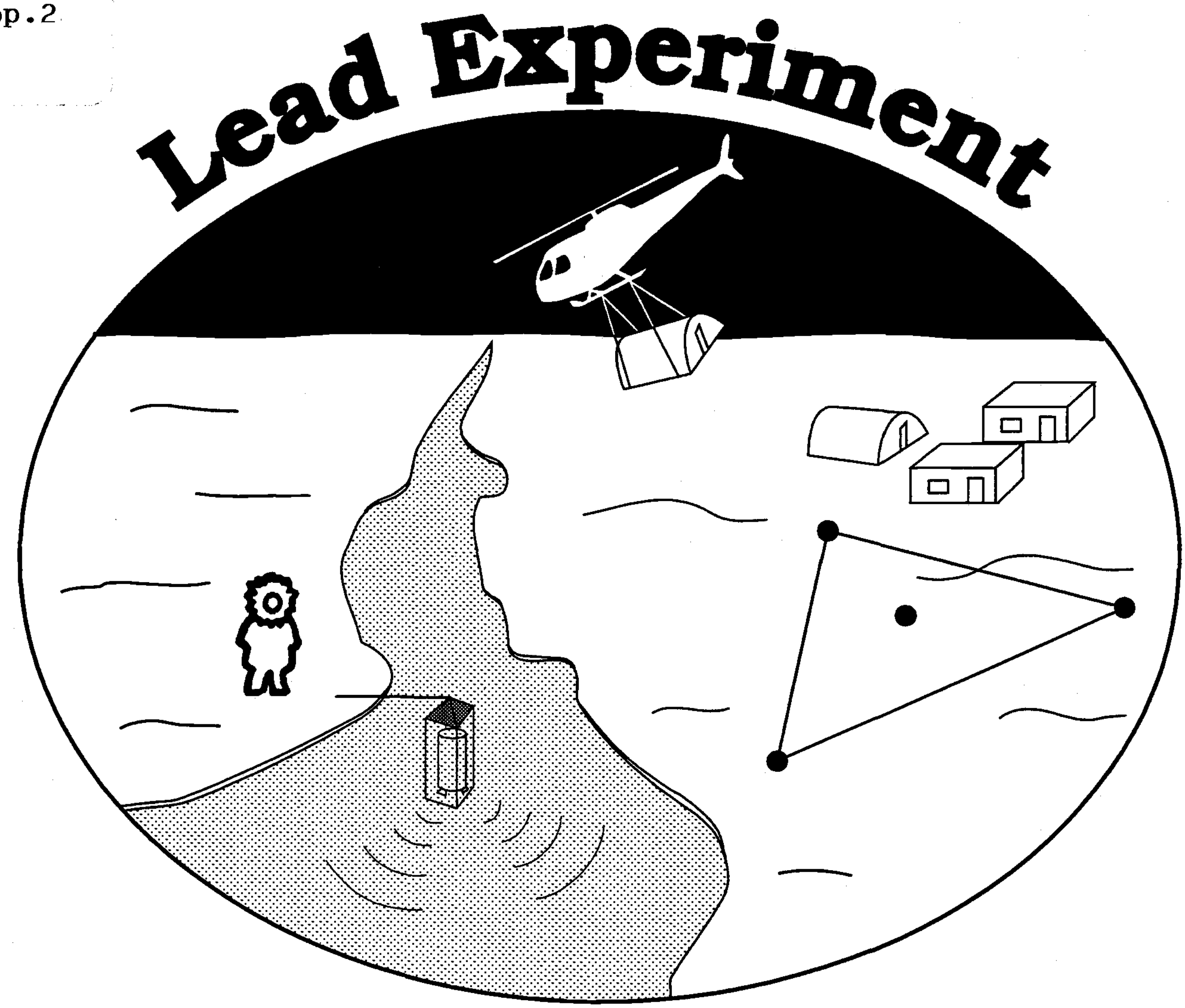

OBSERVATIONS FROM LEADEX, BEAUFORT SEA ARCTIC OCEAN MARCH - APRIL 1992

by

Murray D. Levine
Clayton A. Paulson
Jay Simpkins
Steve R. Gard

Reference 93 - 1
April 1993
Data Report 153

Office of Naval Research
N00014 - 91 - J - 1801

College of Oceanic & Atmospheric Sciences

OREGON STATE UNIVERSITY

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER 93-1	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Observations from LEADEX, Beaufort Sea Arctic Ocean, March-April 1992		5. TYPE OF REPORT & PERIOD COVERED Reprint Data Report #153 6. PERFORMING ORG. REPORT NUMBER
7. AUTHORS(s) Murray D. Levine, Clayton A. Paulson Jay Simpkins, Steve R. Gard		8. CONTRACT OR GRANT NUMBER(s) N00014-91-J-1801
9. PERFORMING ORGANZATION NAME AND ADDRESS College of Oceanic & Atmospheric Sciences Oregon State University Corvallis, Oregon 97331-5503		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Office of Naval Research Ocean Science & Technology Division Arlington, Virginia 22217		12. REPORT DATE April 1993 13. NUMBER OF PAGES 160
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Arctic Ocean, LEADS Internal Waves

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report presents time series measurements of velocity, temperature and conductivity made during the Lead Experiment (LEADEX). These observations were made in the Beaufort Sea, Arctic Ocean, in the vicinity of 73°N, 144°W, during March-April 1992. Month-long observations at the base camp were made between the surface and 400 m depth; horizontal separations ranged from 70 to 140 m. Several-day records of velocity profiles to 130 m depth in two newly formed leads aways from the base camp are also presented.

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S/N 0102-014-6601

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Observations from

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Beaufort Sea
Arctic Ocean

March-April 1992

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Acknowledgements

We thank chief scientist Jamie Morison, logistics coordinator Andy Heiberg, and camp managers John "Jumper" Bitters and Dean Stuart for making LEADEX a successful experiment. Thanks are extended to all the other support personel, including helper Steve Vorhees and cooks Tony and Dax Parra. We thank Tim Stanton and Jim Stockel for their help in deploying the ADCP. The efforts of Dennis Barstow in helping to calibrate the instruments are much appreciated.

We appreciate the labor and enthusiasm of program manager Thomas Curtin in organizing the LEADEX project. Thanks also to program manager Alan Brandt for his continued support. The support for this research by the Office of Naval Research through grant N00014-91-J-1801 is gratefully acknowledged.

TABLE OF CONTENTS

Observations from LEADEX

INTRODUCTION

Leads are openings in the floating pack ice that permit direct contact between the ocean and atmosphere. The fluxes of heat and salt through leads are thought to be important in the thermodynamic balance of the Arctic Ocean; yet the details of the process are not well understood.

To increase our knowledge of the role of leads, the Office of Naval Research sponsored an Accelerated Research Initiative (ARI) in Arctic Lead Dynamics. Some of the specific goals of this program are to (*Arctic Lead Dynamics Science Review*, T.B. Curtin, editor, report # 1125AR-91-033, Arctic Sciences Program, Office of Naval Research, 1991):

- characterize upper ocean variability induced by individual leads,
- understand the heat, salt and momentum fluxes including frazil ice formation,
- understand the net effect of many leads on regional properties of the upper ocean.

This report presents moored observations of velocity, temperature and conductivity made during the LEADEX experiment. The measurements were made in the Beaufort Sea, Arctic Ocean, in the vicinity of 73°N, 144°W, during March-April 1992.

The main objective of this project was to measure the background temperature, salinity and velocity structure in the mixed layer and upper pycnocline under the pack ice at the main camp. Lead-caused oceanic anomalies are expected to be small, and it is important to measure and understand the structure well away from leads and to search for evidence of the effects of leads on the far field. Specific goals include:

- to measure background fluctuations in the far-field of leads in order to aid in interpreting observations in leads, and
- to measure the characteristics of the internal wave field to compare with previous observations in the Arctic Ocean.

In addition, a self-contained acoustic Doppler current profiler (ADCP) was deployed at several lead-site camps to provide a detailed picture of the velocity structure at the edge of a lead.

INSTRUMENTATION

Description

A horizontal and vertical array of instruments measuring temperature, conductivity and velocity were suspended from the ice at the LEADEX main camp. Instruments included: temperature recorders (MTR, MDR), temperature-conductivity recorders (Seacats), and electromagnetic current meters (S-4).

The central mooring contained most of the instruments; the majority of those were located in the upper 60 m. A cluster of sensors was also located around 250 m to record internal wave activity. Three other satellite moorings, containing two temperature recorders at 250 m, were deployed in a triangular pattern around the center (Figure 1). The depth and technical details of each instrument are presented in Tables 1 and 2.

An acoustic Doppler current profiler was deployed at two lead-site camps (named Lead #3 and Lead #4). The instrument operated at 307 kHz in a self-recording mode. Technical details of the ADCP are given in Table 3.

Deployment/Recovery

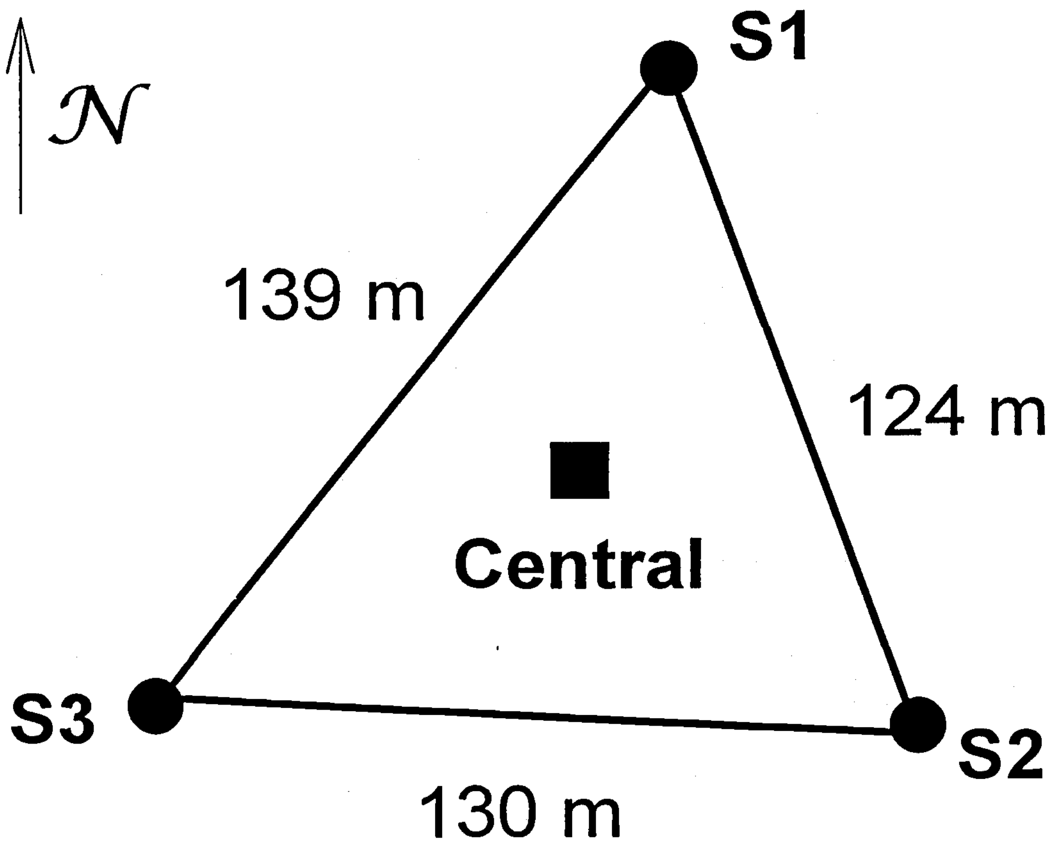
The central mooring was deployed on 23 March (GMT); the satellite deployment was completed on 25 March. The location and velocity of the ice camp as it drifted westward are shown in Figure 2 from GPS data kindly supplied by Miles McPhee (McPhee Research).

The central mooring was deployed from an A-frame mounted inside a hut through a 3-foot diameter hole in the nearly 4-meter thick ice. The strength member of the mooring consisted of 3/8" dacron line. Temperature recorders (MTR) were attached to the line using nylon ties and black electrical tape; temperature-conductivity recorders (Seacats) and current meters (S-4) were shackled in series with the line. The mooring was kept taut with a 200 lb weight at the bottom. A small electric capstan and come-along were used to lower the mooring and transfer loads. The hole was kept free from ice by continuously adding heat from the space heater by circulating water through a heat exchanger.

The satellite moorings were deployed through 8" holes drilled through the ice. The 250-m long mooring line was laid out on the ice. A 50 lb anchor was attached and the line was lowered by a person (C. Paulson) holding the top end and walking toward the hole; an oil drum at the hole provided a smooth surface over which the line slipped as it was lowered.

The satellite moorings were retrieved through 12" holes using a hole melter. The holes were made alongside the mooring line that had frozen into the ice; the line was then pulled sideways into the open hole for retrieval. The line was secured to a snowmobile and pulled over an oil drum.

The ADCP was deployed twice in leads at Leads #3 and #4 (Figure 2). The floatation was provided by a collar that fit around the main body of the instrument. A frame around the



	ANGLE, deg
S1-S2-C	30
S1-C-S2	120
S1-S3-C	24
S1-C-S3	127
S2-S1-C	30
S2-C-S3	113
S2-S3-C	30
S3-S1-C	28
S3-S2-C	36

Distances between, m	S1	S2	S3
C	72	72	83
S1		124	139
S2			130

Figure 1. Plan view of the location of the Central and Satellite moorings. Tables give the distances and angles between moorings.

Table 1 **CENTRAL MOORING Instrumentation**

Depth, m	Type of measurement	Manufacturer	Model Number	Serial Number	Date of Calibration
4	V	InterOcean	S-4	20661	
5.46	T,C	SBE	SBE-16	40	5 Feb 92
5.93	T	PMEL	MTR	3094	Jul 92
10.07	T	PMEL	MTR	3082	Jul 92
10.09	T	PMEL	MTR	3074	Jul 92
12.08	T	PMEL	MTR	3075	Jul 92
~~14.07~~	~~T~~	~~PMEL~~	~~MTR~~	~~3084~~	No data
14.09	T	PMEL	MTR	3076	Jul 92
16.08	T	PMEL	MTR	3077	Jul 92
18.08	T	PMEL	MTR	3078	Jul 92
19.55	V	InterOcean	S-4	20655	
20.01	T,C	SBE	SBE-16	41	5 Feb 92
22.05	T	PMEL	MTR	3079	Jul 92
24.04	T	PMEL	MTR	3080	Jul 92
26.05	T	PMEL	MTR	3081	Jul 92
28.05	T	PMEL	MTR	3070	Jul 92
30.05	T	PMEL	MTR	3072	Jul 92
33.05	T	PMEL	MTR	3085	Jul 92
35.49	V	InterOcean	S-4	20642	
35.95	T,C	SBE	SBE-16	43	10 Jan 92
38.97	T	PMEL	MTR	3086	Jul 92
41.96	T	PMEL	MTR	3088	Jul 92
44.96	T	PMEL	MTR	3089	Jul 92
47.96	T	PMEL	MTR	3090	Jul 92

Depth, m	Type of measure-ment	Manu-facturer	Model Number	Serial Number	Date of Calib-ration
~~50.40~~	~~V~~	~~InterOcean~~	~~S-4~~	~~20660~~	No data
50.87	T,C	SBE	SBE-16	50	13 Feb 92
51.57	P	ParoScien.	Digiquartz	21449	
53.90	T	PMEL	MTR	3091	Jul 92
56.90	T	PMEL	MTR	3093	Jul 92
~~59.90~~	~~T~~	~~PMEL~~	~~MTR~~	~~3073~~	No data
150	V	InterOcean	S-4	20763	
235	T	PMEL	MTR	3095	Jul 92
240	T	PMEL	MTR	3096	Jul 92
245	T	PMEL	MTR	3097	Jul 92
~~249.5~~	~~V~~	~~InterOcean~~	~~S-4~~	~~20760~~	No data
250	T,C	SBE	SBE-16	51	29 Jan 92
250.5	P	ParoScien.	Digiquartz	21432	
255	T	PMEL	MTR	3098	Jul 92
260	T	PMEL	MTR	3099	Jul 92
265	T	PMEL	MTR	3100	Jul 92
400	V	InterOcean	S-4	20764	

Table 2 **SATELLITE MOORING Instrumentation**

Location Depth: 250 m	Type of measure-ment	Manu-facturer	Model Number	Serial Number	Date of Calib-ration
S1	T	PMEL	MTR	3101	Jan 92
S1	T,P	Alpha-Omega	MDR	116	Aug 92
S2	T	PMEL	MTR	3103	Jul 92
S2	T	Alpha-Omega	MDR	118	Aug 92
S3	T	PMEL	MTR	3113	Jul 92
S3	T	Alpha-Omega	MDR	119	Aug 92

Table 3. ACOUSTIC DOPPLER PROFILER Technical Information

Parameter	Value	Comment
Acoustic frequency	307 kHz	
Model/serial no.	ADCP-SC #199	Upgraded with solid-state memory; firmware 17.07
Bin length	4 meters	
Pulse length	4 meters	
Pings/ensemble	130	
Time between pings	.44 s	
Number of depth cells	32	
Signal/noise threshold	6.0 dB	
Percent good threshold	25%	If less than 25% of the pings in the ensemble are good, no data are taken
Pitch, roll compensation	Not used, but recorded	
Compass compensation	Not used in velocity data, but recorded	Data were recorded relative to fixed ADCP. Absolute orientation of beams was done by survey.
Blank beyond transmit	2 meters	Delay from end of transmit to start of data acquisition.

Velocity scaling

The speed is scaled by the factor C_{trans}/ 1536 m/s, where C_{trans} is the speed of sound at the transducer. The constant value of C_{trans} = 1434.5 m/s was used, based on S = 30 ppt and T = -1.65°C

ADCP Depth Bins

RDI assumes a sound speed of 1475.1 m/s (1.566 ms/m) in calculating the length of a bin in meters. We used a sound speed of c = 1440 m/s to be representative of the conditions at LEADEX.
The depth in meters, z, of the center of each bin can be found using the formula:

$$z=\frac{c}{2}\cos\theta\left[\frac{T}{2}+D+\left(B-\frac{1}{2}\right)\Delta t\right]+H$$

where B = bin number,
T = pulse duration in seconds = 4 m x 1.566 ms/m
D = delay after transmit in seconds = 2 m x 1.566 ms/m
Δt = bin length in seconds = 4 m x 1.566 ms/m
H = transducer depth below ice = 1 m
θ = transducer angle = 30°

For these parameters the equation becomes:

$$z=3.93+\left(B-\frac{1}{2}\right)3.91$$

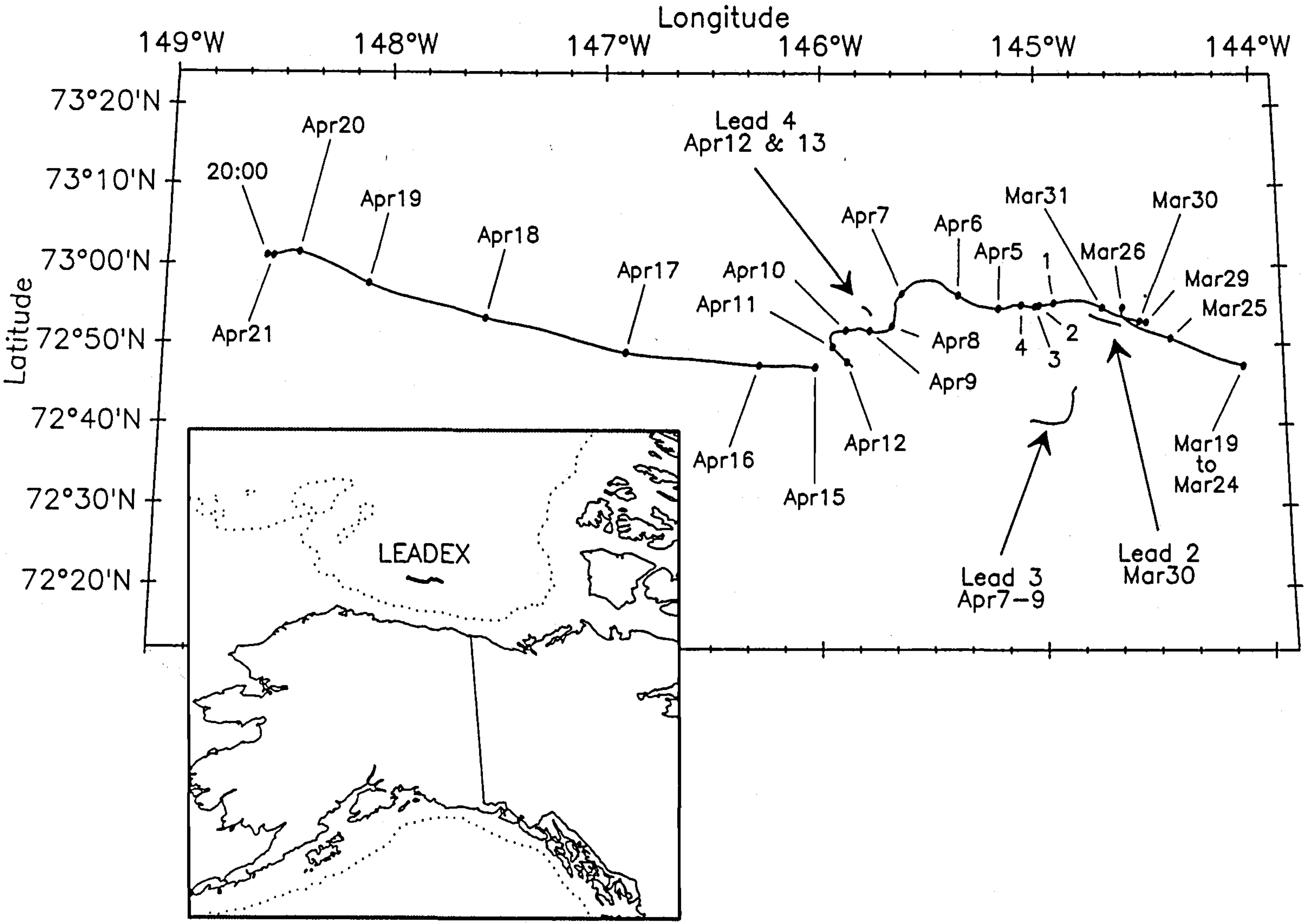


Figure 2a. Location of main ice camp during LEADEX. The position of the lead-site camps, Leads #2, #3 and #4, are also shown. The location of the 1000 m isobath is shown in the inset.

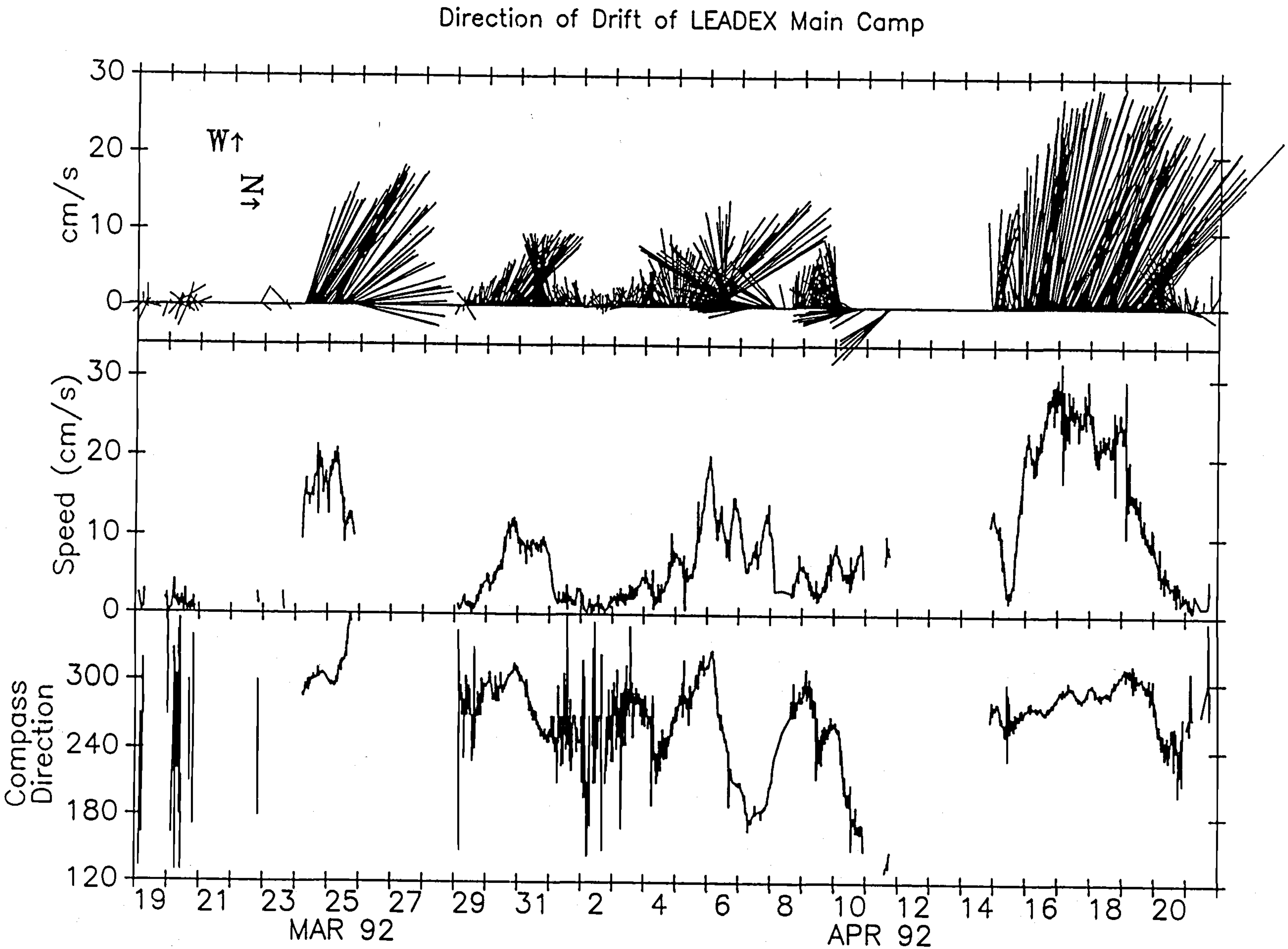


Figure 2b. Speed and direction of the drift of the main camp. Note that in the vector plot *up* is to the west.

instrument protected the transducers and provided a point of attachment to a 5-meter pole (2.5" diameter aluminum tubing joined from short sections) that was attached by rope to wooden posts that were secured into the ice. The deployment was accomplished by holding the pole and simply sliding the instrument on the side of its frame into the water. Once in the water the ADCP rotated 90 degrees and floated vertically, with the transducers pointing downwards. The ADCP was kept at 10°-15°C in its crate by heating with two 100W light bulbs. The crate was transported by helicopter to the lead sites, and the ADCP was deployed from the crate into the lead within a couple of hours.

The ice was chipped regularly around the ADCP. Recovery was essentially the reverse of the deployment procedure.

CALIBRATION

MTR Temperature Recorders

Calibrations were performed before and after the deployment at OSU. The post-deployment calibrations were used to convert most of the data. Pre-calibrations were used for one instrument (#3101) because it failed during deployment and was not post-calibrated. The calibrations were calculated from 6 temperature steps ranging from -2° to 0.2° C. The steps were not steady, but drifted at a rate of about 1 millidegree per minute. A 5-minute average was used as a calibration point at each step after about a 45-minute equilibration time. The temperature standard was an SBE-3 from Sea-Bird Electronics (#544) that has been calibrated many times using a platinum thermometer and triple point cell (Dennis Barstow, OSU).

In addition, data were taken in an ice bath which had a much smaller drift rate than at the 6 calibration steps. The ice-bath point provides a more stable estimate of absolute temperature than the drifting steps; hence the calibration curves were forced to go through this value by adding an offset to the instrument counts.

During calibration, an unexpected counting problem was noticed in the instruments. Count values of modulus 25 were recorded preferentially (about .03°). This behavior is obvious in histograms of counts. This error can be seen in some of the time series plots as flat spots in the records. The cause of this behavior was a grounding problem that was not previously noticed by the manufacturer.

Seacat Temperature-Conductivity Recorders

Calibrations were performed by the manufacturer, Sea-Bird Electronics, at Northwest Regional Calibration Center, before the experiment.

Temperature Standards

Temperature calibrations of MTRs were done at OSU; calibrations of Seacats were done by Sea-Bird Electronics (at Northwest Regional Calibration Center; NRCC). Using these calibrations, MTRs and Seacats moored next to each other in the mixed layer during

LEADEX showed a systematic difference of about 0.005°C; the MTRs are systematically *warmer* than the Seacats. The cause of this difference is unclear at this time and is under investigation.

S-4 Current Meters

Compasses were checked before and after deployment. Most compasses were within 3° of the expected values when rotated; all were within 5°.

The only calibration of speed that was performed was to set an offset in the instrument so that a value of zero was read in a still water bath. After the experiment a still water test revealed that some of the instruments recorded a speed up to 2 cm/s. The temporal variation of this offset is not understood.

There were some obvious problems with some of the instruments. The instrument at 250 m recorded a constant speed value of 4 cm/s--reason unknown. The instrument at 50 m had a significant low frequency drift in addition to bursts of high frequency noise--this record is not usable. Although the data from 150 and 400 m are presented here, there are features of the data that are not understood. There are coherent jumps in total current speed and magnetic compass heading among the instruments at 150, 250 and 400 m. These jumps do not always behave the same--often the jumps are out of phase between pairs of intstruments. Correlated noise spikes at independent instruments separated vertically by 250 m are difficult to explain. This behavior had not been seen previously; the cause remains under investigation.

Magnetic Declination

A constant value of 35° was subtracted from compass headings in order to convert from magnetic to true north. Different locations will have values that differ from this constant; however, these variations are expected to be within a few degrees.

ADCP Alignment

The alignment of the ADCP was determined from an internal compass and checked with a hand-held compass sighting along the pole used to secure the ADCP to the ice. The hand-held compass differed by less than 10° from the internal compass. The orientation of the ADCP did not change significantly during a deployment.

ADCP Echo Intensity

Counts were converted to echo intensity in decibels by multiplying by 0.45, as indicated by the manufacturer (RD Instruments). This is a measure of relative backscatter--no absolute calibration has been done.

Pressure/Depth

Pressure sensors were located at 250 m at the end of the Satellite 1 mooring (MDR) and on

the central mooring (Seacat; Paroscientific sensor). A constant value of 10 db was subtracted for the atmospheric contribution to the total pressure (Figure 3).
The factor used to convert pressure in decibars to depth in meters was 0.991 m/db; this is based on an average density of 1026.5 kg m^{-3} and a gravitational acceleration of 9.831 m s^{-2}. Therefore the depth of the pressure sensor is about 253.5 db x .991 m/db = 251.2 m, when the mooring motion is low. This is very close to the depth of 250.5 m estimated by direct measurement of the mooring line (Table 2).

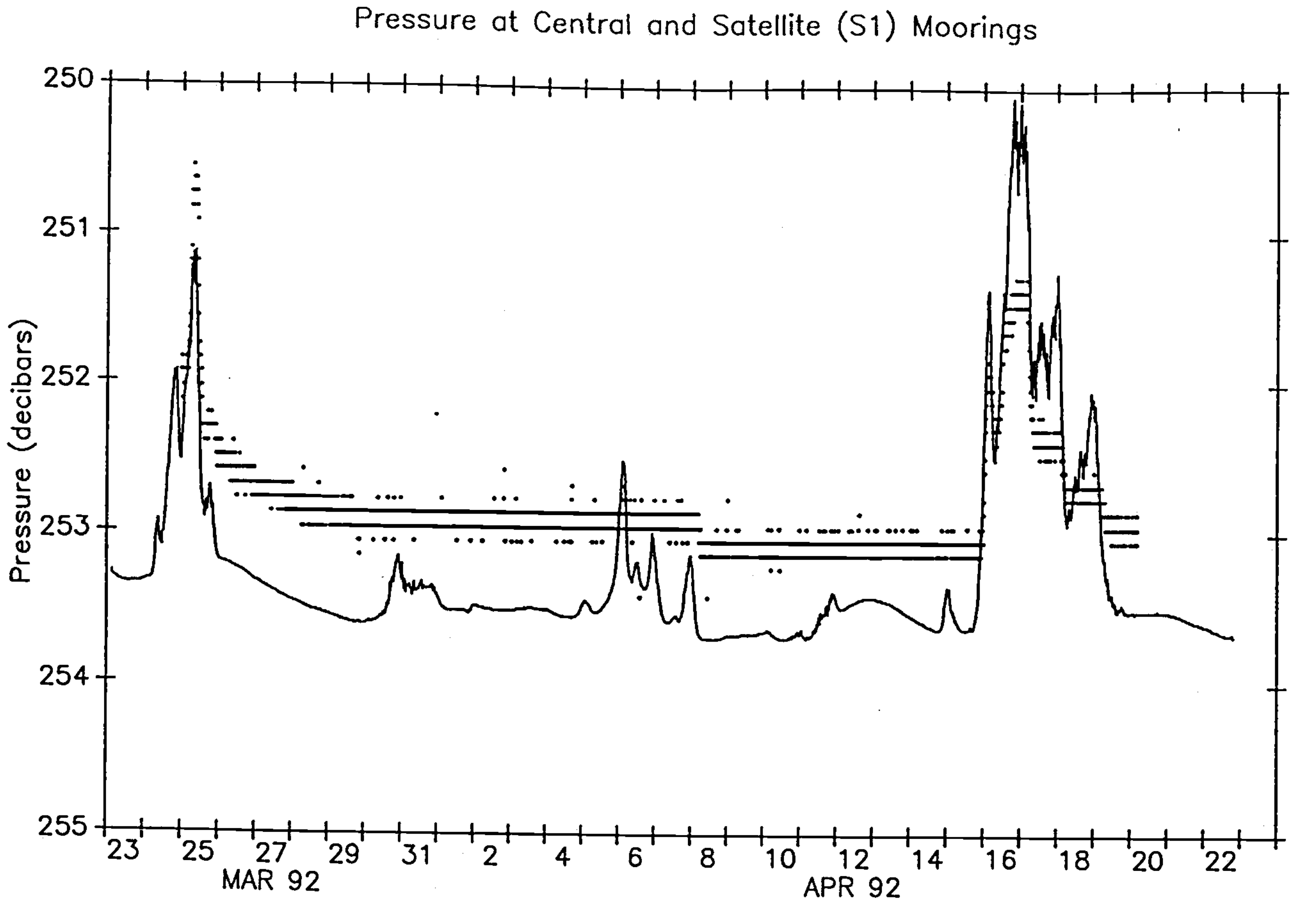


Figure 3. Pressure at Central mooring at 250.5 m recorded by Seacat with a ParoScientific pressure sensor (solid line); pressure at S1 at 250 m recorded by MDR with Aanderaa pressure sensor (dotted line).

Time Zone

All times in this report are referenced to GMT; recall 1992 was a leap year. Date is cross-referenced to Day of Year in the Table below.

	15 Mar	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
DOY	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91

	1 Apr	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DOY	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107

	17 Apr	18	19	20	21	22	23	24	25	26	27	28	29	30
DOY	108	109	110	111	112	113	114	115	116	117	118	119	120	121

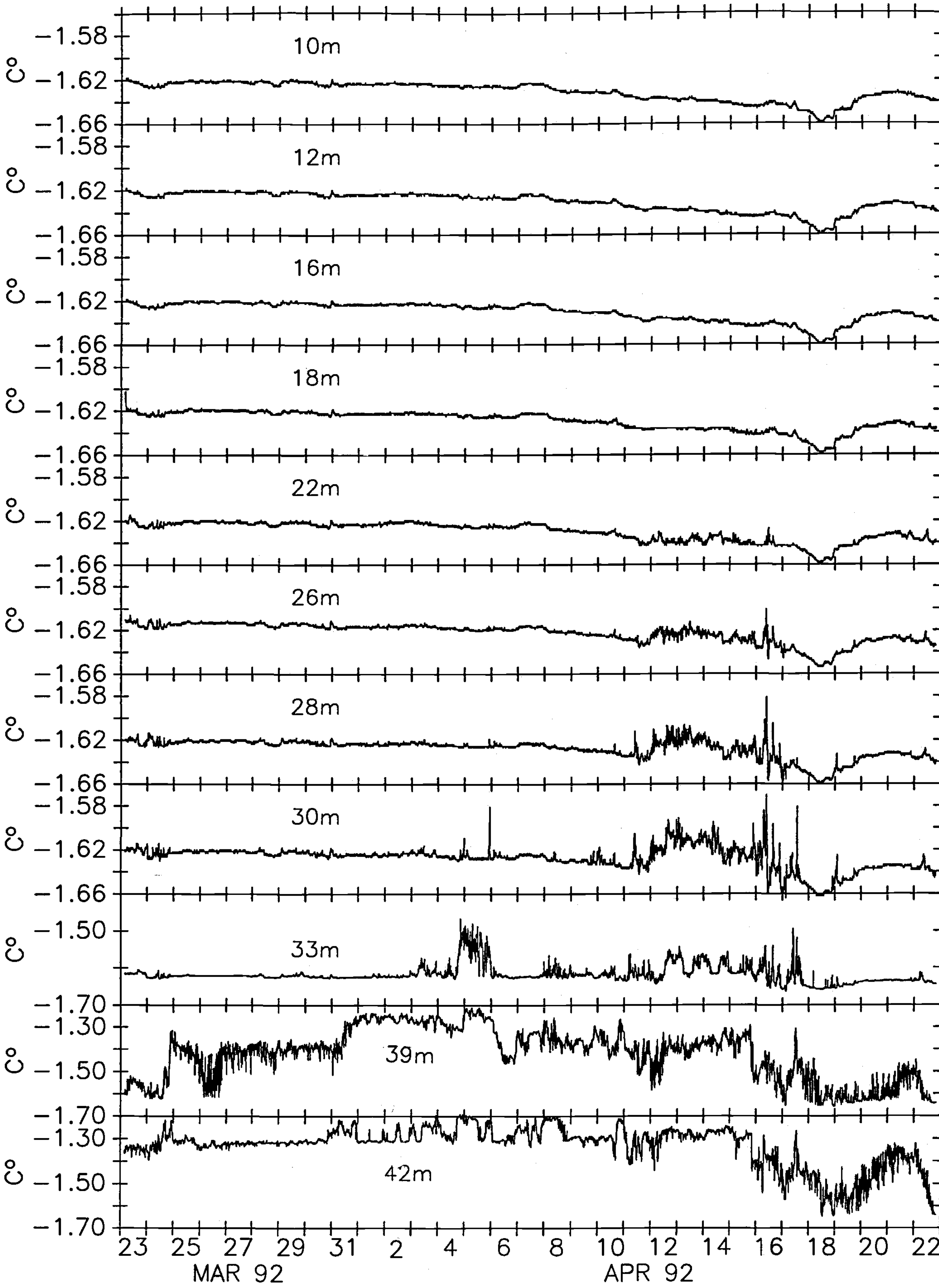
TIME SERIES of TEMPERATURE and VELOCITY at CENTRAL MOORING: Line Plots

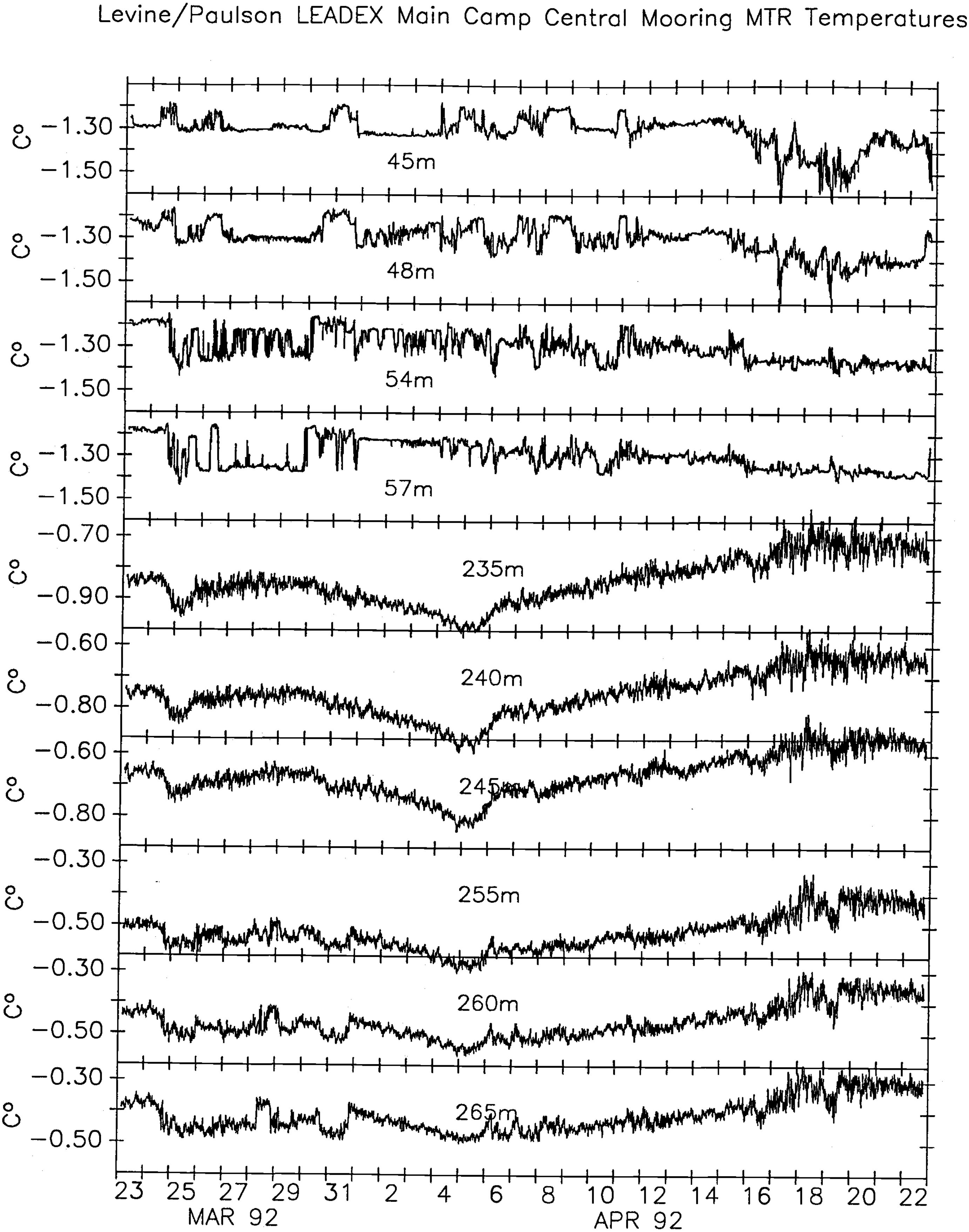
The following four plots are observations at the Central mooring of:

- temperature from 10 to 265 m, as recorded by MTR sensors at 1 minute sampling, and

- velocity from 4 to 400 m measured relative to the drifting ice, as recorded by S-4 current meters, at 2 or 4 minute sampling.

Levine/Paulson LEADEX Main Camp Central Mooring MTR Temperatures




Levine/Paulson LEADEX Main Camp Central Mooring MTR Temperatures
C°
−1.30
−1.50
45m
48m
54m
57m
−0.70
−0.90
235m
−0.60
−0.80
240m
245m
−0.30
−0.50
255m
260m
265m
23
25
27
29
31
2
4
6
8
10
12
14
16
18
20
22
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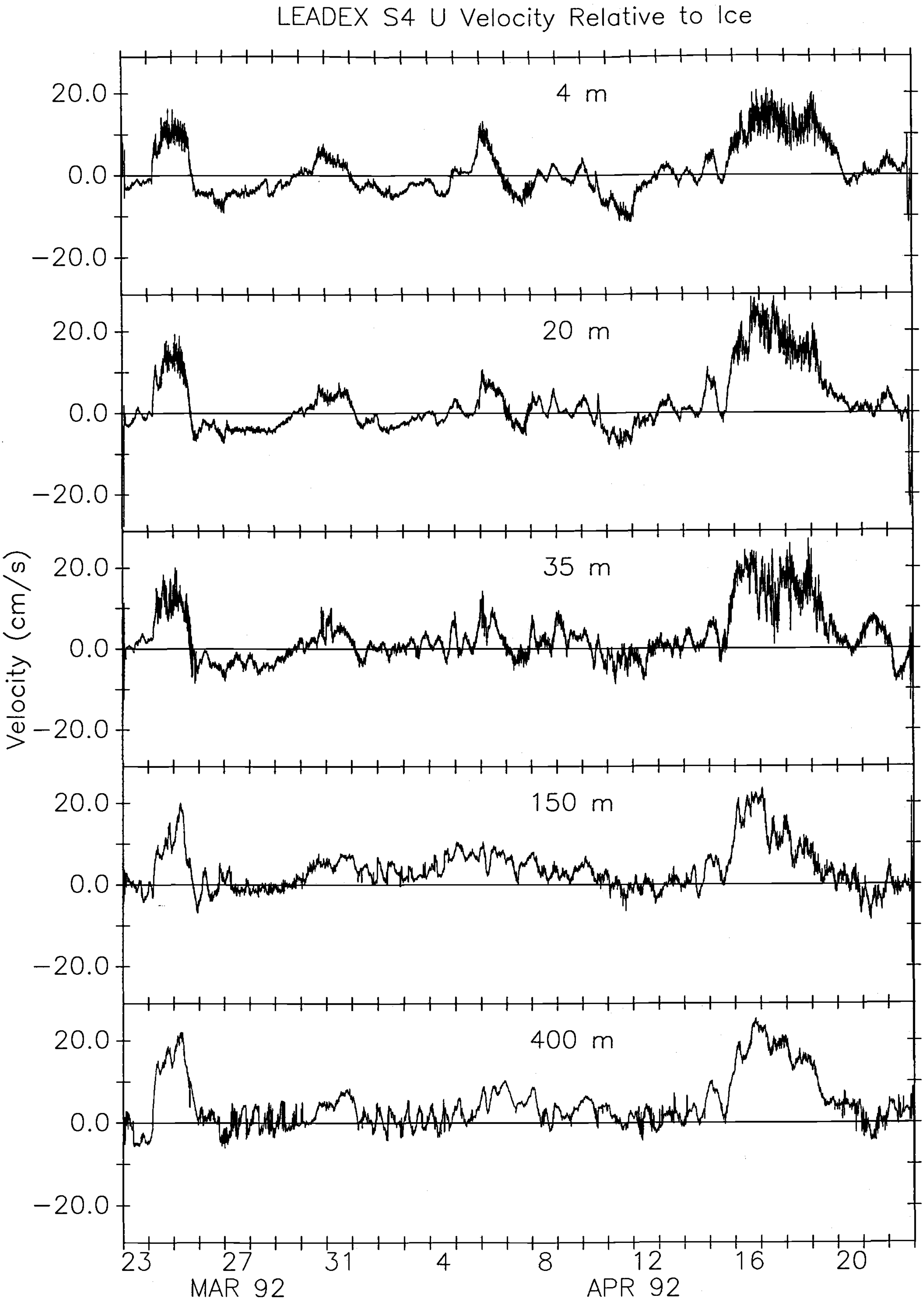
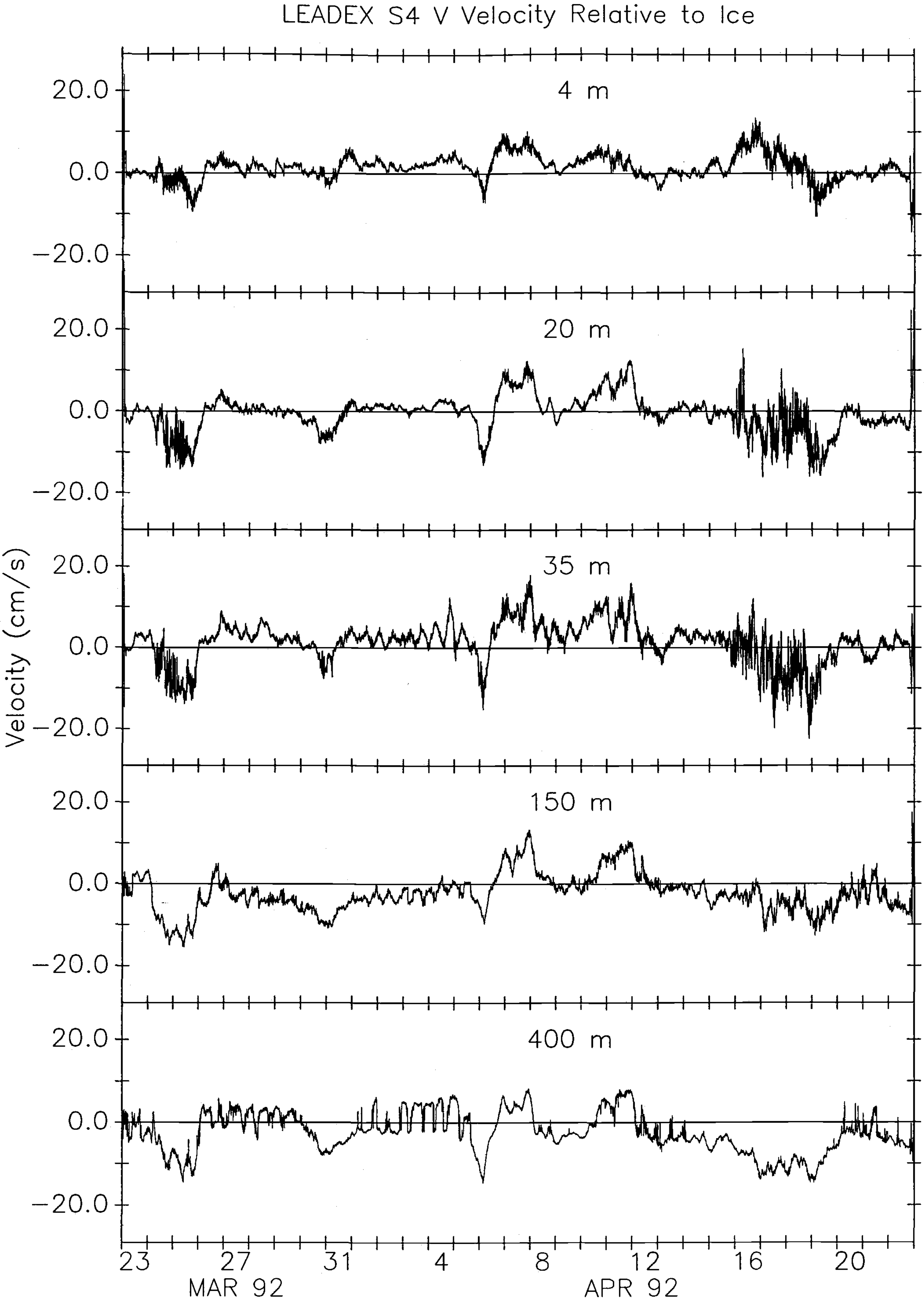

LEADEX S4 U Velocity Relative to Ice
4 m
20 m
35 m
150 m
400 m
Velocity (cm/s)
20.0
0.0
−20.0
23
27
31
4
8
12
16
20
MAR 92
APR 92


LEADEX S4 V Velocity Relative to Ice
4 m
20 m
35 m
150 m
400 m
20.0
0.0
−20.0
Velocity (cm/s)
23
27
31
4
8
12
16
20
MAR 92
APR 92

TIME SERIES of TEMPERATURE at CENTRAL MOORING:

Color Contour Presentation

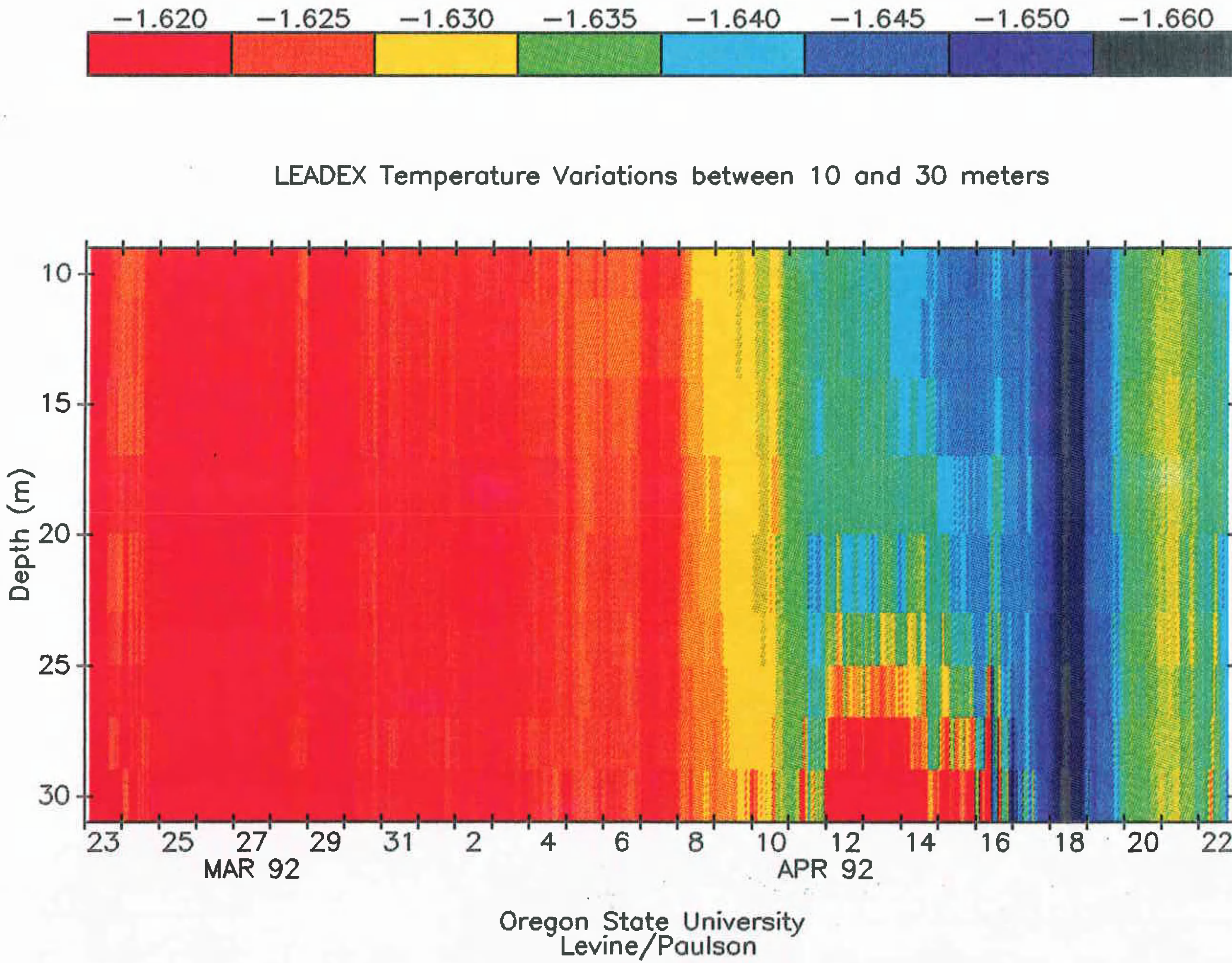
The following two plots are observations of temperature averaged 6 minutes:

- over the depth range from 10 to 30 m from 9 MTR sensors

- over the depth range from 10 to 60 m from 16 MTR sensors

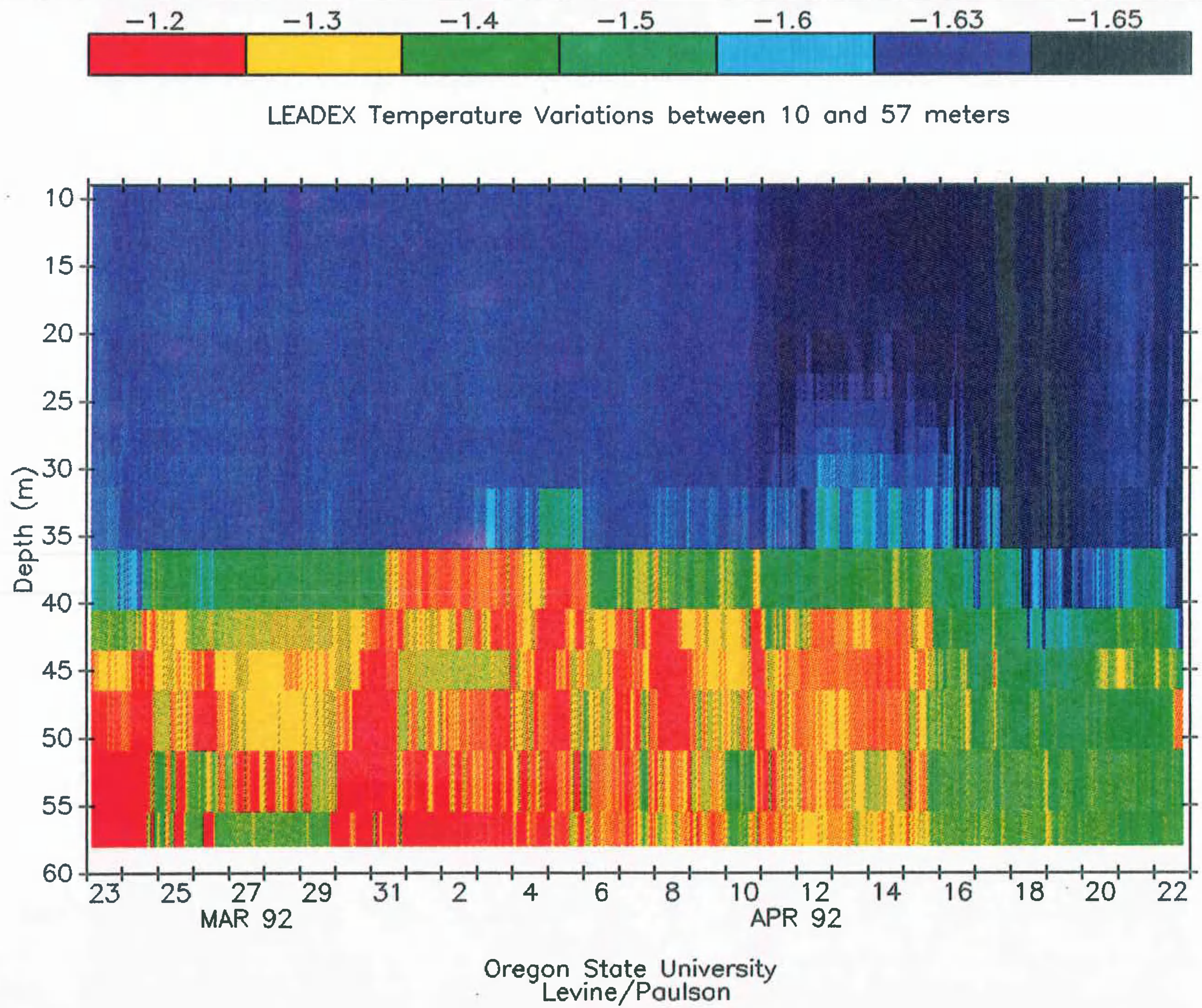
For plotting purposes small offsets were added to records in the upper 30 m to account for obvious calibration inconsistencies, as follows:

Depth, m	Offset, °C
10	.0000
12	-.0019
16	.0000
18	.0015
22	.0005
24	.0035
26	-.0025
28	-.0025
30	-.0004



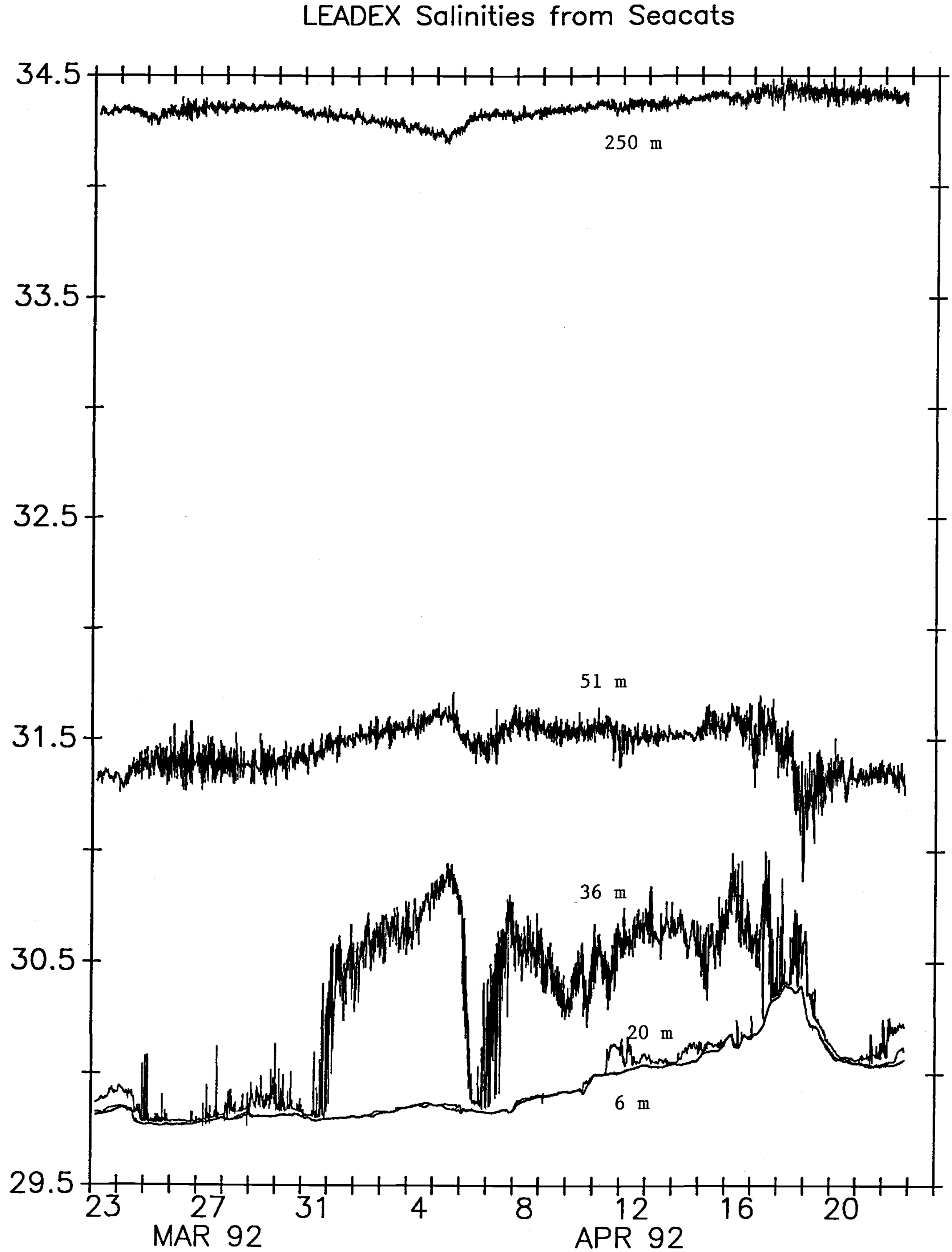
−1.620
−1.625
−1.630
−1.635
−1.640
−1.645
−1.650
−1.660
LEADEX Temperature Variations between 10 and 30 meters
Depth (m)
10
15
20
25
30
23
25
27
29
31
2
4
6
8
10
12
14
16
18
20
22
MAR 92
APR 92
Oregon State University
Levine/Paulson

23


-1.2 -1.3 -1.4 -1.5 -1.6 -1.63 -1.65
LEADEX Temperature Variations between 10 and 57 meters
Depth (m)
10 15 20 25 30 35 40 45 50 55 60
23 25 27 29 31 2 4 6 8 10 12 14 16 18 20 22
MAR 92
APR 92
Oregon State University
Levine/Paulson

SALINITY AND T-S OBSERVATIONS

The following 6 pages present salinity time series from Seacats at 5, 20, 36, 51, and 250 m and T-S scatter plots from the same instruments. The freezing point curve at a pressure of 3 db is shown were appropriate; the curve is the UNESCO standard (Millero, 1978) and claims an accuracy of $\pm 0.004°C$.


