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OCEAN CIRCULATION AND METEOROLOGY OFF THE GEORGIA COAST

Part 1. Real-Time Telemetry System for Data Collection

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Introduction

This technical report describes the design, operation, and use in oceanographic research of a fixed platform located about 17 km offshore of Savannah, Georgia (Fig. 1). The platform structure consists of the Savannah Navigational Light Tower (SNLT), operated and maintained by the U.S. Coast Guard. The dredged channel for the Savannah River entrance runs west-northwest from SNLT, and the major axes of the tidal current ellipses lie approximately along this bearing. Total water depth is 16m at mean low water, and the tidal range at SNLT varies between 2 and 3m--the largest range on the U. S. Atlantic coast south of Cape Cod.

The area around SNLT is typical of the nearshore region from Cape Romain, South Carolina to Fernandina Beach, Florida. The coastline is indented with tidal inlets spaced 10 to 20km apart, each of which feed an extensive network of interconnected sounds and waterways. Major rivers such as the Pee Dee, Savannah, and Altamaha discharge fresh water through some of the inlets. Others are little more than pocket estuaries where freshwater input is almost zero. The large tidal range and the extensive network of shallow sounds and salt marshes act together to form a 10 to 20km wide band of turbid and low salinity water along the coast. The low salinity water forms a frontal zone along the inner shelf, which greatly influences circulation in the region (Blanton, 1980, 1981; Blanton and Atkinson, 1983). SNLT is located within this regime.

This report will describe the present configuration of sensors and the data acquisition system for SNLT. The system encodes data which are then transmitted via radio to Skidaway Institute of Oceanography. A computer located there records data on disk with back-up to tape. A review of software and data editing procedures is included in this report.

Data from SNLT have greatly increased our understanding of circulation processes in the inner continental shelf off Georgia. This report will include some detailed analyses of oceanographic and meteorological data acquired at SNLT. We will summarize these analyses by describing monthly summaries of data, seasonal differences in wind-generated currents off Georgia, and examples of the use of such data. A description of SNLT and the telemetry system has been previously published in less detailed format (Schwing et al., 1983a).

History of SNLT

SNLT is one of several permanent platforms along the U.S. Atlantic coast that replaced U.S. Coast Guard Lightships in the decade of the 1960s. They serve as navigational beacons for ships and are usually unattended. SNLT has a large cabin located about 20m above the water (Figs. 2, 3) which houses power-generating equipment that operates the navigational light and fog horn.

Dr. D.W. Hayes, an oceanographer at the Savannah River Laboratory, E.I. Dupont de Nemours, Aiken, S.C., originally conceived and initiated the concept that SNLT would serve as a valuable monitoring platform for meteorological and oceanographic information off the coast. The tower is well-built and likely to survive the worst of storms. It also has ample electrical power to operate a wide variety of sensors. At Dr. Hayes' suggestion, the U.S. Atomic Energy Commission (now Department of Energy) signed an interagency agreement with the U.S. Coast Guard in 1975 to allow contractors access to the tower and to permit the deployment of oceanographic and meteorological sensors. The Savannah River Laboratory, under Dr. Hayes' direction, operated the sensors on SNLT from 1976 through 1978. Two data reports issued by Skidaway Institute of Oceanography summarize the data obtained during that period (Blanton et al., 1978, 1980).

In 1979, the Department of Energy transferred the responsibility to acquire data at SNLT from Savannah River Laboratory to Skidaway Institute of Oceanography. At that time, the data acquisition system was changed from a magnetic tape data-storage system located in the cabin of SNLT to a telemetering system that broadcasts data to a computer located at the Institute. From 1979 to the present, SNLT has been operated in this configuration to support several large oceanographic experiments sponsored by the Department of Energy.

The cabin located at the top of the tower houses the sensor power supplies, the microprocessor, and the radio transmitter (Fig. 4). The main power supply comes from an electrical generator, operated by the Coast Guard, which is backed up for short periods by a bank of batteries. Details of this system will be covered in the next section.

The present data acquisition system ties together a suite of meteorological and oceanographic sensors (Figs. 3, 4). Wind velocity, air and cabin temperature, and barometric pressure are measured at the top of the tower. The wind sensor is located 30 meters above the water surface. Below water, sensors are deployed to measure ocean currents, temperature, and salinity at three levels--1, 8, and 13m off the bottom--and water level (tides). We have had varying success with this deployment. Above-water sensors usually operate over long periods of time, while underwater sensors frequently suffer from the effects of storm damage and fishermen. Our salinity sensors have been largely unsuccessful, while underwater temperature and water level sensors have yielded long data records. Figure 5 and Table 1 summarize the data return of the 1977 through 1981 period.

Instrumentation

The majority of the equipment used in our data collection efforts is located at SNLT, with data processing and storage facilities situated at Skidaway Institute of Oceanography (SKIO). At present, instrumentation on SNLT records wind, barometer, temperature, current, salinity, and sea level information. The location of all sensors is shown in Figure 3. Table 2 summarizes instrument models used.[1]

Each sensor (Fig. 3) is connected by electrical cable to an associated deck unit located in the upper cabin of SNLT. The deck units (Fig. 4) contain electronics which adapt the sensor's voltage output signal for input to the microprocessor. The microprocessor, custom manufactured by Gary Howell, Consulting Engineer, Gainesville, FL, includes a small computer which produces a coded data stream. This data stream is transmitted by a VHF transmitter to SKIO at a frequency of 164.35 MHz. The transmitter, microprocessor, and deck units are all powered from a 110VAC wall outlet converted to 56VDC. A pack of batteries is continuously recharged, and provides a backup power source to the system should the generator powering the AC electrical system fail.

We have had varying amounts of success with each sensor unit. In general, meteorological sensors have been fairly reliable over long periods of time. One exception is the WeatherMeasure barometer, which has required frequent recalibration. With the exception of the temperature probes, underwater sensors have not been nearly as reliable. Underwater pressure sensors have required regular recalibration. Thermisters have been bent or broken by snagged fishing lines, and have to be protected with pvc casing.

The stainless steel components on Marsh-McBirney current sensors have rapidly electrolyzed, rendering the sensor useless, often within a month after deployment. Beckman conductivity cells usually have flooded shortly after deployment, and salinity data have consisted only of sporadically short records. Biological fouling of sensors has also created problems. Monthly cleaning has been necessary to keep many units in operation. Some sensors have also been treated with antifoulant paint.

The reliability of each deck unit also varied, often due to the complexity of the circuitry. One example was the Marsh-McBirney units, which suffered from electrical "cross-talk" that scrambled x and y current components. This problem has been solved.

In summary, our wind and temperature units were the most reliable. The barometer worked well, but we had great difficulty both in our own calibrations and proper use of factory calibration results. The underwater pressure sensor worked well with periodic recalibration for use as a tide and wave gauge. The Marsh-McBirney current meter units are relatively inexpensive and give accurate readings. We have spent a great

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[1]Use of equipment trade names in this report is for identification only and does not imply the authors' endorsement or criticism beyond the context of the information presented herein.

deal of time in calibrating the current sensors and insulating the x-y components from electrical interference. Considerable effort has been devoted to the research and development of these units, and we will continue to use them for the foreseeable future. The conductivity units experienced severe flooding and instrument drift problems. In the future, we are planning to use a different type of conductivity sensor, manufactured by Sea Bird Electronics.

The VHF transmission from SNLT is received at SKIO by a Repco model 810-055 mono-frequency receiver which interfaces with a Hewlett-Packard 9825 computer. The computer samples the data stream on the hour, and data are subsequently recorded on disk as described in a later section (Figs. 6, 7).

Calibration, Operation, and Analysis

Prior to any field installations, all instrumentation was calibrated by factory and SKIO personnel. After each instrument was individually calibrated, the entire system was assembled and tested in the lab under constant environmental conditions. A regression analysis was performed to compare actual and sensor-measured parameters, and calibration curves were established to adjust the various sensor readouts where necessary (Fig. 8, Table 3).

The most detailed calibration involved the current sensors. A flume was constructed at SKIO which could produce a maximum current of 55 cm/s with an accuracy +/- 1 cm/s. Each sensor was calibrated in the flume at three different current speeds. At each speed, sensors were rotated to various compass headings to simulate a current flowing in different directions, and x and y components were recorded in each of 16 compass orientations to test directional accuracy (Fig. 9). In addition, measured current speed was determined at each orientation, and variability in speed as a function of direction analyzed (Fig. 10, Table 4).

Conductivity units were calibrated in seawater solutions of three different salinities. Simple linear regression curves were fit to measured values for each sensor (Fig. 8c). Similarly, temperature sensors were calibrated in constant temperature baths set to 0°C and 45°C, and calibration tables were set (Fig. 8b). In most cases, instrument readout matched the calibration conditions and mathematical adjustment of the measured values was unnecessary. Non-linearity was considered to be negligible.

Although we do not have a device to test our pressure sensors at different atmospheric pressures, the barometer and underwater pressure transducer were temporarily installed at the National Weather Service at Travis Field (Savannah) to record atmospheric pressure. These data were compared to values obtained by the NWS instruments, and regression analyses were made for each unit deployed (Fig. 8a).

Instrumentation was periodically checked for accuracy during operation at SNLT as well. Collected data were checked statistically for reasonable mean and variance values. Data were plotted (detailed in later section) to visually inspect files for suspicious values. The instantaneous data output was also compared to actual observations made while personnel were working on or near SNLT.

Operation. A summary of dates when instrumentation was operational on SNLT is given in Table 1. Much of the data have been catalogued in other technical reports (Blanton et al., 1978, 1980). During normal operation, the data stream is sampled on the hour for 150 seconds. Flow charts for data collection, storage, and processing are included (Figs. 6, 7). The output from the pressure transducer is 2 values/second to provide sufficient data for wave analysis. All other sensors output 1 value/second. At least 96 of the 150 seconds must be sampled to make a statistically valid reading possible. Otherwise, the loop is reinitiated and the data stream sampled again. A mean and standard deviation of the digitally coded voltages are calculated for each sensor and recorded on disk and tape, along with maximum and minimum values for each channel. At 0900 and 1500 EST, a summary is printed out in engineering units for the NWS and other agencies, containing air and water temperature, wind speed and direction, and barometric pressure means for that hour (Fig. 11). Significant wave height is calculated and also printed, along with a spectrum of wave variance. Additional printouts of recorded data or non-hourly sampling of the data stream are possible using the appropriate software, discussed elsewhere in this report.

Once data are properly collected from the data stream, they are stored in a standard NODC (National Oceanographic Data Center) format. Major editing of the data is done from this form. Data can be listed out in several ways, including weekly (Fig. 12; Appendix A) and monthly plots (Appendix B) and can be output in either voltage or engineering units. From these, missing data can be interpolated and inserted, and unreasonable values adjusted. The final edited data are saved on disk at SKIO. Time series of a finite time-span are converted to engineering units, reformatted into a packed BCD file, and transferred to and saved on tape on the Cyber computer at either the University of Georgia or the Georgia Institute of Technology. The BCD files are used for subsequent analyses. A flow chart showing the processing of SNLT data at SKIO is outlined in Figures 6 and 13.

All the software used in collecting, storing, editing, and the preliminary analysis of data has been specifically written for the various Hewlett-Packard 9825 computers and peripheral devices available at SKIO (Table 5).

After discrete time series of the tower data have been transferred to the Cyber, the data undergo a standard reduction and interpretation

(Fig. 13). A detailed analysis is performed using standard time series analysis routines. To remove "noise" from the series, each series is low-passed with a Lanczos filter with a quarter-power cutoff of three hours. The filter allows the integrity of any tidal signal to remain in the series while removing signals with a period of three hours or less. A 40-hour low-passed series is also generated with a Lanczos-squared filter for further analysis of subtidal events. The filter cutoffs for these filters are presented in Figure 14. The filter specifications are summarized in Table 6. Many of the series tend to contain a very low frequency trend extending through the entire series, thus causing potential problems with aliasing or excessive "red noise" on the lower end of the spectrum. Because of this, data collected are usually detrended and tapered with a cosine filter before analysis (Bendat and Piersol, 1971).

In addition to these various smoothing techniques, data may undergo other transformations. Vectors, normally recorded in an east(x) and north(y) oceanographic convention, may be rotated relative to the shoreline or local isobaths. Difference series may also be created to examine vertical gradients of temperature and salinity. Some series were bandpassed to better define events at a specific frequency. This was done for wind series to examine the daily sea breeze and its impact on the nearshore current (Fig. 15).

A standard statistical summary is given for all time series, giving the series mean, standard deviation, and range. Time series plots of all data are generated. See Appendix A for plots of SNLT data from 1980 and 1981.

Time series analysis. Spectral analysis is performed on the 3-hour and 40-hour low-passed time series using the techniques described by Mooers (1973). Tidal and diurnal events are examined in the 3-hour series, while meteorological and other important low-frequency events are defined from the 40-hour data sets.

In either case, a software package of FORTRAN programs is available to spectrally analyze time series (Fig. 13). This package (FESTSA, Fast and EaSy Time Series Analysis) performs statistical operations on time series and produces a documented set of files. The A and B Fourier coefficients of each series are calculated with a Fourier transform and stored for further computations. For scalar series (i.e., salinity, temperature, pressure), these coefficients are used to derive spectral densities for each series, and covariance, phase, and coherence spectra between any two scalars (e.g. Fig. 16). Vectors (wind, current) are further analyzed in two ways. First, x and y components of a vector are cross-correlated to produce cospectra, phase, and coherence spectra between the components, as well as a principle axis for the vector and clockwise and counterclockwise rotary spectra with the associated rotary statistics (Table 7). Secondly, two vectors can also be cross-correlated with a Fast Fourier Transform to produce cartesian and rotary correlations (Table 7). Correlations between a vector and scalar, such as wind stress and sea level, can also be made to identify the vector angle which produces the best correlation with a scalar at different frequencies (Fig. 17). The example presented in Figure 17 shows that the wind and current were most highly correlated when the wind was blowing in an alongshore direction (northeast or southwest) at frequencies less than 0.25 cpd, and were approximately in phase, with the wind leading the current by about 20° (13 hours) at 0.1 cpd. All spectral output files are saved for subsequent plotting and comparison.

SNLT Data Summary

An intimate relationship exists between the passage of meteorological fronts over the surface of the ocean and the oceanographic response of the water column below.

Variations in SNLT data on the order of four to seven days are associated with meteorological frontal passages through the SAB region (Lee and Brooks, 1979; Blanton and Maddox, 1980; Schwing et al., 1983b). The effects of frontal passages are particularly evident during spring months, as seen in the typical weekly data summary of 19-25 April 1981 (Fig. 12). On the 20th, a low pressure system moved through the area, as evidenced by a drop in barometric pressure. Winds associated with the low rapidly increased in speed and rotated clockwise, blowing strongly to the southwest on the 21st. Currents responded within a few hours to the rotating winds. Superimposed on the tidal current of the 21st and 22nd was a net southerly wind-driven flow. Prior to this, the net current was to the northeast in response to the northeastward wind stress.

Other parameters measured at SNLT were also influenced by the frontal passage. Although the large tidal range makes it difficult to see, net sea level at SNLT rose in response to the onshore blowing wind. Salinity increased nearly 2 ppt, as the prevailing northeasterlies trapped higher salinity water in the nearshore zone, and prevented low salinity estuarine water from diluting this water mass. Air temperature dropped by several degrees during the frontal passage, and surface water temperature responded in a similar fashion. The water column on the 19th and 20th was thermally stratified, but became well-mixed by strong winds on the 21st. Because of this, temperatures at lower depths increased slightly.

On the 22nd, barometric pressure increased and wind speeds decreased. By the 23rd, winds had shifted back around to the north, and currents quickly responded. Other parameters had also returned to values similar to those measured prior to the frontal passage. This regime was short-lived, however, as winds again increased and rotated clockwise, blowing southeasterly in response to another low pressure system arriving late on the 24th.

These SNLT data show that meteorological frontal passages dominate the sub-tidal oceanographic and meteorological regime of the nearshore region of the SAB. Frontal passages on the 21st and again on the 25th match well with the four- to seven-day cycle described by Lee and Brooks (1979) and Blanton and Maddox (1980). A four-day period is typical of spring and fall conditions, while data collected during summer show a slightly longer cyclic pattern (Schwing et al., 1983b).

Future Development for SNLT

Operations involving SNLT have undergone periodic modifications and will continue to do so. Since the collection of the data described in this report, an additional wind sensor and additional air thermisters have been added to observe vertical gradients in wind and temperature. Cable connections near the water (Fig. 3) have been removed, and cables strengthened to prevent damage due to water intrusion and wear. Electronics and power supplies at SNLT have been modified and replaced to reduce the possibility of failure there. At present, SNLT is being operated primarily as a meteorological station, providing the information shown in Figure 11.

New experiments are also using information from SNLT. These include the collection of shipboard data near SNLT, as well as implementation of new and different equipment on the tower. Conductivity measurements have been a continuing problem. New sensors manufactured by Sea Bird Electronics have been acquired and will be deployed on SNLT in the Spring of 1984. These sensors will be part of a conductivity-temperature-density chain that will measure these parameters at six different depths and store the information on a Sea Data Corporation data logger. If preliminary experiments are successful, these sensors will be merged into the data acquisition system described above. Additional current data will be recorded by a pair of General Oceanics current meters moored nearby. The data acquisition system is also flexible enough to consider the implementation of other sensors such as those which measure solar radiation and water turbidity. If the need arises, sensors such as these can be interfaced into the system for "real-time" telemetry to shore.

Another experiment to be installed in association with SNLT involves the deployment of a series of bottom mounted CTD data loggers, also manufactured by Sea Data. Current meters will also be deployed nearby. These instruments will be installed along a line perpendicular to shore using the tower as the seaward endpoint (Fig. 18). Information from these locations, along with meteorological and CTD data from SNLT, will help describe the density structure of the nearshore region of the SAB.

Although great efforts are taken to keep equipment working continuously, SNLT is currently operated on an intermittent basis during times of oceanographic field experiments. A single deployment of equipment at SNLT seldom works unattended for more than a few months due to the severe environmental degradation of the instrumentation. It obviously would be better to have the tower in more continuous operation. We plan to achieve this goal by acquiring complete redundancy for all the electronic equipment in the tower cabin as well as for all sensors and cables. SNLT becomes idle over long periods due to a lack of time and funds necessary to replace and reinstall equipment that has failed or has been destroyed by severe weather or gradual environmental wear.

The regional weather offices of the National Weather Service access our up-to-the-hour data from SNLT as long as the equipment remains operational. The NWS offices use inexpensive computer terminals and a telephone connection to achieve hourly reports in the format shown in Figure 11. These updated reports play an important role in regional weather forecasting, particularly during times of severe storm and hurricane conditions. Obviously, more continuous operation of the equipment on SNLT would benefit anyone requiring over-the-ocean weather data in their operations. A proposal has been submitted to NWS for funds necessary to keep SNLT in continuous operation, at least as a meteorological observation platform. In the interim, data will continue to be collected and archived as frequently as possible and used in conjunction with ongoing research. Existing data, such as those described in this report, will be used as an indicator of seasonal and annual trends in the hydrography of the nearshore region of the South Atlantic Bight.

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Table 1

Period		No. Hourly Values
1	17 Feb 1977 - 17 May 1977	2122
2	26 May 1977 - 21 July 1977	1345
3	27 July 1977 - 20 Sept 1977	1321
4	3 Apr 1980 - 22 May 1980	3332
5	7 Mar 1981 - 22 May 1981	1844
6	20 July 1981 - 23 Oct 1981	2291
-	12 Nov 1982 - 23 Dec 1982	-
-	5 Nov 1983 - 21 Jan 1984	-

Table 2

Parameter	Sensor	Range	Accuracy
wind	MRI 1074-2 wind sensor	0-55 m/s	± 0.5 m/s, 4°
barometric pressure	WeatherMeasure B242 analog barometer sensor	950-1050 mb	± 1 mb
temperature	Analog Devices AC2626 temperature probe	-10-40°	± 0.6°C
	*YSI-44032 precision thermometer	- 5-35°C	± 0.15°C
underwater pressure	Sensotec TJE/727 pressure transducer	1200-1700 mb	± 5 cm
	*Paroscientific 245-A "digi-quartz" pressure sensor	0-20 m	± 0.4 cm
current	Marsh-McBirney 511 electromagnetic water current meter	0-100 cm/s	± 2 cm/s
	*General Oceanics 6011 Niskin winged current meter	0-225 cm/s, 2°	± 1 cm/s, 2°
conductivity	Beckman SME-3-111A-KFX24-Y15-Z300 electrodeless conductivity cell	0-60 mmho/cm	± 1.2 mmho/cm
	*Sea Bird Electronics SBE-4 conductivity meter	0-70 mmho/cm	± 0.01 mmho/cm

*Refers to sensors scheduled for future deployment on SNLT.

Table 3

CALIBRATION FILE cal009

CHANNEL	UNIT	SENSOR	m	C	STAT	MIN	MAX
1	mb	Sub-surface pres.	344.7385	-0.0000	1	-1.2688	1722.8507
2	mmhos/cm	Conductivity L1B	11.8750	0.3420	1	-59.0330	59.6880
3	mmhos/cm	Conductivity L2T	11.9990	-0.0960	1	-60.0617	59.8697
4	mmhos/cm	Conductivity L3T	12.4500	-1.2810	1	-63.5036	50.9385
5	C	Temp 1 L1A	10.0000	-0.0000	1	-49.9756	49.9755
6	C	Temp 2 L1B	10.0000	-0.0000	1	-49.9756	49.9756
7	C	Temp 3 L2A	10.0000	-0.0000	1	-49.9756	49.9756
8	C	Temp 4 L2B	10.0000	-0.0000	1	-49.9756	49.9755
9	C	Temp 5 L3A	10.0000	-0.0000	1	-49.9756	49.9755
10	C	Temp 6 L3B	10.0000	-0.0000	1	-49.9756	49.9756
11	C	7 Air Temp	10.0000	-0.0000	1	-49.9756	49.9756
12	C	8 Cabin Temp	10.0000	-0.0000	1	-49.9756	49.9756
13	C	9 Box Temp	10.0000	-0.0000	0	-49.9756	49.9755
14	volts	Battery Status	10.0000	-0.0000	1	-49.9756	49.9756
15	cm/s	Current X L1 B S364	100.0000	-0.0000	1	-499.7558	499.7558
16	cm/s	Current Y L1 B	100.0000	-0.0000	1	-499.7558	499.7558
17	cm/s	Current X L2 M S199	100.0000	-0.0000	1	-499.7558	499.7558
18	cm/s	Current Y L2 M	100.0000	-0.0000	1	-499.7558	499.7558
19	cm/s	Current X L3 T S404	100.0000	-0.0000	1	-499.7558	499.7558
20	cm/s	Current Y L3 T	100.0000	-0.0000	1	-499.7558	499.7558
21	m/sec	Wind 1 Speed	11.1800	0.0000	1	-0.0410	55.8727
22		Wind 1 Direction	135.0000	-0.0000	1	-0.4945	674.6703
23	mb	Barometer	100.0000	950.0000	1	949.6337	1050.7326
24	volts	Generator	1.0000	-0.0000	1	-5.0000	5.0024
25			0.0000	0.0000	0	0.0000	0.0000
26			0.0000	0.0000	0	0.0000	0.0000
27			0.0000	0.0000	0	0.0000	0.0000
28			0.0000	0.0000	0	0.0000	0.0000
29			0.0000	0.0000	0	0.0000	0.0000
30			0.0000	0.0000	0	0.0000	0.0000
31			0.0000	0.0000	0	0.0000	0.0000
32			0.0000	0.0000	0	0.0000	0.0000

TABLE 4

Sensor S364   Box # 1   Date 7-28-82

	3VDC		70 mV		4VDC	110 mV		5VDC	150 mV
Deg.	X	Y	Sum	X	Y	Sum	X	Y	Sum
0	0	30	30.0	- 1	37	37.0	- 0.5	44	44.0
30	-14	26	29.5	-19	33	38.1			
45	-21	22	30.4	-27	28	38.9	-31	33	45.3
60	-26.5	16.5	31.2						
90	-30	0	30.0	-37.5	0	37.5	-44	1	44.0
120	-26.5	-15	30.5						
135	-22	-21.5	30.8	-28.5	-27.5	39.6	-33.5	-31.5	46.0
150	-16.5	-26.5	31.2						
180	- 0.5	-30	30.0	- 0.5	-38	38.0	0	-45	45.0
210	14	-28	31.3						
225	21	-23	31.1	27.5	-29.5	40.3	32	-34	46.7
240	25	-17	30.2						
270	28.5	- 0.5	28.5	37	0	37.0	43	0	43.0
300	26	13.5	29.3						
315	21.5	20.5	29.7	28	26.5	38.6	33	31.5	45.6
330	16	26	30.5						
360	0	29	29.0	0	37.5	37.5	0	44	44.0

SAMPLE STATS:	3VDC	SAMPLE STATS:	4VDC	SAMPLE STATS:	5VDC
Mean	30.188	Mean	38.250	Mean	44.844
Variance	0.662	Variance	1.212	Variance	1.390
Std. Dev.	0.814	Std. Dev.	1.101	Std. Dev.	1.179
N	17.000	N	10.000	N	9.000

Table 5

Program USE Disk & Tape	USE Tape Only	Description & Use
24 HOUR		
itime	Titime	Wait for time to take more data from the Savannah Navigational Light Tower (SNLT) on the top of the hour. When interupt is generated by the real time clock on the top of the hour, the program rec is called in to run.
rec	Trec	Log data from SNLT at the top of the hour and call up the program to run the US WEATHER SERVICE REPORT.
uswre		Report to the US WEATHER SERVICE (Fig. 11).
ON REQUEST		
look	Tlooks	Look at any channel from SNLT on demand.
mean	Tmean	Take the average of a channel of data from the SNLT hourly raw data files.
header	Thead	Print out a listing of the exceptions for certain parameters.
SPECIAL RUN		
tapdsk		Move raw data file from tape to disk.
fixdsk		Enable raw data on disk to be edited and resaved.
nodpak		Take NODC daily files and convert them into a compacted form of a specified time period for in-house processing.
NORMAL WEEKLY RUN		
tocopy		Set up data acquisition disk for SNLT raw hourly data files.
tamark		Mark out SNLT raw hourly data files.
taplis		List out SNLT raw hourly data files found on data cartridge.
nodrn4		Convert SNLT raw hourly data files to NODC daily files.
EDITING		
dfport		Plot out a week of NODC daily files.
eport		Plot out a week of NODC daily files on a sensor by sensor format.
nodsct nodsch		Edit NODC daily file on CRT.
sctek schp		Edit only text on CRT.

Table 6

Filter Characteristics for Filters Used in Processing SNLT Data

	3 hour low-pass	40 hour low-pass
0.25 amplitude period (frequency)	3 hr (8.0 cpd)	40 hr (0.6 cpd)
0.1 amplitude period (frequency)	2.6 hr (9.2 cpd)	34 hr (0.7 cpd)
Number of weights	5	193
Data loss, each end	2 hr	4 days

Table 7

DIRECTORY FOR UNIT 1

FILE	TITLE	LENGTH	START
1	A&B COEF SNLT WIND SE COMP 40HRLP WINT'77	554	1.000E+00
2	A&B COEF SNLT WIND NE COMP 40HRLP WINT'77	554	1.000E+00
3	A&B COEF CUR 2M OFF BOTTOM SE COMP	554	1.000E+00
4	A&B COEF CUR 2M OFF BOTTOM NE COMP	554	1.000E+00

1 /CARTESIAN PARAMETERS FOR VECTOR #1 AND VECTOR #2

FREQ	X1	Y1	AMPL1	PHAS1	X2	Y2	AMPL2	PHAS2
.009	542.44	903.13	275.29	101.01	498.36	810.13	532.30	-175.44
.018	330.08	473.59	221.47	77.34	59.28	95.28	48.58	27.42
.027	88.63	141.86	87.28	119.11	35.99	71.58	32.28	60.94
.036	5.27	2.91	3.59	112.56	.20	.69	.12	-72.20
.045	.72	.53	.61	104.24	.04	.10	.06	-78.50
.055	.33	.20	.26	104.39	.03	.03	.03	-71.61
.064	.20	.10	.14	103.77	.02	.01	.02	-69.48
.073	.13	.05	.08	103.18	.01	.01	.01	-67.04
.082	.09	.03	.05	102.90	.01	.00	.01	-66.77
.091	.07	.02	.04	102.44	.01	.00	.00	-56.71
.100	.06	.01	.03	101.89	.01	.00	.00	-58.47

2 /CARTESIAN PARAMETERS BETWEEN VECTOR #1 AND VECTOR #2

FREQ	XCOHSQ	XPHAS	YCOHSQ	YPHAS
.009	.153	10.258	.482	2.298
.018	.062	-78.870	.775	-65.382
.027	.131	33.328	.725	-83.790
.036	.133	-29.123	.814	-127.589
.045	.957	51.887	.994	-130.534
.055	.997	42.985	.999	-132.905
.064	.999	36.932	.999	-136.246
.073	.999	33.046	1.000	-137.124
.082	.994	31.826	.998	-137.799
.091	.998	22.189	.999	-136.976
.100	1.000	22.975	1.000	-137.376

3 /ROTARY SPECTRA FOR VECTOR #1

FREQ	CLOK(-)	ANTI(+)	ROTC	IANG	STAB
.009	993.011	452.556	.374	-81.877	.079
.018	617.928	185.744	.538	72.964	.065
.027	191.503	38.986	.662	-61.041	.336
.036	7.403	.773	.811	-24.711	.575
.045	1.219	.027	.957	-28.842	.985
.055	.520	.016	.938	-22.243	.990
.064	.279	.013	.911	-16.468	.995
.073	.170	.011	.875	-12.554	.997
.082	.113	.010	.833	-10.080	.998
.091	.080	.009	.789	-8.244	.999
.100	.059	.009	.747	-6.852	.999

Table 7 (continued)

4 /ROTARY SPECTRA FOR VECTOR #2

FREQ	CLOK(-)	ANTI(+)	ROTC	IANG	STAB
.009	611.890	696.605	-.065	-53.186	.718
.018	99.650	54.907	.289	56.329	.399
.027	81.996	25.567	.525	69.312	.268
.036	.331	.559	-.256	85.797	.338
.045	.010	.129	-.856	78.555	.750
.055	.002	.057	-.938	54.591	.913
.064	.001	.032	-.927	34.843	.974
.073	.001	.020	-.880	26.020	.992
.082	.001	.013	-.836	20.741	.972
.091	.002	.009	-.712	20.955	.992
.100	.001	.007	-.699	18.443	.999

5 /INNER COHERENCE AND PHASE FOR --- & +++ FREQUENCY

FREQ	RCOH(-)	PHAS(-)	RCOH(+)	PHAS(+)
.009	.298	-11.708	.454	-3.982
.018	.540	58.548	.244	-102.149
.027	.462	61.869	.193	175.758
.036	.951	114.097	.156	49.884
.045	.790	104.211	.982	109.991
.055	.925	62.764	.989	90.812
.064	.979	28.828	.992	73.785
.073	.992	14.369	.996	62.810
.082	.968	5.503	.997	56.536
.091	.990	12.193	.999	46.341
.100	.999	6.982	.999	43.608

6 /OUTER COHERENCE AND PHASE FOR --- & +++ FREQUENCY

FREQ	RCOH(-)	PHAS(-)	RCOH(+)	PHAS(+)
.009	.208	-104.502	.230	-146.609
.018	.558	174.636	.649	78.325
.027	.475	-111.714	.844	69.798
.036	.625	57.232	.522	52.758
.045	.762	45.515	.997	52.548
.055	.932	16.910	.999	46.446
.064	.991	-4.352	1.000	40.904
.073	.998	-10.736	1.000	37.759
.082	.961	-14.766	.999	36.328
.091	.989	-4.458	.999	29.828
.100	1.000	-6.722	1.000	29.917

LIST OF FIGURES

Figure 9b. Example of regression and statistical analysis of calibration performed on Marsh-McBirney current meters deployed at SNLT. Output represents transducer voltage, which may be converted to flume velocity from Figure 9a.

Figure 10a. Strip chart record of Marsh-McBirney current meter directional calibration performed in flume at Skidaway Institute. Pressure signal records transducer pressure which is converted to flume velocity. X and y components of current were recorded at various directional orientations relative to flow. Current values were digitized from this record for further analysis.

Figure 10b. Example of plot showing directional variability in Marsh-McBirney current meter. Dark circles represent three different flume velocities. Dark points represent measured current speed calculated from x and y components at each compass direction in Figure 10a. Lighter circles on graph paper represent 10 cm/s increments. The data on this Figure are also summarized in Table 4.

Figure 11. SNLT data summary printed for National Weather Service and other agencies. Summary includes air and water temperature, wind speed and direction, barometric pressure, and significant wave height and wave spectrum.

Figure 12. Example of SNLT weekly data summary, from the week of 19 April 1981. Data were smoothed with a three-hour low-pass filter.

Figure 13. Flow chart of data analysis showing various software packages used to convert data between BCD (Fortran) and FESTSA format, and perform spectral analysis on finite time series. Top of figure shows various sources of data in addition to SNLT.

Figure 14. Energy response of three- and 40-hour low-pass filters used in the reduction of SNLT data. A summary of the filter characteristics is found in Table 6.

Figure 15. Example of bandpassed SNLT wind and current time series from Period 3 (27 July-20 September 1977). Bandpass filter used for this analysis is centered on 24 hours to define daily (1 cpd) events in the record, and minimize higher- and lower-frequency events. The 14-day cycle seen in the plots is associated with the fortnightly cycle. From top to bottom, the time series plotted are wind stress major axis, wind stress minor axis, current u, current v.

Figure 16. Example of output plot from auto- and cross-spectral analysis between two series. The two plots at the top are the time series. The first column of plots at the bottom include the

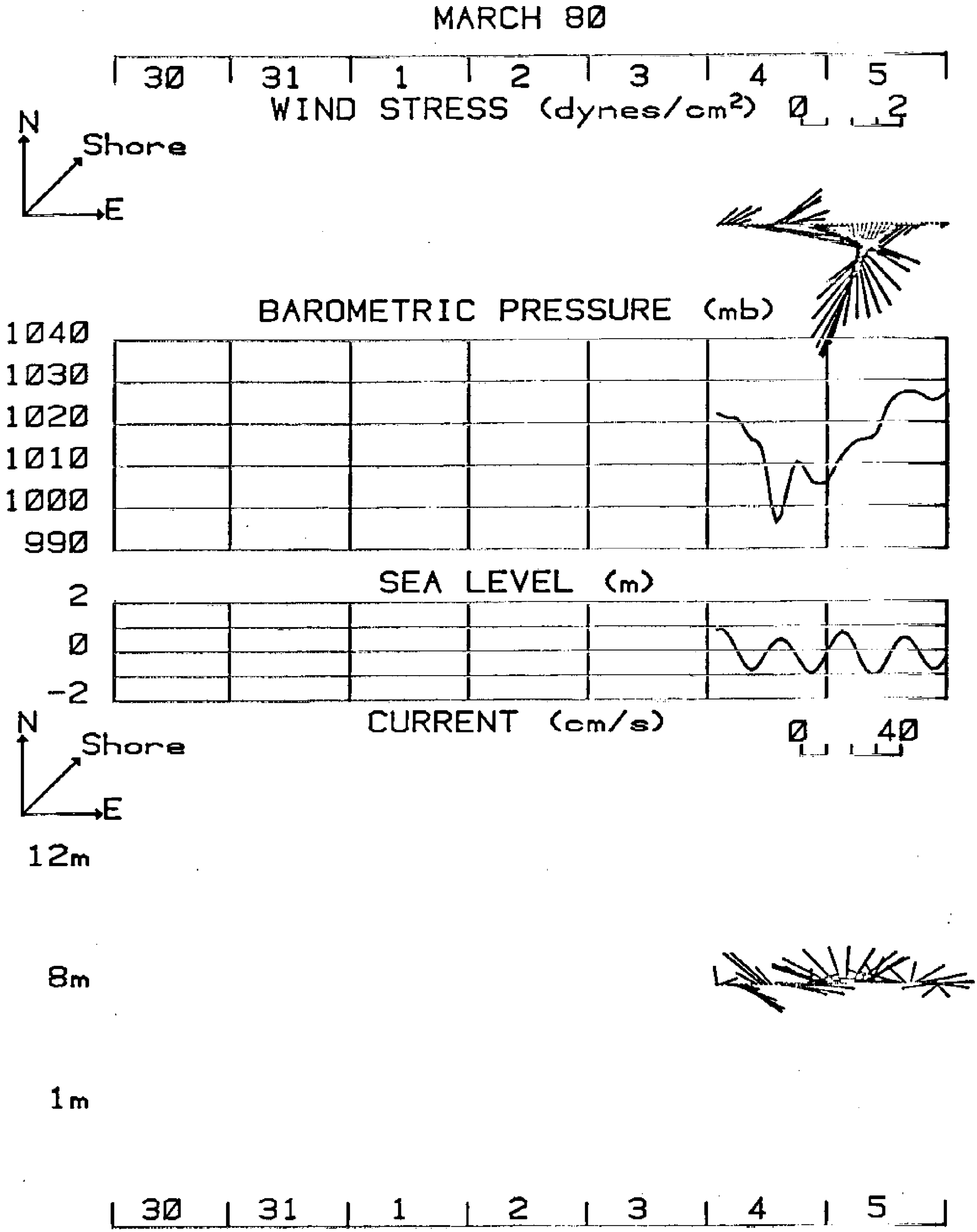
two auto-spectra and the cross-spectrum. The second column includes the spectra divided by frequency. The third column includes plots of coherence, phase, and gain between the two series.

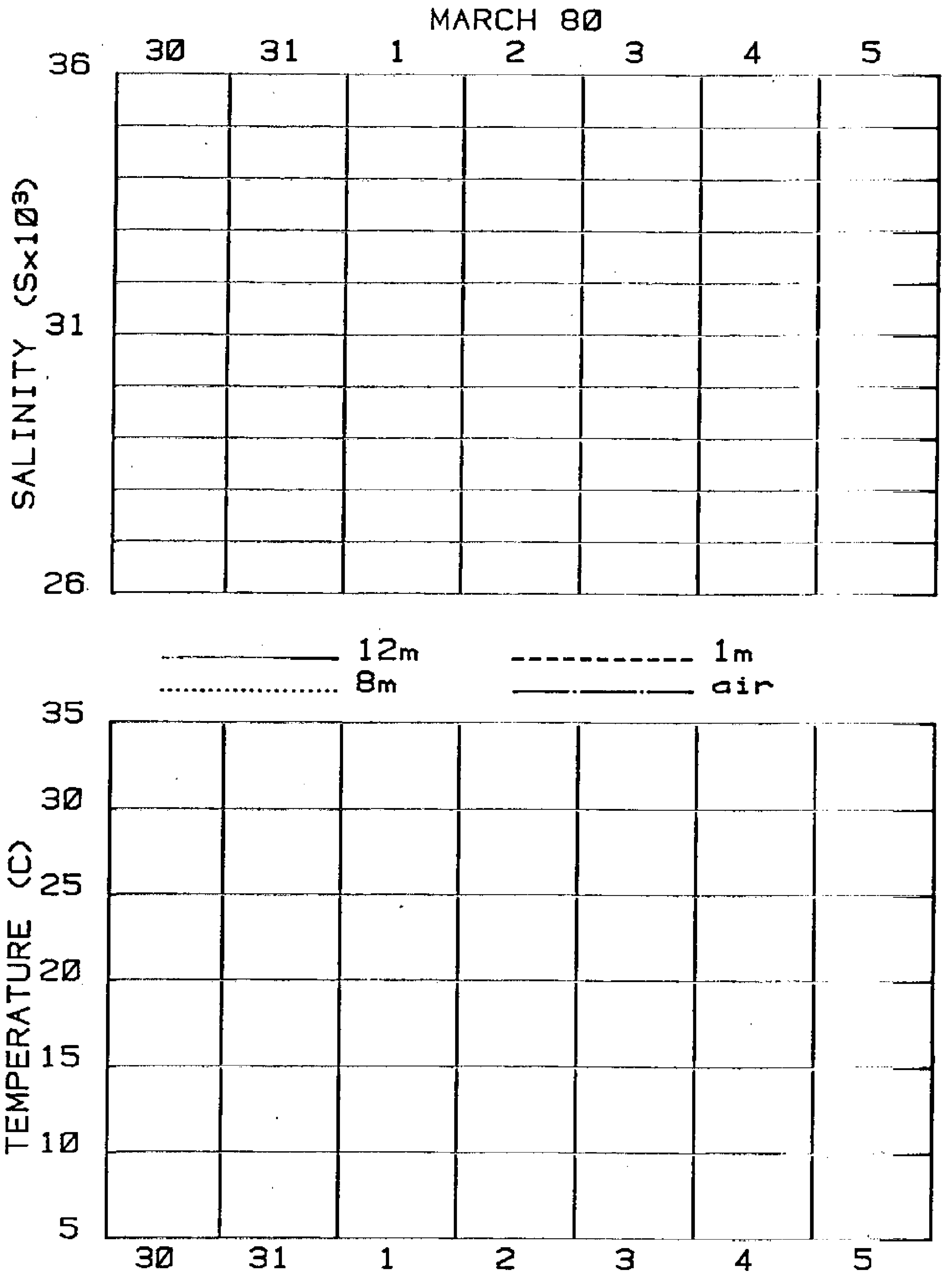
Figure 17. Examples of rotary spectra correlation between a vector and a scalar. The vector is SNLT wind and the scalar is the principal component ($\theta = 62.8°$) of the current from period 5 (6 Mar-22 May 1981). The solid lines enclose the wind directions and frequencies at which the current was coherent with the wind at the 90% (.48) and 95% (.64) confidence level. The broken lines represent the phase relationship, in degrees, between the scalar and vector. Positive phases indicate the scalar leads the vector. Concentric circles represent frequency in cycles per day. Compass directions and current scalar and shoreline orientation are also included.

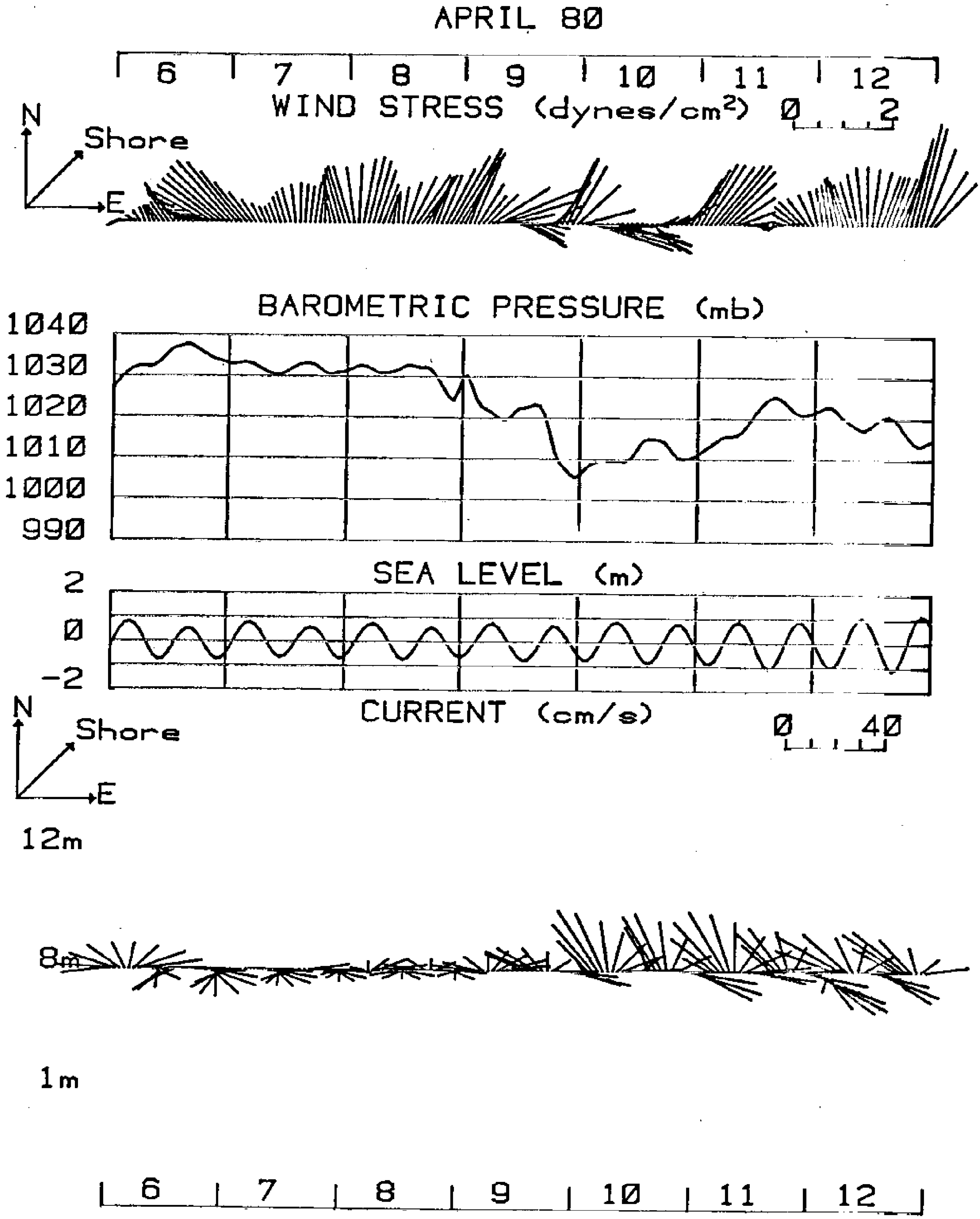
Figure 18. Map showing location of future experiments. Circles indicate locations of Sea Data CTD microloggers to be periodically deployed at permanently placed lighted buoys beginning Spring 1984. Triangles indicate locations of other instrument packages to be periodically deployed by cooperating institutions in the ongoing work sponsored by DOE. Square indicates location of SNLT, which will be in operation during all nearby deployments.

Appendix A:

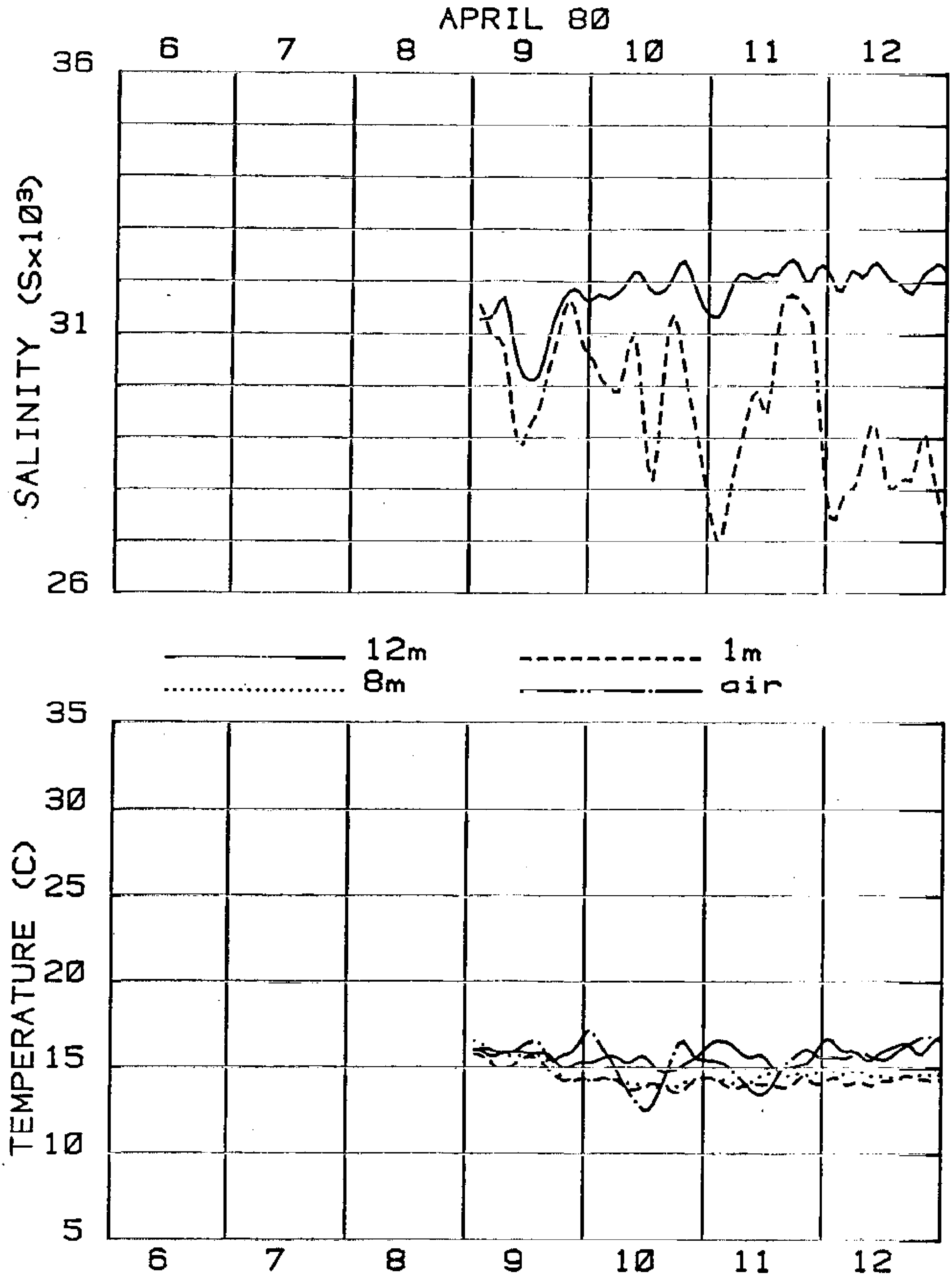
Plots of Weekly Data Summaries of SNLT Data Collected During 1980 and 1981


MARCH 80
30 31 1 2 3 4 5
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
30 31 1 2 3 4 5

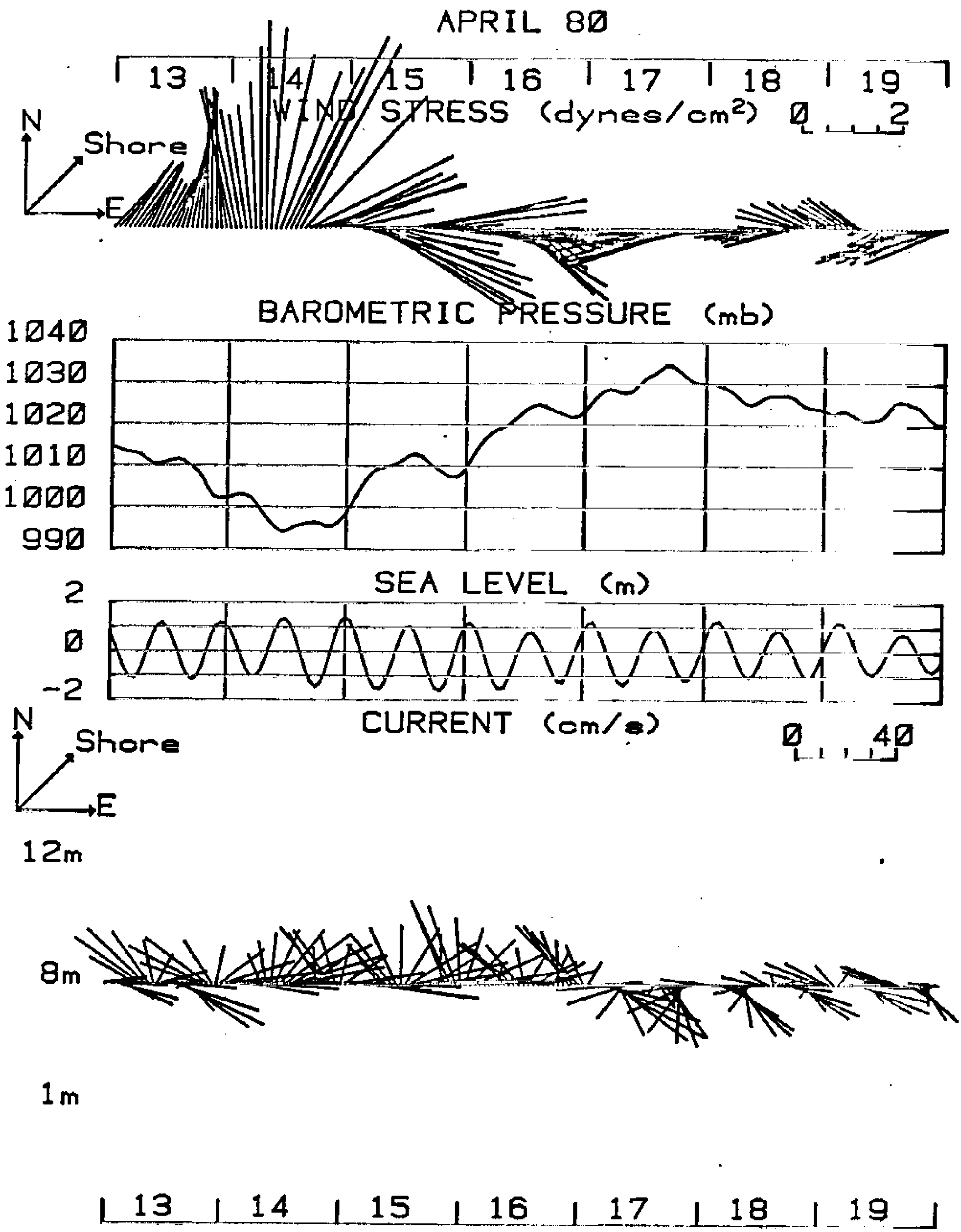

MARCH 80
30
31
1
2
3
4
5
36
31
26
SALINITY (S×10³)
12m
8m
1m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
30
31
1
2
3
4
5



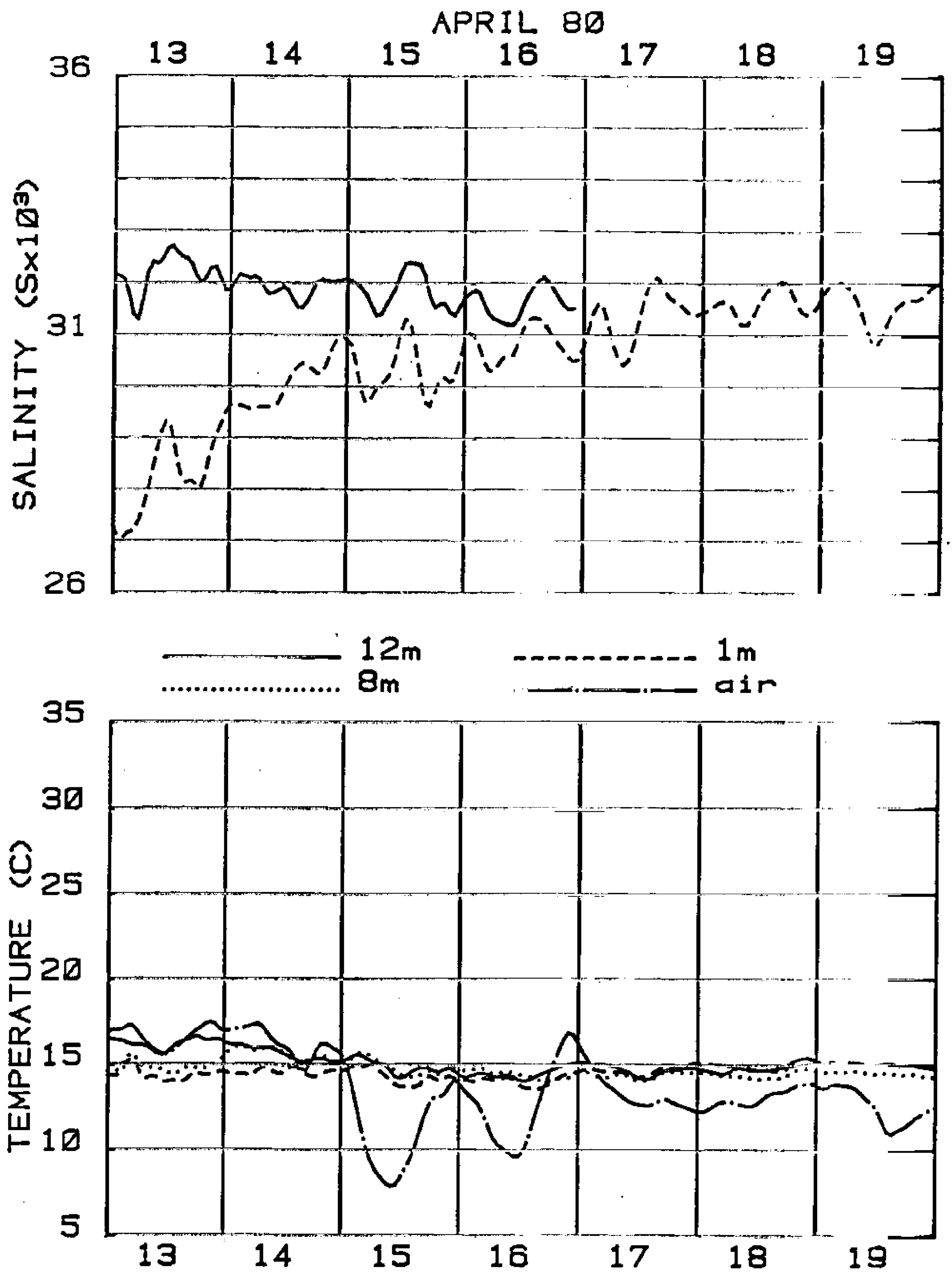
APRIL 80
6
7
8
9
10
11
12
WIND STRESS (dynes/cm²)
0
2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s)
0
40
N
Shore
E
12m
8m
1m
6
7
8
9
10
11
12



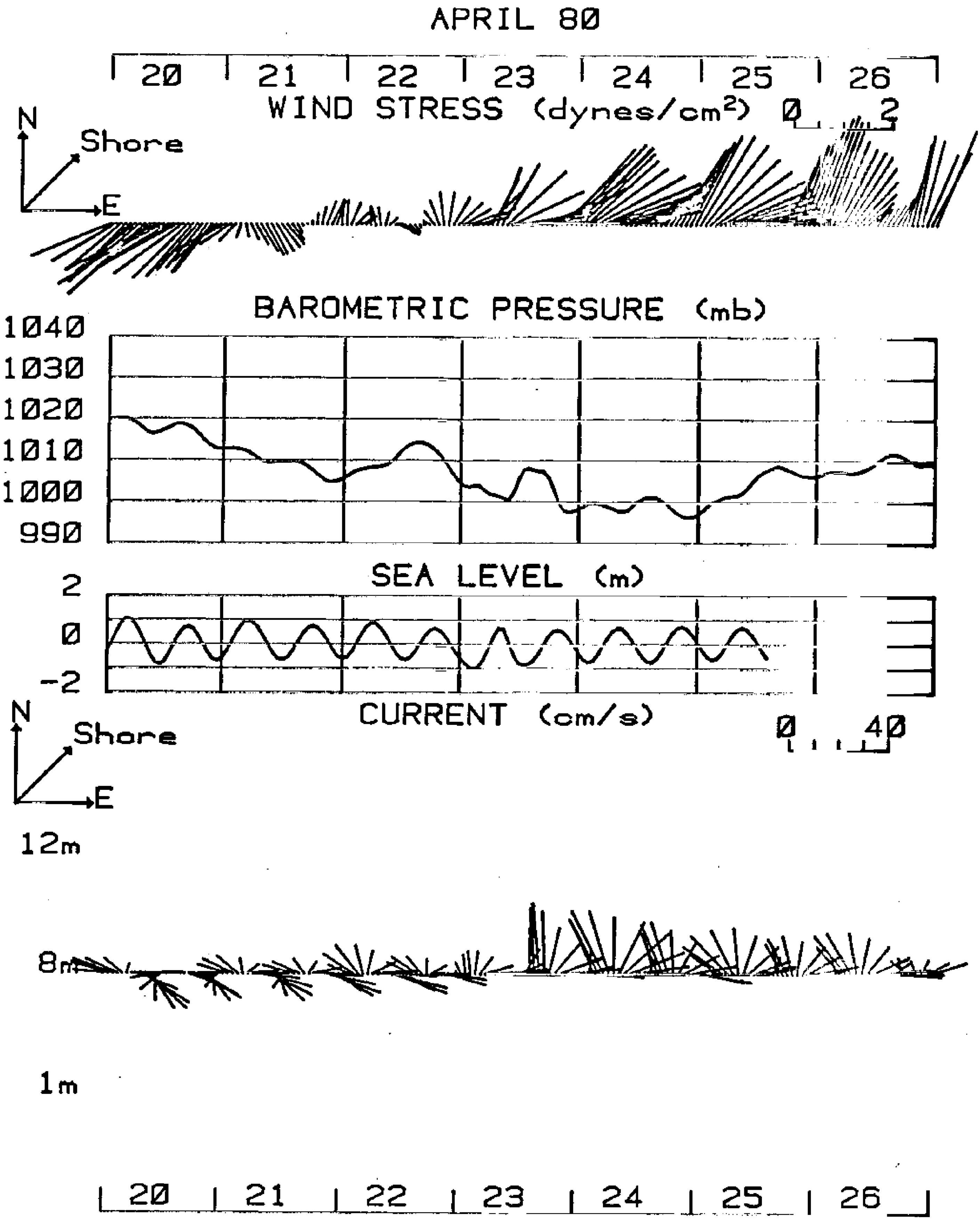
APRIL 80
6
7
8
9
10
11
12
36
31
26
SALINITY (S×10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)

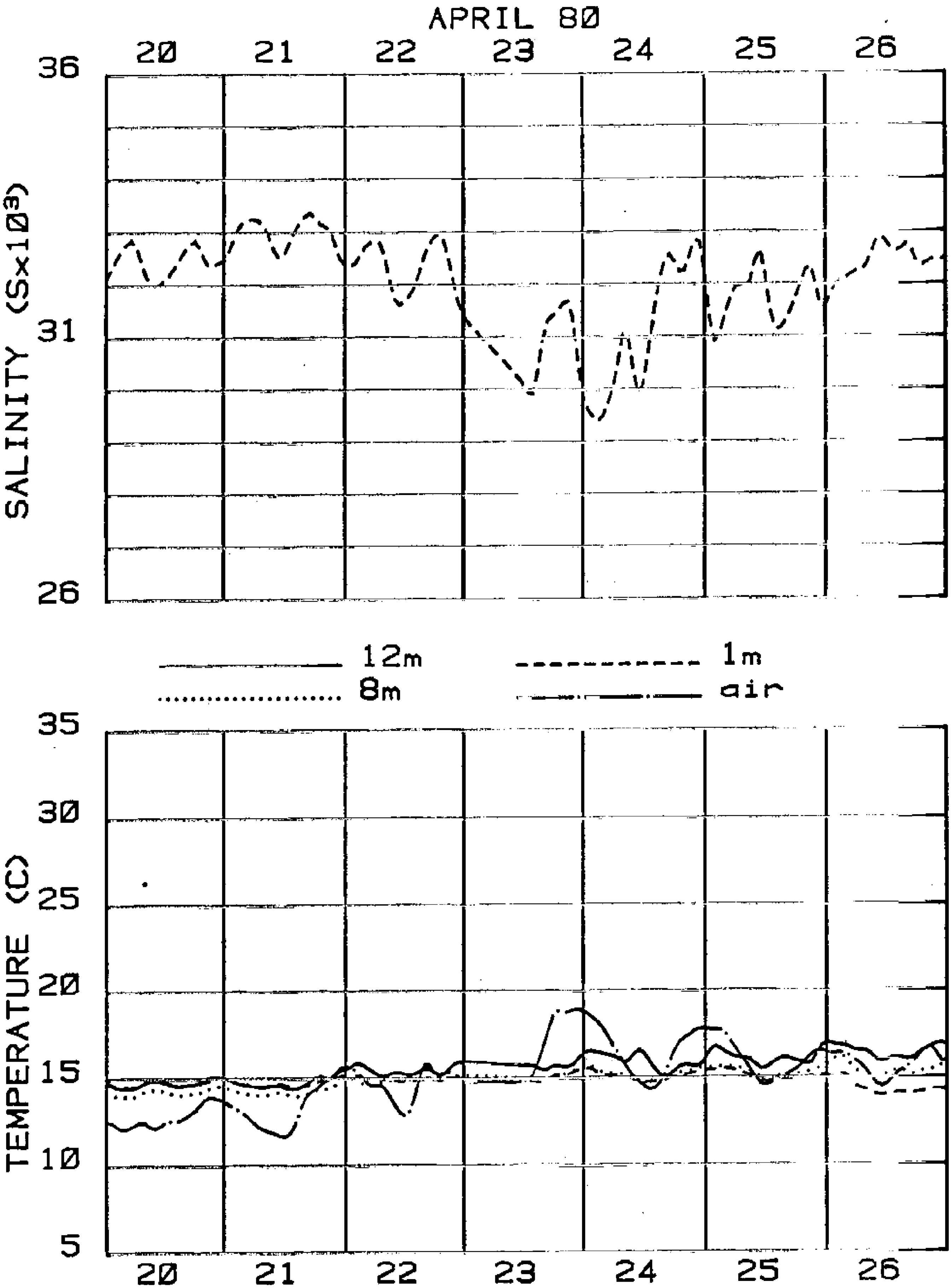


APRIL 80
13
14
15
16
17
18
19
WIND STRESS (dynes/cm²)
0
2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s)
0
40
N
Shore
E
12m
8m
1m
13
14
15
16
17
18
19



APRIL 80
13
14
15
16
17
18
19
36
31
26
SALINITY (S×10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
13
14
15
16
17
18
19


APRIL 80
20
21
22
23
24
25
26
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
20
21
22
23
24
25
26


