

Preliminary Report
of
The Hakuho Maru Cruise KH-70-3
(2nd GARP Cruise)

July, 1970
East China Sea and Southern Region off Japan

Ocean Research Institute

University of Tokyo

Nakano, Tokyo

1971

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By
The Members of Expedition
Edited by
Atsushi Takeda

Condolence

Captain Tsuyoshi Yano was confined to sickbed for some while, and died on February 26th 1971. His excellent penetration and his well experienced seamanship contributes very much to the advances of oceanography and its environmental sciences. His opinions on winds and waves which were accumulated throughout his long career as the captain of sailing vessels of Navigation Training Establishment, were very valuable and suggestive. We must treasure them. We would like to express our deep regret over his death and to bless his memory.

Table of Contents

1.	Introduction	1
2.	List of the members of the expedition	3
3.	Outline of KH-70-3	4
3.1	Itinerary	4
3.2	Track chart	4
4.	Surveys in air-sea interaction for GARP	6
4.1	Measurements of wind fluctuations and waves at the bow-boom	8
4.2	Turbulent flux measurements at the foremast	10
4.3	Measurements of fine structure of turbulent air flow at the bow-boom	14
4.4	Measurements of profiles of wind, temperature and humidity on board	17
4.5	Observation of wide range wind fluctuations	18
4.6	Buoy observation of the profiles and turbulent fluctuations in the atmospheric surface layer	19
4.7	Captive balloon observation of profiles and turbulent fluctuations up to 500 m height in the atmosphere	20
4.8	Aerological observation	22
4.9	Surface temperature observations with an infrared radiation thermometer	24
4.10	Salinity and temperature observations	25
4.11	Observation of the breaking of wind waves and the sea water droplets in relevant to air-sea boundary processes	27
5.	Other joint surveys	31
5.1	Gravity measurement at sea in the KH-70-3 cruise of the Hakuho Maru ...	31
5.2	The boron concentration in the atmosphere over the sea	34
Appendix I	Routine observation data	35
Appendix II	Aerological data	61
Appendix III	Weather charts	67
Appendix IV	The R/V Hakuho Maru equiped with the apparatus for this expedition	77

These two regions are divided by 'Kuroshio'.

Although indirectly related to GARP, some groups took their opportunity to advance their research works. Thus gravity survey and chemical observation of the boron concentration joined the expedition.

Throughout the cruise, the R/V Hakuho Maru exerted her full faculty. It was owing to skillful seamanship. On behalf of all scientists aboard, I would like to express our thanks to Captain Tsuyoshi Yano and his crew. Thanks are also due to Miss Junko Matsumoto for her help in editing this report. This expedition was operated as a cooperative project undertaken by the Ocean Research Institute, while most attended groups have their study partly supported by a Scientific Research Fund for Special Study Nos. 99203 and 499203 (GARP) from the Ministry of Education.

2 List of the members of the expedition

Takeda, Atsushi (Chief Scientist):	Ocean Research Institute, University of Tokyo
Tomoda, Yoshibumi:	"
Taira, Keisuke:	"
Nakai, Toshisuke:	"
Otobe, Hiroataka:	"
Ishikawa, Koji:	"
Misawa, Nobuhiko:	"
Igarashi, Takao:	"
Nakaya, Syu:	Faculty of Fishery, Hokkaido University
Takahashi, Tadao:	Faculty of Fishery, Kagoshima University
Chaen, Masaaki:	"
Takeuchi, Kanehito:	"
Nishimura, Hiroshi:	"
Toba, Yoshiaki:	Geophysical Institute, Kyoto University
Okuda, Kuniaki:	"
Watabe, Isao:	National Research Center for Disaster Prevention, Science and Technology Agency
Mitsuta, Yasushi:	Disaster Prevention Research Institute, Kyoto University
Hanafusa, Tatsuo:	Geophysical Institute, Kyoto University
Maitani, Toshihiko:	"
Fujitani, Tokunosuke:	"
Iwashima, Tatsuya:	"
Onishi, Gaishi:	Geophysical Institute, Tohoku University
Yokoyama, Osayuki:	National Research Institute for Pollution and Resources
Hayashi, Masayasu:	"
Gamo, Minoru:	"
Fujita, Toshio:	Meteorological Research Institute/JMA
Uotsu, Hiroshi:	"
Takuma, Shin-ichi:	Kobe Marine Observatory/JMA
Fukuda, Nobuaki:	Meisei Electric Co. Ltd.
Ooba, Kenichi:	Ginsei Ad Co. Ltd.

3 Outline of KH-70-3

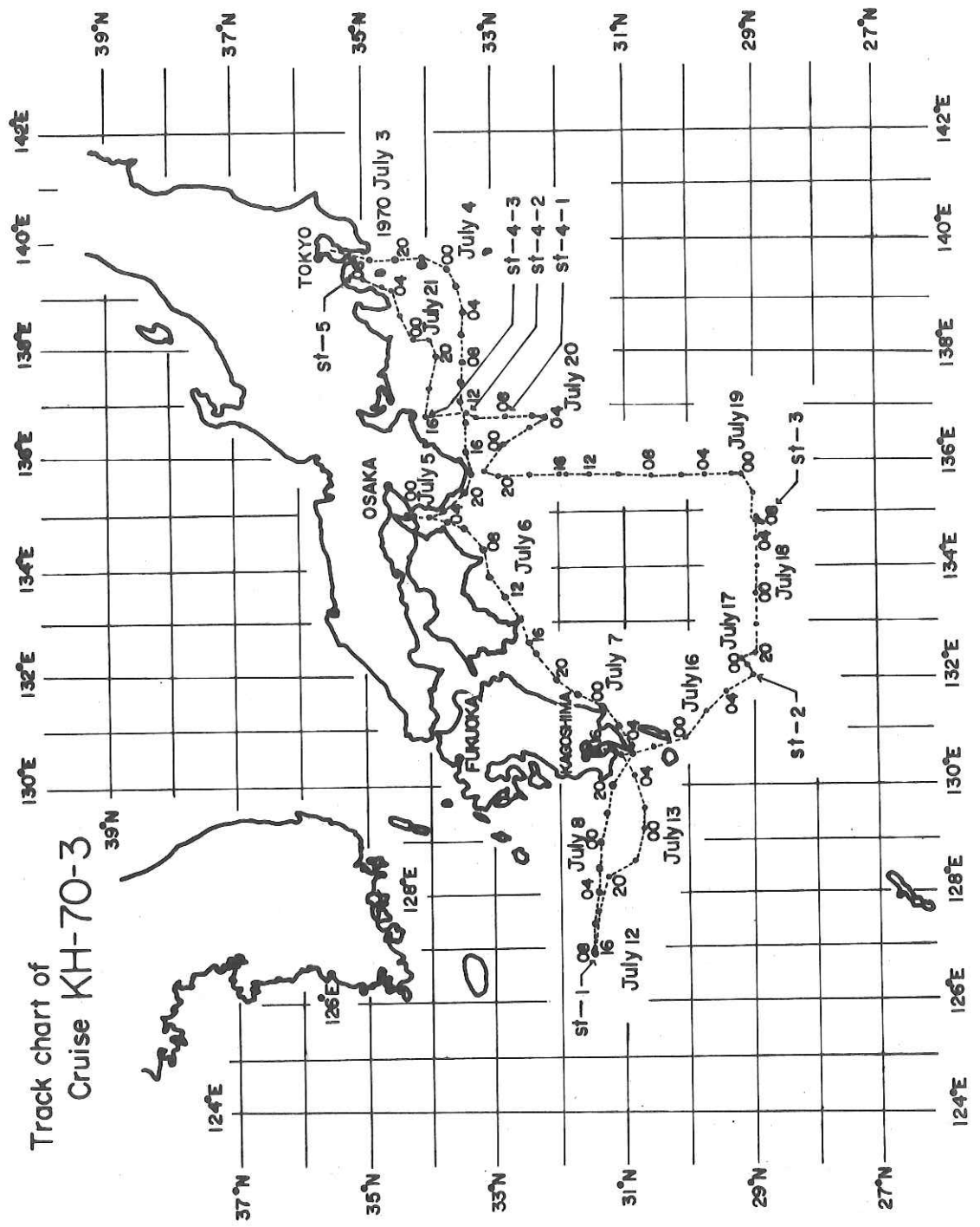
3-1 Itinerary

Date	Time	Position	Remarks
July 3	14:00	Lv. Tokyo	
5	01:05	Ar. off Fuke in Osaka Bay	Sheltering from typhoon 7008 (Oruga)
6	00:50	Lv. Osaka Bay	
7	08:35	Ar. Kagoshima	
	15:00	Lv. Kagoshima	
8	08:11	Ar. St. 1 (31.5°N, 127°E)	Anchoring obs.
12	14:58	Lv. St. 1	
13	10:30	Ar. Kagoshima	
15	17:00	Lv. Kagoshima	
16	06:00	Ar. St. 2 (29°N, 132°E)	Drifting obs.
17	18:30	Lv. St. 2	
18	05:43	Ar. St. 3 (29°N, 135°E)	Drifting obs. (St. TANGO)
	19:00	Lv. St. 3	
20	07:30	Ar. St. 4-1 (32°50'N, 136°55'E)	Drifting obs.
	08:27	Lv. St. 4-1	
	10:40	Ar. St. 4-2 (33°20'N, 136°55'E)	Drifting obs.
	11:40	Lv. St. 4-2	
	13:40	Ar. St. 4-3 (33°50'N, 136°55'E)	Drifting obs.
	14:45	Lv. St. 4-3	
21	07:55	Ar. St. 5 (35°N, 139°21'E)	Drifting obs.
	12:12	Lv. St. 5	
22	09:28	Ar. Tokyo	

3-2 Track Chart

The track chart of this cruise is shown in the next page. Open circles denote the positions along the outward voyage and dots denote those along the home voyage. Detailed positions are tableted in Appendix I.

Track chart of
Cruise KH-70-3



4. Surveys in Air-Sea Interaction for GARP

The first scheme of observation for our objective is an intercomparison experiment among various feasible methods to evaluate surface fluxes on an open sea.

Although for this purpose a convectional research vessel serves as an appropriate platform with wide mobility, powerful facilities and comfortable accommodation, two attributive characteristics of ship, i. e., unstable effects against air flows and waves due to the large hull, and motions of pitching, rolling and etc. caused by waves are very inconvenient for the micrometeorological experiments in present context.

In order to overcome the foregoing troubles, three installation methods of sensors are considered:

1. a specially designed bow boom (Fig. 1 and Appendix IV)
2. a moored buoy (see 4.7)
3. a foremast (Fig. 2)

They are effective when the bow faces to a wind direction by the aid of the bow thruster (Appendix IV).

To eliminate the latter trouble, the following schemes were arranged according to three principles of flux determination which have been generally discussed;

1. profile methods with simple corrections of the motion
2. direct measurements of fluxes of Reynolds regime with precise corrections of the motion
3. as for the momentum flux, estimation from the argument of turbulent energy dissipation isotropic range which does not need the correction of the effect of motion.

A correction system of motion has been developed and is described in Preliminary Report of the Hakuho Maru Cruise KH-69-3.

Several combinations of installations and measuring schemes were tried by each group as presented in the following sections in this chapter.

In addition to the flux evaluation itself, explicit observations of those physical properties which represent the characteristics of air-sea interface and a boundary layer over it were necessary, because the surface fluxes should be ultimately expressed as a function of such mean properties

The second scheme of observation aims to follow the penetration processes of the surface fluxes into the deeper layers of atmosphere and ocean.

Two items were planned;

1. observation of vertical distribution of fluxes and mean properties (by a captive balloon radiosondes and STD)
2. observation of horizontal advection by rawinsondes and ocean current meters.

Unfortunately item 2 was not in practice in the present expedition.

by

A. Takeda, K. Taira, K. Ishikawa, N. Misawa and I. Watabe

Measurements of turbulent fluctuations of wind velocities with a three-dimensional sonic anemometer and of surface waves by a sonic wave gauge were made on the observational bow-boom projected ahead horizontally from the top of a bow. Quantities of ship motion at the boom were also recorded simultaneously to correct the wind velocities and the wave heights which contained the error due to the ship motion.

The simultaneously observed quantities in all are as follows:

1. relative wave heights
2. horizontal component (A) of wind velocity
3. horizontal component (B) of wind velocity
4. vertical component of wind velocity
5. horizontal acceleration (X) of acceleration (by an accelerometer)
6. horizontal component (Y) of acceleration (by an accelerometer)
7. vertical component of acceleration (by an accelerometer)
8. pitching angle (by a gyroscope)
9. rolling angle (by a gyroscope)
10. azimuth angle (by a gyroscope)

Data logging were done directly through the computer aboard, operating on the real time processing. Sampling rate of the data was set at 3 Hz for each quantity.

A list of the observational runs are tabulated below.

Run	Time	Date
1	0855-0920	July 10
2	0920-0950	July 10
3	0950-1010	July 10
4	1025-1055	July 10
5	1055-1125	July 10
6	1130-1158	July 10
7	1202-1228	July 10
8	1230-1258	July 10
9	1300-1330	July 10

Run	Time	Date
10	1337-1403	July 10
11	1405-1415	July 10
12	1436-1454	July 10
13	1455-1523	July 10
14	2220-2250	July 10
15	1420-1448	July 11
16	1450-1520	July 11
17	2110-2140	July 11
18	0835-0903	July 12
19	0905-0935	July 12
20	0937-1000	July 12
21	2035-2103	July 16
22	2105-2135	July 16
23	2136-2204	July 16
24	2300-2330	July 16
25	2332-0000	July 16
26	0002-0032	July 17
27	0034-0100	July 17
28	0203-0233	July 17
29	0235-0305	July 17
30	0306-0320	July 17
31	1033-1102	July 17
32	1105-1133	July 17
33	1135-1204	July 17
34	1301-1330	July 17
35	1425-1450	July 17
36	1520-1543	July 17
37	1545-1600	July 17
38	1000-1028	July 18
39*	1030-1059	July 18
40*	1100-1130	July 18
41	1300-1329	July 18
42	1404-1434	July 18
43	1503-1523	July 18
44	1700-1729	July 18
45	1730-1800	July
46	0920-0950	July 21
47	0952-1021	July 21
48	1023-1053	July 21
49	1054-1059	July 21
50	1100-1120	July 21

* Simultaneous observations with those by Kyoto University group

by

Y. Mitsuta, T. Hanafusa, T. Maitani and T. Fujitani

The purpose of the present study is to measure turbulent fluxes of momentum, sensible heat and water vapor over the ocean by the direct method on board.

The method of direct observation of the turbulent fluxes from a ship has been developed and tested by the present authors through last two ocean expeditions of GARP in 1968 and 1969. The same method of observation is succeeded in the present observation with minor changes.

The measurement of fluctuating components of meteorological entities are measured at the top of the foremast where the effects of a shipbody is supposed to be minimum. Three dimensional components of wind velocity relative to the ship are measured by a three dimension sonic anemometer-thermometer (Kaijo Electric Co., PAT-311-1) together with air temperature. Wind velocity components relative to the ground-fixed coordinate are computed from these relative wind by the use of the data of the ship movements, e. i., speed, yawing, pitching and rolling, in the course of the data processing after the cruise. Ship speed and yawing (ship heading) signals are supplied from the ship routine recording panel and pitching and rolling are detected by the specially designed clinometer (supplied by Sokkisha Co.) in the No. 1 Laboratory.

The dry and wet-bulb temperature fluctuations are detected by a fine wire thermo-couple psychrometer installed on the sonic anemometer sensor. From these signals water vapor fluctuation is calculated.

All signals are multiplexed into FM signal by a multiplexer (TEAC Co., AU-1000) and recorded on a magnetic tape recorder (TEAC Co., R-200). The entities recorded on this recorder are as follows,

- 1) Three dimensional wind velocity components relative to the ship measured by the sonic anemometer-thermometer.
- 2) Air temperature measured by the sonic anemometer-thermometer.
- 3) Dry and wet bulb temperature measured by the fine wire thermocouple psychrometer.
- 4) Pitching and Rolling measured by the clinometer.
- 5) Ship speed supplied from the ship.
- 6) Ship yawing (ship heading) supplied from the ship.

About thirty observations, each of which is about an hour in sampling duration, are made during this cruise. The time and condition of each observation are shown in the following table. These data will be analyzed by the use of the high speed A-D converter and the electronic computer of Kyoto University after this cruise. The results of the computation of turbulent fluxes of momentum, sensible heat and water vapor will be published by the end of this year.

Run GARP '70	Date July '70	Time		Ship		Wind Direction	Relative Wind Speed m/s from	Temperature		Note	
		h m	h m	Position	Heading Speed			Sea Surface	Air		
1	5	14:44-15:35		34°22.0'N 135°08.2'E	43°	Anchor	NE	13 right 5°	21.5°C	21.5°C	
2	5	18:33-19:29		"	62°	"	"	16 left 7°	20.8	21.1	
3	8	14:42-15:38		31°29.6'N 126°59.4'E	260°	"	W	5 right 9°	23.2	22.2	
4	8	15:50-16:48		"	267°	"	SW	5 left 30°	23.2	22.1	
5	8	21:43-22:40		"	147°	"	WSW	5 right 105°	23.5	21.7	H-1
6	9	15:07-16:05		"	219°	"	SSW	4 left 17°	23.3	24.0	H-2
7	9	16:15-17:04		"	232°	"	"	3 left 25°	23.3	24.1	H-3
8	9	21:20-21:55		"	143°	"	NE	2 left 86°	23.3	23.2	H-4
9	11	06:59-07:55		"	344°	"	NNW	7 0°	23.6	23.4	
10	11	11:17-12:17		"	79°	"	NE	7 left 23°	23.5	23.2	
11	11	12:52-13:49		"	112°	"	ENE	5 left 33°	23.7	23.5	H-5
12	11	20:00-20:57		"	183°	"	SSE	3 left 33°	24.2	23.5	H-7
13	16	10:12-11:07		29°00.0'N 132°00.3'E	174°	Drift	SSW	4 right 10°	28.5	27.9	H-8
14	16	14:00-14:55		29°06.2'N 132°07.3'E	158°	"	SSE	4 right 3°	28.7	28.7	H-9
15	16	15:10-16:06		29°04.3'N 132°09.0'E	150°	2kt	"	5 right 5°	29.1	28.7	
16	16	19:58-20:48		29°04.0'N 132°13.4'E	165°	Drift	"	5 right 5°	28.7	28.2	H-10
17	17	04:35-05:30		29°10.7'N 135°15.3'E	202°	"	SW	5 right 13°	28.4	27.6	
18	17	07:57-08:55		29°13.4'N 132°16.4'E	210°	"	SSW	5 left 20°	28.3	28.4	
19	17	13:30-14:24		29°18.0'N 132°20.3'E	218°	"	SW	7 right 5°	28.5	28.6	H-12
20	18	10:26-11:22		28°45.3'N 134°40.5'E	203°	"	"	7 right 20°	28.9	28.6	
21	18	17:08-18:07		28°52.2'N 134°42.4'E	237°	"	"	8 right 20°	28.8	28.6	

Run GARP '70	Date July '70	Time h m h m	Ship		Wind Direction	Relative Wind Speed m/s from	Temperature		Note	
			Position	Heading			Sea Surface	Air		
22	19	00:03-01:00	29°07.7'N 135°40.3'E	240°	WSW	11	right 3°	28.1	27.5	
23	19	14:11-15:00	31°57.6'N 135°39.5'E	250°	"	12	0°	26.9	26.9	
24	20	07:38-08:04	32°50.8'N 136°55.0'E	345°	"	7	left 90°	27.1	27.0	
25	20	11:45-12:11	33°23.3'N 136°58.1'E	344°	NW	9	left 20°	27.2	26.6	
26	20	15:00-15:53	33°58.2'N 136°53.0'E	13°	NNW	4	left 30°	25.5	26.1	

by

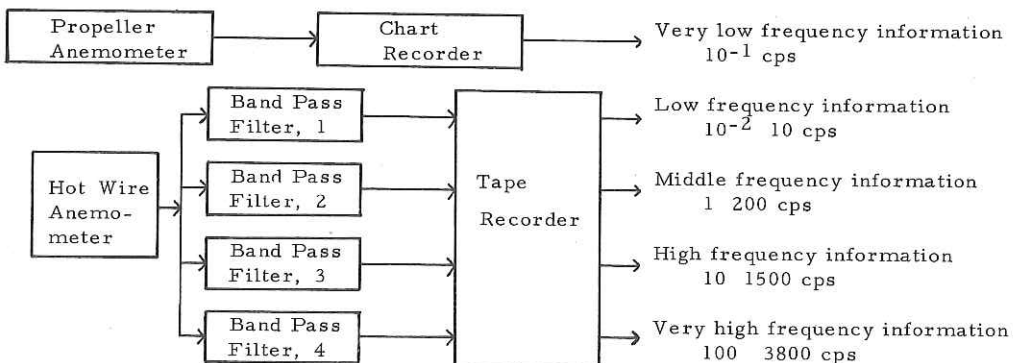
Y. Mitsuta, T. Hanafusa, T. Maitani, T. Fujitani and M. Gamo

The purpose of this measurement is to obtain wide range turbulent spectra of wind velocity fluctuations over the sea. The shape of the low frequency side of the spectrum supplies us the knowledge of the mechanism of generation of the microscale turbulence, while we can estimate energy dissipation rate of turbulence from the shape of the high frequency side of the spectrum. The aim of the present study is to obtain spectrum of wind fluctuations in the range from 10^{-4} to 10^3 cps.

Measurement was made by the use of two kinds of sensors of wind speed. One is the propeller type anemometer installed on the foremast of the ship and its signal is supplied from the ship. Another sensor is hot wire anemometer (Nihon Kagaku Kogyo Co., Kanomax 28-3111) with platinum wire of 5 microns in diameter. From the fluctuating components of the former sensor spectral density of the frequency range lower than 10^{-1} cps is analyzed and the higher side of the spectrum is obtained from the data of the latter sensor.

The signal of the propeller type anemometer is recorded continuously throughout the period on the chart recorder, when the ship is not moving. In order to obtain a wide dynamic range, the hot wire signal is filtered by the four band pass filters and the resulting four channel signals are amplified and recorded on the four channels of a magnetic tape recorder (TEAC Co., R-200). The observations of hot wire were made at the top of the foremast or on the observing boom at the bow. The sampling duration is from 30 to 60 min. for each run.

The schematic diagram of the observation is as follows.



The wide range spectra can be composed from five kinds of spectra obtained from these band divided data.

During the cruise, about sixty fours of chart record of the propeller anemometer signal and twelve runs of hot wire observations were obtained. The details of hot wire observations are shown in the following table. The data will be analyzed after this cruise.

Run GARP 70'	Date July 70'	Time h m h m	Ship		Wind Direction	Relative Wind m/s	Speed from	Temperature		Note
			Position	Heading				Sea Surface	Air	
H-1	8	21:49-	31°29.6'N 126°59.4'E	147°	SW	4	right 90°	23.5	21.7	Foremast
H-2	9	15:26-16:22	"	205°	SSW	4	left 10°	23.3	23.9	"
H-3	9	16:34-17:30	"	240°	SW	3	left 15°	23.3	24.1	"
H-4	9	22:00-22:30	"	130°	NE	2	left 80°	23.3	23.2	"
H-5	11	12:53-13:51	"	117°	ENE	6	left 40°	23.7	23.5	"
H-6	11	14:44-15:58	"	"	E	3	left 35°	23.9	23.2	Boom and Foremast
H-7	11	20:02-20:55	"	190°	SSE	4	left 35°	24.2	23.4	Boom and Foremast
H-8	16	10:18-11:13	29°00.0'N 132°00.3'E	168°	S	4	right 5°	28.5	27.9	Mast
H-9	16	14:05-14:31	29°06.2'N 132°07.3'E	151°	SSE	2	right 5°	28.7	28.7	Boom and Foremast
H-10	16	19:58-20:54	29°04.0'N 132°13.1'E	154°	"	6	right 10°	28.7	28.2	Boom and Foremast
H-11	17	09:59-10:22	29°15.6'N 132°17.5'E	219°	NW	5	right 100°	28.3	28.5	Boom
H-12	17	13:38-14:11	29°18.0'N 132°20.3'E	220°	SW	7	right 5°	28.5	28.6	Boom

by

T. Fujita and H. Uotsu

The aim of the present observation is to estimate vertical fluxes of momentum, heat and water vapor near the sea surface by the measurements of the profiles of wind, temperature and humidity.

The instruments of measuring the profiles were as follows:

1) Wind speed: Small three-cup anemometer. The signal of rotation was made through "lamp-photocell" devices for the purpose of minimizing the mechanical friction. The number of the rotations was printed out in digit every 10 min.

2) Temperature and humidity: aspirated psychrometers the sensors of which were thermistors. The observations were made every 10 min.

Five sets of the instruments mentioned above were installed along the pole (see Figs. 1), two sets were installed on the foremast (see Fig. 2 heights from the mean sea level: 15.5, 21.5 m) and one set was installed on the post of the boom at the ship bow (see Fig. 1 height from the mean sea level: 8.2 m). The pole was supported vertically by the horizontal boom which was 7.5 m high above the mean sea level. The measurement was made for about 55 hours. About 330 runs were obtained, each of which lasted for 10 min. The measurement by three sets which were installed on the foremast and the post was made for about 200 hours from 4th to 21st July.

