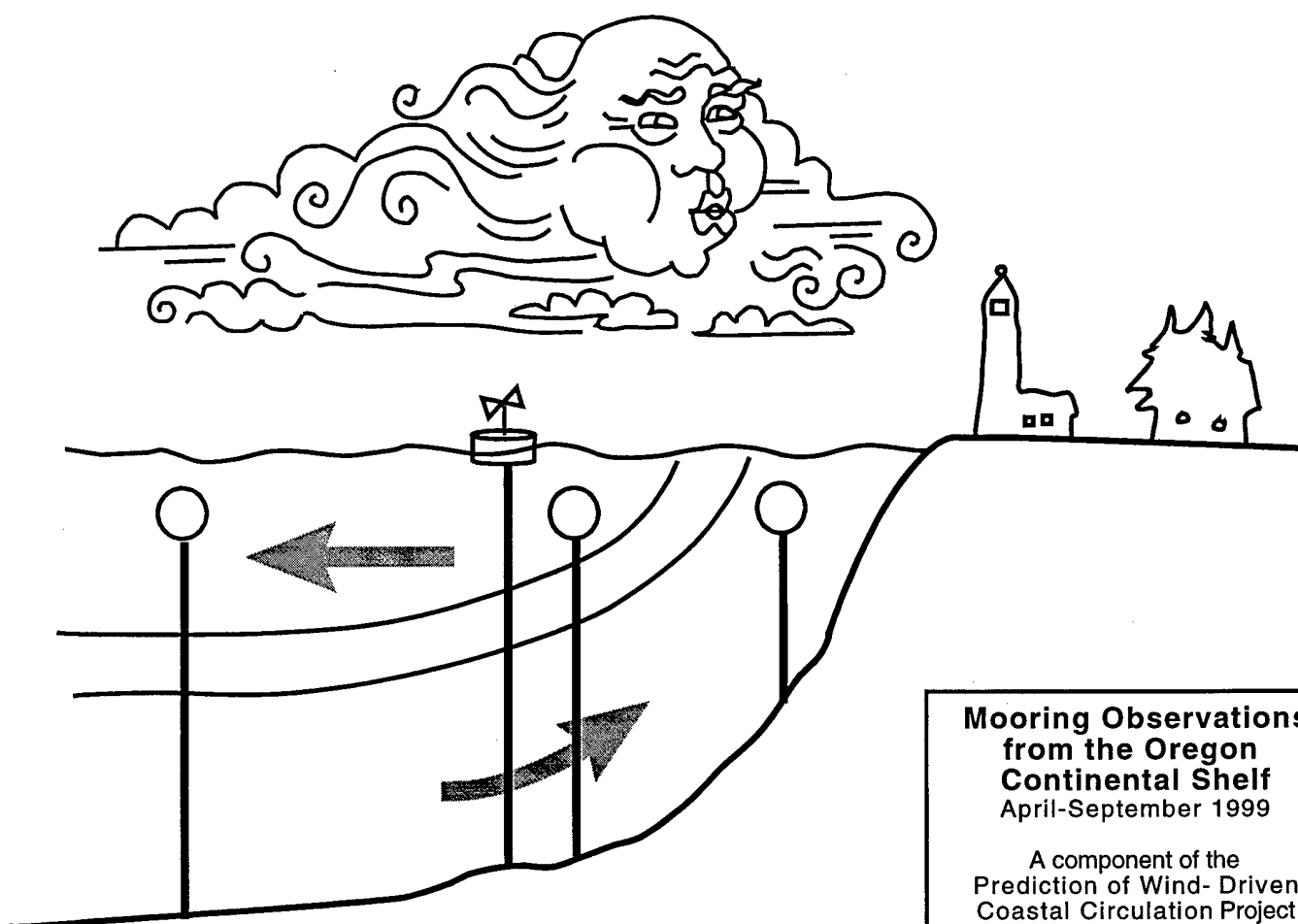


College of  
**OCEANIC &  
ATMOSPHERIC SCIENCES**



**Mooring Observations  
from the Oregon  
Continental Shelf**  
April-September 1999

A component of the  
Prediction of Wind- Driven  
Coastal Circulation Project

by  
**Timothy Boyd  
Murray D. Levine  
P. Michael Kosro  
Steve R. Gard**

Reference 00-1  
April 2000  
Data Report 177

Funded by NOPP  
(National Oceanographic  
Partnership Program)

**OREGON STATE UNIVERSITY**

**20020411 059**

# Mooring Observations from the Oregon Continental Shelf

April-September 1999

A component of  
The Prediction of Wind-Driven Coastal  
Circulation Project

Timothy Boyd  
Murray D. Levine  
P. Michael Kosro  
Steve R. Gard

Oregon State University  
College of Oceanic and Atmospheric Sciences  
104 Ocean Admin Bldg  
Corvallis, OR 97331

Sponsor: National Oceanographic Partnership Program  
Grant: N00014-98-1-0787

Data Report 177  
COAS Reference 00-1

Approved for Public Release  
Distribution is Unlimited  
April 2000

## ACKNOWLEDGEMENTS

We gratefully acknowledge the leadership, scientific insight, and organizational skills of John Allen and Jack Barth, the lead PIs of the overall project. We also acknowledge the other co-PIs at Oregon State University: Gary Egbert, Robert Miller, Roger Samelson, Eric Skyllingstad, Jane Huyer, Doug Caldwell, Jim Moum; and recognize our partners Jan Svejksky (Ocean Imaging), Don Barrick (CODAR), William Peterson (NOAA/NMFS), James Wilczak and Jack Harlan (NOAA/ETL).

We thank Walt Waldorf for his optimistic attitude and technical expertise in preparing, deploying, repairing, re-deploying and recovering the moorings. Special thanks to Dennis Root for assembly of the meteorological system and overall assistance and guidance. The field work could not have been done without the efforts of Marine Superintendent Fred Jones, Captain Danny Arnsdorf, and the entire crew of the R/V Wecoma. We were indeed fortunate to benefit from the help of all the Marine Techs at one time or another: Marc Willis, Daryl Swensen, Linda Fayer, and Toby Martin. We are also grateful for the assistance of student volunteers on the cruises: James Wheeler, Renellys Perez, Brandy Kuebel, Oliver Levine and Jesi Levine. The graphic assistance of Barbara Levine in designing the logo is much appreciated. Thanks also to Kirk Lee who found our Argos transmitter on the beach in Pt. Reyes, about 1 month after it was released prematurely by a trawler.

We appreciate the support of this project by the National Ocean Partnership Program (NOPP) through grant N00014-98-1-0787 and the efforts of program manager Scott Sandgathe of the Office of Naval Research.

## TABLE OF CONTENTS

|                                                                                       |    |
|---------------------------------------------------------------------------------------|----|
| INTRODUCTION .....                                                                    | 1  |
| DEPLOYMENT HISTORY .....                                                              | 1  |
| MOORINGS AND INSTRUMENTATION .....                                                    | 13 |
| <i>Mooring Construction</i>                                                           |    |
| <i>Instrument Calibration</i>                                                         |    |
| <i>ADCP/ADP Data Quality</i>                                                          |    |
| <i>Conversion of Velocities from Magnetic to Geographic Coordinates</i>               |    |
| <i>Data Filtering</i>                                                                 |    |
| Table 1. Oceanographic instrumentation: mooring/depth/model/serial #/calibration info |    |
| Table 2. ADP/ADCP sampling parameters                                                 |    |
| Table 3. Meteorological instrumentation                                               |    |
| Table 4. MTR/MDR temperature calibrations                                             |    |
| Table 5. Year-day conversion chart                                                    |    |
| Figure 1. Mooring location map                                                        |    |
| Figure 2. Oceanographic data schematic                                                |    |
| Figure 3. ADP velocity component standard deviations: vertical profiles               |    |
| Figure 4. ADP beam signal-to-noise ratios: vertical profiles                          |    |
| Figure 5. Shelf-Break mooring – Period D ADP vertical velocity standard deviation     |    |
| Figure 6. Shelf-Break mooring – D ADP diagnostics and solar radiation: time series    |    |
| REFERENCES .....                                                                      | 25 |
| Contour Plots of VELOCITY and TEMPERATURE .....                                       | 27 |
| Velocity Time Series: 40-hour Low-pass Filtered                                       |    |
| Temperature Time Series: 40-hour Low-pass Filtered                                    |    |
| VELOCITY Time Series: 40-hour Low-pass Filtered .....                                 | 35 |
| Inshore Mooring                                                                       |    |
| East & North Components (every other depth bin 4m-40m, dz=4m) .....                   | 38 |
| Mid-Shelf Mooring                                                                     |    |
| East & North Components (every other depth bin 3m-71m, dz=4m) .....                   | 40 |
| Shelf-Break Mooring Period A                                                          |    |
| East & North Components (every other depth bin 75m-115m, dz=4m) .....                 | 42 |
| Shelf-Break Mooring Period D                                                          |    |
| East & North Components (every other depth bin 4m-88m, dz=4m) .....                   | 44 |

|                                                                                |     |
|--------------------------------------------------------------------------------|-----|
| Fixed-depth Plots                                                              |     |
| East & North Components (10m, 20m, 30m, 40m, 50m, 60m, & 70m) .....            | 46  |
| TEMPERATURE Time Series: 40-hour Low-pass Filtered .....                       | 43  |
| Inshore Mooring .....                                                          | 55  |
| Mid-Shelf Mooring .....                                                        | 56  |
| Met Mooring .....                                                              | 57  |
| Shelf-Break Mooring .....                                                      | 58  |
| Fixed-depth Plots: Inshore      Mid-Shelf(Met)      Shelf-Break A/B/C/D .....  | 59  |
| 2m                      (2m)                      2/2/-/2m                     |     |
| 16m                     16m                     16/-/17/17m                    |     |
| 20m                     20m                     20/19/21/21m                   |     |
| 28m                     28m                     28/27/29/29m                   |     |
| 48m                     48m                     48/51/49/49m                   |     |
| -                        60m                     60/63/61/61m                  |     |
| -                        70m                     72/73/73/73m                  |     |
| -                        78m                     82/85/83/83m                  |     |
| SALINITY Time Series: 40-hour Low-pass Filtered .....                          | 67  |
| Inshore & Shelf-Break Moorings                                                 |     |
| Mid-Shelf Mooring/Met mooring                                                  |     |
| METEOROLOGICAL Time Series: 40-hour Low-pass Filtered .....                    | 71  |
| Air Pressure, Air Temperature, Relative Humidity, Solar Radiation, Wind Speed, |     |
| Wind Vector, Velocity from North, Velocity from East                           |     |
| PRESSURE Time Series: 1-hour & 40-hour Low-pass Filtered Pressure .....        | 75  |
| Mid-Shelf & Shelf-Break Moorings                                               |     |
| VELOCITY Time Series: 1-hour Low-pass Filtered .....                           | 79  |
| Inshore Mooring                                                                |     |
| East & North Components (10m, 20m, 30m, 40m) .....                             | 81  |
| Mid-Shelf Mooring                                                              |     |
| East & North Components (9m, 29m, 49m, 69m) .....                              | 94  |
| Shelf-Break Mooring Period A                                                   |     |
| East & North Component (79m, 91m, 103m, 115m) .....                            | 107 |
| Shelf-Break Mooring Period D                                                   |     |
| East & North Component (28m, 48m, 68m, 88m) .....                              | 110 |
| TEMPERATURE Time Series: 1-hour Low-pass Filtered .....                        | 115 |
| Inshore Mooring (13m, 16m, 20m, 28m, 40m, 48m) .....                           | 117 |
| Mid-Shelf Mooring (16m, 20m, 24m, 28m, 36m, 48m, 60m, 70m, 78m) .....          | 130 |
| Met Mooring (2m, 4m, 6m, 10m) .....                                            | 143 |
| Shelf-Break Mooring .....                                                      | 156 |

|                                                                                                                                                             |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| SALINITY Time Series: 1-hour Low-pass Filtered .....                                                                                                        | 169 |
| Inshore Mooring Days 118-148.....                                                                                                                           | 171 |
| Inshore, Mid-Shelf, & Shelf-Break Moorings .....                                                                                                            | 172 |
| <br>METEOROLOGICAL Time Series: 1-hour Low-pass Filtered .....                                                                                              | 185 |
| Air Pressure, Air Temperature, Relative Humidity, Solar Radiation, Wind Speed,<br>Wind Vector, Velocity from North, Velocity from East (Days 118-238) ..... | 187 |
| Solar Radiation, Mean Vector Wind Speed, Air Temperature, and 2-m Water Temperature<br>from Met, Inshore, and Shelf-Break moorings (Days 118-228).....      | 199 |
| <br>PRESSURE Time Series: 1-hour & 40-hour Low-pass Filtered Pressure .....                                                                                 | 211 |
| Mid-Shelf Mooring .....                                                                                                                                     | 213 |
| Shelf-Break Mooring .....                                                                                                                                   | 215 |

## INTRODUCTION

This report documents oceanographic and meteorological measurements made from instruments deployed on four moorings over the continental shelf west of Oregon, from spring through summer, 1999. These moorings were a component of an observational and numerical modeling program to study the response of the coastal ocean to wind forcing.