APRIL 80
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21
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23
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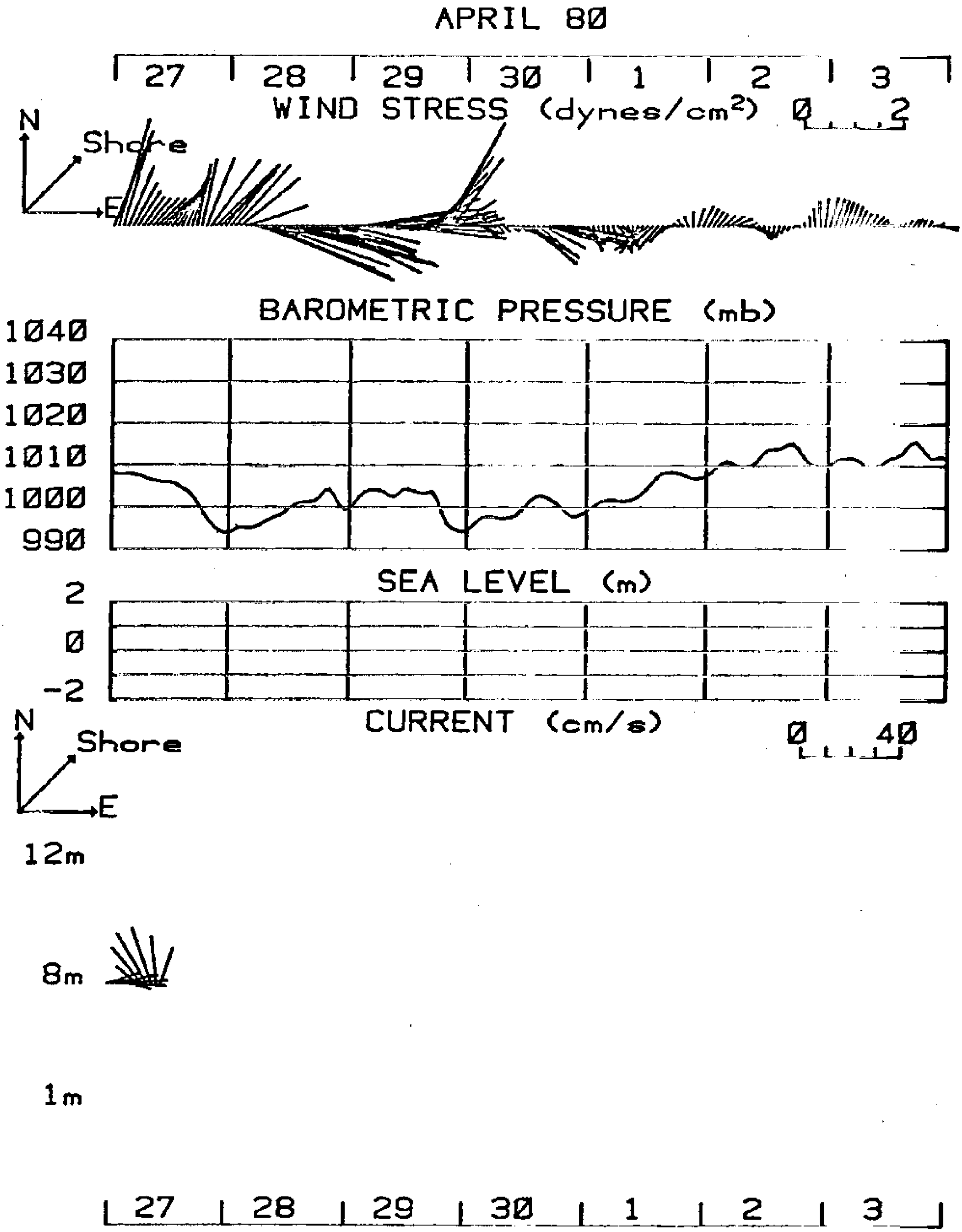
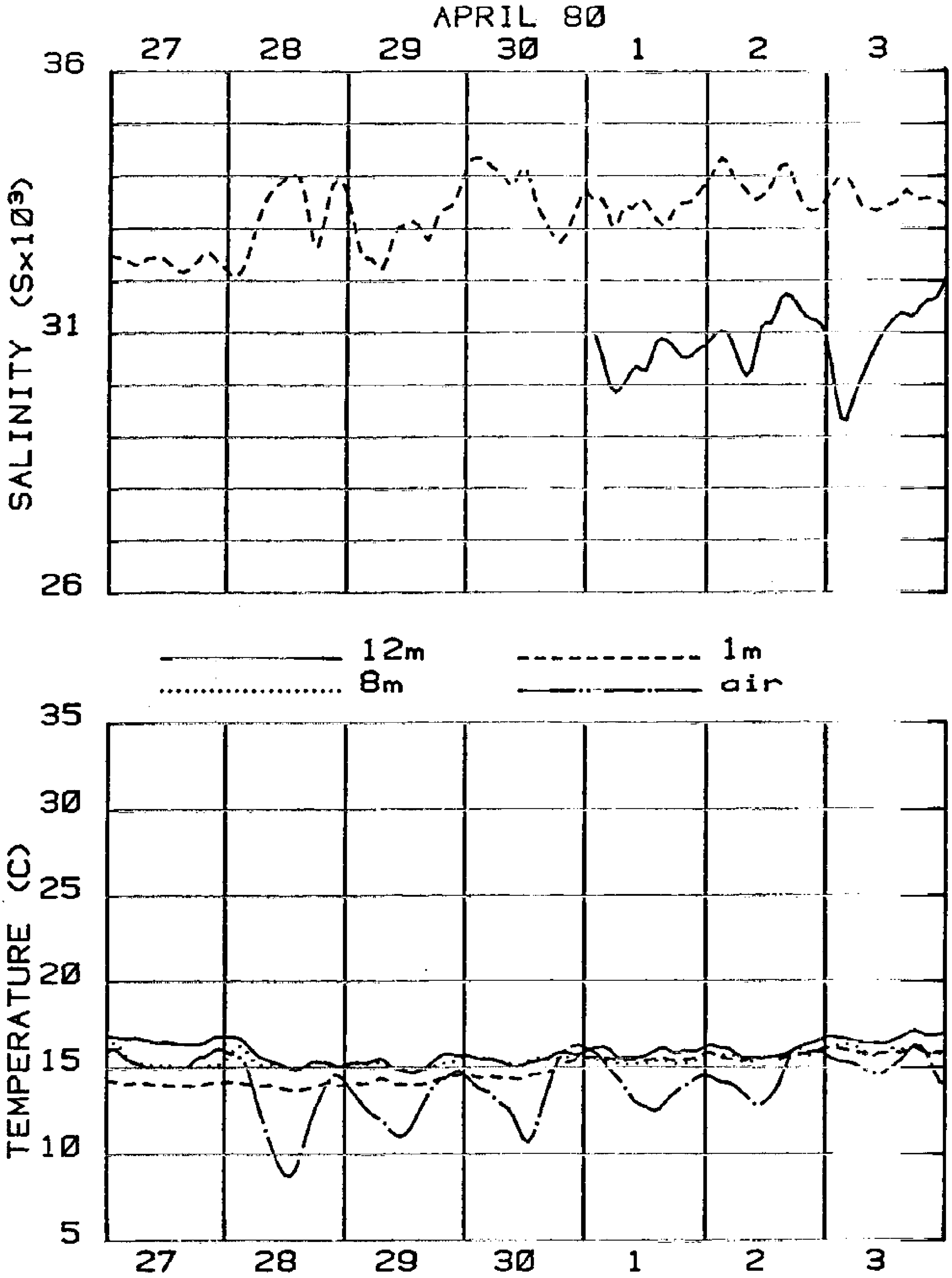
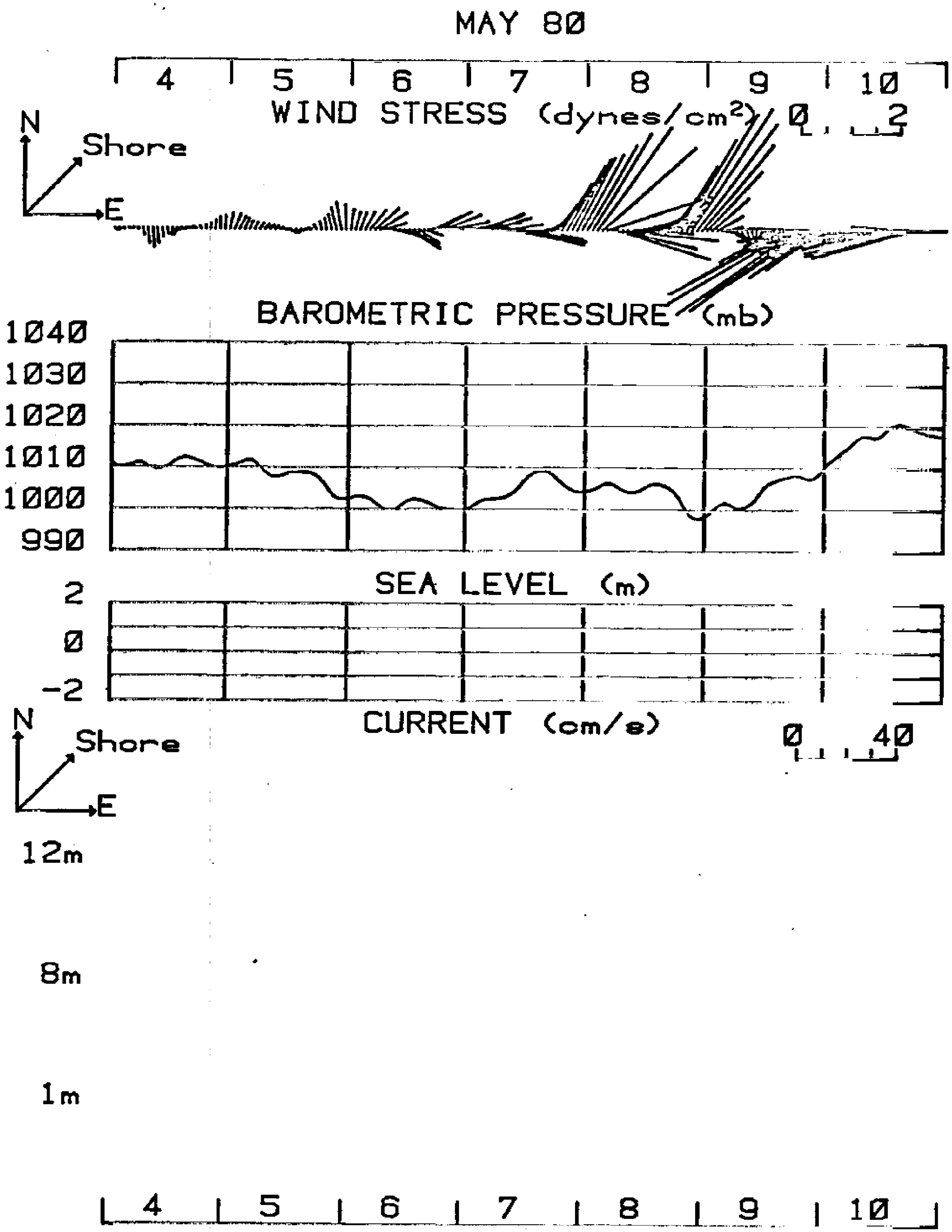
36
31
26
SALINITY (S×10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
20
21
22
23
24
25
26



APRIL 80
27
28
29
30
1
2
3
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
27
28
29
30
1
2
3



APRIL 80
27
28
29
30
1
2
3
36
31
26
SALINITY (Sx10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
27
28
29
30
1
2
3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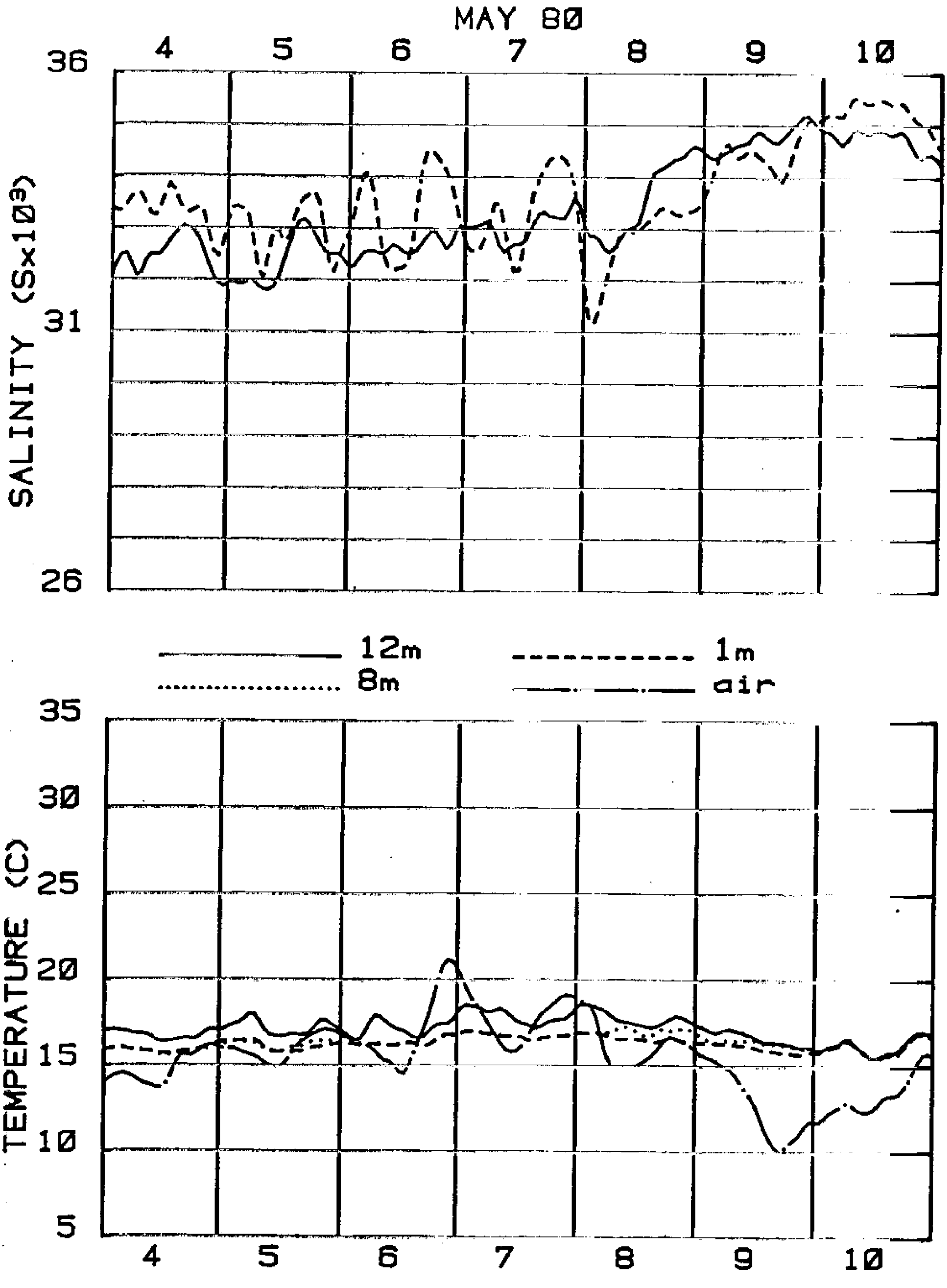
4 5 6 7 8 9 10
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
4 5 6 7 8 9 10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4
5
6
7
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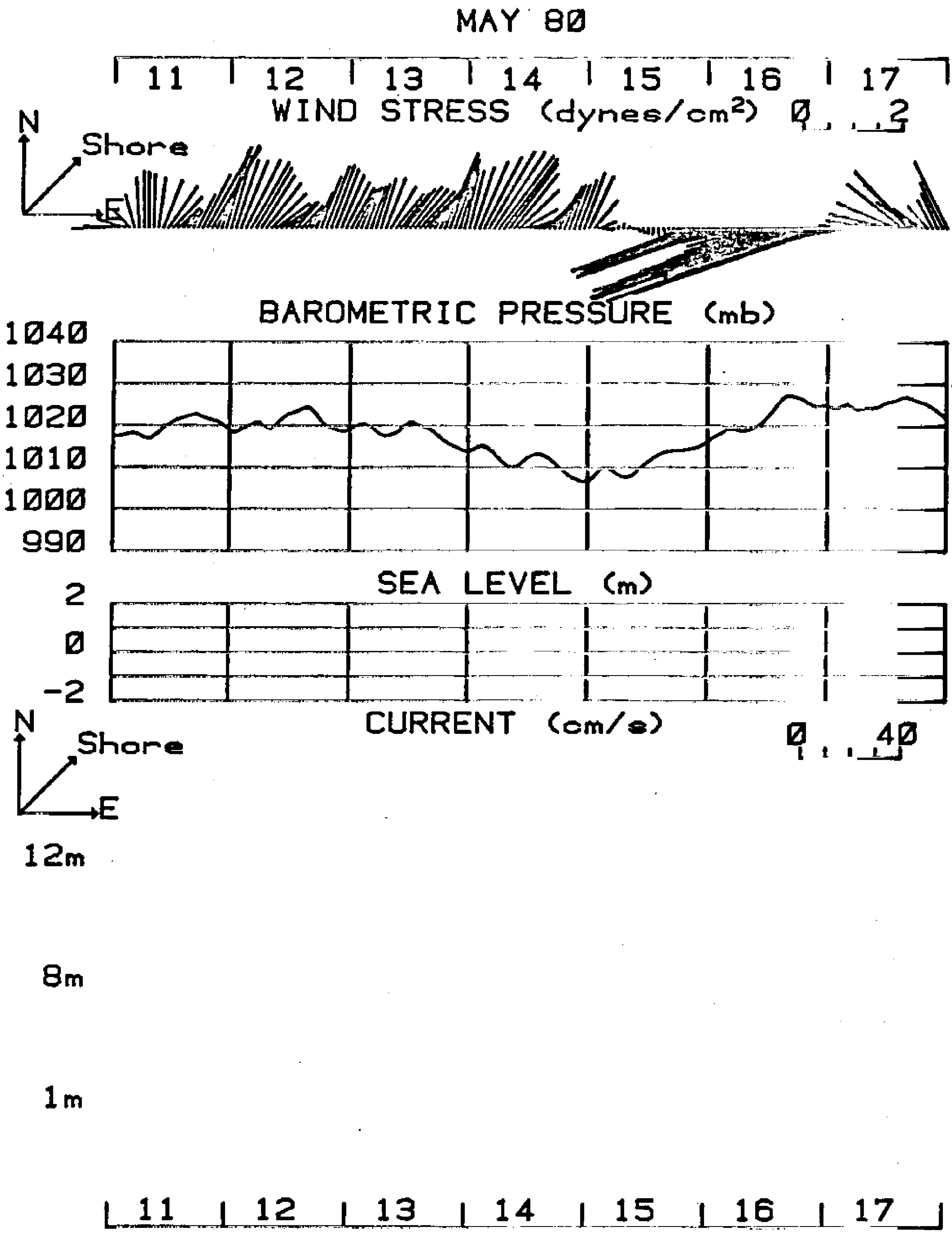
9
10
36
31
26
SALINITY (S×10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
4
5
6
7
8
9
10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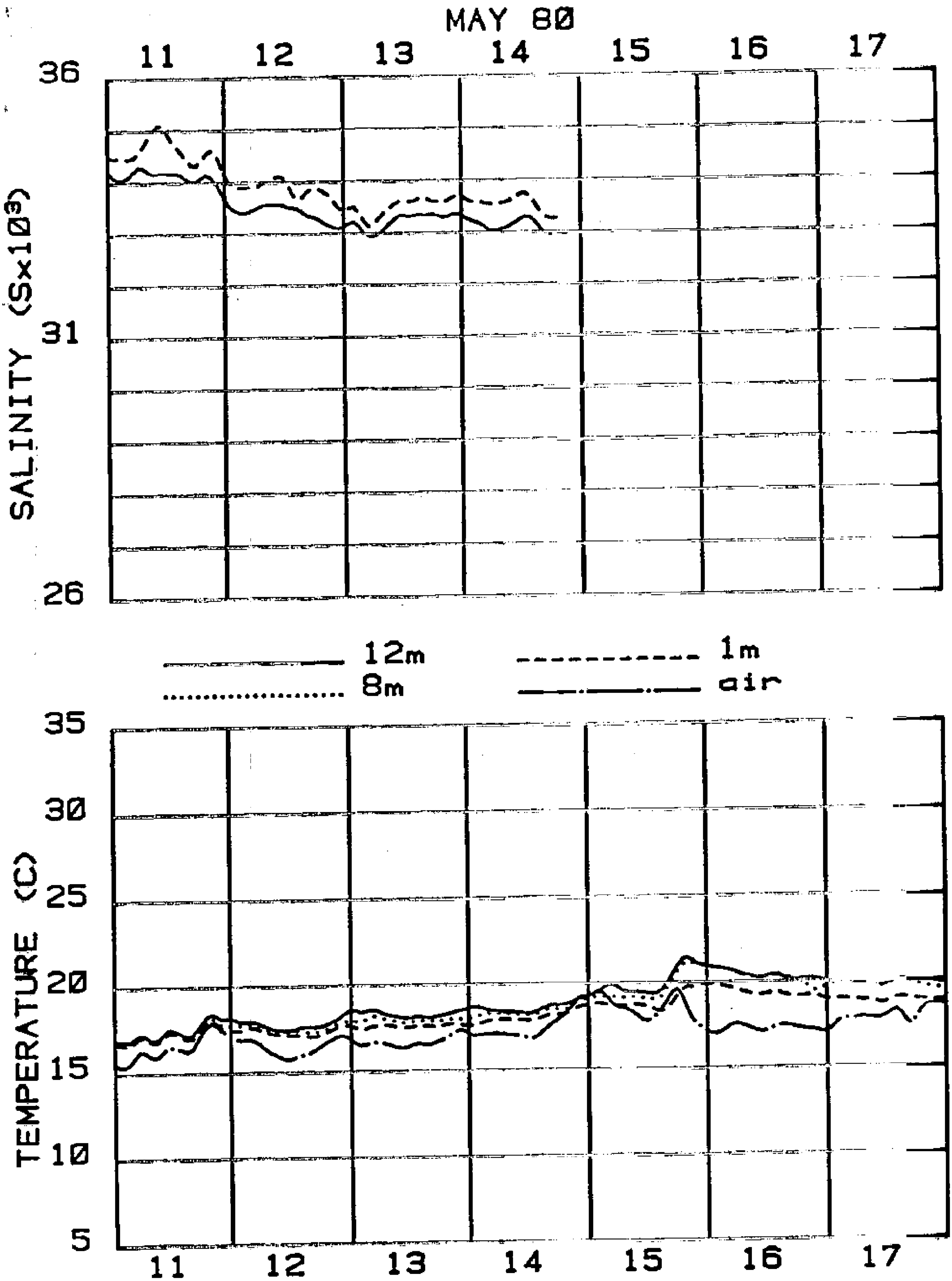
11
12
13
14
15
16
17
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
11
12
13
14
15
16
17



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12
13
14
15
16
17
36
31
26
SALINITY (S×10³)
12m
1m
8m
air
35
30
25
20
15
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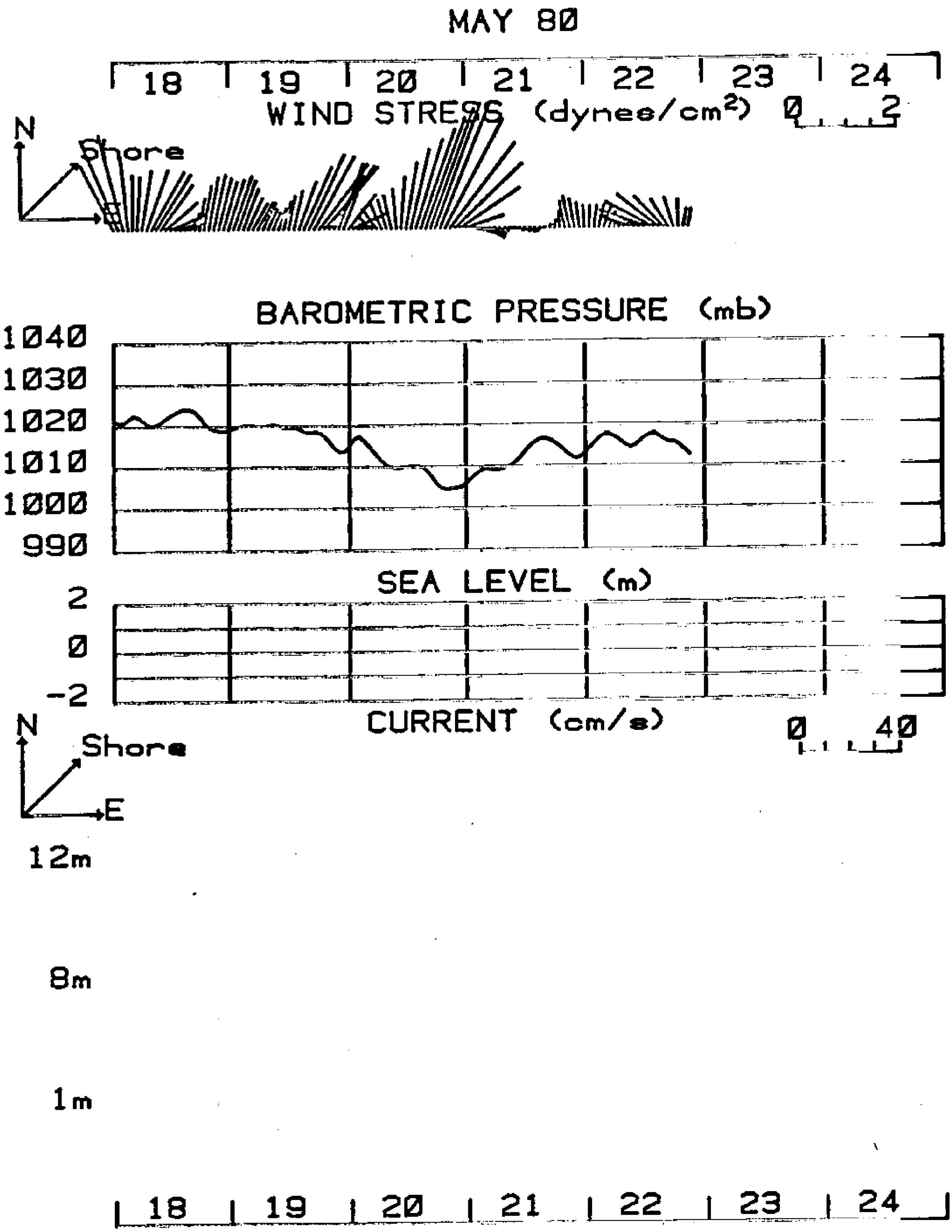
5
TEMPERATURE (C)
11
12
13
14
15
16
17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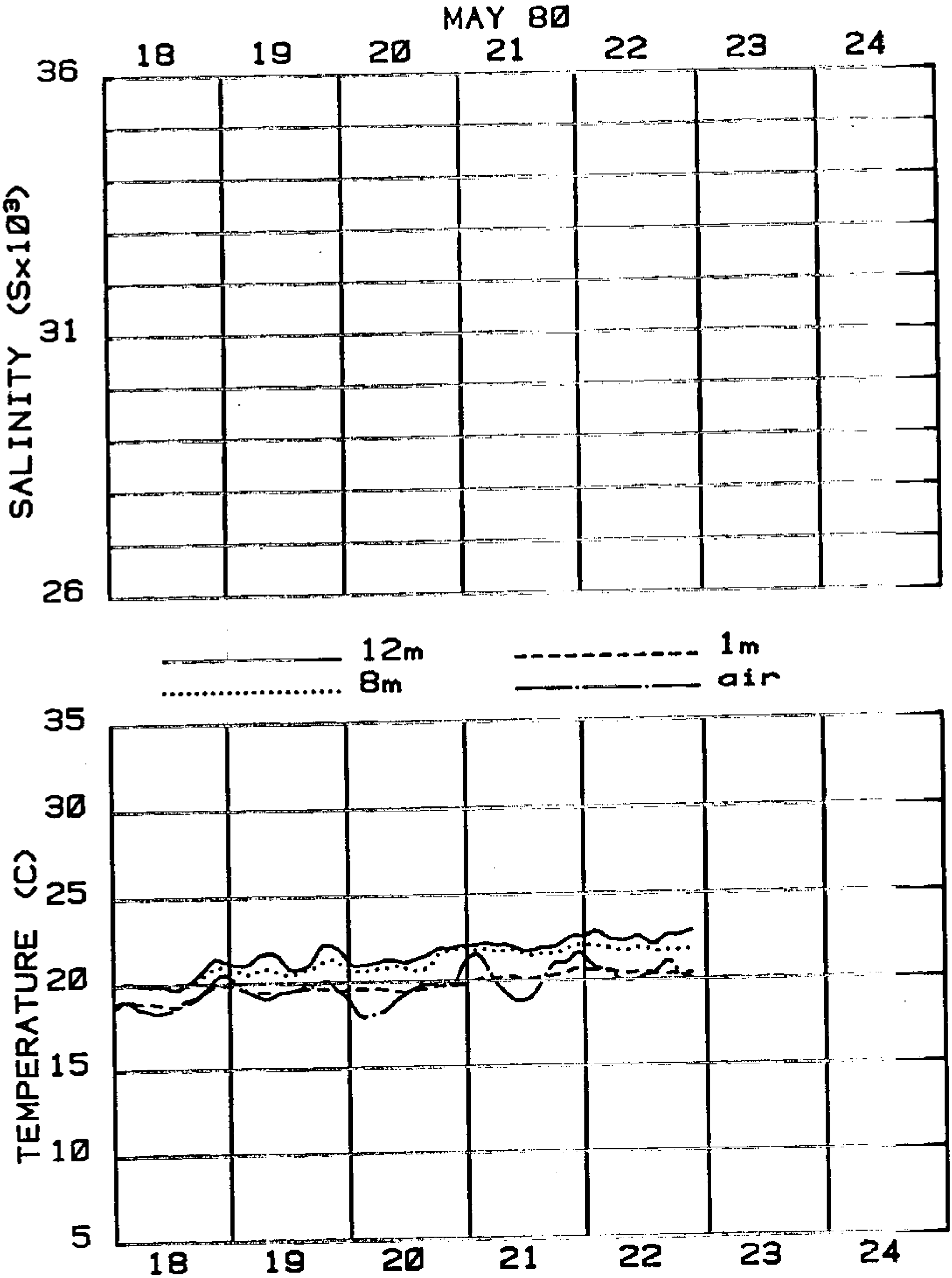
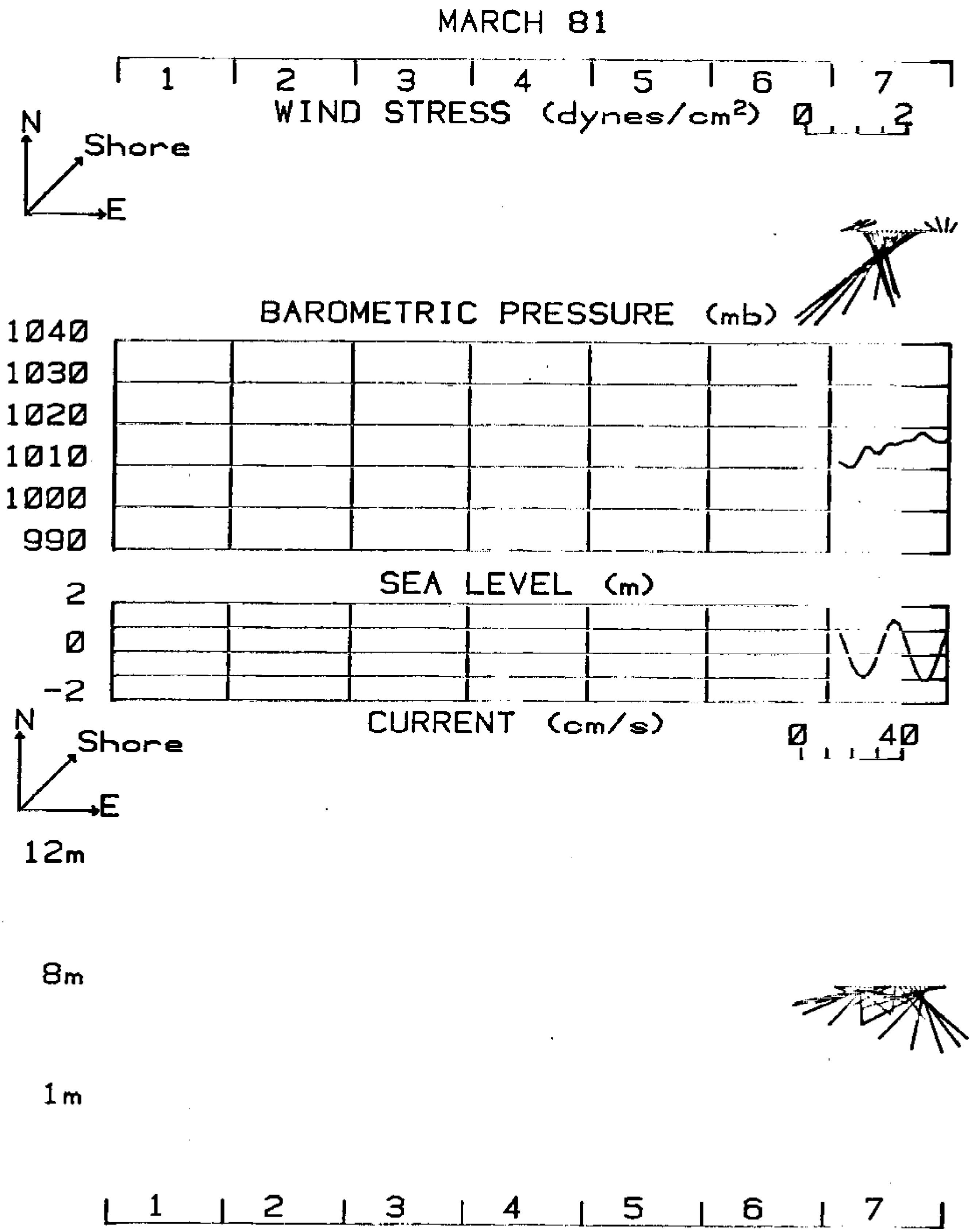
20
21
22
23
24
WIND STRESS (dynes/cm²) 0 2
N
Shore
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
18
19
20
21
22
23
24



MAY 80
18
19
20
21
22
23
24
36
31
26
SALINITY (S×10³)
12m
8m
1m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
18
19
20
21
22
23
24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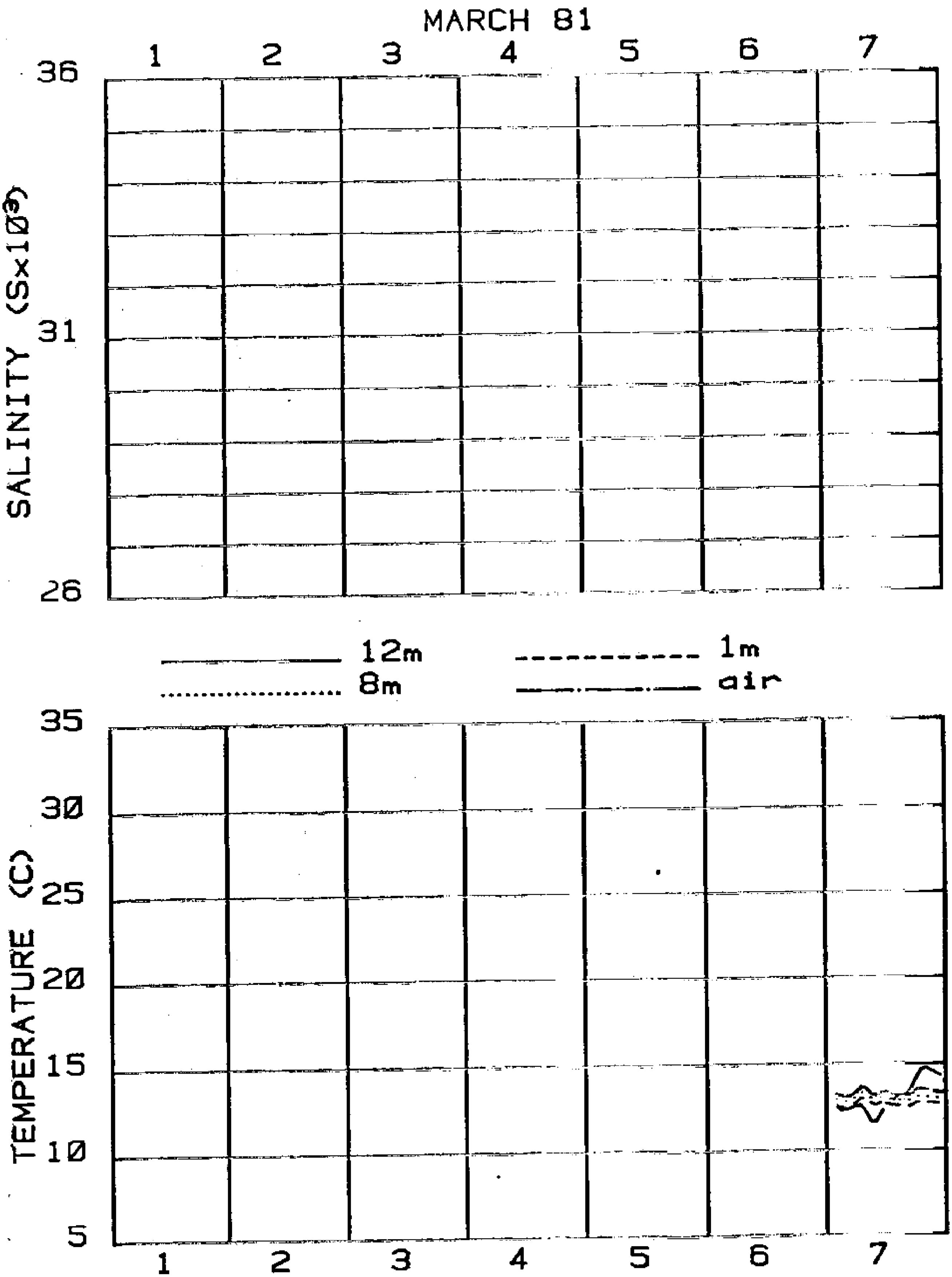
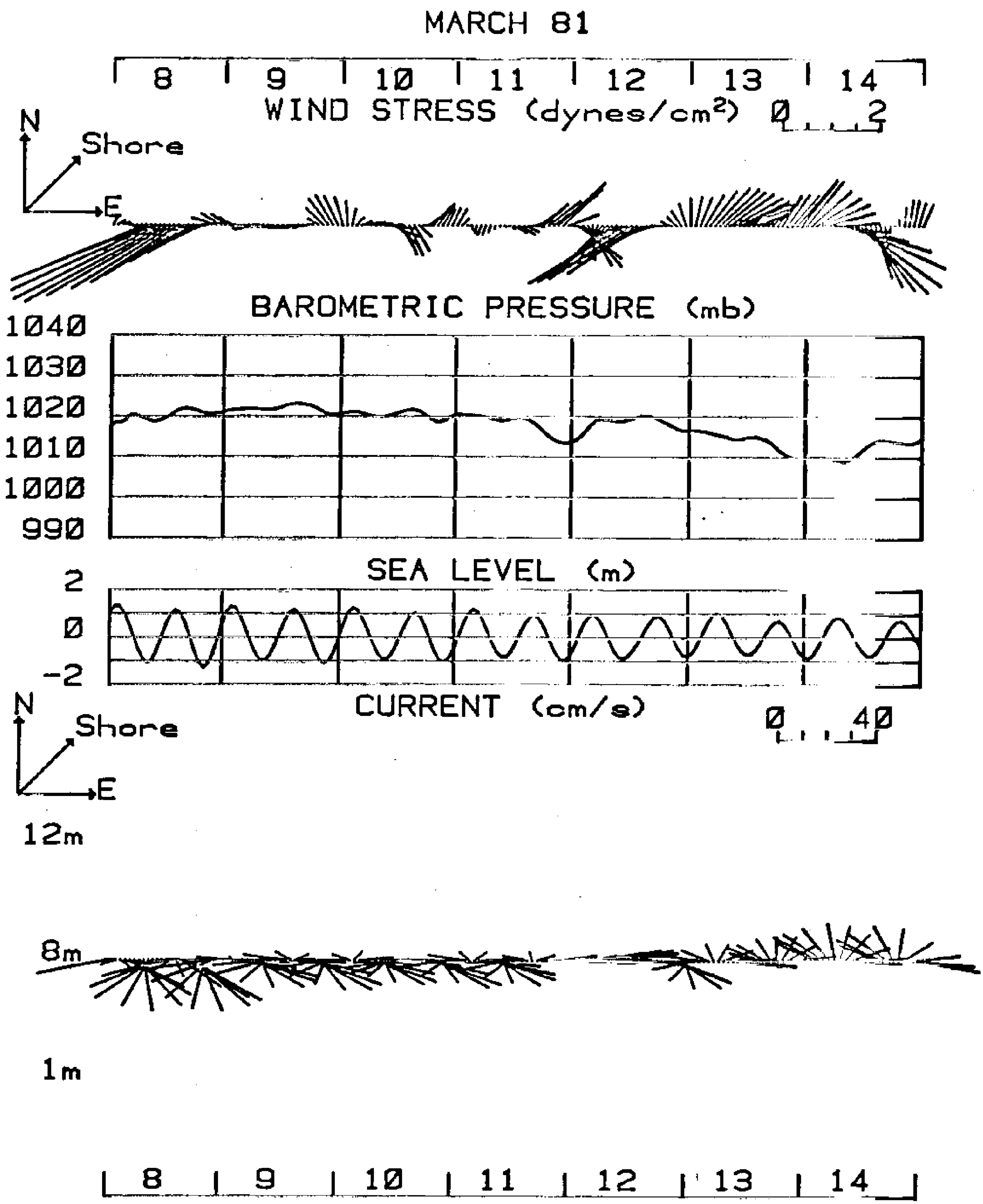
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
1 2 3 4 5 6 7



MARCH 81
1
2
3
4
5
6
7
SALINITY (S×10³)
36
31
26
12m
8m
1m
air
TEMPERATURE (C)
35
30
25
20
15
10
5
1
2
3
4
5
6
7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9
10
11
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13
14
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s)
0 40
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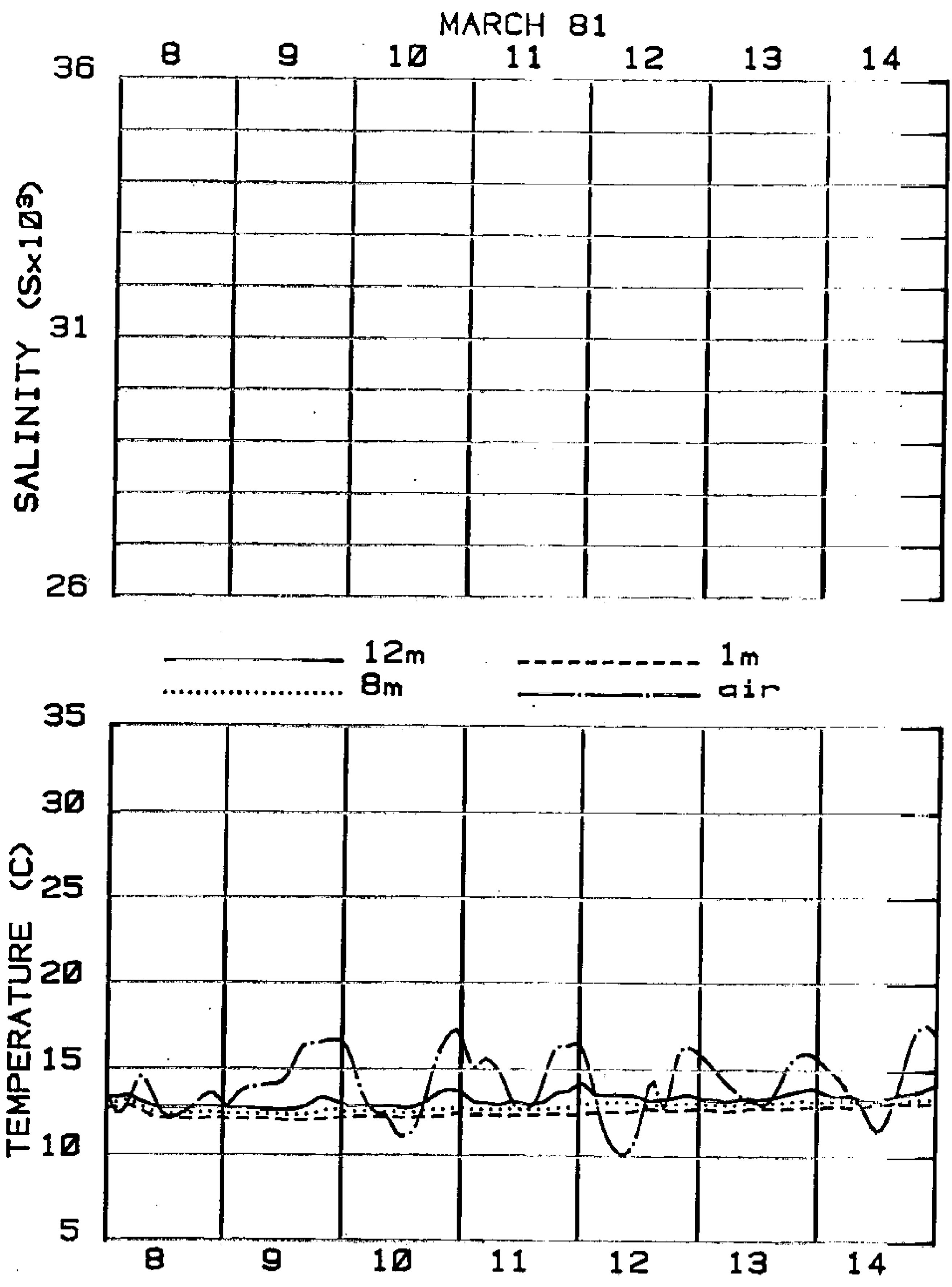
11
12
13
14


MARCH 81
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10
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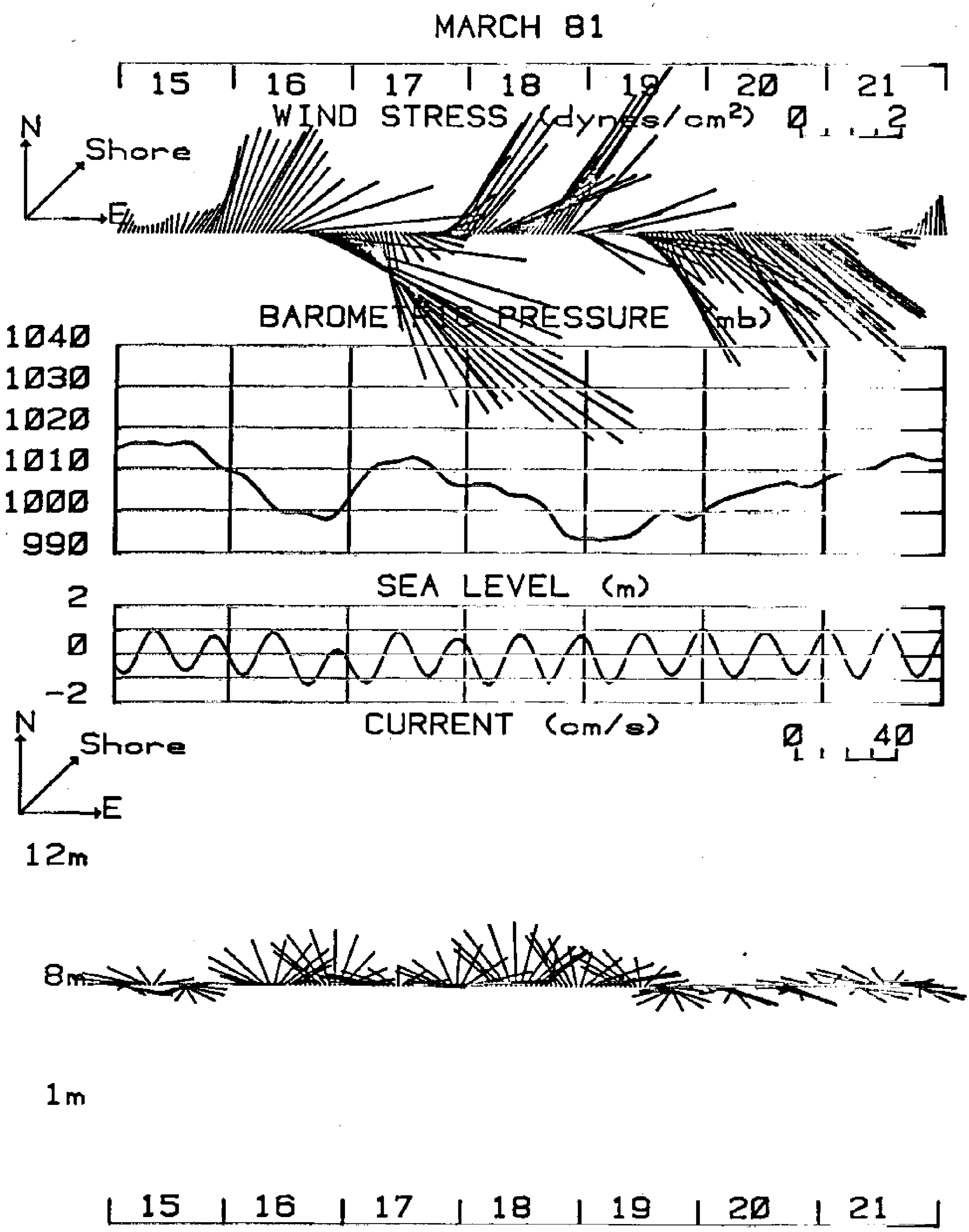
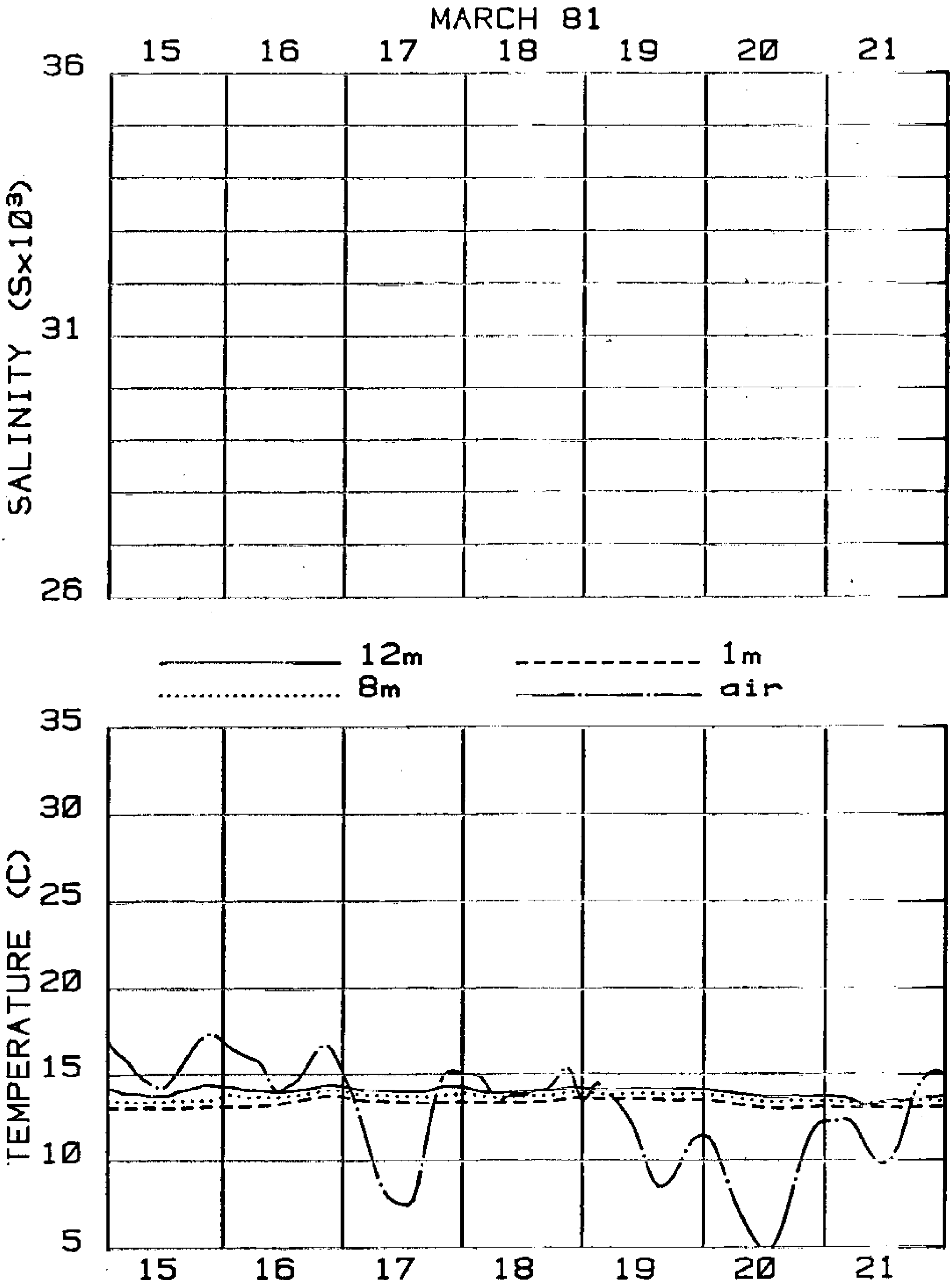
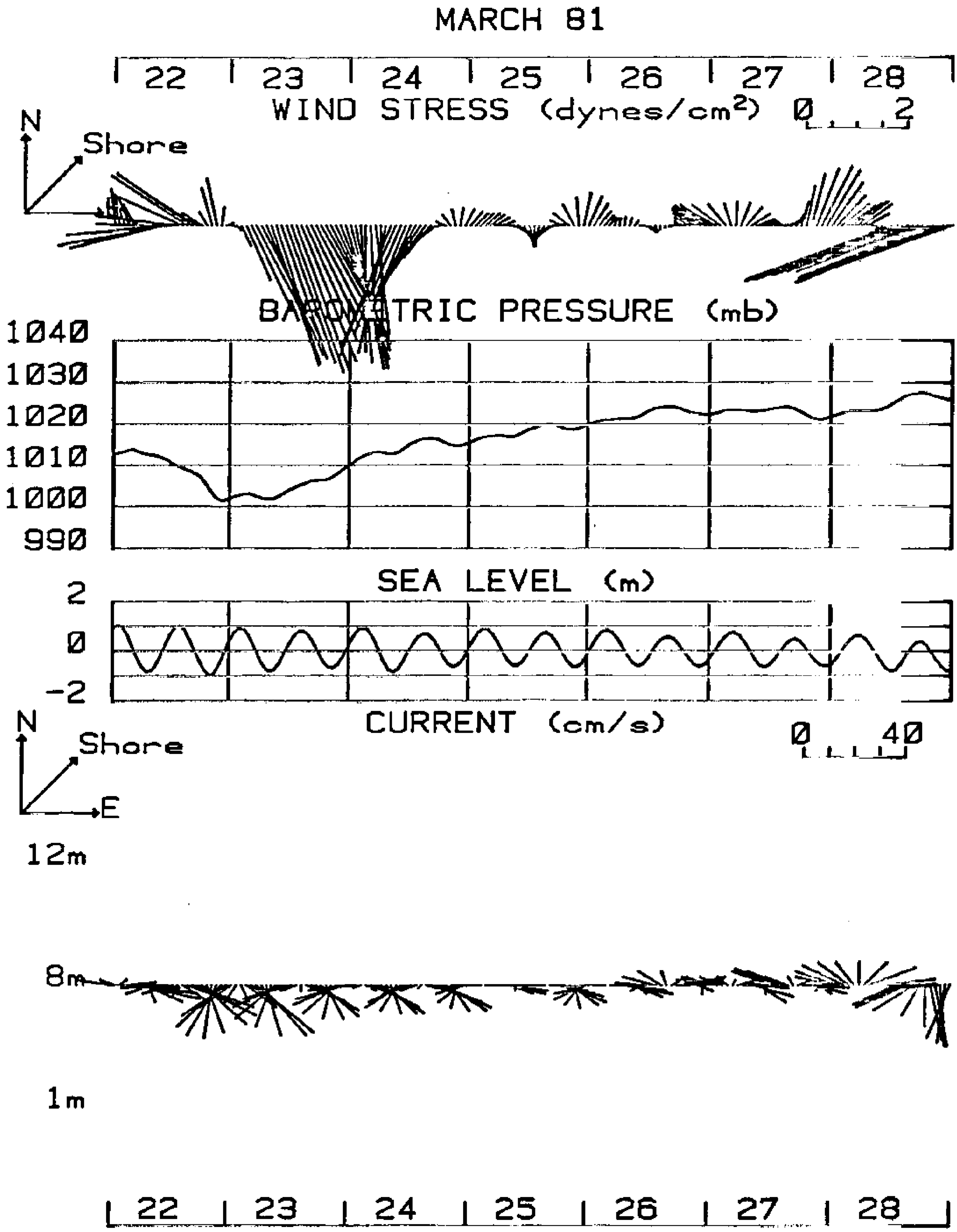
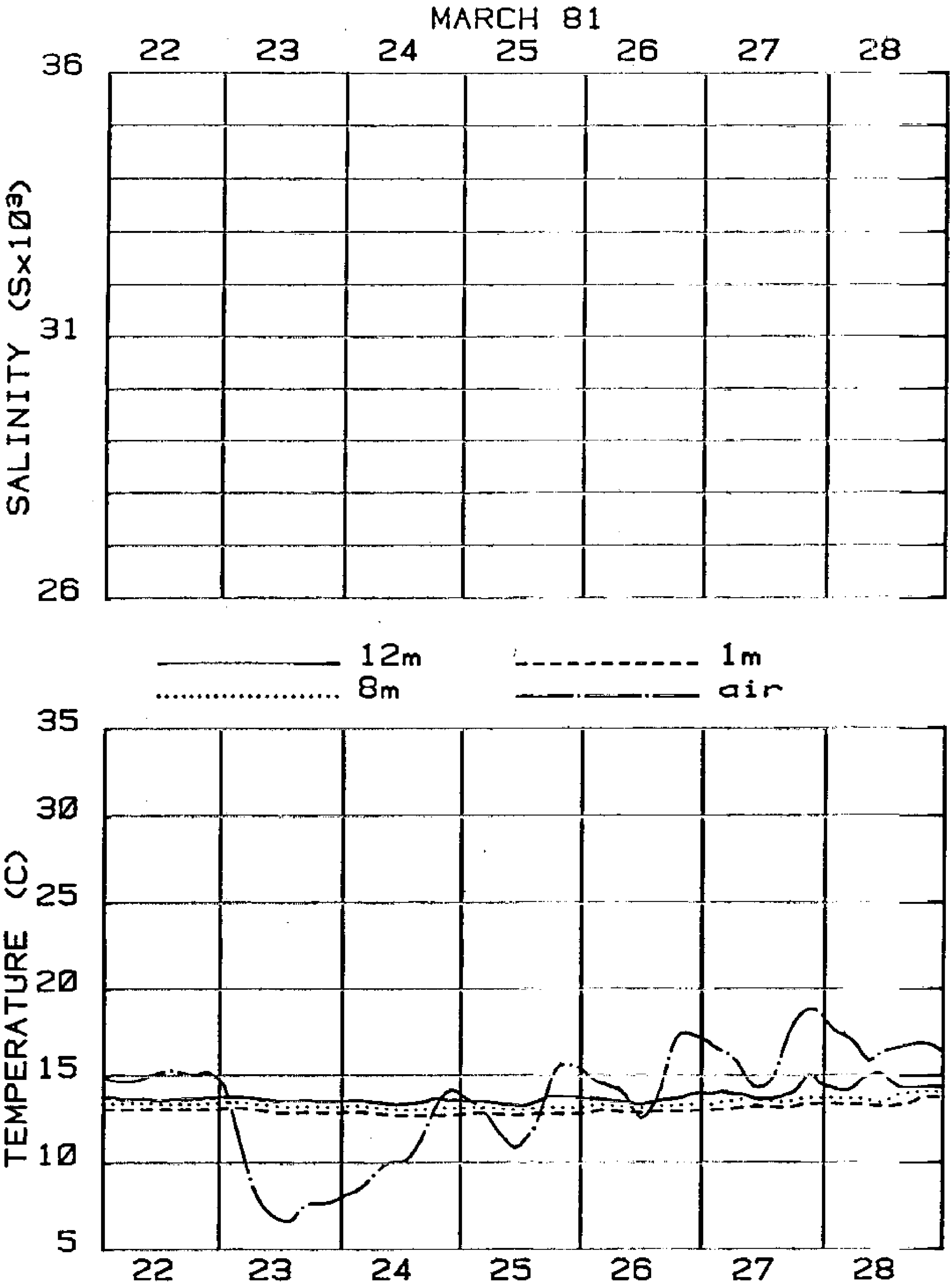
14
36
31
26
SALINITY (S×10³)
12m
8m
1m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
8
9
10
11
12
13
14


MARCH 81
15
16
17
18
19
20
21
WIND STRESS (dynes/cm²)
0
2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s)
0
40
N
Shore
E
12m
8m
1m
15
16
17
18
19
20
21



MARCH 81
15
16
17
18
19
20
21
36
31
26
SALINITY (Sx10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
15
16
17
18
19
20
21


MARCH 81
22
23
24
25
26
27
28
WIND STRESS (dynes/cm²) 0 2
N
Shore
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
22
23
24
25
26
27
28


MARCH 81
22
23
24
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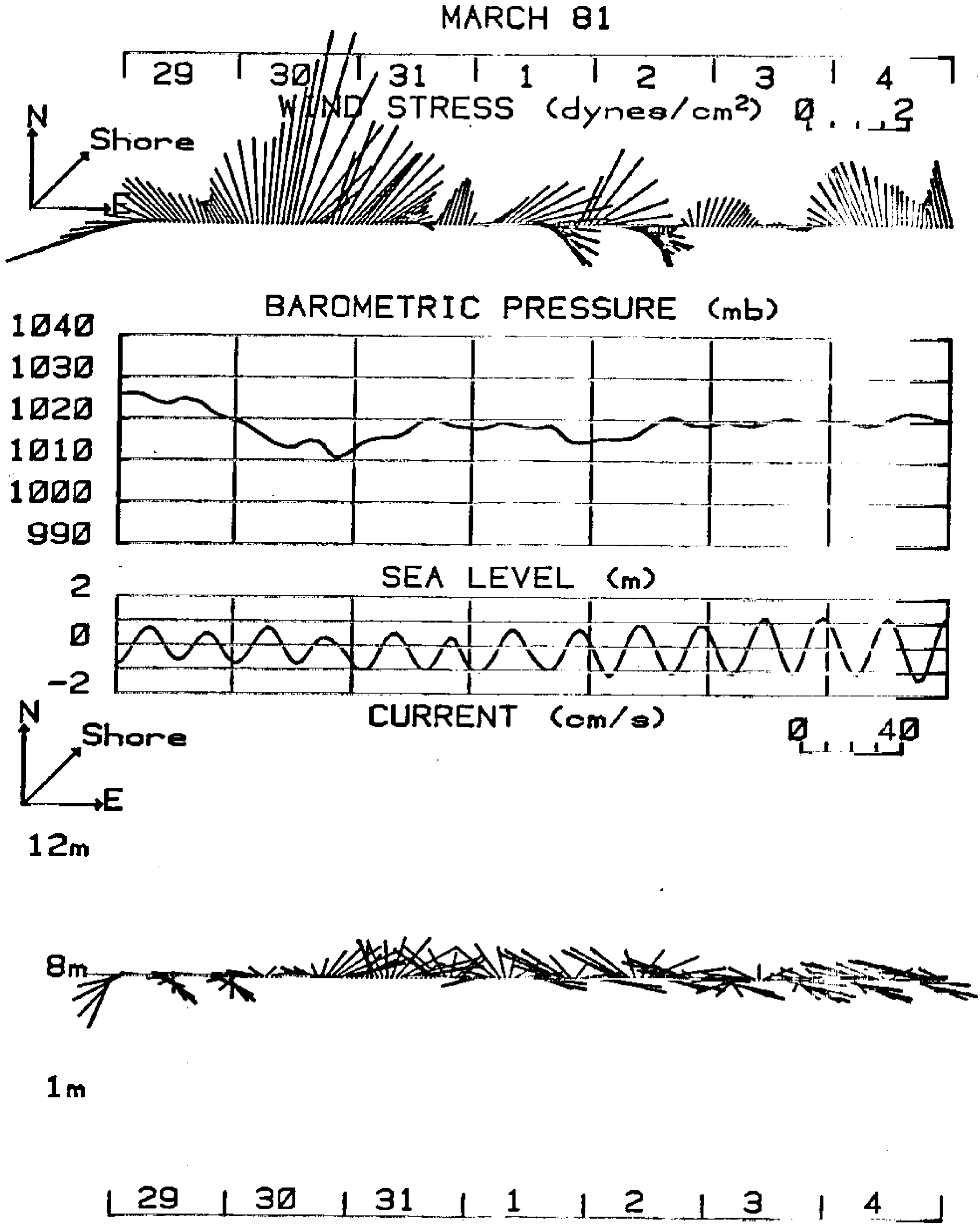
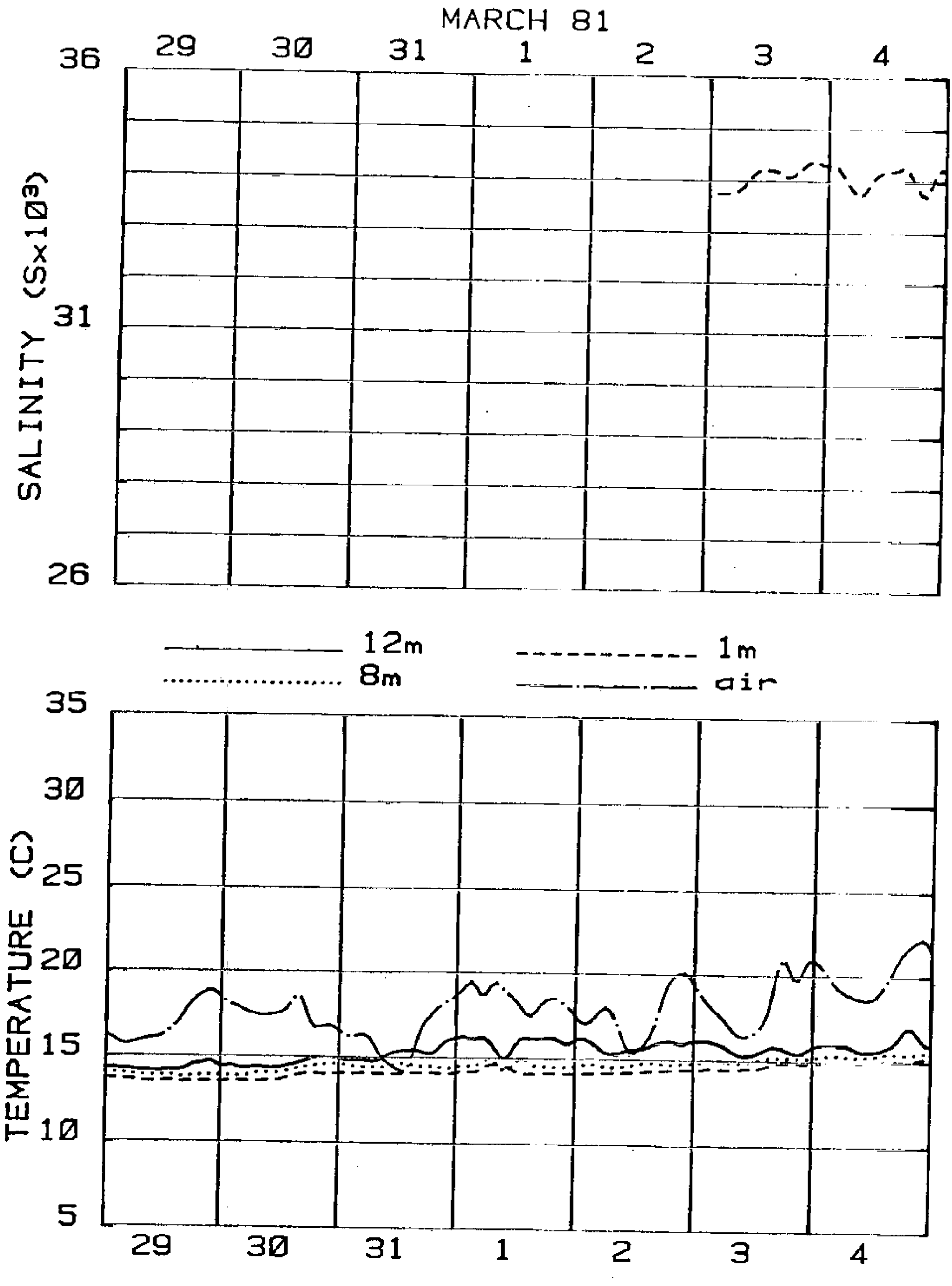
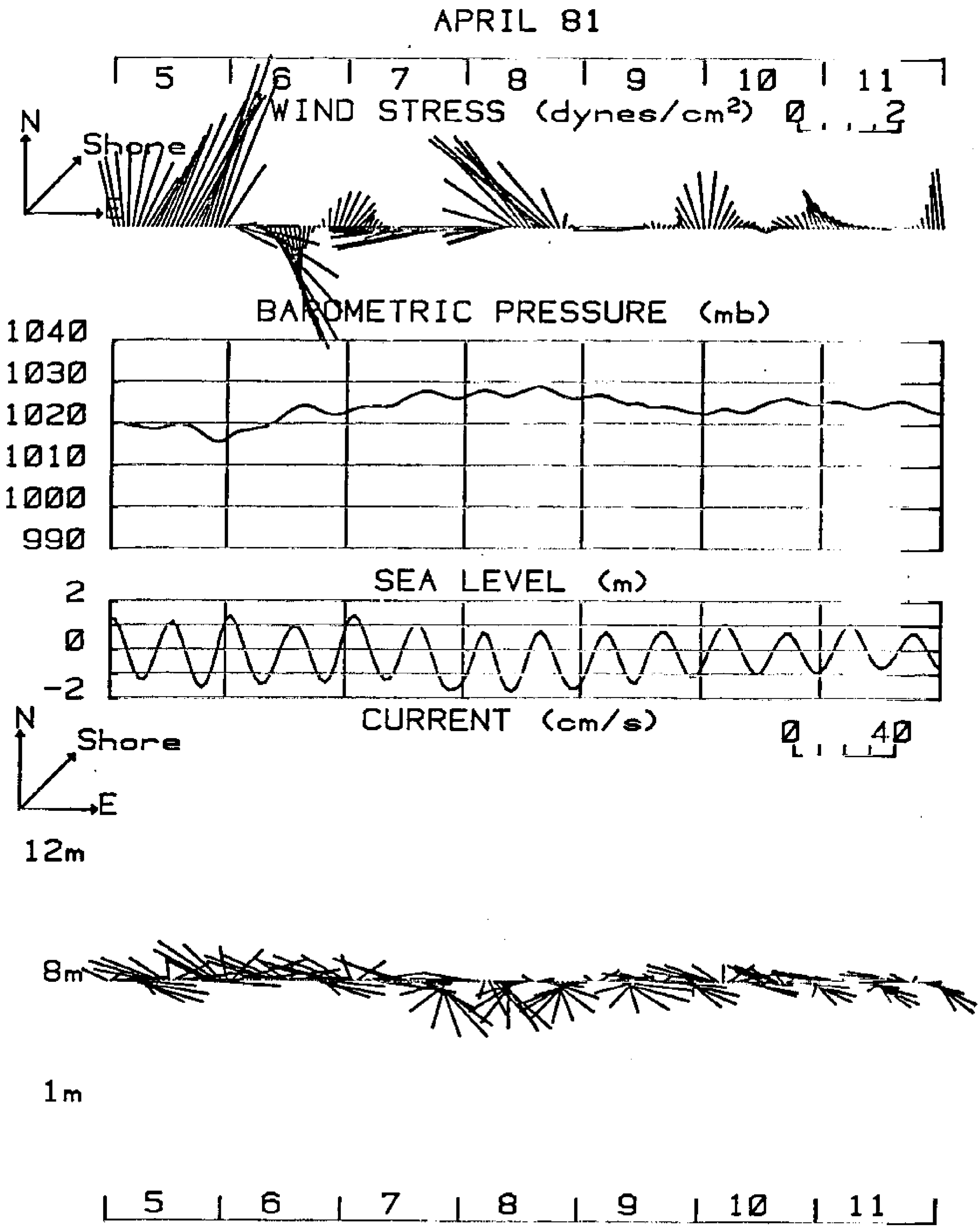
27
28
36
31
26
SALINITY (S×10³)
12m
8m
1m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
22
23
24
25
26
27
28