LEADEX Salinities from Seacats
34.5
33.5
32.5
31.5
30.5
29.5
250 m
51 m
36 m
20 m
6 m
23
27
31
4
8
12
16
20
MAR 92
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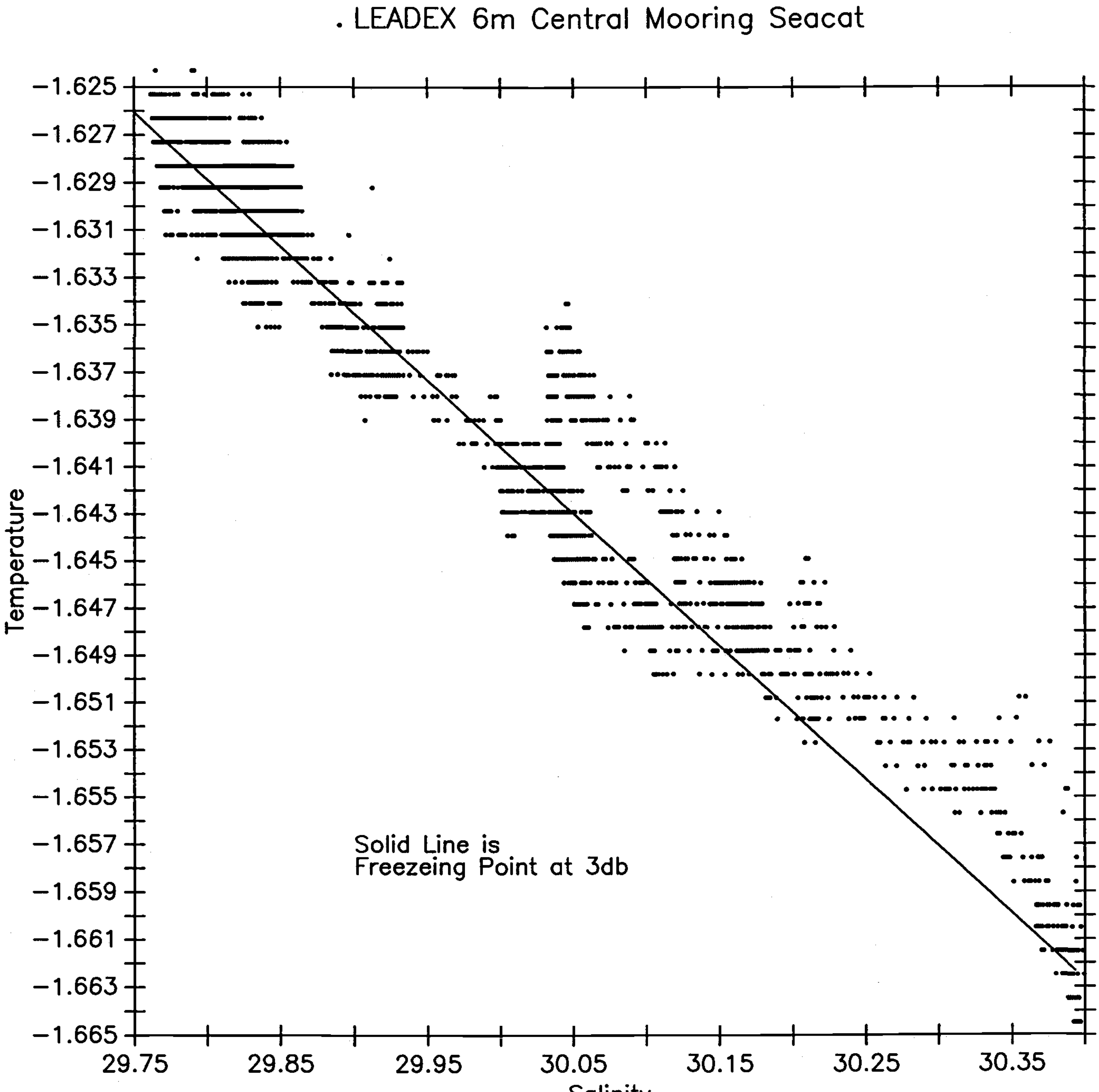
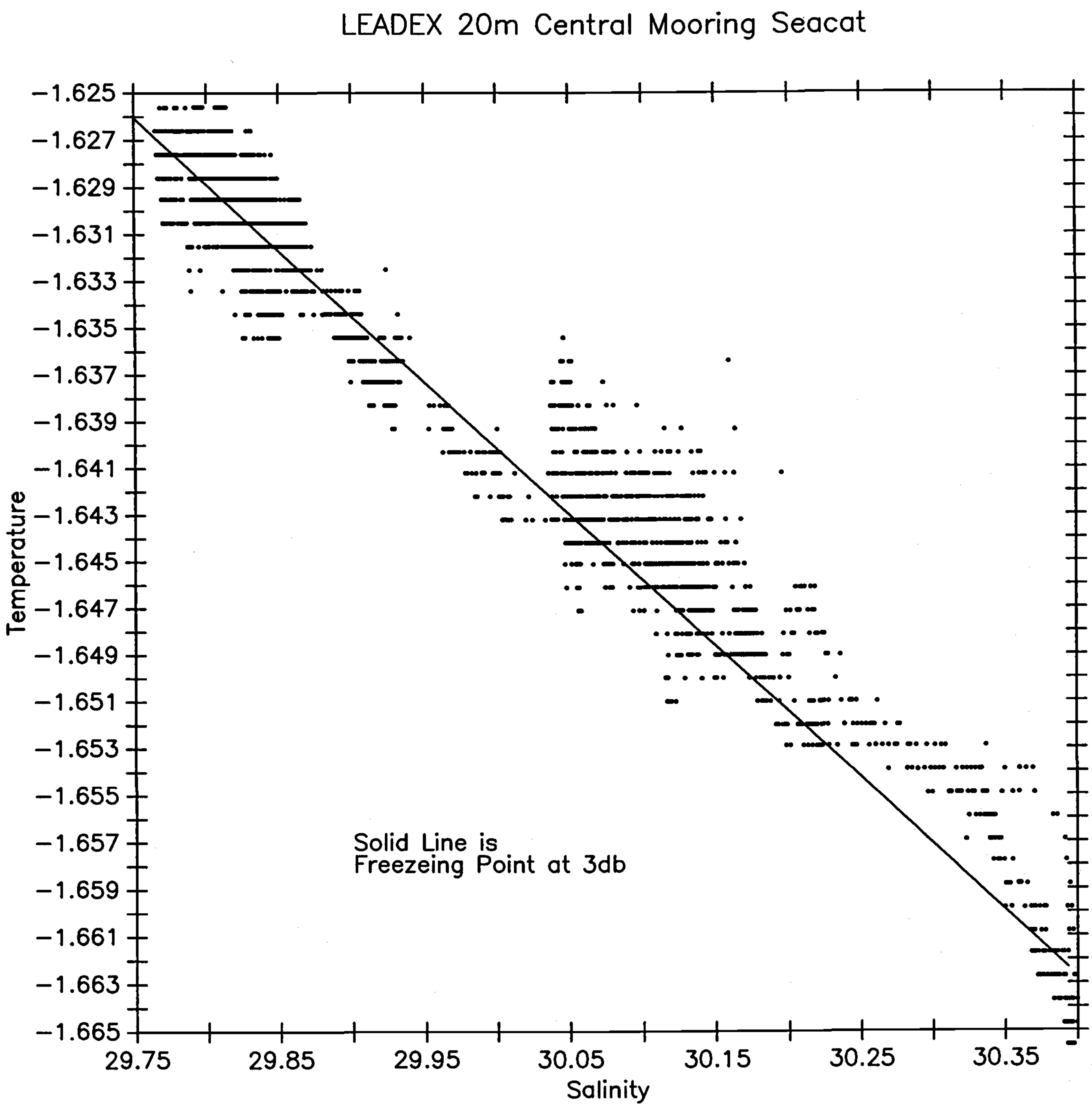
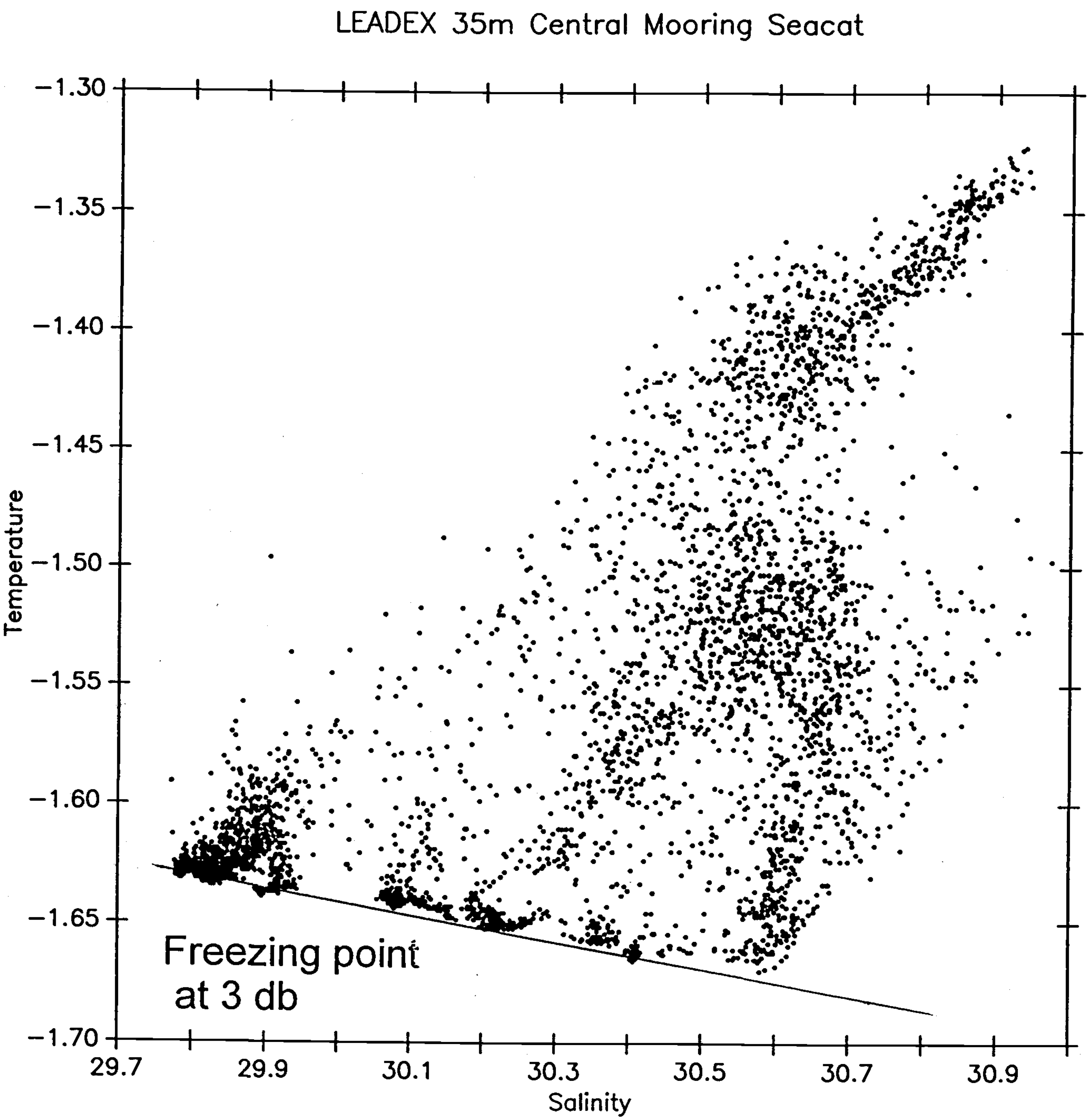
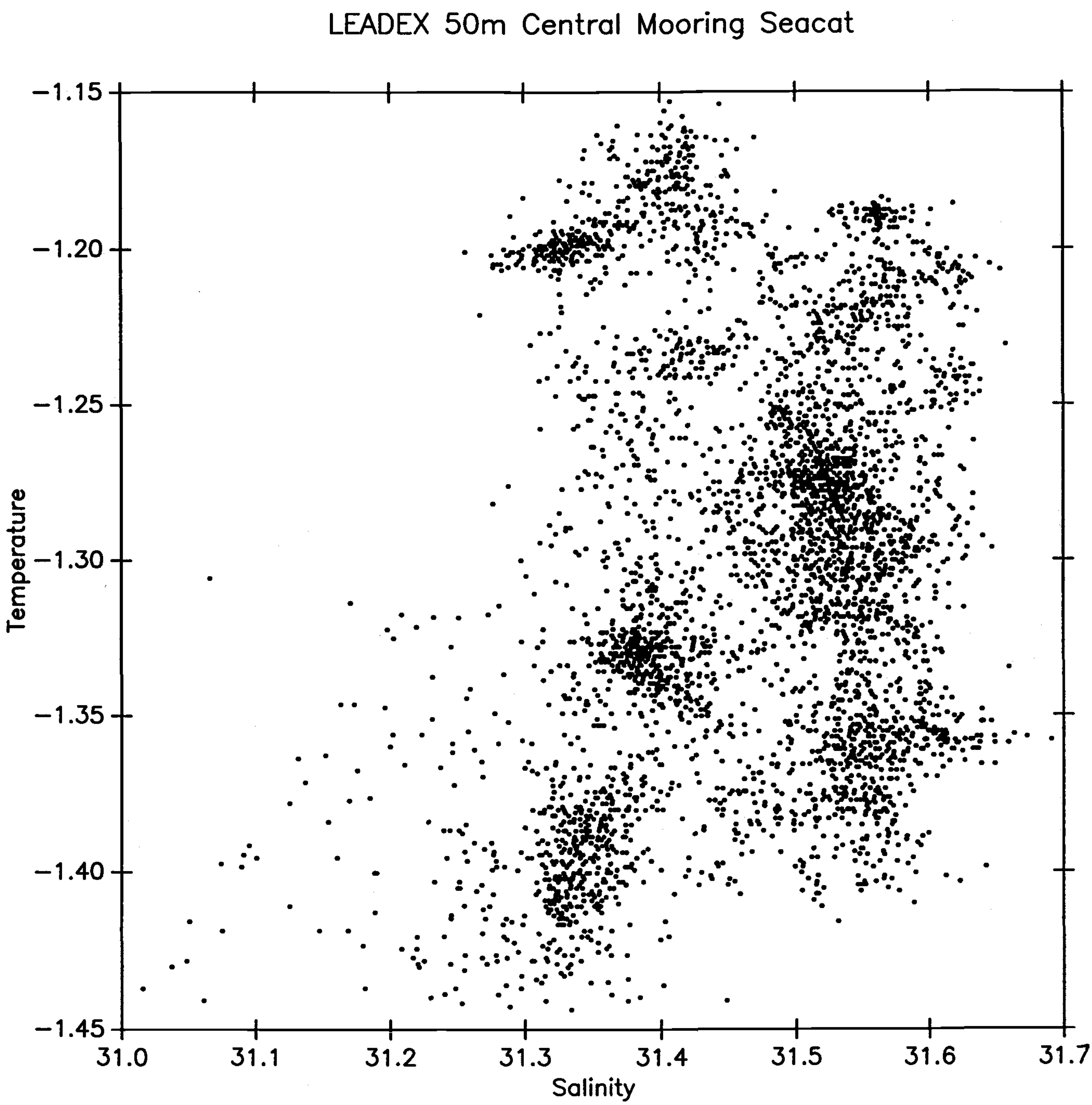
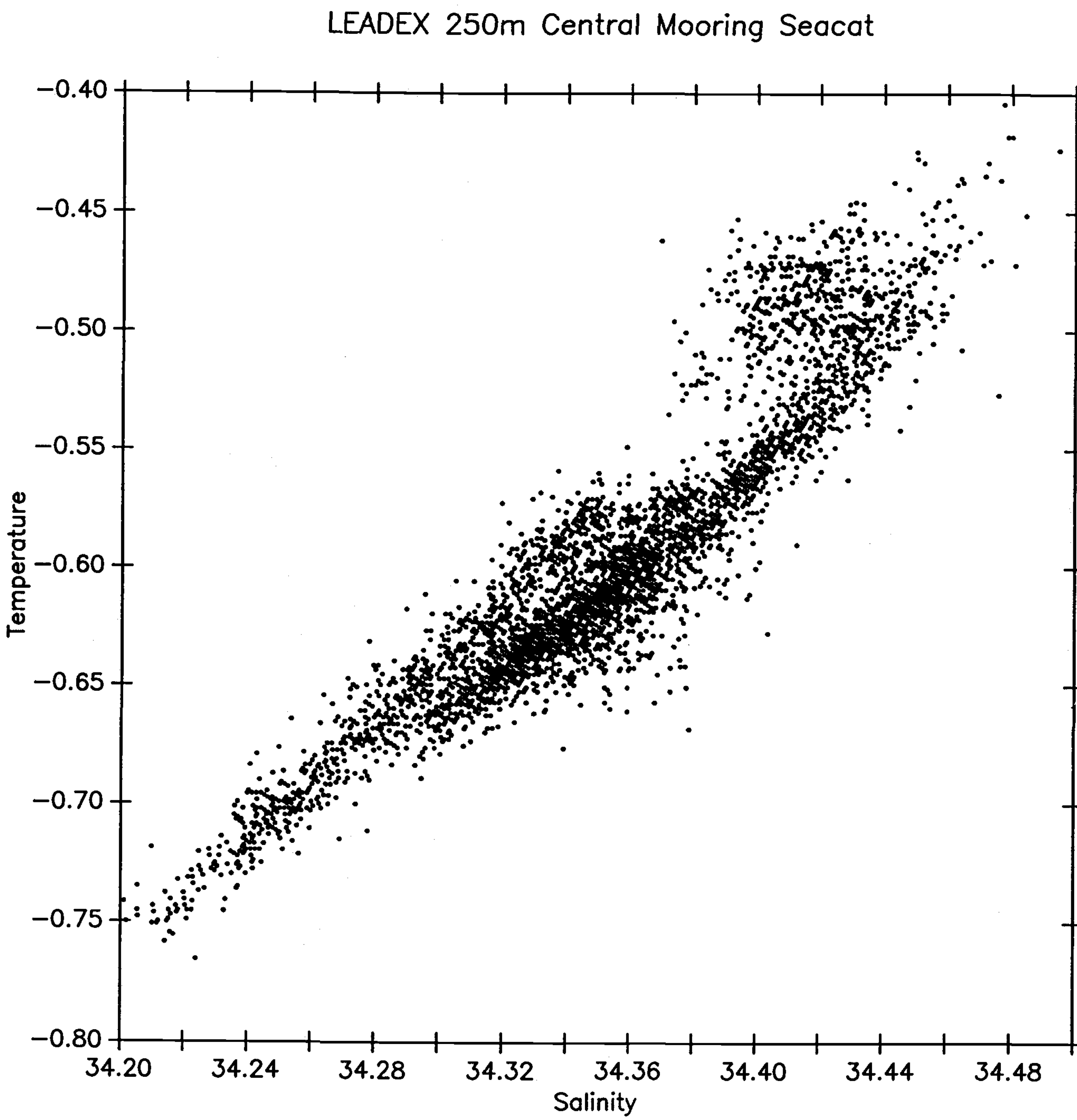

. LEADEX 6m Central Mooring Seacat
−1.625
−1.627
−1.629
−1.631
−1.633
−1.635
−1.637
−1.639
−1.641
−1.643
−1.645
−1.647
−1.649
−1.651
−1.653
−1.655
−1.657
−1.659
−1.661
−1.663
−1.665
Temperature
29.75
29.85
29.95
30.05
30.15
30.25
30.35
Salinity
Solid Line is
Freezeing Point at 3db


LEADEX 20m Central Mooring Seacat
Temperature
-1.625
-1.627
-1.629
-1.631
-1.633
-1.635
-1.637
-1.639
-1.641
-1.643
-1.645
-1.647
-1.649
-1.651
-1.653
-1.655
-1.657
-1.659
-1.661
-1.663
-1.665
Solid Line is
Freezeing Point at 3db
29.75
29.85
29.95
30.05
30.15
30.25
30.35
Salinity

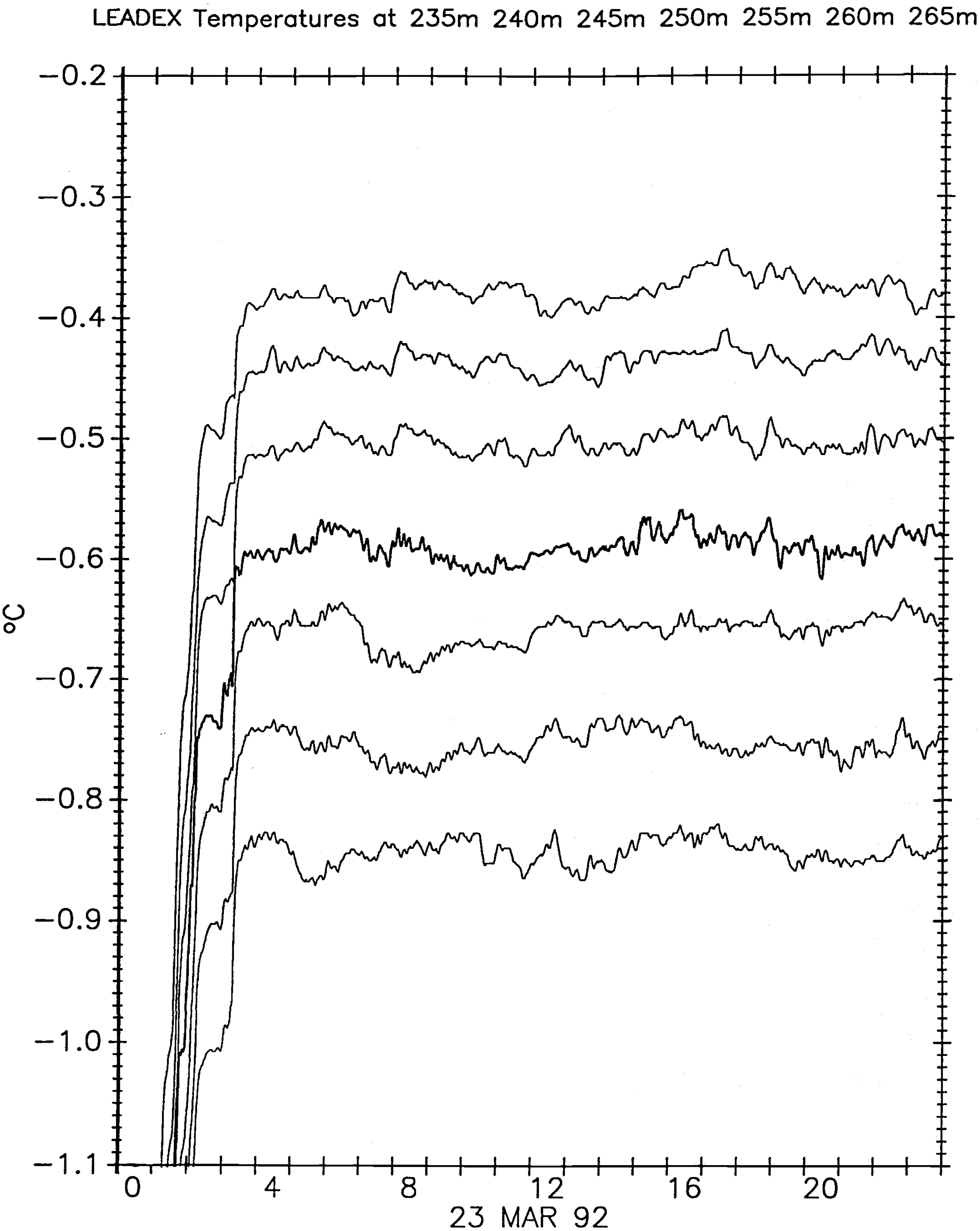

LEADEX 35m Central Mooring Seacat
Temperature
−1.30
−1.35
−1.40
−1.45
−1.50
−1.55
−1.60
−1.65
−1.70
29.7
29.9
30.1
30.3
30.5
30.7
30.9
Salinity
Freezing point
at 3 db


LEADEX 50m Central Mooring Seacat
Temperature
Salinity
−1.15
−1.20
−1.25
−1.30
−1.35
−1.40
−1.45
31.0
31.1
31.2
31.3
31.4
31.5
31.6
31.7

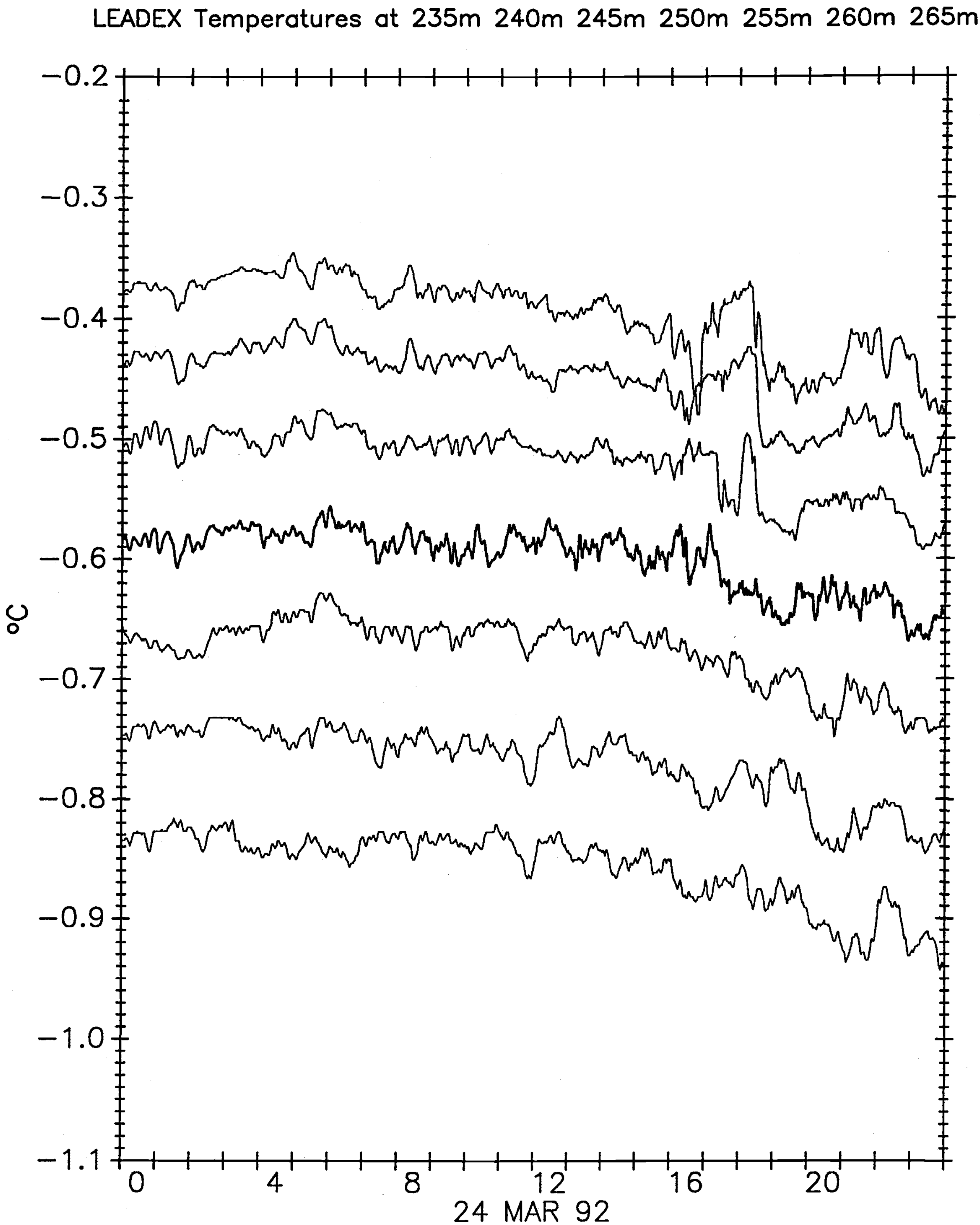

LEADEX 250m Central Mooring Seacat
Temperature
Salinity
-0.40
-0.45
-0.50
-0.55
-0.60
-0.65
-0.70
-0.75
-0.80
34.20
34.24
34.28
34.32
34.36
34.40
34.44
34.48

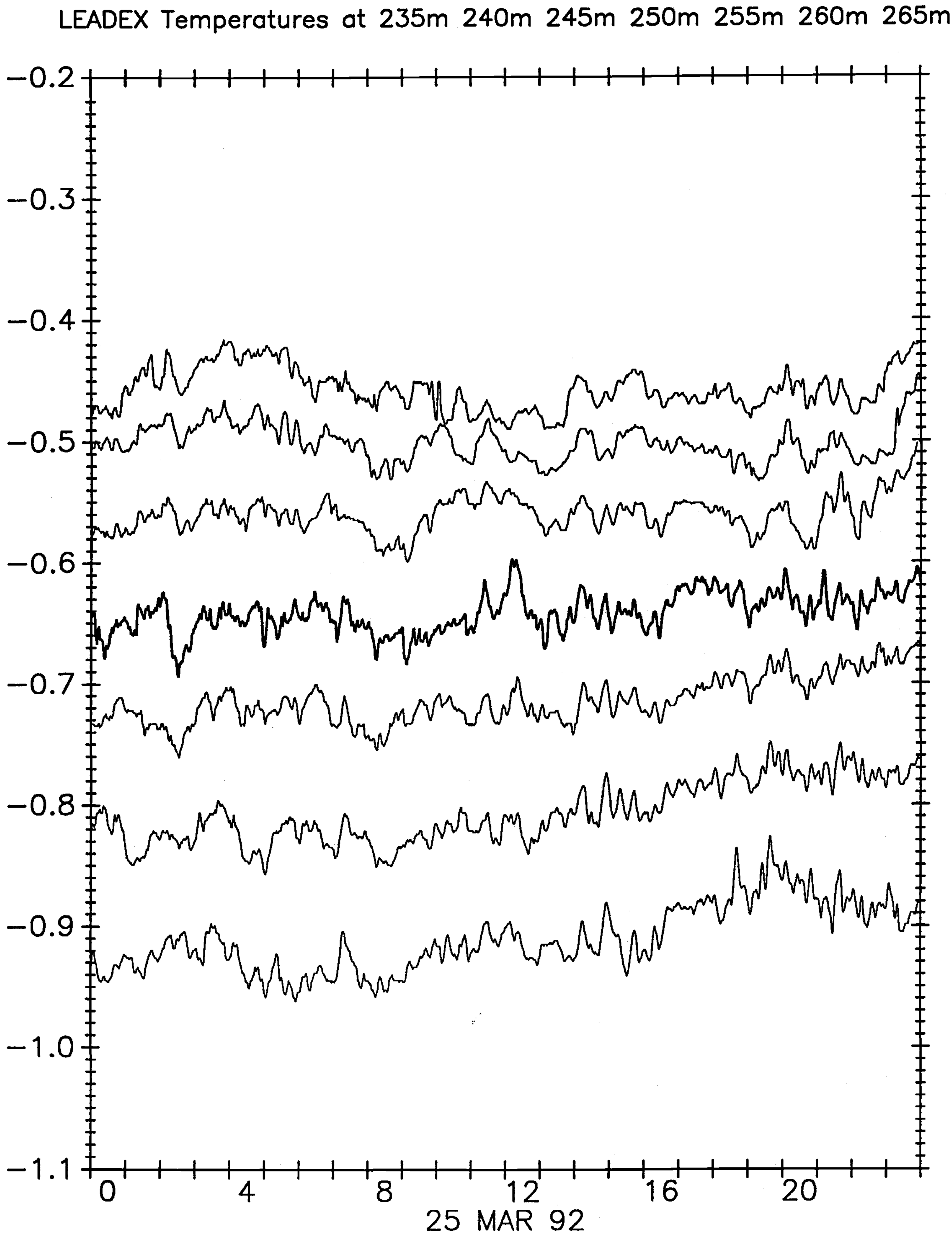
TIME SERIES of TEMPERATURE at CENTRAL MOORING: Cluster around 250 m

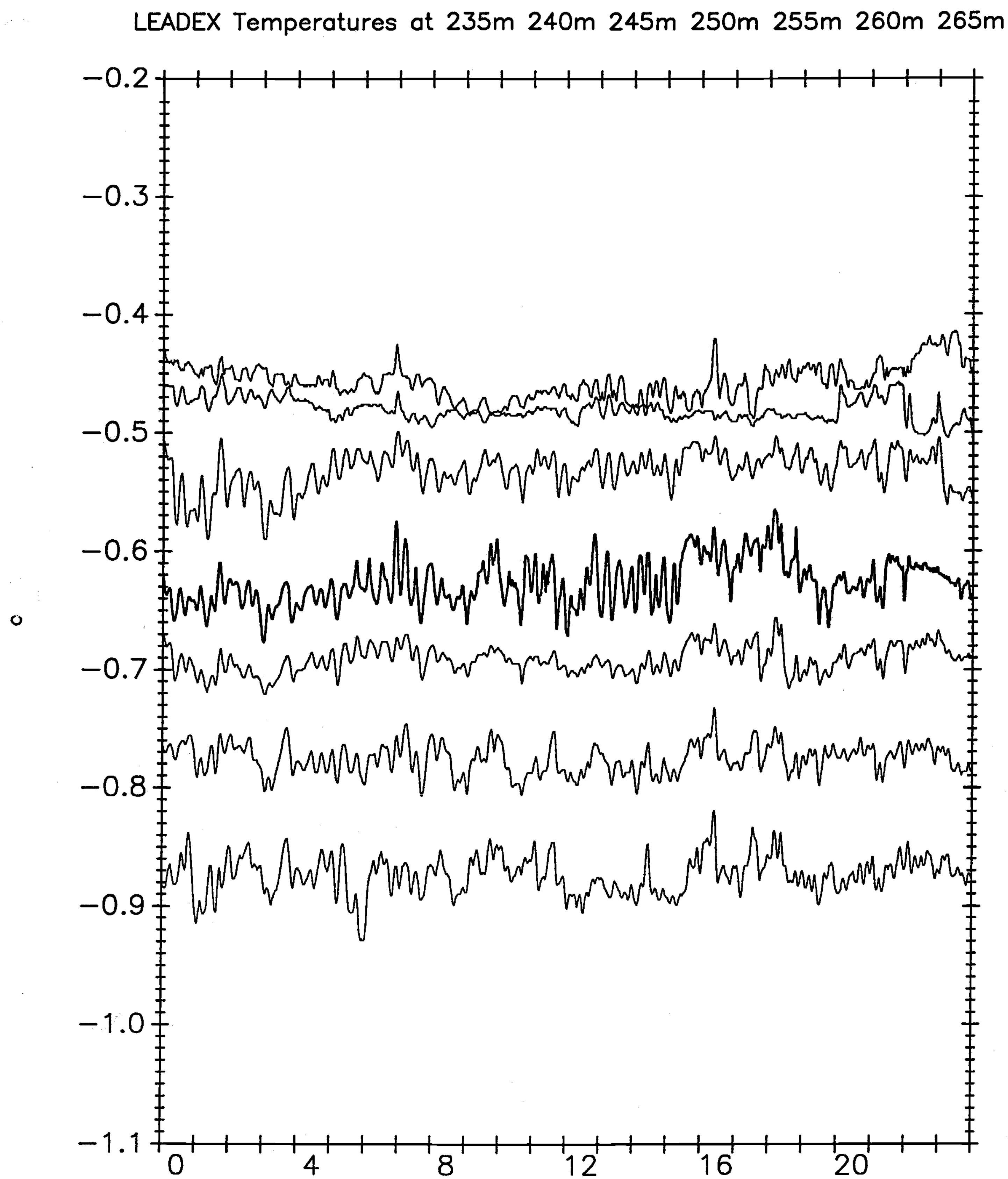
The following 31 pages are observations of temperature every 5 m from 235 to 265 m at the Central mooring. The instrument at 250 m is a Seacat (plotted bold); the 6 other instruments are MTRs. Sampling rate is 1 minute.

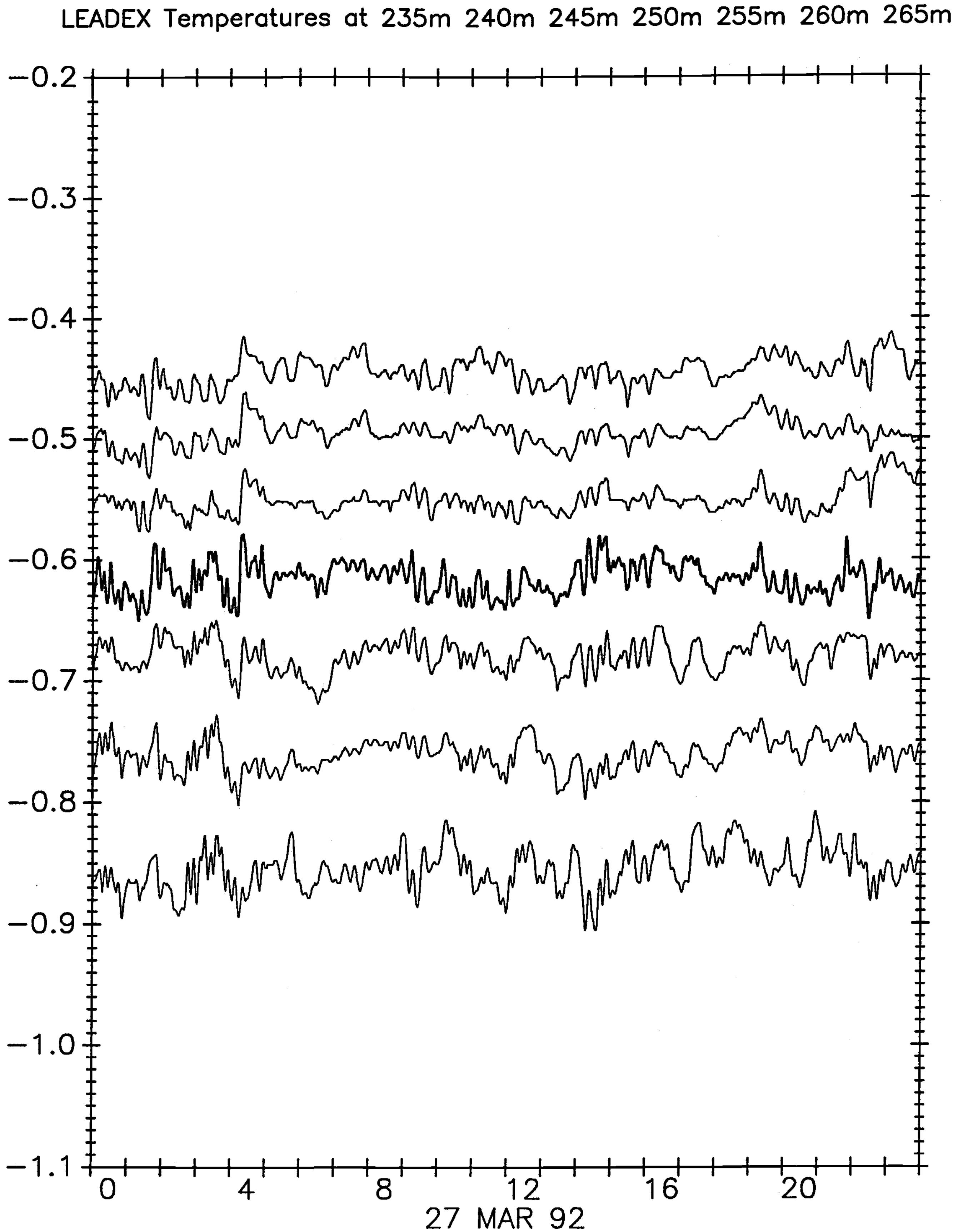


LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
°C
0
4
8
12
16
20
23 MAR 92

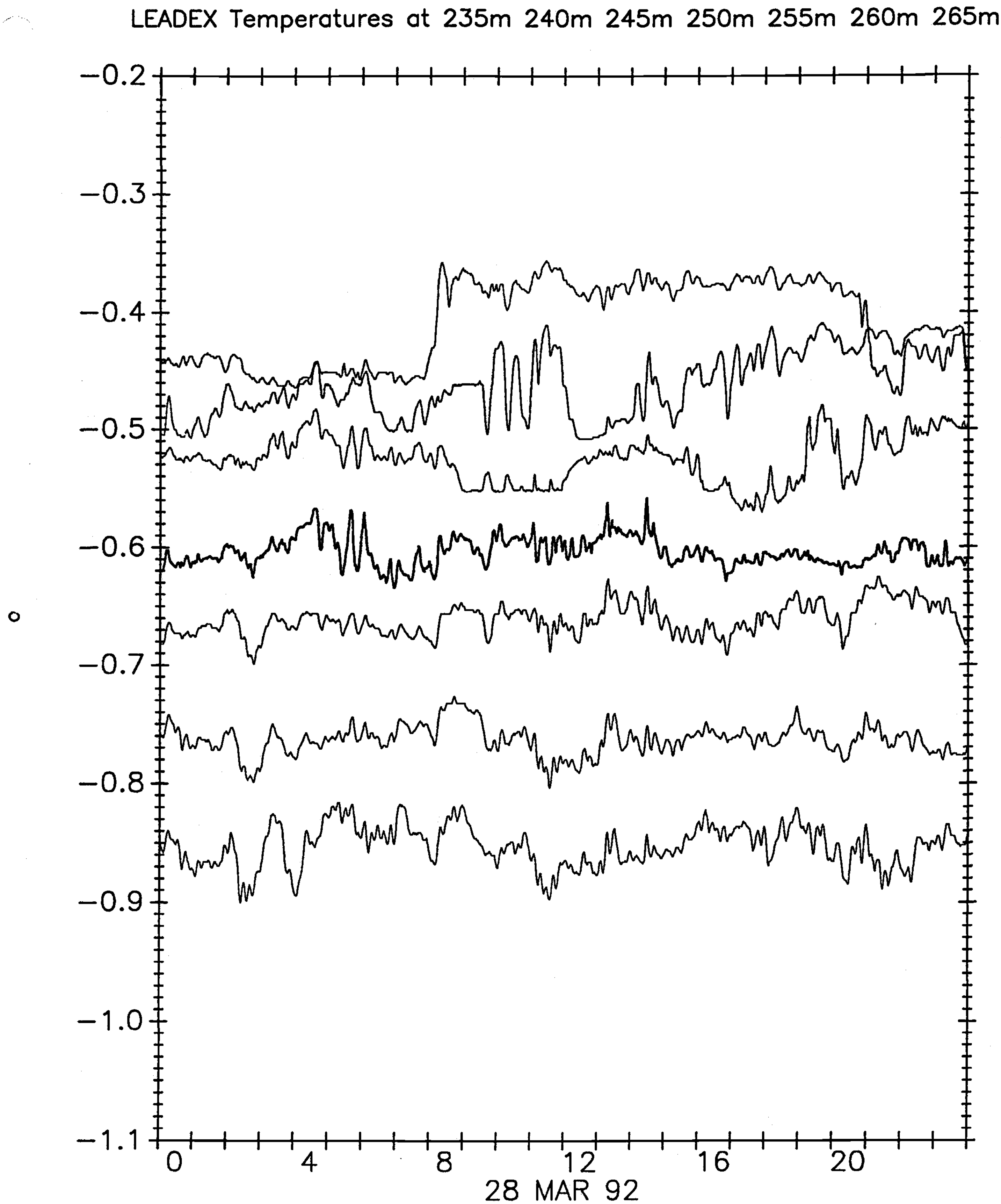

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
°C
0
4
8
12
16
20
24 MAR 92