*The Dynamics and Prediction of Wind-Driven Coastal Circulation* was funded by the National Oceanographic Partnership Program (NOPP) with the principal goal to develop nowcast and forecast systems for wind-driven coastal flow fields. The observational program was designed to provide measurements that would allow testing and improvement of the modeling capability. See <http://www.oce.orst.edu/po/research/nopp/>, <http://diana.OCE.ORST.EDU/cmoweb/nopp/>, and Austin et al. (2000) for description of the modeling program and a description of other aspects of the observational program.

This report is divided into two sections. The first section contains descriptions of the instrumentation deployed on the NOPP moorings including locations, sampling rates, and calibrations. The second section contains plots of the observations. Several views of the time series recorded by the moorings are presented. Time series of vertically separated velocity, temperature, and salinity are shown for each mooring. Velocity and temperature observations from the same depth on horizontally separated moorings are also shown. These data are presented as both 40-hour low-pass filtered and 1-hour low-pass filtered time series. Time is given as day of year 1999 in all of the time series plots; conversion to calendar date is provided in Table 5.

## DEPLOYMENT HISTORY

Three subsurface oceanographic moorings and one meteorological mooring were deployed from the R/V Wecoma on the continental shelf west of Newport, OR, on 27 April 1999. An Inshore mooring was deployed in 50 m, a Mid-Shelf mooring was deployed 12.5 km farther west in 80 m, and a Shelf-Break mooring was deployed 16.18 km west of the Mid-Shelf mooring in 130 m of water. The meteorological ("Met") mooring was deployed adjacent to the Mid-Shelf mooring in 81 m of water. In Figure 1, the locations of the moorings are shown in relation to the bathymetry of the Oregon shelf. The positions, dates, and instruments supported by each of these moorings are listed in Table 1. The sampling parameters for the acoustic current profilers on the subsurface moorings are listed in Table 2, and the meteorological variables sampled on the Met mooring are listed in Table 3. The locations of the various oceanographic variables sampled are illustrated in Figure 2. Also shown in Figure 2 are the depth bins for which the ADP and ADCP velocities are good.

The subsurface moorings were marked at the surface by a spar buoy with a radar reflector and light located 3.5 m above the surface. The spar buoys were loosely tethered to the main buoyancy, located at roughly 10 m depth. Because these moorings were deployed in a heavily fished region, it was important to bring descriptions and positions of the moorings to the

attention of the commercial fishing fleet. To that end, an advertisement was run in *National Fisherman*, a notice to mariners was posted, posters were displayed at docks frequented by commercial fisherman, and laminated calling cards with mooring positions were distributed at the poster locations. We requested that commercial fishermen steer clear of the moorings and report to us any signs of mooring or instrument damage.

Despite the notices, the M/V *Sea Eagle*, a trawler under contract to NOAA/NMFS, encountered the Shelf-Break mooring on 22 May. Parts of the mooring were hit by the *Sea Eagle*'s trawling gear as it was being hauled in at the conclusion of a tow. During recovery of the trawl gear, the surface spar buoy was dragged under water. The spar buoy resurfaced near the stern of the *Sea Eagle*, where the mast was damaged in the subsequent line tangle at the stern. Apparently during this episode, the near-bottom VACM came off the mooring chain and was not recovered later with the remainder of the mooring.

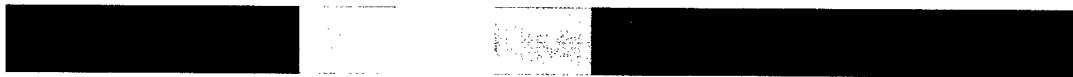
An Argos transmitter (PTT) strapped to the topmost subsurface float was torn free of its bracket during the encounter with the trawler, rose to the surface, and transmitted once before going offline for good. The quality of this single transmission was not sufficiently high to obtain an accurate position. The PTT was later found washed ashore at North Beach, Pt Reyes National Seashore the week of 21 June 1999, and subsequently returned to OSU by mail.

During a day trip aboard the R/V *Sacajawea* on 3 June to conduct a visual inspection of the mooring damage, the Shelf-Break mooring was found in 120 m of water 4 km south of the deployed position. At this time, the topmost subsurface float was at the surface and attached to the demasted spar buoy. On a second trip to the new mooring site on 19 June, the original spar buoy was recovered and replaced with a smaller, temporary spar buoy.

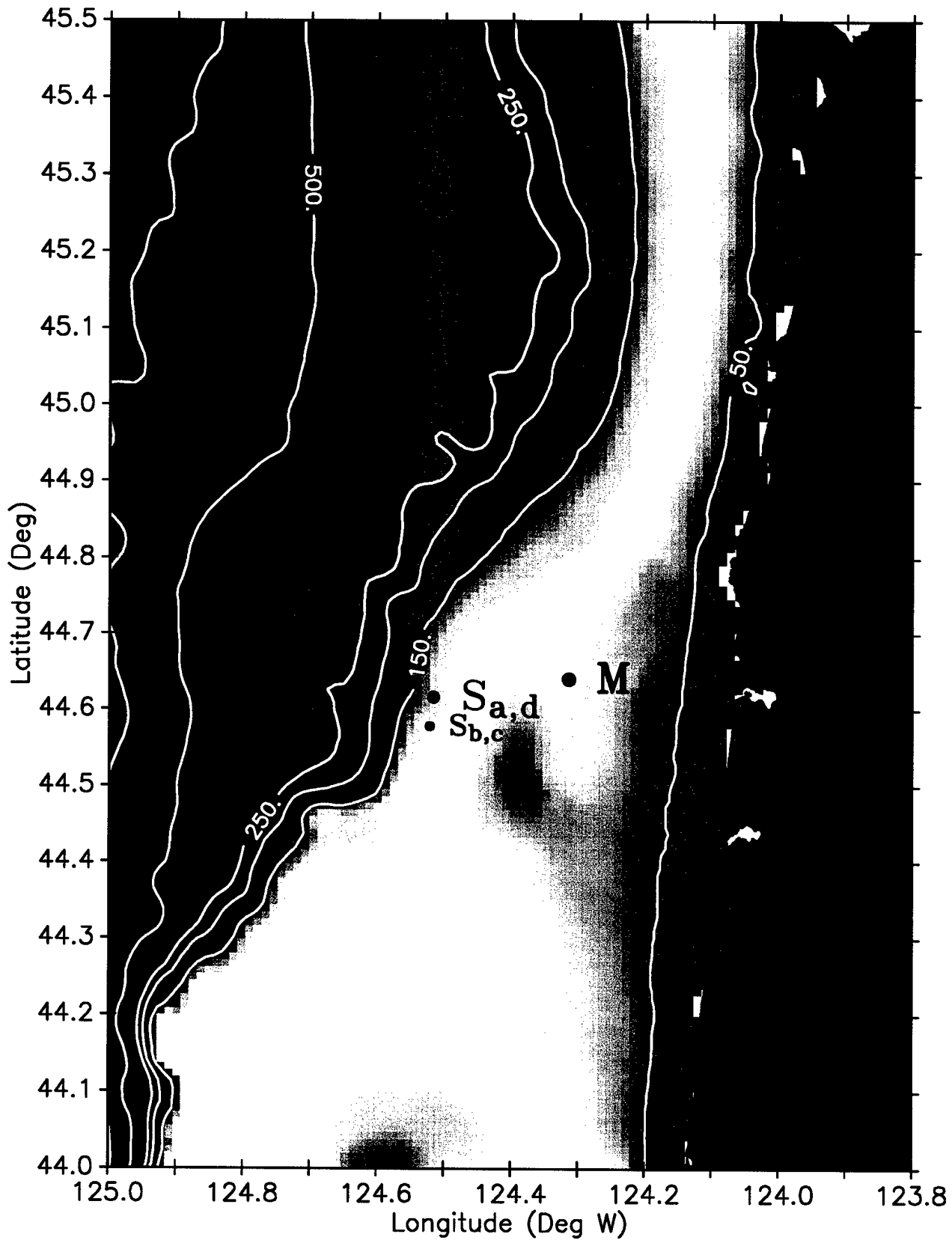
The Shelf-Break mooring was recovered and redeployed during the main NOPP cruise aboard R/V *Wecoma*, 13-31 July. Recovery was complicated by the fact that the surface spar buoy was not found at its last recorded position, however successful communication with the acoustic release indicated that at least some part of the mooring remained at that location. *Wecoma* then returned briefly to Newport to load equipment for a dragging operation: the deep sea traction winch, chain, and various grapnel hooks. During the first dragging attempt, near midnight on 17 July, the mooring chain was grabbed near the middle of the mooring while following a semicircular path around the mooring location. In addition to the spar buoy, one of the subsurface floats was missing. This reduction in buoyancy caused the remaining upper buoy to float at about 10 m depth, leaving the bottom 7-10m of the mooring resting on the bottom. Loss of the flotation was probably due to mechanical wearing of hardware connecting the buoys, which were supposed to be subsurface, but were riding in the wave zone after being dragged. After downloading data and some reconfiguration of instruments, the mooring was redeployed at its original location on 19 July 1999 with replacement flotation buoys, a replacement 500 kHz ADP, and one replacement MTR, but without the SBE 16 SEACAT that had not worked during the first deployment.

The Met mooring located over the Mid-Shelf was deployed with a sturdy wooden fence to prevent access to the surface buoy by seals/sea lions. Visual inspection of the Met mooring from the R/V *Sacajawea* during the NOPP mini-bat surveys of the mid- and inner-shelf (May-Sept 1999, Austin et al., 2000), revealed the fence gone and seals on the buoy after 1 month.

5 25 50 75 100 125 150 250 500 1000 2000



### Approximate Bathymetry at NOPP Mooring Sites



I = Inshore M = MidShelf & Met S = ShelfBreak periods a,b,c,d

**Table 1.**

**a. NOPP Shelf-Break Mooring – First Deployment – 4/27/99 to 7/16/99 (117 to 197)**

Three time periods:

A – 4/27/99 to 5/23/99 (117 to 143)      44°36.99N, 124°30.98W (130 m)

B – 5/23/99 to 7/6/99 (143 to 187) **44°34.71N, 124°31.30W (120 m)**dragged by fishing boat  
(mooring became shallower by 9 m)

|                                    |   |   |   |                                                        |
|------------------------------------|---|---|---|--------------------------------------------------------|
| C - 7/6/99 to 7/16/99 (187 to 197) | " | " | " | Lost upper buoyancy<br>(mooring became deeper by 10 m) |
|------------------------------------|---|---|---|--------------------------------------------------------|

| Sensor            | Serial #           | Depth, m |     |     | $\Delta$ t, min | Comments                   |
|-------------------|--------------------|----------|-----|-----|-----------------|----------------------------|
|                   |                    | A        | B   | C   |                 |                            |
| MTR               | 3098               | 2        | 2   |     | 4               | on spar buoy; recover 6/19 |
| <del>Seacat</del> | <del>50</del>      |          |     |     |                 | did not record data        |
| MTR               | 3075               | 16       | 7   | 17  | 4               |                            |
| MDR w/P           | 100                | 20       | 11  | 21  | 4               |                            |
| Microcat          | 39                 | 28       | 19  | 29  | 2               |                            |
| SBE 39            | 88                 | 36       | 27  | 37  | 2               |                            |
| MTR               | 3079               | 48       | 39  | 49  | 4               |                            |
| Microcat          | 43                 | 60       | 51  | 61  | 2               |                            |
| MTR               | 3093               | 72       | 63  | 73  | 4               |                            |
| MTR               | 3078               | 82       | 73  | 83  | 4               |                            |
| MTR               | 3010               | 94       | 85  | 95  | 4               |                            |
| Microcat          | 41                 | 120      | 111 | 120 | 2               |                            |
| ADP-250           | C12                | 125      |     |     | 2               | no data during B and C     |
| <del>VACM</del>   | <del>195037c</del> |          |     |     |                 | lost                       |
| MTR               | 3073               | 128      | 119 | 120 | 4               | on release                 |

**b. NOPP Shelf-Break Mooring – Second Deployment – 7/19/99 to 9/3/99 (200 to 246)— period D**

**44°37.17N, 124°30.90W (131 m)**

| Sensor         | Serial #        | Depth | $\Delta$ t, min | Comments                          |
|----------------|-----------------|-------|-----------------|-----------------------------------|
| MTR            | 3098            | 2     | 4               |                                   |
| Microcat       | 43              | 13    | 2               |                                   |
| MTR            | 3075            | 17    | 2               |                                   |
| MDR w/P        | 100             | 21    | 2               |                                   |
| Microcat       | 39              | 29    | 2               |                                   |
| SBE 39         | 88              | 37    | 2               |                                   |
| MTR            | 3079            | 49    | 2               |                                   |
| MTR            | 3010            | 61    | 2               |                                   |
| MTR            | 3093            | 73    | 2               |                                   |
| MTR            | 3078            | 83    | 2               |                                   |
| ADP-500        | 3               | 91    | 2               |                                   |
| <del>MTR</del> | <del>3077</del> |       |                 | on ADP frame; did not record data |
| Microcat       | 41              | 121   | 2               |                                   |
| MTR            | 3073            | 129   | 2               | on release                        |

Table 1 (cont.).