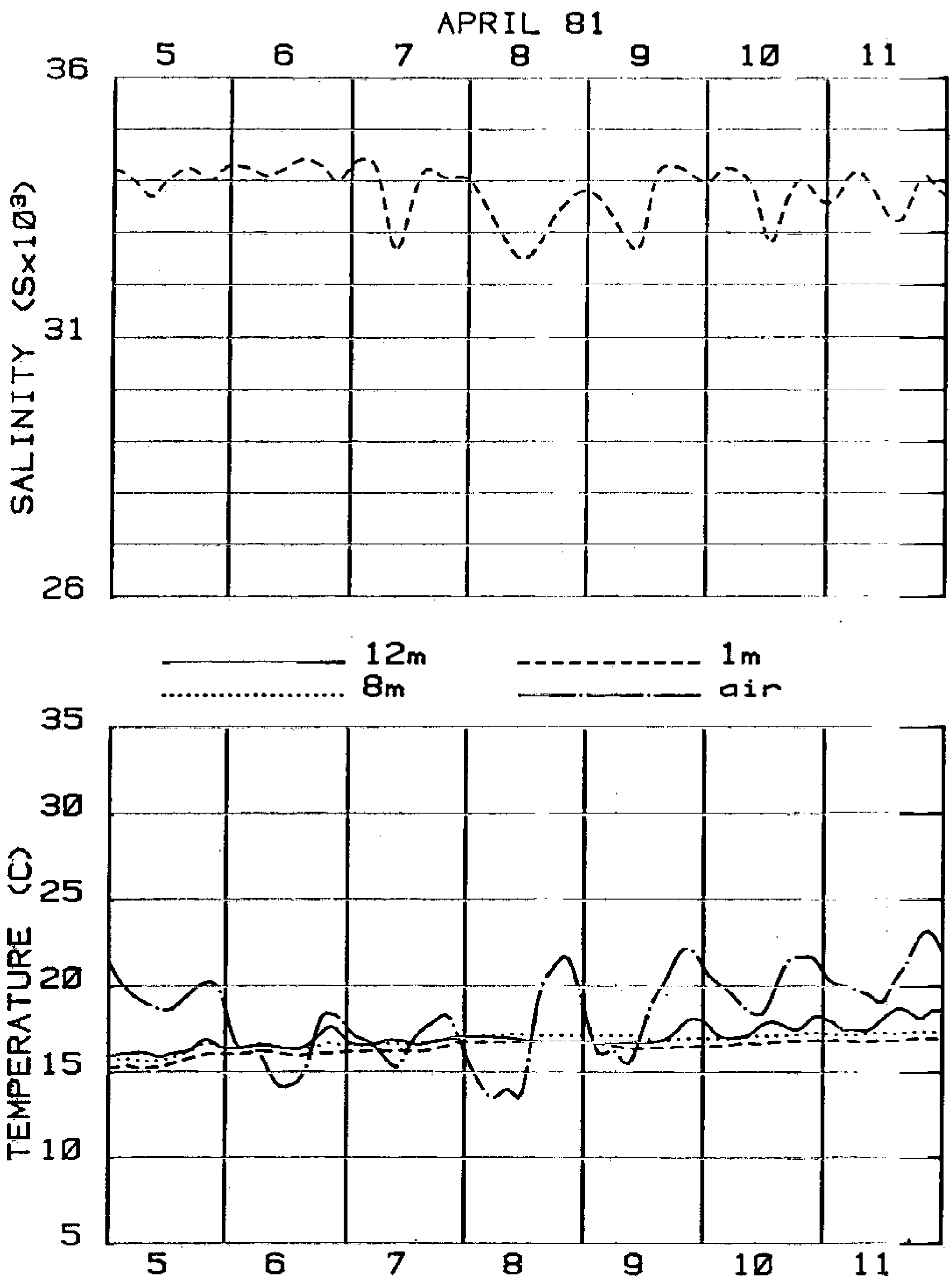


MARCH 81
29
30
31
1
2
3
4
WIND STRESS (dynes/cm²)
Ø
2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s)
Ø
40
N
Shore
E
12m
8m
1m
29
30
31
1
2
3
4

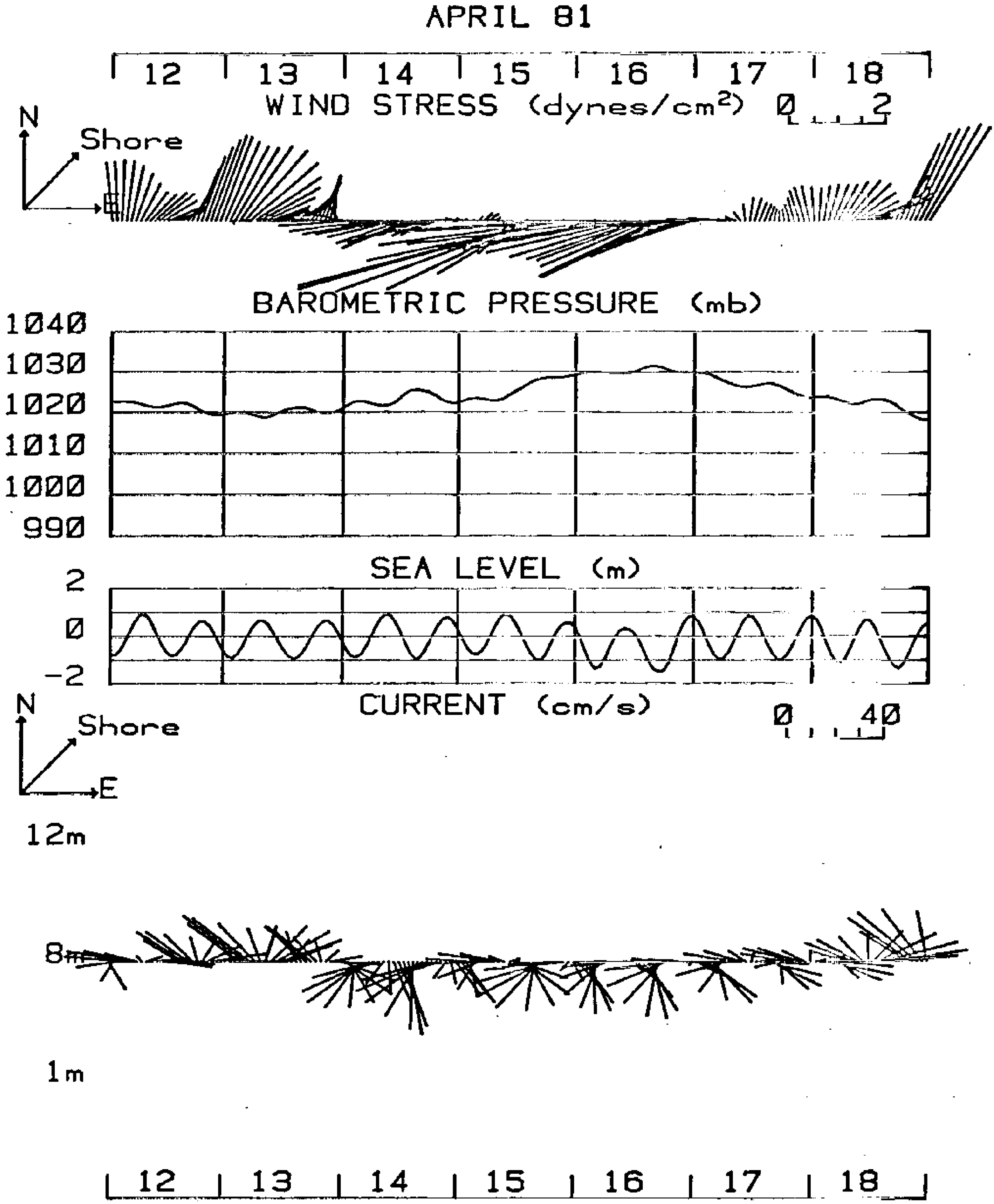


MARCH 81
29 30 31 1 2 3 4
36
31
26
SALINITY (S×10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
29 30 31 1 2 3 4


APRIL 81
5
6
7
8
9
10
11
WIND STRESS (dynes/cm²)
0
2
N
Shore
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s)
0
40
N
Shore
E
12m
8m
1m
5
6
7
8
9
10
11



APRIL 81
5
6
7
8
9
10
11
36
31
26
SALINITY (S×10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
5
6
7
8
9
10
11



APRIL 81
12
13
14
15
16
17
18
WIND STRESS (dynes/cm²)
0
2
N
Shore
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s)
0
40
N
Shore
E
12m
8m
1m
12
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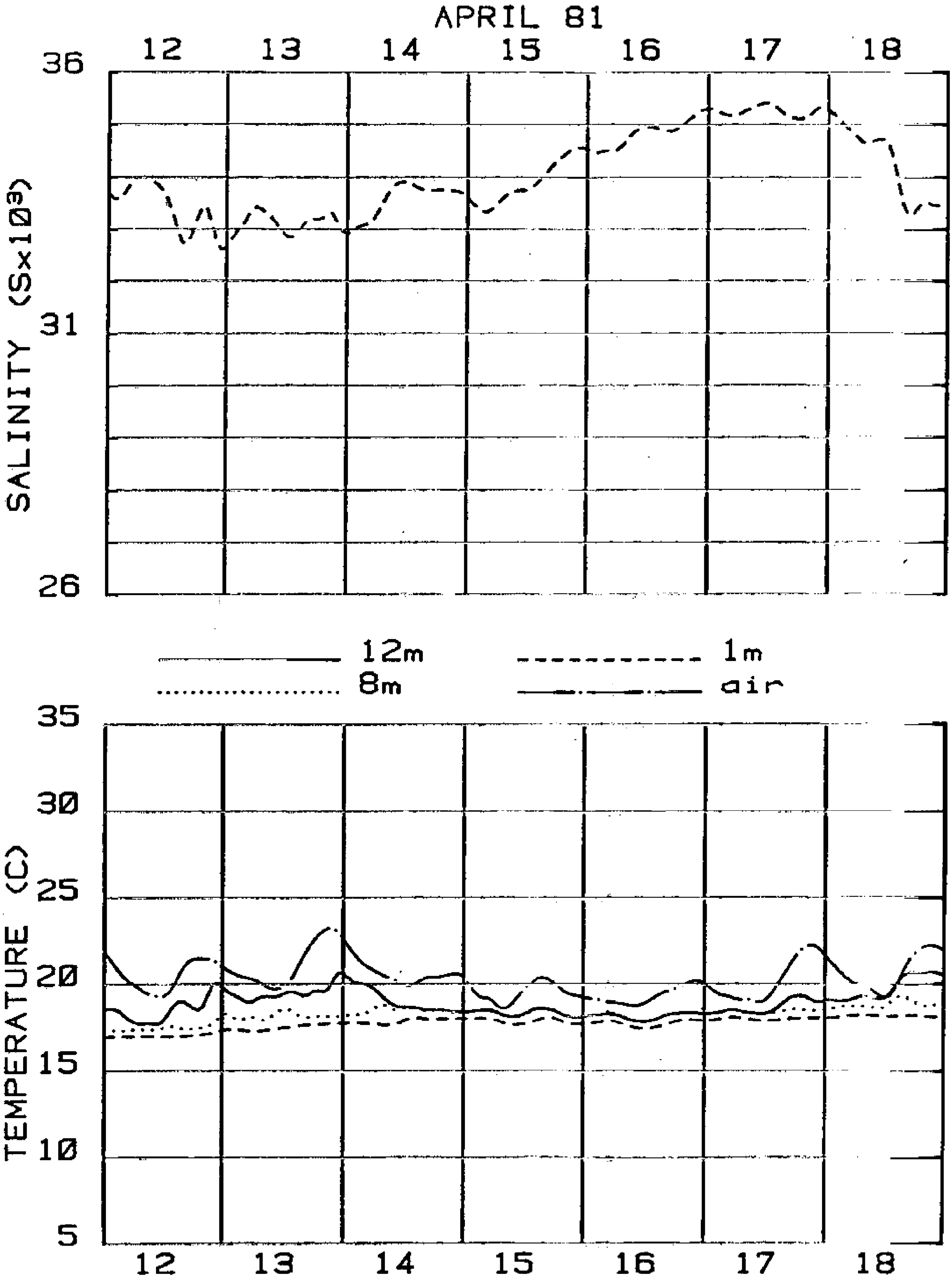
14
15
16
17
18



APRIL 81
12
13
14
15
16
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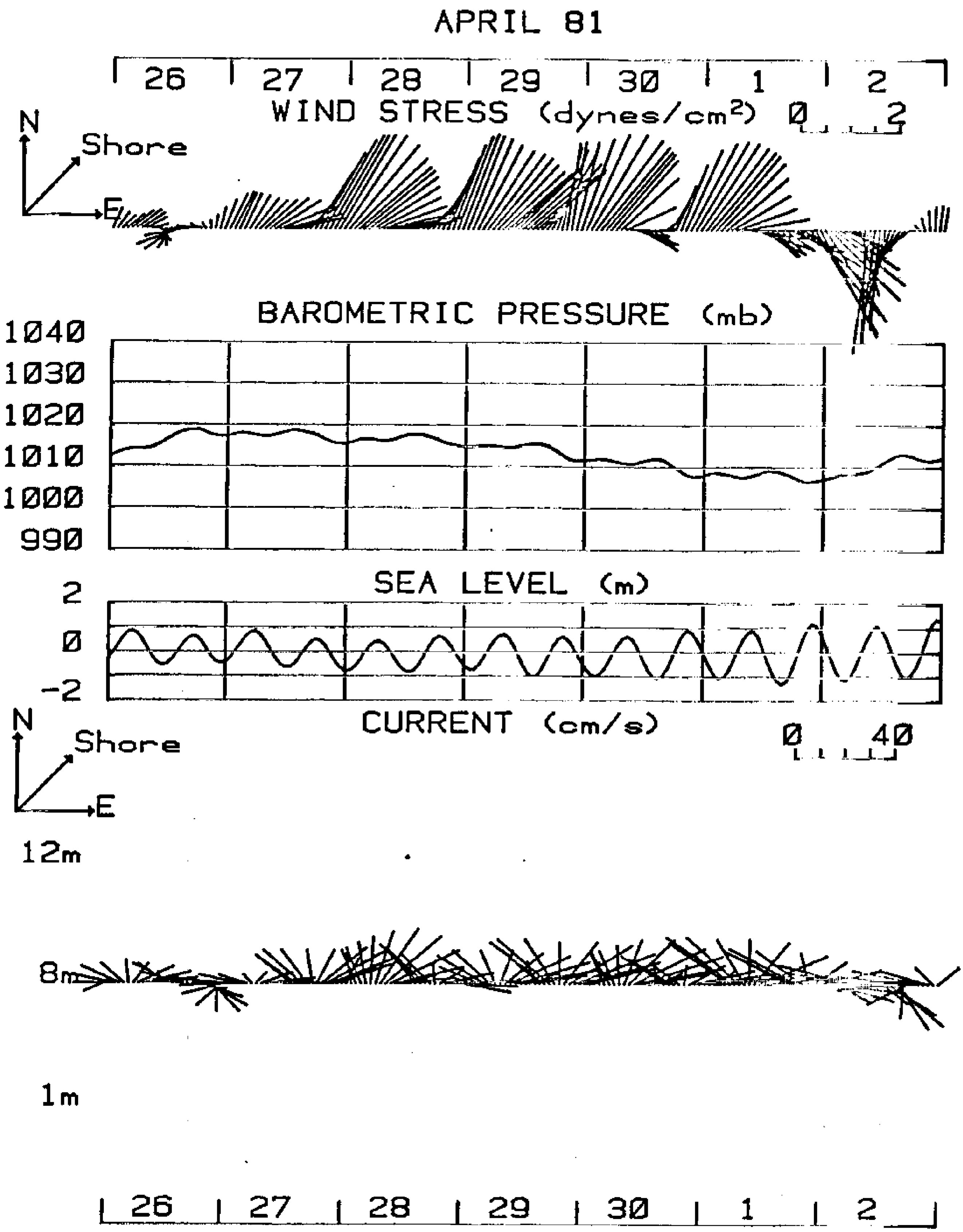
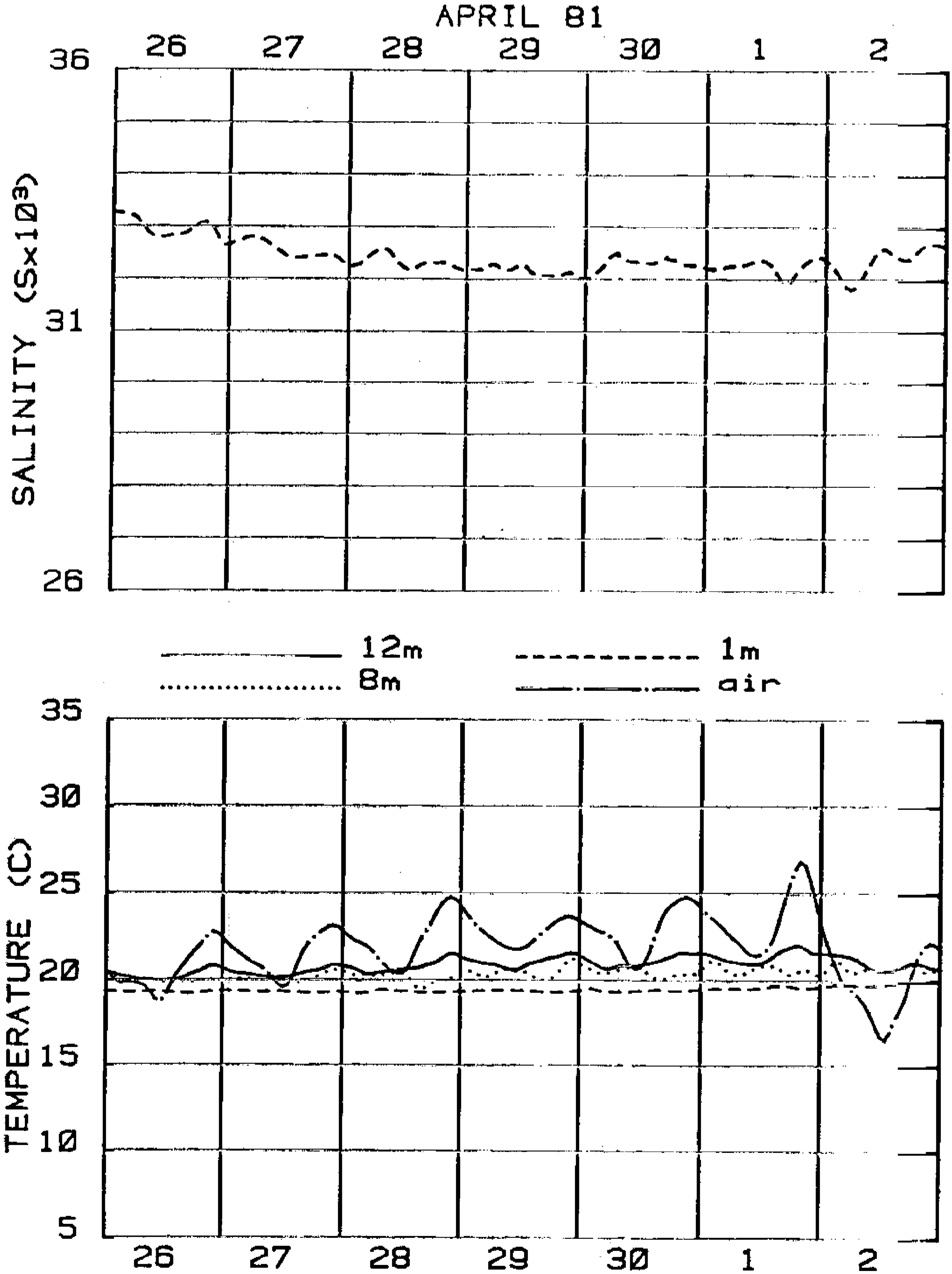
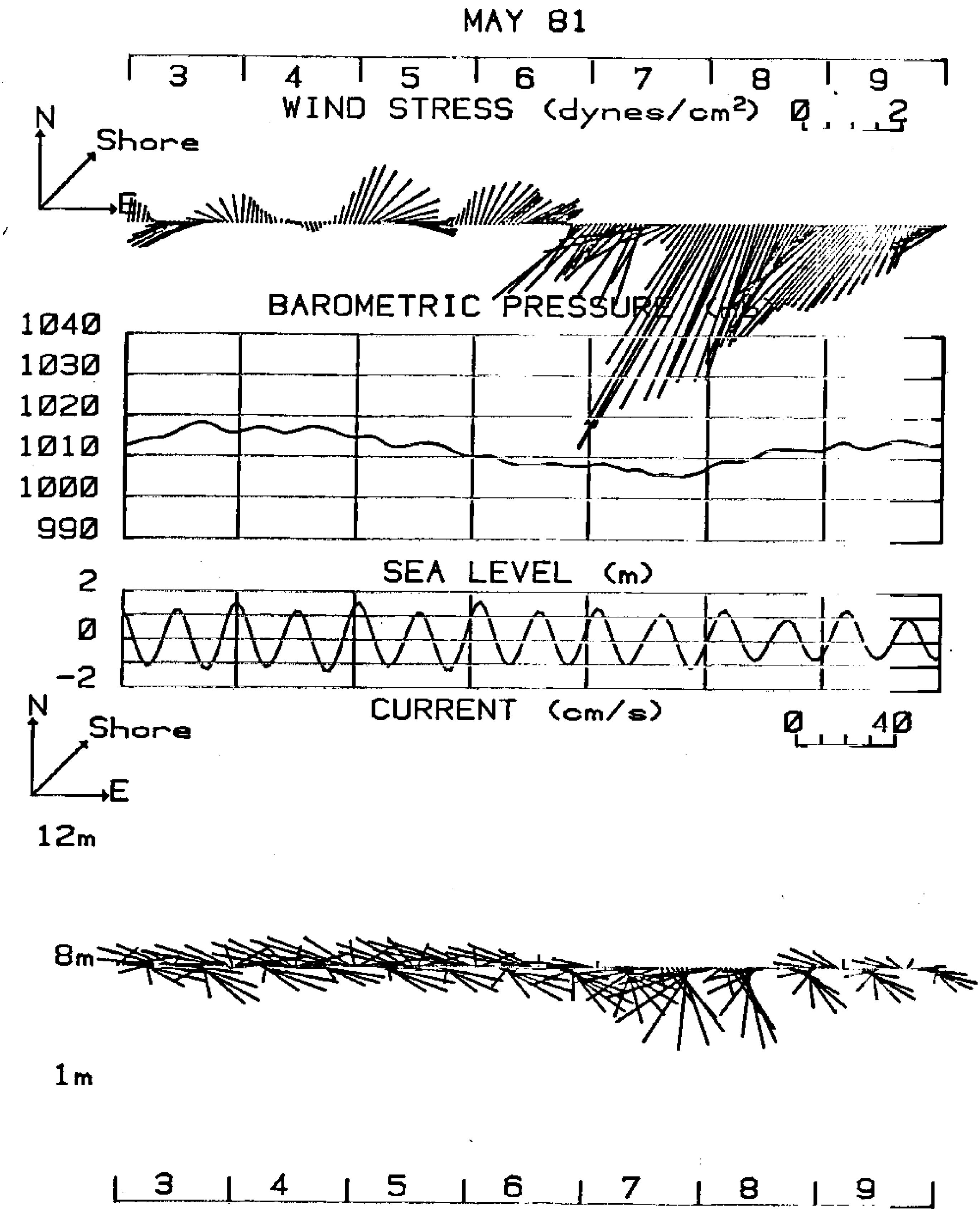
18
36
31
26
SALINITY (S×10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
12
13
14
15
16
17
18



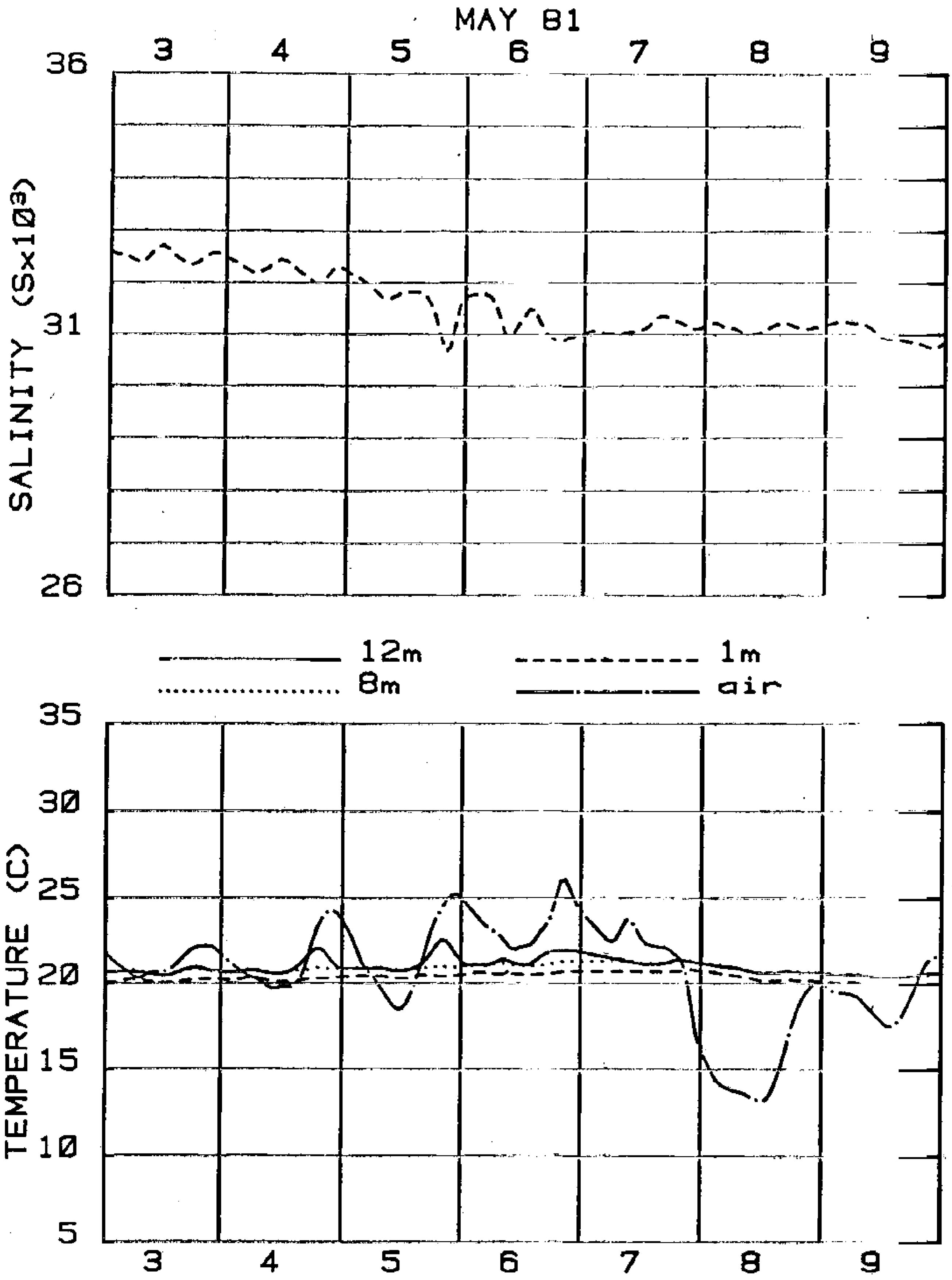
APRIL 81
26 27 28 29 30 1 2
WIND STRESS (dynes/cm²) Ø 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s)
Ø 40
N
Shore
E
12m
8m
1m
26 27 28 29 30 1 2



APRIL 81
26
27
28
29
30
1
2
36
31
26
SALINITY (S×10³)
12m
8m
1m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
26
27
28
29
30
1
2



MAY 81
3
4
5
6
7
8
9
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
3
4
5
6
7
8
9


MAY 81
3
4
5
6
7
8
9
36
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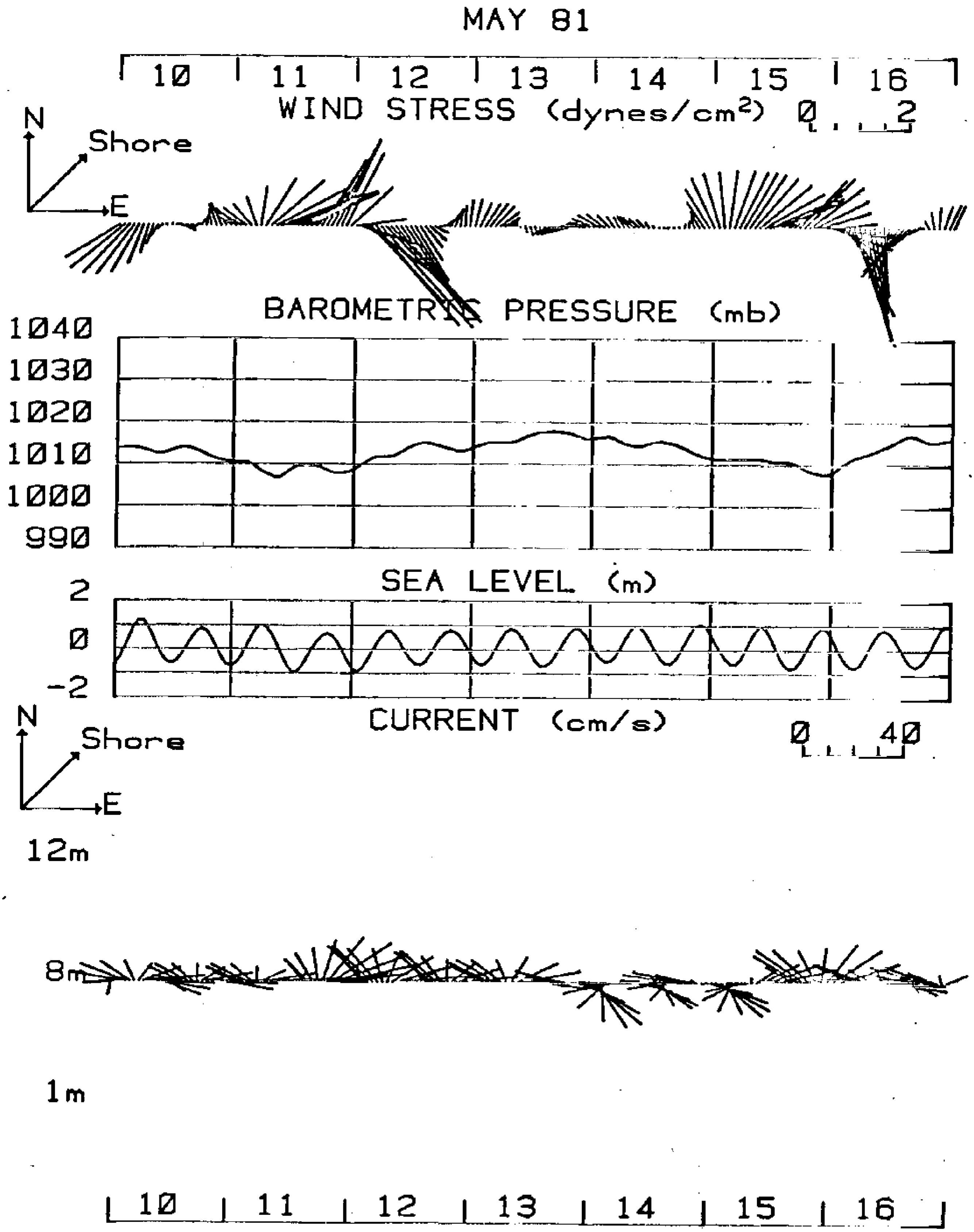
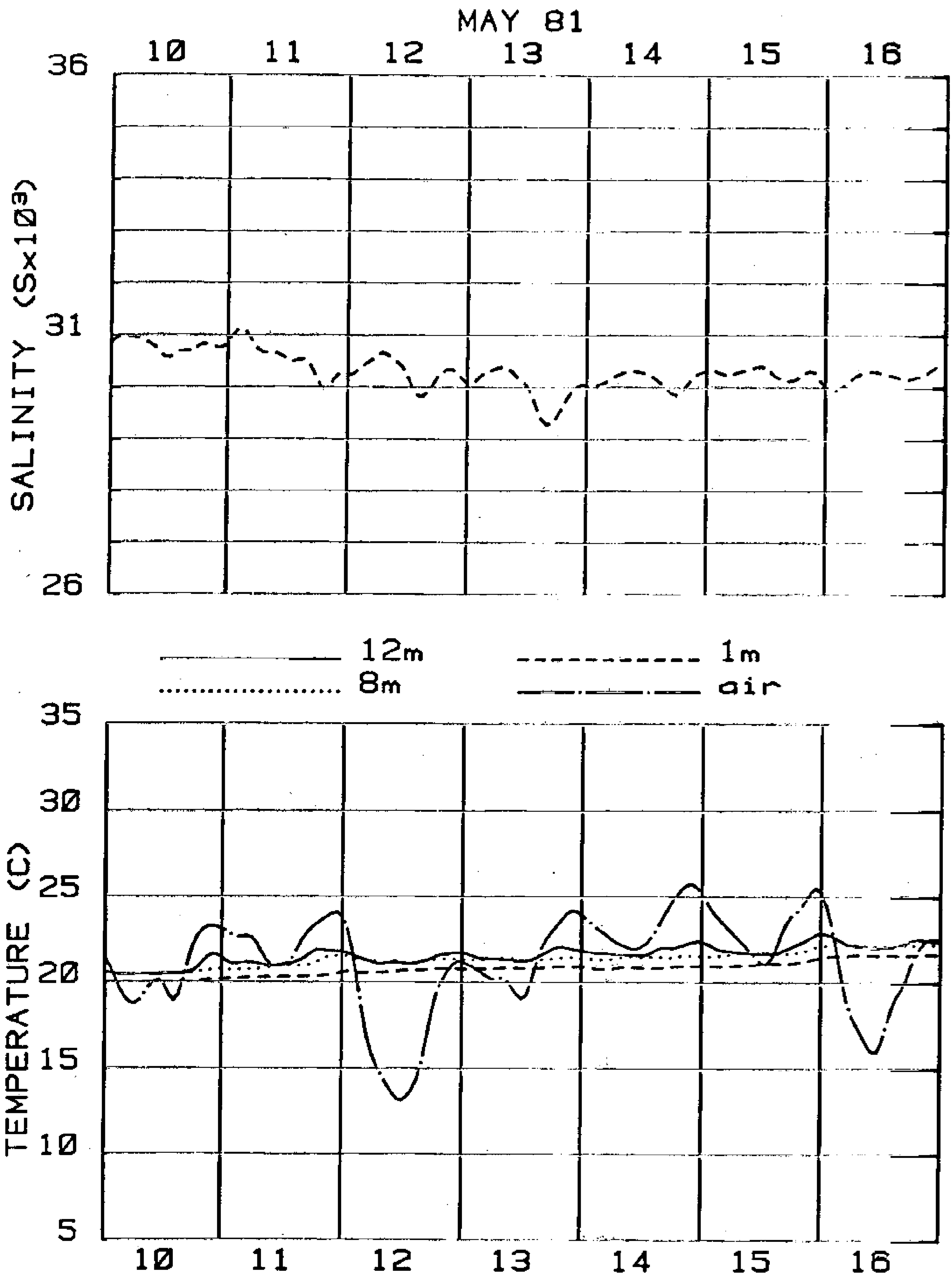
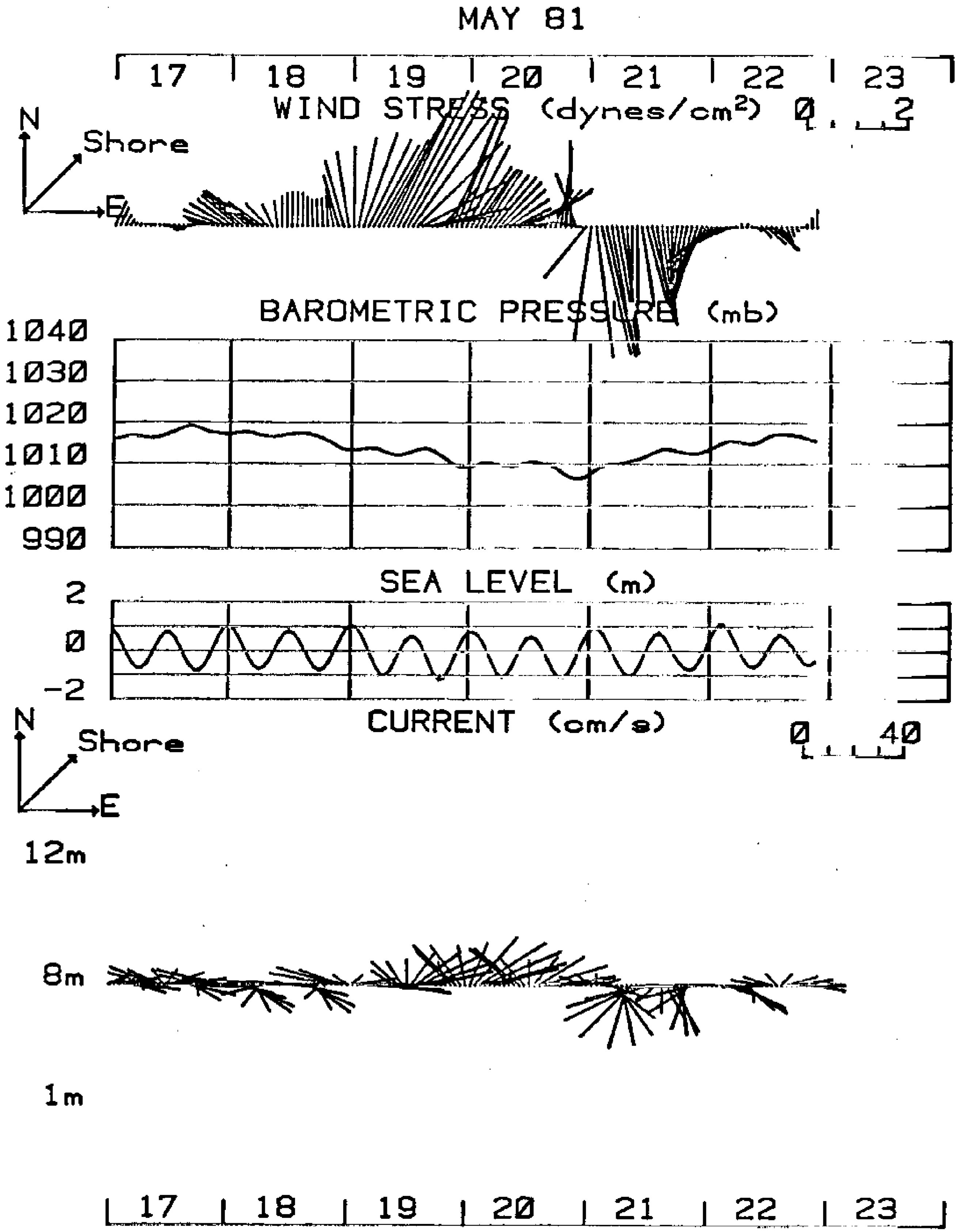
26
SALINITY (S×10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)


MAY 81
10 11 12 13 14 15 16
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
10 11 12 13 14 15 16


MAY 81
10
11
12
13
14
15
16
36
31
26
SALINITY (Sx10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
10
11
12
13
14
15
16


MAY 81
17
18
19
20
21
22
23
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s)
0 40
N
Shore
E
12m
8m
1m
17
18
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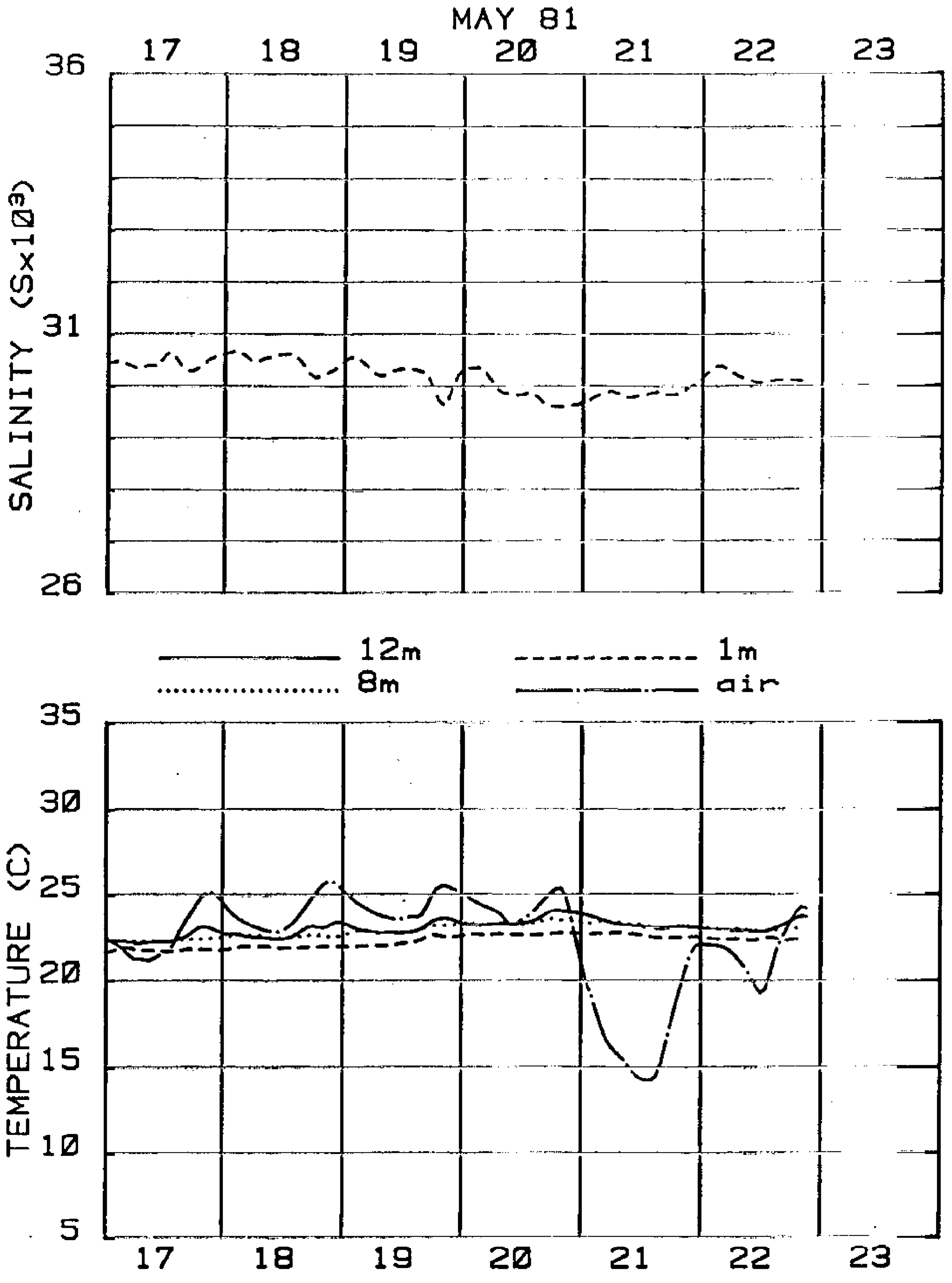
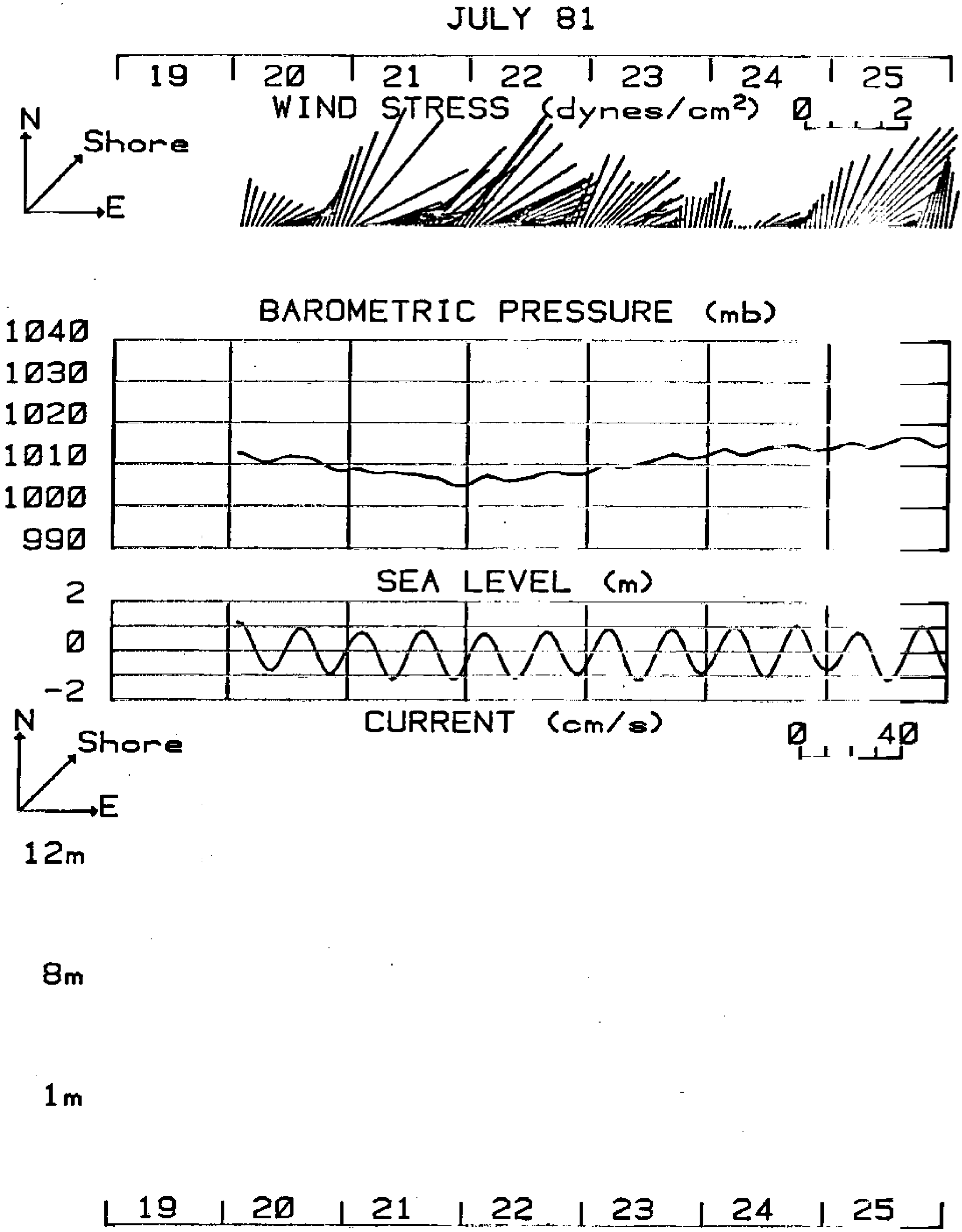
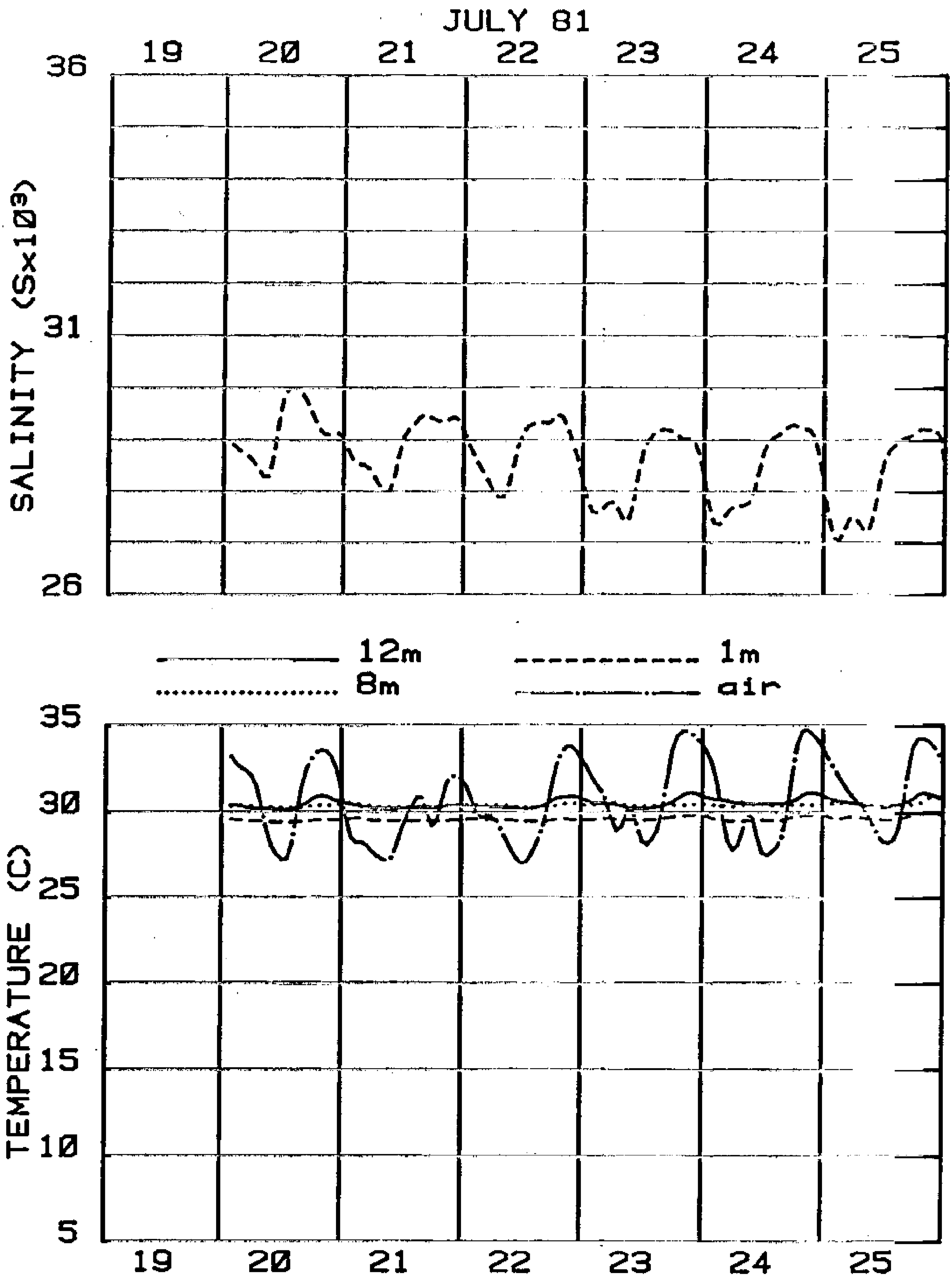
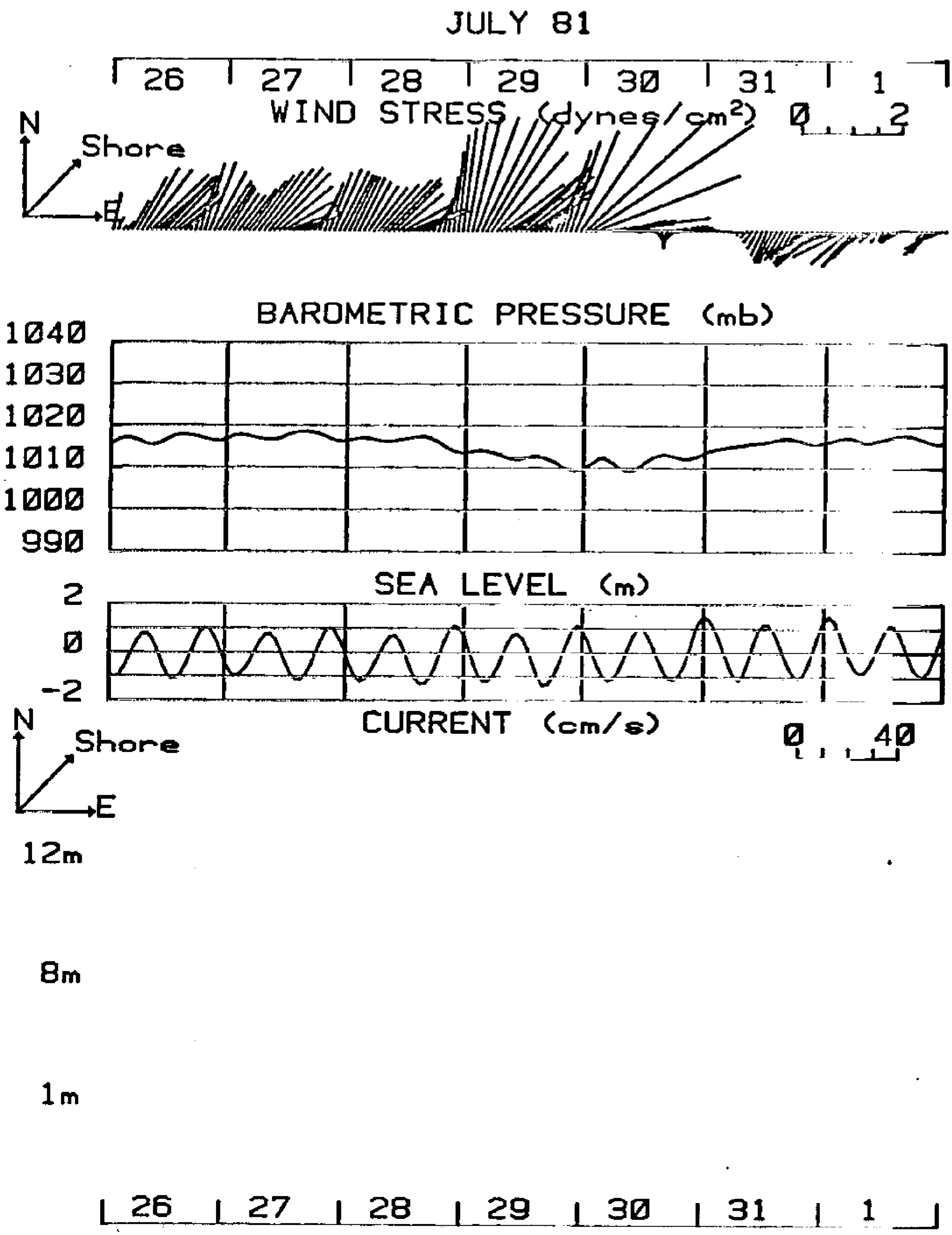
20
21
22
23

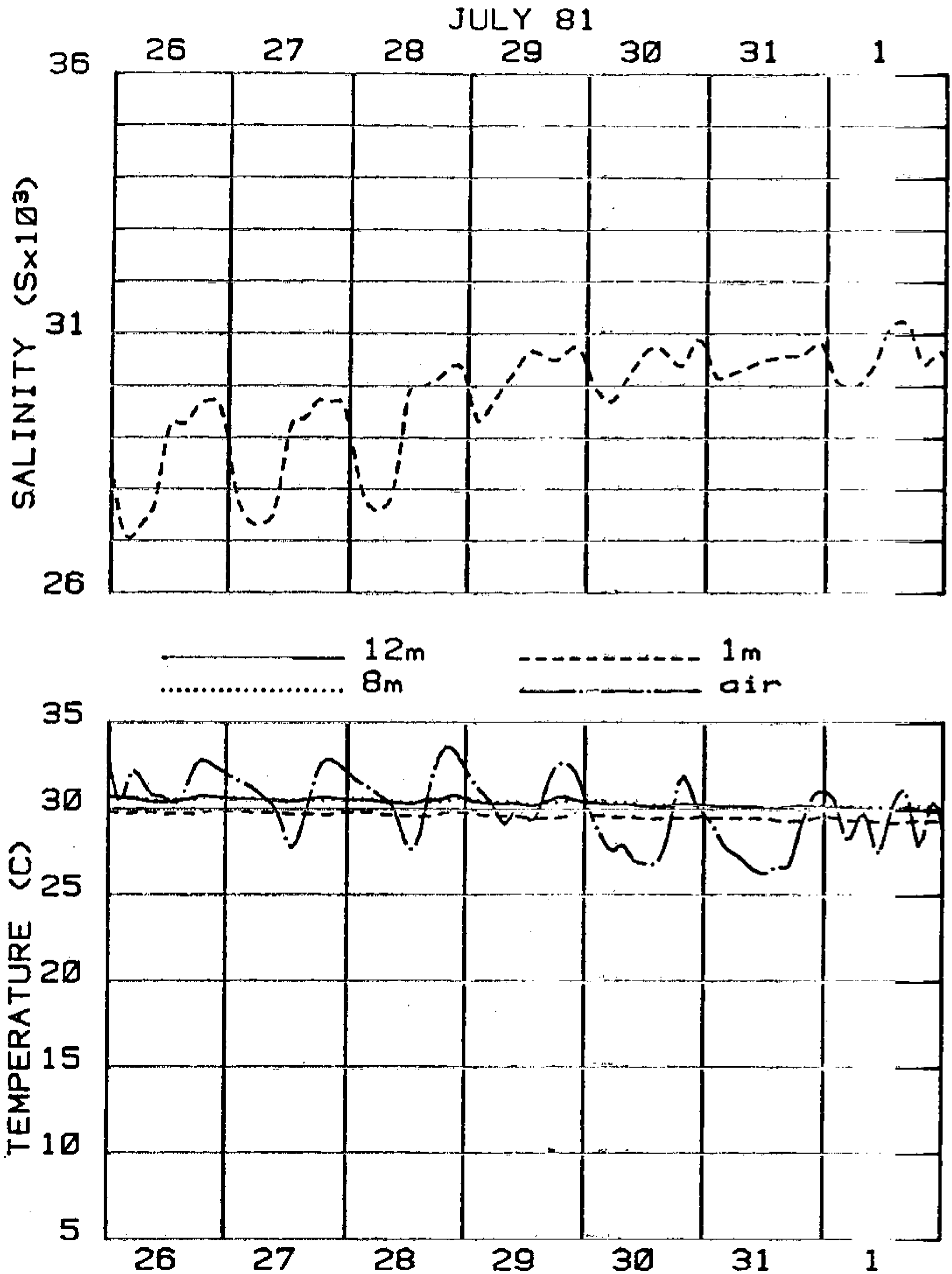


MAY 81
17
18
19
20
21
22
23
36
31
26
SALINITY (S×10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
17
18
19
20
21
22
23

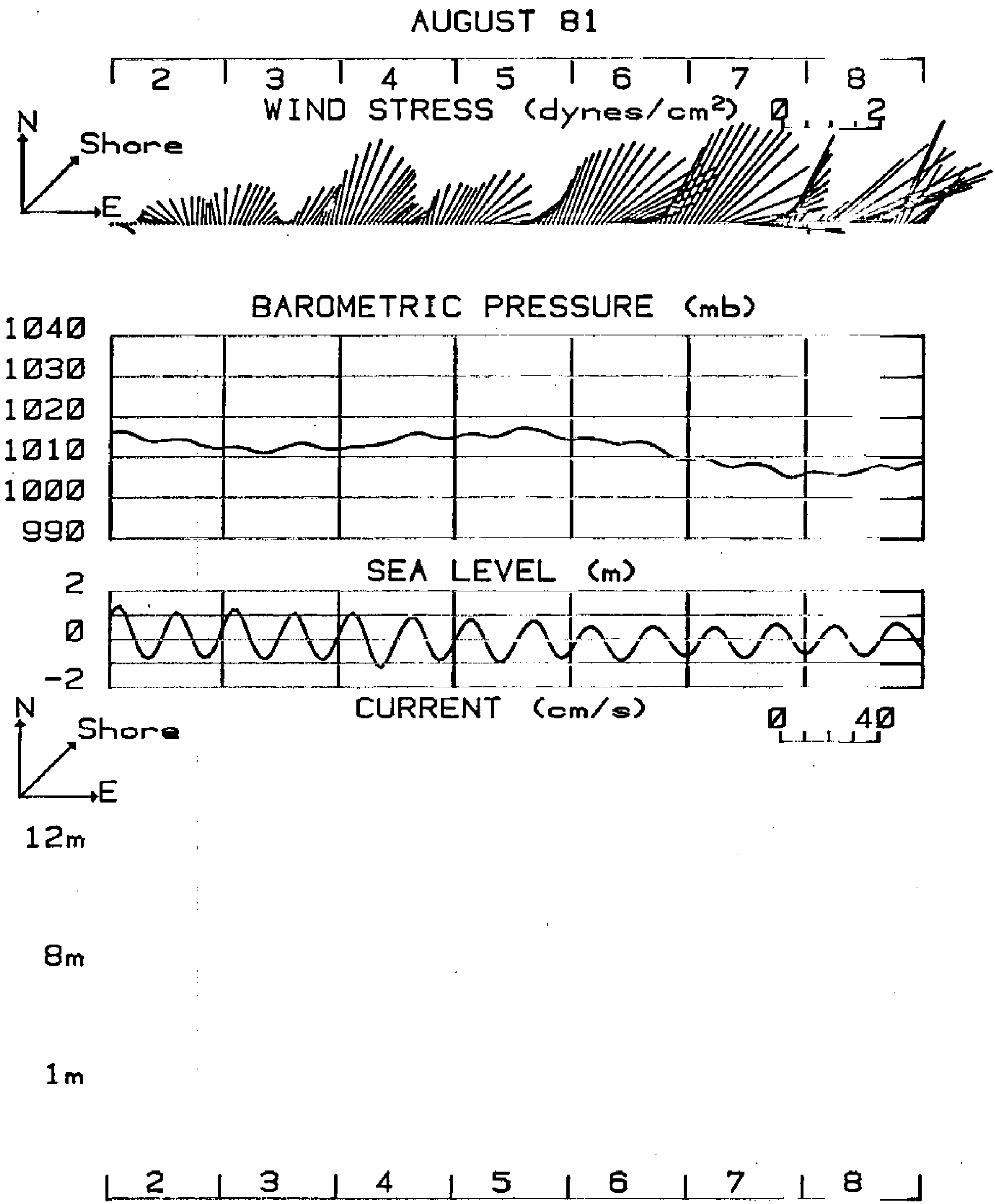

JULY 81
19 20 21 22 23 24 25
WIND STRESS (dynes/cm²) Ø 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
Ø
-2
CURRENT (cm/s) Ø 40
N
Shore
E
12m
8m
1m
19 20 21 22 23 24 25

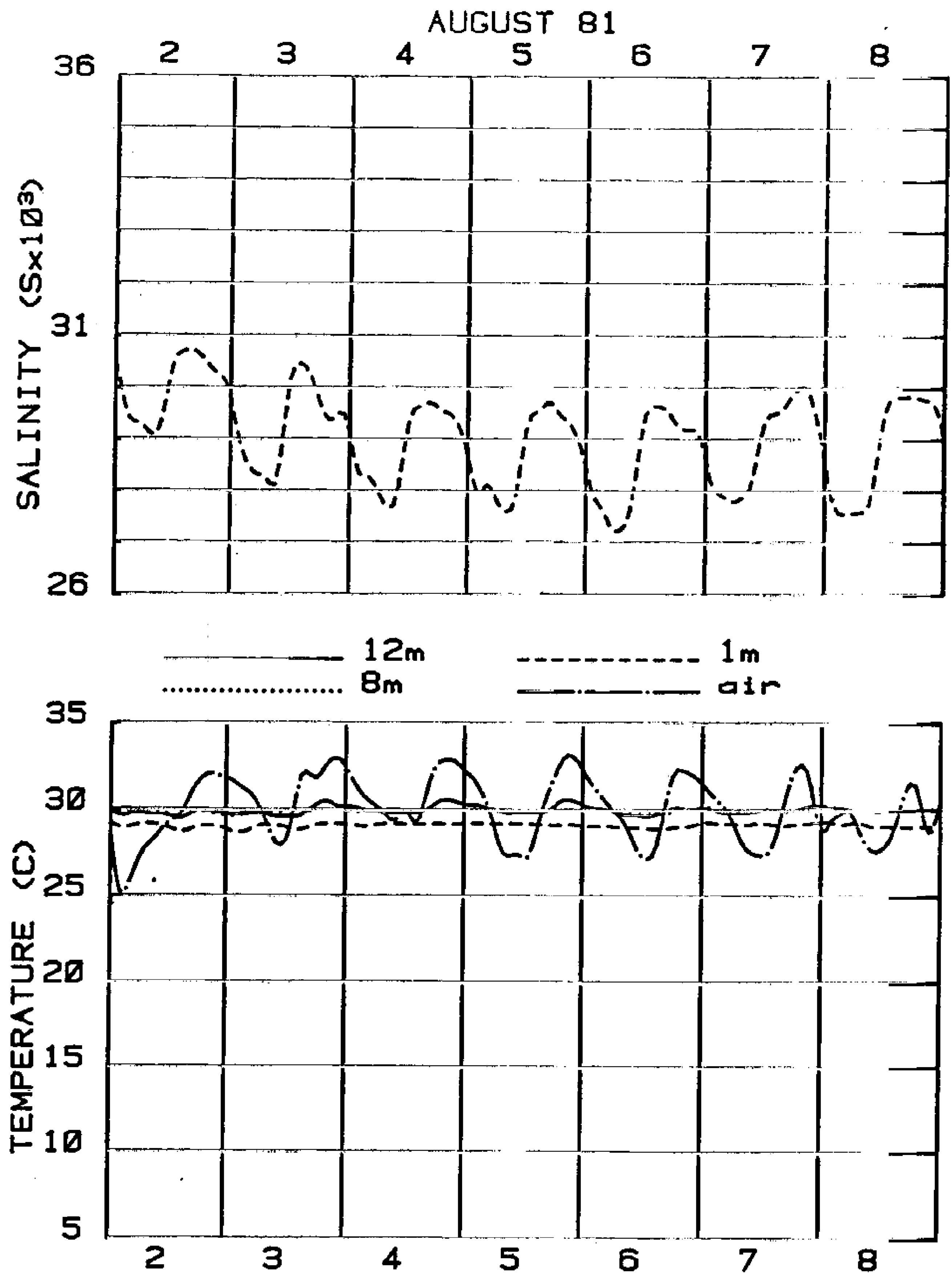

JULY 81
19
20
21
22
23
24
25
36
31
26
SALINITY (Sx10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
19
20
21
22
23
24
25