The data will be analyzed later.

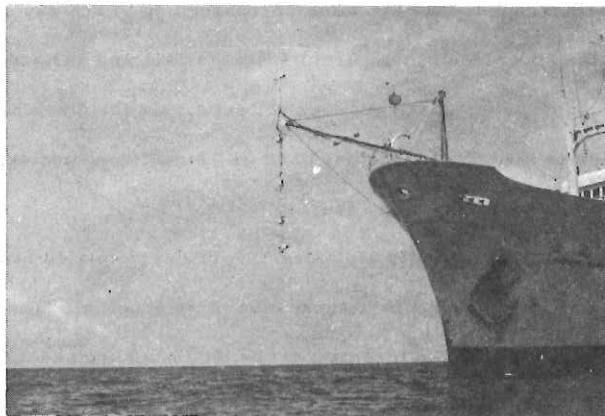


Fig. 1

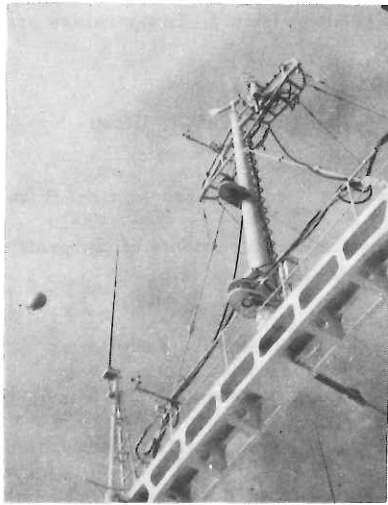


Fig. 2

4-5 Observation of Wide Range Wind Fluctuations

by

G. Onishi

The irregularity of the surface and the difference of temperature between air and surface are the main causes of turbulence in the surface wind. From the measurement of wind velocity over the land and from the previous cruise KH-69-3 which took place from July 4th to July 8th 1969, power spectra of wind velocity were calculated. Values of power spectral components over the land decrease with frequency but the value corresponding to one day's is exceptionally large. This means that the difference of temperature between air and surface is the main cause of turbulence and that a gap of power spectrum does not exist. On the other hand the measurement of wind velocity at the Cruise lasted only four days and we can not conclude exactly, that there is not large one day's components and that a gap does not exist.

Whether a gap does or does not exist is an interesting problem related to the causes of turbulence. The aim of this investigation is to make clear this problem. The measurements are done with an anemometer installed on the foremast of the Hakuho-maru and a hot wire anemometer on the foremast. The analysis of data is left for the future laboratory work.

Buoy Observation of the Profiles and Turbulent Fluctuations
in the Atmospheric Surface Layer

by

T. Takahashi, M. Chaen, K. Takeuchi and H. Nishimura

An attempt for micrometeorological study of the atmospheric structure in a layer next to the sea surface up to a level of the lower deck of a research vessel by means of a floating micrometeorological buoy were already carried out on the sea west off Kyushu, associated with the first GARP Cruise of the Hakuho-maru last year. This year, further observations aiming at the acquisition of improved data of mean profiles and atmospheric turbulence were tried again using improved buoys of two different types. The mooring system of the buoys had been already inquired in advance with great caution, though all the instruments were same as those used last year, i. e., cup anemometers of Robinson type, dry and wet bulbs of resistance thermometers, and an ultrasonic anemometer-thermometer. At the defined station, $31^{\circ}29'30''N$, $126^{\circ}59'30''E$, the operation of mooring system of buoys could not have been completed because of unfavorable winds and unexpected water flows around the Hakuho-maru, inspite of enormous efforts of scientists and crew. A few successful data were obtained only by the sonic anemometer-thermometer in consequence of the circumstances.

As our conclusive opinion, most troubles in the operation of buoy mooring is caused by breakdown in signal sending cables binded loosely with a mooring rope. We should advance toward developing a wireless telemetering system.

up to 500 m Height in the Atmosphere

by

O. Yokoyama, M. Hayashi, M. Gamo and A. Takeda

The atmospheric boundary layer has important roles for the energy (sensible and latent heat) transfer processes which feed almost all energy sources of the atmospheric motions at various scales. The energy transfer processes are primarily governed by the mean profiles of wind speed, temperature, humidity and eddy diffusivities which concern to the fluctuations of those quantities.

Boundary layer over land surface has been explored by many researchers (e. g., Lumly and Panofsky (1964) and transfer processes through it are comparatively well understood though the research for it is still continued. On the other hand, boundary layer over the sea surface is still being outside of reach. We can expect many different points between the sea and the land boundary layer, on it's behavior concerned to roughness, horizontal homogeneity, stability and so forth. Our purpose of the present research is to carry observations of these physical elements in inner and outer atmospheric boundary layer and to make clear these points and so the structure of the atmospheric boundary layer over the sea surface.

The mean vertical profiles of the wind speed, temperature and humidity are measured by a wireless telemetering instrument. (CBS-T-3 sonde) mounted on a captive balloon. The sensors of CBS-T-3 sonde are small cup-anemometer, thermister thermometer, and thermister wet bulb thermometer. Signals from these sensors are converted into frequency modulated signals by time shearing method and sent to the ground by AM, VHF wave.

In the present observation, the mean quantities were measured at 50, 100, 150, 200, 300, 400, 500 m height (cable length) and the averaging time was about 5 min.

The fluctuations of wind speed, temperature are measured by another wireless telemetering instrument (CBS-W-sonde) mounted on a captive balloon. The sensors of the CBS-W sonde are small light bi-vane with magnetic compass and cup-anemometer, platinum-wire resistance thermometer.

These quantities are continuously transmitted by FM, VHF wave to the receiver on the ship.

In the present observation, the fluctuating quantities were measured at 50, 100, 150, and 200 m height (cable length) and the observation time was about 20 to 30 min.

Further details of the instruments are found in Yokoyama (1969).

The captive balloon was launched from stern deck of Hakuho-maru. Captive cable was connected to the deck by rubber strings for reducing rock of the ship. Observations of the mean profiles and the fluctuations were carried out by one after the other, using same captive balloon.

The present observations were carried out in different locations. One is in the East-China Sea (St. 1..... see the track chart in page 5) where the ship was anchored and others are in the region of the Pacific Ocean along south coast of the Japan Islands (St. 2, St. 3, St. 4 and St. 5) where the ship was drifted.

Data obtained during the present observation are summarized in the following tables.

Table 1 Data at St. 1 (anchoring)

(C. B. S. -T-3)			(C. B. S. -W)		
Date	Time	Height (m)	Date	Time	Height (m)
July 8	1143-1413	50-500	July 8	1419-1445	50
	1555-1748	50-500		1448-1520	100
	1849-2313	50-400		1523-1540	200
July 9	0906-1027	50-500		1810-1830	50
	1148-1316	50-500		2140-2157	50
	1510-1542	50-500		2200-2225	50
1	1751-1910	50-450		2228-2245	100
July 11	1300-1420	50-500	July 9	1035-1055	50
	1519-1612	50-400		1057-1120	100
				1122-1138	150
				1335-1350	50
				1355-1515	150
				1418-1442	100
				1448-1500	50
				1915-1930	50

Table 2 Data at St. 2, 3, 4, 5 (drifting)

(C. B. S. -T-3)			(C. B. S. -W)		
Date	Time	Height	Date	Time	Height (m)
July 16	0945-1119	50-500	July 16	1139-1200	200
	1336-1537	50-400		1205-1230	100
	1617-1954	50-400		1235-1300	50
	2139-2328	50-400		1305-1325	150
July 17	0130-0330	50-400		1625-1655	100
	0541-0748	50-400		1702-1730	200
	0948-1138	50-400		1732-1805	150
July 18	1000-1138	50-100		2334-0014	50
July 20	0756-1120	50-200	July 17	0020-0050	100
	1256-1442	50-400		0052-0120	150
July 21	0840-1012	50-500		0425-0455	50
				0459-0530	100
			July 21	1020-1050	50
				1052-1120	100

4-8 Aerological Observation

by

S. Takuma, T. Iwashima and A. Takeda

During the cruise, aerological observations with radiosonde were made on board. The SBM (JMA) type radiosonde with 400 Mc signal transmitter was launched by a balloon filled with helium, whose buoyancy is 3000 g. The averaged ascending speed of the balloon from 400 mb to 200 mb is about 350 m/min.

The list of the observations is shown in following table and a part of the aerological data obtained by these observations is shown in the Appendix. The last sounding, shown as D-3, was made during the ship was cruising at 14 kt.

The detailed analysis and final check of the data will be made after the cruise.

Table

No.	Date	Time(JST)	Position	Maximum Altitude
1	July 8	08:30-09:04	31.5°N 127°E	197 mb
2	"	14:30-15:00	"	316 (Interference)
3	"	20:30-21:10	"	198
4	July 9	08:30-09:00	"	262 (Interference)
5	"	14:30-15:05	"	199
6	"	20:30-21:03	"	198
7	"	08:30-09:09	"	199
8	"	14:30-15:07	"	194
9	"	20:30-21:07	"	199
10	July 11	08:30-09:05	"	194
11	"	14:30-15:05	"	194
12	"	20:30-21:00	"	192
13	July 12	08:30-09:20	"	194
14	"	14:30-15:07	"	196
D-1	July 16	20:30-21:04	29°N 132°E	197
D-2	July 17	08:30-09:08	"	199
D-3	"	20:30-21:06	"	200

4-9 Surface Temperature Observations with an
Infrared Radiation Thermometer

by

N. Misawa, K. Taira and A. Takeda

Measurements of sea surface temperature with an infrared radiation thermometer were performed. The thermometer we used was Model PRT 14-313 made by Barnes Engineering Company of U. S. A. and output signal was recorded by a strip-chart recorder. The optical unit was set obliquely on the starboard side of the bridge deck.

The longitudinal distribution of sea surface temperature are shown in Fig. 3. The values are sampled at intervals of one nautical miles in the longitude between 127°E and 130°E. The latitude of the observed area is around 31°N and detail of the surveyed trace may be referred to the cruising course.

Reference

Ogura, Y. et al, 1969: Survey of Sea Temperature of the Tsushima Warm Current with Seaborne and Airborne Radiation Thermometers. (GARP-Severe Rainstorm Research Project). J. Met. Soc. Japan. Vol. 48, No. 4.

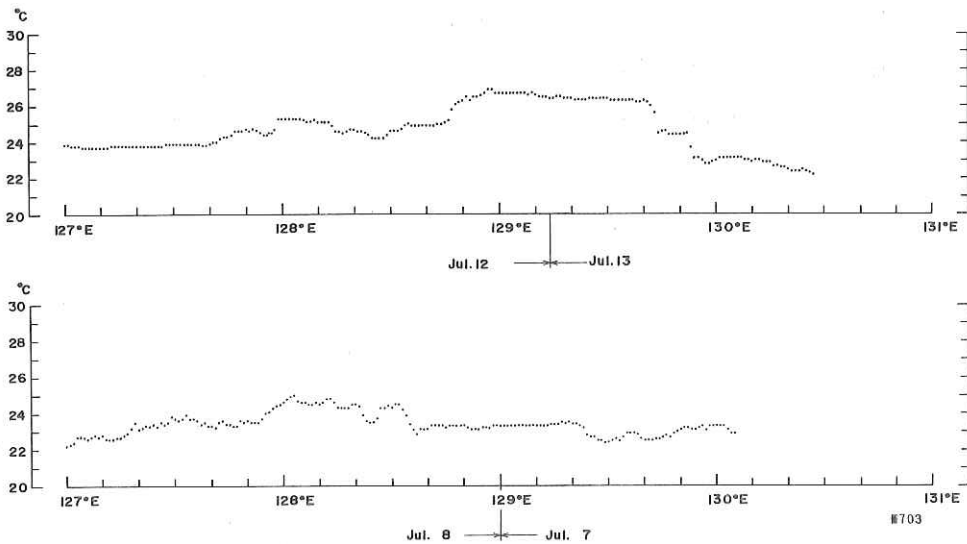


Fig. 3

by

T. Nakai, H. Otohe, N. Misawa, K. Taira and A. Takeda

The vertical distributions of salinity and temperature were made at the three stations with a STD system (Hytech 9006 STD Data Acquisition System).

At the first station (31.5°N, 127°E) in the East China Sea where the depth of water was 106-107 m, the observations were carried out to the bottom layer of 100 m deep at a rate of three times a day (9:00, 15:00 and 21:00) during the period from 15:00 on July 8 to 14:00 on July 12. All the profiles of salinity and temperature obtained in downward casts are shown in Fig. 4. Between two successive observations, the STD was set at a constant depth of 20 m, the top layer of the seasonal thermocline, and continuous recordings were made in analog form so that the time variations of salinity and temperature could be observed.

To examine a possible variation of salinity due to showers, water intaking was made 13 times by a cam-pump in the upper three layers of 0 cm, 50 cm and 100 cm deep during the period of 22:00 on July 10 to 14:00 on July 12. The result is shown in Fig. 5 being comparing with another parameters.

The another two stations were taken in the Pacific Ocean south off Honshu, at the points of 29°N, 132°E, 5000 m deep and 29°N, 135°, 4500 m deep respectively. The STD observations were carried out to the 1200 m deep layer in both the two cases and the profiles are shown in Fig. 6.

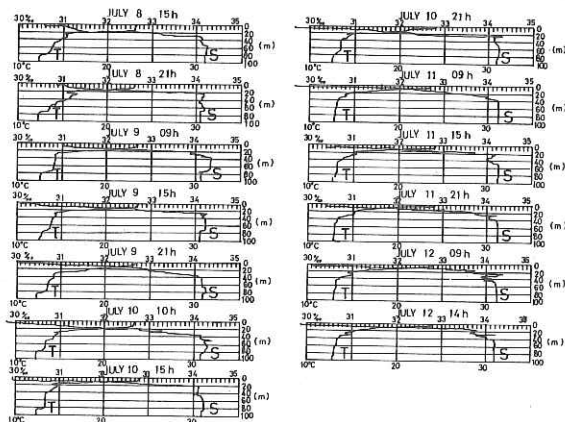


Fig. 4

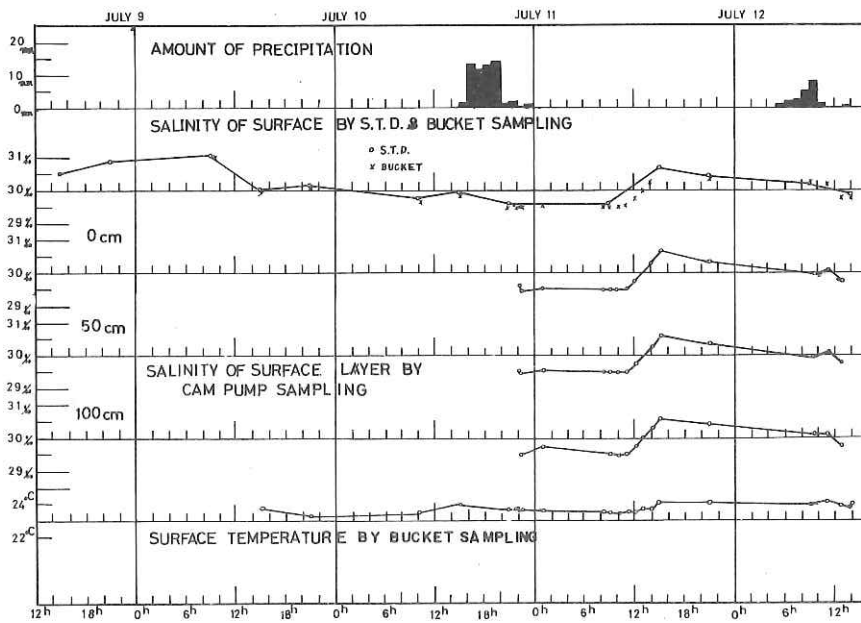


Fig. 5

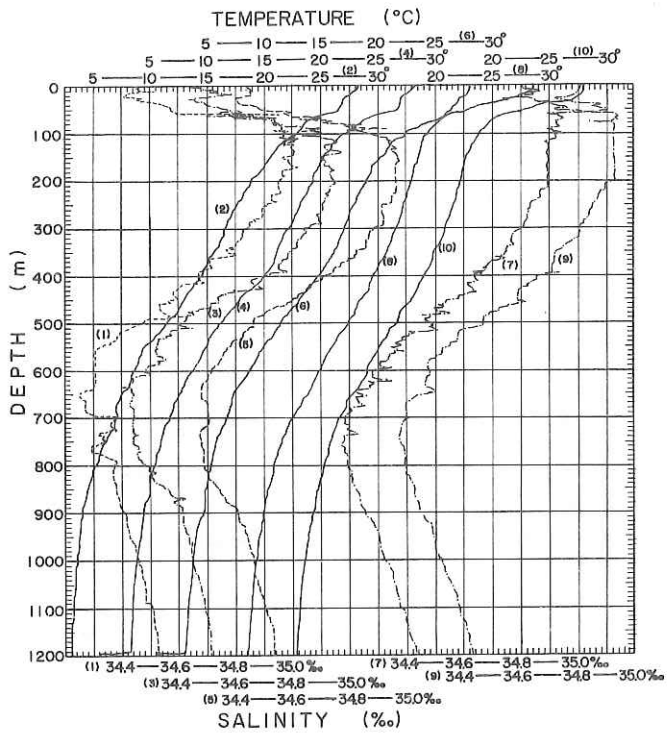


Fig. 6

4-11 Observation of the Breaking of Wind Waves and the Sea Water Droplets
in Relevant to Air-Sea Boundary Processes

by

Y. Toba, K. Okuda and M. Chaen

It has been clearly demonstrated by Toba and Kunishi (1970), by use of the data from their windwave tunnel experiments, that the breaking, or the air entrainment of wind waves, has an important bearing on the exchange processes of physical quantities, such as the momentum, between the air and the sea. Namely, it has been shown that the breaking of wind waves is not a function only of the wind speed, but is described by means of a kind of Reynolds number, which is constructed by U^* , the friction velocity representing the wind stress, H , the characteristic wave height, or L , the characteristic wave length representing the present state of the wave field, and V , the kinematic viscosity of air or of water: $Re_2^* = U^* H/v$ or $Re_4^* = U^* L/v_w = U^*_{wg} T^2 / 2V_w$, where T is the characteristic wave period, and the subscript W expresses the values of water. These Reynolds numbers represent the intensity of turbulence of the water surface itself. It has been also found that the breaking of wind waves commences at a value of $Re_2^* = 1 \times 10^3$, or $Re_4^* = 3 \times 10^3$, and that, at the same time, the drag coefficient, C_{D10} , plotted against these Reynolds numbers, begins to increase at this critical value of Re_2^* or Re_4^* . It is considered that this increase of C_{D10} arises from the 'boundary penetration of turbulence' caused by the breaking of water surface.

Also, the breaking of wind waves directly results in the production of sea-water droplets, and it is naturally expected that the flux of water content from the sea surface to the air increases as the breaking of waves increases.

The objective of the present observation is as follows:

- (1) to measure quantitatively the overall degree of breaking of the sea surface, as well as the amount of the existence of sea water droplets on the sea surface, and to express these values as a function of the above mentioned Reynolds numbers;
- (2) to establish the production rate, and the way of vertical distribution, of sea water droplets near the sea surface, under various conditions of wind and waves, in order to obtain secure foundation for the estimation of the effect of these droplets on sea surface evaporation, as well as of the supply of sea-salt particles to the air above.

During the present cruise, about 50 runs of observations have been performed. Each run consists of the following items of observations.

(a) Photograph of the sea surface

In order to undertake a quantitative analysis of the overall degree of breaking of the sea surface, color pictures of the sea surface, including the horizon in each picture, have been taken from a fixed height of 14 m (the Comp. Bri. Deck). Reversal color film of 35 mm width has been used. The analysis is left for the future laboratory works.

(b) Sea water droplets

For the purpose of collecting sea-water droplets, two types of samplers have been used: one is the 3 mm-ribbon sampler, which is a revised type of the 5 mm-ribbon sampler used during the KH-69-3 Cruise and described by Toba and Chaen (1969), and the other is a hand operated impactor which was used during the same cruise (Toba and Tanaka, 1967). Fig. 7 shows the condition of the 3 mm-ribbon sampler being used at the foremost P. C. C.

As the sampling surface for the measurement of the mass of salt contained in each droplet, a halide-ion sensitive reagent film has been used, which was used also during the KH-69-3 Cruise (Toba and Tanaka, 1967). Fig. 8 shows an example of the microscopic photographs of halos developed by sea water droplets on the halide-ion sensitive film. Besides, a film coated with MgO has been used to measure the size of droplets at the collected instants, in order to compare the salt-mass distribution with the size distribution of the droplets.

The ribbon sampler collects effectively particles larger than 10^{-10} gm in the salt mass, and the hand-operated impactor collects particles larger than 10^{-11} gm in the salt-mass that exist abundantly above the sea surface. The salt-mass distributions, obtained by use of the both types of samplers during the last year's cruise, showed a very good continuation to give wide range salt-mass distribution curves. These results will be published elsewhere shortly.

The period of the present cruise is divided into 3 parts: from July 4 to July 5, from July 7 to July 13, and from July 16 to July 20. During the first and the third periods, simultaneous sampling by use of the ribbon sampler and of the impactor have been performed, at a height of about 6 m (the foremost P. C. C. or the nearest F. L. 's). During the second period, simultaneous samplings were performed at three heights of 13 m (Comp. Bri. Deck), 6 m and 4.5 m (the rear edge of Main Deck), by the use of either the ribbon samplers or the impactors, when the ship was

anchored at Station 1. Comparative simultaneous samplings of the 3 mm-ribbon sampler with the reagent film, the 5 mm-ribbon samplers with the reagent film and with the MgO film, and the hand-operated impactor have been performed several times.

The samples collected have been treated on board ship, and microscopic photographs have been taken for all reagent-film samples. The reading out and the analysis are left for the future laboratory works

(c') Period of wind waves and swells

Period of wind waves and swells have been measured by use of a stop watch, by watching some marks on the water surface such as bubbles entrained by wind waves. Several tens of waves have been measured and averaged for each run.

(d) Others

Wind speed, air temperature, dew point, and surface temperature have been read out, for each run, from meters or recorders furnished by the ship. Remarks of sea surface conditions, etc., have been watched and noted.

Although the analysis of data is left for future laboratory works, a few points are noted here.

When Typhoon 7002 hit Japanese coast on July 5, 1970, the ship was anchored in Osaka Bay, and the wind speed reached 18 m/sec blowing from the cross bay direction, without rain, before the dusk. We were able to perform observations in this conditions. So, during the present cruise, our observation have been able to cover a wide range of wind conditions from weaker than 2 m/sec. up to 18 m/sec.

Preliminary inspection of the samples on board ship shows a consistent trend with data of the KH-69-3 Cruise.

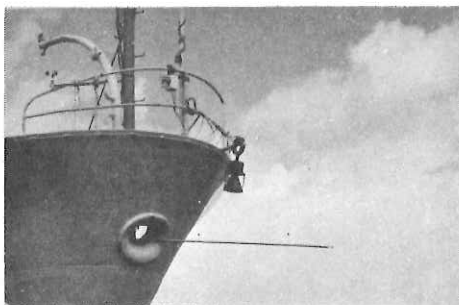


Fig. 7

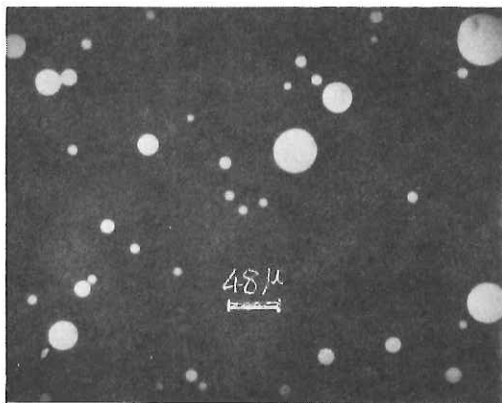


Fig. 8

5-1 Gravity Measurement at Sea in the KH-70-3 Cruise of the Hakuho Maru

by

Y. Tomoda and T. Igarashi

Throughout the KH 70-3 cruise of the Hakuho-maru, gravity was measured by T. S. S. G. at sea in the southwestern part of the Sea of Japan and the East China Sea. Two sets of T. S. S. G. were used and the data from the gravity meters were processed by use of an electronic computer Facom 270-20 of the ship. The data-processing method was the same as that used in the previous cruise and will not be described here. The position index map is shown in the track chart. Free air, Bouguer gravity anomalies and the bottom topography along the ship's track are shown in Fig. 9 and 10.

Fig. 9 shows free air, Bouguer gravity anomalies and bottom topography from Tokyo to Kagoshima along the outward voyage (see 3-2 track chart). The negative free air gravity anomalies at position index 70 July 06 represent the trough off Omaezaki. Amount of the negative free air gravity anomalies in the trough is not so large as expected from the bottom topography. The Bouguer gravity anomaly here is positive and amounts to about 250 mgals, suggesting the existence of thin oceanic crust under the trough. The positive free air gravity anomalies at position index 70 July 18 and the anomalies at position index 70 July 12 correspond to Shionomisaki and the Muroto peninsula. Free air gravity anomalies in these peninsulas are 110 mgals and 70 mgals respectively and Bouguer gravity anomalies are 180 mgals and 80 mgals respectively. At the position index 70 July 20 there is a remarkable negative anomaly and this corresponds to the gravimetric trench east of the Kyushu district. The minimum of -140 mgals lies just at the lowermost position of the continental slope there. The Bouguer anomaly is about -100 mgals there.