**c. NOPP Mid-Shelf Mooring – 4/27/99 to 9/3/99 (117 to 246)**  
**44°38.42N, 124°18.84W (81 m)**

| Sensor   | Serial # | Depth | $\Delta$ t, min | Comments            |
|----------|----------|-------|-----------------|---------------------|
| Seacat   | 5†       |       |                 | did not record data |
| MTR      | 3085     | 16    | 4               |                     |
| MDR w/P  | 116      | 20    | 4               |                     |
| MTR      | 3113     | 24    | 4               |                     |
| Microcat | 40       | 28    | 2               |                     |
| SBE 39   | 86       | 36    | 2               |                     |
| MTR      | 3086     | 48    | 4               |                     |
| MTR      | 3090     | 60    | 4               |                     |
| Seacat   | 41       | 70    | 4               |                     |
| ADP-500  | 4038     | 74    | 4               |                     |
| VACM     | 1950869  | 76    | 16              |                     |
| MTR      | 3080     | 78    | 4               | on release          |

**d. NOPP Meteorological Mooring – 4/27/99 to 9/3/99 (117 to 246)**  
**44°38.60N, 124°19.02W (80 m)**

| Sensor | Serial # | Depth | $\Delta$ t, min | Comments                                   |
|--------|----------|-------|-----------------|--------------------------------------------|
| Seacat | 43       | 2     | 4               | on surface buoy bridle                     |
| MTR    | 3074     | 4     | 4               |                                            |
| MTR    | 3084     | 6     | 4               |                                            |
| MTR    | 3081     | 10    | 4               | calibration bias .01 to .015 (see Table 4) |

**e. NOPP Inshore Mooring – 4/27/99 to 9/3/99 (117 to 246)**  
**44°38.14N, 124°9.33W (50 m)**

| Sensor          | Serial #           | Depth | $\Delta$ t, min | Comments            |
|-----------------|--------------------|-------|-----------------|---------------------|
| MTR             | 3082               | 2     | 4               | on spar buoy        |
| Seacat          | 40                 | 13    | 4               |                     |
| MTR             | 3094               | 16    | 4               |                     |
| MTR             | 3099               | 20    | 4               |                     |
| SBE 39          | 87                 | 28    | 2               |                     |
| Microcat        | 42                 | 40    | 2               |                     |
| ADCP-300        | 1552               | 46    | 4               |                     |
| <del>VACM</del> | <del>1950a94</del> |       |                 | did not record data |
| MTR             | 3095               | 48    | 4               | on release          |

Table 2a. Sampling Parameters for Acoustic Doppler (Current) Profilers

Shelf-break Mooring; first deployment—periods A, B, C

| Parameter                                      | Value                                                                                                                        | Comment                                                                      |
|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Manufacturer                                   | Sontek, Inc.                                                                                                                 | Acoustic Doppler Profiler (ADP)                                              |
| Acoustic frequency                             | 250 kHz / 3 beams                                                                                                            | simultaneous pinging                                                         |
| Model / serial no.                             | Stand-alone ADP / C12                                                                                                        | purchased by Kosro                                                           |
| CPU / DSP Versions                             | ADP 4.6 / DSP 5.0                                                                                                            | Board Rev. D                                                                 |
| Slant angle                                    | 25 degrees                                                                                                                   |                                                                              |
| Cell size / number of cells                    | 4 m / 35 cells                                                                                                               | 3.2 W @ 100% duty cycle                                                      |
| Averaging interval                             | 40 s                                                                                                                         |                                                                              |
| Number of pings / sample                       | 160                                                                                                                          |                                                                              |
| Sampling interval                              | 120 s                                                                                                                        | duty cycle = $40/120 = 0.333$                                                |
| Blanking distance                              | 2 m                                                                                                                          |                                                                              |
| Coordinate system                              | ENU                                                                                                                          |                                                                              |
| Data filename (binary)                         | N9904001.ADP                                                                                                                 | 11,130,866 bytes                                                             |
| First profile<br>Last profile                  | 0340 4/25/99 GMT<br>1828 6/6/99 GMT                                                                                          | Time of center of pinging                                                    |
| Number of profiles                             | 22,172                                                                                                                       |                                                                              |
| Location                                       | Shelfbreak Mooring<br>at 125 m depth                                                                                         | 44 deg 36.99' N; 124 deg 30.98'W                                             |
| Cell depths (center)<br>strikeout = unreliable | 119, 115, 111, 107, 103, 99, 95, 91, 87, 83, 79, 75, 71, 67, 63,<br>59, 55, 51, 47, 43, 39, 35, 31, 27, 23, 19, 15, 11, 7, 3 |                                                                              |
| Salinity used in $c_{\text{sound}}$            | 33.5 ppt                                                                                                                     | not very sensitive to S; 1.2 m/s per ppt                                     |
| Auxiliary sensors                              | temperature, tilt (2),<br>compass heading                                                                                    |                                                                              |
| Battery type                                   | lithium (3 packs)                                                                                                            |                                                                              |
| Energy available (est.)                        | 5442 Wh                                                                                                                      | = $3 \times 21.6 \text{ V} \times 84 \text{ Ah}$                             |
| Energy used (est.)                             | 1074 Wh                                                                                                                      | = $3.2 \text{ W} \times 0.33 \times 42 \text{ days} \times 24 \text{ h/day}$ |

**Table 2b. Sampling Parameters for Acoustic Doppler (Current) Profilers****Shelf-break Mooring; second deployment— period D**

| Parameter                           | Value                                                                                                                                                                                                                               | Comment                                                                  |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Manufacturer                        | Sontek, Inc.                                                                                                                                                                                                                        | Acoustic Doppler Profiler (ADP)                                          |
| Acoustic frequency                  | 500 kHz / 3 beams                                                                                                                                                                                                                   | sequential pinging                                                       |
| Model / serial no.                  | Stand-alone ADP / 3                                                                                                                                                                                                                 | purchased by Kosro                                                       |
| CPU / DSP Versions                  | ADP 5.3 / DSP 4.0                                                                                                                                                                                                                   | Board Rev. D                                                             |
| Slant angle                         | 25 degrees                                                                                                                                                                                                                          |                                                                          |
| Cell size / number of cells         | 2 m / 50 cells                                                                                                                                                                                                                      | 2 W @ 100% duty cycle                                                    |
| Averaging interval                  | 48 s                                                                                                                                                                                                                                |                                                                          |
| Number of pings / sample            | 96                                                                                                                                                                                                                                  |                                                                          |
| Sampling interval                   | 120 s                                                                                                                                                                                                                               | duty cycle = $48/120 = 0.4$                                              |
| Blanking distance                   | 1 m                                                                                                                                                                                                                                 |                                                                          |
| Coordinate system                   | ENU                                                                                                                                                                                                                                 |                                                                          |
| Data filename (binary)              | N9907001.ADP                                                                                                                                                                                                                        | 28,411,854 bytes                                                         |
| First profile<br>Last profile       | 0000 7/13/99 GMT<br>2036 9/8/99 GMT                                                                                                                                                                                                 | Time of center of pinging                                                |
| Number of profiles                  | 41,659                                                                                                                                                                                                                              |                                                                          |
| Location                            | Shelfbreak Mooring<br>at 91 m depth                                                                                                                                                                                                 | 44 deg 37.17' N; 124 deg 30.90'W                                         |
| Cell depths (center)                | 88, 86, 84, 82, 80, 78, 76, 74, 72, 70, 68, 66, 64, 62, 60, 58, 56,<br>54, 52, 50, 48, 46, 44, 42, 40, 38, 36, 34, 32, 30, 28, <del>26</del> , <del>24</del> , <del>22</del> ,<br><del>20</del> , 18, 16, 14, 12, 10, 8, 6, 4, 2, 0 |                                                                          |
| Salinity used in $c_{\text{sound}}$ | 33.0 ppt                                                                                                                                                                                                                            | not very sensitive to S; 1.2 m/s per ppt                                 |
| Auxiliary sensors                   | temperature, tilt (2),<br>compass heading                                                                                                                                                                                           |                                                                          |
| Battery type                        | alkaline                                                                                                                                                                                                                            |                                                                          |
| Energy available (est.)             | 2268 Wh                                                                                                                                                                                                                             | = $3 \times 18 \text{ V} \times 24 \text{ Ah}$                           |
| Energy used (est.)                  | 1114 Wh                                                                                                                                                                                                                             | = $2 \text{ W} \times 0.4 \times 58 \text{ day} \times 24 \text{ h/day}$ |

**Table 2c. Sampling Parameters for Acoustic Doppler (Current) Profilers****Mid-Shelf Mooring**

| Parameter                                                 | Value                                                                                                                                        | Comment                                  |
|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| Manufacturer                                              | Sontek, Inc.                                                                                                                                 | Acoustic Doppler Profiler (ADP)          |
| Acoustic frequency                                        | 500 kHz / 3 beams                                                                                                                            | sequential pinging                       |
| Model / serial no.                                        | Stand-alone ADP / 4038                                                                                                                       | purchased by Levine / Boyd               |
| CPU / DSP Versions                                        | ADP 4.2 / DSP 4.0                                                                                                                            | Board Rev. D                             |
| Slant angle                                               | 25 degrees                                                                                                                                   |                                          |
| Cell size / number of cells                               | 2 m / 40 cells                                                                                                                               | 2 W @ 100% duty cycle                    |
| Averaging interval                                        | 150 s                                                                                                                                        |                                          |
| Number of pings / sample                                  | 300                                                                                                                                          |                                          |
| Sampling interval                                         | 240 s                                                                                                                                        | duty cycle = $150/240 = 0.625$           |
| Blanking distance                                         | 1 m                                                                                                                                          |                                          |
| Coordinate system                                         | ENU                                                                                                                                          |                                          |
| Data filename (binary)                                    | N9904002.ADP                                                                                                                                 | 27,250,672 bytes                         |
| First profile<br>Last profile                             | 0552 4/27/99 GMT<br>2220 9/8/99 GMT                                                                                                          | Time of center of pinging                |
| Number of profiles                                        | 48,488                                                                                                                                       |                                          |
| Location                                                  | Mid-Shelf Mooring<br>at 74 m depth                                                                                                           | 44 deg 38.42' N; 124 deg 18.84'W         |
| Cell depths (center)<br><del>strikeout</del> = unreliable | 71, 69, 67, 65, 63, 61, 59, 57, 55, 53, 51, 49, 47, 45, 43, 41, 39,<br>37, 35, 33, 31, 29, 27, 25, 23, 21, 19, 17, 15, 13, 11, 9, 7, 5, 3, 1 |                                          |
| Salinity used in $c_{\text{sound}}$                       | 33.5 ppt                                                                                                                                     | not very sensitive to S; 1.2 m/s per ppt |
| Auxiliary sensors                                         | temperature, tilt (2),<br>compass heading                                                                                                    |                                          |
| Battery type                                              | lithium (3 packs)                                                                                                                            |                                          |
| Energy available (est.)                                   | 5442 Wh                                                                                                                                      | = 3 x 21.6 V x 84 Ah                     |
| Energy used (est.)                                        | 4080 Wh                                                                                                                                      | = 2 W x 0.625 x 136 day x 24 h/day       |

