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**Atmospheric and Oceanographic Data Report for
Saroma-ko Lagoon of the SARES
(Saroma-Resolute Studies) Project, 1992*,****

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Abstract : As part of the joint Japanese and Canadian scientific experiment of the SARES (Saroma-Resolute Studies) project, meteorological and oceanographic studies were carried out

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at Saroma-ko Lagoon during winter and spring of 1992. Several meteorological and oceanographic variables obtained from this experiment are summarized in this study. Long-term atmospheric data have been collected at a permanently installed 5-m tower at a cape on Saroma-ko Lagoon to characterize the general atmospheric and climatological features at the lagoon. A number of atmospheric boundary layer variables were obtained to characterize the atmospheric boundary layer and sea-ice features in Saroma-ko Lagoon during winter and spring over a limited period. A number of oceanographic variables were obtained to describe the general physical oceanographic features in the lagoon. Measurements of turbulent fluxes of momentum, heat and salt were made to characterize the oceanic boundary layer under the sea-ice during winter over a limited period.

要旨：日本とカナダとの共同研究である [SARES (Saroma-Resolute Studies) Project] の一端として、冬季サロマ湖において、気象学、海洋学、生物学の総合的研究が1992年に行なわれた。本研究では、このサロマ湖の観測において得られた気象学及び海洋学的要素について議論する。サロマ湖の岬に設置された5mの気象塔からは一年間の気象要素の変動が求められた。サロマ湖の冬から春にかけては、海氷を通しての 대기境界層、海洋境界層、海氷下の水塊構造、海氷の性質等の現場観測が行なわれた。また、海氷下の乱流構造の研究も行なわれ、運動量、熱及び塩フラックスが求められた。

Key words : Atmospheric variables, Oceanographic variables, Sea ice, Saroma-ko Lagoon, Turbulent flux

キーワード：気象要素，海洋要素，海氷，サロマ湖，乱流フラックス

I. Introduction

Initiation of the SARES (Saroma-Resolute Studies) project was described in a paper e.g. by Legendre (1993), and its summary is briefly introduced below. The SARES project was conducted within the context of the Canada-Japan Agreement on Cooperation in Science and Technology, signed in Tokyo on 7 May 1986. In order to implement this agreement, the two countries conducted a joint study for enhanced cooperation in the field of science and technology, i.e. Canada-Japan Complementarity Study. One of the six studies recommended for this Complementarity Study was "The influence of the North Polar region on global climatic change and global scale simulation". One of its subthemes was "The biological CO₂ pump under the first-year ice of the Arctic Ocean", proposed by a group of Canadian oceanographers in collaboration with Japanese colleagues. They recommended a study of the role of the ice-covered Arctic Ocean including its marginal seas as a potential sink of carbon dioxide. Additionally, a parallel Japanese proposal was "The biological processes in the Arctic polynya areas", funded by the Ministry of Education, Science and Culture of Japan. The Japanese and Canadian joint field

works of the SARES project were conducted during winter and spring of 1992, in Saroma-ko Lagoon, Hokkaido, Japan, between 18 February and 28 March, and in Resolute, Northwest Territories, Canada, between 7 April and 30 June.

As part of the SARES project, atmospheric and oceanographic studies were carried out at Saroma-ko Lagoon during winter and spring of 1992. Observations of atmospheric and oceanographic variables obtained from this field work are summarized in Table 1.

II. Characteristics of Ice Conditions at Saroma-ko Lagoon

The General characteristics of Saroma-ko Lagoon are described in a paper by Shirasawa (1993). Saroma-ko Lagoon, located on the Okhotsk Sea coast of Hokkaido, is 149.2 km² in area, 19.5 m in maximum depth and 14.5 m in mean depth (Fig. 1). The lagoon has two channels which are connected to the Sea of Okhotsk. About 90 % of the total inflow from the sea to the lagoon passes through the main channel, which was opened in 1927. The remainder passes through the secondary channel, which was built in December, 1978. Freshwater input, which is mainly supplied by two major rivers, causes a reduction of salinity to less than 32 ppt. During winter most of the lagoon surface is covered with sea ice. Shown in Fig. 2 are year-to-year changes in the duration of complete ice coverage in Saroma-ko Lagoon, along with the ice coverage duration in the Sea of Okhotsk adjacent to the lagoon observed with the sea-ice radar in Abashiri (Fig. 1). It is shown that the trend of variations in the duration appears to be similar in both areas and that both durations have decreased for the past ten years (Fig. 2). Duration of complete ice coverage before and after the opening of the secondary channel was 110 ± 10 days during the period between 1963 and 1978, and 72 ± 35 days during the period between 1979 and 1992, respectively. Comparison of the correlation in annual ice coverage duration between the lagoon and the sea showed that the period after the opening of the second channel was much better correlated (0.88) than that before the opening (0.39). The opening of the channel, therefore, might have caused changes in the water mass and current circulation of the lagoon, and in the exchange processes of the water between sea and lagoon waters. It was also suggested that these changes in the lagoon's water budget following the opening of the second channel might be related to the decrease in period of ice cover (Shirasawa, 1993).

During the winter of 1992, the surface of Saroma-ko Lagoon was completely covered with sea ice from 5 February to 4 April, while sea ice in the Sea of Okhotsk existed within the 30 -n.m. radar coverage at the Abashiri radar station (Fig. 1) from 29 January to 6 April (4.4 and 5. in Table 1).

Table 1. Observations of meteorological, oceanographic and ice conditions at Saroma-ko Lagoon during a period from December, 1991 to December, 1992.

Site	Observation	Item	In charge	Duration Day/Month/Year	
1. Kimuaneppu	Meteorological data at 5-m tower at the cape	Wind speed/azimuth, air temperature	Shirasawa	27/Dec/91–31/Dec/92	
2. Sakaeura	Meteorological data on the breakwater	Wind speed/azimuth, air/surface temps., solar radiation, humidity	Shirasawa	24/Dec/91–10/Jun/92	
3. Near Ice Sta. (44°06'34"N 143°56'32"E)	Oceanographic data Electromagnetic current meter	Current speed/azimuth, water temperature	Shirasawa	19/Dec/91–13/Apr/92	
4. Ice Station (44°06'52"N 143°56'59"E)	1. Meteorological data a. on the snow/ice surface b. on the pool	Wind speed/azimuth, air/ice/water/sur. temps., momentum, heat & CO ₂ fluxes	Shirasawa	22/Feb/92–05/Mar/92	
		2. Oceanographic data	CTD profiles		Shirasawa
		Tide gauge	Ingram		21/Feb/92–06/Mar/92
		Current speed/azimuth, temp. & sal. (S4)	Ingram		22/Feb/92–05/Mar/92
		Momentum, heat & salt fluxes	Shirasawa		26/Feb/92–28/Feb/92
		Melt rate of ice	Hudier		28/Feb/92–02/Mar/92
	3. Ice structure	Ice core sampling	Shirasawa, Robineau		
	4. Ice condition	Ice/snow thickness	Robineau		
	Complete ice coverage	Shirasawa	05/Feb/92–04/Apr/92		
5. Abashiri	Ice condition Sea-ice radar	Sea-ice distribution, ice coverage duration	Shirasawa	29/Jan/92–06/Apr/92	

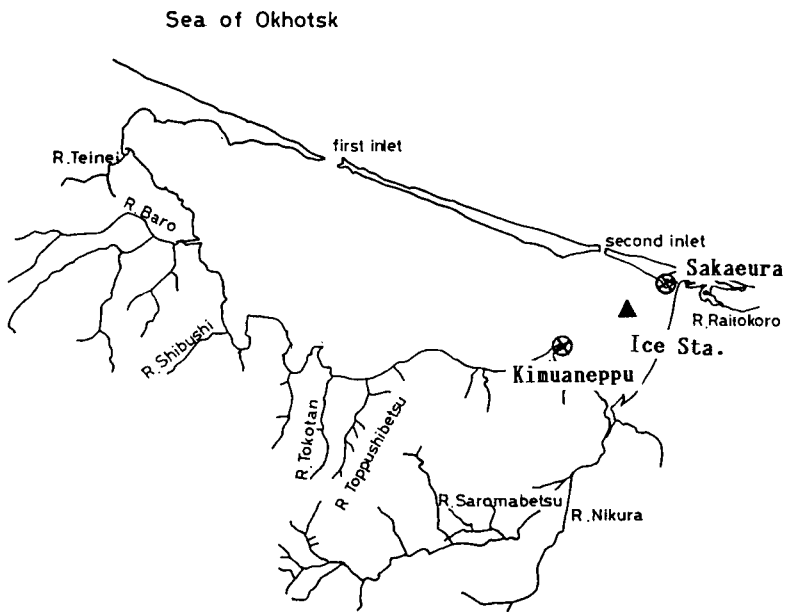
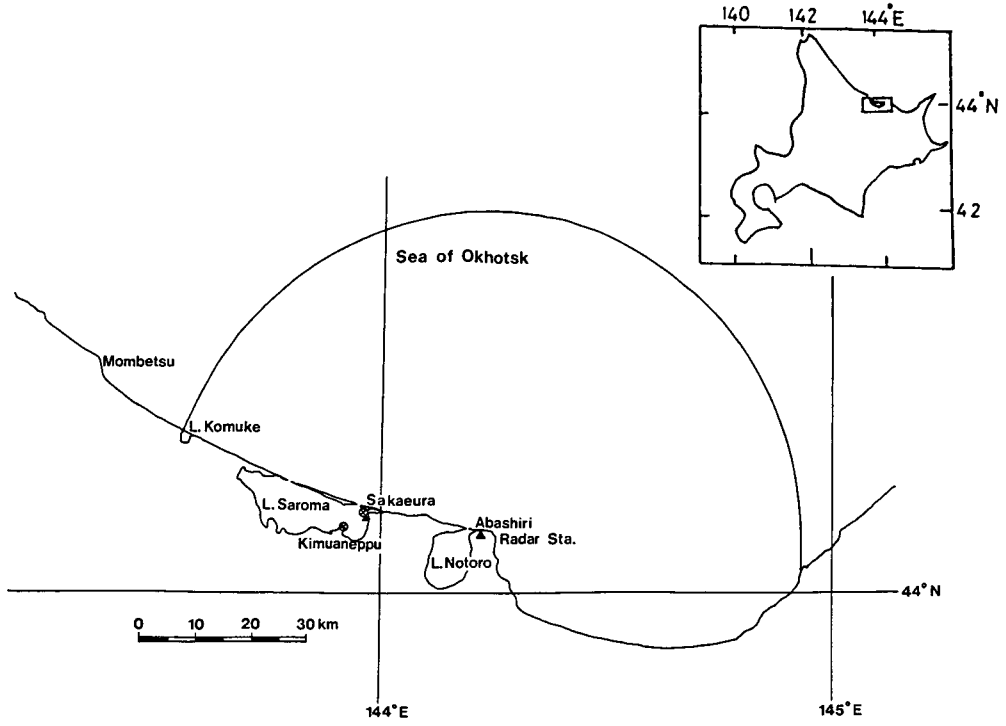


Fig. 1 Study area

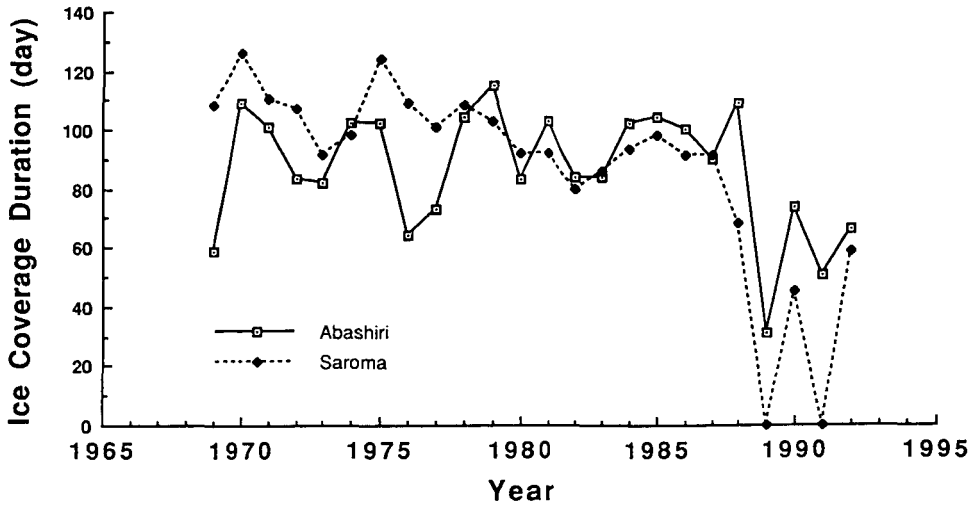


Fig. 2 Year-to-year changes in duration of complete ice coverage in Saroma-ko Lagoon and ice coverage duration within the 30-n.m. radar coverage at the Abashiri ice-radar station

III. Atmospheric Data

1. Atmospheric data at the meteorological tower at Kimuanepu

A location map of the meteorological tower at Kimuanepu along with other study areas in this paper is shown in Fig. 1. The Saroma Research Center of Aquaculture in Tokoro has been operating a 5-m meteorological tower (Intelligent Data-Stocker DS-64 and LM-30K, Kona Sapporo Co.) at the cape of Kimuanepu since 1989 (Fig. 3). Atmospheric variables such as wind speed and direction and air temperature have been measured in conjunction with the SARES project since 27 December 1991 (1. in Table 1). The daily values of air temperature, wind speed and direction, and solar radiation during the period from 27 December 1991 to 31 December 1992 are listed in Table 2. A pyrhelimeter was installed at the beginning of August, 1992. Therefore the solar radiation data are available only from 4 August 1992. Time series of wind speed and direction, air temperature, and solar radiation are shown in Fig. 4 for each month. Values for those graphs were obtained at a sampling interval of 10 min except for stick diagrams of wind vectors on the uppermost frame in the figure, which were produced from data with a sampling interval of one hour. A time series of windroses for each month for the year 1992 is shown in Fig. 5. Northerly winds were predominant in February. Subsequently, predominant winds shifted to southerly and easterly in March.



Fig. 3 A 5-m meteorological tower set up at the cape of Kimuaneppu

2. Atmospheric data on the breakwater at Sakaeura

A portable meteorological station (Squirrel Meter/Logger 1200 Ser., Grant Instruments Ltd.) was installed on the breakwater of the Sakaeura harbour to obtain meteorological variables in the atmospheric boundary layer over Saroma-ko Lagoon during winter and spring of 1992 (Fig. 1). A number of variables such as wind speed and direction, air temperatures at the heights of 2, 75, 150, and 184 cm, surface brightness temperature, humidity at the height of 150 cm, and solar radiation were obtained during the period from 24 December 1991 through 10 June 1992 (2. in Table 1). Time series of wind speed, air temperature at the height of 1.84 m, surface brightness temperature, and solar radiation, all obtained with a sampling interval of 30 min are shown in Fig. 6. The stick diagram of winds on the uppermost frame in Fig. 6 was drawn from values with a sampling interval of two hours. During February through March the wind speed was about 15 m/s at maximum and NW winds were predominant. The air temperature started to increase early in March and significantly increased beyond 0°C late March. The surface brightness temperature also increased suddenly in late March in response to ice breakup around the breakwater. The solar radiation was about 400 W/m^2 at the daily maximum early in February and increased to about 700 W/m^2 at the daily maximum at the end of March.

Table 2 Daily values of air temperature, wind speed and azimuth, and solar radiation obtained at Kimuaneppu during the period between 27 December 1991 and 31 December 1992.
December 1991 Kimuaneppu, Saroma-ko Lagoon

Date	Air Temperature			Wind				Solar Radiation		
	Mean °C	Max. °C	Min. °C	Mean m/s	Max. m/s	Min. m/s	Most Freq. Dir.	Cumulative kW/m ² ·h	Max. kW/m ²	Min. kW/m ²
1	---	---	---	---	---	---	---	---	---	---
2	---	---	---	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---	---	---	---
5	---	---	---	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---	---	---	---
8	---	---	---	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---	---	---	---
11	---	---	---	---	---	---	---	---	---	---
12	---	---	---	---	---	---	---	---	---	---
13	---	---	---	---	---	---	---	---	---	---
14	---	---	---	---	---	---	---	---	---	---
15	---	---	---	---	---	---	---	---	---	---
16	---	---	---	---	---	---	---	---	---	---
17	---	---	---	---	---	---	---	---	---	---
18	---	---	---	---	---	---	---	---	---	---
19	---	---	---	---	---	---	---	---	---	---
20	---	---	---	---	---	---	---	---	---	---
21	---	---	---	---	---	---	---	---	---	---
22	---	---	---	---	---	---	---	---	---	---
23	---	---	---	---	---	---	---	---	---	---
24	---	---	---	---	---	---	---	---	---	---
25	---	---	---	---	---	---	---	---	---	---
26	---	---	---	---	---	---	---	---	---	---
27	-4.3	-1.3	-7.2	3.0	5.2	2.1	\$\$\$	---	---	---
28	-3.2	0.0	-6.6	5.3	12.9	2.0	ENE	---	---	---
29	-1.7	-0.2	-3.7	12.8	21.2	7.7	NNW	---	---	---
30	-5.3	-3.3	-6.7	10.8	14.6	6.8	WNW	---	---	---
31	-4.5	-3.0	-6.4	11.4	16.6	7.0	NW	---	---	---

\$\$\$ means that there are more than two most frequent wind directions.

Frequency of Wind Direction

Date	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
11	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
14	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
15	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
16	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
17	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
18	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
19	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
20	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
21	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
22	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
23	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
24	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
25	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
26	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
27	0	0	1	0	10	7	2	2	10	10	1	0	0	0	0	0	43
28	0	0	0	36	4	14	19	6	5	24	6	0	0	0	0	0	114
29	44	9	14	4	0	0	0	0	0	0	0	0	0	0	1	72	144
30	5	0	0	0	0	0	0	0	0	0	0	1	26	65	27	20	144
31	0	0	0	0	0	0	0	0	0	0	0	0	7	50	74	13	144
TOTAL	49	9	15	40	14	21	21	8	15	34	7	1	33	115	102	105	589

January 1992 Kimuaneppu, Saroma-ko Lagoon

Date	Air Temperature			Wind			Most Freq. Dir.	Solar Radiation		
	Mean °C	Max. °C	Min. °C	Mean m/s	Max. m/s	Min. m/s		Cumulative kW/m ² ·h	Max. kW/m ²	Min. kW/m ²
1	-4.9	0.7	-9.0	4.0	10.2	2.0	SSW	-----	-----	-----
2	-3.0	2.0	-6.4	3.2	5.3	2.0	SSW	-----	-----	-----
3	-3.0	-1.2	-4.5	2.8	4.4	2.0	WNW	-----	-----	-----
4	-4.2	-0.6	-7.0	3.0	6.0	2.0	SSW	-----	-----	-----
5	-4.2	-2.3	-5.8	6.0	13.1	2.2	NW	-----	-----	-----
6	-4.5	-3.0	-7.8	6.4	12.7	2.2	NW	-----	-----	-----
7	-4.9	-2.1	-9.3	3.7	8.3	2.0	SSW	-----	-----	-----
8	-3.0	0.7	-6.6	9.4	17.4	2.0	NW	-----	-----	-----
9	-3.5	-2.0	-5.8	5.1	8.6	2.0	S	-----	-----	-----
10	-4.1	-2.6	-5.8	7.4	12.3	2.2	NNW	-----	-----	-----
11	-2.8	-0.4	-6.6	5.9	9.7	2.2	NW	-----	-----	-----
12	-2.4	1.4	-8.9	4.5	10.5	2.0	S	-----	-----	-----
13	-3.1	-1.1	-6.0	6.3	10.8	2.0	WNW	-----	-----	-----
14	-7.0	-4.7	-12.5	7.2	10.7	2.5	NNW	-----	-----	-----
15	-7.0	-4.3	-11.5	5.6	9.8	2.0	NNW	-----	-----	-----
16	-5.9	-1.0	-12.3	4.0	7.7	2.0	S	-----	-----	-----
17	0.2	3.5	-4.6	5.1	11.1	2.1	SSE	-----	-----	-----
18	-0.4	1.9	-2.1	7.2	13.3	2.1	ENE	-----	-----	-----
19	-3.9	-2.2	-5.2	10.3	14.3	6.1	N	-----	-----	-----
20	-4.4	-1.2	-9.2	5.5	11.5	2.1	S	-----	-----	-----
21	-4.4	-2.4	-7.8	4.5	9.0	2.0	S	-----	-----	-----
22	-2.4	-1.4	-4.5	5.0	11.5	2.0	SSW	-----	-----	-----
23	-6.1	-3.6	-7.9	5.5	9.2	2.4	NNE	-----	-----	-----
24	-8.8	-7.0	-12.7	6.9	11.7	2.2	WNW	-----	-----	-----
25	-7.7	-0.7	-11.5	4.8	12.3	2.0	S	-----	-----	-----
26	-6.1	-1.4	-11.2	3.3	6.6	2.0	S	-----	-----	-----
27	-2.0	1.0	-6.1	9.1	18.1	2.1	S	-----	-----	-----
28	-4.4	-2.3	-6.0	8.2	15.7	2.9	W	-----	-----	-----
29	-5.4	-3.9	-7.0	8.3	12.5	4.9	NW	-----	-----	-----
30	-6.6	-4.8	-11.2	5.3	8.5	2.1	W	-----	-----	-----
31	-9.8	-5.9	-13.9	3.1	5.1	2.0	E	-----	-----	-----

\$\$\$ means that there are more than two most frequent wind directions.

Frequency of Wind Direction

Date	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
1	0	0	0	0	0	0	0	1	35	69	11	2	2	9	4	0	133
2	0	0	0	0	0	0	0	3	42	46	7	1	0	0	0	0	99
3	5	3	0	2	1	1	4	4	7	4	3	6	2	8	2	2	54
4	0	0	0	0	0	0	1	7	21	23	5	0	0	0	0	0	57
5	21	0	0	0	0	0	1	0	18	24	3	1	9	14	27	26	144
6	0	0	0	0	0	0	0	2	12	16	6	0	10	10	62	13	131
7	0	0	0	0	0	1	3	8	41	47	13	1	0	0	0	0	114
8	0	0	0	0	0	0	1	6	0	4	1	0	2	13	56	13	96
9	7	2	3	0	0	0	0	3	47	40	1	0	0	9	4	5	121
10	24	1	0	0	0	0	0	0	0	0	3	5	12	27	29	43	144
11	0	0	0	0	0	0	0	3	7	13	2	7	31	23	35	7	128
12	0	0	0	0	3	2	7	16	41	32	1	1	1	1	2	0	107
13	31	2	0	0	0	0	0	0	0	1	1	0	4	36	15	20	110
14	18	23	22	1	0	0	1	0	1	6	1	7	13	2	8	32	135
15	13	1	1	0	0	1	0	3	14	5	10	15	10	8	16	29	126
16	0	0	0	2	1	8	16	6	41	32	11	5	3	0	0	0	125
17	0	0	0	0	4	12	26	33	19	21	12	0	0	0	0	0	127
18	2	12	18	29	27	5	4	3	4	0	0	0	0	0	0	0	104
19	60	9	0	0	0	0	0	0	2	0	1	8	9	6	6	43	144
20	3	0	1	0	0	0	1	5	22	14	4	7	22	10	12	18	119
21	1	0	0	1	7	13	5	4	24	18	7	3	1	0	6	12	102
22	5	2	0	0	0	1	2	7	13	15	1	2	6	13	11	3	81
23	21	55	27	35	2	1	0	0	0	0	0	0	0	0	0	3	144
24	15	16	9	0	0	0	0	1	17	7	5	6	2	21	20	20	139
25	2	11	3	0	0	0	1	4	33	32	2	0	0	0	0	0	88
26	0	0	0	1	0	1	3	7	24	21	4	1	1	0	1	3	67
27	0	0	0	0	0	0	0	6	68	39	2	9	5	8	2	1	140
28	0	0	0	0	0	0	0	0	0	0	1	21	78	30	12	0	142
29	0	0	0	0	0	0	0	0	0	0	0	2	21	53	65	3	144
30	18	0	0	0	0	1	0	0	1	3	2	3	57	5	18	12	120
31	0	0	8	11	16	4	0	1	13	1	4	0	0	0	0	0	58
TOTAL	246	137	92	82	61	51	76	133	567	533	124	113	301	306	413	308	3543

February 1992 Kimuanepu, Saroma-ko Lagoon

Date	Air Temperature			Wind				Solar Radiation		
	Mean °C	Max. °C	Min. °C	Mean m/s	Max. m/s	Min. m/s	Most Freq. Dir.	Cumulative kW/m ² ·h	Max. kW/m ²	Min. kW/m ²
1	-7.0	-4.6	-10.4	8.6	13.2	4.4	N	---	---	---
2	-8.1	-6.0	-12.0	8.5	13.9	2.0	NW	---	---	---
3	-3.2	2.0	-8.1	5.0	10.4	2.0	SSW	---	---	---
4	-6.1	-2.5	-10.3	5.7	8.9	3.3	NNW	---	---	---
5	-11.4	-9.0	-15.0	4.1	6.8	2.1	SSW	---	---	---
6	-6.0	-0.5	-15.4	5.3	10.3	2.1	S	---	---	---
7	-1.8	2.3	-4.5	6.5	14.5	2.1	S	---	---	---
8	-6.0	-3.9	-11.0	4.6	9.5	2.0	SW	---	---	---
9	-8.9	-5.7	-13.9	4.7	8.3	2.0	NNE	---	---	---
10	-2.9	2.3	-7.8	5.2	12.1	2.0	N	---	---	---
11	-6.6	-3.0	-10.4	3.5	6.7	2.1	N	---	---	---
12	-3.6	1.1	-8.6	5.8	9.6	2.8	NNE	---	---	---
13	-5.1	-0.3	-10.8	3.4	6.9	2.0	N	---	---	---
14	-5.6	-1.3	-11.0	2.9	5.0	2.0	N	---	---	---
15	-1.6	4.4	-5.9	5.9	10.1	2.1	SE	---	---	---
16	0.3	4.6	-3.9	6.4	12.1	2.0	SE	---	---	---
17	-4.4	-2.0	-7.7	8.6	15.9	2.3	SE	---	---	---
18	-4.4	0.9	-9.5	3.2	5.0	2.0	NNE	---	---	---
19	-5.8	-1.2	-11.5	---	---	---	---	---	---	---
20	-8.4	-4.5	-11.7	---	---	---	---	---	---	---
21	-6.7	-1.8	-10.8	2.7	3.8	2.1	SSE	---	---	---
22	-8.5	-5.3	-20.1	---	---	---	---	---	---	---
23	-4.6	-1.7	-9.9	3.8	5.4	2.0	N	---	---	---
24	-3.1	1.8	-10.4	3.0	4.9	2.0	NNE	---	---	---
25	-5.2	-3.3	-10.6	5.3	6.7	2.5	N	---	---	---
26	-3.6	-1.5	-9.2	3.4	4.3	2.2	NNE	---	---	---
27	-4.1	2.5	-8.0	3.8	5.3	2.1	SW	---	---	---
28	-2.5	1.0	-7.7	4.8	10.7	2.0	E	---	---	---
29	0.3	5.6	-4.9	4.1	8.3	2.0	ENE	---	---	---

\$\$\$ means that there are more than two most frequent wind directions.

Frequency of Wind Direction

Date	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
1	28	15	13	4	0	0	0	0	0	0	0	0	0	0	1	25	86
2	0	0	0	0	0	0	0	0	9	23	1	0	0	20	49	28	130
3	0	0	0	6	5	7	3	6	35	53	4	1	1	0	0	1	122
4	11	0	0	0	2	0	1	0	0	0	0	0	0	0	25	105	144
5	1	1	1	2	4	4	6	3	16	31	15	8	6	3	8	11	120
6	0	0	1	3	1	3	5	20	44	41	12	3	0	0	1	0	134
7	0	1	2	2	5	3	9	18	36	9	3	19	5	4	14	1	131
8	0	0	0	0	0	2	11	13	11	9	27	24	11	5	0	2	115
9	22	43	3	3	9	6	3	0	0	0	0	0	0	0	0	0	89
10	63	6	2	3	3	4	17	28	8	1	1	0	0	0	0	0	136
11	69	9	3	2	2	6	5	0	0	0	0	0	0	0	0	0	96
12	24	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67
13	17	4	1	0	5	5	2	6	8	8	0	0	0	0	0	0	56
14	10	8	2	2	1	1	2	2	3	4	4	3	3	2	0	0	47
15	7	13	13	3	2	0	16	13	1	0	1	0	0	0	0	4	73
16	0	0	4	6	1	2	53	2	7	9	7	3	1	5	5	1	106
17	4	9	14	18	17	27	29	2	0	0	0	0	0	0	0	0	120
18	5	24	4	4	0	0	0	0	0	0	0	0	0	0	0	0	37
19	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
20	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
21	1	3	3	1	0	0	3	8	0	0	0	0	0	0	0	0	19
22	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
23	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
24	4	17	3	0	0	2	3	0	0	0	0	0	0	0	0	0	29
25	17	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
26	13	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
27	1	9	0	0	2	0	0	0	13	23	0	0	0	0	0	0	48
28	3	14	27	21	28	0	0	0	0	0	0	0	0	0	0	0	93
29	0	4	6	29	11	5	0	0	13	26	7	0	0	0	0	0	101
TOTAL	316	245	102	109	98	77	168	121	178	214	124	68	27	39	103	178	2167

March 1992 Kimuaneppu, Saroma-ko Lagoon

Date	Air Temperature			Wind			Most Freq. Dir.	Solar Radiation		
	Mean °C	Max. °C	Min. °C	Mean m/s	Max. m/s	Min. m/s		Cumulative kW/m ² ·h	Max. kW/m ²	Min. kW/m ²
1	0.3	5.6	-4.9	5.9	14.1	2.0	SSE	-----	-----	-----
2	-3.6	-0.2	-7.5	4.4	6.3	2.2	N	-----	-----	-----
3	-5.0	-4.0	-8.8	-----	-----	-----	-----	-----	-----	
4	-6.7	-5.0	-10.4	-----	-----	-----	-----	-----	-----	
5	-5.6	-3.5	-10.0	2.9	4.6	2.1	NNE	-----	-----	-----
6	-5.3	-2.1	-9.0	-----	-----	-----	-----	-----	-----	
7	-6.3	-5.0	-8.5	-----	-----	-----	-----	-----	-----	
8	-7.0	-4.9	-10.1	3.1	4.8	2.0	S	-----	-----	-----
9	-5.4	0.4	-11.5	5.2	9.5	2.1	E	-----	-----	-----
10	-3.0	2.4	-13.9	5.5	9.2	2.0	E	-----	-----	-----
11	0.7	7.2	-4.1	4.1	6.3	2.0	SSE	-----	-----	-----
12	-3.4	-1.2	-6.6	3.7	6.2	2.1	NNE	-----	-----	-----
13	-----	-----	-----	-----	-----	-----	-----	-----	-----	
14	-----	-----	-----	-----	-----	-----	-----	-----	-----	
15	-----	-----	-----	-----	-----	-----	-----	-----	-----	
16	-----	-----	-----	-----	-----	-----	-----	-----	-----	
17	-----	-----	-----	-----	-----	-----	-----	-----	-----	
18	-----	-----	-----	-----	-----	-----	-----	-----	-----	
19	-----	-----	-----	-----	-----	-----	-----	-----	-----	
20	-----	-----	-----	-----	-----	-----	-----	-----	-----	
21	-----	-----	-----	-----	-----	-----	-----	-----	-----	
22	-----	-----	-----	-----	-----	-----	-----	-----	-----	
23	-----	-----	-----	-----	-----	-----	-----	-----	-----	
24	2.1	6.4	-0.1	3.7	5.6	2.1	ENE	-----	-----	-----
25	1.5	4.6	0.0	5.1	10.3	2.0	SSW	-----	-----	-----
26	0.1	1.9	-1.6	5.2	10.4	2.0	WNW	-----	-----	-----
27	1.9	5.6	-1.7	3.0	5.1	2.0	S	-----	-----	-----
28	3.0	7.1	-0.2	3.4	8.0	2.0	SSW	-----	-----	-----
29	1.6	6.4	-1.7	4.0	10.6	2.0	\$\$\$	-----	-----	-----
30	5.5	8.8	1.4	5.7	11.8	2.0	S	-----	-----	-----
31	4.1	7.7	1.2	4.1	7.4	2.0	ENE	-----	-----	-----

\$\$\$ means that there are more than two most frequent wind directions.

Frequency of Wind Direction

Date	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
1	7	13	5	8	10	19	12	21	0	0	4	0	0	0	0	0	99
2	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
5	4	11	2	0	0	0	0	0	0	0	0	0	0	0	0	0	17
6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
8	2	0	1	1	2	5	0	10	16	0	0	0	0	0	0	0	37
9	1	6	2	0	29	0	2	4	5	3	18	9	0	0	0	0	79
10	0	5	14	34	56	1	3	5	10	1	0	0	0	0	0	0	129
11	0	6	7	7	3	4	3	24	9	11	4	0	0	0	0	0	78
12	5	10	5	4	4	5	2	0	1	0	0	0	0	0	0	0	36
13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
14	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
15	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
16	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
17	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
18	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
19	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
20	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
21	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
22	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
23	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
24	0	0	3	21	9	0	2	9	3	4	3	2	2	1	0	0	59
25	0	0	0	2	3	20	3	6	18	57	8	1	0	0	0	0	118
26	1	0	0	0	0	0	0	0	5	2	0	0	4	50	36	10	108
27	2	1	6	1	1	2	7	5	11	10	3	1	2	3	1	3	59
28	2	0	0	0	0	4	4	3	15	16	3	1	0	3	8	4	63
29	4	9	9	2	3	0	6	4	9	5	1	1	0	2	0	0	55
30	0	0	2	3	3	6	13	19	42	5	1	1	3	0	0	0	98
31	1	0	17	22	1	2	4	1	9	7	1	0	2	1	1	0	69
TOTAL	41	61	73	105	124	68	61	111	153	121	46	16	13	60	46	17	1116

April 1992 Kimuanepu, Saroma-ko Lagoon

Date	Air Temperature			Wind				Solar Radiation		
	Mean °C	Max. °C	Min. °C	Mean m/s	Max. m/s	Min. m/s	Most Freq. Dir.	Cumulative kW/m ² ·h	Max. kW/m ²	Min. kW/m ²
1	8.1	17.3	3.7	5.6	11.6	2.0	S	---	---	---
2	7.3	12.4	2.9	5.3	10.2	2.1	S	---	---	---
3	6.6	11.4	-0.3	3.1	5.4	2.1	SSW	---	---	---
4	13.1	19.9	7.3	7.0	13.3	2.0	S	---	---	---
5	11.4	17.0	4.3	9.0	16.0	2.1	SSW	---	---	---
6	0.2	4.3	-1.7	7.2	9.4	4.1	NNE	---	---	---
7	-1.5	0.1	-2.8	3.8	9.4	2.0	NNE	---	---	---
8	3.2	12.8	-3.4	4.5	8.8	2.0	SSW	---	---	---
9	5.5	11.9	2.6	6.7	18.8	2.1	W	---	---	---
10	0.4	4.7	-1.9	7.6	14.5	2.1	NNW	---	---	---
11	-0.3	1.3	-1.6	5.0	8.8	2.1	ENE	---	---	---
12	-0.2	0.6	-0.9	4.2	6.7	2.1	NE	---	---	---
13	0.2	0.6	-0.1	6.1	10.1	2.1	N	---	---	---
14	0.5	0.8	0.1	5.3	11.3	2.4	NNE	---	---	---
15	1.5	2.9	0.4	4.6	7.1	2.0	ENE	---	---	---
16	3.4	6.9	0.0	6.1	12.0	2.1	S	---	---	---
17	3.0	6.2	0.4	4.0	9.3	2.0	NNW	---	---	---
18	6.3	12.7	1.3	6.6	13.3	2.2	S	---	---	---
19	10.2	16.0	4.3	7.4	14.0	2.1	SSW	---	---	---
20	4.0	9.1	1.5	6.2	11.9	2.1	NW	---	---	---
21	2.3	5.3	-0.4	5.8	13.1	2.0	NW	---	---	---
22	3.3	5.7	0.1	4.7	9.7	2.1	ESE	---	---	---
23	0.9	2.7	-0.5	8.9	15.0	2.0	NNW	---	---	---
24	7.4	17.6	0.4	5.7	11.8	2.2	SSW	---	---	---
25	3.0	10.9	0.6	9.3	20.0	2.0	NW	---	---	---
26	9.0	14.4	2.2	5.4	11.1	2.1	WSW	---	---	---
27	5.4	8.4	2.0	4.0	9.9	2.0	NNW	---	---	---
28	11.2	18.3	3.7	8.7	16.0	2.1	S	---	---	---
29	7.2	11.2	4.6	9.0	16.6	2.3	WNW	---	---	---
30	4.6	5.8	2.5	9.3	15.3	2.2	NW	---	---	---

\$\$\$ means that there are more than two most frequent wind directions.

Frequency of Wind Direction

Date	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
1	3	3	3	1	0	1	1	12	42	40	6	1	1	0	0	0	114
2	2	0	0	2	4	2	3	2	53	29	5	3	0	0	3	0	108
3	0	3	6	5	0	4	9	4	10	20	1	1	0	0	0	0	63
4	0	0	0	0	0	0	0	2	68	66	6	2	0	0	0	0	144
5	0	0	0	0	0	0	0	2	49	59	11	5	8	8	1	0	143
6	13	82	10	0	0	0	0	0	0	0	0	0	0	5	11	23	144
7	27	35	11	3	7	1	4	5	6	2	0	0	0	1	1	18	121
8	0	0	0	1	1	5	6	10	25	27	17	2	2	24	5	0	125
9	4	0	1	1	0	2	1	1	4	2	2	9	42	30	9	11	119
10	33	4	2	0	1	3	3	7	3	0	0	0	0	0	6	52	114
11	0	0	6	38	28	38	20	7	3	0	0	0	0	0	0	0	140
12	0	15	49	42	12	12	3	0	0	0	0	0	0	0	0	0	133
13	81	26	5	1	0	0	0	0	0	0	0	0	0	0	0	31	144
14	39	45	37	19	0	0	0	0	0	0	0	0	0	0	0	2	142
15	0	6	11	29	8	5	0	0	0	4	4	0	1	0	0	0	68
16	0	0	0	0	3	0	4	27	57	32	5	2	0	0	0	2	132
17	4	0	0	0	0	0	0	1	12	15	2	9	7	10	14	26	100
18	0	0	0	0	0	0	0	10	85	44	2	1	0	0	0	0	142
19	1	2	1	0	0	1	2	2	32	40	12	18	19	0	2	0	132
20	14	6	2	0	0	2	2	0	3	6	5	3	2	8	44	22	119
21	17	1	4	3	0	0	1	0	1	1	2	0	2	5	23	19	79
22	0	0	0	0	22	36	11	24	17	5	0	1	2	11	1	0	130
23	14	0	0	0	0	0	0	0	3	11	3	0	1	15	28	57	132
24	0	2	1	0	0	1	5	11	32	33	5	2	4	18	4	2	120
25	0	0	1	1	0	0	0	0	3	10	0	2	15	20	51	31	134
26	0	0	0	3	1	0	1	0	16	12	22	29	17	17	3	4	135
27	6	5	8	3	0	0	0	0	4	3	1	1	10	11	7	14	73
28	0	0	0	0	3	4	7	15	70	35	3	0	0	0	0	0	137
29	1	0	0	0	0	1	0	1	16	17	0	0	6	43	33	9	127
30	0	0	0	0	0	1	0	1	0	4	5	2	12	33	44	34	136
TOTAL	259	235	158	152	90	118	84	143	615	517	119	93	161	259	230	357	3650

May 1992 Kimuaneppu, Saroma-ko Lagoon

Date	Air Temperature			Wind			Most Freq. Dir.	Solar Radiation		
	Mean °C	Max. °C	Min. °C	Mean m/s	Max. m/s	Min. m/s		Cumulative kW/m ² ·h	Max. kW/m ²	Min. kW/m ²
1	4.0	6.4	1.9	5.2	13.5	2.0	NW	-----	-----	-----
2	6.1	9.2	2.2	9.4	16.6	2.0	W	-----	-----	-----
3	6.1	10.2	3.4	3.5	7.2	2.0	NNW	-----	-----	-----
4	3.7	4.8	2.0	8.8	16.1	2.8	NW	-----	-----	-----
5	1.8	2.7	1.0	12.3	18.4	5.5	NNW	-----	-----	-----
6	3.8	9.1	0.6	5.3	9.9	2.0	NNW	-----	-----	-----
7	8.9	16.2	1.6	7.5	16.5	2.0	S	-----	-----	-----
8	7.2	9.8	5.1	9.4	17.4	2.0	S	-----	-----	-----
9	6.5	10.4	4.6	5.4	12.4	2.0	ENE	-----	-----	-----
10	8.9	16.1	2.8	7.1	13.3	2.0	W	-----	-----	-----
11	9.9	14.5	2.3	2.9	4.5	2.0	NE	-----	-----	-----
12	12.0	16.0	8.1	4.0	7.4	2.1	NE	-----	-----	-----
13	14.0	20.8	7.8	7.9	17.7	2.0	S	-----	-----	-----
14	9.1	11.3	5.1	7.4	19.5	2.0	S	-----	-----	-----
15	8.9	11.8	5.0	4.2	10.5	2.0	NNW	-----	-----	-----
16	10.9	13.7	7.5	3.3	5.7	2.0	ENE	-----	-----	-----
17	8.9	13.0	4.4	4.9	8.4	2.1	NE	-----	-----	-----
18	14.2	20.9	10.3	8.9	18.2	2.5	S	-----	-----	-----
19	10.5	13.0	8.7	4.1	9.4	2.0	S	-----	-----	-----
20	13.1	22.7	10.0	5.2	9.6	2.1	NE	-----	-----	-----
21	10.2	15.6	8.3	3.5	8.3	2.0	NE	-----	-----	-----
22	8.4	12.3	5.3	4.3	7.8	2.0	ENE	-----	-----	-----
23	10.7	16.7	9.3	3.5	7.5	2.0	WNW	-----	-----	-----
24	6.9	9.2	5.4	4.5	7.5	2.0	NW	-----	-----	-----
25	10.9	15.0	6.0	5.0	9.8	2.0	ESE	-----	-----	-----
26	10.2	12.2	7.7	4.5	7.1	2.2	ENE	-----	-----	-----
27	7.7	9.6	6.3	4.7	7.8	2.0	NW	-----	-----	-----
28	9.7	12.5	7.7	4.9	9.0	2.0	NW	-----	-----	-----
29	9.6	12.2	8.1	3.4	5.1	2.1	NW	-----	-----	-----
30	9.6	13.9	6.2	4.0	8.7	2.0	NE	-----	-----	-----
31	13.7	16.2	9.9	4.9	9.1	2.0	ENE	-----	-----	-----

\$\$\$ means that there are more than two most frequent wind directions.