In the East China Sea it will be worth noticing that the correlation between the free air gravity anomalies and the bottom topography are not so clear, if we consider that the water depth is shallower than 500 m. As seen from the profile the Bouguer gravity anomaly is maximum at the northern part of Okinawa trough and amounts to about +70 mgals.

Fig. 10 shows free air, Bouguer and Bottom topography profiles from Kagoshima to back to Tokyo. In the profile from Kagoshima to the northern part of the Philippine Basin, (from position index 17 July 15 to 00 July 19), minimum free air anomaly of about -100 mgals lies at the continental shelf southeast of the Tanegashima Island. The horizontal extent of the gravimetric trench is not so large, and it is suggested that the negative is caused by the marginal effect of the continental crust. This also suggests that the crustal structure from continental one to oceanic one is very sharp and the region is quite isostatic unlike the northern part of the negative region. In the northern part of the Philippine Basin the free air gravity anomaly is smooth despite the rough bottom topography, and it is suggested that the small scale topographic unevenness in the region is isostatic. This characteristics are clearly seen in the Bouguer gravity anomalies profile as shown in Fig. 10. The Bouguer gravity anomalies are exactly a mirror image of the bottom topography. In the later part of the profile the ship often altered her course to complete a contoured map and the results will be discussed elsewhere.

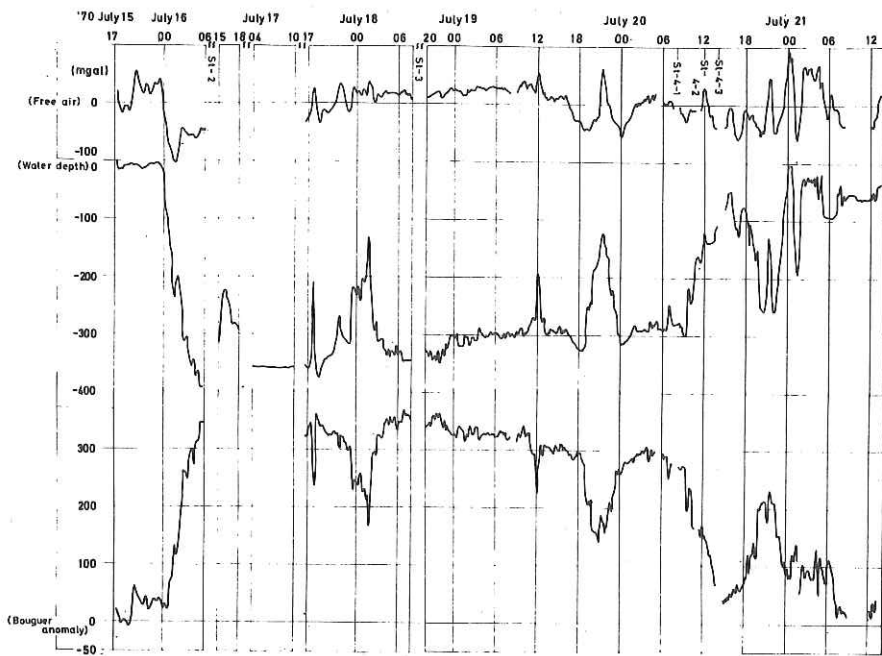


Fig. 9

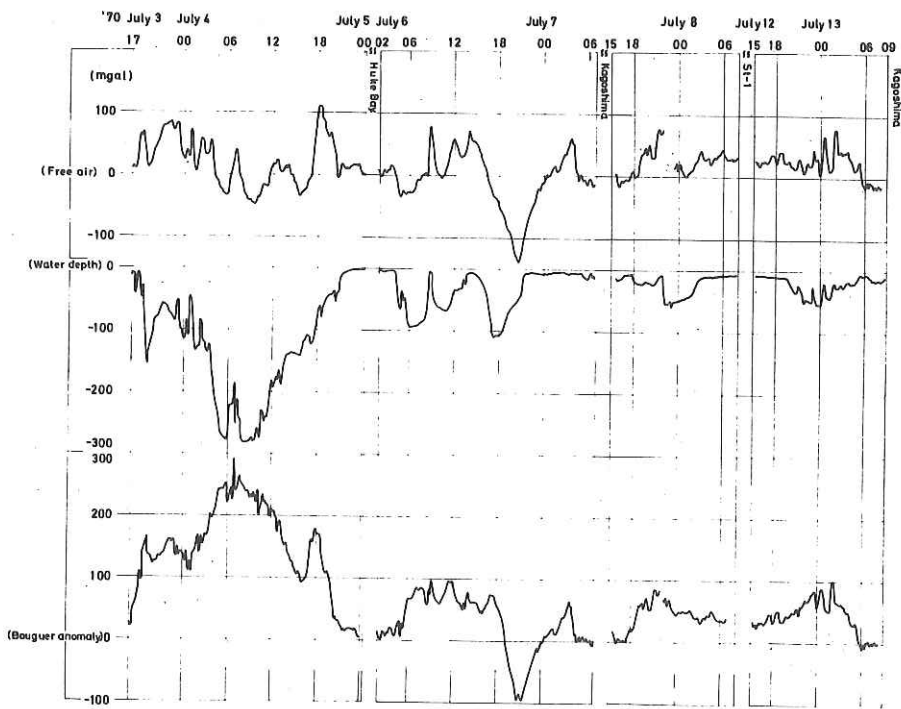


Fig. 10

by

S. Nakaya

The final goal of this study is to understand the exchange cycle of boron between the atmosphere and sea or in other words, to identify the source and sink of boron in the atmosphere.

Several workers reported that the B/Cl ratio in precipitation was higher than that in sea water. This was confirmed also by our observation made previously at Hokkaido, over the sea, Greenland and the Antarctic.

Since atmospheric matters are removed by precipitation, the above result may indicate that atmospheric boron originates not only from sea water droplets ejected from the sea surface, but also from air pollution and others, and boron may also evaporate from the sea surface, as reported by Gast and Thompson.

However, little is known about the concentration of boron in the atmosphere.

It is intended to measure the concentrations of boron and chloride and thereby to find the B/Cl ratio in the air over the sea surface. We intend also to measure the concentration of boron, chloride, calcium, magnesium, sodium and potassium in rainwater to find the ratios of B/Cl, Ca/Cl, Mg/Cl, Na/Cl and K/Cl.

Air was pumped at the rate of 2 l/min. 4 l/min. for 5-9 hours and boron was condensed in test tubes which were cooled -74°C by methyl alcohol saturated with dry ice. Chloride was collected in distilled water by bubbling air through glass bottles for 9 hours at the rate of 1.5 l/min.

Rainwater samples were collected by a 50 cm \times 50 cm collector installed on upper deck.

Totally, 5 rainwater samples and 20 air samples for boron and chloride were collected. After the cruise, boron and chloride will be analyzed by the spectrophotometric method, and calcium, magnesium, sodium, and potassium by the atomic absorption method at our laboratory in Hokkaido University.

The result of analysis will be published in near future.

* The results of KH-69-3 cruise was read at the Annual Meeting of the Chemical Society of Japan, 1970. 4, Tokyo

Appendix I
Routine Observation
Data

Denotations of some quantities and descriptions about the sensors of routine observation are tabulated at the end of Appendix I.
(page 59 and 60)

Date (1970)	Time (J. S. T.) GMT + 9hr	Position Lat. (North)	Long. (East)	Ship heading (°)	Ship speed (kt)	Depth (m): uncorrected	Remarks
July 3	15:00	-	-	-	-	-	14:00 left Tokyo
	16:00	35°-21.5'	139°-44.2'	-	-	-	
	17:00	35°-09.7'	139°-45.8'	194	12.9	230	a/c
	17:30	35°-03.1'	139°-44.1'	196	-	600	a/c
	17:53	34°-58.3'	139°-42.4'	180	-	75	a/c
	18:00	34°-56.8'	139°-42.4'	180	13.2	110	
	19:00	34°-42.9'	139°-42.5'	180	13.9	2100	
	20:00	34°-28.7'	139°-42.6'	180	14.2	1200	
	21:00	34°-14.4'	139°-43.0'	180	14.3	900	
	22:00	34°-01.2'	139°-45.5'	180	13.4	1050	
	22:29	33°-54.7'	139°-47.0'	234	-	1190	
	22:32	33°-54.2'	139°-46.6'	-	-	-	o/c
	23:00	33°-50.7'	139°-40.2'	234	13.6	820	
	23:11	33°-49.4'	139°-38.7'	-	-	750	
	23:20	33°-48.0'	139°-37.0'	-	-	1160	
	23:36	33°-46.2'	139°-34.5'	-	-	1620	
	23:54	33°-44.3'	139°-30.7'	-	-	1670	
July 4	00:00	33°-43.5'	139°-29.6'	246	11.3	1670	
	00:10	33°-42.6'	139°-27.5'	239	-	1550	a/c
	00:30	33°-40.9'	139°-23.5'	237	-	1600	a/c
	00:35	33°-40.0'	139°-22.2'	234	-	-	a/c
	00:41	33°-39.2'	139°-21.2'	-	-	1330	
	00:47	33°-38.5'	139°-20.0'	237	-	-	a/c
	00:53	33°-38.1'	139°-18.6'	245	-	660	a/c
	01:00	33°-37.3'	139°-17.5'	237	11.7	800	a/c
	01:30	33°-33.9'	139°-11.0'	-	-	1940	
	02:00	33°-30.4'	139°-05.1'	237	12.2	1850	
	02:30	33°-26.6'	138°-59.4'	-	-	1300	
	03:00	33°-23.8'	138°-53.6'	237	11.7	1950	
	03:20	33°-21.6'	138°-50.3'	270	-	1900	a/c
	04:00	33°-21.7'	138°-40.5'	-	-	2720	
	05:00	33°-22.3'	138°-25.8'	270	12.3	3880	
	06:00	33°-22.6'	138°-11.8'	270	11.7	3780	
	07:00	33°-23.4'	137°-58.2'	267	11.8	2660	a/c
	08:00	33°-23.5'	137°-47.0'	267	9.4	4070	
	09:00	33°-24.2'	137°-36.1'	262	9.2	4020	
	10:00	33°-23.0'	137°-26.5'	262	8.1	3750	
	11:00	33°-21.3'	137°-16.0'	267	9.1	3480	
	12:00	33°-20.4'	137°-04.5'	267	9.5	2820	
	13:00	33°-19.3'	136°-53.1'	267	9.6	2560	
	13:15	33°-18.9'	136°-49.6'	276	-	2400	a/c
	14:00	33°-19.8'	136°-40.7'	276	10.6	2050	
	15:00	33°-21.0'	136°-28.6'	270	10.0	2030	a/c
	16:00	33°-22.0'	136°-15.8'	270	10.7	1850	
	16:05	33°-22.3'	136°-15.0'	260	-	1720	a/c
	17:00	33°-19.3'	136°-03.6'	270	10.7	1770	a/c
	18:00	33°-21.0'	135°-51.7'	270	10.4	1000	
	18:30	33°-21.1'	135°-45.5'	294	-	1150	a/c

Atmospheric pressure (mb): sea level value	Air temperature (°C)	Dew pt. temperature (°C)	Sea surface temperature (°C)	Wind direction	Wind speed (m/s)	Cloud amount (10 grades)	Weather	Wind waves	Swells	Precipitation (mm): a preceding hour	Visibility	Date and time
-	-	-	21.7	S	3	-	bc	2	1	0	6	3/15:00
-	-	-	21.4	S	3	-	bc	2	1	0	6	16:00
-	-	-	19.9	S	4	-	c	2	1	0	7	17:00
-	-	-	-	-	-	-	-	-	-	-	-	17:30
-	-	-	19.6	SE	5	-	c	2	1	0	7	17:53
-	-	-	19.0	SE	2	-	c	2	1	0	7	18:00
1009.0	-	-	19.6	SE	3	-	c	3	2	0	6	19:00
1009.0	-	-	20.1	E	4.5	-	c	3	2	0	7	20:00
1009.0	-	-	-	-	-	-	-	-	-	0	-	21:00
1009.4	-	-	-	-	-	-	-	-	-	-	-	22:00
1009.4	-	-	-	-	-	-	-	-	-	-	-	22:29
1009.5	-	-	-	-	-	-	-	-	-	-	-	22:32
1009.0	-	-	24.8	SSE	4	-	bc	3	3	0	7	23:00
1009.3	-	-	-	-	-	-	-	-	-	-	-	23:11
1009.2	-	-	-	-	-	-	-	-	-	-	-	23:20
1009.0	-	-	-	-	-	-	-	-	-	-	-	23:36
1009.0	-	-	-	-	-	-	-	-	-	-	-	23:54
1009.0	27.6	24.3	25.8	SSE	4.5	-	bc	3	3	0	7	4/00:00
1008.8	28.5	24.0	-	-	-	-	-	-	-	-	-	00:10
1008.6	28.3	23.1	-	-	-	-	-	-	-	-	-	00:30
1008.5	28.3	22.7	-	-	-	-	-	-	-	-	-	00:35
1008.3	28.0	22.3	-	-	-	-	-	-	-	-	-	00:41
1008.1	28.2	22.3	-	-	-	-	-	-	-	-	-	00:47
1008.0	28.0	22.2	-	-	-	-	-	-	-	-	-	00:53
1008.0	28.1	22.2	25.1	SE	4	-	bc	3	3	0	7	01:00
1007.5	29.1	23.0	-	-	-	-	-	-	-	-	-	01:30
1007.5	29.5	23.5	25.6	SE	4	-	c	3	3	0	7	02:00
1007.0	29.4	24.0	-	-	-	-	-	-	-	-	-	02:30
1007.0	29.0	24.0	25.6	S	4	-	o	3	3	0.0	7	03:00
1007.0	29.1	24.5	-	-	-	-	-	-	-	-	-	03:20
1007.0	30.3	24.7	25.1	S	5	-	c	3	3	0.0	7	04:00
1006.4	30.7	25.2	24.5	SSE	4.5	-	o	3	2	0.0	6	05:00
1006.3	30.8	25.4	25.9	SSE	4.5	-	r	3	2	0.0	7	06:00
1006.2	30.7	25.0	27.8	S	5.5	-	r	3	2	0.0	7	07:00
1006.2	30.0	24.8	25.9	S	5.5	-	r	3	2	0.0	7	08:00
1006.8	28.9	24.2	26.5	S	5	-	r	3	2	0.0	6	09:00
1006.1	27.0	24.8	26.3	SE	7	-	r	3	3	2.1	5	10:00
1006.1	29.4	25.5	25.9	SE	7	-	r	3	3	0.0	5	11:00
1006.0	27.0	24.3	25.5	S	4	-	r	3	4	0.0	6	12:00
1005.8	26.0	24.9	25.9	SSE	4	-	r	3	4	4.2	6	13:00
1005.9	27.0	25.1	-	-	-	-	-	-	-	-	-	13:15
1005.0	26.7	25.2	25.4	SE	6	-	r	3	4	11.2	6	14:00
1004.0	25.0	24.3	26.0	S	4	-	r	3	4	9.6	6	15:00
1004.1	25.0	24.8	26.3	N	3	-	c	3	4	0.0	6	16:00
1004.0	26.0	25.0	-	-	-	-	-	-	-	-	-	16:05
1004.0	26.4	24.4	26.3	N	2.5	-	r	3	4	0.2	6	17:00
1004.0	25.2	24.3	25.8	NNE	3.5	-	r	3	4	0.3	6	18:00
1003.9	24.8	23.8	-	-	-	-	-	-	-	-	-	18:30

Date (1970)	Time (J. S. T.) GMT + 9hr	Position Lat. (North)	Long. (East)	Ship heading (°)	Ship speed (kt)	Depth (m): uncorrected	Remarks
July 4	19:00	33°-23.5'	135°-39.3'	294	11.1	770	
	19:33	33°-26.9'	135°-31.8'	287	—	640	a/c
	20:00	33°-28.2'	135°-25.7'	294	12.4	600	a/c
	20:20	33°-29.8'	135°-21.3'	316	—	550	a/c
	20:28	33°-31.2'	135°-19.4'	—	—	800	
	21:00	33°-36.2'	135°-13.6'	316	13.1	280	
	22:00	33°-46.7'	135°-02.0'	316	14.3	80	
	22:13	33°-49.2'	134°-59.4'	360	—	70	a/c
	22:30	33°-52.7'	134°-58.6'	—	—	50	
	23:00	34°-00.0'	134°-59.2'	(000)	14.2	20	
July 5	00:00	34°-14.6'	134°-59.4'	(000)	14.6	20	
	00:10	34°-16.9'	134°-59.4'	30	—	20	a/c
	00:30	34°-20.5'	135°-02.3'	—	—	20	
	01:00	—	—	—	11.8		01:05 anchored at Fuke-kō
	02:00	34°-22.0'	135°-08.2'	—	0		(typhoon 7002)
	03:00						
	04:00						
	05:00						
	06:00						
	07:00						
	08:00						
	09:00						
	10:00						
	11:00						
	12:00						
	13:00						
	14:00						
	15:00						
	16:00						
	17:00						
	18:00						
19:00							
20:00							
21:00							
22:00							
23:00							
July 6	00:00						00:50 left Fuke-kō
	01:00						
	01:44	34°-16.9'	134°-59.3'	186	—	—	s/c
	01:50	34°-15.5'	134°-59.1'	—	—	90	
	02:00	34°-13.2'	134°-58.9'	186	—	65	
	02:30	34°-06.5'	134°-58.0'	—	—	74	
	03:00	34°-00.3'	134°-57.5'	187	13.0	70	a/c
	03:30	33°-53.8'	134°-56.5'	—	—	75	
	04:00	33°-47.6'	134°-55.1'	186	12.8	80	a/c
	05:00	33°-35.4'	134°-53.0'	186	12.4	550	
05:45	33°-26.5'	134°-51.7'	248	—	1080	a/c	
06:00	33°-25.0'	134°-49.0'	248	11.7	1380		

Atmospheric pressure (mb): sea level value	Air temperature (°C)	Dew pt. temperature (°C)	Sea surface temperature (°C)	Wind direction	Wind speed (m/s)	Cloud amount (10 grades)	Weather	Wind waves	Swells	Precipitation (mm): a preceding hour	Visibility	Date and time
1003.8	24.5	24.0	24.8	NNE	5.5	-	o	3	4	0.1	6	4/19:00
1003.5	25.5	24.8	-	-	-	-	-	-	-	-	-	19:33
1003.0	25.3	25.4	24.9	ENE	3.5	-	o	3	3	0.0	6	20:00
1002.9	25.3	25.3	-	-	-	-	-	-	-	-	-	20:20
1003.0	26.0	25.3	-	-	-	-	-	-	-	-	-	20:28
1002.1	27.0	25.7	24.9	ESE	5	-	o	3	3	0.0	6	21:00
1001.9	26.1	25.4	24.2	SE	7	-	c	3	3	0.0	6	22:00
1001.7	26.0	25.4	-	-	-	-	-	-	-	-	-	22:13
1001.5	26.7	24.9	-	-	-	-	-	-	-	-	-	22:30
1001.0	26.0	24.7	24.5	SE	8	-	c	3	3	0.0	6	23:00
1000.8	29.8	24.5	22.4	ESE	5	-	bc	3	3	0.0	7	5/00:00
1000.5	29.4	24.0	-	-	-	-	-	-	-	-	-	00:10
1000.1	25.9	24.5	-	-	-	-	-	-	-	-	-	00:30
1000.0	25.1	24.8	21.0	E	3.5	-	bc	2	2	0.0	5	01:00
999.0	28.0	25.4	22.2	E	4.5	-	c	-	-	0.0	5	02:00
998.0	25.4	23.5	21.1	ENE	5	-	c	-	-	0.0	6	03:00
997.2	24.7	23.7	20.9	ENE	3.5	-	c	-	-	0.0	6	04:00
996.2	24.5	23.0	21.0	ENE	4	-	c	-	-	0.0	-	05:00
995.5	25.2	23.2	21.2	ENE	5	-	c	-	-	0.0	-	06:00
994.6	28.9	23.9	21.0	ENE	7	-	o	-	-	0.0	-	07:00
994.0	29.0	23.7	21.4	ENE	6	-	o	-	-	0.0	-	08:00
992.2	30.0	23.7	21.3	NE	8	-	c	-	-	0.0	-	09:00
991.5	27.5	23.0	21.3	NE	9	-	c	-	-	0.0	-	10:00
989.0	28.2	23.0	21.3	NE	10	-	c	-	-	0.0	-	11:00
988.0	27.0	22.5	21.1	NE	10	-	c	-	-	0.0	-	12:00
987.0	26.4	21.9	22.0	NE	12.5	-	c	-	-	0.0	-	13:00
985.1	25.6	21.4	21.4	NE	12	-	c	-	-	0.0	-	14:00
984.0	26.0	21.7	21.3	NE	13	-	c	-	-	0.0	-	15:00
983.0	26.0	21.4	21.2	NE	17	-	o	-	-	0.0	-	16:00
981.2	25.5	21.3	21.0	NNE	13	-	o	-	-	0.0	-	17:00
980.0	26.0	21.2	21.0	NE	20	-	r	-	-	0.0	-	18:00
978.5	23.4	21.0	21.0	NE	19.5	-	r	-	-	0.0	-	19:00
976.8	23.0	21.0	21.0	NE	25	-	r	-	-	0.1	-	20:00
975.0	21.8	21.8	21.7	NE	25	-	r	-	-	2.3	-	21:00
976.0	21.3	22.3	20.7	NE	20	-	r	-	-	3	-	22:00
978.0	23.8	23.2	20.8	SE	19	-	o	-	-	2.8	-	23:00
982.0	22.0	22.3	20.8	S	19	-	r	-	-	-	-	6/00:00
986.0	22.1	22.5	20.7	S	14.5	-	r	5	3	2	6	01:00
987.2	21.3	21.6	-	-	-	-	-	-	-	-	-	01:44
987.9	21.9	21.8	-	-	-	-	-	-	-	-	-	01:50
988.3	22.8	22.0	21.4	S	13	-	o	5	3	0.0	7	02:00
988.9	23.6	22.6	-	-	-	-	-	-	-	-	-	02:30
989.5	23.5	22.6	23.8	ESE	7	-	r	3	3	0.0	7	03:00
990.0	23.5	22.6	-	-	-	-	-	-	-	-	-	03:30
990.8	23.6	23.0	24.1	E	6	-	o	4	4	0.0	7	04:00
991.0	23.0	22.1	23.3	SSW	3.5	-	c	3	4	0.0	7	05:00
991.0	23.2	21.0	-	-	-	-	-	-	-	-	-	05:45
991.3	23.2	20.3	23.3	SW	8	-	c	3	4	0.0	7	06:00

Date (1970)	Time (J. S. T.) GMT + 9hr	Position Lat. (North)	Long. (East)	Ship heading (°)	Ship speed (kt)	Depth (m): uncorrected	Remarks
July 6	06:40	33°-21.7'	134°-40.9'	255	—	1380	a/c
	07:00	33°-20.3'	134°-36.2'	255	11.8	1370	
	08:00	33°-16.1'	134°-22.5'	—	12.2	1220	
	08:40	33°-12.6'	134°-12.8'	—	—	250	
	08:44	33°-12.3'	134°-11.8'	241	—	—	a/c Pt. Muroto
	08:50	33°-11.6'	134°-10.3'	—	—	82	
	09:00	33°-10.5'	134°-07.8'	241	13.6	110	
	10:00	33°-04.2'	133°-53.2'	239	13.8	900	a/c
	11:00	32°-57.5'	133°-39.2'	239	13.6	990	
	12:00	32°-51.7'	133°-28.5'	241	10.8	560	
	12:30	32°-48.6'	133°-22.7'	—	—	500	
	12:40	32°-47.4'	133°-20.2'	244	—	460	a/c
	13:00	32°-45.6'	133°-15.8'	244	12.4	470	
	13:30	32°-42.5'	133°-08.6'	—	—	360	
	13:40	32°-41.5'	133°-06.2'	—	—	150	
	13:46	32°-41.0'	133°-05.0'	266	—	—	a/c
	13:50	32°-40.8'	133°-04.2'	—	—	120	
	14:00	32°-40.6'	133°-02.4'	—	13.2	100	
	14:20	32°-39.8'	132°-56.1'	—	—	90	
	14:30	32°-40.0'	132°-54.0'	—	—	90	
	15:00	32°-40.0'	132°-47.8'	264	11.8	140	a/c
	16:00	32°-38.8'	132°-33.0'	221	12.4	390	a/c
	17:00	32°-29.5'	132°-24.6'	221	11.4	1450	
	18:00	32°-20.7'	132°-15.3'	221	12.0	1575	
	19:00	32°-11.7'	132°-05.0'	221	12.4	1190	
	20:00	32°-01.6'	131°-55.7'	221	12.8	870	
	21:00	31°-51.4'	131°-46.7'	221	12.9	580	
22:00	31°-41.1'	131°-37.1'	221	13.1	100		
22:30	31°-36.2'	131°-31.9'	205	—	90	a/c	
23:00	31°-30.5'	131°-29.0'	205	12.8	100		
23:55	31°-20.1'	131°-23.0'	235	—	120		
July 7	00:00	31°-19.4'	131°-21.9'	235	12.8	120	
	01:00	31°-11.3'	131°-09.0'	—	—	100	
	02:00	31°-03.6'	130°-57.0'	240	13.0	80	a/c
	03:00	30°-57.7'	130°-45.1'	—	—	90	
	03:05	30°-57.2'	130°-45.2'	250	10.0	—	a/c
	03:19	30°-56.3'	130°-42.1'	295	—	120	a/c
	03:37	30°-57.7'	130°-38.6'	346	—	—	a/c
	03:40	30°-58.3'	130°-38.6'	—	—	75	
	04:00	31°-02.5'	130°-38.4'	355	11.7	80	
	04:08	31°-04.6'	130°-38.3'	27	—	75	a/c
	04:30	31°-08.9'	130°-40.6'	30	—	100	a/c
	04:54	31°-13.8'	130°-43.9'	338	—	90	a/c
	05:00	31°-15.1'	130°-43.3'	338	13.9	100	
	05:30	31°-21.7'	130°-40.0'	—	—	210	
	06:00	31°-28.2'	130°-36.8'	—	14.2	220	
	06:12	31°-30.9'	130°-35.7'	165	—	100	a/c
	06:44	31°-24.3'	130°-37.7'	345	—	150	a/c
07:00	31°-27.6'	130°-36.5'	345	13.1	230		