**Table 2d. Sampling Parameters for Acoustic Doppler (Current) Profilers****Inshore Mooring**

| Parameter                                                | Value                                                                                        | Comment                                                                                                |
|----------------------------------------------------------|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| Manufacturer                                             | RDI, Inc.                                                                                    | Acoustic Doppler Current Profiler (ADCP)                                                               |
| Acoustic frequency                                       | 300 kHz / 4 beams                                                                            | purchased by Levine / Boyd                                                                             |
| Model / serial no.                                       | Workhorse / 0067                                                                             | Firmware: 8.27 operating; 1.13 boot                                                                    |
| Slant angle                                              | 20 degrees                                                                                   |                                                                                                        |
| Bin length / number of bins                              | 2 m / 28 bins                                                                                |                                                                                                        |
| % good minimum                                           | 25%                                                                                          |                                                                                                        |
| Number of pings / sample                                 | 25                                                                                           |                                                                                                        |
| Sampling interval                                        | 240 s                                                                                        |                                                                                                        |
| Blanking distance                                        | 1.76 m                                                                                       |                                                                                                        |
| Coordinate system                                        | Earth                                                                                        |                                                                                                        |
| Data filename (binary)                                   | N9904000.000                                                                                 | 34,146,032 bytes                                                                                       |
| First profile<br>Last profile                            | 0630 4/27/99 GMT<br>1218 9/9/99 GMT                                                          |                                                                                                        |
| Number of profiles                                       | 48,838                                                                                       |                                                                                                        |
| Location                                                 | Inner Shelf Mooring<br>at 46 m depth                                                         | 40 deg 29.50' N; 70 deg 30.46'W                                                                        |
| Bin depths (center)<br><del>strikeout</del> = unreliable | <del>42, 40, 38, 36, 34, 32, 30, 28, 26, 24, 22, 20, 18, 16, 14, 12, 10, 8, 6, 4, 2, 0</del> |                                                                                                        |
| Salinity used in $c_{\text{sound}}$                      | 34 ppt                                                                                       | not very sensitive to S; 1.2 m/s per ppt                                                               |
| Auxiliary sensors                                        | temperature, tilt (2),<br>compass heading                                                    |                                                                                                        |
| Battery type                                             | alkaline                                                                                     | source: RDI                                                                                            |
| Energy available (est.)                                  | 400 Wh                                                                                       | specified by RDI                                                                                       |
| Energy used (est.)                                       | 395 Wh                                                                                       | from RDI "Plan" program – 136 days;<br>powered 30 more days @ 7°C before<br>full memory; final: 32 VDC |

**Table 3. Meteorological Buoy (components purchased from Campbell Scientific Inc.)**

|                                                                                 |                                         |
|---------------------------------------------------------------------------------|-----------------------------------------|
| <b>Sensors:</b>                                                                 |                                         |
| Air Temperature & Relative Humidity                                             | (Model HMP45C; Vaisala, Inc.)           |
| Wind Speed & Direction                                                          | (Model 05106-5; RM Young)               |
| Barometric Pressure                                                             | (Model CS105; Vaisala, Inc.)            |
| Pyranometer (solar radiation)                                                   | (Model LI200X; Li-Cor)                  |
| Buoy Compass                                                                    | (Model C100; KVH)                       |
| <b>Controller:</b>                                                              |                                         |
| Data Logger                                                                     | (Model CR10X; Campbell Scientific Inc.) |
| Sampling Program (NOPP2)—written by Dennis Root.                                |                                         |
| Data are averaged over 15 minutes, using samples taken every:                   |                                         |
| 5 seconds (wind speed, vane direction, & buoy compass)                          |                                         |
| 1 minute (air temperature, relative humidity, barometric pressure, & radiation) |                                         |
| Battery voltage is sampled and recorded once per day.                           |                                         |
| <b>Communication:</b>                                                           |                                         |
| Cell phone package                                                              | (Model CDM100; Motorola)                |
| Cell phone system is turned on between 1600 and 1700 UT each day.               |                                         |

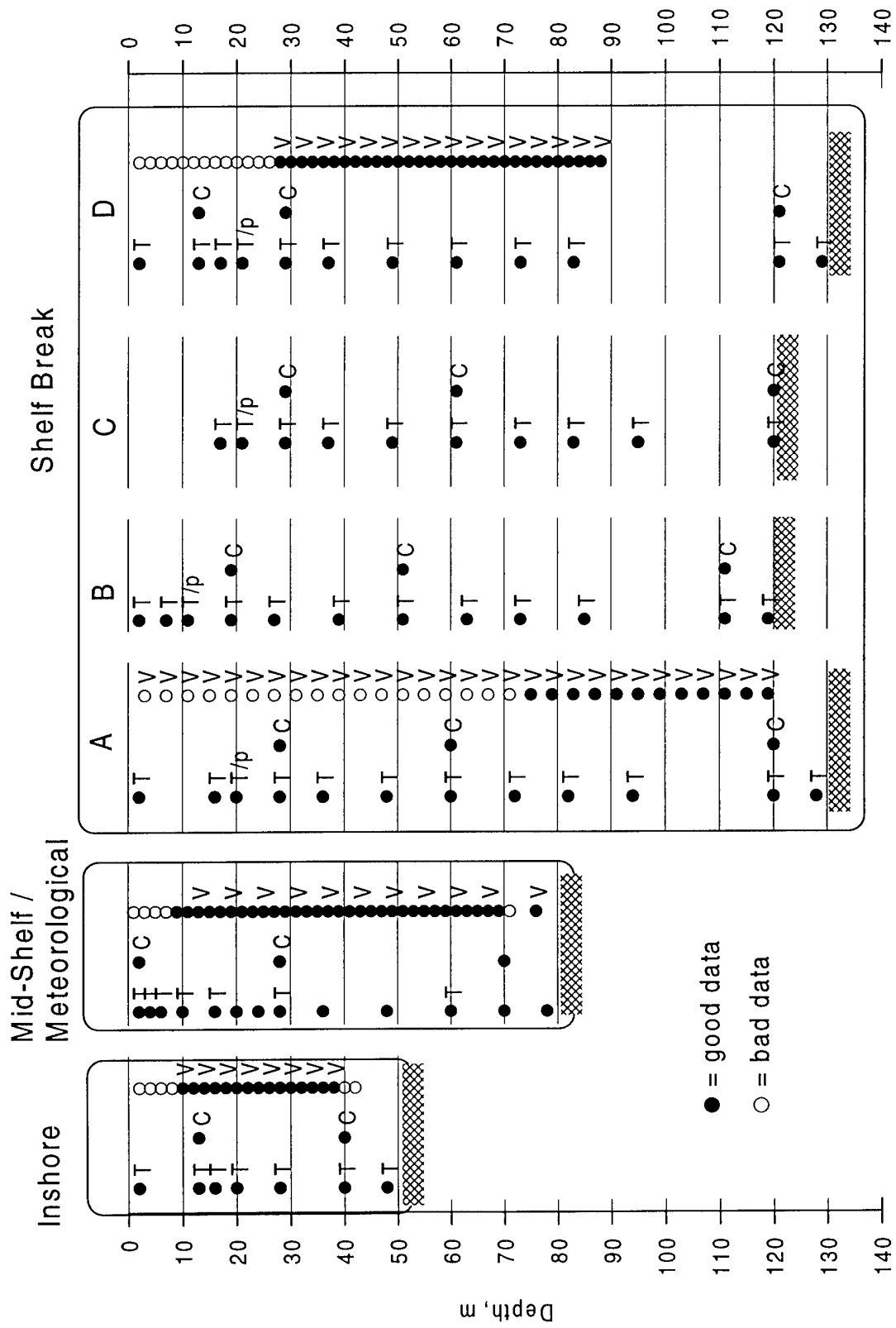
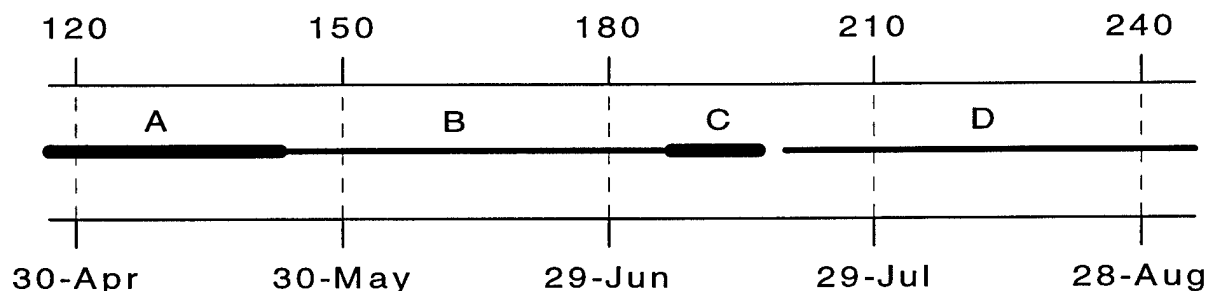


Figure 2.

Beginning 22 July, cellular phone downloads of meteorological data showed that the anemometer had failed. Subsequent visual inspection of the Met buoy conducted by R/V Wecoma during the NOPP intensive survey revealed the anemometer absent, and the anemometer cable extracted to full length suspended in the water, consistent with either vandalism or contact with a fishing boom. The anemometer was replaced and one guy wire was repaired on 3 August 1999. Shortly after replacement of the anemometer, all other meteorological sensors failed. The failure was due to an internal short of the temperature sensor circuitry for reasons that remain a mystery.

The mooring field work concluded when the three subsurface moorings and surface Met mooring were recovered at their deployed locations without incident on 3 September 1999. In the figures that follow, we refer to the period of time between the initial deployment and the trawler accident as Period A, the time between the trawler accident and the loss of Shelf-Break mooring buoyancy as Period B, and the time between loss of buoyancy and the recovery of the first Shelf-Break mooring as Period C. Period D refers to the entire duration of the second deployment of the Shelf-Break mooring. These periods are illustrated in the following time line.



## MOORINGS and INSTRUMENTATION

### *Mooring Construction*

The primary strength member of all the moorings was 1/2" long-link chain. The buoyancy for the subsurface moorings was provided by steel spheres: two 37" diameter spheres provided 1280 lbs net buoyancy on the Shelf-Break mooring, one 48" sphere provided 1370 lbs net buoyancy on the Mid-Shelf mooring, and one 37" sphere provided 640 lbs net buoyancy on the Inshore mooring. The subsurface mooring sites were marked by spar buoys with radar reflectors and lights at 3.5m above the water. The spar buoys netted about 250 lbs of buoyancy and were filled with foam to minimize the consequences of a leak. The spar buoys were loosely tethered to the subsurface spheres, and were not intended to support the mooring in the event of a failure of the primary buoyancy.

The Met buoy is a 1.78m diameter toroid constructed of DuPont Surlyn foam (Gilman Corp.), providing a maximum 2580 lbs of buoyancy (i.e., at the point of total submergence). The Met mooring total length was 114 m, resulting in a scope of 1.4 (length of chain/depth of water).

The anchor for each mooring was composed of three railroad wheels welded to an axial pipe with a lower flange, weighing approximately 2500 lbs.

### ***Instrument Calibration***

The SBE 16 (SEACAT) and SBE 37-SM (MicroCAT) conductivity/temperature sensors were calibrated by Sea-Bird Electronics (SBE) in February 1999. The SBE 39 Temperature Recorders were factory calibrated by SBE in January 1999. Both SBE 39 Temperature Recorders and SBE 37 MicroCats output data in engineering units using these most recent SBE-installed coefficients. The February 1999 coefficients were used to convert to SBE 16 temperature and salinity

The most recent thorough calibration of the MTR and MDR temperature recorders was completed in October 1996 at OSU following the PRIMER/CM&O mooring deployment of July-September, 1996 (see Boyd et al., 1997 for a discussion of the temperature calibration). Prior to the NOPP deployment in April 1999, the MTR & MDR temperature coefficients were validated by comparison to a bath standard in three steps over the temperature range 5-18°C. The bath reference temperature was measured by an SBE-38 Digital Immersion Thermometer, which was calibrated by SBE in September 1997. The instrumental temperature errors (sensor minus bath reference temperature) were computed separately for the three temperature steps, over which the bath temperature drifted upward by 0.33 °C/day. The MTR step-averaged errors, shown in Table 4, are biased toward positive values and larger at the highest temperature step. The average MTR error is 0.004°C at 18°C. The average MDR error, which is not obviously correlated to the bath temperature, is 0.008°C.

All pressure measurements in NOPP were made by MDRs, which were calibrated at OSU following the NOPP deployment in September 1996, using a dead-weight tester and a Paroscientific pressure standard.

Self-calibrations of the compasses on the Sontek ADP Doppler current profilers were performed per manufacturer specification at OSU with the instruments suspended from a tree as configured for deployment within their respective mooring frames. Self-calibration of the RDI ADCP was conducted per manufacturer specifications at OSU with the instrument in the mooring frame. All calibrations were checked by comparison of instrument magnetic north to local magnetic north

An Alpha-Omega model 9407 Vector Averaging Current Meter was deployed two meters above the acoustic release on each mooring. The VACM on the Inshore mooring didn't start, and the VACM on the initial Shelf-Break mooring was missing at the time of recovery. Verification of the compass calibration for Mid-Shelf VACM was performed after recovery at OSU in the VACM mounting bracket and with a short section of steel chain attached. The VACM compass error varied sinusoidally over 360° of compass heading with amplitude of 10°, and was used to correct the velocity data (G. Gunderson, personal communication).