JULY 81
26
27
28
29
30
31
1
WIND STRESS (dynes/cm²)
0
2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s)
0
40
N
Shore
E
12m
8m
1m
26
27
28
29
30
31
1

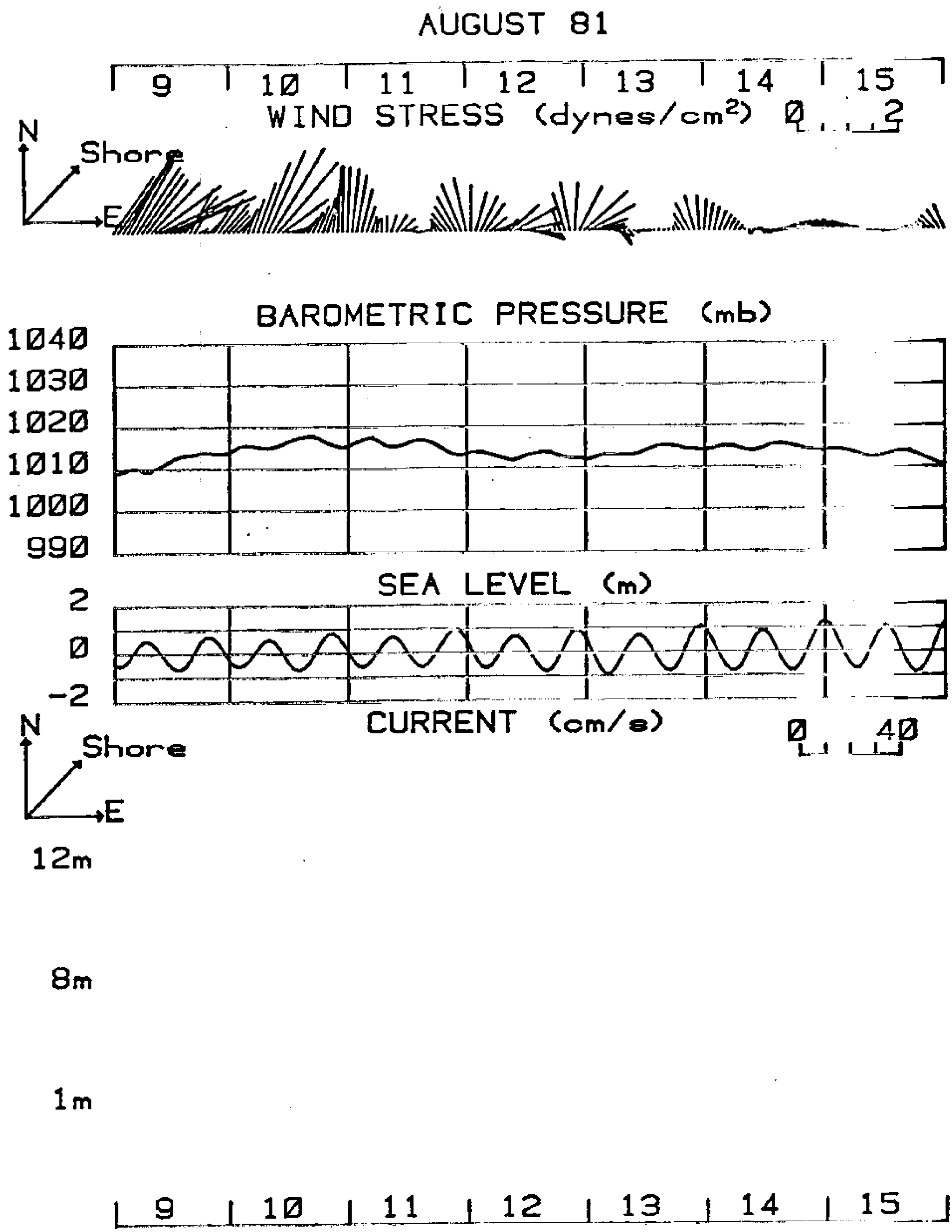


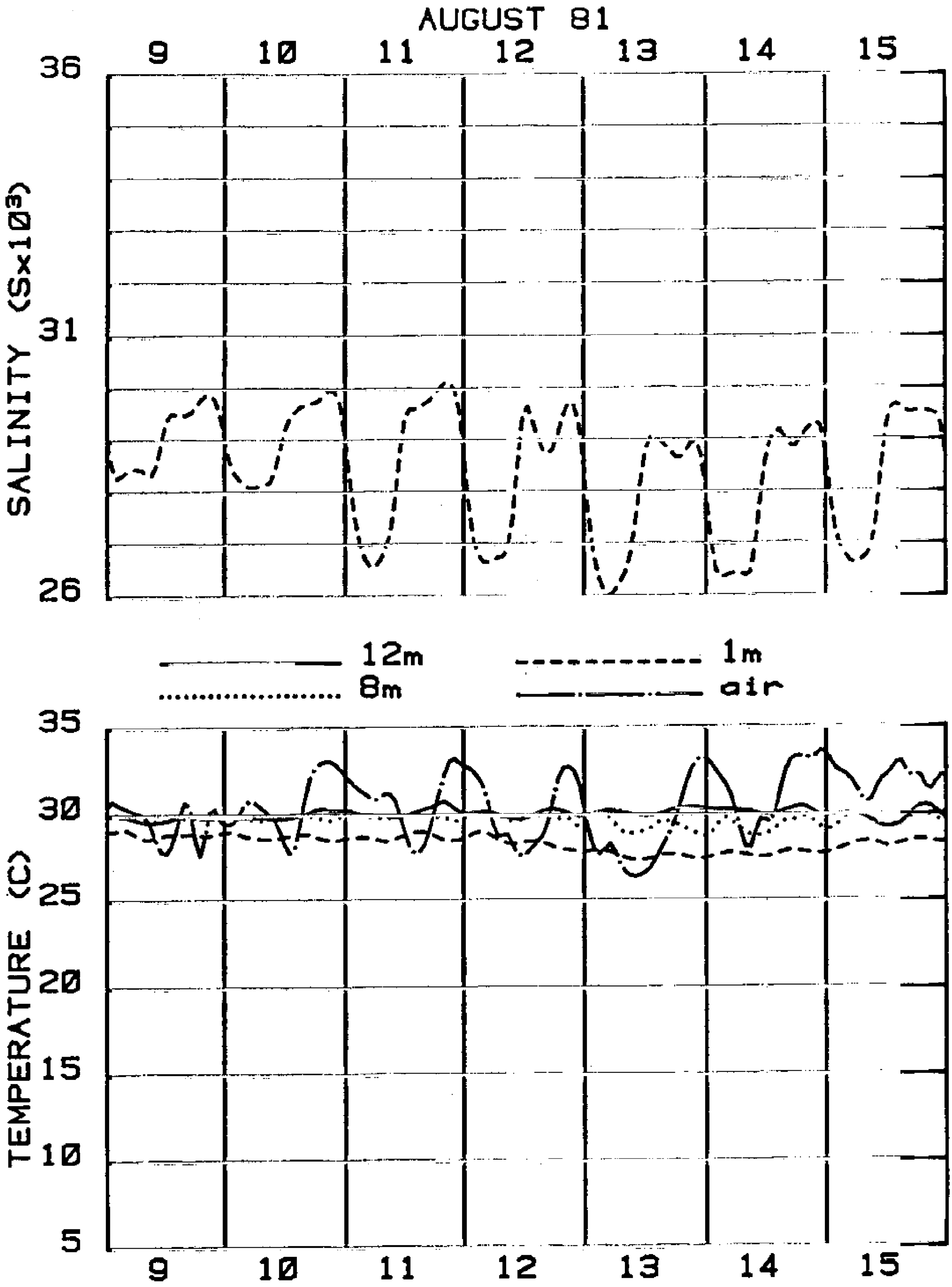
JULY 81
26
27
28
29
30
31
1
36
31
26
SALINITY (S×10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
26
27
28
29
30
31
1


AUGUST 81
2 3 4 5 6 7 8
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
2 3 4 5 6 7 8

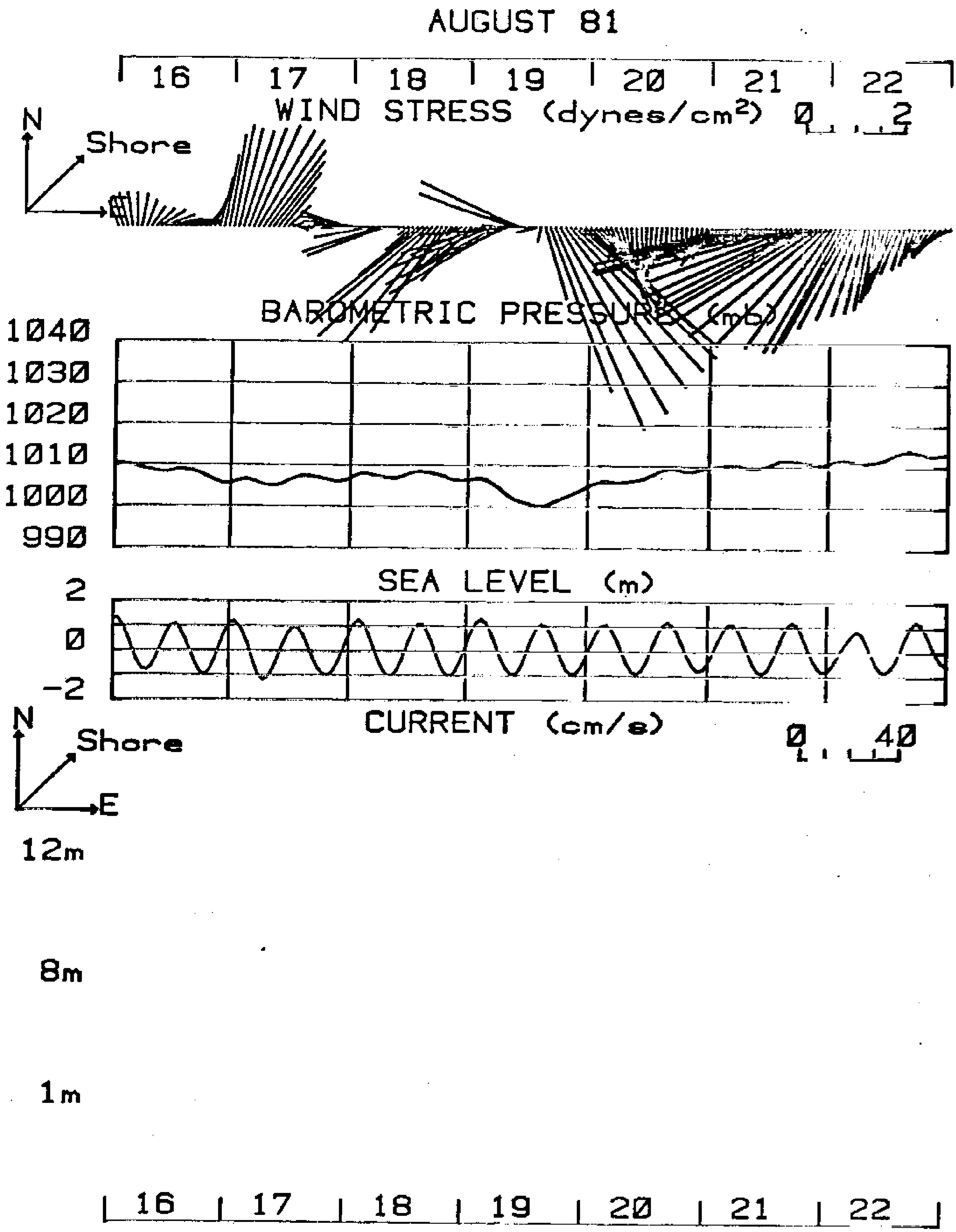


AUGUST 81
2 3 4 5 6 7 8
36
31
26
SALINITY (Sx10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
2 3 4 5 6 7 8

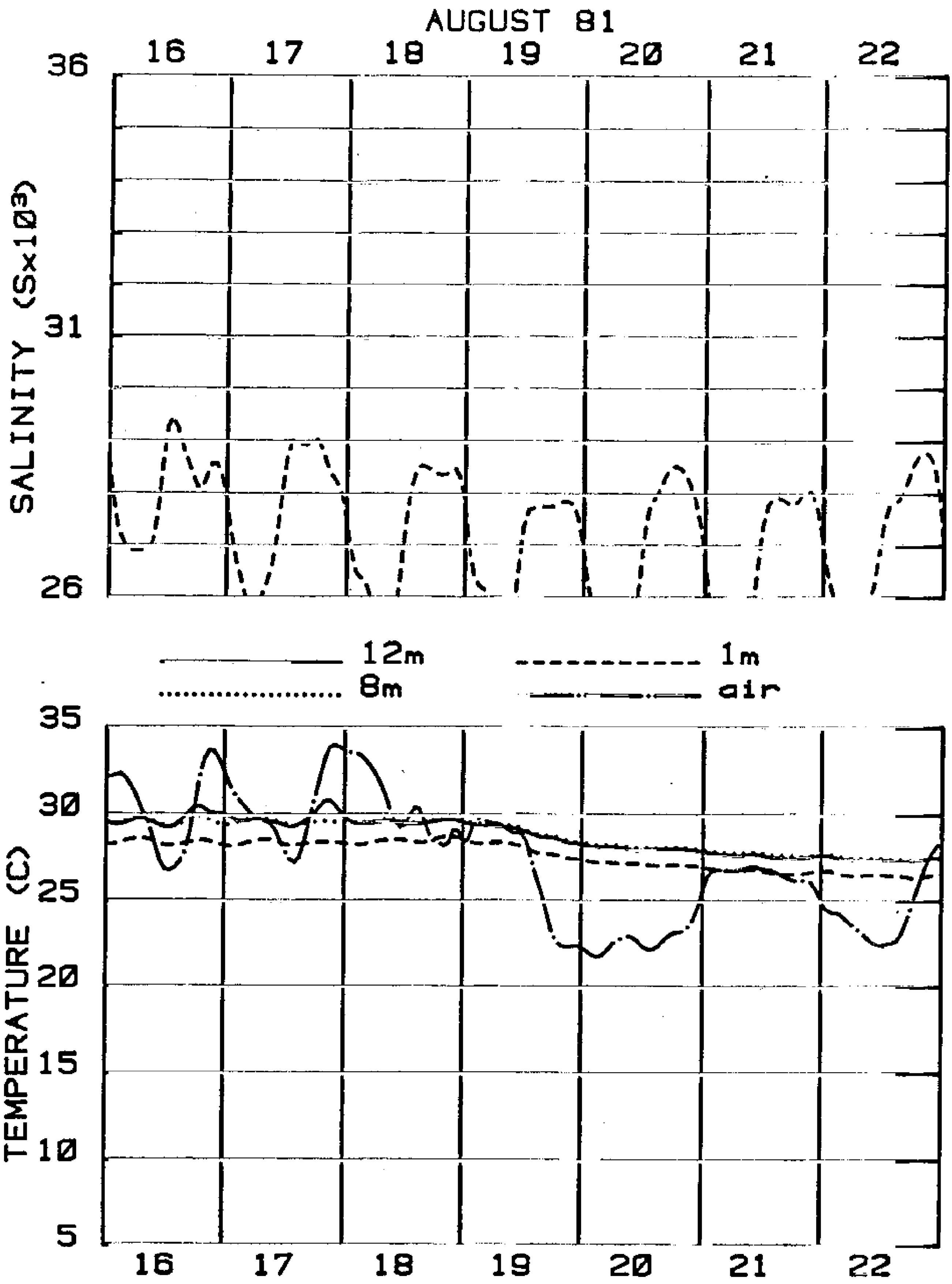

AUGUST 81
9
10
11
12
13
14
15
WIND STRESS (dynes/cm²) Ø 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1Ø4Ø
1Ø3Ø
1Ø2Ø
1Ø1Ø
1ØØØ
99Ø
SEA LEVEL (m)
2
Ø
-2
CURRENT (cm/s) Ø 4Ø
N
Shore
E
12m
8m
1m
9
1Ø
11
12
13
14
15



AUGUST 81
9
10
11
12
13
14
15
SALINITY (Sx10³)
36
31
26
12m
8m
1m
air
TEMPERATURE (C)
35
30
25
20
15
10
5



AUGUST 81
16 17 18 19 20 21 22
WIND STRESS (dynes/cm²) 0 2
N
Shore
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
16 17 18 19 20 21 22



AUGUST 81
16
17
18
19
20
21
22
36
31
26
SALINITY (S×10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
16
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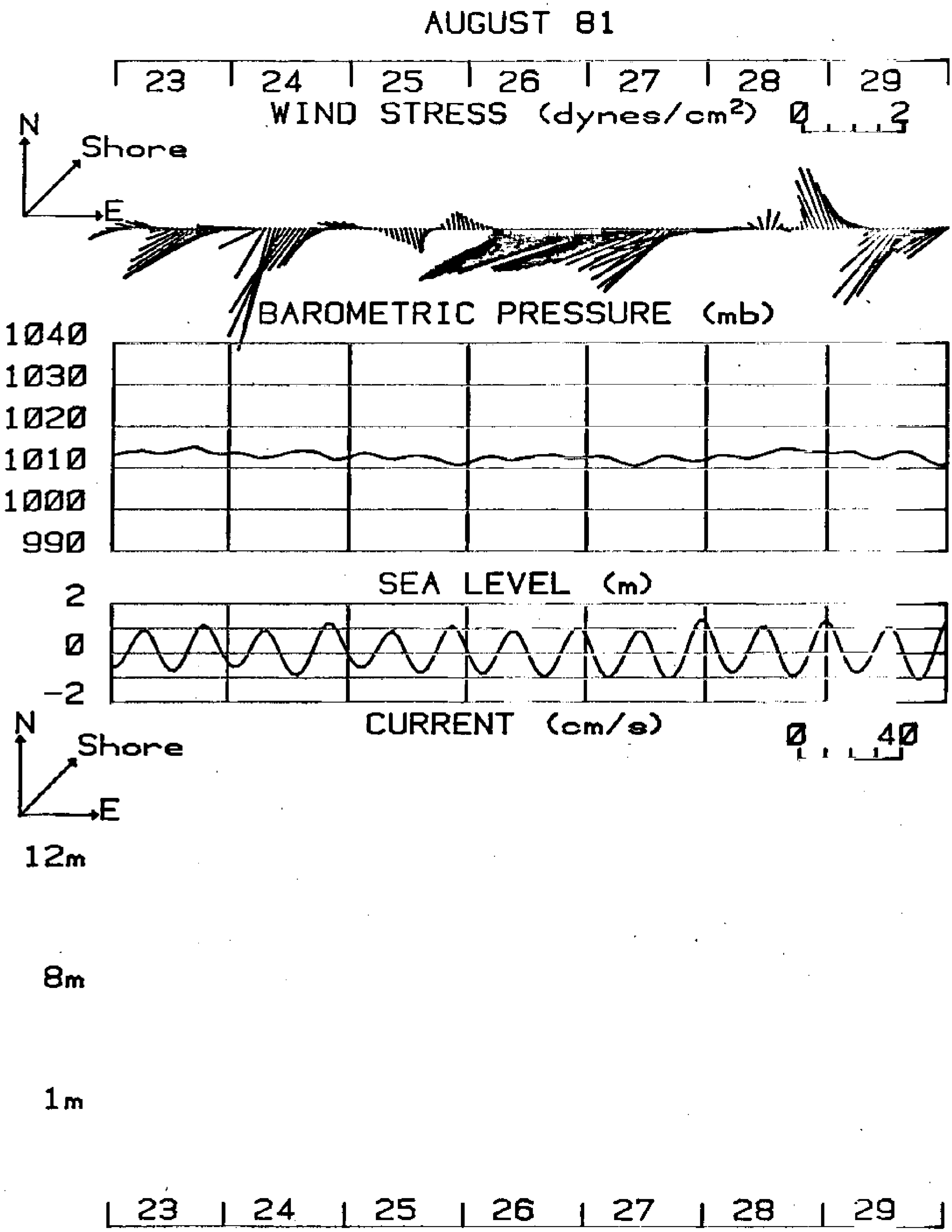
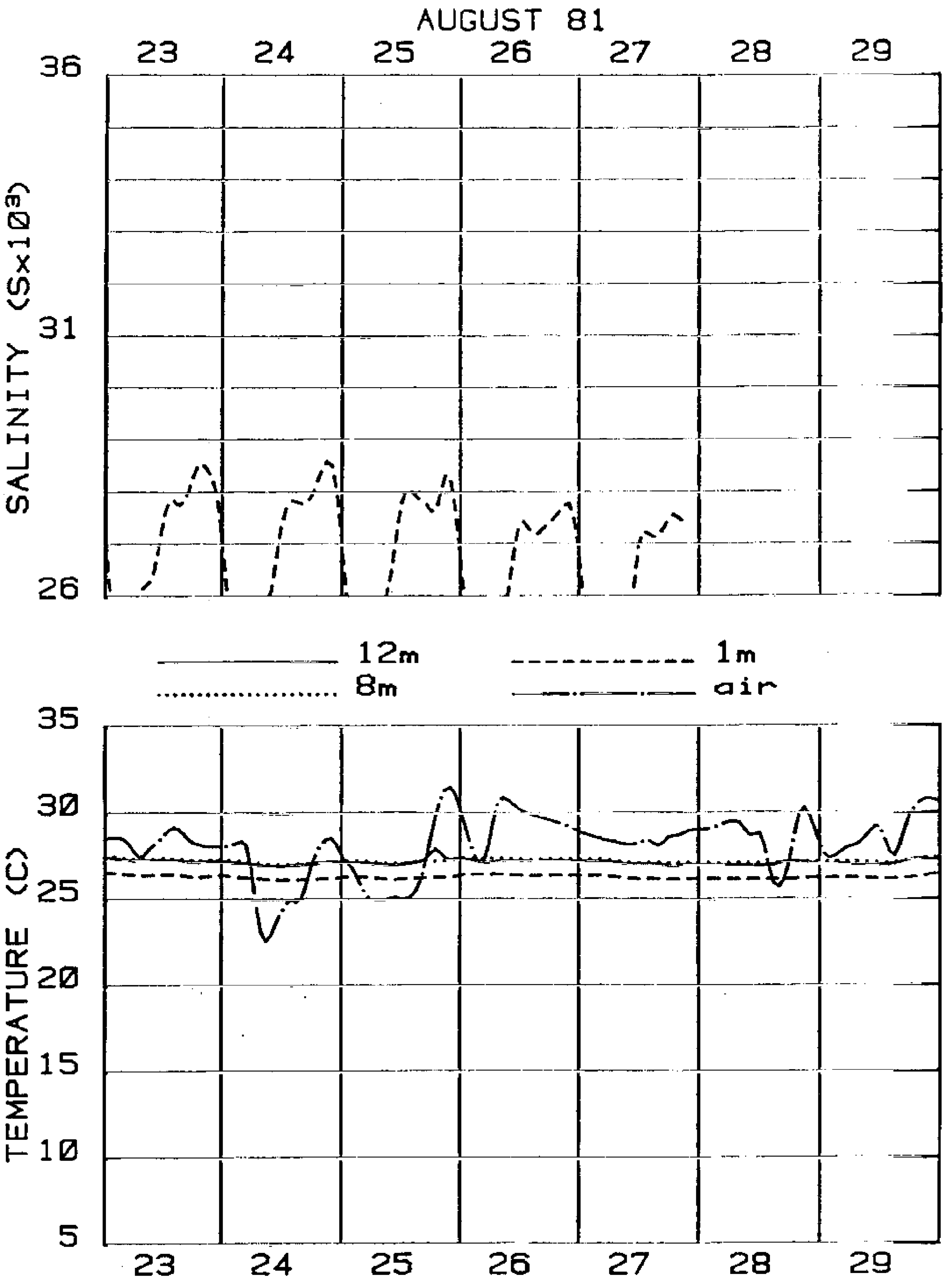
18
19
20
21
22



AUGUST 81
23 24 25 26 27 28 29
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
23 24 25 26 27 28 29



AUGUST 81
23
24
25
26
27
28
29
36
31
26
SALINITY (S×10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
23
24
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26
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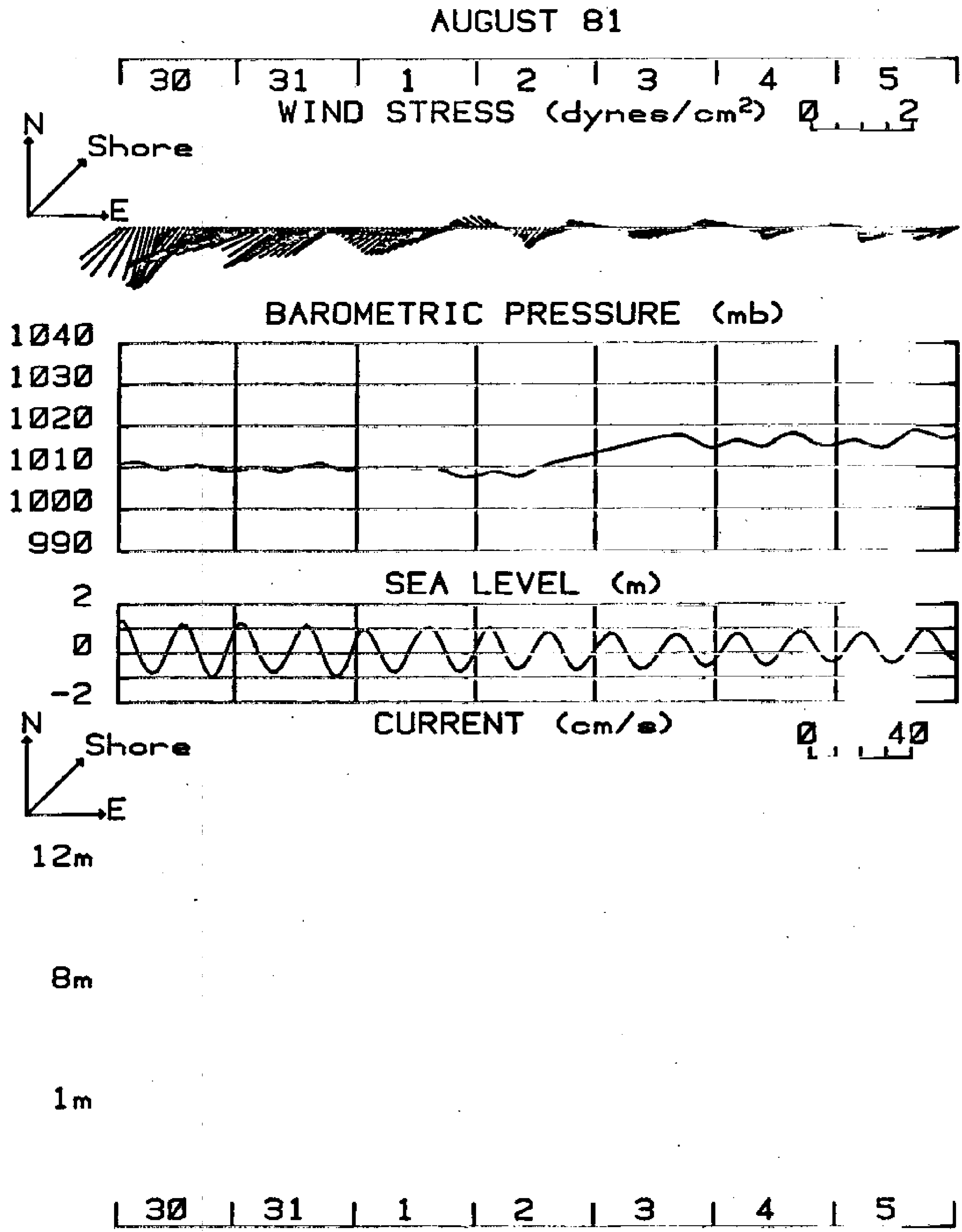
29


AUGUST 81
30
31
1
2
3
4
5
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
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1m
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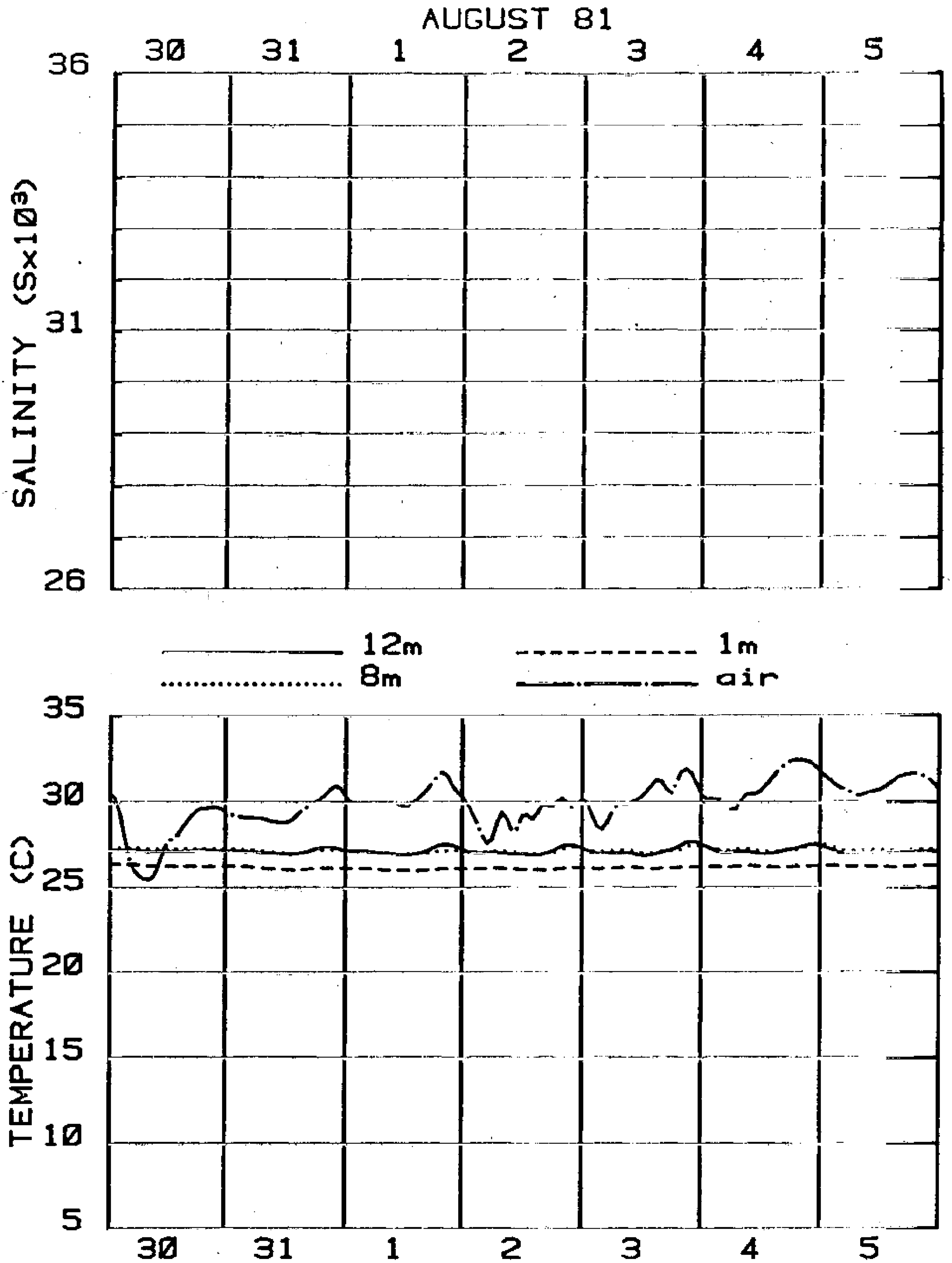
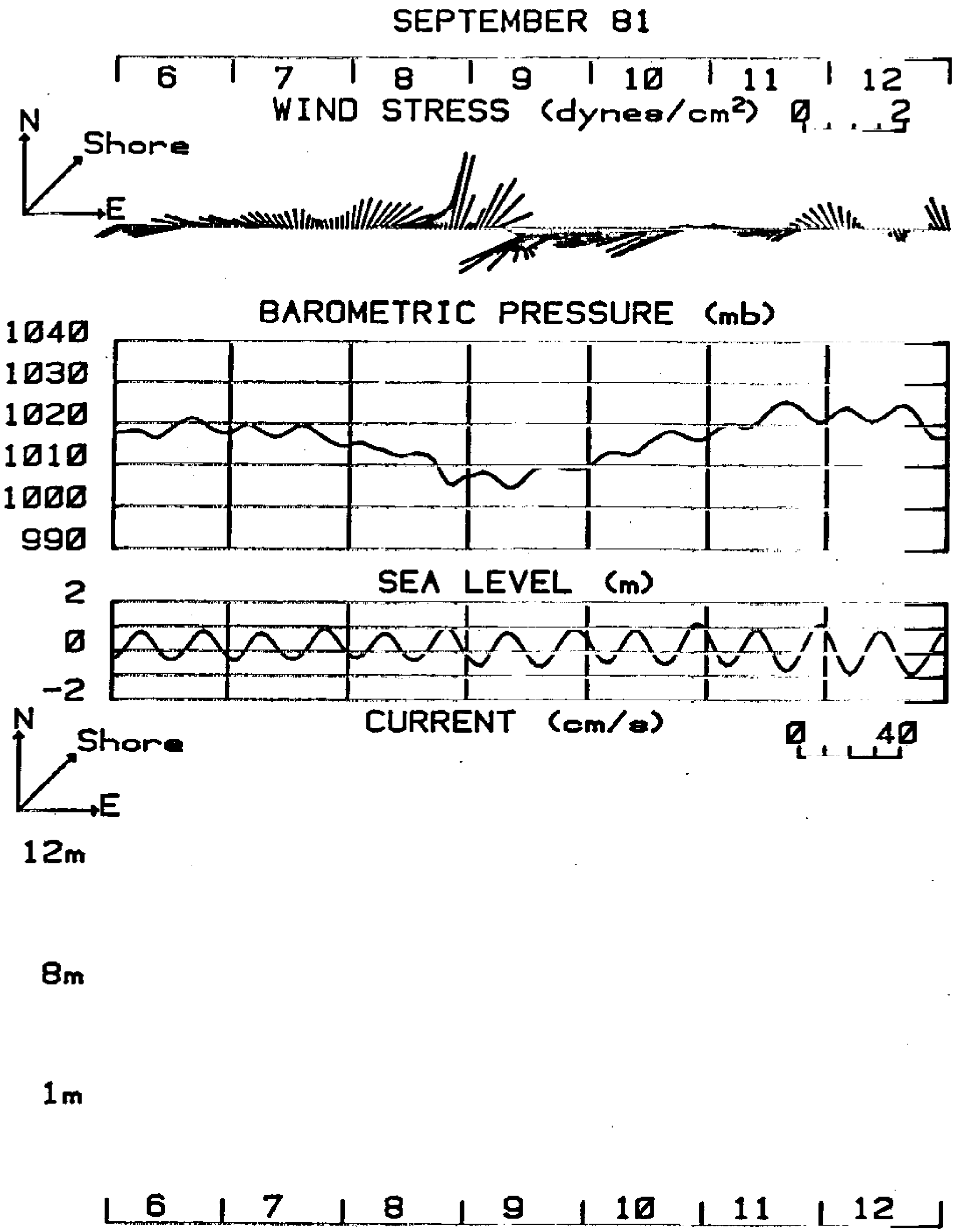
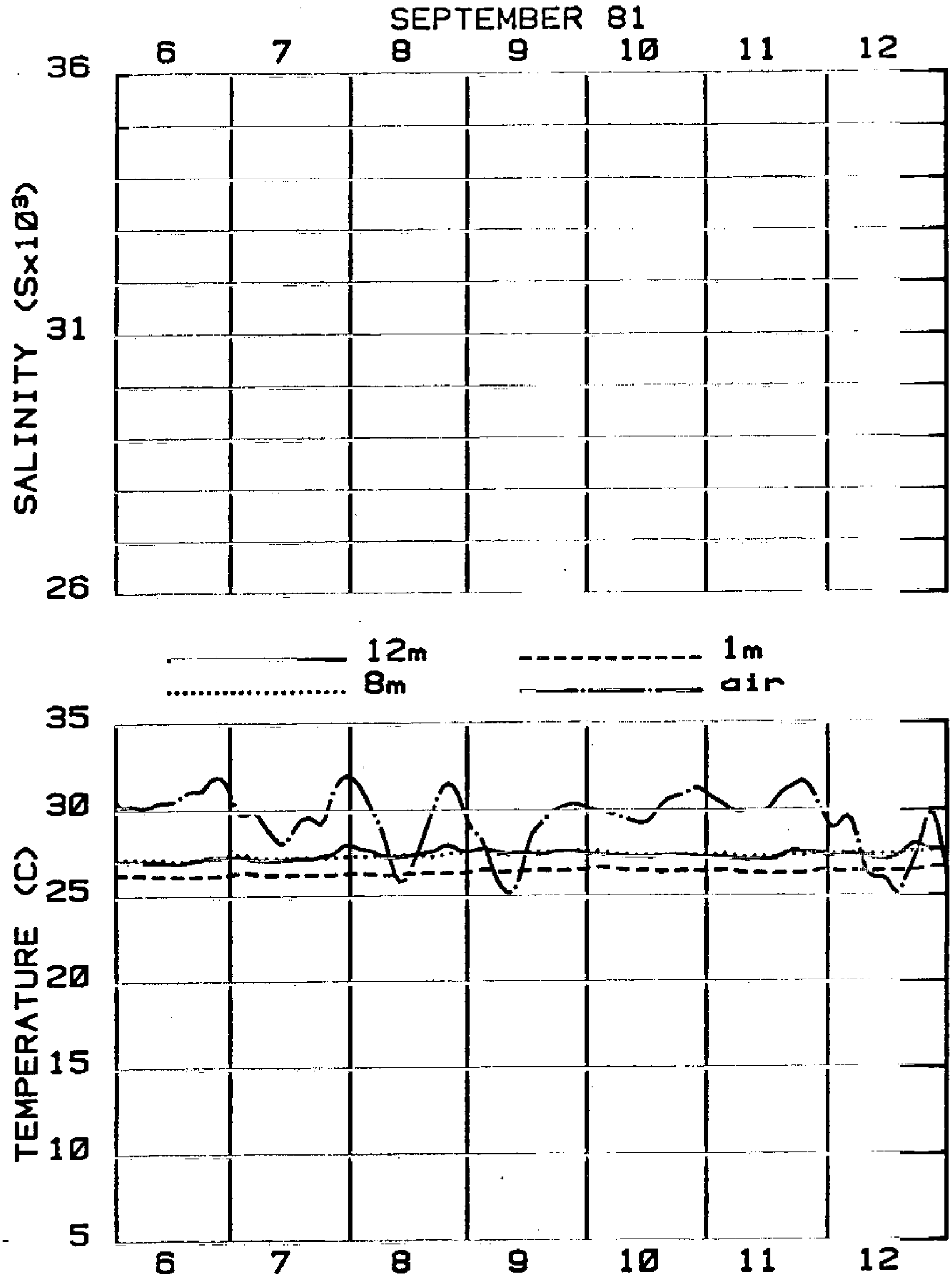
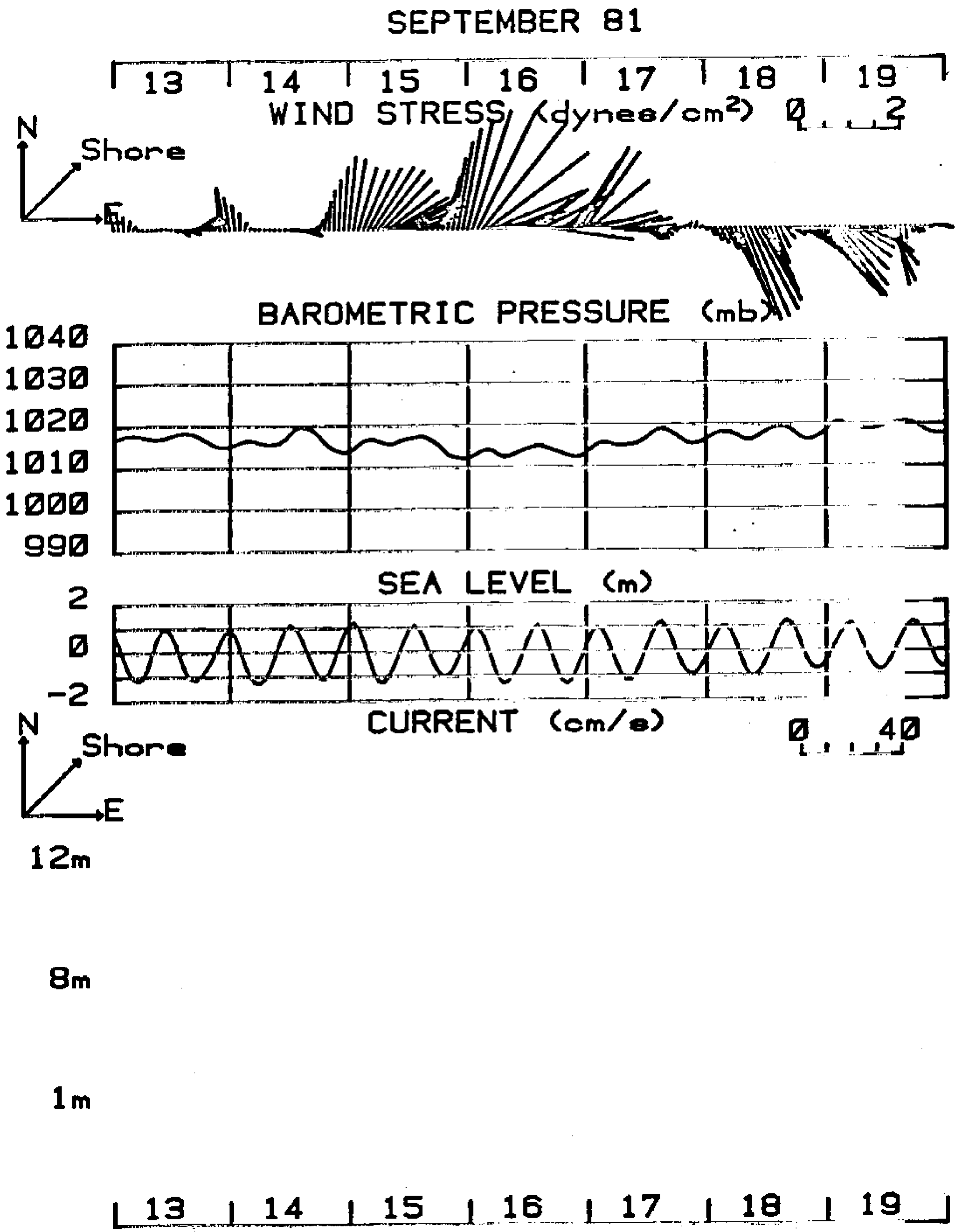
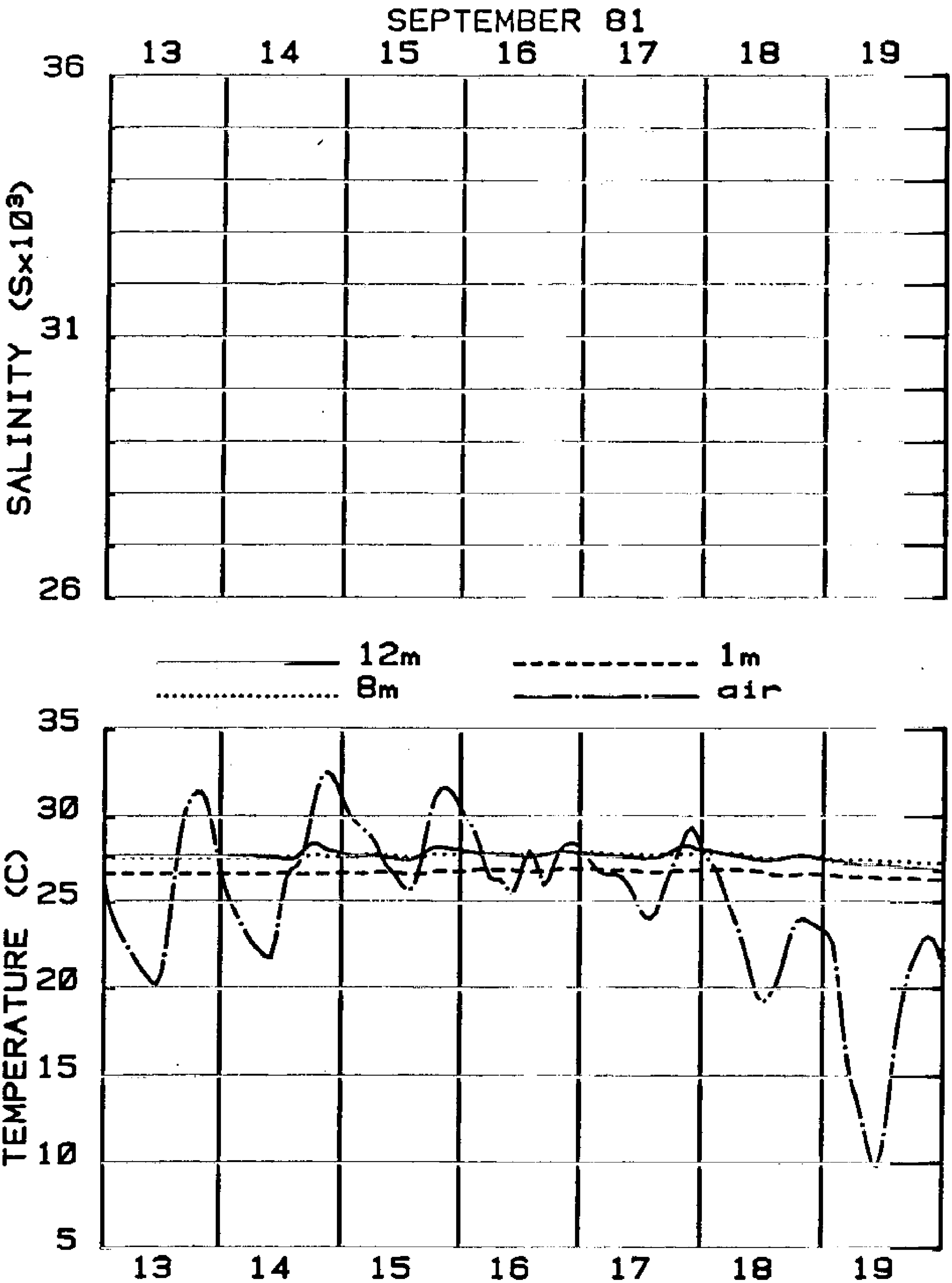
31
1
2
3
4
5


AUGUST 81
30 31 1 2 3 4 5
SALINITY (S×10³)
36
31
26
12m
8m
1m
air
TEMPERATURE (C)
35
30
25
20
15
10
5
30 31 1 2 3 4 5

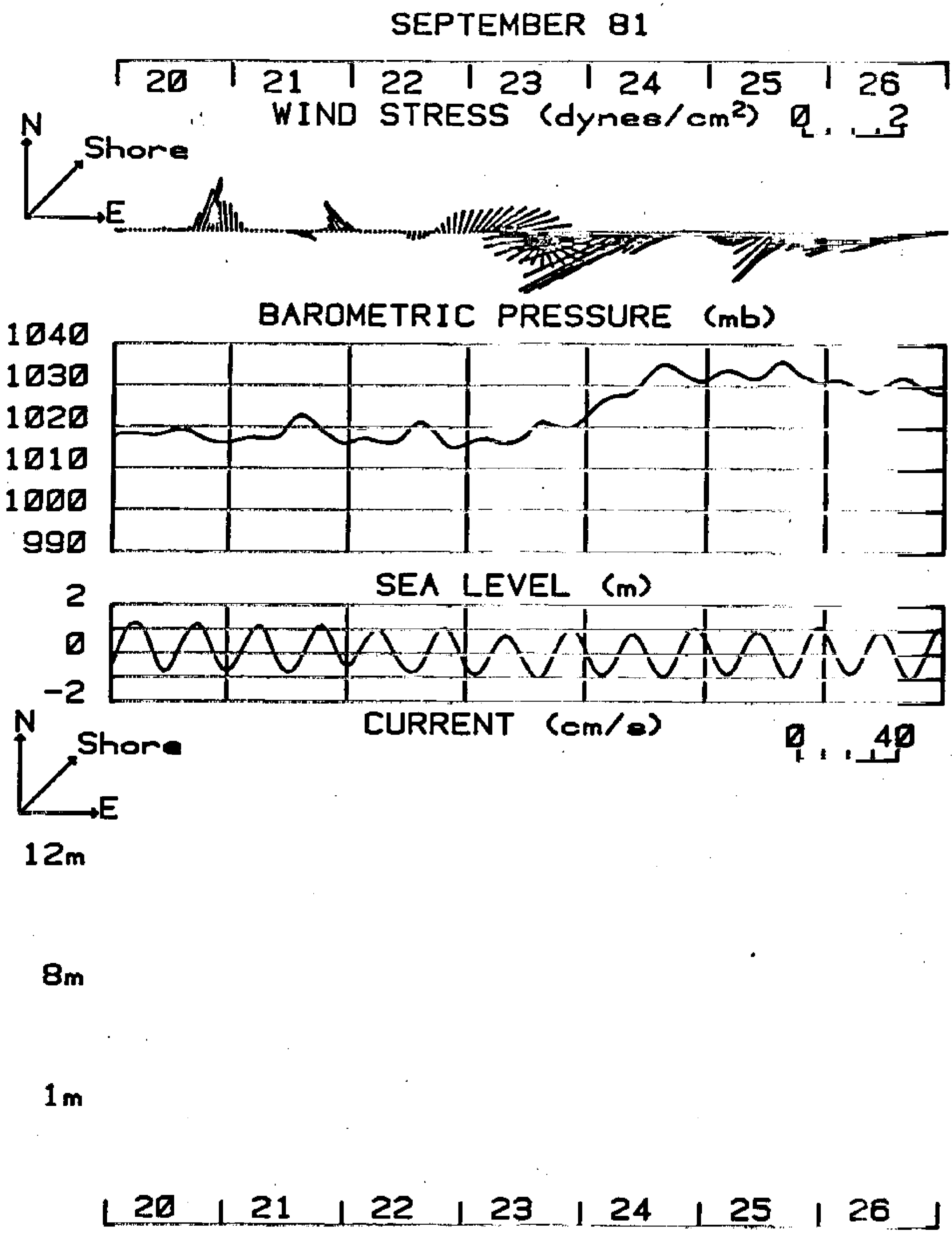

SEPTEMBER 81
6 7 8 9 10 11 12
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
6 7 8 9 10 11 12

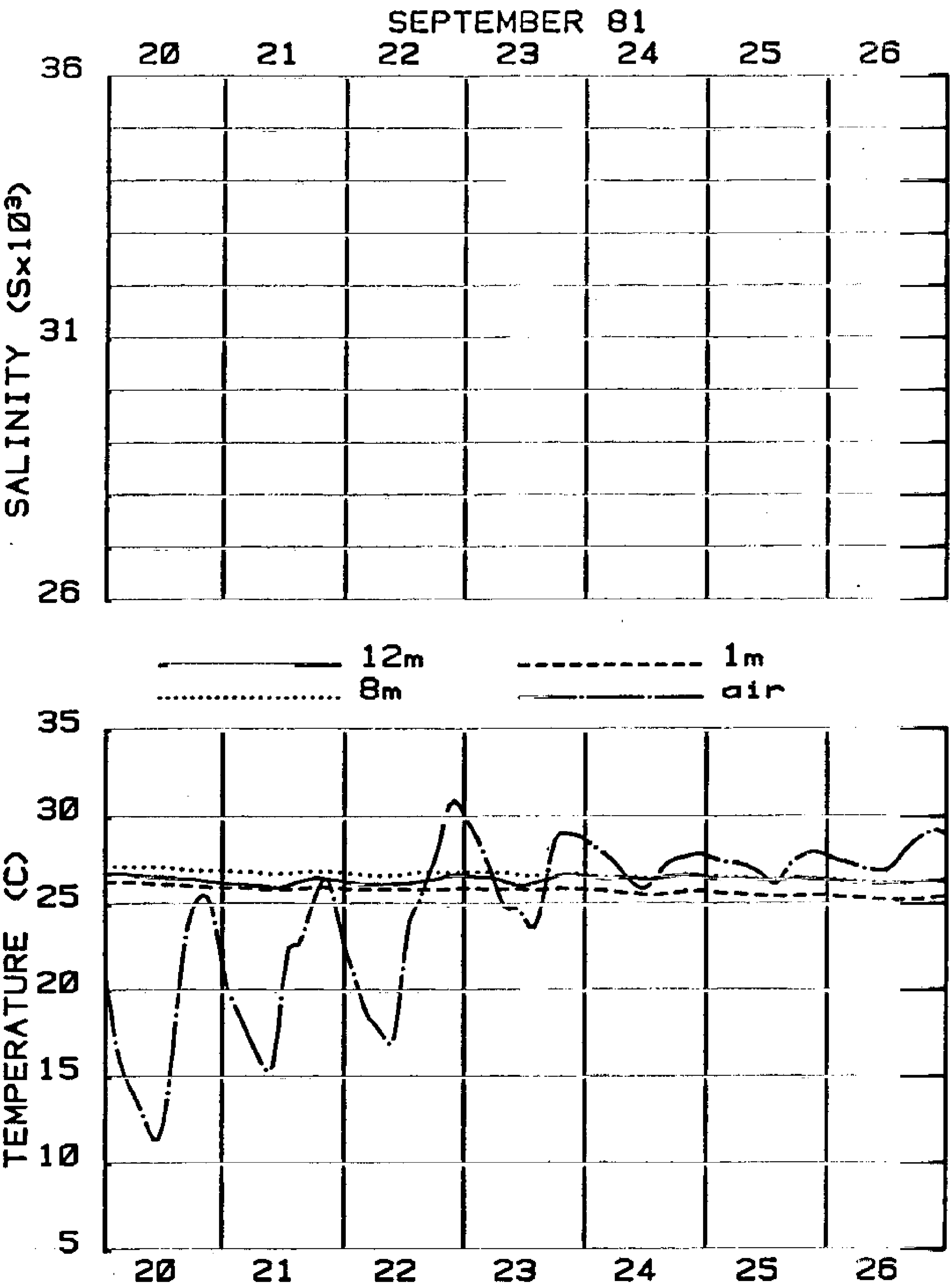

SEPTEMBER 81
6
7
8
9
10
11
12
36
31
26
SALINITY (Sx10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)


SEPTEMBER 81
13
14
15
16
17
18
19
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
13
14
15
16
17
18
19

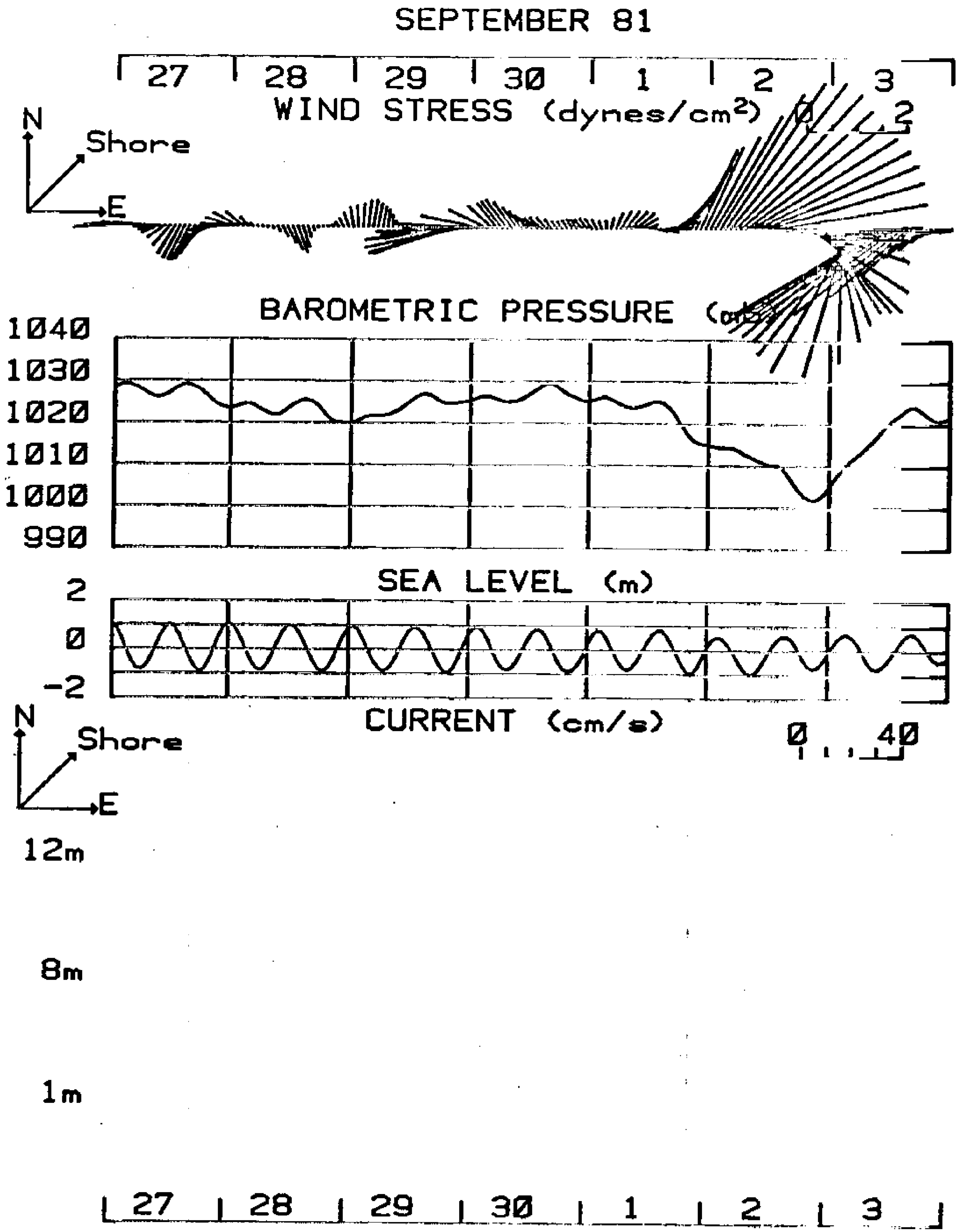


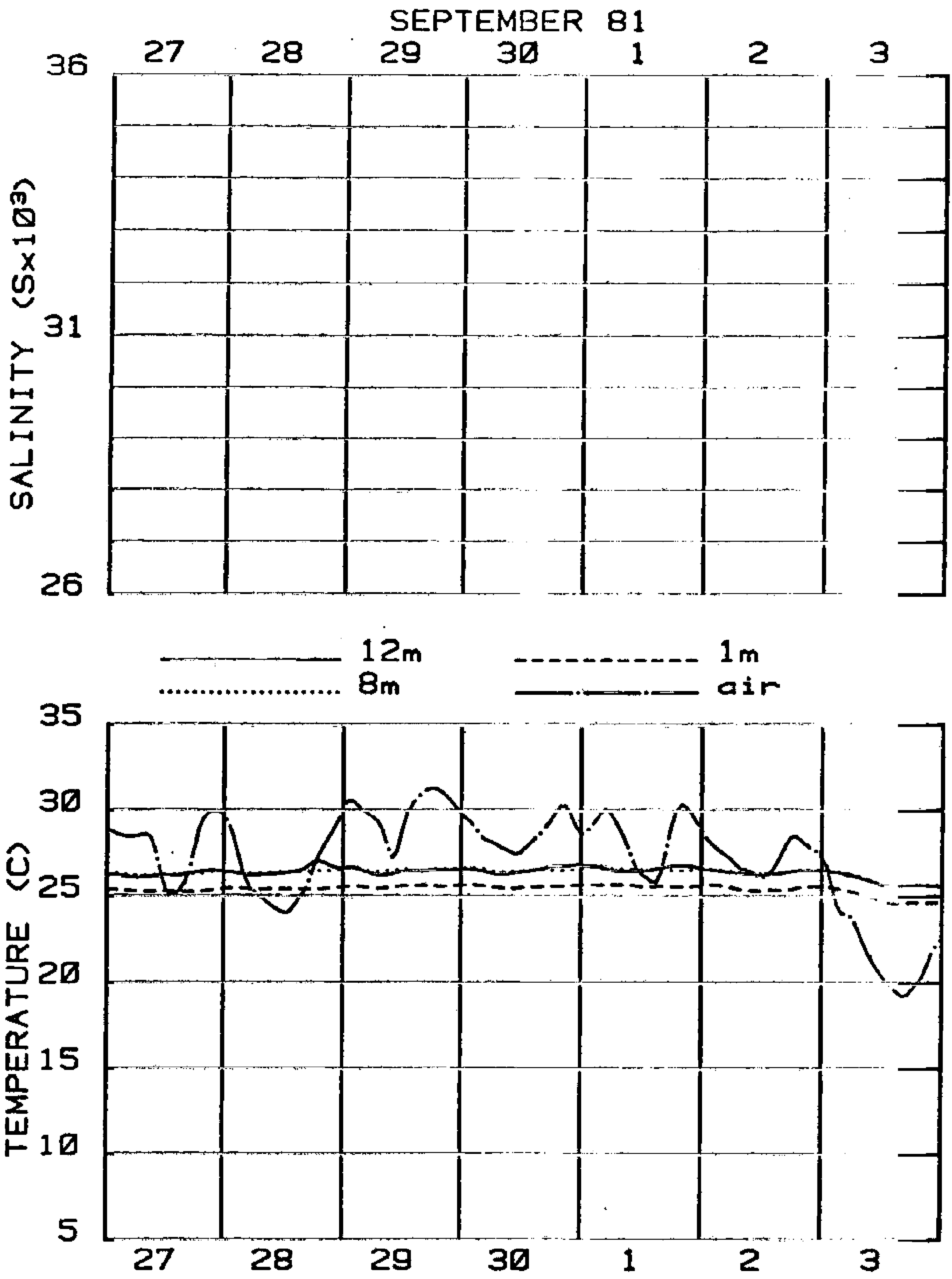
SEPTEMBER 81
13 14 15 16 17 18 19
36
31
26
SALINITY (S×10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
13 14 15 16 17 18 19

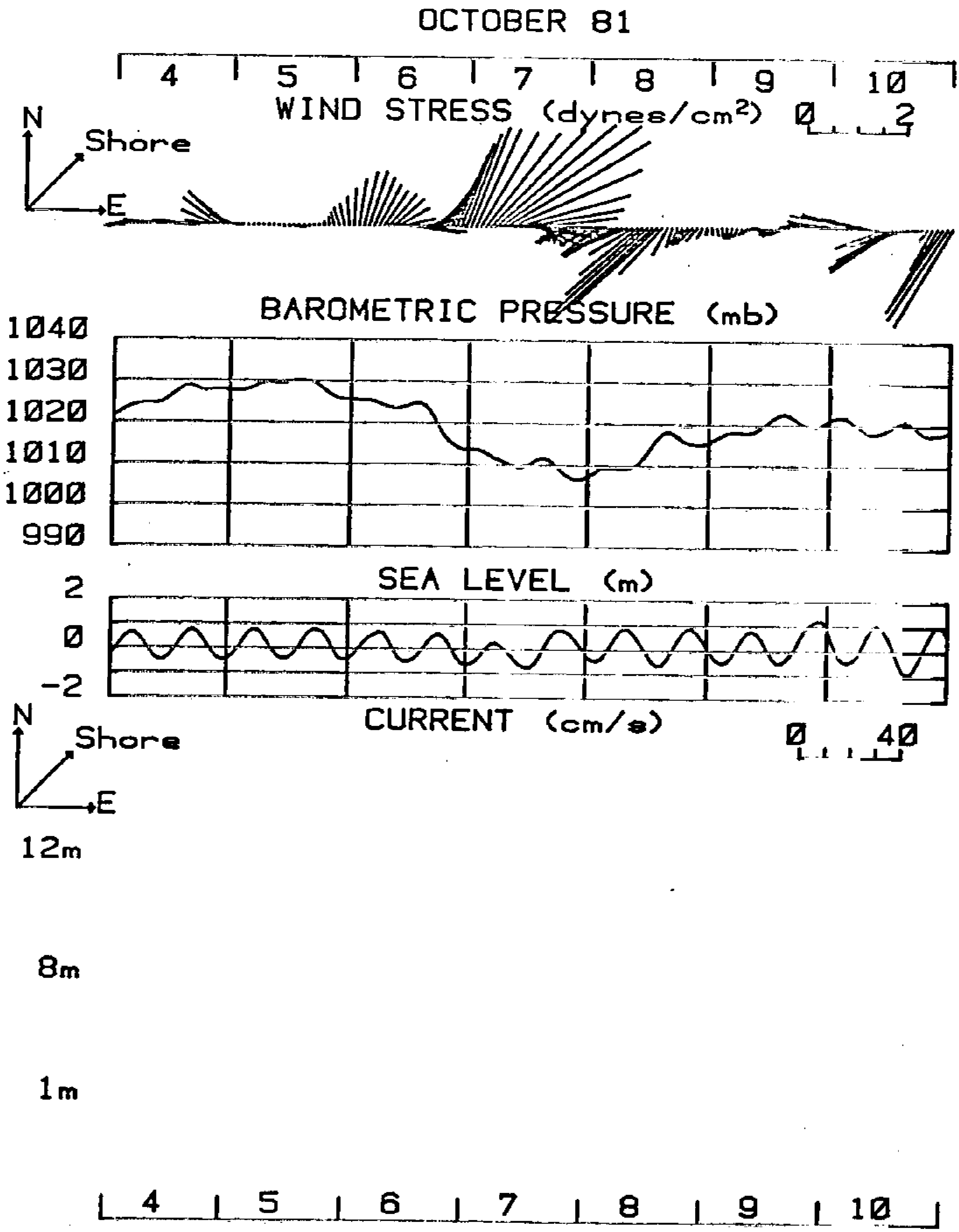

SEPTEMBER 81
20
21
22
23
24
25
26
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
20
21
22
23
24
25
26

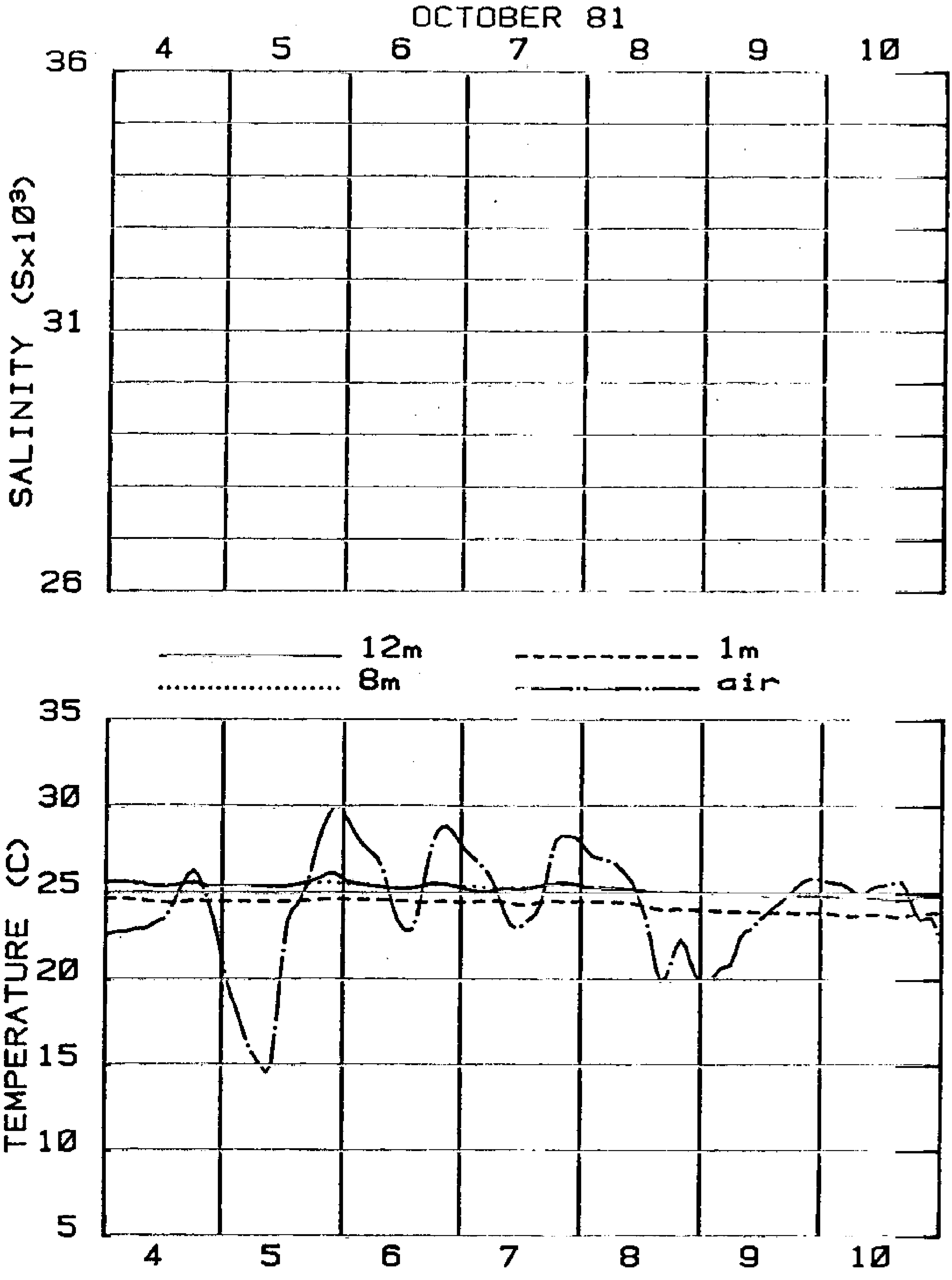


SEPTEMBER 81
20
21
22
23
24
25
26
SALINITY (Sx10³)
36
31
26
12m
1m
8m
air
TEMPERATURE (C)
35
30
25
20
15
10
5
20
21
22
23
24
25
26