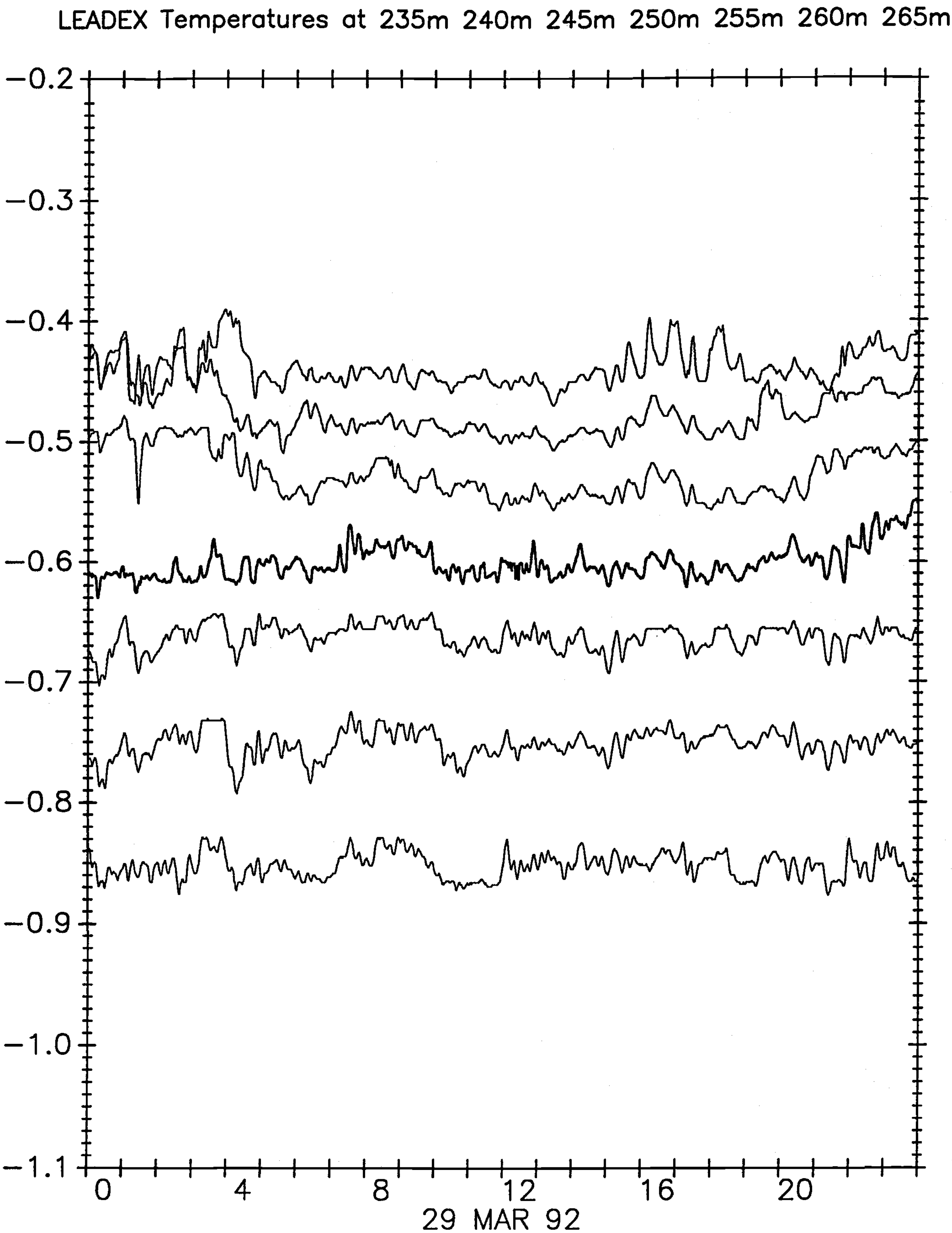

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
0
4
8
12
16
20
25 MAR 92

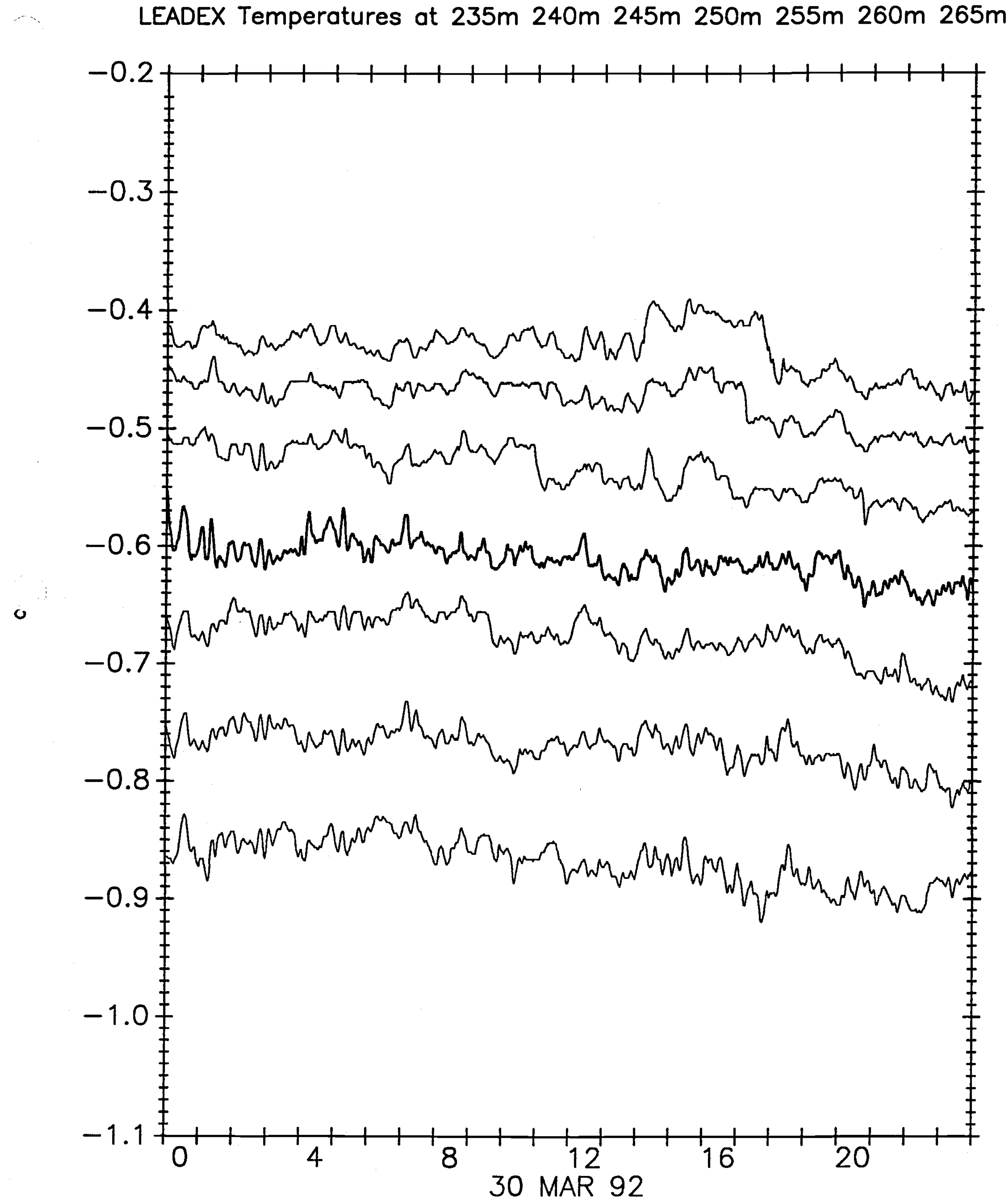

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
C
0
4
8
12
16
20
26 MAR 92



LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
0
4
8
12
16
20
27 MAR 92

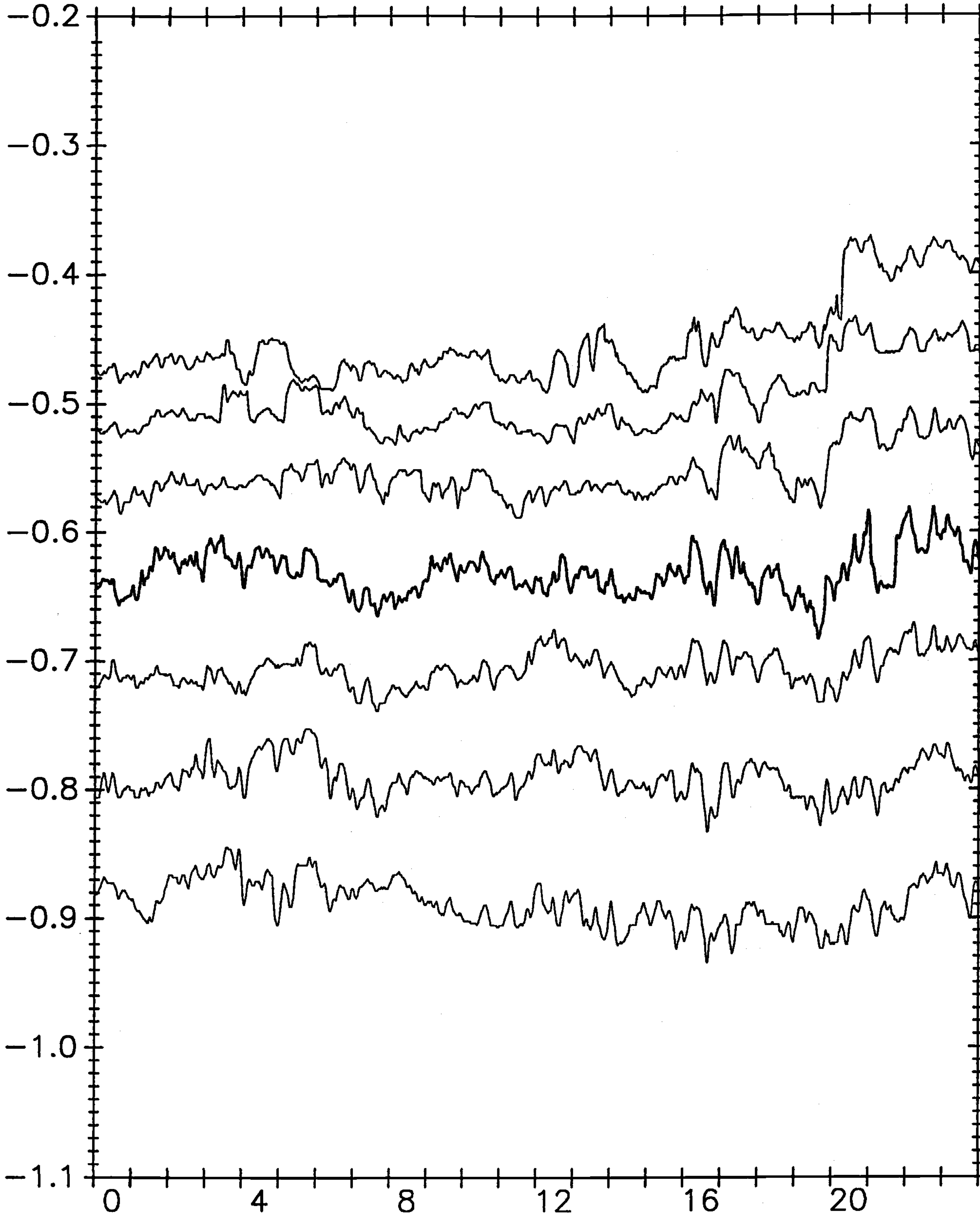

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
0
4
8
12
16
20
28 MAR 92
o

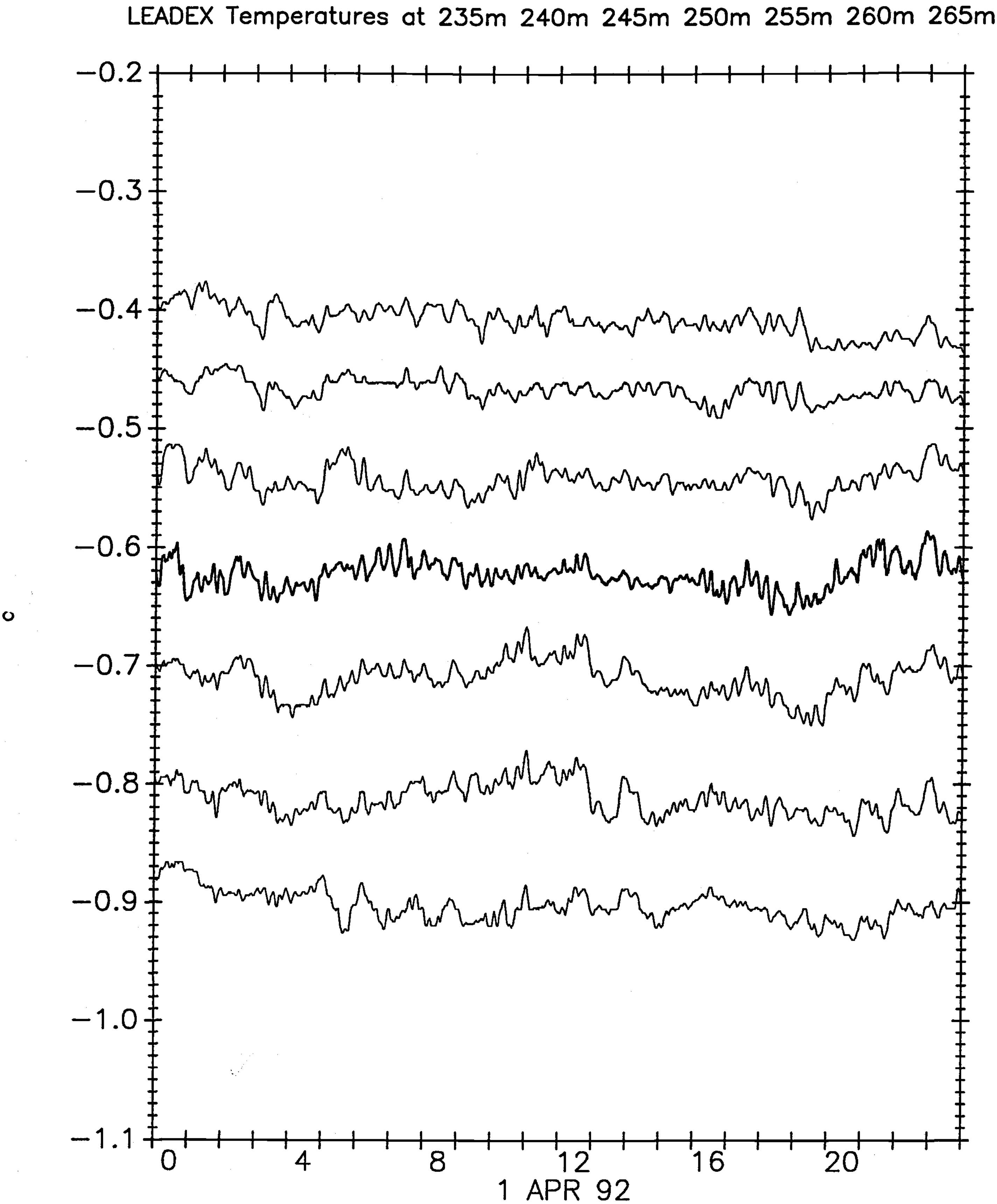

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
0
4
8
12
16
20
29 MAR 92

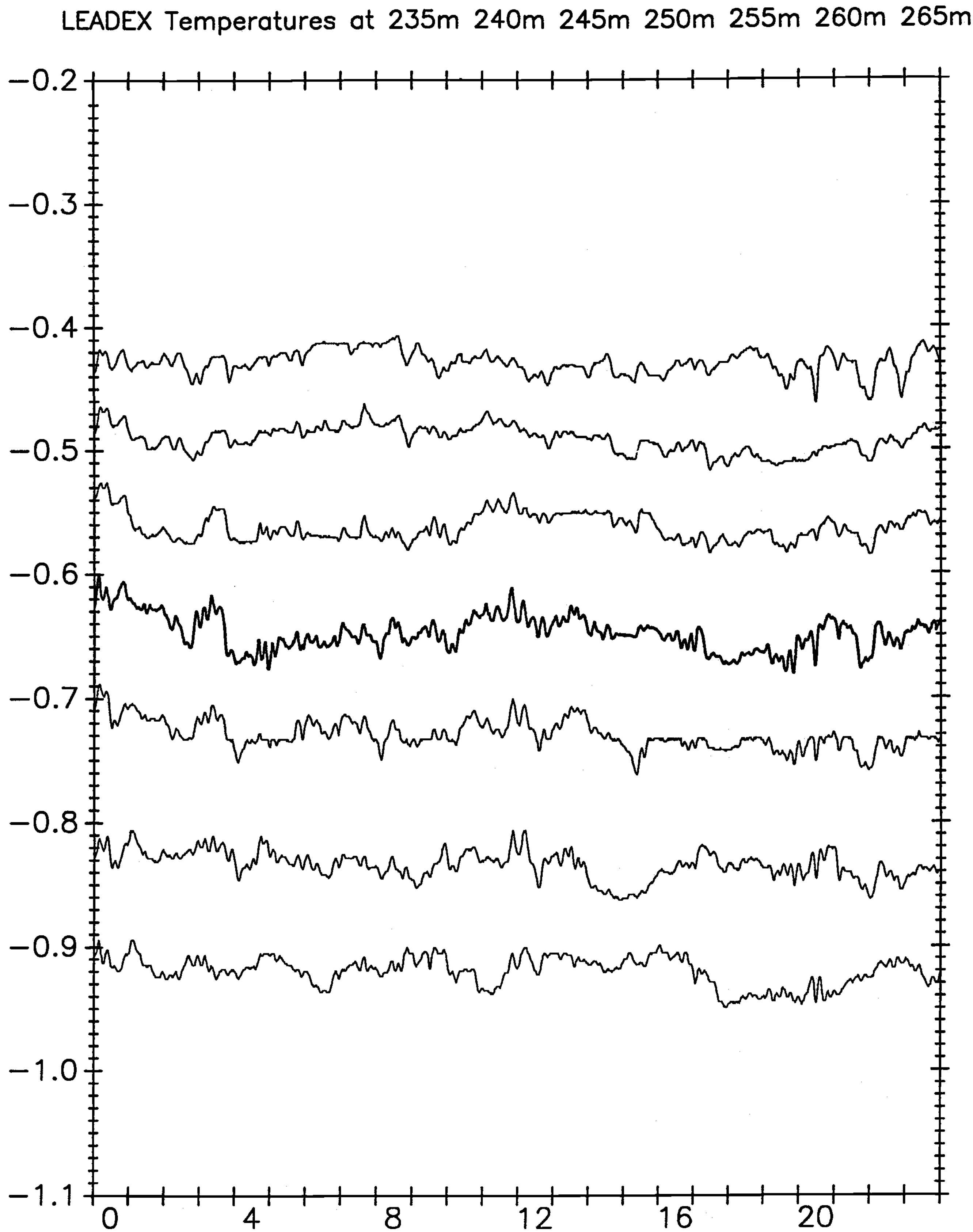


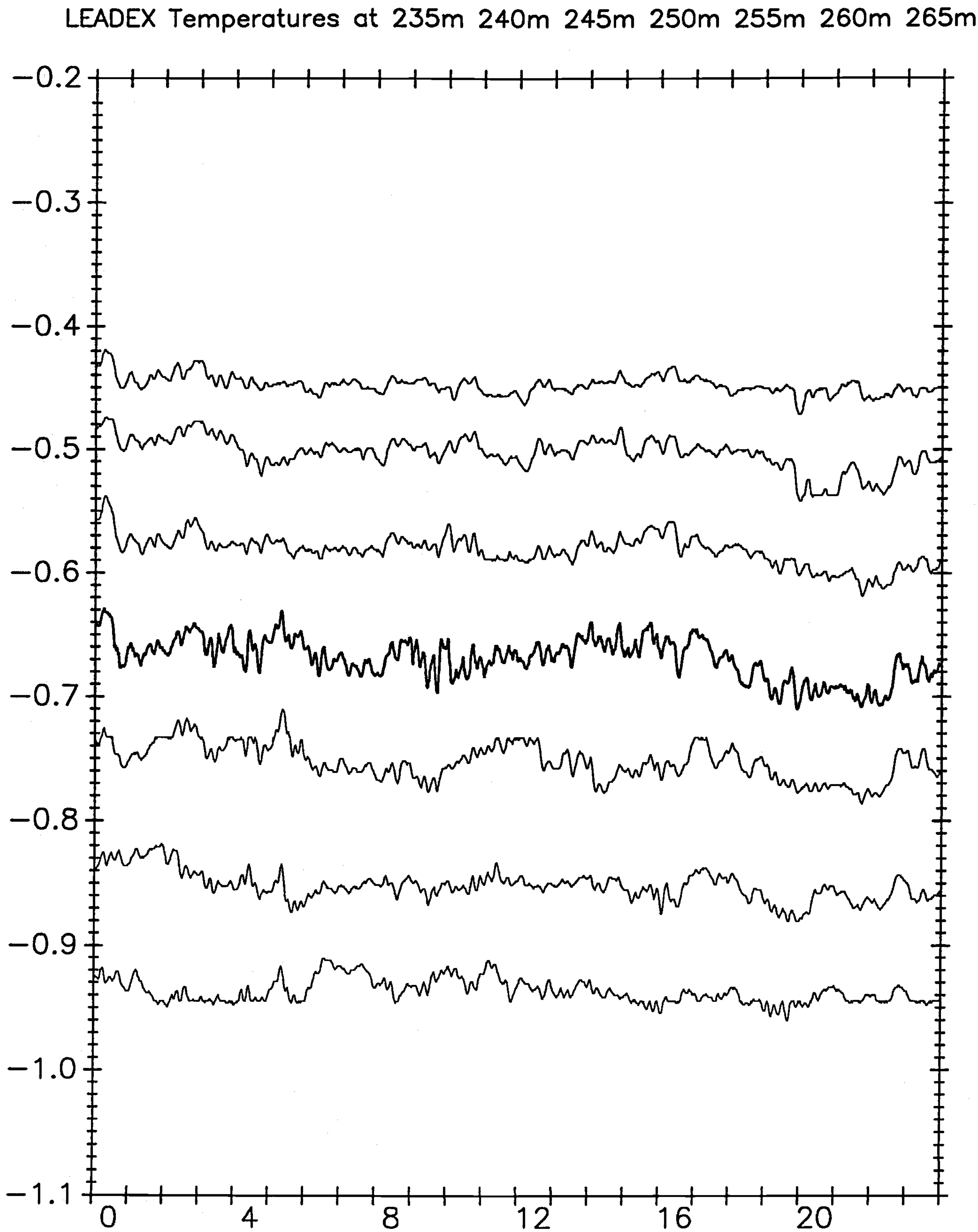
LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
c
0
4
8
12
16
20
30 MAR 92

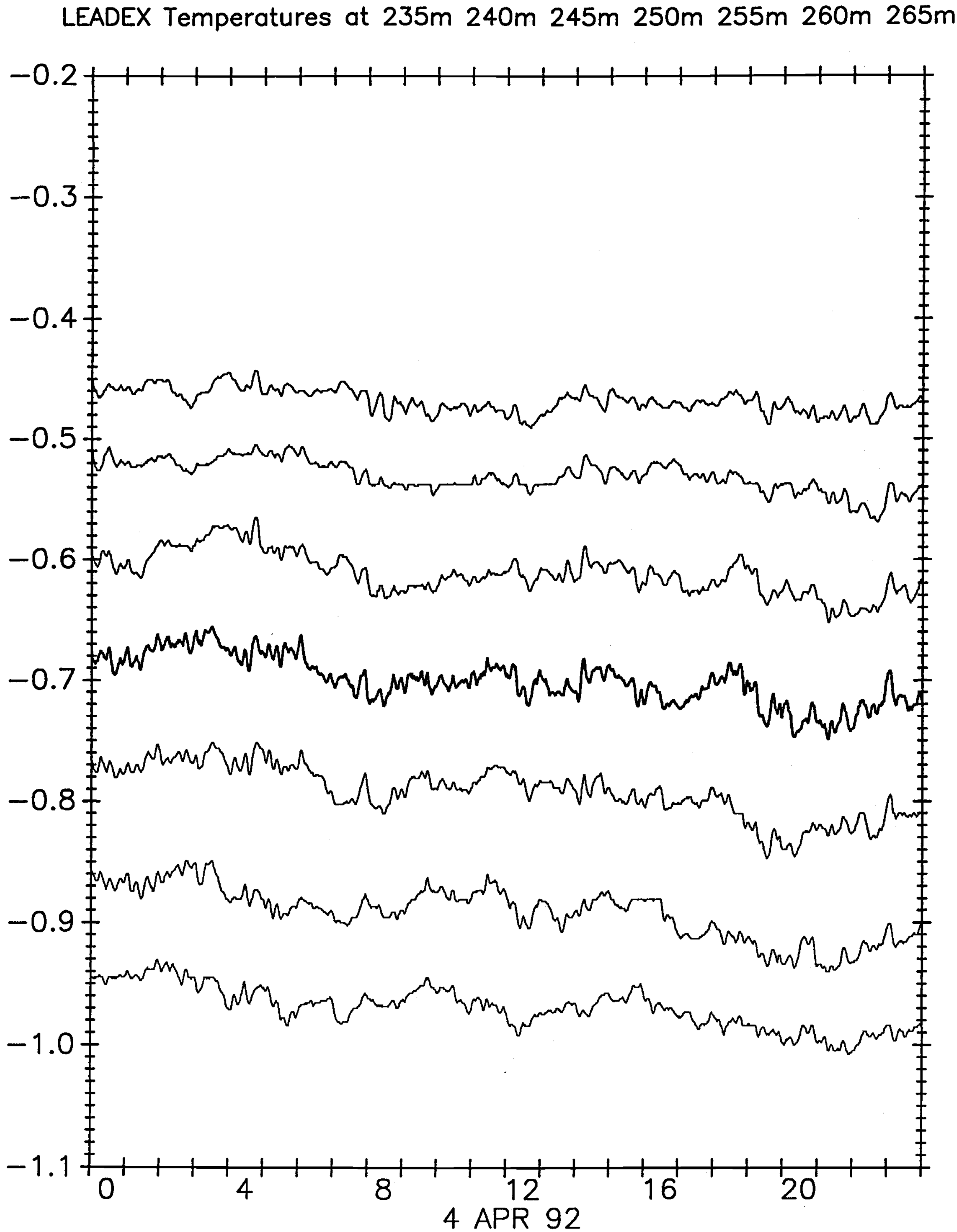
LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m

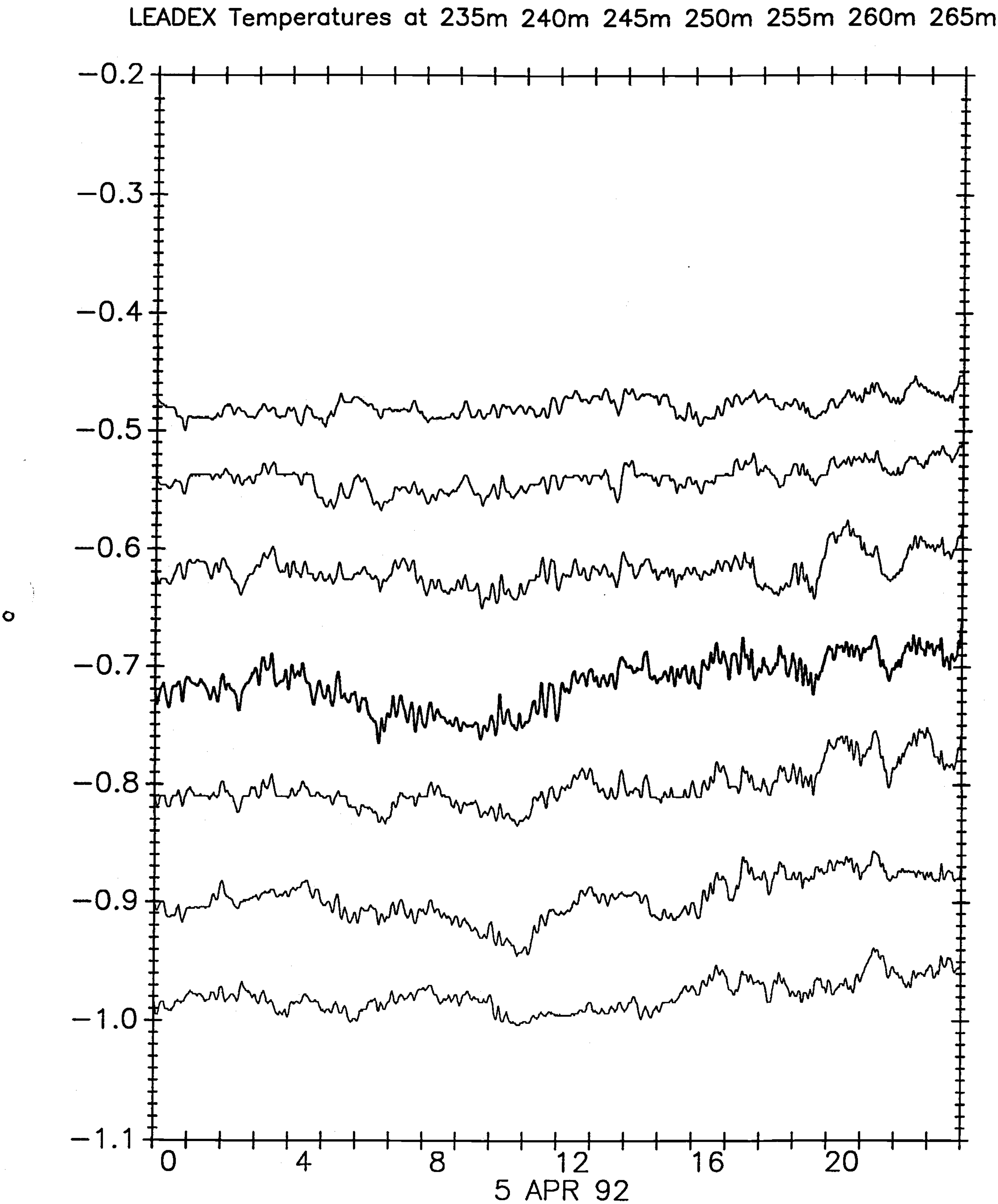



LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
c
0
4
8
12
16
20
1 APR 92

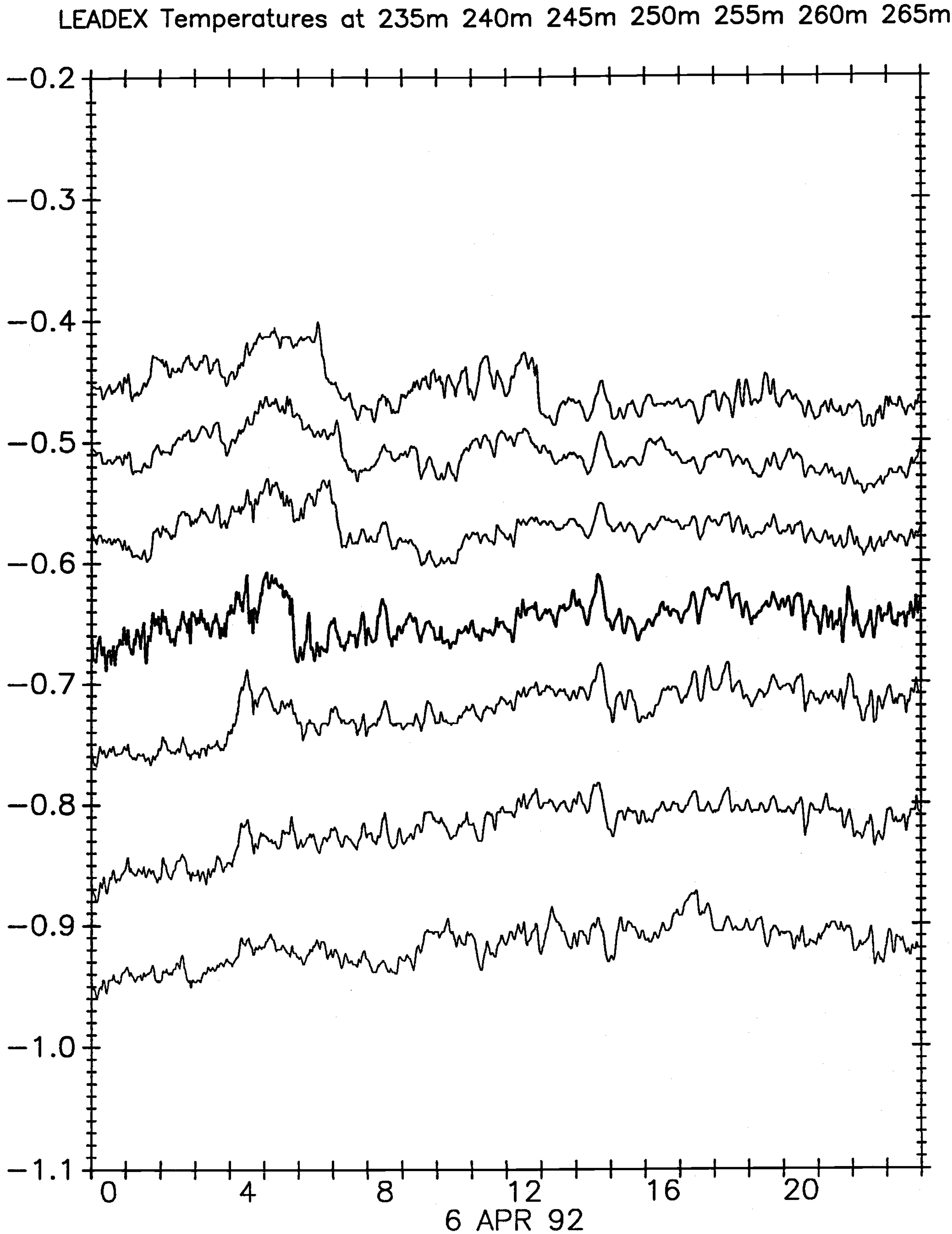

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
0
4
8
12
16
20
2 APR 92

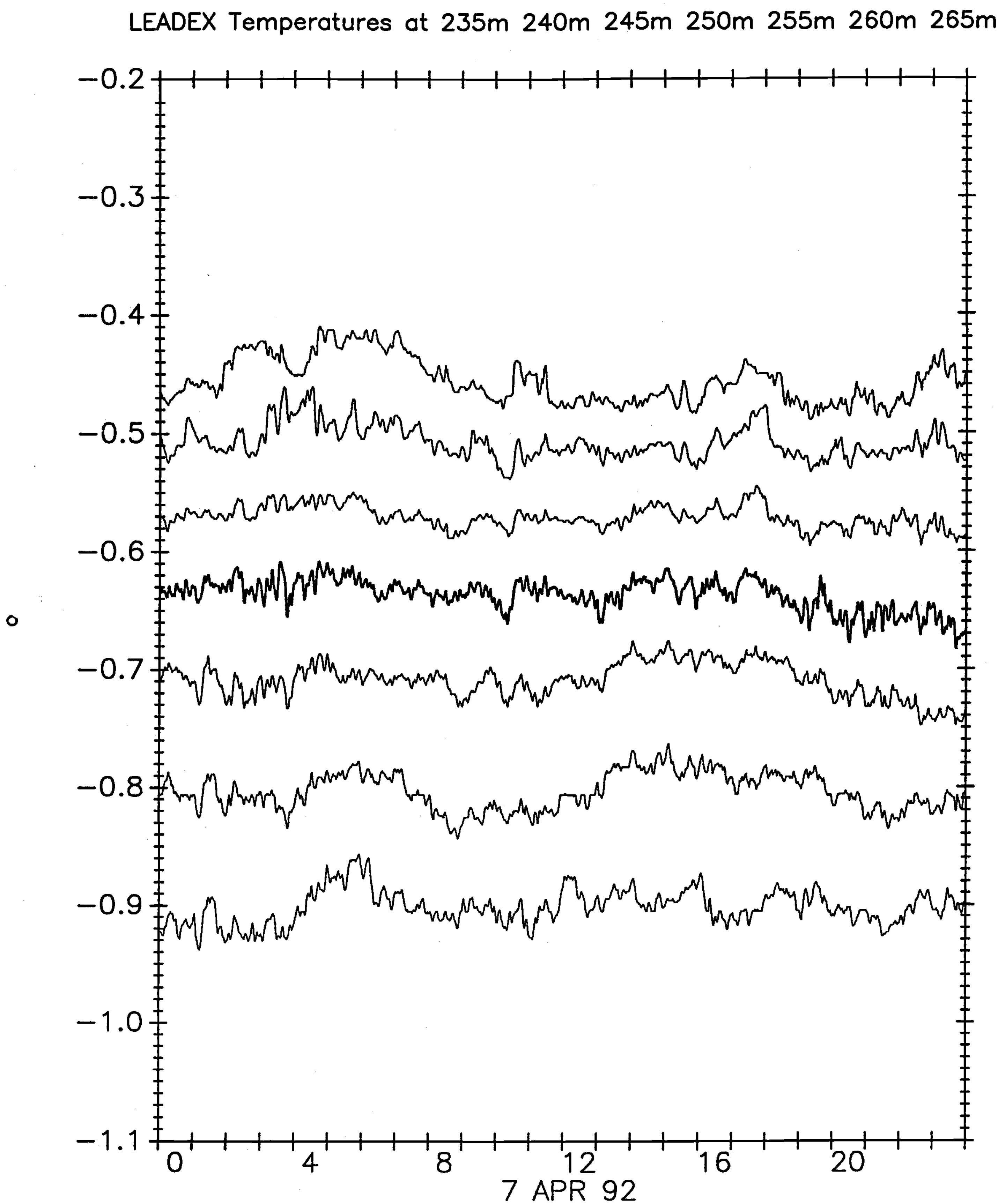

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
c
0
4
8
12
16
20
3 APR 92

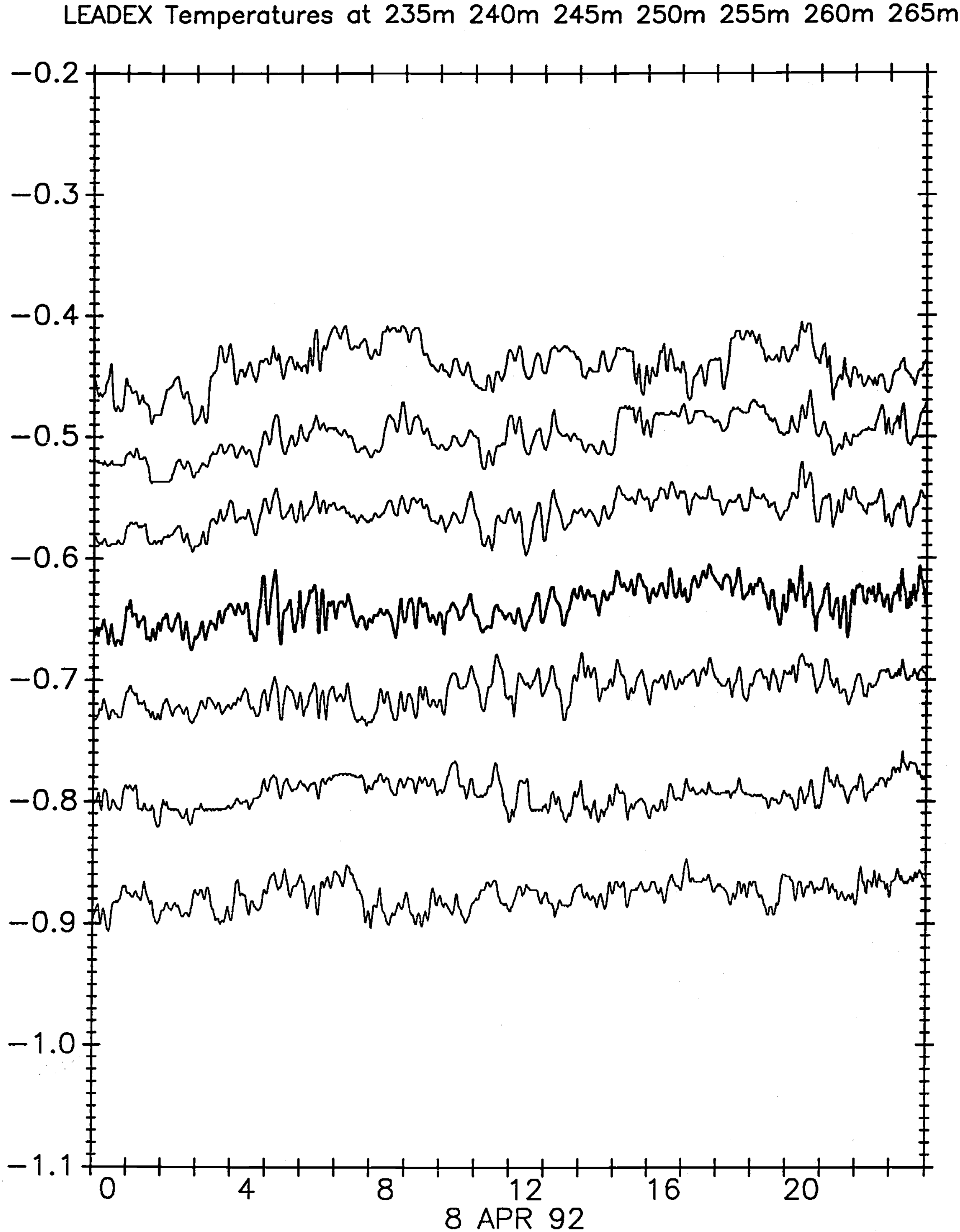

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
0
4
8
12
16
20
4 APR 92

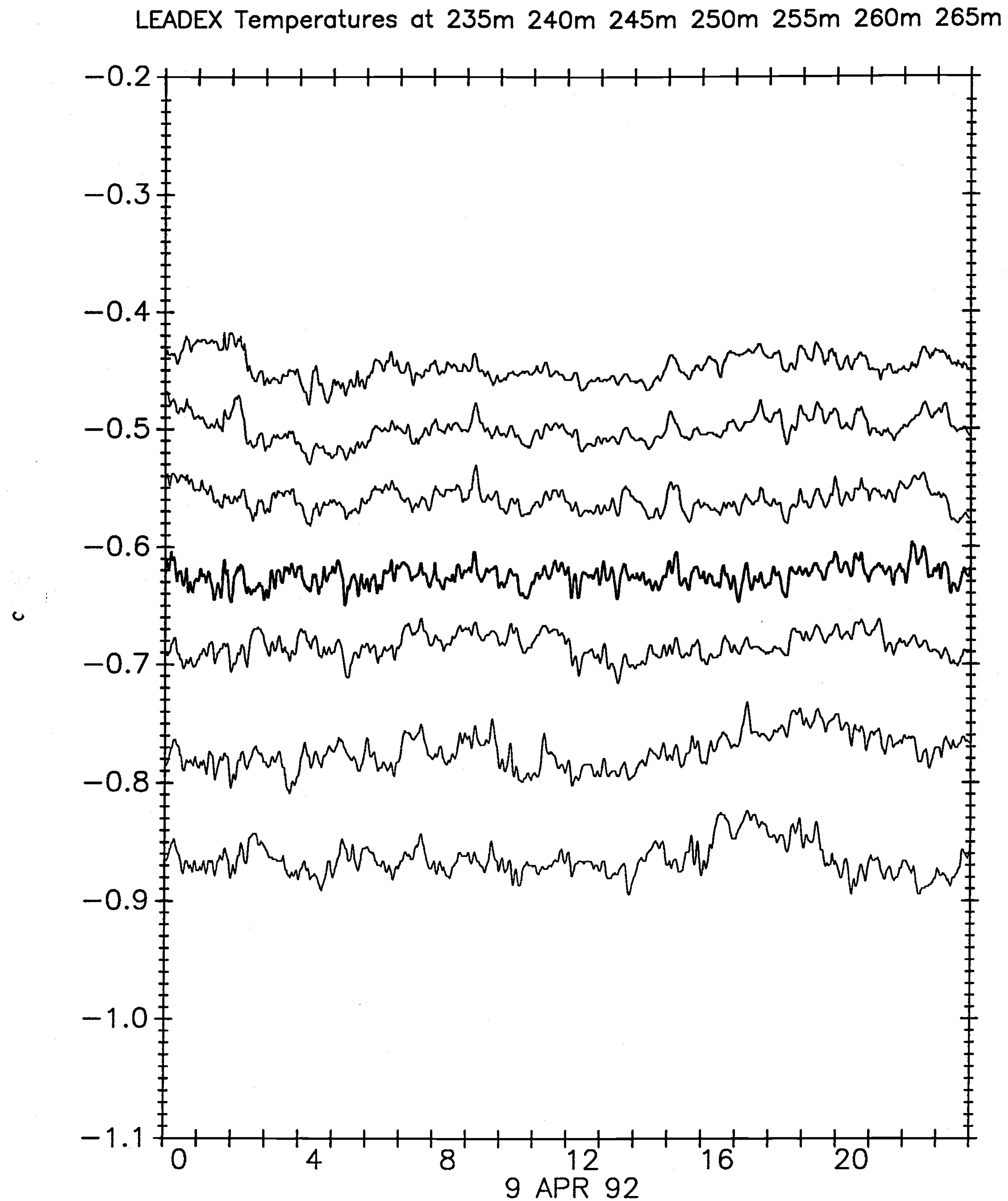


LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
o
0
4
8
12
16
20
5 APR 92

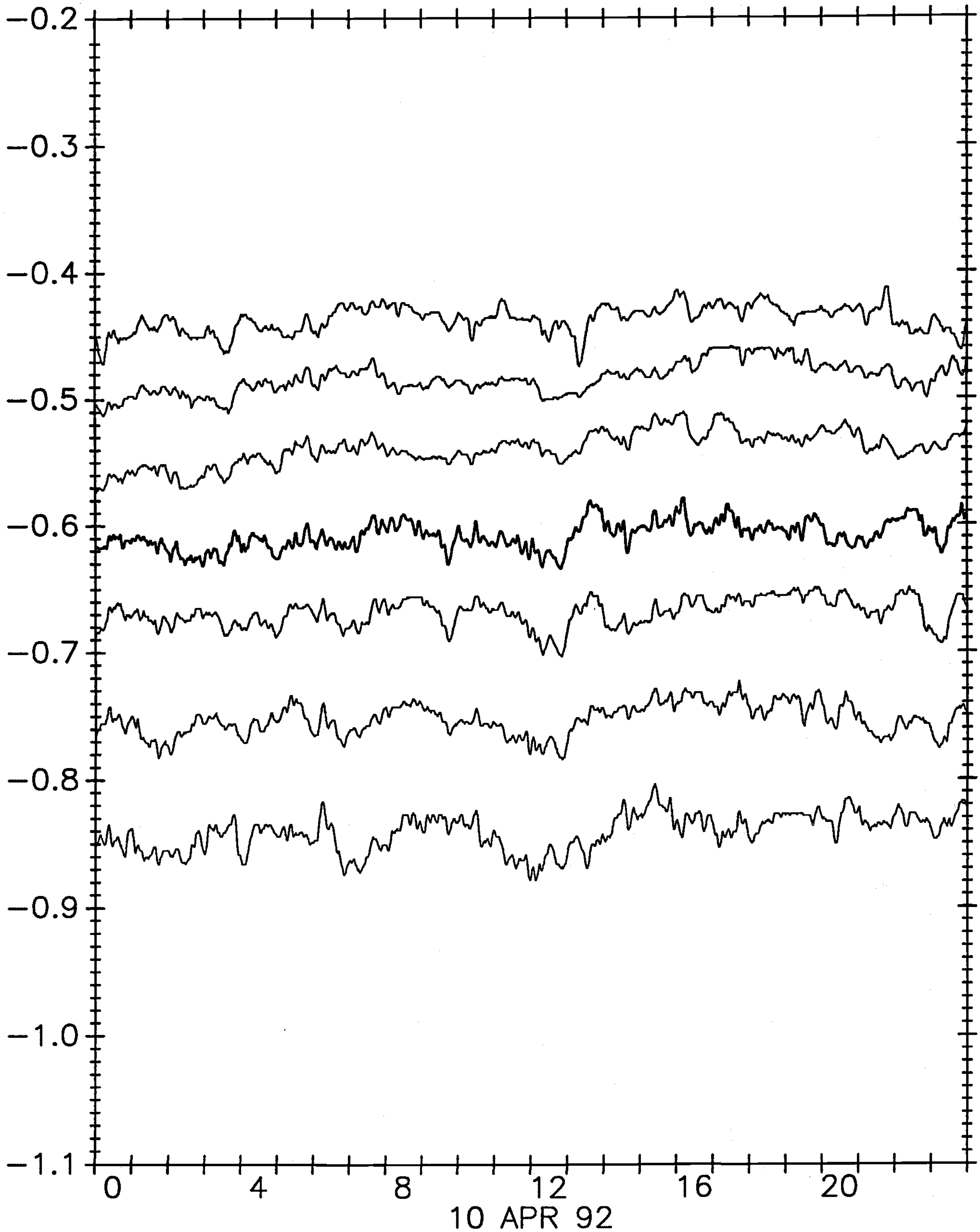

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
0
4
8
12
16
20
6 APR 92


LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
o
0
4
8
12
16
20
7 APR 92

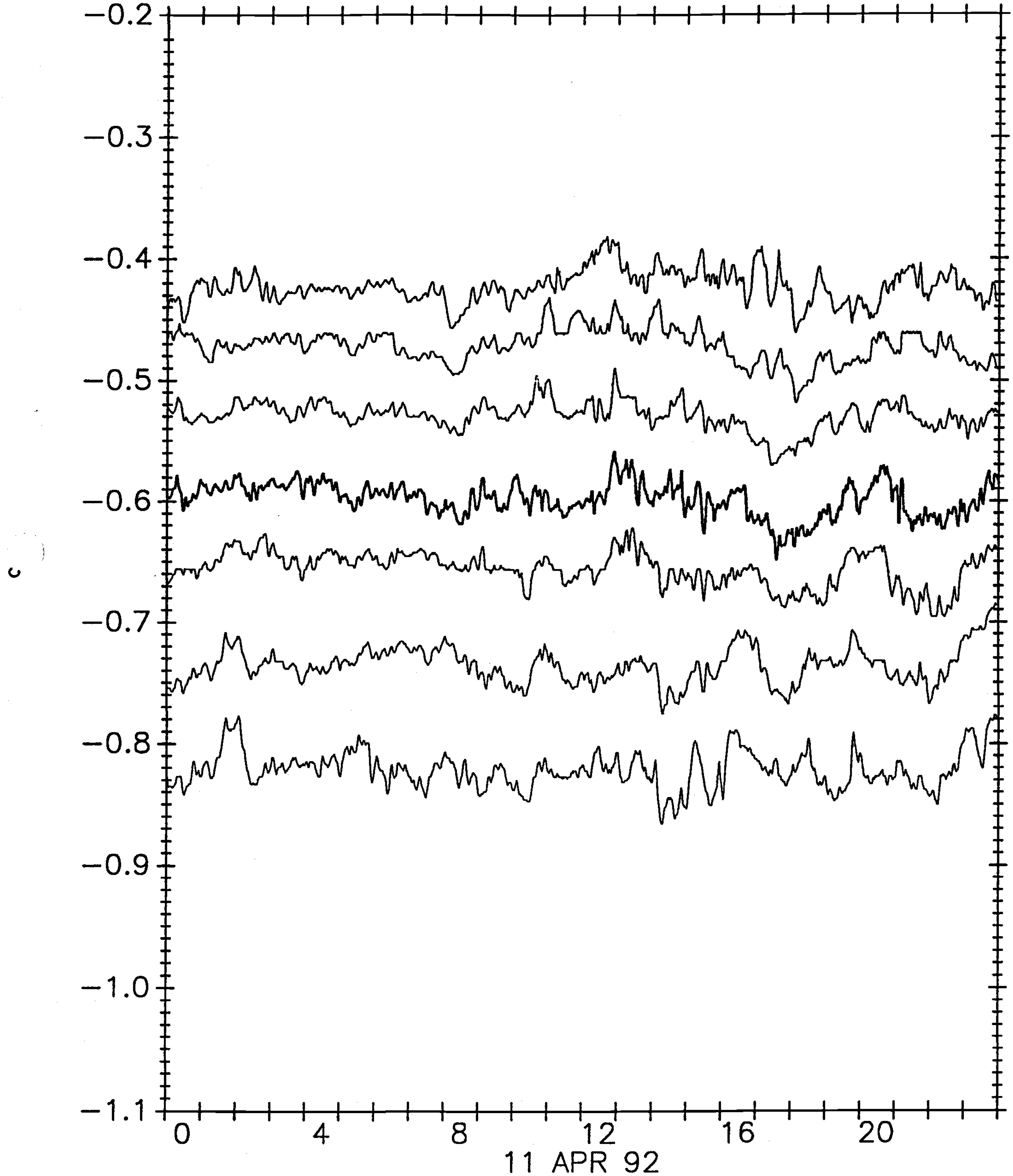

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
0
4
8
12
16
20
8 APR 92

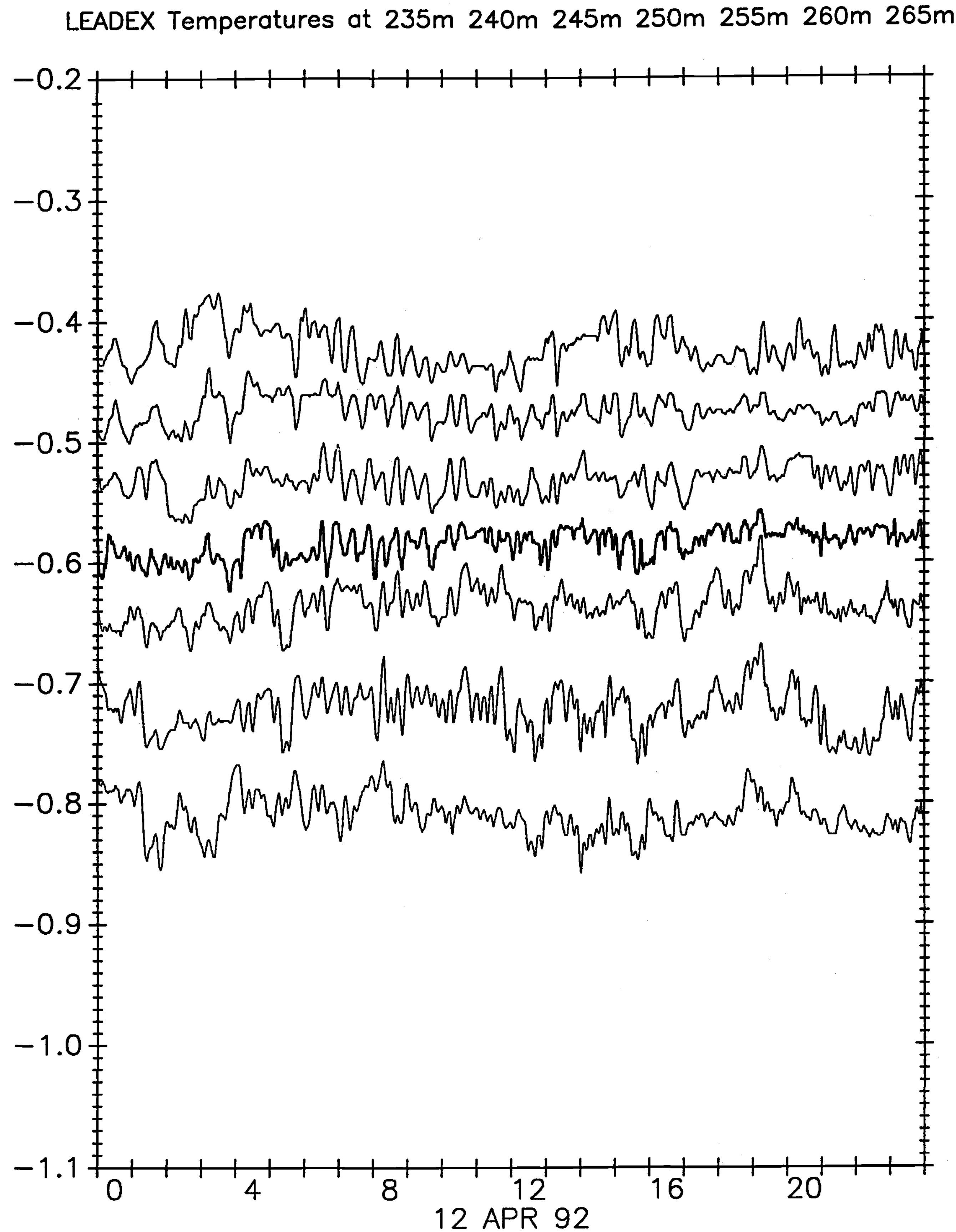

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
c
0
4
8
12
16
20
9 APR 92

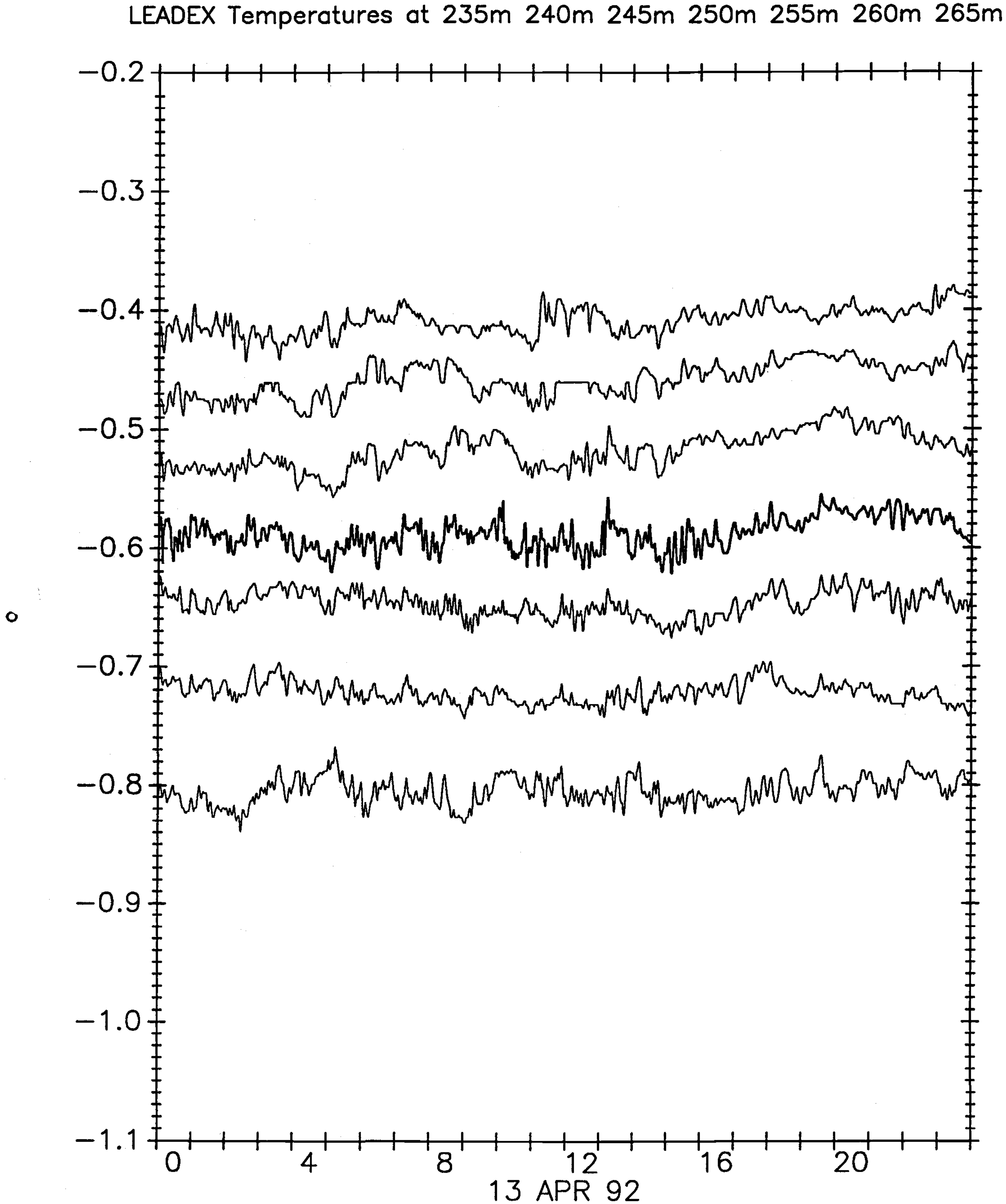
LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m

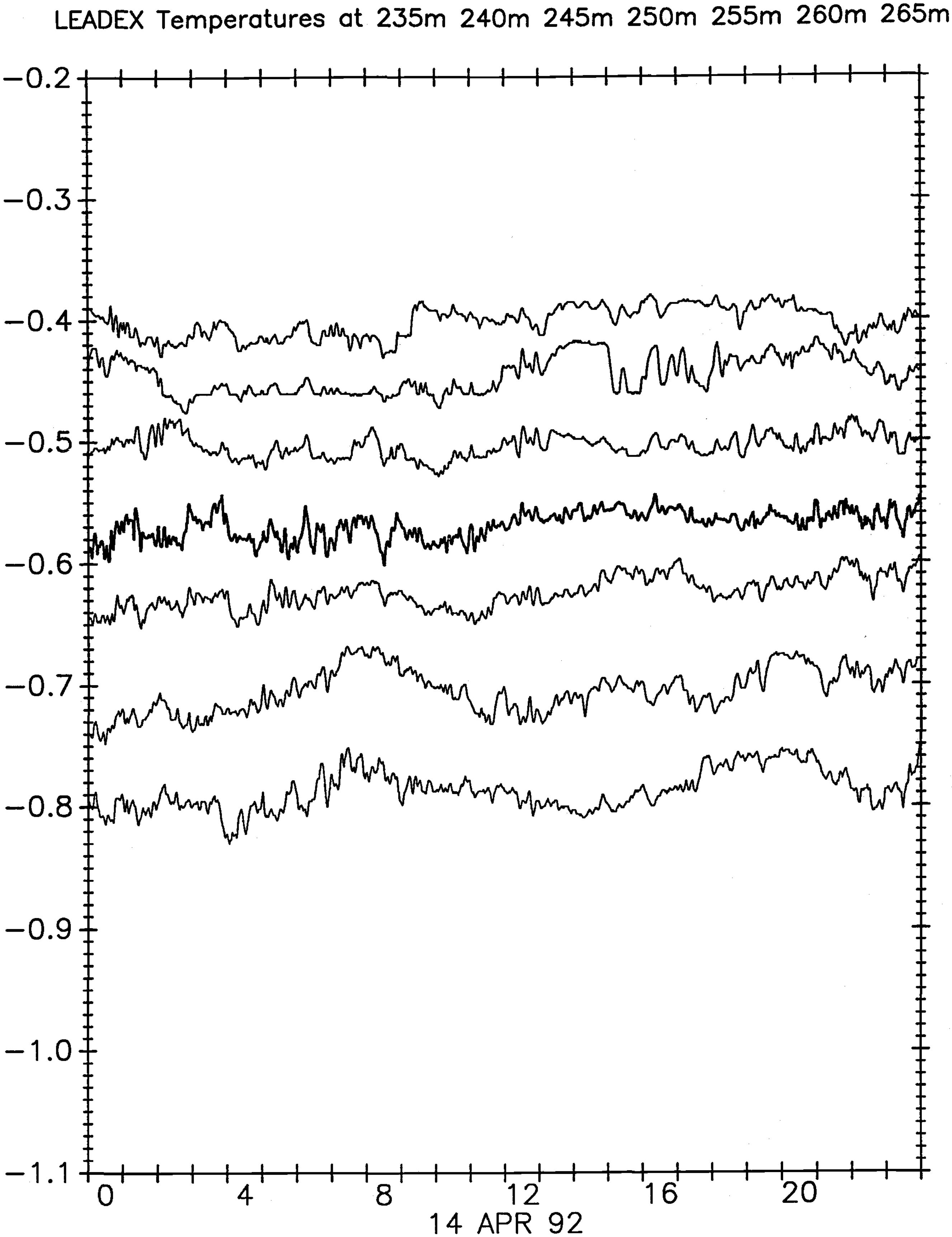


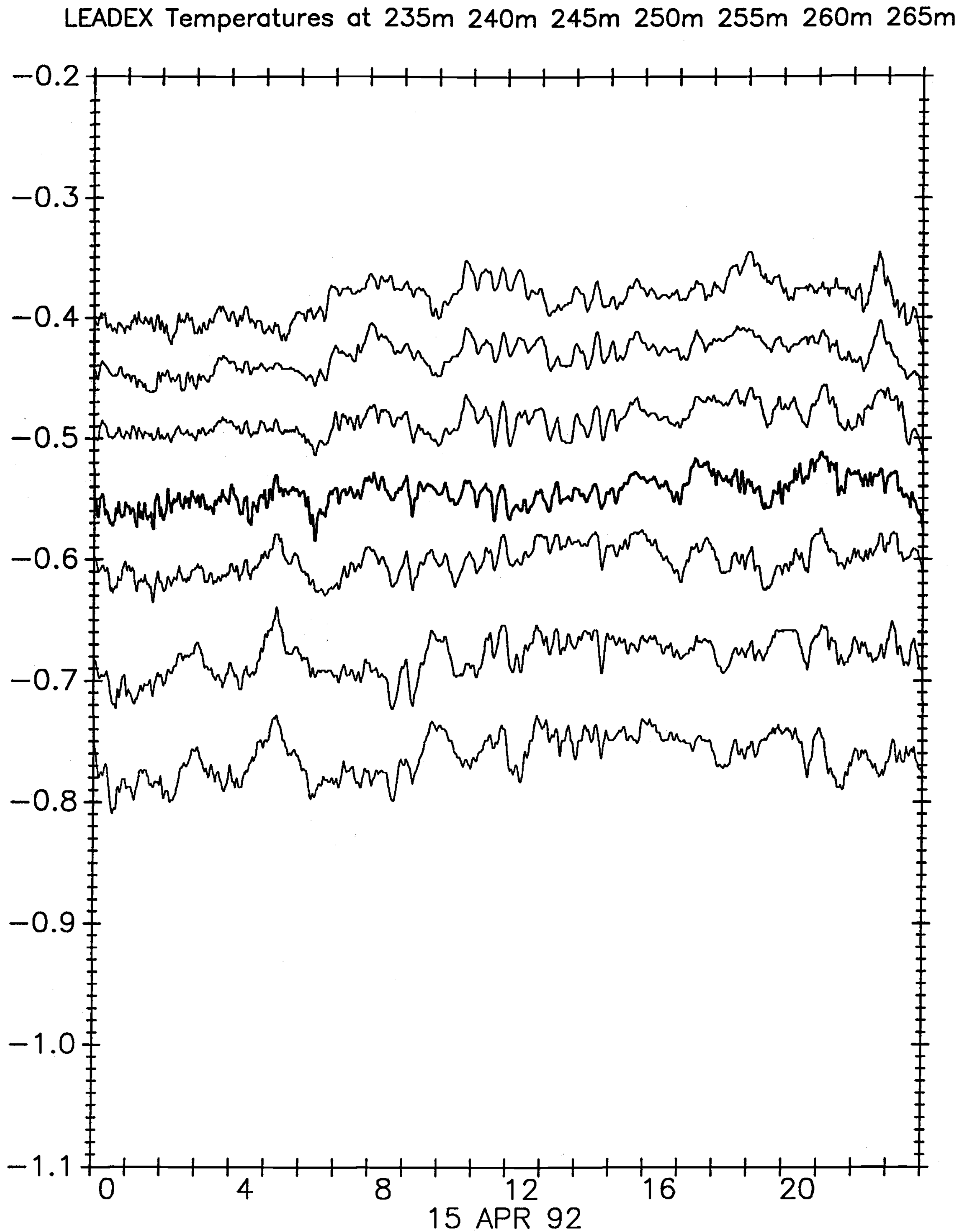
LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m