Frequency of Wind Direction

Date	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
1	0	4	17	22	0	0	0	0	10	8	5	4	6	11	28	3	118
2	0	0	0	0	0	0	0	0	1	2	11	8	57	50	8	1	138
3	13	13	3	1	3	0	2	5	5	6	3	3	3	1	8	26	95
4	0	0	0	0	0	0	0	0	0	0	0	0	1	13	75	45	134
5	46	0	0	0	0	0	0	0	0	0	0	0	0	0	42	56	144
6	0	4	0	0	0	0	1	0	0	6	2	2	1	4	12	42	74
7	0	0	2	6	5	4	8	15	58	14	0	0	0	0	0	0	112
8	0	0	0	0	0	0	0	19	82	6	6	1	1	10	11	0	136
9	0	0	17	27	4	5	0	2	0	2	0	1	2	18	25	1	104
10	2	4	1	0	0	1	0	0	7	10	20	49	18	10	3	0	125
11	0	1	19	18	6	0	1	1	15	9	0	2	3	7	3	0	85
12	3	7	26	14	2	0	0	1	23	23	4	1	1	0	1	0	106
13	0	0	0	0	1	1	0	6	80	54	0	0	0	0	0	0	142
14	0	0	0	0	0	5	15	20	48	27	2	0	6	0	7	2	132
15	2	3	4	1	5	4	6	1	2	13	3	0	5	16	13	18	96
16	2	3	21	31	0	0	0	1	4	3	0	1	3	4	4	0	77
17	0	16	22	22	3	18	1	0	4	8	2	1	0	0	0	0	97
18	0	4	4	6	8	6	10	11	39	33	8	1	1	0	0	0	131
19	1	2	9	6	4	5	4	10	28	15	6	2	0	0	1	1	94
20	1	7	27	12	7	3	5	3	9	5	12	2	1	4	3	1	102
21	2	7	13	3	1	1	2	2	7	1	0	0	3	7	8	3	60
22	0	1	26	43	23	4	9	12	4	0	1	0	0	0	0	0	123
23	0	1	0	3	9	7	11	4	6	4	1	1	4	39	10	0	100
24	7	5	0	2	0	0	0	0	0	0	0	0	1	18	56	29	118
25	0	1	5	3	11	42	11	3	0	0	0	1	2	2	5	0	86
26	0	3	15	33	7	10	7	2	0	0	0	0	0	13	15	2	107
27	2	3	8	2	0	0	0	0	2	0	0	0	8	24	47	16	112
28	1	1	20	18	0	0	1	1	0	0	0	0	0	8	33	3	86
29	5	23	1	0	0	0	0	0	0	0	0	1	4	12	24	22	92
30	2	7	34	7	0	1	6	1	0	0	0	0	0	5	13	14	90
31	0	10	23	24	1	0	0	0	0	15	4	0	3	8	19	0	107
TOTAL	89	130	317	304	100	117	100	120	427	261	80	52	165	292	481	288	3323

June 1992 Kimuanepu, Saroma-ko Lagoon

Date	Air Temperature				Wind			Solar Radiation		
	Mean °C	Max. °C	Min. °C	Mean m/s	Max. m/s	Min. m/s	Most Freq. Dir.	Cumulative kW/m ² ·h	Max. kW/m ²	Min. kW/m ²
1	17.2	25.2	10.4	5.2	11.1	2.5	SSW	-----	-----	-----
2	11.7	14.5	8.4	4.2	7.7	2.0	NW	-----	-----	-----
3	10.3	14.3	7.4	5.4	9.8	2.0	ENE	-----	-----	-----
4	16.0	19.9	9.9	9.8	20.0	2.1	S	-----	-----	-----
5	16.9	20.8	13.4	8.1	14.6	2.0	S	-----	-----	-----
6	8.8	13.4	7.0	3.6	5.8	2.2	NNW	-----	-----	-----
7	7.0	9.1	6.1	4.1	7.0	2.0	ENE	-----	-----	-----
8	9.9	11.8	8.5	6.3	11.7	2.6	SSE	-----	-----	-----
9	11.5	15.1	8.8	4.3	8.6	2.1	SSE	-----	-----	-----
10	8.6	9.7	8.0	3.9	6.4	2.0	WNW	-----	-----	-----
11	10.7	16.8	7.8	4.3	6.8	2.1	NW	-----	-----	-----
12	15.5	20.3	13.2	4.5	8.8	2.0	ESE	-----	-----	-----
13	13.0	16.0	9.6	3.0	5.9	2.0	NE	-----	-----	-----
14	15.7	19.8	11.8	3.6	7.6	2.0	SSW	-----	-----	-----
15	9.2	12.3	7.1	6.3	10.6	3.2	NW	-----	-----	-----
16	7.2	8.2	6.2	3.1	4.6	2.0	N	-----	-----	-----
17	7.8	9.0	6.4	4.1	6.7	2.1	ENE	-----	-----	-----
18	9.4	11.5	8.3	3.1	4.7	2.0	NE	-----	-----	-----
19	9.5	10.8	8.5	3.5	5.9	2.1	NW	-----	-----	-----
20	11.8	13.8	9.5	3.1	4.7	2.0	NNE	-----	-----	-----
21	13.2	16.7	10.8	3.4	5.7	2.0	NE	-----	-----	-----
22	9.4	11.9	7.7	3.2	5.0	2.0	NNE	-----	-----	-----
23	9.2	11.4	6.8	3.3	5.4	2.0	NE	-----	-----	-----
24	10.2	13.0	5.9	3.4	5.0	2.0	NE	-----	-----	-----
25	13.3	17.7	7.5	2.7	3.9	2.0	NE	-----	-----	-----
26	15.4	18.5	12.6	3.5	5.9	2.0	NE	-----	-----	-----
27	16.8	20.5	11.7	4.5	6.9	2.1	NE	-----	-----	-----
28	19.5	24.6	16.2	3.3	5.1	2.0	SSW	-----	-----	-----
29	18.3	23.2	14.1	3.6	7.5	2.0	NE	-----	-----	-----
30	18.3	22.2	13.9	3.8	6.7	2.0	ENE	-----	-----	-----

\$\$\$ means that there are more than two most frequent wind directions.

Frequency of Wind Direction

Date	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
1	0	0	0	0	0	0	1	10	35	60	8	0	11	8	1	0	134
2	7	0	7	4	0	0	0	4	9	15	3	0	1	7	19	19	95
3	2	2	24	50	5	2	0	0	0	0	0	0	12	10	1	108	
4	0	0	0	0	0	1	1	4	54	54	9	1	1	2	7	1	135
5	2	0	0	0	1	0	1	4	59	50	4	1	1	2	7	1	133
6	25	21	3	0	0	0	0	0	0	0	0	0	2	8	27	51	137
7	13	10	14	43	9	12	10	7	1	0	0	0	0	0	1	6	126
8	0	0	0	0	0	9	20	64	49	1	0	0	0	0	0	0	143
9	0	0	0	0	0	1	22	65	15	0	1	0	1	20	6	0	131
10	1	0	0	0	0	0	0	0	0	0	0	0	16	46	32	17	112
11	5	6	17	0	0	0	9	4	5	3	0	0	0	7	18	8	82
12	0	0	0	2	3	34	18	15	12	1	0	0	10	12	7	0	114
13	3	8	19	12	3	1	0	0	0	0	0	0	0	1	15	8	70
14	0	2	11	15	4	6	10	6	19	20	3	0	0	6	7	3	112
15	7	0	0	0	0	0	0	0	0	0	0	0	1	39	63	34	144
16	60	24	6	0	0	0	0	0	0	0	0	1	0	0	2	21	114
17	1	1	27	39	25	10	0	2	7	2	1	2	0	0	0	0	117
18	10	16	23	7	13	13	0	0	0	0	0	0	0	0	19	14	115
19	8	0	3	3	4	0	0	0	0	0	0	0	2	25	41	19	105
20	6	25	16	4	3	1	0	1	2	4	3	0	0	2	4	4	75
21	9	13	21	6	0	0	0	0	7	16	2	0	0	1	6	9	90
22	33	61	3	0	0	0	0	0	0	1	4	1	0	2	7	24	136
23	7	10	33	19	6	2	0	1	0	1	7	2	0	0	2	7	97
24	7	25	29	0	0	0	0	0	2	0	0	0	0	0	2	5	70
25	1	5	18	2	0	0	0	0	1	5	2	0	0	0	0	0	34
26	0	1	7	2	5	3	0	3	0	0	1	0	0	0	0	0	22
27	0	1	23	21	7	0	0	0	3	0	0	3	4	2	0	0	64
28	4	12	20	1	0	0	0	0	15	24	4	2	0	1	0	0	83
29	0	1	26	22	13	0	8	3	3	2	0	0	0	0	0	0	78
30	0	7	15	19	11	14	3	9	5	3	0	0	0	1	1	1	89
TOTAL	211	251	365	271	112	109	103	202	298	267	52	10	49	206	306	253	3065

July 1992 Kimuaneppu, Saroma-ko Lagoon

Date	Air Temperature			Wind			Most Freq. Dir.	Solar Radiation		
	Mean °C	Max. °C	Min. °C	Mean m/s	Max. m/s	Min. m/s		Cumulative kW/m ² ·h	Max. kW/m ²	Min. kW/m ²
1	15.0	16.7	12.2	5.1	8.3	2.3	NW	-----	-----	-----
2	15.6	19.3	11.9	3.8	7.1	2.1	ENE	-----	-----	-----
3	18.7	24.6	16.5	3.7	12.3	2.1	SSW	-----	-----	-----
4	17.9	22.9	13.6	3.5	7.1	2.0	S	-----	-----	-----
5	16.0	19.1	12.5	3.6	7.6	2.0	SSW	-----	-----	-----
6	16.4	18.7	13.3	4.2	6.4	2.0	NE	-----	-----	-----
7	20.1	25.1	15.2	3.6	5.3	2.0	ENE	-----	-----	-----
8	20.9	26.8	16.6	4.4	9.5	2.0	SSW	-----	-----	-----
9	17.1	18.9	15.3	3.6	6.1	2.0	NE	-----	-----	-----
10	13.9	17.0	12.2	5.8	8.9	2.9	NNW	-----	-----	-----
11	12.6	13.4	11.5	4.0	6.4	2.0	N	-----	-----	-----
12	16.1	19.8	12.4	4.0	9.9	2.0	SSW	-----	-----	-----
13	17.9	23.3	13.8	4.9	8.1	2.1	SSW	-----	-----	-----
14	17.4	21.4	15.0	4.5	8.0	2.0	SSW	-----	-----	-----
15	17.0	19.1	15.6	3.0	5.5	2.0	NE	-----	-----	-----
16	15.4	16.7	14.2	2.5	3.3	2.0	NE	-----	-----	-----
17	20.3	24.2	14.5	5.1	11.7	2.0	SSW	-----	-----	-----
18	19.0	22.9	15.7	9.2	15.6	2.1	S	-----	-----	-----
19	18.5	20.0	16.2	6.1	11.7	2.4	SSE	-----	-----	-----
20	19.4	22.2	17.6	3.9	8.1	2.0	SSW	-----	-----	-----
21	16.3	18.6	13.5	3.7	6.2	2.1	WNW	-----	-----	-----
22	14.7	16.9	12.8	4.9	8.4	2.0	ENE	-----	-----	-----
23	18.9	23.0	15.1	5.5	10.7	2.1	SSW	-----	-----	-----
24	16.6	17.8	15.3	3.0	7.3	2.0	NE	-----	-----	-----
25	17.9	19.8	16.1	4.0	7.8	2.0	ENE	-----	-----	-----
26	21.4	26.3	18.2	6.4	14.1	2.4	S	-----	-----	-----
27	21.6	22.5	20.7	11.2	16.2	6.0	S	-----	-----	-----
28	24.7	30.0	19.7	3.5	6.2	2.0	SSW	-----	-----	-----
29	22.5	25.9	20.7	3.2	4.6	2.1	NE	-----	-----	-----
30	20.5	25.1	15.7	3.6	8.8	2.0	SSW	-----	-----	-----
31	13.7	16.0	12.5	7.2	11.0	4.7	NNW	-----	-----	-----

\$\$\$ means that there are more than two most frequent wind directions.

Frequency of Wind Direction

Date	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
1	3	0	0	0	0	0	0	0	0	0	0	0	0	6	45	42	96
2	3	3	12	24	12	15	11	4	3	3	0	0	0	1	16	14	121
3	2	3	7	5	10	10	5	7	12	18	8	0	0	1	4	3	95
4	7	6	5	1	2	2	1	0	32	17	0	1	4	12	11	5	106
5	3	8	15	13	0	3	3	3	3	20	7	0	0	0	0	0	78
6	0	0	45	17	2	2	0	0	2	2	1	0	1	1	0	0	73
7	0	0	6	28	19	11	0	0	0	0	0	0	0	0	0	0	64
8	1	0	0	0	0	3	7	1	14	34	11	6	3	6	2	7	95
9	2	9	15	13	5	9	2	1	6	2	3	0	3	5	4	4	83
10	38	0	0	0	0	0	0	0	0	0	0	0	0	0	28	78	144
11	31	13	24	22	17	13	0	0	0	0	0	0	0	0	0	11	131
12	0	5	2	1	3	9	4	7	27	43	4	0	0	0	0	0	105
13	0	5	14	7	3	4	1	2	39	63	5	0	0	0	0	0	143
14	2	4	16	4	0	0	1	0	23	43	2	1	1	6	4	3	110
15	4	22	23	2	1	0	2	0	2	0	0	0	3	14	5	0	78
16	5	11	12	11	4	1	2	0	0	0	0	0	0	1	0	0	47
17	0	3	18	25	10	1	0	0	16	26	6	0	0	1	0	0	106
18	0	0	0	0	0	0	0	30	75	16	9	2	4	2	0	0	138
19	0	0	0	0	0	0	14	74	47	7	1	0	0	0	0	0	143
20	0	6	18	22	9	13	2	1	10	32	2	0	0	0	0	0	115
21	7	20	2	0	0	0	0	0	0	0	1	0	3	29	29	28	119
22	0	14	21	40	21	1	1	2	8	2	0	0	0	0	0	0	110
23	1	0	0	0	0	0	1	7	38	50	20	3	6	7	5	3	141
24	6	5	13	11	7	6	2	1	2	1	0	0	0	4	9	7	74
25	1	0	1	22	11	15	5	9	9	1	2	0	1	2	1	1	81
26	0	0	10	4	0	0	0	0	9	74	42	2	0	0	0	0	141
27	0	0	0	0	0	0	0	1	94	49	0	0	0	0	0	0	144
28	6	5	3	2	1	4	3	4	24	29	10	4	2	2	2	2	103
29	0	0	23	17	7	0	0	2	14	8	7	3	0	0	0	0	81
30	1	1	2	2	3	6	1	4	12	15	2	1	8	11	4	3	76
31	0	0	0	0	0	0	0	0	0	0	0	0	7	38	33	66	144
TOTAL	123	143	307	293	147	128	68	169	586	523	103	21	46	149	202	277	3285

August 1992 Kimuaneppu, Saroma-ko Lagoon

Date	Air Temperature			Wind				Solar Radiation		
	Mean °C	Max. °C	Min. °C	Mean m/s	Max. m/s	Min. m/s	Most Freq. Dir.	Cumulative kW/m ² ·h	Max. kW/m ²	Min. kW/m ²
1	14.7	16.3	13.4	7.9	13.8	3.1	NW	---	---	---
2	13.3	14.4	12.1	4.3	6.9	2.3	NW	---	---	---
3	13.4	15.1	11.1	3.5	5.2	2.0	NNW	---	---	---
4	15.8	17.8	12.9	4.4	10.3	2.1	ESE	1.7	0.7	0.0
5	19.0	25.0	13.9	6.0	13.9	2.0	SSW	5.8	1.1	0.0
6	23.1	30.1	15.9	4.7	8.9	2.1	S	5.4	1.2	0.0
7	21.4	24.9	17.2	3.2	5.9	2.0	NNW	2.7	0.8	0.0
8	16.4	18.6	14.2	3.4	5.9	2.0	SE	2.5	0.9	0.0
9	17.1	18.2	15.9	4.3	17.2	2.1	ESE	0.8	0.1	0.0
10	16.0	19.3	14.3	8.9	18.4	2.3	NNW	4.1	1.3	0.0
11	17.4	22.6	12.0	4.0	7.3	2.0	ESE	7.3	0.9	0.0
12	19.5	23.8	16.1	4.4	8.5	2.1	SSE	6.5	1.0	0.0
13	16.8	20.2	13.6	5.3	14.4	2.2	S	1.6	0.3	0.0
14	20.1	27.3	15.5	3.4	7.5	2.0	S	3.6	1.2	0.0
15	15.9	17.7	14.4	3.1	4.8	2.1	NE	4.8	1.0	0.0
16	16.0	16.8	15.2	3.1	4.7	2.0	NE	2.0	0.4	0.0
17	17.5	19.5	15.2	2.7	4.3	2.0	NNW	3.4	0.9	0.0
18	19.6	21.5	18.2	2.9	4.7	2.0	NNE	5.6	0.8	0.0
19	19.9	22.2	18.4	2.9	4.6	2.0	NW	4.0	0.9	0.0
20	17.1	19.4	15.5	3.3	6.1	2.1	NNE	1.0	0.2	0.0
21	16.8	18.8	15.1	4.5	9.0	2.2	ESE	3.5	0.8	0.0
22	21.8	27.7	16.8	5.7	10.8	2.1	S	6.7	0.9	0.0
23	21.6	24.6	18.7	3.7	8.9	2.0	SSW	5.0	1.0	0.0
24	22.0	24.6	19.1	3.8	7.1	2.2	ESE	5.4	0.8	0.0
25	21.9	26.8	17.7	4.2	9.8	2.0	NE	3.3	1.0	0.0
26	21.2	25.5	17.2	3.8	7.4	2.0	NNW	6.5	0.8	0.0
27	21.1	24.0	17.3	3.0	4.2	2.0	NE	5.3	0.9	0.0
28	18.9	21.2	16.7	3.5	6.1	2.0	N	3.7	0.9	0.0
29	16.7	17.7	15.4	4.1	7.4	2.1	E	1.3	0.3	0.0
30	19.3	24.2	15.9	6.9	12.0	2.1	S	5.2	0.9	0.0
31	21.9	26.0	18.2	3.9	8.8	2.0	SSW	4.8	1.0	0.0

\$\$\$ means that there are more than two most frequent wind directions.

Frequency of Wind Direction

Date	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
1	0	0	0	0	0	0	0	0	0	0	0	15	28	30	61	10	144
2	1	0	0	0	0	0	0	0	0	0	0	5	29	76	28		139
3	16	18	4	0	0	0	0	2	1	2	0	0	0	12	34		89
4	0	10	4	23	10	8	6	2	2	5	1	3	0	1	0	0	75
5	2	0	0	0	0	0	0	4	51	60	9	0	0	0	0	0	126
6	0	0	1	3	0	0	0	6	43	36	9	16	7	0	0	0	121
7	11	5	1	0	0	2	1	3	13	12	0	1	2	6	9	20	86
8	3	5	4	3	9	22	23	5	6	4	1	1	0	0	0	0	86
9	0	3	6	22	28	30	24	10	0	0	0	0	0	7	2	0	132
10	11	0	0	0	0	0	0	0	0	0	0	0	0	20	52	61	144
11	0	0	6	26	9	4	0	5	24	23	2	1	2	2	0	0	104
12	0	0	0	0	0	10	30	36	25	30	1	2	0	0	0	0	134
13	0	0	0	4	19	31	18	16	35	15	0	0	0	0	0	0	138
14	9	4	5	6	2	0	1	6	26	18	9	2	0	5	19	8	120
15	11	17	25	15	3	3	0	0	2	0	0	0	0	2	4	6	88
16	5	10	31	12	15	14	4	1	0	0	0	0	0	0	0	0	92
17	2	7	4	6	3	8	4	0	4	0	0	0	2	12	0	0	52
18	3	23	12	3	1	3	0	0	0	2	0	0	0	8	4	4	63
19	8	9	7	1	0	0	0	0	0	0	1	0	0	13	3		42
20	21	32	13	0	0	0	0	0	0	0	0	0	0	1	10	24	101
21	1	7	22	51	16	17	2	5	4	0	0	0	0	0	0	1	126
22	0	0	0	0	0	0	3	18	61	35	6	0	0	0	0	0	123
23	0	14	19	3	0	0	0	0	9	33	8	3	0	1	0	0	90
24	0	11	13	15	10	7	2	0	0	0	0	0	1	5	12	3	79
25	7	7	16	7	2	2	8	8	11	2	0	0	0	0	0	3	73
26	8	6	7	4	3	4	4	4	6	5	0	0	1	2	9	13	76
27	0	2	16	12	6	0	0	2	5	6	2	0	0	0	0	0	51
28	28	26	3	8	6	0	0	0	1	1	0	0	0	2	12	4	91
29	0	0	2	40	50	17	3	1	6	8	1	0	0	0	0	0	128
30	0	0	0	0	0	0	0	3	75	55	6	2	0	0	0	0	141
31	0	6	13	5	3	1	1	1	27	28	1	2	1	4	2	0	95
TOTAL	147	222	234	269	195	183	134	138	437	380	56	49	49	137	297	222	3149

September 1992 Kimuaneppu, Saroma-ko Lagoon

Date	Air Temperature			Wind				Solar Radiation		
	Mean °C	Max. °C	Min. °C	Mean m/s	Max. m/s	Min. m/s	Most Freq. Dir.	Cumulative kW/m ² ·h	Max. kW/m ²	Min. kW/m ²
1	21.8	24.5	18.9	2.7	4.6	2.0	S	5.7	0.9	0.0
2	21.8	23.3	20.2	6.4	20.2	2.0	S	1.4	0.2	0.0
3	18.6	22.8	14.3	14.5	21.9	3.1	WNW	2.0	0.6	0.0
4	13.6	14.3	12.8	8.0	13.5	5.1	N	1.4	0.2	0.0
5	12.7	13.3	11.7	7.3	10.3	3.2	NE	1.0	0.2	0.0
6	12.9	14.8	11.1	4.9	9.8	2.0	E	2.7	0.9	0.0
7	15.0	19.2	11.7	7.8	11.3	3.4	S	5.9	0.8	0.0
8	16.0	18.9	13.2	7.8	13.5	2.0	S	6.0	1.0	0.0
9	17.5	19.1	15.6	7.6	14.7	2.0	SSW	1.3	0.3	0.0
10	14.8	17.4	12.6	4.0	8.2	2.0	NNW	1.1	0.4	0.0
11	12.8	13.3	12.3	9.6	25.7	3.7	N	0.6	0.1	0.0
12	14.2	17.9	11.9	8.8	22.3	2.1	WNW	3.6	0.9	0.0
13	16.0	20.7	11.9	3.7	8.1	2.0	ENE	5.3	0.9	0.0
14	15.1	17.8	11.7	4.3	8.2	2.0	ENE	5.8	0.8	0.0
15	15.1	17.7	12.1	4.1	8.5	2.0	ENE	4.5	0.8	0.0
16	16.8	21.5	13.1	4.4	9.1	2.1	S	5.3	0.8	0.0
17	16.3	20.6	13.6	5.8	12.5	2.0	S	2.8	0.8	0.0
18	16.0	21.3	11.3	4.1	12.6	2.0	SW	5.4	0.8	0.0
19	13.2	15.7	10.6	4.5	9.8	2.0	S	1.3	0.3	0.0
20	11.7	13.5	9.8	11.1	17.3	4.4	WNW	4.6	1.0	0.0
21	11.1	12.0	6.7	9.5	16.2	2.1	NNW	3.7	1.0	0.0
22	11.3	16.0	5.8	4.2	10.4	2.0	S	5.5	0.8	0.0
23	13.8	17.8	9.8	4.9	10.6	2.0	SSW	5.3	0.8	0.0
24	16.1	19.7	12.1	5.8	11.3	2.1	S	1.1	0.3	0.0
25	13.4	16.3	10.5	6.5	12.0	2.0	NE	0.5	0.1	0.0
26	9.8	10.6	9.0	7.5	14.2	2.0	N	1.7	0.3	0.0
27	10.8	14.0	8.7	8.0	13.8	2.0	ENE	3.0	0.8	0.0
28	9.2	10.7	5.3	7.6	12.8	2.3	N	4.1	0.8	0.0
29	10.2	15.2	4.2	5.7	12.0	2.1	S	4.1	0.6	0.0
30	16.0	19.9	11.0	7.9	17.7	2.0	S	2.8	0.8	0.0

\$\$\$ means that there are more than two most frequent wind directions.

Frequency of Wind Direction

Date	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
1	0	3	5	7	3	1	2	4	9	8	2	0	0	0	0	0	44
2	0	0	0	0	0	0	7	19	51	13	1	2	0	1	1	0	95
3	0	0	0	0	0	0	0	0	1	3	5	3	19	44	25	44	144
4	50	44	28	0	0	0	0	0	0	0	0	0	0	0	3	19	144
5	2	65	69	7	1	0	0	0	0	0	0	0	0	0	0	0	144
6	0	0	17	14	27	21	12	10	14	4	0	0	0	0	0	0	119
7	0	0	0	0	0	0	0	18	106	20	0	0	0	0	0	0	144
8	0	0	0	0	0	0	1	49	80	13	0	0	0	0	0	0	143
9	0	0	0	0	0	0	0	0	46	63	21	3	2	2	0	0	137
10	28	15	8	0	0	0	0	0	0	0	0	0	2	11	17	41	122
11	70	4	0	0	0	0	0	0	0	0	0	0	0	0	15	55	144
12	8	1	0	0	0	0	1	3	13	15	0	1	10	52	16	9	129
13	0	0	6	19	8	9	3	0	8	12	1	2	3	7	0	0	78
14	0	5	9	27	15	8	15	6	5	12	0	0	0	0	0	0	102
15	0	3	3	34	6	5	8	9	20	17	7	2	0	0	0	0	114
16	0	0	0	0	0	2	10	19	58	37	3	0	0	0	0	0	129
17	1	0	0	0	0	0	0	3	40	31	7	5	4	15	10	7	123
18	0	1	7	6	0	0	4	7	8	8	20	14	18	7	9	2	111
19	11	1	1	2	2	0	0	9	32	10	6	4	18	7	8	10	121
20	0	0	0	0	0	0	0	0	0	0	3	33	43	28	37	0	144
21	16	0	0	0	0	0	0	0	7	3	1	0	0	6	14	93	140
22	1	3	10	9	3	13	8	0	34	30	0	0	3	7	0	0	121
23	0	0	15	15	1	1	0	0	21	43	8	0	0	0	0	0	104
24	1	0	0	0	1	3	0	7	50	30	3	1	2	3	2	4	107
25	13	14	38	38	13	1	0	0	0	0	0	0	0	0	0	0	117
26	37	13	16	8	2	5	6	4	5	0	0	0	0	0	2	32	130
27	0	9	18	30	18	15	4	3	7	1	0	0	0	0	0	0	105
28	68	12	0	0	0	0	0	0	15	10	3	1	0	1	31	0	141
29	0	0	0	0	0	2	1	23	77	39	1	0	0	0	0	0	143
30	0	0	0	0	0	5	7	41	51	26	6	0	0	0	0	0	136
TOTAL	306	193	250	216	100	91	89	234	743	453	102	43	115	205	151	384	3675

October 1992 Kimuaneppu, Saroma-ko Lagoon

Date	Air Temperature			Wind				Solar Radiation		
	Mean °C	Max. °C	Min. °C	Mean m/s	Max. m/s	Min. m/s	Most Freq. Dir.	Cumulative kW/m ² ·h	Max. kW/m ²	Min. kW/m ²
1	15.2	17.2	12.4	3.7	6.3	2.0	SSW	4.6	0.7	0.0
2	17.3	23.4	10.7	5.4	12.6	2.0	SSW	4.6	0.7	0.0
3	14.7	19.8	11.2	3.0	6.3	2.0	S	3.4	0.7	0.0
4	11.5	17.4	6.7	5.3	16.5	2.1	N	1.4	0.3	0.0
5	8.4	10.9	5.5	5.3	10.4	2.0	W	4.6	0.8	0.0
6	9.3	13.7	4.5	3.2	5.5	2.0	S	4.8	0.7	0.0
7	10.8	14.0	6.7	3.5	9.1	2.0	S	5.0	0.7	0.0
8	12.6	16.7	9.8	8.3	12.7	4.0	SSW	4.6	0.7	0.0
9	13.4	16.4	11.5	5.0	12.3	2.0	SE	2.1	0.5	0.0
10	11.2	12.4	9.7	14.4	19.3	9.4	NNW	1.0	0.2	0.0
11	13.5	17.9	10.1	4.5	13.9	2.0	WNW	4.1	0.7	0.0
12	12.6	18.3	10.0	4.3	9.4	2.0	N	3.1	0.6	0.0
13	10.3	15.1	6.3	3.5	6.9	2.0	SSW	4.4	0.6	0.0
14	10.4	14.4	6.6	3.5	6.2	2.0	NE	4.5	0.6	0.0
15	9.7	14.2	6.4	3.9	6.6	2.0	E	4.3	0.6	0.0
16	11.1	15.4	5.3	5.5	14.5	2.0	SSW	4.1	0.6	0.0
17	7.9	11.9	5.5	5.0	12.6	2.0	SW	1.5	0.5	0.0
18	6.9	9.1	3.7	3.7	7.1	2.0	NNE	3.6	0.7	0.0
19	5.6	8.3	2.2	4.5	8.7	2.0	NNW	3.8	0.7	0.0
20	5.8	9.1	1.6	4.6	8.9	2.0	S	4.1	0.7	0.0
21	8.3	10.5	5.9	3.7	7.1	2.0	SSW	3.2	0.7	0.0
22	7.3	12.6	3.6	3.3	5.1	2.0	SSW	1.6	0.6	0.0
23	10.1	14.2	7.5	2.6	4.2	2.1	SSW	0.1	0.1	0.0
24	10.5	14.3	7.9	3.9	7.7	2.0	E	1.9	0.6	0.0
25	9.8	11.6	8.0	5.4	12.7	2.0	N	1.2	0.3	0.0
26	7.7	8.8	6.6	11.9	18.0	5.2	N	1.0	0.2	0.0
27	9.1	10.6	6.1	6.6	12.4	2.1	NNW	1.5	0.4	0.0
28	8.8	13.6	3.8	3.3	6.2	2.0	SSW	3.6	0.6	0.0
29	8.9	11.4	5.4	4.0	8.6	2.0	SSW	2.8	0.7	0.0
30	12.6	16.7	9.6	4.4	9.1	2.0	S	2.1	0.5	0.0
31	9.8	12.6	7.7	6.6	13.9	2.2	NW	1.1	0.4	0.0

\$\$\$ means that there are more than two most frequent wind directions.

Frequency of Wind Direction

Date	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
1	0	1	10	17	5	7	4	1	7	20	8	1	0	1	0	0	82
2	0	0	0	0	0	1	1	1	36	54	17	3	0	3	3	1	119
3	8	4	2	0	2	5	8	9	10	7	5	1	6	6	2	6	81
4	45	23	8	1	0	0	0	0	0	0	0	1	5	12	15	12	122
5	1	3	7	1	0	3	2	1	1	10	9	13	29	8	11	15	114
6	2	6	5	13	0	6	2	1	27	22	3	0	0	2	1	6	96
7	0	1	8	17	10	2	2	5	33	30	3	0	2	0	0	0	113
8	0	0	0	0	0	0	0	0	4	68	71	1	0	0	0	0	144
9	0	0	0	12	11	26	39	33	12	0	0	0	0	0	0	0	133
10	6	10	12	34	0	0	0	0	0	0	0	0	0	14	33	35	144
11	0	2	6	8	6	2	3	3	21	9	0	0	5	22	8	0	95
12	36	21	2	0	0	0	1	9	23	23	2	0	0	0	1	2	120
13	8	3	3	6	8	3	1	2	19	30	6	0	0	0	0	1	90
14	0	0	20	13	8	1	2	2	4	13	2	0	0	0	0	0	65
15	0	0	12	13	17	3	0	0	10	17	5	0	0	0	0	0	77
16	0	0	11	5	1	2	2	0	14	32	8	3	3	11	24	9	125
17	12	6	2	0	1	0	0	2	15	15	17	13	5	14	2	7	111
18	16	24	9	1	1	0	0	1	6	23	2	1	6	8	3	6	107
19	3	0	0	0	0	0	0	0	1	17	29	0	0	3	15	12	121
20	0	0	3	15	14	10	4	6	27	18	1	0	0	0	0	0	98
21	21	11	1	1	0	0	0	0	4	26	1	2	1	5	13	14	120
22	3	6	1	0	1	0	0	0	12	19	6	0	4	2	0	0	54
23	0	1	0	0	0	0	0	0	2	7	3	0	0	0	1	0	14
24	0	0	1	19	31	23	4	4	9	4	1	0	0	0	0	0	96
25	32	22	10	1	2	0	0	0	0	0	0	4	2	8	3	19	103
26	53	5	0	0	0	0	0	0	0	0	0	0	16	20	16	34	144
27	0	0	0	0	0	0	0	9	10	1	6	11	33	28	11	34	143
28	0	2	4	0	1	0	0	8	20	31	8	2	2	9	0	0	87
29	0	0	9	12	3	8	4	3	18	33	10	1	0	0	0	0	101
30	0	0	0	0	4	2	13	15	42	29	8	0	1	0	0	1	115
31	0	0	0	0	0	0	3	6	8	1	1	1	5	17	54	15	111
TOTAL	246	161	156	189	126	103	95	126	475	574	133	57	128	205	213	258	3245

November 1992 Kimuanepu, Saroma-ko Lagoon

Date	Air Temperature			Wind			Most Freq. Dir.	Solar Radiation		
	Mean °C	Max. °C	Min. °C	Mean m/s	Max. m/s	Min. m/s		Cumulative kW/m ² -h	Max. kW/m ²	Min. kW/m ²
1	6.5	9.2	1.3	8.9	22.7	2.0	W	2.34	0.53	0.01
2	3.0	5.6	1.3	9.4	20.8	2.1	WNW	3.37	0.60	0.01
3	6.4	9.6	1.7	8.0	13.9	2.1	S	2.46	0.50	0.01
4	9.1	11.6	4.4	8.3	16.7	2.2	W	2.35	0.60	0.01
5	7.6	13.4	3.2	3.5	6.0	2.0	S	3.58	0.54	0.01
6	8.8	13.4	4.5	4.5	8.4	2.0	S	1.45	0.22	0.01
7	2.7	7.5	-0.2	8.9	13.1	5.2	NNW	1.48	0.27	0.01
8	0.7	3.1	-2.0	4.6	9.7	2.1	WNW	4.25	0.55	0.01
9	4.4	8.7	-0.9	5.9	13.0	2.0	S	3.16	0.50	0.01
10	5.3	7.8	2.4	4.0	7.7	2.0	S	1.66	0.41	0.01
11	7.0	9.5	3.2	5.6	13.9	2.0	WNW	2.71	0.52	0.01
12	7.3	12.0	2.2	4.7	9.9	2.0	S	3.36	0.59	0.01
13	4.4	7.4	0.5	7.1	14.5	2.0	NW	3.22	0.51	0.01
14	3.8	7.4	-1.6	3.4	5.0	2.0	SSW	3.16	0.48	0.01
15	9.3	16.2	3.8	6.8	14.1	2.0	S	3.16	0.52	0.01
16	6.5	11.0	0.7	8.8	15.5	2.1	W	2.46	0.60	0.01
17	1.6	5.4	-0.8	6.0	16.9	2.0	W	2.68	0.51	0.01
18	0.8	2.2	-2.9	9.3	18.7	2.1	WNW	3.36	0.67	0.01
19	1.0	6.3	-3.3	5.4	16.1	2.0	S	2.55	0.59	0.01
20	6.0	14.7	0.9	11.9	16.3	6.5	NNW	1.71	0.36	0.01
21	-1.1	1.6	-4.3	7.7	13.0	2.2	NNW	1.02	0.15	0.01
22	1.4	6.1	-4.7	6.7	13.4	2.0	SSE	2.98	0.61	0.01
23	5.4	9.7	1.3	5.3	18.8	2.0	S	1.70	0.40	0.01
24	3.2	6.0	0.9	6.5	17.6	2.2	WNW	2.38	0.55	0.01
25	4.4	7.9	1.3	8.0	13.6	2.1	NW	2.72	0.49	0.01
26	-0.4	1.5	-2.6	5.4	15.7	2.1	WNW	2.18	0.50	0.01
27	-2.4	-0.9	-6.8	10.7	17.9	2.6	W	2.11	0.45	0.02
28	-0.6	3.8	-7.0	4.6	9.8	2.0	S	2.49	0.53	0.01
29	3.8	5.8	-0.1	8.9	18.6	2.0	WNW	2.11	0.47	0.01
30	-0.3	1.2	-1.7	6.3	11.4	2.2	NNW	1.77	0.62	0.01

\$\$\$ means that there are more than two most frequent wind directions.

Frequency of Wind Direction

Date	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
1	0	0	0	0	0	3	4	3	4	7	3	8	44	34	5	6	121
2	0	0	0	0	0	0	0	0	5	30	4	1	3	72	24	3	142
3	0	0	0	0	0	0	0	1	76	58	4	1	0	0	0	0	140
4	0	0	0	0	0	0	0	0	17	25	9	6	45	37	2	0	141
5	0	0	0	0	0	0	1	9	48	43	16	3	2	3	0	0	125
6	2	6	7	2	2	2	4	3	34	25	0	0	0	1	7	10	105
7	30	30	23	0	0	0	0	0	0	0	0	0	1	4	4	52	144
8	0	0	0	0	0	0	0	3	8	16	24	7	10	40	15	1	124
9	5	8	4	5	1	3	3	0	56	36	12	0	0	0	0	0	133
10	19	0	0	0	0	3	23	13	34	15	6	1	1	0	3	3	121
11	0	0	0	0	0	0	1	0	9	16	19	10	8	42	9	2	116
12	2	1	4	9	7	2	0	5	27	15	4	2	21	10	0	0	109
13	8	1	3	6	2	2	2	5	2	0	1	3	7	36	19	9	99
14	0	0	10	4	5	4	2	1	7	16	3	0	1	0	0	0	53
15	0	0	0	0	0	0	2	5	62	45	16	2	0	1	1	1	135
16	0	0	0	0	0	0	0	3	19	12	8	9	40	33	11	2	137
17	0	0	0	0	0	0	2	5	8	9	8	20	43	20	6	1	122
18	0	0	0	0	0	0	0	1	2	6	9	4	18	77	16	0	133
19	0	0	1	0	6	14	8	28	46	37	2	0	0	0	0	0	142
20	0	0	0	1	0	0	3	9	50	3	0	0	0	2	22	54	144
21	20	1	1	1	0	1	2	4	4	14	3	0	0	4	19	69	143
22	0	0	3	2	6	10	14	37	36	22	6	0	2	0	0	1	139
23	0	2	3	0	5	7	8	3	25	22	13	5	6	5	1	1	106
24	10	1	8	8	6	8	11	10	15	1	0	0	1	26	13	11	129
25	1	0	0	0	0	2	7	15	11	6	1	7	21	25	37	8	141
26	2	0	1	0	1	1	4	6	3	9	2	1	17	21	18	10	96
27	0	0	0	0	0	0	0	0	2	2	7	62	35	19	17	144	
28	0	0	0	0	0	1	2	3	55	44	11	12	6	0	0	0	134
29	2	0	1	2	1	1	0	2	34	12	1	1	6	36	20	10	129
30	40	1	0	0	0	0	0	0	0	0	1	2	9	11	76	140	
TOTAL	141	51	69	40	42	64	103	171	700	548	186	109	363	544	299	357	3787

December 1992 Kimuaneppu, Saroma-ko Lagoon

Date	Air Temperature			Wind				Solar Radiation		
	Mean °C	Max. °C	Min. °C	Mean m/s	Max. m/s	Min. m/s	Most Freq. Dir.	Cumulative kW/m ² -h	Max. kW/m ²	Min. kW/m ²
1	-2.4	-0.2	-3.7	4.7	8.9	2.0	N	1.89	0.50	0.02
2	1.8	5.1	-0.3	8.1	20.7	2.5	N	2.46	0.49	0.01
3	-0.5	1.3	-1.9	6.2	12.1	2.0	WNW	2.31	0.58	0.01
4	-2.1	-0.4	-3.4	6.1	10.7	3.0	WNW	1.12	0.37	0.02
5	---	---	---	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---	---	---	---
7	6.6	8.1	5.5	7.3	12.9	2.2	SSE	0.86	0.22	0.01
8	4.4	9.1	1.9	7.4	14.4	2.1	WNW	0.92	0.28	0.01
9	1.4	2.0	0.7	6.1	10.1	2.0	NNW	1.16	0.28	0.01
10	2.7	6.1	0.5	4.3	7.7	2.0	S	1.33	0.33	0.01
11	4.3	7.5	0.6	6.7	12.5	2.0	NW	1.14	0.30	0.01
12	-1.6	0.8	-3.7	7.1	15.6	2.0	WSW	2.27	0.39	0.02
13	0.8	2.9	-1.1	4.8	12.5	2.0	WSW	2.71	0.60	0.01
14	-0.8	0.1	-4.3	8.4	16.0	2.0	W	0.86	0.12	0.02
15	-1.1	0.3	-4.4	8.1	12.8	3.0	W	1.80	0.40	0.02
16	-1.3	2.4	-4.5	4.0	9.3	2.0	WSW	2.59	0.62	0.01
17	-2.5	0.2	-5.8	3.5	7.2	2.0	WSW	2.83	0.61	0.02
18	-2.3	0.0	-4.9	8.2	18.8	2.0	NNW	2.12	0.37	0.02
19	-2.7	-0.6	-6.9	8.5	18.9	2.1	NNW	2.06	0.49	0.02
20	-3.8	-1.1	-7.0	4.4	8.5	2.1	SSE	1.82	0.26	0.02
21	-1.8	-0.1	-6.1	5.1	8.1	2.1	NNE	2.16	0.54	0.02
22	-2.7	1.7	-8.9	4.9	12.5	2.0	SSE	1.36	0.25	0.02
23	-0.4	1.5	-2.3	6.0	13.3	2.2	WSW	2.54	0.51	0.02
24	-2.8	-1.5	-4.0	6.8	15.0	2.0	WNW	1.62	0.37	0.02
25	-2.6	-1.3	-4.4	12.2	17.0	5.2	WNW	2.18	0.41	0.02
26	-2.4	0.2	-3.8	6.2	10.8	2.2	WNW	2.52	0.39	0.02
27	-0.5	2.5	-3.4	5.1	10.2	2.0	S	1.81	0.44	0.01
28	-2.3	0.2	-4.0	7.8	13.2	2.4	NNW	1.37	0.27	0.02
29	-5.0	-0.6	-8.7	3.3	6.3	2.0	SSW	2.78	0.43	0.02
30	-2.9	0.4	-6.8	5.5	9.2	2.5	S	2.52	0.44	0.02
31	-3.2	-1.2	-4.9	6.5	11.3	2.3	W	1.64	0.32	0.02

\$\$\$ means that there are more than two most frequent wind directions.