Atmospheric pressure (mb): sea level value	Air temperature (°C)	Dew pt. temperature (°C)	Sea surface temperature (°C)	Wind direction	Wind speed (m/s)	Cloud amount (10 grades)	Weather	Wind waves	Swells	Precipitation (mm): a preceding hour	Visibility	Date and time
992.5	23.1	20.0	-	-	-	-	-	-	-	-	-	6/06:40
992.7	23.2	20.0	23.0	SW	7	-	c	3	4	0.0	7	07:00
993.0	23.3	19.5	23.5	W	8	-	o	4	4	0.0	7	08:00
994.2	22.8	19.7	-	-	-	-	-	-	-	-	-	08:40
994.2	22.7	19.3	-	-	-	-	-	-	-	-	-	08:44
994.5	22.8	19.0	-	-	-	-	-	-	-	-	-	08:50
994.8	22.8	19.3	22.1	W	8	-	c	4	4	0.0	8	09:00
995.0	23.5	18.3	23.1	W	10.5	-	bc	4	4	0.0	8	10:00
995.8	24.0	19.3	22.9	SW	8.5	-	bc	4	4	0.0	8	11:00
995.8	24.5	19.2	23.1	SW	10.5	-	bc	3	4	0.0	8	12:00
995.8	24.4	19.4	-	-	-	-	-	-	-	-	-	12:30
995.9	24.4	19.3	-	-	-	-	-	-	-	-	-	12:40
995.3	24.2	19.5	23.3	SW	9	-	bc	3	4	0.0	8	13:00
996.0	24.1	19.5	-	-	-	-	-	-	-	-	-	13:30
996.0	24.2	19.5	-	-	-	-	-	-	-	-	-	13:40
996.0	24.2	20.0	-	-	-	-	-	-	-	-	-	13:46
996.0	24.3	20.0	-	-	-	-	-	-	-	-	-	13:50
996.0	24.2	20.0	23.8	SW	4	-	bc	3	3	0.0	8	14:00
996.3	24.3	20.2	-	-	-	-	-	-	-	-	-	14:20
996.2	24.7	19.9	-	-	-	-	-	-	-	-	-	14:30
996.2	25.0	19.2	24.8	SW	5	-	b	2	2	0.0	8	15:00
996.5	25.7	20.0	24.8	SW	4	-	b	1	2	0.0	8	16:00
996.5	26.9	20.5	26.2	S	3.3	-	b	1	2	0.0	8	17:00
996.7	25.3	22.8	26.2	S	3.3	-	b	1	2	0.0	8	18:00
997.5	25.0	21.0	23.7	W	4	-	b	1	2	0.0	8	19:00
998.0	25.0	20.5	23.4	WSW	7	-	b	2	2	0.0	8	20:00
999.5	24.3	20.5	23.8	WSW	10	-	b	3	2	0.0	8	21:00
1000.5	23.8	19.8	23.3	SW	10	-	b	3	3	0.0	7	22:00
1001.0	23.1	19.5	-	-	-	-	-	-	-	-	-	22:30
1001.5	22.7	20.1	23.3	W	10.5	-	b	3	3	0.0	7	23:00
1001.5	22.3	20.0	-	-	-	-	-	-	-	-	-	23:55
1001.9	22.5	19.9	22.8	W	8	-	b	3	3	0.0	7	7/00:00
1002.3	21.9	20.2	22.6	WSW	5	-	b	2	2	0.0	7	01:00
1001.0	22.7	21.4	21.0	WSW	5	-	b	2	1	0.0	7	02:00
1001.8	21.9	21.3	22.5	W	6	-	b	2	1	0.0	7	03:00
1001.9	21.9	21.5	-	-	-	-	-	-	-	-	-	03:05
1001.9	22.0	21.9	-	-	-	-	-	-	-	-	-	03:19
1001.6	22.9	22.1	-	-	-	-	-	-	-	-	-	03:37
1001.6	22.7	22.2	-	-	-	-	-	-	-	-	-	03:40
1001.8	22.8	22.0	23.4	NNE	5	-	bc	2	1	0.0	7	04:00
1001.7	22.5	22.0	-	-	-	-	-	-	-	-	-	04:08
1002.0	23.0	22.1	-	-	-	-	-	-	-	-	-	04:30
1002.0	23.2	22.2	-	-	-	-	-	-	-	-	-	04:54
1002.1	22.8	21.1	24.4	NNE	1	-	c	1	1	0.0	7	05:00
1002.7	22.3	21.6	-	-	-	-	-	-	-	-	-	05:30
1002.8	23.0	21.5	24.5	ENE	3	-	bc	1	1	0.0	7	06:00
1002.9	23.0	21.8	-	-	-	-	-	-	-	-	-	06:12
1003.0	23.1	22.0	-	-	-	-	-	-	-	-	-	06:44
1003.2	23.5	22.1	24.7	ENE	3	-	bc	1	1	-	7	07:00

Date (1970)	Time (J. S. T.) GMT + 9hr	Position Lat. (North)	Long. (East)	Ship heading (°)	Ship speed (kt)	Depth (m): uncorrected	Remarks
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July 7	08:00						08:35 arrived at Kagoshima
	12:00				0		
	15:00						left Kagoshima
	15:28	31°-30.1'	130°-36.3'	160	—		s/c
	16:00	31°-24.7'	130°-39.2'	160	—	224	
	16:35	31°-16.9'	130°-42.5'	180	—	162	a/c
	16:58	31°-12.0'	130°-42.9'	215	—	97	a/c
	17:00	31°-11.7'	130°-42.6'	215	13.5	110	
	17:36	31°-05.2'	130°-37.3'	273	—	90	a/c
	18:00	31°-05.4'	130°-31.5'	282	13.0	260	a/c
	19:00	31°-08.7'	130°-15.7'	282	14.1	320	
	20:00	31°-12.1'	130°-00.5'	282	13.6	300	
	21:00	31°-15.3'	129°-45.1'	276	13.7	230	
22:00	31°-17.5'	129°-30.3'	276	13.0	720		
23:00	31°-20.3'	129°-15.0'	274	13.5	850		

July 8	00:00	31°-22.7'	128°-59.5'	274	13.2	710	
	00:30	31°-23.9'	128°-52.5'	270	—	680	s/c
	01:00	31°-24.6'	128°-44.5'	270	13.2	650	
	02:00	31°-25.9'	128°-29.7'	270	12.7	500	
	03:00	31°-26.0'	128°-15.2'	270	12.5	160	
	03:35	31°-25.6'	128°-07.1'	275	—	150	a/c
	04:00	31°-25.6'	128°-00.0'	275	13.0	140	
	05:00	31°-26.8	127°-44.8'	275	13.0	130	
	06:00	31°-27.9'	127°-29.5'	275	13.0	125	
	07:00	31°-28.3'	127°-14.0'	275	13.5	110	
	07:30	31°-28.8'	127°-06.5'	283	—	100	a/c 07:55 stop eng.
	08:00	31°-29.9'	126°-59.0'	—	12.2	105	08:11 anchored at the fixed station.
	09:00	31°-29.5'	126°-59.5'	—	—	—	
	10:00				0		
	11:00						
	12:00						
	13:00						
	14:00						
	15:00						
16:00							
17:00							
18:00							
19:00							
20:00							
21:00							
22:00							
23:00							

July 9	00:00	31°-29.5'	126°-59.5'		0		
	01:00						
	02:00						
	03:00						
	04:00						
	05:00						

Atmospheric pressure (mb): sea level value	Air temperature (°C)	Dew pt. temperature (°C)	Sea surface temperature (°C)	Wind direction	Wind speed (m/s)	Cloud amount (10 grades)	Weather	Wind waves	Swells	Precipitation (mm): a preceding hour	Visibility	Date and time
1003.9	22.6	21.3	23.2	N	2	-	bc	1	1	-	7	7/08:00
1003.5	25.9	23.4	23.9	SE	3	-	c	-	-	-	-	12:00
1003.9	25.7	23.8	-	-	-	-	-	-	-	-	-	15:00
1002.8	25.3	23.0	-	-	-	-	-	-	-	-	-	15:28
1003.3	25.4	23.8	25.0	SSE	3	-	r	1	1	-	7	16:00
1003.0	26.0	22.0	-	-	-	-	-	-	-	-	-	16:35
1002.3	26.1	22.0	-	-	-	-	-	-	-	-	-	16:58
1002.0	26.0	22.1	24.5	SSE	6	-	o	2	1	-	7	17:00
1002.0	25.0	22.0	-	-	-	-	-	-	-	-	-	17:36
1002.0	24.5	20.0	22.9	SE	8	-	o	4	2	-	7	18:00
1002.1	23.9	20.9	22.9	SE	8	-	o	4	2	-	7	19:00
1002.5	-	-	23.2	SE	12	-	o	4	2	-	7	20:00
1002.2	-	-	23.4	SSE	12	-	o	4	3	-	7	21:00
1001.5	-	-	23.1	SE	13	-	c	4	3	-	7	22:00
1002.0	-	-	23.6	SE	11	-	r	4	3	-	7	23:00
1001.0	-	-	23.7	SE	11	-	r	4	3	-	6	8/00:00
999.0	-	-	-	-	-	-	-	-	-	-	-	00:30
1000.2	-	-	23.6	S	8	-	r	4	3	-	7	01:00
1000.3	-	-	24.2	W	7	-	bc	4	3	-	7	02:00
1000.1	-	-	24.2	W	7	-	bc	4	3	-	7	03:00
1000.5	-	-	-	-	-	-	-	-	-	-	-	03:35
1000.8	-	-	24.5	W	7	-	bc	4	3	-	7	04:00
1001.0	-	-	23.7	W	3	-	bc	4	3	-	7	05:00
1002.0	-	-	23.8	WSW	5	-	bc	4	3	-	8	06:00
1002.2	-	-	23.2	WSW	6	-	bc	4	3	-	8	07:00
1002.5	-	-	-	-	-	-	-	-	-	-	-	07:30
1002.9	-	-	23.0	W	6	-	bc	4	3	-	8	08:00
1003.5	22.1	20.0	22.8	W	5	-	bc	3	3	-	8	09:00
1004.0	22.9	20.1	22.7	W	5.5	-	bc	3	3	-	8	10:00
1004.0	22.9	19.8	22.7	W	5	-	bc	3	3	-	8	11:00
1003.9	23.0	19.5	22.9	W	4.5	-	bc	2	3	-	8	12:00
1004.0	23.0	18.2	23.2	W	5	-	bc	2	3	-	8	13:00
1003.9	22.8	19.2	23.0	W	4	-	bc	2	3	-	8	14:00
1004.2	22.3	19.1	23.1	W	5	5	bc	2	2	-	8	15:00
1004.3	21.9	19.1	23.3	W	4	-	bc	2	2	-	8	16:00
1004.1	21.9	18.9	23.2	WSW	3	-	bc	2	2	-	8	17:00
1004.1	21.6	19.0	23.1	SW	2	5	bc	2	2	-	8	18:00
1004.1	21.5	18.7	23.2	WSW	2	-	b	2	2	-	8	19:00
1004.0	21.5	19.2	23.2	SW	2	-	b	2	2	-	8	20:00
1004.1	21.5	19.2	23.3	WSW	3	-	b	2	2	-	8	21:00
1004.2	21.5	19.2	23.5	SW	4	-	b	2	2	-	8	22:00
1004.3	21.3	19.5	23.5	WSW	4	-	b	2	2	-	8	23:00
1004.2	21.3	19.8	23.5	WSW	4	-	b	2	2	-	8	9/00:00
1004.3	21.5	19.8	23.4	W	4	-	b	2	2	-	8	01:00
1004.0	21.5	19.8	23.6	W	3	-	c	2	2	-	7	02:00
1003.9	21.5	19.8	23.0	W	3	9	c	2	1	-	7	03:00
1003.9	21.5	20.0	23.0	W	3	-	c	2	1	-	7	04:00
1003.9	21.8	20.1	23.0	SW	2	-	c	2	1	-	7	05:00

Date (1970)	Time (J. S. T.) GMT + 9hr	Position Lat. (North)	Long. (East)	Ship heading (°)	Ship speed (kt)	Depth (m): uncorrected	Remarks
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July 9

06:00
07:00
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July 10

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21:00
22:00
23:00

31°-29.5' 126°-59.5'

31°-29.9' 126°-59.0'

0

08:00 10:00 anchor reset

0

July 11

00:00
01:00
02:00
03:00
04:00

31°-29.9' 126°-59.0'

0

Atmospheric pressure (mb): sea level value	Air temperature (°C)	Dew pt. temperature (°C)	Sea surface temperature (°C)	Wind direction	Wind speed (m/s)	Cloud amount (10 grades)	Weather	Wind waves	Swells	Precipitation (mm): a preceding hour	Visibility	Date and time
1004.0	22.0	20.5	23.0	SW	2	6	c	2	1	-	8	9/06:00
1004.6	-	-	23.0	SW	3	-	c	2	1	-	8	07:00
1004.8	-	-	23.2	SW	5	-	c	2	1	-	8	08:00
1004.8	23.0	21.0	23.3	SSW	3	5	c	2	1	-	8	09:00
1004.5	23.0	21.6	23.5	SW	4	-	c	2	1	-	8	10:00
1004.5	23.3	21.9	23.4	WSW	4	-	bc	2	1	-	8	11:00
1004.0	23.5	22.0	23.6	WSW	3.5	7	c	2	2	-	8	12:00
1003.9	23.3	22.1	23.4	WSW	3	-	bc	2	2	-	8	13:00
1004.1	23.7	22.0	23.4	WSW	2	-	bc	1	2	-	8	14:00
1004.5	25.0	21.8	23.2	SSW	3	6	c	2	2	-	8	15:00
1004.5	25.0	21.1	23.3	SSW	3	-	bc	2	2	-	8	16:00
1003.7	24.0	21.0	23.4	SSW	2	-	bc	2	2	-	8	17:00
1003.4	23.7	21.0	23.3	SSW	2	5	bc	2	2	-	8	18:00
1003.3	23.7	21.0	23.1	Calm	0	-	bc	1	1	-	8	19:00
1003.5	-	-	23.4	Calm	0	-	bc	1	1	-	8	20:00
1003.5	-	-	23.2	Calm	0	3	bc	1	1	-	8	21:00
1003.6	-	-	23.3	ENE	2	-	bc	1	1	-	8	22:00
1003.3	-	-	23.3	ENE	2	-	c	1	1	-	7	23:00
1003.4	23.6	22.1	23.5	ENE	4	8	c	1	1	-	7	10/00:00
1003.0	23.8	22.1	23.6	E	3	-	c	1	1	-	7	01:00
1003.3	24.4	23.1	23.6	SEE	3.5	-	c	1	1	-	7	02:00
1003.2	24.0	23.0	23.5	SE	5.5	7	c	1	1	-	6	03:00
1003.2	23.6	22.9	23.5	SE	5.5	-	c	2	1	-	6	04:00
1003.0	24.0	23.4	23.5	SE	5	-	c	2	1	-	6	05:00
1003.6	23.9	24.0	23.4	ESE	4	8	o	2	1	-	7	06:00
1003.6	24.0	24.3	23.5	ESE	4	-	r	2	1	-	7	07:00
1003.6	23.5	23.8	23.5	ESE	4	-	r	2	1	-	7	08:00
1003.6	23.9	24.0	23.5	ESE	5	-	o	2	1	-	7	09:00
1003.5	24.1	24.0	23.5	E	7	-	r	2	1	-	7	10:00
1003.5	24.0	23.7	23.5	E	7	-	r	2	2	-	7	11:00
1003.0	24.4	23.6	23.6	ESE	9.5	8	r	2	2	-	7	12:00
1002.5	24.3	24.2	23.7	ESE	6	-	r	2	2	-	7	13:00
1002.2	24.2	24.3	23.6	ESE	5.5	-	o	2	2	-	7	14:00
1004.0	24.1	24.9	23.8	E	6	8	r	3	2	-	6	15:00
1002.0	23.0	23.8	23.8	E	8	-	r	3	2	0.7	6	16:00
1002.1	23.0	23.9	23.8	E	7	-	r	3	2	12.3	4	17:00
1002.1	22.7	23.9	23.9	ENE	7	8	r	3	2	11.6	6	18:00
1002.5	22.0	23.0	24.4	NNE	5	-	r	3	2	13.3	4	19:00
1002.0	22.6	23.0	24.0	N	7.5	-	r	3	2	14.3	5	20:00
1003.0	22.4	23.0	24.0	N	10	8	r	3	2	1.2	5	21:00
1001.5	22.9	23.2	23.9	NE	7	-	r	3	2	2.2	5	22:00
1001.5	23.1	23.7	23.9	NE	10	-	r	3	2	0.3	6	23:00
1001.1	23.0	23.3	23.8	NNE	9	8	r	3	2	1.4	6	11/00:00
1001.0	22.6	22.6	23.8	ENE	8	-	o	3	2	0.2	6	01:00
1002.0	22.5	22.5	23.7	NE	5	-	r	3	2	0.25	6	02:00
1002.4	22.5	22.7	23.7	Calm	0	8	o	2	2	0.25	6	03:00
1002.5	22.9	22.5	23.6	Calm	0	-	c	1	2	0.0	7	04:00

Date (1970)	Time (J. S. T.) GMT + 9hr	Position Lat. (North)	Long. (East)	Ship heading (°)	Ship speed (kt)	Depth (m): uncorrected	Remarks
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July 11 05:00
06:00
07:00
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13:00
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20:00
21:00
22:00
23:00

July 12 00:00 31°-29.9' 126°-59.0'
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
15:15 31°-31.5' 127°-00.0' 110 110
16:00 31°-28.8' 127°-10.8' 110 — 115
16:30 31°-27.3' 127°-18.5' 116 — 120
17:00 31°-25.3' 127°-26.2' 116 13.7 130
18:00 31°-20.8' 127°-42.1' 116 14.3 135
19:00 31°-16.2' 127°-57.8' 116 14.3 150
19:30 31°-14.1' 128°-05.7' 120 — 155
20:00 31°-11.0' 128°-13.2' 120 14.3 310
21:00 31°-05.2' 128°-27.5' 120 13.6 330
22:00 30°-57.0' 128°-40.8' 110 14.1 675
23:00 30°-54.6' 128°-58.0' 110 15.0 380

14:58 left the fixed station

July 13 00:00 30°-49.8' 129°-13.8' 120 14.2 790
00:45 30°-45.2' 129°-26.0' 95 — —

Atmospheric pressure (mb): sea level value	Air temperature (°C)	Dew pt. temperature (°C)	Sea surface temperature (°C)	Wind direction	Wind speed (m/s)	Cloud amount (10 grades)	Weather	Wind waves	Swells	Precipitation (mm): a preceding hour	Visibility	Date and time
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1003.6	23.2	22.4	23.6	NW	7	-	c	1	2	0.0	8	11/05:00
1004.7	22.5	22.0	23.4	NW	7	6	c	2	2	0.0	8	06:00
1005.1	23.0	21.3	23.5	NNW	6	-	c	3	3	0.0	8	07:00
1004.5	23.5	21.0	23.4	N	7	-	c	4	2	-	8	08:00
1005.0	23.0	21.1	23.5	N	5	-	c	3	2	-	8	09:00
1004.8	23.1	21.1	23.5	N	7	-	o	3	2	-	7	10:00
1004.3	23.0	21.2	23.6	NE	6	-	c	3	2	-	7	11:00
1004.5	23.0	21.4	23.5	NE	6.5	6	c	3	2	-	8	12:00
1005.0	23.0	21.6	23.5	NE	5.5	-	c	3	3	-	8	13:00
1005.0	23.0	21.9	23.7	E	3	-	c	3	3	-	7	14:00
1005.9	23.0	22.2	23.8	E	2	8	c	3	3	-	8	15:00
1006.2	23.0	22.3	23.1	E	3	-	c	3	3	-	8	16:00
1006.7	23.0	22.5	24.2	Calm	0	-	r	3	3	-	7	17:00
1007.5	23.0	22.6	24.2	SE	2	7	o	2	3	-	7	18:00
1008.0	23.0	22.9	24.2	SE	3	-	o	2	3	-	7	19:00
1007.6	23.0	23.0	24.2	S	2	-	o	2	3	-	7	20:00
1007.9	23.0	23.1	24.2	SE	2.5	8	c	2	3	-	7	21:00
1007.5	22.9	23.0	24.1	SE	1	-	o	2	3	-	7	22:00
--	-	-	24.3	Calm	0	-	o	0	2	-	7	23:00
-	-	-	24.2	Calm	0	8	o	0	2	-	7	12/00:00
-	-	-	24.2	Calm	0	-	c	1	2	-	7	01:00
-	-	-	24.1	E	2	-	r	1	2	0.1	6	02:00
-	-	-	24.0	E	3	9	r	1	2	0.1	6	03:00
-	-	-	23.9	E	3	-	r	1	2	0.2	6	04:00
-	-	-	24.0	ENE	4.5	-	r	1	2	0.0	6	05:00
-	-	-	24.1	ENE	4.5	8	r	1	2	1.1	6	06:00
-	-	-	24.3	E	7	-	r	3	2	1.7	6	07:00
-	-	-	24.3	E	6	-	r	3	2	2.4	6	08:00
1006.5	22.0	22.6	24.2	E	8	8	r	3	2	3.8	5	09:00
1007.0	21.8	22.9	24.2	E	5	-	r	3	2	8.2	5	10:00
1007.2	22.0	22.9	24.2	ENE	5	-	r	3	2	1.2	5	11:00
1006.8	21.9	22.6	24.2	E	6	8	r	3	2	0.0	5	12:00
1006.0	22.9	24.0	24.1	SE	6	-	r	3	2	0.0	7	13:00
1005.5	23.0	24.3	24.0	S	6.5	-	o	3	2	0.5	6	14:00
1005.9	23.2	24.5	24.0	S	6	7	o	3	2	0.0	7	15:00
1005.7	23.2	24.8	-	-	-	-	-	-	-	-	-	15:15
1005.5	23.4	24.8	23.8	S	8	-	c	3	2	0.0	7	16:00
1005.7	23.3	24.5	-	-	-	-	-	-	-	-	-	16:30
1005.6	23.2	24.4	23.9	SW	8	-	r	3	2	0.0	6	17:00
1006.2	23.8	24.2	23.9	SW	8	7	r	3	2	0.0	6	18:00
1006.5	24.3	25.7	24.7	SW	8	-	o	3	2	0.0	7	19:00
1007.0	24.7	26.1	-	-	-	-	-	-	-	-	-	19:30
1007.0	24.9	26.2	25.5	SW	9	-	o	4	2	0.0	7	20:00
1007.5	24.9	25.9	25.0	SSW	7	7	c	3	2	0.0	6	21:00
1008.0	25.5	26.5	25.2	SW	9	-	bc	3	2	0.0	6	22:00
1008.0	26.1	26.9	26.7	SW	9	-	bc	3	2	0.0	6	23:00
1007.5	26.4	26.6	27.1	SW	9	-	bc	3	2	-	6	13/00:00
1007.5	26.3	26.6	-	-	-	-	-	-	-	-	-	00:45