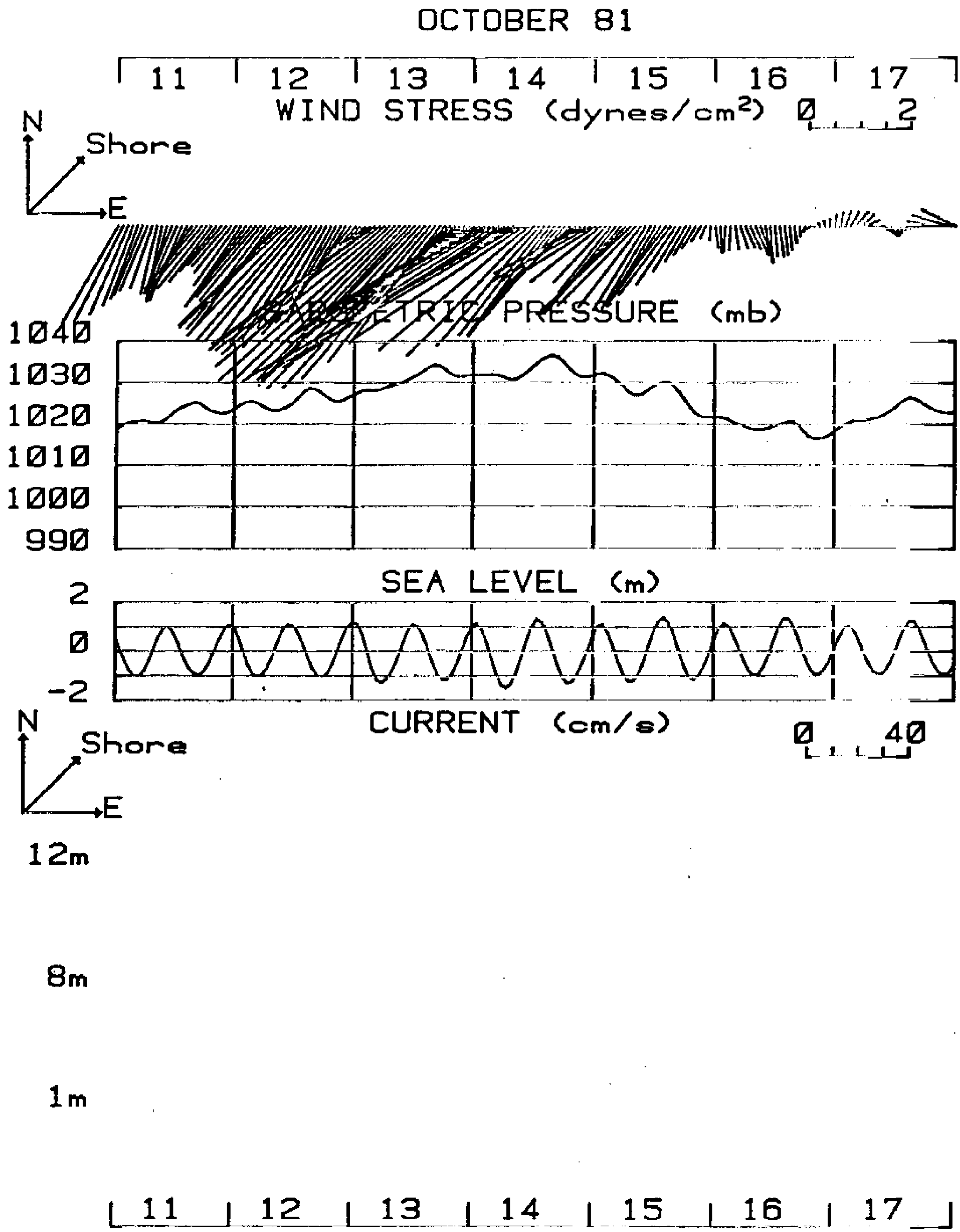

SEPTEMBER 81
27
28
29
30
1
2
3
WIND STRESS (dynes/cm²)
0
2
N
Shore
E
BAROMETRIC PRESSURE
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s)
0
40
N
Shore
E
12m
8m
1m
27
28
29
30
1
2
3

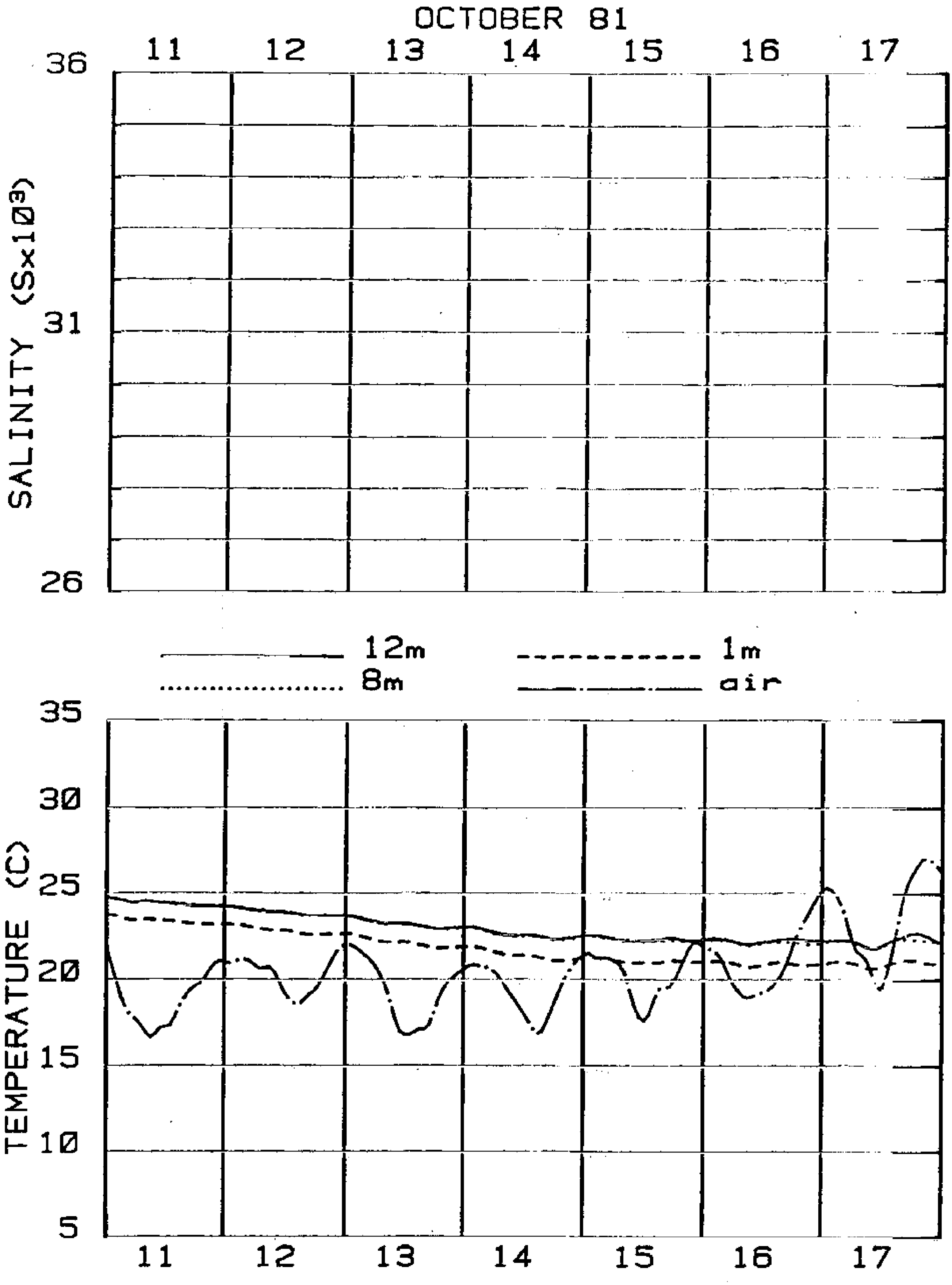

SEPTEMBER 81
27
28
29
30
1
2
3
36
31
26
SALINITY (S×10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
27
28
29
30
1
2
3

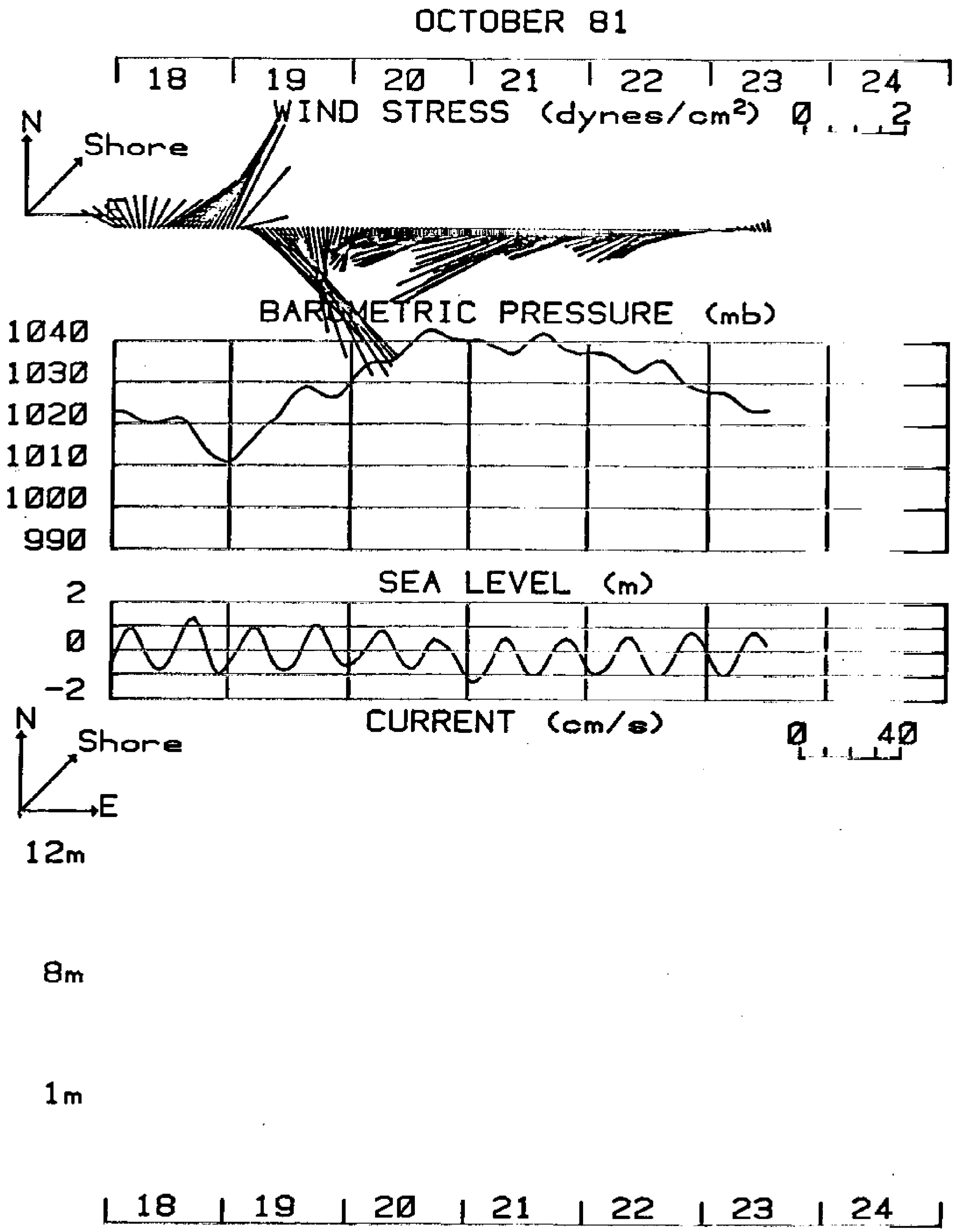

OCTOBER 81
4 5 6 7 8 9 10
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
4 5 6 7 8 9 10

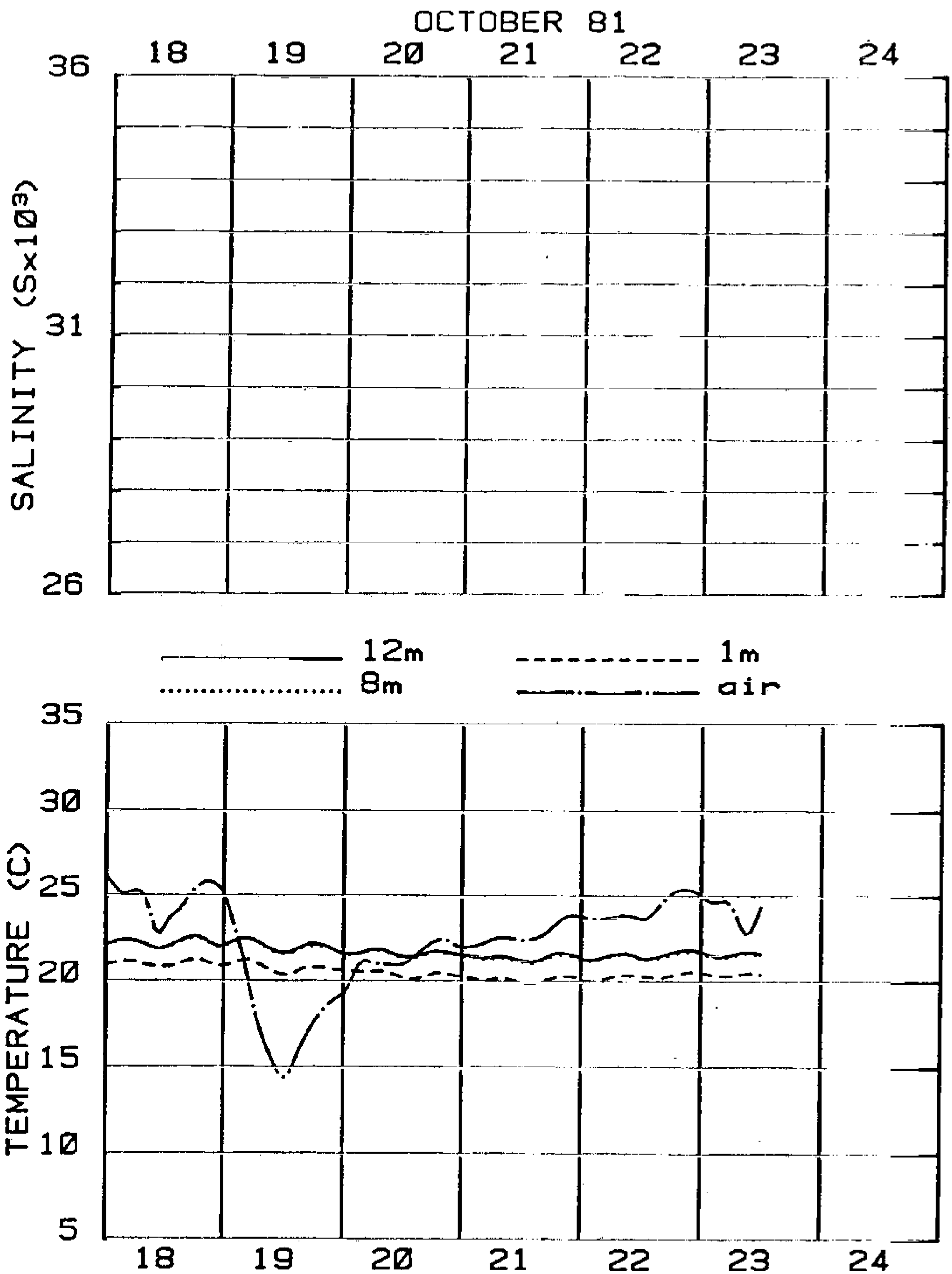


OCTOBER 81
4 5 6 7 8 9 10
SALINITY (S×10³)
36
31
26
12m
1m
8m
air
TEMPERATURE (C)
35
30
25
20
15
10
5
4 5 6 7 8 9 10


OCTOBER 81
11 12 13 14 15 16 17
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
11 12 13 14 15 16 17


OCTOBER 81
11 12 13 14 15 16 17
36
31
26
SALINITY (Sx10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
11 12 13 14 15 16 17

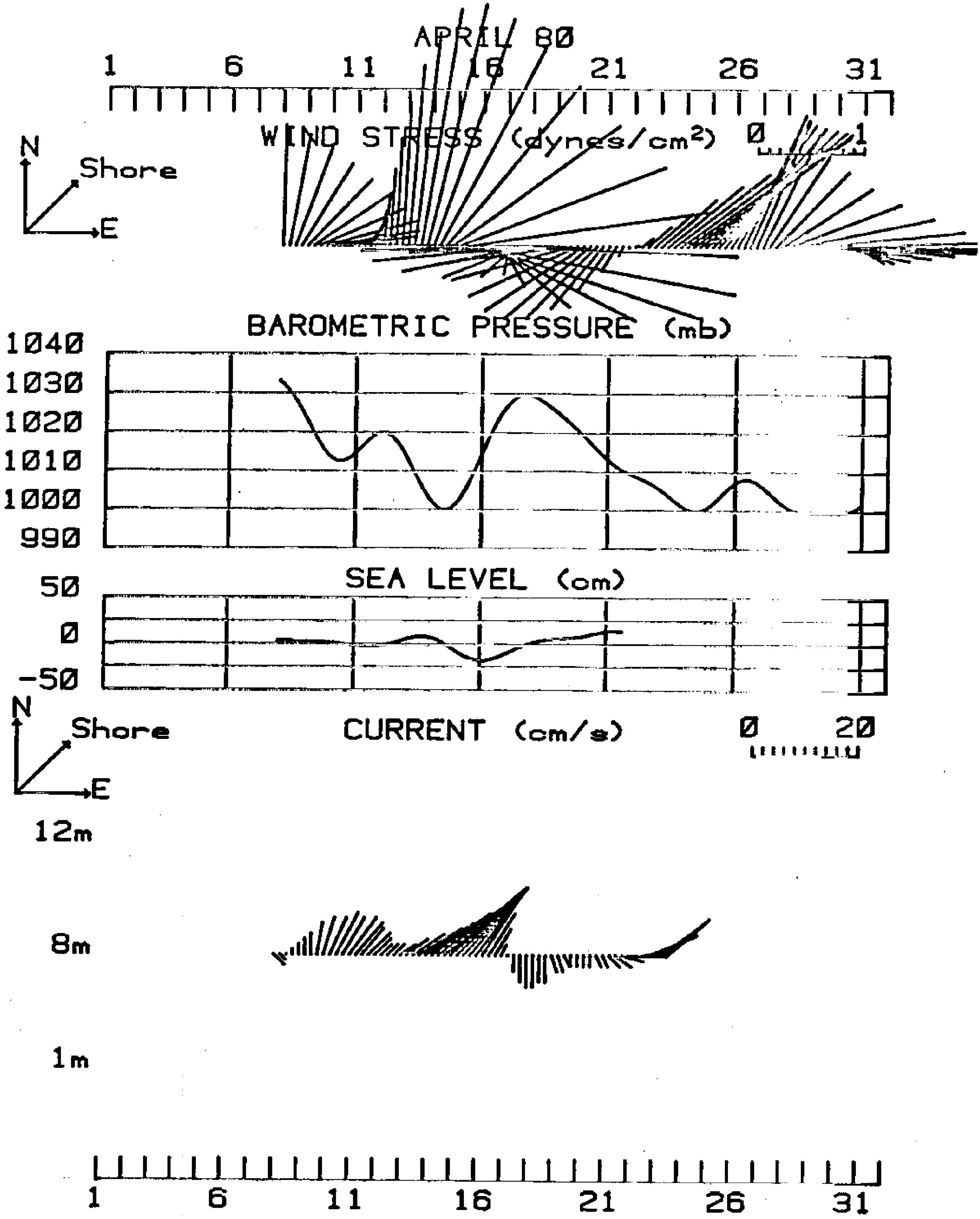

OCTOBER 81
18
19
20
21
22
23
24
WIND STRESS (dynes/cm²) 0 2
N
Shore
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (m)
2
0
-2
CURRENT (cm/s) 0 40
N
Shore
E
12m
8m
1m
18
19
20
21
22
23
24



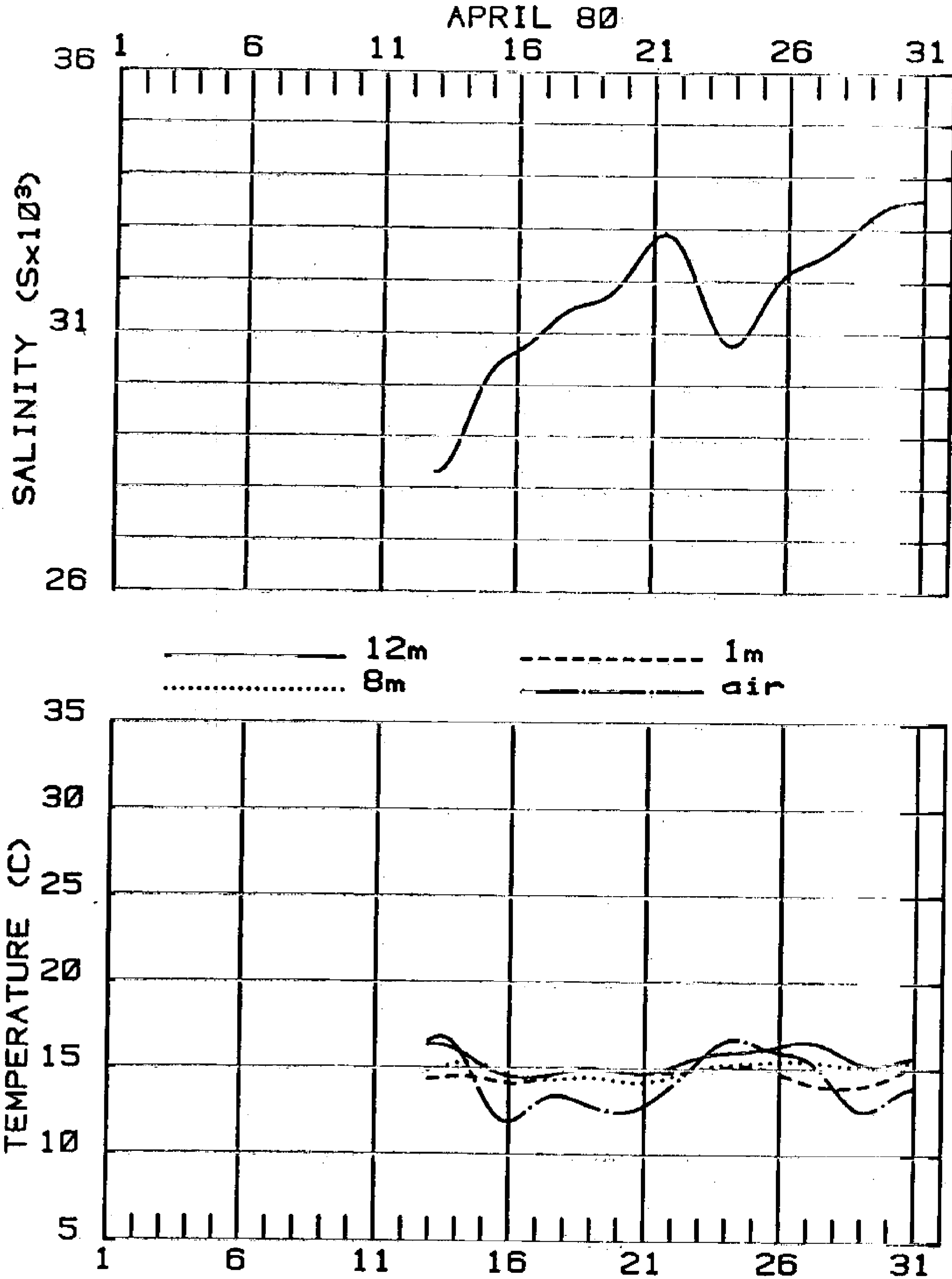
OCTOBER 81
18 19 20 21 22 23 24
36
31
26
SALINITY (Sx10³)
12m
8m
1m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
18 19 20 21 22 23 24

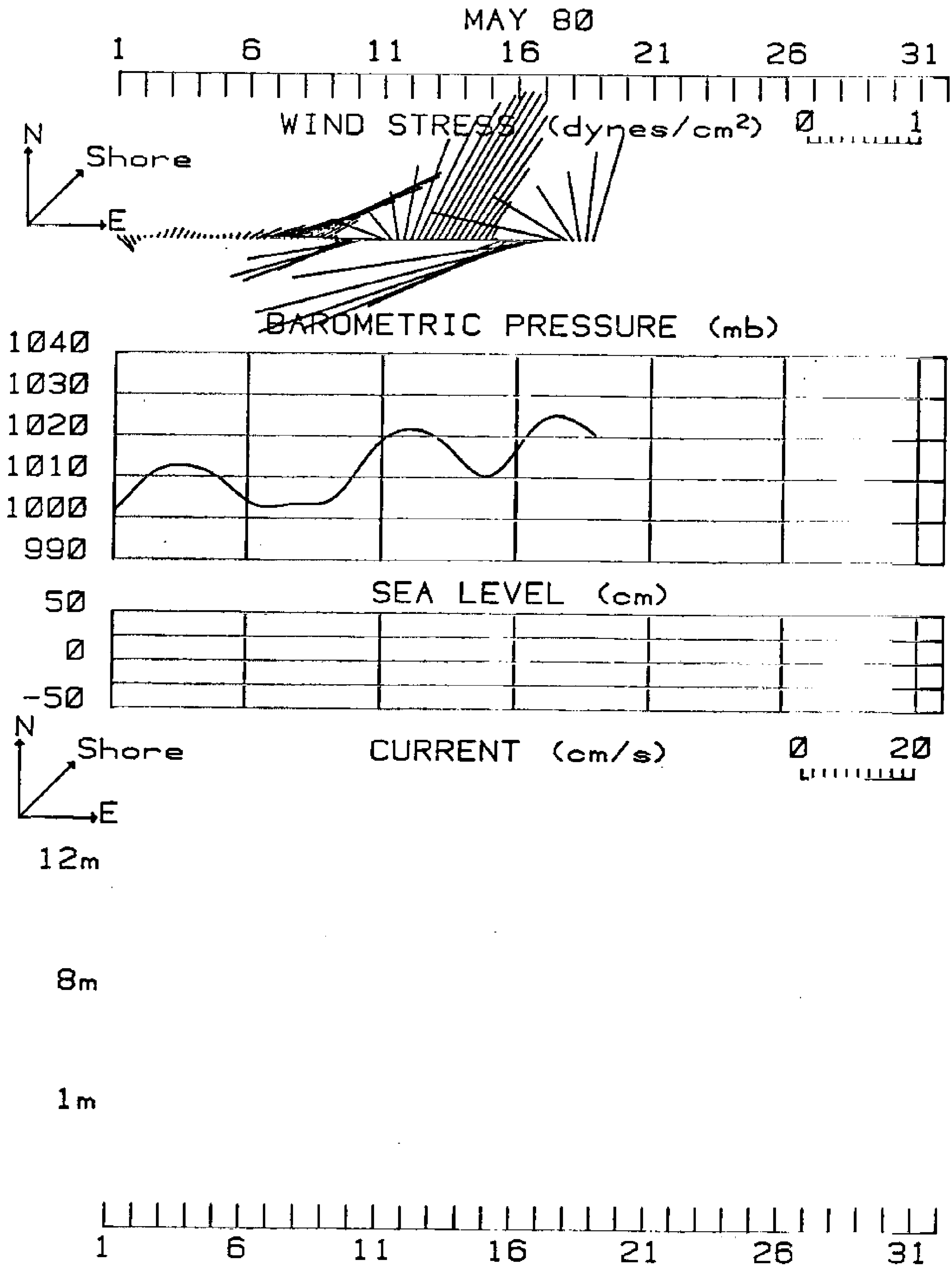
Appendix B:

Plots of Monthly Data Summaries of SNLT Data Collected During 1980 and 1981

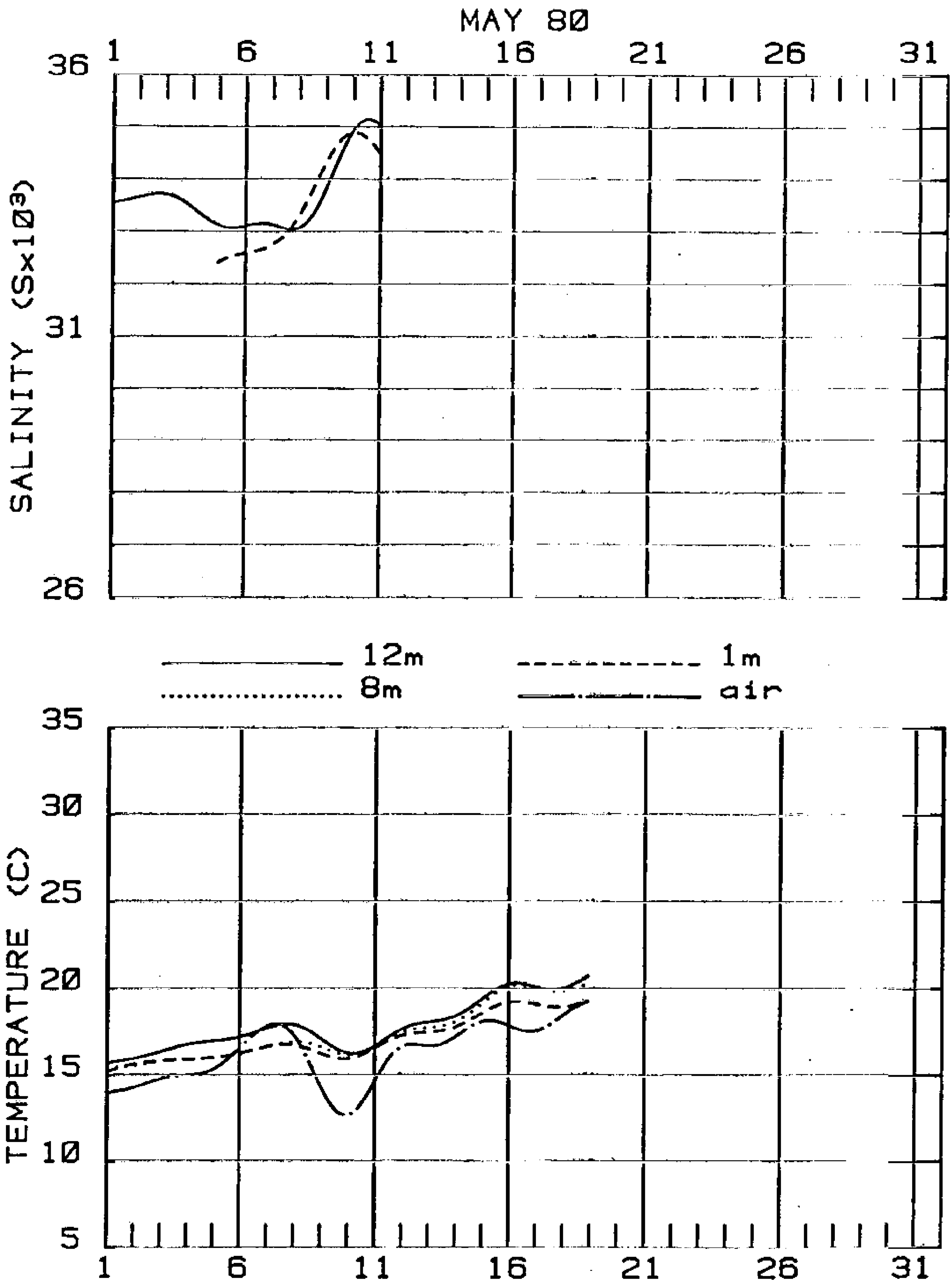


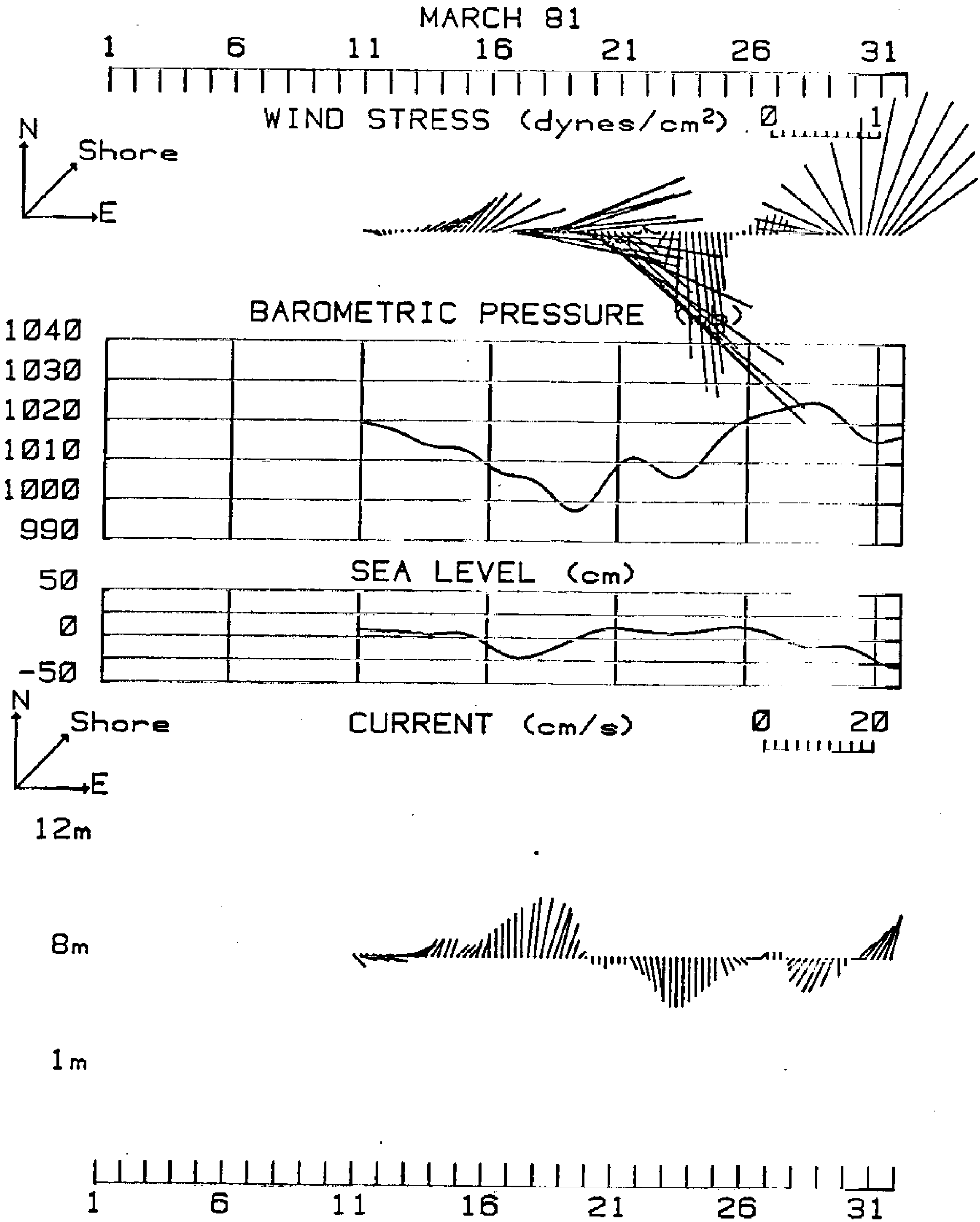
APRIL 80
1
6
11
16
21
26
31
WIND STRESS (dynes/cm²)
0
1
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (cm)
50
0
-50
N
Shore
E
CURRENT (cm/s)
0
20
12m
8m
1m
1
6
11
16
21
26
31

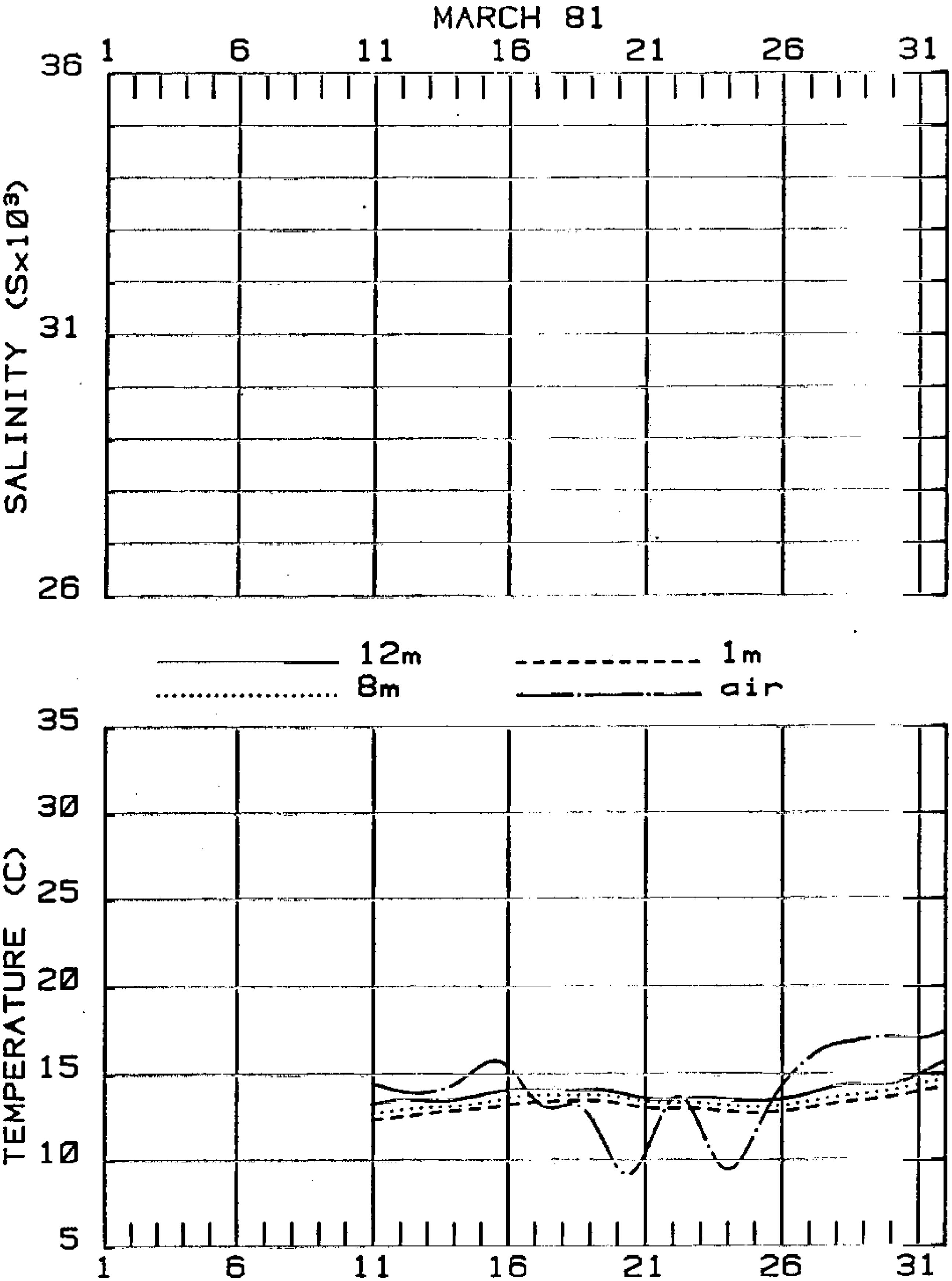

APRIL 80
SALINITY (S×10³)
36
31
26
1
6
11
16
21
26
31
12m
1m
8m
air
TEMPERATURE (C)
35
30
25
20
15
10
5

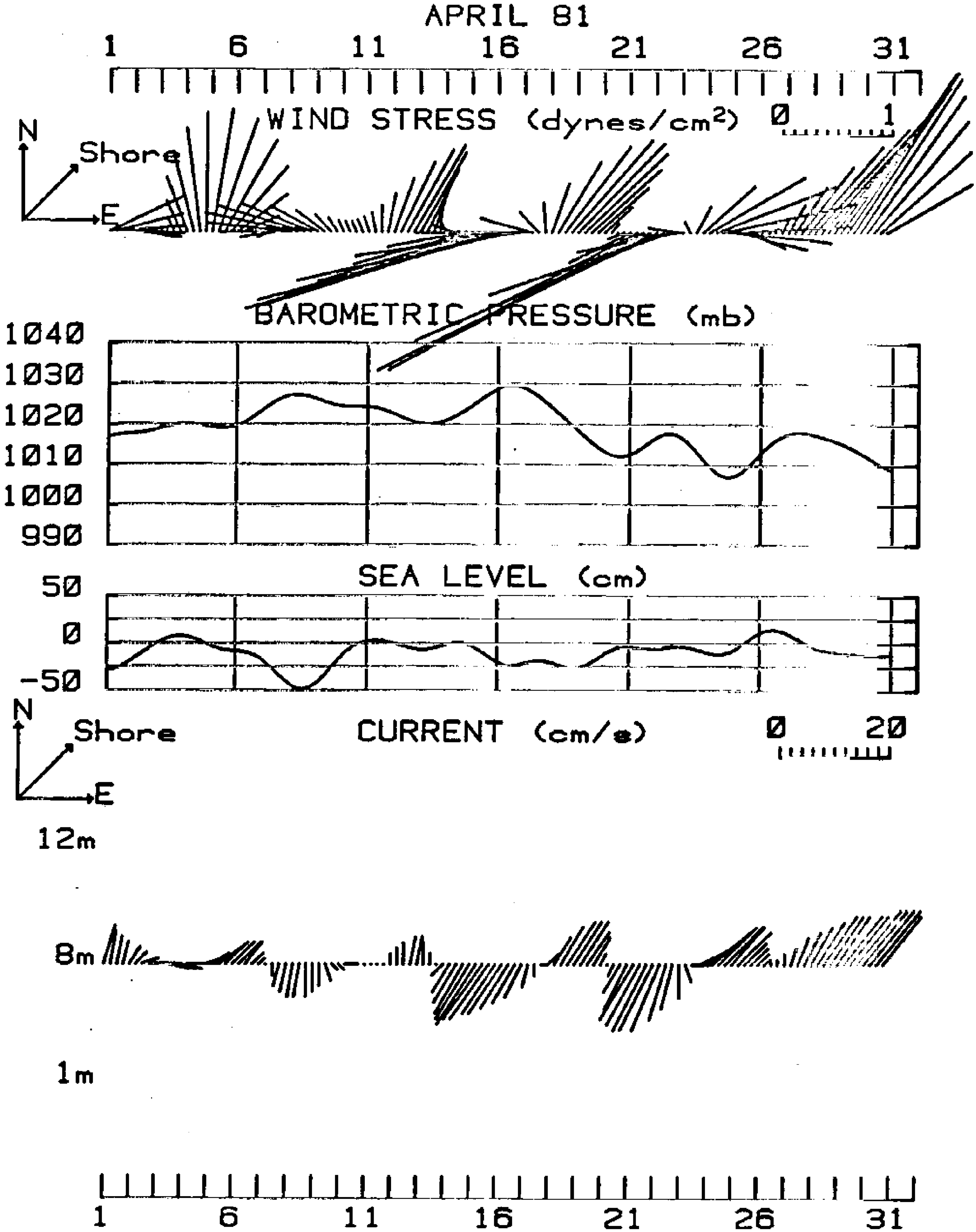


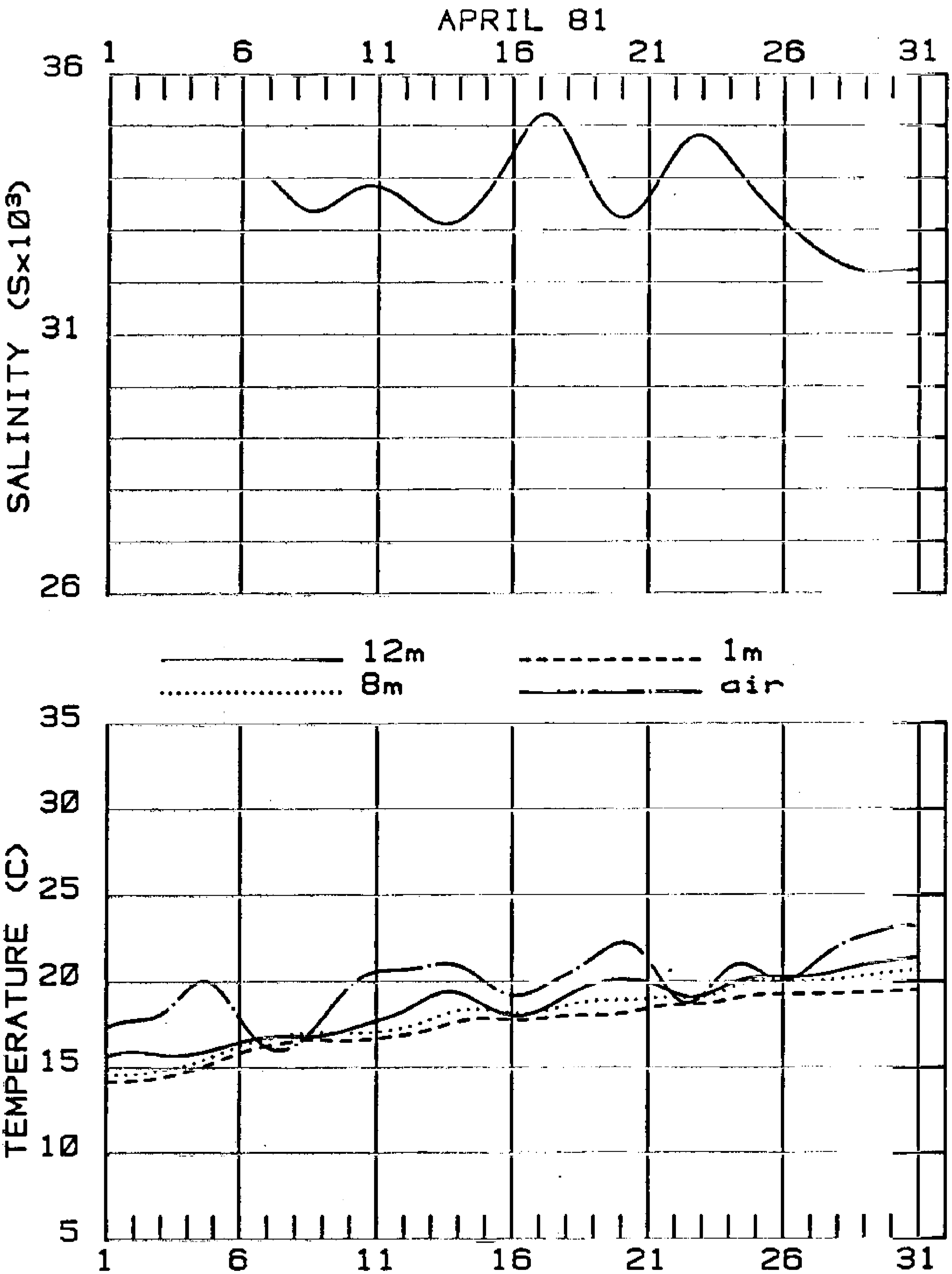
MAY 80
1
6
11
16
21
26
31
WIND STRESS (dynes/cm²)
Ø
1
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (cm)
50
Ø
-50
N
Shore
E
CURRENT (cm/s)
Ø
20
12m
8m
1m
1
6
11
16
21
26
31


MAY 80
1
6
11
16
21
26
31
36
31
26
SALINITY (Sx10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)

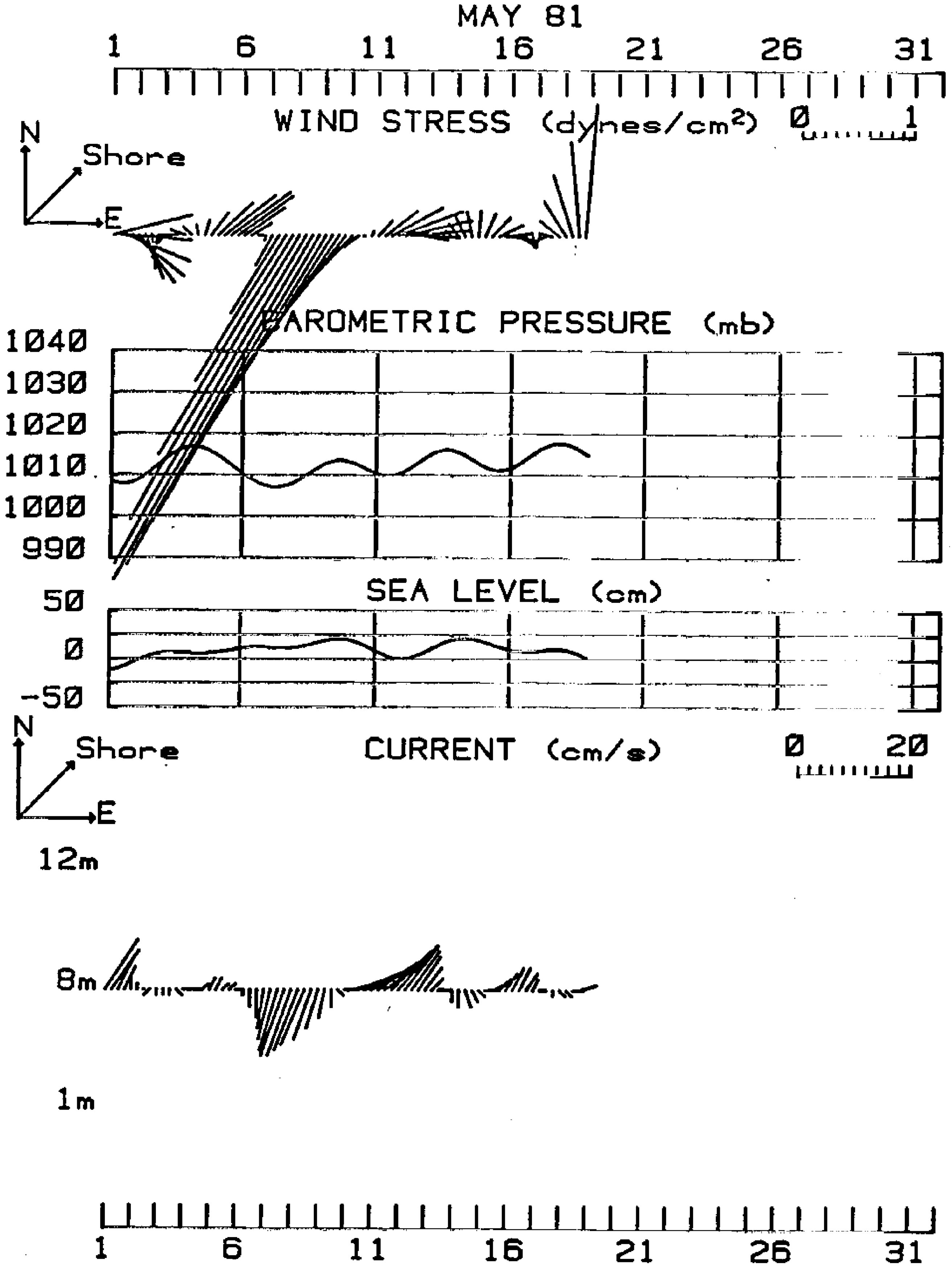

MARCH 81
1
6
11
16
21
26
31
WIND STRESS (dynes/cm²)
0
1
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (cm)
50
0
-50
N
Shore
E
CURRENT (cm/s)
0
20
12m
8m
1m
1
6
11
16
21
26
31


MARCH 81
SALINITY (Sx10³)
36
31
26
1
6
11
16
21
26
31
12m
1m
8m
air
TEMPERATURE (C)
35
30
25
20
15
10
5

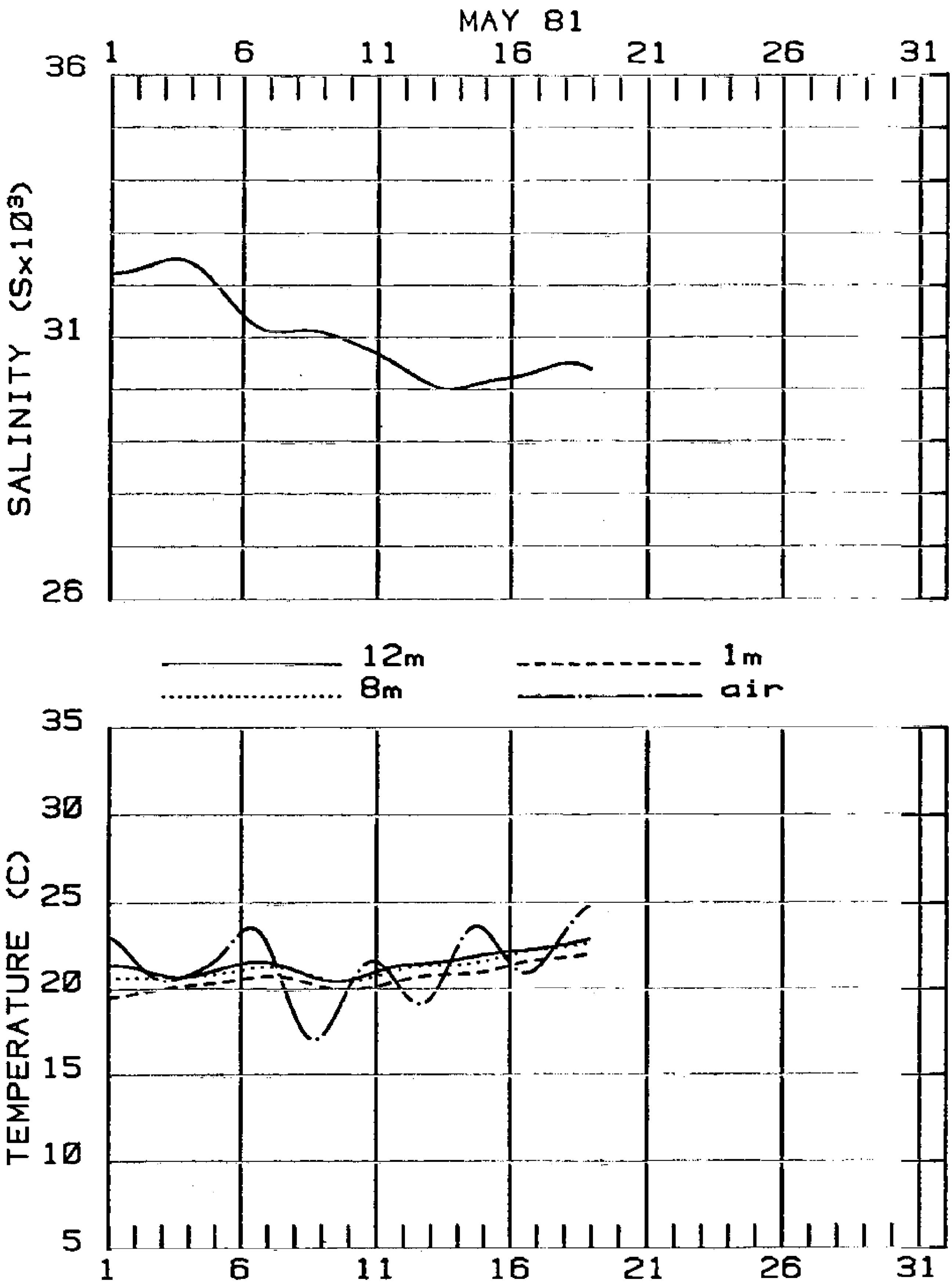

APRIL 81
1
6
11
16
21
26
31
WIND STRESS (dynes/cm²)
0
1
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (cm)
50
0
-50
N
Shore
E
CURRENT (cm/s)
0
20
12m
8m
1m
1
6
11
16
21
26
31



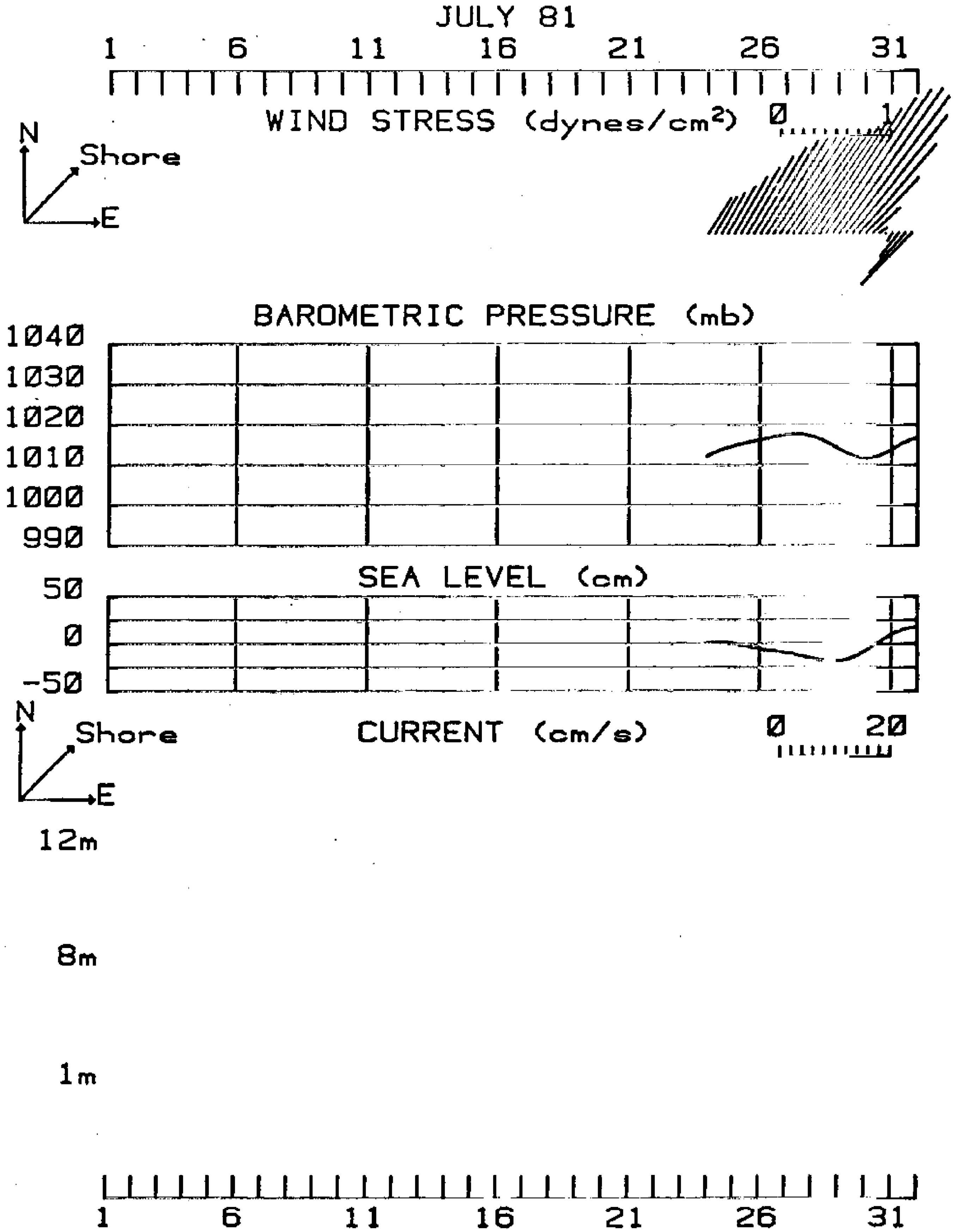
APRIL 81
1
6
11
16
21
26
31
36
31
26
SALINITY (S×10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
1
6
11
16
21
26
31

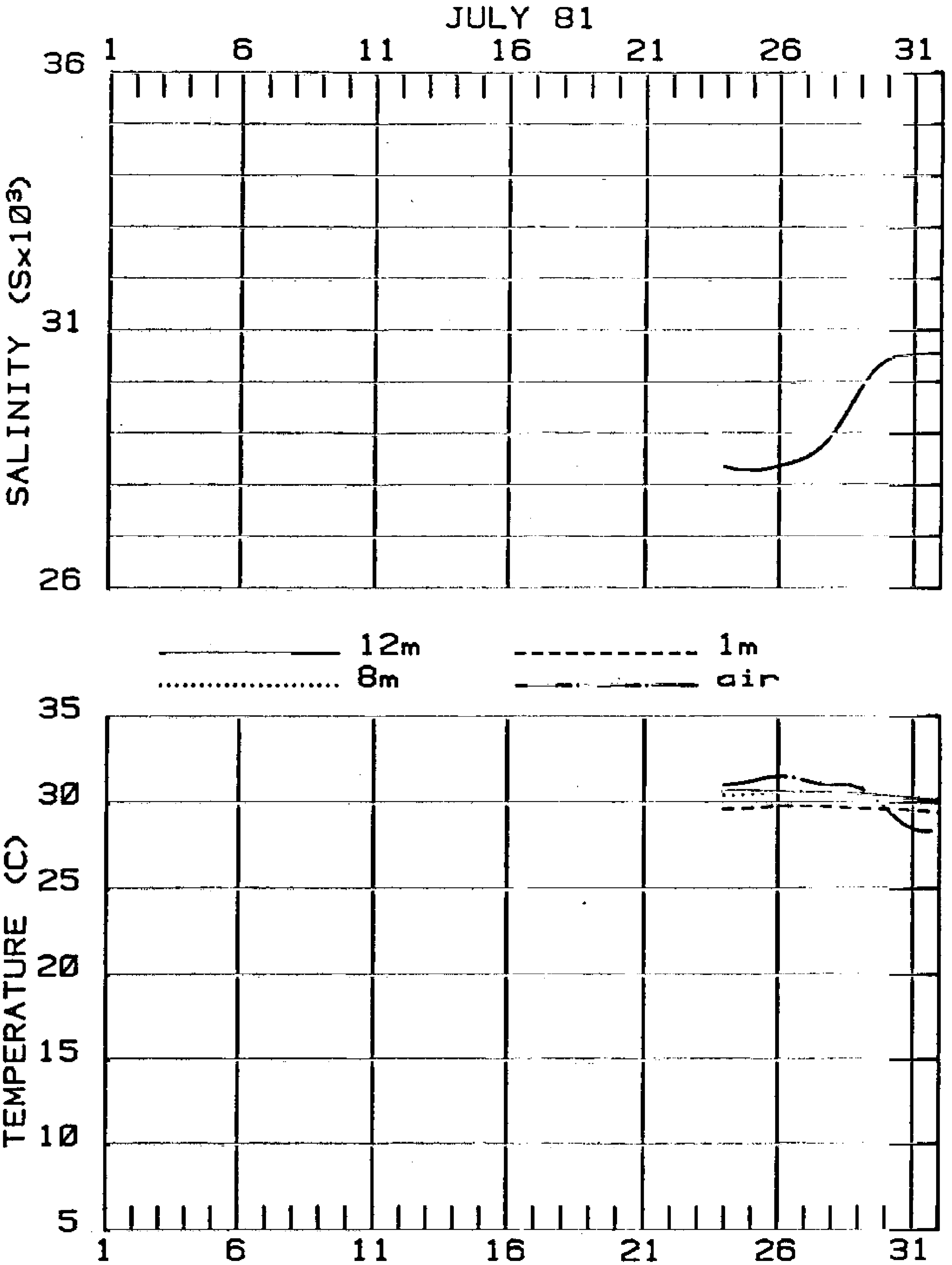


MAY 81
1
6
11
16
21
26
31
WIND STRESS (dynes/cm²)
0
1
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (cm)
50
0
-50
N
Shore
E
CURRENT (cm/s)
0
20
12m
8m
1m
1
6
11
16
21
26
31

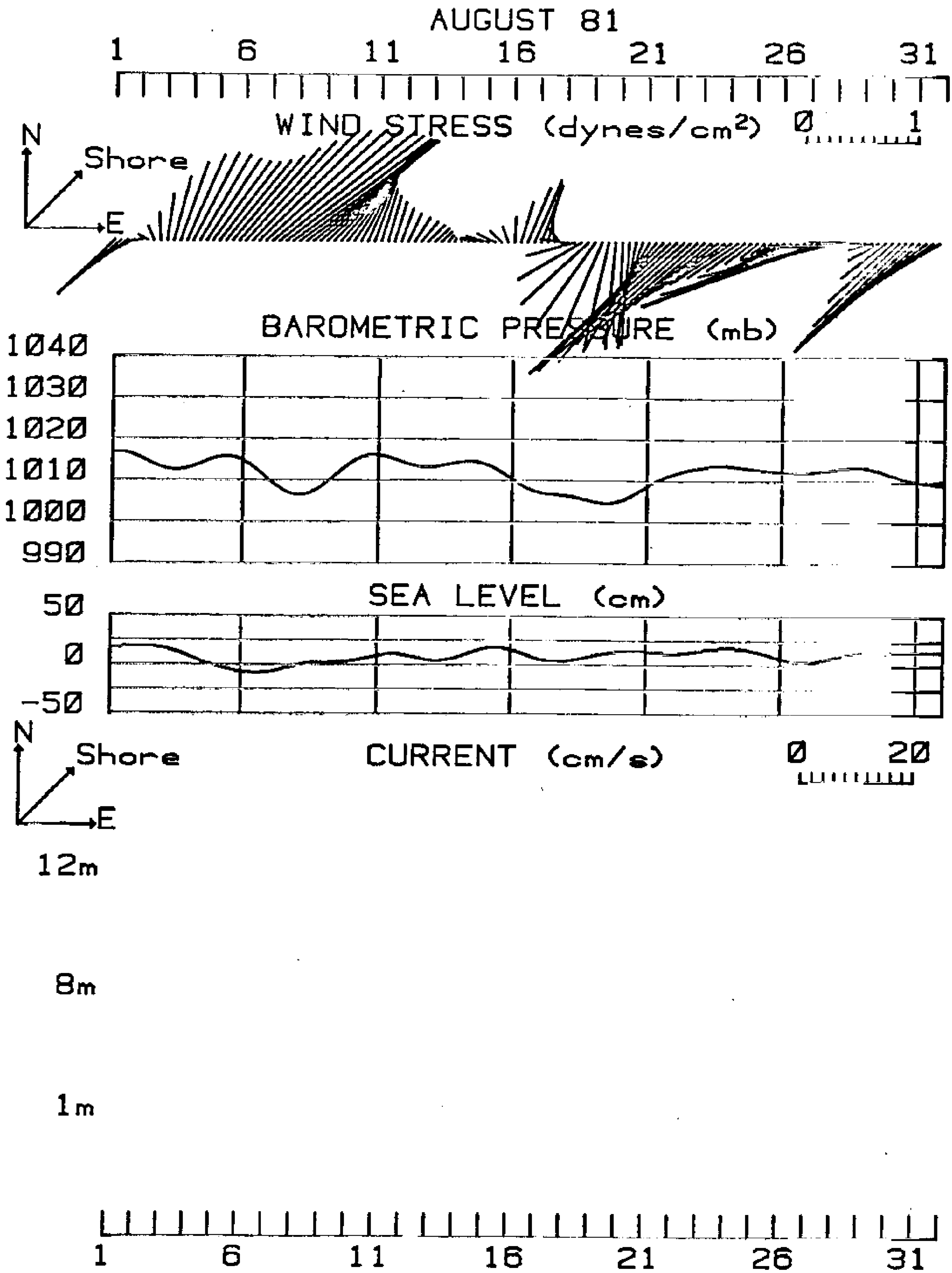


MAY 81
1
6
11
16
21
26
31
36
31
26
SALINITY (Sx10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)