Frequency of Wind Direction

Date	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
1	32	10	0	3	11	18	17	2	2	0	0	0	0	0	0	0	95
2	28	4	0	0	6	19	11	2	0	0	0	8	19	13	7	14	131
3	0	0	0	0	1	0	1	0	0	0	1	0	14	50	19	1	87
4	5	0	0	0	0	0	0	0	0	0	0	2	9	37	17	16	86
5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
7	0	0	2	3	8	4	10	19	16	8	1	0	0	0	0	0	71
8	0	0	0	0	0	1	0	6	0	5	11	3	2	76	16	6	126
9	10	7	3	3	1	2	2	11	8	5	1	0	0	8	50	0	111
10	0	0	0	1	4	21	23	16	29	25	1	2	0	0	0	0	122
11	0	0	1	1	0	5	11	8	12	3	0	2	8	23	32	23	129
12	0	0	0	0	0	1	3	4	1	2	25	61	25	11	1	0	134
13	0	0	0	1	8	6	4	9	6	6	20	29	25	8	0	0	122
14	4	1	1	0	2	0	0	0	0	1	4	5	34	26	29	24	131
15	0	0	0	0	0	0	0	0	0	0	7	13	60	48	16	0	144
16	0	4	5	2	6	6	2	2	8	10	7	21	15	2	0	0	90
17	0	2	1	0	0	0	2	5	11	9	11	26	19	22	9	2	119
18	7	1	1	0	0	1	0	1	2	4	6	2	11	11	24	37	108
19	10	6	1	2	1	1	4	3	5	10	2	0	0	11	19	66	141
20	0	0	1	4	5	20	20	28	25	12	5	1	3	2	1	0	127
21	19	28	20	6	2	0	0	0	5	3	3	0	1	0	1	2	90
22	0	0	0	2	3	9	22	39	24	10	9	0	0	0	0	0	118
23	0	0	0	1	1	1	1	4	4	12	38	67	11	0	0	0	140
24	0	0	0	0	0	0	0	0	0	1	20	28	31	40	15	4	139
25	0	0	0	0	0	0	0	0	0	0	0	0	7	71	63	3	144
26	0	1	1	0	1	1	4	7	12	6	2	0	11	50	29	6	131
27	0	1	1	5	5	6	4	8	27	22	5	3	7	16	15	2	127
28	3	0	0	0	0	0	0	0	0	0	0	0	2	15	55	63	138
29	0	2	1	0	2	0	5	6	23	44	18	4	7	5	0	0	117
30	0	0	3	2	9	8	10	14	41	26	6	2	15	6	0	0	142
31	4	0	0	0	0	0	0	0	0	1	4	49	49	11	24	142	3502
TOTAL	122	67	42	36	76	130	156	194	261	224	204	283	385	592	387	343	3502

Kimuaneppu, Saroma-ko Lagoon

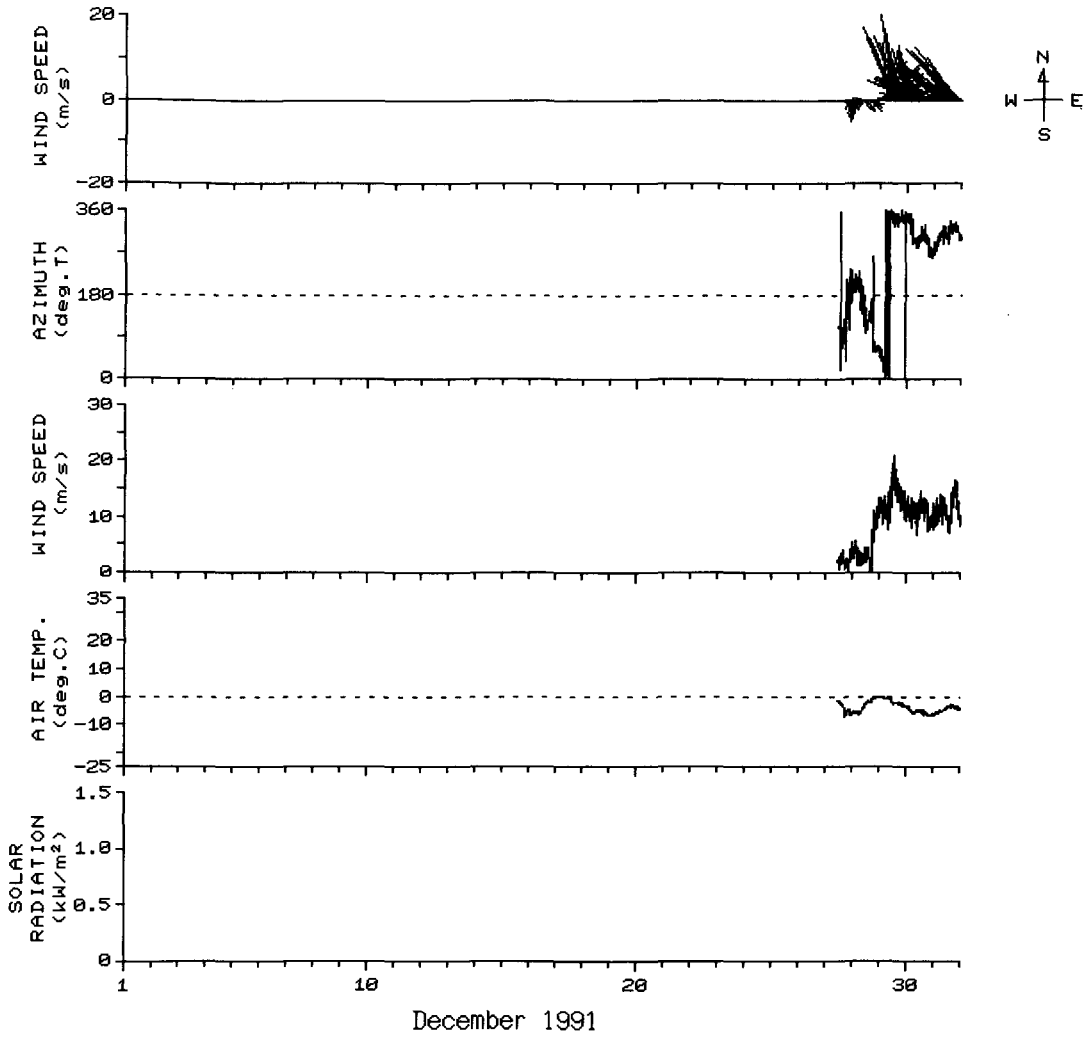
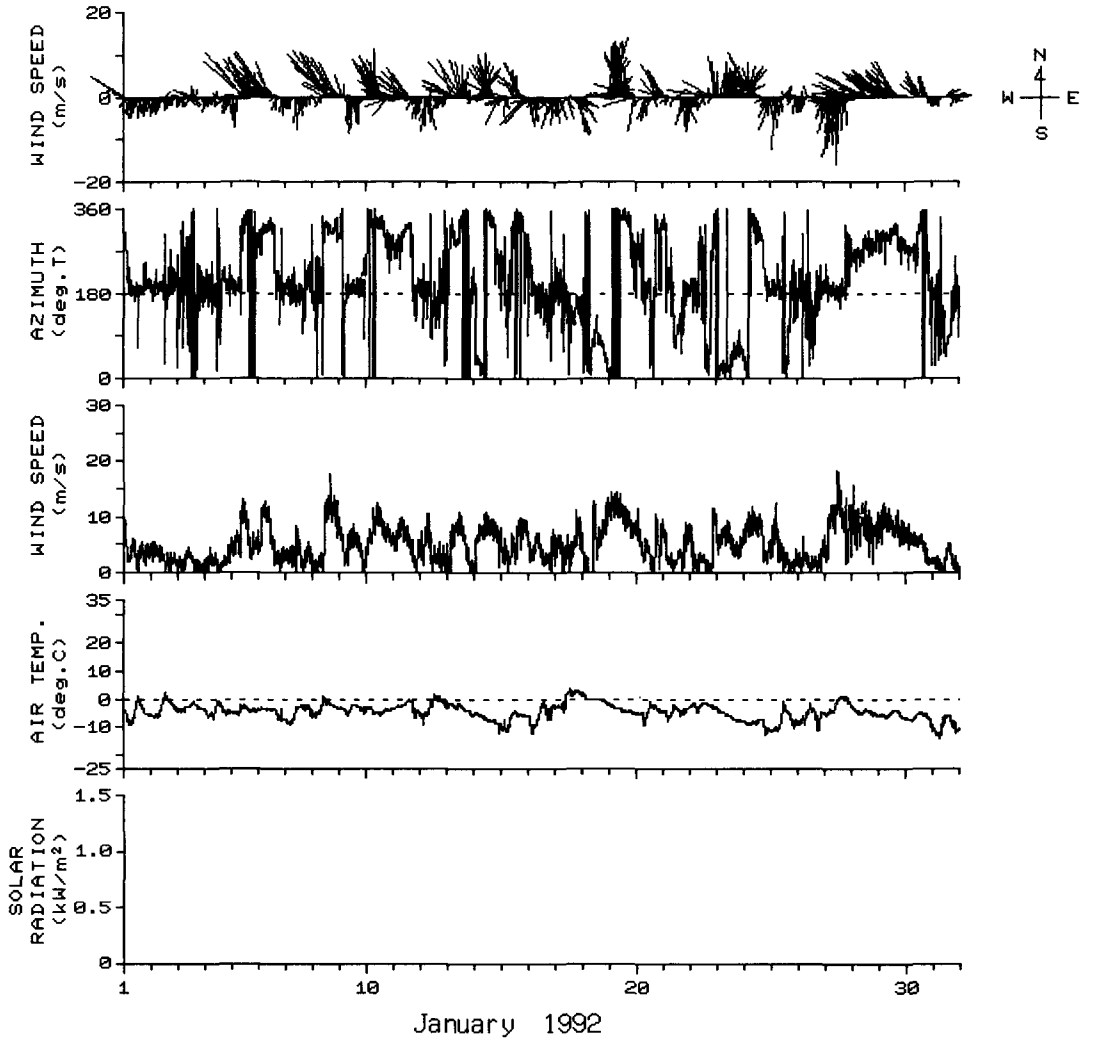
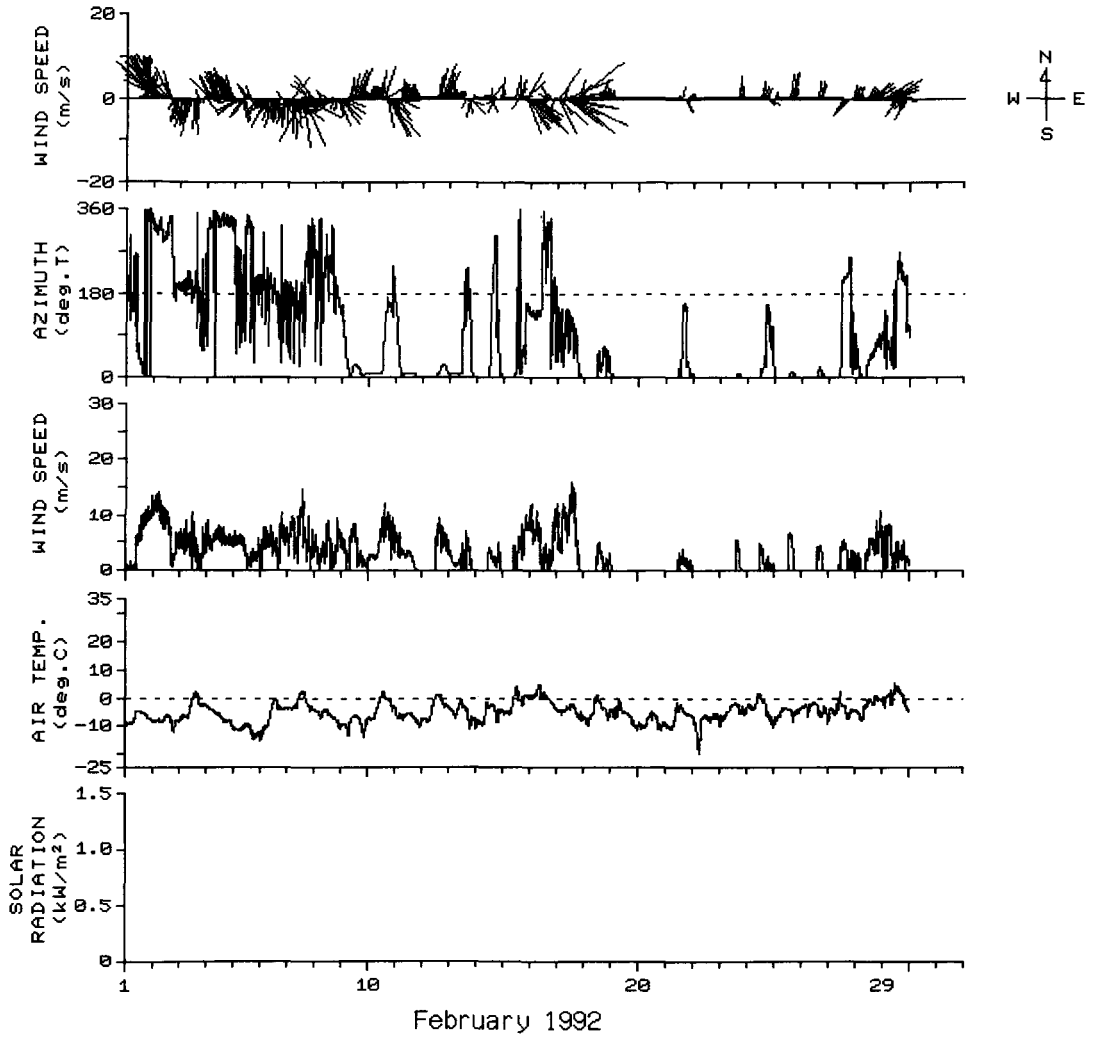


Fig. 4 Wind speed and direction, air temperature, and solar radiation obtained at Kimuaneppu during the period between December 1991 and December 1992