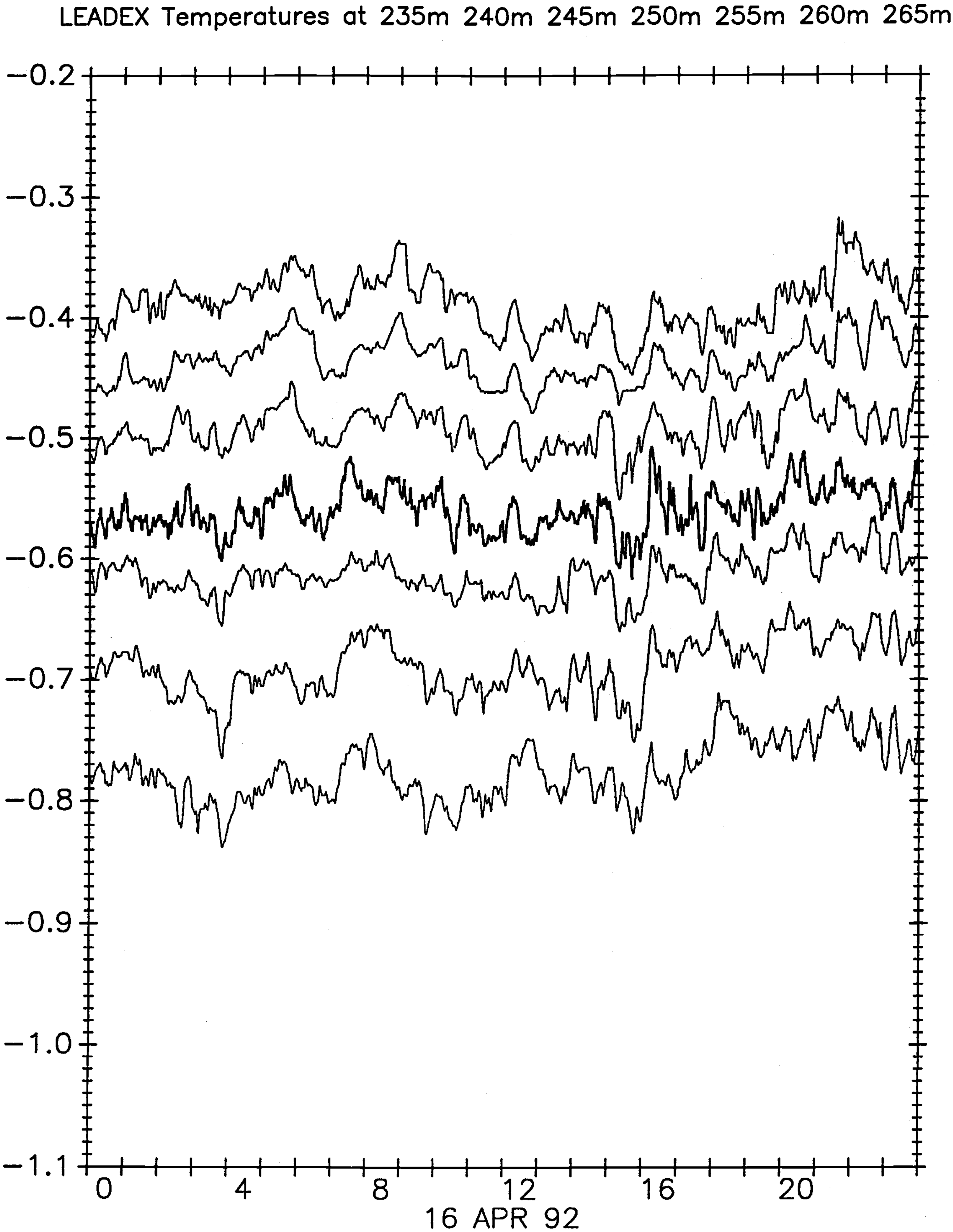


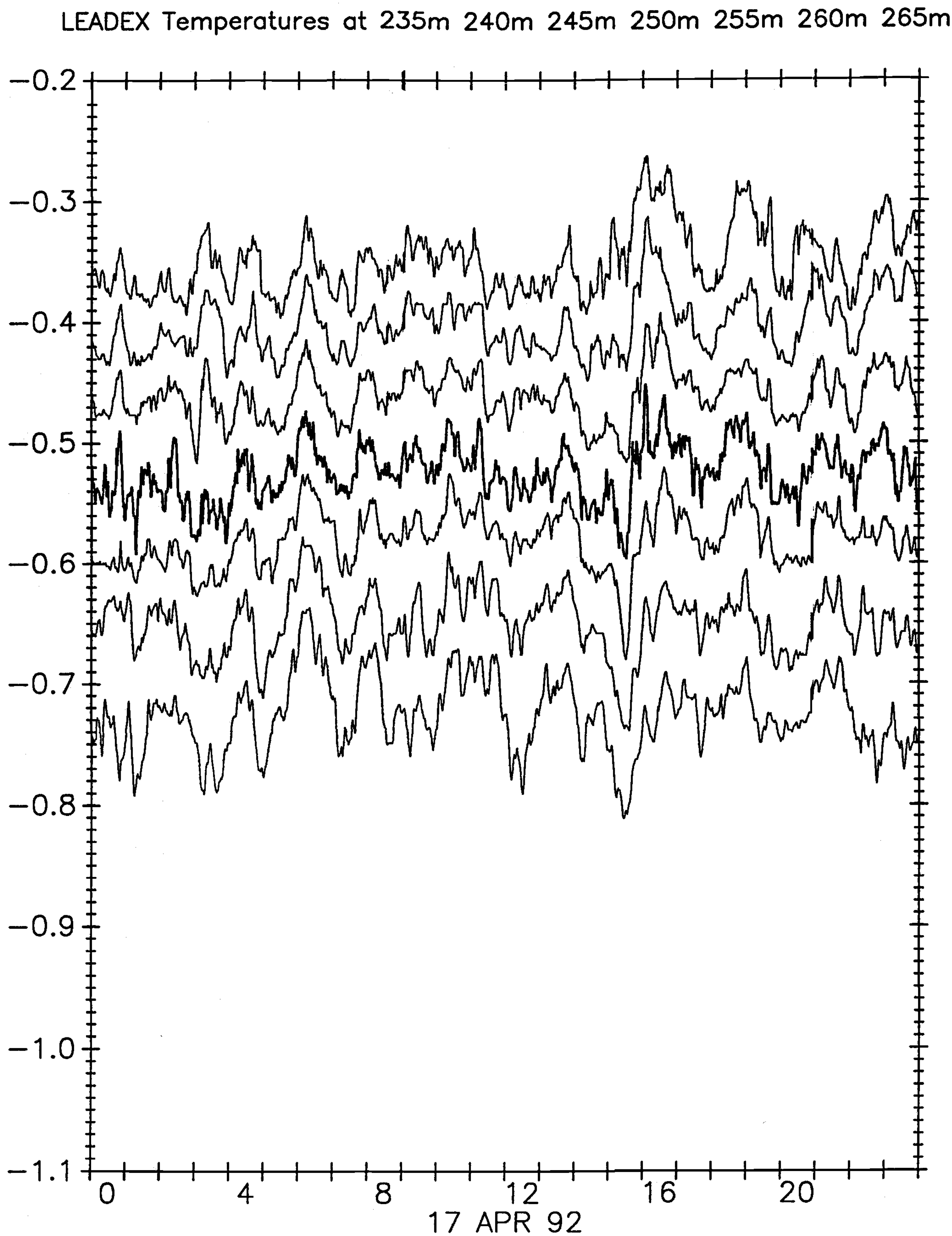

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
0
4
8
12
16
20
12 APR 92

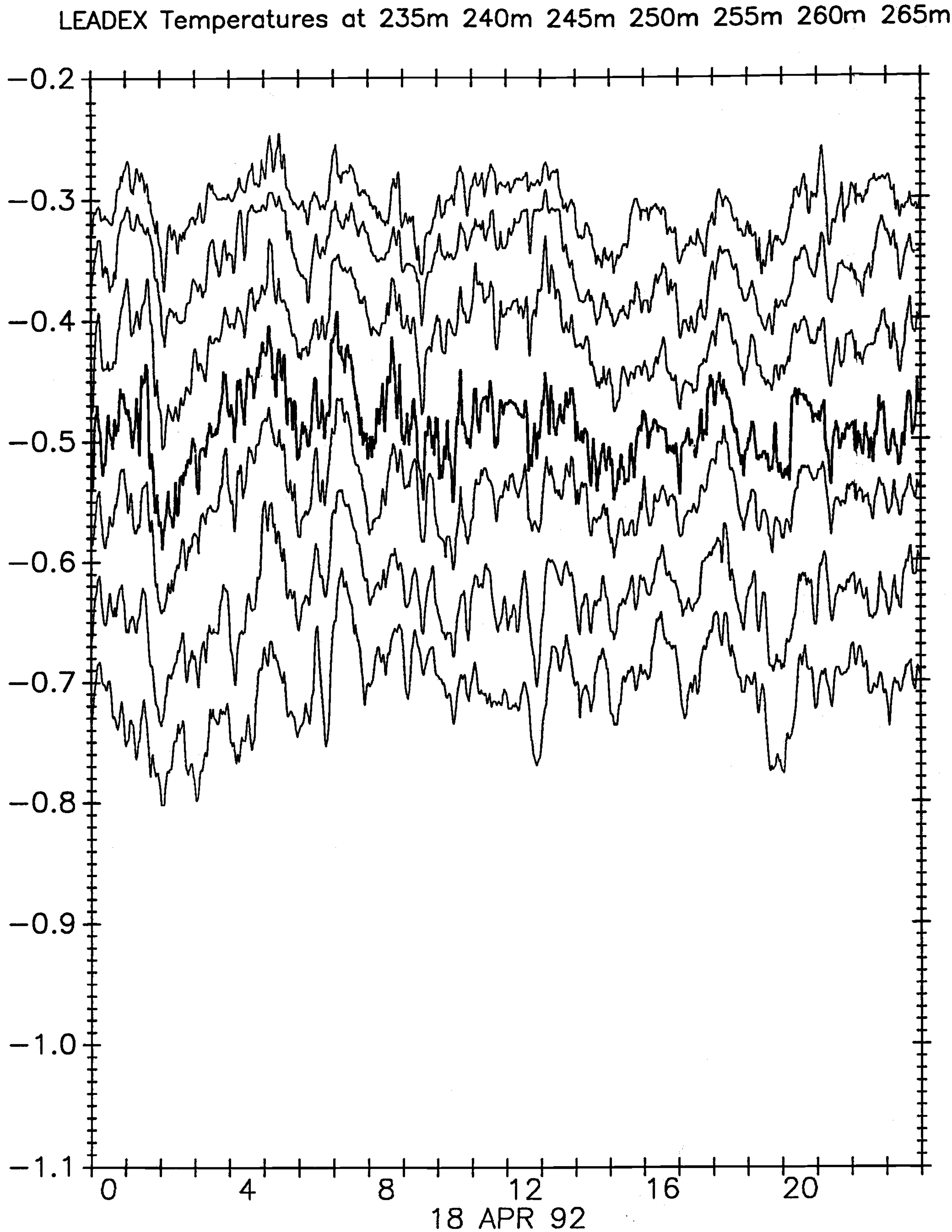

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
0
4
8
12
16
20
13 APR 92
o

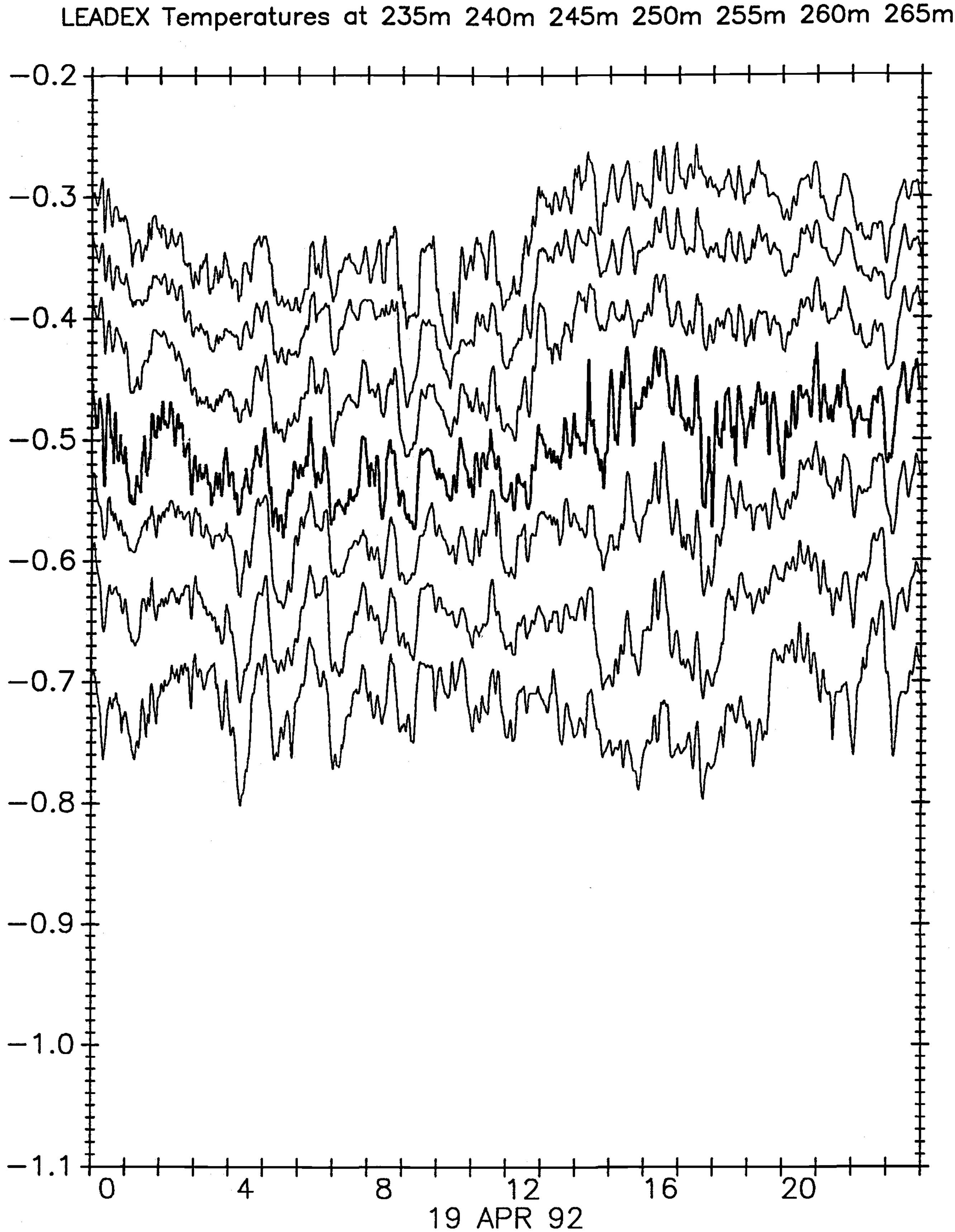

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
0
4
8
12
16
20
14 APR 92

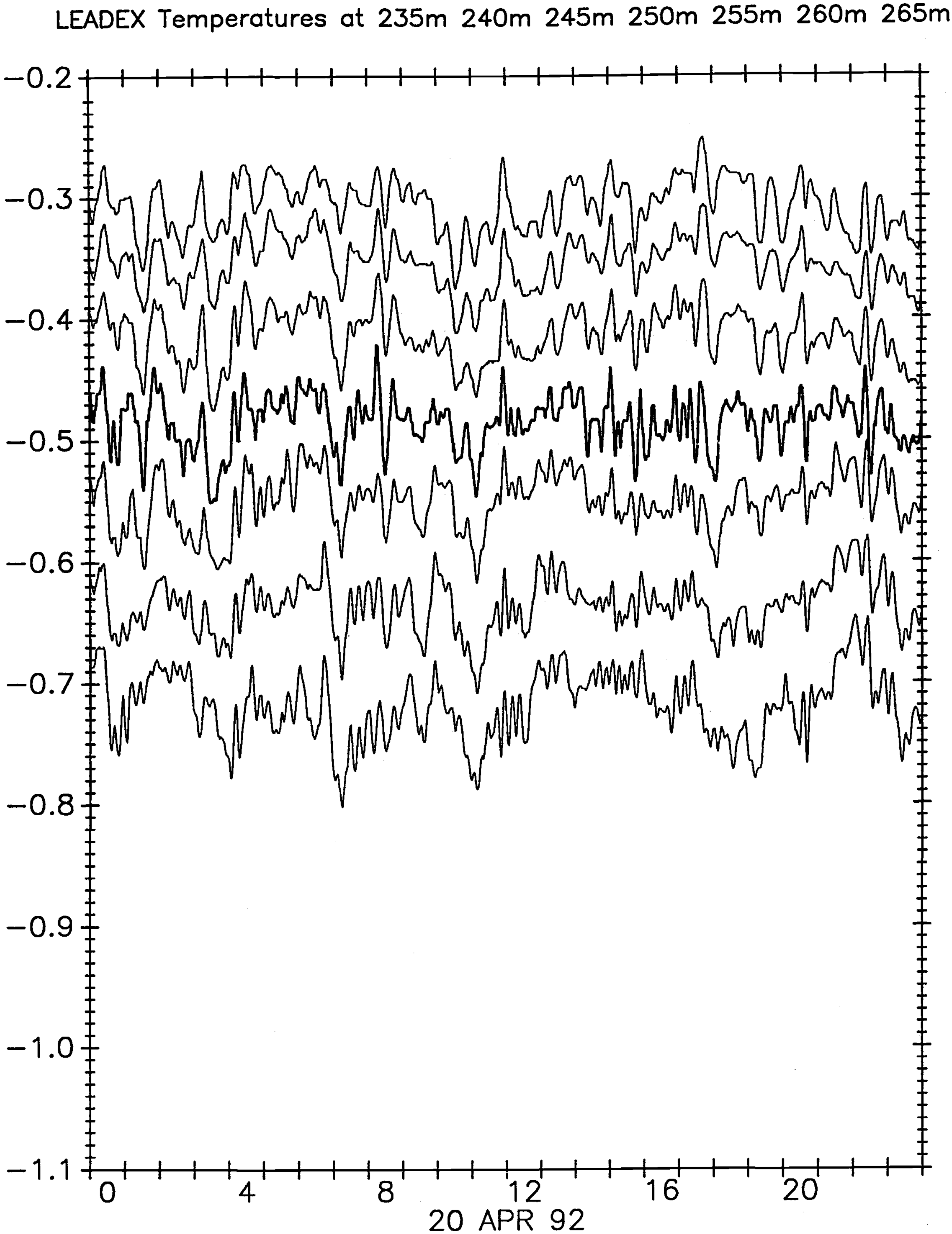

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
c
0
4
8
12
16
20
15 APR 92

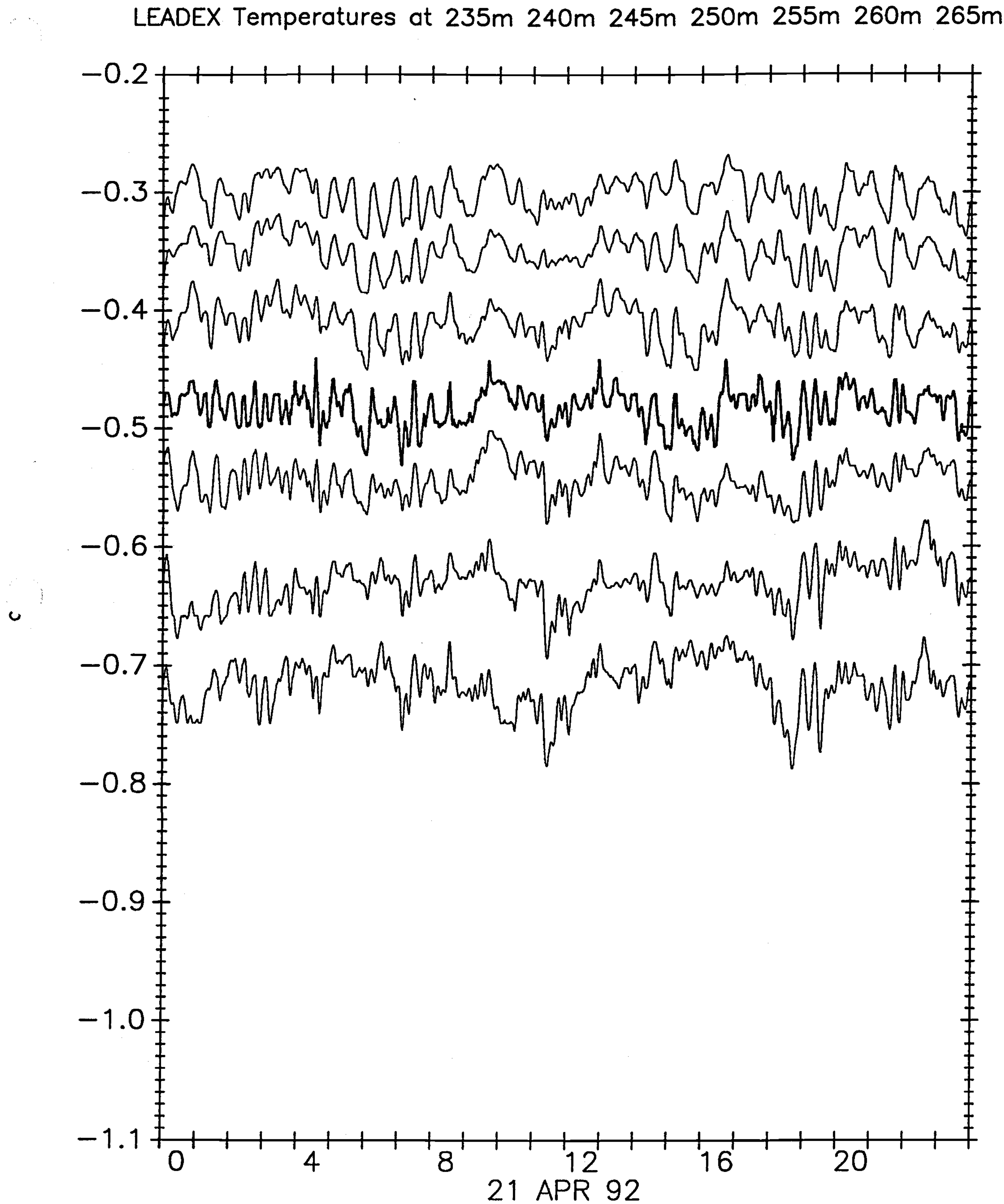

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
0
4
8
12
16
20
16 APR 92

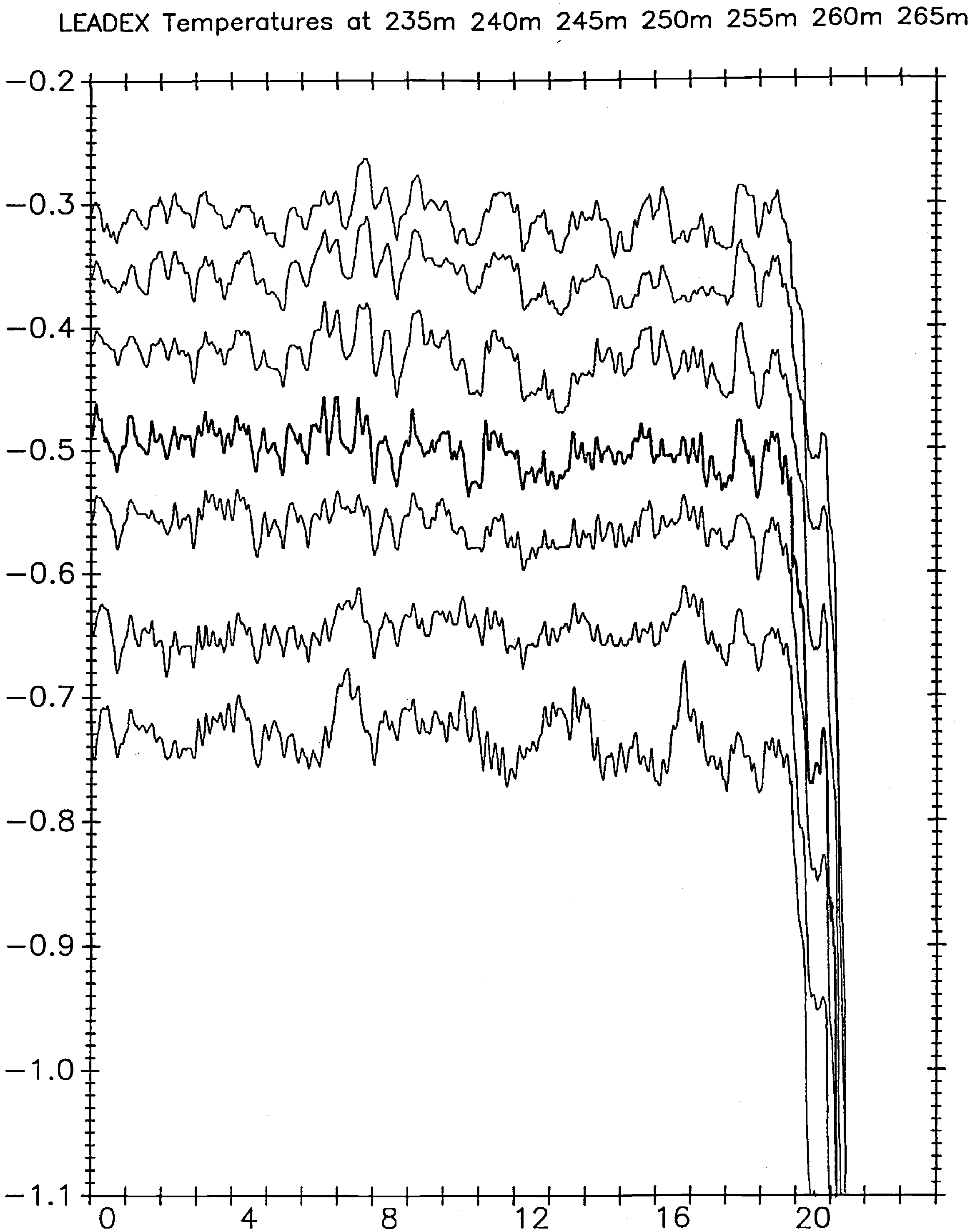

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
0
4
8
12
16
20
17 APR 92


LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
0
4
8
12
16
20
18 APR 92


LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
c
0
4
8
12
16
20
19 APR 92

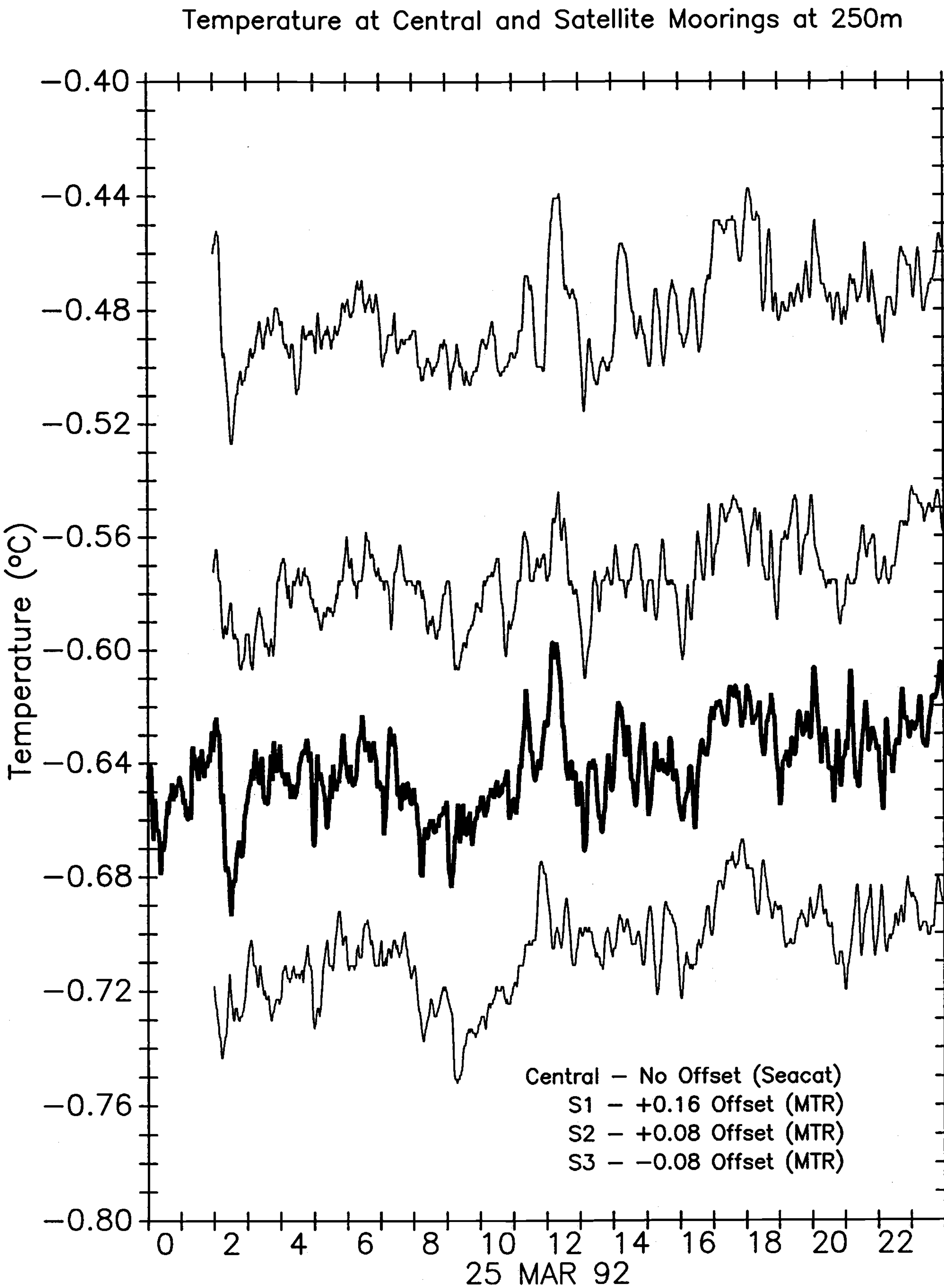

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
0
4
8
12
16
20
20 APR 92

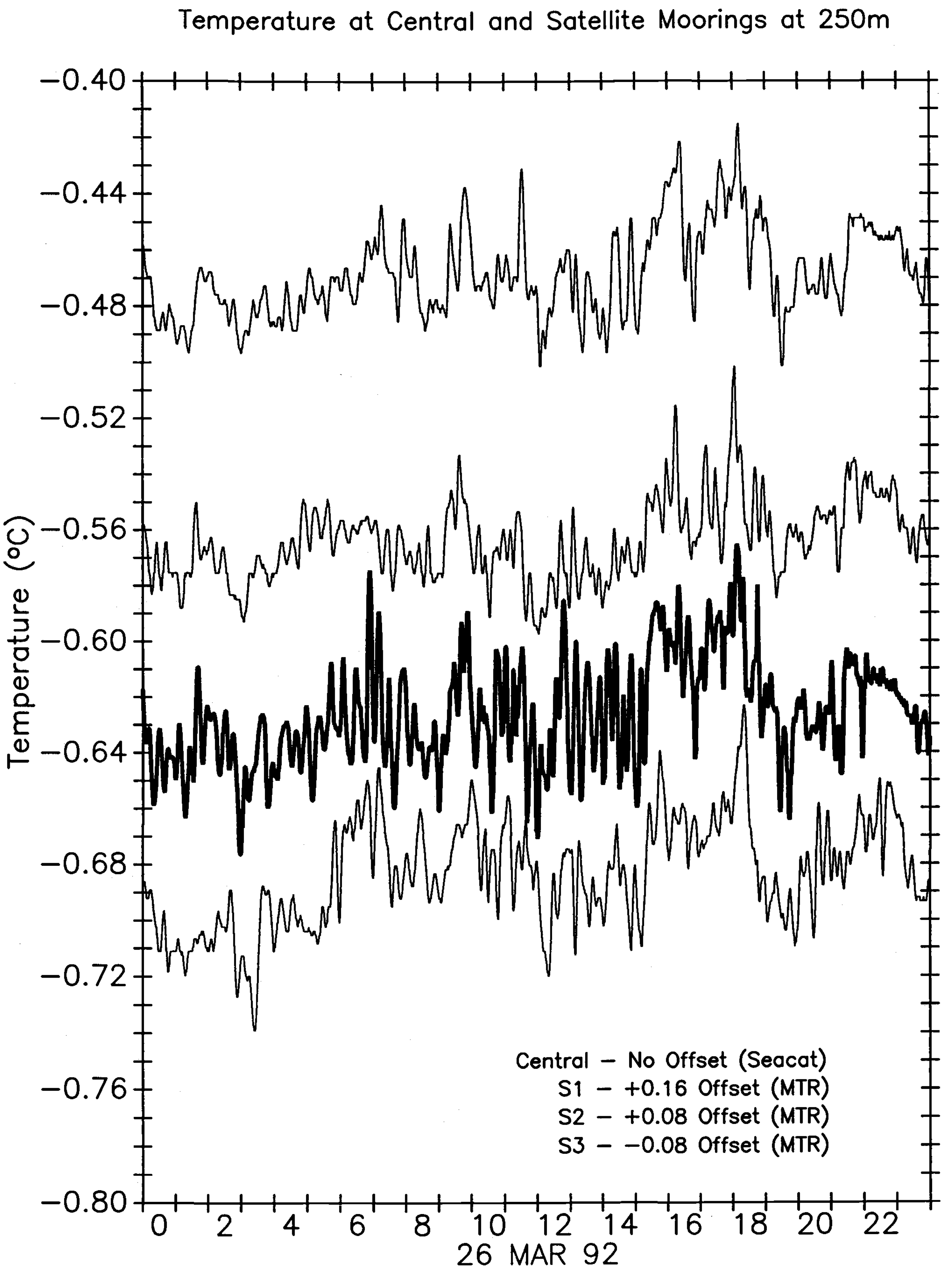

LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
c
0
4
8
12
16
20
21 APR 92


LEADEX Temperatures at 235m 240m 245m 250m 255m 260m 265m
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
0
4
8
12
16
20
22 APR 92

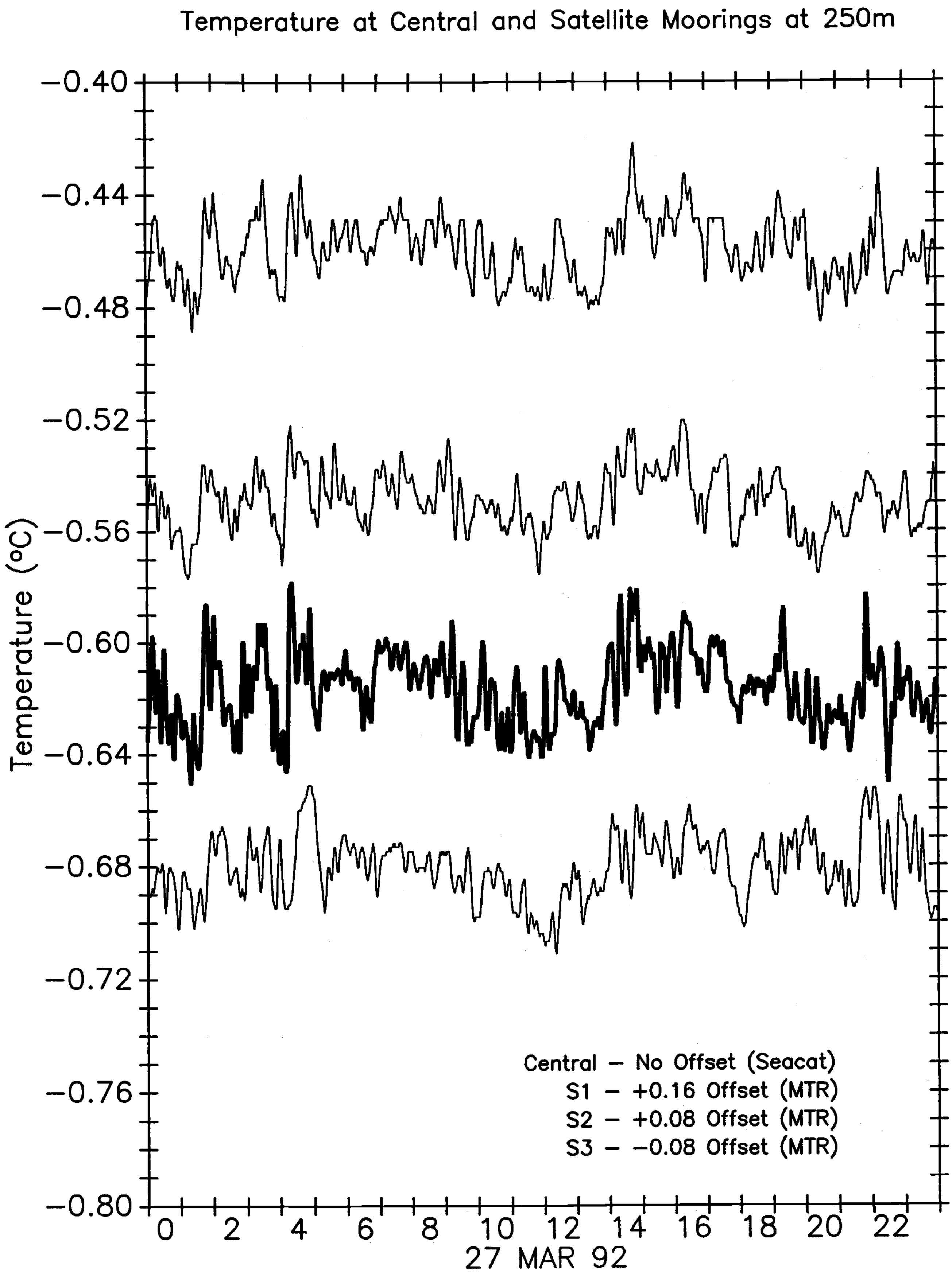
TIME SERIES of TEMPERATURE from HORIZONTAL ARRAY at 250 m

The following 27 pages are observations of temperature from the Central, S1, S2, and S3 moorings at 250 m. The Central mooring time series is from a Seacat (plotted bold); the Satellite time series are from MTRs. The Satellite records have been offset as indicated. Sampling rate is 1 minute.


Temperature at Central and Satellite Moorings at 250m
-0.40
-0.44
-0.48
-0.52
-0.56
-0.60
-0.64
-0.68
-0.72
-0.76
-0.80
Temperature (°C)
0
2
4
6
8
10
12
14
16
18
20
22
25 MAR 92
Central – No Offset (Seacat)
S1 – +0.16 Offset (MTR)
S2 – +0.08 Offset (MTR)
S3 – -0.08 Offset (MTR)



Temperature at Central and Satellite Moorings at 250m
Temperature (°C)
−0.40
−0.44
−0.48
−0.52
−0.56
−0.60
−0.64
−0.68
−0.72
−0.76
−0.80
0
2
4
6
8
10
12
14
16
18
20
22
26 MAR 92
Central − No Offset (Seacat)
S1 − +0.16 Offset (MTR)
S2 − +0.08 Offset (MTR)
S3 − −0.08 Offset (MTR)



Temperature at Central and Satellite Moorings at 250m
Temperature (°C)
−0.40
−0.44
−0.48
−0.52
−0.56
−0.60
−0.64
−0.68
−0.72
−0.76
−0.80
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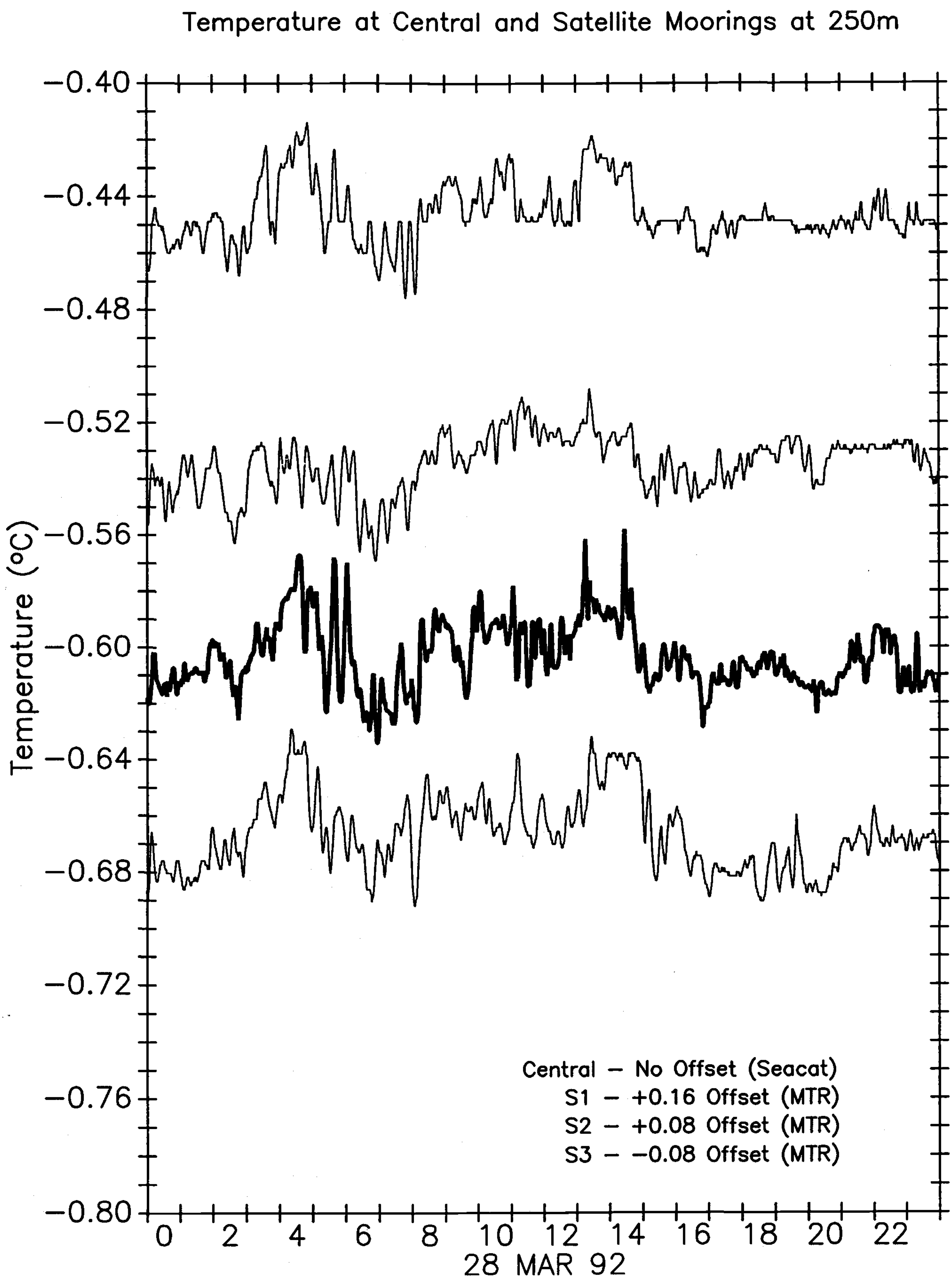
27 MAR 92
Central – No Offset (Seacat)
S1 – +0.16 Offset (MTR)
S2 – +0.08 Offset (MTR)
S3 – −0.08 Offset (MTR)


Temperature at Central and Satellite Moorings at 250m
Temperature (°C)
−0.40
−0.44
−0.48
−0.52
−0.56
−0.60
−0.64
−0.68
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−0.76
−0.80
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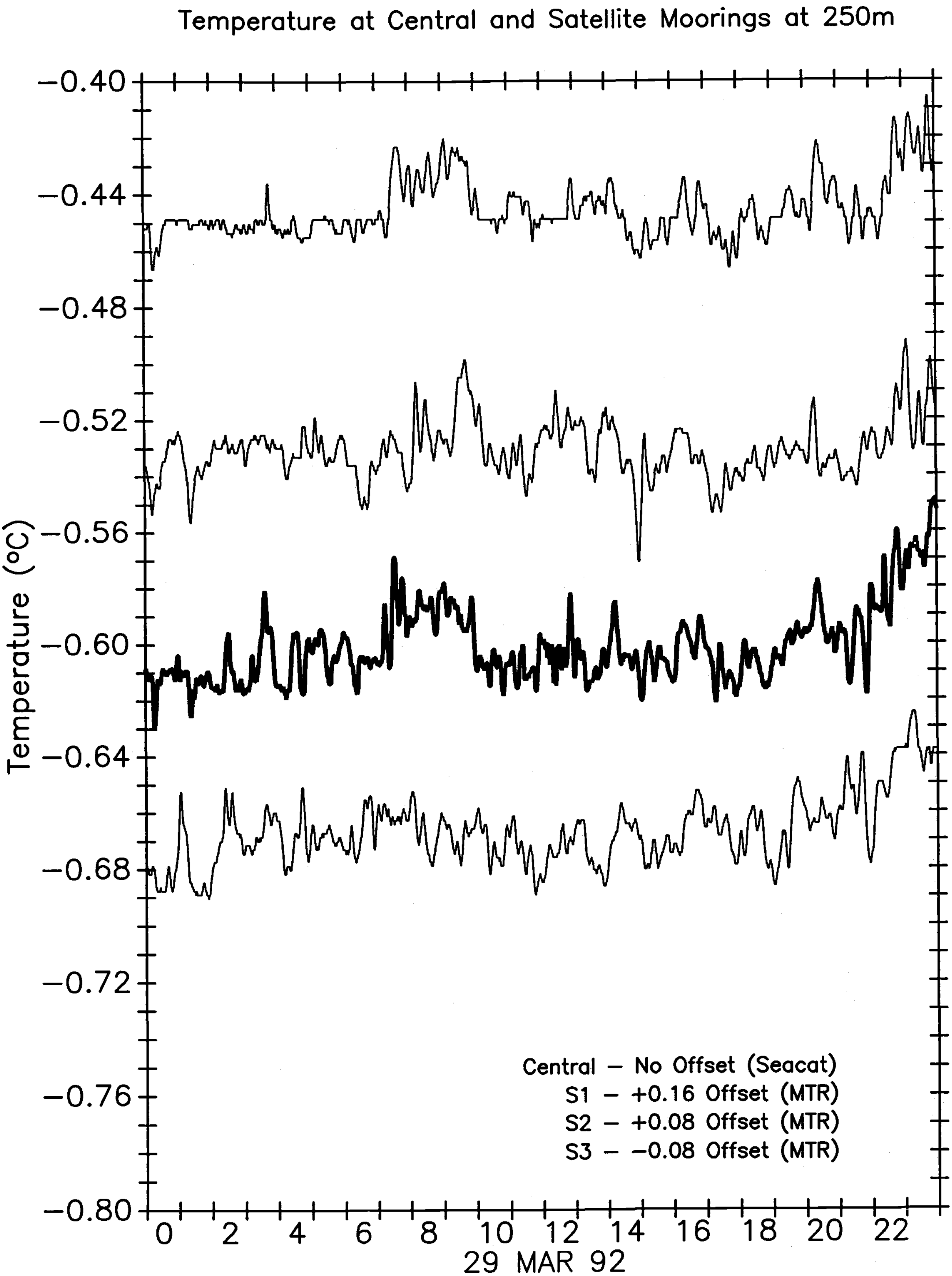
28 MAR 92
Central – No Offset (Seacat)
S1 – +0.16 Offset (MTR)
S2 – +0.08 Offset (MTR)
S3 – −0.08 Offset (MTR)



Temperature at Central and Satellite Moorings at 250m
Temperature (°C)
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−0.48
−0.52
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−0.64
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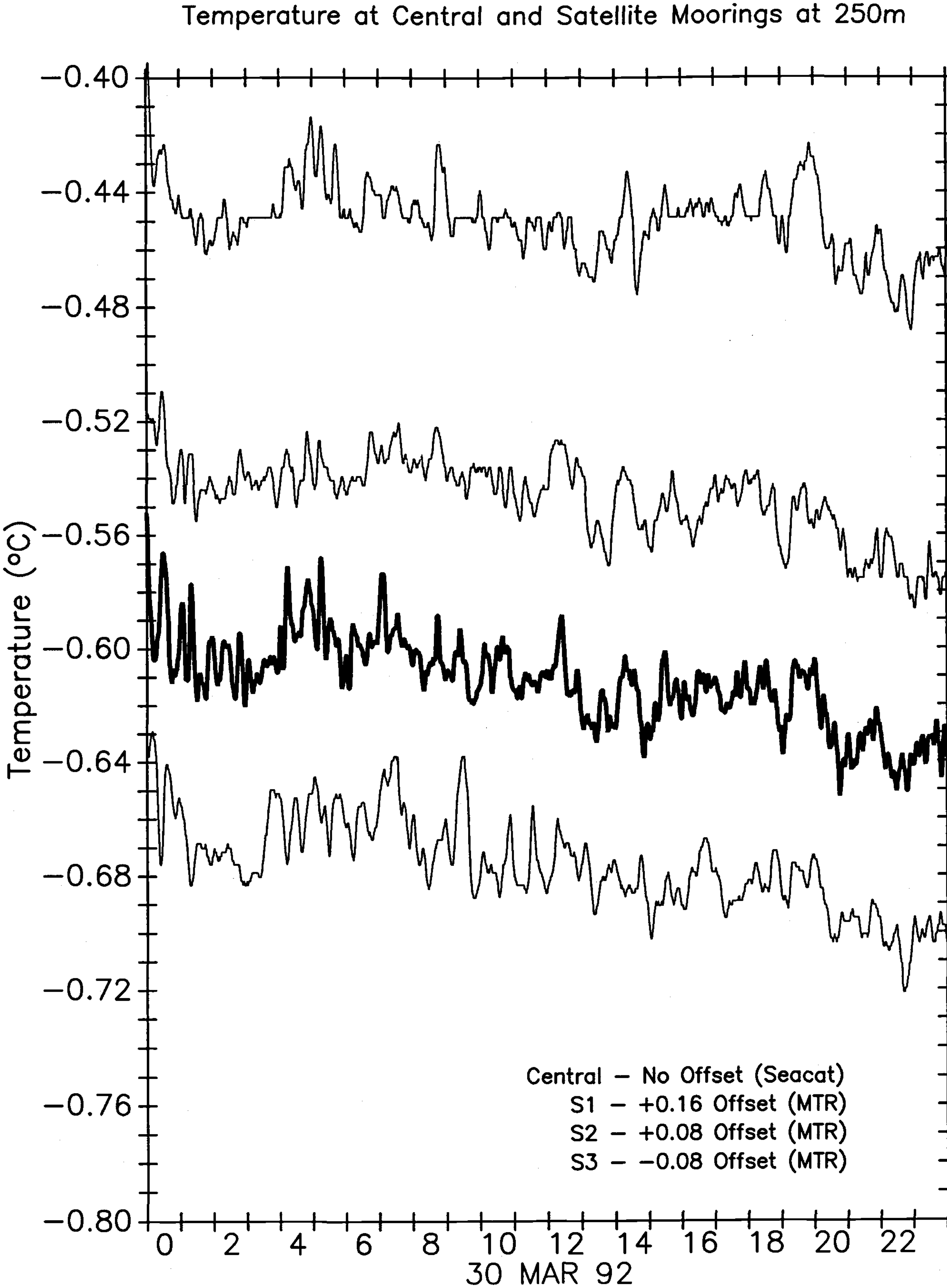
29 MAR 92
Central — No Offset (Seacat)
S1 — +0.16 Offset (MTR)
S2 — +0.08 Offset (MTR)
S3 — −0.08 Offset (MTR)


Temperature at Central and Satellite Moorings at 250m
Temperature (°C)
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−0.52
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−0.60
−0.64
−0.68
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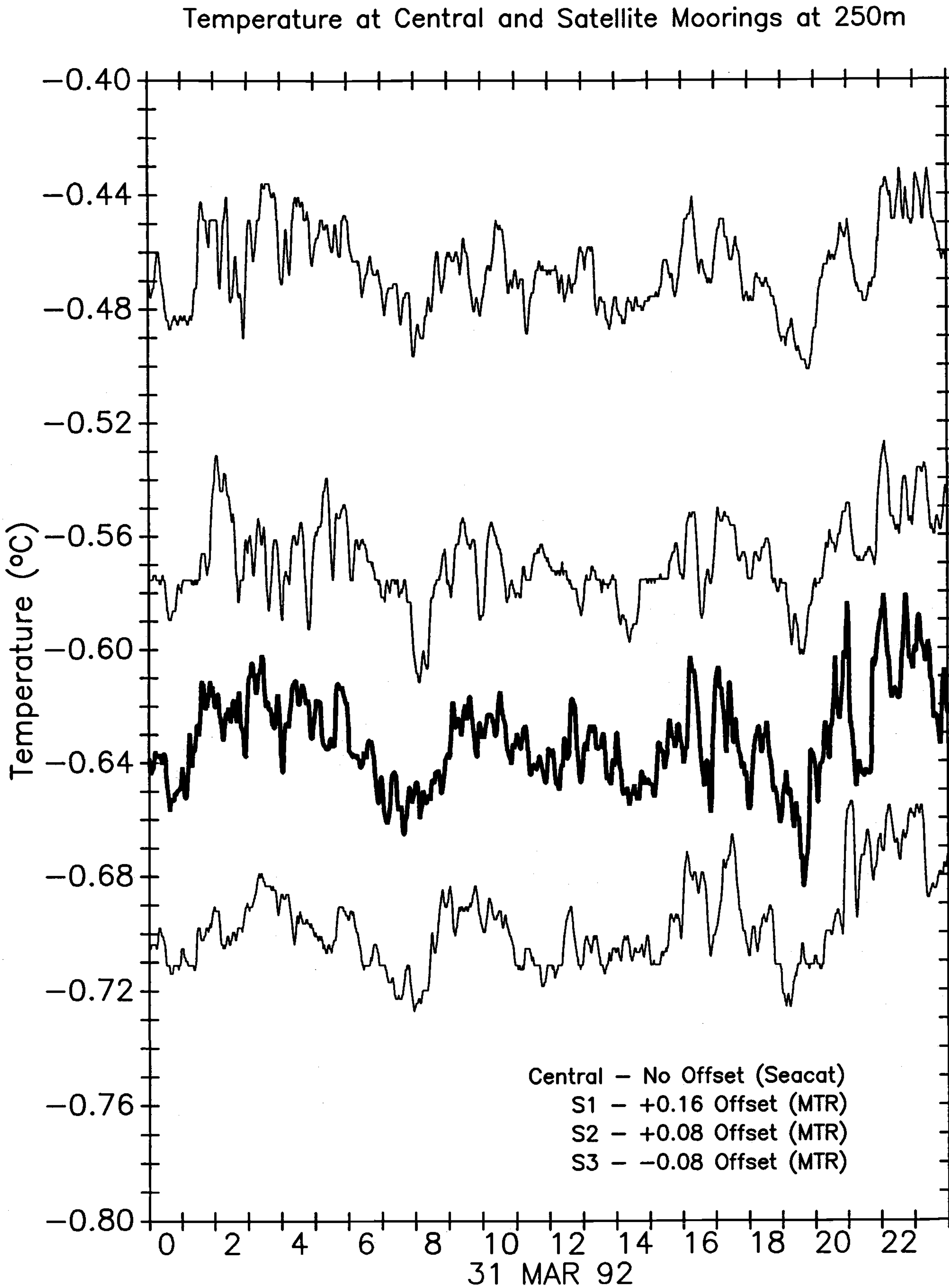
30 MAR 92
Central – No Offset (Seacat)
S1 – +0.16 Offset (MTR)
S2 – +0.08 Offset (MTR)
S3 – −0.08 Offset (MTR)


Temperature at Central and Satellite Moorings at 250m
Temperature (°C)
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−0.56
−0.60
−0.64
−0.68
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−0.76
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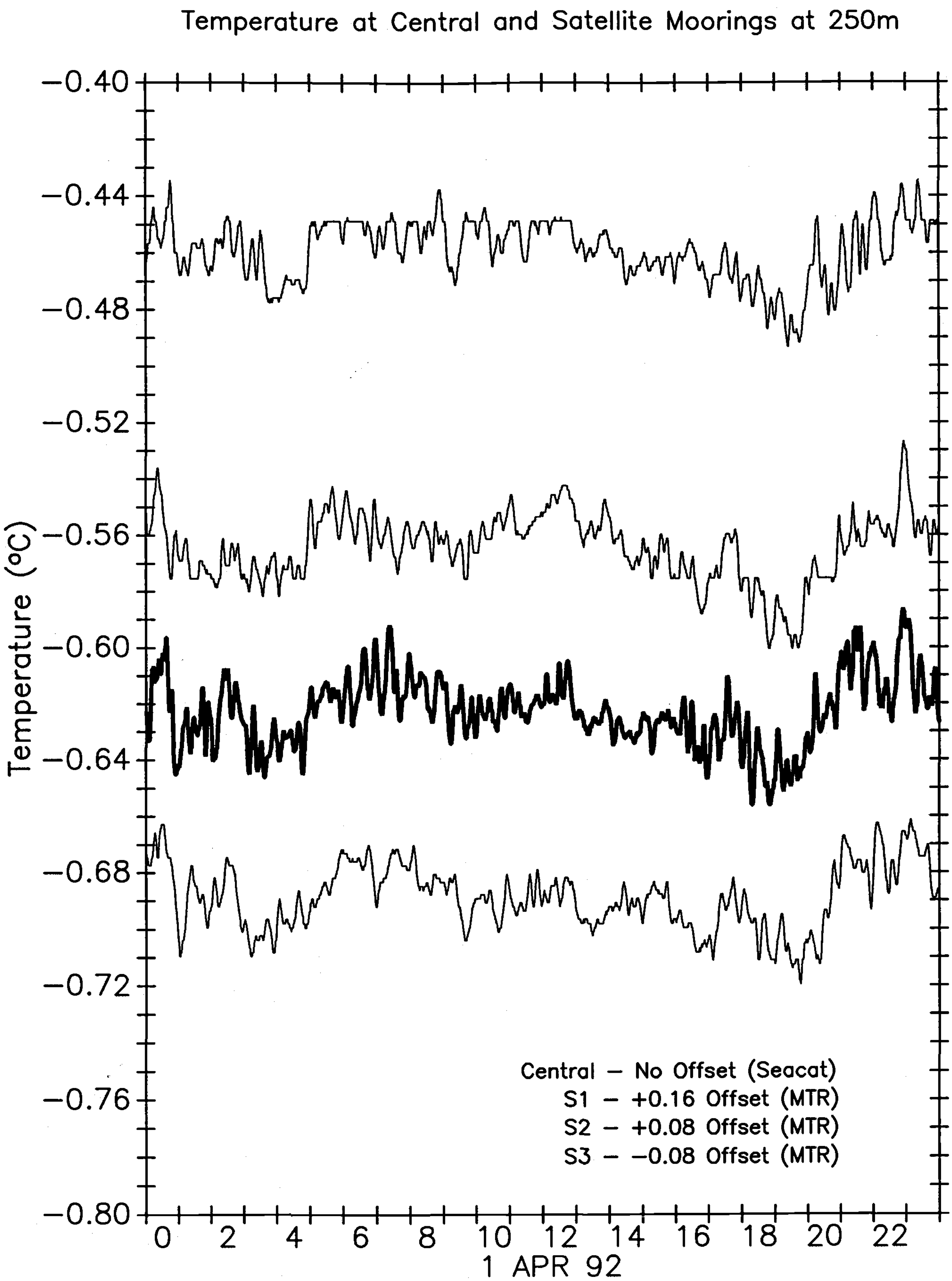
31 MAR 92
Central – No Offset (Seacat)
S1 – +0.16 Offset (MTR)
S2 – +0.08 Offset (MTR)
S3 – −0.08 Offset (MTR)