Date (1970)	Time (J. S. T.) GMT + 9hr	Position Lat. (North)	Long. (East)	Ship heading (°)	Ship speed (kt)	Depth (m): uncorrected	Remarks
July 13	01:00	30°-45.2'	129°-30.2'	95	15.4	620	
	01:30	30°-44.7'	129°-39.1'	89	—	590	a/c
	01:50	30°-45.0'	129°-45.0'	85	—	290	a/c
	02:00	30°-45.4'	129°-47.4'	85	15.1	290	
	02:33	30°-46.1'	129°-57.5'	62	15.1		a/c
	03:00	30°-48.7'	130°-04.1'	—	—	360	
	04:00	30°-54.6'	130°-19.4'	60	14.6	260	a/c
	04:30	30°-57.7'	130°-27.3'	51	—	290	a/c
	05:00	31°-01.9'	130°-34.3'	51	14.8	180	05:10 eng.
	05:13	31°-03.7'	130°-36.8'	35	—	120	a/c
	05:57	31°-10.6'	130°-42.7'	25	—	100	a/c
	06:00	31°-11.1'	130°-43.0'	25	11.9	100	
	06:12	31°-13.0'	130°-44.0'	345	—	95	a/c
	06:34	31°-16.8'	130°-42.7'	337	—	150	a/c
	07:00	31°-21.4'	130°-40.4'	337	11.1	200	
	07:30	31°-26.6'	130°-37.9'	157	—	230	a/c 07:45
	08:00	31°-22.1'	130°-39.9'	337	—	210	a/c
	08:53	31°-31.3'	130°-35.8'	—	10.5	130	slow
	09:00	31°-32.0'	130°-35.6'	—	—	150	
	12:00						10:30 arrived at Kagoshima
	14:00						
	15:00						
	16:00						
	19:00						
	20:00						
	21:00						
	23:00						
July 14	00:00						
	02:00						
	03:00						
	04:00						
	06:00						
	07:00						
	08:00						
	09:00						
	12:00						
	15:00						
	16:00						
	20:00						
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July 15	00:00						
	03:00						
	04:00						
	05:00						
	08:00						
	12:00						
	15:00						
	16:00						

Atmospheric pressure (mb): sea level value	Air temperature (°C)	Dew pt. temperature (°C)	Sea surface temperature (°C)	Wind direction	Wind speed (m/s)	Cloud amount (10 grades)	Weather	Wind waves	Swells	Precipitation (mm): a preceding hour	Visibility	Date and time
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1007.3	26.3	26.4	27.1	S	9	-	bc	3	2	-	7	13/01:00
1007.0	26.3	26.4	-	-	-	-	-	-	-	-	-	01:30
1007.2	26.3	26.1	-	-	-	-	-	-	-	-	-	01:50
1007.2	26.0	25.8	25.2	S	7	-	bc	3	2	-	7	02:00
1007.0	25.7	25.8	-	-	-	-	-	-	-	-	-	02:33
1007.0	24.6	24.9	23.6	S	7	-	bc	3	2	-	7	03:00
1006.5	23.6	24.6	23.6	S	6	-	b	3	2	-	7	04:00
1006.9	24.0	24.3	-	-	-	-	-	-	-	-	-	04:30
1007.0	23.3	23.9	23.0	SSW	5	-	c	3	2	-	7	05:00
1007.0	23.2	23.7	-	-	-	-	-	-	-	-	-	05:13
1007.2	24.1	23.8	-	-	-	-	-	-	-	-	-	05:57
1007.3	24.2	23.9	23.9	SSW	5	-	c	2	2	-	7	06:00
1007.5	24.3	23.9	-	-	-	-	-	-	-	-	-	06:12
1007.7	23.8	23.9	-	-	-	-	-	-	-	-	-	06:34
1007.8	24.2	24.3	24.5	SSW	6	-	c	2	1	-	8	07:00
1007.9	24.4	24.5	-	-	-	-	-	-	-	-	-	07:30
1008.1	24.7	24.2	24.6	ENE	5	-	o	2	1	-	8	08:00
1008.2	25.6	24.3	-	-	-	-	-	-	-	-	-	08:53
1008.2	25.6	24.4	24.6	SE	5	-	c	2	1	-	8	09:00
(1007.0)	28.3	25.6	24.6	S	4	-	r	-	-	-	-	12:00
1006.5	27.2	26.5	-	-	-	-	-	-	-	2.1	-	14:00
1006.2	29.2	26.0	-	-	-	-	-	-	-	-	-	15:00
(1006.3)	30.0	25.5	-	SW	4	-	bc	-	-	-	-	16:00
1006.5	27.3	26.1	-	-	-	-	-	-	-	0.65	-	19:00
(1006.3)	26.3	26.0	-	S	3	-	o	-	-	0.3	-	20:00
1006.7	25.8	25.8	-	-	-	-	-	-	-	0.0	-	21:00
1006.8	25.7	26.0	-	-	-	-	-	-	-	2.8	-	23:00
(1006.2)	25.5	26.0	-	S	3	-	r	-	-	3.2	-	14/00:00
1005.7	25.3	26.0	-	-	-	-	-	-	-	1.4	-	02:00
1005.4	25.5	25.9	-	-	-	-	-	-	-	0.2	-	03:00
(1005.6)	25.8	25.7	-	Calm	0	-	o	-	-	0.1	-	04:00
1006.2	25.5	25.0	-	-	-	-	-	-	-	0.1	-	06:00
1006.1	24.9	25.3	-	-	-	-	-	-	-	1.9	-	07:00
(1006.6)	25.4	25.7	-	SW	3.5	-	r	-	-	0.9	-	08:00
-	-	-	-	-	-	-	-	-	-	-	-	09:00
(1007.0)	29.5	25.1	-	WSW	5	-	c	-	-	-	-	12:00
-	-	-	-	-	-	-	-	-	-	-	-	15:00
(1006.7)	-	-	25.2	W	2	-	c	-	-	-	-	16:00
(1009.0)	27.9	25.0	-	W	3	-	c	-	-	-	-	20:00
-	-	-	-	-	-	-	-	-	-	-	-	21:00
(1009.3)	26.8	25.0	24.4	W	1	-	bc	-	-	-	-	15/00:00
1009.9	26.3	25.0	-	-	-	-	-	-	-	-	-	03:00
(1010.0)	26.5	25.0	24.3	W	2	-	bc	-	-	-	-	04:00
1010.3	25.6	24.9	-	-	-	-	-	-	-	-	-	05:00
(1011.8)	26.0	27.3	25.0	Calm	0	-	r	-	-	-	-	08:00
(1011.8)	28.3	26.5	24.2	S	4	-	b	-	-	-	-	12:00
1010.5	28.5	26.8	-	-	-	-	-	-	-	-	-	15:00
(1010.7)	27.9	26.3	25.3	S	2	-	bc	-	-	-	-	16:00

Date (1970)	Time (J. S. T.) GMT + 9hr	Position Lat. (North)	Long. (East)	Ship heading (°)	Ship speed (kt)	Depth (m): uncorrected	Remarks
July 15	17:00						
	17:20	31°-32.7'	130°-35.4'	157	—	25	R/a eng. Co
	18:00	31°-24.3'	130°-39.7'	157	—	210	
	18:33	31°-17.3'	130°-43.5'	185	—	125	a/c
	18:54	31°-12.2'	130°-43.3'	214	—	95	a/c
	19:00	31°-10.9'	130°-42.3'	214	14.3	100	
	19:30	31°-05.1'	130°-37.7'	188	—	80	a/c
	19:53	30°-59.6'	130°-37.2'	168	—	100	a/c
	20:00	30°-58.0'	130°-37.7'	168	14.2	90	
	21:00	30°-43.8'	130°-42.6'	176	14.9	200	
	22:00	30°-29.9'	130°-44.4'	176	14.0	90	
	22:40	30°-14.8'	130°-45.8'	141	—	75	a/c
	23:00	30°-16.1'	130°-49.2'	141	14.7	60	
	23:32	30°-10.5'	130°-54.8'	—	—	80	
July 16	00:00	30°-05.5'	130°-59.5'	141	14.1	570	
	01:00	29°-54.8'	131°-10.1'	141	14.0	2190	
	02:00	29°-45.5'	131°-21.9'	141	13.8	3170	
	03:00	29°-35.0'	131°-33.0'	141	14.3	4260	
	03:10	29°-33.3'	131°-34.9'	149	—	4500	a/c
	04:00	29°-24.0'	131°-42.9'	149	14.0	5000	
	05:00	29°-12.8'	131°-50.9'	149	13.3	5340	
	06:00	29°-00.0'	132°-00.3'	—	15.5	5520	stop 06:00
	07:00	29°-00.5'	132°-00.8'	270	—	—	arrived at station 1
	08:00	29°-01.0'	132°-01.5'	280	—	—	
	09:00	29°-01.6'	132°-02.1'	270	—	—	
	10:00	29°-02.3'	132°-02.7'	270	—	—	
	10:15						
	11:00	29°-03.0'	132°-03.5'	180	—	—	
	12:00	29°-03.9'	132°-04.4'	180	—	—	
	13:00	29°-04.5'	132°-05.2'	180	—	—	
	14:00	29°-05.2'	132°-06.2'	180	—	—	
	15:00	29°-06.2'	132°-07.3'	—	—	4640	
	16:00	29°-04.3'	132°-09.0'	140	2.4	3250	
	17:00	29°-03.3'	132°-10.3'	—	2.0	4090	stop
	18:00	29°-03.5'	132°-10.9'	—	—	4250	
	19:00	29°-03.7'	132°-11.8'	—	—	—	Vai
	20:00	29°-03.8'	132°-12.7'	—	—	—	Vai
	21:00	29°-04.2'	132°-13.4'	—	—	—	
	22:00	29°-04.7'	132°-14.0'	—	—	—	eng. stop
	23:00	29°-05.3'	132°-14.4'	—	—	—	
July 17	00:00	29°-06.0'	132°-14.8'	—	—	—	
	01:00	29°-07.3'	132°-14.9'	—	—	—	
	02:00	29°-08.5'	132°-14.4'	—	—	—	
	03:00	29°-09.7'	132°-14.5'	—	—	—	
	04:00	29°-10.7'	132°-15.3'	—	—	5130	
	05:00	29°-11.5'	132°-15.3'	—	—	5150	Vai 05:30 stop
	06:00	29°-11.5'	132°-15.5'	—	—	5160	
	07:00	29°-12.6'	132°-16.0'	—	—	5170	

Atmospheric pressure (mb): sea level value	Air temperature (°C)	Dew pt. temperature (°C)	Sea surface temperature (°C)	Wind direction	Wind speed (m/s)	Cloud amount (10 grades)	Weather	Wind waves	Swells	Precipitation (mm): a preceding hour	Visibility	Date and time
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1010.1	27.6	26.3	-	-	-	-	-	-	-	-	-	15/17:00
1010.3	27.9	25.8	-	-	-	-	-	-	-	-	-	17:20
1011.0	27.8	25.7	27.0	SSW	5	-	b	2	1	-	8	18:00
1012.0	27.5	25.7	25.7	-	-	-	-	-	-	-	-	18:33
1012.0	26.7	26.3	-	-	-	-	-	-	-	-	-	18:54
1012.0	26.7	26.3	25.8	SW	3	-	bc	2	1	-	8	19:00
1012.4	26.8	26.8	-	-	-	-	-	-	-	-	-	19:30
1012.8	26.3	26.3	-	-	-	-	-	-	-	-	-	19:53
1012.9	26.1	26.3	26.3	Calm	0	-	b	2	2	-	8	20:00
1013.1	26.0	26.3	26.8	N	2	-	b	2	1	-	8	21:00
1013.5	26.1	25.7	25.6	E	2.5	-	b	2	1	-	8	22:00
1013.0	25.9	26.2	-	-	-	-	-	-	-	-	-	22:40
1013.2	25.5	26.2	25.9	SSW	4	-	bc	2	2	-	8	23:00
1013.5	24.8	25.8	-	-	-	-	-	-	-	-	-	23:32
1013.1	25.3	26.4	25.7	SSW	3.5	-	b	2	2	-	8	16/00:00
1013.0	25.5	26.6	26.2	S	3	-	b	2	2	-	8	01:00
1012.4	26.7	26.7	27.6	S	2	-	b	2	2	-	8	02:00
1012.8	26.9	26.7	27.7	SSW	3	-	b	2	2	-	8	03:00
1012.6	26.9	26.7	-	-	-	-	-	-	-	-	-	03:10
1012.5	27.0	26.3	28.1	SSW	3	-	b	2	2	-	8	04:00
1013.2	26.9	26.6	28.0	S	3	-	b	2	2	-	8	05:00
1014.5	27.0	26.7	28.3	SSW	5	3	b	2	2	-	8	06:00
1014.6	27.2	26.6	28.0	S	4	-	b	2	2	-	8	07:00
1014.7	27.5	26.2	28.2	S	4	-	b	2	2	-	8	08:00
1015.0	27.7	26.7	28.3	S	4	3	b	2	2	-	9	09:00
1014.8	28.0	26.9	28.3	S	3	-	b	2	2	-	9	10:00
1014.7	28.3	26.7	-	-	-	-	-	-	-	-	-	10:15
1014.6	28.7	26.8	28.6	S	3	-	b	2	2	-	9	11:00
1014.6	29.9	26.4	28.7	S	2	4	bc	2	2	-	9	12:00
1014.0	29.9	26.4	28.6	S	2	-	bc	2	2	-	9	13:00
1013.8	29.9	26.3	28.9	S	2	-	bc	2	2	-	9	14:00
1013.0	30.0	26.3	28.5	S	3	4	bc	2	2	-	9	15:00
1012.3	29.5	26.4	29.0	SSE	3	-	bc	2	4	-	9	16:00
1013.0	28.7	26.3	29.1	SSE	3.5	-	bc	2	2	-	9	17:00
1013.1	28.3	26.5	29.0	SSE	3	6	bc	2	2	-	9	18:00
1013.5	28.0	26.1	28.5	SSE	3	-	bc	2	2	-	9	19:00
1013.5	28.0	26.6	28.9	SSE	4	-	bc	2	2	-	8	20:00
1013.5	27.9	26.8	28.7	SSE	4	5	bc	2	2	-	8	21:00
1014.3	27.7	26.5	28.7	S	5	-	bc	2	2	-	8	22:00
1014.5	27.7	26.9	28.8	S	4	-	bc	2	2	-	8	23:00
1014.0	27.5	26.8	28.9	S	4	5	bc	2	2	-	8	17/00:00
1013.5	27.3	26.8	28.6	S	2.5	-	bc	2	2	-	8	01:00
1013.0	27.3	26.8	28.5	S	2	-	bc	2	2	-	8	02:00
1013.0	27.5	25.9	28.5	SSW	4	2	bc	2	2	-	8	03:00
1013.0	27.4	25.8	28.5	SW	4	-	bc	2	2	-	8	04:00
1012.7	27.3	26.0	28.0	SSW	4	-	bc	2	2	-	8	05:00
1013.0	27.3	26.0	28.2	SSW	3	6	bc	2	2	-	8	06:00
1013.2	27.7	26.1	28.4	S	5	-	bc	2	2	-	8	07:00

Date (1970)	Time (J.S.T.) GMT + 9hr	Position Lat. (North)	Long. (East)	Ship heading (°)	Ship speed (kt)	Depth (m): uncorrected	Remarks
July 17	08:00	29°-13.4'	132°-16.4'	—	—	5180	
	09:00	29°-14.5'	132°-17.0'	—	—	5175	
	10:00	29°-15.6'	132°-17.5'	—	—	5150	bow thruster stop drifted
	11:00	29°-16.8'	132°-18.9'	—	—	—	
	12:00	29°-17.7'	132°-19.3'	—	—	—	
	13:00	29°-18.0'	132°-20.3'	—	—	—	
	14:00						
	15:00						
	16:00	29°-18.5'	132°-22.3'	—	—	—	16:19 shifted to station 1
	16:30	29°-17.6'	132°-21.7'	—	—	5120	R/u eng.
	17:00	29°-12.8'	132°-16.8'	227	—	5170	
	18:00	29°-03.3'	132°-06.3'	227	13.2	4700	
	18:30	28°-58.5'	132°-01.3'	90	—	5400	a/c left the station 1.
	19:00	28°-58.3'	132°-09.3'	90	13.4	5170	
	20:00	28°-58.6'	132°-25.6'	90	14.4	4900	
	21:00	28°-57.9'	132°-42.8'	90	15.1	4520	
	22:00	28°-58.0'	132°-59.0'	90	14.3	4370	
23:00	28°-57.9'	133°-15.0'	87	14.0	4575		
July 18	00:00	28°-58.0'	133°-31.5'	87	14.6	3410	
	01:00	28°-57.7'	133°-46.2'	87	13.0	2970	
	02:00	28°-58.2'	134°-01.6'	87	13.2	2880	
	03:00	28°-58.4'	134°-17.0'	87	13.5	4475	
	04:00	28°-59.0'	134°-32.2'	87	13.5	4700	
	05:00	29°-01.1'	134°-48.8'	87	14.4	4760	
	05:43	29°-01.3'	135°-00.4'	224	—	4830	a/c arrived at the station 2
	06:00	28°-58.4'	134°-57.8'	224	—	4830	
	07:00	28°-48.2'	134°-46.3'	224	14.5	4975	
	07:26	28°-43.8'	134°-40.8'	—	—	4975	stop eng. stopped near
	08:00	28°-44.3'	134°-40.5'	—	—	4975	the Weather ship "Nojima"
	09:00	28°-44.6'	134°-40.5'	—	—	—	
	10:00	28°-45.0'	134°-40.5'	—	—	—	
	11:00	28°-45.3'	134°-40.5'	—	—	—	
	12:00	28°-45.7'	134°-40.5'	—	—	—	
	13:00						
	14:00	28°-49.1'	134°-41.6'	—	—	—	
	15:00						
	16:00	28°-50.5'	134°-41.1'	—	—	—	
	17:00						
	18:00	28°-52.7'	134°-42.8'	—	—	—	
	19:00						
	19:22	28°-52.4'	134°-43.0'	—	—	4770	slow ahead eng.
19:37	28°-52.8'	134°-45.7'	—	—	4940	R/u eng. left the station 2	
19:44	28°-53.7'	134°-47.5'	60	—	4850	s/c	
20:00	28°-55.4'	134°-50.9'	60	—	4730		
20:40	29°-00.0'	135°-00.0'	90	—	4740		
21:00	29°-01.1'	135°-06.3'	90	15.2	4940		
22:00	29°-00.7'	135°-23.5'	90	15.1	5050		
23:00	29°-00.7'	135°-39.6'	90	14.0	4680		
23:20	29°-00.7'	135°-45.0'	360	—	4420		

Atmospheric pressure (mb): sea level value	Air temperature (°C)	Dew pt. temperature (°C)	Sea surface temperature (°C)	Wind direction	Wind speed (m/s)	Cloud amount (10 grades)	Weather	Wind waves	Swells	Precipitation (mm): a preceding hour	Visibility	Date and time
1014.0	28.0	25.7	28.4	S	4	-	bc	3	2	-	8	17/08:00
1013.0	28.3	26.0	28.3	S	4	4	bc	2	2	-	8	09:00
1013.4	28.6	25.8	28.3	SSW	4.5	-	bc	2	2	-	9	10:00
1013.2	28.2	26.2	28.1	SSW	5	-	bc	2	2	-	9	11:00
1013.0	28.0	26.3	28.2	SSW	6	4	bc	3	2	-	9	12:00
1012.0	28.5	25.8	28.3	SSW	5	-	bc	3	2	-	9	13:00
1012.0	29.4	25.8	28.4	SSW	5	-	bc	3	2	-	9	14:00
1011.5	29.4	26.0	28.3	SW	5	3	bc	3	2	-	9	15:00
1011.2	29.3	25.8	28.5	SW	5	-	bc	3	2	-	9	16:00
1011.2	28.9	26.2	-	-	-	-	-	-	-	-	-	16:30
1011.5	29.0	25.4	28.5	SW	4	-	bc	4	2	-	9	17:00
1011.5	28.8	26.0	28.9	SW	5.5	6	bc	4	2	-	9	18:00
1012.0	28.6	26.0	-	-	-	-	-	-	-	-	-	18:30
1011.7	28.2	26.4	28.6	SSW	5.5	-	bc	4	2	-	9	19:00
1011.2	28.0	26.2	28.7	SW	5.5	-	bc	3	2	-	9	20:00
1012.8	28.0	25.8	28.6	SW	5.5	3	bc	3	2	-	9	21:00
1012.9	27.4	26.6	28.0	SW	4	-	b	2	2	-	9	22:00
1012.8	27.1	26.7	27.7	SW	3	-	bc	2	2	-	9	23:00
1012.5	27.0	26.7	27.8	SW	3	3	bc	2	2	-	9	18/00:00
1012.0	27.2	26.4	28.0	SW	5	-	bc	2	2	-	8	01:00
1012.0	27.3	26.1	28.0	SW	4	-	bc	2	2	-	8	02:00
1011.5	27.4	26.0	28.0	SW	4	4	bc	2	2	-	8	03:00
1011.2	27.5	26.0	28.1	SW	4	-	bc	2	2	-	8	04:00
1011.5	27.6	25.6	28.5	SW	3.5	-	bc	3	2	-	8	05:00
1011.3	27.7	25.6	-	-	-	-	-	-	-	-	-	05:43
1011.0	28.1	25.3	28.8	SW	4	2	bc	3	2	-	8	06:00
1011.5	28.6	25.1	28.7	SW	5	-	bc	3	2	-	8	07:00
1011.2	28.7	25.5	-	-	-	-	-	-	-	-	-	07:26
1011.3	28.2	25.8	28.8	SW	5	-	bc	3	2	-	8	08:00
1011.3	27.3	25.9	28.8	W	4.5	7	bc	3	2	-	8	09:00
1011.1	29.0	25.7	28.9	SW	5	-	bc	3	2	-	9	10:00
1011.0	28.6	26.2	28.9	SW	5	-	bc	3	2	-	9	11:00
1010.9	29.0	25.9	28.9	SW	6	5	bc	3	2	-	9	12:00
1010.0	29.4	26.5	28.9	SW	5	-	bc	3	2	-	9	13:00
1010.2	29.5	25.3	28.9	SW	6	-	bc	3	2	-	9	14:00
1009.9	29.6	25.7	28.7	SW	6	2	bc	3	2	-	9	15:00
1009.6	29.6	25.8	28.7	SW	6	-	b	3	2	-	9	16:00
1009.5	28.9	26.3	28.8	SW	6	-	b	3	2	-	9	17:00
1009.4	28.7	25.9	28.8	SW	6	2	b	3	2	-	9	18:00
1009.6	28.3	26.1	28.8	SW	6	-	b	3	2	-	9	19:00
1009.3	28.3	26.0	-	-	-	-	-	-	-	-	-	19:22
1009.1	28.2	26.7	-	-	-	-	-	-	-	-	-	19:37
1009.8	28.2	26.4	-	-	-	-	-	-	-	-	-	19:44
1009.5	28.3	26.3	28.8	SW	6	-	-	3	2	-	8	20:00
1009.6	28.1	25.9	-	-	-	-	-	-	-	-	-	20:40
1009.8	28.0	26.3	28.8	-	7	2	-	3	2	-	8	21:00
1009.7	27.8	26.3	28.2	SW	2.5	-	b	3	2	-	8	22:00
1009.6	27.9	26.4	28.5	WSW	7	-	b	3	2	-	8	23:00
												23:20

Date (1970)	Time (J. S. T.) GMT + 9hr	Position Lat. (North)	Long. (East)	Ship heading (°)	Ship speed (kt)	Depth (m): uncorrected	Remarks
July 19	00:00	29°-10.3'	135°-45.5'	360	15.1	4400	
	01:00	29°-05.0'	135°-35.2'	60	10.6	4630	a/c R/up eng.
	01:45	29°-10.0'	135°-45.5'	360	—	—	a/c
	02:00	29°-13.0'	135°-45.5'	360	13.5	4400	
	03:00	29°-26.8'	135°-45.4'	360	13.8	4480	
	04:00	29°-40.6'	135°-45.8'	360	13.8	4300	
	05:00	29°-54.4'	135°-45.3'	360	14.0	4350	
	06:00	30°-07.6'	135°-44.3'	260	13.2	4275	
	07:00	30°-21.6'	135°-44.2'	360	14.0	4410	
	08:00	30°-35.3'	135°-45.2'	360	13.8	4380	
	09:00	30°-49.4'	135°-45.5'	358	14.1	4260	
	10:00	31°-03.4'	135°-46.2'	354	13.9	4370	
	11:00	31°-17.4'	135°-44.9'	358	14.1	4050	
	12:00	31°-31.0'	135°-45.2'	358	13.6	2475	
	13:00	31°-45.6'	135°-45.4'	358	14.6	4280	
	14:00	31°-59.3'	135°-45.1'	250	13.5	4230	half down eng. a/c
	15:00	31°-56.8'	135°-36.2'	250	8.2	4210	
	15:10	31°-56.1'	135°-35.0'	70	—	4120	a/c R/up eng.
	15:52	31°-50.0'	135°-45.2'	358	—	—	a/c
	16:00	32°-00.8'	135°-45.3'	358	12.7	4200	
	17:00	32°-14.6'	135°-45.4'	358	13.8	4460	
	18:00	32°-29.2'	135°-45.8'	358	14.5	4695	
	19:00	32°-43.2'	135°-46.0'	358	14.0	4000	
	19:34	32°-51.5'	135°-47.3'	—	—	3720	
	19:40	32°-52.0'	135°-48.3'	350	—	—	s/c
	20:00	32°-57.3'	135°-47.4'	—	14.5	2750	
	21:00	33°-10.6'	135°-46.6'	350	13.1	2120	
	22:00	33°-06.8'	135°-53.5'	155	14.3	2360	
	23:00	32°-53.7'	136°-04.0'	144	15.8	3640	
July 20	00:00	32°-43.6'	136°-15.9'	146	14.0	4580	a/c
	01:00	32°-32.5'	136°-26.0'	146	14.1	4450	
	02:00	32°-20.8'	136°-36.5'	146	14.7	4100	
	03:00	32°-09.0'	136°-46.8'	146	14.7	4210	
	03:45	32°-00.1'	136°-55.3'	356	—	—	a/c 04:24 co vai
	04:00	32°-03.0'	136°-55.8'	356	14.0	4240	04:26 co again
	05:00	32°-17.0'	136°-55.0'	356	14.0	4035	
	06:00	32°-30.2'	136°-54.3'	356	13.2	4200	
	07:00	32°-43.8'	136°-54.2'	356	13.8	3560	
	07:30	32°-50.6'	136°-54.8'	—	—	4080	stop eng.
	08:00	32°-50.8'	136°-55.0'	—	—	4060	
	08:27	32°-51.1'	136°-56.6'	357	—	4030	
	09:00	32°-58.1'	136°-58.0'	335	7.1	4250	
	10:00	32°-10.4'	136°-53.6'	349	12.7	3550	
	10:40	32°-19.7'	136°-54.0'	—	—	2550	stop eng.
	10:45	32°-20.2'	136°-54.0'	—	—	—	
	10:50	—	—	—	—	2410	drift
	11:00	32°-20.3'	136°-55.3'	—	—	2370	
	11:24	32°-20.4'	136°-56.6'	—	—	—	
	11:40	32°-20.9'	136°-58.1'	344	—	2270	R/up