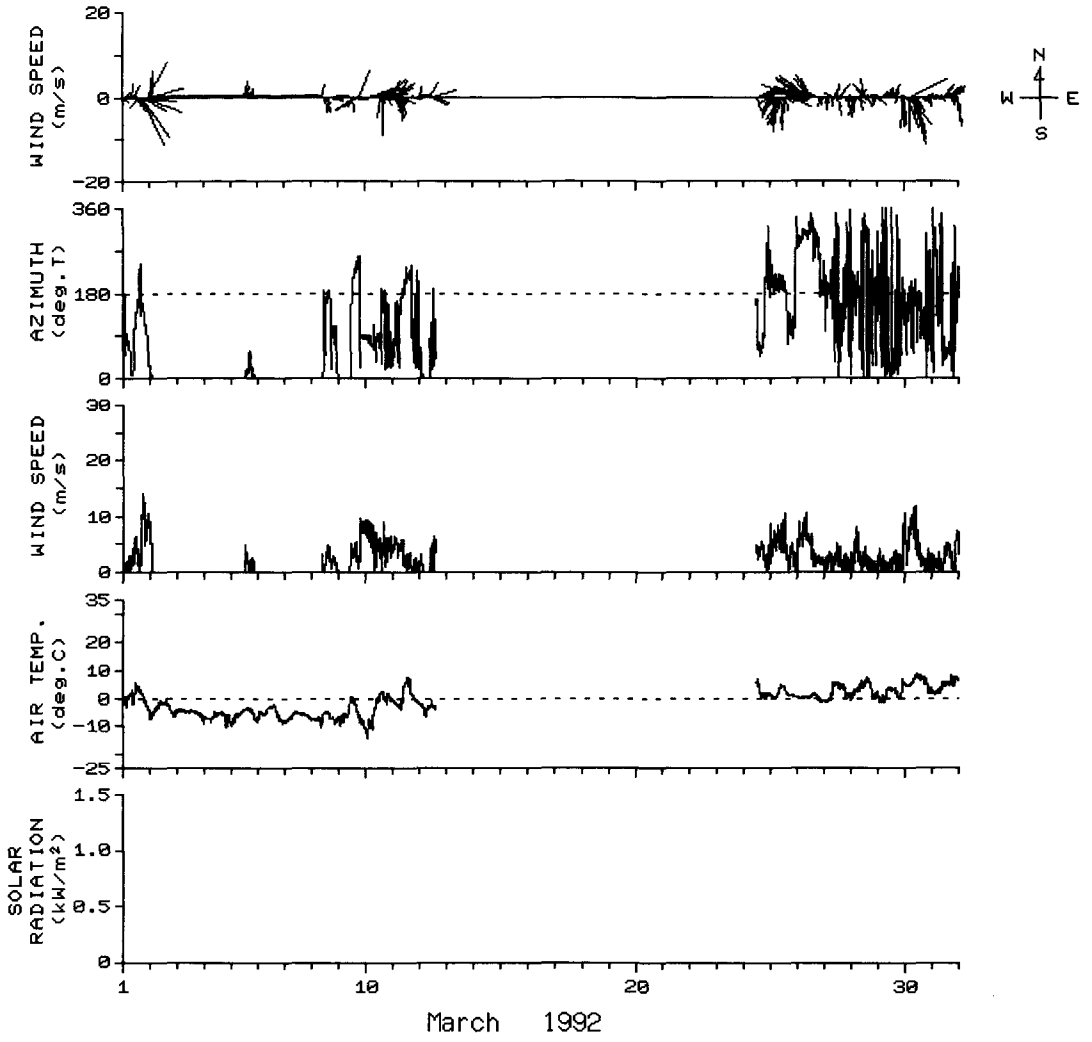
Kimuaneppu, Saroma-ko Lagoon



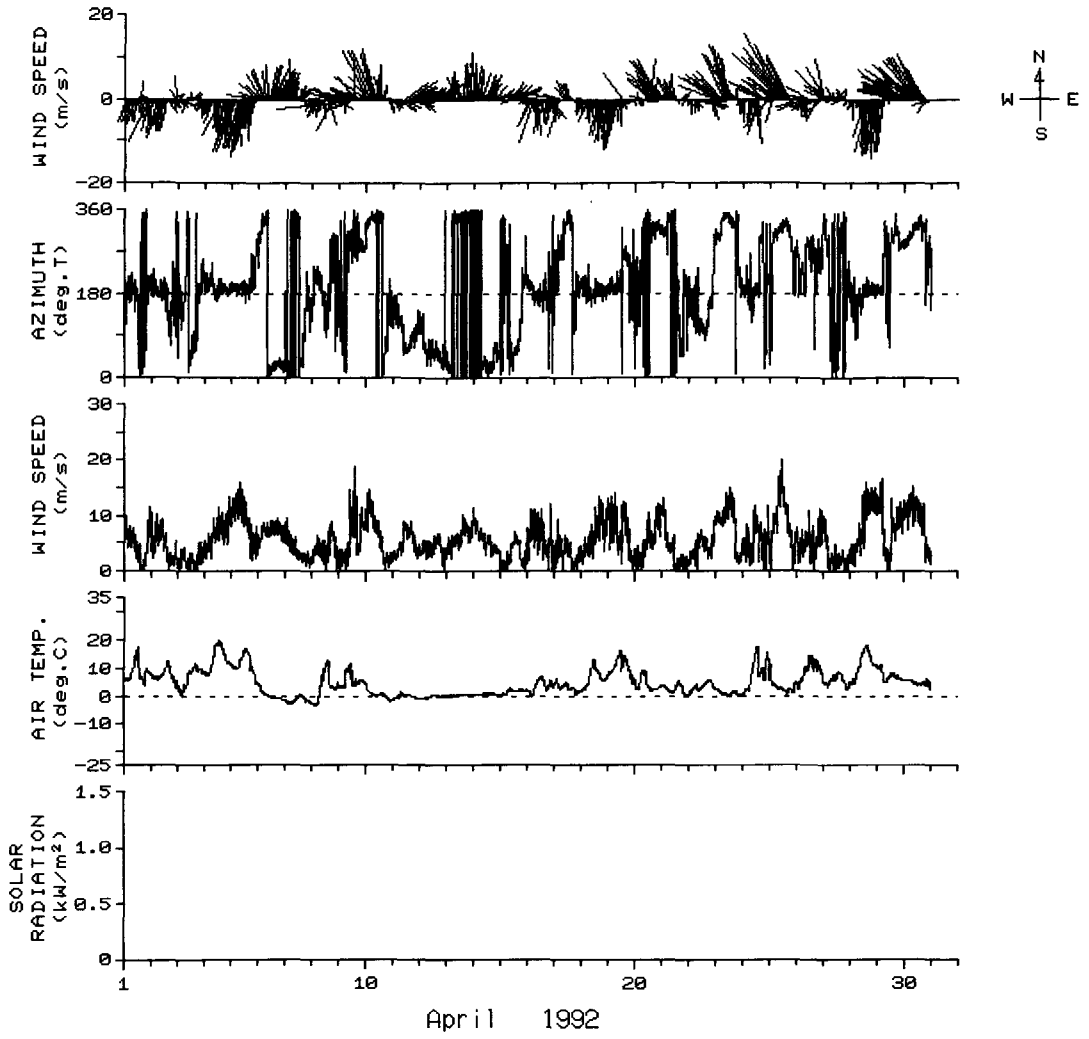
Kimuaneppu, Saroma-ko Lagoon



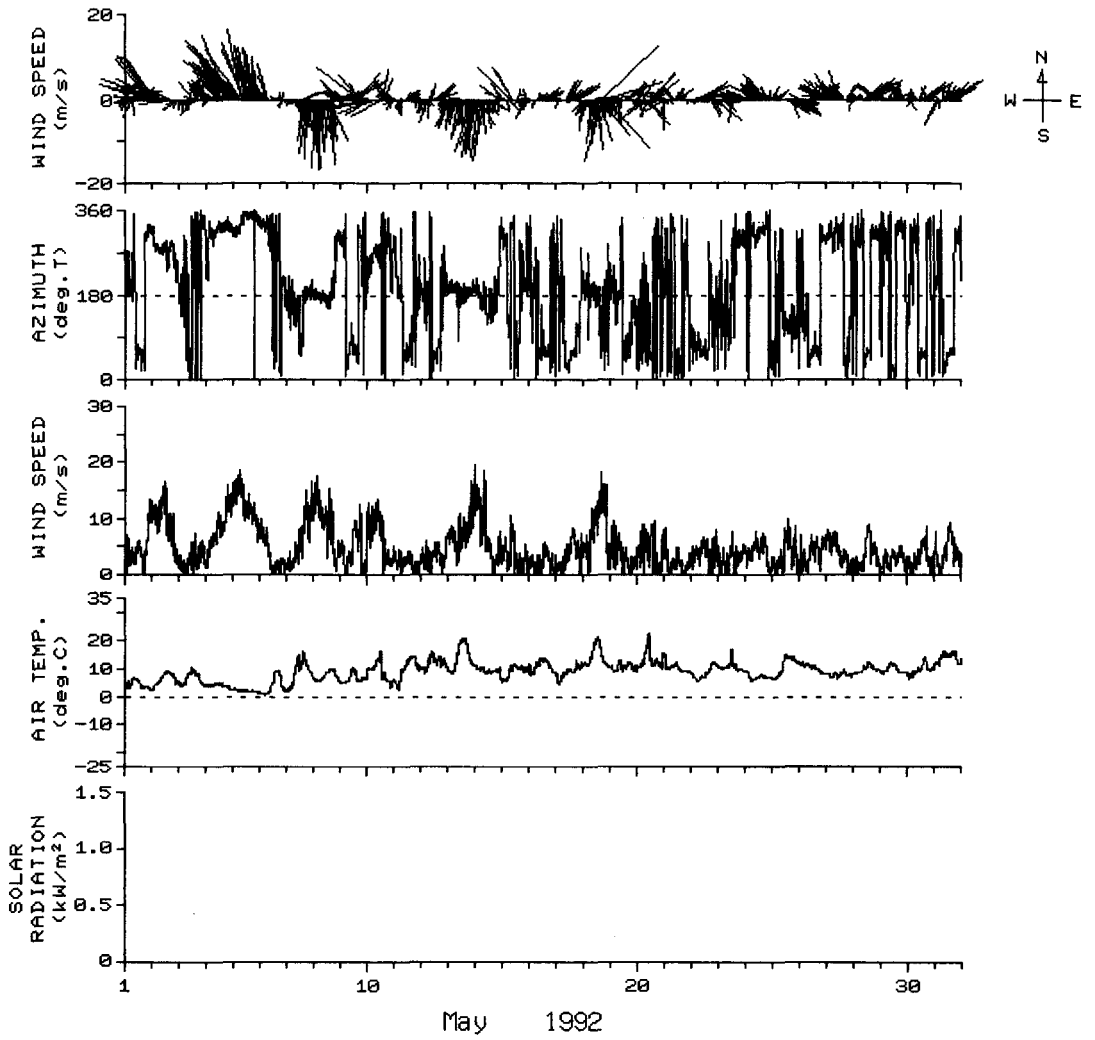
Kimuanepu, Saroma-ko Lagoon



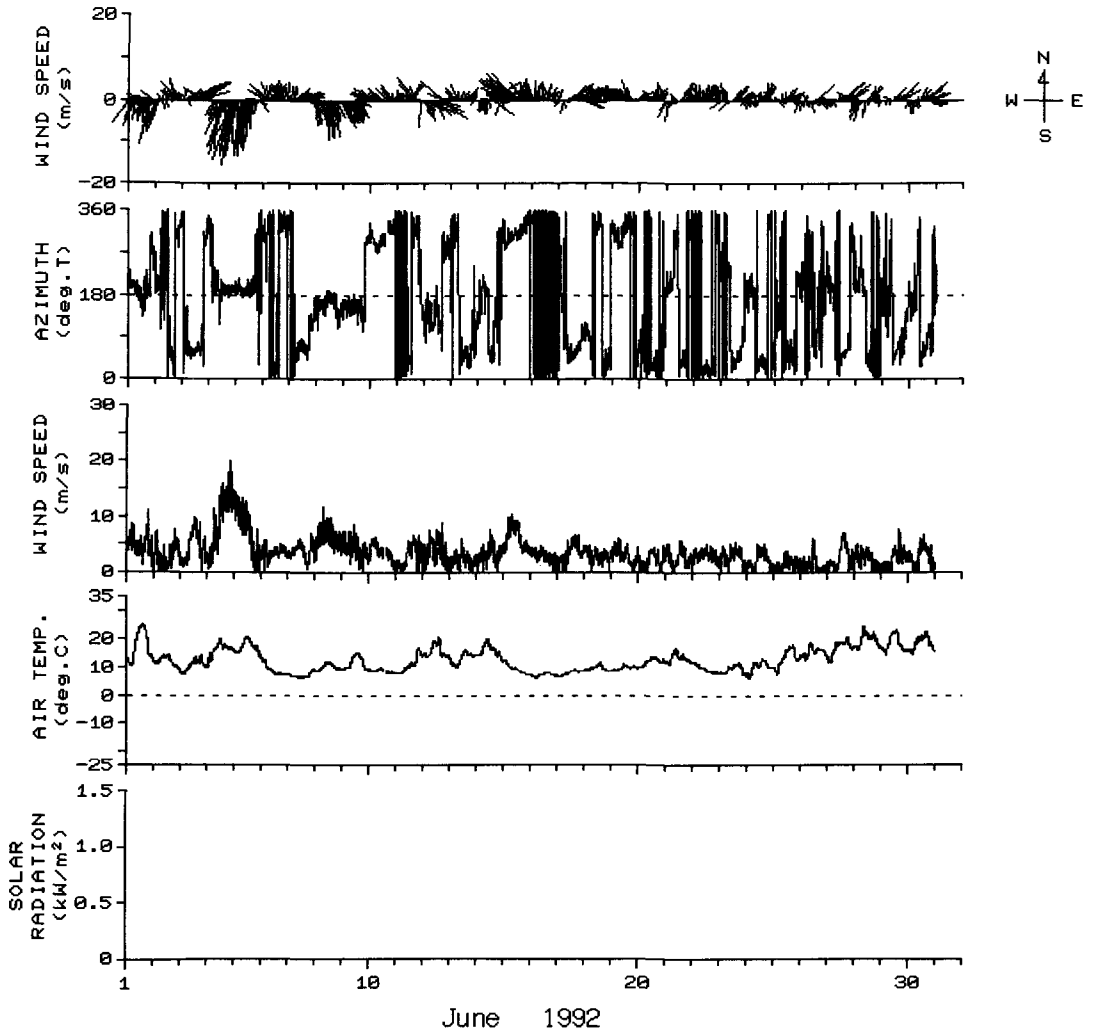
Kimuanepu, Saroma-ko Lagoon



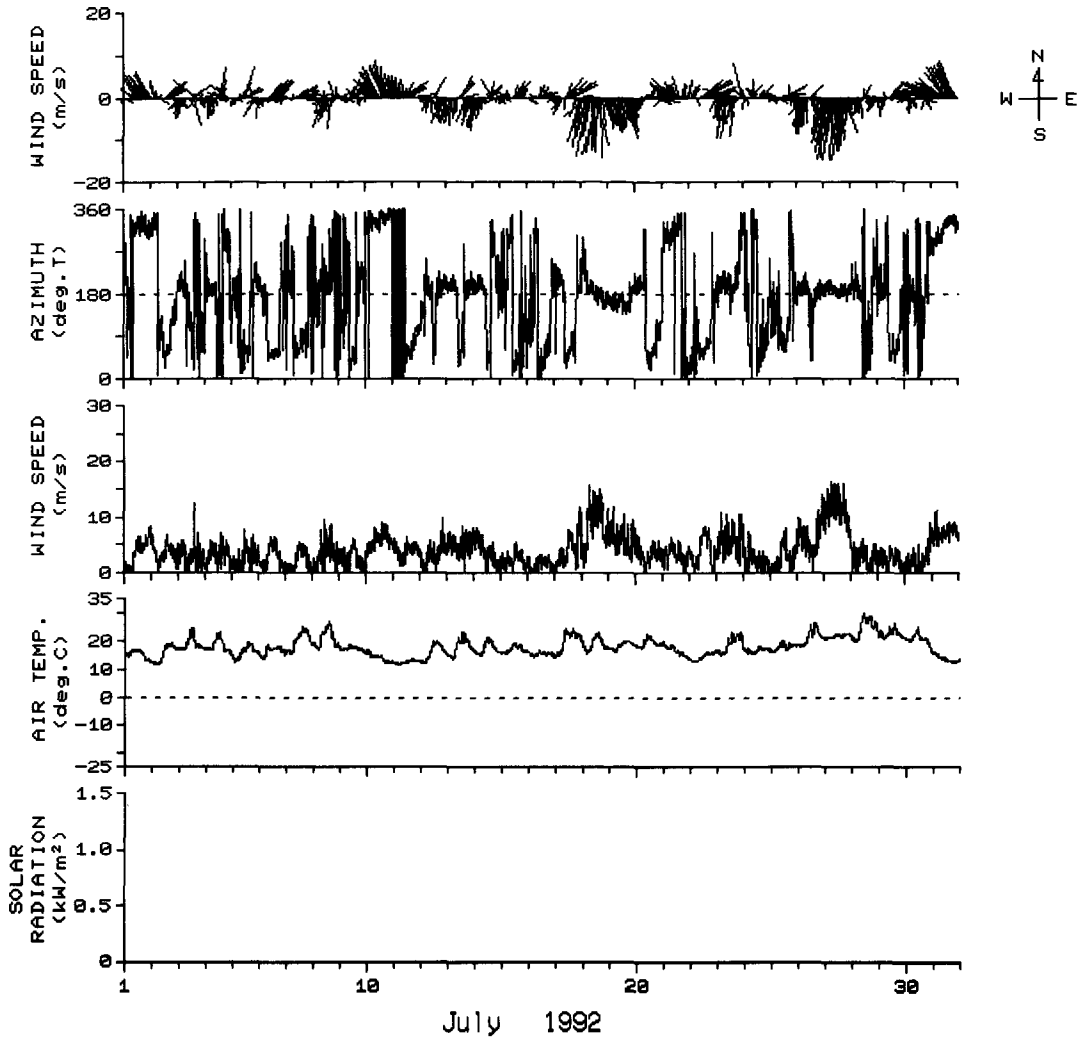
Kimuaneppu, Saroma-ko Lagoon



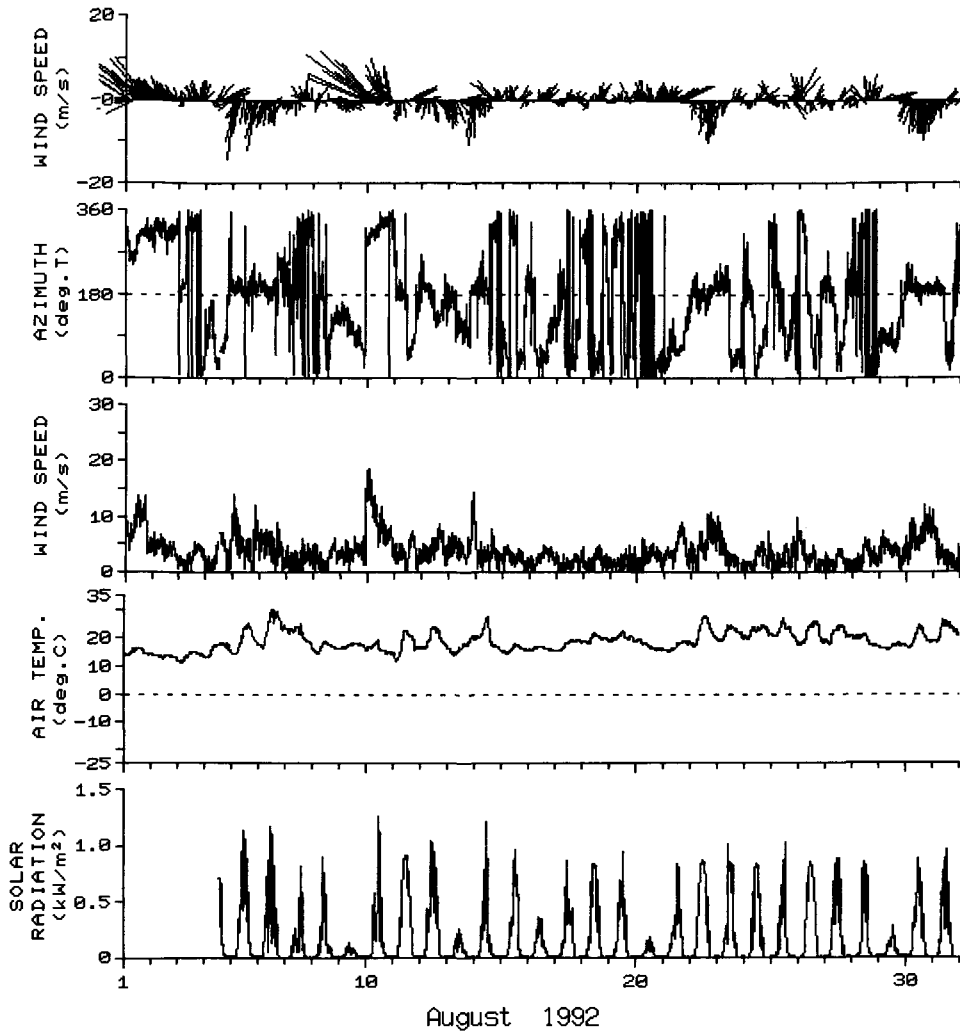
Kimuaneppu, Saroma-ko Lagoon



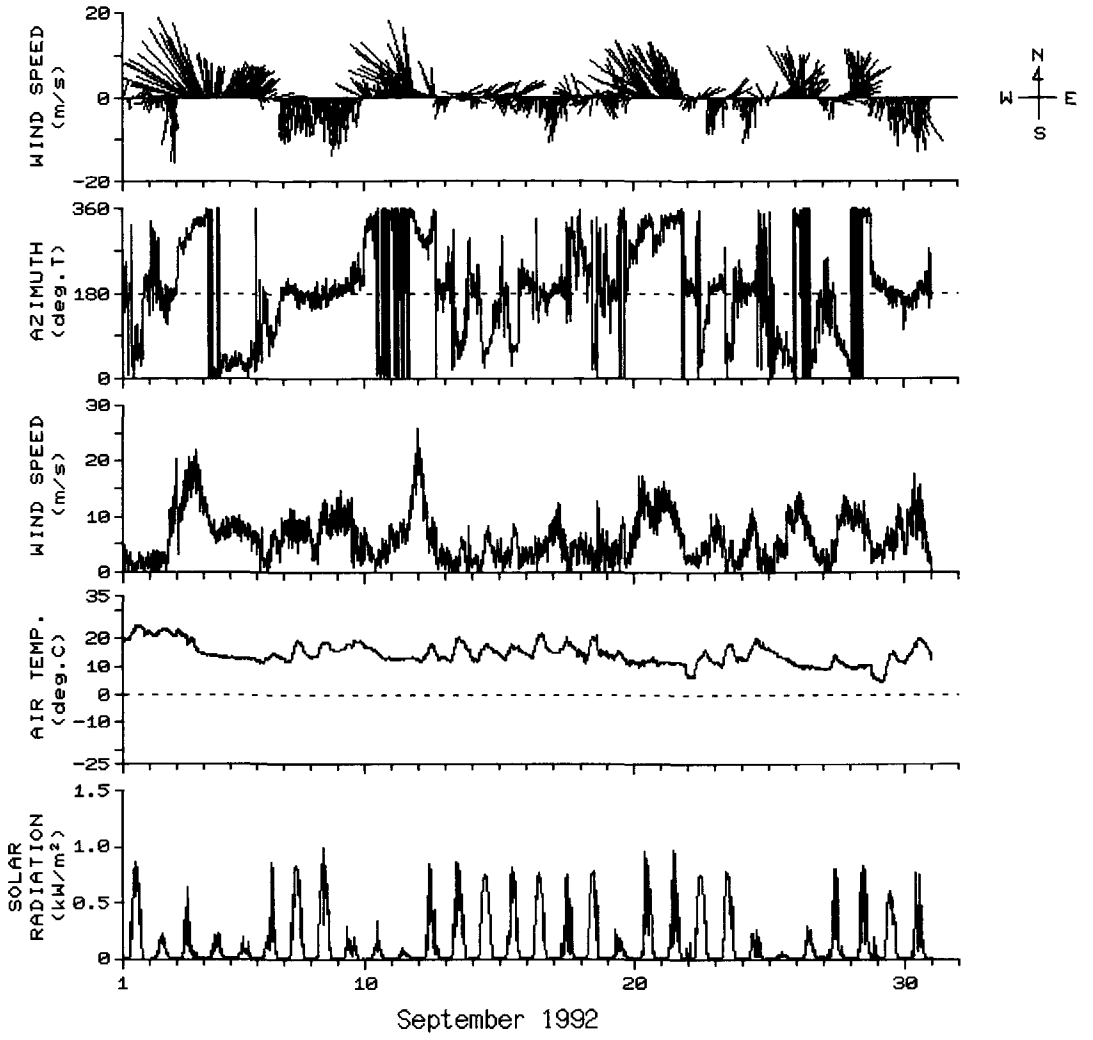
Kimuaneppu, Saroma-ko Lagoon



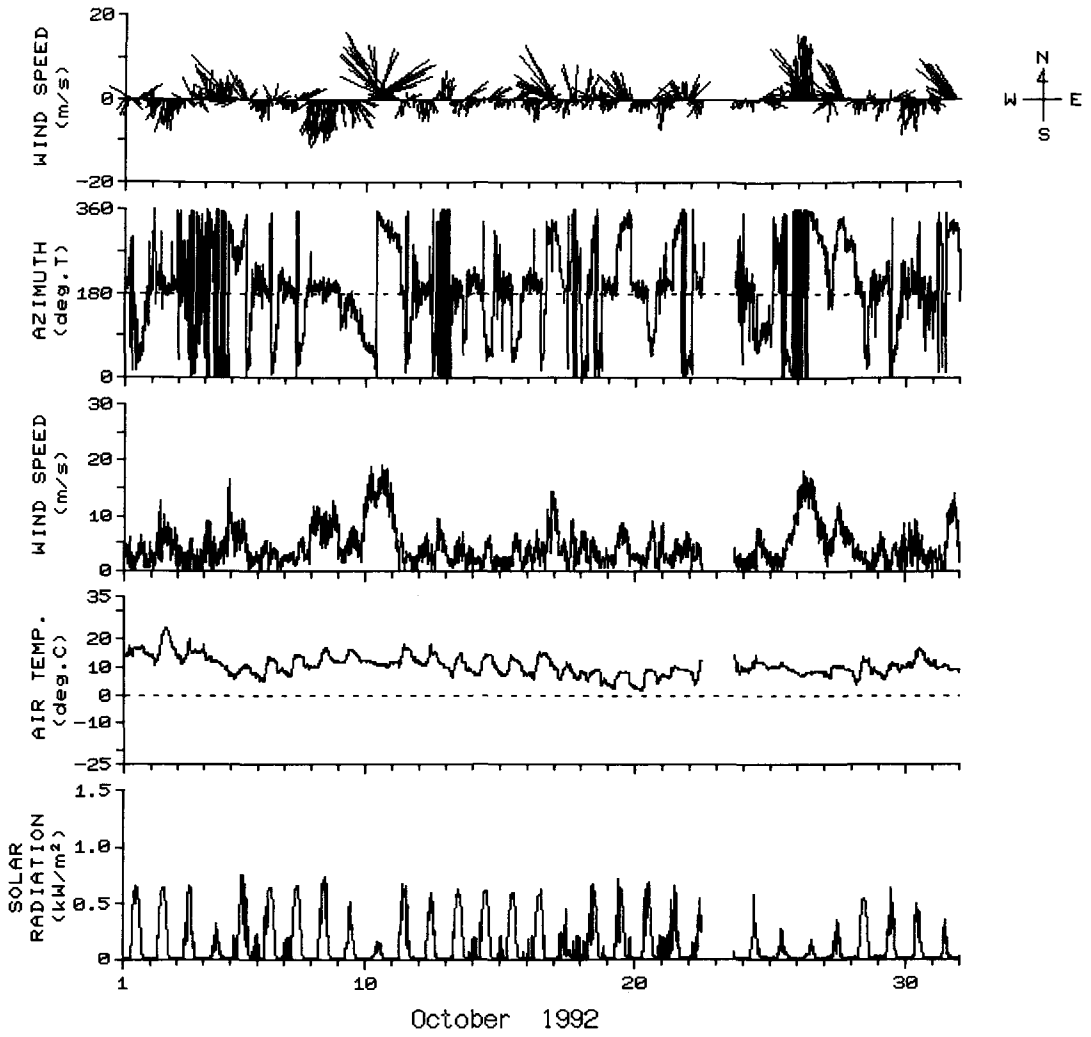
Kimuaneppu, Saroma-ko Lagoon



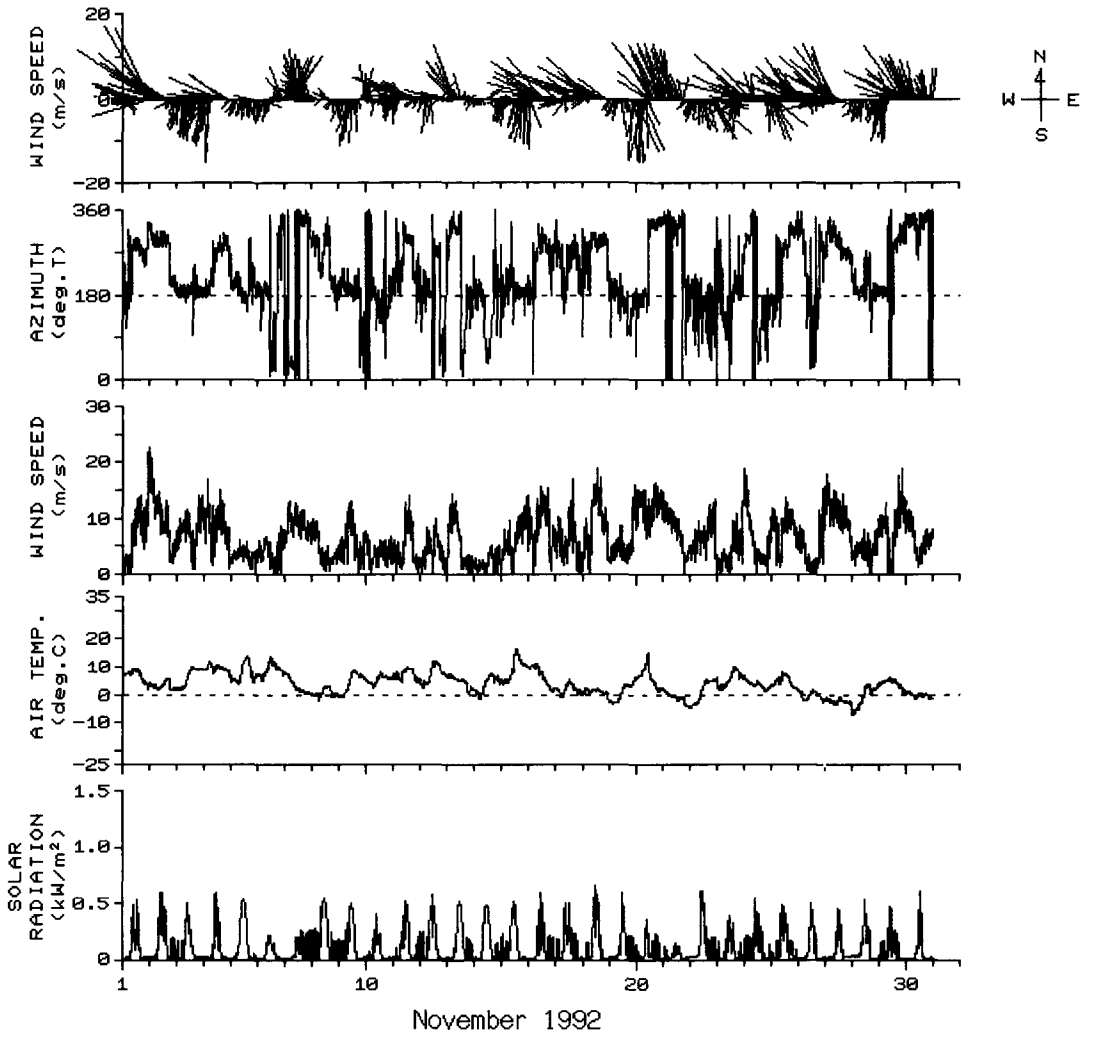
Kimuaneppu, Saroma-ko Lagoon



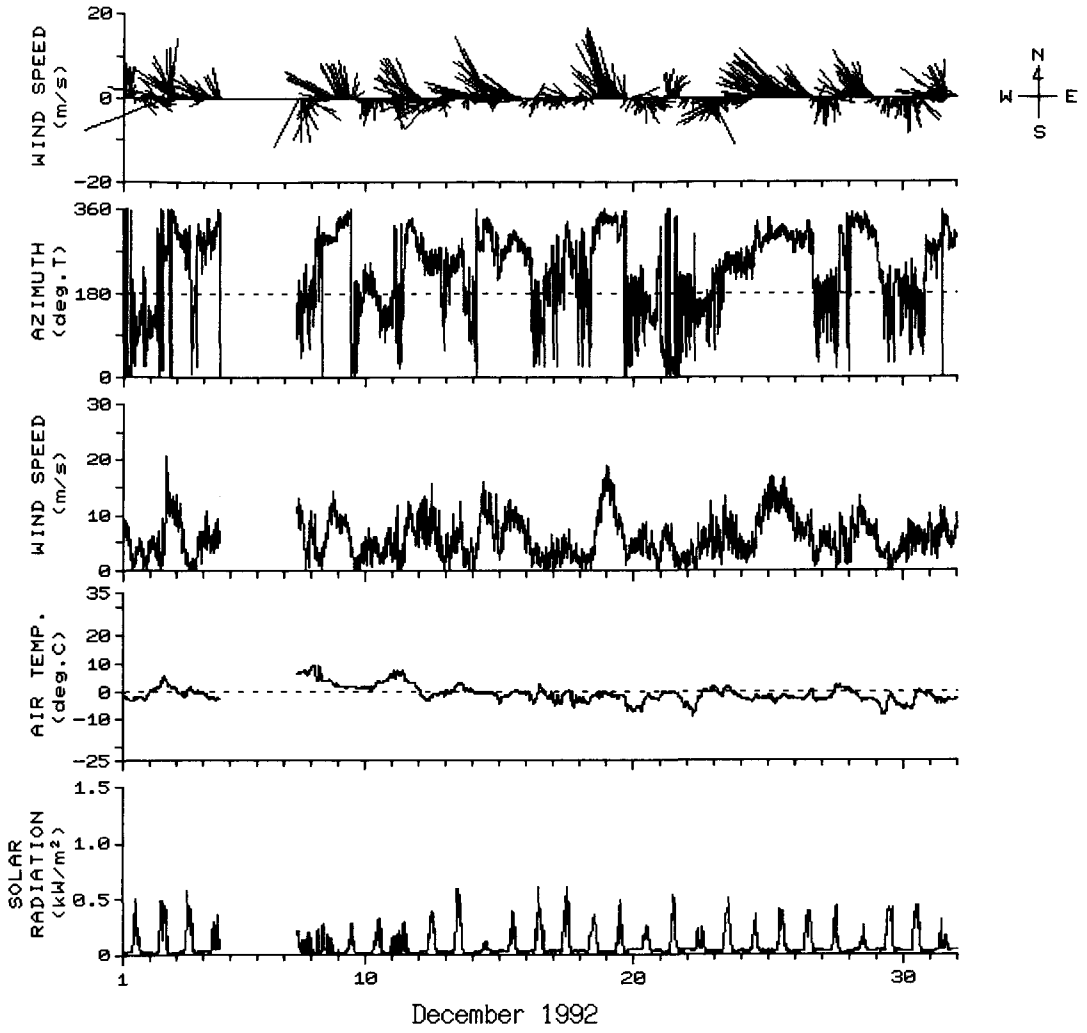
Kimuanepu, Saroma-ko Lagoon



Kimuanepu, Saroma-ko Lagoon



Kimuanepu, Saroma-ko Lagoon



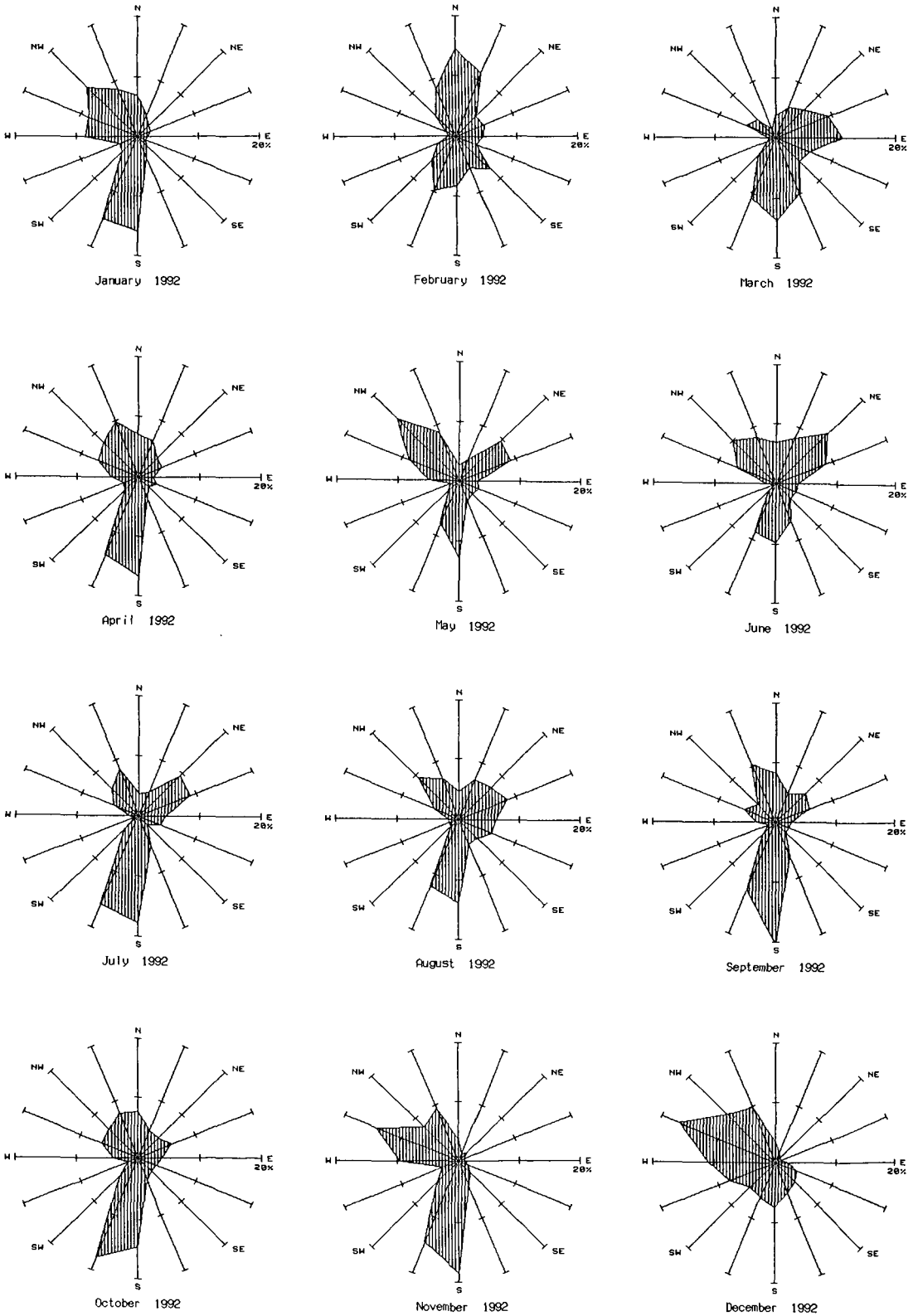


Fig. 5 Windroses for each month of the year 1992 at Kimuaneppu

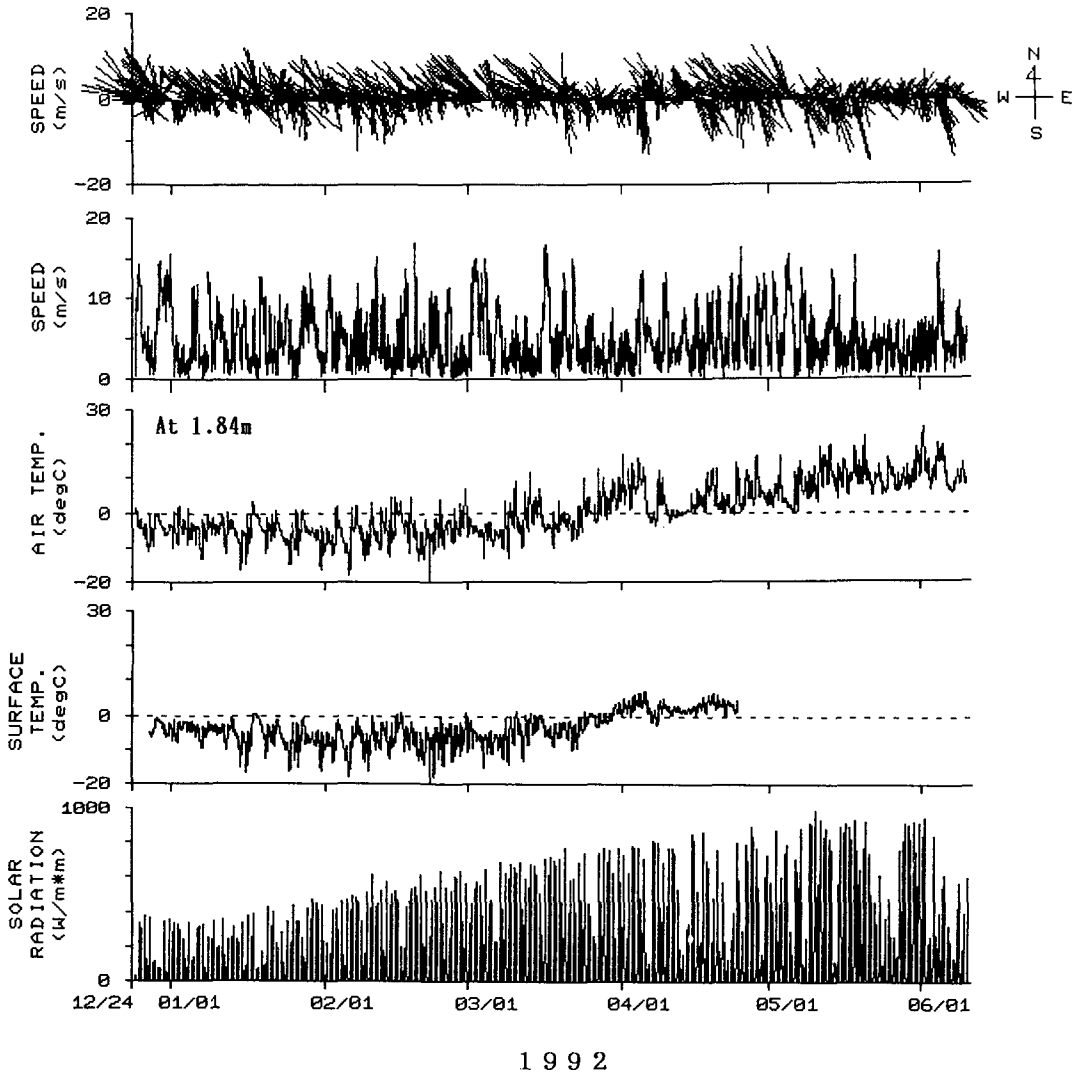


Fig. 6 Wind speed, air temperature at 1.84 m height, surface brightness temperature, and solar radiation obtained on the breakwater at the Sakaeura harbor during the period between 24 December 1991 and 10 June 1992.

3. Atmospheric data at the ice station

3.1. Atmospheric variables at a portable meteorological station

The ice station was located approximately 1.5 km offshore of Saroma-ko Lagoon near the Saroma Research Center of Aquaculture in Sakaeura ($44^{\circ}06'52''\text{N}$, $143^{\circ}56'59''\text{E}$). Water depth was about 10 m. The area was entirely covered with first-year, land-fast ice. The ice thickness at the ice station was 33 to 35 cm at the beginning of the experiment on 21 February, and it increased up to 39 cm by the end of the experiment on 7 March. Installation of atmospheric and oceanographic equipment at the ice station is schematically shown in Fig. 7. A portable

meteorological station (Squirrel Meter/Logger 1200 Ser., Grant Instruments Ltd.) was installed on the ice to measure wind speed and direction, air, ice, and snow-surface temperatures during the period from 22 February to 5 March 1992 (4.1. in Table 1 and (A) in Fig. 7). Time series of wind speed, air and surface temperatures, and humidity obtained with a sampling interval of 10 min are shown in Fig. 8. The maximum wind speed during the sampling period was about 14 m/s at the beginning of March, and the maximum temperature exceeded 0°C at the end of February during the period of relatively weak winds.

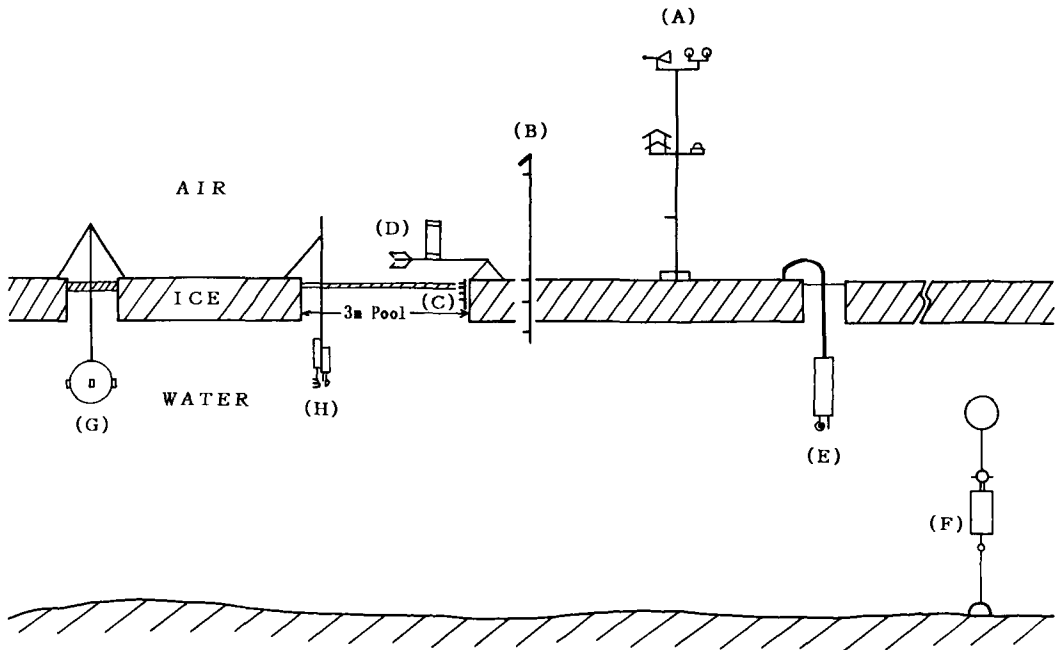


Fig. 7 Installation of atmospheric and oceanographic equipment at the ice station: (A) portable meteorological station; (B) a mast for air and ice temperature sensors; (C) a chain of ice temperature sensors installed in the pool; (D) a three-dimensional ultrasonic anemometer-thermometer and a gas flux meter installed over the pool; (E) a Sea-Bird CTD profiler; (F) an Alec electromagnetic current meter; (G) a S4 electromagnetic current meter; (H) a three-dimensional ultrasonic current meter and conductivity-temperature meter installed at the corner of pool

3.2. Ice temperatures at the ice station

A series of thermistor probes (Squirrel Meter/Logger 1200 Ser., Grant Instruments Ltd.) was installed in the ice sheet at the ice station (4.1. in Table 1 and (B) in Fig. 7). The two probes at the ice surface and at the depth of 15 cm from the ice surface were within the 34 cm-thick ice sheet, and the 35 cm-depth probe was in the under-ice water at the beginning of the experiment on 22 February. Shown in Fig. 9 are time series of air temperature at the height of 1.2 m above the snow surface, and ice temperatures at the surface and depths of 15 and 35 cm obtained with a sampling interval of 10 min. The trend of the surface temperature appears to

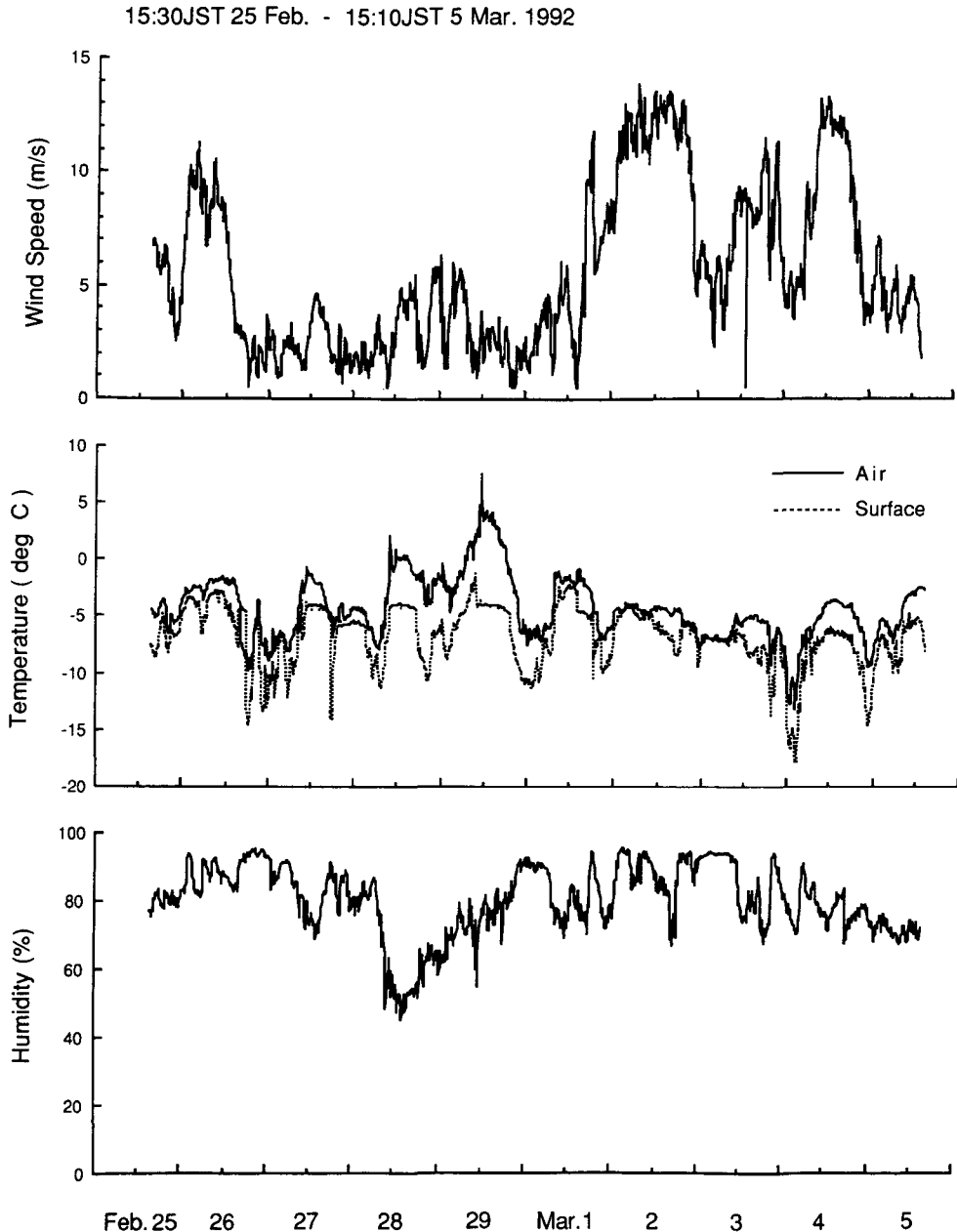


Fig. 8 Wind speed, air and surface temperatures, and humidity obtained from a meteorological station ((A) in Fig. 7) at the ice station during the period between 25 February and 5 March 1992

be similar to that of the air temperature, while the ice and/or water temperatures were less variable, fluctuating between 0.1 to 0.2°C throughout the sampling period.

3.3. Ice temperatures at an artificial pool at the ice station

A pool approximately 3 x 3 m was artificially constructed in the approximately 34 cm -thick ice at the ice station (Fig. 7). The pool was mainly used to measure turbulent eddy fluxes

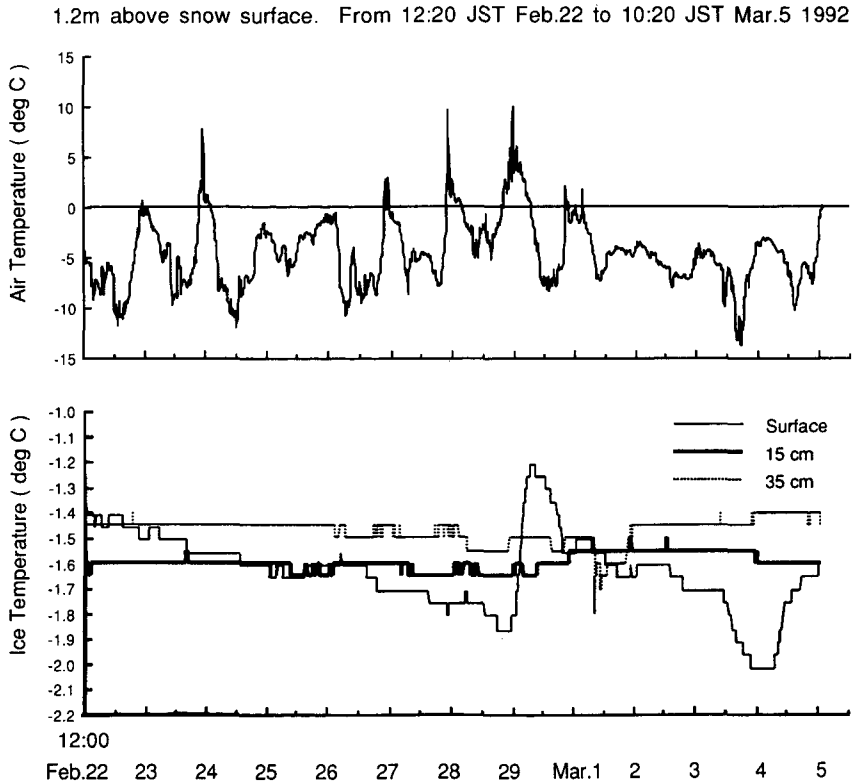


Fig. 9 Time series of air temperature at 1.2 m height, and ice temperatures at the surface and 15 and 35 cm depths obtained at the ice station ((B) in Fig. 7) during the period between 22 February and 5 March 1992

of momentum, sensible/latent heat, salt, and CO_2 in the atmospheric/oceanic boundary layers through the water and newly growing thin ice in the pool (4.1./4.2. in Table 1 and (D)/(H) in Fig. 7). The pool was cleared out new ice to make open water at the beginning of the experiment. This was repeated a couple of times during the period of the experiment.

A series of thermistor probes (Squirrel Meter/Logger 1200 Ser., Grant Instruments Ltd.) was installed at the surface and depths of 5, 10 and 15 cm in the pool to measure ice/water temperatures of new ice in the pool (4.1. in Table 1 and (C) in Fig. 7). Time series of ice temperatures at the surface and depths of 5 and 15 cm, obtained with a sampling interval of 10 min, are shown in Fig. 10. A time series of ice thickness is also shown in Fig. 10. The pool was cleared out to make open water in the afternoon of 22 February, and the ice in the pool grew up to 15 cm by the afternoon of 26 February. The pool was again cleared out to make open water for another boundary layer experiment in the afternoon of 26 February. The new ice in the pool grew up to 3.4 cm in about two days. Time series of ice thickness and ice growth rates for the two-day period are shown in Fig. 11. Time series of ice temperatures in Fig. 10 show

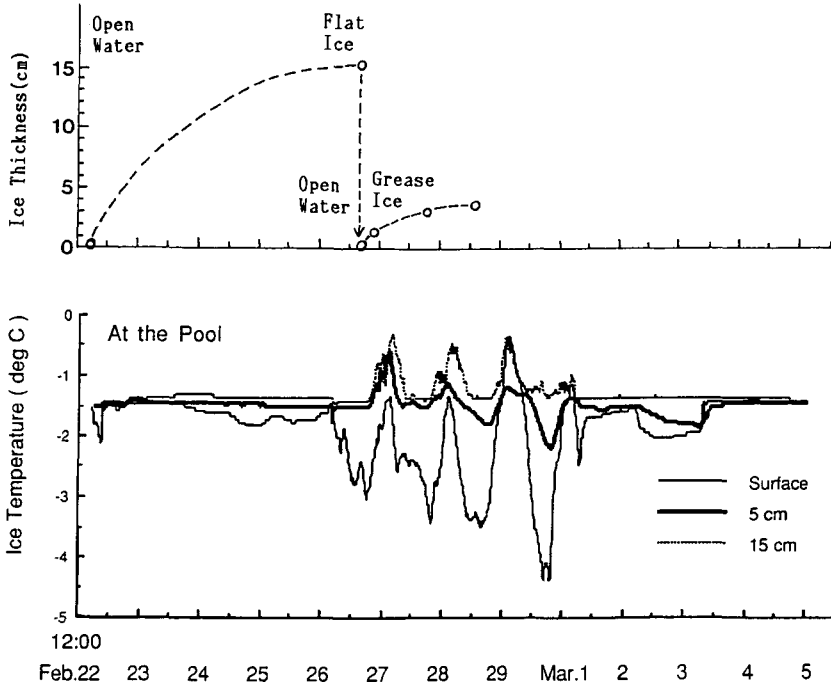


Fig. 10 Ice temperatures at the surface and 5 and 15 cm depths, and ice thickness obtained in the pool at the ice station ((C) in Fig. 7) during the period between 22 February and 5 March 1992

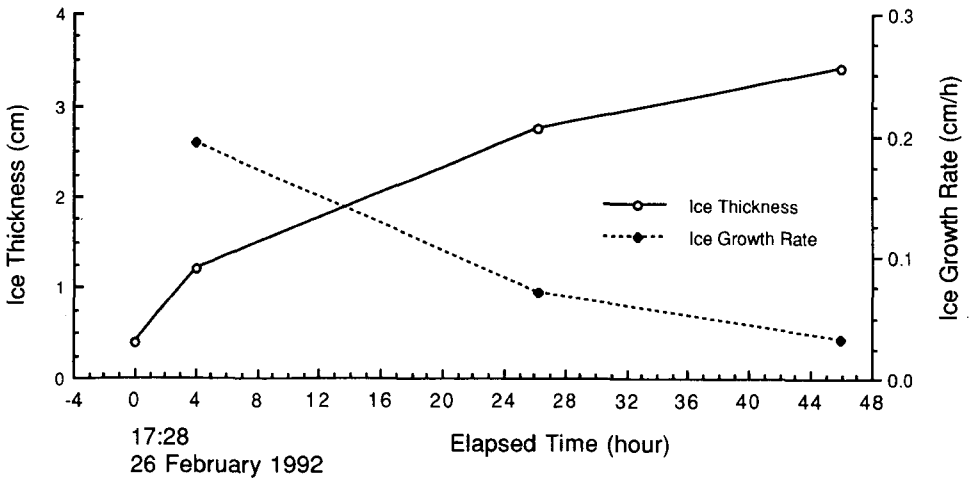


Fig. 11 Ice thickness and ice growth rate for newly growing ice in the pool at the ice station (Fig. 7)

diurnal variations during the period between 27 February and 1 March, which appear to be in response to the variations in air temperature shown in Fig. 9.

IV. Oceanographic Data

1. Conductivity-Temperature-Depth profiles at the ice station

A number of CTD (Conductivity-Temperature-Depth) profilings was taken by a CTD profiler (Sea-Bird Model SBE-19) through a hole in the ice to monitor the stratification of the water column under the ice during the period between 21 February and 24 March 1992 (4.2. in Table 1 and (E) in Fig. 7). Temperature and salinity values for every 0.5 m are listed in Table 3. Profiles of temperature and salinity against depth are shown graphically in Fig. 12.

2. CTD profiles on the transection between the second inlet and the mouth of Saromabetsu River

A series of CTD profilings on the transection between the second inlet and the mouth of Saromabetsu River was taken by a CTD profiler (Sea-Bird Model SBE-19) through a hole in the ice on 11 March 1992. A location map for casting stations on the transection is shown in Fig. 13. The casting stations are numbered in the figure, and their numbers correspond to those listed in Table 4. Temperature and salinity values for every 0.5 m are listed in Table 4, along with positions in latitude and longitude and water depths. Profiles of temperature and salinity against depth are shown graphically in Fig. 14.

3. Long-term currents and water temperature near the ice station

An electromagnetic current meter (ACM-8M, Alec Electronics Co., Ltd.) was deployed on 19 December 1991 to monitor the current regime and water temperature near the ice station throughout the winter and early spring (3. in Table 1 and (F) in Fig. 7). The current meter was recovered on 13 April 1992. Time series of current speed and direction, west-east and south-north components, and water temperature during the period between 19 December 1991 and 11 March 1992 are shown in Fig. 15. It is shown that the average current speed of the north-south component is about 3 to 4 cm/s and that of the east-west component is about -1.0 cm/s with very little time variability during the ice-covered period. Diurnal/semidiurnal tidal variabilities appeared clearly during the sampling period.

4. Oceanographic data at the ice station

A water level recorder (Model WLR-5, Aanderaa Instruments), an electromagnetic current meter (Model S4, InterOcean Systems, Inc.), a thermistor chain (Aanderaa Instruments), and two small conductivity and temperature sensors (Aanderaa Instruments) were deployed under the sea ice at the ice station during the period between 21 February and 6 March 1992 (4.2. in

Table 3 Temperature, salinity and depth obtained at the ice station during the period between 21 February and 24 March 1992.

File Name CTD	Date	Time (JST)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
D0	21 Feb	15:53	0.5	-1.3213	29.8302
			1	-1.3155	30.829
			1.5	-1.3205	31.227
			2	-1.3518	31.4964
			2.5	-1.3755	31.5785
			3	-1.3935	31.6415
			3.5	-1.404	31.6852
			4	-1.3854	31.7503
			4.5	-1.3659	31.7637
			5	-1.3618	31.7878
			5.5	-1.3625	31.7975
			6	-1.3413	31.7897
			6.5	-1.2589	31.7595
			7	-1.1757	31.7413
7.5	-1.1152	31.764			
D1	21 Feb	16:37	0.5	-1.3606	29.8858
			1	-1.3444	30.5345
			1.5	-1.3625	30.9438
			2	-1.389	31.2458
			2.5	-1.4108	31.2763
			3	-1.4114	31.4266
			3.5	-1.4169	31.4911
			4	-1.3934	31.5493
			4.5	-1.3964	31.6703
			5	-1.3851	31.6914
			5.5	-1.361	31.7227
			6	-1.3128	31.7271
			6.5	-1.3022	31.7564
			7	-1.2334	31.6973
7.5	-1.1502	31.6722			
8	-1.1074	31.709			
D2	22 Feb	17:07	0.5	-1.3522	23.9587
			1	-1.3648	24.6481
			1.5	-1.4078	25.066
			2	-1.4425	25.3365
			2.5	-1.4492	25.5732
			3	-1.4278	25.7516
			3.5	-1.3967	25.8602
			4	-1.3848	26.001
			4.5	-1.3722	26.1126
			5	-1.3645	26.2899
			5.5	-1.3293	26.3835
			6	-1.2934	26.4095
			6.5	-1.2666	26.5296
			7	-1.177	26.6037
7.5	-1.1345	26.6745			
8	-1.1137	26.7461			
D3	25 Feb	17:25	0.5	-1.4087	23.3346
			1	-1.3737	24.1617
			1.5	-1.3934	24.816
			2	-1.428	25.1662
			2.5	-1.4212	25.5302
			3	-1.389	25.713
			3.5	-1.3646	25.9296
			4	-1.3376	26.1063
			4.5	-1.3108	26.2458
			5	-1.268	26.4042
			5.5	-1.2393	26.4404
			6	-1.2257	26.5949
			6.5	-1.216	26.7073
			7	-1.1475	26.7523
7.5	-1.0674	26.8182			
8	-1.0453	26.9514			
8.5	-1.0614	27.1276			

File Name CTD	Date	Time (JST)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
D4	26 Feb	17:08	0.5	-1.3949	30.1348
			1	-1.3763	30.4614
			1.5	-1.4044	30.9911
			2	-1.422	31.2698
			2.5	-1.4254	31.4268
			3	-1.3943	31.4812
			3.5	-1.3533	31.4944
			4	-1.3106	31.4778
			4.5	-1.2737	31.528
			5	-1.2509	31.5879
			5.5	-1.2441	31.6173
			6	-1.2334	31.7741
			6.5	-1.1903	31.7764
D5	26 Feb	20:21	0.5	-1.4221	23.1455
			1	-1.4276	23.0421
			1.5	-1.3771	23.0248
			2	-1.3532	23.0032
			2.5	-1.342	22.9937
			3	-1.3349	22.9921
			3.5	-1.3349	22.9879
			4	-1.3247	22.981
			4.5	-1.302	22.9625
			5	-1.3007	22.9639
			5.5	-1.2741	22.9434
			6	-1.2558	22.9345
			6.5	-1.2348	22.9255
7	-1.1657	22.8809			
7.5	-1.0545	22.8016			
8	-1.012	22.7761			
D6	26 Feb	21:19	0.5	-1.4222	22.0248
			1	-1.4043	21.9384
			1.5	-1.4282	21.8976
			2	-1.4383	21.8577
			2.5	-1.422	21.8144
			3	-1.3964	21.7765
			3.5	-1.3643	21.7398
			4	-1.3418	21.7127
			4.5	-1.3196	21.6872
			5	-1.2962	21.6668
			5.5	-1.2784	21.6531
			6	-1.2723	21.6484
			6.5	-1.2384	21.6236
7	-1.1659	21.5728			
7.5	-1.08	21.5099			
8	-1.0064	21.4546			
D7	26 Feb	22:19	0.5	-1.3828	17.4383
			1	-1.3041	17.6186
			1.5	-1.3007	17.5988
			2	-1.3011	17.604
			3.5	-1.3057	17.6141
			5	-1.2973	17.6104
			5.5	-1.2929	17.6141
			6	-1.2645	17.6265
			6.5	-1.2323	17.6356
			7	-1.1959	17.6475
			7.5	-1.0971	17.6304
			8	-0.9858	17.6056

File Name CTD	Date	Time (JST)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
D8	26 Feb	23:20	0.5	-1.3732	11.6343
			1	-1.4129	11.6676
			1.5	-1.4402	11.7071
			2	-1.4427	11.7518
			2.5	-1.4209	11.7821
			3	-1.3943	11.8129
			3.5	-1.371	11.8439
			4	-1.3369	11.8677
			4.5	-1.3209	11.9033
			5	-1.2915	11.9244
			5.5	-1.2775	11.942
			6	-1.2623	11.9614
			6.5	-1.2241	11.9706
			7	-1.1941	11.9874
7.5	-1.099	11.9877			
D9	27 Feb	07:20	0.5	-1.398	17.6662
			1	-1.4067	17.6823
			1.5	-1.4309	17.7085
			2	-1.4156	17.711
			2.5	-1.3908	17.7068
			3	-1.3753	17.7054
			3.5	-1.3491	17.6983
			4	-1.3369	17.6993
			4.5	-1.3063	17.6902
			5	-1.2705	17.6769
			5.5	-1.2596	17.6756
			6	-1.258	17.682
			6.5	-1.2546	17.6861
			7	-1.2333	17.6805
7.5	-1.2251	17.6854			
8	-1.1886	17.6726			
D10	27 Feb	08:18	0.5	-1.3667	30.4615
			1	-1.3775	31.3055
			1.5	-1.3933	31.5514
			2	-1.3859	31.6362
			2.5	-1.3607	31.6713
			3	-1.3534	31.7044
			3.5	-1.3319	31.7203
			4	-1.3222	31.7371
			4.5	-1.3	31.753
			5	-1.2467	31.7462
			5.5	-1.2605	31.8176
			6	-1.2651	31.8504
			6.5	-1.2523	31.859
			7	-1.2538	31.8925
7.5	-1.2025	31.8639			
8	-1.0776	31.8087			
D11	27 Feb	09:18	0.5	-1.3585	29.6857
			1	-1.3698	31.2578
			1.5	-1.3886	31.6126
			2	-1.3798	31.8416
			2.5	-1.361	31.8961
			3	-1.3448	31.8977
			3.5	-1.3221	31.8714
			4	-1.3168	31.9089
			4.5	-1.2797	31.8948
			5	-1.2526	31.9038
			5.5	-1.2534	31.9357
			6	-1.2575	31.9594
			6.5	-1.2541	31.9716
			7	-1.255	31.9763
7.5	-1.2446	31.9766			
8	-1.0642	31.8989			
8.5	-1.0177	31.8889			