### ***ADCP/ADP Data Quality***

The upward-looking RDI 300kHz Workhorse ADCP (WH300) mounted at 46m depth on the Inshore mooring returned reasonable data throughout most of the water column for the entire

**Table 4.** Temperature differences between existing sensor output ( $T_{MTR}$ ) and calibration bath ( $T_{calibration}$ ) at 3 temperatures.

| MTR<br>Sensor # | Average ( $T_{MTR} - T_{calibration}$ ) / $10^{-3} \text{ }^{\circ}\text{C}$ |       |       |
|-----------------|------------------------------------------------------------------------------|-------|-------|
|                 | $T_{calibration} =$                                                          |       |       |
|                 | 18.16                                                                        | 5.00  | 6.00  |
| 3010            | 3.7                                                                          | 1.6   | 0.5   |
| 3073            | 0.8                                                                          | -0.7  | -1.2  |
| 3074            | 3.6                                                                          | 1.2   | 0.5   |
| 3075            | 5.6                                                                          | 2.4   | 1.8   |
| 3078            | 4.1                                                                          | 0.8   | -0.1  |
| 3079            | 2.2                                                                          | 0     | -0.6  |
| 3080            | -1.0                                                                         | -1.3  | -1.8  |
| 3081            | -10.1                                                                        | -17.2 | -18.0 |
| 3082            | 1.8                                                                          | 0     | -0.8  |
| 3084            | 0.5                                                                          | 0.3   | -0.7  |
| 3085            | 3.5                                                                          | 1.4   | 1.1   |
| 3086            | 2.6                                                                          | 1.2   | 0.5   |
| 3090            | 3.4                                                                          | 1.5   | 0.6   |

| MTR<br>Sensor # | Average ( $T_{MTR} - T_{calibration}$ ) / $10^{-3} \text{ }^{\circ}\text{C}$ |      |      |
|-----------------|------------------------------------------------------------------------------|------|------|
|                 | $T_{calibration} =$                                                          |      |      |
|                 | 18.16                                                                        | 5.00 | 6.00 |
| 3093            | 2.9                                                                          | 0.7  | 0.1  |
| 3094            | 6.8                                                                          | 4.6  | 3.6  |
| 3095            | 5.5                                                                          | 3.4  | 2.7  |
| 3098            | 3.4                                                                          | 2.3  | 1.8  |
| 3099            | 6.5                                                                          | 3.0  | 2.0  |
| 3113            | 1.1                                                                          | 0.1  | -0.5 |

| MDR<br>Sensor # | Average ( $T_{MDR} - T_{calibration}$ ) / $10^{-3} \text{ }^{\circ}\text{C}$ |      |      |
|-----------------|------------------------------------------------------------------------------|------|------|
|                 | $T_{calibration} =$                                                          |      |      |
|                 | 18.16                                                                        | 5.00 | 6.00 |
| 100             | 8.2                                                                          | 10.3 | 8.5  |
| 116             | 5.1                                                                          | 8.2  | 7.1  |

**Table 5.** Day of year calendar for 1999.

|         | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |         |
|---------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|---------|
| Day # 1 | 1   | 32  | 60  | 91  | 121 | 152 | 182 | 213 | 244 | 274 | 305 | 335 | Day # 1 |
| Day # 2 | 2   | 33  | 61  | 92  | 122 | 153 | 183 | 214 | 245 | 275 | 306 | 336 | Day # 2 |
| Day # 3 | 3   | 34  | 62  | 93  | 123 | 154 | 184 | 215 | 246 | 276 | 307 | 337 | Day # 3 |
| Day # 4 | 4   | 35  | 63  | 94  | 124 | 155 | 185 | 216 | 247 | 277 | 308 | 338 | Day # 4 |
| Day # 5 | 5   | 36  | 64  | 95  | 125 | 156 | 186 | 217 | 248 | 278 | 309 | 339 | Day # 5 |
| Day # 6 | 6   | 37  | 65  | 96  | 126 | 157 | 187 | 218 | 249 | 279 | 310 | 340 | Day # 6 |
| Day # 7 | 7   | 38  | 66  | 97  | 127 | 158 | 188 | 219 | 250 | 280 | 311 | 341 | Day # 7 |
| Day # 8 | 8   | 39  | 67  | 98  | 128 | 159 | 189 | 220 | 251 | 281 | 312 | 342 | Day # 8 |
| Day # 9 | 9   | 40  | 68  | 99  | 129 | 160 | 190 | 221 | 252 | 282 | 313 | 343 | Day # 9 |
| Day #10 | 10  | 41  | 69  | 100 | 130 | 161 | 191 | 222 | 253 | 283 | 314 | 344 | Day #10 |
| Day #11 | 11  | 42  | 70  | 101 | 131 | 162 | 192 | 223 | 254 | 284 | 315 | 345 | Day #11 |
| Day #12 | 12  | 43  | 71  | 102 | 132 | 163 | 193 | 224 | 255 | 285 | 316 | 346 | Day #12 |
| Day #13 | 13  | 44  | 72  | 103 | 133 | 164 | 194 | 225 | 256 | 286 | 317 | 347 | Day #13 |
| Day #14 | 14  | 45  | 73  | 104 | 134 | 165 | 195 | 226 | 257 | 287 | 318 | 348 | Day #14 |
| Day #15 | 15  | 46  | 74  | 105 | 135 | 166 | 196 | 227 | 258 | 288 | 319 | 349 | Day #15 |
| Day #16 | 16  | 47  | 75  | 106 | 136 | 167 | 197 | 228 | 259 | 289 | 320 | 350 | Day #16 |
| Day #17 | 17  | 48  | 76  | 107 | 137 | 168 | 198 | 229 | 260 | 290 | 321 | 351 | Day #17 |
| Day #18 | 18  | 49  | 77  | 108 | 138 | 169 | 199 | 230 | 261 | 291 | 322 | 352 | Day #18 |
| Day #19 | 19  | 50  | 78  | 109 | 139 | 170 | 200 | 231 | 262 | 292 | 323 | 353 | Day #19 |
| Day #20 | 20  | 51  | 79  | 110 | 140 | 171 | 201 | 232 | 263 | 293 | 324 | 354 | Day #20 |
| Day #21 | 21  | 52  | 80  | 111 | 141 | 172 | 202 | 233 | 264 | 294 | 325 | 355 | Day #21 |
| Day #22 | 22  | 53  | 81  | 112 | 142 | 173 | 203 | 234 | 265 | 295 | 326 | 356 | Day #22 |
| Day #23 | 23  | 54  | 82  | 113 | 143 | 174 | 204 | 235 | 266 | 296 | 327 | 357 | Day #23 |
| Day #24 | 24  | 55  | 83  | 114 | 144 | 175 | 205 | 236 | 267 | 297 | 328 | 358 | Day #24 |
| Day #25 | 25  | 56  | 84  | 115 | 145 | 176 | 206 | 237 | 268 | 298 | 329 | 359 | Day #25 |
| Day #26 | 26  | 57  | 85  | 116 | 146 | 177 | 207 | 238 | 269 | 299 | 330 | 360 | Day #26 |
| Day #27 | 27  | 58  | 86  | 117 | 147 | 178 | 208 | 239 | 270 | 300 | 331 | 361 | Day #27 |
| Day #28 | 28  | 59  | 87  | 118 | 148 | 179 | 209 | 240 | 271 | 301 | 332 | 362 | Day #28 |
| Day #29 | 29  |     | 88  | 119 | 149 | 180 | 210 | 241 | 272 | 302 | 333 | 363 | Day #29 |
| Day #30 | 30  |     | 89  | 120 | 150 | 181 | 211 | 242 | 273 | 303 | 334 | 364 | Day #30 |
| Day #31 | 31  |     | 90  |     | 151 |     | 212 | 243 |     | 304 |     | 365 | Day #31 |

duration of the deployment. Data at 42 m was mostly error values and has not been included in any plots or distributed data files. The WH300 has 4 transducers at  $20^\circ$  angles from vertical, and uses data from all 4 beams to derive horizontal velocities when possible. The separation at the surface between oppositely facing beams was 33.5 m. Among the error statistics reported by the WH300 is the percentage of good 4-beam solutions used in each ensemble average, as well as the percentage of good 3-beam solutions per ensemble. The record-mean for ensemble percentage of good 4-beam solutions was greater than 98% for depths greater than 8 m, and the mean for good 3- or 4-beam solutions was greater than 99.5% for those depths. The error velocity is the difference between the estimates of vertical velocity from orthogonal pairs of transducers. Ideally, the two estimates of vertical velocity would be the same if the velocity field were homogeneous over the beam separations. The magnitude of the record-mean of the ensemble error velocity was less than 0.1 cm/s for depths greater than 8 m, with the exception of high error velocities at 40 m depth. Velocity data at 40 m depth otherwise appears reasonable. Mean vertical velocity is nearly constant -0.1 to -0.2 cm/s throughout most of the water column, with the exception of the top two bins, which are strongly influenced by surface reflections. RMS vertical velocity fluctuations increase gradually towards the surface, but are significantly larger in the bin closest to the surface due to the surface reflections. In summary, velocities at depths shallower than 10 m are suspect.

The 500kHz Sontek ADP deployed on the Mid-Shelf mooring returned reasonable data throughout most of the water column for the duration of the experiment. A different suite of error diagnostics is available for the Sontek ADPs than the RDI ADCP. The Sontek ADPs have 3 transducers mounted at  $25^\circ$  angles from vertical, and thus have no redundant information on velocity components. The 3 beams of the Mid-Shelf ADP were separated by 59.8 m at the surface. With the exception of the deepest bin and the four bins closest to the surface, the mean vertical velocity from the Mid-Shelf ADP is -0.6 to -0.9 cm/s. Data from the bins with larger vertical velocities, the bin at 71 m and the bins at depths shallower than 9 m, are suspect. In addition, the rms vertical velocity fluctuations increase gradually towards the surface, with the exception of the bottom bin (71 m) and the top three bins (1, 3, and 5 m), for which the vertical velocity standard deviation is larger (Figure 3). Data from these bins should probably be disregarded for this reason. The standard deviation over each ensemble of single-ping velocity components is recorded for each depth bin. The record-mean of the vertical velocity standard deviation is less than 0.65 cm/s for all depths greater than 9 m. Above 9 m, the mean of ensemble standard deviations increases toward the surface, rising to a maximum of 1.2 cm/s for the 1 m bin. The record-mean signal-to-noise ratios for each beam are nearly identical and decrease gradually by a factor of almost 4 towards the surface, with the exception of the 1 to 5-m and 71-m bins (Figure 4a). The signal-to-noise ratios (s/n) for the 1 to 5-m bins are significantly impacted by surface reflection, to a degree that varies with beam and presumably depends on mean tilt of the ADP. The s/n ratio at 71-m is lower than at the next shallower bin, but is still substantially larger than the near-surface values. Sontek ADP beam amplitudes and signal-to-noise ratios are completely correlated, thus containing no independent information.

The upward-looking 250kHz Sontek ADP used in the first deployment of the Shelf-Break mooring was located at 125 m and had its three beams separated by 101 m at the surface. Data was recorded only up to the time the mooring was struck by the M/V Sea Eagle. Standard deviations of the horizontal and vertical components of velocity show local maxima at 60 m and 30 m, which interrupt the otherwise monotonically increasing with range standard deviation