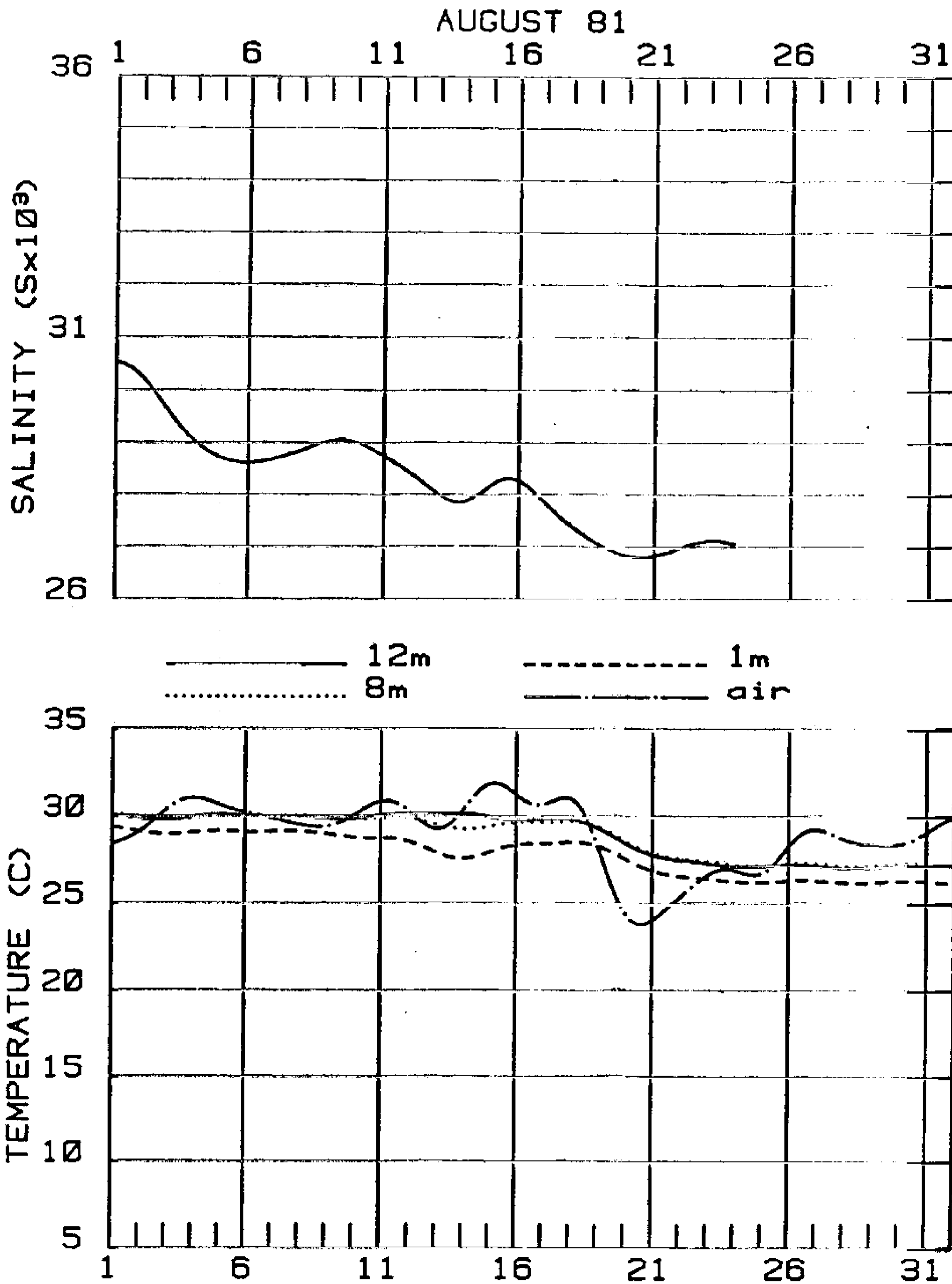

JULY 81
1 6 11 16 21 26 31
WIND STRESS (dynes/cm²)
0 1
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (cm)
50
0
-50
N
Shore
E
CURRENT (cm/s)
0 20
12m
8m
1m
1 6 11 16 21 26 31

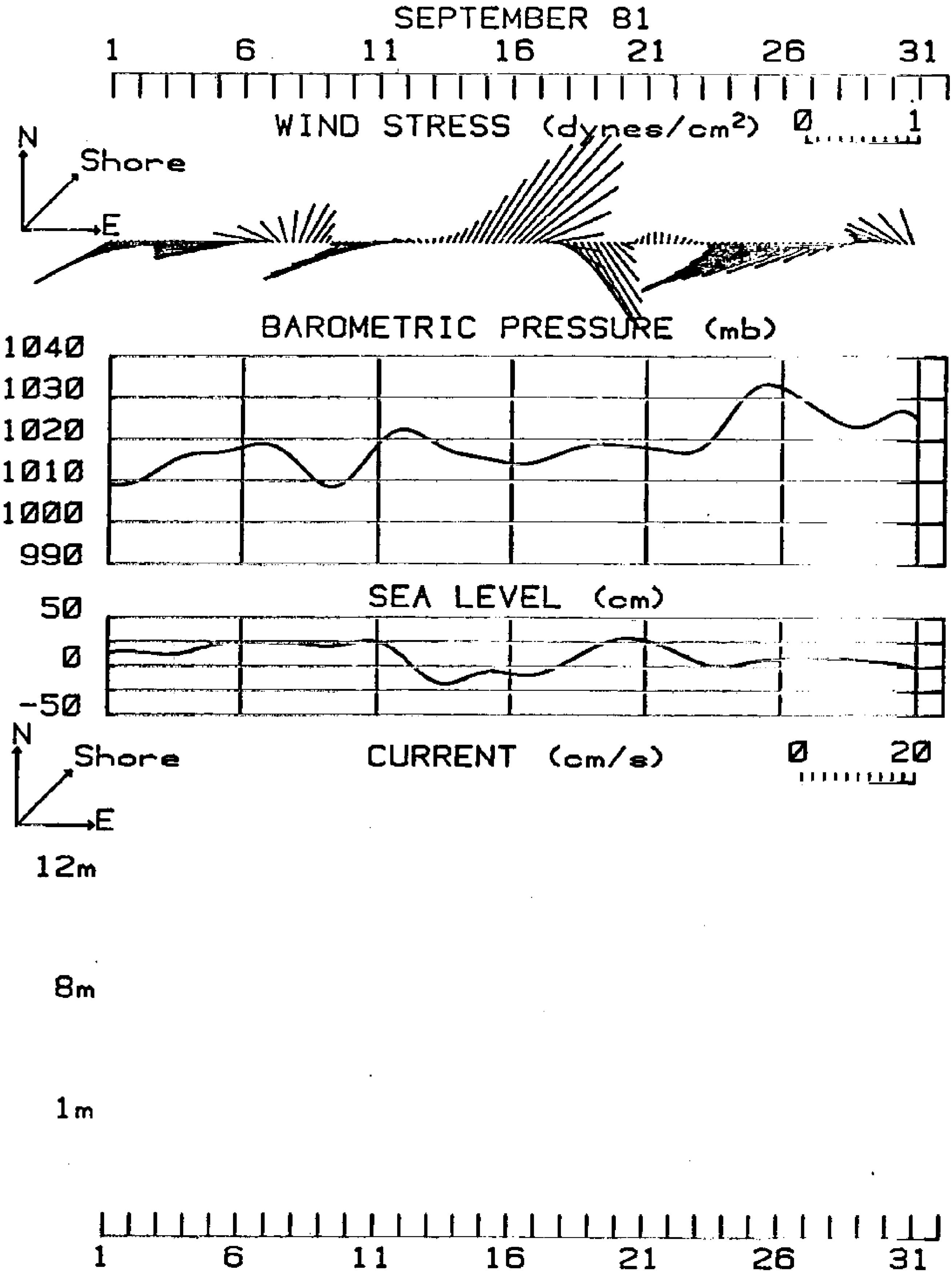


JULY 81
1
6
11
16
21
26
31
36
31
26
SALINITY (S×10³)
12m
8m
1m
air
35
30
25
20
15
10
5
TEMPERATURE (C)
1
6
11
16
21
26
31

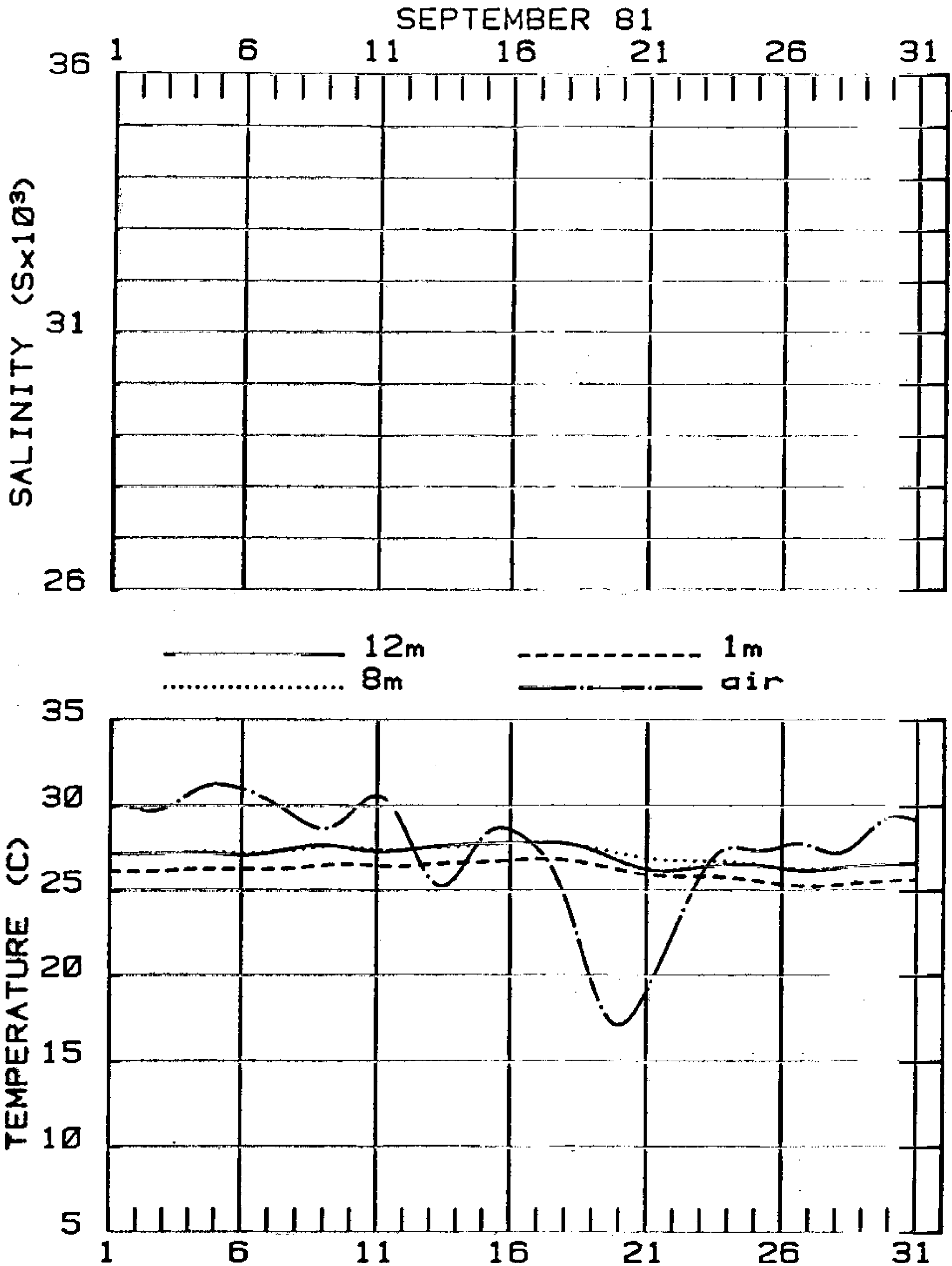


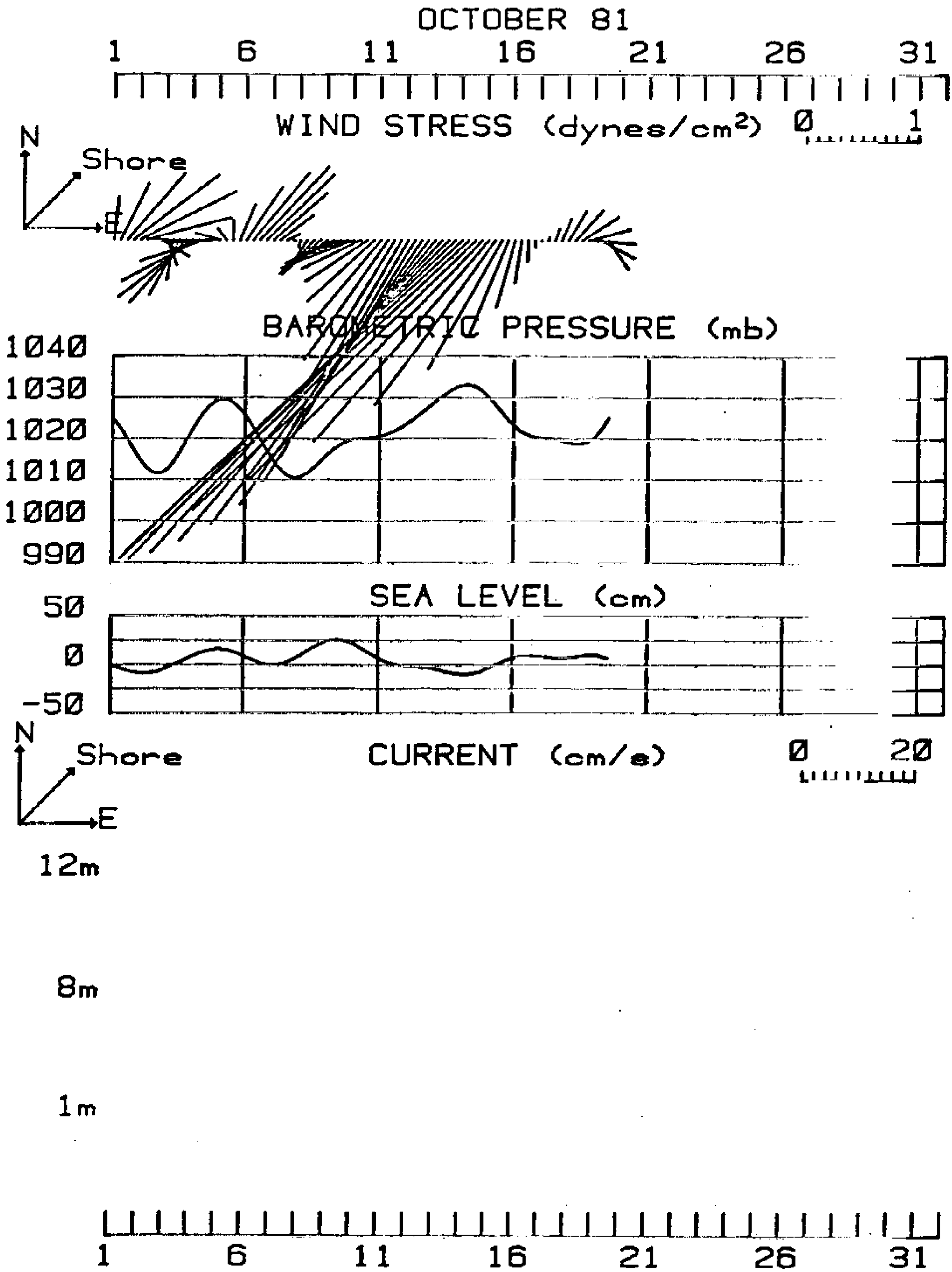
AUGUST 81
1
6
11
16
21
26
31
WIND STRESS (dynes/cm²)
0
1
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (cm)
50
0
-50
N
Shore
E
CURRENT (cm/s)
0
20
12m
8m
1m
1
6
11
16
21
26
31

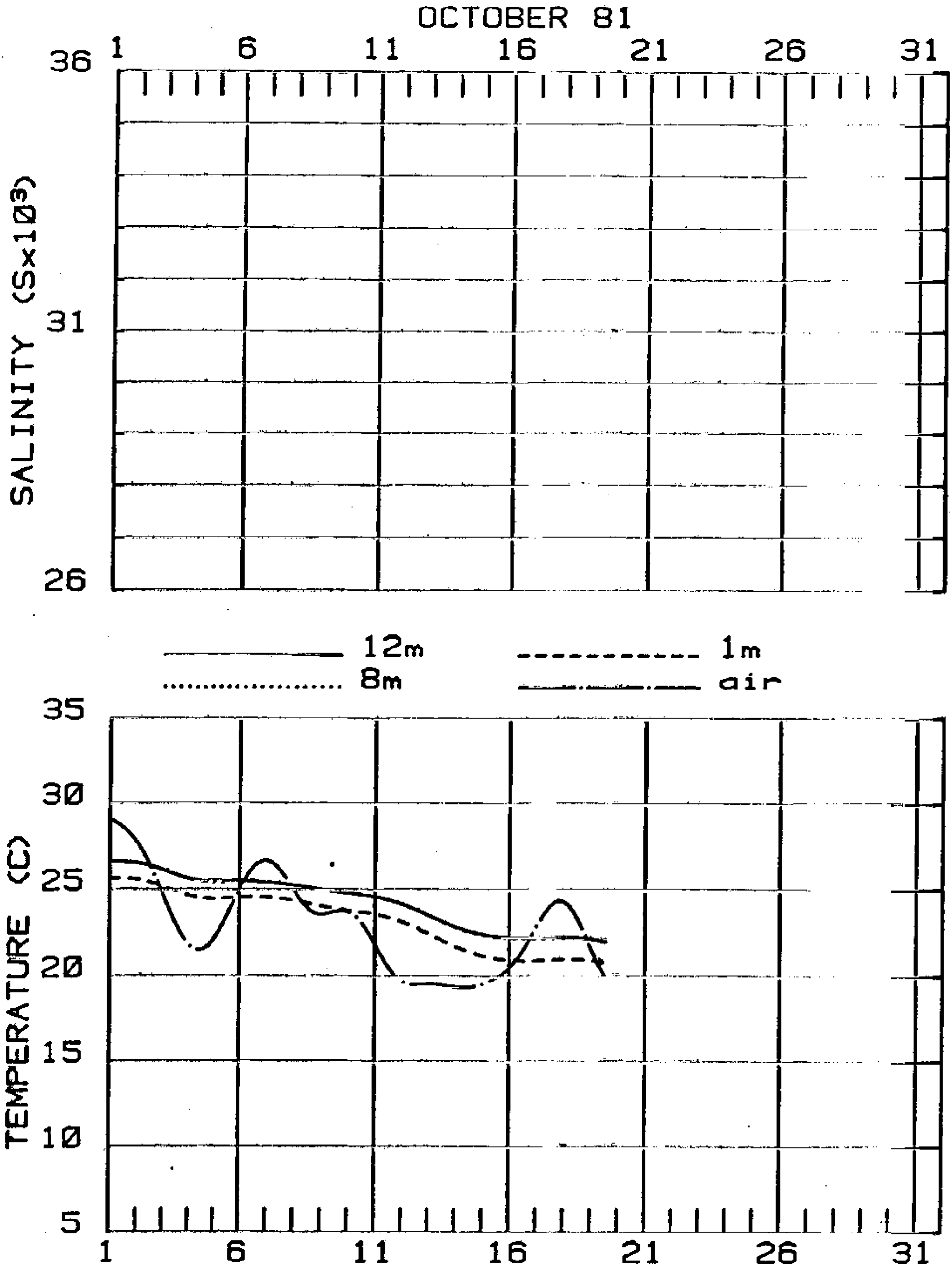

AUGUST 81
1
6
11
16
21
26
31
36
31
26
SALINITY (S×10³)
12m
1m
8m
air
35
30
25
20
15
10
5
TEMPERATURE (C)



SEPTEMBER 81
1
6
11
16
21
26
31
WIND STRESS (dynes/cm²)
0
1
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (cm)
50
0
-50
N
Shore
E
CURRENT (cm/s)
0
20
12m
8m
1m
1
6
11
16
21
26
31


SEPTEMBER 81
SALINITY (S×10³)
36
31
26
1 6 11 16 21 26 31
12m
1m
8m
air
TEMPERATURE (C)
35
30
25
20
15
10
5
1 6 11 16 21 26 31

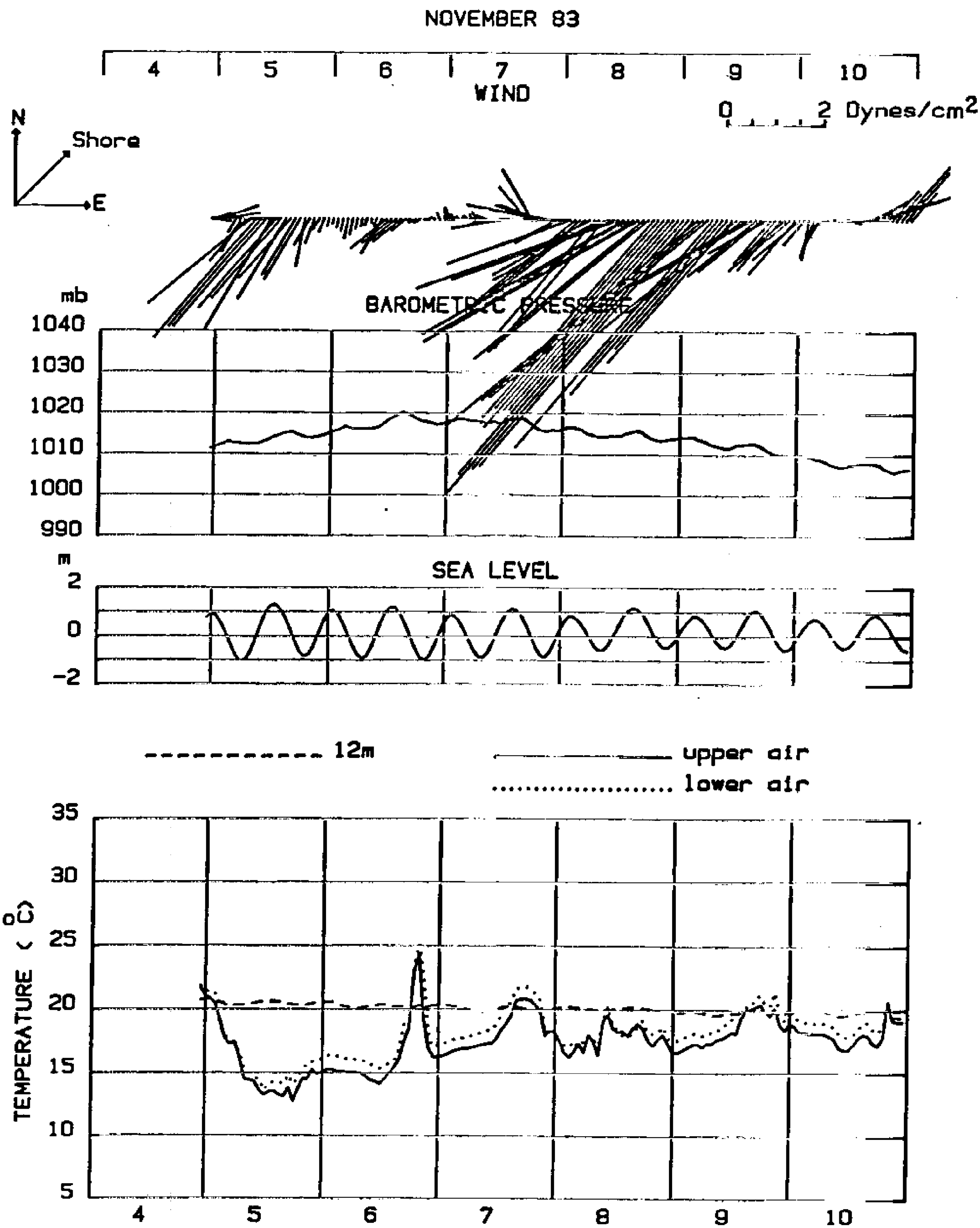

OCTOBER 81
1 6 11 16 21 26 31
WIND STRESS (dynes/cm²) 0 1
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (cm)
50
0
-50
N
Shore
E
CURRENT (cm/s) 0 20
12m
8m
1m
1 6 11 16 21 26 31



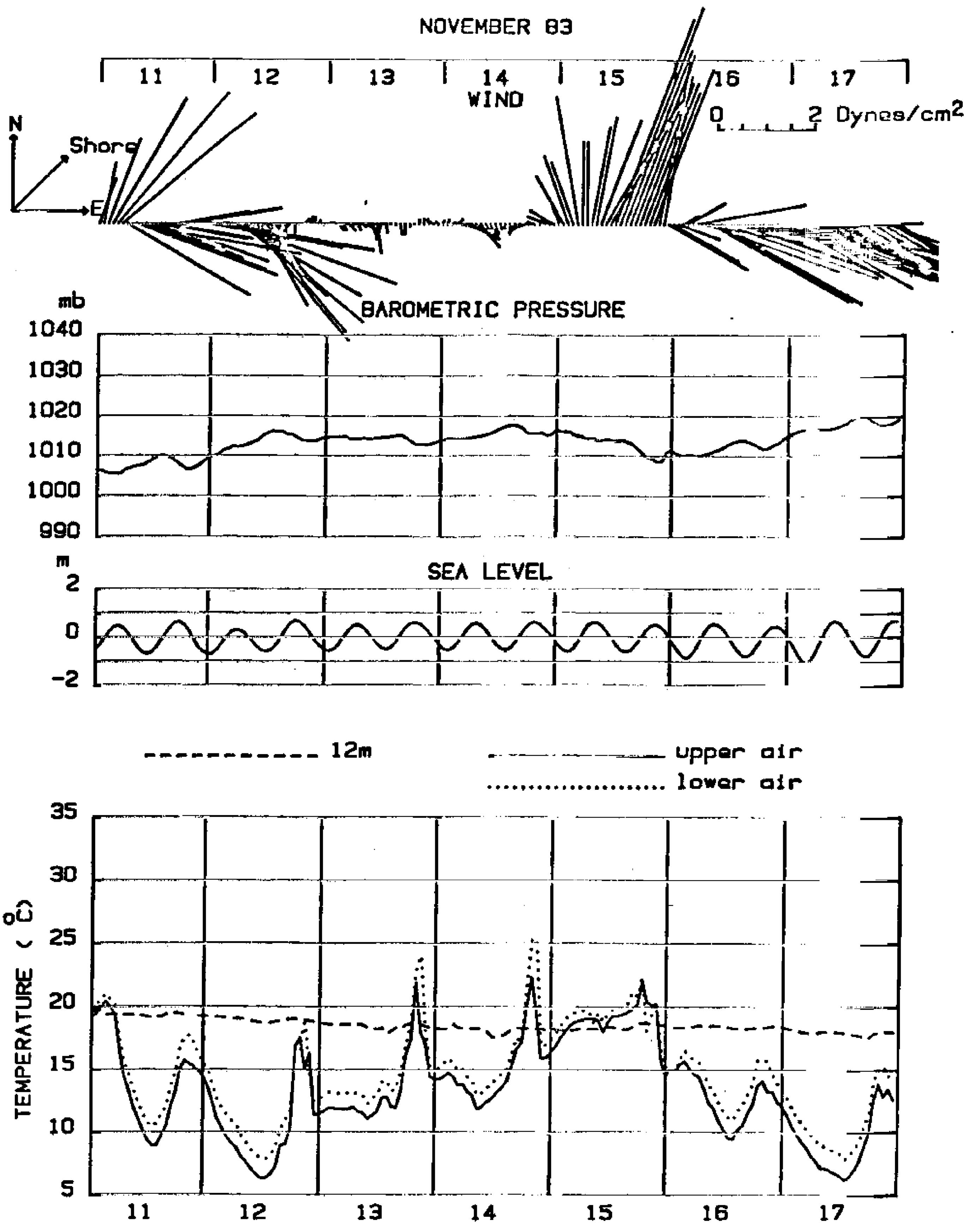
OCTOBER 81
SALINITY (S×10³)
36
31
26
12m
1m
8m
air
TEMPERATURE (C)
35
30
25
20
15
10
5
1
6
11
16
21
26
31

Appendix C:

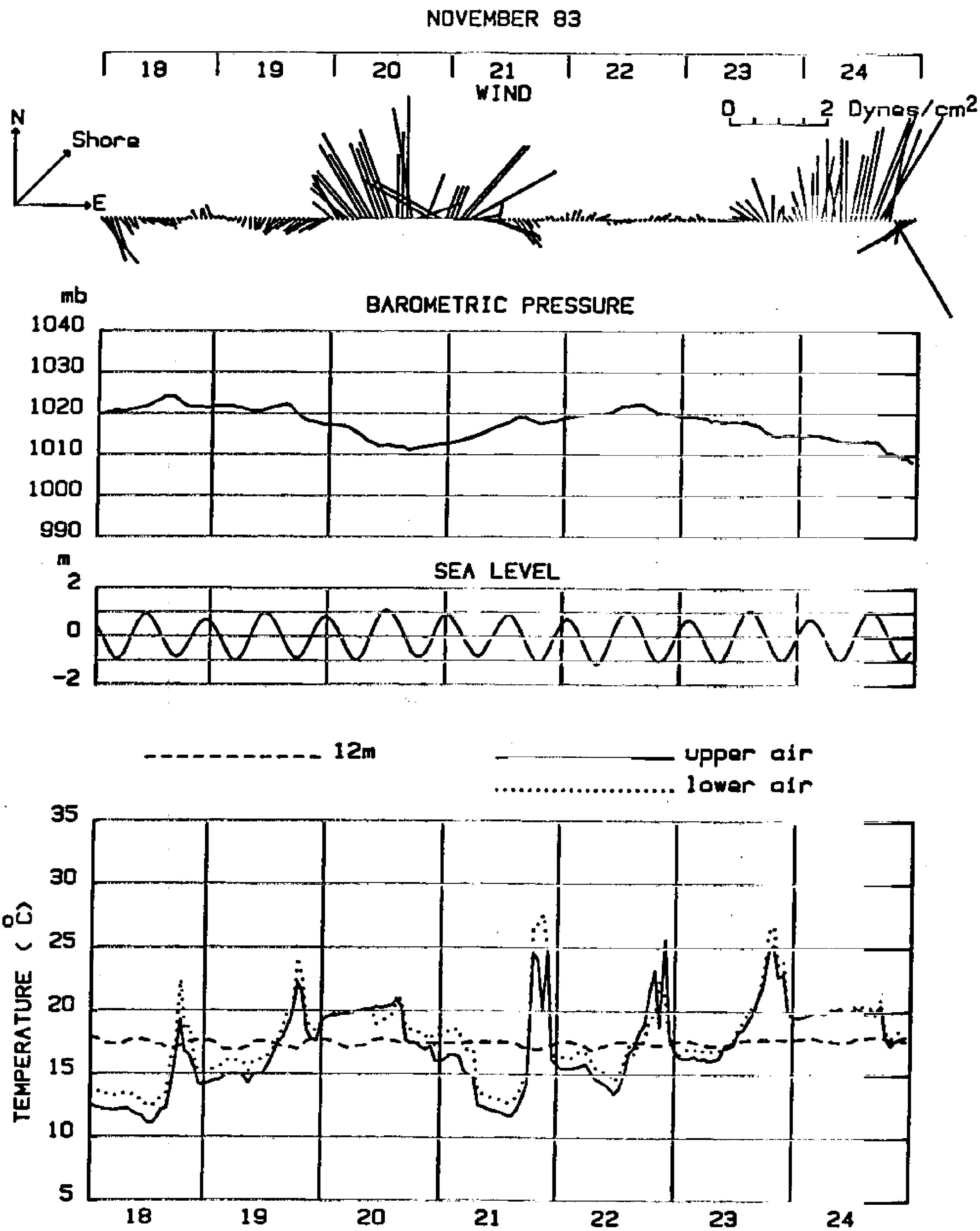
Plots of Weekly and Monthly Data Summaries of SNLT Data Collected During 1983 and 1984



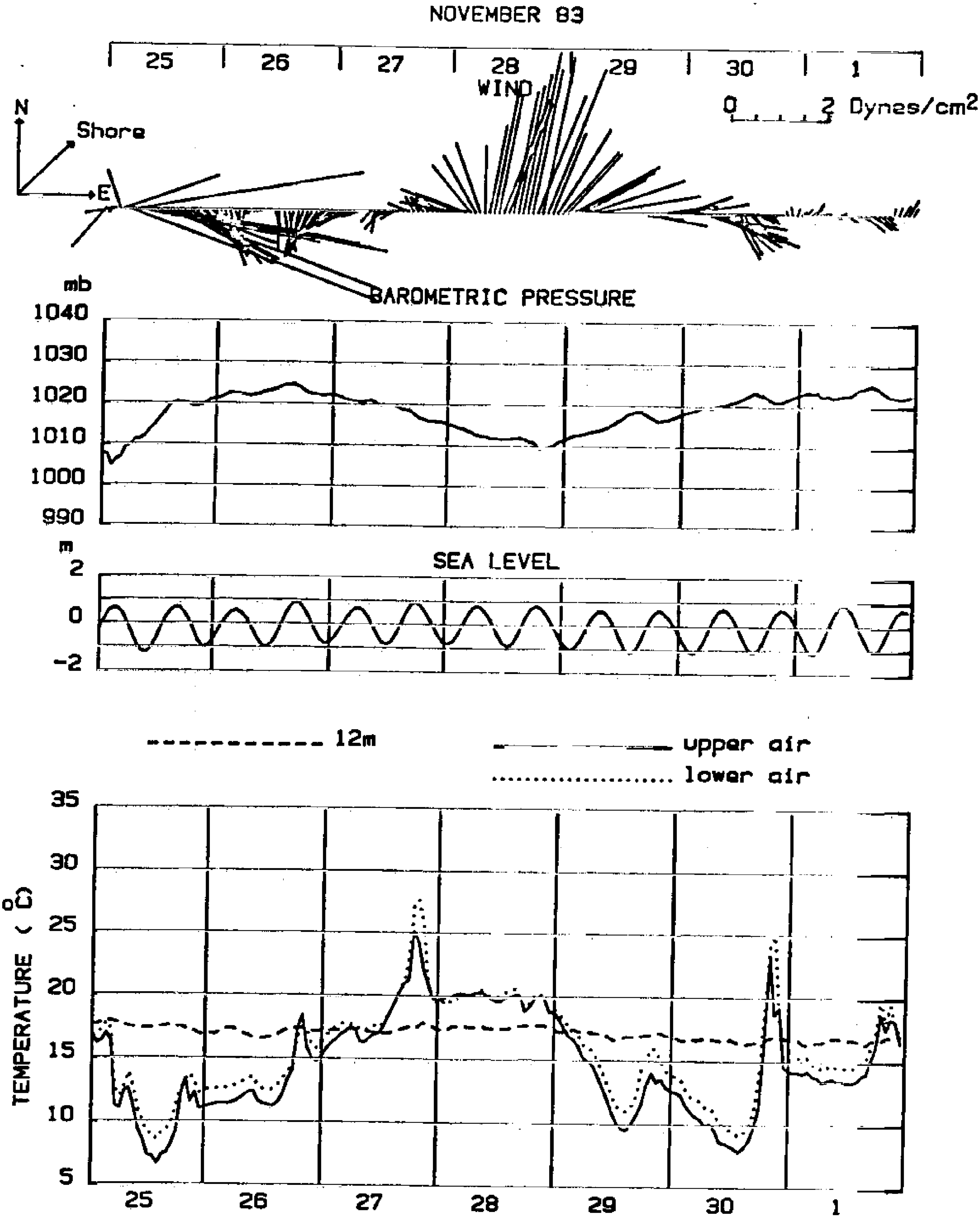
NOVEMBER 83
4 5 6 7 8 9 10
WIND
0 2 Dynes/cm2
N
Shore
E
BAROMETRIC PRESSURE
mb
1040
1030
1020
1010
1000
990
SEA LEVEL
m
2
0
-2
12m
upper air
lower air
TEMPERATURE (oC)
35
30
25
20
15
10
5
4 5 6 7 8 9 10



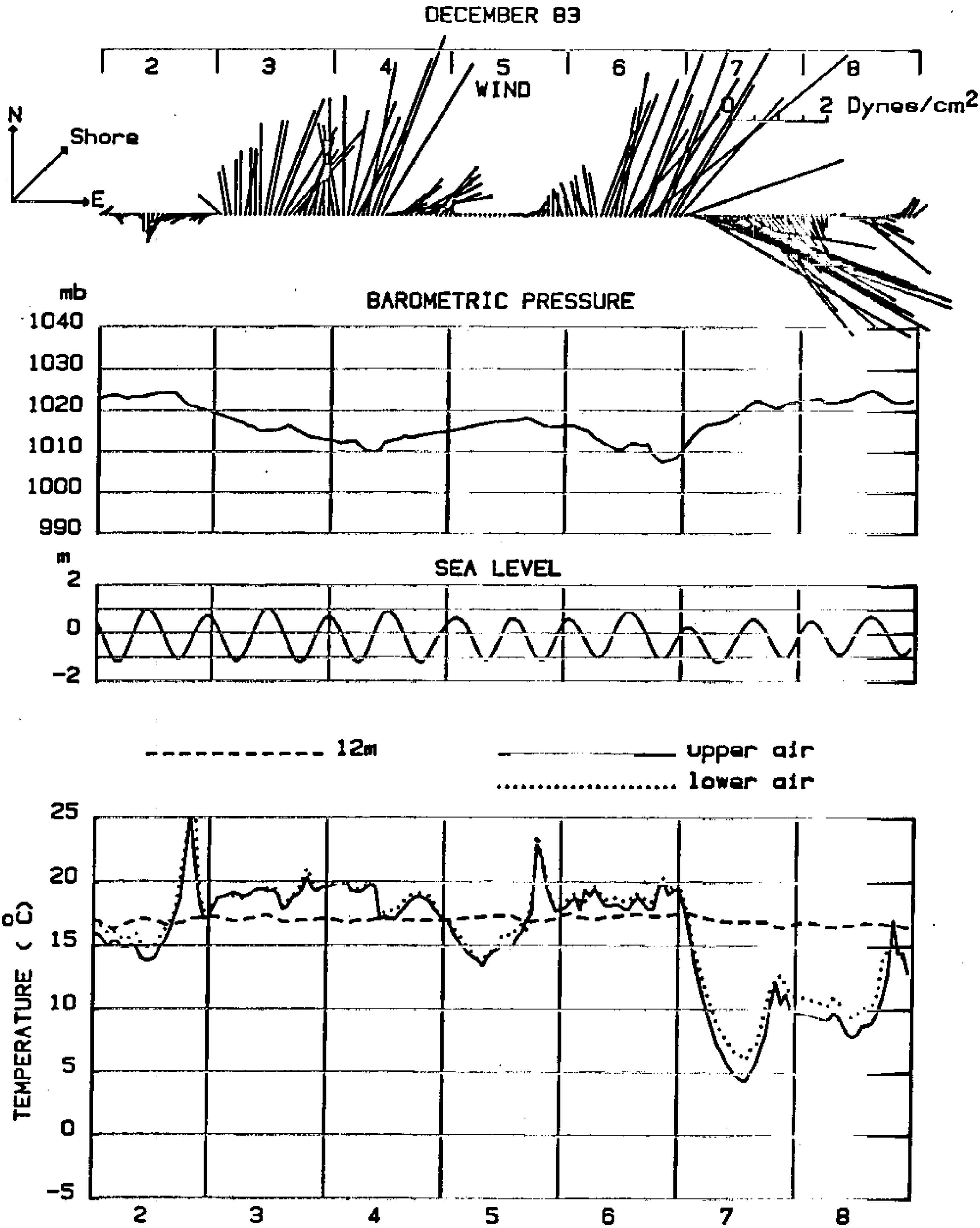
NOVEMBER 83
11
12
13
14
15
16
17
WIND
0 2 Dynes/cm2
N
Shore
E
BAROMETRIC PRESSURE
mb
1040
1030
1020
1010
1000
990
SEA LEVEL
m
2
0
-2
12m
upper air
lower air
35
30
25
20
15
10
5
TEMPERATURE (oC)



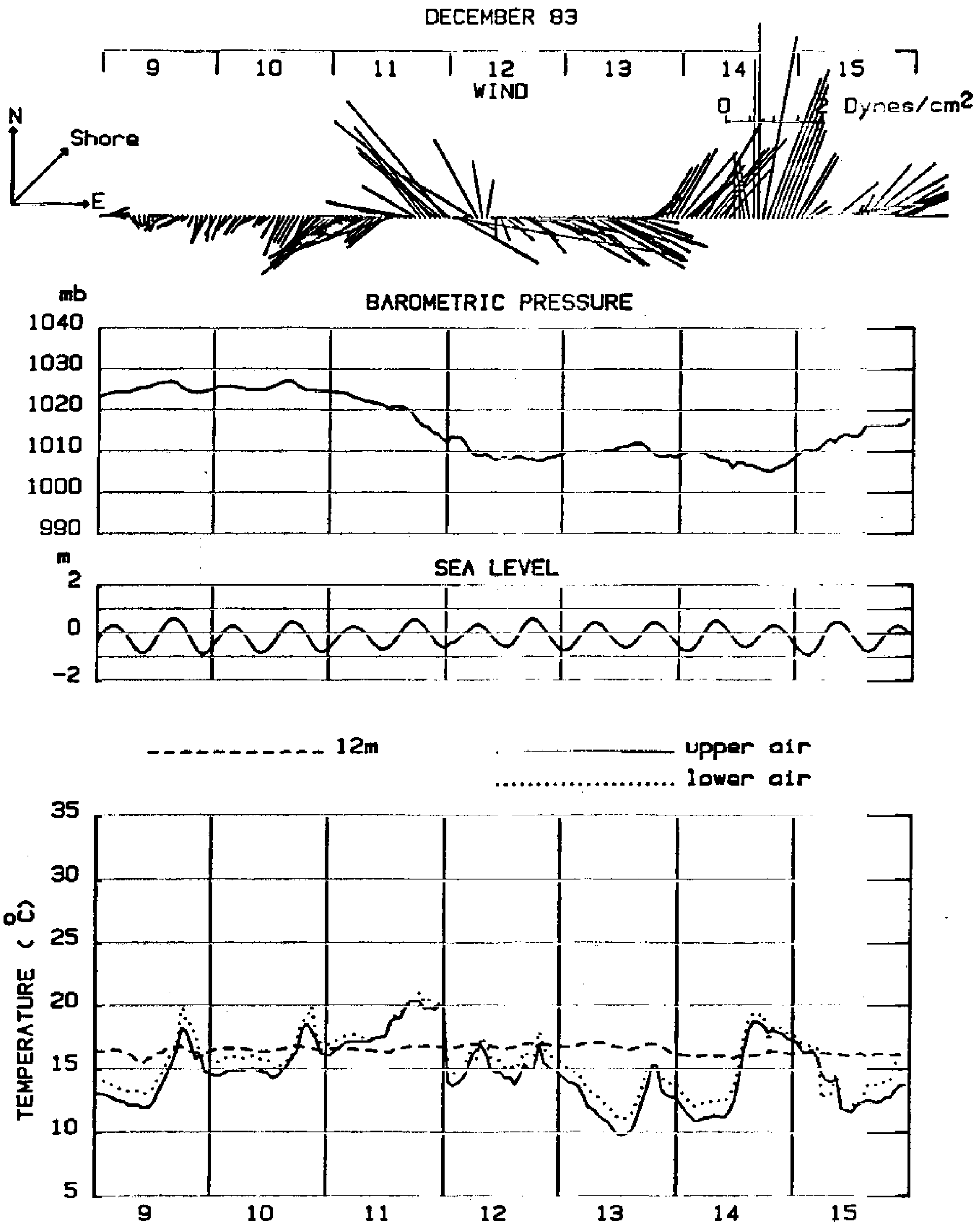
NOVEMBER 83
18
19
20
21
22
23
24
WIND
0 2 Dynes/cm2
N
Shore
E
mb
BAROMETRIC PRESSURE
1040
1030
1020
1010
1000
990
m
SEA LEVEL
2
0
-2
12m
upper air
lower air
35
30
25
20
15
10
5
TEMPERATURE (°C)
18
19
20
21
22
23
24

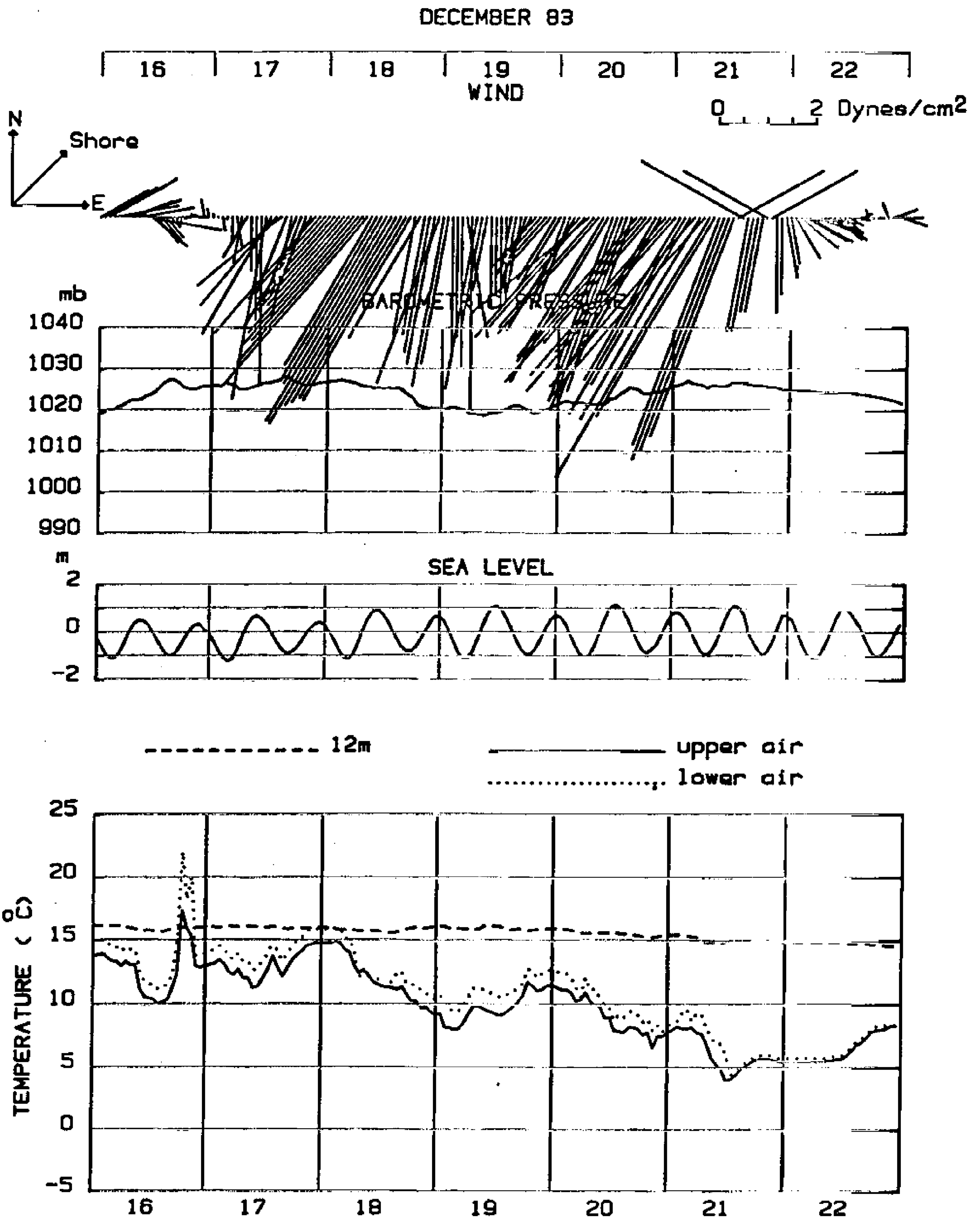


NOVEMBER 83
25
26
27
28
29
30
1
WIND
0 2 Dynes/cm2
N
Shore
E
BAROMETRIC PRESSURE
mb
1040
1030
1020
1010
1000
990
SEA LEVEL
m
2
0
-2
12m
upper air
lower air
TEMPERATURE (°C)
35
30
25
20
15
10
5
25
26
27
28
29
30
1

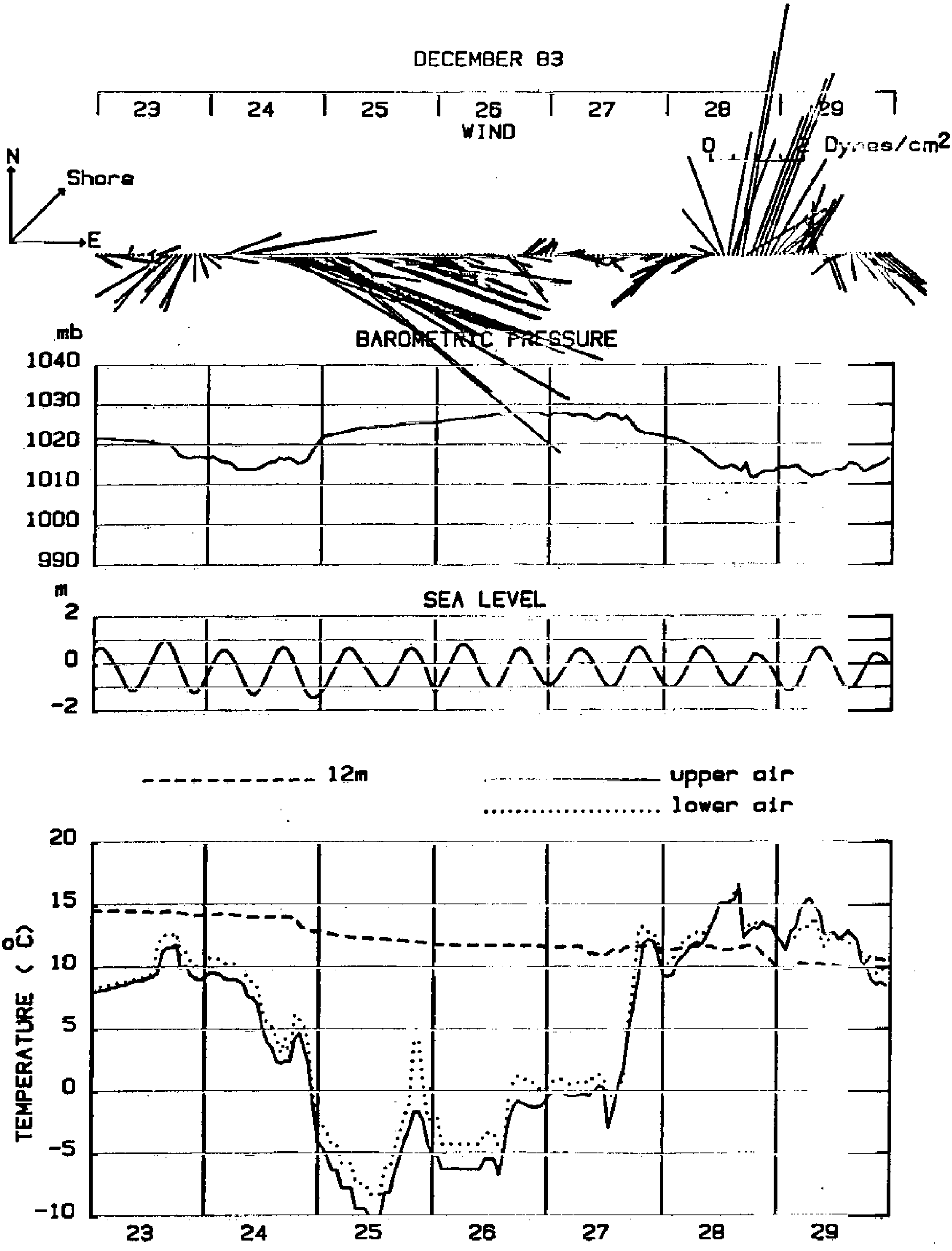


DECEMBER 83
2
3
4
5
6
7
8
WIND
N
Shore
E
0 2 Dynes/cm2
BAROMETRIC PRESSURE
mb
1040
1030
1020
1010
1000
990
SEA LEVEL
m
2
0
-2
12m
upper air
lower air
TEMPERATURE (°C)
25
20
15
10
5
0
-5
2
3
4
5
6
7
8

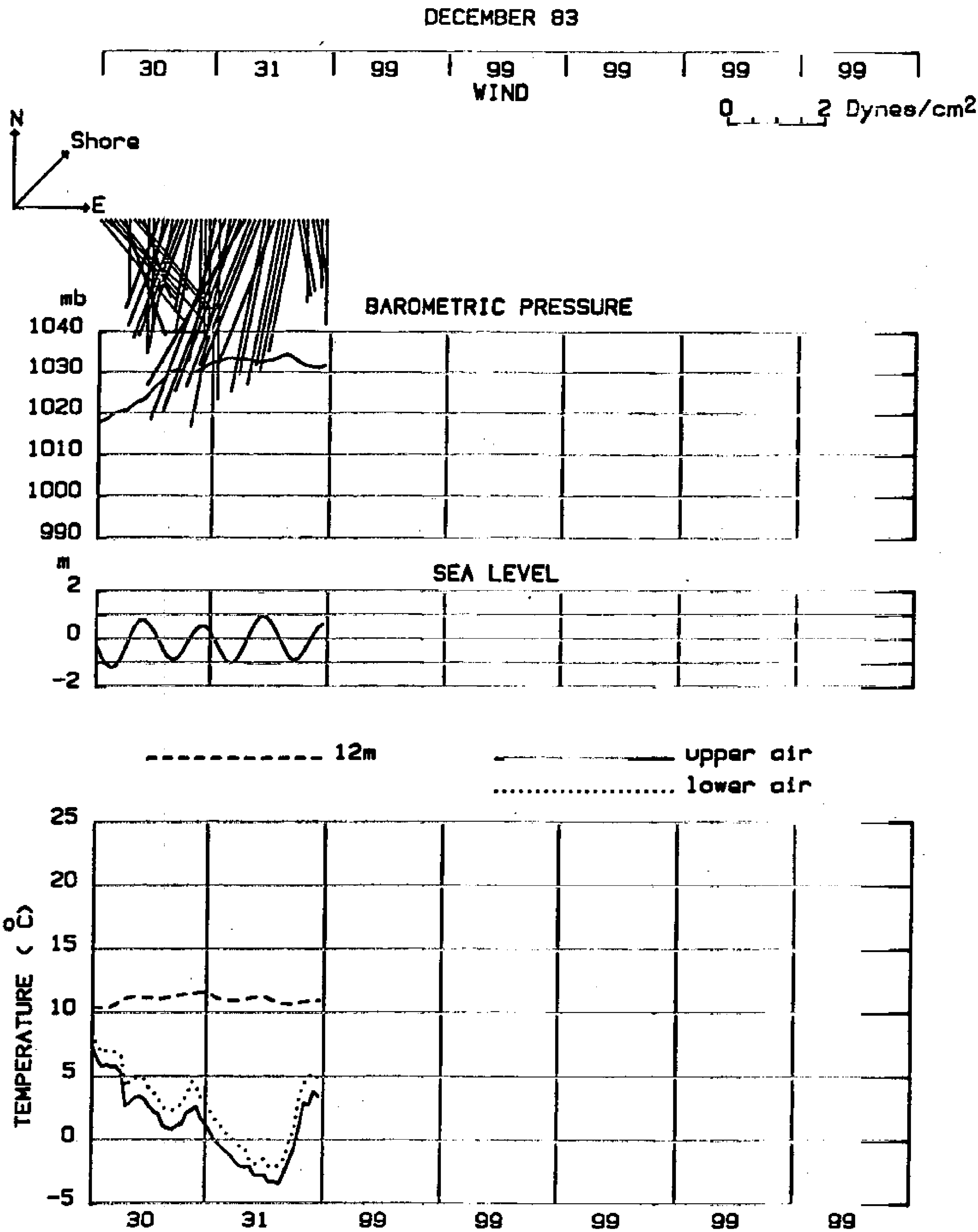

DECEMBER 83
9
10
11
12
13
14
15
WIND
0
2 Dynes/cm2
N
Shore
E
BAROMETRIC PRESSURE
mb
1040
1030
1020
1010
1000
990
SEA LEVEL
m
2
0
-2
12m
upper air
lower air
TEMPERATURE (°C)
35
30
25
20
15
10
5
9
10
11
12
13
14
15



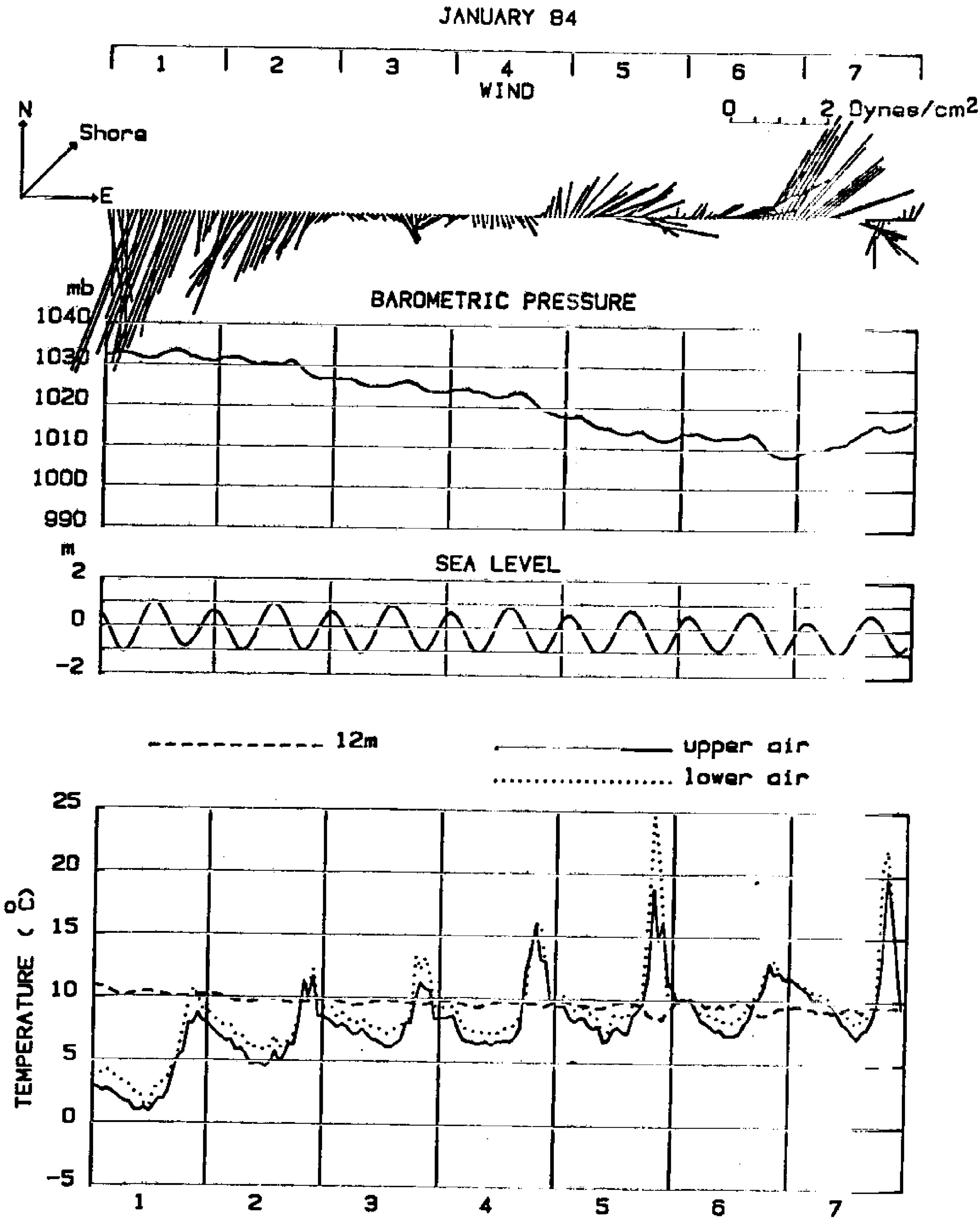
DECEMBER 83
16
17
18
19
20
21
22
WIND
0 2 Dynes/cm2
N
Shore
E
BAROMETRIC PRESSURE
mb
1040
1030
1020
1010
1000
990
SEA LEVEL
m
2
0
-2
12m
upper air
lower air
25
20
15
10
5
0
-5
TEMPERATURE (oC)



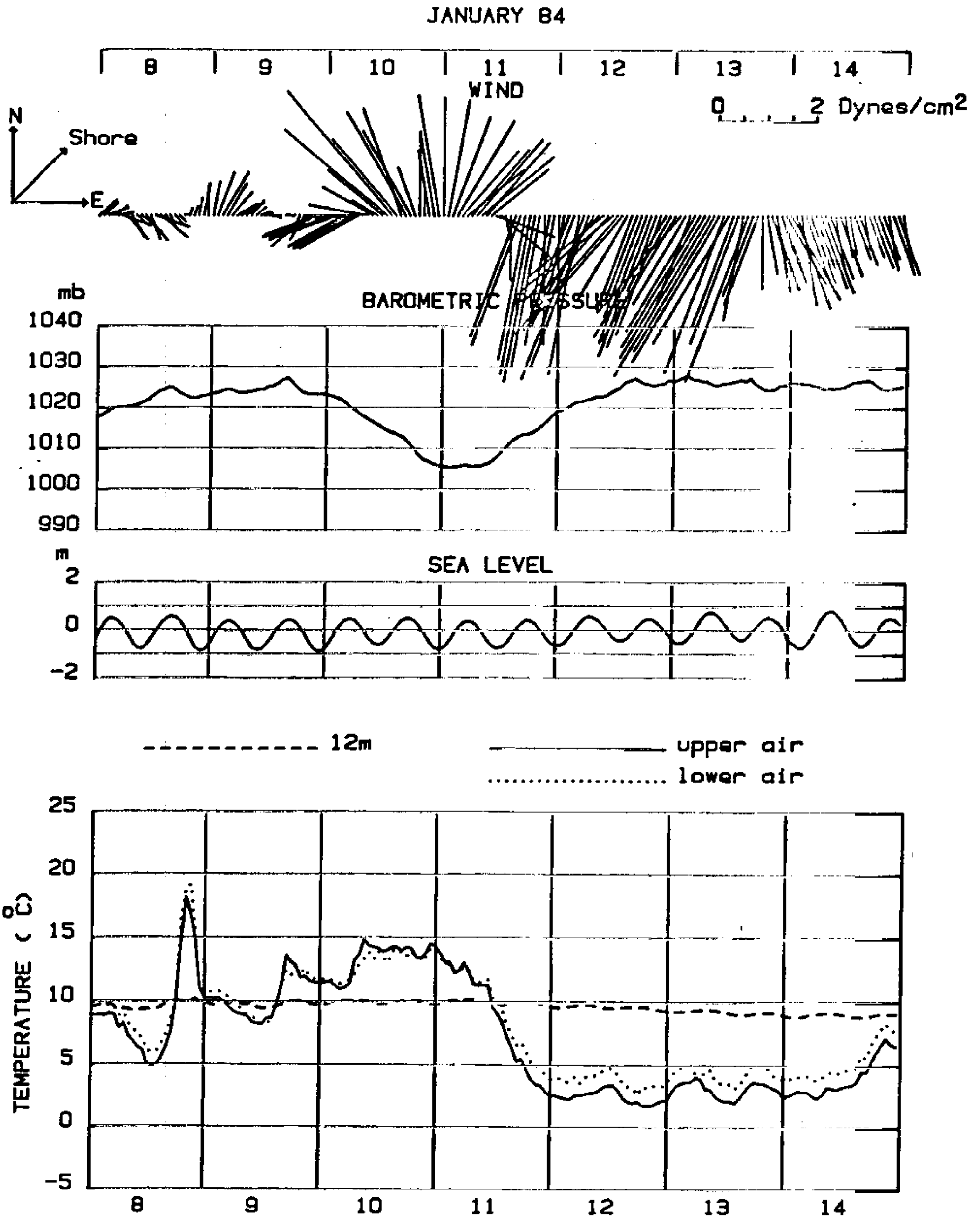
DECEMBER 83
23
24
25
26
27
28
29
WIND
0
Dynes/cm2
N
Shore
E
BAROMETRIC PRESSURE
mb
1040
1030
1020
1010
1000
990
SEA LEVEL
m
2
0
-2
12m
upper air
lower air
TEMPERATURE (°C)
20
15
10
5
0
-5
-10
23
24
25
26
27
28
29



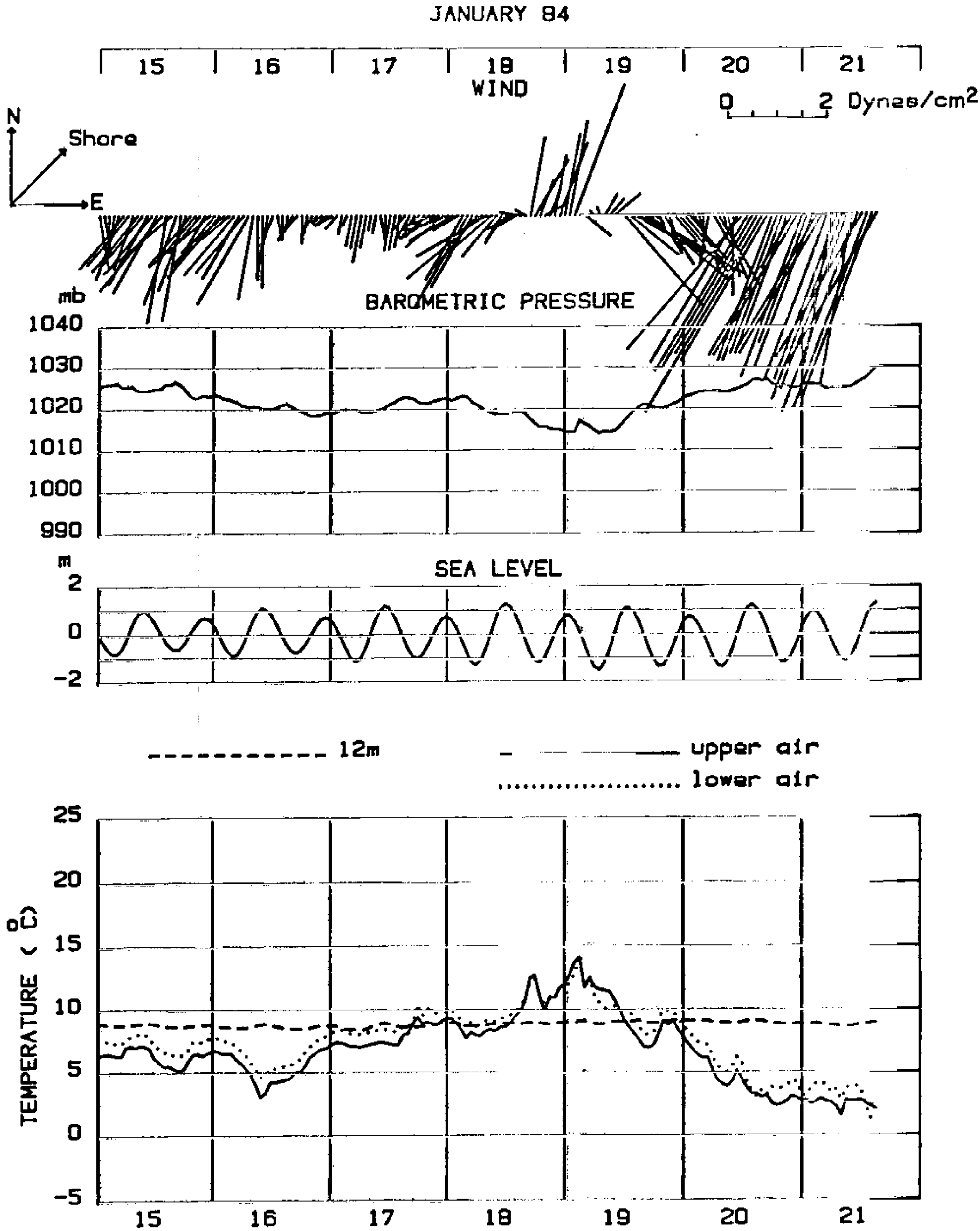
DECEMBER 83
30
31
99
99
99
99
99
WIND
0 2 Dynes/cm2
N
Shore
E
BAROMETRIC PRESSURE
mb
1040
1030
1020
1010
1000
990
SEA LEVEL
m
2
0
-2
12m
upper air
lower air
TEMPERATURE (°C)
25
20
15
10
5
0
-5
30
31
99
99
99
99
99