File Name CTD	Date	Time (JST)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
D12	27 Feb	10:17	0.5	-1.356	31.0441
			1	-1.3869	31.5323
			1.5	-1.4043	31.7737
			2	-1.3965	31.8299
			2.5	-1.3603	31.8047
			3	-1.3397	31.9072
			3.5	-1.34	31.93
			4	-1.3177	31.925
			4.5	-1.2861	31.9422
			5	-1.2685	31.962
			5.5	-1.2707	31.9567
			6	-1.2591	31.962
			6.5	-1.2542	31.9678
			7	-1.2282	31.9613
			7.5	-1.1617	31.9389
			8	-1.0576	31.8678
D13	27 Feb	11:19	0.5	-1.3034	29.327
			1	-1.3656	31.2467
			1.5	-1.3835	31.7237
			2	-1.3864	31.8141
			2.5	-1.3484	31.8816
			3	-1.3278	31.941
			3.5	-1.3164	31.8621
			4	-1.3073	31.8522
			4.5	-1.263	31.8728
			5	-1.2668	31.8402
			5.5	-1.2637	31.8576
			6	-1.2509	31.8744
			6.5	-1.2361	31.8735
			7	-1.2337	31.9092
			7.5	-1.1852	31.8891
			8	-0.9907	31.7199
D14	27 Feb	12:18	0.5	-1.3566	30.5966
			1	-1.3789	30.9499
			1.5	-1.3953	31.527
			2	-1.3812	31.6571
			2.5	-1.345	31.601
			3	-1.3437	31.7586
			3.5	-1.3323	31.6838
			4	-1.3212	31.7896
			4.5	-1.2883	31.7448
			5	-1.2672	31.8022
			5.5	-1.2719	31.8759
			6	-1.2557	31.8903
			6.5	-1.2595	31.9217
			7	-1.2526	31.9331
			7.5	-1.1141	31.837
			8	-0.9935	31.7228
D15	27 Feb	13:20	0.5	-1.3568	30.3903
			1	-1.3846	30.7831
			1.5	-1.3721	31.1941
			2	-1.3576	31.3243
			2.5	-1.339	31.4847
			3	-1.3222	31.5439
			3.5	-1.3112	31.6168
			4	-1.29	31.6361
			4.5	-1.2725	31.6762
			5	-1.2585	31.7084
			5.5	-1.2458	31.6917
			6	-1.2376	31.7124
			6.5	-1.2179	31.7057
			7	-1.1142	31.6231
			7.5	-0.9682	31.6562
			8	-0.9936	31.7607
8.5	-0.961	31.6916			

File Name CTD	Date	Time (JST)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
D17	27 Feb	15:17	0.5	-1.3623	28.4783
			1	-1.3949	30.6012
			1.5	-1.4021	30.8769
			2	-1.3847	31.1665
			2.5	-1.3543	31.3391
			3	-1.3489	31.4319
			3.5	-1.3369	31.4214
			4	-1.3124	31.5449
			4.5	-1.2738	31.6949
			5	-1.2568	31.7474
			5.5	-1.264	31.7937
			6	-1.2722	31.8419
			6.5	-1.2549	31.8712
			7	-1.2298	31.8071
			7.5	-1.1603	31.8891
			8	-1.078	31.8707
8.5	-1.0145	31.9055			
D18	27 Feb	16:19	0.5	-1.3486	29.108
			1	-1.3885	30.728
			1.5	-1.4077	31.1812
			2	-1.3984	31.233
			2.5	-1.3617	31.3764
			3	-1.3276	31.4541
			3.5	-1.2968	31.5833
			4	-1.2862	31.6041
			4.5	-1.2474	31.5906
			5	-1.2295	31.6512
			5.5	-1.24	31.7352
			6	-1.2467	31.7472
			6.5	-1.2517	31.749
			7	-1.2261	31.7904
			7.5	-1.0812	31.6994
			8	-0.9617	31.6174
D19	27 Feb	17:19	0.5	-1.3687	30.302
			1	-1.3947	31.0014
			1.5	-1.4123	31.3111
			2	-1.4117	31.4696
			2.5	-1.3893	31.4379
			3	-1.3583	31.4049
			3.5	-1.3216	31.6829
			4	-1.3133	31.6516
			4.5	-1.2712	31.7429
			5	-1.2713	31.8103
			5.5	-1.2663	31.7865
			6	-1.2719	31.8257
			6.5	-1.2721	31.8827
			7	-1.2375	31.7828
			7.5	-1.0204	31.6295
			D20	27 Feb	19:18
1	-1.3591	30.7687			
1.5	-1.378	31.0037			
2	-1.3764	31.1477			
2.5	-1.3636	31.4848			
3	-1.3457	31.507			
3.5	-1.323	31.4975			
4	-1.2813	31.669			
4.5	-1.2522	31.701			
5	-1.2581	31.7332			
5.5	-1.2579	31.7633			
6	-1.2178	31.737			
6.5	-1.2058	31.7666			
7	-1.1561	31.7746			
7.5	-1.0203	31.7763			
8	-1.0101	31.8147			

File Name CTD	Date	Time (JST)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
D21	28 Feb	10:47	0.5	-1.3003	28.628
			1	-1.3654	30.9939
			1.5	-1.3713	31.3544
			2	-1.3403	31.5506
			2.5	-1.3328	31.5906
			3	-1.3306	31.3139
			3.5	-1.3209	31.6863
			4	-1.2922	31.6705
			4.5	-1.2423	31.604
			5	-1.2069	31.8006
			5.5	-1.2474	31.8323
			6	-1.2604	31.8651
			6.5	-1.2565	31.8798
7	-1.2462	31.9099			
7.5	-1.1676	31.9149			
8	-1.0647	31.797			
D22	28 Feb	13:53	0.5	-1.3024	28.5015
			1	-1.3841	30.5591
			1.5	-1.3881	31.0559
			2	-1.3503	31.4193
			2.5	-1.3388	31.4073
			3	-1.2746	31.5592
			3.5	-1.257	31.7095
			4	-1.2532	31.7308
			4.5	-1.2617	31.7649
			5	-1.2362	31.7597
			5.5	-1.2483	31.8347
			6	-1.257	31.8775
			6.5	-1.2429	31.8852
7	-1.2324	31.8915			
7.5	-1.0597	31.7507			
8	-0.9489	31.7324			
D23	28 Feb	14:57	0.5	-1.2584	28.6702
			1	-1.3805	31.0491
			1.5	-1.403	31.4136
			2	-1.3705	31.5305
			2.5	-1.3367	31.6573
			3	-1.2963	31.6977
			3.5	-1.2702	31.4436
			4	-1.2635	31.782
			4.5	-1.2389	31.8277
			5	-1.2471	31.8769
			5.5	-1.2552	31.9024
			6	-1.2564	31.8684
			6.5	-1.2557	31.941
7	-1.2212	31.9198			
7.5	-1.1178	31.9256			
D24	29 Feb	10:14	0.5	-1.2763	31.6218
			1	-1.3817	32.1402
			1.5	-1.3674	32.434
			2	-1.354	32.1625
			2.5	-1.3201	32.1489
			3	-1.2807	32.1319
			3.5	-1.2322	32.1216
			4	-1.218	32.0409
			4.5	-1.2067	32.1294
			5	-1.1986	32.176
			5.5	-1.209	32.1004
			6	-1.2465	32.0567
			6.5	-1.2619	32.03
7	-1.1868	32.0303			
7.5	-1.0932	32.0515			
8	-1.0231	31.9775			
8.5	-0.9636	31.946			

File Name CTD	Date	Time (JST)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
D25	29 Feb	12:04	0.5	-1.3286	32.2114
			1	-1.398	32.174
			1.5	-1.415	32.043
			2	-1.3924	32.1174
			2.5	-1.3357	32.1278
			3	-1.2923	31.8584
			3.5	-1.2446	31.9882
			4	-1.215	32.0177
			4.5	-1.2206	31.9655
			5	-1.2125	31.9722
			5.5	-1.2351	32.0144
			6	-1.26	32.0066
			6.5	-1.2686	32.0307
7	-1.2264	32.0141			
7.5	-1.0916	31.9852			
8	-1.0493	31.9811			
D26	01 Mar	10:52	0.5	-1.3601	31.3203
			1	-1.4104	31.731
			1.5	-1.4055	31.9124
			2	-1.3891	31.9828
			2.5	-1.3686	31.9828
			3	-1.2977	31.9077
			3.5	-1.2463	31.8593
			4	-1.2072	31.8738
			4.5	-1.2044	31.8825
			5	-1.2079	31.9035
			5.5	-1.2205	31.946
			6	-1.2366	31.9477
			6.5	-1.2286	31.9378
7	-1.1366	31.89			
7.5	-1.0167	31.8625			
8	-0.9494	31.8449			
D27	01 Mar	16:10	0.5	-1.3496	30.0695
			1	-1.4112	31.1403
			1.5	-1.4106	31.4049
			2	-1.366	31.5601
			2.5	-1.3189	31.6606
			3	-1.2831	31.7107
			3.5	-1.222	31.7297
			4	-1.2166	31.7542
			4.5	-1.2054	31.7833
			5	-1.2037	31.8347
			5.5	-1.2068	31.8581
			6	-1.2115	31.9068
			6.5	-1.2259	31.9401
7	-1.1765	31.9169			
7.5	-1.0203	31.8519			
8	-0.9545	31.8697			
D28	02 Mar	11:25	0.5	-1.4379	28.1434
			1	-1.4374	28.4479
			1.5	-1.4146	28.8711
			2	-1.3842	29.037
			2.5	-1.3408	29.3999
			3	-1.2909	29.3939
			3.5	-1.2366	29.6357
			4	-1.2438	29.7696
			4.5	-1.2197	29.917
			5	-1.2433	30.2506
			5.5	-1.2519	30.58
			6	-1.2393	30.6362
			6.5	-1.2212	30.7378
7	-1.1528	30.8533			
7.5	-1.0475	30.7065			
8	-1.0397	30.8847			
8.5	-1.0002	30.9902			

File Name CTD	Date	Time (JST)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
D29	02 Mar	16:22	1	-1.3823	31.8847
			1.5	-1.3756	31.8847
			2.5	-1.3636	31.8807
			3	-1.3416	31.8841
			3.5	-1.2818	31.8844
			4	-1.2454	31.9017
			4.5	-1.218	31.9152
			5	-1.2033	31.9072
			5.5	-1.1873	31.9478
			6	-1.2044	31.9742
			6.5	-1.2174	31.992
			7	-1.2025	31.9903
			7.5	-1.1558	31.9527
8	-1.0406	31.9553			
D30	03 Mar	09:44	0.5	-1.2362	29.9312
			1	-1.2824	31.4578
			1.5	-1.2735	31.4433
			2	-1.2147	31.6768
			2.5	-1.3081	31.7789
			3	-1.3053	31.8256
			3.5	-1.2631	31.8619
			4	-1.2278	31.8828
			4.5	-1.2073	31.9026
			5	-1.1996	31.9249
			5.5	-1.1981	31.9377
			6	-1.1998	31.9515
			6.5	-1.1695	31.9769
			7	-1.112	31.9621
			7.5	-1.0777	31.967
8	-1.0065	31.9803			
8.5	-0.9075	31.9476			
D31	03 Mar	17:04	0.5	-1.3858	31.3937
			1	-1.2909	31.5196
			1.5	-1.2332	31.5919
			2	-1.2064	31.5731
			2.5	-1.1967	31.6939
			3	-1.1898	31.6079
			3.5	-1.184	31.6645
			4	-1.1815	31.7357
			4.5	-1.1548	31.4625
			5	-1.1535	31.5491
			5.5	-1.1528	31.5867
			6	-1.1446	31.4601
			6.5	-1.1485	31.5471
			7	-1.0988	31.6642
			7.5	-1.0384	31.7496
8	-1.003	31.6926			
8.5	-1.0022	31.6392			
D32	04 Mar	11:07	0.5	-1.2825	23.631
			1	-1.3312	23.6609
			1.5	-1.3112	23.6932
			2	-1.3039	23.7295
			2.5	-1.2848	23.7524
			3	-1.2495	23.7624
			3.5	-1.1922	23.749
			4	-1.1808	23.7687
			4.5	-1.1668	23.7872
			5	-1.15	23.8034
			5.5	-1.1254	23.8122
			6	-1.174	23.8805
			6.5	-1.1518	23.8919
			7	-1.1096	23.8817
			7.5	-1.0467	23.8629
8	-0.9191	23.7788			
8.5	-0.8394	23.7399			

File Name CTD	Date	Time (JST)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
D33	05 Mar	14:11	0.5	-1.3066	31.2869
			1	-1.3296	31.4919
			1.5	-1.3674	31.6939
			2	-1.3616	31.7835
			2.5	-1.3054	31.7762
			3	-1.2428	31.7522
			3.5	-1.2232	31.8461
			4	-1.2508	31.9233
			4.5	-1.2216	31.9044
			5	-1.2019	31.9259
			5.5	-1.2009	31.9375
			6	-1.1975	31.9577
			6.5	-1.1707	31.9576
			7	-1.1027	31.9171
			7.5	-0.9509	31.8512
8	-0.8716	31.8674			
8.5	-0.8708	31.8897			
D34	06 Mar	14:27	0.389	-1.2494	31.607
			3.5	-1.2339	31.6133
			4	-1.2291	31.651
			4.5	-1.2165	31.7295
			5	-1.2067	31.7573
			5.5	-1.194	31.7994
			6	-1.1807	31.8023
			6.5	-1.1515	31.8353
			7	-1.1187	31.8375
7.5	-1.0483	31.8241			
D35	08 Mar	15:14	0.5	-1.1993	32.0233
			1	-1.2742	32.1578
			1.5	-1.294	32.0491
			2	-1.3268	32.1078
			2.5	-1.2696	31.8941
			3	-1.2878	31.9348
			3.5	-1.2802	31.9822
			4	-1.2859	31.9871
			4.5	-1.279	32.0155
			5	-1.2643	32.0678
			5.5	-1.2718	32.0196
			6	-1.2513	32.018
			6.5	-1.2116	32.011
			7	-1.1268	32.0332
			7.5	-0.9999	32.0147
8	-0.9251	31.996			
8.5	-0.9053	31.9922			
D36	08 Mar	16:51	0.5	-1.3293	29.9821
			1	-1.3175	31.3058
			1.5	-1.3552	31.4827
			2	-1.3531	31.5693
			2.5	-1.3243	31.7395
			3	-1.3179	31.7783
			3.5	-1.3188	31.8194
			4	-1.3204	31.8306
			4.5	-1.3068	31.9267
			5	-1.2925	31.9372
			5.5	-1.2715	31.9475
			6	-1.2621	31.9629
			6.5	-1.2096	31.9665
			7	-1.0973	31.942
			7.5	-0.99	31.8872
8	-0.9406	31.942			
8.5	-0.932	31.9709			
9	-0.9398	31.9892			
9.5	-0.9767	32.0101			

File Name CTD	Date	Time (JST)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
D37	9 Mar	13:54	0.5	-1.1679	31.8318
			1	-1.265	32.0648
			1.5	-1.3097	32.1901
			2	-1.3159	32.0657
			2.5	-1.2893	32.0668
			3	-1.2803	31.9888
			3.5	-1.2937	32.1041
			4	-1.2673	32.0394
			4.5	-1.213	31.9978
			5	-1.2621	31.9944
			5.5	-1.2589	32.0099
D38	9 Mar	14:43	0.5	-1.2785	28.6734
			1	-1.3253	31.2556
			1.5	-1.3386	31.4283
			2	-1.337	31.7082
			2.5	-1.3073	31.7398
			3	-1.3107	31.79
			3.5	-1.3203	31.841
			4	-1.2897	31.8693
			4.5	-1.3081	31.8896
			5	-1.2926	31.9477
			5.5	-1.2559	31.9504
D39	10 Mar	09:34	0.5	-1.2402	31.5839
			1	-1.2679	31.8083
			1.5	-1.2957	31.9655
			2	-1.2681	31.9489
			2.5	-1.2725	32.0895
			3	-1.2882	32.0884
			3.5	-1.2902	32.1514
			4	-1.2753	32.0939
			4.5	-1.2644	32.0636
			5	-1.255	32.0847
			5.5	-1.2533	32.0466
D39	10 Mar	09:34	6	-1.2577	32.1011
			6.5	-1.2547	32.0542
			7	-1.165	32.0031
			7.5	-0.9533	31.9404
			8	-0.9384	31.968
			8.5	-1.041	32.0464
			9	-1.1437	32.0832
			9.5	-1.1762	32.0874

File Name CTD	Date	Time (JST)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
D40	10 Mar	09:39	0.5	-1.2813	29.5239
			1	-1.3144	31.1959
			1.5	-1.3384	31.5244
			2	-1.2971	31.6242
			2.5	-1.3003	31.749
			3	-1.3142	31.8261
			3.5	-1.3237	31.9044
			4	-1.3156	31.9167
			4.5	-1.2953	31.9089
			5	-1.2765	31.9256
			5.5	-1.2755	31.9586
			6	-1.2808	31.9697
			6.5	-1.2731	31.962
D41	10 Mar	14:11	0.5	-1.2495	30.9859
			1	-1.3359	31.5193
			1.5	-1.3231	31.6571
			2	-1.3165	31.8262
			2.5	-1.315	31.8873
			3	-1.3273	31.926
			3.5	-1.3156	31.9237
			4	-1.2861	31.9418
			4.5	-1.2638	31.9444
			5	-1.2385	31.9649
			5.5	-1.2189	31.9745
			6	-1.2023	31.981
			6.5	-1.1417	31.9273
7	-1.0532	31.9253			
7.5	-1.0568	31.9763			
8	-1.1411	32.0689			
8.5	-1.1862	32.1006			
9	-1.2188	32.1219			
9.5	-1.2422	32.1369			
10	-1.2651	32.1508			
D42	16 Mar	09:41	0.5	-1.1941	29.8687
			1	-1.2363	31.0539
			1.5	-1.2493	31.3968
			2	-1.2399	31.6535
			2.5	-1.2291	31.8041
			3	-1.2294	31.825
			3.5	-1.2292	31.8812
			4	-1.209	31.8654
			4.5	-1.2266	31.9063
			5	-1.2253	31.9496
			5.5	-1.2603	32.0288
			6	-1.2813	32.0655
			6.5	-1.296	32.0903
D44	16 Mar	15:01	0.507	-1.0112	31.9141
			1.5	-1.0088	31.9342
			2	-1.0055	31.8947
			2.5	-1.0051	31.8371
			3	-1.0026	31.9193
			3.5	-1.0004	31.9066
			4	-1.0013	31.8123
4.5	-1.0018	31.9019			
D45	16 Mar	15:30	0.5	-0.9992	31.9031
			1	-0.9911	31.9025
			1.5	-0.9852	31.8928
			2	-0.9863	31.8978
			3	-0.9889	31.8954
			3.5	-0.9912	31.9129
			4	-0.9934	31.9181
4.5	-0.9929	31.8794			
5	-0.9925	31.8688			

File Name CTD	Date	Time (JST)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
D46	16 Mar	16:01	0.5	-1.0194	31.4075
			1	-1.0151	31.2211
			1.5	-1.0123	31.4355
			2	-1.0108	31.4631
			2.5	-1.0081	31.476
			3	-1.009	31.428
			3.5	-1.008	31.4191
D47	16 Mar	16:32	0.5	-1.28	31.2063
			1	-1.1238	31.7794
			1.5	-1.0871	31.6032
			2.5	-1.049	31.7487
			3.5	-1.0396	31.7676
			4.5	-1.0354	31.7437
			5	-1.0303	31.7071
D55	17 Mar	10:32	0.5	-0.7104	32.0239
			1	-0.712	32.0269
			1.5	-0.7117	32.0324
			2	-0.711	32.0366
			2.5	-0.7158	32.0367
			3	-0.7154	32.0409
			3.5	-0.712	32.0443
			4	-0.7123	32.0449
			4.5	-0.7111	32.0454
D56	17 Mar	11:00	0.5	-0.6858	32.0505
			1	-0.6866	32.0531
			2	-0.6878	32.0534
			3.5	-0.6868	32.0514
			4.5	-0.689	32.0513
			5	-0.6899	32.0464
D57	17 Mar	11:32	0.5	-0.6493	32.0424
			1	-0.6501	32.0418
			1.5	-0.6512	32.0404
			2	-0.6525	32.0421
			2.5	-0.653	32.0433
			3	-0.6523	32.0509
			3.5	-0.6521	32.0484
			4	-0.6529	32.0489
D58	17 Mar	12:05	0.5	-0.6246	31.81
			1	-0.6383	31.8277
			1.5	-0.6119	32.0379
			2	-0.6132	32.0257
			2.5	-0.6152	32.0266
			3	-0.6166	32.0275
			3.5	-0.6167	32.0274
			4	-0.6167	32.0314
			4.5	-0.6167	32.0301
			5	-0.6177	32.0309
D60	17 Mar	12:32	0.5	-0.5754	31.9771
			1	-0.5776	32.0014
			1.5	-0.5779	32.0203
D61	17 Mar	13:03	0.5	-0.5388	31.7793
			1	-0.537	31.9789
			1.5	-0.5386	31.9412
			2	-0.5374	31.954
			2.5	-0.5373	31.9825
			3	-0.5398	31.9914
3.5	-0.5414	31.99			

File Name CTD	Date	Time (JST)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
D62	17 Mar	13:31	0.5	-0.5363	31.5005
			1	-0.5224	31.8961
			1.5	-0.5234	31.8933
			2	-0.5248	31.9128
			2.5	-0.5228	31.9088
			3	-0.5251	31.832
			3.5	-0.5261	31.8794
			4	-0.5282	31.888
D63	23 Mar	10:25	0.5	-0.899	28.6276
			1	-0.8111	31.8857
			1.5	-0.8021	31.7216
			2	-0.8249	31.8833
			2.5	-0.8344	31.9289
			3	-0.8636	32.0107
			3.5	-0.8888	32.0775
			4	-0.8727	32.0753
			4.5	-0.8619	32.0693
			5	-0.8583	32.0762
			5.5	-0.8548	32.0642
			6	-0.8723	32.0932
			6.5	-0.8986	32.1127
			7	-0.9231	32.1301
			7.5	-0.9613	32.1668
			8	-0.9644	32.1545
8	-0.9549	32.0969			
7.5	-0.962	32.0932			
7	-0.9524	32.0878			
D64	23 Mar	13:12	0.5	-0.8441	23.585
			1	-0.8263	27.7151
			1.5	-0.812	30.7473
			2	-0.7497	30.6096
			2.5	-0.6854	31.1987
			3	-0.8188	31.7516
			3.5	-0.8636	31.7388
			4	-0.8818	31.9881
			4.5	-0.8674	31.9633
			5	-0.8734	32.0244
			5.5	-0.9032	32.054
			6	-0.9225	32.0868
			6.5	-0.9551	32.1347
			7	-0.9722	32.1049
			7.5	-0.9762	32.1278
			8	-0.966	32.1231
8.5	-0.9551	32.129			
9	-0.935	32.1215			
9.5	-0.9366	32.1322			
D65	23 Mar	17:48	0.5	-0.8736	24.9097
			1	-0.8488	30.453
			1.5	-0.805	29.1668
			2	-0.7979	30.9901
			2.5	-0.8515	32.7431
			3	-0.8381	32.0274
			3.5	-0.8591	32.0298
			4	-0.8778	32.0604
			4.5	-0.8876	32.076
			5	-0.9291	32.1281
			5.5	-0.9513	32.1456
			6	-0.9722	32.1459
			6.5	-0.9777	32.1357
			7	-0.9974	32.1411
			7.5	-1.0186	32.1495
			8	-1.002	32.1308
8.5	-0.983	32.1174			
9	-0.9842	32.123			
9.5	-0.9773	32.115			

File Name CTD	Date	Time (JST)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
D66	23 Mar	21:23	0.5	-0.847	24.7437
			1	-0.8565	30.5344
			1.5	-0.8134	30.4149
			2	-0.777	31.4467
			2.5	-0.7867	31.7579
			3	-0.7901	31.8339
			3.5	-0.8067	31.7742
			4	-0.8308	31.9676
			4.5	-0.8478	32.0386
			5	-0.8721	32.1495
			5.5	-0.8755	32.1139
			6	-0.8631	32.1812
			6.5	-0.8363	32.1673
			7	-0.8459	32.1401
			7.5	-0.9298	32.2052
			8	-0.9744	32.2399
8.5	-0.9787	32.2116			
9	-0.964	32.1863			
9.27	-0.9482	32.2207			
D67	24 Mar	01:59	0.5	-0.859	13.2069
			1	-0.7598	17.6711
			2.5	-0.8168	16.6573
			3.5	-0.8112	16.6934
			4	-0.8275	17.1932
			4.5	-0.8692	18.4233
			5	-0.8838	18.6125
			5.5	-0.9414	20.0477
			6	-1.0381	21.1146
			6.5	-1.0387	21.488
7	-1.0326	22.0079			
7.5	-1.0194	22.0939			
8	-1.0271	24.4801			
D69	24 Mar	09:57	0.5	-0.8288	20.8254
			1	-0.7763	29.9798
			1.5	-0.7715	30.9815
			2	-0.7829	31.4405
			2.5	-0.8159	31.8276
			3	-0.8042	31.8685
			3.5	-0.7664	31.8666
			4	-0.7539	31.8944
			4.5	-0.7617	31.9469
			5	-0.7802	31.9764
			5.5	-0.7969	32.0004
			6	-0.8309	32.0133
			6.5	-0.8829	32.054
			7	-0.9226	32.0796
			7.5	-0.9391	32.0656
8	-0.9931	32.0767			
8.5	-1.0164	32.1087			
9	-0.9797	32.0771			
9.5	-0.9655	32.1186			
D70	24 Mar	12:57	0.5	-0.7441	23.6808
			1	-0.7625	29.044
			1.5	-0.751	31.093
			2	-0.7413	31.9191
			2.5	-0.7917	32.0299
			3	-0.7799	32.0741
			3.5	-0.7742	32.1837
			4	-0.7678	32.1718
			4.5	-0.7746	32.297
			5	-0.7961	32.3734
			5.5	-0.828	32.1574
			6	-0.8412	32.3381
			6.5	-0.9011	32.278
			7	-0.931	32.2634
			7.5	-0.9944	32.3468
8	-0.9489	32.2839			
8.5	-0.9542	32.2338			
9	-0.935	32.2236			
D71	24 Mar	13:31	0.5	-0.0686	30.4015
			1	-0.355	30.9538

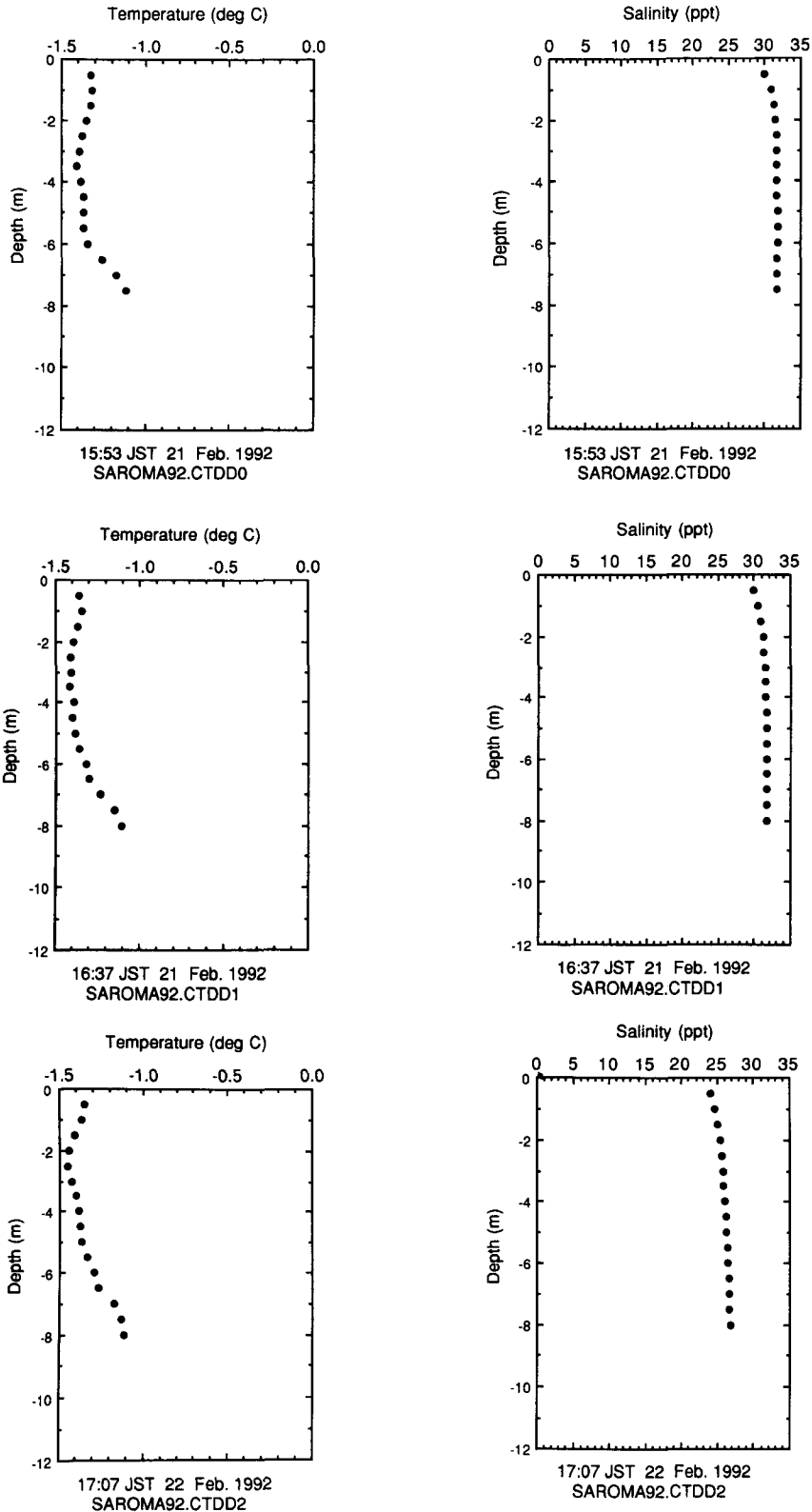
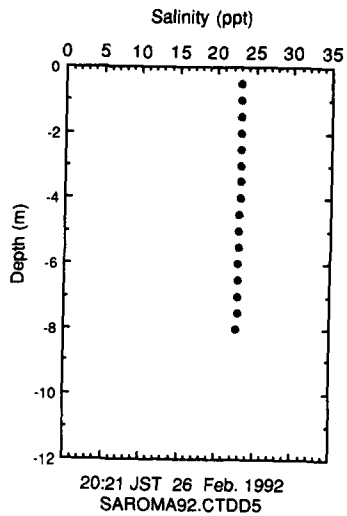
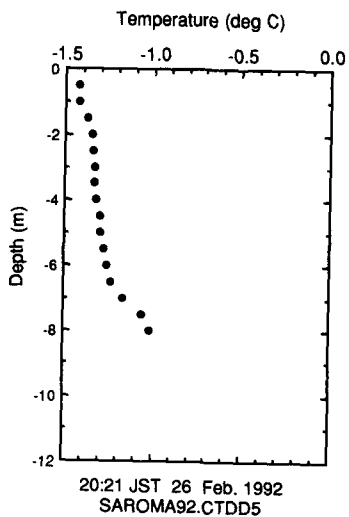
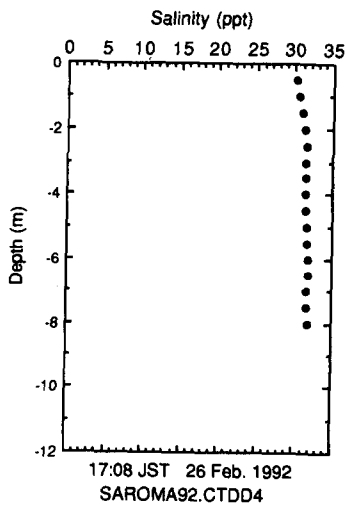
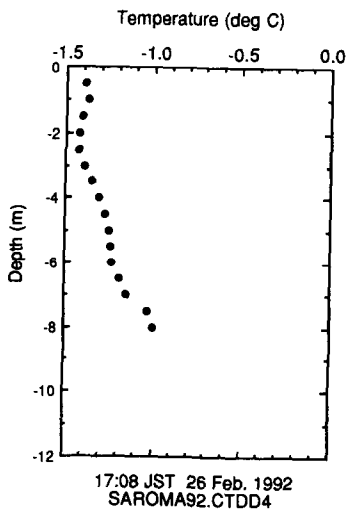
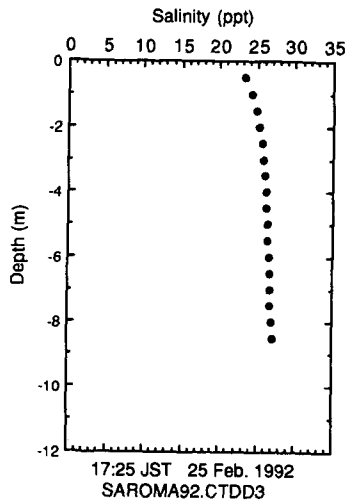
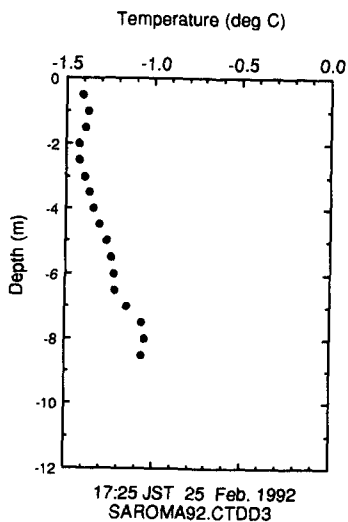
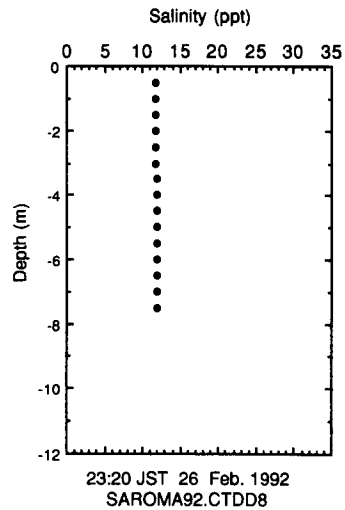
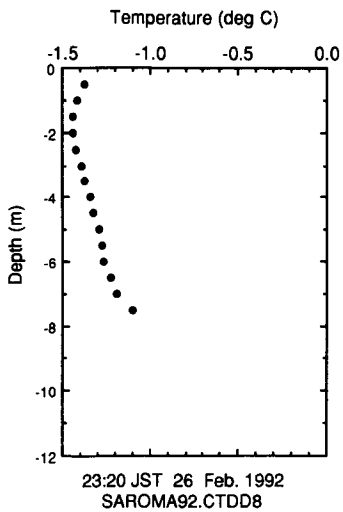
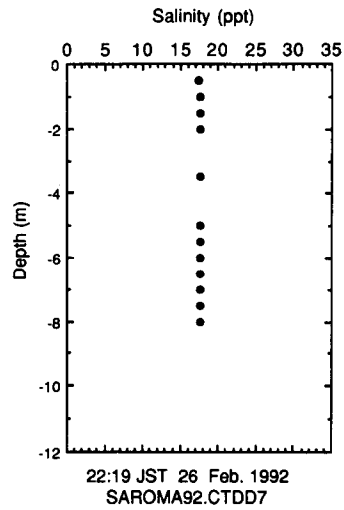
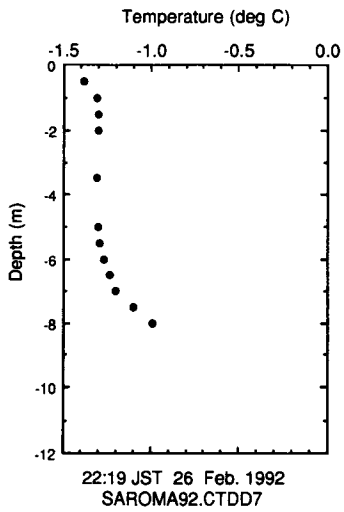
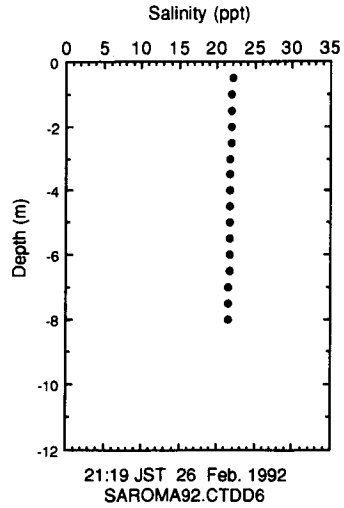
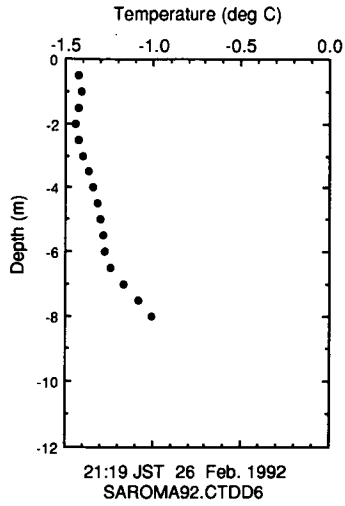
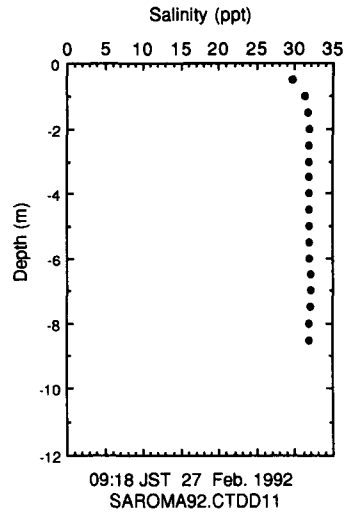
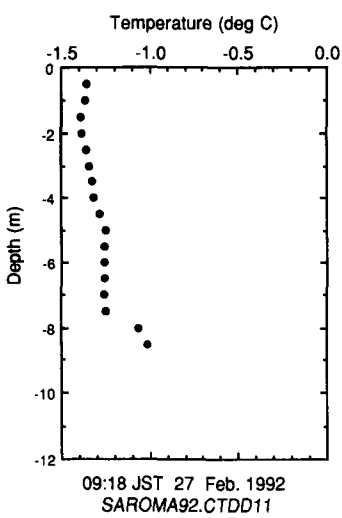
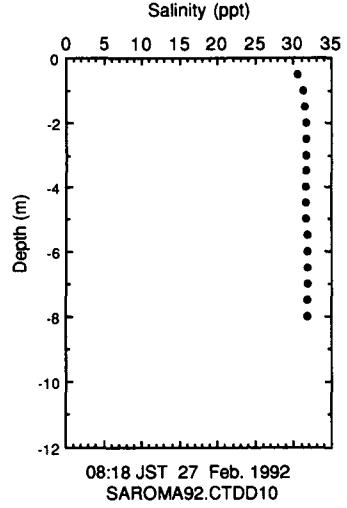
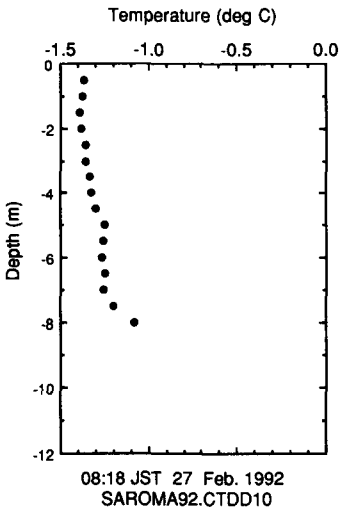
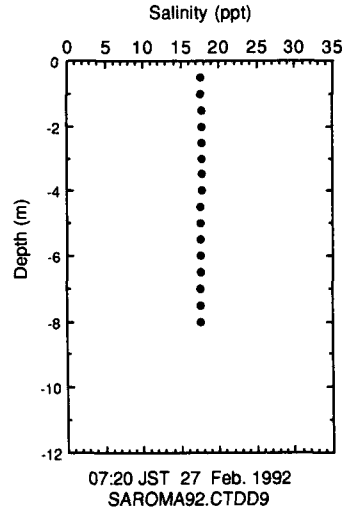
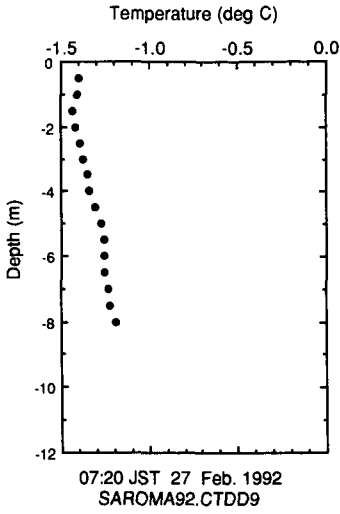
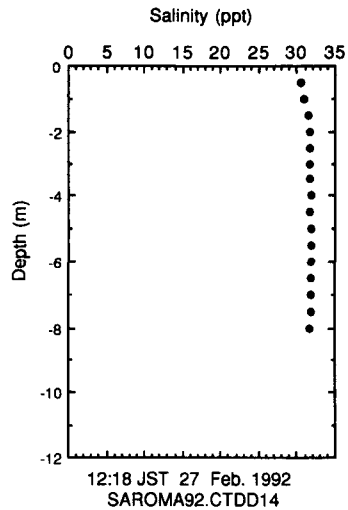
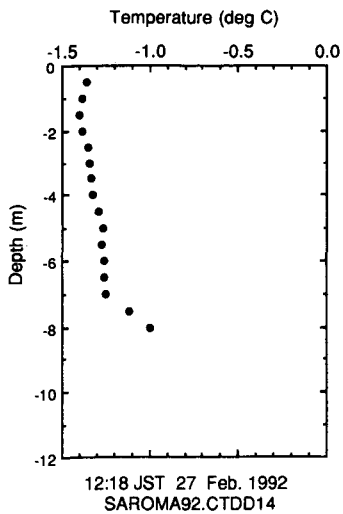
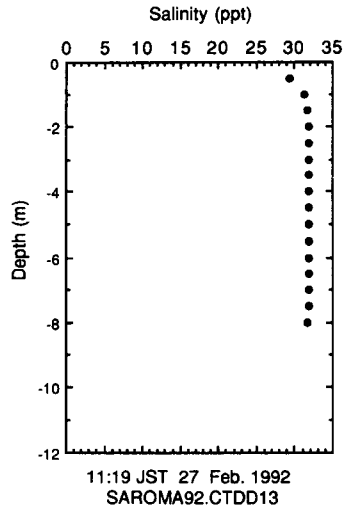
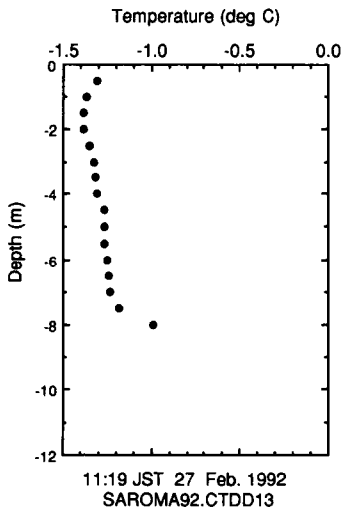
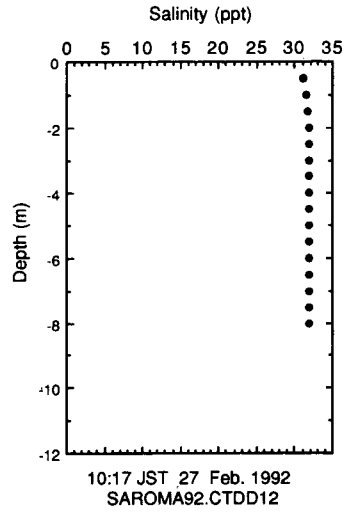
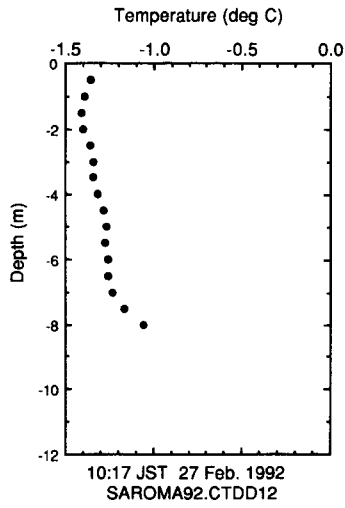


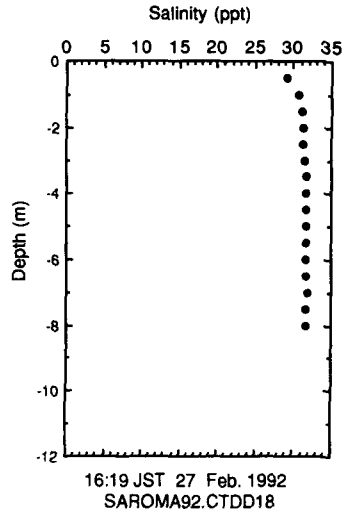
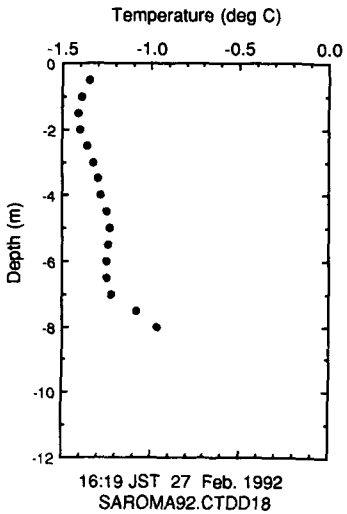
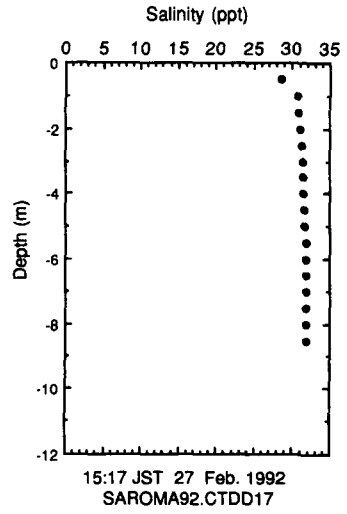
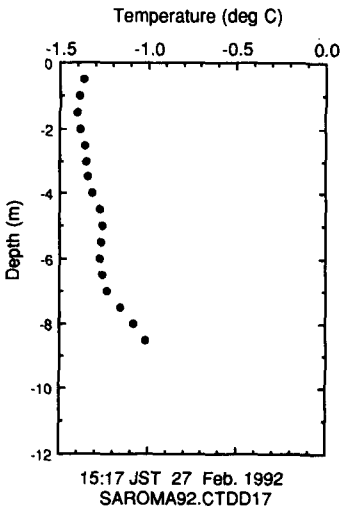
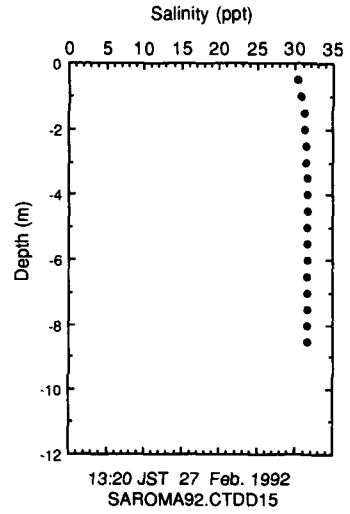
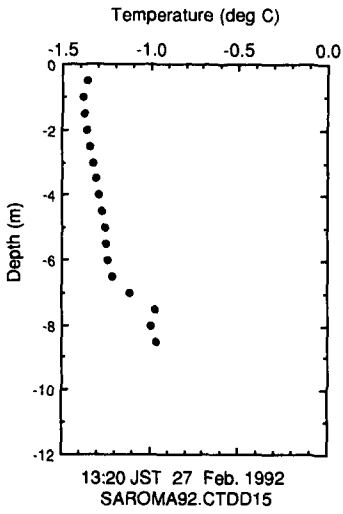
Fig. 12 Vertical profiles of temperature and salinity obtained at the ice station ((E) in Fig. 7) during the period between 21 February and 24 March 1992.