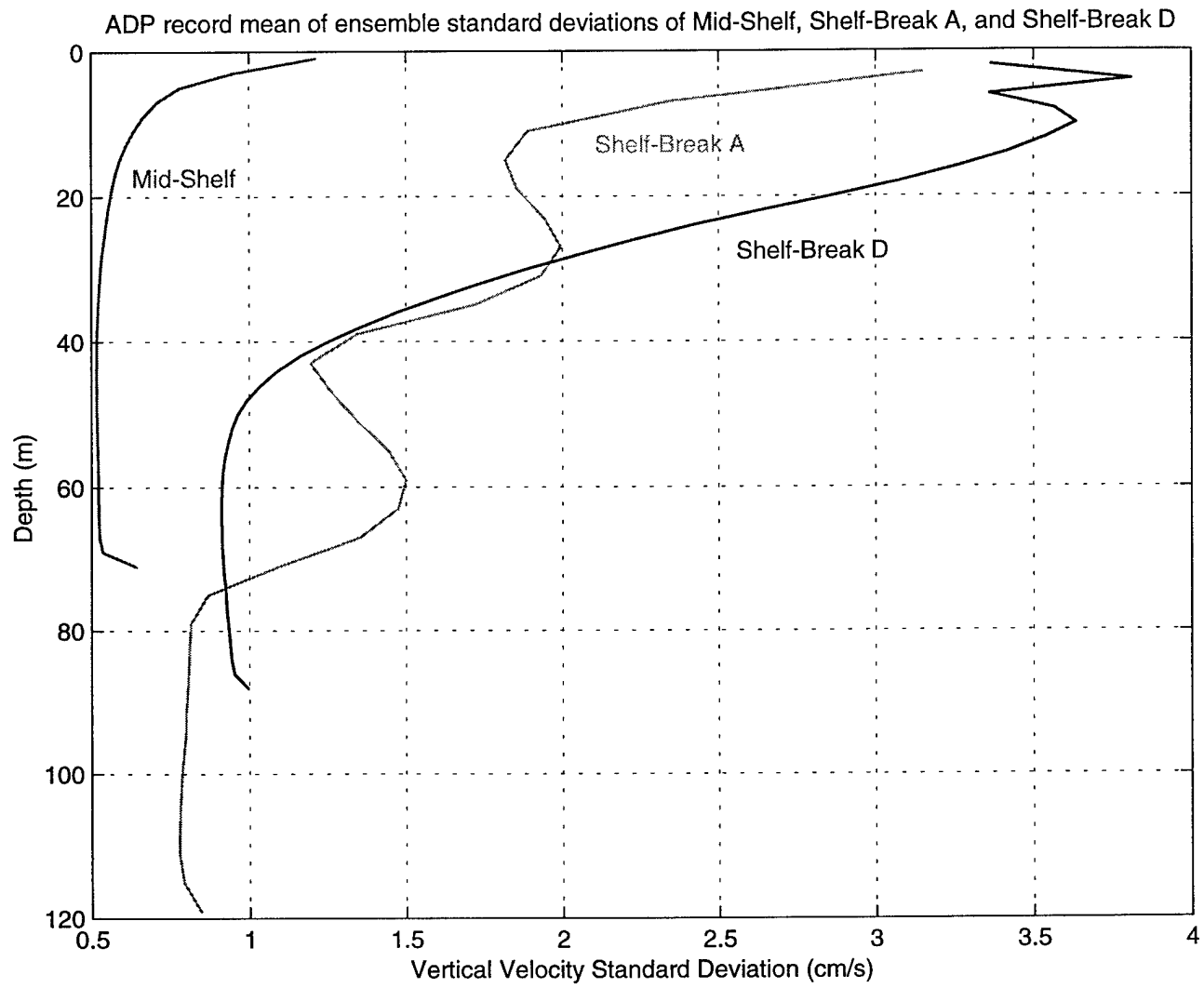


Figure 3a.

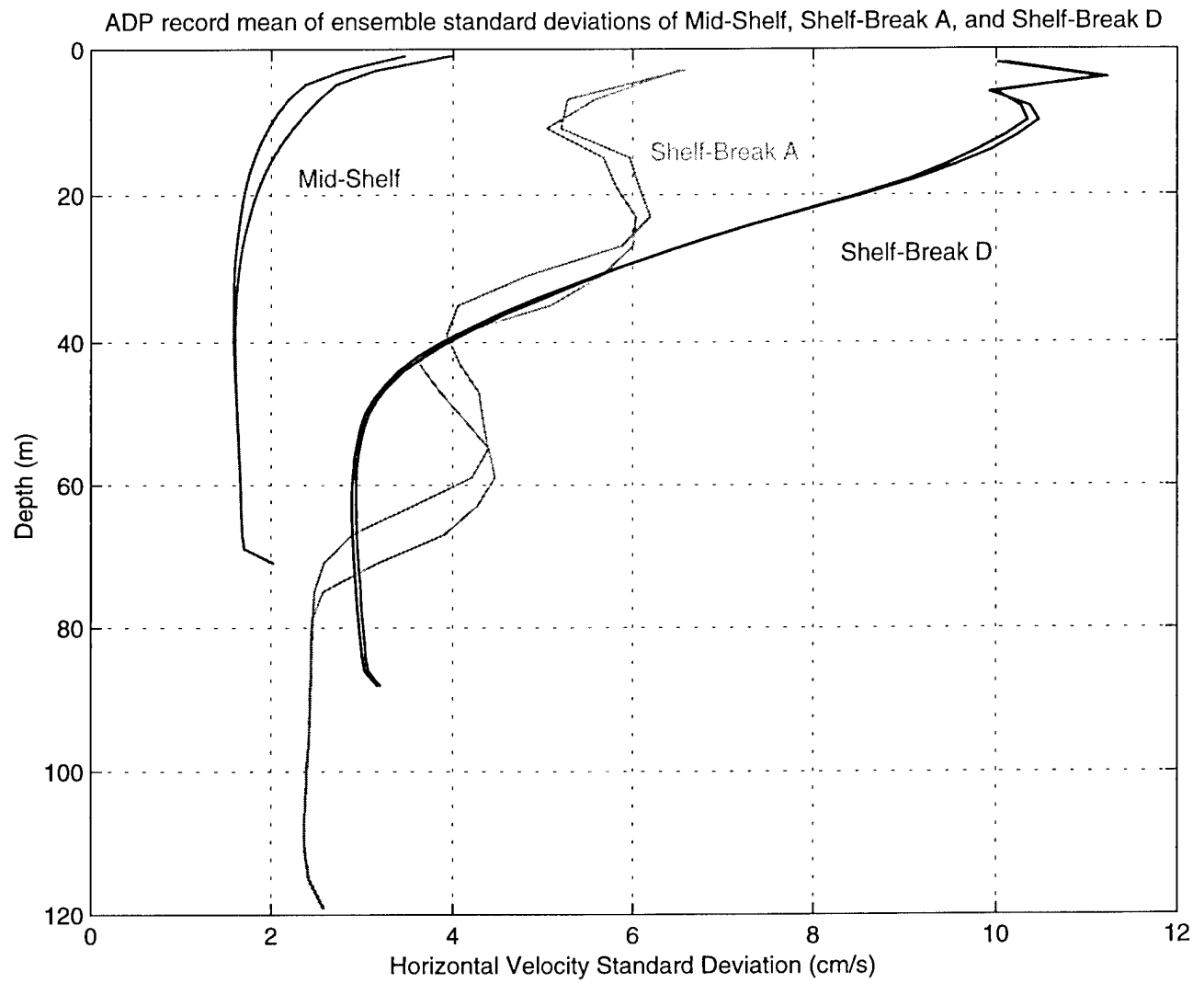


Figure 3b.

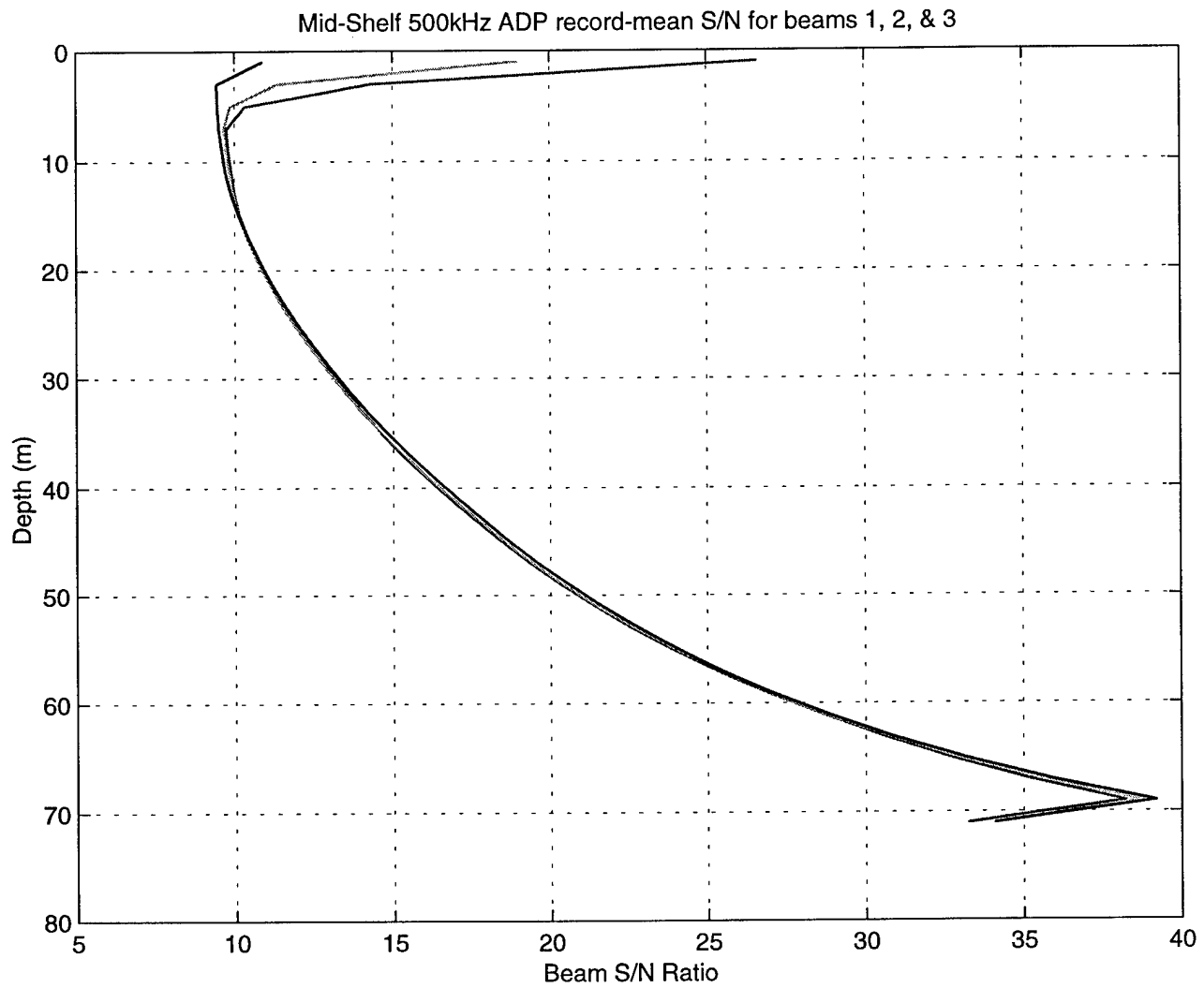


Figure 4a.

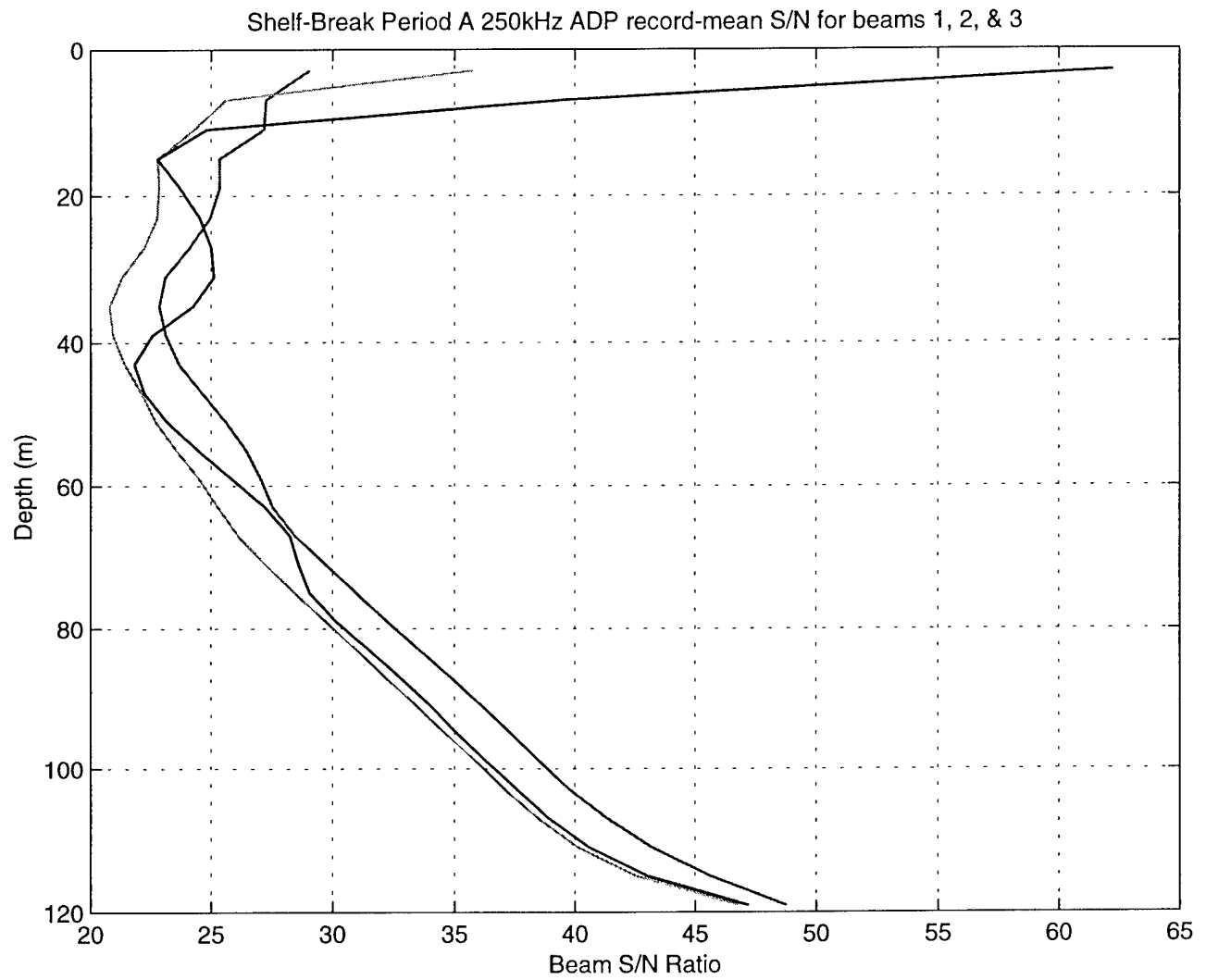


Figure 4b.