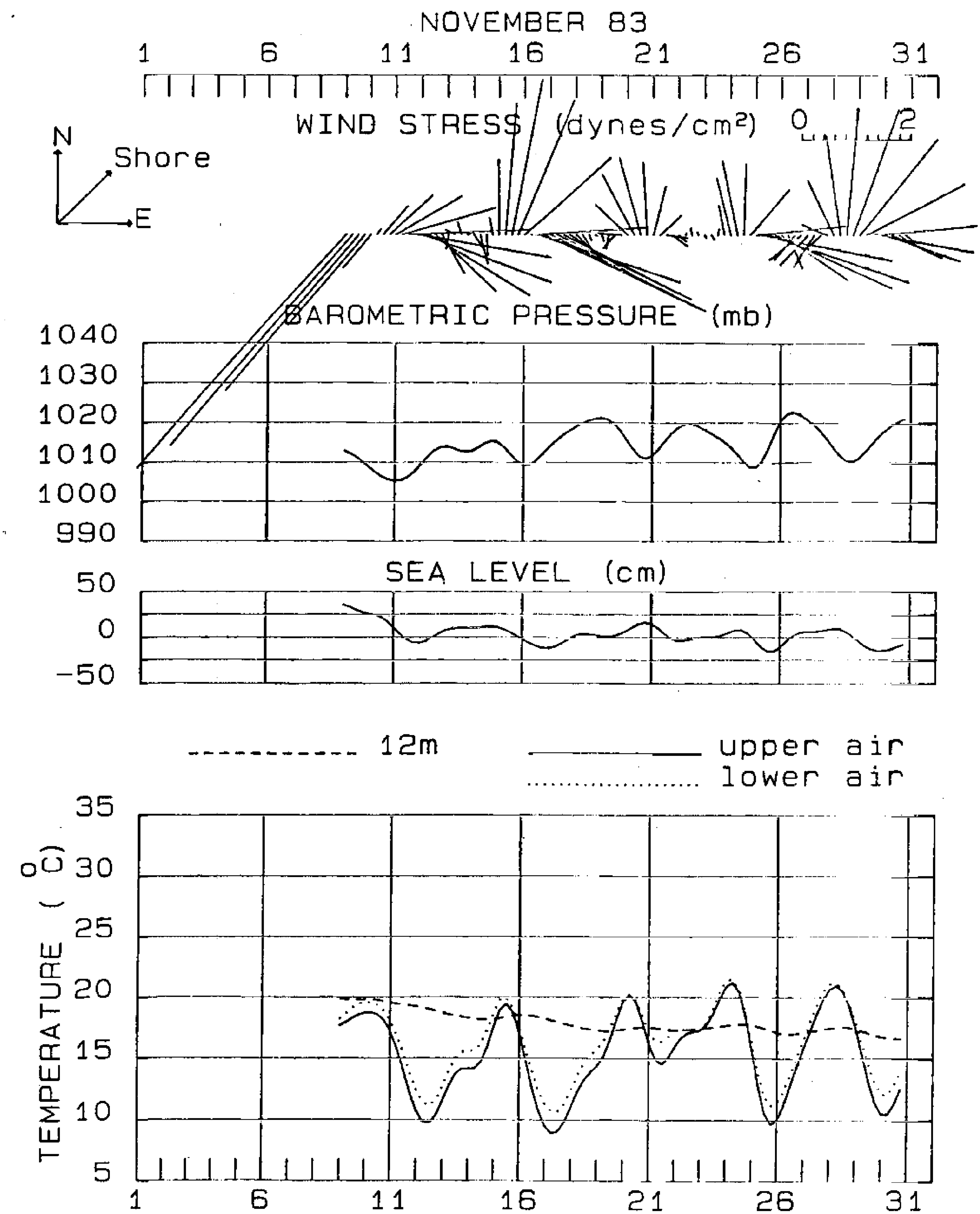
JANUARY 84
1
2
3
4
5
6
7
WIND
0
2 Dynes/cm2
N
Shore
E
mb
1040
1030
1020
1010
1000
990
BAROMETRIC PRESSURE
m
2
0
-2
SEA LEVEL
12m
upper air
lower air
25
20
15
10
5
0
-5
TEMPERATURE (oC)



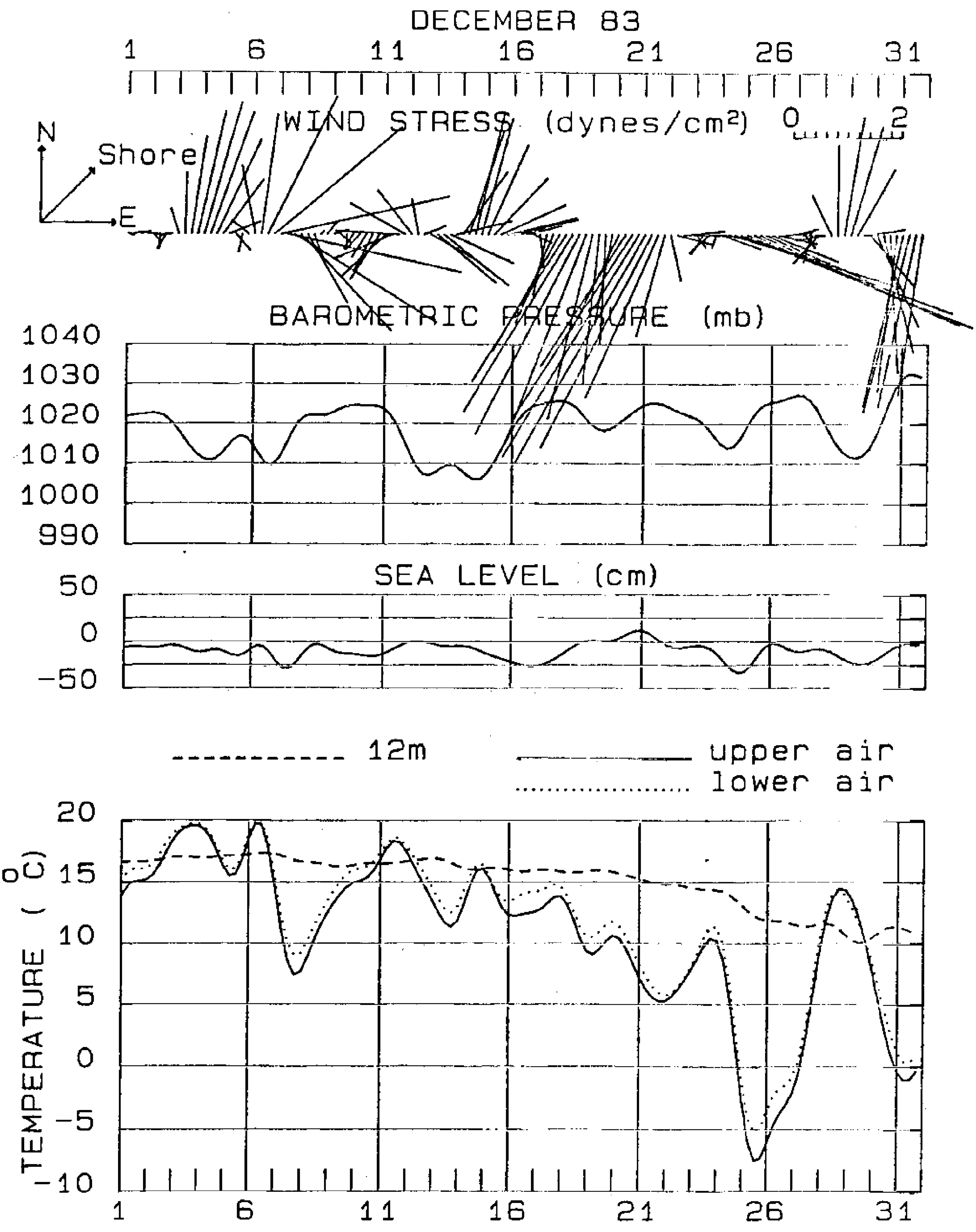
JANUARY 84
8
9
10
11
12
13
14
WIND
0 2 Dynes/cm2
N
Shore
E
BAROMETRIC PRESSURE
mb
1040
1030
1020
1010
1000
990
SEA LEVEL
m
2
0
-2
12m
upper air
lower air
TEMPERATURE (°C)
25
20
15
10
5
0
-5



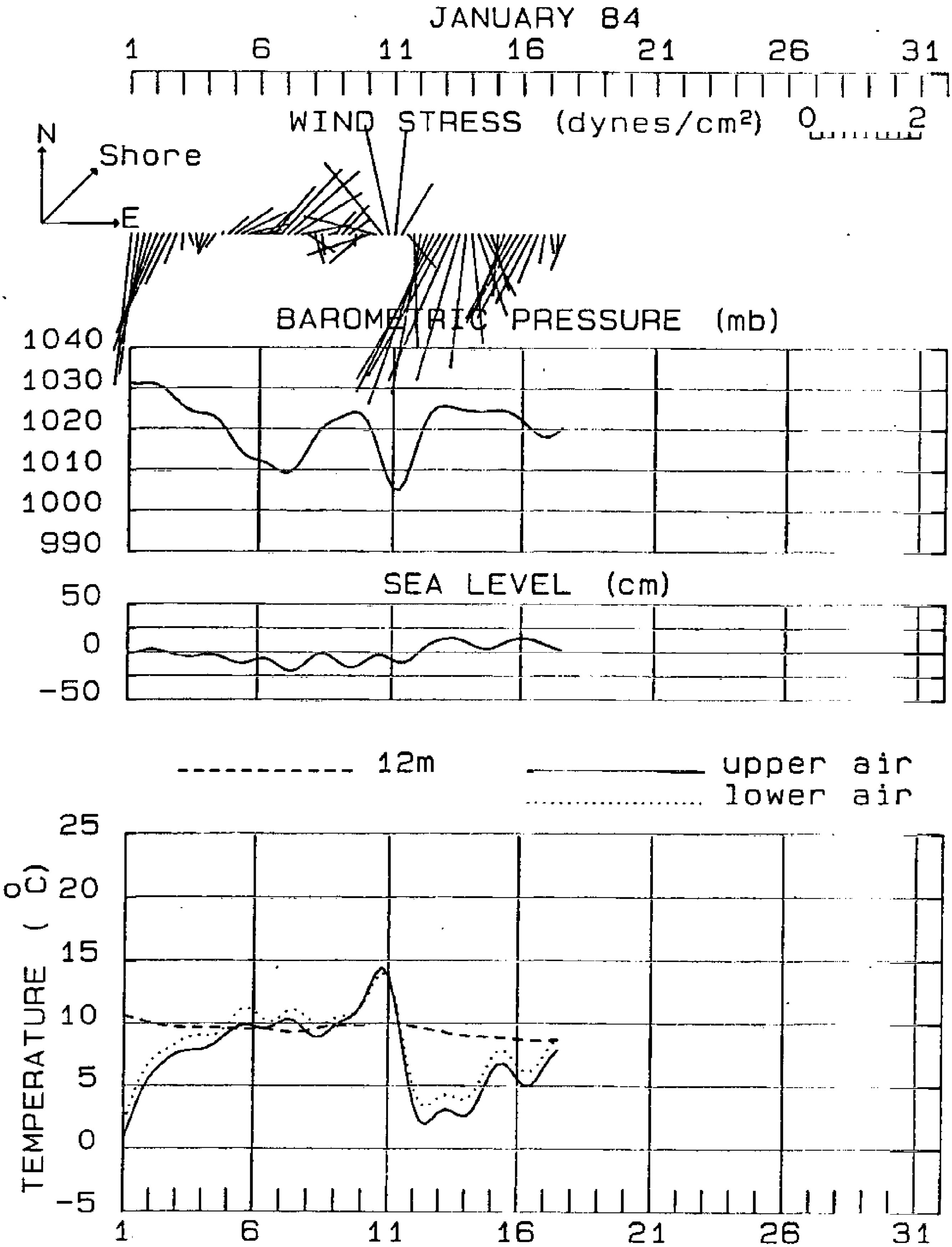
JANUARY 84
15
16
17
18
19
20
21
WIND
0 2 Dynes/cm2
N
Shore
E
mb
BAROMETRIC PRESSURE
1040
1030
1020
1010
1000
990
m
SEA LEVEL
2
0
-2
12m
upper air
lower air
25
20
15
10
5
0
-5
TEMPERATURE (oC)
15
16
17
18
19
20
21



NOVEMBER 83
1
6
11
16
21
26
31
WIND STRESS (dynes/cm²)
0
2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (cm)
50
0
-50
12m
upper air
lower air
35
30
25
20
15
10
5
TEMPERATURE (°C)
1
6
11
16
21
26
31



DECEMBER 83
WIND STRESS (dynes/cm²)
0
2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040
1030
1020
1010
1000
990
SEA LEVEL (cm)
50
0
-50
12m
upper air
lower air
TEMPERATURE (°C)
20
15
10
5
0
-5
-10
1
6
11
16
21
26
31



JANUARY 84
1 6 11 16 21 26 31
WIND STRESS (dynes/cm²) 0 2
N
Shore
E
BAROMETRIC PRESSURE (mb)
1040 1030 1020 1010 1000 990
SEA LEVEL (cm)
50 0 -50
12m
upper air
lower air
TEMPERATURE (°C)
25 20 15 10 5 0 -5
1 6 11 16 21 26 31

Appendix D:

Calibration Tables for SNLT Deployments

CALIBRATION FILE cal001

CHANNEL	UNIT	SENSOR	m	C	STAT	MIN	MAX
1	mb	Sub-surface pres.	344.7385	-0.0000	1	-1.2628	1722.8507
2	mmhos/cm	Conductivity L1	11.6628	-0.7992	1	-59.1135	57.4865
3	mmhos/cm	Conductivity L2	11.6628	-0.7992	1	-59.0550	57.4865
4	mmhos/cm	Conductivity L3	11.6628	-0.7992	1	-59.0550	57.4865
5	C	Temp 1 L1A	10.0000	-0.0000	1	-49.9756	49.9756
6	C	Temp 2 L1B	10.0000	-0.0000	1	-49.9756	49.9756
7	C	Temp 3 L2A	10.0000	-0.0000	1	-49.9756	49.9756
8	C	Temp 4 L2B	10.0000	-0.0000	1	-49.9756	49.9756
9	C	Temp 5 L3A	10.0000	-0.0000	1	-49.9756	49.9756
10	C	Temp 6 L3B	10.0000	-0.0000	1	-49.9756	49.9756
11	C	Cabin Temp	10.0000	-0.0000	1	-49.9756	49.9756
12	C	Outside Air Temp	10.0000	-0.0000	1	-49.9756	49.9756
13	C		10.0000	-0.0000	1	-49.9756	49.9756
14	C		10.0000	-0.0000	1	-49.9756	49.9756
15	cm/s	Current X L1	60.0000	0.0000	-1	299.8535	-299.8535
16	cm/s	Current Y L1	60.0000	0.0000	1	-299.8535	299.8535
17			0.0000	0.0000	0	0.0000	0.0000
18			0.0000	0.0000	0	0.0000	0.0000
19			0.0000	0.0000	0	0.0000	0.0000
20			0.0000	0.0000	0	0.0000	0.0000
21	m/sec	Wind 1 Speed	11.1800	0.0000	1	-0.0410	55.8727
22		Wind 1 Direction	135.0000	-0.0000	1	-0.4945	674.6703
23	mb	Barometer	100.0000	950.0000	1	949.6337	1050.7326
24	volts	Generator	1.0000	-0.0000	1	-5.0000	5.0024
25			0.0000	0.0000	0	0.0000	0.0000
26			0.0000	0.0000	0	0.0000	0.0000
27			0.0000	0.0000	0	0.0000	0.0000
28			0.0000	0.0000	0	0.0000	0.0000
29			0.0000	0.0000	0	0.0000	0.0000
30			0.0000	0.0000	0	0.0000	0.0000
31			0.0000	0.0000	0	0.0000	0.0000
32			0.0000	0.0000	0	0.0000	0.0000

CALIBRATION FILE cal002

CHANNEL	UNIT	SENSOR	m	C	STAT	MIN	MAX
1	mb	Sub-surface pres.	344.7385	-0.0000	1	-1.2628	1722.8507
2	mmhos/cm	Conductivity L1B	11.6628	-0.7992	1	-59.1135	57.4865
3	mmhos/cm	Conductivity L2M	11.6628	-0.7992	1	-59.0850	57.4865
4	mmhos/cm	Conductivity L3T	11.6628	-0.7992	1	-59.0650	57.4865
5	C	Temp 1 L1A	10.0000	-0.0000	1	-49.9756	49.9756
6	C	Temp 2 L1B	10.0000	-0.0000	1	-49.9756	49.9756
7	C	Temp 3 L2A	10.0000	-0.0000	1	-49.9756	49.9756
8	C	Temp 4 L2B	10.0000	-0.0000	1	-49.9756	49.9756
9	C	Temp 5 L3A	10.0000	-0.0000	1	-49.9756	49.9756
10	C	Temp 6 L3B	10.0000	-0.0000	1	-49.9756	49.9756
11	C	Cabin Temp	10.0000	-0.0000	1	-49.9756	49.9756
12	C	Outside Air Temp	10.0000	-0.0000	1	-49.9756	49.9756
13	C		10.0000	-0.0000	1	-49.9756	49.9756
14			10.0000	-0.0000	0	-49.9756	49.9756
15	cm/s	Current X L1 B	66.0000	0.0000	-1	329.8388	-329.8388
16	cm/s	Current Y L1 B	66.0000	0.0000	1	-329.8388	329.8388
17	cm/s	Current X L2 M	89.0000	0.0000	-1	444.7827	-444.7827
18	cm/s	Current Y L2 M	89.0000	0.0000	1	-444.7827	444.7827
19	cm/s	Current X L3 T	86.0000	0.0000	-1	429.7900	-429.7900
20	cm/s	Current Y L3 T	86.0000	0.0000	1	-429.7900	429.7900
21	m/sec	Wind 1 Speed	11.1800	0.0000	1	-0.0410	55.8727
22		Wind 1 Direction	135.0000	-0.0000	1	-0.4945	674.6703
23	mb	Barometer	100.0000	950.0000	1	949.6337	1050.7326
24	volts	Generator	1.0000	-0.0000	1	-5.0000	5.0024
25			0.0000	0.0000	0	0.0000	0.0000
26			0.0000	0.0000	0	0.0000	0.0000
27			0.0000	0.0000	0	0.0000	0.0000
28			0.0000	0.0000	0	0.0000	0.0000
29			0.0000	0.0000	0	0.0000	0.0000
30			0.0000	0.0000	0	0.0000	0.0000
31			0.0000	0.0000	0	0.0000	0.0000
32			0.0000	0.0000	0	0.0000	0.0000

CALIBRATION FILE cal003

CHANNEL	UNIT	SENSOR	m	C	STAT	MIN	MAX
1	mb	Sub-surface pres.	344.7385	-0.0000	1	-1.2628	1722.8507
2	mmhos/cm	Conductivity L1B	23.0240	7.9177	1	-107.2022	122.9814
3	mmhos/cm	Conductivity L2M	12.6536	-1.0959	1	-64.3329	62.1411
4	mmhos/cm	Conductivity L3T	11.4635	4.4744	1	-52.8150	61.7639
5	C	Temp 1 L1A	10.0000	-0.0000	1	-49.9756	49.9756
6	C	Temp 2 L1B	10.0000	-0.0000	1	-49.9756	49.9756
7	C	Temp 3 L2A	10.0000	-0.0000	1	-49.9756	49.9756
8	C	Temp 4 L2B	10.0000	-0.0000	1	-49.9756	49.9756
9	C	Temp 5 L3A	10.0000	-0.0000	1	-49.9756	49.9756
10	C	Temp 6 L3B	10.0000	-0.0000	1	-49.9756	49.9756
11	C	7 Outside Air Temp	10.0000	-0.0000	1	-49.9756	49.9756
12	C	8 Cabin Temp	10.0000	-0.0000	1	-49.9756	49.9756
13	C	9 Box Temp	10.0000	-0.0000	1	-49.9756	49.9756
14			10.0000	-0.0000	0	-49.9756	49.9756
15	cm/s	Current X L1 B S-251	100.0000	-0.0000	0	-499.7558	499.7558
16	cm/s	Current Y L1 B	100.0000	-0.0000	0	-499.7558	499.7558
17	cm/s	Current X L2 M S-253	100.0000	-0.0000	1	-499.7558	499.7558
18	cm/s	Current Y L2 M	100.0000	-0.0000	1	-499.7558	499.7558
19	cm/s	Current X L3 T S-252	100.0000	-0.0000	0	-499.7558	499.7558
20	cm/s	Current Y L3 T	100.0000	-0.0000	0	-499.7558	499.7558
21	m/sec	Wind 1 Speed	11.1800	0.0000	1	-0.0410	55.8727
22		Wind 1 Direction	135.0000	-0.0000	1	-0.4945	674.6703
23	mb	Barometer	100.0000	950.0000	1	949.6337	1050.7326
24	volts	Generator	1.0000	-0.0000	1	-5.0000	5.0024
25			0.0000	0.0000	0	0.0000	0.0000
26			0.0000	0.0000	0	0.0000	0.0000
27			0.0000	0.0000	0	0.0000	0.0000
28			0.0000	0.0000	0	0.0000	0.0000
29			0.0000	0.0000	0	0.0000	0.0000
30			0.0000	0.0000	0	0.0000	0.0000
31			0.0000	0.0000	0	0.0000	0.0000
32			0.0000	0.0000	0	0.0000	0.0000

CALIBRATION FILE cal004

CHANNEL	UNIT	SENSOR	m	C	STAT	MIN	MAX
1	mb	Sub-surface pres.	344.7385	-0.0000	1	-1.2628	1722.8507
2	mmhos/cm	Conductivity L1B	23.0240	7.9177	1	-107.2022	122.9814
3	mmhos/cm	Conductivity L2T	12.6536	-1.0959	1	-64.3329	62.1411
4	mmhos/cm	Conductivity L3T	11.4635	4.4744	1	-52.8150	61.7639
5	C	Temp 1 L1A	10.0000	-0.0000	1	-49.9756	49.9756
6	C	Temp 2 L1B	10.0000	-0.0000	1	-49.9756	49.9756
7	C	Temp 3 L2A	10.0000	-0.0000	1	-49.9756	49.9756
8	C	Temp 4 L2B	10.0000	-0.0000	1	-49.9756	49.9756
9	C	Temp 5 L3A	10.0000	-0.0000	1	-49.9756	49.9756
10	C	Temp 6 L3B	10.0000	-0.0000	1	-49.9756	49.9756
11	C	7 Outside Air Temp	10.0000	-0.0000	1	-49.9756	49.9756
12	C	8 Cabin Temp	10.0000	-0.0000	1	-49.9756	49.9756
13	C	9 Box Temp	10.0000	-0.0000	1	-49.9756	49.9756
14			10.0000	-0.0000	0	-49.9756	49.9756
15	cm/s	Current X L1 B S-251	100.0000	-0.0000	0	-499.7558	499.7558
16	cm/s	Current Y L1 B	100.0000	-0.0000	0	-499.7558	499.7558
17	cm/s	Current X L2 M S-253	100.0000	-0.0000	1	-499.7558	499.7558
18	cm/s	Current Y L2 M	100.0000	-0.0000	1	-499.7558	499.7558
19	cm/s	Current X L3 T S-252	100.0000	-0.0000	1	-499.7558	499.7558
20	cm/s	Current Y L3 T	100.0000	-0.0000	1	-499.7558	499.7558
21	m/sec	Wind 1 Speed	11.1800	0.0000	1	-0.0410	55.8727
22		Wind 1 Direction	135.0000	-0.0000	1	-0.4945	674.6703
23	mb	Barometer	50.8530	979.6035	1	979.4172	1030.8290
24	volts	Generator	1.0000	-0.0000	1	-5.0000	5.0024
25			0.0000	0.0000	0	0.0000	0.0000
26			0.0000	0.0000	0	0.0000	0.0000
27			0.0000	0.0000	0	0.0000	0.0000
28			0.0000	0.0000	0	0.0000	0.0000
29			0.0000	0.0000	0	0.0000	0.0000
30			0.0000	0.0000	0	0.0000	0.0000
31			0.0000	0.0000	0	0.0000	0.0000
32			0.0000	0.0000	0	0.0000	0.0000

CALIBRATION FILE cal005

CHANNEL	UNIT	SENSOR	m	C	STAT	MIN	MAX
1	mb	Sub-surface pres.	344.7385	-0.0000	1	-1.2628	1722.8507
2	mmhos/cm	Conductivity L1B	23.0240	7.9177	1	-107.2022	122.9814
3	mmhos/cm	Conductivity L2T	12.6536	-1.0959	1	-64.3329	62.1411
4	mmhos/cm	Conductivity L3T	11.4635	4.4744	1	-52.8150	61.7639
5	C	Temp 1 L1A	10.0000	-0.0000	1	-49.9756	49.9756
6	C	Temp 2 L1B	10.0000	-0.0000	1	-49.9756	49.9756
7	C	Temp 3 L2A	10.0000	-0.0000	1	-49.9756	49.9756
8	C	Temp 4 L2B	10.0000	-0.0000	1	-49.9756	49.9756
9	C	Temp 5 L3A	10.0000	-0.0000	1	-49.9756	49.9756
10	C	Temp 6 L3B	10.0000	-0.0000	1	-49.9756	49.9756
11	C	7 Outside Air Temp	10.0000	-0.0000	1	-49.9756	49.9756
12	C	8 Cabin Temp	10.0000	-0.0000	1	-49.9756	49.9756
13	C	9 Box Temp	10.0000	-0.0000	1	-49.9756	49.9756
14			10.0000	-0.0000	0	-49.9756	49.9756
15	cm/s	Current X L1 B S-251	100.0000	-0.0000	0	-499.7558	499.7558
16	cm/s	Current Y L1 B	100.0000	-0.0000	0	-499.7558	499.7558
17	cm/s	Current X L2 M S-253	100.0000	-0.0000	1	-499.7558	499.7558
18	cm/s	Current Y L2 M	100.0000	-0.0000	1	-499.7558	499.7558
19	cm/s	Current X L3 T S-252	100.0000	-0.0000	1	-499.7558	499.7558
20	cm/s	Current Y L3 T	100.0000	-0.0000	1	-499.7558	499.7558
21	m/sec	Wind 1 Speed	11.1800	0.0000	1	-0.0410	55.8727
22		Wind 1 Direction	135.0000	-0.0000	1	-0.4945	674.6703
23	mb	Barometer	50.8530	979.6035	1	979.4172	1030.8290
24	volts	Generator	1.0000	-0.0000	1	-5.0000	5.0024
25			0.0000	0.0000	0	0.0000	0.0000
26			0.0000	0.0000	0	0.0000	0.0000
27			0.0000	0.0000	0	0.0000	0.0000
28			0.0000	0.0000	0	0.0000	0.0000
29			0.0000	0.0000	0	0.0000	0.0000
30			0.0000	0.0000	0	0.0000	0.0000
31			0.0000	0.0000	0	0.0000	0.0000
32			0.0000	0.0000	0	0.0000	0.0000

CALIBRATION FILE cal006

CHANNEL	UNIT	SENSOR	m	C	STAT	MIN	MAX
1	mb	Sub-surface pres.	344.7385	-0.0000	1	-1.2628	1722.8507
2	mmhos/cm	Conductivity L1B	23.0240	7.9177	1	-107.2222	122.9814
3	mmhos/cm	Conductivity L2T	12.6536	-1.0959	1	-64.3329	62.1411
4	mmhos/cm	Conductivity L3T	11.4635	4.4744	1	-52.8150	61.7639
5	C	Temp 1 L1A	10.0000	-0.0000	1	-49.9756	49.9756
6	C	Temp 2 L1B	10.0000	-0.0000	1	-49.9756	49.9756
7	C	Temp 3 L2A	10.0000	-0.0000	1	-49.9756	49.9756
8	C	Temp 4 L2B	10.0000	-0.0000	1	-49.9756	49.9756
9	C	Temp 5 L3A	10.0000	-0.0000	1	-49.9756	49.9756
10	C	Temp 6 L3B	10.0000	-0.0000	1	-49.9756	49.9756
11	C	7 Outside Air Temp	10.0000	-0.0000	1	-49.9756	49.9756
12	C	8 Cabin Temp	10.0000	-0.0000	1	-49.9756	49.9756
13	C	9 Box Temp	10.0000	-0.0000	1	-49.9756	49.9756
14			10.0000	-0.0000	0	-49.9756	49.9756
15	cm/s	Current X L1 B S-251	100.0000	-0.0000	0	-499.7558	499.7558
16	cm/s	Current Y L1 B	100.0000	-0.0000	0	-499.7558	499.7558
17	cm/s	Current X L2 M S-253	100.0000	-0.0000	1	-499.7558	499.7558
18	cm/s	Current Y L2 M	100.0000	-0.0000	1	-499.7558	499.7558
19	cm/s	Current X L3 T S-252	100.0000	-0.0000	1	-499.7558	499.7558
20	cm/s	Current Y L3 T	100.0000	-0.0000	1	-499.7558	499.7558
21	m/sec	Wind 1 Speed	11.1800	0.0000	1	-0.0410	55.8727
22		Wind 1 Direction	135.0000	-0.0000	1	-0.4945	674.6703
23	mb	Barometer	50.8530	979.6035	1	979.4172	1030.8290
24	volts	Generator	1.0000	-0.0000	1	-5.0200	5.0024
25			0.0000	0.0000	0	0.0200	0.0000
26			0.0000	0.0000	0	0.0200	0.0000
27			0.0000	0.0000	0	0.0200	0.0000
28			0.0000	0.0000	0	0.0200	0.0000
29			0.0000	0.0000	0	0.0000	0.0000
30			0.0000	0.0000	0	0.0200	0.0000
31			0.0000	0.0000	0	0.0200	0.0000
32			0.0000	0.0000	0	0.0200	0.0000

CALIBRATION FILE cal007

CHANNEL	UNIT	SENSOR	m	C	STAT	MIN	MAX
1	mb	Sub-surface pres.	344.7385	-0.0000	1	-1.2628	1722.8507
2	mmhos/cm	Conductivity L1B	23.0240	7.9177	1	-107.2022	122.9814
3	mmhos/cm	Conductivity L2T	12.6536	-1.0959	1	-64.3329	62.1411
4	mmhos/cm	Conductivity L3T	11.4635	4.4744	1	-52.8150	61.7639
5	C	Temp 1 L1A	10.0000	-0.0000	1	-49.9756	49.9756
6	C	Temp 2 L1B	10.0000	-0.0000	1	-49.9756	49.9756
7	C	Temp 3 L2A	10.0000	-0.0000	1	-49.9756	49.9756
8	C	Temp 4 L2B	10.0000	-0.0000	1	-49.9756	49.9756
9	C	Temp 5 L3A	10.0000	-0.0000	1	-49.9756	49.9756
10	C	Temp 6 L3B	10.0000	-0.0000	1	-49.9756	49.9756
11	C	7 Outside Air Temp	10.0000	-0.0000	1	-49.9756	49.9756
12	C	8 Cabin Temp	10.0000	-0.0000	1	-49.9756	49.9756
13	C	9 Box Temp	10.0000	-0.0000	1	-49.9756	49.9756
14			10.0000	-0.0000	0	-49.9756	49.9756
15	cm/s	Current X L1 B S-251	100.0000	-0.0000	0	-499.7558	499.7558
16	cm/s	Current Y L1 B	100.0000	-0.0000	0	-499.7558	499.7558
17	cm/s	Current X L2 M S-253	100.0000	-0.0000	1	-499.7558	499.7558
18	cm/s	Current Y L2 M	100.0000	-0.0000	1	-499.7558	499.7558
19	cm/s	Current X L3 T S-252	100.0000	-0.0000	1	-499.7558	499.7558
20	cm/s	Current Y L3 T	100.0000	-0.0000	1	-499.7558	499.7558
21	m/sec	Wind 1 Speed	11.1800	0.0000	1	-0.0410	55.8727
22		Wind 1 Direction	135.0000	-0.0000	1	-0.4945	674.6703
23	mb	Barometer	50.8530	979.6035	1	979.4172	1030.8290
24	volts	Generator	1.0000	-0.0000	1	-5.0000	5.0024
25			0.0000	0.0000	0	0.0000	0.0000
26			0.0000	0.0000	0	0.0000	0.0000
27			0.0000	0.0000	0	0.0000	0.0000
28			0.0000	0.0000	0	0.0000	0.0000
29			0.0000	0.0000	0	0.0000	0.0000
30			0.0000	0.0000	0	0.0000	0.0000
31			0.0000	0.0000	0	0.0000	0.0000
32			0.0000	0.0000	0	0.0000	0.0000

CALIBRATION FILE cal008

CHANNEL	UNIT	SENSOR	m	C	STAT	MIN	MAX
1	mb	Sub-surface pres.	344.7385	-0.0000	1	-1.2628	1722.8507
2	mmhos/cm	Conductivity L1B	23.0240	7.9177	0	-107.2022	122.9814
3	mmhos/cm	Conductivity L2T	12.6536	-1.0959	0	-64.3329	62.1411
4	mmhos/cm	Conductivity L3T	11.4635	4.4744	0	-52.8150	61.7639
5	C	Temp 1 L1A	10.0000	-0.0000	0	-49.9756	49.9756
6	C	Temp 2 L1B	10.0000	-0.0000	1	-49.9756	49.9756
7	C	Temp 3 L2A	10.0000	-0.0000	0	-49.9756	49.9756
8	C	Temp 4 L2B	10.0000	-0.0000	1	-49.9756	49.9756
9	C	Temp 5 L3A	10.0000	-0.0000	1	-49.9756	49.9756
10	C	Temp 6 L3B	10.0000	-0.0000	1	-49.9756	49.9756
11	C	7 Air Temp	10.0000	-0.0000	1	-49.9756	49.9756
12	C	8 Cabin Temp	10.0000	-0.0000	1	-49.9756	49.9756
13	C	9 Box Temp	10.0000	-0.0000	1	-49.9756	49.9756
14			10.0000	-0.0000	0	-49.9756	49.9756
15	cm/s	Current X L1 B S-251	100.0000	-0.0000	0	-499.7558	499.7558
16	cm/s	Current Y L1 B	100.0000	-0.0000	0	-499.7558	499.7558
17	cm/s	Current X L2 M S-253	100.0000	-0.0000	0	-499.7558	499.7558
18	cm/s	Current Y L2 M	100.0000	-0.0000	0	-499.7558	499.7558
19	cm/s	Current X L3 T S-252	100.0000	-0.0000	0	-499.7558	499.7558
20	cm/s	Current Y L3 T	100.0000	-0.0000	0	-499.7558	499.7558
21	m/sec	Wind 1 Speed	11.1800	0.0000	1	-0.0410	55.8727
22		Wind 1 Direction	135.0000	-0.0000	1	-0.4945	674.6703
23	mb	Barometer	100.0000	952.4000	1	952.0337	1053.1326
24	volts	Generator	1.0000	-0.0000	1	-5.0000	5.0024
25			0.0000	0.0000	0	0.0000	0.0000
26			0.0000	0.0000	0	0.0000	0.0000
27			0.0000	0.0000	0	0.0000	0.0000
28			0.0000	0.0000	0	0.0000	0.0000
29			0.0000	0.0000	0	0.0000	0.0000
30			0.0000	0.0000	0	0.0000	0.0000
31			0.0000	0.0000	0	0.0000	0.0000
32			0.0000	0.0000	0	0.0000	0.0000

CALIBRATION FILE cal009

CHANNEL	UNIT	SENSOR	m	C	STAT	MIN	MAX
1	mb	Sub-surface pres.	344.7385	-0.0000	1	-1.2628	1722.8507
2	mmhos/cm	Conductivity L1B	11.8750	0.3420	1	-59.0330	59.6880
3	mmhos/cm	Conductivity L2T	11.9990	-0.0960	1	-60.0617	59.8697
4	mmhos/cm	Conductivity L3T	12.4500	-1.2810	1	-63.5006	60.9386
5	C	Temp 1 L1A	10.0000	-0.0000	1	-49.9756	49.9756
6	C	Temp 2 L1B	10.0000	-0.0000	1	-49.9756	49.9756
7	C	Temp 3 L2A	10.0000	-0.0000	1	-49.9756	49.9756
8	C	Temp 4 L2B	10.0000	-0.0000	1	-49.9756	49.9756
9	C	Temp 5 L3A	10.0000	-0.0000	1	-49.9756	49.9756
10	C	Temp 6 L3B	10.0000	-0.0000	1	-49.9756	49.9756
11	C	7 Air Temp	10.0000	-0.0000	1	-49.9756	49.9756
12	C	8 Cabin Temp	10.0000	-0.0000	1	-49.9756	49.9756
13	C	9 Box Temp	10.0000	-0.0000	0	-49.9756	49.9756
14	volts	Battery Status	10.0000	-0.0000	1	-49.9756	49.9756
15	cm/s	Current X L1 B S364	100.0000	-0.0000	1	-499.7558	499.7558
16	cm/s	Current Y L1 B	100.0000	-0.0000	1	-499.7558	499.7558
17	cm/s	Current X L2 M S199	100.0000	-0.0000	1	-499.7558	499.7558
18	cm/s	Current Y L2 M	100.0000	-0.0000	1	-499.7558	499.7558
19	cm/s	Current X L3 T S404	100.0000	-0.0000	1	-499.7558	499.7558
20	cm/s	Current Y L3 T	100.0000	-0.0000	1	-499.7558	499.7558
21	m/sec	Wind 1 Speed	11.1800	0.0000	1	-0.0410	55.8727
22		Wind 1 Direction	135.0000	-0.0000	1	-0.4945	674.6703
23	mb	Barometer	100.0000	950.0000	1	949.6337	1050.7326
24	volts	Generator	1.0000	-0.0000	1	-5.0000	5.0024
25			0.0000	0.0000	0	0.0000	0.0000
26			0.0000	0.0000	0	0.0000	0.0000
27			0.0000	0.0000	0	0.0000	0.0000
28			0.0000	0.0000	0	0.0000	0.0000
29			0.0000	0.0000	0	0.0000	0.0000
30			0.0000	0.0000	0	0.0000	0.0000
31			0.0000	0.0000	0	0.0000	0.0000
32			0.0000	0.0000	0	0.0000	0.0000

CALIBRATION FILE cal010

CHANNEL	UNIT	SENSOR	m	C	STAT	MIN	MAX
1	mb	Sub-surface pres.	344.7385	-0.0000	1	1200.0504	1700.1207
2	mmhos/cm	Conductivity L1B	11.8750	0.3420	1	0.3420	59.7170
3	mmhos/cm	Conductivity L2M	11.9990	-0.0960	1	-0.0960	59.8990
4	mmhos/cm	Conductivity L3T	12.4500	-1.2810	1	-1.2810	60.9690
5	C	Temp 1 L1A	10.0000	-0.0000	1	-10.0000	40.0000
6	C	Temp 2 L1B	10.0000	-0.0000	1	-10.0000	40.0000
7	C	Temp 3 L2A	10.0000	-0.0000	1	-10.0000	40.0000
8	C	Temp 4 L2B	10.0000	-0.0000	1	-10.0000	40.0000
9	C	Temp 5 L3A	10.0000	-0.0000	1	-10.0000	40.0000
10	C	Temp 6 L3B	10.0000	-0.0000	0	-10.0000	40.0000
11	C	7 Air Temp Upper	10.0000	-0.0000	1	-10.0000	40.0000
12	C	8 Cabin Temp	10.0000	-0.0000	1	-10.0000	40.0000
13	C	9 Air Temp Lower	10.0000	-0.0000	1	-10.0000	40.0000
14	volts	Battery Status	10.0000	-0.0000	1	-50.0000	50.0000
15	cm/s	Current X L1 B S364	100.0000	0.0000	-1	100.0000	-100.0000
16	cm/s	Current Y L1 B	100.0000	0.0000	-1	100.0000	-100.0000
17	cm/s	Current X L2 M S199	100.0000	0.0000	-1	100.0000	-100.0000
18	cm/s	Current Y L2 M	100.0000	0.0000	-1	100.0000	-100.0000
19	cm/s	Current X L3 T S404	100.0000	0.0000	-1	100.0000	-100.0000
20	cm/s	Current Y L3 T	100.0000	0.0000	-1	100.0000	-100.0000
21	m/sec	Wind 1 Speed	11.1800	0.0000	1	0.0000	55.0263
22		Wind 1 Direction	135.0000	-0.0000	1	-0.0000	540.1648
23	mb	Barometer	100.0000	950.0000	1	950.0000	1050.0000
24	volts	Generator	1.0000	-0.0000	1	-5.0000	5.0000
25			0.0000	0.0000	0	0.0000	0.0000
26			0.0000	0.0000	0	0.0000	0.0000
27			0.0000	0.0000	0	0.0000	0.0000
28			0.0000	0.0000	0	0.0000	0.0000
29			0.0000	0.0000	0	0.0000	0.0000
30			0.0000	0.0000	0	0.0000	0.0000
31			0.0000	0.0000	0	0.0000	0.0000
32			0.0000	0.0000	0	0.0000	0.0000

CALIBRATION FILE cal011

CHANNEL	UNIT	SENSOR	m	C	STAT	MIN	MAX
1	mb	Sub-surface pres.	344.7385	-0.0000	1	1200.0004	1700.1207
2	mmhos/cm	Conductivity L1B	11.8750	0.3420	0	0.3420	59.7170
3	mmhos/cm	Conductivity L2M	11.9990	-0.0960	0	-0.0960	59.8990
4	mmhos/cm	Conductivity L3T	12.4500	-1.2810	0	-1.2810	60.9690
5	C	L1B Temp #1	10.0000	-0.0000	0	-10.0000	40.0000
6	C	L1B Temp #2	10.0000	-0.0000	0	-10.0000	40.0000
7	C	L2M Temp #1	10.0000	-0.0000	0	-10.0000	40.0000
8	C	L2M Temp #2	10.0000	-0.0000	0	-10.0000	40.0000
9	C	L3T Temp #1	10.0000	-0.0000	1	-10.0000	40.0000
10	C	L3T Temp #2	10.0000	-0.0000	1	-10.0000	40.0000
11	C	Air Temp Below Cabin	10.0000	-0.0000	1	-10.0000	40.0000
12	C	Cabin Temp	10.0000	-0.0000	1	-10.0000	40.0000
13	C	Air Temp W. Suf #1	10.0000	-0.0000	1	-10.0000	40.0000
14	C	Air Temp W. Suf #2	10.0000	-0.0000	1	-10.0000	40.0000
15	cm/s	Current X L1 B S364	100.0000	-0.0000	0	-100.0000	100.0000
16	cm/s	Current Y L1 B	100.0000	-0.0000	0	-100.0000	100.0000
17	cm/s	Current X L2 M S199	100.0000	-0.0000	0	-100.0000	100.0000
18	cm/s	Current Y L2 M	100.0000	-0.0000	0	-100.0000	100.0000
19	cm/s	Current X L3 T S404	100.0000	-0.0000	0	-100.0000	100.0000
20	cm/s	Current Y L3 T	100.0000	-0.0000	0	-100.0000	100.0000
21	m/sec	Wind 1 Speed	11.1800	0.0000	1	0.0000	55.0263
22		Wind 1 Direction	135.0000	-0.0000	1	-0.0000	540.1648
23	mb	Barometer	100.0000	950.0000	1	950.0000	1050.0000
24	volts	Generator	1.0000	-0.0000	1	-5.0000	5.0000
25	volts	Battery Status	1.0000	-45.0000	1	-50.0000	-40.0000
26			0.0000	0.0000	0	0.0000	0.0000
27			0.0000	0.0000	0	0.0000	0.0000
28			0.0000	0.0000	0	0.0000	0.0000
29			0.0000	0.0000	0	0.0000	0.0000
30			0.0000	0.0000	0	0.0000	0.0000
31	volts	REF channel 1	1.0000	-0.0000	1	-5.0000	5.0000
32	volts	REF channel 2	1.0000	-0.0000	1	-5.0000	5.0000

CALIBRATION FILE cal012

CHANNEL	UNIT	SENSOR	m	C	STAT	MIN	MAX
1	mb	Sub-surface pres.	344.7385	-0.0000	1	1200.0004	1700.1207
2	mmhos/cm	Conductivity L1B	11.8750	0.3420	0	0.3420	59.7170
3	mmhos/cm	Conductivity L2M	11.9990	-0.0960	0	-0.0960	59.8990
4	mmhos/cm	Conductivity L3T	12.4500	-1.2810	0	-1.2810	60.9690
5	C	L1B Temp #1	10.0000	-0.0000	0	-10.0000	40.0000
6	C	L1B Temp #2	10.0000	-0.0000	0	-10.0000	40.0000
7	C	L2M Temp #1	10.0000	-0.0000	0	-10.0000	40.0000
8	C	L2M Temp #2	10.0000	-0.0000	0	-10.0000	40.0000
9	C	L3T Temp #1	10.0000	-0.0000	1	-10.0000	40.0000
10	C	L3T Temp #2	10.0000	-0.0000	1	-10.0000	40.0000
11	C	Air Temp Below Cabin	10.0000	-0.0000	1	-10.0000	40.0000
12	C	Cabin Temp	10.0000	-0.0000	1	-10.0000	40.0000
13	C	Air Temp W. Suf #1	10.0000	-0.0000	1	-10.0000	40.0000
14	C	Air Temp W. Suf #2	10.0000	-0.0000	1	-10.0000	40.0000
15	cm/s	Current X L1 B S364	100.0000	-0.0000	0	-100.0000	100.0000
16	cm/s	Current Y L1 B	100.0000	-0.0000	0	-100.0000	100.0000
17	cm/s	Current X L2 M S199	100.0000	-0.0000	0	-100.0000	100.0000
18	cm/s	Current Y L2 M	100.0000	-0.0000	0	-100.0000	100.0000
19	cm/s	Current X L3 T S404	100.0000	-0.0000	0	-100.0000	100.0000
20	cm/s	Current Y L3 T	100.0000	-0.0000	0	-100.0000	100.0000
21	m/sec	Wind 1 Speed	11.1800	0.0000	1	0.0000	55.0263
22		Wind 1 Direction	135.0000	-0.0000	1	-0.0000	540.1648
23	mb	Barometer	100.0000	950.0000	1	950.0000	1050.0000
24	volts	Generator	1.0000	-0.0000	1	-5.0000	5.0000
25	volts	Battery Status	1.0000	-45.0000	1	-50.0000	-40.0000
26			0.0000	0.0000	0	0.0000	0.0000
27			0.0000	0.0000	0	0.0000	0.0000
28			0.0000	0.0000	0	0.0000	0.0000
29			0.0000	0.0000	0	0.0000	0.0000
30			0.0000	0.0000	0	0.0000	0.0000
31	volts	REF channel 1	1.0000	-0.0000	1	-5.0000	5.0000
32	volts	REF channel 2	1.0000	-0.0000	1	-5.0000	5.0000

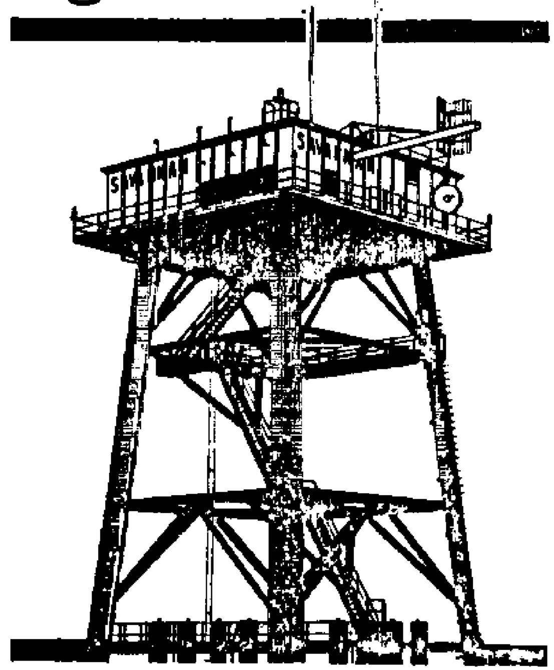
Appendix E:
Public Information Brochures on SNLT Operations
Distributed to Public

This project maintained by:
Skidaway Institute of Oceanography
P.O. Box 13687
Savannah, GA 31416

Funded by:
U.S. Department of Energy

with the cooperation of:
U.S. Coast Guard

Oceanographic Weather Station at Savannah Navigational Light Tower



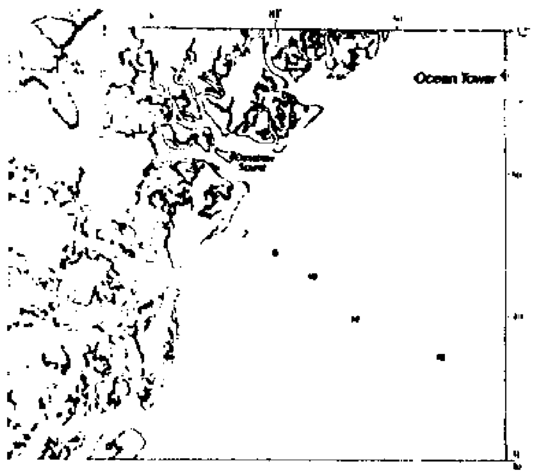
Updating marine weather fore-casting for Savannah and the Georgia / South Carolina coast.

Skidaway Institute of Oceanography

U.S. Dept. of Energy

U.S. Coast Guard

Oceanographic Weather Station Off Savannah, Georgia



Map locating SNLT.

Skidaway Institute of Oceanography maintains an oceanographic weather station on the Savannah Navigational Light Tower located about eight nautical miles from the mouth of the Savannah River. The operation of this station is made possible through a cooperative agreement between the Institute, the U.S. Department of Energy, and the U.S. Coast Guard. Data collected by this installation include barometric pressure, air and sea temperature, wind velocity, and wave height. The information collected by the station is transmitted to shore where it is then utilized to provide more accurate forecasting of marine weather for the Georgia and South Carolina coast. Up-to-the-hour information is reported to the National Weather Service where it is broadcast via the local NOAA Weather Radio.

We appeal to the community of divers, fishermen, and other sportsmen to carry out their activities around the tower in a manner that will not cause any damage to the installation. Watch out for cables that have come loose during storms and report any damage to the address listed below. We will fix such damage as soon as we can. Your cooperation is sincerely appreciated, and we will try to keep the station running as continuously as possible.

For more information or to report trouble, contact

Skidaway Institute of Oceanography
P.O. Box 13687
Savannah, Georgia 31416

Telephone: 912-356-2342 or 912-356-2457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SAVANNAH NAVIGATIONAL LIGHT TOWER
METEOROLOGICAL STATION
RUN BY
SKIDAWAY INSTITUTE OF OCEANOGRAPHY
P.O. BOX 13687
SAVANNAH, GA  31416
Date:                        11 NOV 1983
File:                        316H08
Number of Data Points:       150
Begin Time (GMT)             08:00:03
End   Time (GMT)             08:02:48

AIR TEMP                     13.3 C (56F)
WATER TEMP                   19.4 C (67F)
WIND SPEED                   12.5 m/s (25k)
WIND DIR                     276 deg
BAROMETER                    1007.5 mb

           Wave Information

 Pressure variance (cm*cm) =    70.36
 Adjusted variance (cm*cm) =  4002.26
 Significant height (cm)   =   179.04
 Significant height (ft)   =     5.87