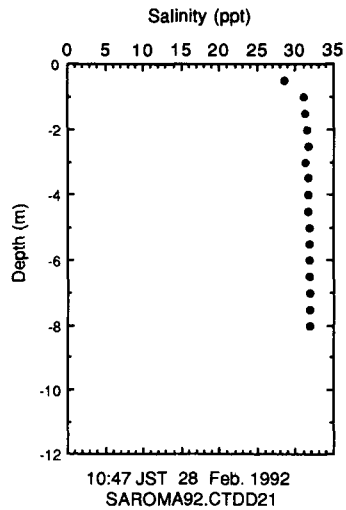
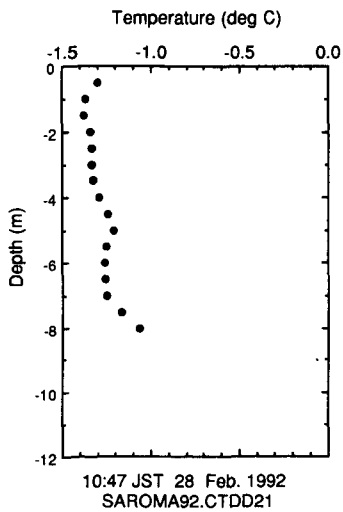
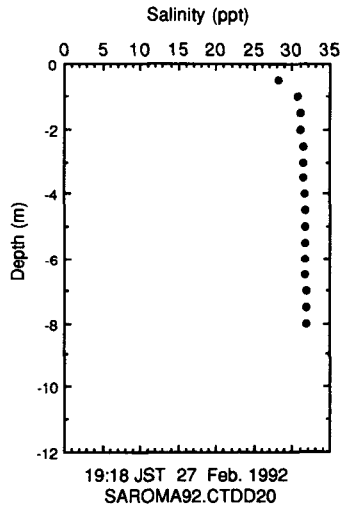
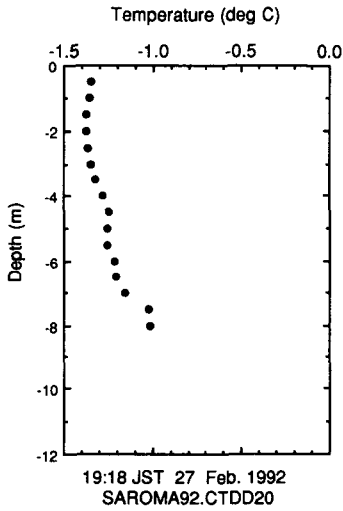
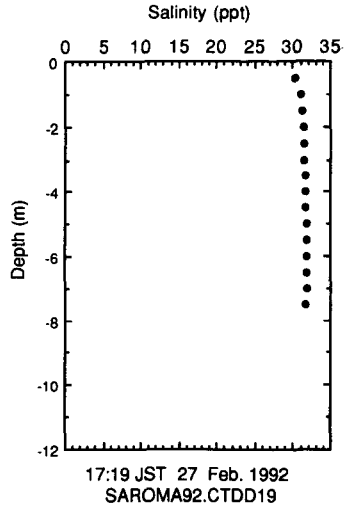
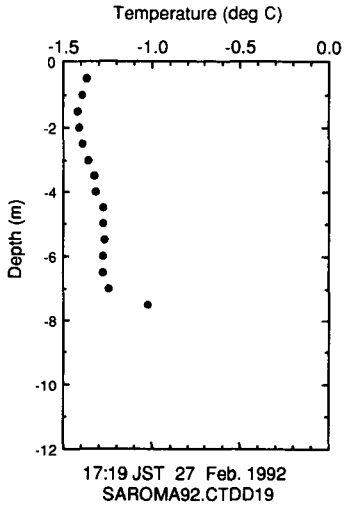


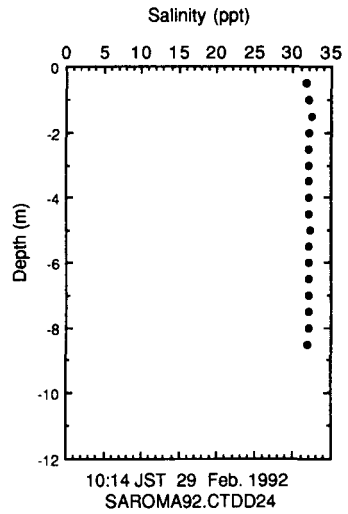
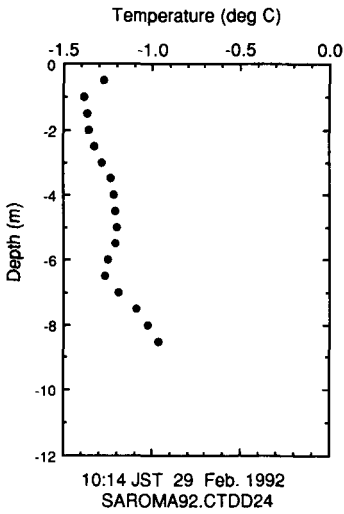
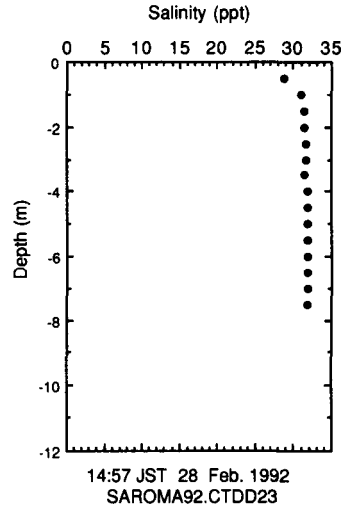
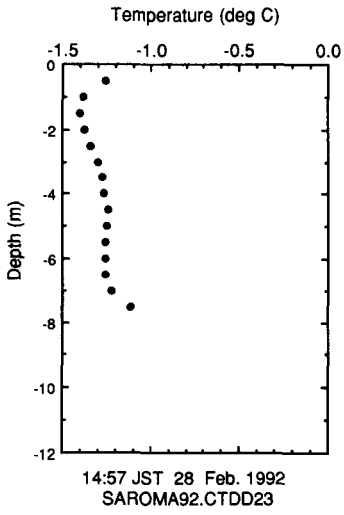
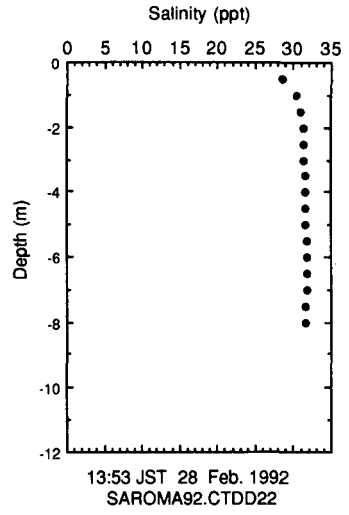
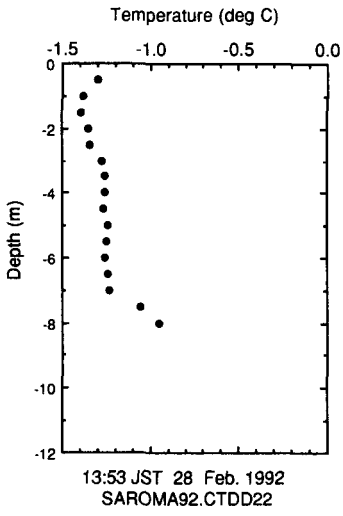


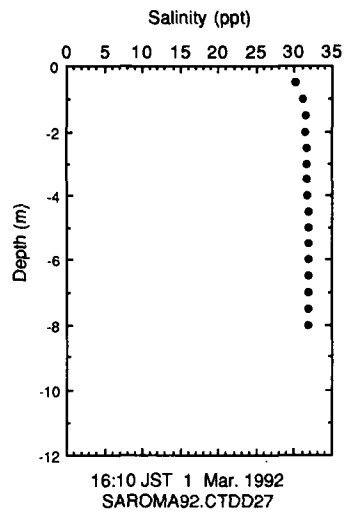
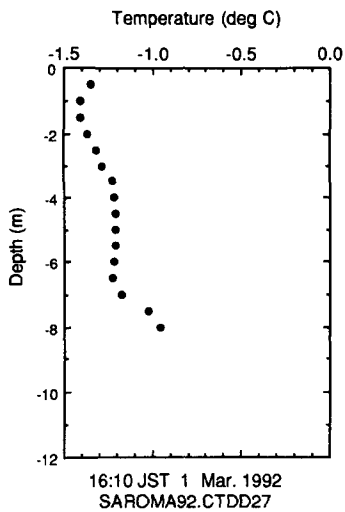
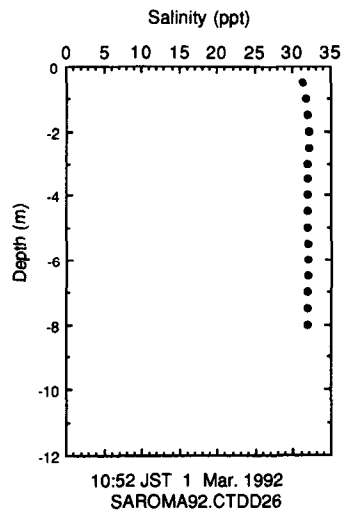
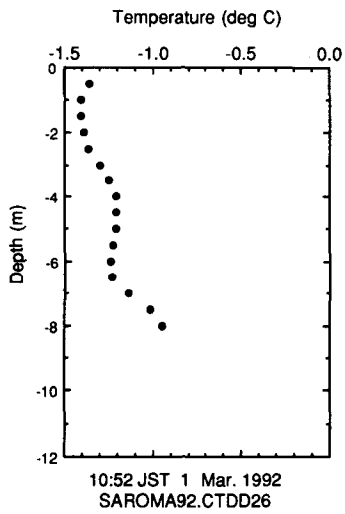
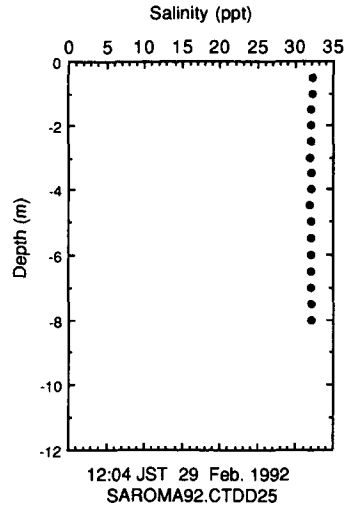
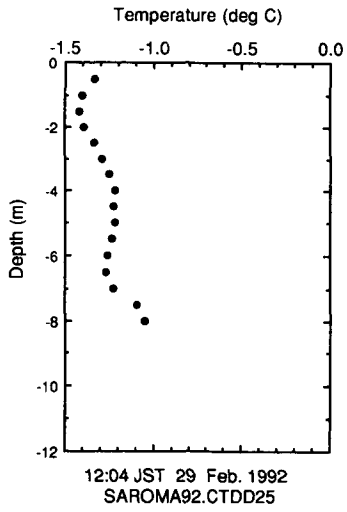


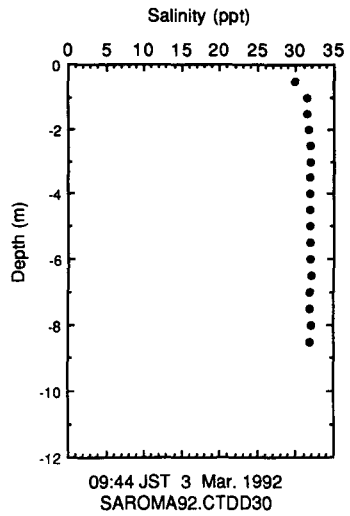
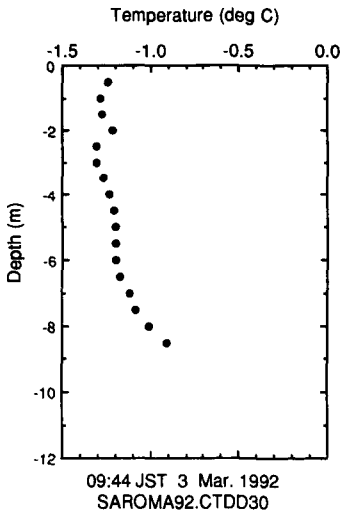
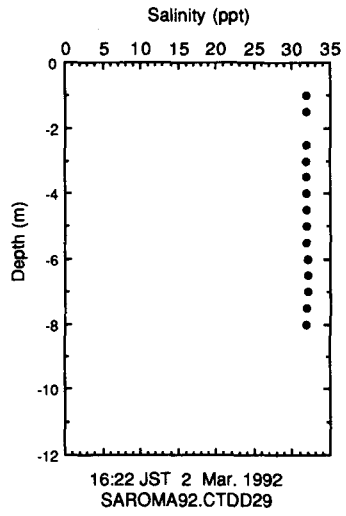
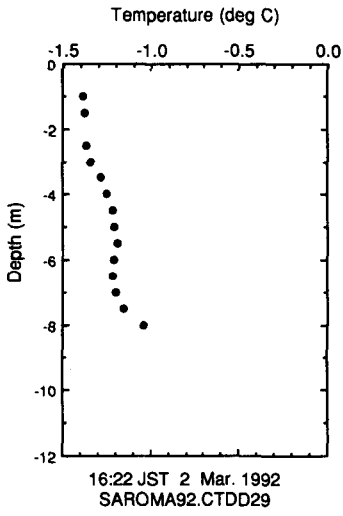
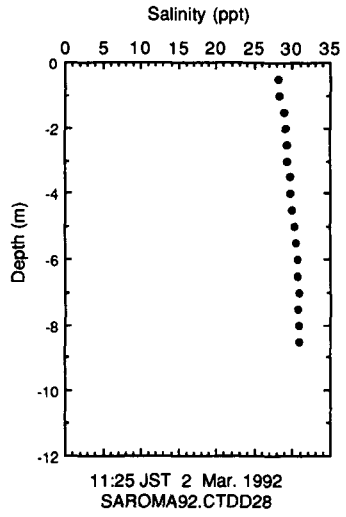
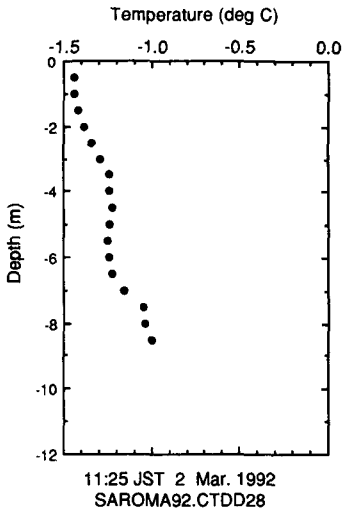


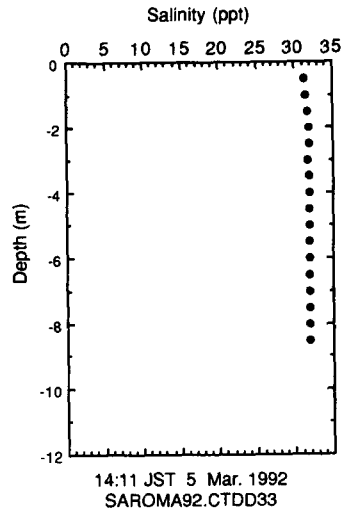
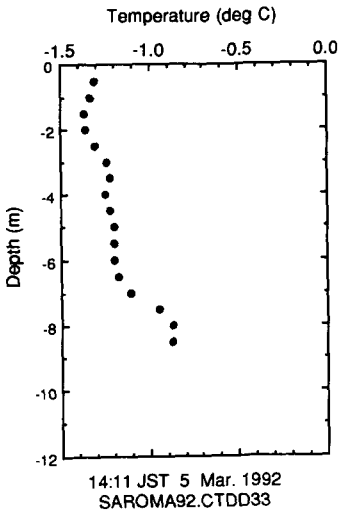
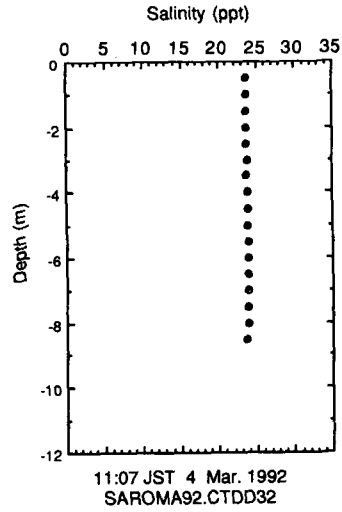
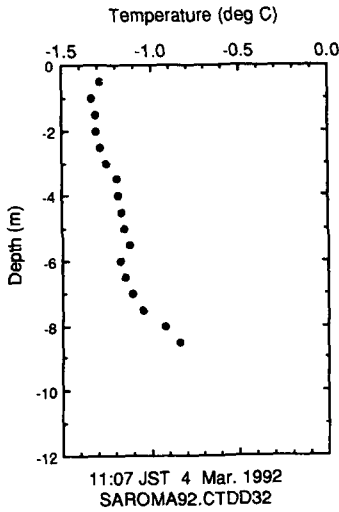
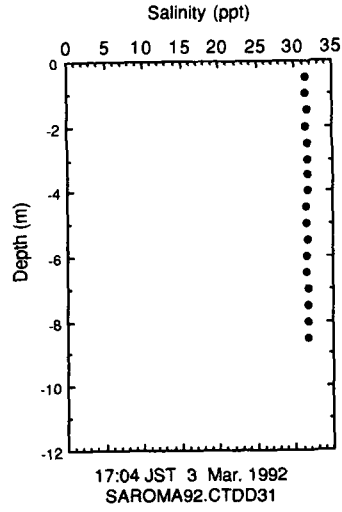
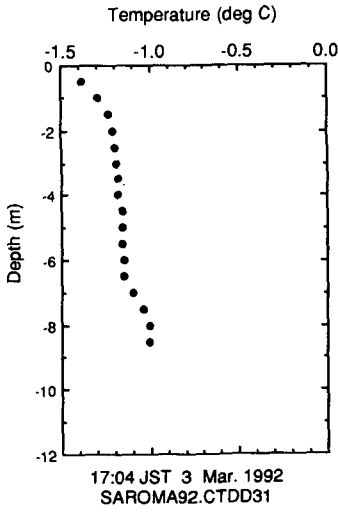


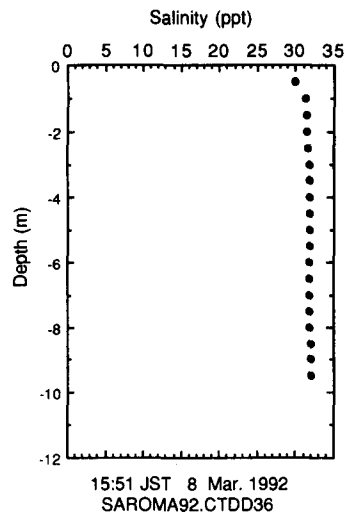
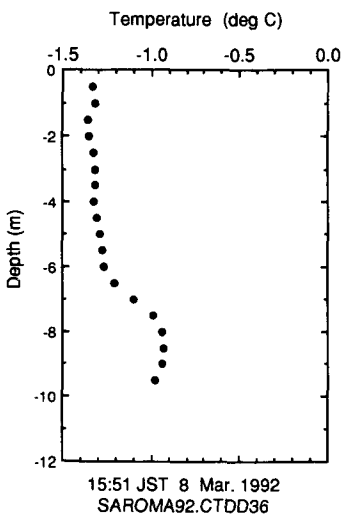
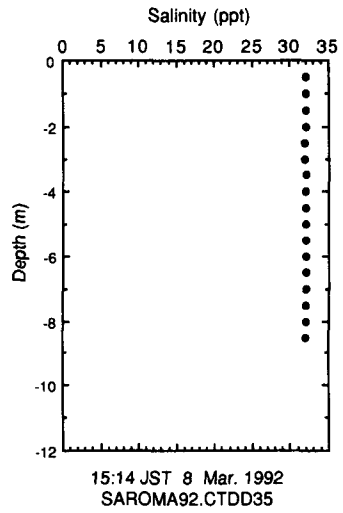
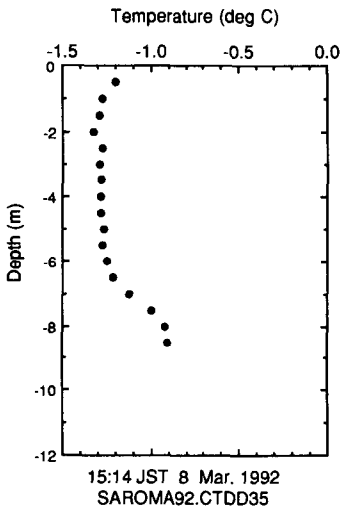
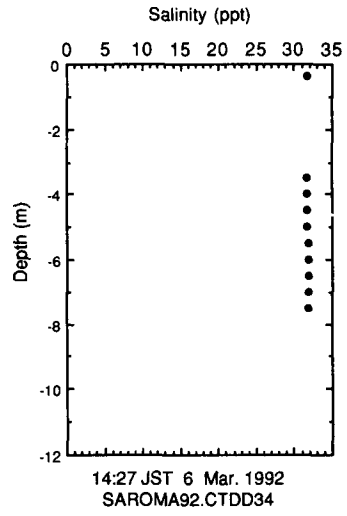
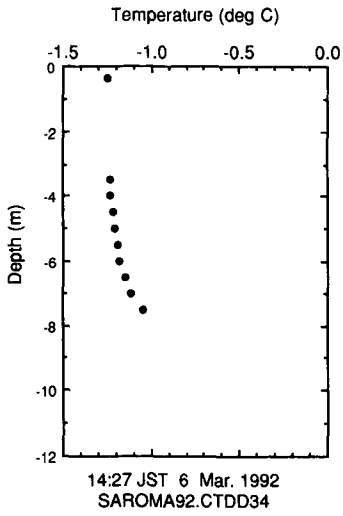


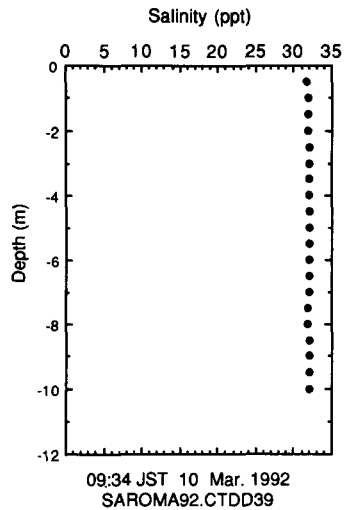
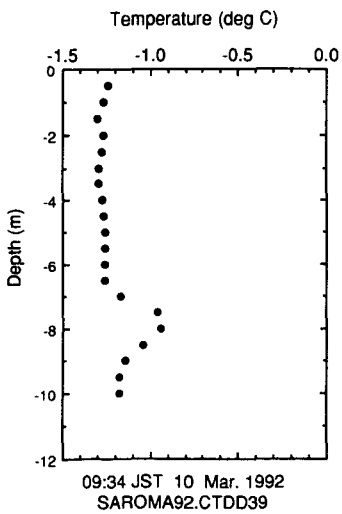
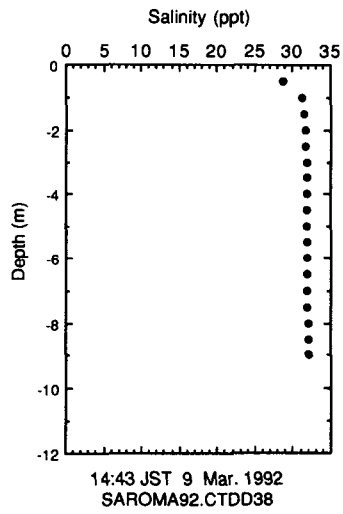
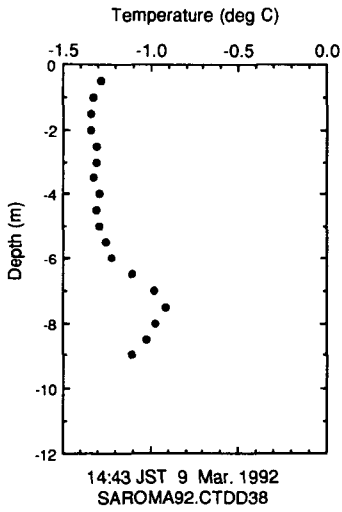
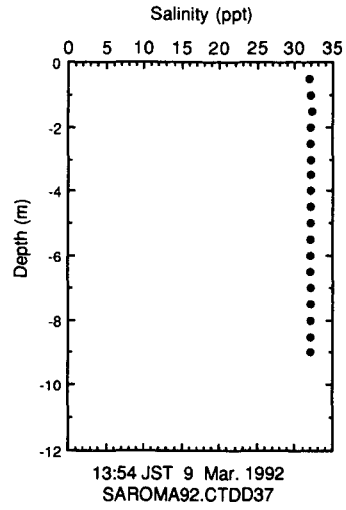
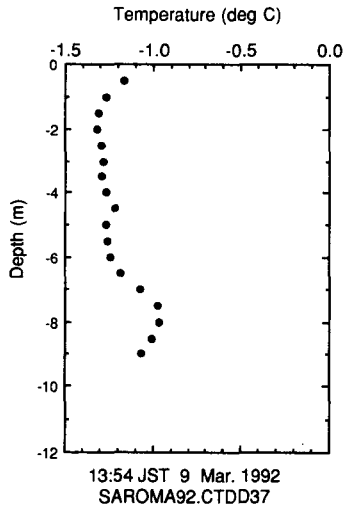


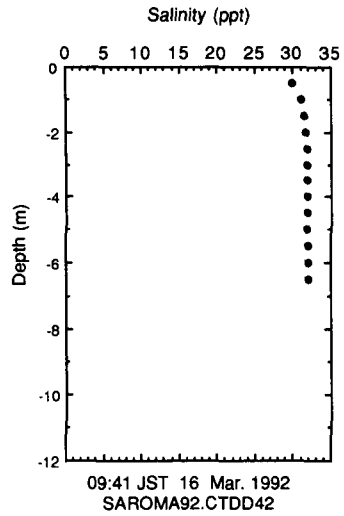
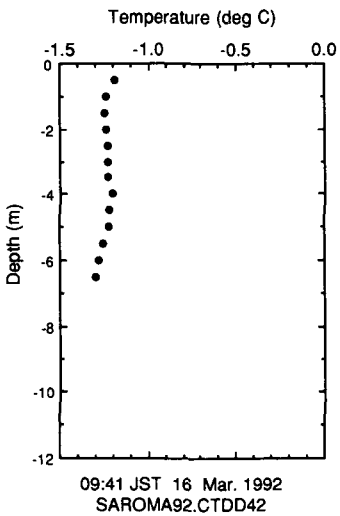
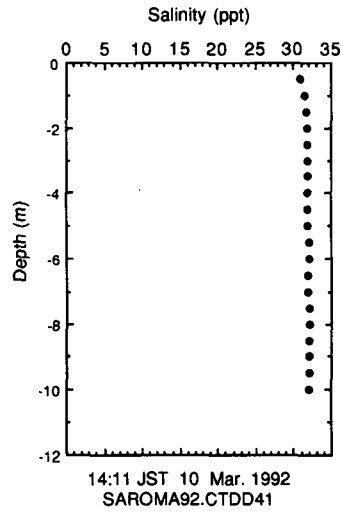
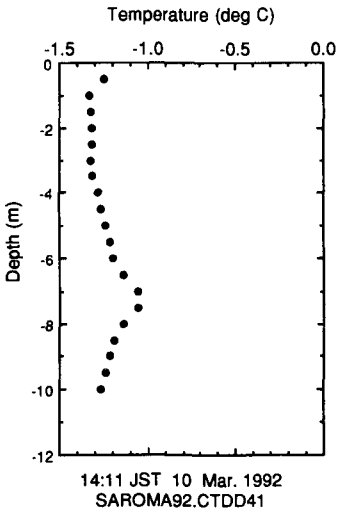
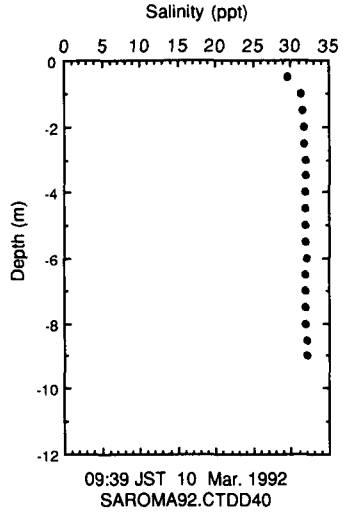
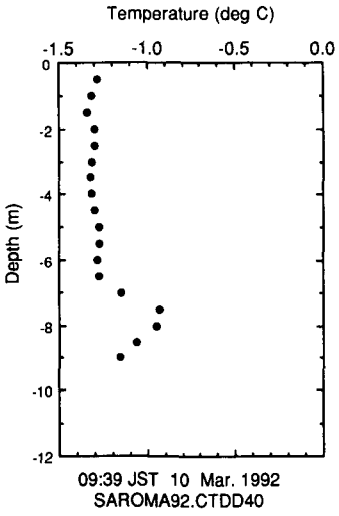


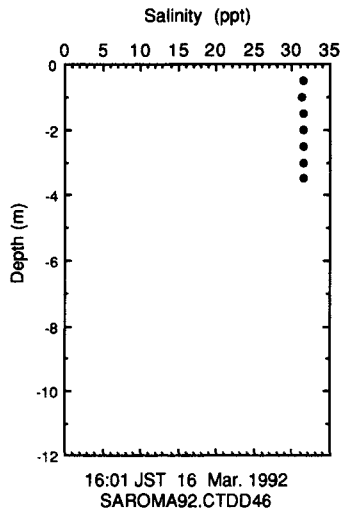
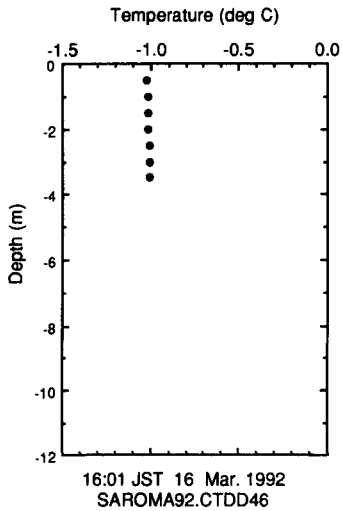
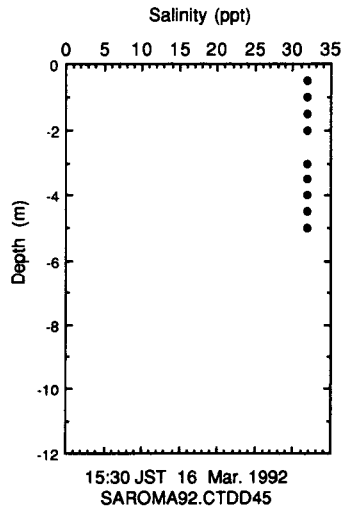
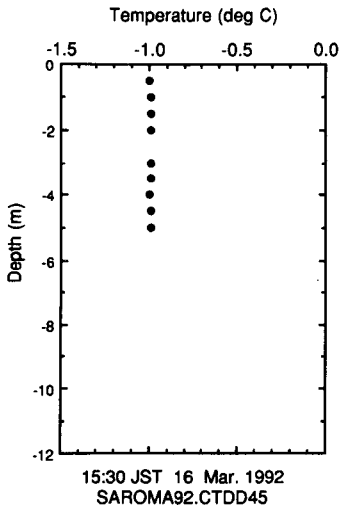
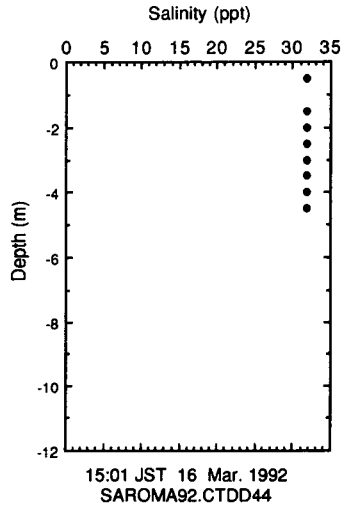
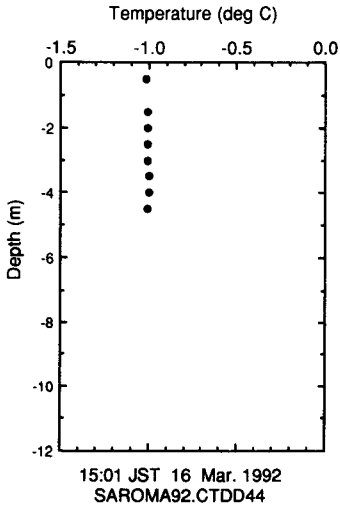


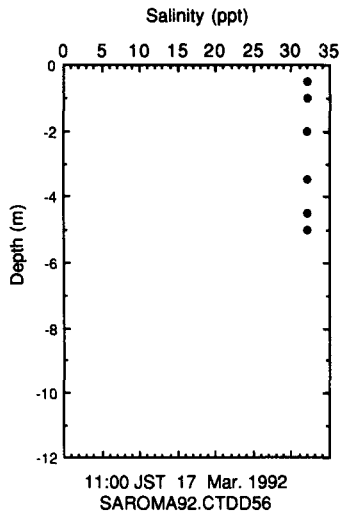
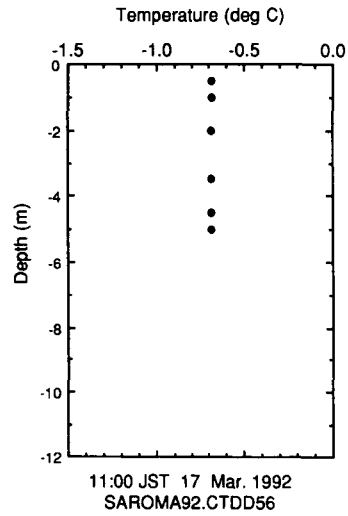
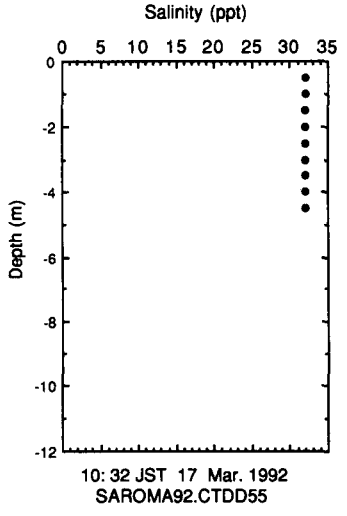
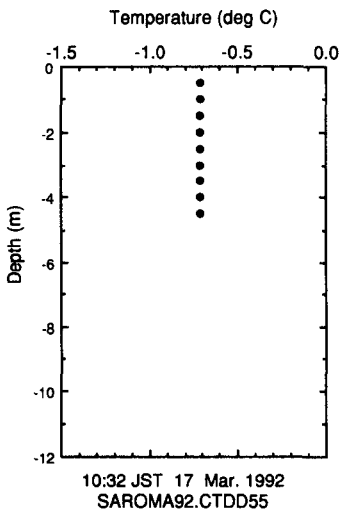
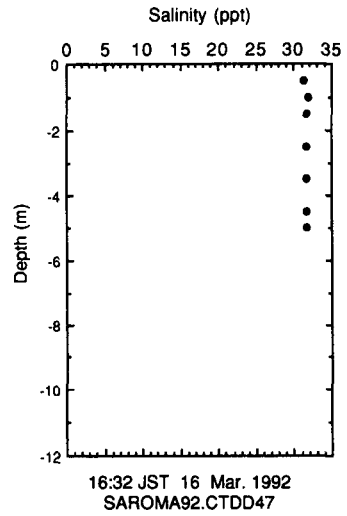
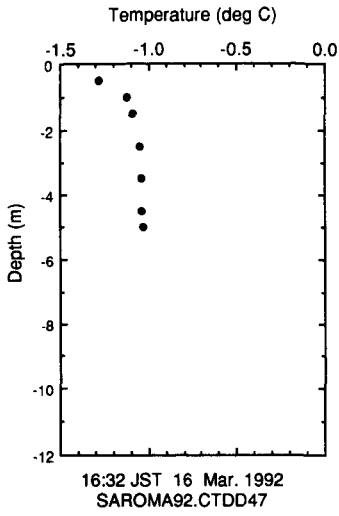