Atmospheric pressure (mb): sea level value	Air temperature (°C)	Dew pt. temperature (°C)	Sea surface temperature (°C)	Wind direction	Wind speed (m/s)	Cloud amount (10 grades)	Weather	Wind waves	Swells	Precipitation (mm): a preceding hour	Visibility	Date and time
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1009.3	27.8	26.5	28.6	SW	7.5	2	b	3	2	-	8	19/00:00
1009.7	27.9	26.6	28.0	WSW	4.5	-	bc	3	2	-	8	01:00
1009.4	28.0	26.2	-	-	-	-	-	-	-	-	-	01:45
1009.3	27.7	26.4	28.0	WSW	7	-	bc	3	2	-	8	02:00
1008.5	27.4	26.7	28.0	WSW	7	1	b	3	2	-	8	03:00
1008.5	27.3	26.4	27.8	WSW	7	-	b	3	2	-	8	04:00
1008.1	27.2	26.3	27.7	WSW	9	-	c	3	2	-	8	05:00
1008.5	27.1	25.9	27.3	WSW	9	2	bc	4	2	-	8	06:00
1007.4	27.4	25.9	27.0	WSW	9	-	bc	4	2	-	8	07:00
1007.3	27.9	26.1	27.7	SW	11	-	bc	5	3	-	8	08:00
1007.0	27.9	26.3	27.8	SW	11	5	bc	5	3	-	8	09:00
1006.5	27.7	26.3	26.8	SW	11	-	c	5	3	-	8	10:00
1006.3	27.5	26.7	26.8	SW	11	-	c	5	3	-	8	11:00
1006.0	27.3	26.6	27.0	SW	11	4	c	5	3	-	7	12:00
1005.1	27.4	26.7	26.4	SW	9	-	bc	5	3	-	7	13:00
1004.5	26.9	26.4	26.4	SW	10	-	c	5	4	-	7	14:00
1003.8	26.6	25.7	26.9	SW	8	7	c	5	4	-	7	15:00
1003.9	26.1	25.3	-	-	-	-	-	-	-	-	-	15:10
1004.4	26.8	25.7	-	-	-	-	-	-	-	-	-	15:52
1004.5	26.7	25.7	26.8	SW	8	-	c	5	4	-	7	16:00
1003.7	26.8	26.3	26.6	WSW	9	-	c	4	4	-	7	17:00
1003.0	26.9	26.6	27.2	WSW	9	-	c	4	4	-	7	18:00
1002.9	26.9	26.6	27.5	WSW	7.5	-	c	4	4	-	7	19:00
1003.0	26.8	26.3	-	-	-	-	-	-	-	-	-	19:34
1003.0	26.7	26.3	-	-	-	-	-	-	-	-	-	19:40
1003.0	26.5	26.3	27.0	WSW	5	-	c	4	4	0.0	7	20:00
1003.5	25.9	25.6	26.9	WSW	3.5	-	c	3	4	0.0	7	21:00
1004.0	25.5	25.6	26.9	W	5.5	-	c	3	4	0.0	7	22:00
1004.2	25.9	26.1	26.4	W	5.5	-	bc	3	4	0.0	7	23:00
1004.5	26.2	26.7	27.3	W	6	-	bc	3	4	0.0	7	20/00:00
1004.5	26.3	26.5	27.2	W	5.5	-	bc	3	4	0.0	7	01:00
1004.5	26.3	26.8	27.0	W	6	-	bc	3	4	0.0	7	02:00
1004.5	26.1	26.8	26.8	W	6.5	-	bc	3	4	0.0	7	03:00
1005.0	26.0	26.6	-	-	-	-	-	-	-	-	-	03:45
1005.0	25.9	26.6	26.6	W	7.5	-	bc	3	4	0.0	7	04:00
1005.0	26.0	26.8	26.7	W	7	-	c	3	4	0.0	7	05:00
1005.7	26.0	26.9	26.7	W	7	-	bc	3	4	0.0	7	06:00
1006.0	26.5	26.9	26.8	W	7	-	bc	3	3	0.0	7	07:00
1006.2	26.6	26.9	-	-	-	-	-	-	-	-	-	07:30
1005.7	26.7	26.7	27.2	W	5	-	c	3	2	0.0	7	08:00
1006.0	26.9	26.8	-	-	-	-	-	-	-	-	-	08:27
1006.0	27.0	27.0	27.1	W	5	-	bc	3	2	0.0	7	09:00
1006.0	26.7	26.6	26.4	WSW	5	-	bc	3	2	0.0	7	10:00
1005.9	26.7	26.3	-	-	-	-	-	-	-	-	-	10:40
1005.8	26.8	26.1	-	-	-	-	-	-	-	-	-	10:45
1005.7	26.8	26.0	-	-	-	-	-	-	-	-	-	10:50
1005.7	26.9	26.1	25.9	W	3	-	bc	2	2	0.0	8	11:00
1006.0	26.3	25.8	-	-	-	-	-	-	-	-	-	11:24
1005.9	26.3	25.9	-	-	-	-	-	-	-	-	-	11:40

Date (1970)	Time (J. S. I., GMT + 9hr)	Position Lat. (North)	Long. (East)	Ship heading (°)	Ship speed (kt)	Depth (m): uncorrected	Remarks
July 20	12:00	32°-25.4'	136°-58.0'	344	4.5	1770	
	13:00	32°-39.0'	136°-56.3'	342	13.7	2025	a/c
	13:40	32°-47.3'	136°-52.2'	—	—	1770	
	14:00						
	14:45	33°-50.5'	136°-51.5'	12	—	—	s/c
	15:00	33°-52.2'	136°-51.8'	12	—	1180	R/up eng.
	15:50	34°-04.2'	136°-54.1'	110	—	700	a/c
	16:00	34°-03.7'	136°-56.5'	110	14.5	930	16:04 co vai
	16:08	34°-02.7'	136°-58.0'	—	—	1150	co again
	17:00	33°-59.5'	137°-11.3'	110	13.2	1860	
	18:00	33°-55.5'	137°-26.1'	110	12.8	1160	
	19:00	33°-51.9'	137°-41.1'	110	13.1	1980	
	20:00	33°-47.2'	137°-56.0'	110	13.3	3520	
	21:00	33°-43.0'	138°-13.5'	110	15.0	3490	
	21:20	33°-41.3'	138°-19.9'	360	—	1900	a/c
22:00	33°-52.0'	138°-19.9'	—	16.4	3740		
23:00	34°-06.2'	138°-19.2'	360	14.2	2550	a/c	
July 21	00:00	34°-18.0'	138°-19.1'	360	11.9	250	
	00:30	34°-24.7'	138°-19.6'	82	—	0	a/c
	01:00	34°-25.6'	138°-27.5'	82	13.0	2270	
	02:00	34°-27.8'	138°-43.5'	82	13.4	750	
	02:50	34°-34.0'	138°-57.5'	45	—	380	a/c
	03:00	34°-32.2'	138°-59.6'	35	14.3	370	a/c
	03:50	34°-42.5'	139°-09.2'	—	—	510	half down eng.
	04:00	34°-43.8'	139°-10.0'	—	—	550	
	04:30	34°-48.8'	139°-14.9'	—	—	875	04:42 half ah'd eng.
	04:46	34°-49.6'	139°-15.7'	360	—	800	a/c
	04:50	34°-50.7'	139°-15.8'	360	10.4	300	
	05:00	34°-52.4'	139°-16.1'	—	—	1150	05:16 co vai 05:25 co again
	06:00	35°-01.1'	139°-16.2'	360	8.7	1375	06:09 slow down eng.
	06:10	35°-02.1'	139°-16.2'	30	—	1370	a/c
	07:00	35°-06.2'	139°-19.9'	—	6.2	1280	
	07:20	35°-07.6'	139°-22.0'	360	—	800	a/c
	07:55	—	—	—	—	920	stop eng.
	08:00	35°-11.4'	139°-22.1'	—	—	1000	drift
	09:00	35°-12.0'	139°-21.6'	—	—	780	drift
	10:00	35°-12.5'	139°-21.2'	—	—	870	drift
	11:00	35°-12.7'	139°-21.9'	—	—	900	
	12:00	35°-13.1'	139°-21.1'	—	—	880	drift
	12:15	—	—	125	—	—	s/c 12:12 start
	12:30	35°-11.8'	139°-24.0'	—	—	740	12:50 fog, half down
12:55	35°-08.7'	139°-29.2'	—	—	750	full ah'd eng.	
13:00	35°-08.4'	139°-30.5'	125	—	570		
13:20	35°-06.1'	139°-33.8'	—	—	480		
14:00	—	—	90	—	—		
15:00	—	—	360	—	—		
16:00	35°-29.5'	139°-50.0'	22	—	—	16:28 arrived at Haneda	
17:00							
18:00							
19:00							
20:00							
21:00							

Atmospheric pressure (mb): sea level value	Air temperature (°C)	Dew pt. temperature (°C)	Sea surface temperature (°C)	Wind direction	Wind speed (m/s)	Cloud amount (10 grades)	Weather	Wind waves	Swells	Precipitation (mm): a preceding hour	Visibility	Date and time
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1005.7	26.9	26.1	26.8	W	3	-	bc	1	2	0.0	8	20/12:00
1005.0	26.9	25.3	24.5	Calm	0	-	bc	1	2	0.0	8	13:00
1005.0	26.4	24.8	-	-	-	-	-	-	-	-	-	13:40
1005.0	26.0	24.4	24.8	WSW	3.5	-	bc	1	2	0.0	8	14:00
1004.6	25.7	24.5	-	-	-	-	-	-	-	-	-	14:45
1004.5	25.8	24.7	24.6	WSW	2	-	bc	1	2	0.0	8	15:00
1004.3	27.0	24.7	26.0	SSE	3	-	bc	1	2	0.0	8	15:50
1004.3	26.3	24.6	-	-	-	-	-	-	-	-	-	16:00
1004.2	26.2	24.4	-	-	-	-	-	-	-	-	-	16:08
1004.2	25.6	24.8	25.4	SW	5	-	bc	2	2	0.0	7	17:00
1004.0	25.0	25.3	24.8	SW	5	-	bc	2	2	0.0	7	18:00
1004.7	24.9	25.4	24.2	SW	5	-	bc	2	2	0.0	7	19:00
1005.0	24.8	25.4	25.0	SSW	3.5	-	c	2	2	0.0	6	20:00
1005.0	25.0	26.0	25.0	SW	5	-	c	2	2	0.0	6	21:00
1005.3	25.0	26.0	-	-	-	-	-	-	-	-	-	21:20
1005.3	24.8	25.6	24.5	WSW	7.5	-	c	3	2	0.0	6	22:00
1005.8	24.1	24.5	23.0	WSW	7.5	-	bc	3	2	0.0	6	23:00
1005.9	23.8	24.3	22.4	Calm	0	-	bc	2	2	0.0	6	21/00:00
1005.5	23.4	24.0	-	-	-	-	-	-	-	-	-	00:30
1005.0	23.0	23.6	23.2	Calm	0	-	bc	2	2	0.0	6	01:00
1005.0	23.0	23.9	24.2	Calm	0	-	bc	1	2	-	6	02:00
1005.2	23.3	24.2	-	-	-	-	-	-	-	-	-	02:50
1005.2	23.0	24.0	24.3	N	2	-	bc	1	1	-	6	03:00
1005.3	22.7	22.7	-	-	-	-	-	-	-	-	-	03:50
1005.5	22.3	22.4	22.8	Calm	0	-	f	1	1	-	0	04:00
1005.9	22.4	23.6	-	-	-	-	-	-	-	-	-	04:30
1005.9	22.4	23.7	-	-	-	-	-	-	-	-	-	04:46
1006.0	22.3	23.7	-	-	-	-	-	-	-	-	-	04:50
1006.0	22.3	23.7	23.5	Calm	0	-	f	1	1	-	1	05:00
1006.0	21.7	22.9	22.7	Calm	0	-	f	1	1	-	1	06:00
1006.0	21.7	22.9	-	-	-	-	-	-	-	-	-	06:10
1006.5	21.7	23.1	23.0	Calm	0	-	f	1	1	-	1	07:00
1006.8	21.7	23.1	-	-	-	-	-	-	-	-	-	07:20
1006.7	21.6	23.0	-	-	-	-	-	-	-	-	-	07:55
1006.5	21.6	23.0	23.3	ENE	2	-	f	1	1	-	4	08:00
1006.5	23.0	23.2	23.0	Calm	0	-	f	0	1	-	4	09:00
1007.0	24.6	23.2	22.3	S	2	-	m	1	1	-	4	10:00
1006.0	24.6	23.2	22.6	Calm	0	-	m	1	1	-	4	11:00
1005.8	24.7	23.3	23.9	S	2.5	-	m	1	1	-	4	12:00
1005.5	24.6	23.5	-	-	-	-	-	-	-	-	-	12:15
1005.8	24.7	23.8	-	-	-	-	-	-	-	-	-	12:30
1005.9	24.5	23.6	23.4	S	2.5	-	m	1	1	-	3	12:55
1005.9	23.6	23.5	-	-	-	-	-	-	-	-	-	13:00
1006.0	24.0	23.5	23.6	S	3	-	bc	1	1	-	5	13:20
1005.7	24.4	23.2	-	SW	4	-	bc	1	1	-	6	14:00
1005.0	28.8	25.2	-	SW	5	-	bc	1	1	-	6	15:00
1004.8	28.3	25.1	-	-	-	-	-	-	-	-	-	16:00
1005.3	27.4	25.4	24.5	SSW	5	-	bc	1	1	-	6	17:00
1006.1	26.6	25.3	-	-	-	-	-	-	-	-	-	18:00
1007.3	25.6	24.7	25.4	SSW	4	-	bc	1	1	-	7	19:00
1008.0	25.3	24.8	-	-	-	-	-	-	-	-	-	20:00
												21:00

Date (1970)	Time (J. S. T.) GMT + 9hr	Position Lat. (North)	Long. (East)	Ship heading (°)	Ship speed (kt)	Depth (m): uncorrected	Remarks
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July 21 22:00
23:00

July 22 00:00
04:00
08:00
09:00

08:34 left Haneda
09:28 arrived at Tokyo

Atmospheric pressure (mb): sea level value	Air temperature (°C)	Dew pt. temperature (°C)	Sea surface temperature (°C)	Wind direction	Wind speed (m/s)	Cloud amount (10 grades)	Weather	Wind waves	Swells	Precipitation (mm): a preceding hour	Visibility	Date and time
1008.0	24.9	25.0	25.4	S	2	-	c	-	-	-	-	21/22:00
1008.3	24.7	24.8	-	-	-	-	-	-	-	-	-	23:00
1008.3	24.5	25.0	25.4	Calm	0	-	c	-	-	-	-	22/00:00
1009.1	24.3	24.9	25.3	Calm	0	-	m	-	-	-	-	04:00
1009.9	25.1	25.2	25.0	Calm	0	-	f	-	-	-	-	08:00 09:00

Denotations;

Weather;

b:	blue sky	d:	drizzling rain
bc:	partly cloudy	p:	passing shower
c:	cloudy	r:	rain
o:	overcast	f:	fog

Wind waves;

	height of waves (m)		height of waves (m)
0:	0	5:	2.5 - 4
1:	0 - 0.1	6:	4 - 6
2:	0.1 - 0.5	7:	6 - 9
3:	0.5 - 1.3	8:	9 - 14
4:	1.3 - 2.5	9:	more than 14

Swells;

	length		height
0:	no swell		less than 2 m
1:	short or average		"
2:	long		"
3:	short	2 m - 4 m	{ short less than 100 m average 100 m - 200 m long more than 200 m
4:	average	"	
5:	long	"	
6:	short	more than 4 m	
7:	average	"	
8:	long	"	

Visibility;

0:	0 m - .50 m	5:	2 km - 4 km
1:	50 m - 200 m	6:	4 km - 10 km
2:	200 m - 500 m	7:	10 km - 20 km
3:	500 m - 1 km	8:	20 km - 50 km
4:	1 km - 2 km	9:	more than 50 km

Sensors of Routine Observations

* see Appendix IV

Quantities	Sensors	Location #	Height above M. S. L.	Scheme of original record
1 Position of ship	Loran	Compus bridge deck	20 m	Ship's log book
2 Depth	Precision Depth Recorder	Bottom of the ship	-5.5 m	Strip chart
3 Ship heading	Gyroscope	Gyro room	8.0 m	"
4 Ship speed	Pressure log	Bottom of the ship	-5.5 m	"
5 Atmospheric pressure	Aneroid barometer	Chart room	10.5 m	Drum chart
6 Air temperature	Tungsten wire thermometer (aspirated)	Compus bridge deck	13.5 m	Strip chart
7 Dew point temperature	Dew cell (aspirated)	"	"	"
8 Sea surface temperature	Platinum wire thermometer	Sea water intake	-1.0 m	"
9 Wind direction and speed	Aero-vane	Top of the foremast	21.8 m	"
10 Cloudiness	Observation by seamen's eyes	_____	_____	Ship's log book
11 Weather	"	_____	_____	Ship's log book or Quartermaster's log book
12 Wind seas	"	_____	_____	
13 Swells	"	_____	_____	
14 Precipitation	Rain gauge	Top of the antirolling tank	11.5 m	Drum chart
15 Visibility	Observation by naked eyes	_____	_____	Quartermaster's log book

Appendix II

Aerological Data

(Please refer Section 4-8, p22)

No.		1			No.		2		
Date		1970.7.8			Date		1970.7.8		
Time		0830-0904			Time		1430-1500		
Position		31.5°N 127°E			Position		31.5°N 127°E		
Surface Wind		265° 6 m/s			Surface Wind		260° 4 m/s		
Surface Pressure		1003.5 mb			Surface Pressure		1004.6 mb		
Note		2 Cu			Note		8 Ac Cu		
Pres- sure	Height	Air Temp.	Hum.	Dew P. Temp.	Pres- sure	Height	Air Temp.	Hum.	Dew P. Temp.
(mb)	(gpm)	(c°)	(%)	(c°)	(mb)	(gpm)	(c°)	(%)	(c°)
Surface		21.2	84	18.2	Surface		23.2	72	17.8
1000	31	20.7	86	18.2	1000	41	22.8	73	17.6
900	934	15.2	89	13.4	900	949	16.1	78	12.3
850	1418	12.9	82	9.9	850	1434	12.2	92	10.9
800	1931	14.7	61	7.2	800	1944	13.2	71	8.6
700	3049	9.6	28	-8.1	700	3065	11.1	36	-3.4
600	4318	3.9	21	-16.5	600	4340	6.4	12	-21.0
500	5783	-0.2	10	-28.3	500	5815	-0.9	12	-26.8
400	7528	-12.7	18	-32.2	400	7560	-11.6	20	-30.0
350	8532	-20.2	17	-39.1	350	8565	-20.5	24	-35.9
300	9652	-29.7	18	-46.6	300	-	-	-	-
250	10924	-40.1	22	(-53.7)	250	-	-	-	-
200	12413	-49.7	-	-	200	-	-	-	-

No.		3			No.		4		
Date		1970.7.8			Date		1970.7.9		
Time		2030-2110			Time		0830-0900		
Position		31.5°N 127°E			Position		31.5°N 127°E		
Surface Wind		255° 5 m/s			Surface Wind		205° 4 m/s		
Surface Pressure		1004.3 mb			Surface Pressure		1005.0 mb		
Note		1 Cu			Note		7 Ac Cu		
Pres- sure	Height	Air Temp.	Hum.	Dew P. Temp.	Pres- sure	Height	Air Temp.	Hum.	Dew P. Temp.
(mb)	(gpm)	(c°)	(%)	(c°)	(mb)	(gpm)	(c°)	(%)	(c°)
Surface		23.1	73	17.9	Surface		22.2	87	19.9
1000	37	22.5	74	17.6	1000	44	22.0	88	19.8
900	943	16.1	78	12.3	900	954	16.9	89	15.2
850	1429	14.5	74	9.9	850	1441	15.6	68	9.7
800	1944	14.6	62	7.4	800	1956	13.6	83	10.7
700	3064	10.6	34	-4.6	700	3076	8.9	81	5.8
600	4332	4.8	14	-20.6	600	4337	1.7	85	-0.6
500	5798	-3.4	40	-15.1	500	5789	-5.4	41	-16.6
400	7525	-14.2	23	-30.8	400	7511	-15.4	13	-37.7
350	8524	-21.6	23	-37.2	350	8506	-22.4	23	-37.9
300	9642	-29.7	40	-39.1	300	9622	-28.5	57	-34.3
250	10914	-40.5	-	-	250	-	-	-	-
200	12401	-50.2	-	-	200	-	-	-	-

No.		5			No.		6		
Date		1970. 7. 9			Date		1970. 7. 9		
Time		1430-1505			Time		2030-2103		
Position		31.5°N 127°E			Position		31.5°N 127°E		
Surface Wind		210° 4 m/s			Surface Wind		- 0 m/s		
Surface Pressure		1004.4 mb			Surface Pressure		1003.8 mb		
Note		8 Cu Ci			Note		0 Cu Ci		
Pres- sure	Height	Air Temp.	Hum.	Dew P. Temp.	Pres- sure	Height	Air Temp.	Hum.	Dew P. Temp.
(mb)	(gpm)	(c°)	(%)	(c°)	(mb)	(gpm)	(c°)	(%)	(c°)
Surface		24.2	81	20.7	Surface		23.4	85	20.6
1000	39	23.7	83	20.6	1000	33	23.2	84	20.3
900	949	17.0	83	14.2	900	947	19.2	88	16.9
850	1437	16.8	70	11.3	850	1437	17.6	69	11.7
800	1954	14.3	71	9.0	800	1954	15.1	73	10.4
700	3072	8.5	74	4.0	700	3074	8.6	41	-4.1
600	4334	3.1	21	-17.2	600	4336	4.0	7	-28.8
500	5791	-4.1	6	-36.5	500	5794	-4.5	9	-32.7
400	7513	-16.0	13	-38.2	400	7515	-15.4	64	-20.7
350	8507	-21.8	25	-36.6	350	8511	-22.3	66	-27.0
300	9623	-29.7	26	-43.2	300	9630	-29.1	60	-34.4
250	10903	-37.7	37	-47.1	250	10906	-38.9	39	-47.7
200	12405	-48.9	-	-	200	12399	-51.1	-	-

No.		7			No.		8		
Date		1970. 7. 10			Date		1970. 7. 10		
Time		0830-0909			Time		1430-1507		
Position		31.5°N 127°E			Position		31.5°N 127°E		
Surface Wind		100° 4 m/s			Surface Wind		90° 7 m/s		
Surface Pressure		1004.0 mb			Surface Pressure		1002.4 mb		
Note		10 Sc Ns			Note		10 Cb Ns		
Pres- sure	Height	Air Temp.	Hum.	Dew P. Temp.	Pres- sure	Height	Air Temp.	Hum.	Dew P. Temp.
(mb)	(gpm)	(c°)	(%)	(c°)	(mb)	(gpm)	(c°)	(%)	(c°)
Surface		23.6	94	22.6	Surface		23.9	94	22.9
1000	35	23.3	94	22.3	1000	21	23.8	94	22.8
900	950	18.8	100	18.8	900	938	19.0	97	18.5
850	1440	16.7	98	16.8	850	1429	17.1	98	16.8
800	1958	15.8	81	17.5	800	1946	14.5	93	13.4
700	3082	9.3	89	7.6	700	3067	9.1	96	8.4
600	4348	3.3	79	0.0	600	4334	3.2	98	2.8
500	5806	-4.9	59	-11.7	500	5794	-4.6	90	-6.1
400	7531	-15.2	60	-21.2	400	7527	-12.0	85	-14.0
350	8531	-19.9	77	-22.8	350	8540	-17.8	60	-23.7
300	9656	-28.7	74	-31.9	300	9674	-26.5	66	-31.0
250	10933	-38.8	69	-42.4	250	10968	-35.7	71	-39.2
200	12428	-50.3	-	-	200	12481	-48.6	-	-