    300
V   280
A   260
R   240
I   220
A   200
N   180
C   160
E   140              *
    120              *
C   100              *
M    80            * *
*    60            * *       *
C    40            * *     * *
M    20            * * * * * *   *
      0* * * * * * * * * * * * * * *
     16.0 8.0     4.0    2.7     2.0
           Wave Period (sec)
```

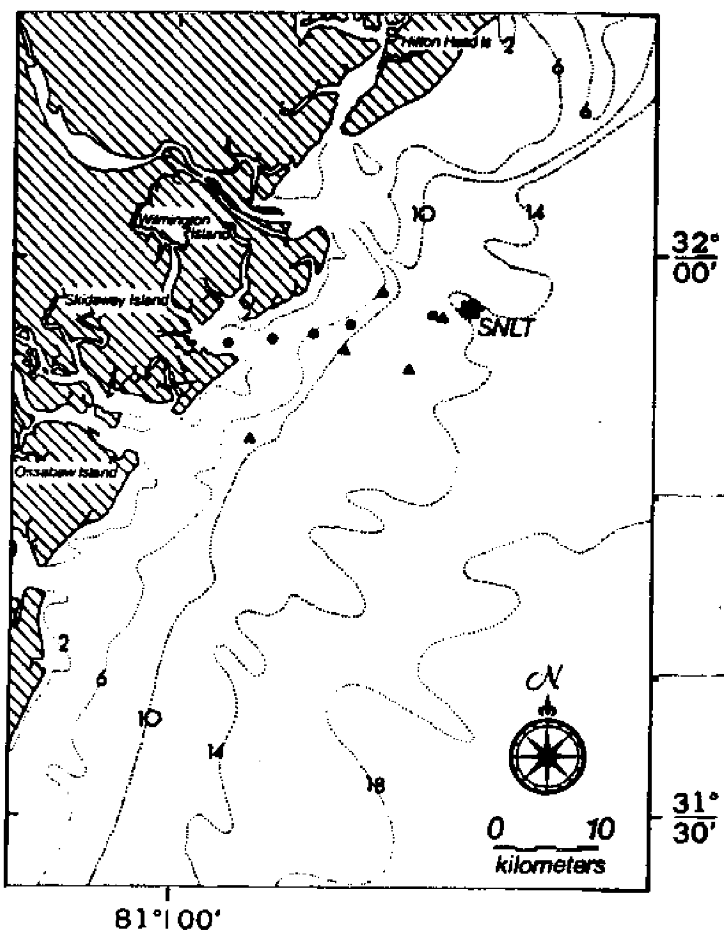
Example of hourly weather report from SNLT printed for National Weather Service and other agencies. Report includes air and water temperature, wind speed and direction, barometric pressure, and significant wave height and period.

Underwater Installations Off the Georgia Coast

The Skidaway Institute of Oceanography is beginning a large study in cooperation with several other oceanographic institutes to measure and record information on events that cause and change ocean currents off the Georgia coast. The information will be used to predict the strength and direction of ocean currents caused by winds and tides. This information will be very useful to commercial and sport fishermen, personnel in charge of air-sea rescue operations, and other people working and playing in the ocean off our coast.

During February 1984, we will install self-recording instruments at several underwater locations indicated on the map. These locations will be marked by large lighted buoys with radar reflectors. Other equipment will be installed near the Savannah Navigational Light Tower (SNLT). The equipment below surface is large and massive and would tear up any nets and lines that happened to snag on them. We are urging everyone to exercise caution when approaching within 500 yards of the buoys and SNLT. While some of the instruments may be temporarily removed for servicing from time to time, most of them will remain in place until the autumn of 1985.

The project is supported by our tax dollars and represents a large investment of time and equipment. We are trying to inform the public about this project so that we can minimize the loss in equipment to ourselves and other people who might be near one of the underwater instruments. If you would like further information about the project, please call (912) 356-2453 at Skidaway Institute.



- SAVANNAH NAVIGATIONAL LIGHT TOWER
- ▲ TEMPORARY MOORINGS
- ● PERMANENT MOORINGS

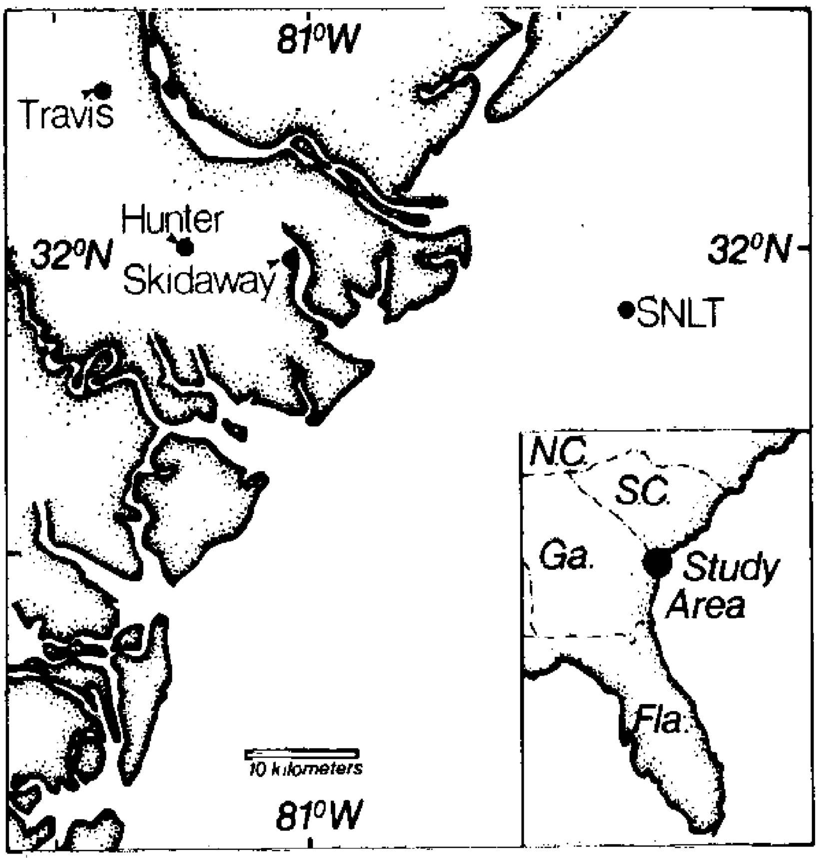
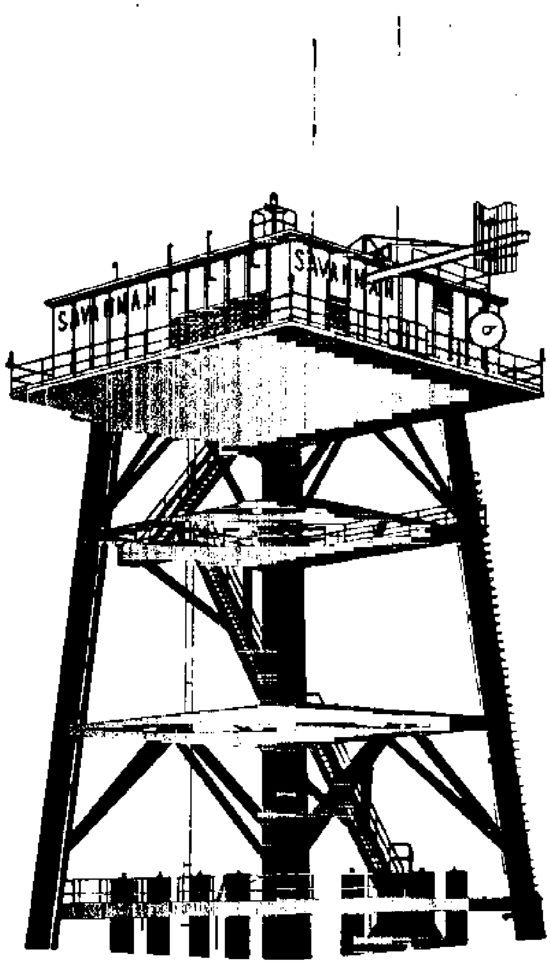


Figure 1. Map showing location of Savannah Navigational Light Tower (SNLT), Skidaway Institute of Oceanography, Hunter Army Air Field, and Travis Field (National Weather Service). Meteorological data from Hunter and Travis were used to calibrate SNLT instrumentation.

Figure 2. Savannah Navigational Light Tower (SNLT).



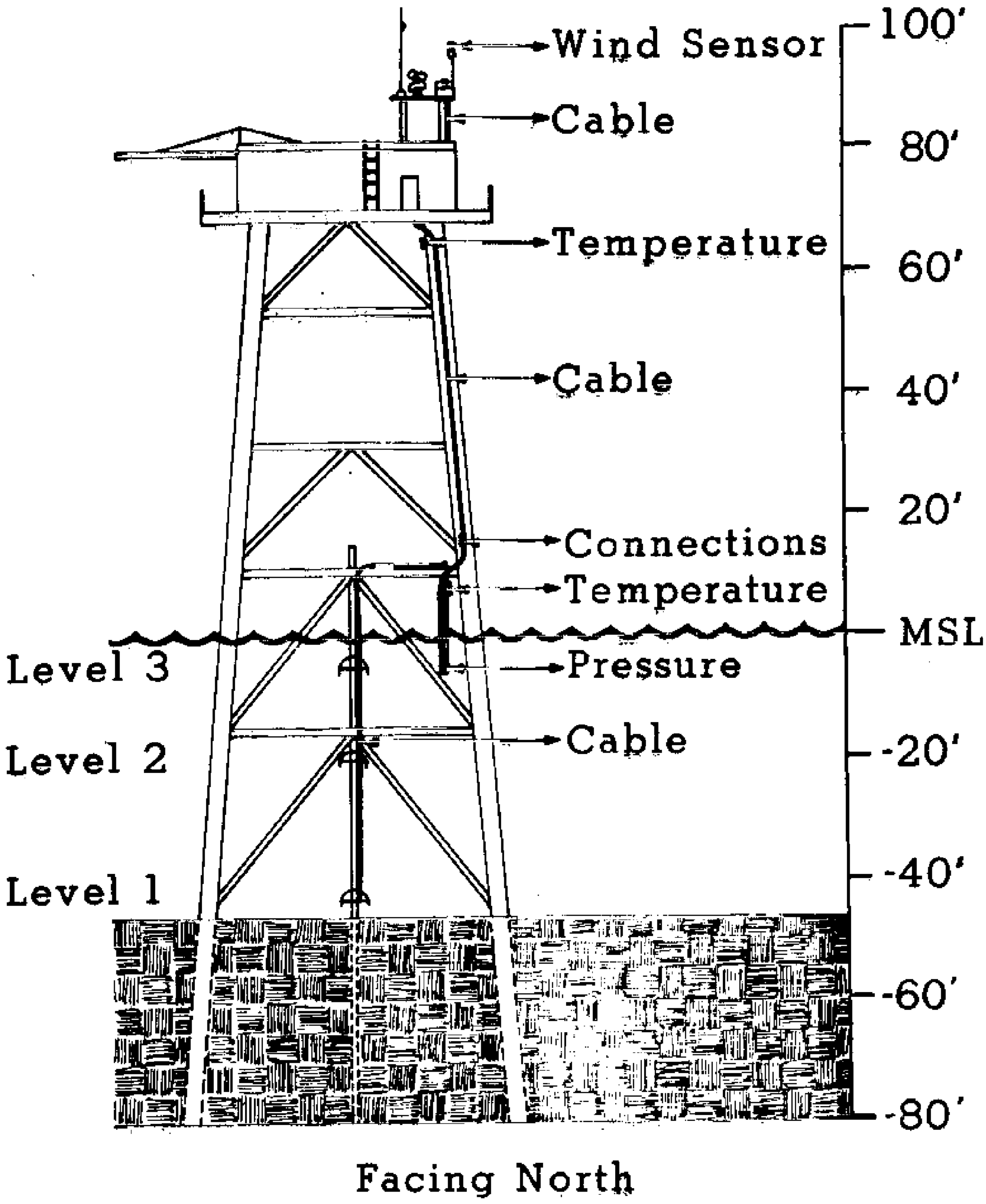


Figure 3. Schematic of SNLT showing location of oceanographic and meteorological instrumentation. Current, conductivity, and temperature are measured at each underwater level, located 1, 8 and 13m from the bottom.

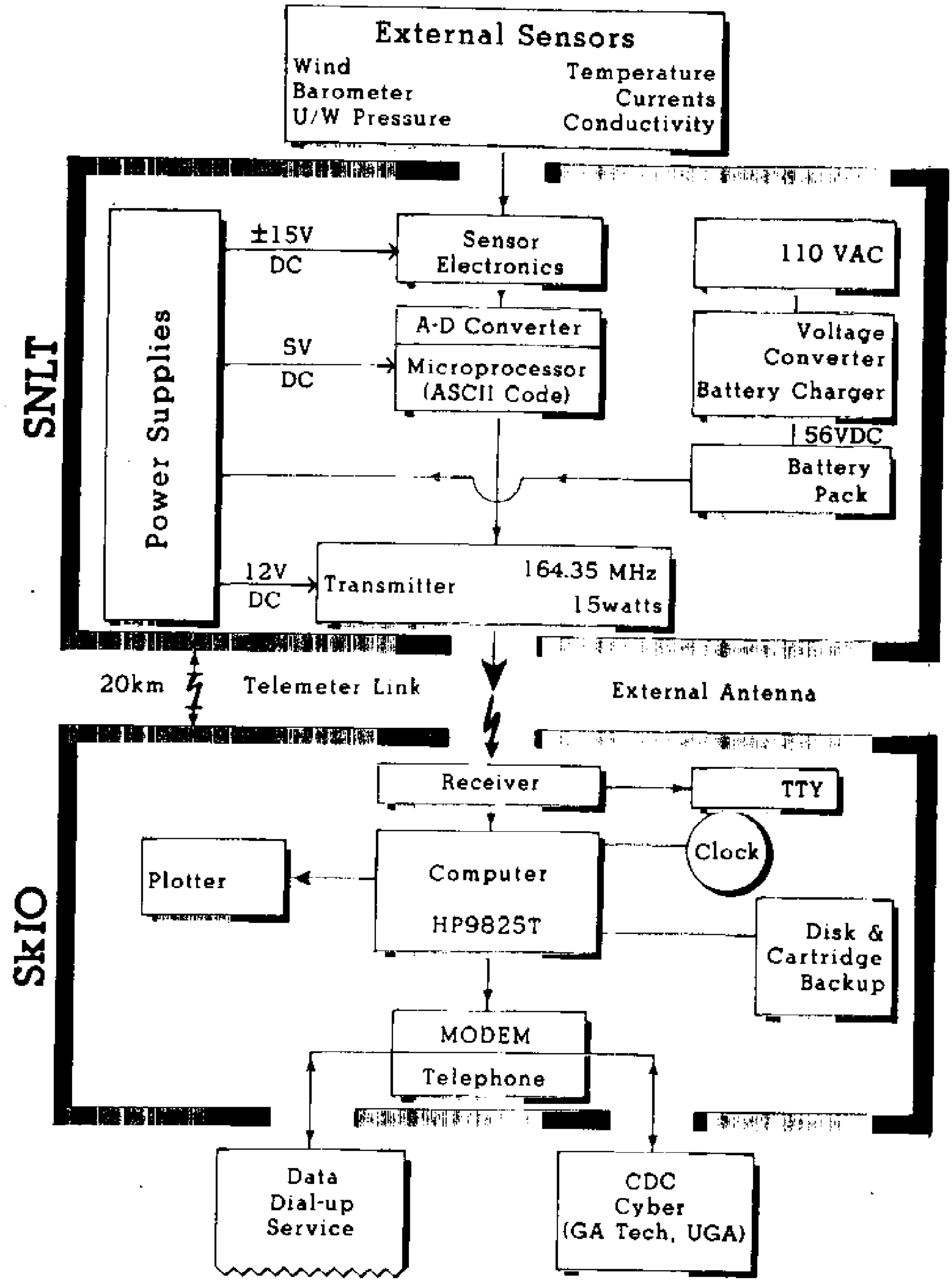


Figure 4. Schematic of data acquisition system showing instrumentation at SNLT, telemetry link, and computer hardware at Skidaway Institute.

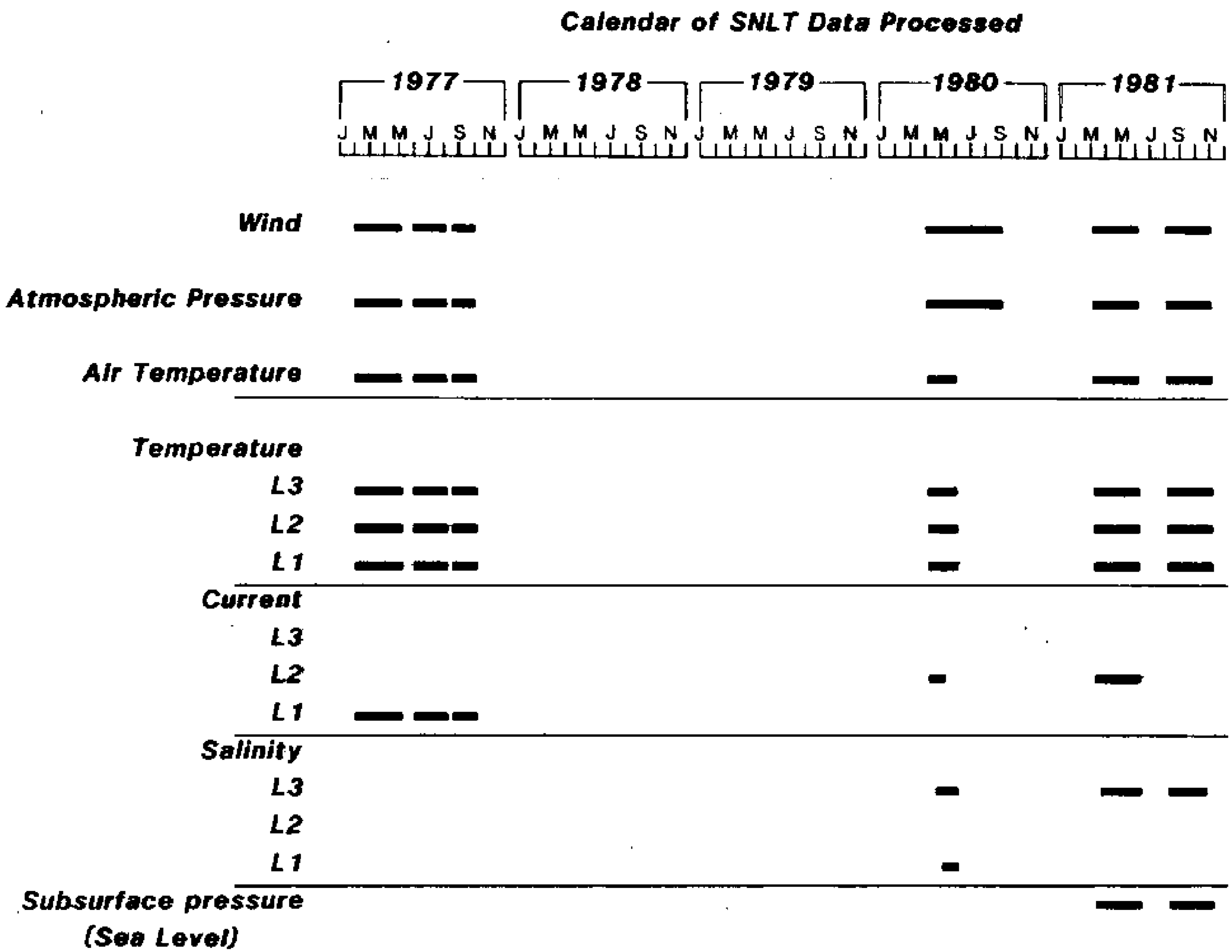


Figure 5. Summary of dates during which data were collected for various parameters at SNLT. L1, L2, and L3 refer to temperature, current, or salinity from 1, 8 and 13m from the bottom, respectively.

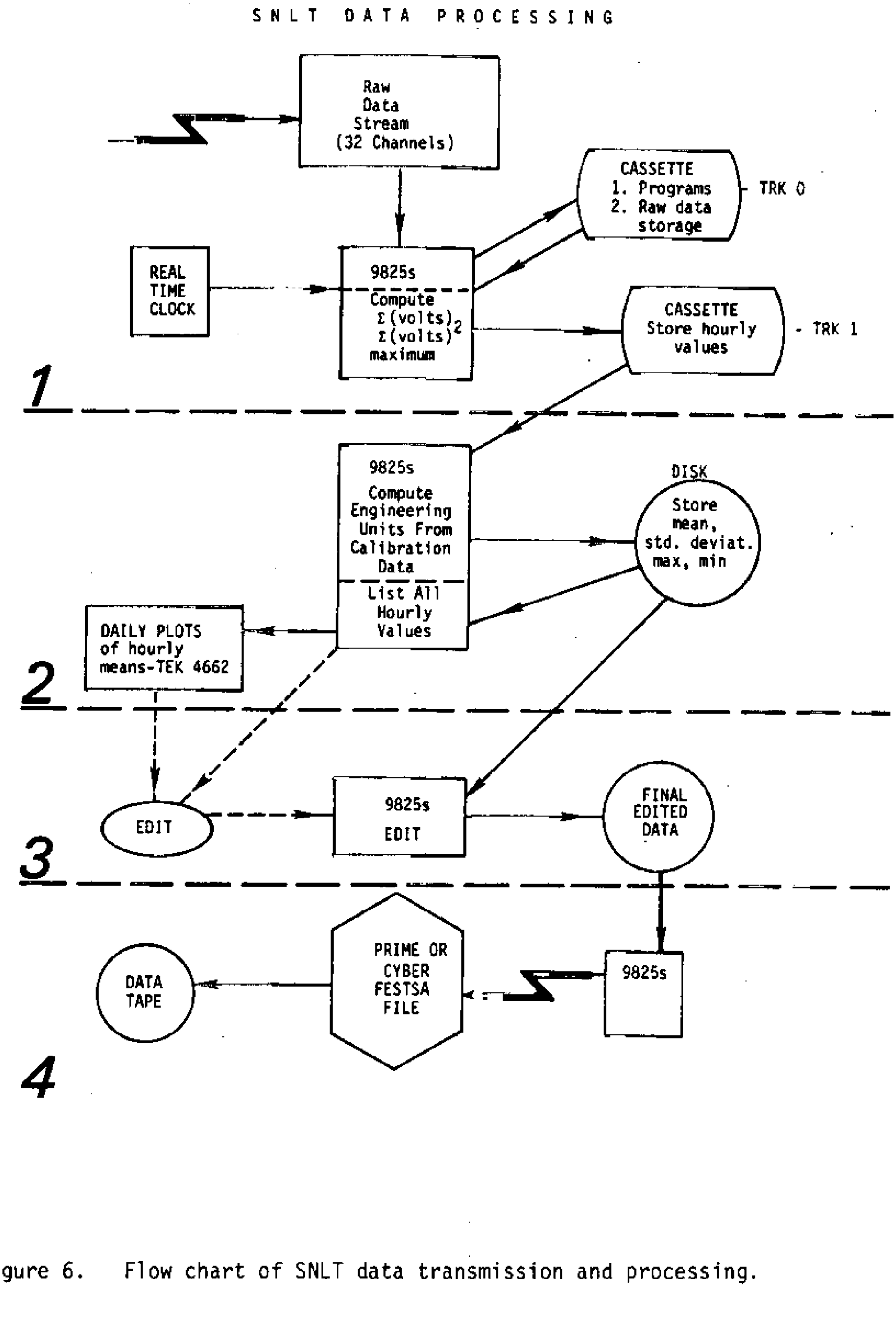


Figure 6. Flow chart of SNLT data transmission and processing.

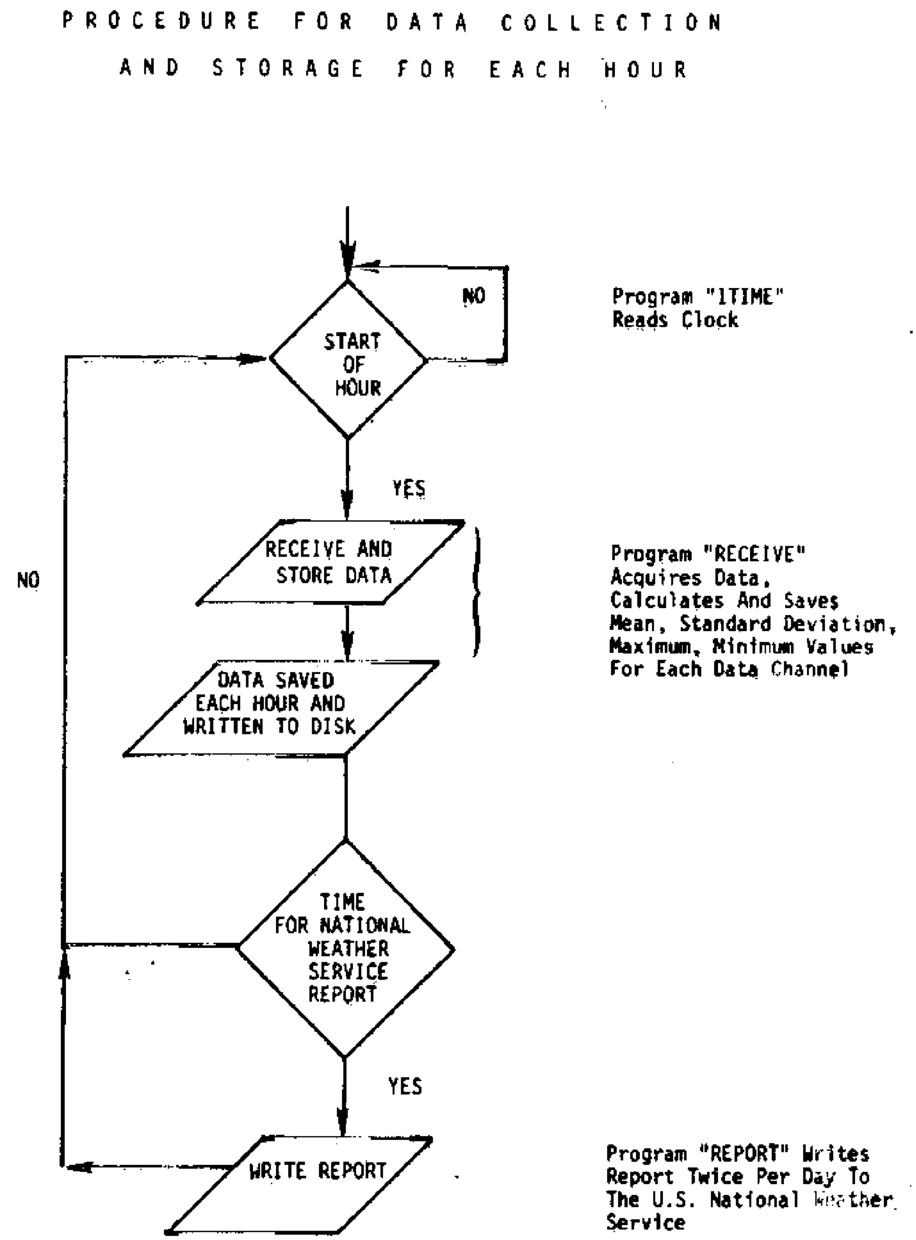


Figure 7. Flow chart of data collection, reduction, and storage by Hewlett-Packard system at Skidaway Institute.

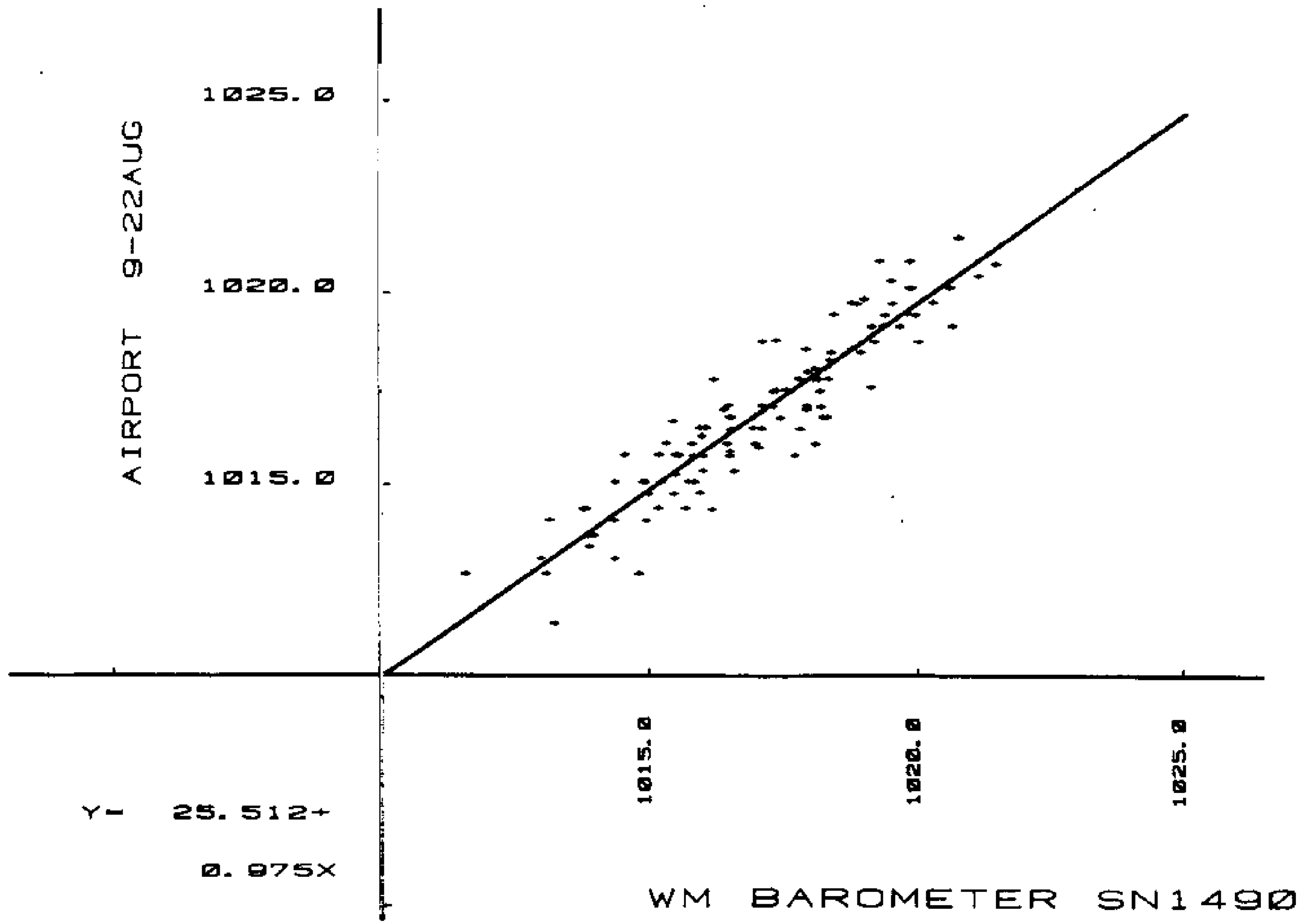
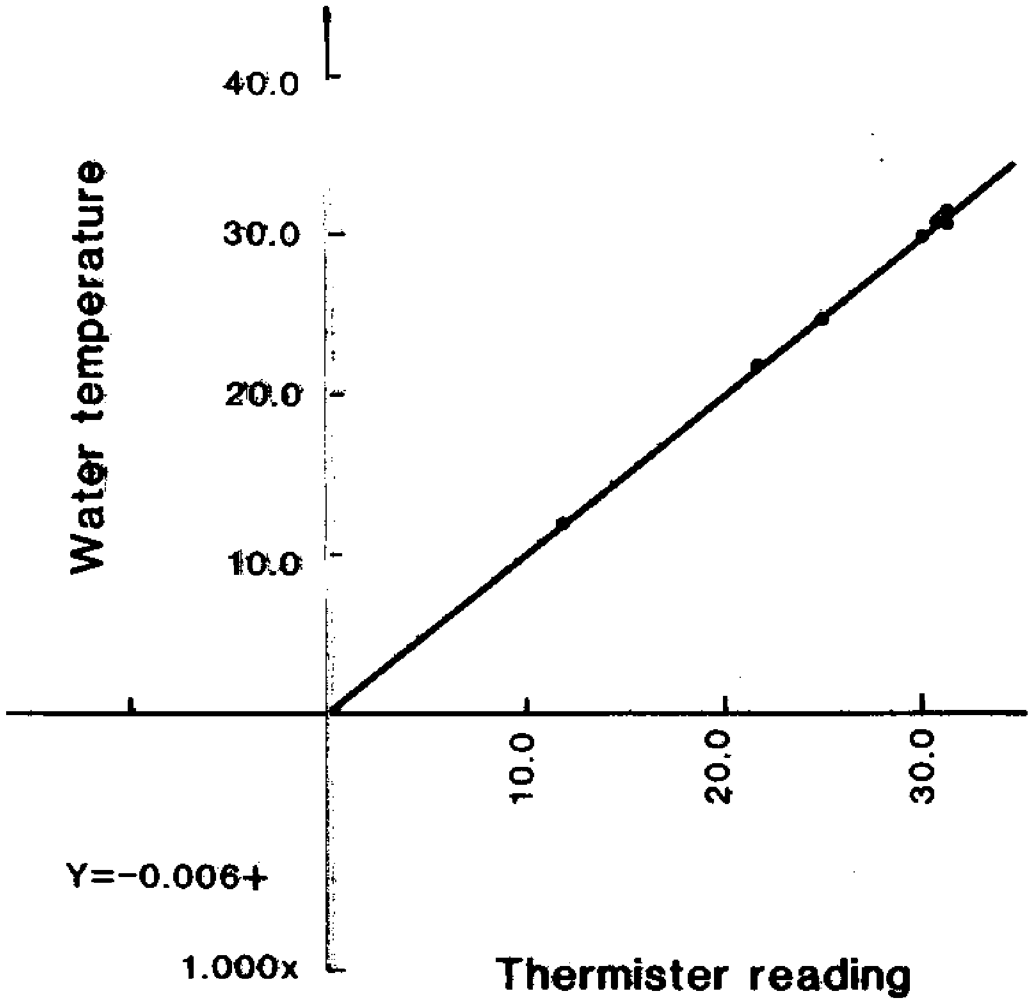
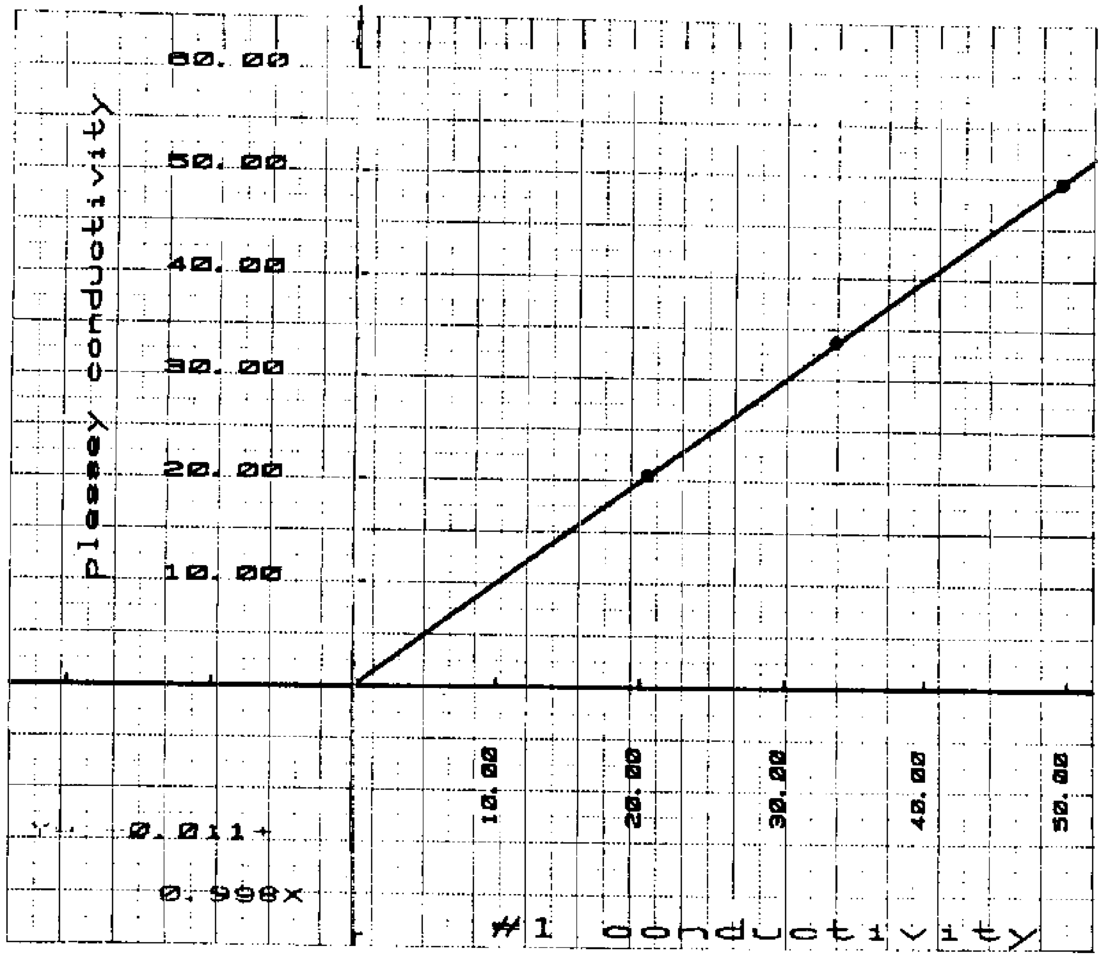


Figure 8a. Example of regression of calibration between WeatherMeasure barometer deployed at SNLT and barometer maintained by National Weather Service. Calibration was performed at NWS office, Travis Field, Savannah.



No. of Pairs	10
Corr.Coef.	1.000
Regression Results:	
Slope	1.000
Std.Error	0.001
Intercept	-0.006
Std.Error	0.012
AOV Table:	
Source	
Total	
Regression	
Residual	
Sum of Squares	1563.673 1563.669 0.004
Deg.Freedom	9.000 1.000 8.000
Mean Square	173.741 1563.669 0.001
F-Test Results:	
F-Stat.	2971497.494
D.F.Num.	1.000
D.F.Den.	8.000

Figure 8b. Example of regression and statistical analysis of calibration performed on Analog Devices thermisters deployed at SNLT. Zero-point water bath calibration performed at Skidaway Institute.



Regression
(Y + A + BX)
****

X-Min	[illegible]
X-Max	65.000
Y-Min	[illegible]
Y-Max	65.000
Data Listing:	
X	
Y	
	20.100
	20.[illegible]3
	33.300
	33.263
	49.300
	49.141

****

Sample Stats:	
X-Mean	34.233
X-Var	213.813
XStd.Dev	14.622
Y-Mean	34.137
Y-Var	212.756
YStd.Dev	14.586
No.of Pairs	3
Corr.Coef.	1.000
Regression Results:	
Slope	0.998
Std.Error	0.003
Intercept	-0.011
Std.Error	0.122

Figure 8c. Example of regression and statistical analysis of calibration performed on Beckman conductivity sensors deployed at SNLT. Sensor readings calibrated with water bath conductivity measured by Plessey 6230N laboratory salinometer.

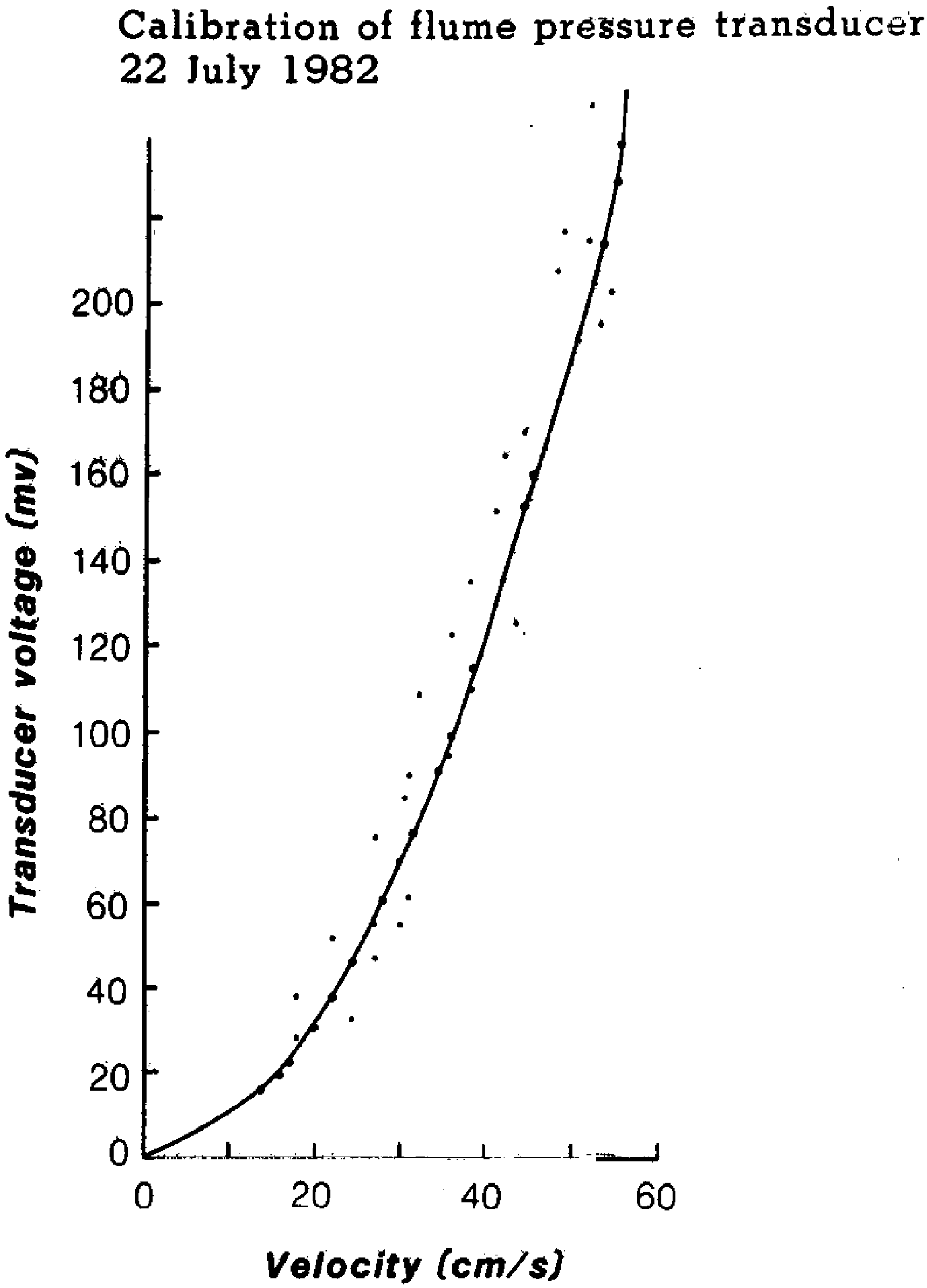
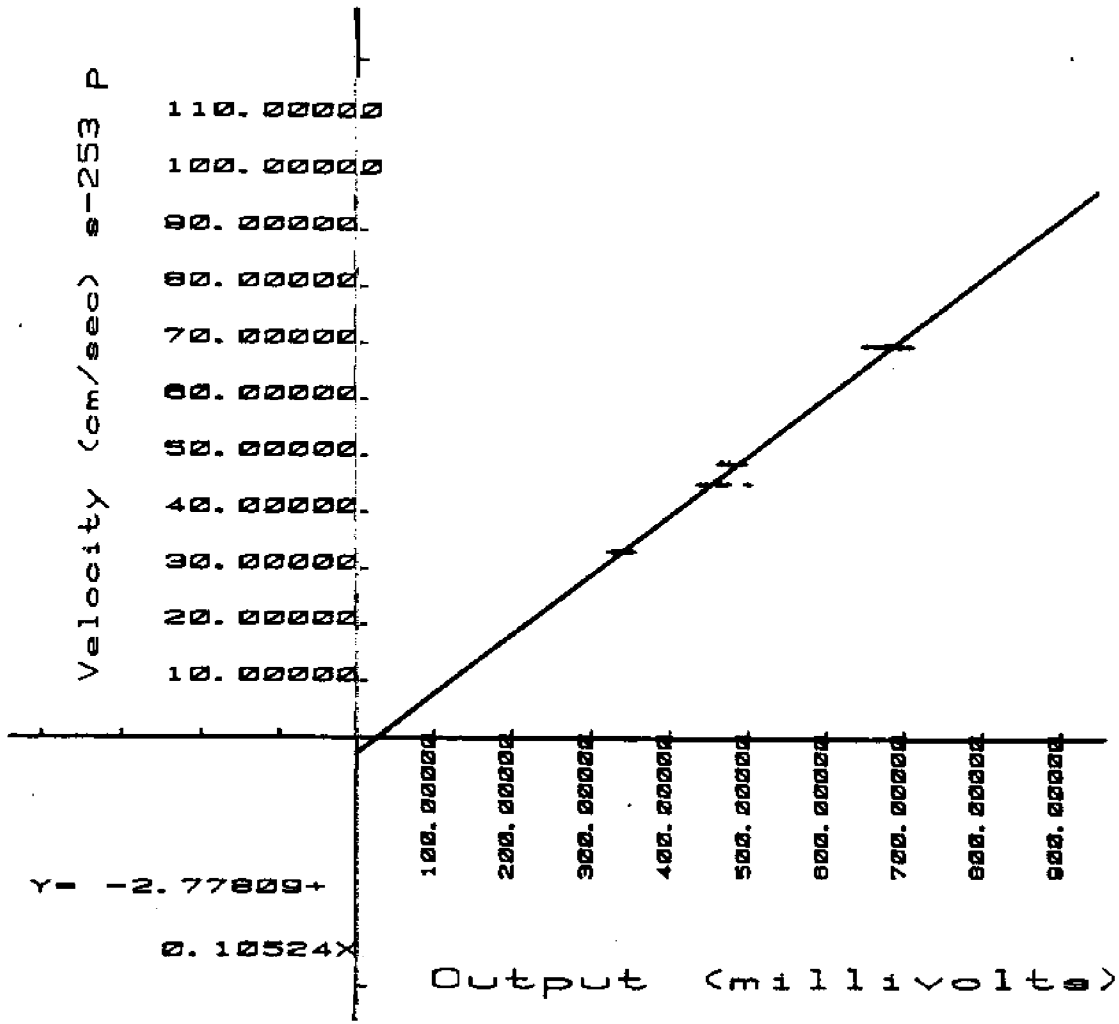


Figure 9a. Calibration curve used to determine flow velocity in Skidaway Institute flume. Larger points used to describe curve represent actual flume velocity determined from pressure head. Smaller points represent transducer voltages corresponding to flume velocities measured by calibrated Marsh-McBirney current meters.



No. of Pairs 51
Corr.Coef. 0.99594

Regression Results:

Slope 0.10524
Std.Error 0.00136

Intercept -2.77809
Std.Error 0.69523

AOV Table:
Source
Total
Regression
Residual

Sum of Squares
11710.52949
11615.65282
94.87666

Deg. Freedom
50.00000
1.00000
49.00000

Mean Square
234.21059
11615.65282
1.93626

F-Test Results:

F-Stat. 5999.01986
D.F.Num. 1.00000
D.F.Den. 49.00000

Figure 9b. Example of regression and statistical analysis of calibration performed on Marsh-McBirney current meters deployed at SNLT. Output represents transducer voltage, which may be converted to flume velocity from Figure 9a.

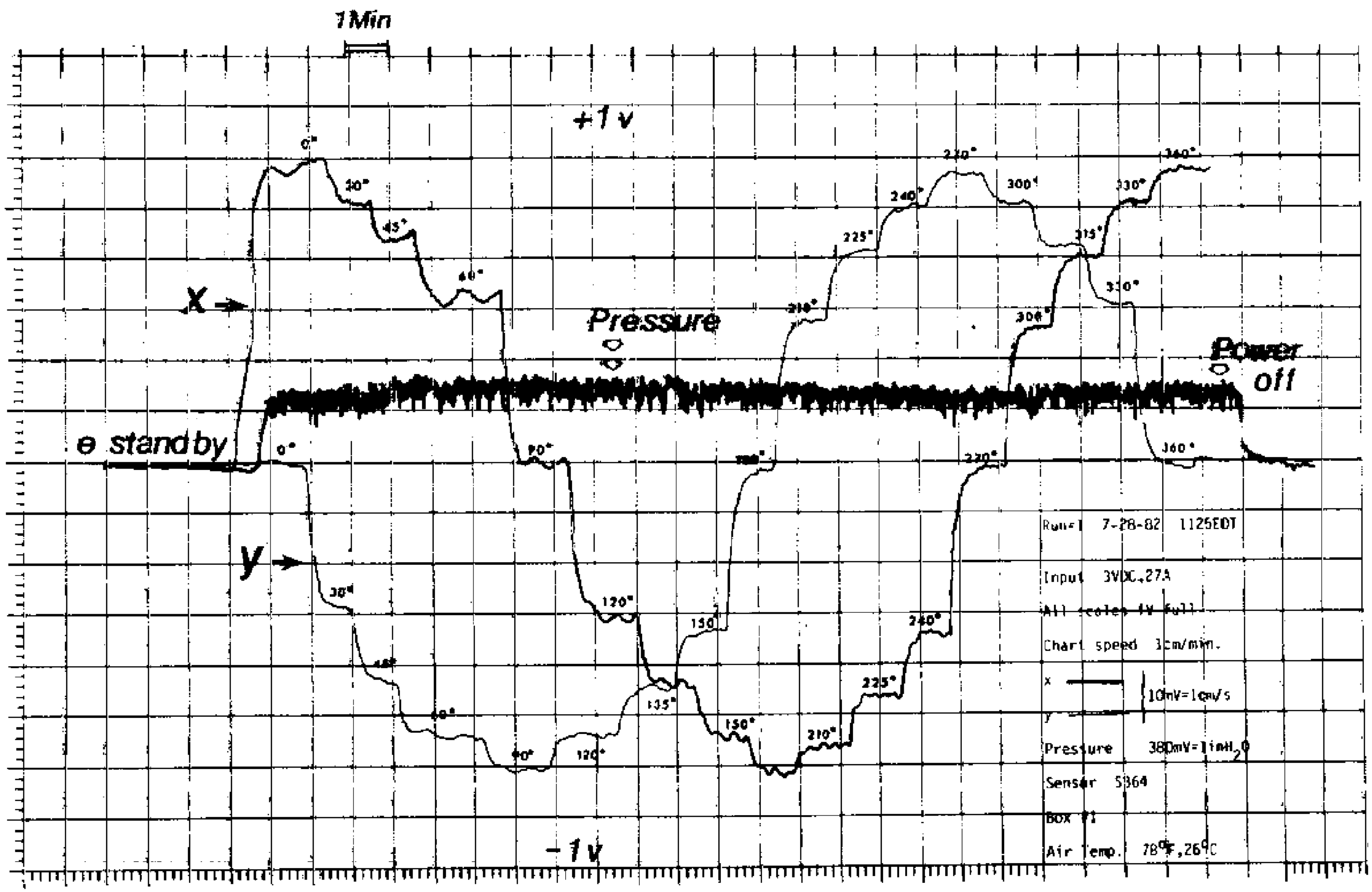


Figure 10a. Strip chart record of Marsh-McBirney current meter directional calibration performed in flume at Skidaway Institute. Pressure signal records transducer pressure which is converted to flume velocity. X and y components of current were recorded at various directional orientations relative to flow. Current values were digitized from this record for further analysis.

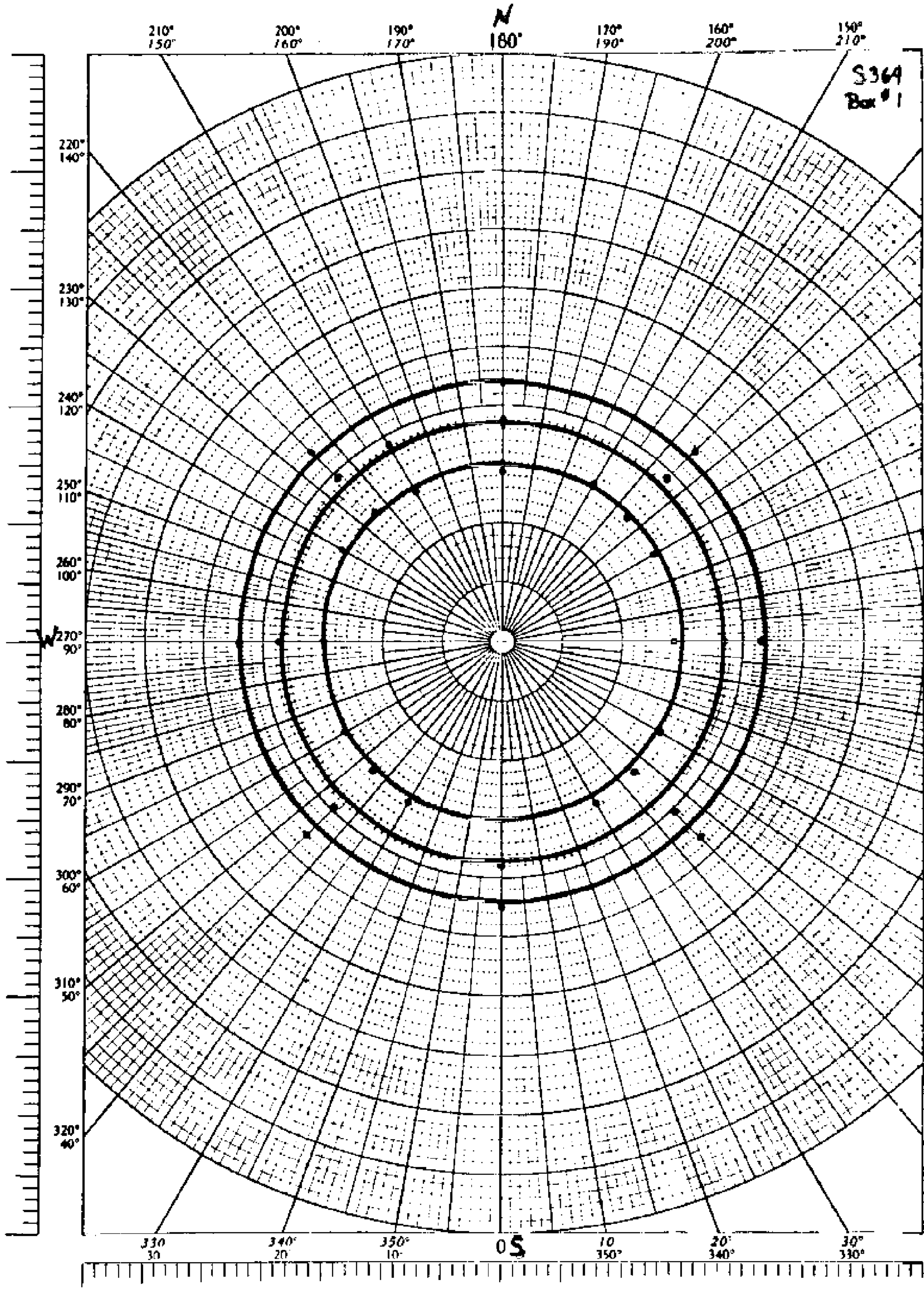


Figure 10b. Example of plot showing directional variability in Marsh-McBirney current meter. Dark circles represent three different flume velocities. Dark points represent measured current speed calculated from x and y components at each compass direction in Figure 10a. Lighter circles on graph paper represent 10 cm/s increments. The data on this Figure are also summarized in Table 4.

```
SAVANNAH NAVIGATIONAL LIGHT TOWER
METEOROLOGICAL STATION
RUN BY
SKIDAWAY INSTITUTE OF OCEANOGRAPHY
P.O. BOX 13687
SAVANNAH, GA.  31416

Date:                      1 July 1982
File:                      183H16
Number of Data Points:     148
Begin Time (GMT)           16:43:00
End Time (GMT)             16:44:14

  AIR TEMP (C)                 27.8
  WATER TEMP (C)               25.0
  WIND SPEED (m/s)              7.5
  WIND DIR                     44
  BAROMETER (mb)             1012.1

     Wave Information

Pressure variance (cm*cm) =  229.75
Adjusted variance (cm*cm) = 1756.29
Significant height (cm)   =  118.60
Significant height (ft)   =    3.89

       750
       725
       700
       675
       650
       625
V      600            *
A      575            *
R      550            *
I      525            *
A      500            *
N      475            *
C      450            *
E      425            *
       400            *
(      375            *
c      350            *
m      325            *
*      300            *
c      275            *
m      250            *
)      225            * *
       200            * *
       175            * *
       150        *   * *       *
       125        *   * *     * *
       100        *   * *   * * *
       75         *   * *   * * *
       50         * * * * * * * * *
       25         * * * * * * * * *
       0    * * * * * * * * * * * * * * * *
            16.0 8.0     4.0     2.7     2.0
                     Period (sec)
```

Figure 11. SNLT data summary printed for National Weather Service and other agencies. Summary includes air and water temperature, wind speed and direction, barometric pressure, and significant wave height and wave spectrum.

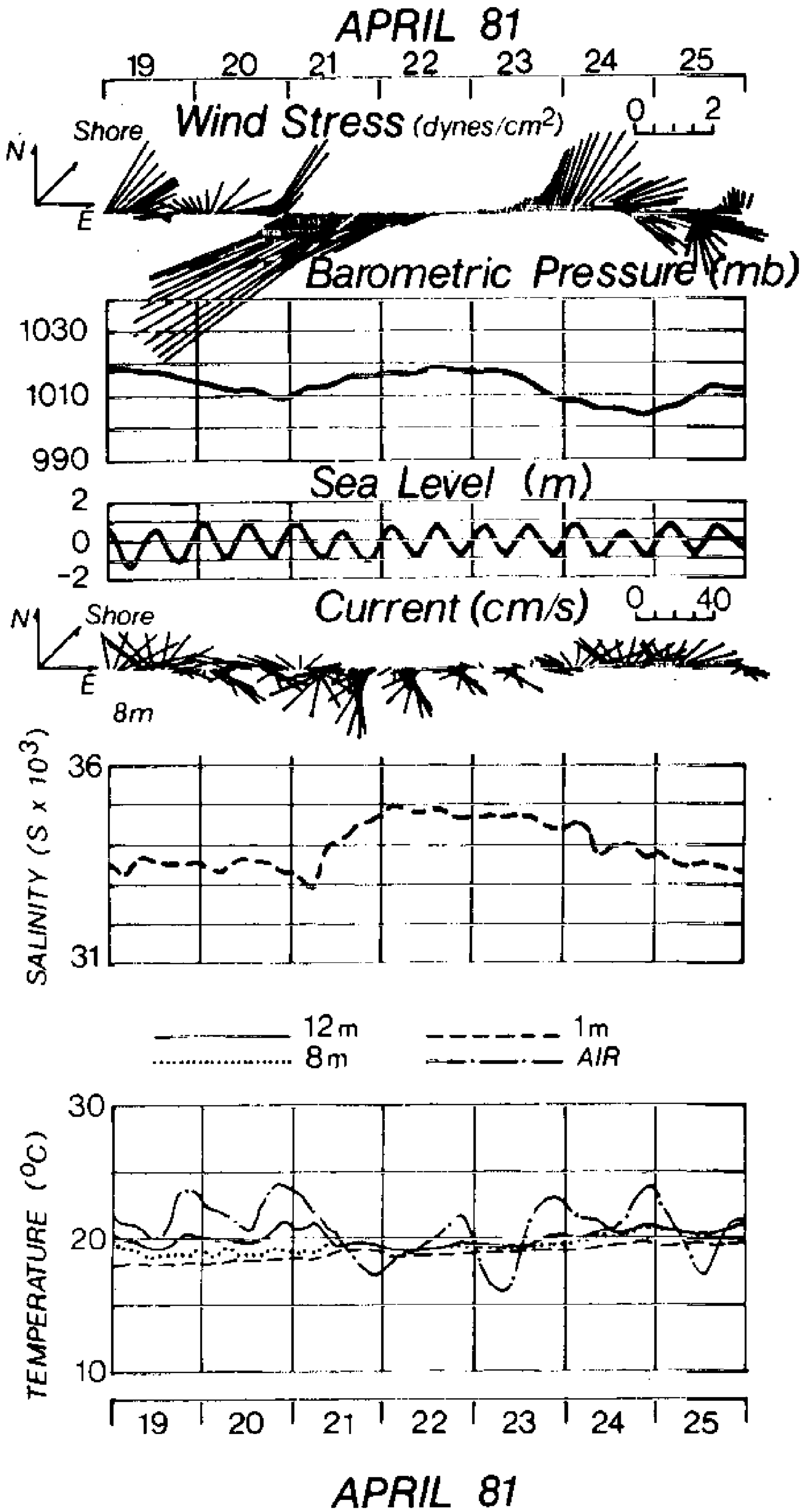


Figure 12. Example of SNLT weekly data summary, from the week of 19 April 1981. Data were smoothed with a three-hour low-pass filter.

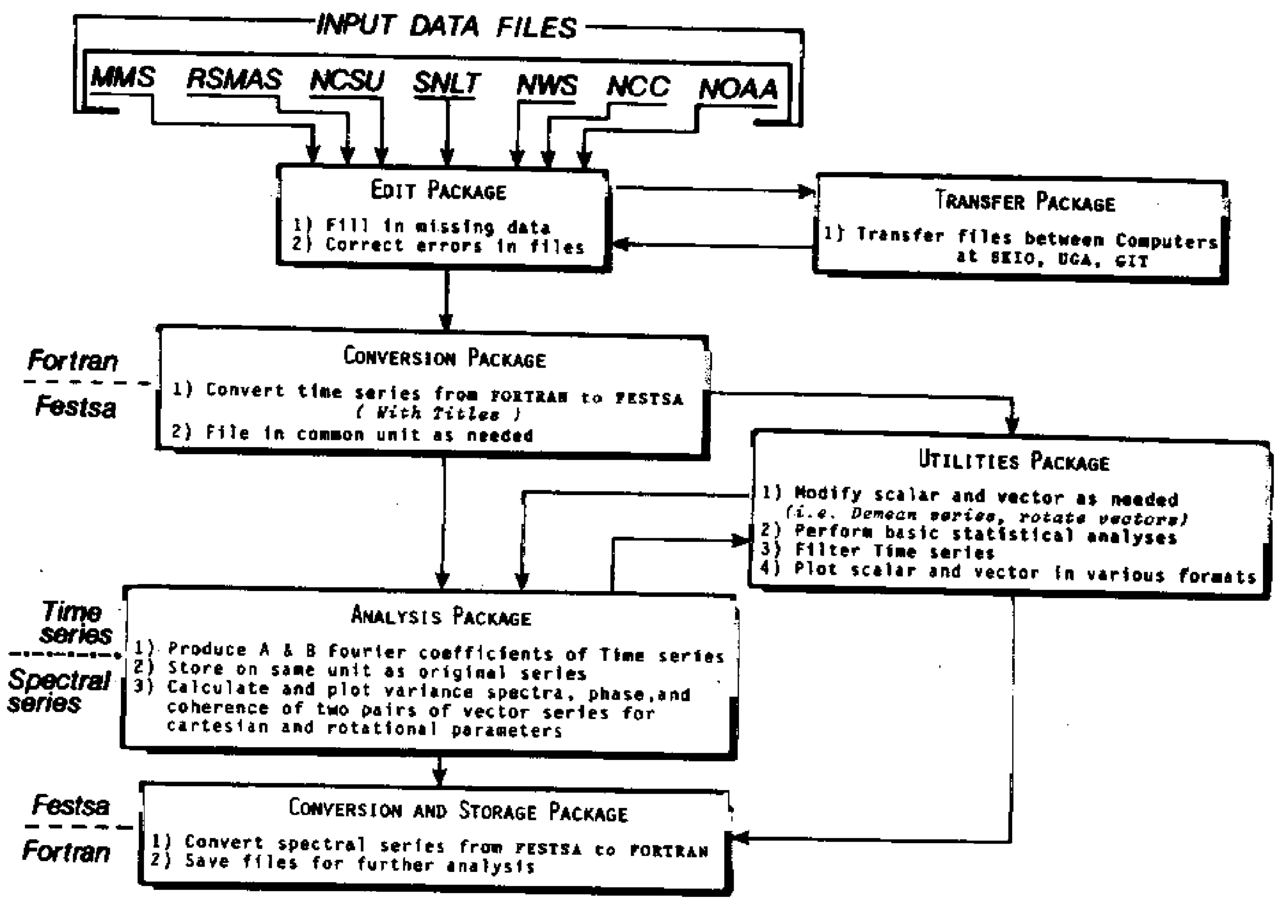


Figure 13. Flow chart of data analysis showing various softward packages used to convert data between BCD (Fortran) and FESTSA format, and perform spectral analysis on finite time series. Top of figure shows various sources of data in addition to SNLT.

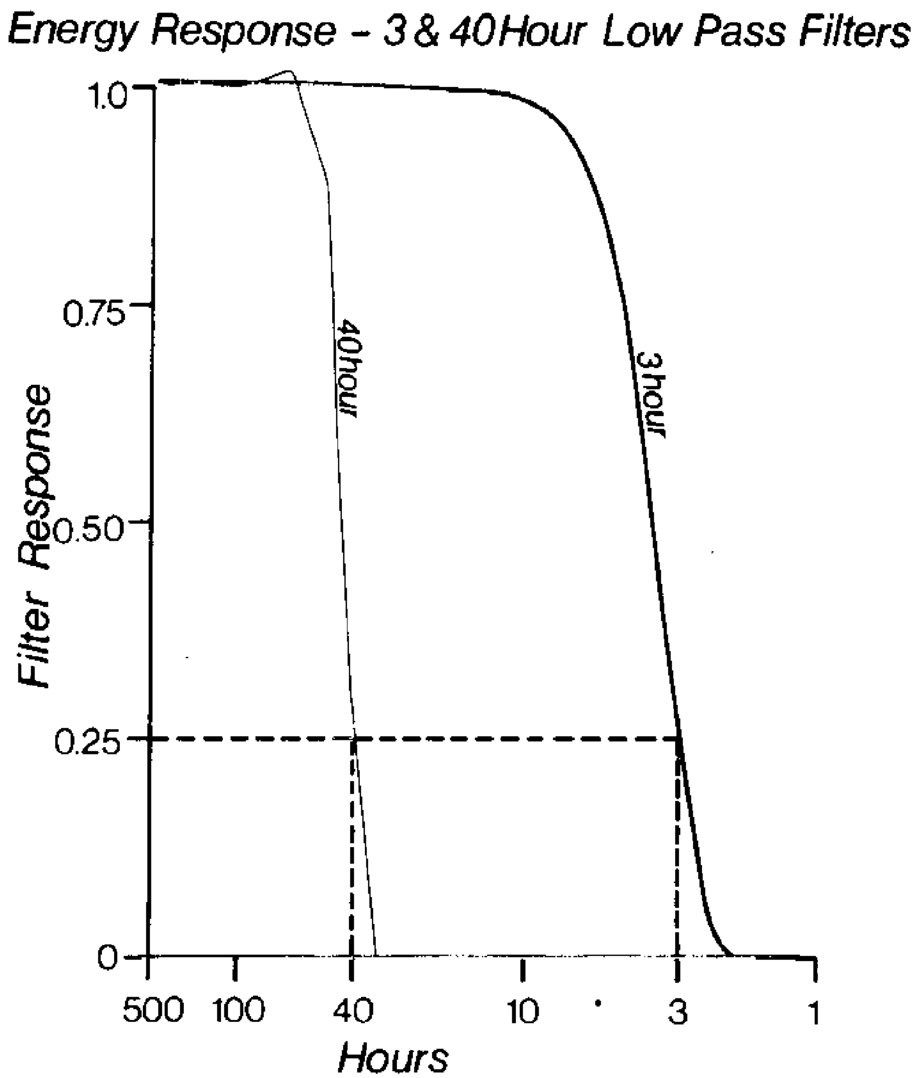


Figure 14. Energy response of three- and 40-hour low-pass filters used in the reduction of SNLT data. A summary of the filter characteristics is found in Table 6.

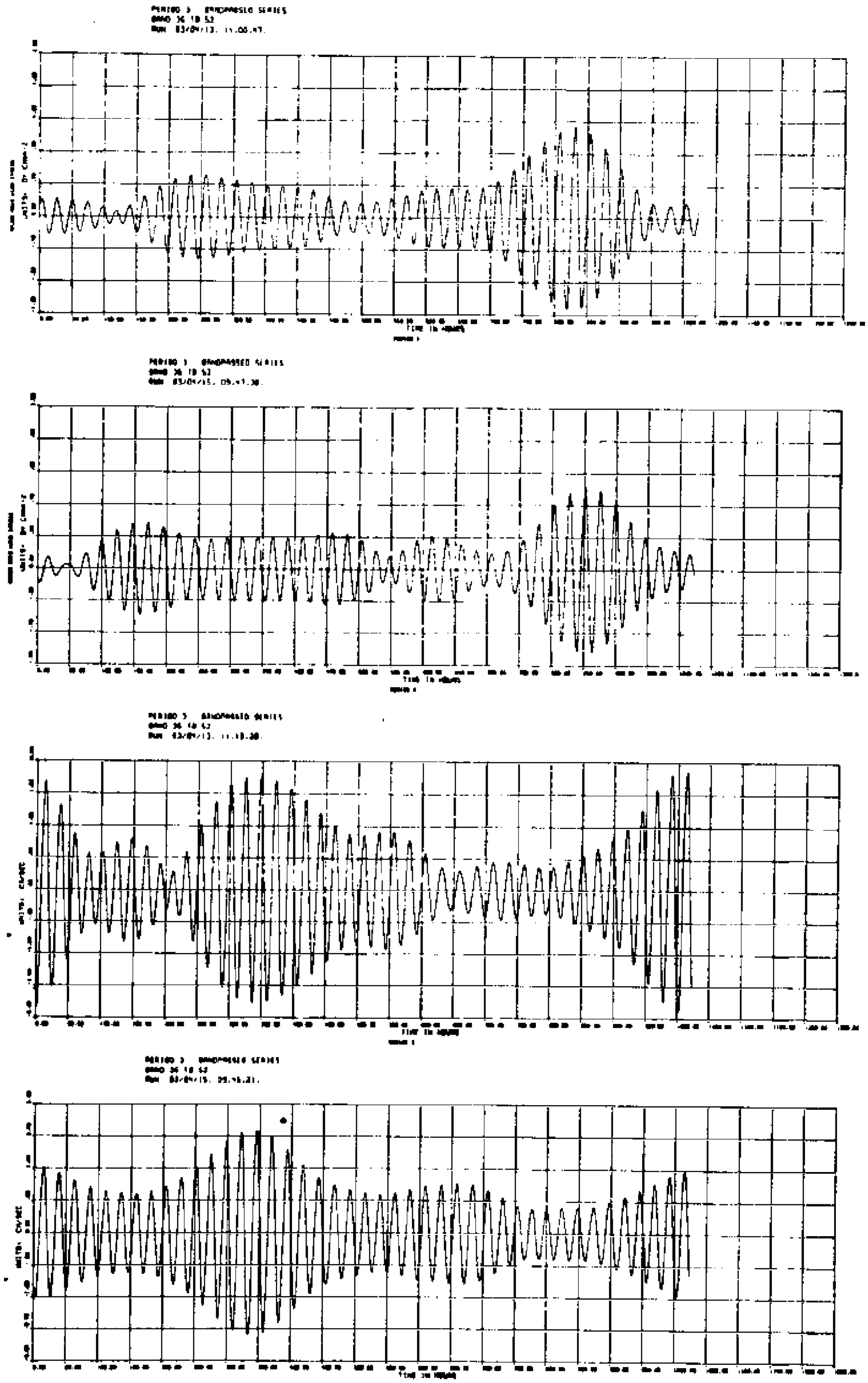


Figure 15. Example of bandpassed SNLT wind and current time series from Period 3 (27 July-20 September 1977). Bandpass filter used for this analysis is centered on 24 hours to define daily (1 cpd) events in the record, and minimize higher- and lower-frequency events. The 14-day cycle seen in the plots is associated with the fortnightly cycle. From top to bottom, the time series plotted are wind stress major axis, wind stress minor axis, current u, current v.

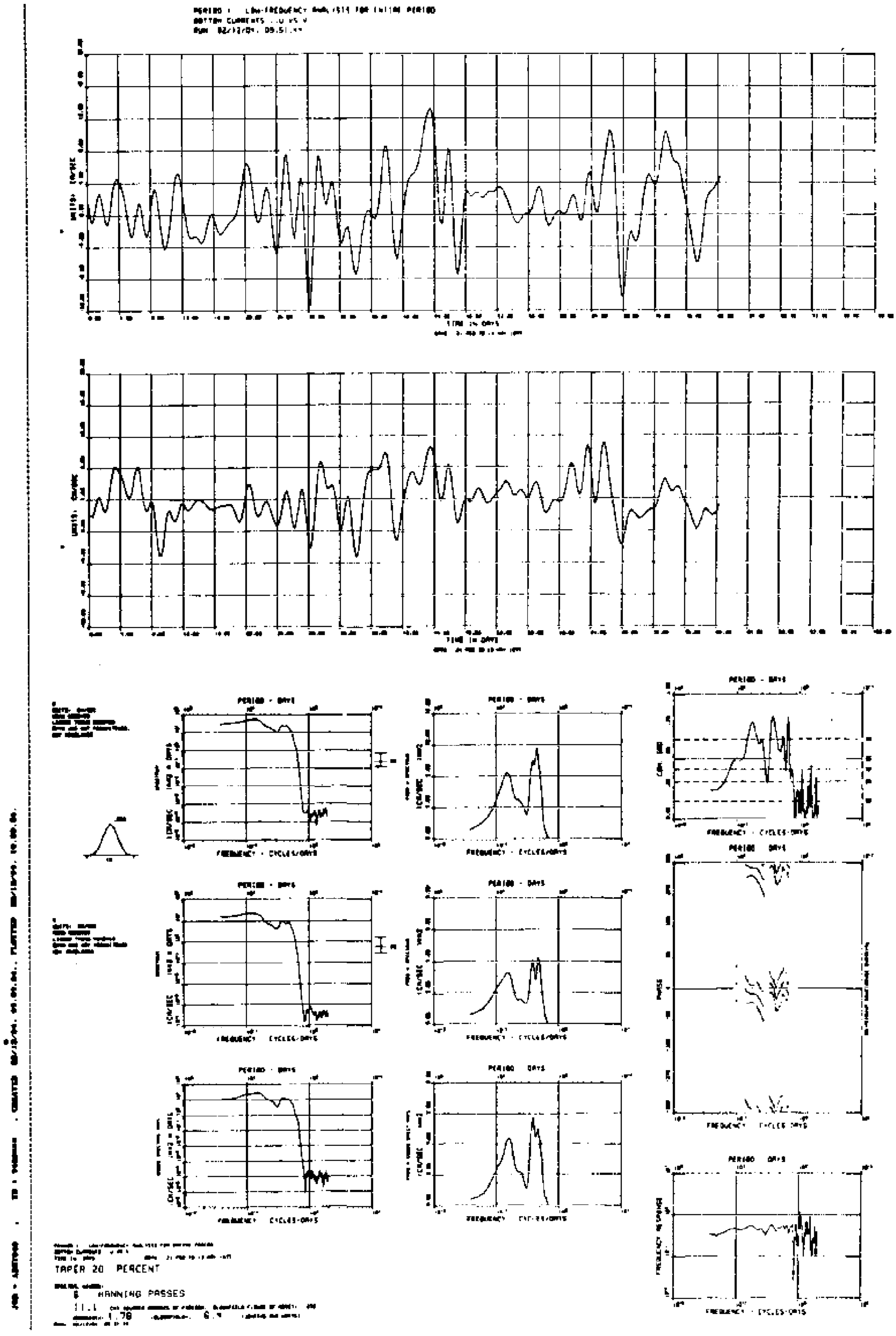


Figure 16. Example of output plot from auto- and cross-spectral analysis between two series. The two plots at the top are the time series. The first column of plots at the bottom include the two auto-spectra and the cross-spectrum. The second column includes the spectra divided by frequency. The third column includes plots of coherence, phase, and gain between the two series.

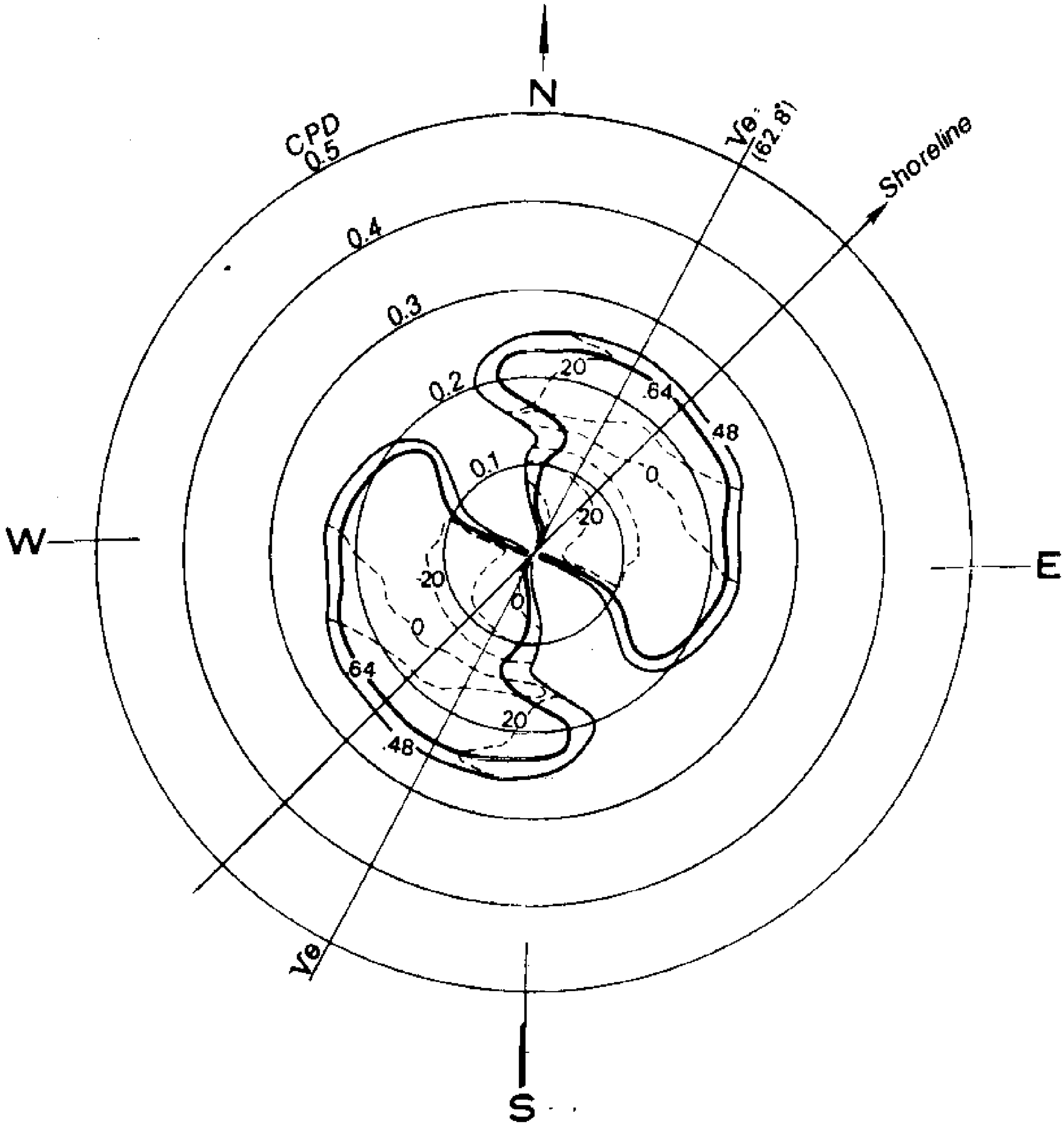
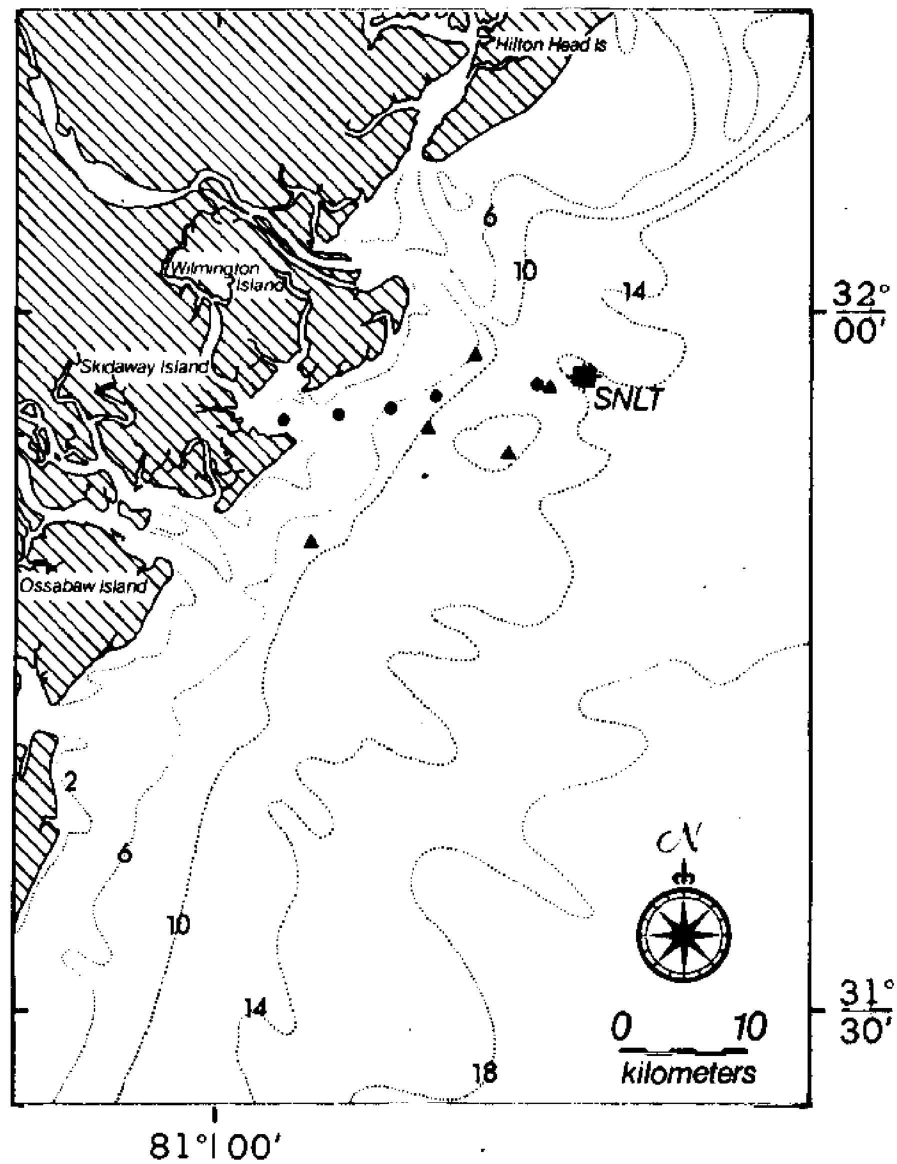


Figure 17. Examples of rotary spectra correlation between a vector and a scalar. The vector is SNLT wind and the scalar is the principal component (θ = 62.8°) of the current from period 5 (6 Mar-22 May 1981). The solid lines enclose the wind directions and frequencies at which the current was coherent with the wind at the 90% (.48) and 95% (.64) confidence level. The broken lines represent the phase relationship, in degrees, between the scalar and vector. Positive phases indicate the scalar leads the vector. Concentric circles represent frequency in cycles per day. Compass directions and current scalar and shoreline orientation are also included.



✱ Savannah Navigational Light Tower
▲ Temporary Moorings
● Permanent Moorings

Figure 18. Map showing location of future experiments. Circles indicate locations of Sea Data CTD microloggers to be periodically deployed at permanently placed lighted buoys beginning Spring 1984. Triangles indicate locations of other instrument packages to be periodically deployed by cooperating institutions in the ongoing work sponsored by DOE. Square indicates location of SNLT, which will be in operation during all nearby deployments.