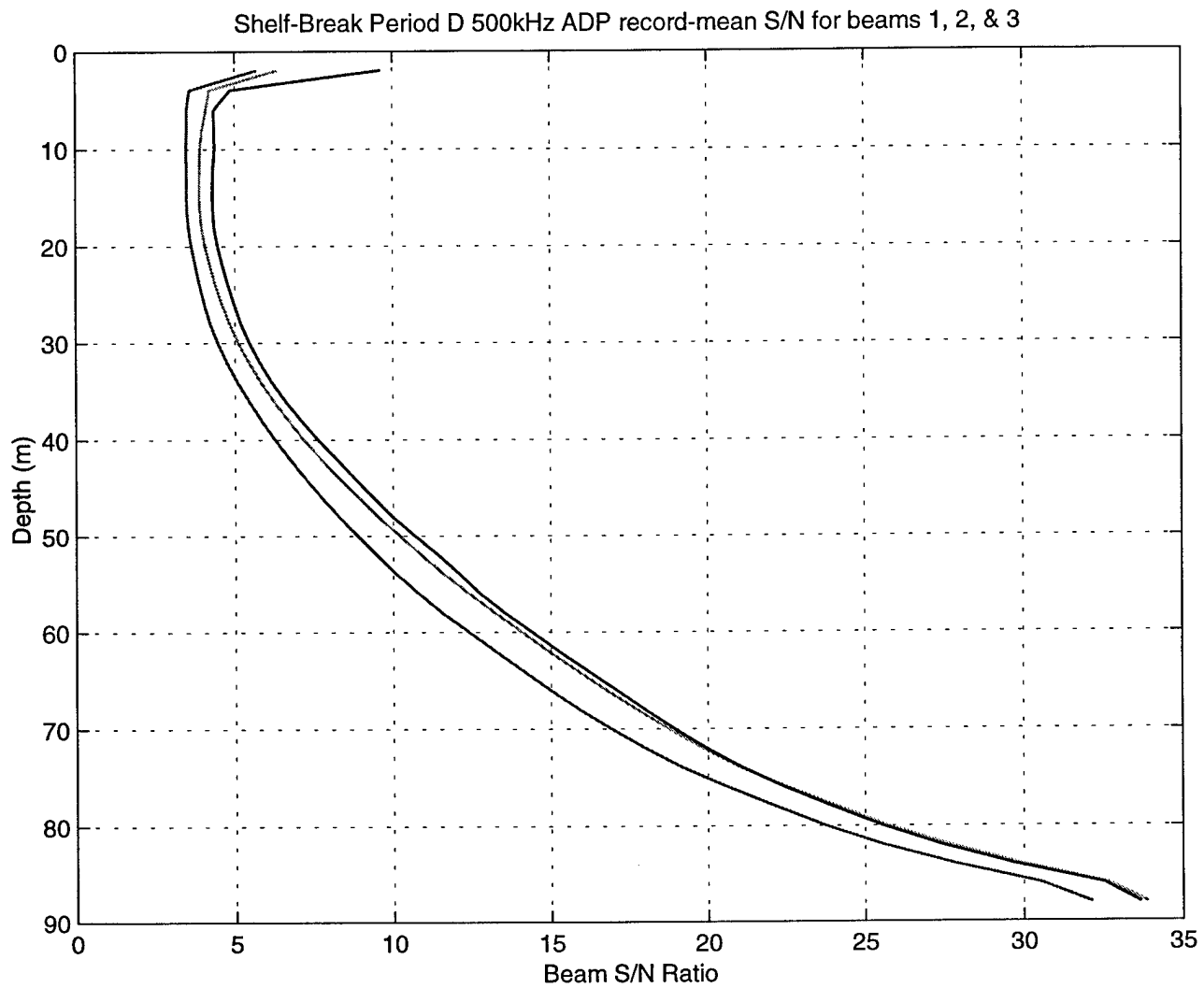


Figure 4c.

(Figure 3). A similar structure is observed in both the beam amplitude and signal-to-noise ratios, and is especially strong for one of the three beams (Figure 4b). The depth ranges of these peculiarities in the ADP diagnostics correspond to the depth ranges of strange behavior in the velocity fields. We consider only velocity data below 71 m to be reasonable for period A of the first deployment.

The upward-looking 500kHz Sontek ADP used in the second deployment of the Shelf-Break mooring was located at 91 m and had its three beams separated by 73.5 m at the surface. During this deployment, the Shelf-Break ADP exhibited vertically coherent diurnal variations in signal-to-noise ratio on all three beams. The diurnal increase in s/n corresponds to decreases in ensemble standard deviation of both near-surface vertical and horizontal components of velocity (Figure 5). Variations in solar radiation recorded on the Met mooring were roughly in phase with the near-surface ensemble standard deviation of all velocity components, and thus out of phase with beam signal-to-noise (Figure 6). Signal-to-noise would thus appear to improve (increase) as solar radiation went to zero each day, due to increased scatterer concentration in the near-surface layer, thus reducing the standard deviation of the velocity estimates.

Throughout most of the period D Shelf-Break velocity record, low levels of s/n above 40-60 m are interrupted on a daily basis by vertically coherent higher levels of s/n. Toward the end of the record, the diurnal variation in the near-surface signal-to-noise ratio and velocity standard deviation is neither as clear nor regular as earlier in the record. After day 232, low levels of s/n extend from the surface to below 60 m, and diurnal increases in s/n do not extend all the way to the surface, suggesting loss of transmission power near the end of the record. At the same time, high values of velocity standard deviation, which extended down to only 20 m early in the record, extended to 30 – 40 m and, following day 239, continuously in time (Figure 5).

Early in the period D Shelf-Break velocity record, the coincident periods of low vertical velocity standard deviation and high s/n are bounded by short periods of large vertical velocity magnitude: upward at the leading edge of the low solar radiation period and downward at the trailing edge. Examples of the early period D temporal relationships between solar radiation, beam s/n, velocity component standard deviation, and vertical velocity are shown in figure 5. In Figure 6, we show the hourly averaged vertical velocity standard deviation (VVSD) in gray-scale for each depth bin together with the 1 cm/s contour of the low-pass filtered VVSD. Velocity from bins above this contour are not good a significant fraction of the time.

Estimates of the total energy consumption over the course of the deployment for each of the Doppler current profilers are shown in Table 2. Estimates of the maximum possible sampling time for the NOPP ADCP/ADP sampling parameters with the battery types used in NOPP are also shown in Table 2.

### *Conversion of Velocities from Magnetic to Geographic Coordinates*

Vector currents were rotated from magnetic coordinates to geographic coordinates using the magnetic declination of 18° 12' E. This value was obtained from the web site of the Geological Survey of Canada (<http://www.geolab.nrcan.gc.ca/>) for the Mid-Shelf deployment location: 44° 38' N; 124° 19' W.

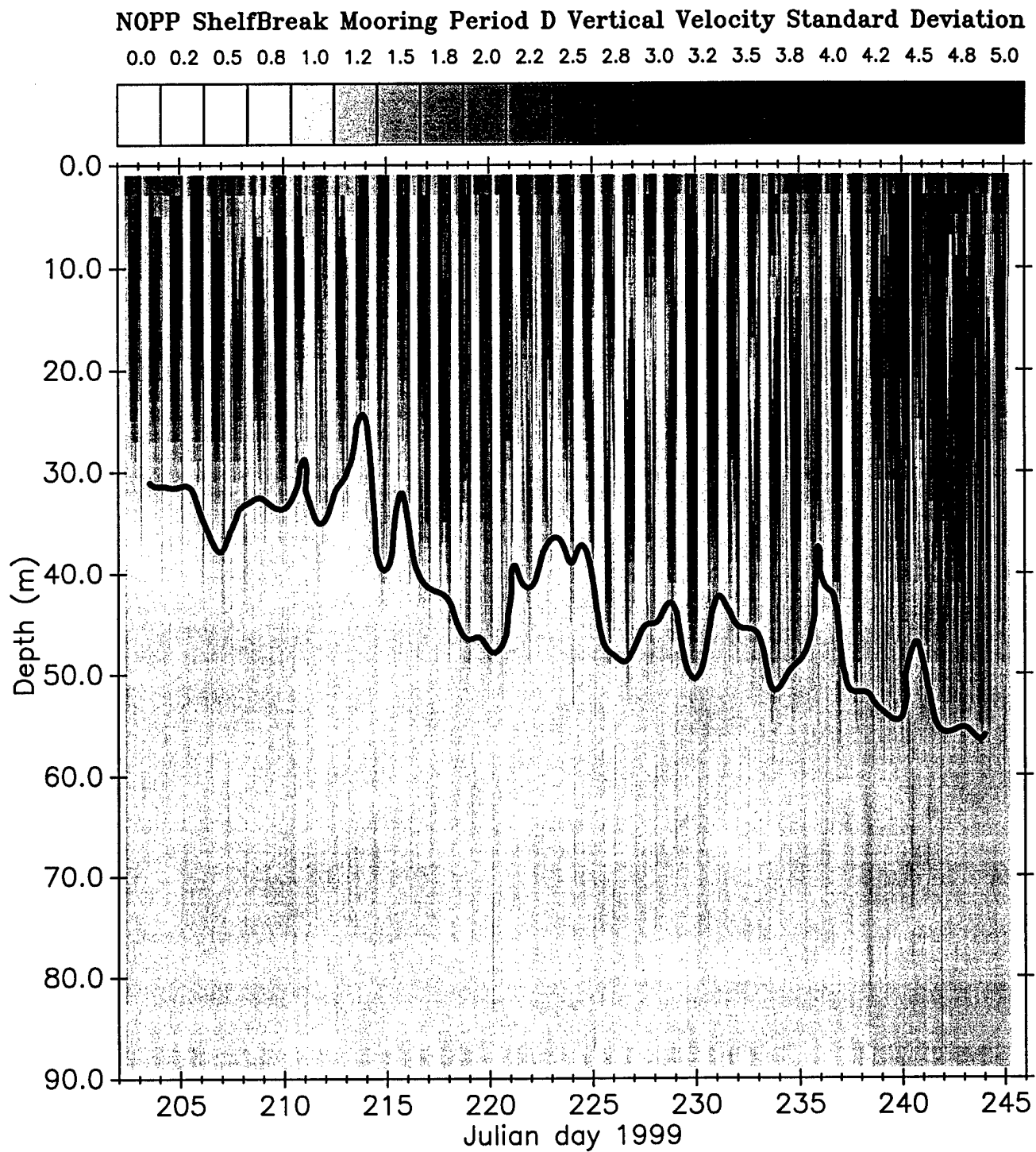


Figure 5.