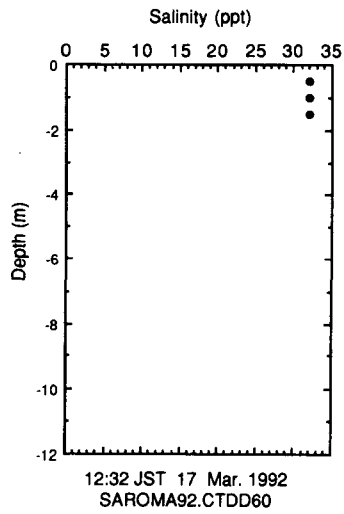
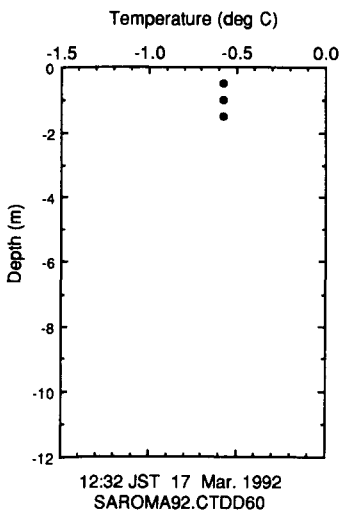
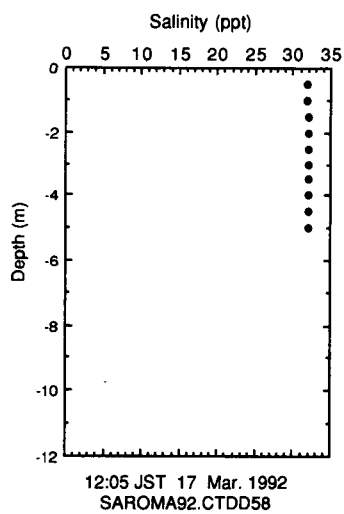
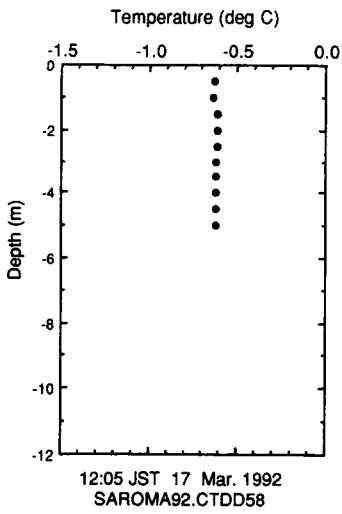
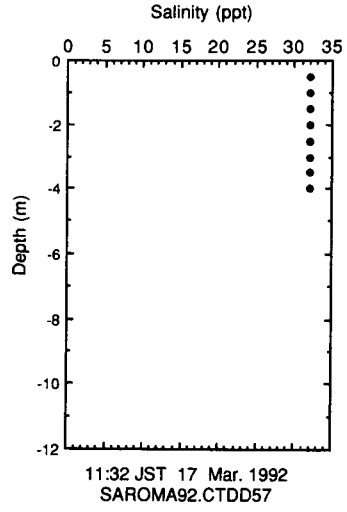
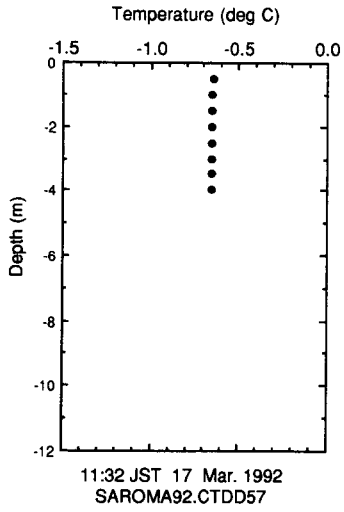


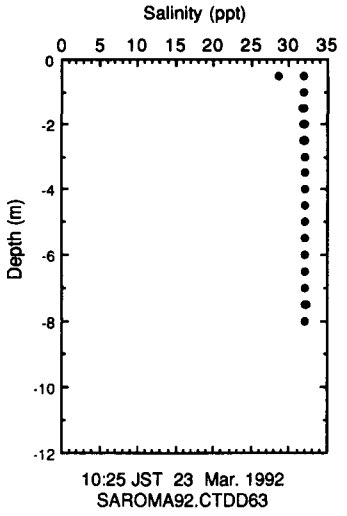
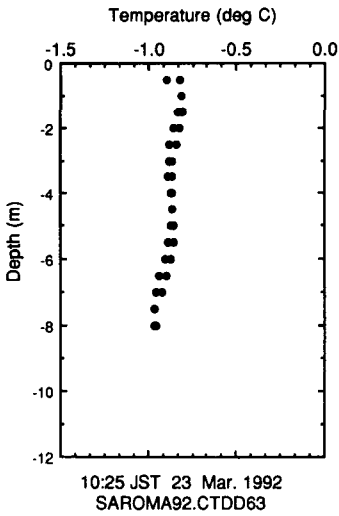
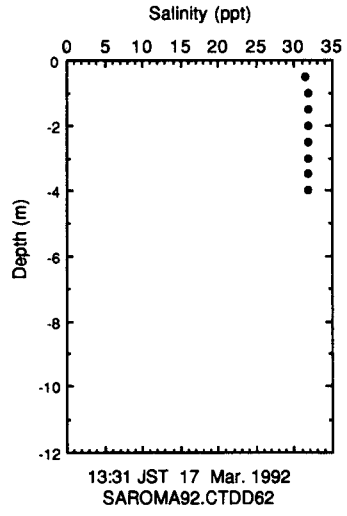
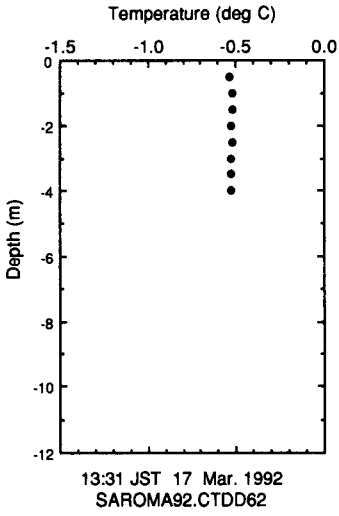
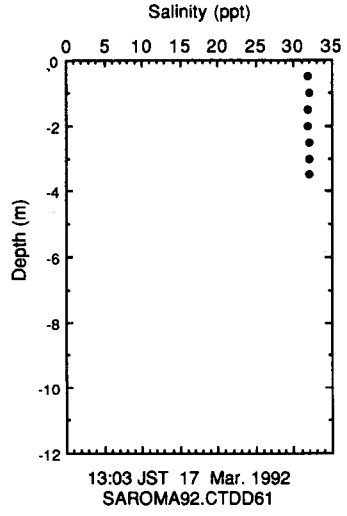
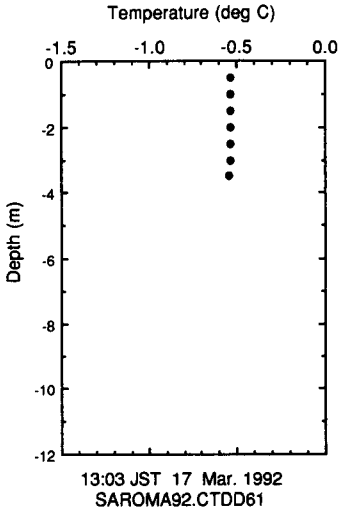


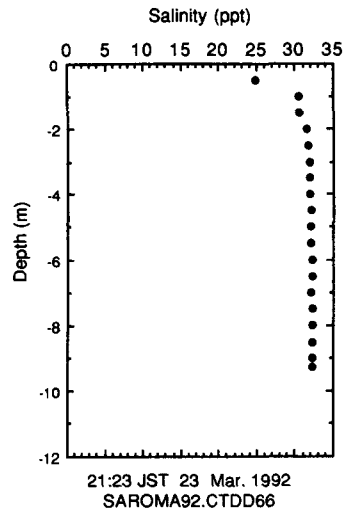
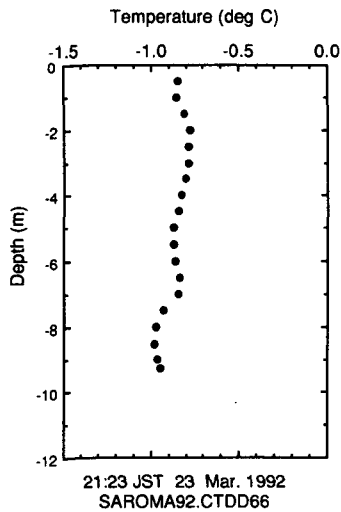
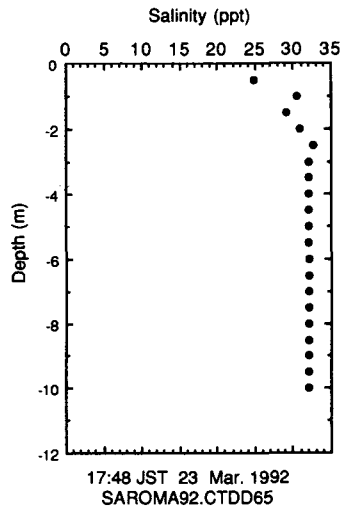
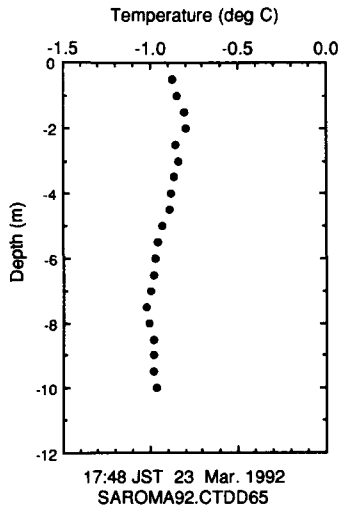
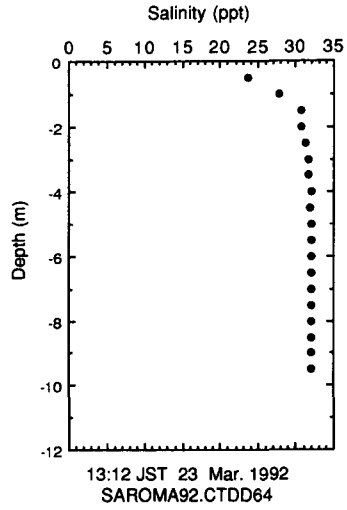
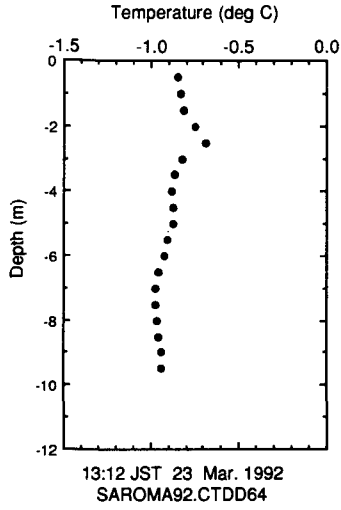


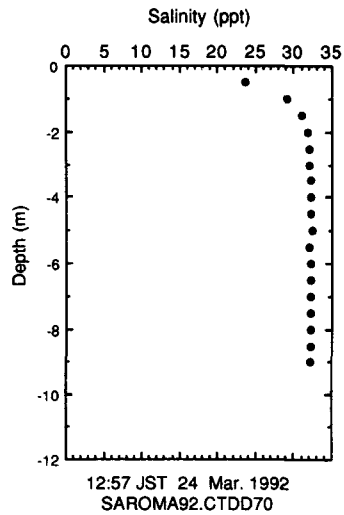
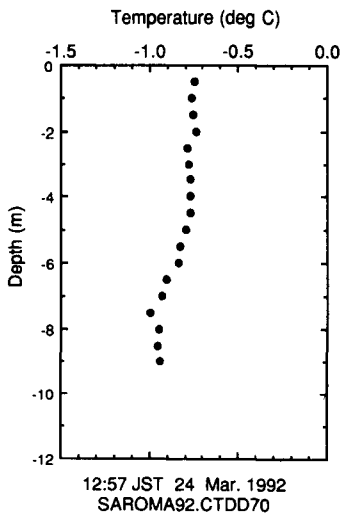
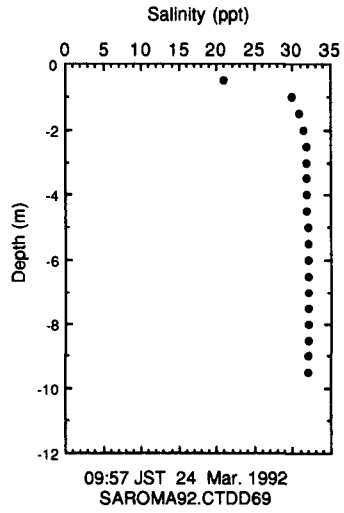
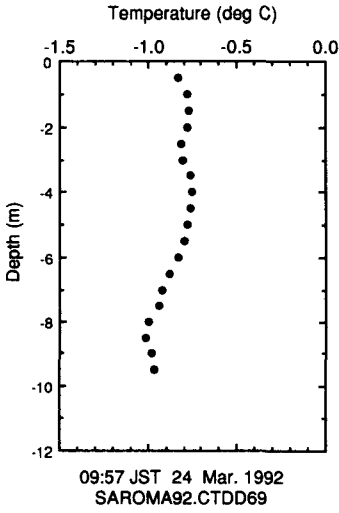
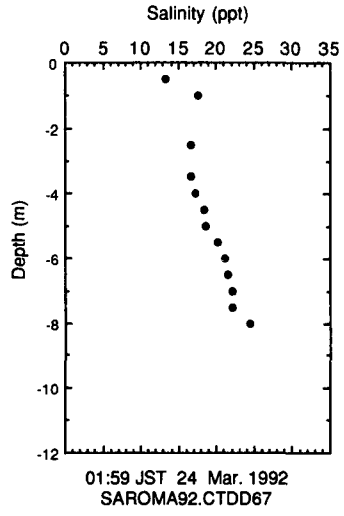
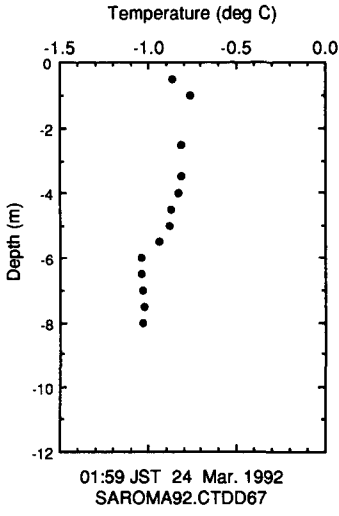


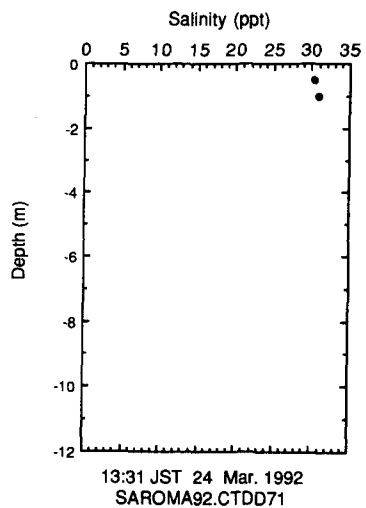
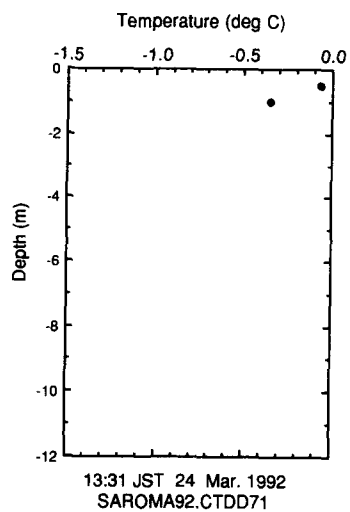












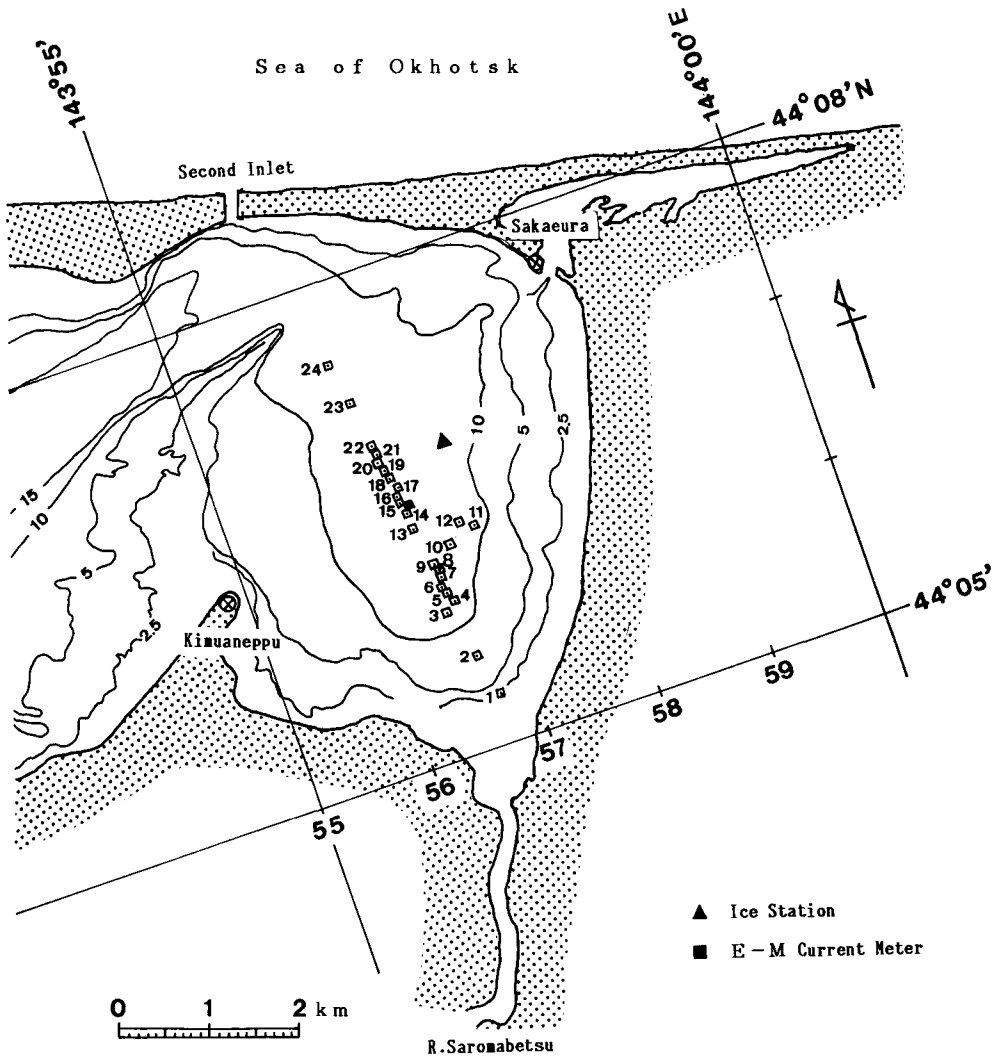


Fig. 13 A location map for CTD casting stations on the transect between the second inlet and Saromabetsu River obtained on 11 March 1992

Table 4 Temperature, salinity and depth obtained on the transection between the second inlet and Saromabetsu River on 11 March 1992.

Date	Time (JST)	NO	Station		Water Depth (m)	Depth (m)	Temperature (°C)	Salinity (ppt)
			Latitude	Longitude				
11 Mar	14:24	1	44° 5.313 N	143° 56.733 E		0.5	-0.161	3.6539
						1	-0.3289	18.8667
						1.5	-0.2686	31.9511
11 Mar	14:37	2	5.579	56.660		0.5	-0.3166	7.1381
						1	-0.725	24.8648
						1.5	-0.8411	27.9922
						2	-1.0461	29.5841
						2.5	-1.1687	30.5631
						3	-1.2251	30.865
						3.5	-1.144	30.9694
						4	-1.1613	31.3347
						4.5	-1.1884	31.5108
						5	-1.1828	31.6284
11 Mar	14:50	3	5.888	56.529	10.480	0.5	-1.1495	26.0842
						1	-1.1977	27.5587
						1.5	-1.1682	29.327
						2	-1.1842	30.2205
						2.5	-1.2466	30.8626
						3	-1.2103	30.7172
						3.5	-1.1657	31.1751
						4	-1.1792	31.4276
						4.5	-1.2074	31.4478
						5	-1.2357	31.4227
11 Mar	14:55	4	5.933	56.628	10.238	0.5	-1.0642	23.574
						1	-1.2125	28.3035
						1.5	-1.2299	29.3808
						2	-1.2668	30.2841
						2.5	-1.2577	30.9756
						3	-1.2146	31.1866
						3.5	-1.2092	31.4176
						4	-1.2307	31.533
						4.5	-1.2474	31.622
						5	-1.2593	31.6837
11 Mar	14:55	4	5.933	56.628	10.238	5.5	-1.2387	31.6089
						6	-1.2118	31.6117
						6.5	-1.1768	31.7947
						7	-1.1008	31.845
						7.5	-1.0128	31.8664
						8	-1.0589	31.9501
						8.5	-1.1348	31.9914
						9	-1.151	31.9909
						9.5	-1.1493	32.0187

Date	Time (JST)	NO	Station		Water Depth (m)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
			Latitude	Longitude				
11 Mar	14:58	5	5.990	56.582	10.412	0.5	-1.0462	16.2922
						1	-1.3138	28.6454
						1.5	-1.2878	29.2748
						2	-1.3065	30.0252
						2.5	-1.2721	30.9224
						3	-1.2383	31.2194
						3.5	-1.2226	31.3533
						4	-1.223	31.4325
						4.5	-1.2676	31.6236
						5	-1.2799	31.6773
						5.5	-1.2762	31.7444
						6	-1.2621	31.8214
						6.5	-1.1957	31.8175
7	-1.1347	31.8283						
7.5	-1.0891	31.8749						
8	-1.1164	31.9393						
8.5	-1.1799	31.9878						
9	-1.1828	31.9985						
9.5	-1.182	32.0087						
11 Mar	15:01	6	6.035	56.557	10.595	0.5	-1.1366	27.7029
						1	-1.2916	28.499
						1.5	-1.3038	30.1043
						2	-1.3071	30.732
						2.5	-1.2631	31.1151
						3	-1.2259	31.3915
						3.5	-1.2034	31.4385
						4	-1.2181	31.6354
						4.5	-1.2515	31.6433
						5	-1.2764	31.779
						5.5	-1.2242	31.8121
						6	-1.2372	31.8266
						6.5	-1.235	31.8927
7	-1.1706	31.8759						
7.5	-1.1139	31.8795						
8	-1.1641	31.9973						
8.5	-1.2201	32.0293						
9	-1.2137	32.0005						
9.5	-1.2466	32.0638						
10	-1.2543	32.065						
10.5	-1.2521	32.0662						
11 Mar	15:03	7	6.099	56.588	10.774	0.5	-1.0944	22.9588
						1	-1.3595	30.6353
						1.5	-1.3206	29.4714
						2	-1.3104	30.4946
						2.5	-1.2642	31.0648
						3	-1.2446	31.2428
						3.5	-1.2311	31.3548
						4	-1.2249	31.5097
						4.5	-1.2297	31.5799
						5	-1.2453	31.782
						5.5	-1.2467	31.8365
						6	-1.2607	31.8624
						6.5	-1.2364	31.8848
7	-1.1803	31.8836						
7.5	-1.1574	31.9195						
8	-1.2734	32.0429						
8.5	-1.3217	32.0379						
9	-1.2886	32.0306						
9.5	-1.2943	31.9252						
10	-1.3015	32.0189						
10.5	-1.2986	31.9925						

Date	Time (JST)	NO	Station		Water Depth (m)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
			Latitude	Longitude				
11 Mar	15:06	8	6.158	56.582	11.131	0.5	-1.1588	27.334
						1	-1.3509	29.464
						1.5	-1.326	30.0923
						2	-1.3039	30.6473
						2.5	-1.2643	31.1723
						3	-1.2482	31.3392
						3.5	-1.2441	31.5952
						4	-1.2364	31.7402
						4.5	-1.2357	31.7643
						5	-1.2401	31.8548
						5.5	-1.2489	31.9043
						6	-1.2744	31.9472
						6.5	-1.2445	31.9433
						7	-1.2237	31.9551
						7.5	-1.2278	31.9905
						8	-1.2869	32.0355
8.5	-1.3555	32.0614						
9	-1.3251	32.0564						
9.5	-1.2847	32.0264						
10	-1.2796	32.052						
10.5	-1.2795	32.0423						
11 Mar	15:11	9	6.187	56.560	10.952	0.5	-1.2297	26.3604
						1	-1.3592	29.939
						1.5	-1.3281	30.2663
						2	-1.2866	30.4499
						2.5	-1.2536	30.912
						3	-1.2471	31.0501
						3.5	-1.2383	31.1554
						4	-1.2362	31.3892
						4.5	-1.2393	31.5592
						5	-1.264	31.6517
						5.5	-1.2593	31.6949
						6	-1.2588	31.7666
						6.5	-1.2351	31.7851
						7	-1.233	31.8264
						7.5	-1.3274	31.9996
						8	-1.3797	32.0402
8.5	-1.4063	32.0637						
9	-1.3497	31.9852						
9.5	-1.2873	31.991						
10	-1.3002	32.0182						
10.5	-1.2902	32.0083						
11 Mar	15:15	10	6.263	56.743	10.952	0.5	-1.2207	10.4394
						1	-1.3691	10.2897
						1.5	-1.3235	10.393
						2	-1.2915	10.8526
						2.5	-1.2567	11.5907
						3	-1.2479	12.7664
						3.5	-1.2424	15.0887
						4	-1.2338	16.8178
						4.5	-1.2428	18.6641
						5	-1.2596	20.6661
						5.5	-1.2559	22.628
						6	-1.2441	24.041
						6.5	-1.239	24.9948
						7	-1.3265	25.8549
						7.5	-1.3722	26.5787
						8	-1.3666	27.1088
8.5	-1.365	27.4712						
9	-1.4056	27.8454						
9.5	-1.3633	28.1321						
10	-1.3171	28.3008						
10.5	-1.3047	28.5324						

Date	Time (JST)	NO	Station		Water Depth (m)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
			Latitude	Longitude				
11 Mar	15:20	11	6.321	56.982	10.863	0.5	-1.1859	27.0041
						1	-1.3793	28.9464
						1.5	-1.3293	30.1326
						2	-1.2968	30.6935
						2.5	-1.2672	31.0842
						3	-1.258	31.2449
						3.5	-1.2466	31.374
						4	-1.2374	31.456
						4.5	-1.2481	31.5384
						5	-1.2567	31.6778
						5.5	-1.2582	31.7215
6	-1.2626	31.7853						
6.5	-1.3185	31.8741						
7	-1.3071	31.8831						
7.5	-1.3412	31.9679						
8	-1.4004	32.011						
8.5	-1.407	32.0054						
9	-1.416	32.0247						
9.5	-1.3924	31.983						
10	-1.3341	31.9974						
11 Mar	15:23	12	6.363	56.878	10.952	0.5	-1.2625	26.1093
						1	-1.3734	29.4292
						1.5	-1.3422	30.2453
						2	-1.2868	30.6645
						2.5	-1.2639	30.8161
						3	-1.2607	30.9239
						3.5	-1.248	31.0776
						4	-1.2476	30.9672
						4.5	-1.2531	31.0376
						5	-1.256	31.3332
						5.5	-1.2537	31.708
						6	-1.2462	31.8236
						6.5	-1.2687	31.9083
						7	-1.312	31.9536
7.5	-1.351	31.9843						
8	-1.3899	32.024						
8.5	-1.4083	32.0308						
9	-1.4079	32.0382						
9.5	-1.3967	32.0344						
10	-1.3313	31.9799						
10.5	-1.3166	31.9817						
10.775	-1.312	32.0048						
11 Mar	15:28	13	6.427	56.495	11.041	0.5	-1.1593	26.5018
						1	-1.3436	29.729
						1.5	-1.3357	30.5016
						2	-1.2926	30.8384
						2.5	-1.2719	31.1146
						3	-1.262	31.2266
						3.5	-1.2484	31.3873
						4	-1.2486	31.5073
						4.5	-1.2588	31.6285
						5	-1.264	31.7382
						5.5	-1.2705	31.8044
						6	-1.2807	31.8798
						6.5	-1.3131	31.9395
						7	-1.3636	31.9949
7.5	-1.3535	31.9581						
8	-1.3858	32.0322						
8.5	-1.4105	32.0498						
9	-1.4185	32.0635						
9.5	-1.3999	32.0504						
10	-1.3383	32.0172						
10.5	-1.3213	32.0378						

Date	Time (JST)	NO	Station		Water Depth (m)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
			Latitude	Longitude				
11 Mar	17:56	14	6.522	56.497	11.131	0.5	-1.2918	28.9226
						1	-1.3356	30.1439
						1.5	-1.3157	30.4041
						2	-1.2789	30.8901
						2.5	-1.2603	31.1543
						3	-1.2507	31.3494
						3.5	-1.2382	31.4613
						4	-1.226	31.5545
						4.5	-1.2257	31.6076
						5	-1.2271	31.6641
						5.5	-1.2354	31.7378
						6	-1.2588	31.7959
11 Mar	17:50	15	6.585	56.473	11.131	0.5	-1.279	28.4155
						1	-1.3474	28.686
						1.5	-1.3459	30.5666
						2	-1.3131	29.652
						2.5	-1.2928	31.171
						3	-1.2812	30.7906
						3.5	-1.266	31.5916
						4	-1.253	31.4338
						4.5	-1.2481	31.6139
						5	-1.248	31.6045
						5.5	-1.2507	31.846
						6	-1.2816	31.8931
6.5	-1.3281	31.9459						
7	-1.3717	31.9544						
7.5	-1.4039	31.9813						
8	-1.4191	32.0469						
8.5	-1.4228	32.0649						
9	-1.4146	32.0641						
9.5	-1.3769	32.0815						
10	-1.3566	32.072						
10.5	-1.3433	32.0791						
11	-1.3363	32.0776						
11 Mar	17:47	16	6.637	56.472	11.220	0.5	-1.3359	30.3439
						1	-1.3183	30.519
						1.5	-1.3063	30.7508
						2	-1.2948	30.9618
						2.5	-1.2811	31.1646
						3	-1.2705	31.3051
						3.5	-1.2584	31.4328
						4	-1.2492	31.5183
						4.5	-1.2452	31.6572
						5	-1.2438	31.744
						5.5	-1.2596	31.8128
						6	-1.2946	31.8842
6.5	-1.3504	31.9477						
7	-1.3921	31.9793						
7.5	-1.4094	31.993						
8	-1.4155	32.0242						
8.5	-1.4154	32.0397						
9	-1.3829	32.0376						
9.5	-1.3717	32.0541						
10	-1.3583	32.0606						
10.5	-1.3495	32.0636						
11	-1.3493	32.0776						

Date	Time (JST)	NO	Station		Water Depth (m)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
			Latitude	Longitude				
11 Mar	17:45	17	6.687	56.498	11.220	0.5	-1.3021	27.024
						1	-1.346	28.7693
						1.5	-1.3345	30.1101
						2	-1.3083	30.7202
						2.5	-1.2892	31.2648
						3	-1.2759	31.0957
						3.5	-1.2566	31.6575
						4	-1.2464	31.6902
						4.5	-1.246	31.642
						5	-1.2463	31.8027
						5.5	-1.2701	31.8491
						6	-1.2969	31.8832
						6.5	-1.3473	31.9591
						7	-1.3801	31.9639
						7.5	-1.4086	32.0199
8	-1.4185	32.0435						
8.5	-1.414	32.0527						
9	-1.406	32.0625						
9.5	-1.3667	32.0568						
10	-1.3571	32.0588						
10.5	-1.3516	32.0707						
11 Mar	17:43	18	6.746	56.451	11.220	0.5	-1.2189	28.9177
						1	-1.3575	30.2485
						1.5	-1.3285	30.4915
						2	-1.301	31.0787
						2.5	-1.2864	31.3499
						3	-1.2718	31.3567
						3.5	-1.2597	31.4706
						4	-1.2495	31.6351
						4.5	-1.2447	31.738
						5	-1.2484	31.8014
						5.5	-1.2585	31.8446
						6	-1.3044	31.9012
						6.5	-1.3511	31.9293
						7	-1.381	31.9965
						7.5	-1.4039	32.0187
8	-1.4109	32.0344						
8.5	-1.4126	32.0515						
9	-1.4094	32.0616						
9.5	-1.3925	32.071						
10	-1.3612	32.0679						
10.5	-1.3498	32.07						
11 Mar	17:40	19	6.804	56.433	11.220	0.5	-1.3377	29.9291
						1	-1.3197	30.6883
						1.5	-1.304	30.9582
						2	-1.2943	31.0682
						2.5	-1.2827	31.1987
						3	-1.2688	31.1817
						3.5	-1.2539	31.5191
						4	-1.2455	31.5672
						4.5	-1.2416	31.6707
						5	-1.2438	31.7332
						5.5	-1.2624	31.8002
						6	-1.3171	31.8709
						6.5	-1.3768	31.9387
						7	-1.3963	31.9709
						7.5	-1.3999	31.9996
8	-1.3918	32.0109						
8.5	-1.3766	32.0277						
9	-1.3581	32.0358						
9.5	-1.3498	32.0525						
10	-1.345	32.0603						
10.5	-1.3436	32.0639						

Date	Time (JST)	NO	Station		Water Depth (m)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
			Latitude	Longitude				
11 Mar	17:36	20	6.865	56.403	11.220	0.5	-1.3047	29.7939
						1	-1.339	30.6234
						1.5	-1.3071	30.919
						2	-1.2842	31.1666
						2.5	-1.2759	31.3909
						3	-1.2682	31.4902
						3.5	-1.2566	31.5794
						4	-1.2474	31.6289
						4.5	-1.2429	31.6919
						5	-1.2453	31.7364
						5.5	-1.286	31.8416
						6	-1.337	31.9006
						6.5	-1.3649	31.9315
						7	-1.3905	31.9637
						7.5	-1.4023	31.9383
						11 Mar	17:33	21
1	-1.3338	29.9915						
1.5	-1.3212	30.4557						
2	-1.2894	30.9198						
2.5	-1.2772	31.2547						
3	-1.264	31.3651						
3.5	-1.255	31.5561						
4	-1.2445	31.5877						
4.5	-1.2409	31.6878						
5	-1.2495	31.7415						
5.5	-1.279	31.814						
6	-1.3587	31.8827						
6.5	-1.4031	31.9622						
7	-1.4085	31.9651						
7.5	-1.4076	32.0065						
11 Mar	17:30	22	6.968	56.400	11.131			
						1	-1.2667	31.2407
						1.5	-1.2636	31.286
						2	-1.2599	31.4414
						2.5	-1.2556	31.5021
						3	-1.2526	31.5543
						3.5	-1.2501	31.2391
						4	-1.2389	31.6205
						4.5	-1.2333	31.5871
						5	-1.2404	31.6814
						5.5	-1.266	31.8743
						6	-1.3336	31.9248
						6.5	-1.4108	32.0034
						7	-1.4145	32.0127
						7.5	-1.4136	32.0259
						8	-1.4124	32.0358
8.5	-1.4023	32.0085						
9	-1.3918	32.0472						
9.5	-1.3807	32.0183						
10	-1.3739	32.0451						
10.5	-1.3674	32.0428						

Date	Time (JST)	NO	Station		Water Depth (m)	Depth (m)	Temper- ature (°C)	Salinity (ppt)
			Latitude	Longitude				
11 Mar	17:23	23	7.257	56.343	11.041	0.5	-1.1817	31.411
						1	-1.252	31.4624
						1.5	-1.2526	31.5381
						2	-1.2481	31.6734
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9	-1.3663	32.0556						
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10	-1.3623	32.0721						
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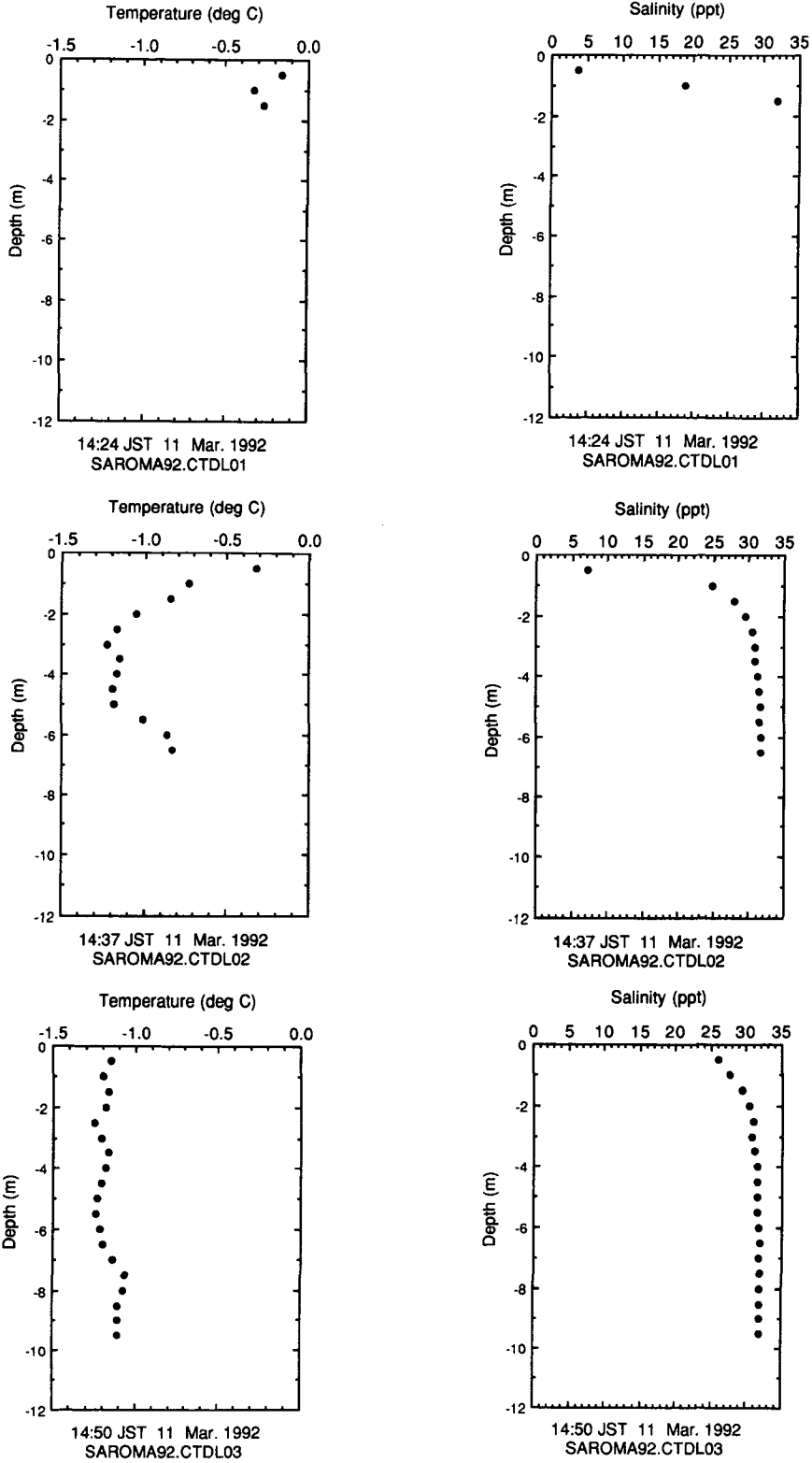
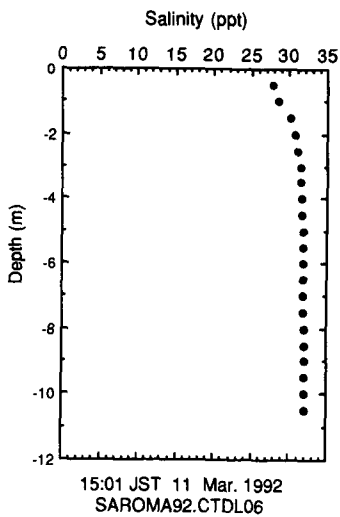
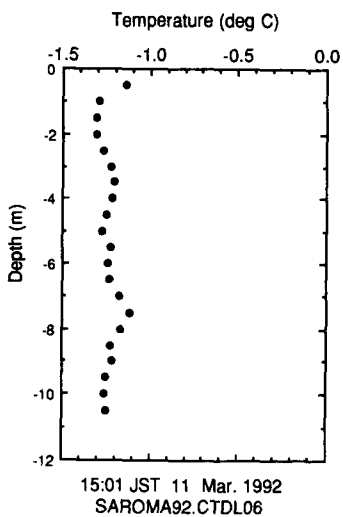
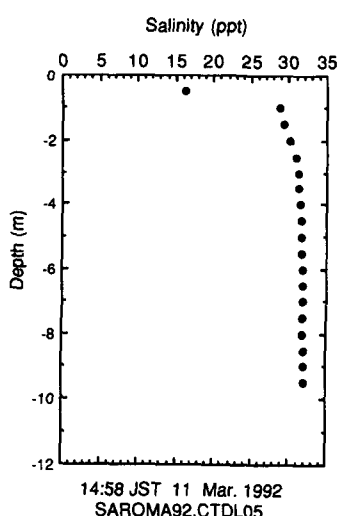
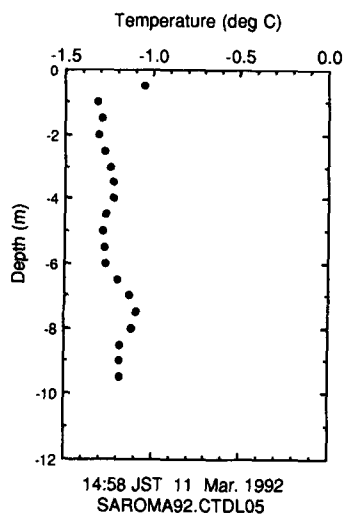
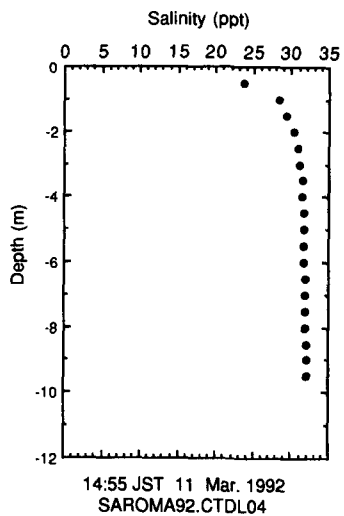
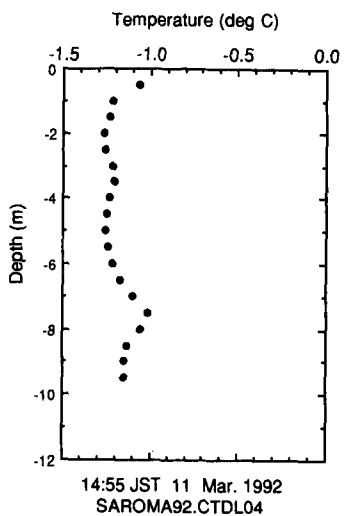
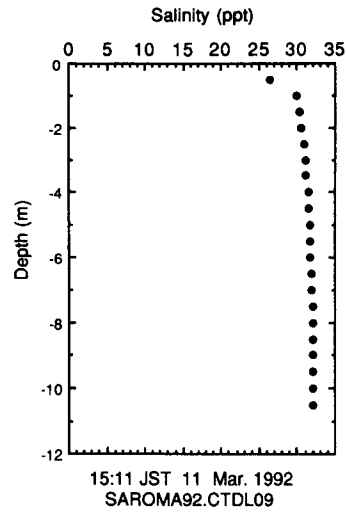
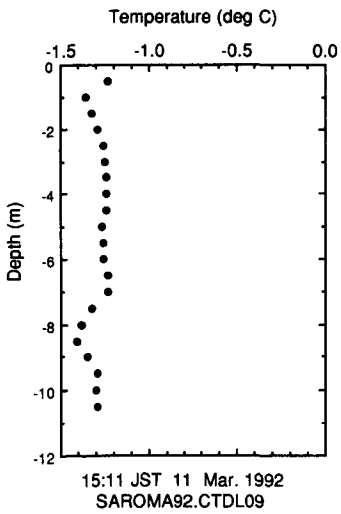
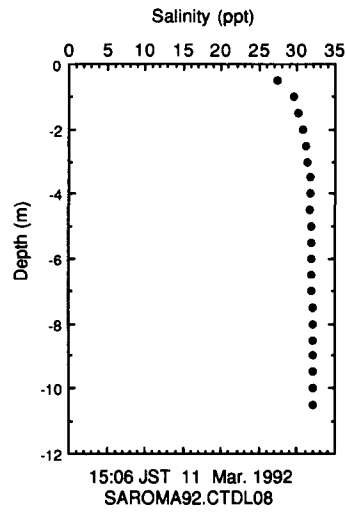
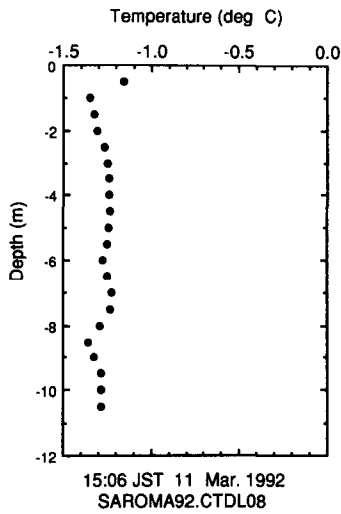
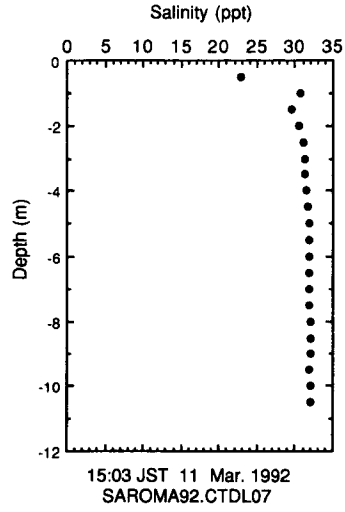
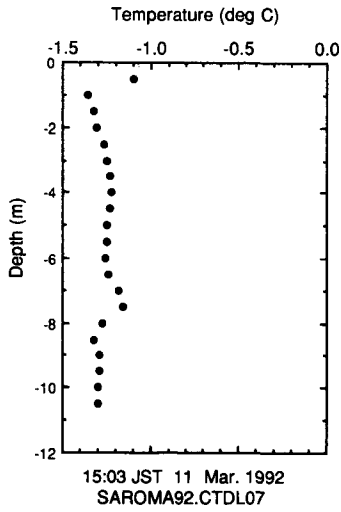
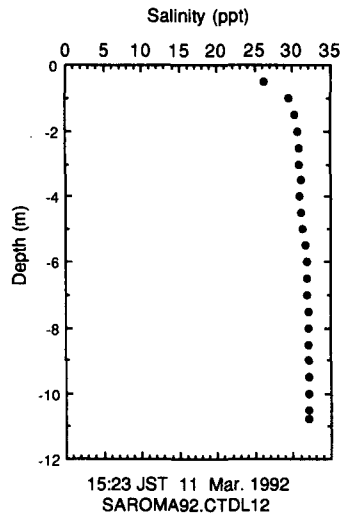
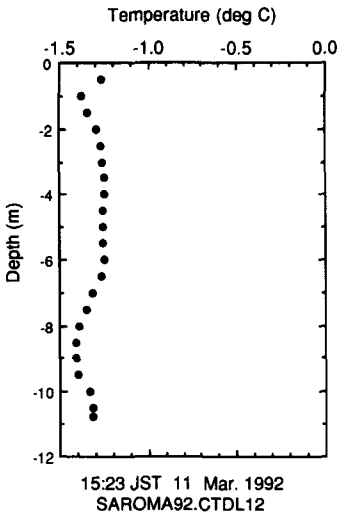
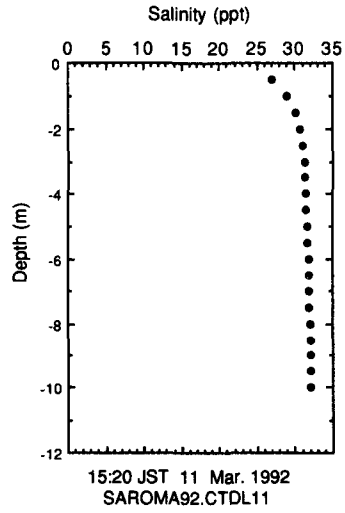
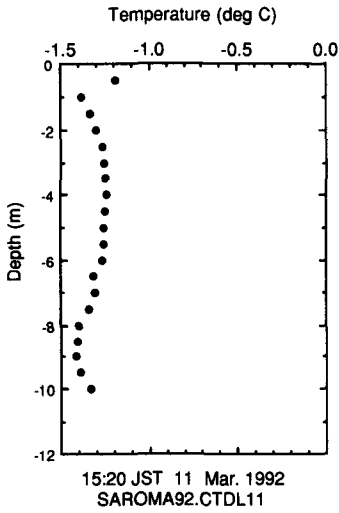
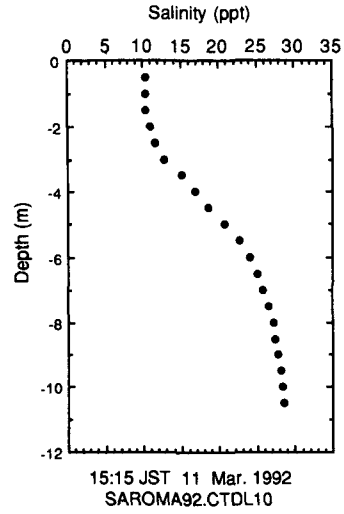
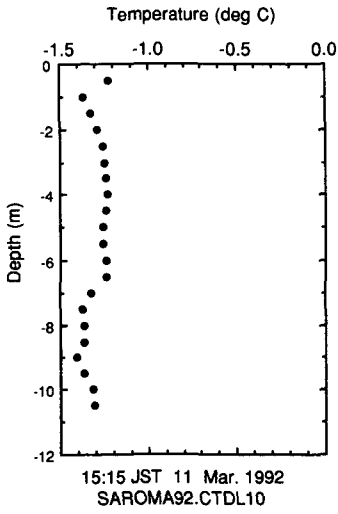
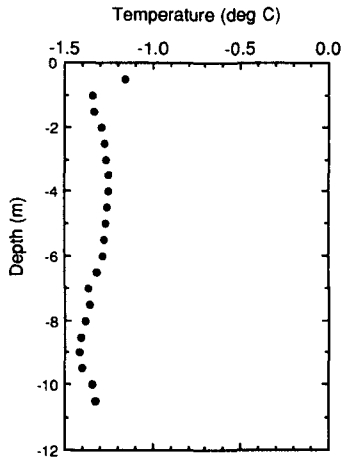