Temperature at Central and Satellite Moorings at 250m
Temperature (°C)
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−0.64
−0.68
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−0.80
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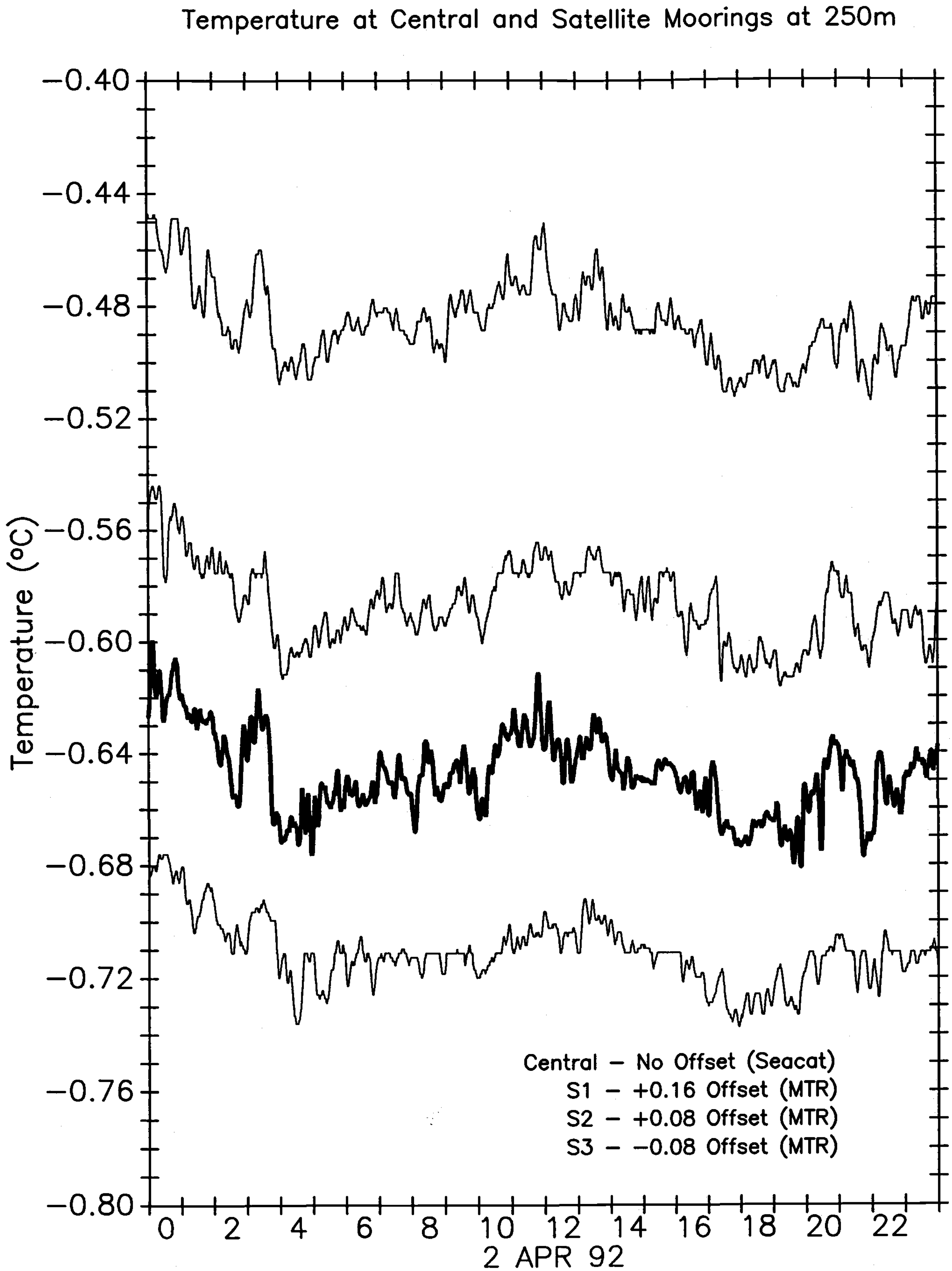
1 APR 92
Central − No Offset (Seacat)
S1 − +0.16 Offset (MTR)
S2 − +0.08 Offset (MTR)
S3 − −0.08 Offset (MTR)


Temperature at Central and Satellite Moorings at 250m
−0.40
−0.44
−0.48
−0.52
−0.56
−0.60
−0.64
−0.68
−0.72
−0.76
−0.80
Temperature (°C)
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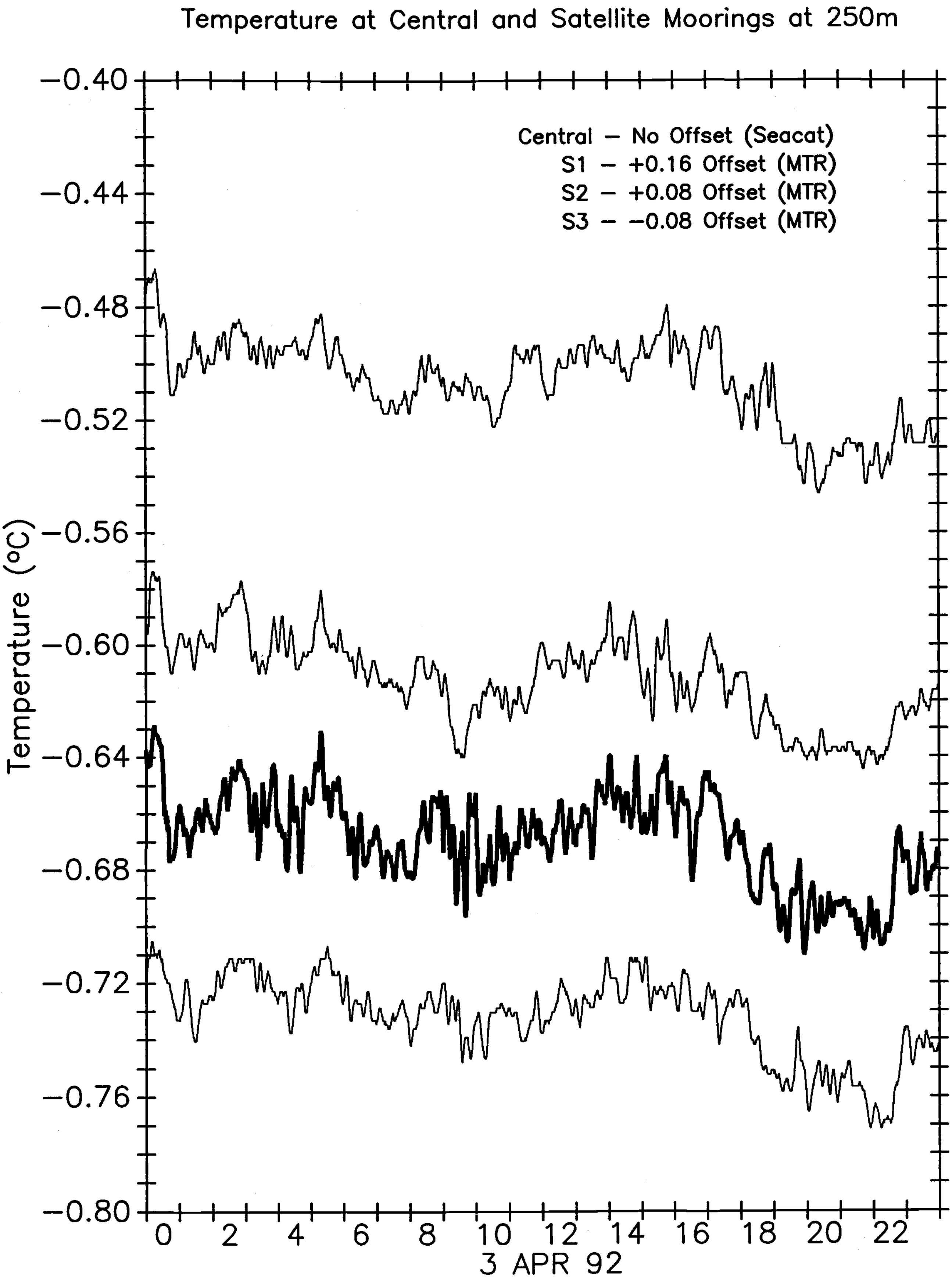
2 APR 92
Central − No Offset (Seacat)
S1 − +0.16 Offset (MTR)
S2 − +0.08 Offset (MTR)
S3 − −0.08 Offset (MTR)


Temperature at Central and Satellite Moorings at 250m
Central – No Offset (Seacat)
S1 – +0.16 Offset (MTR)
S2 – +0.08 Offset (MTR)
S3 – −0.08 Offset (MTR)
Temperature (°C)
−0.40
−0.44
−0.48
−0.52
−0.56
−0.60
−0.64
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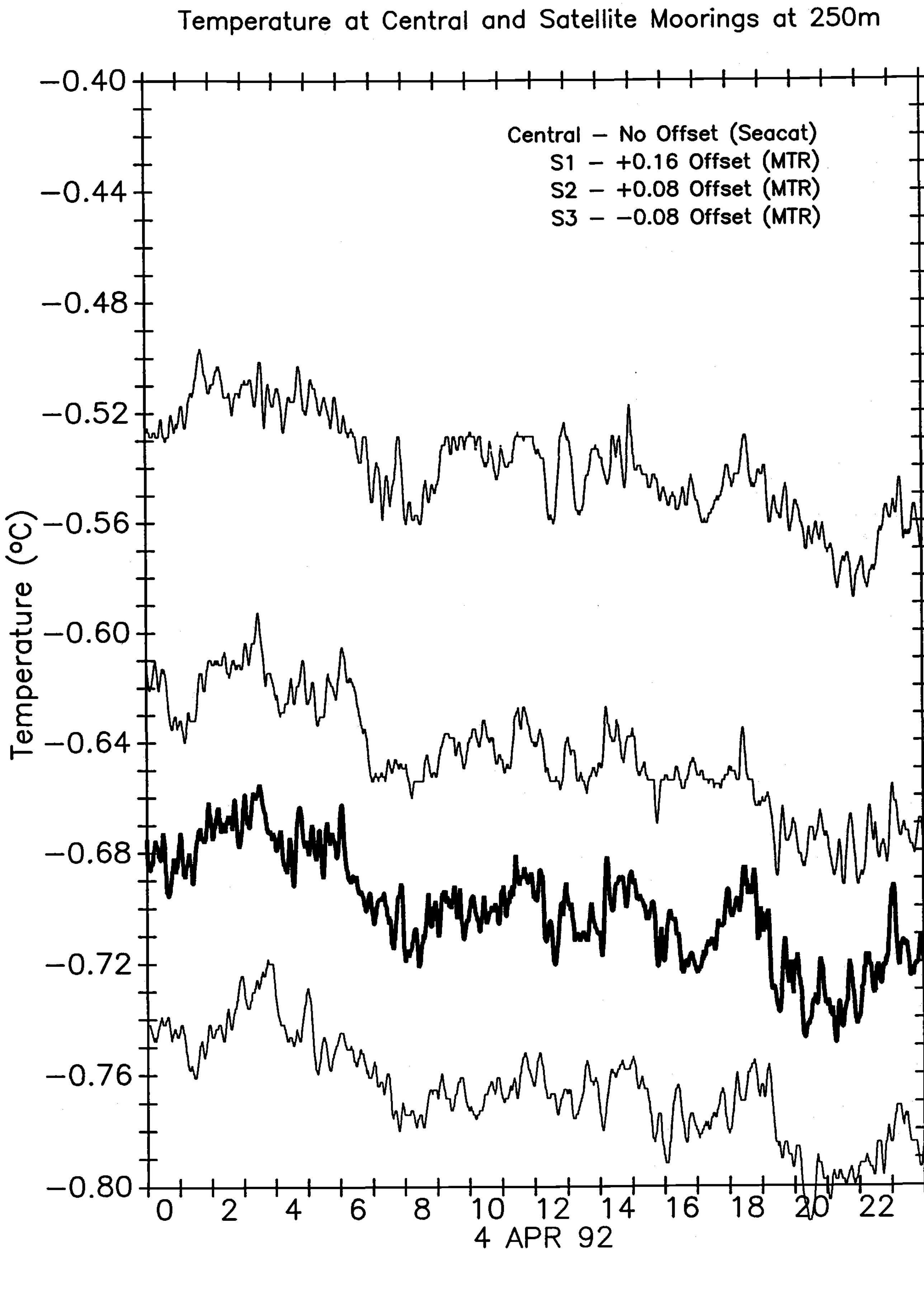
3 APR 92


Temperature at Central and Satellite Moorings at 250m
Central – No Offset (Seacat)
S1 – +0.16 Offset (MTR)
S2 – +0.08 Offset (MTR)
S3 – −0.08 Offset (MTR)
Temperature (°C)
−0.40
−0.44
−0.48
−0.52
−0.56
−0.60
−0.64
−0.68
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−0.80
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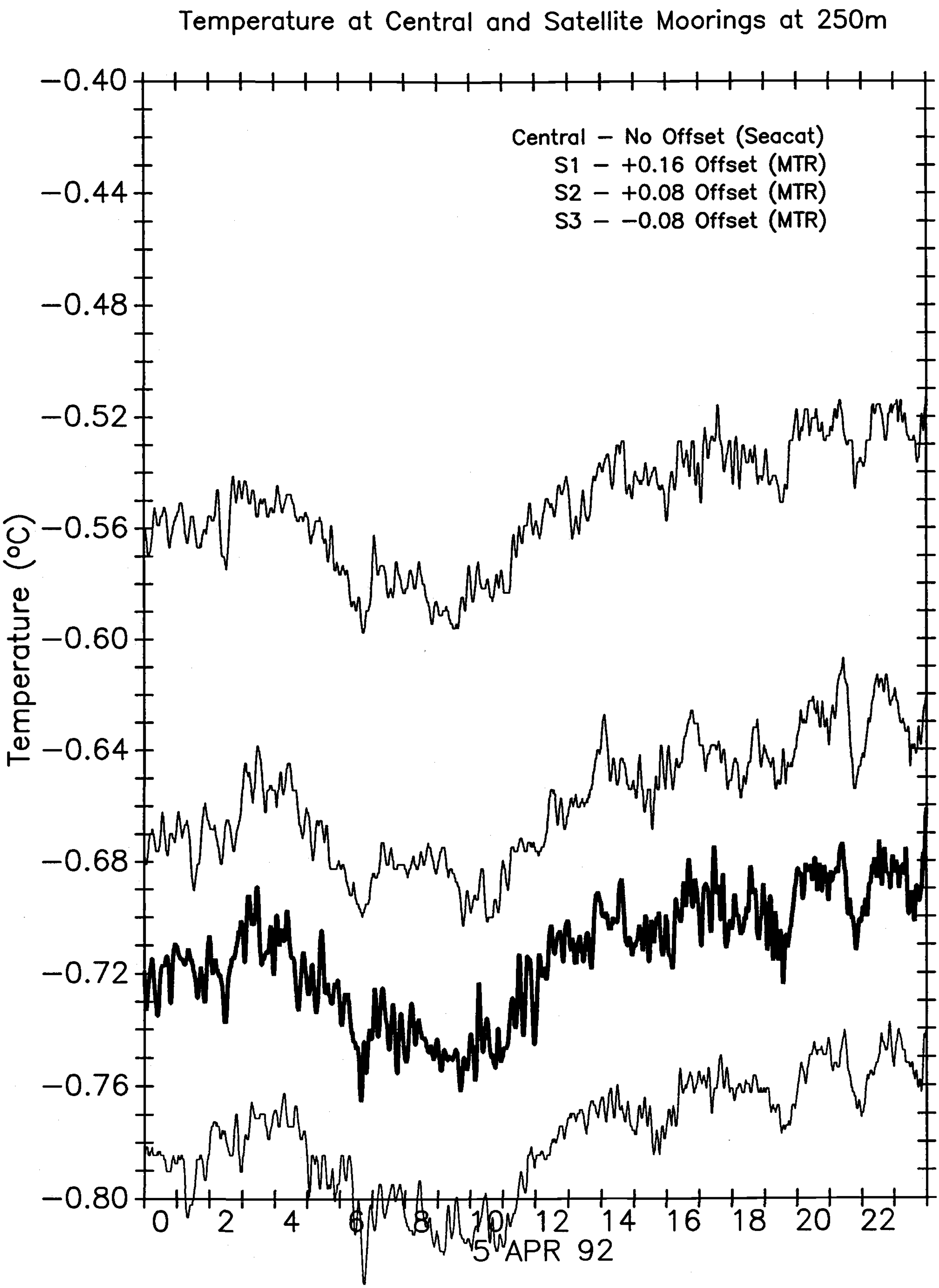
4 APR 92



Temperature at Central and Satellite Moorings at 250m
Central – No Offset (Seacat)
S1 – +0.16 Offset (MTR)
S2 – +0.08 Offset (MTR)
S3 – −0.08 Offset (MTR)
Temperature (°C)
−0.40
−0.44
−0.48
−0.52
−0.56
−0.60
−0.64
−0.68
−0.72
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−0.80
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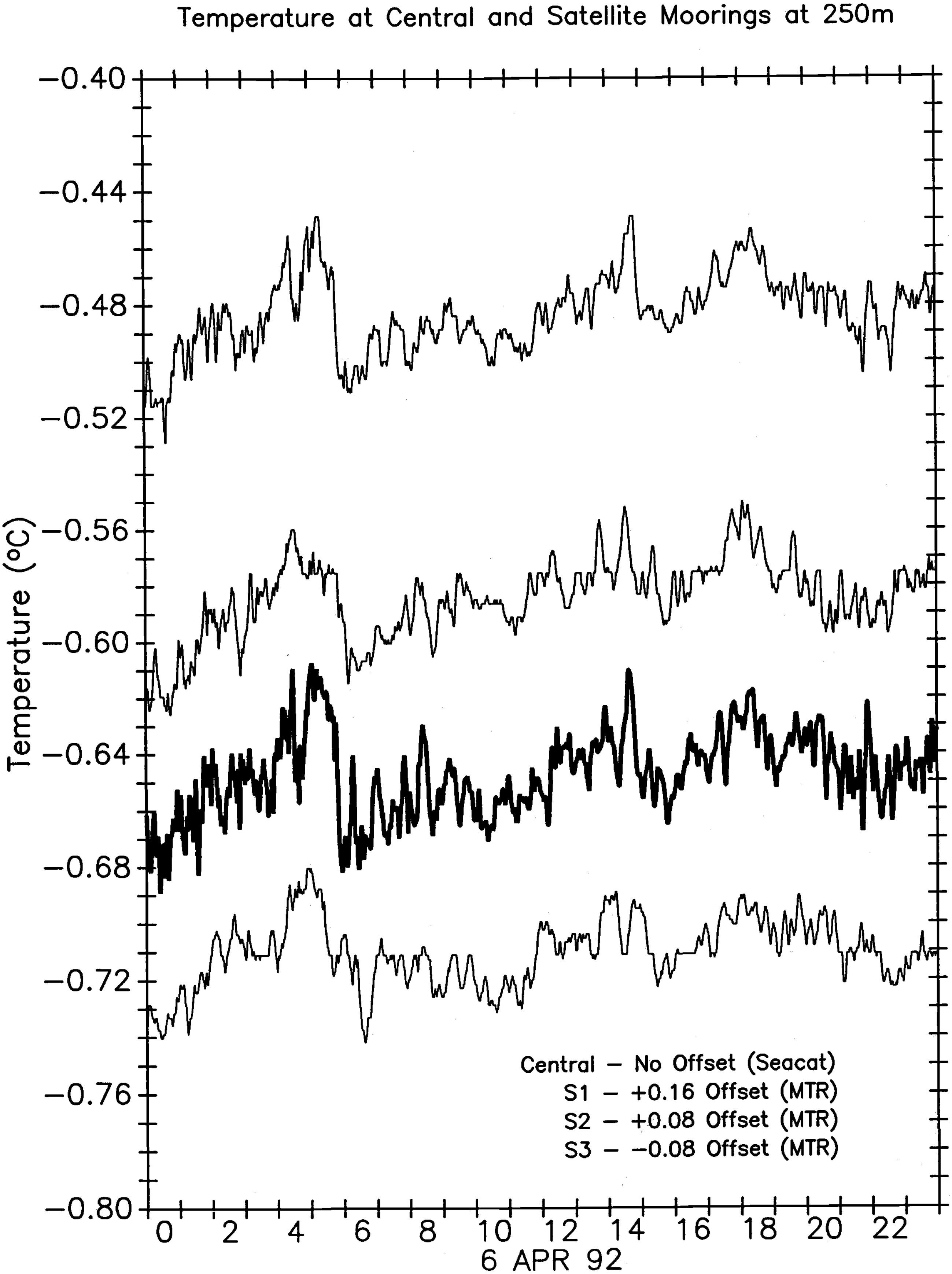
5 APR 92


Temperature at Central and Satellite Moorings at 250m
Temperature (°C)
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−0.44
−0.48
−0.52
−0.56
−0.60
−0.64
−0.68
−0.72
−0.76
−0.80
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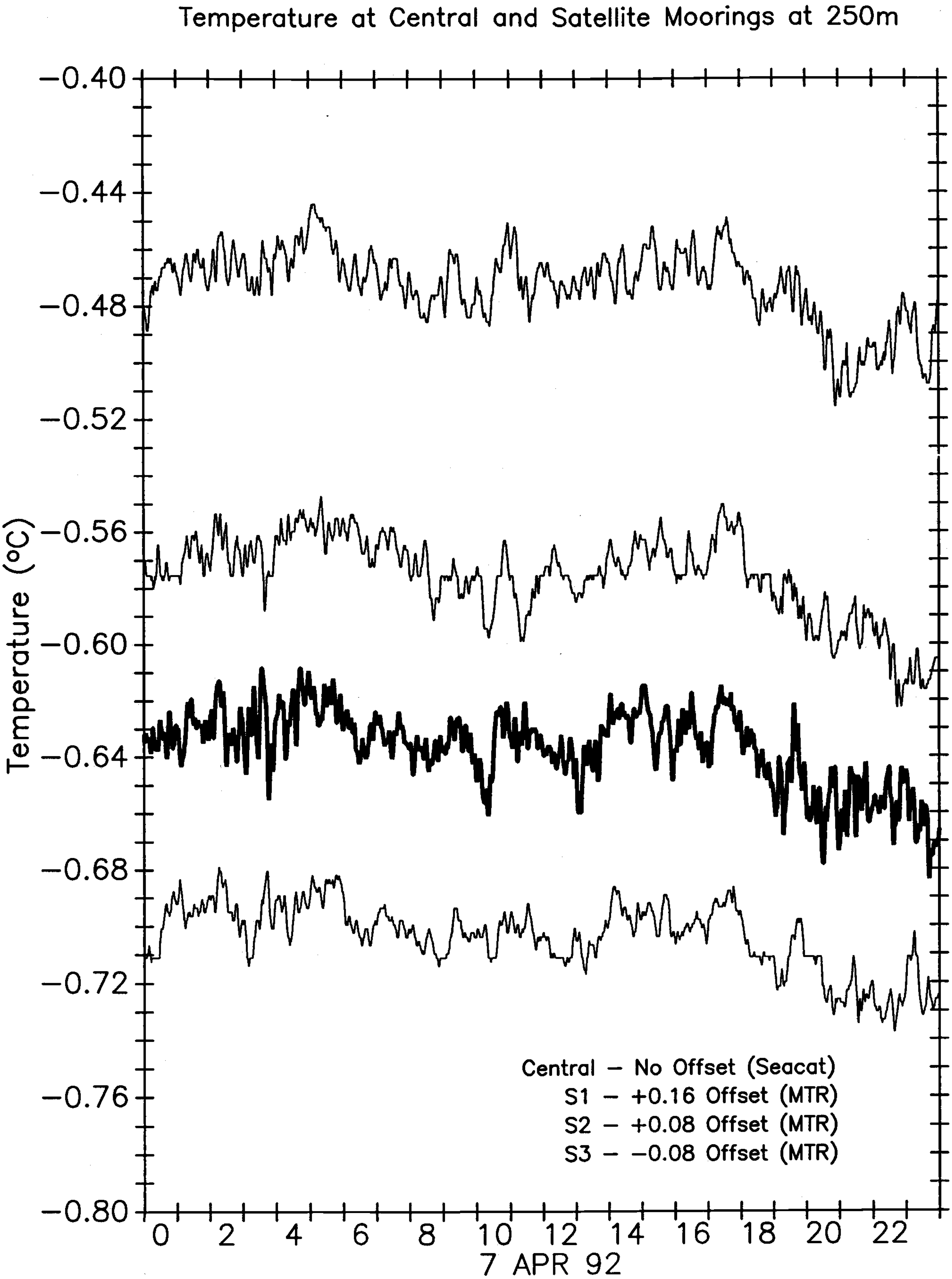
22
6 APR 92
Central − No Offset (Seacat)
S1 − +0.16 Offset (MTR)
S2 − +0.08 Offset (MTR)
S3 − −0.08 Offset (MTR)


Temperature at Central and Satellite Moorings at 250m
Temperature (°C)
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−0.44
−0.48
−0.52
−0.56
−0.60
−0.64
−0.68
−0.72
−0.76
−0.80
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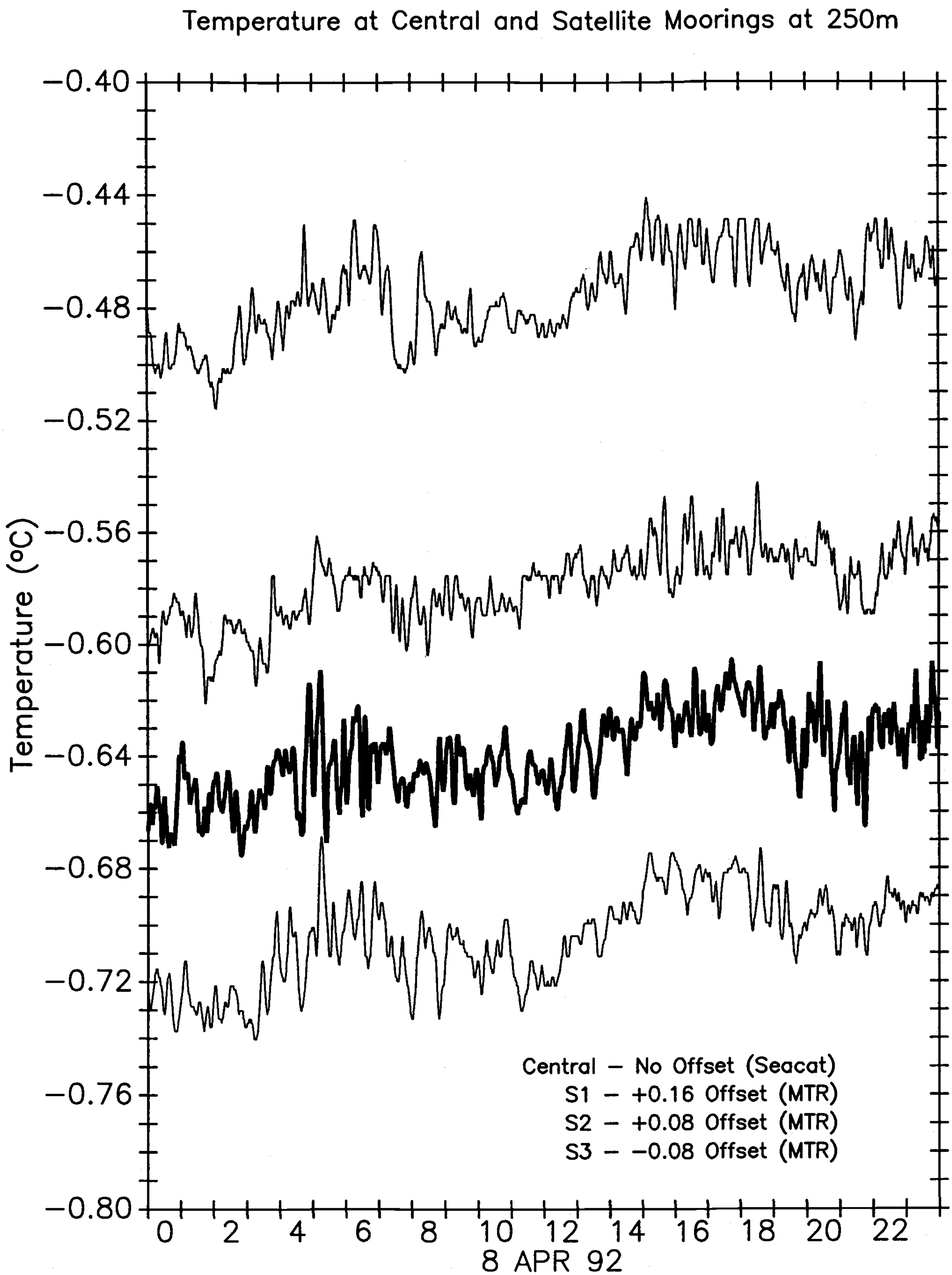
7 APR 92
Central – No Offset (Seacat)
S1 – +0.16 Offset (MTR)
S2 – +0.08 Offset (MTR)
S3 – −0.08 Offset (MTR)


Temperature at Central and Satellite Moorings at 250m
Temperature (°C)
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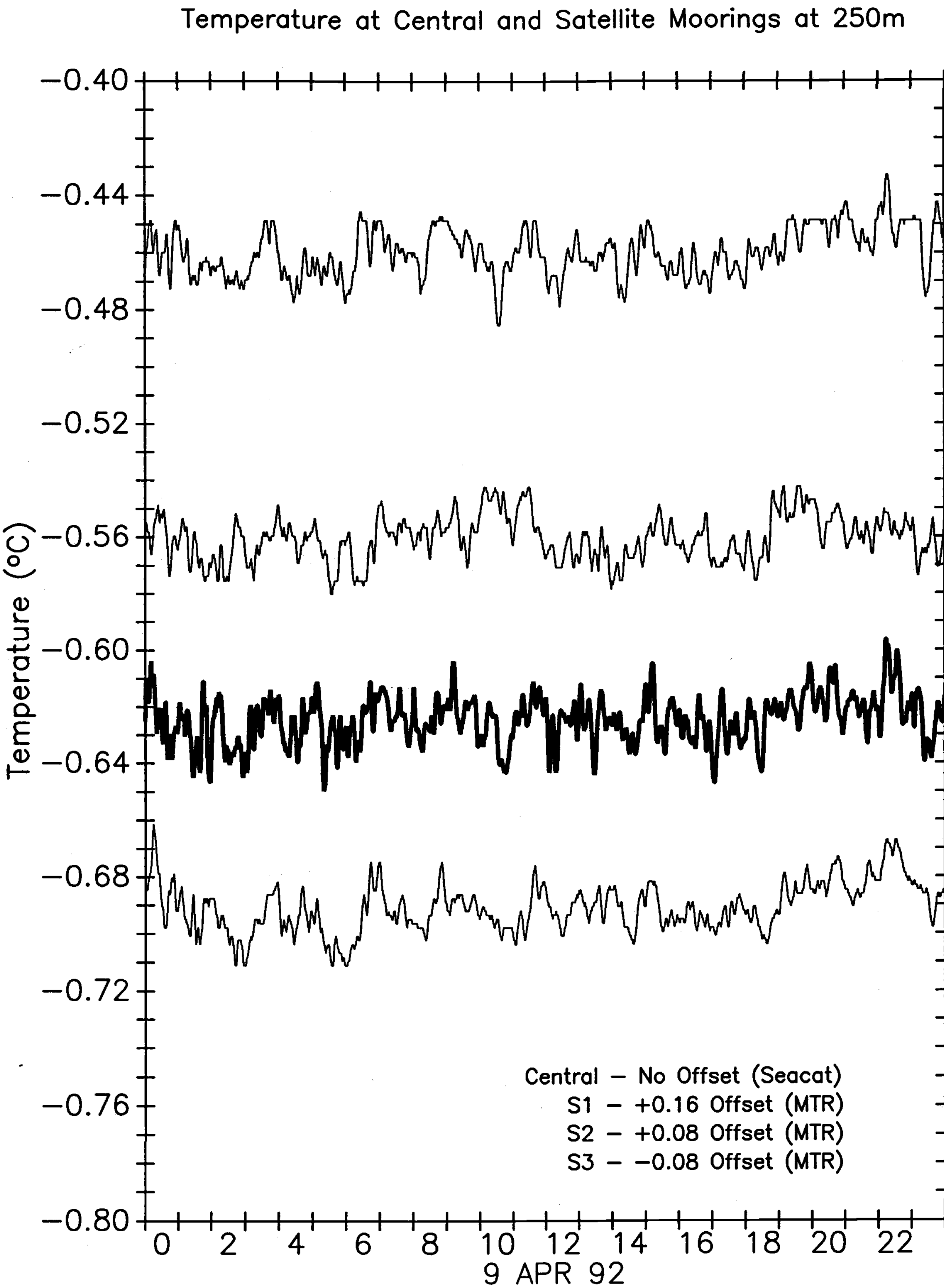
−0.44
−0.48
−0.52
−0.56
−0.60
−0.64
−0.68
−0.72
−0.76
−0.80
0 2 4 6 8 10 12 14 16 18 20 22
8 APR 92
Central – No Offset (Seacat)
S1 – +0.16 Offset (MTR)
S2 – +0.08 Offset (MTR)
S3 – −0.08 Offset (MTR)


Temperature at Central and Satellite Moorings at 250m
Temperature (°C)
−0.40
−0.44
−0.48
−0.52
−0.56
−0.60
−0.64
−0.68
−0.72
−0.76
−0.80
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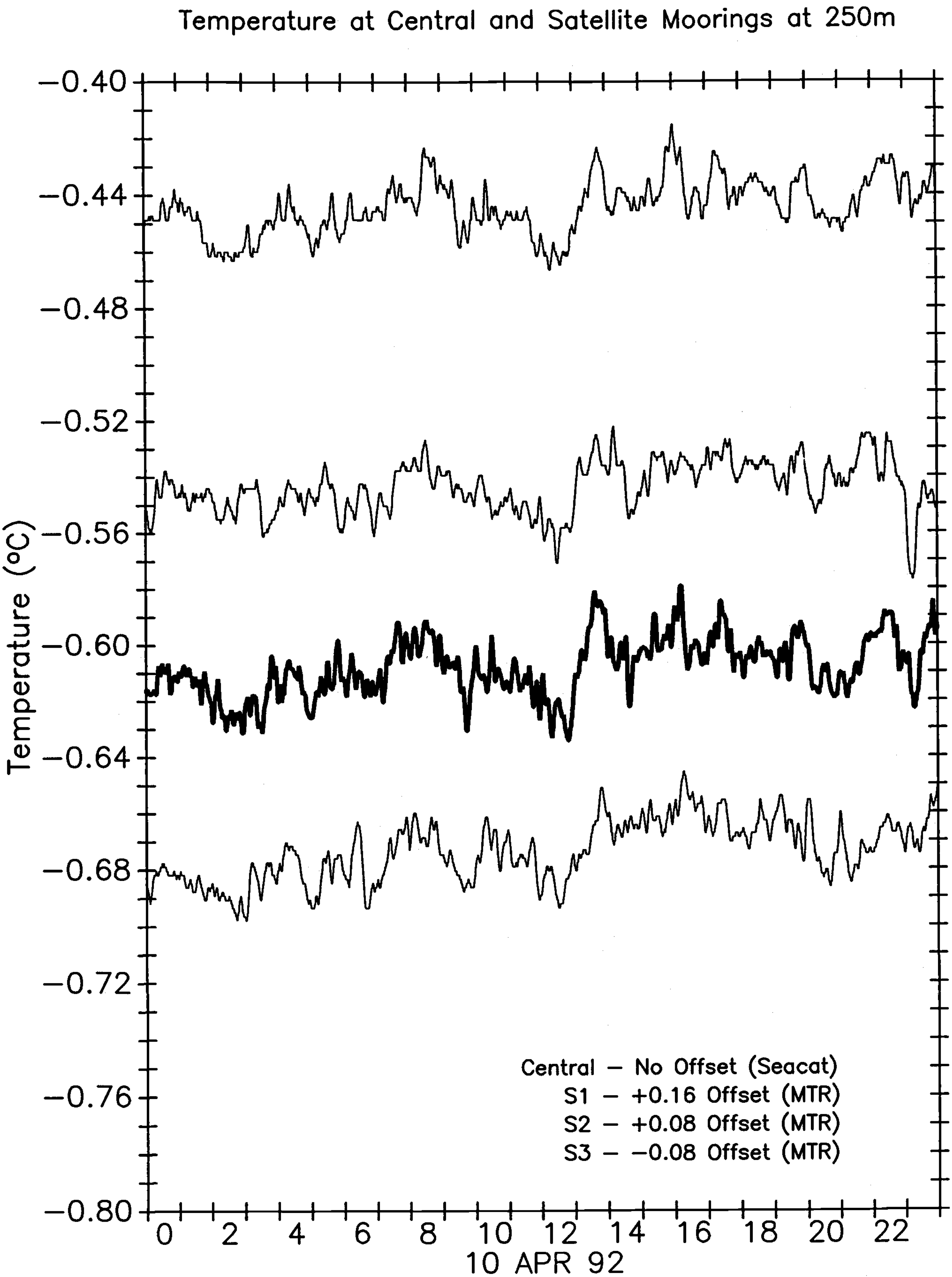
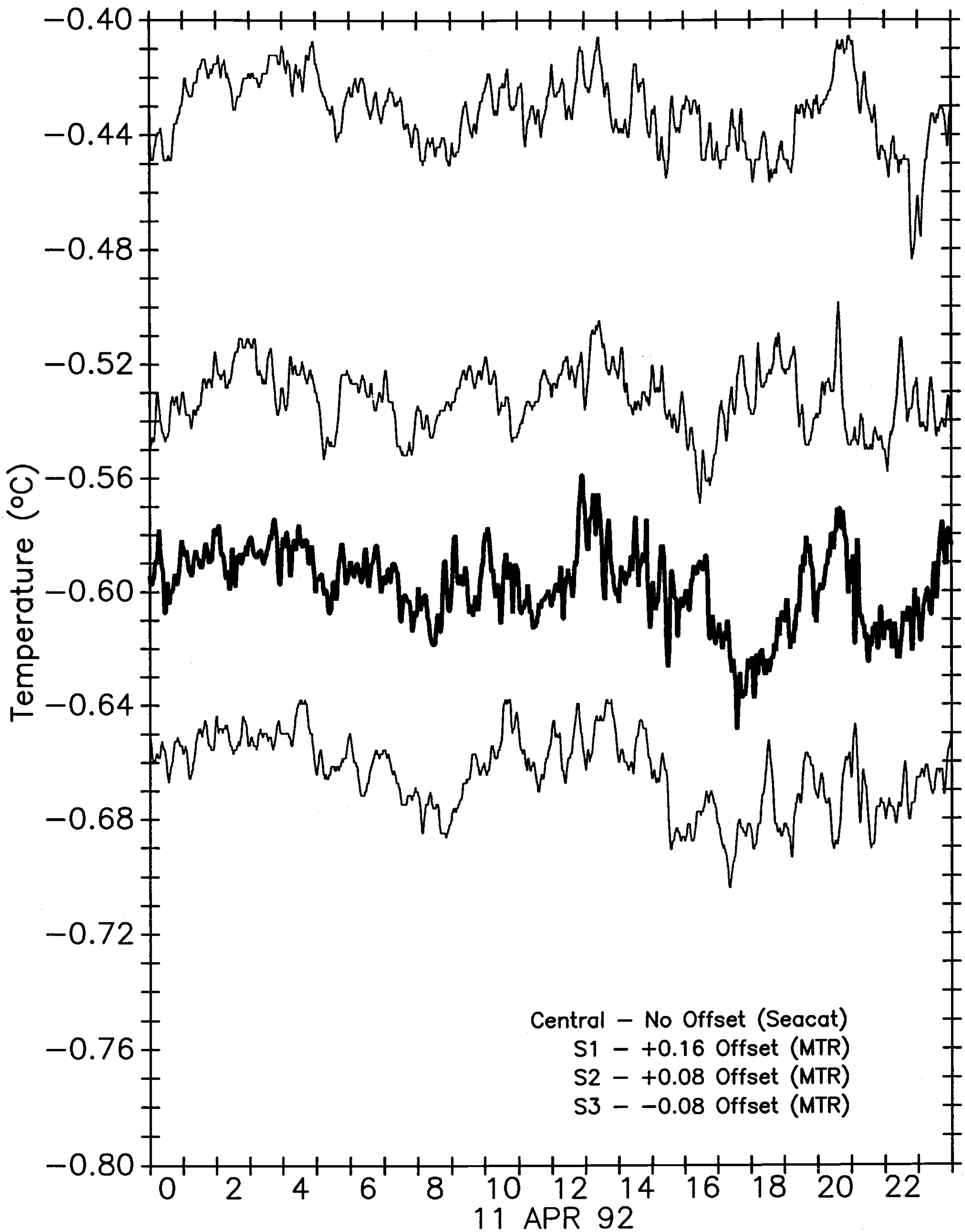
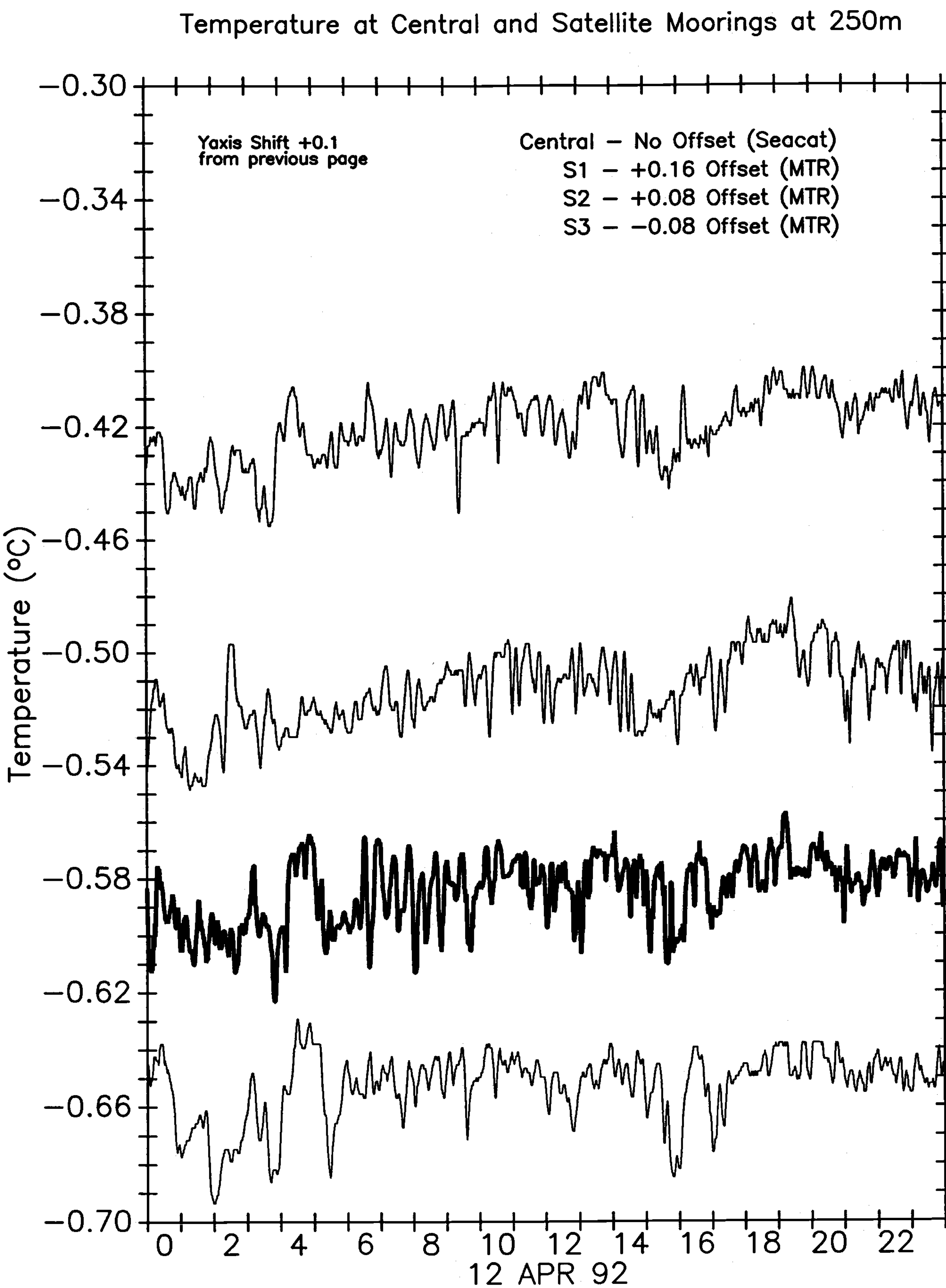
9 APR 92
Central − No Offset (Seacat)
S1 − +0.16 Offset (MTR)
S2 − +0.08 Offset (MTR)
S3 − −0.08 Offset (MTR)


Temperature at Central and Satellite Moorings at 250m
Temperature (°C)
−0.40
−0.44
−0.48
−0.52
−0.56
−0.60
−0.64
−0.68
−0.72
−0.76
−0.80
0 2 4 6 8 10 12 14 16 18 20 22
10 APR 92
Central – No Offset (Seacat)
S1 – +0.16 Offset (MTR)
S2 – +0.08 Offset (MTR)
S3 – −0.08 Offset (MTR)

Temperature at Central and Satellite Moorings at 250m




Temperature at Central and Satellite Moorings at 250m
Yaxis Shift +0.1
from previous page
Central – No Offset (Seacat)
S1 – +0.16 Offset (MTR)
S2 – +0.08 Offset (MTR)
S3 – −0.08 Offset (MTR)
Temperature (°C)
−0.30
−0.34
−0.38
−0.42
−0.46
−0.50
−0.54
−0.58
−0.62
−0.66
−0.70
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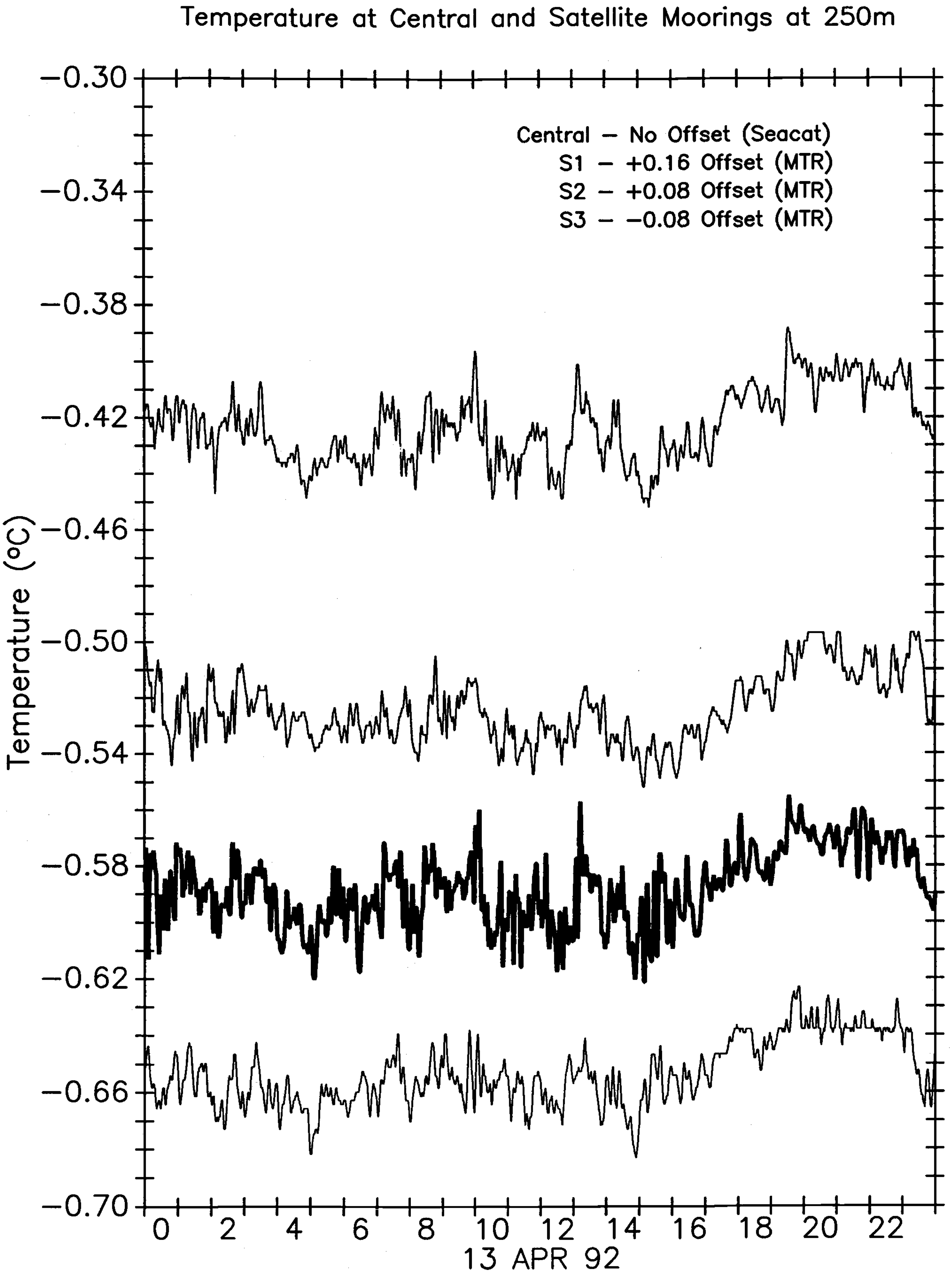
12 APR 92


Temperature at Central and Satellite Moorings at 250m
Central – No Offset (Seacat)
S1 – +0.16 Offset (MTR)
S2 – +0.08 Offset (MTR)
S3 – −0.08 Offset (MTR)
Temperature (°C)
−0.30
−0.34
−0.38
−0.42
−0.46
−0.50
−0.54
−0.58
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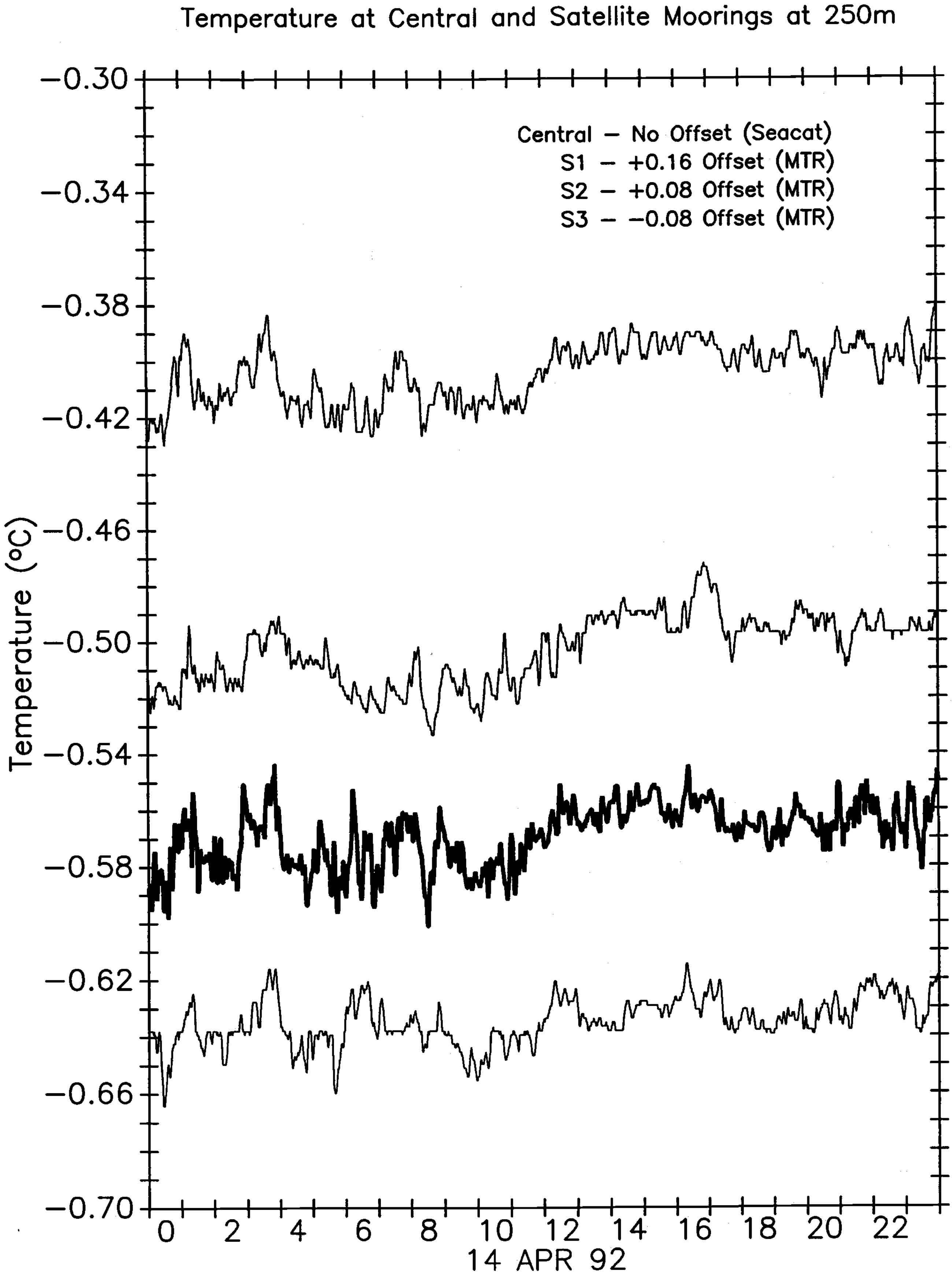
13 APR 92


Temperature at Central and Satellite Moorings at 250m
Central – No Offset (Seacat)
S1 – +0.16 Offset (MTR)
S2 – +0.08 Offset (MTR)
S3 – −0.08 Offset (MTR)
Temperature (°C)
−0.30
−0.34
−0.38
−0.42
−0.46
−0.50
−0.54
−0.58
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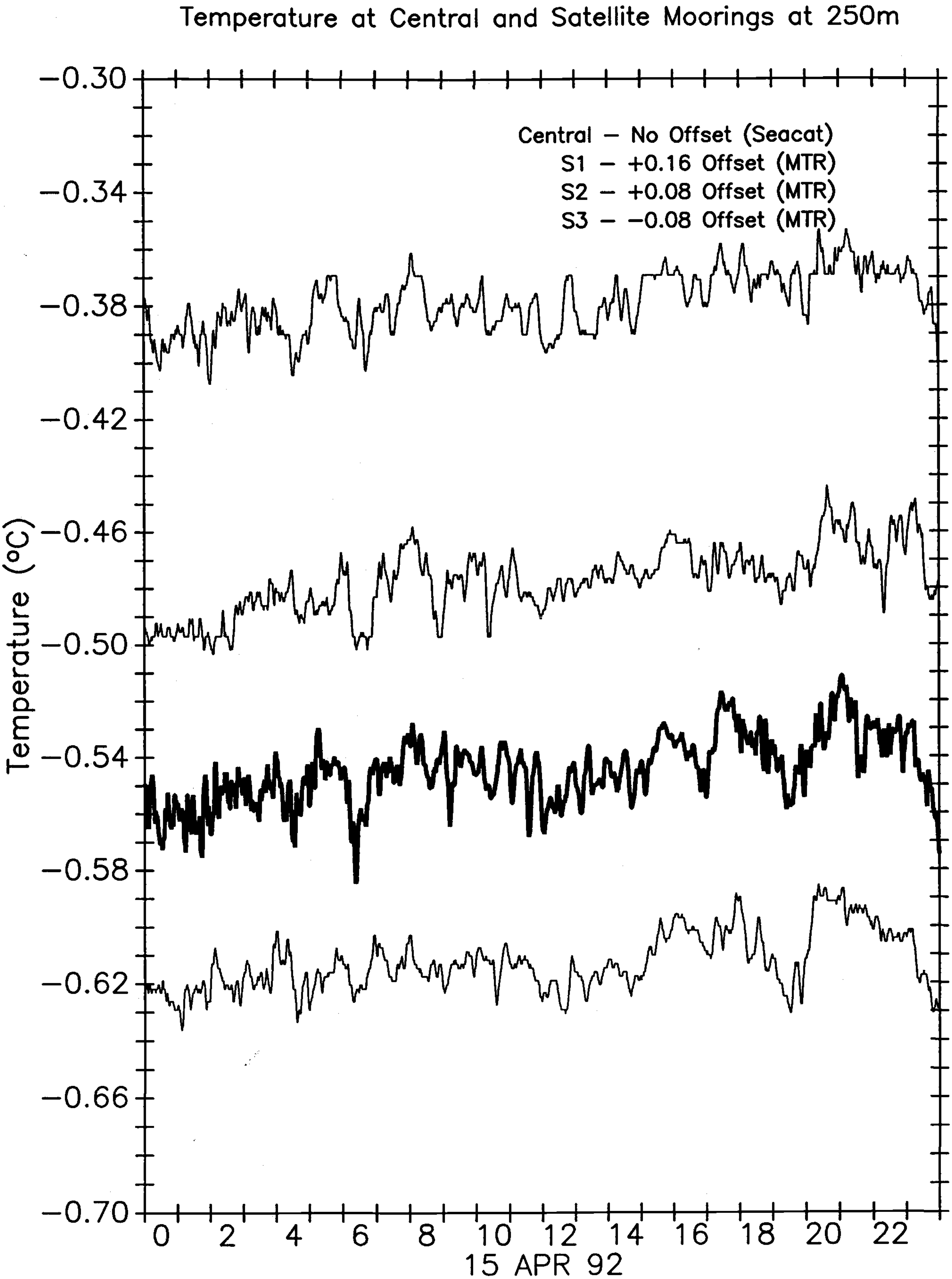
14 APR 92


