202278	Sonde 37	
47	KEO	2013/07/06 04:29	32°16.30'	144°33.11'	202279	Sonde 38	
48	KEO	2013/07/06 06:00	32°24.80'	144°29.80'	202281	Sonde 39	
49	KEO	2013/07/06 07:00	32°24.928'	144°29.901'	KEO10	Release code	
49	KEO	2013/07/06 09:05	32°27.387'	144°30.801'	KEO10	Start recovery	Mooring remnant
49	KEO	2013/07/06 10:59	32°26.242'	144°29.453'	KEO10	End nylon	
50	S1	2013/07/06 13:29	32°42.58'	144°34.95'	202280	Sonde 40	
51	S2	2013/07/06 14:59	32°53.71'	144°38.42'	202282	Sonde 41	
52	NKEO	2013/07/07 03:29	33°50.731'	144°54.229'	NKEO1	Release code	
52	NKEO	2013/07/07 08:15	33°51.442'	144°55.540'	NKEO1	Start recovery	Mooring remnant

52	NKEO	2013/07/07 14:37	33°52.637'	145°02.493'	NKEO1	End wire	Wire cable was broken
53	W11	2013/07/08 07:56	36°00.03'	143.30.00'	202283	Sonde 42	
53	W11	2013/07/08 08:02	36°00.91'	143.29.99'	11074199	XCTD 11	
54	W12	2013/07/08 09:23	36°15.02'	143°30.05'	202284	Sonde 43	
54	W12	2013/07/08 09:27	36°15.71'	143°30.27'	11074198	XCTD 12	
55	W13	2013/07/08 10:50	36°30.05'	143°30.08'	202285	Sonde 44	
55	W13	2013/07/08 10:54	36°30.73'	143°30.36'	11115384	XCTD 13	
56	W13-2	2013/07/08 12:39	36°22.57'	143°30.25'	202286	Sonde 45	Aircraft obs. 12:11-12:56
57	W14	2013/07/08 14:52	36°45.22'	143°30.34'	202290	Sonde 46	
57	W14	2013/07/08 14:57	36°45.90'	143°30.57'	11115385	XCTD 14	
58	W15	2013/07/08 16:16	37°00.02'	143°30.06'	202287	Sonde 47	
58	W15	2013/07/08 16:21	37°00.86'	143°30.43'	11115386	XCTD 15	
59	W16	2013/07/08 17:42	37°15.03'	143°30.04'	202289	Sonde 48	
59	W16	2013/07/08 17:47	37°15.60'	143°30.56'	11115387	XCTD 16	
60	W17	2013/07/08 19:11	37°30.02'	143°30.01'	202288	Sonde 49	
60	W17	2013/07/08 19:15	37°30.66'	143°30.17'	11115388	XCTD 17	
61	W18	2013/07/08 20:37	37°45.02'	143°30.04'	202291	Sonde 50	
61	W18	2013/07/08 20:41	37°45.46'	143°30.38'	11115389	XCTD 18	

62	W19	2013/07/08 22:04	38°00.01'	143°30.03'	202292	Sonde 51	
62	W19	2013/07/08 22:10	38°00.48'	143°30.72'	11115392	XCTD 19	
63	W19	-	-	-	202293	Sonde 52	Failure
63	W19	-	-	-	202294	Sonde 52	Failure
63	W19	2013/07/09 09:13	38°00.38'	143°29.88'	202295	Sonde 52	
64	W18	2013/07/09 10:47	37°45.09'	143°30.11'	202299	Sonde 53	
65	W17	-	-	-	202298	Sonde 54	Failure
65	W17	2013/07/09 12:32	37°30.03'	143°30.03'	202297	Sonde 54	
66	W16	2013/07/09 14:17	37°15.01'	143°29.99'	202296	Sonde 55	
67	W15	2013/07/09 16:17	37°00.09'	143°30.00'	202300	Sonde 56	
68	W14	2013/07/09 18:00	36°44.99'	143°29.98'	202302	Sonde 57	
69	W13	2013/07/09 19:39	36°29.99'	143°30.05'	202303	Sonde 58	
70	W19	2013/07/10 08:02	38°00.18'	143°30.01'	202304	Sonde 59	
71	W18	2013/07/10 09:33	37°45.05'	143°30.09'	202306	Sonde 60	
72	W17	2013/07/10 11:05	37°30.04'	143°30.06'	202305	Sonde 61	
73	W17-2	2013/07/10 11:57	37°31.87'	143°29.25'	202307	Sonde 62	Aircraft obs. 11:27-12:18
74	W16	2013/07/10 13:41	37°15.01'	143°30.00'	202311	Sonde 63	
75	W15	2013/07/10 15:30	37°00.02'	143°29.98'	202310	Sonde 64	
76	W14	2013/07/10 17:14	36°45.07'	143°29.96'	202309	Sonde 65	

77	W13	2013/07/10 18:56	36°30.03'	143°29.89'	202308	Sonde 66	Last observation
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3.7 About data

Some of the data obtained in this cruise may 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 Inoue and his crew for their skillful operation.