No.		9			No.		10		
Date		1970. 7. 10			Date		1970. 7. 11		
Time		2030-2107			Time		0830-0905		
Position		31.5°N 127°E			Position		31.5°N 127°E		
Surface Wind		35° 8 m/s			Surface Wind		360° 6 m/s		
Surface Pressure		1001.1 mb			Surface Pressure		1004.2 mb		
Note		10 Cb Ns			Note		8 Cu		
Pres- sure	Height	Air Temp.	Hum.	Dew P. Temp.	Pres- sure	Height	Air Temp.	Hum.	Dew P. Temp.
(mb)	(gpm)	(c°)	(%)	(c°)	(mb)	(gpm)	(c°)	(%)	(c°)
Surface		20.7	90	20.9	Surface		23.3	90	21.5
1000	10	22.6	90	20.8	1000	37	23.2	90	21.4
900	927	19.4	92	18.0	900	951	18.4	92	17.1
850	1417	16.4	(100)	(16.4)	850	1444	16.6	82	13.5
800	1934	14.4	(100)	(14.4)	800	1957	15.6	75	11.2
700	3057	10.0	99	9.8	700	3078	9.5	84	6.8
600	4328	3.5	92	2.3	600	4347	3.8	56	-4.2
500	5791	-3.9	94	-4.7	500	5808	-3.8	42	-14.9
400	7525	-13.7	99	-13.8	400	7532	-13.4	77	-16.5
350	8528	-20.0	88	-21.4	350	8538	-19.0	84	-20.9
300	9653	-28.4	82	-30.4	300	9669	-27.0	74	-30.3
250	10934	-38.6	79	-40.8	250	10957	-36.9	57	-42.4
200	12424	-51.5	-	-	200	12458	-49.9	-	-

No.		11			No.		12		
Date		1970. 7. 11			Date		1970. 7. 11		
Time		1430-1505			Time		2030-2103		
Position		31.5°N 127°E			Position		31.5°N 127°E		
Surface Wind					Surface Wind		145° 2 m/s		
Surface Pressure		1004.7 mb			Surface Pressure		1006.8 mb		
Note		10 As Ac Cu			Note		8 Sc As Cu		
Pres- sure	Height	Air Temp.	Hum.	Dew P. Temp.	Pres- sure	Height	Air Temp.	Hum.	Dew P. Temp.
(mb)	(gpm)	(c°)	(%)	(c°)	(mb)	(gpm)	(c°)	(%)	(c°)
Surface		23.1	85	20.4	Surface		23.5	90	21.8
1000	41	27.8	86	20.3	1000	59	23.2	91	21.7
900	955	19.6	71	14.1	900	973	18.7	85	16.1
850	1446	17.1	78	13.2	850	1462	16.6	83	13.6
800	1962	13.9	90	12.4	800	1978	14.9	68	9.2
700	3079	10.9	50	0.9	700	3097	8.3	83	5.6
600	4349	5.8	51	-3.5	600	4357	1.6	100	8.4
500	5807	-6.3	78	-9.5	500	5813	-3.5	22	-22.2
400	7534	-12.3	93	-13.3	400	7545	-14.0	53	-21.5
350	8546	-18.0	91	-19.2	350	8550	-19.5	85	-21.3
300	9682	-25.8	89	-27.2	300	9679	-27.3	89	-26.8
250	10977	-36.3	87	37.7	250	10964	-37.8	83	40.6
200	12487	-48.3	-	-	200	12464	-49.3	-	-

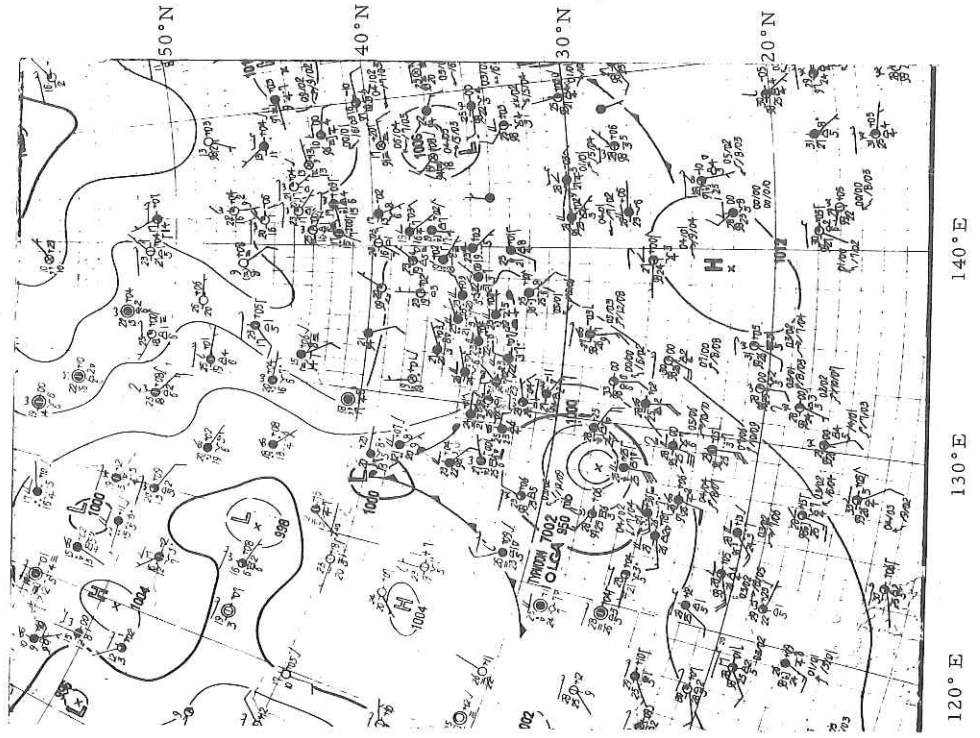
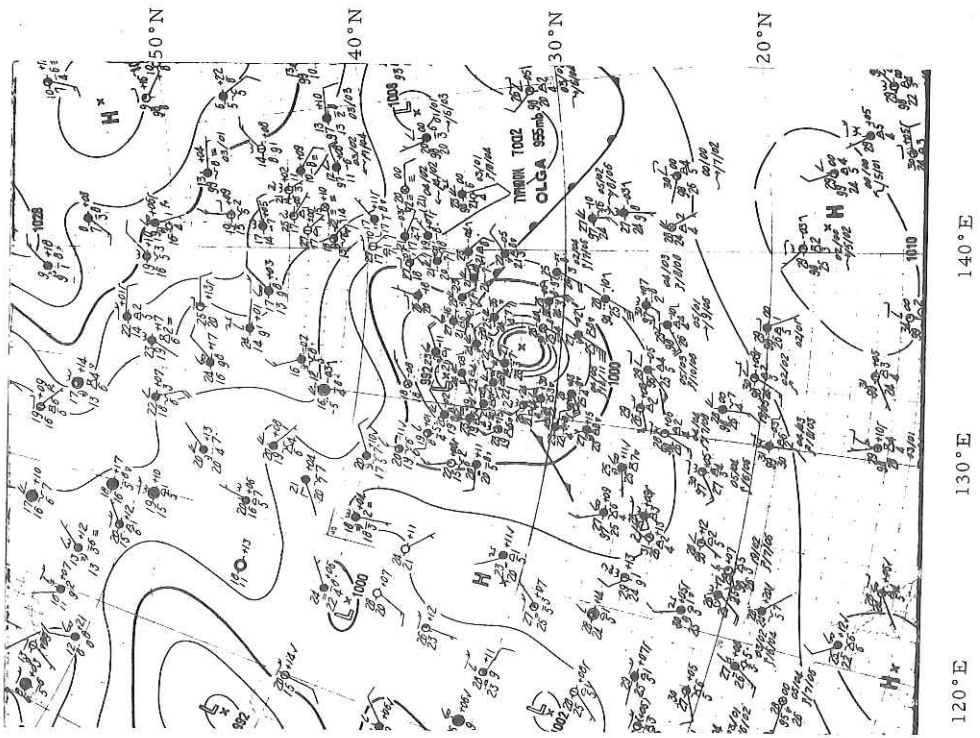
No.		13			No.		14		
Date		1970. 7. 12			Date		1970. 7. 12		
Time		0830-0920			Time		1430-1507		
Position		31.5°N 127°E			Position		31.5°N 127°E		
Surface Wind		90° 8 m/s			Surface Wind		90° 7 m/s		
Surface Pressure		1006.5 mb			Surface Pressure		1005.9 mb		
Note		10 Ns Sc			Note		10 Ns Sc		
Pres- sure	Height	Air Temp.	Hum.	Dew P. Temp.	Pres- sure	Height	Air Temp.	Hum.	Dew P. Temp.
(mb)	(gpm)	(c°)	(%)	(c°)	(mb)	(gpm)	(c°)	(%)	(c°)
Surface		22.8	95	22.0	Surface		24.0	98	23.7
1000	57	22.4	95	21.7	1000	52	24.0	98	23.7
900	969	19.2	93	18.0	900	976	21.2	100	21.2
850	1461	17.7	94	16.7	850	1473	19.2	100	19.2
800	1979	15.2	91	13.8	800	1994	16.4	98	16.1
700	3114	10.0	98	9.7	700	3124	11.1	94	10.2
600	4373	2.3	94	1.4	600	4398	4.5	90	2.9
500	5834	-3.2	95	-3.8	500	5867	-2.5	90	-3.9
400	7576	-11.7	89	-13.2	400	7611	-11.4	92	-12.5
350	8589	-17.6	84	-19.6	350	8623	-17.5	88	-19.1
300	9727	-25.0	80	-27.4	300	9763	-24.4	73	-27.8
250	11027	-34.8	76	-37.7	250	11066	-34.3	48	-41.5
200	12542	-47.6	-	-	200	12585	-45.8	-	-

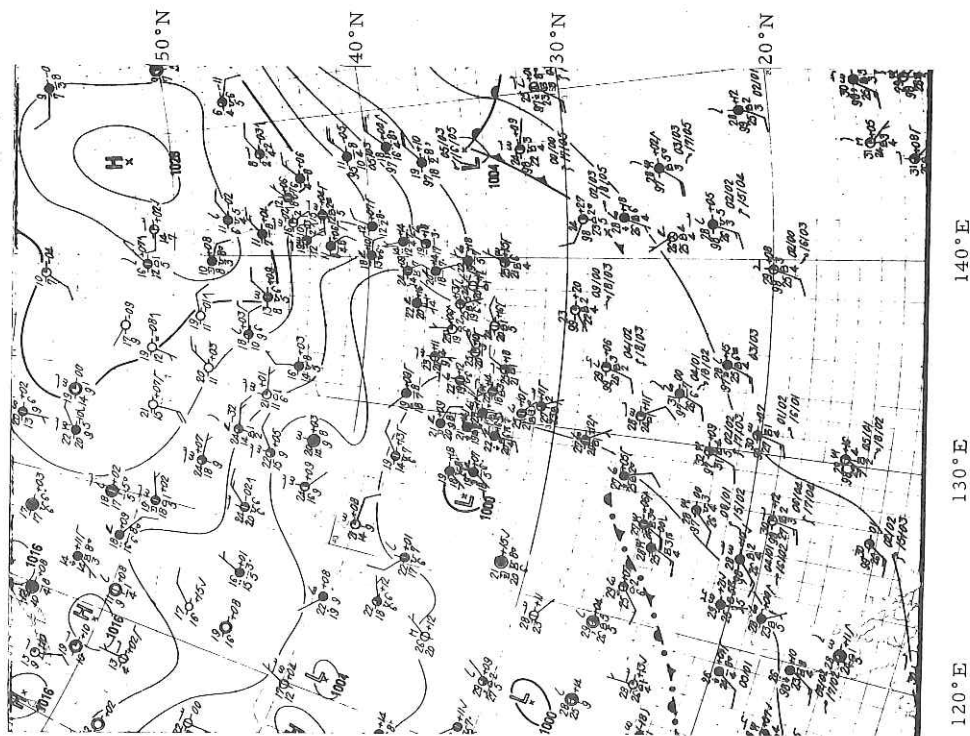
No.		D-1			No.		D-2		
Date		1970. 7. 16			Date		1970. 7. 17		
Time		2030-2104			Time		0830-0903		
Position		29°N 132°E			Position		29°N 132°E		
Surface Wind		170° 5 m/s			Surface Wind		200° 5 m/s		
Surface Pressure		1013.7 mb			Surface Pressure		1013.9 mb		
Note		3 Cu			Note		4 Ci Cu		
Pres- sure	Height	Air Temp.	Hum.	Dew P. Temp.	Pres- sure	Height	Air Temp.	Hum.	Dew P. Temp.
(mb)	(gpm)	(c°)	(%)	(c°)	(mb)	(gpm)	(c°)	(%)	(c°)
Surface		28.3	85	25.6	Surface		28.1	83	25.0
1000	122	27.8	87	25.4	1000	122	27.2	86	24.7
900	1052	22.5	82	19.2	900	1049	21.6	72	16.1
850	1549	20.5	76	16.0	850	1544	19.8	51	9.3
800	2073	20.0	38	5.3	800	2065	18.0	37	3.0
700	3209	12.3	50	2.1	700	3195	12.1	40	-1.1
600	4487	6.3	31	-9.6	600	4469	4.6	53	-4.2
500	5955	-3.1	36	-16.1	500	5933	-3.1	27	-19.6
400	7691	-12.7	18	-32.2	400	7667	-13.6	25	-29.5
350	8695	-19.9	17	-38.8	350	8671	-20.0	39	-30.4
300	9819	-28.8	21	-44.3	300	9796	-28.3	36	-38.7
250	11099	-37.5	34	-47.6	250	11076	-38.6	47	-45.6
200	12598	-50.7	-	-	200	12568	-51.1	-	-

No.	D-3			
Date	1970.7.17			
Time	2030-2106			
Position	29°N 132°E			
Surface Wind	135° 4 m/s			
Surface Pressure	1012.3 mb			
Note	1 Cu			
Pressure	Height	Air Temp.	Hum.	Dew P. Temp.
(mb)	(gpm)	(c°)	(%)	(c°)
Surface		28.3	85	25.5
1000	110	27.8	88	25.6
900	1040	22.7	79	18.8
850	1538	20.3	80	16.6
800	2060	17.9	73	12.9
700	3195	12.7	63	5.8
600	4474	4.6	74	0.4
500	5942	-2.2	47	-12.0
400	7683	-12.7	27	-27.9
350	8689	-19.5	48	-27.7
300	9820	-27.1	57	-33.1
250	1110.5	-37.8	52	-44.1
200	1260.5	-50.5		

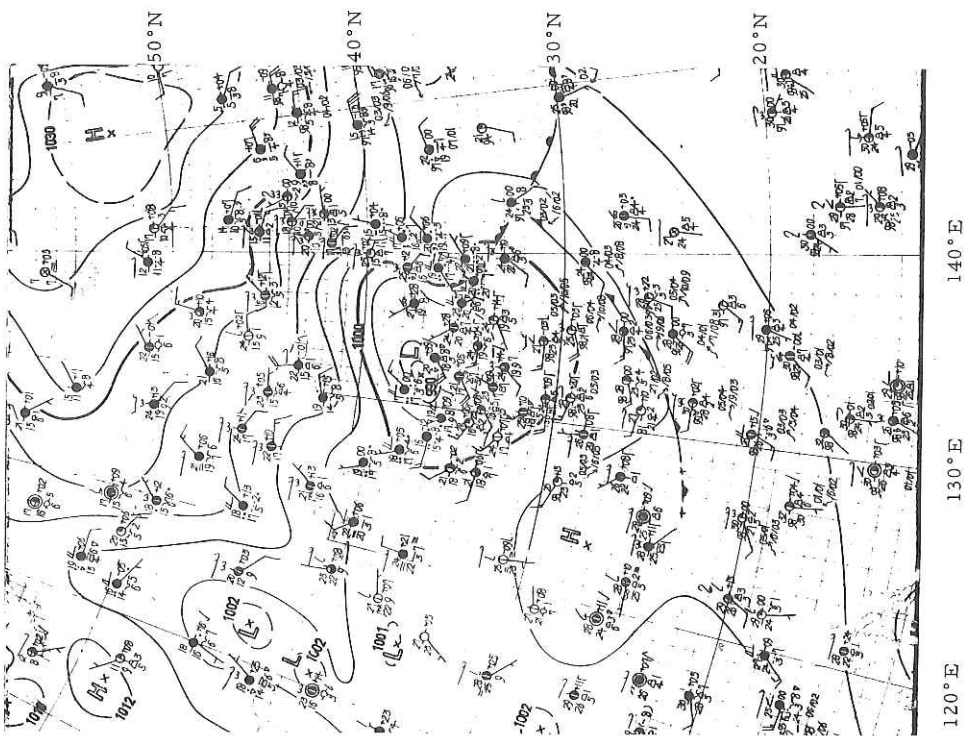
Appendix III
Weather Charts
(July 4--July 21, 1970)