Temperature at Central and Satellite Moorings at 250m
Central – No Offset (Seacat)
S1 – +0.16 Offset (MTR)
S2 – +0.08 Offset (MTR)
S3 – −0.08 Offset (MTR)
Temperature (°C)
−0.30
−0.34
−0.38
−0.42
−0.46
−0.50
−0.54
−0.58
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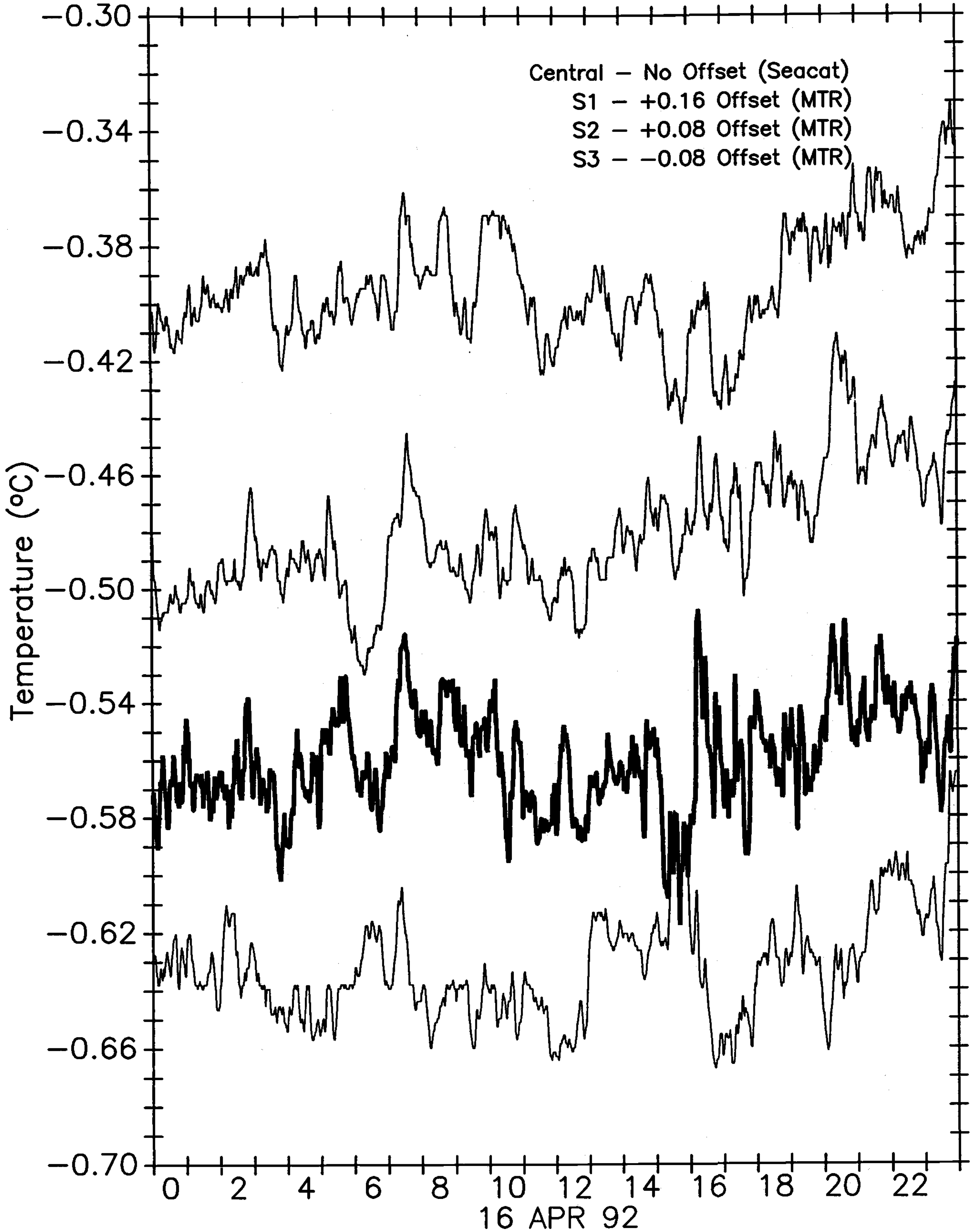
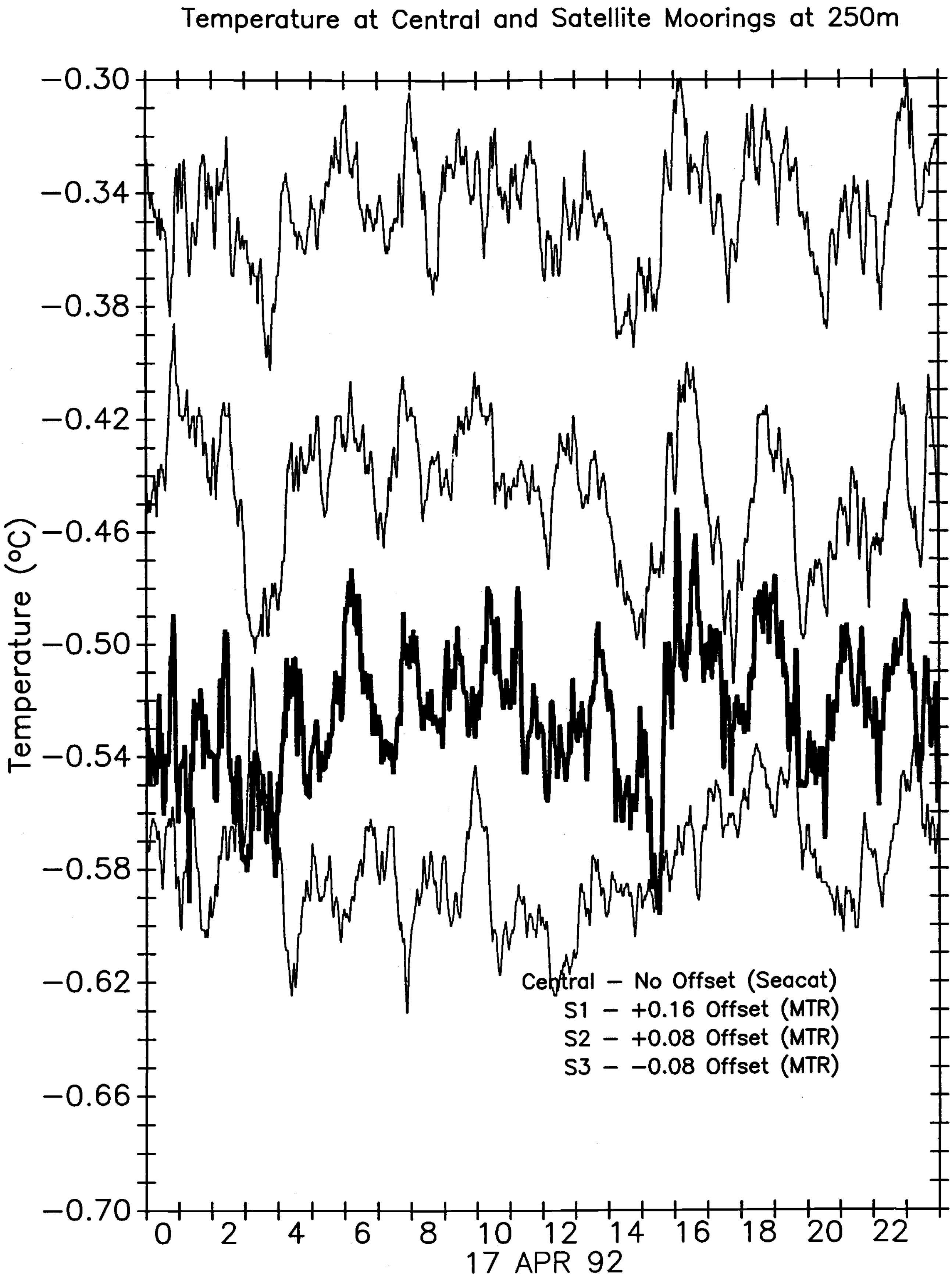
−0.70
0 2 4 6 8 10 12 14 16 18 20 22
15 APR 92

Temperature at Central and Satellite Moorings at 250m





Temperature at Central and Satellite Moorings at 250m
−0.30
−0.34
−0.38
−0.42
−0.46
−0.50
−0.54
−0.58
−0.62
−0.66
−0.70
Temperature (°C)
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4
6
8
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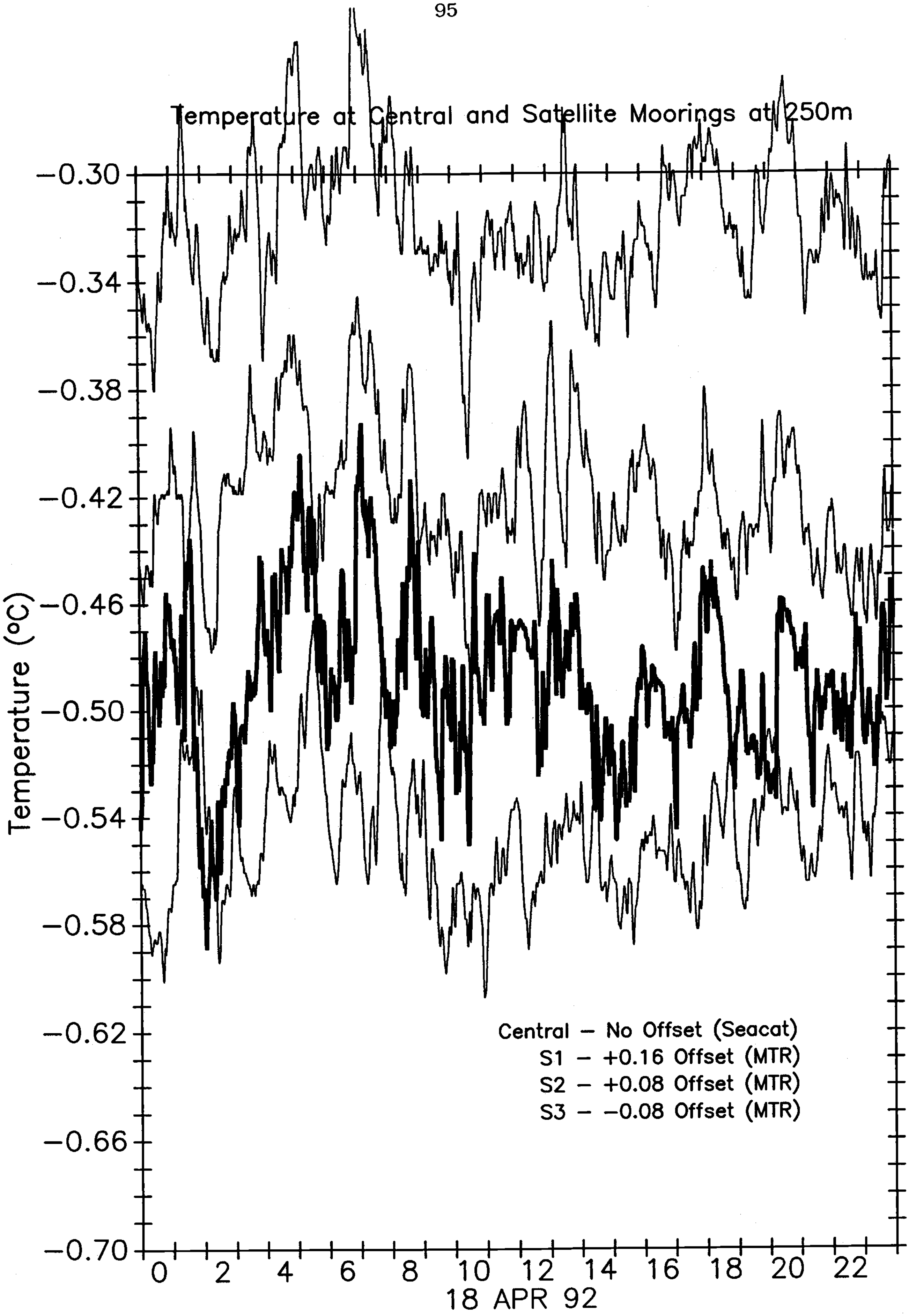
22
17 APR 92
Central − No Offset (Seacat)
S1 − +0.16 Offset (MTR)
S2 − +0.08 Offset (MTR)
S3 − −0.08 Offset (MTR)


Temperature at Central and Satellite Moorings at 250m
−0.30
−0.34
−0.38
−0.42
−0.46
−0.50
−0.54
−0.58
−0.62
−0.66
−0.70
Temperature (°C)
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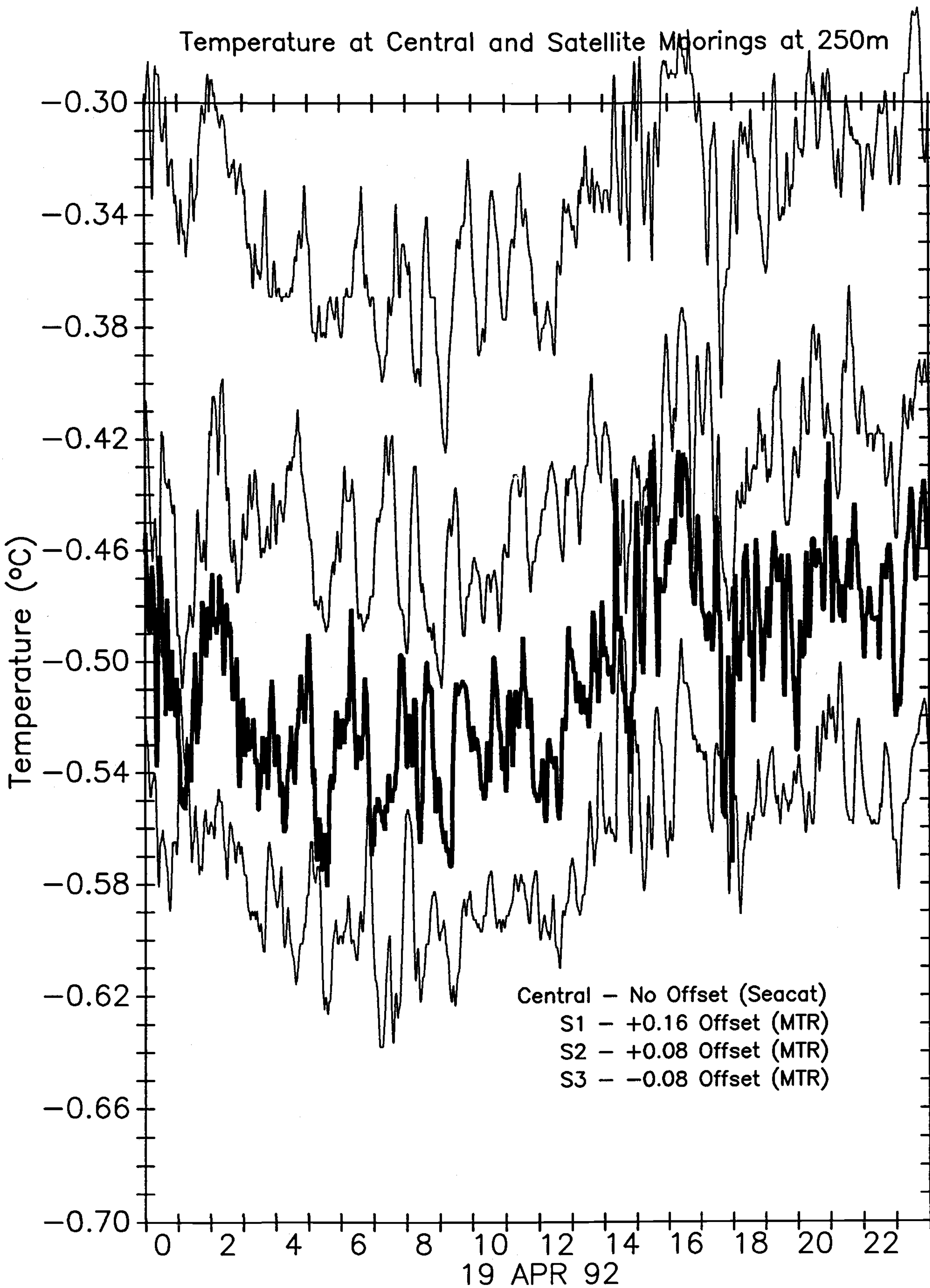
18 APR 92
Central − No Offset (Seacat)
S1 − +0.16 Offset (MTR)
S2 − +0.08 Offset (MTR)
S3 − −0.08 Offset (MTR)


Temperature at Central and Satellite Moorings at 250m
Temperature (°C)
−0.30
−0.34
−0.38
−0.42
−0.46
−0.50
−0.54
−0.58
−0.62
−0.66
−0.70
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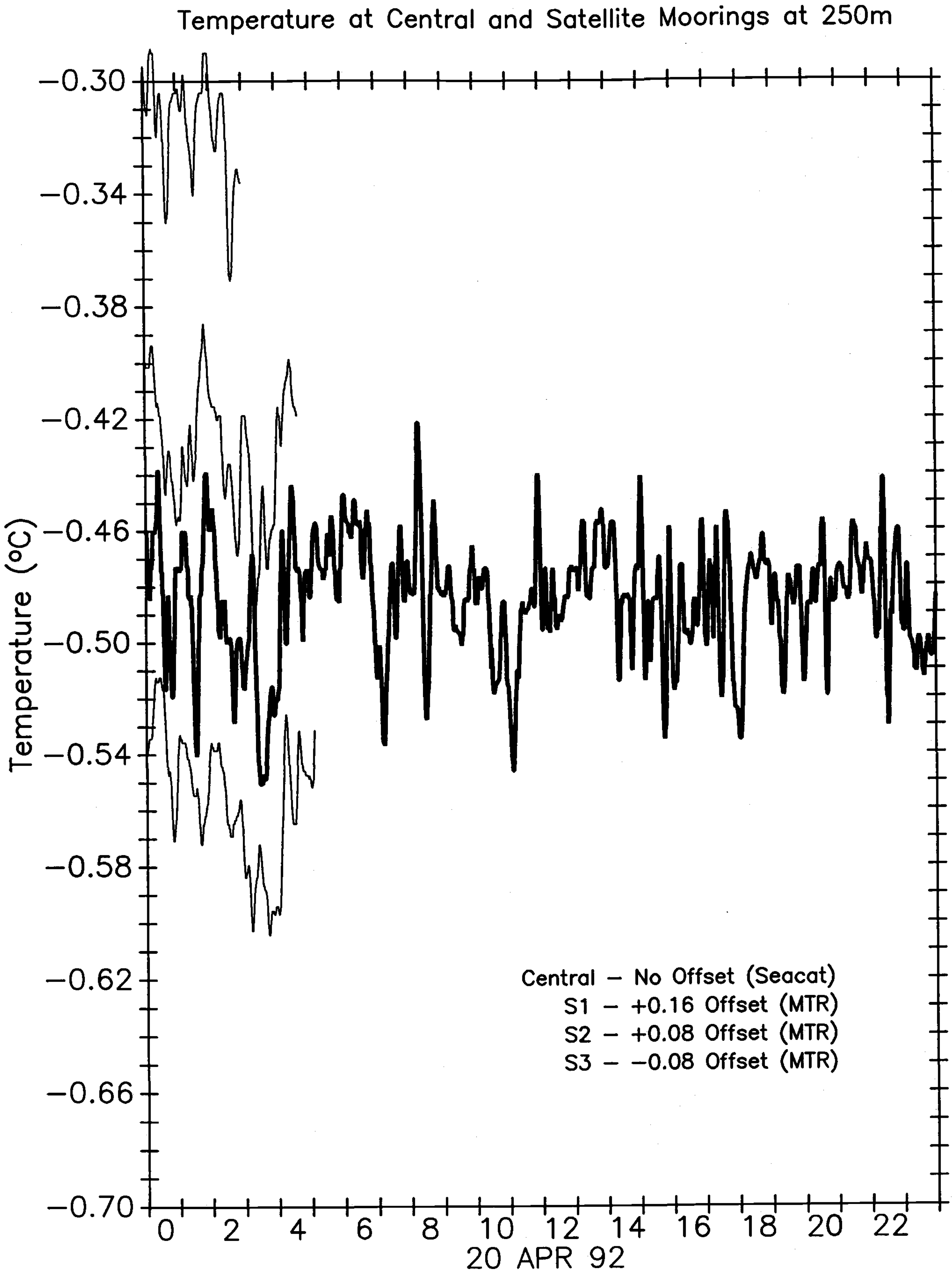
19 APR 92
Central – No Offset (Seacat)
S1 – +0.16 Offset (MTR)
S2 – +0.08 Offset (MTR)
S3 – −0.08 Offset (MTR)


Temperature at Central and Satellite Moorings at 250m
Temperature (°C)
−0.30
−0.34
−0.38
−0.42
−0.46
−0.50
−0.54
−0.58
−0.62
−0.66
−0.70
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22
20 APR 92
Central – No Offset (Seacat)
S1 – +0.16 Offset (MTR)
S2 – +0.08 Offset (MTR)
S3 – −0.08 Offset (MTR)

SPECTRA and COHERENCES of VERTICAL DISPLACEMENT

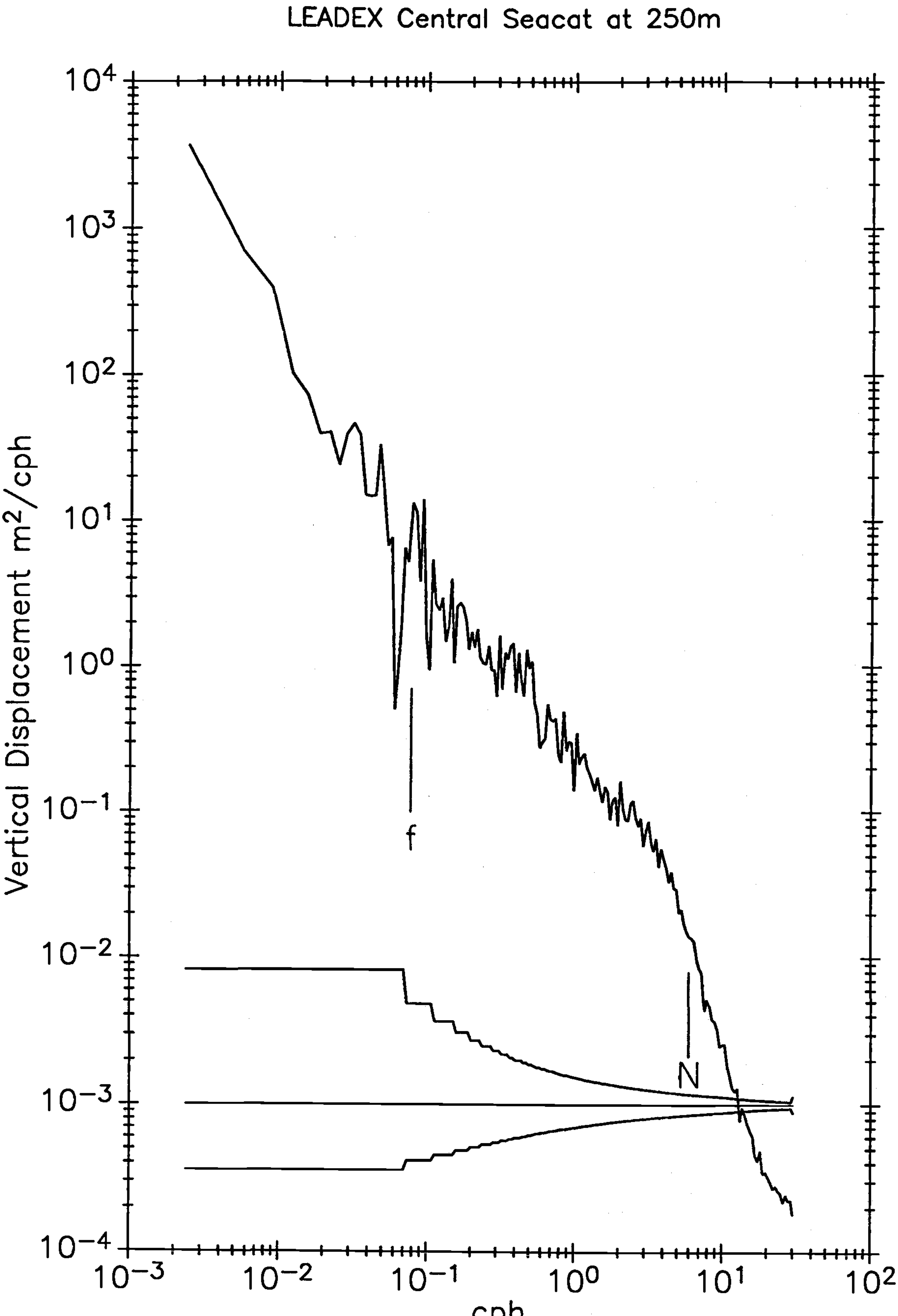
Vertical displacement is inferred from temperature fluctuations by dividing by the mean vertical temperature gradient--here taken to be a constant 0.013°C/m. The following 3 plots contain:

- Spectrum from 250 m on Central mooring (Seacat). The 95% confidence limits are also shown.

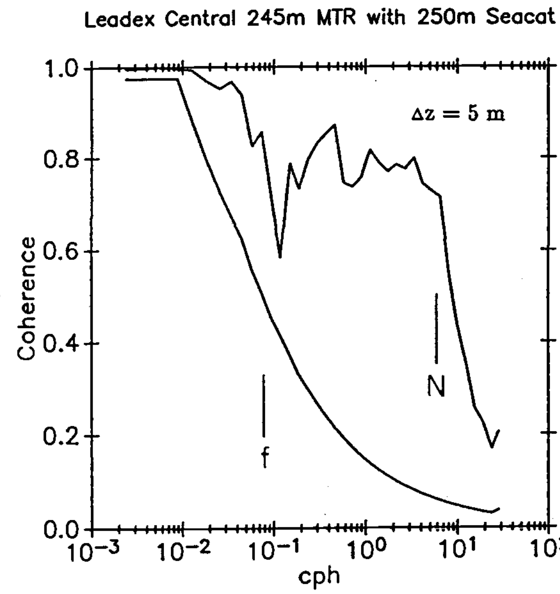
- Vertical coherence from Central mooring (MTR, Seacat). Coherences are shown for vertical separations from 5 to 30 m around 250 m depth. Values above the solid line are non-zero at the 95% confidence level.

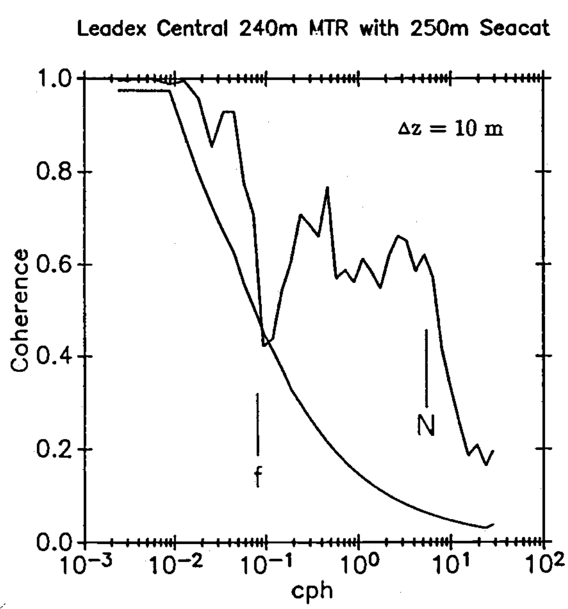
- Horizontal coherences between Central and Satellite moorings (MTR, Seacat) at 250 m depth. Values above the solid line are non-zero at the 95% confidence level.

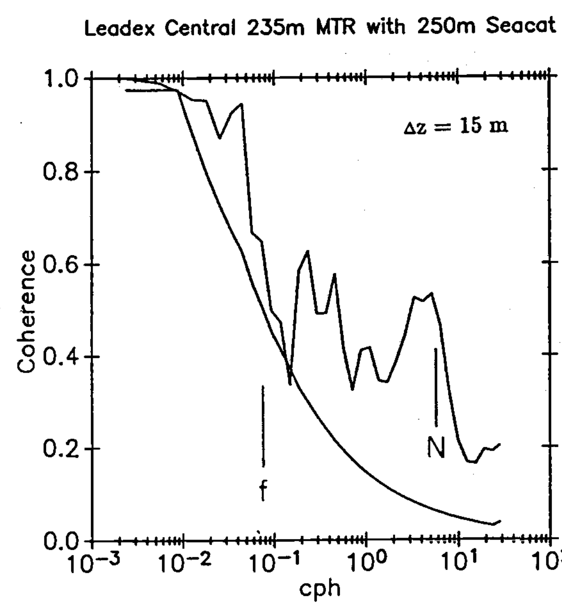
These spectral quantities were estimated from the entire data record (about 1 month).

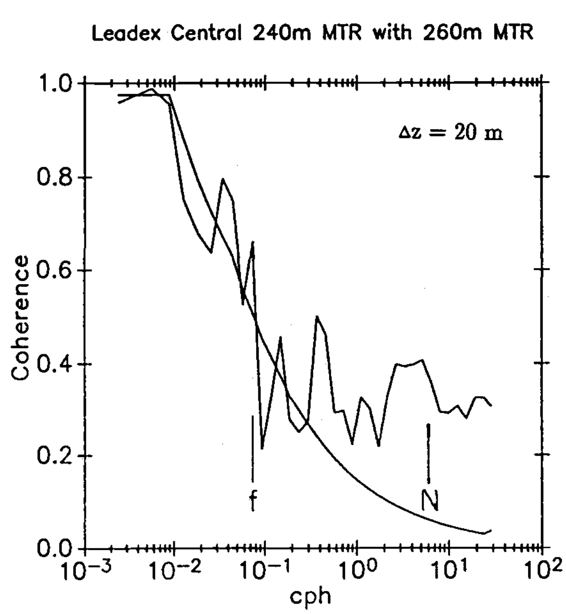

LEADEX Central Seacat at 250m
Vertical Displacement m²/cph
cph
f
N
10⁴
10³
10²
10¹
10⁰
10⁻¹
10⁻²
10⁻³
10⁻⁴
10⁻³
10⁻²
10⁻¹
10⁰
10¹
10²

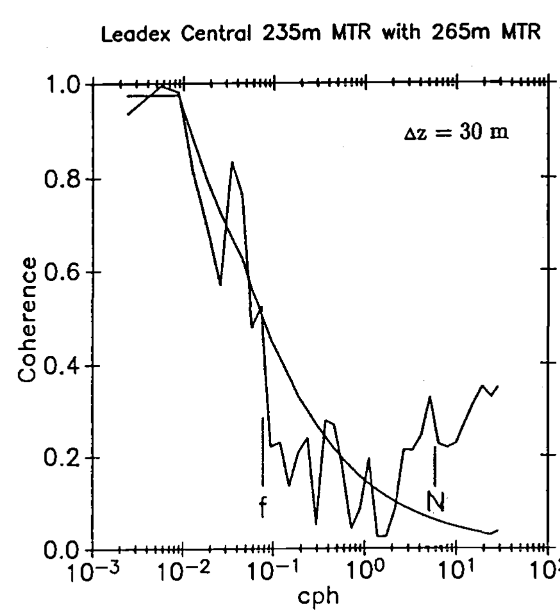
Vertical Coherence of
Vertical Displacement
at Central Mooring



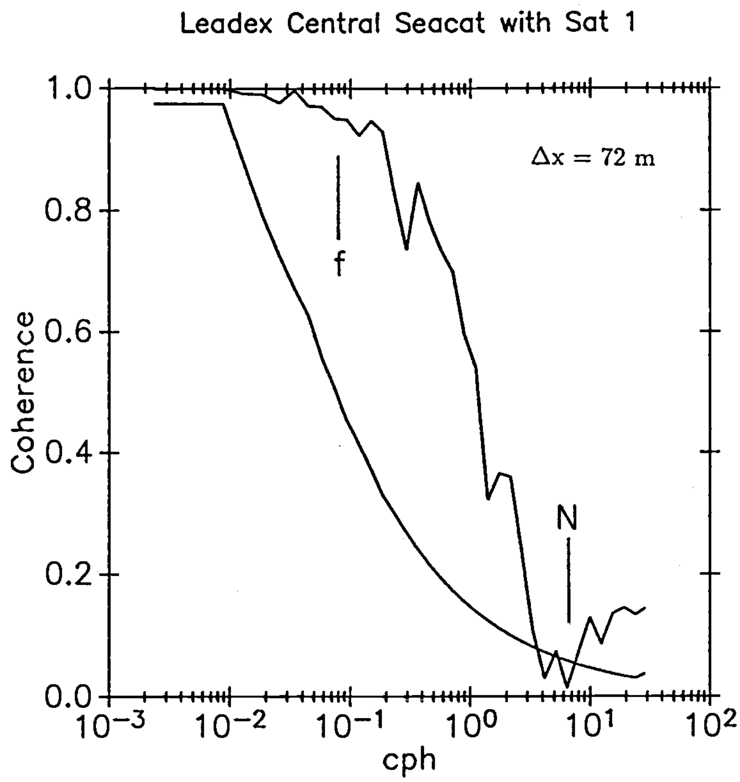


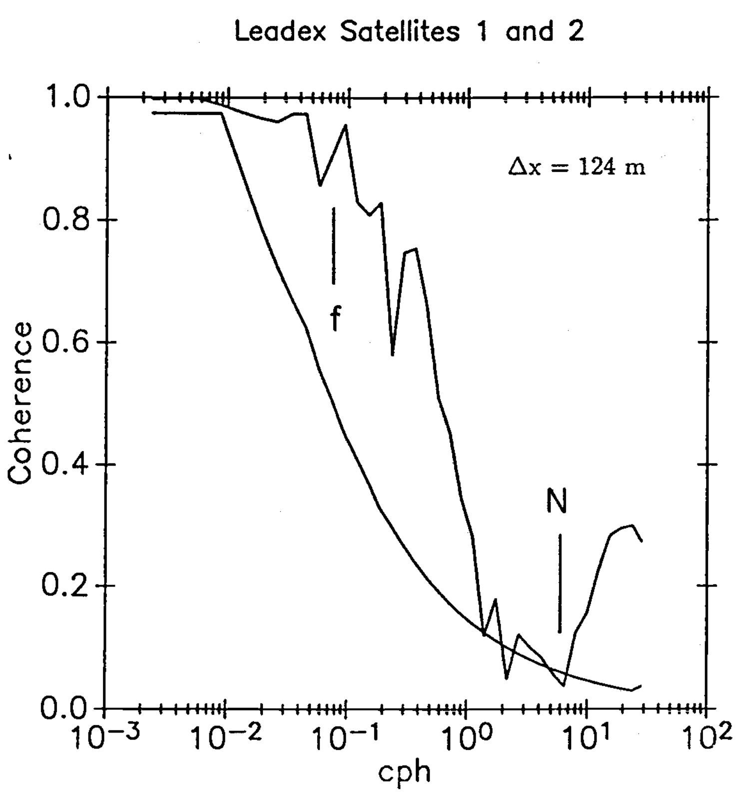






Horizontal Coherence of Vertical Displacement at 250 m.

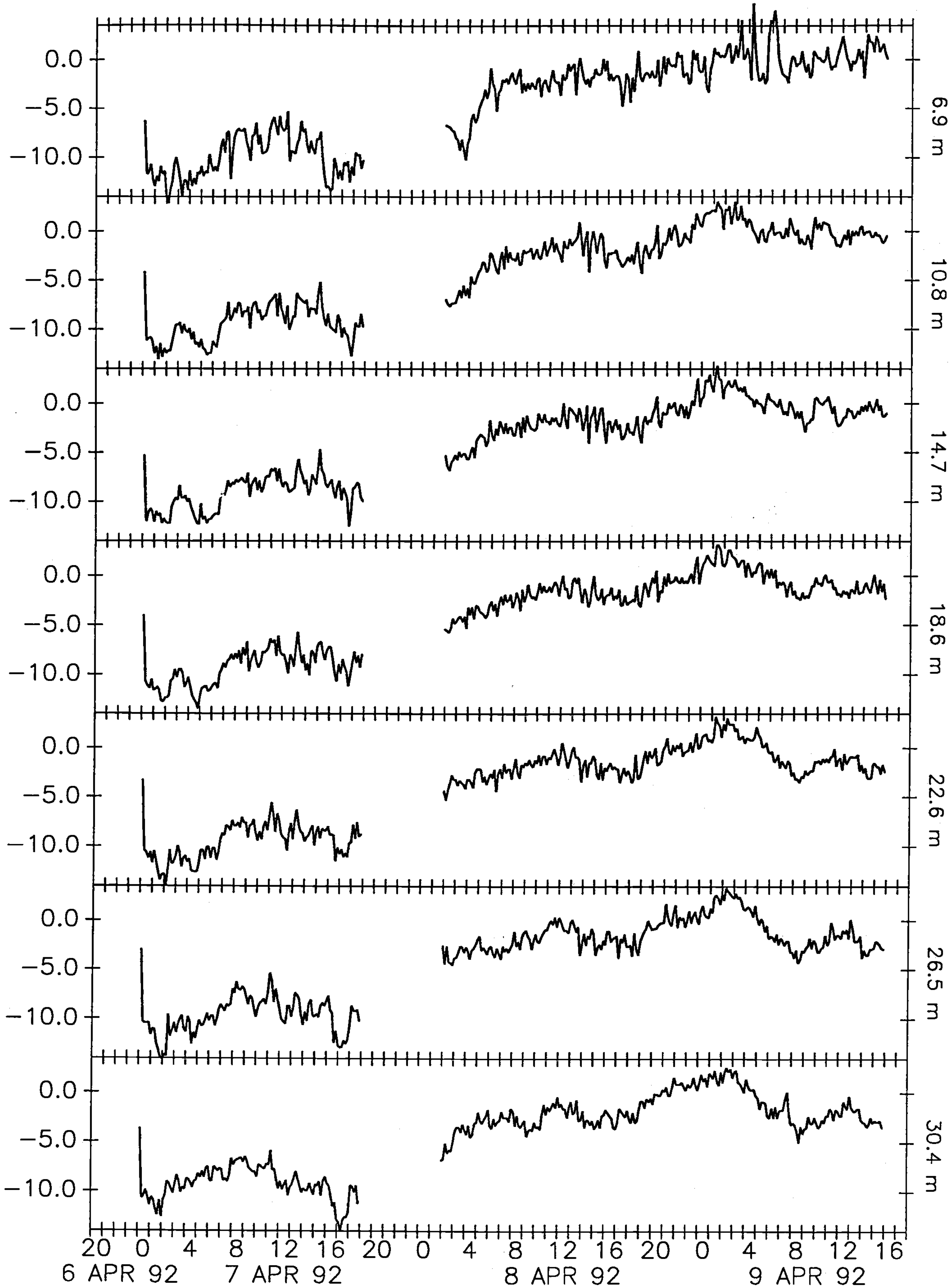


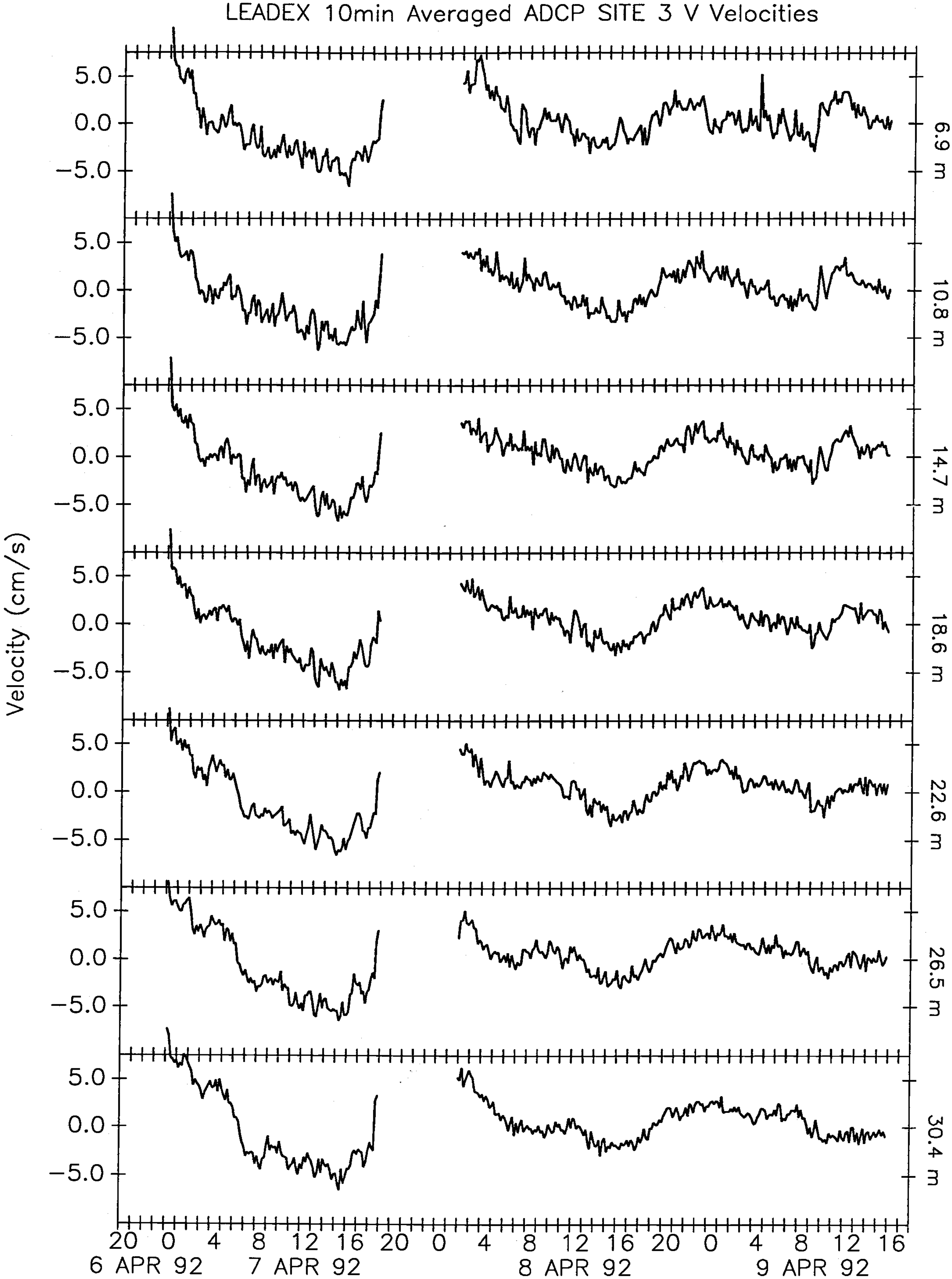


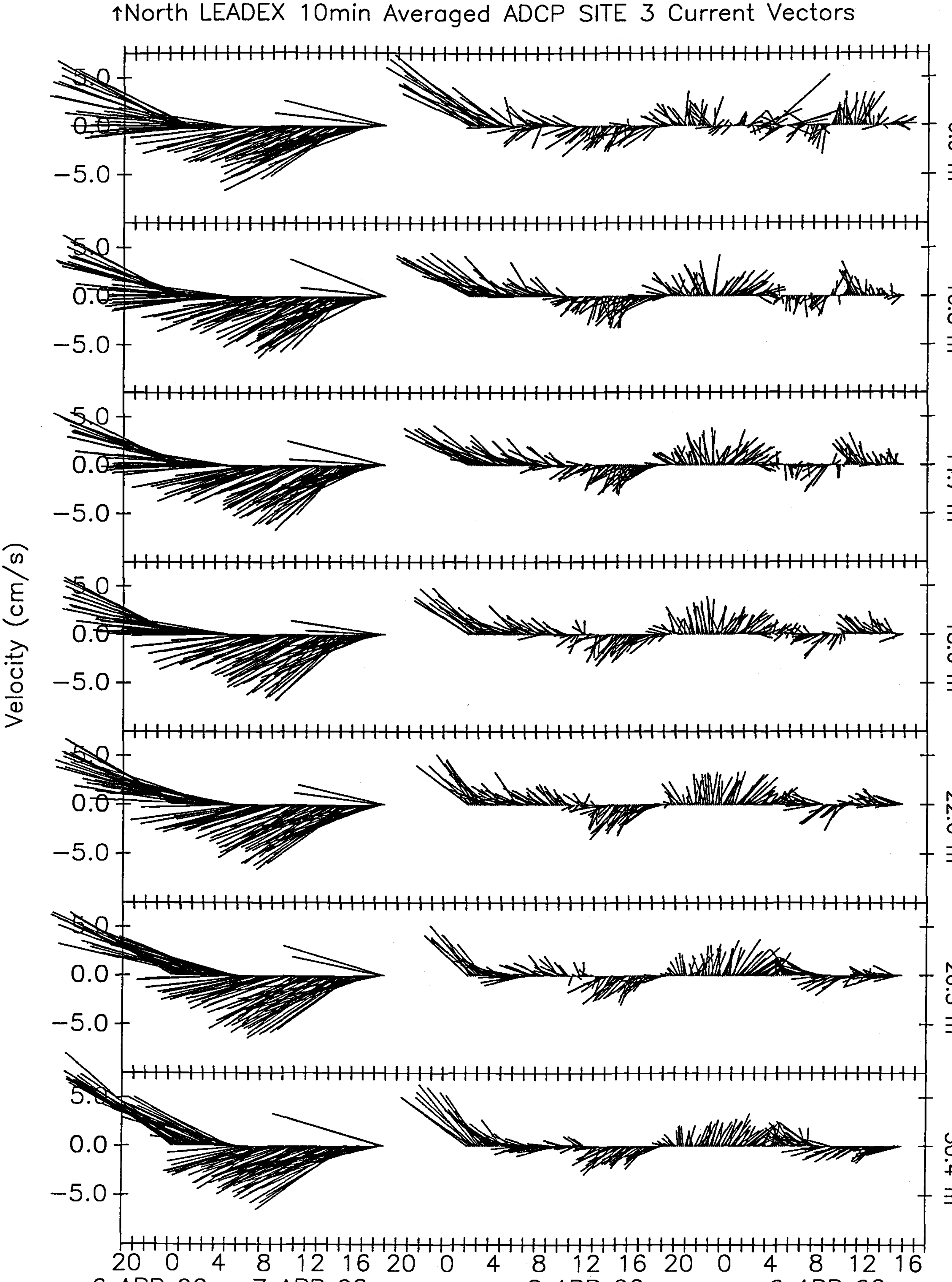
TIME SERIES of VELOCITY from LEAD #3: Line plots relative to ice

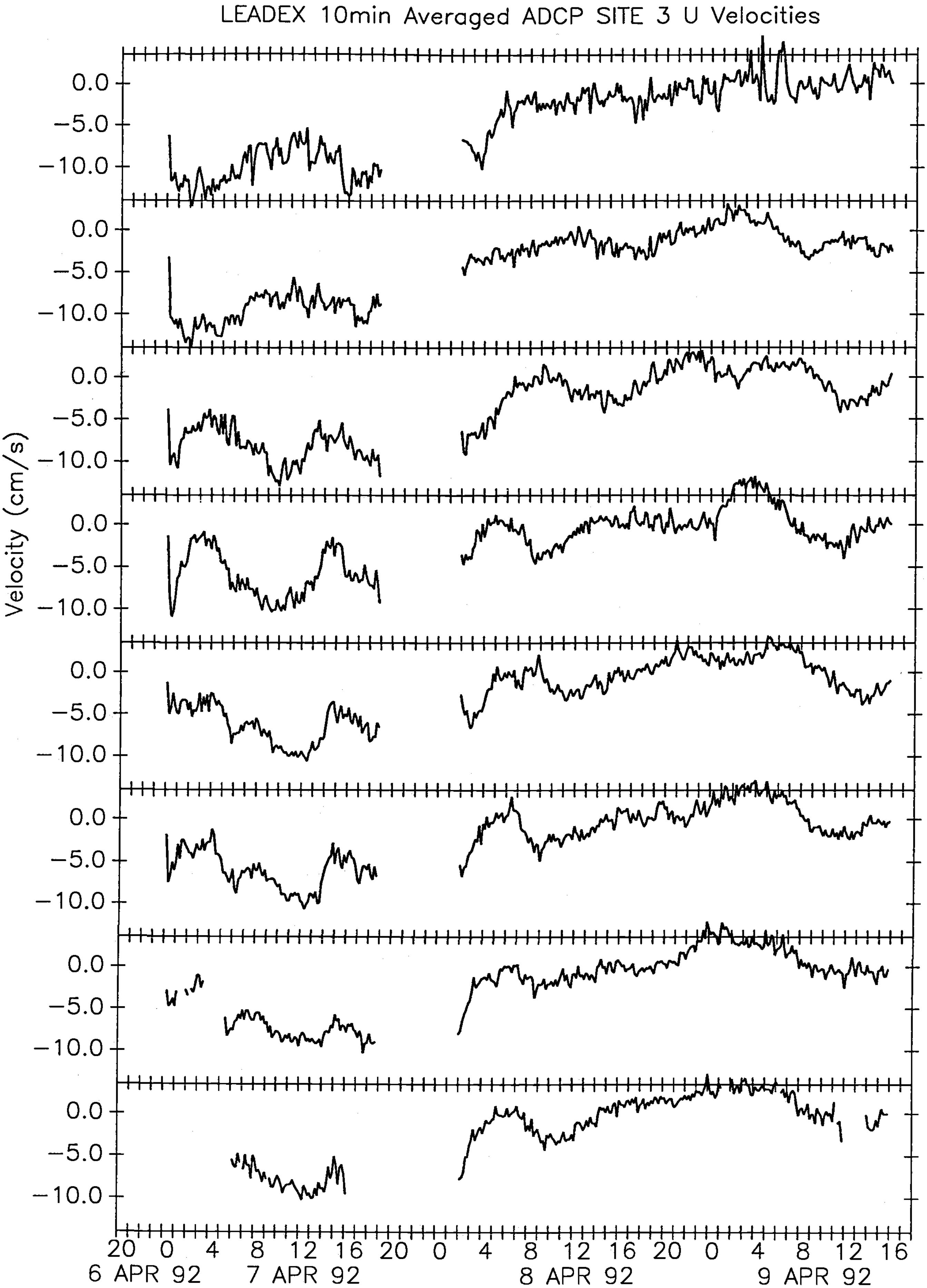
The acoustic Doppler current profiler measured currents from 7 to 128 m. The following 3 pages show observations of u, v, and currents vectors every 4 meters from 7 to 30 m. The next 3 pages show u, v, and current vectors about every 16 meters from 7 to 117 m. All data are derived from all 4 beams and averaged over 10 minutes.