Fig. 14 Vertical profiles of temperature and salinity obtained on the transection between the second inlet and Saromabetsu River on 11 March 1992

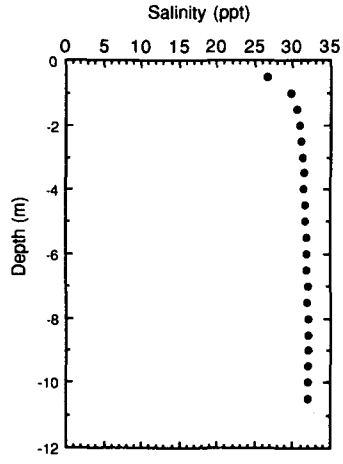




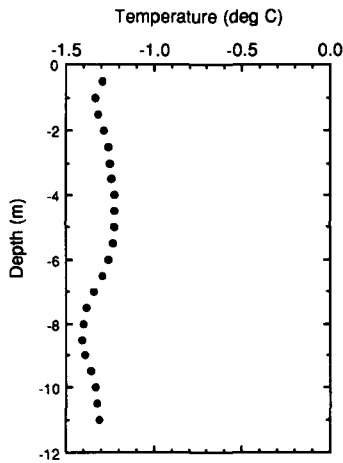




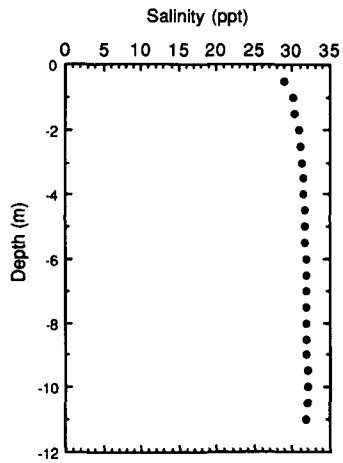
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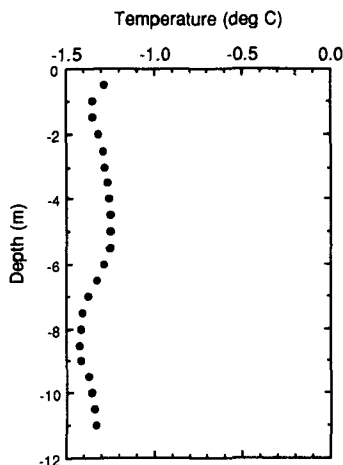
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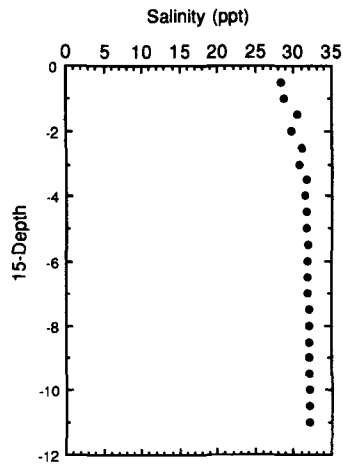
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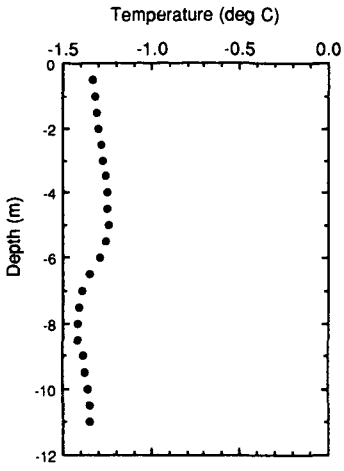
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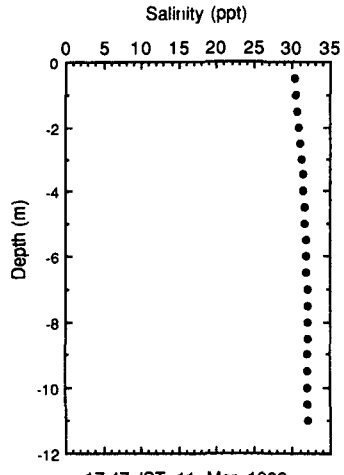
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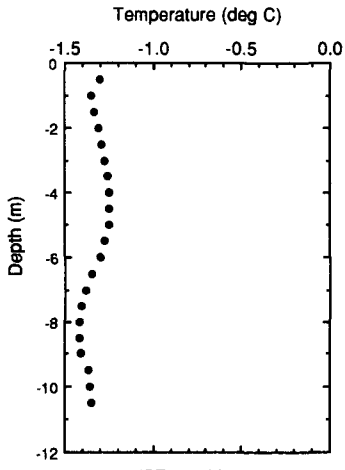
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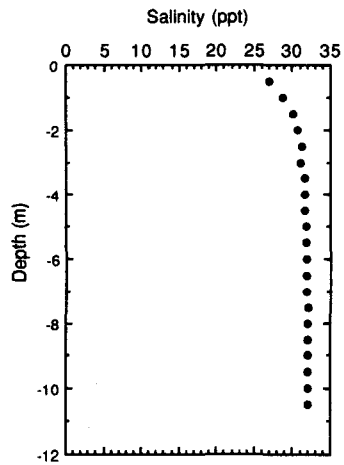
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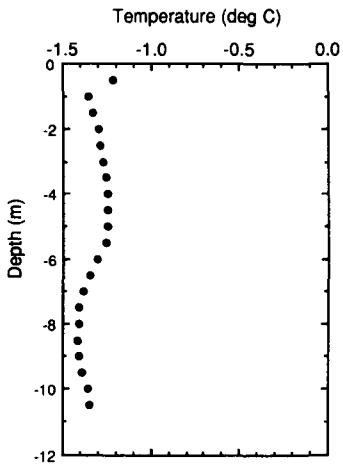
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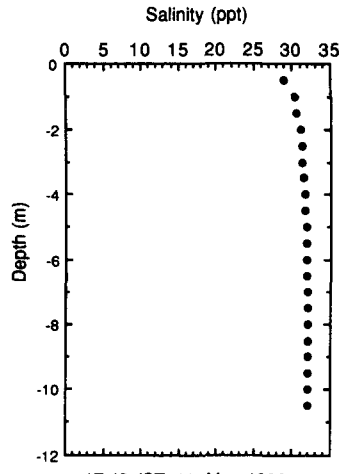
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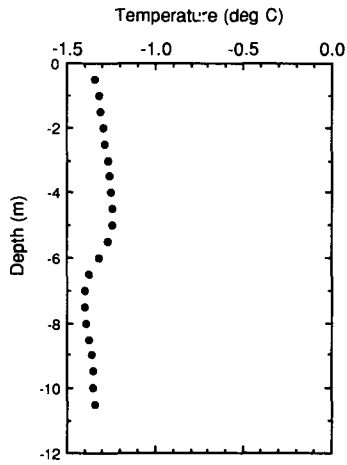
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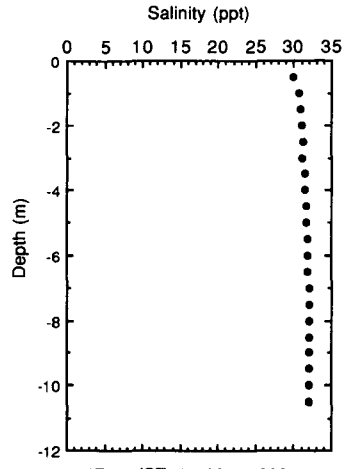
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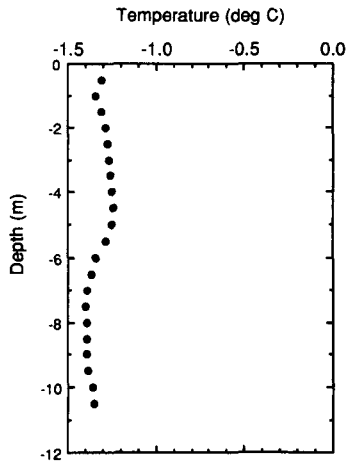
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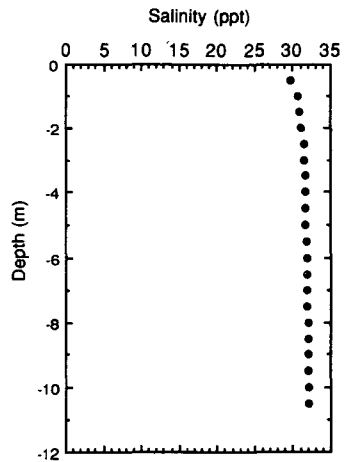
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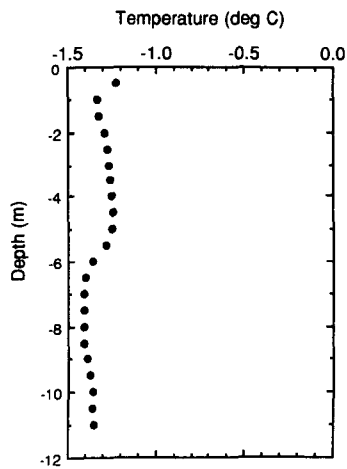
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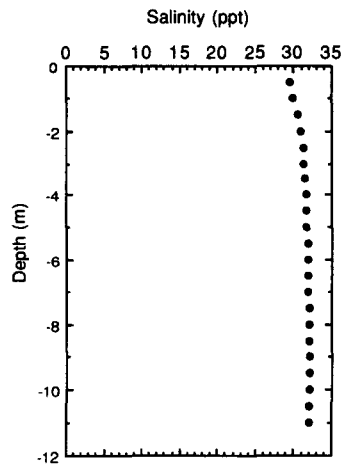
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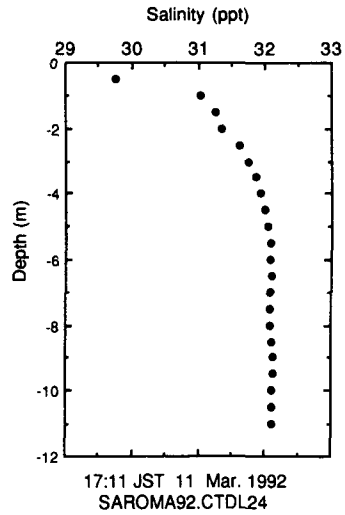
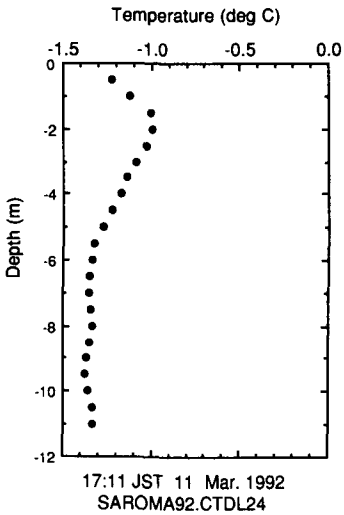
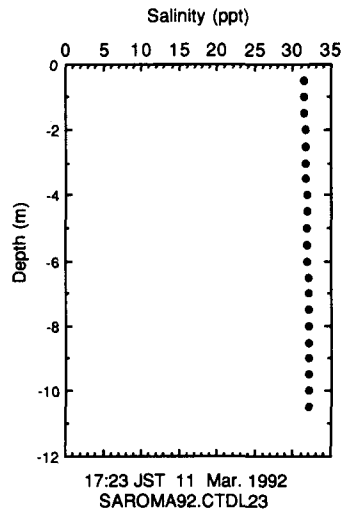
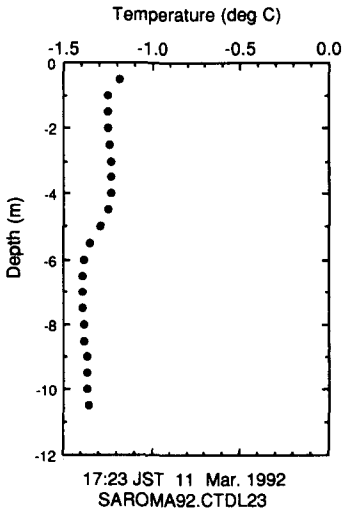
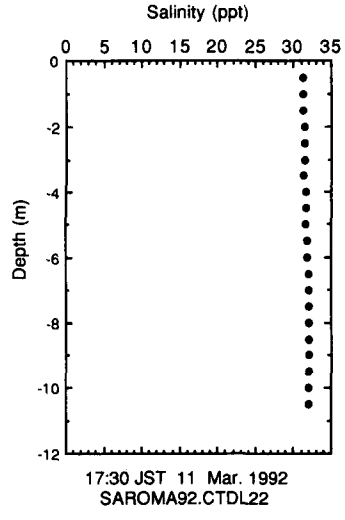
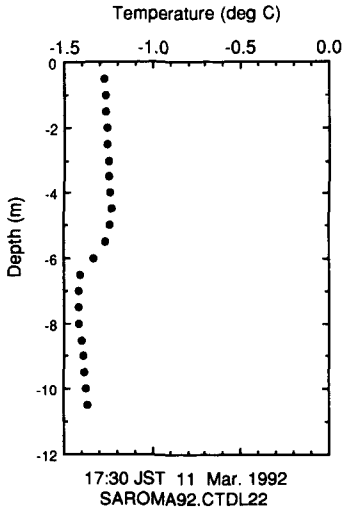
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SAROMA92.CTDL20



17:33 JST 11 Mar. 1992
SAROMA92.CTDL21



17:33 JST 11 Mar. 1992
SAROMA92.CTDL21



Bursting Interval : 20 min
 No. of samples for averaging : 10
 Sampling Interval : 1 sec
 Start Time : 12:00 19-Dec-1991
 Finish Time : 12:00 11-Mar-1992

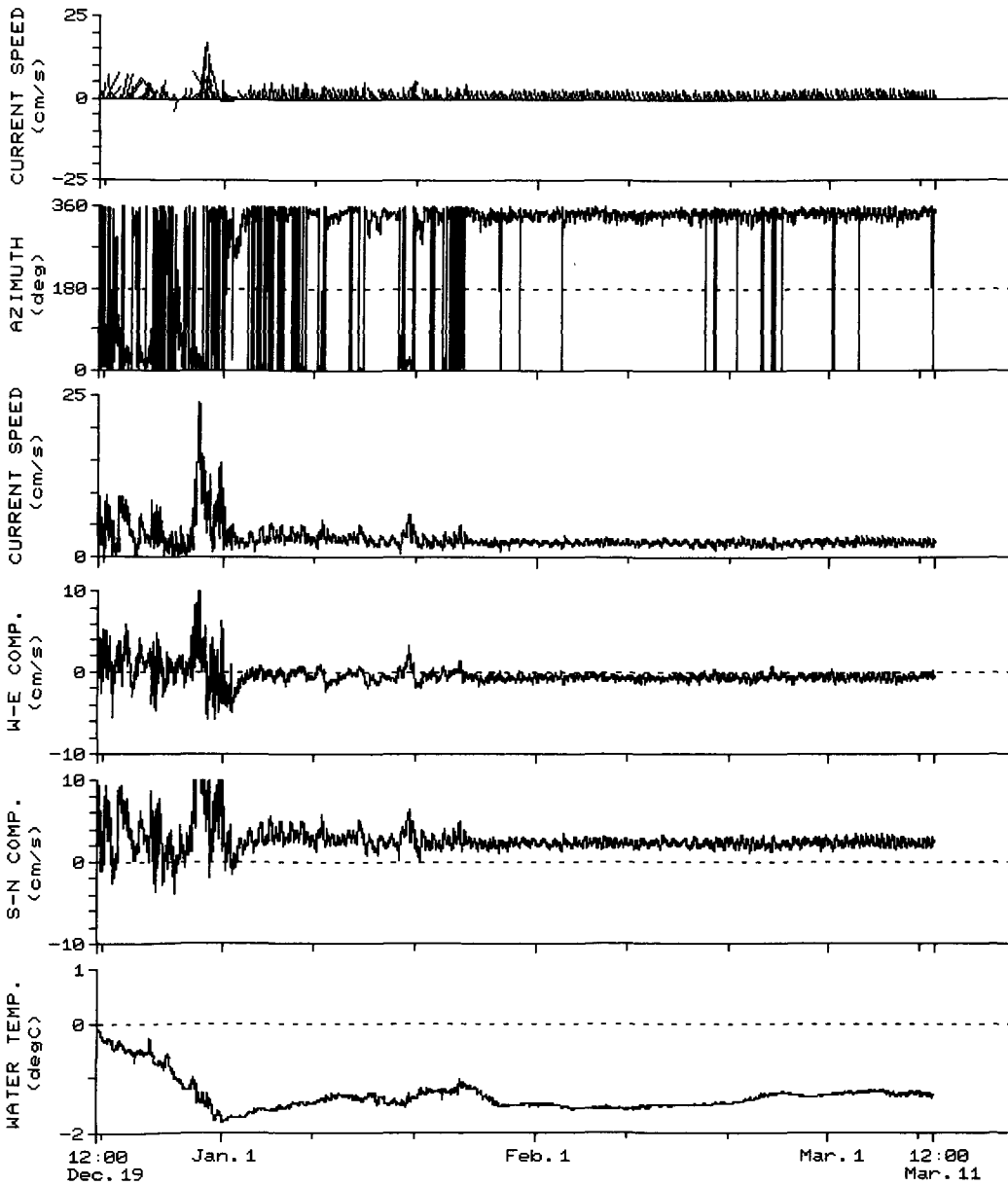


Fig. 15 Long-term current speed and direction, west-east and south-north components, and water temperature obtained near the ice station ((F) in Fig. 7) during the period between 19 December 1991 and 11 March 1992

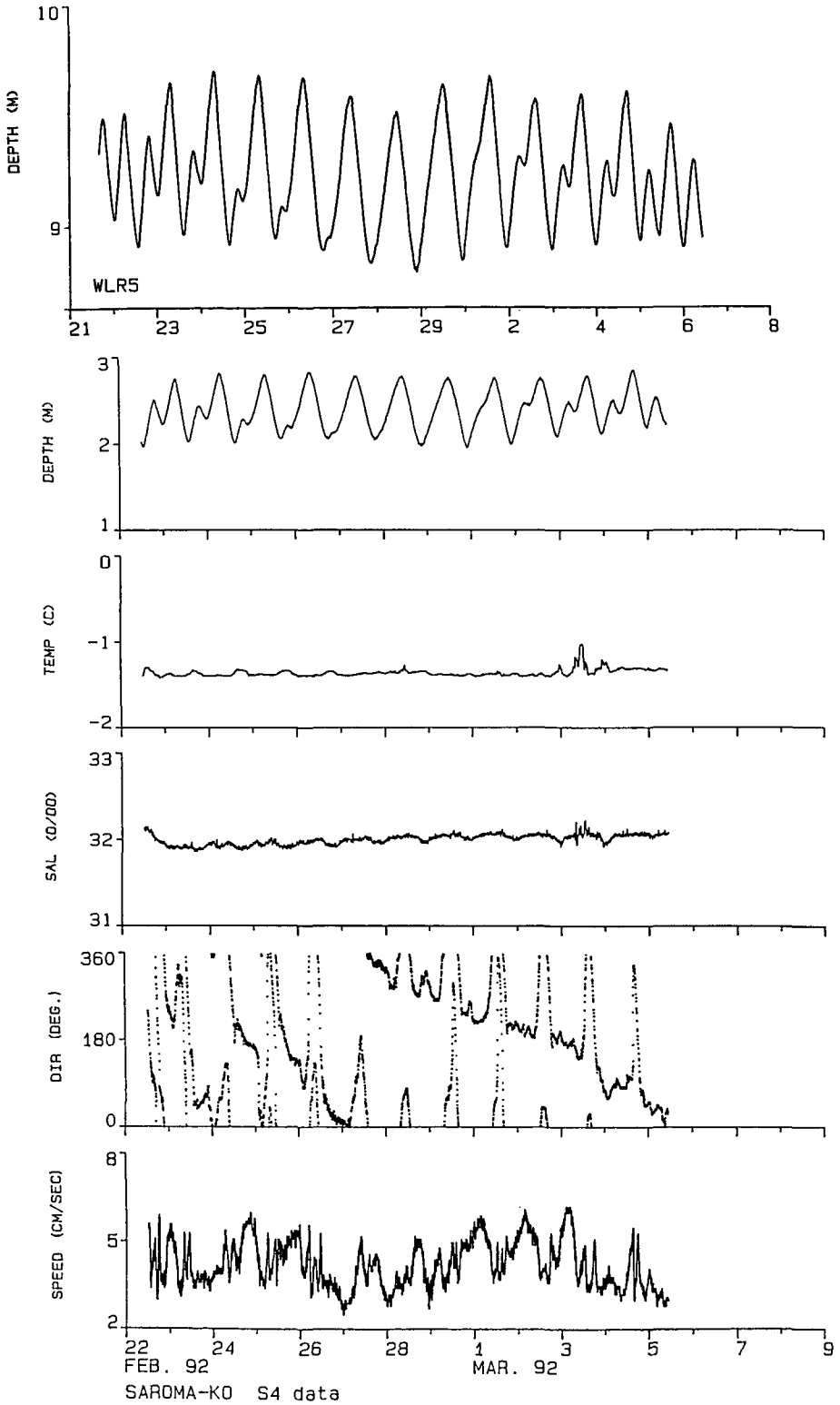


Fig. 16 Water levels, water temperature, salinity, current speed and direction obtained at the ice station ((G) in Fig. 7) during the period between 22 February and 6 March 1992

Table 1 and (G) in Fig. 7). The maximum distance between any two physical measurements was less than 200 m. Shown in Fig. 16 are time series of water level collected with the WLR-5 in the uppermost frame in the figure, water temperature, salinity, current speed and direction collected with the S4 moored at depth 2 m below the ice bottom. Figure 16 shows that the tidal range is quite small, with a maximum of 0.8 m, and that the tidal cycle seems to vary over a two week period from a typically semi-diurnal tide to a completely diurnal signal. Time series of water temperature and salinity show small variations with time, which seem to be related to tidal variabilities. The average current speed is very small at 4.2 cm/s and exhibits very little variability in time. Regular sudden changes in direction appear to be synchronous with the diurnal high tide. It is also shown that the transition to low-frequency current direction changes with periods greater than 48 hours seems to be characterized by a slow steady anticlockwise rotation. This phenomenon suggests that the general circulation pattern in the sampling region was constantly changing during the sampling period.

5. Under-ice momentum, heat and salt fluxes in the pool at the ice station

A three-dimensional ultrasonic current meter (Minilab Model SD-10, Union Engineering Ltd.) and a conductivity-temperature meter (Model RD-CT, Union Engineering Ltd.) were installed on a frame fixed to the ice at the corner of the pool to measure turbulent fluxes of momentum, heat, and salt in the oceanic boundary layer under the sea ice during the period between 26 and 28 February 1992 (4.2. in Table 1 and (H) in Fig. 7). The distance between the sensor probes and the bottom of the ice was 70 cm. The flow between about 270° and 360° is the one passing under the pool, while the flow between about 0° and 270° is passing under some undisturbed smooth flat ice in the lagoon. It is shown in Fig. 17 that the current direction is between 64° and 97° during the approximate one-day period. Measurements of turbulent fluxes were made during the period when the flow was from undisturbed ice. The mean current speed is small and varies between 3.6 and 5.1 cm/s. It is shown in Fig. 18 that the sudden change in salinity appears to be synchronous with that in current direction. A summary of turbulence measurements is listed in Table 5. Turbulence intensities, σ_1/U , σ_2/U and σ_3/U in the table were defined as down-flow, cross-flow and vertical-flow components, respectively. The friction velocity, drag coefficient, sensible heat, heat flux coefficient, and vertical eddy viscosity were described as u^* , C_1 , H , C_h and K_z , respectively. Time series of friction velocity and sensible heat are shown in Fig. 19. The friction velocity is small and varies between 0.05 and 0.18 cm/s during the one-day period. The sensible heat varies between 20.4 and 88.7 W/m², and the pattern of change in sensible heat appears to be related to that in current direction in Fig. 17. A time series of vertical eddy viscosity is shown in Fig. 20. The vertical eddy viscosity is

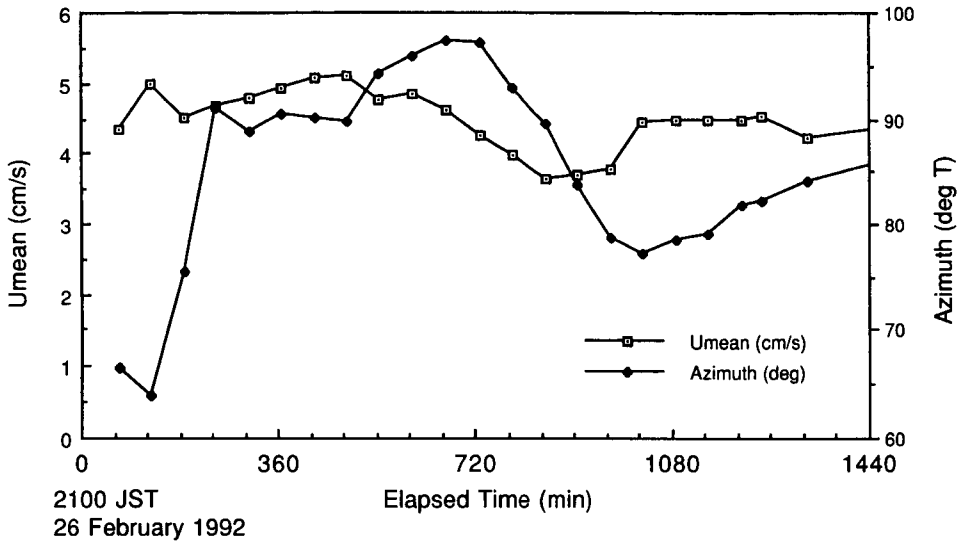


Fig. 17 Mean current speed and direction obtained at the pool at the ice station ((H) in Fig. 7) during the period between 26 and 28 February 1992

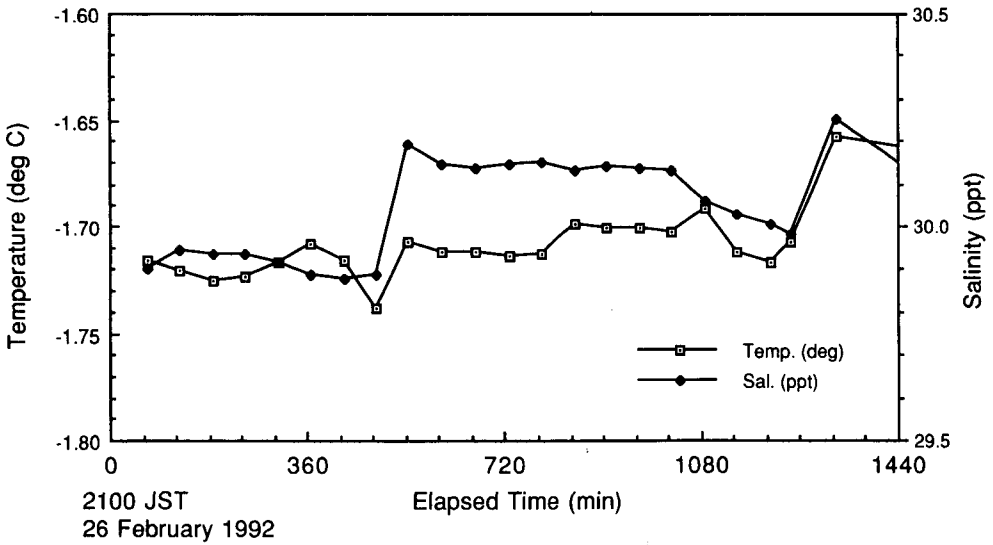


Fig. 18 Temperature and salinity obtained at the pool at the ice station ((H) in Fig. 7) during the period between 26 and 28 February 1992

defined here as ku^*z , where k is the von Karman constant, 0.4, and z is the depth. The vertical eddy viscosity varies between 1.9 and 7.7 cm^2/s during the one-day period.

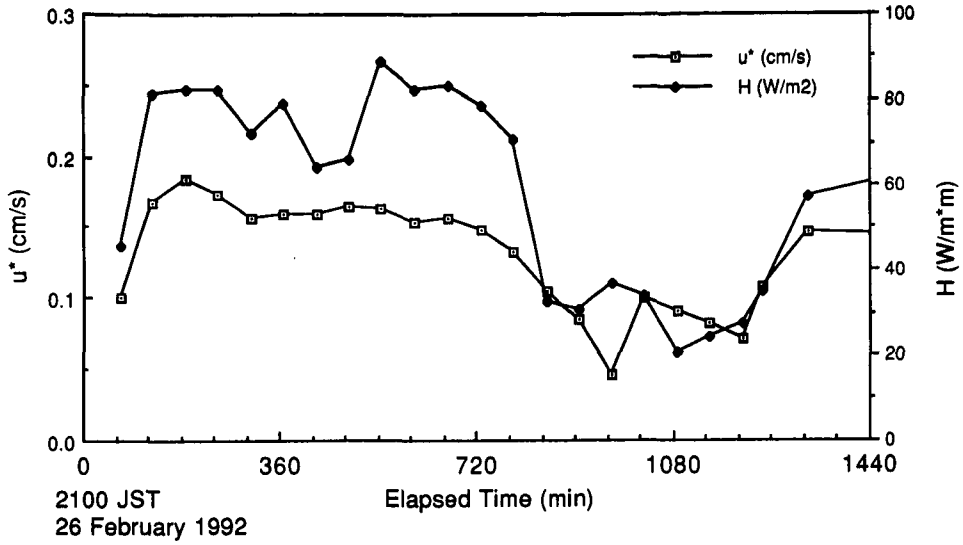


Fig. 19 Friction velocity and heat flux obtained at the pool at the ice station ((H) in Fig. 7) during the period between 26 and 28 February 1992

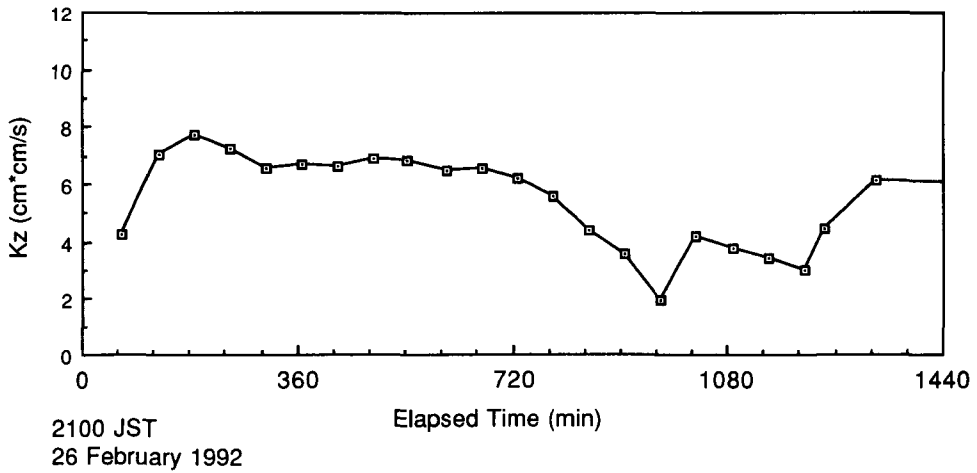


Fig. 20 Vertical eddy viscosity obtained at the pool at the ice station ((H) in Fig. 7) during the period between 26 and 28 February 1992

Table 5 Current speed and azimuth, temperature, salinity, turbulence intensity, friction velocity, drag coefficient, heat flux, heat flux coefficient and vertical eddy viscosity obtained at the ice station during the period between 26 and 28 February 1992.

Run No	Date	Time (JST)	Current		Temperature (°C)	Salinity (ppt)	Turbulence Intensity			u* (cm/s)	C _d	H (W/m ²)	C _n	K _z (cm ² /s)
			Speed (cm/s)	Azimuth (deg. T)			$\frac{\sigma_1}{U}$	$\frac{\sigma_2}{U}$	$\frac{\sigma_3}{U}$					
1	02/26	22:00 - 22:15	4.3	67	-1.716	29.904	0.111	0.102	0.035	0.10	0.00054	45.70	0.00308	4.23
2		23:00 - 23:15	5.0	64	-1.721	29.946	0.083	0.079	0.034	0.17	0.00114	81.18	0.00461	7.05
3	02/27	00:00 - 00:15	4.5	76	-1.725	29.933	0.099	0.061	0.036	0.18	0.00169	82.45	0.00489	7.73
4		01:00 - 01:15	4.7	91	-1.724	29.934	0.078	0.064	0.036	0.17	0.00138	82.41	0.00479	7.26
5		02:00 - 02:15	4.8	89	-1.717	29.914	0.075	0.058	0.032	0.16	0.00108	72.14	0.00437	6.59
6		03:00 - 03:15	4.9	90	-1.708	29.888	0.073	0.057	0.032	0.16	0.00105	78.85	0.00508	6.71
7		04:00 - 04:15	5.1	90	-1.716	29.878	0.071	0.054	0.031	0.16	0.00099	64.34	0.00362	6.65
8		05:00 - 05:15	5.1	90	-1.739	29.888	0.074	0.056	0.031	0.17	0.00106	66.19	0.00296	6.93
9		06:00 - 06:08	4.8	94	-1.707	30.189	0.074	0.058	0.036	0.16	0.00118	88.65	0.00768	6.85
10		07:00 - 07:15	4.8	96	-1.712	30.147	0.071	0.056	0.035	0.15	0.00102	82.20	0.00624	6.47
11		08:00 - 08:15	4.6	97	-1.712	30.135	0.073	0.062	0.035	0.16	0.00115	83.41	0.00658	6.55
12		09:00 - 09:15	4.3	97	-1.714	30.145	0.079	0.066	0.036	0.15	0.00122	78.54	0.00663	6.24
13		10:00 - 10:15	4.0	93	-1.714	30.152	0.095	0.082	0.039	0.13	0.00113	70.67	0.00645	5.59
14		11:00 - 11:15	3.6	90	-1.699	30.131	0.109	0.080	0.037	0.10	0.00083	32.40	0.00401	4.40
15		12:00 - 12:15	3.7	84	-1.701	30.141	0.101	0.068	0.034	0.08	0.00053	30.48	0.00365	3.56
16		13:00 - 13:15	3.8	79	-1.701	30.136	0.116	0.081	0.035	0.05	0.00015	36.58	0.00420	1.93
17		14:00 - 14:15	4.5	77	-1.703	30.133	0.099	0.054	0.028	0.10	0.00051	34.17	0.00325	4.22
18		15:00 - 15:15	4.5	79	-1.692	30.062	0.096	0.056	0.027	0.09	0.00041	20.42	0.00220	3.78
19		16:00 - 16:15	4.5	79	-1.712	30.030	0.093	0.059	0.028	0.08	0.00033	24.07	0.00179	3.45
20		17:00 - 17:15	4.5	82	-1.717	30.004	0.090	0.058	0.029	0.07	0.00025	27.34	0.00187	2.98
21		17:35 - 17:50	4.6	82	-1.707	29.981	0.092	0.058	0.029	0.11	0.00055	34.83	0.00263	4.48
22		19:00 - 19:15	4.2	84	-1.658	30.253	0.097	0.064	0.032	0.15	0.00121	57.28	0.00399	6.15
23	02/28	11:30 - 11:45	5.1	98	-1.702	29.334	0.074	0.063	0.034	0.13	0.00063	84.68	0.00396	5.37
24		13:35 - 13:50	4.6	93	-1.726	29.333	0.122	0.076	0.053	0.24	0.00271	83.64	0.00348	10.09
25		14:40 - 14:55	4.6	94	-1.721	29.352	0.086	0.074	0.034	0.13	0.00075	66.71	0.00295	5.28

JST: Japanese Standard Time

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References

- Legendre, L. (1993) The Canadian SARES projects within the framework of the Canada-Japan complementarity study. *Proc. 8th Okhotsk Sea & Sea Ice*, Mombetsu, Hokkaido, Japan, 1-5 February 1993, 335-336.
- Shirasawa, K. (1993) Variations in atmospheric conditions and ice formations in Lake Saroma. *Bull. Plankton Soc. Japan*, **39**, 2, 156-158.