reprinted from "Monthly Weather Chart"
published by Japan Meteorological Agency

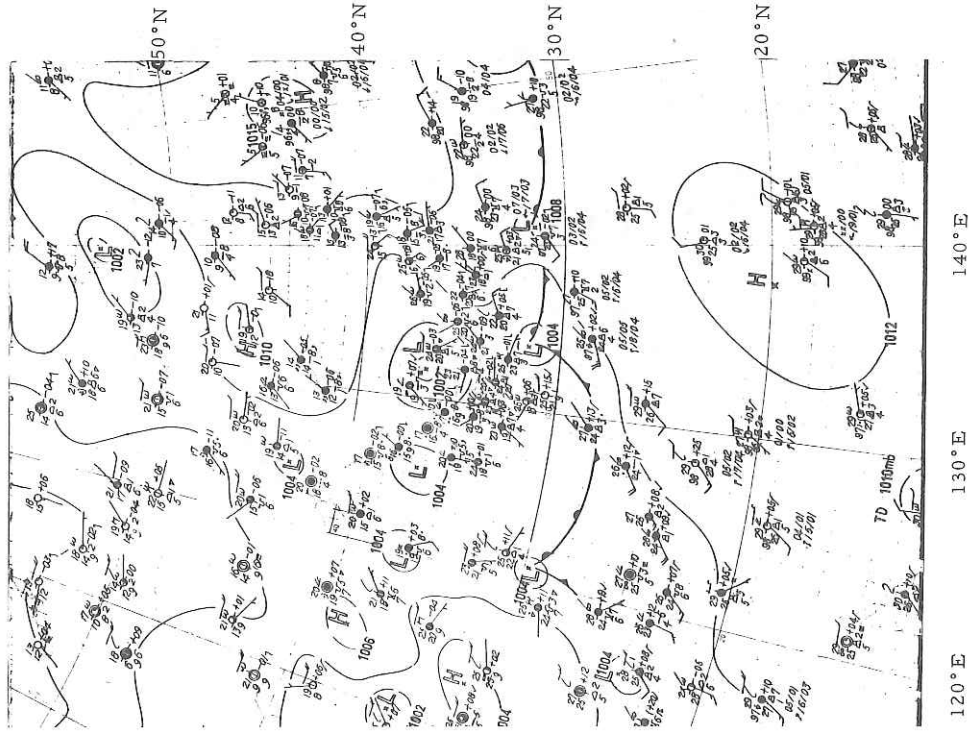




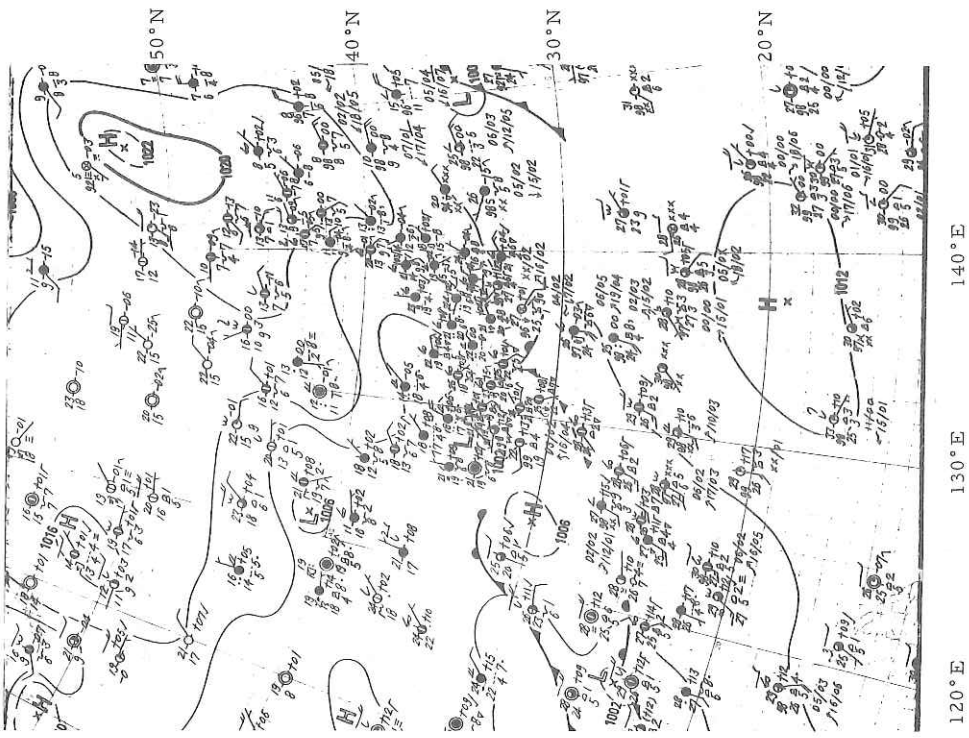
July 7, 0900 JST



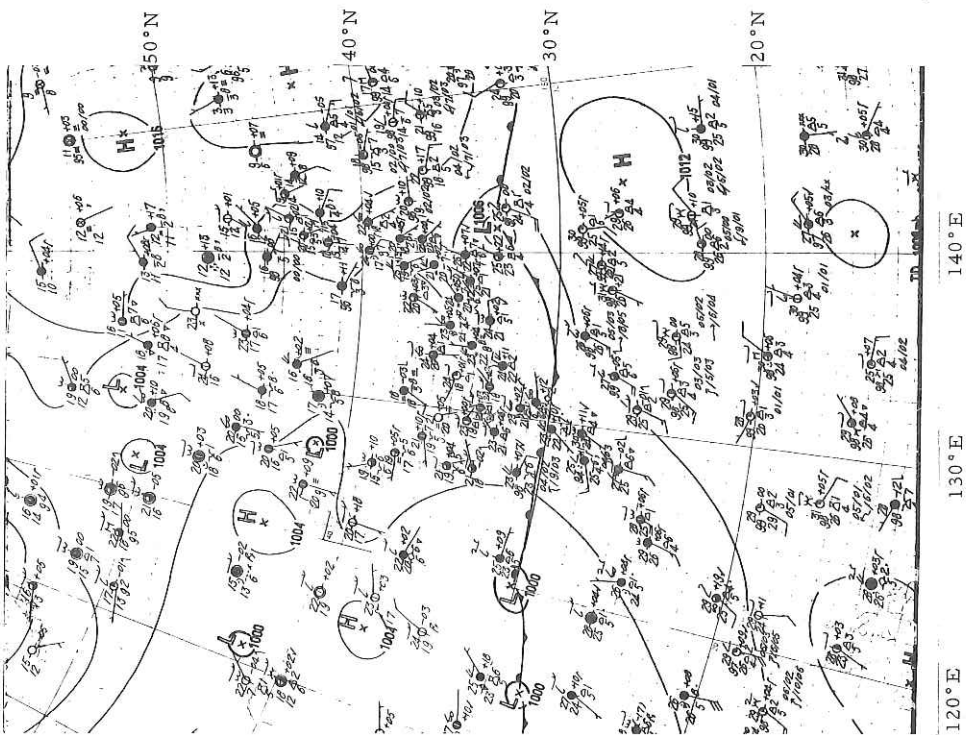
July 6, 0900 JST



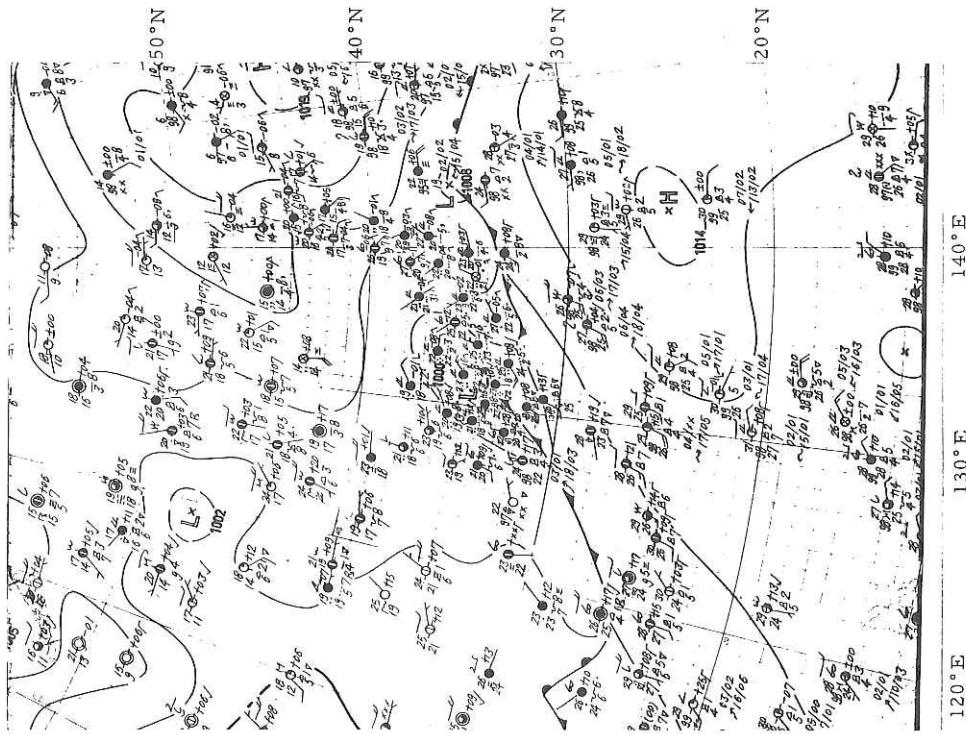
July 9, 0900 JST



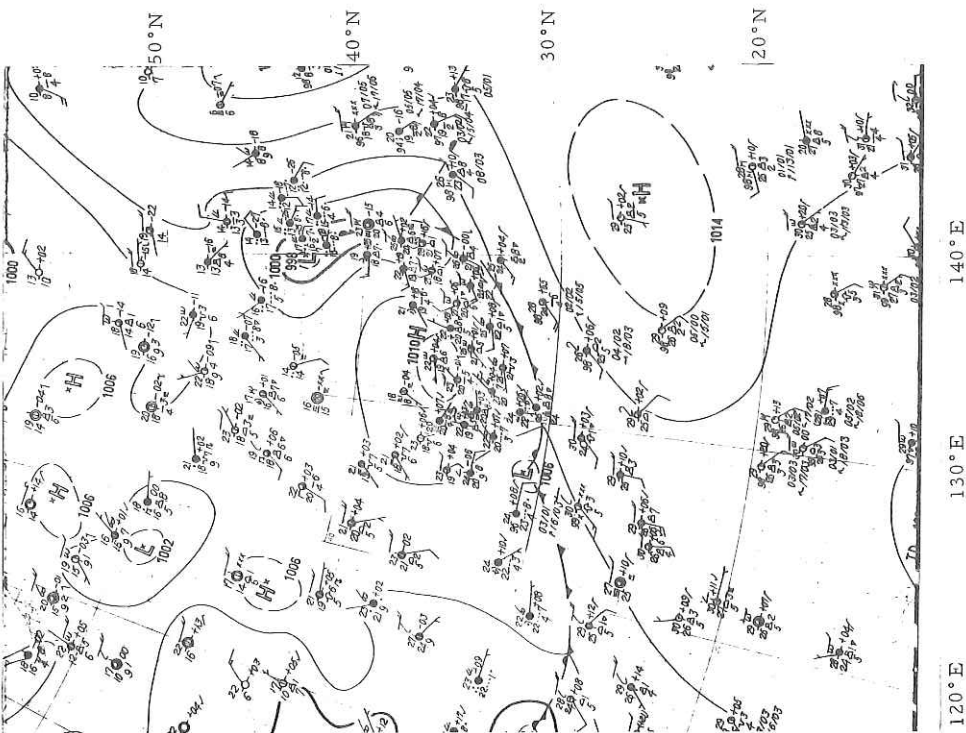
July 8, 0900 JST



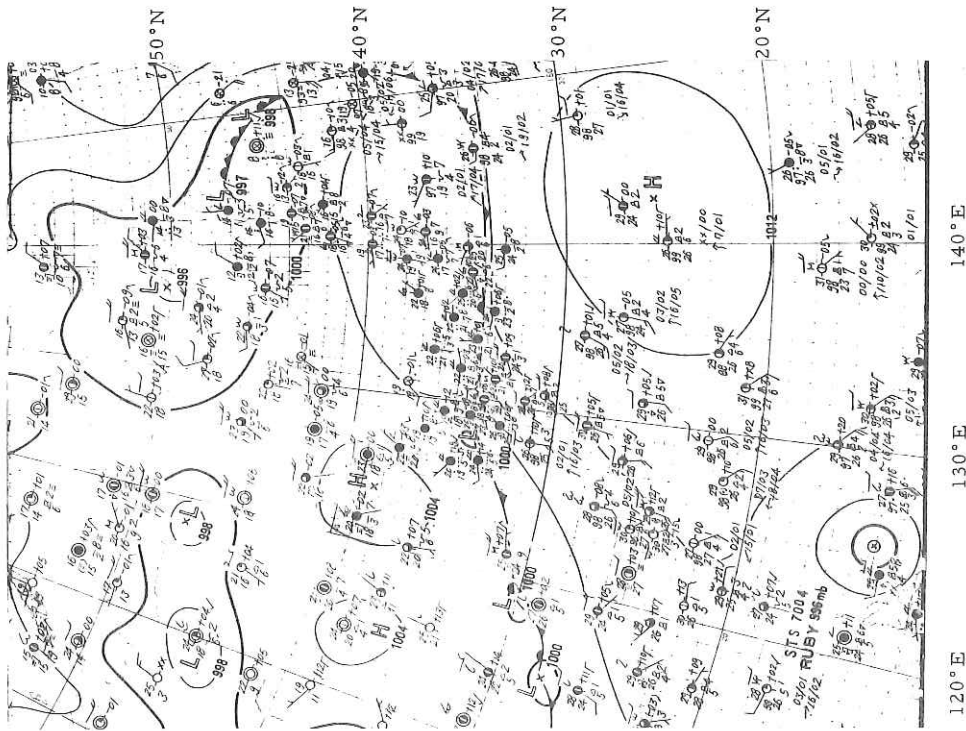
July 10, 0900 JST



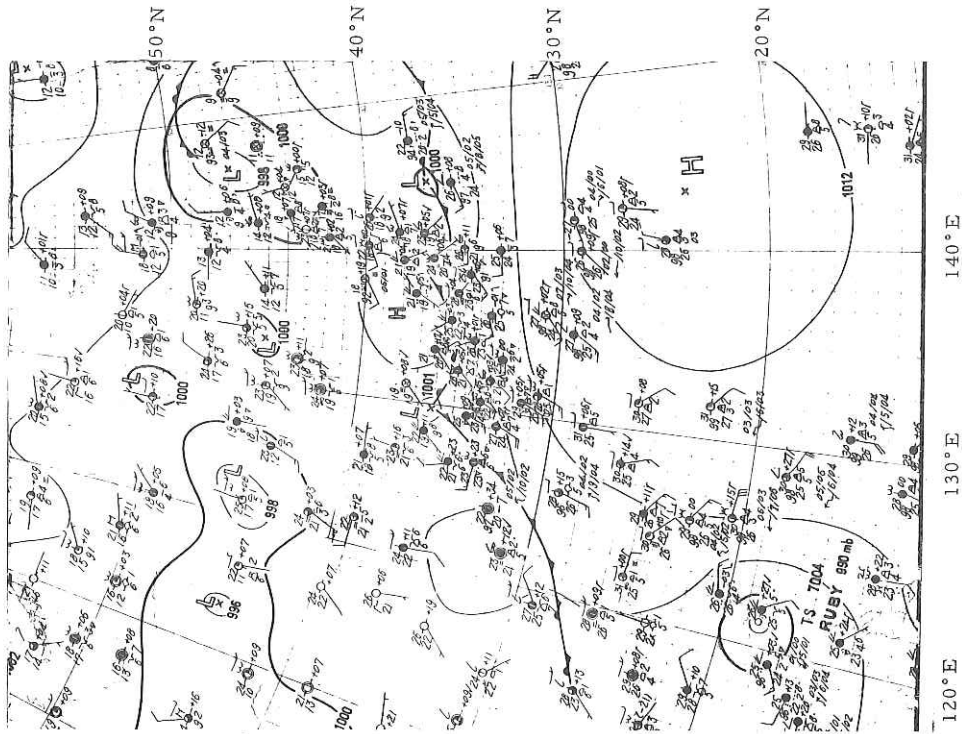
July 11, 0900 JST



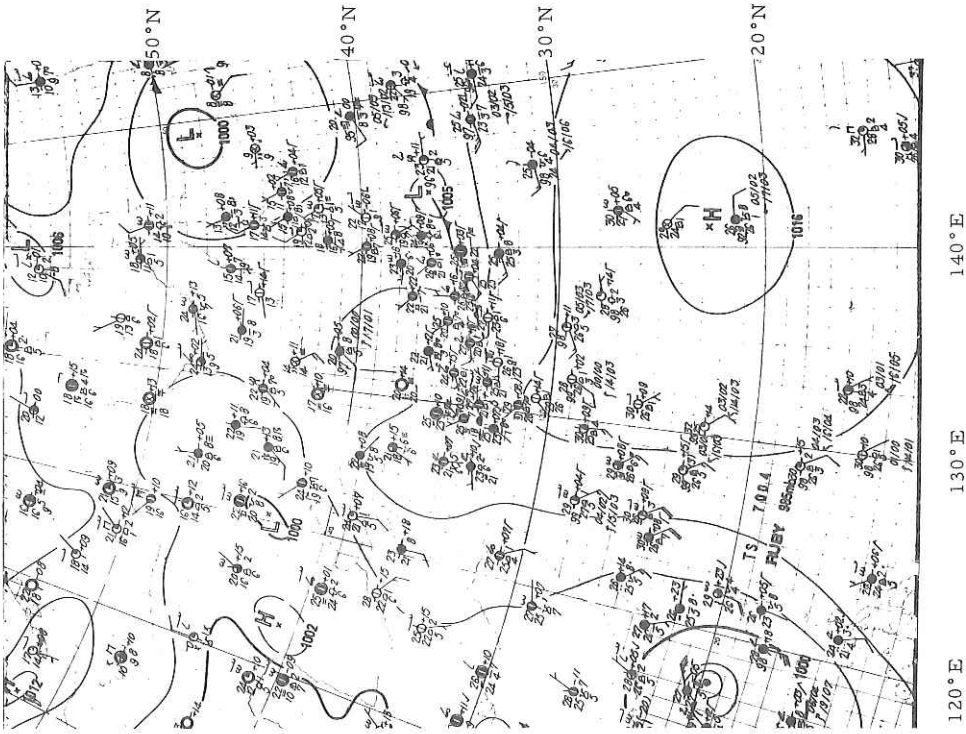
July 12, 0900 JST



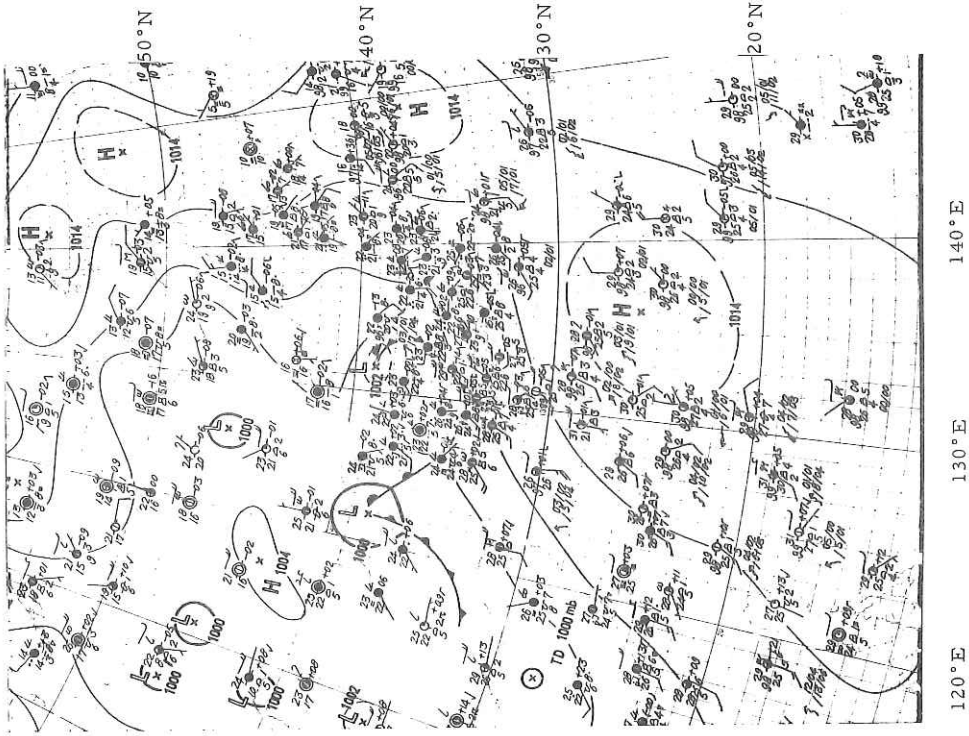
July 13, 0900 JST



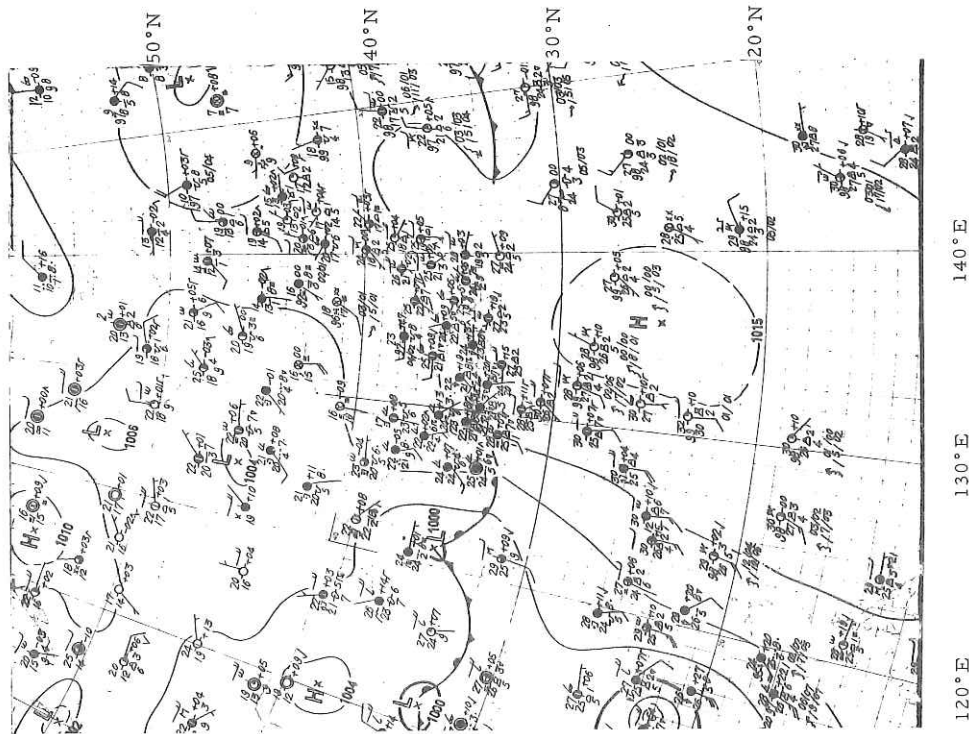
July 14, 0900 JST



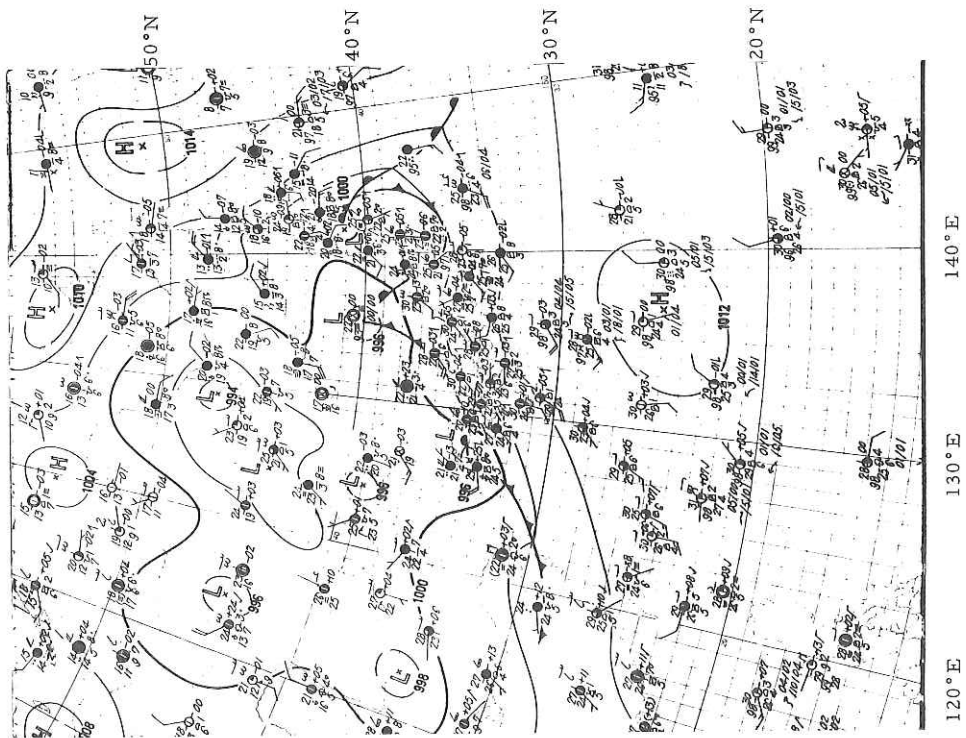
July 15, 0900 JST



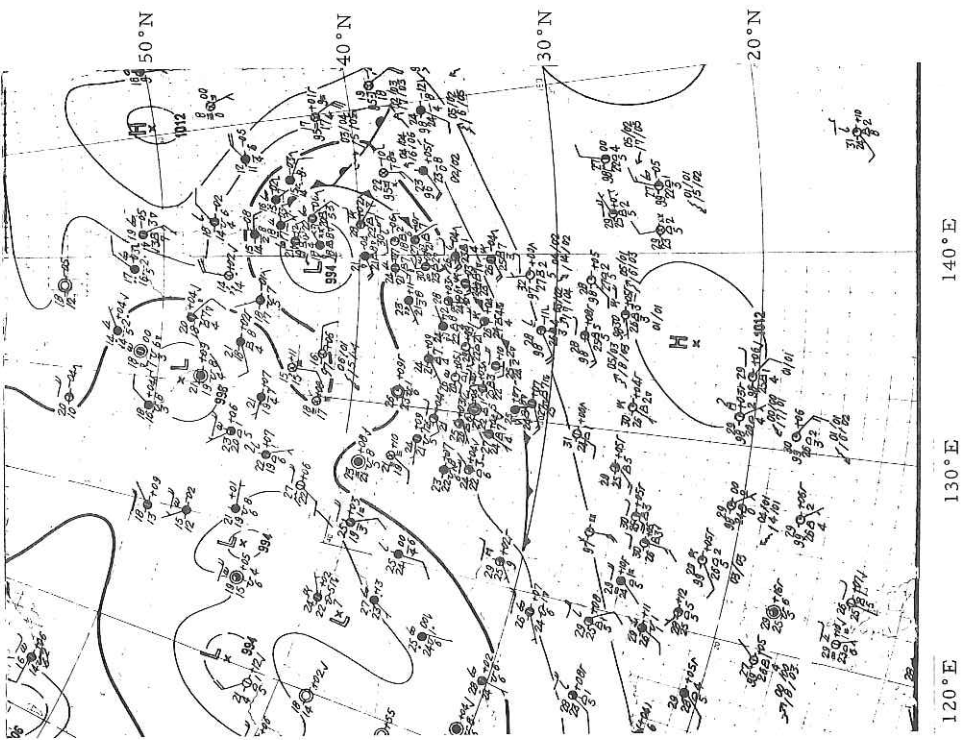
July 17, 0900 JST



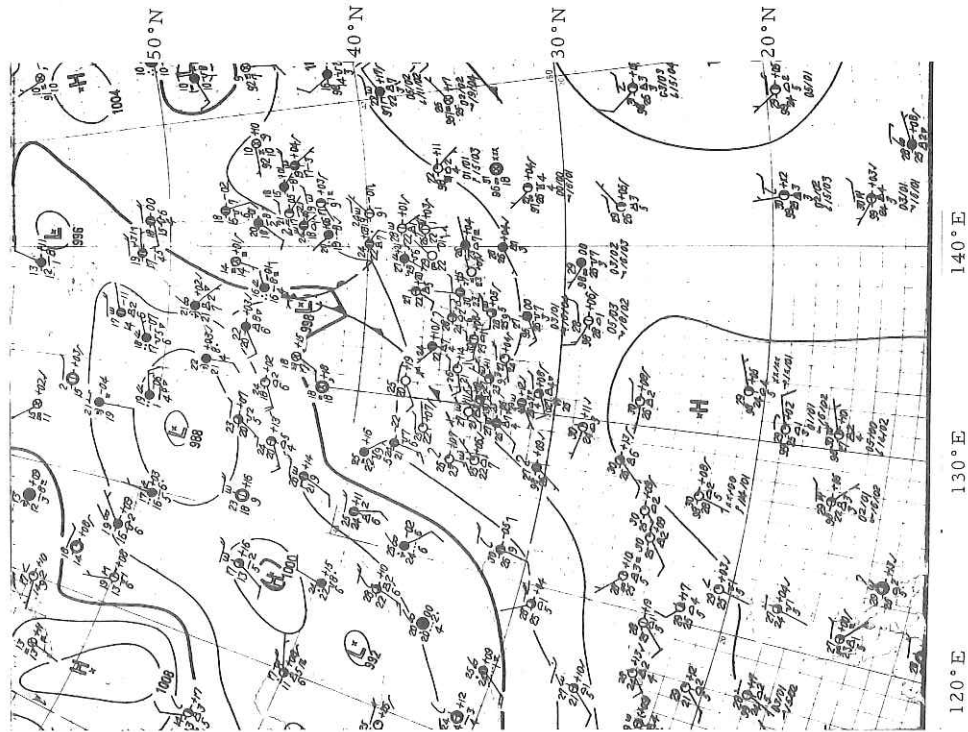
July 16, 0900 JST



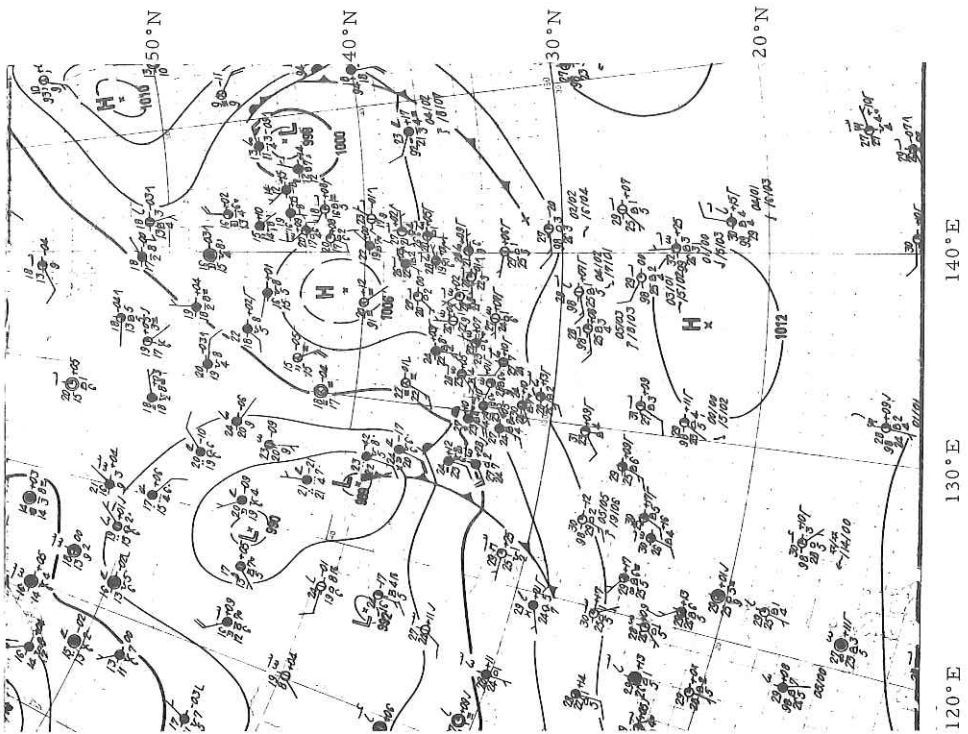
July 18, 0900 JST



July 19, 0900 JST



July 21, 0900 JST



July 20, 0900 JST

Appendix IV

The R/V Hakuho Maru equipped with the apparatus for this expedition

Ship Specification

Length (o. a):	94.96 m
Breadth (mld):	14.80
Depth (mld):	7.30
Gross tonnage:	3225.5 ton
Propulsion:	Diesel electric Twin propellers 700 kw motor x 4
Bow thruster:	375 kw
Max. speed:	16 kt
Complement:	Scientists 32 Crew 55
Research equipments:	9 Laboratories 10 winches 15 ton crane 12 ton boat Electronic computer etc.

Equipments:

- 1: Bow-boom 2: Foremast 3: Balloon release platform for the radiosonde.
- 4: 15 ton crane 5: Winches 6: Bow thruster 7: Captive balloon 8: Moored buoy 9: Chart Rm. 10: No. 1 Lab. 11: No. 2 Lab. 12: No. 3 Lab. 13: No. 6 and 7 Lab. 14: Computer Rm. 15: Gravity meter Rm. 16: Aerovane 17: Thermometer 18: Hygrometer 19: Barometer 20: Rain gauge 21: Radiation thermometer 22: STD sensor