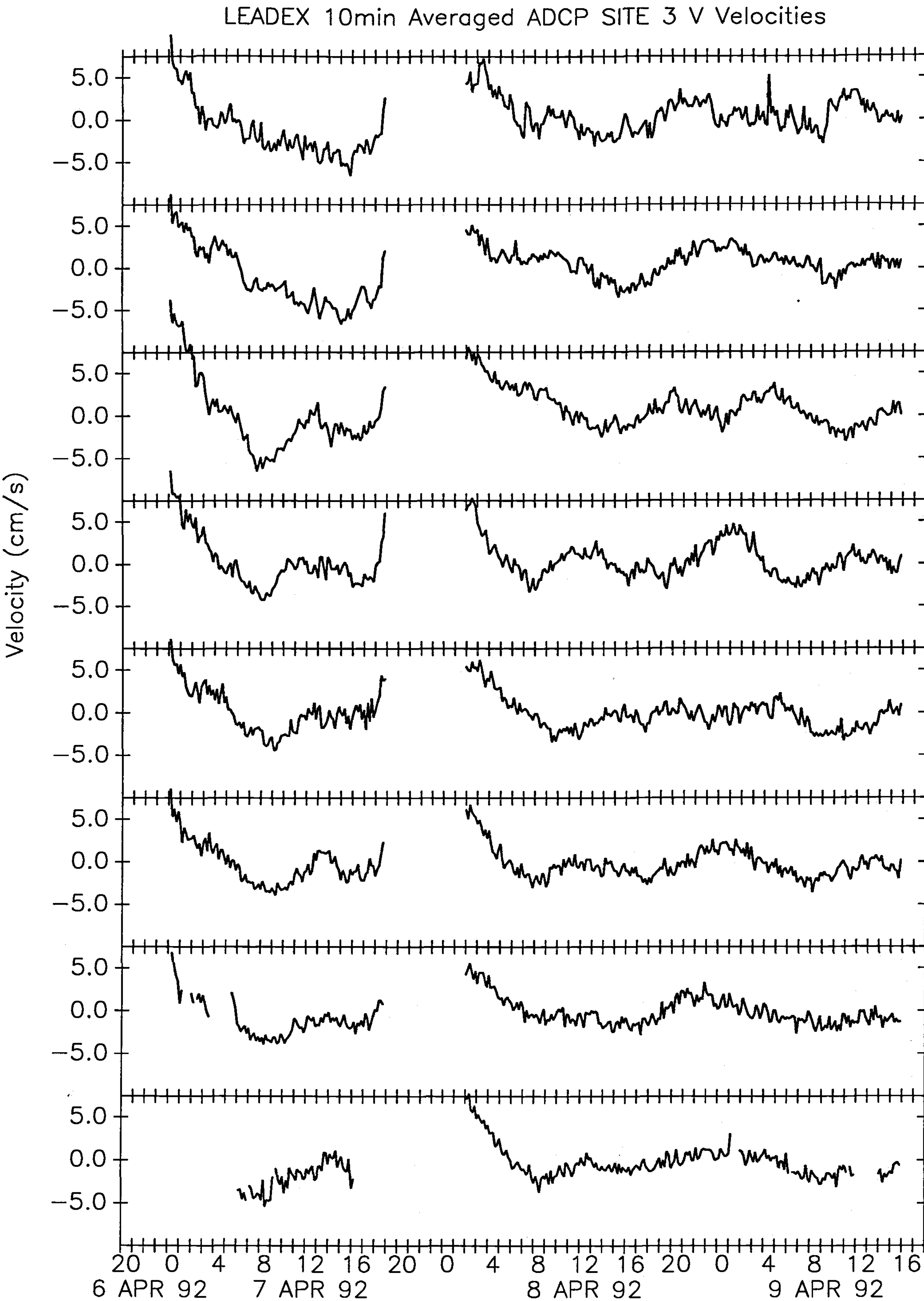
LEADEX 10min Averaged ADCP SITE 3 U Velocities

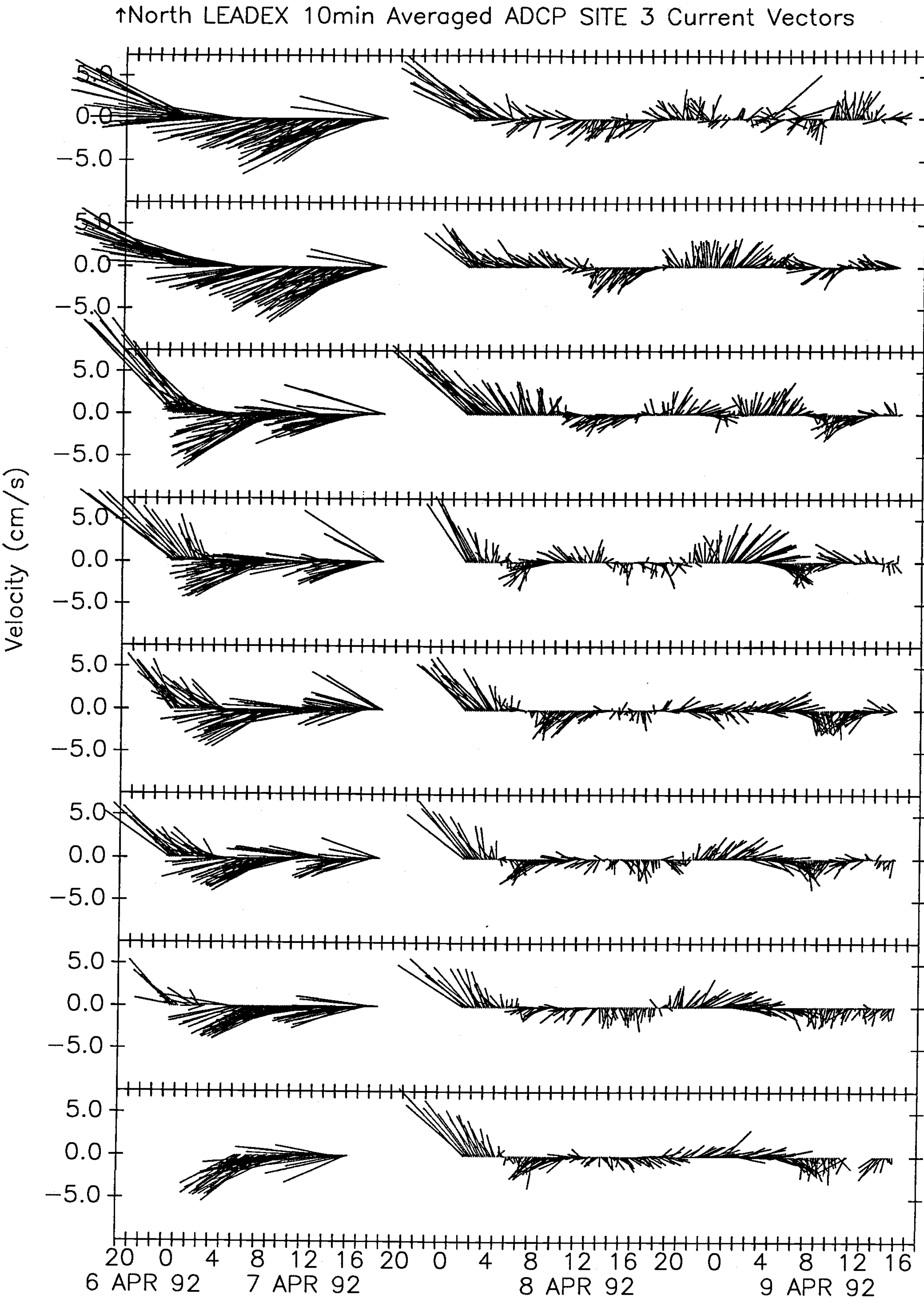



LEADEX 10min Averaged ADCP SITE 3 V Velocities
Velocity (cm/s)
5.0
0.0
−5.0
6.9 m
10.8 m
14.7 m
18.6 m
22.6 m
26.5 m
30.4 m
20 0 4 8 12 16 20 0 4 8 12 16 20 0 4 8 12 16
6 APR 92
7 APR 92
8 APR 92
9 APR 92


↑North LEADEX 10min Averaged ADCP SITE 3 Current Vectors
Velocity (cm/s)
5.0
0.0
-5.0
6.9 m
10.8 m
14.7 m
18.6 m
22.6 m
26.5 m
30.4 m
20 0 4 8 12 16 20 0 4 8 12 16 20 0 4 8 12 16
6 APR 92
7 APR 92
8 APR 92
9 APR 92


LEADEX 10min Averaged ADCP SITE 3 U Velocities
Velocity (cm/s)
0.0
−5.0
−10.0
6.9 m
22.6 m
38.2 m
53.9 m
69.6 m
85.2 m
100.9 m
116.6 m
20 0 4 8 12 16 20 0 4 8 12 16 20 0 4 8 12 16
6 APR 92
7 APR 92
8 APR 92
9 APR 92

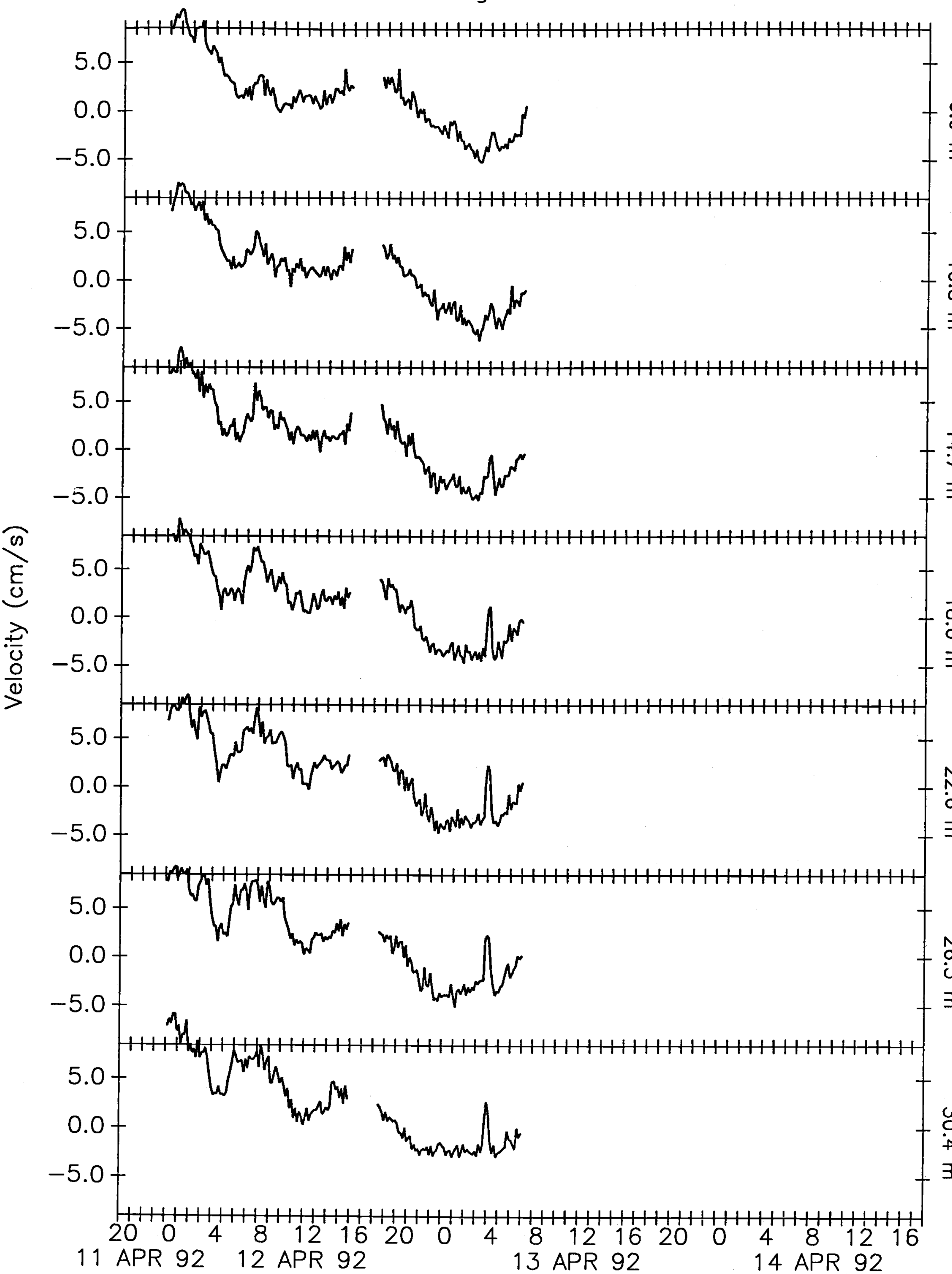

LEADEX 10min Averaged ADCP SITE 3 V Velocities
Velocity (cm/s)
5.0
0.0
−5.0
6.9 m
22.6 m
38.2 m
53.9 m
69.6 m
85.2 m
100.9 m
116.6 m
20 0 4 8 12 16 20 0 4 8 12 16 20 0 4 8 12 16
6 APR 92
7 APR 92
8 APR 92
9 APR 92


↑North LEADEX 10min Averaged ADCP SITE 3 Current Vectors
Velocity (cm/s)
5.0
0.0
−5.0
6.9 m
22.6 m
38.2 m
53.9 m
69.6 m
85.2 m
100.9 m
116.6 m
20 0 4 8 12 16 20 0 4 8 12 16 20 0 4 8 12 16
6 APR 92
7 APR 92
8 APR 92
9 APR 92

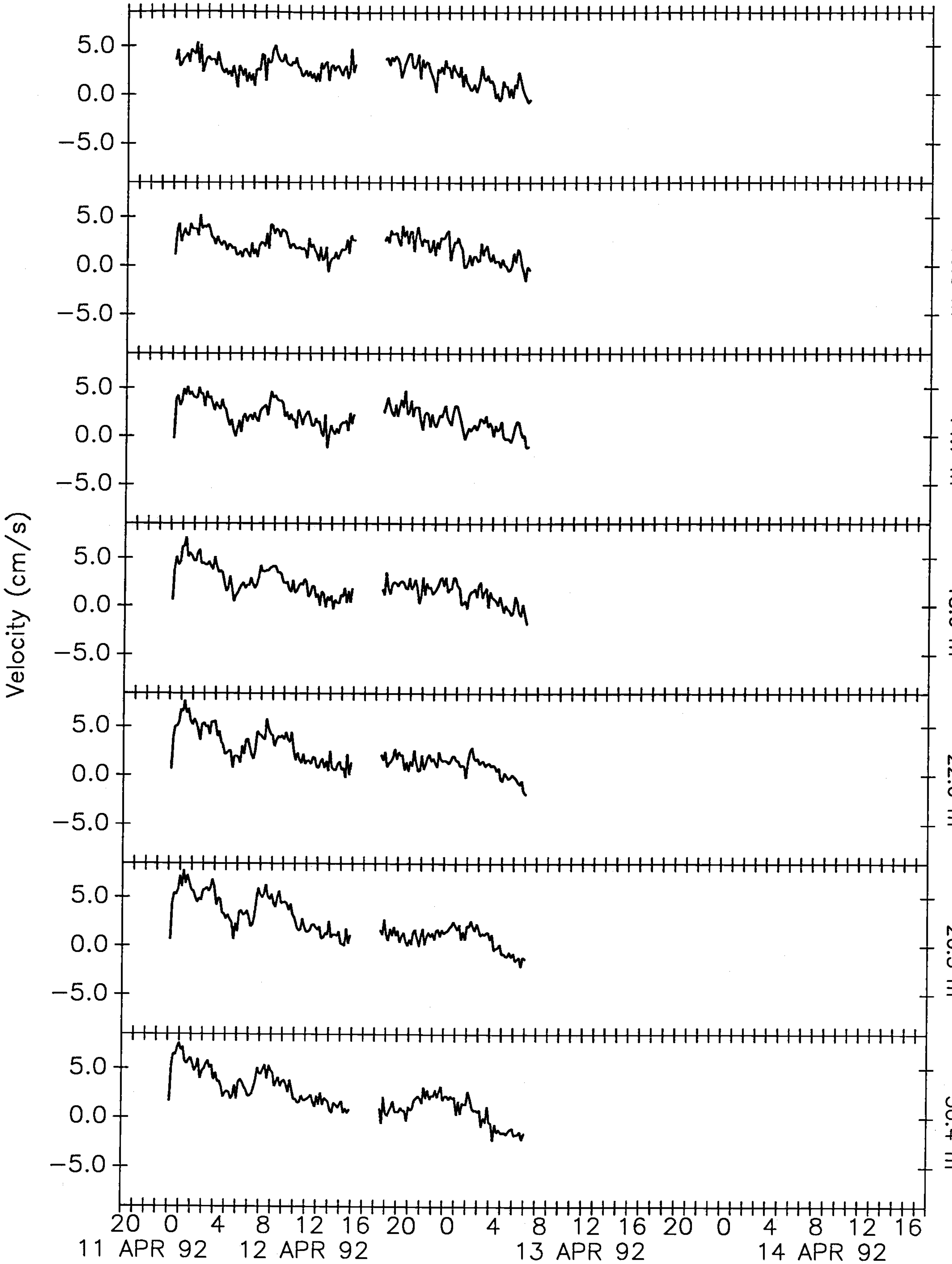
TIME SERIES of VELOCITY from LEAD #4: Line plots relative to ice

The acoustic Doppler current profiler measured currents from 7 to 128 m. The following 3 pages show observations of u, v, and currents vectors every 4 meters from 7 to 30 m. The next 3 pages show u, v, and current vectors about every 16 meters from 7 to 117 m. All data are derived from all 4 beams and averaged over 10 minutes.

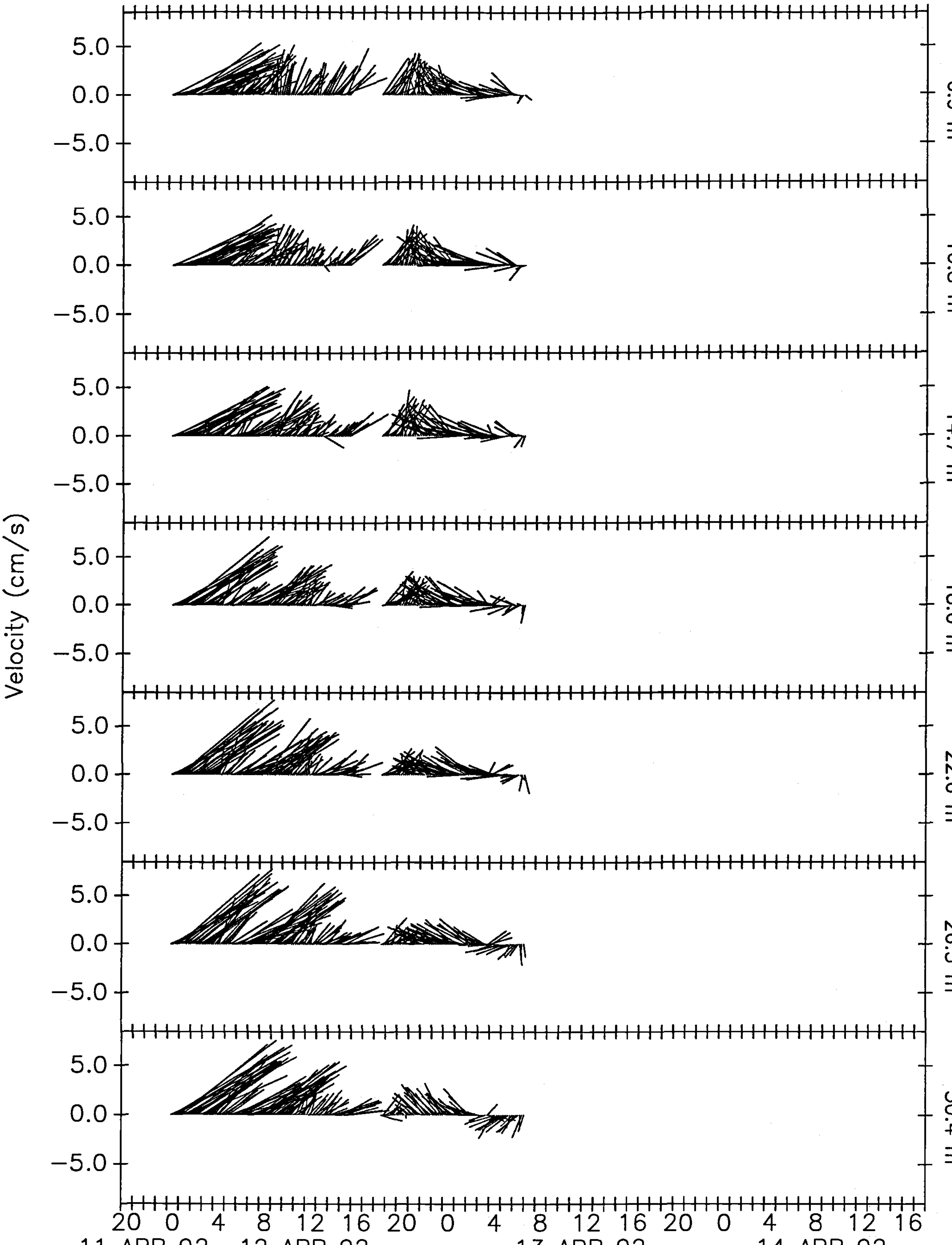
LEADEX 10min Averaged ADCP SITE 4 U Velocities

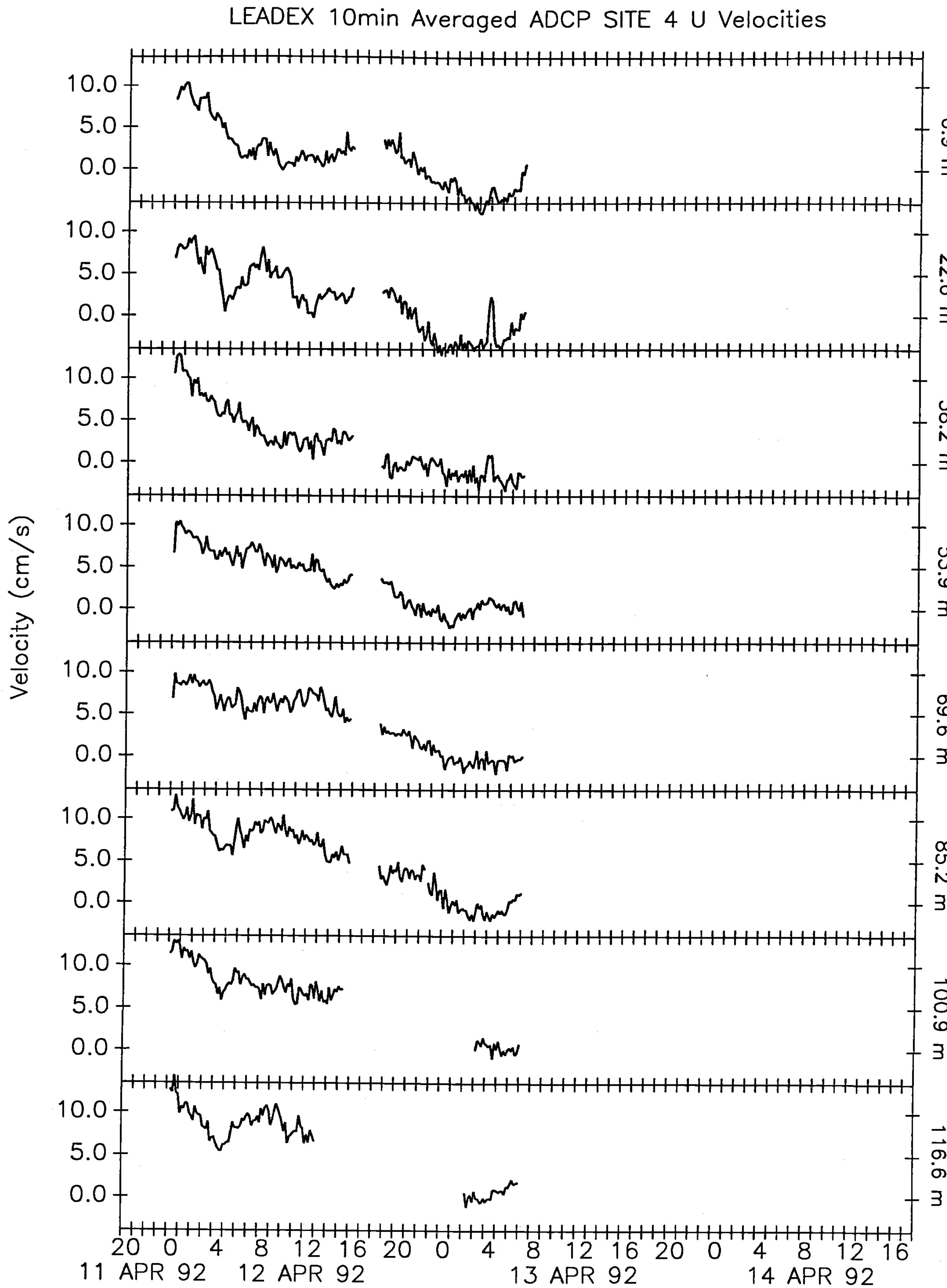


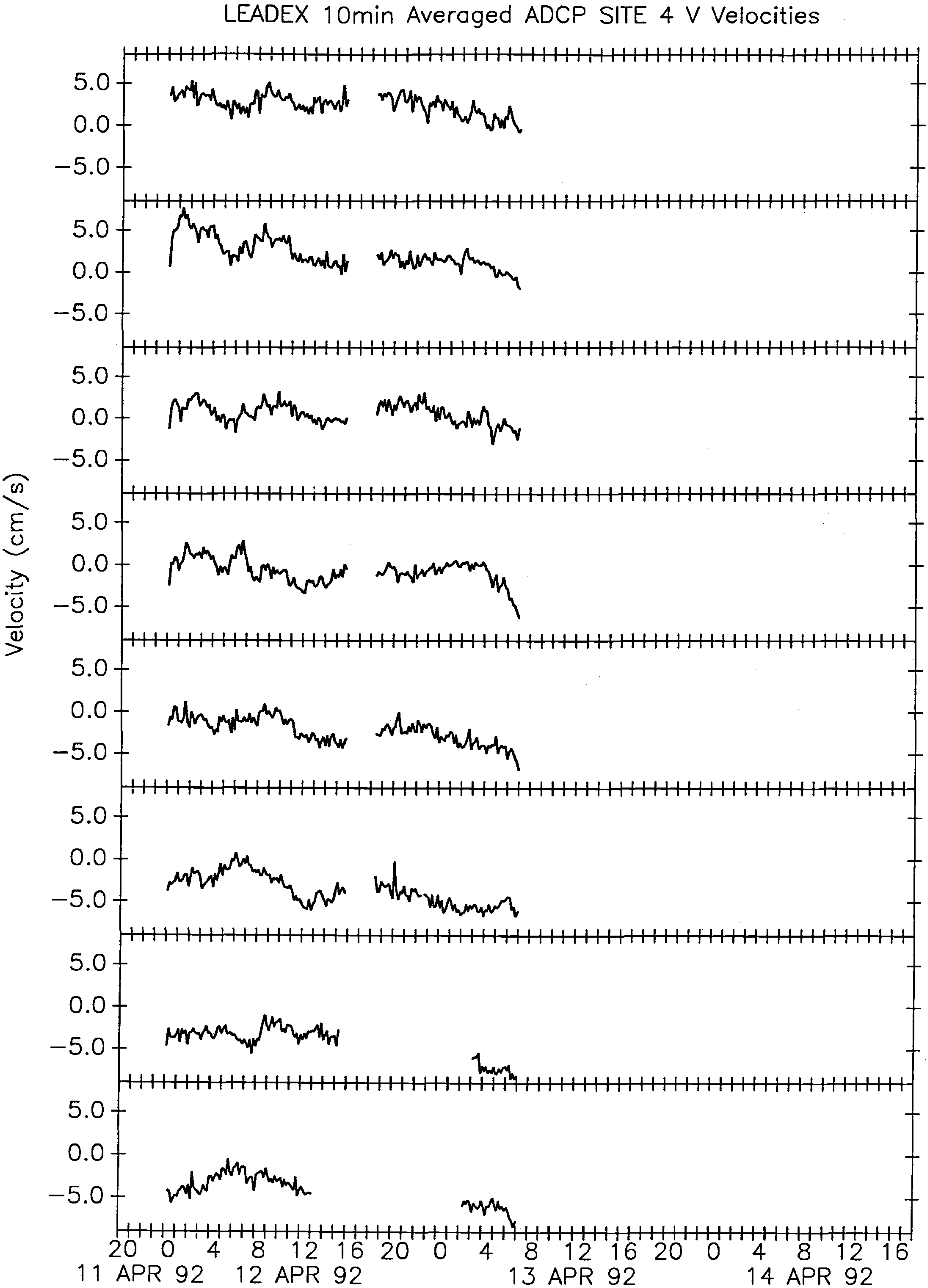
LEADEX 10min Averaged ADCP SITE 4 V Velocities

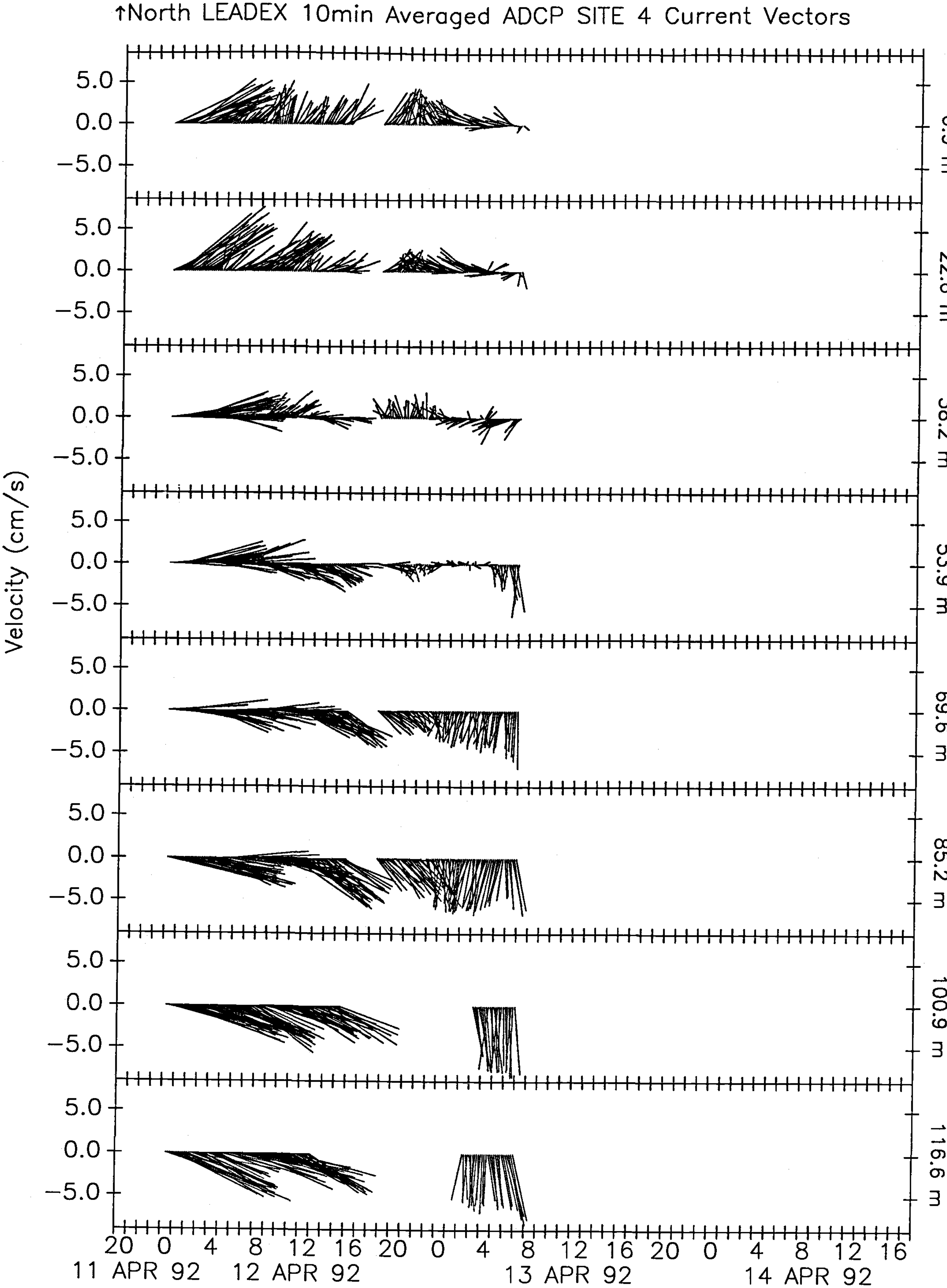


↑North LEADEX 10min Averaged ADCP SITE 4 Current Vectors




LEADEX 10min Averaged ADCP SITE 4 U Velocities
Velocity (cm/s)
10.0
5.0
0.0
6.9 m
22.6 m
38.2 m
53.9 m
69.6 m
85.2 m
100.9 m
116.6 m
20 0 4 8 12 16 20 0 4 8 12 16 20 0 4 8 12 16
11 APR 92 12 APR 92 13 APR 92 14 APR 92

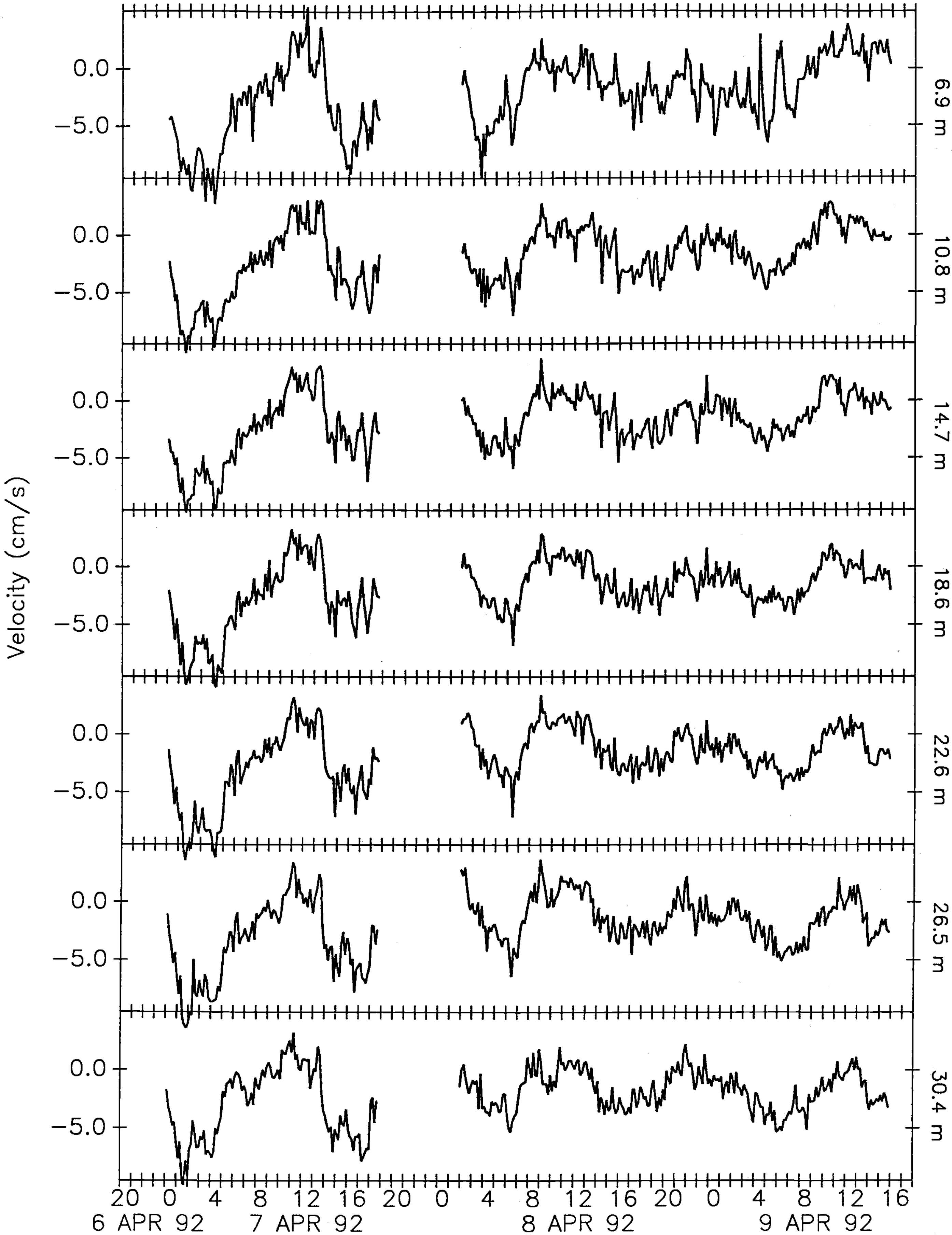

LEADEX 10min Averaged ADCP SITE 4 V Velocities
Velocity (cm/s)
5.0
0.0
-5.0
6.9 m
22.6 m
38.2 m
53.9 m
69.6 m
85.2 m
100.9 m
116.6 m
20 0 4 8 12 16 20 0 4 8 12 16 20 0 4 8 12 16
11 APR 92
12 APR 92
13 APR 92
14 APR 92


↑North LEADEX 10min Averaged ADCP SITE 4 Current Vectors
Velocity (cm/s)
5.0
0.0
−5.0
6.9 m
22.6 m
38.2 m
53.9 m
69.6 m
85.2 m
100.9 m
116.6 m
20 0 4 8 12 16 20 0 4 8 12 16 20 0 4 8 12 16
11 APR 92
12 APR 92
13 APR 92
14 APR 92

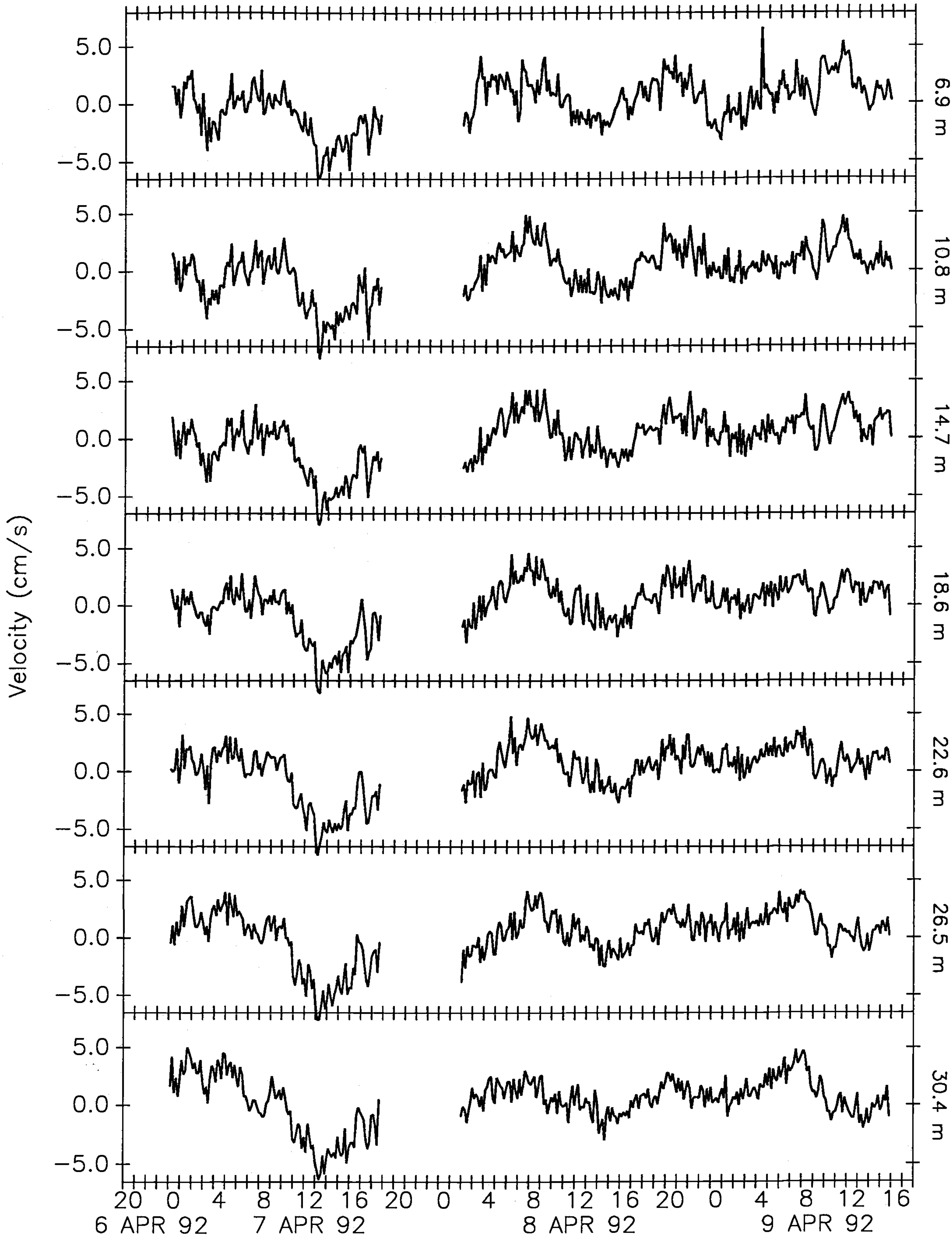
TIME SERIES of VELOCITY from LEAD #3: Line plots relative to 85 m

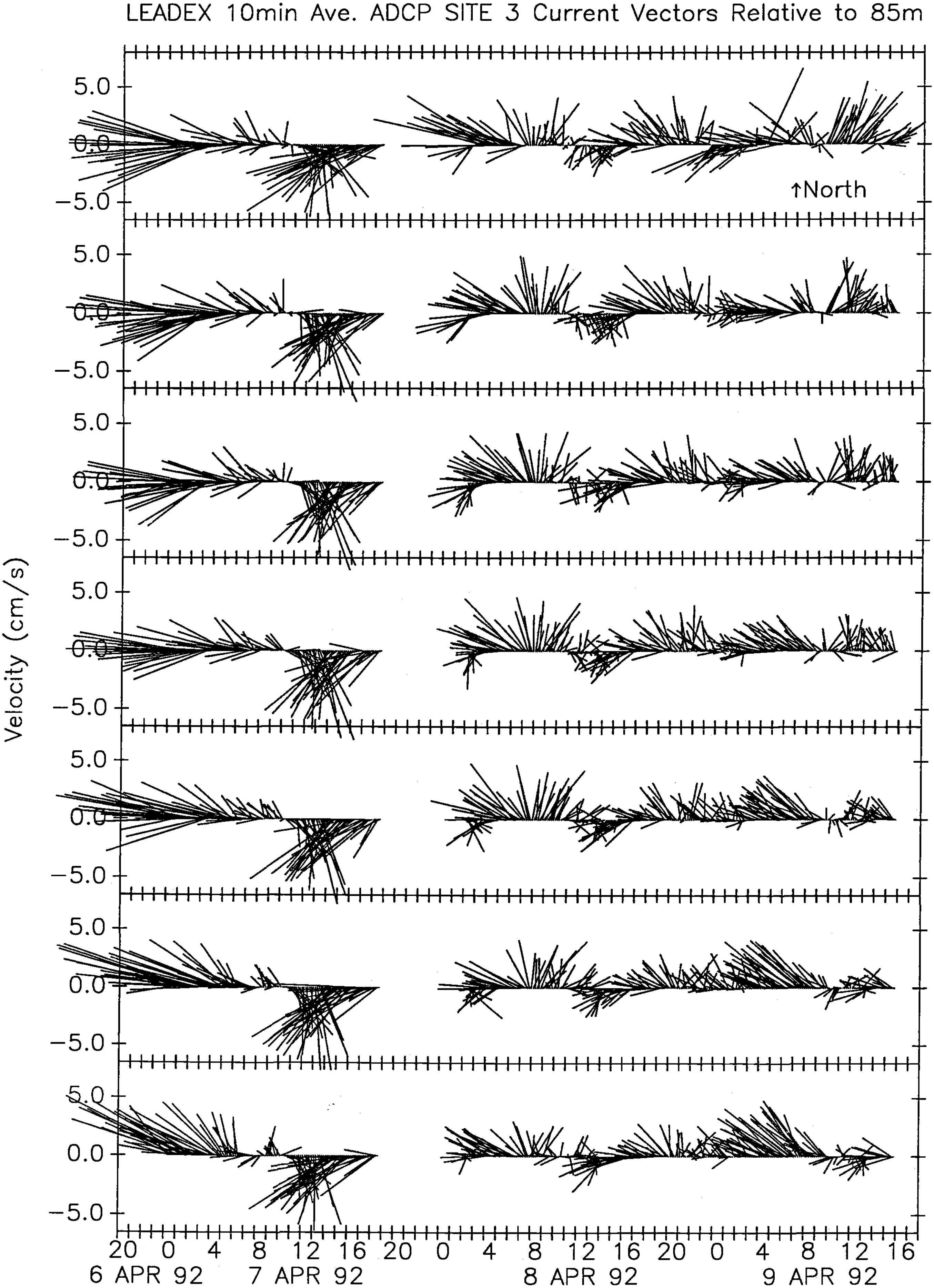
The acoustic Doppler current profiler measured currents from 7 to 128 m. The following 3 pages show observations of u, v, and currents vectors every 4 meters from 7 to 30 m. The next 3 pages show u, v, and current vectors about every 16 meters from 7 to 117 m. All data are derived from all 4 beams and averaged over 10 minutes.

LEADEX 10min Ave. ADCP SITE 3 U Velocities Relative to 85m

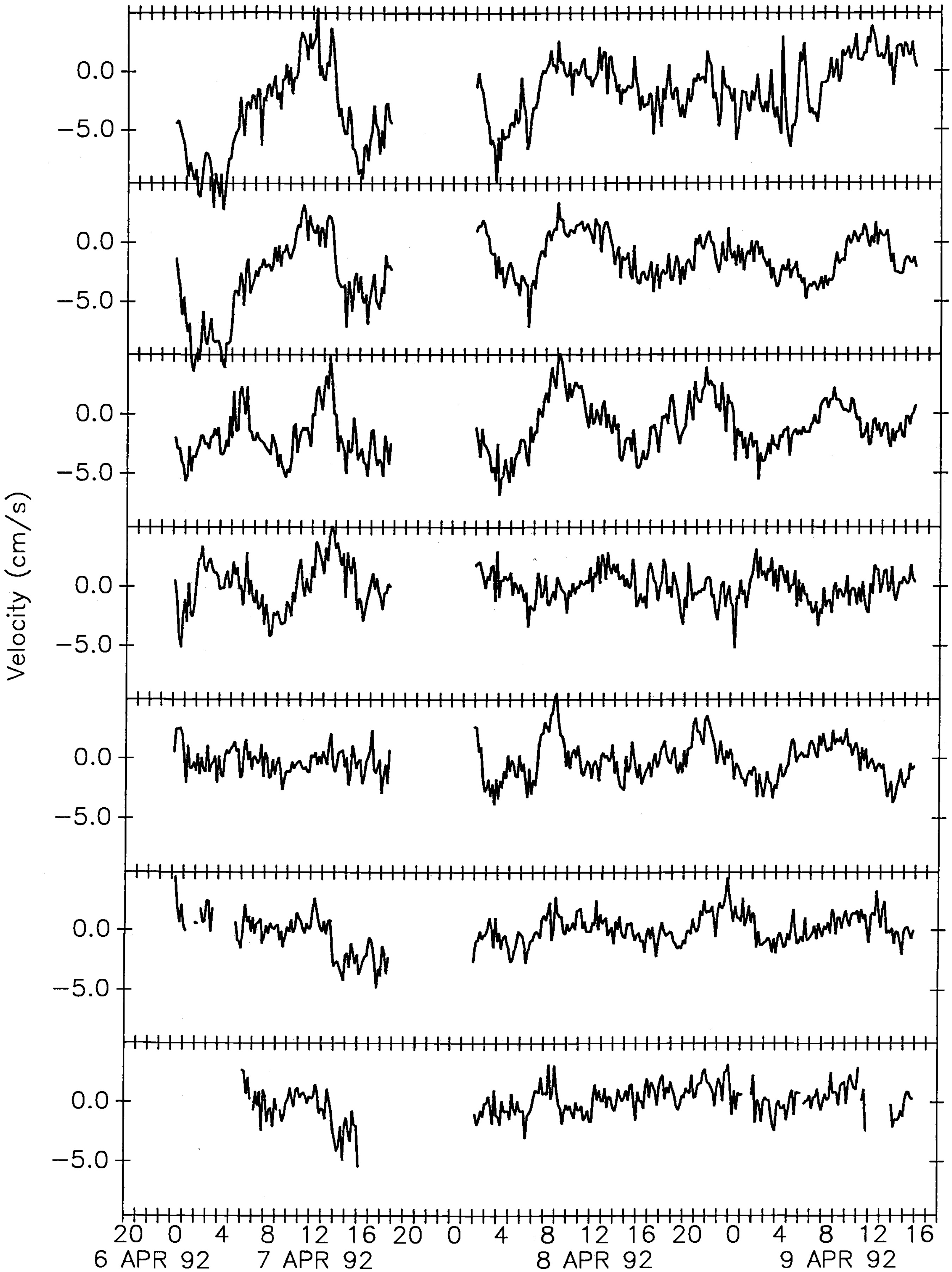


LEADEX 10min Ave. ADCP SITE 3 V Velocities Relative to 85m

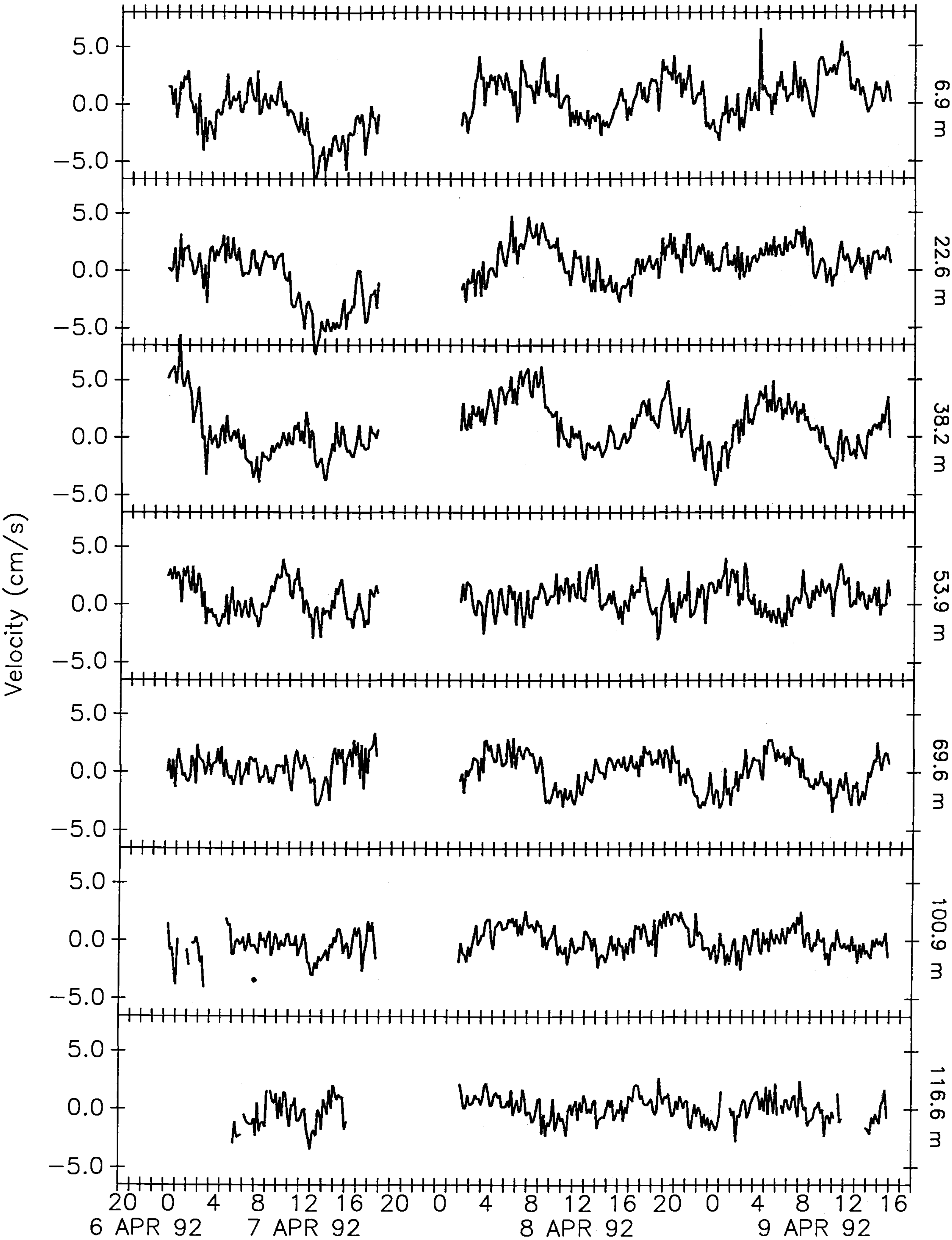



LEADEX 10min Ave. ADCP SITE 3 Current Vectors Relative to 85m
Velocity (cm/s)
5.0
0.0
−5.0
↑North
6.9 m
10.8 m
14.7 m
18.6 m
22.6 m
26.5 m
30.4 m
20 0 4 8 12 16 20 0 4 8 12 16 20 0 4 8 12 16
6 APR 92
7 APR 92
8 APR 92
9 APR 92

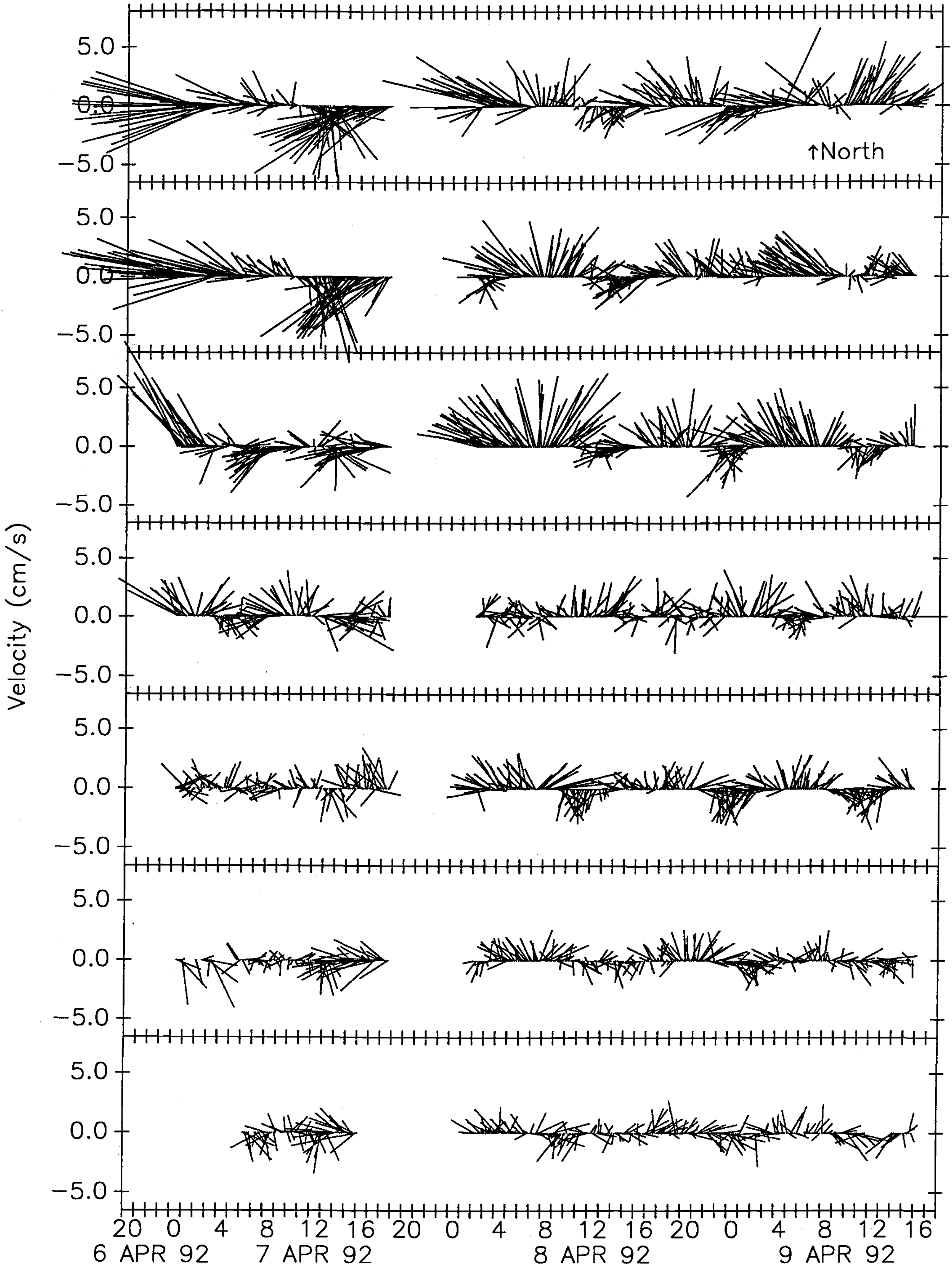
LEADEX 10min Ave. ADCP SITE 3 U Velocities Relative to 85m



LEADEX 10min Ave. ADCP SITE 3 V Velocities Relative to 85m



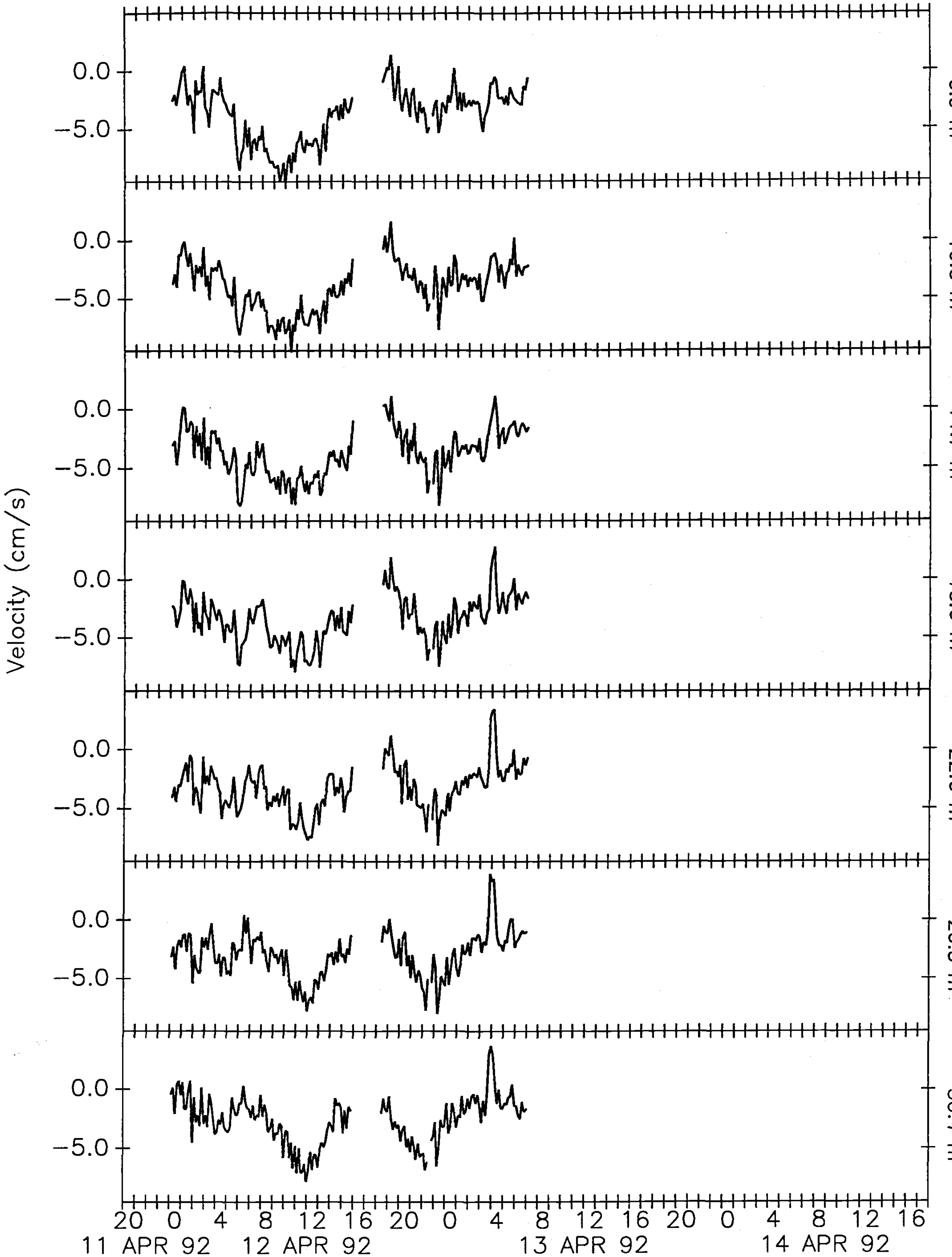
LEADEX 10min Ave. ADCP SITE 3 Current Vectors Relative to 85m

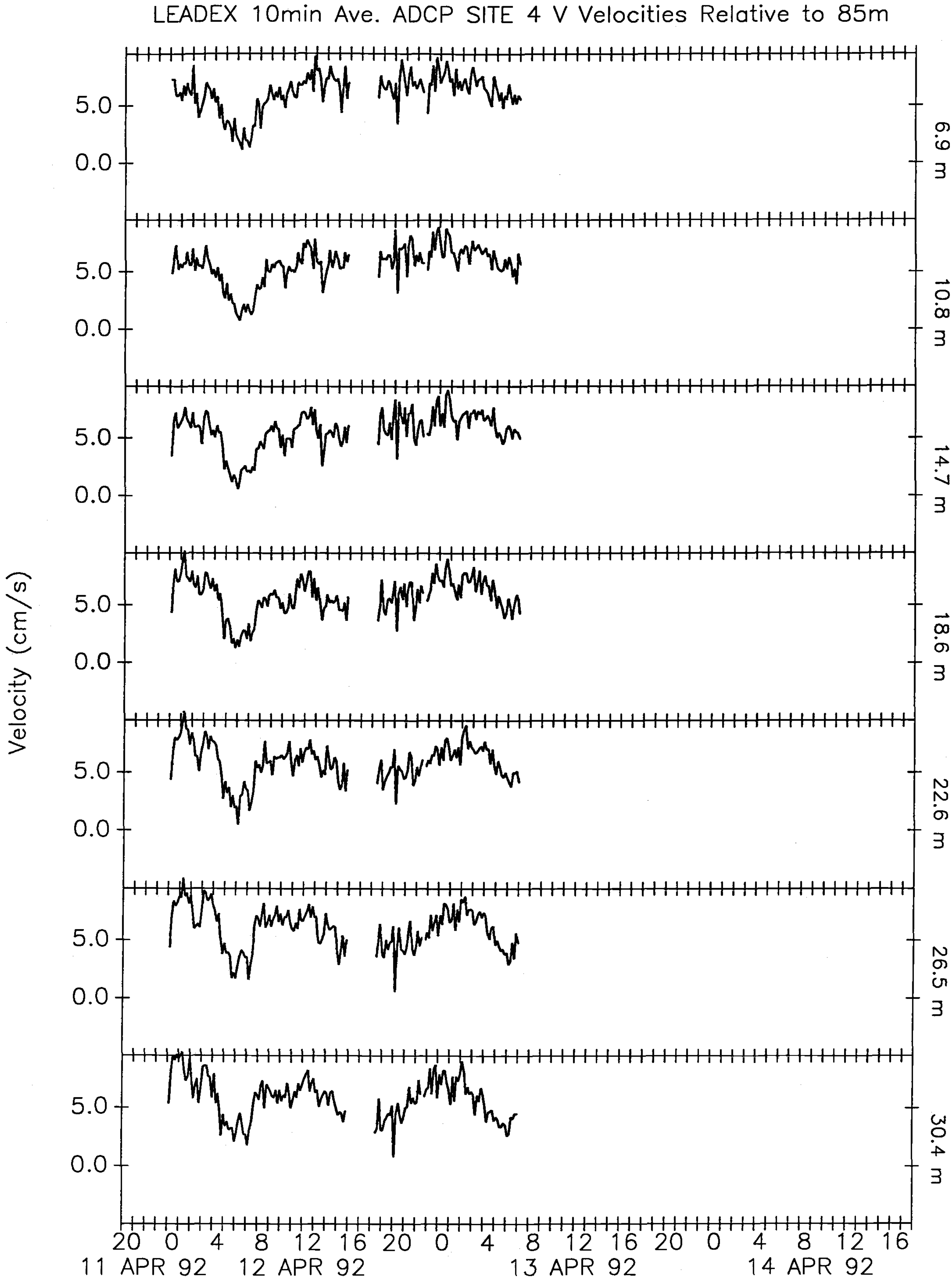


TIME SERIES of VELOCITY from LEAD #4: Line plots relative to 85 m

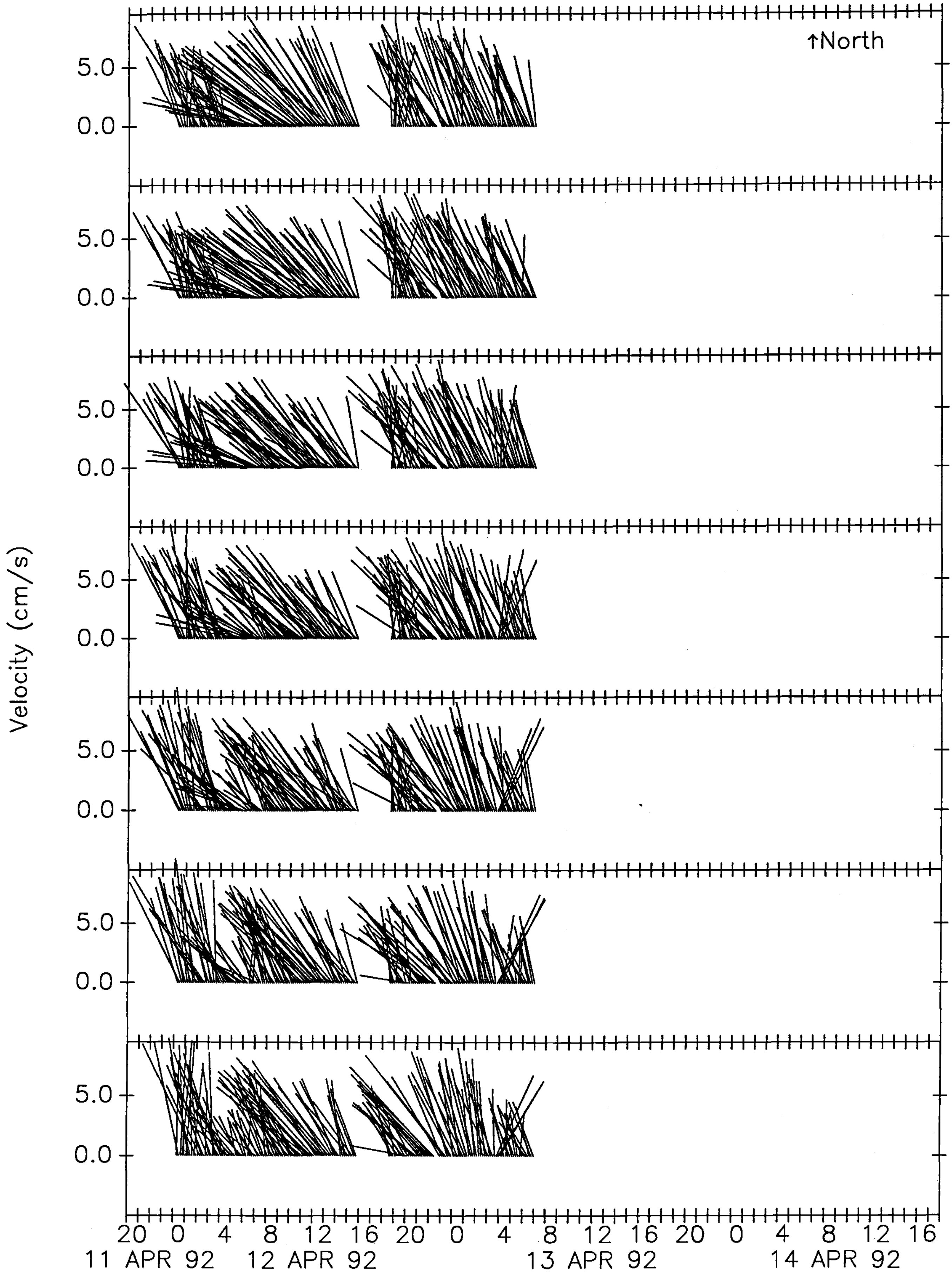
The acoustic Doppler current profiler measured currents from 7 to 128 m. The following 3 pages show observations of u, v, and currents vectors every 4 meters from 7 to 30 m. The next 3 pages show u, v, and current vectors about every 16 meters from 7 to 117 m. All data are derived from all 4 beams and averaged over 10 minutes.

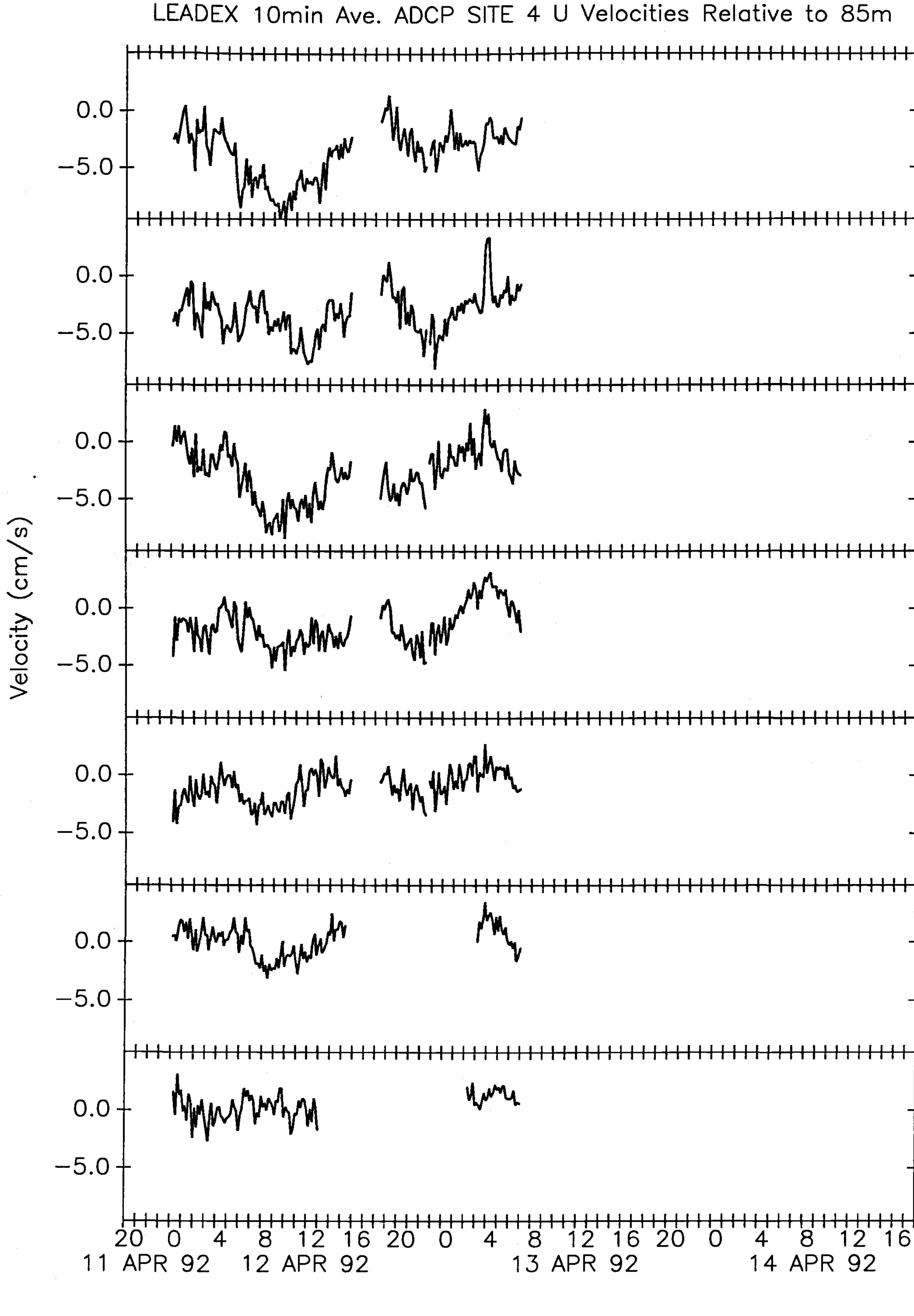
LEADEX 10min Ave. ADCP SITE 4 U Velocities Relative to 85m



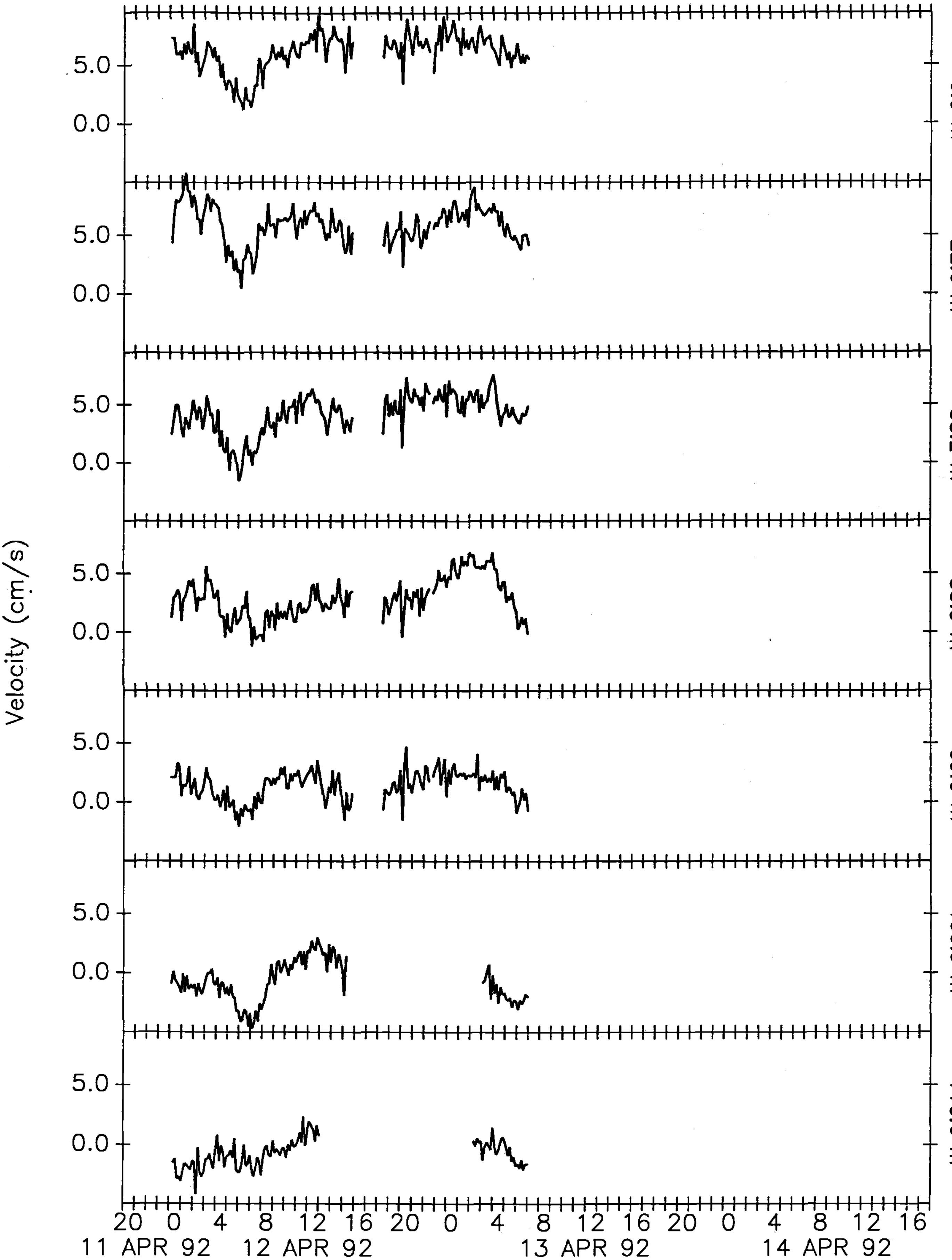

LEADEX 10min Ave. ADCP SITE 4 V Velocities Relative to 85m
Velocity (cm/s)
5.0
0.0
6.9 m
10.8 m
14.7 m
18.6 m
22.6 m
26.5 m
30.4 m
20 0 4 8 12 16 20 0 4 8 12 16 20 0 4 8 12 16
11 APR 92
12 APR 92
13 APR 92
14 APR 92

LEADEX 10min Ave. ADCP SITE 4 Current Vectors Relative to 85m

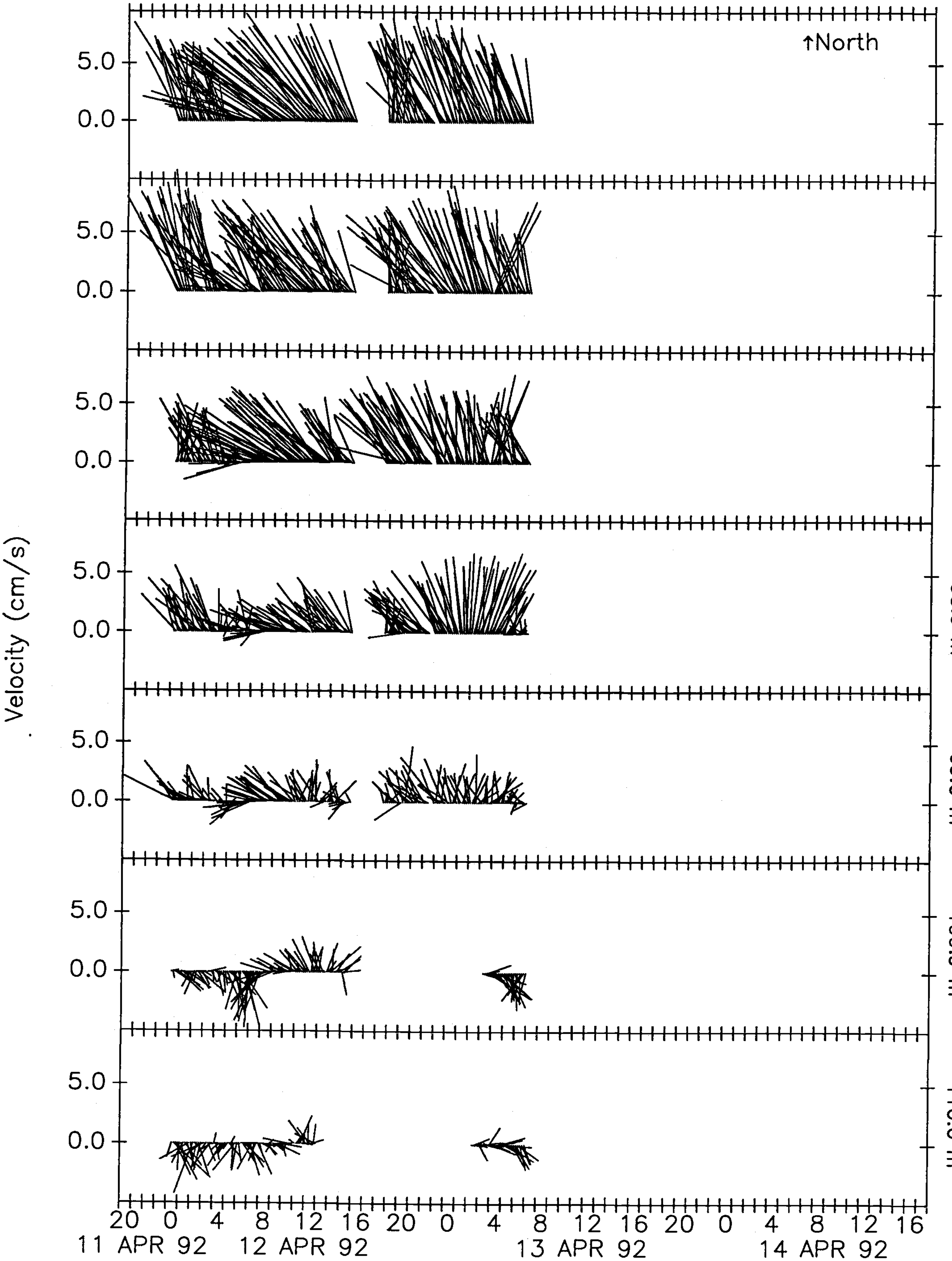



LEADEX 10min Ave. ADCP SITE 4 U Velocities Relative to 85m
Velocity (cm/s)
0.0
-5.0
6.9 m
22.6 m
38.2 m
53.9 m
69.6 m
100.9 m
116.6 m
20 0 4 8 12 16 20 0 4 8 12 16 20 0 4 8 12 16
11 APR 92
12 APR 92
13 APR 92
14 APR 92

LEADEX 10min Ave. ADCP SITE 4 V Velocities Relative to 85m



LEADEX 10min Ave. ADCP SITE 4 Current Vectors Relative to 85m



TIME SERIES of HORIZONTAL, VERTICAL and ERROR VELOCITIES; VERTICAL SHEAR and ECHO INTENSITY from Lead #3: Color contour plots

The acoustic Doppler current profiler measured currents from 7 to 128 m. The following 5 pages show:

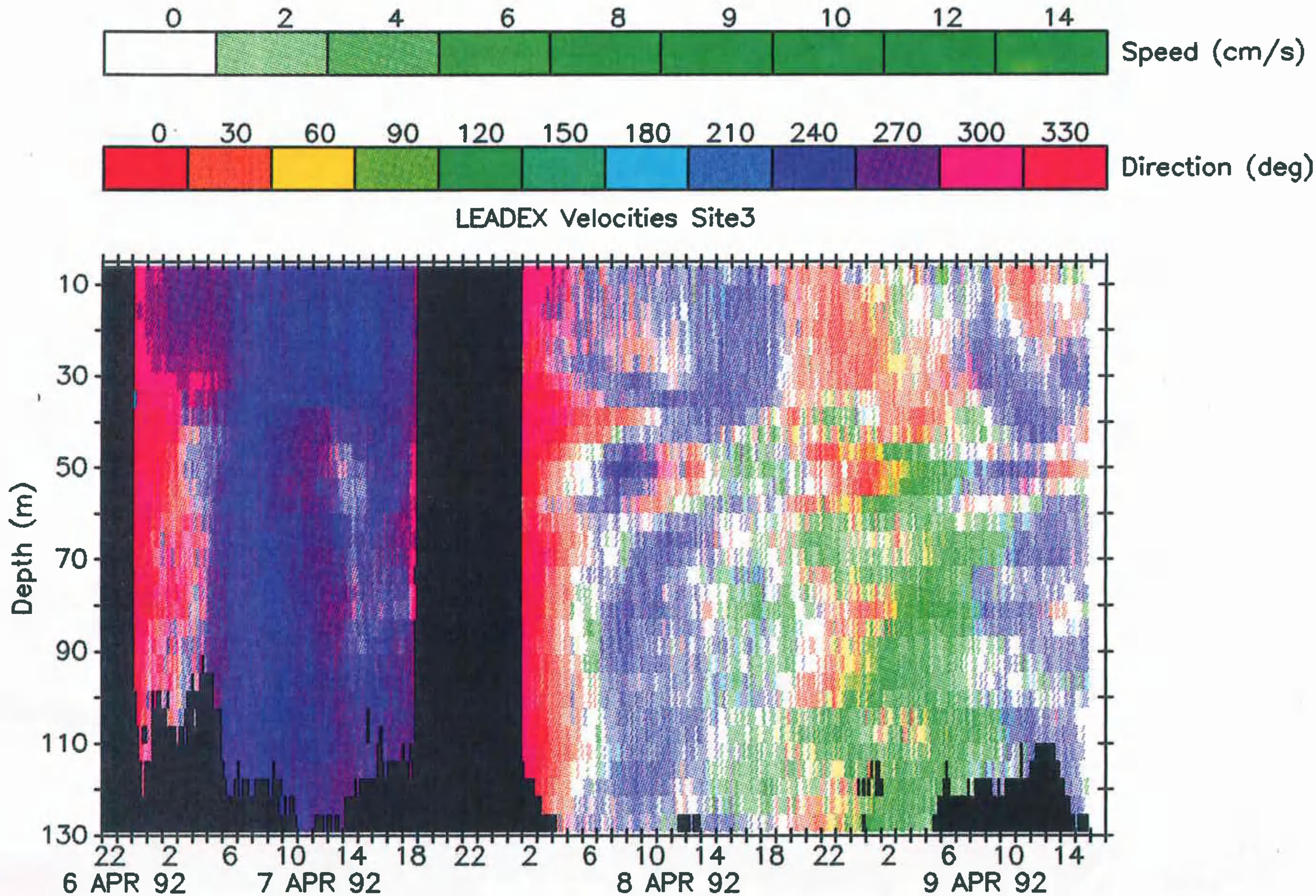
- horizontal velocity (cm/s)--the color indicates the current direction and the intensity indicates the speed

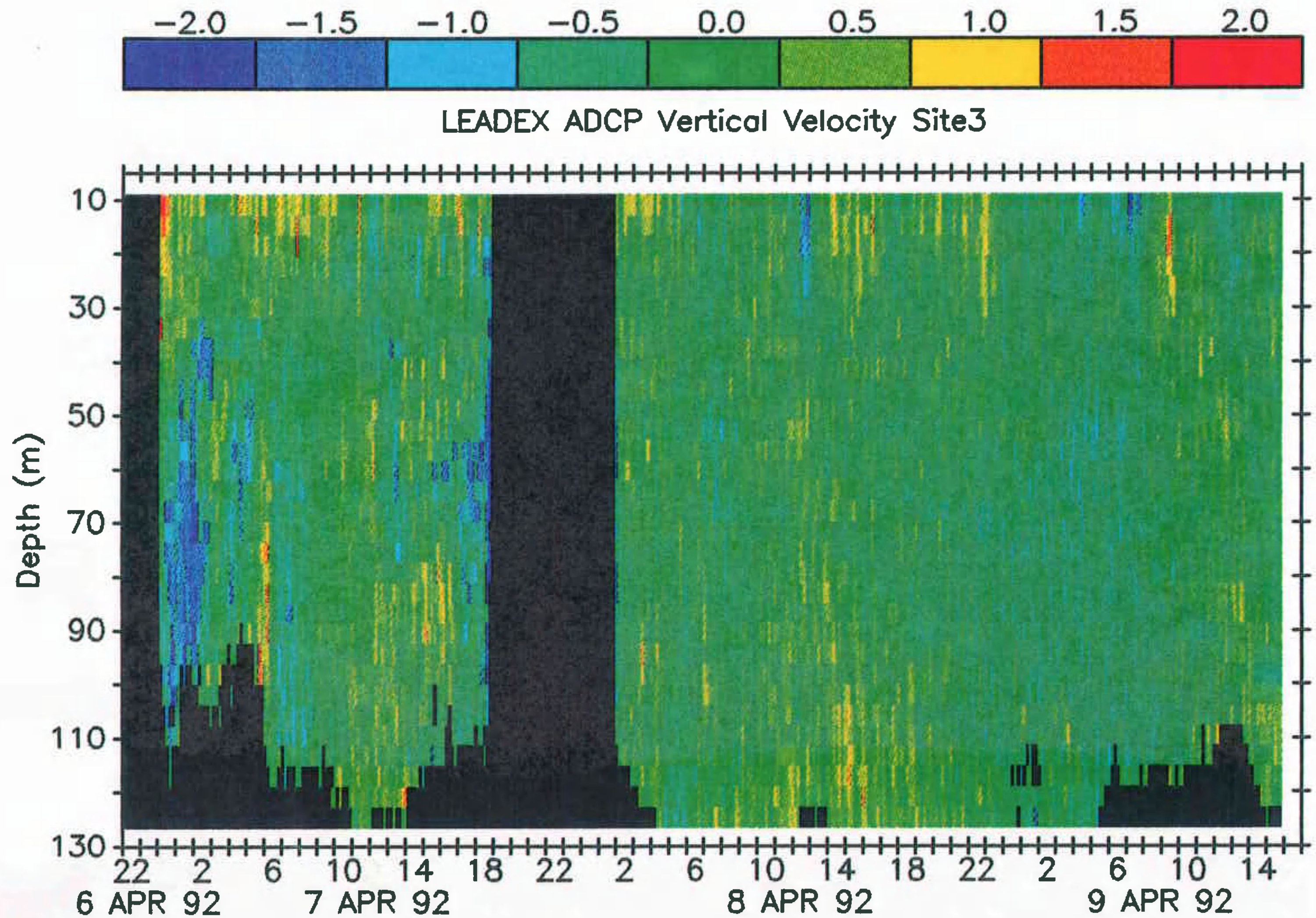
- vertical velocity (cm/s)--the average over all 4 beams

- error velocity (cm/s)--The "error velocity" is a measure of the difference in independent estimates of vertical velocity from beams 1 & 2 and beams 3 & 4. When the error velocity is comparable to the vertical velocity, then there are either large horizontal inhomogeneities in the velocity field or hardware problems.

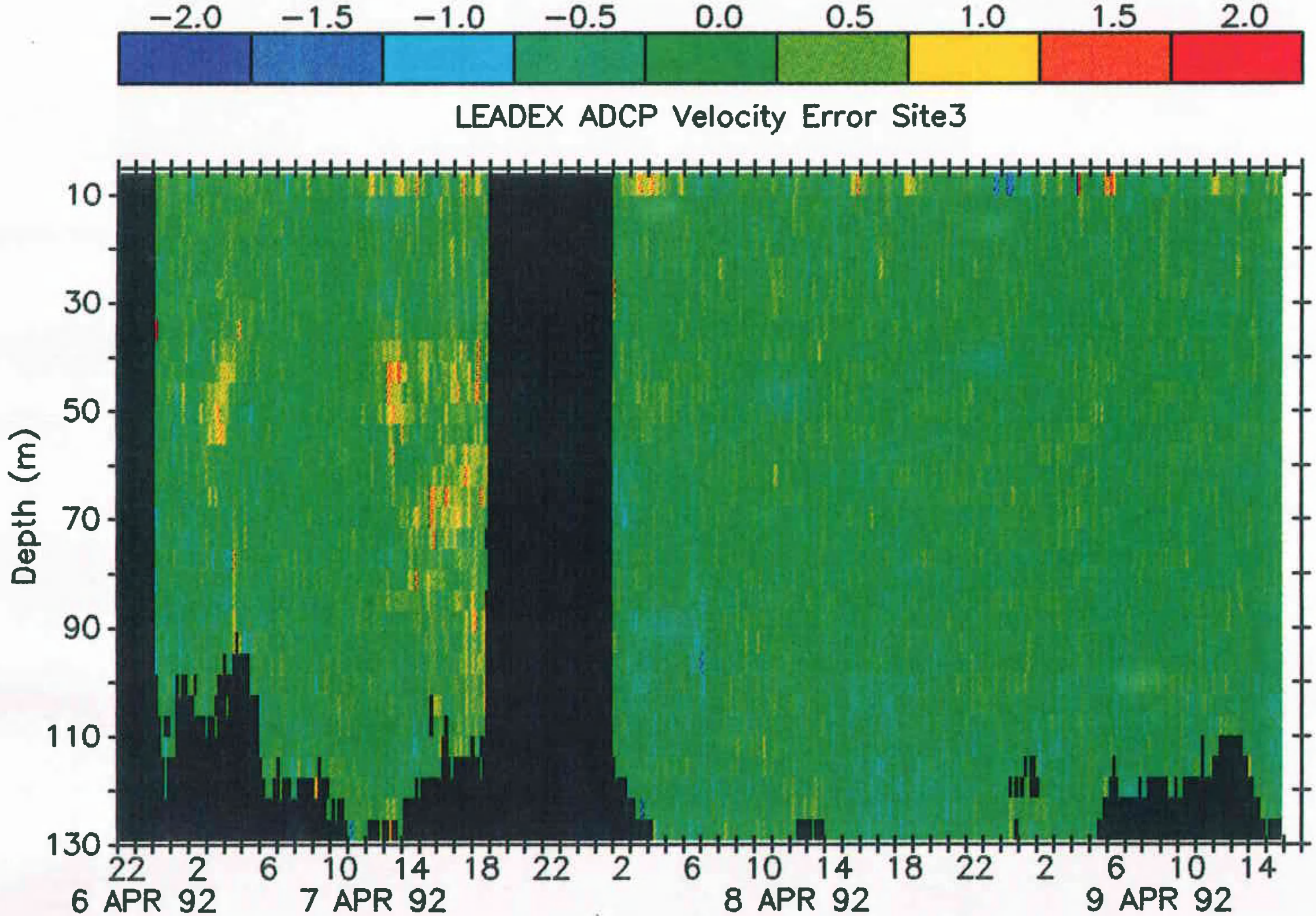
- shear magnitude--units of (cm/s)/m

- echo intensity--units are in decibels--relative only

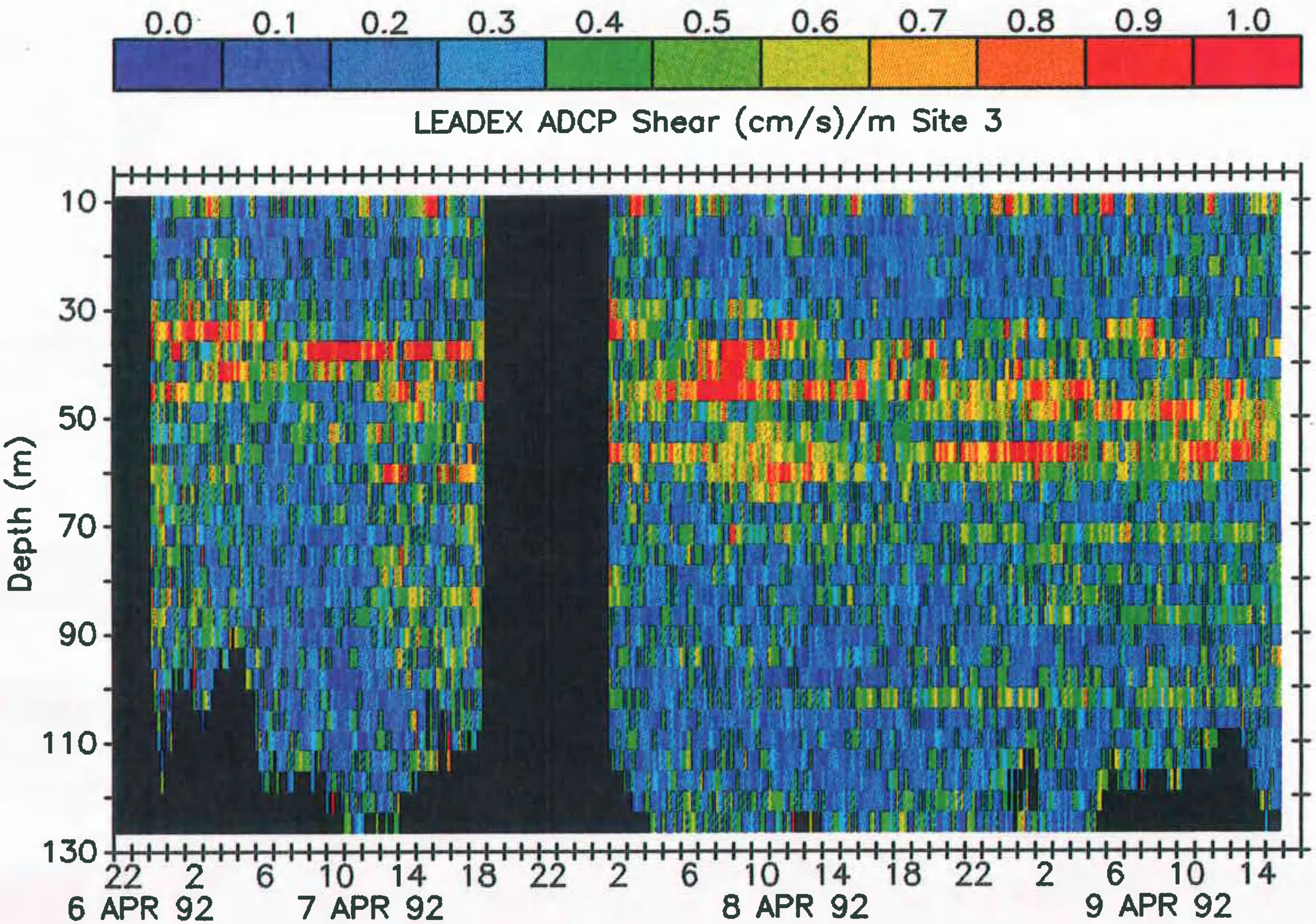

0 2 4 6 8 9 10 12 14
Speed (cm/s)
0 30 60 90 120 150 180 210 240 270 300 330
Direction (deg)
LEADEX Velocities Site3
Depth (m)
10 30 50 70 90 110 130
22 2 6 10 14 18 22 2 6 10 14 18 22 2 6 10 14
6 APR 92
7 APR 92
8 APR 92
9 APR 92

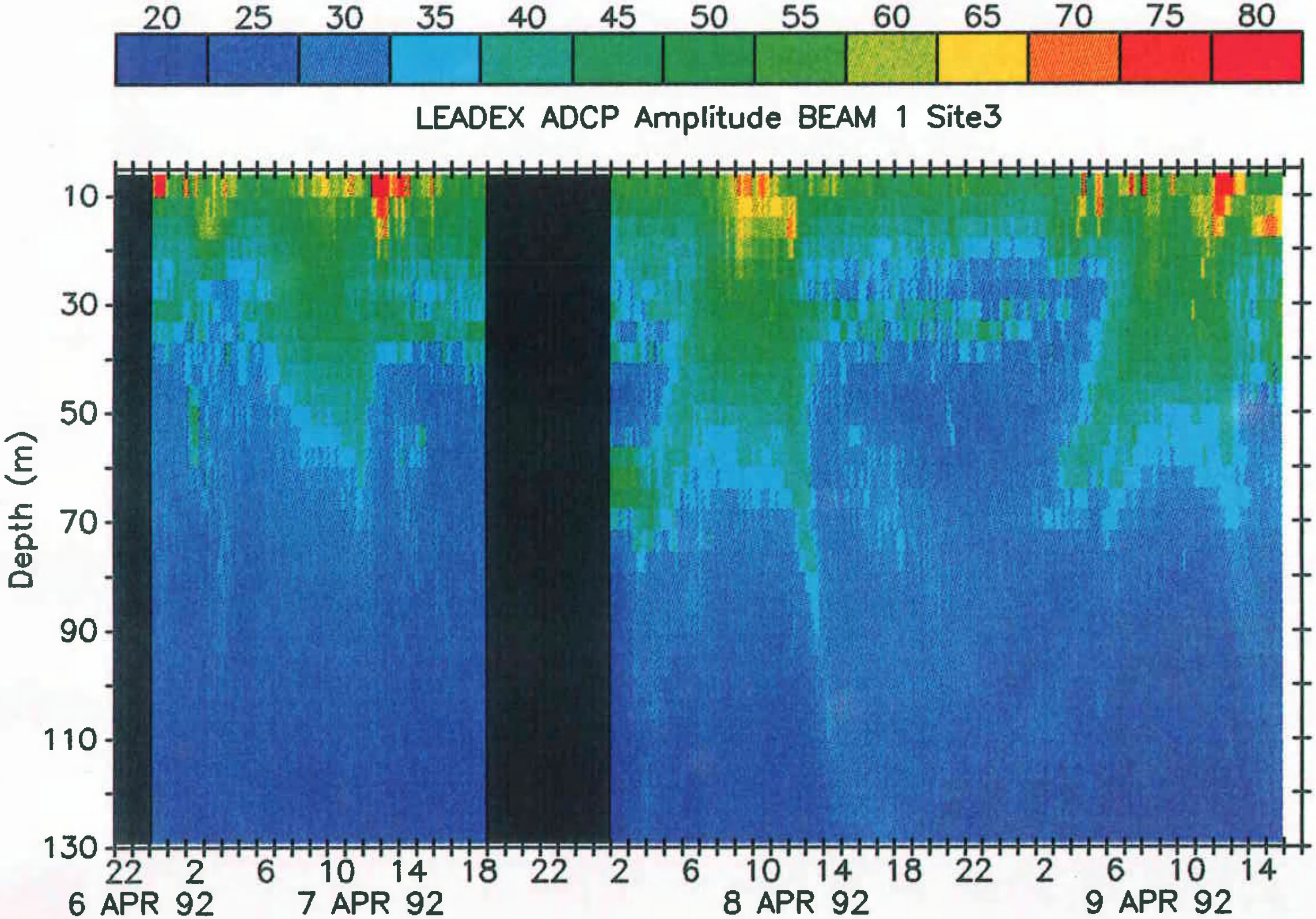


−2.0 −1.5 −1.0 −0.5 0.0 0.5 1.0 1.5 2.0
LEADEX ADCP Vertical Velocity Site3
Depth (m)
10
30
50
70
90
110
130
22 2 6 10 14 18 22 2 6 10 14 18 22 2 6 10 14
6 APR 92
7 APR 92
8 APR 92
9 APR 92



−2.0 −1.5 −1.0 −0.5 0.0 0.5 1.0 1.5 2.0
LEADEX ADCP Velocity Error Site3
Depth (m)
10
30
50
70
90
110
130
22 2 6 10 14 18 22 2 6 10 14 18 22 2 6 10 14
6 APR 92
7 APR 92
8 APR 92
9 APR 92


0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
LEADEX ADCP Shear (cm/s)/m Site 3
Depth (m)
10
30
50
70
90
110
130
22
2
6
10
14
18
22
2
6
10
14
18
22
2
6
10
14
6 APR 92
7 APR 92
8 APR 92
9 APR 92


20 25 30 35 40 45 50 55 60 65 70 75 80
LEADEX ADCP Amplitude BEAM 1 Site3
Depth (m)
10 30 50 70 90 110 130
22 2 6 10 14 18 22 2 6 10 14 18 22 2 6 10 14
6 APR 92
7 APR 92
8 APR 92
9 APR 92

TIME SERIES of HORIZONTAL, VERTICAL and ERROR VELOCITIES; VERTICAL SHEAR and ECHO INTENSITY from Lead #4: Color contour plots

The acoustic Doppler current profiler measured currents from 7 to 128 m. The following 5 pages show:

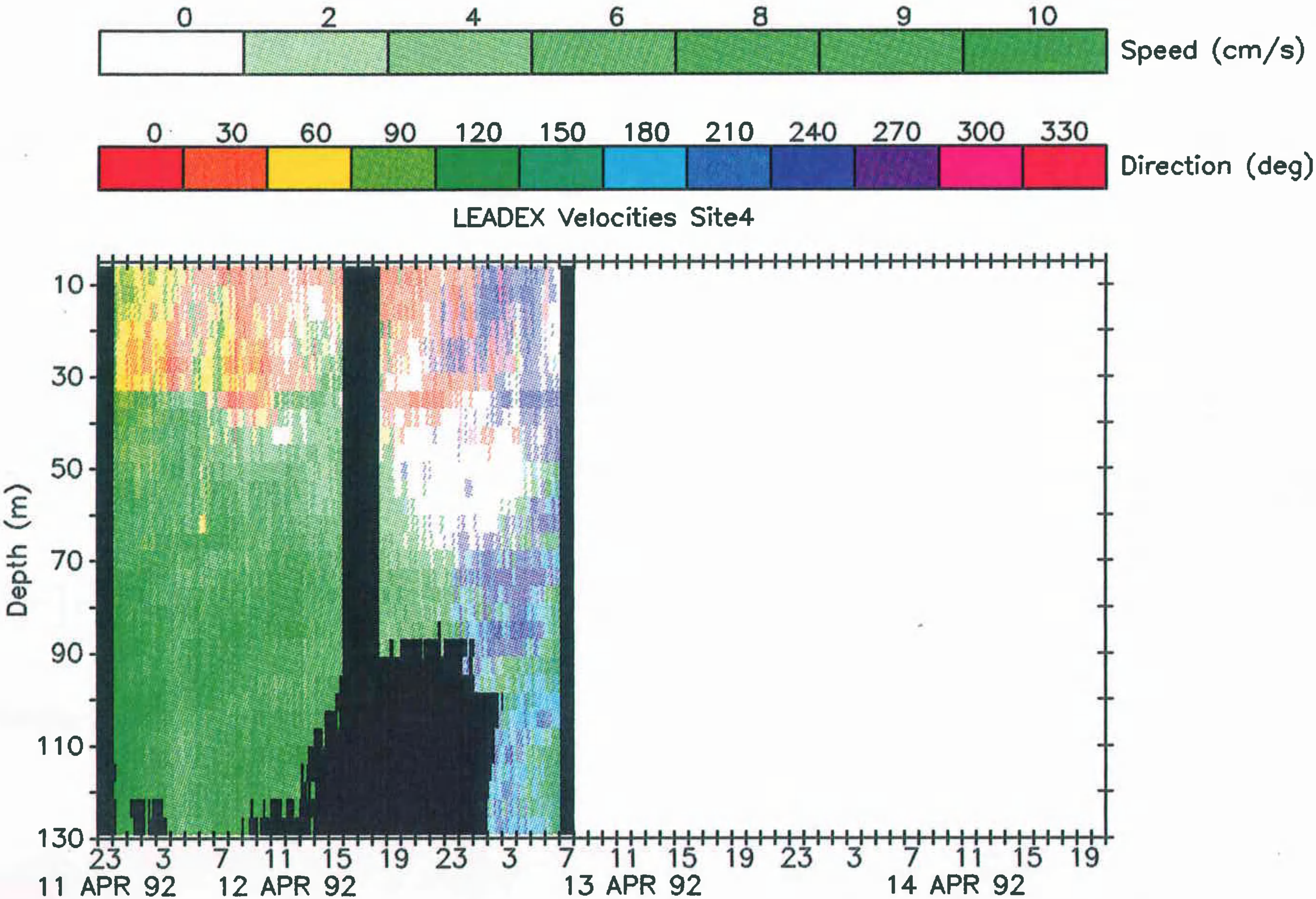
- horizontal velocity (cm/s)--the color indicates the current direction and the intensity indicates the speed

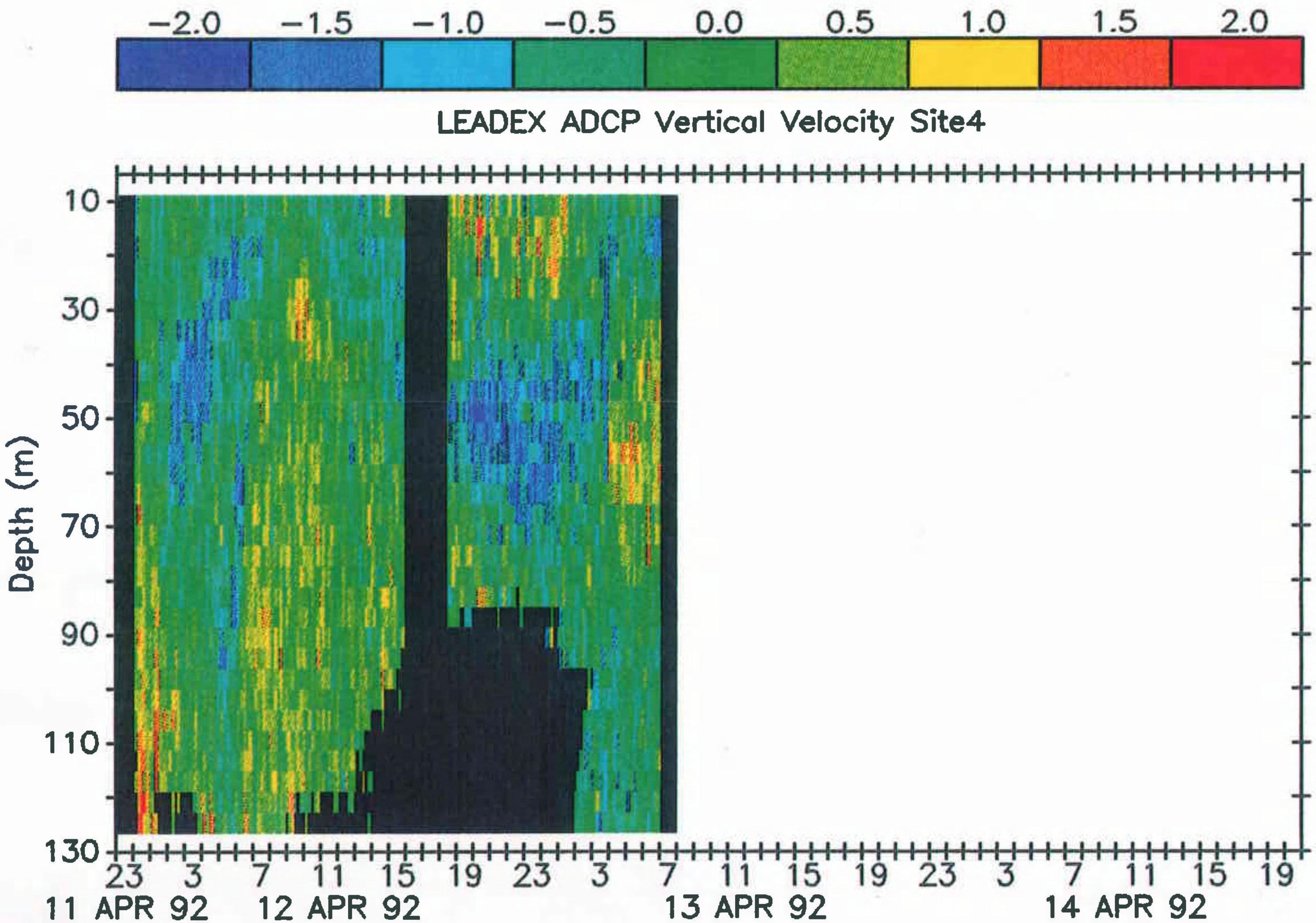
- vertical velocity (cm/s)--the average over all 4 beams

- error velocity (cm/s)--The "error velocity" is a measure of the difference in independent estimates of vertical velocity from beams 1 & 2 and beams 3 & 4. When the error velocity is comparable to the vertical velocity, then there are either large horizontal inhomogeneities in the velocity field or hardware problems.

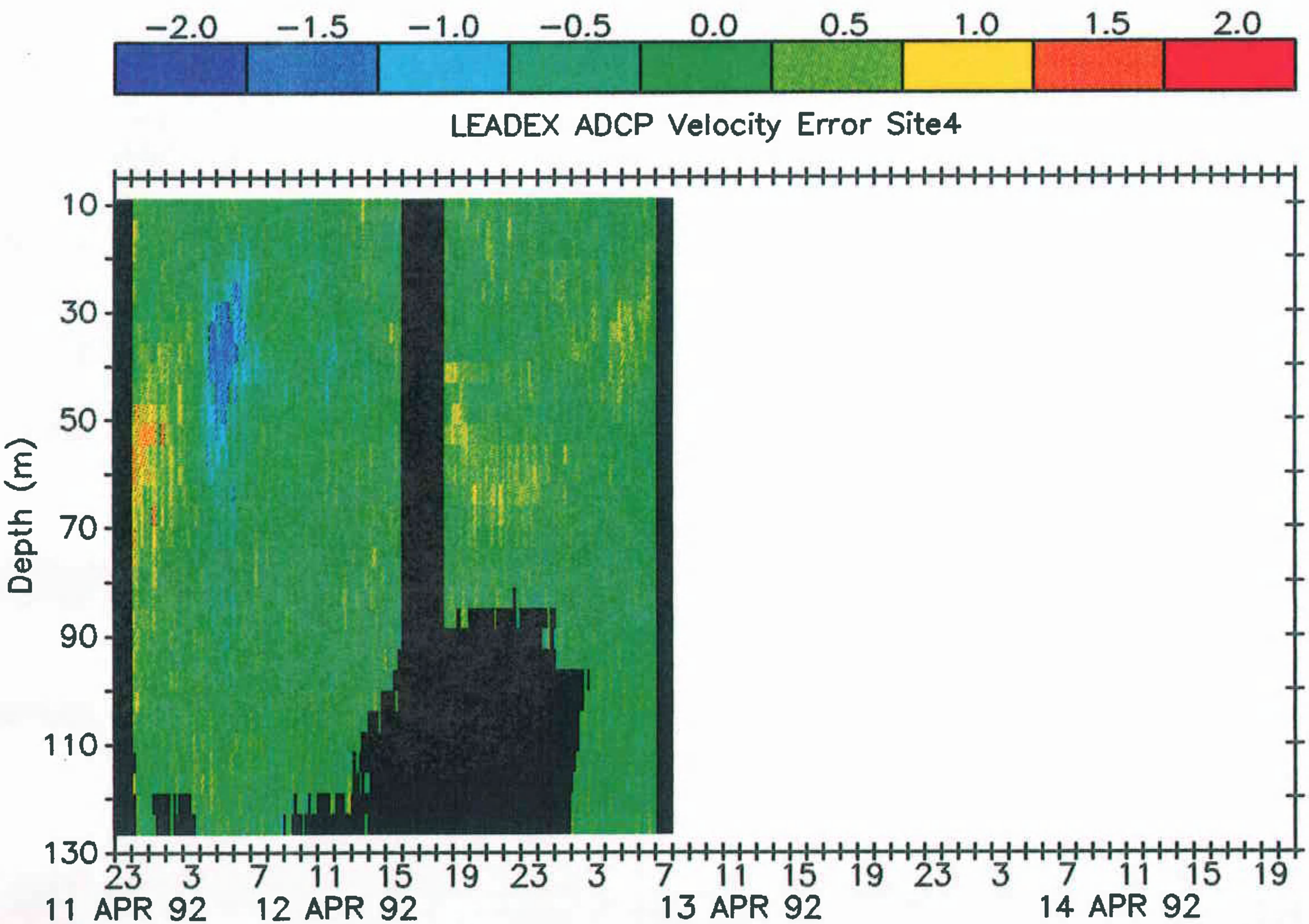
- shear magnitude--units of (cm/s)/m

- echo intensity--units are in decibels--relative only

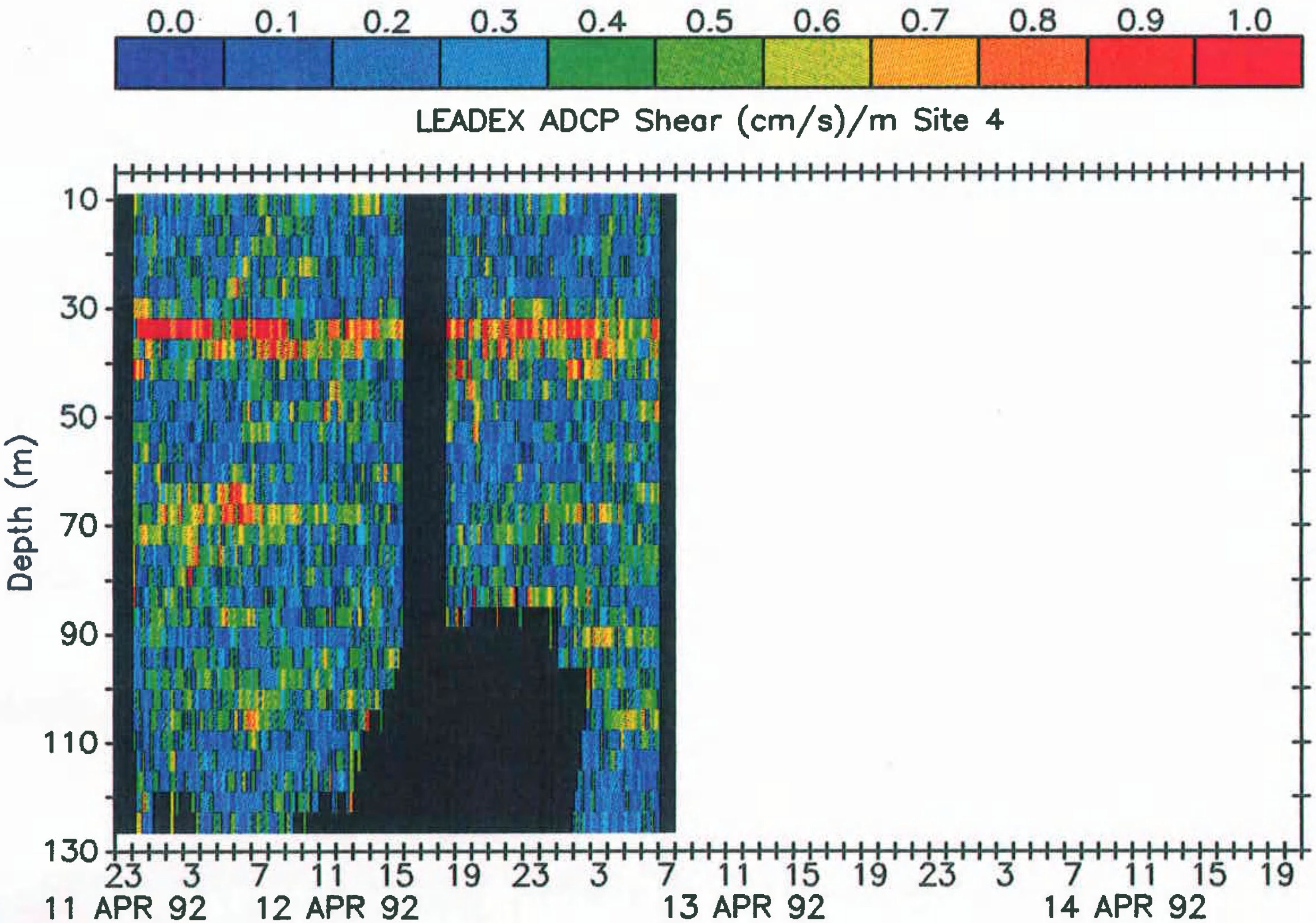

0 2 4 6 8 9 10
Speed (cm/s)
0 30 60 90 120 150 180 210 240 270 300 330
Direction (deg)
LEADEX Velocities Site4
Depth (m)
10 30 50 70 90 110 130
23 3 7 11 15 19 23 3 7 11 15 19 23 3 7 11 15 19
11 APR 92
12 APR 92
13 APR 92
14 APR 92

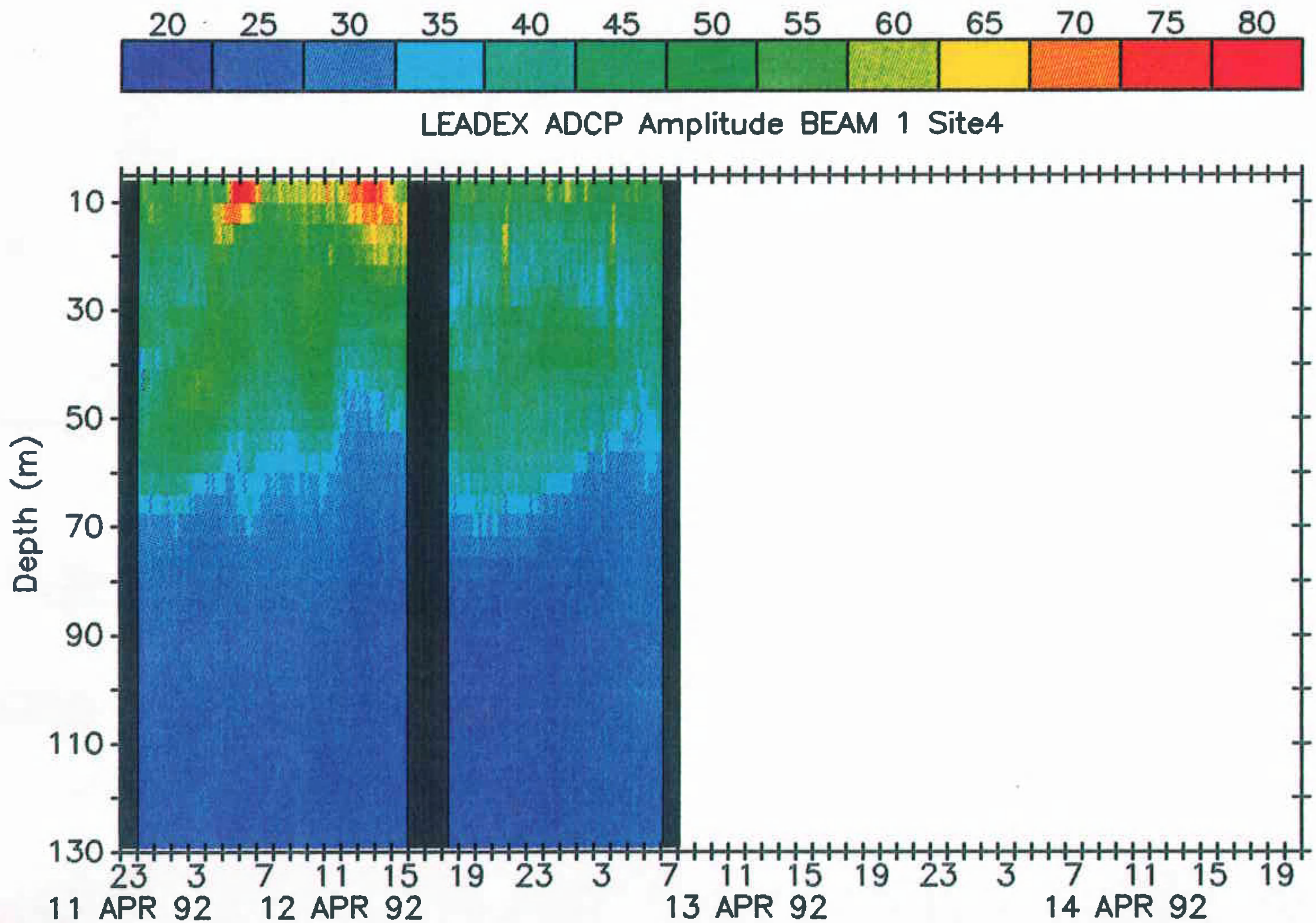


−2.0 −1.5 −1.0 −0.5 0.0 0.5 1.0 1.5 2.0
LEADEX ADCP Vertical Velocity Site4
Depth (m)
10
30
50
70
90
110
130
23 3 7 11 15 19 23 3 7 11 15 19 23 3 7 11 15 19
11 APR 92
12 APR 92
13 APR 92
14 APR 92



−2.0
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
2.0
LEADEX ADCP Velocity Error Site4
Depth (m)
10
30
50
70
90
110
130
23
3
7
11
15
19
23
3
7
11
15
19
23
3
7
11
15
19
11 APR 92
12 APR 92
13 APR 92
14 APR 92


0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
LEADEX ADCP Shear (cm/s)/m Site 4
Depth (m)
10
30
50
70
90
110
130
23 3 7 11 15 19 23 3 7 11 15 19 23 3 7 11 15 19
11 APR 92
12 APR 92
13 APR 92
14 APR 92


20 25 30 35 40 45 50 55 60 65 70 75 80
LEADEX ADCP Amplitude BEAM 1 Site4
Depth (m)
10
30
50
70
90
110
130
23 3 7 11 15 19 23 3 7 11 15 19 23 3 7 11 15 19
11 APR 92
12 APR 92
13 APR 92
14 APR 92