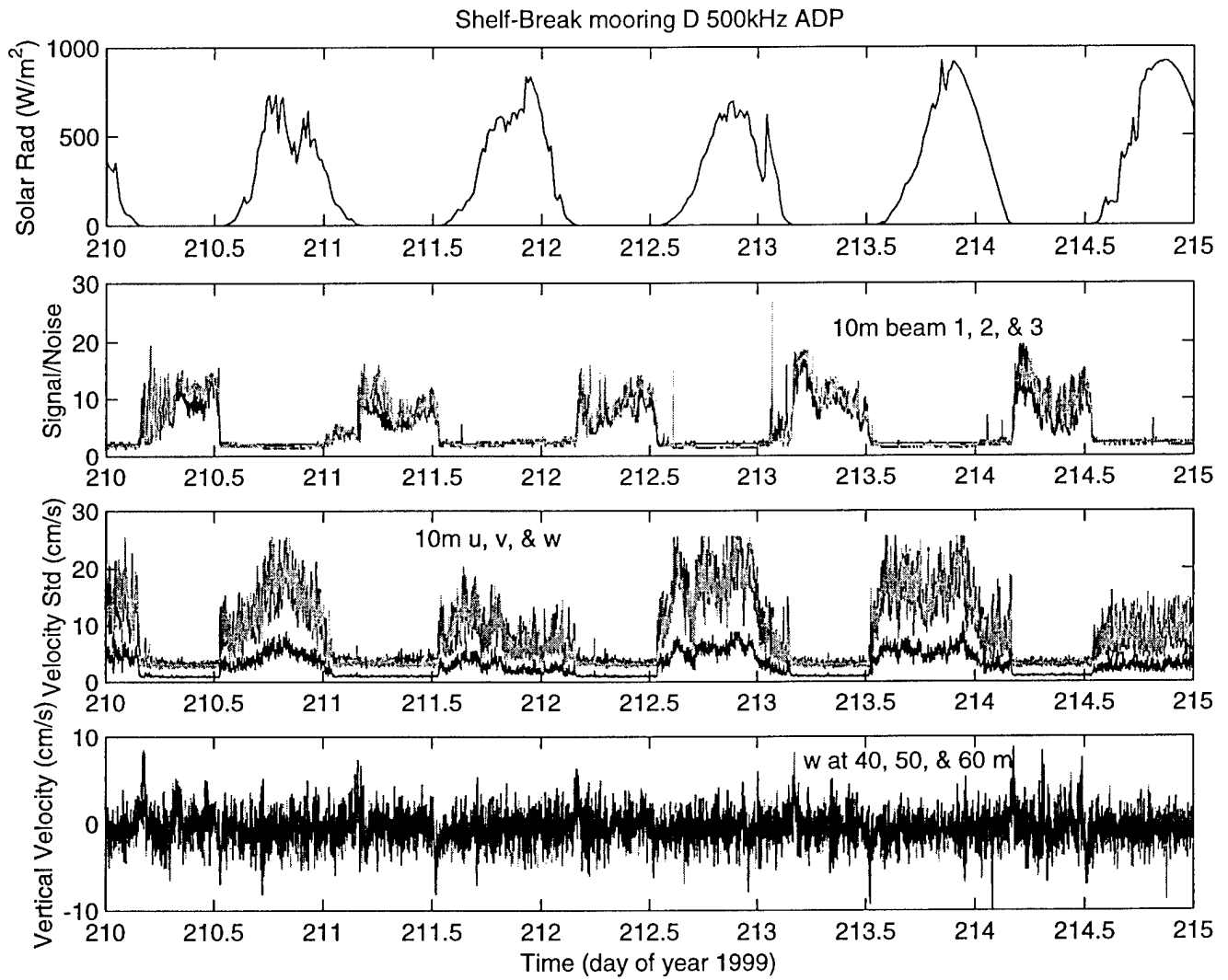


Figure 6.

### **Data Filtering**

Only plots of 1-hour and 40-hour low pass filtered data are presented in this report. The 1-hour low-pass filter has a window  $\frac{1}{2}$  width of 16 hours, and  $\frac{1}{4}$  power point of 1 hour. The 40-hour low-pass filter has a window  $\frac{1}{2}$  width of 122 hours, and  $\frac{1}{4}$  power point of 40 hours. The low pass filter is a symmetric, finite impulse response filter with a Lanczos taper. The filter output is

$$\bar{T}_i = \frac{\sum_{k=-M}^M h_k T_{k+i}}{\sum h_k}, \text{ where the } k\text{th filter weight is } h_k = \frac{\sin(\pi F_c / F_N k \Delta t)}{(\pi F_c / F_N \Delta t)}, \text{ in which } F_c \text{ is the cutoff}$$

frequency,  $F_N$  is the Nyquist frequency and  $\Delta t$  is the sample interval. Because there is no filter output within one filter  $\frac{1}{2}$  width of the start or stop times of the time series, the 40-hour low pass filtered records from the short period C of the Shelf-Break mooring are extremely short.

### **REFERENCES**

Boyd, T., M. D. Levine and S. R. Gard, Mooring observations from the Mid-Atlantic Bight, July-September 1996, Synthetic Aperture Sonar Primer and Coastal Mixing & Optics Programs, Ref. 97-2, Data Report 164, Oregon State University, 226 pp., 1997.

Austin, J. A., S. D. Pierce, and J. A. Barth, Small-Boat Hydrographic Surveys of the Oregon Mid-to-Inner Shelf, May-September 1999, A component of the Prediction of Wind-Driven Coastal Circulation Project, COAS ref 00-2, Data Report 178, 2000.



## **CONTOUR PLOTS of VELOCITY and TEMPERATURE**

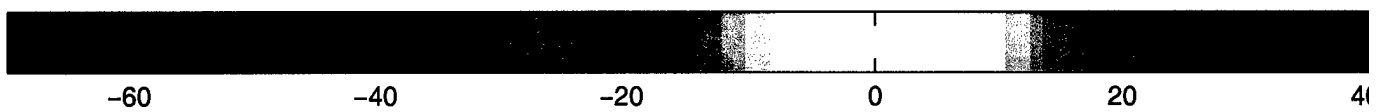
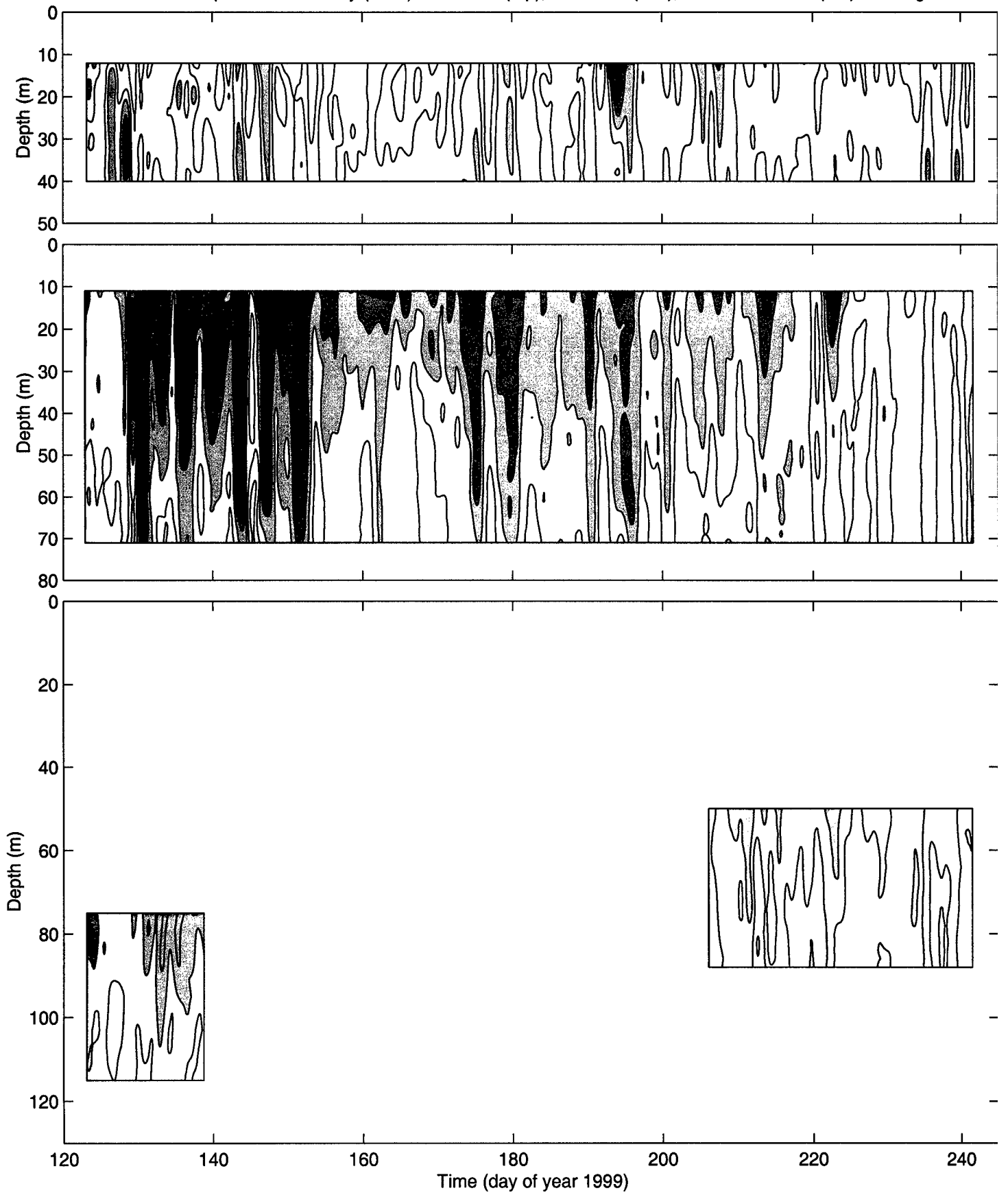
### **40-hour Low-Pass Filtered**

Color contour plots of east and north components of velocity from the Inshore, Mid-Shelf, and Shelf-Break moorings. Color contour plots of temperature from the Inshore, Mid-Shelf, and Shelf-Break moorings. Note that the large gaps at the start and end of each record as well as the gaps between periods A, B, and C of the Shelf-Break records are due to the half-width of the low-pass filter.

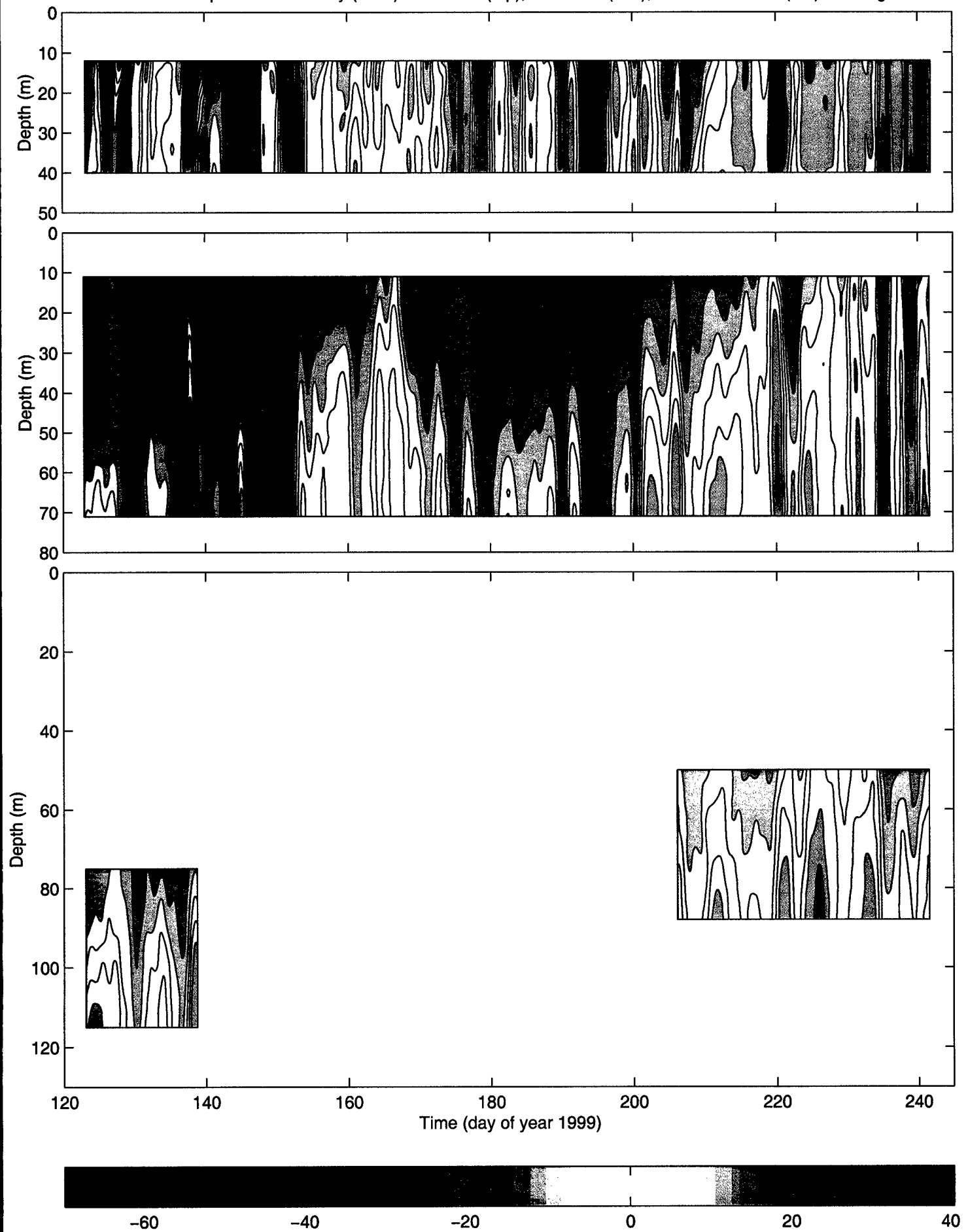




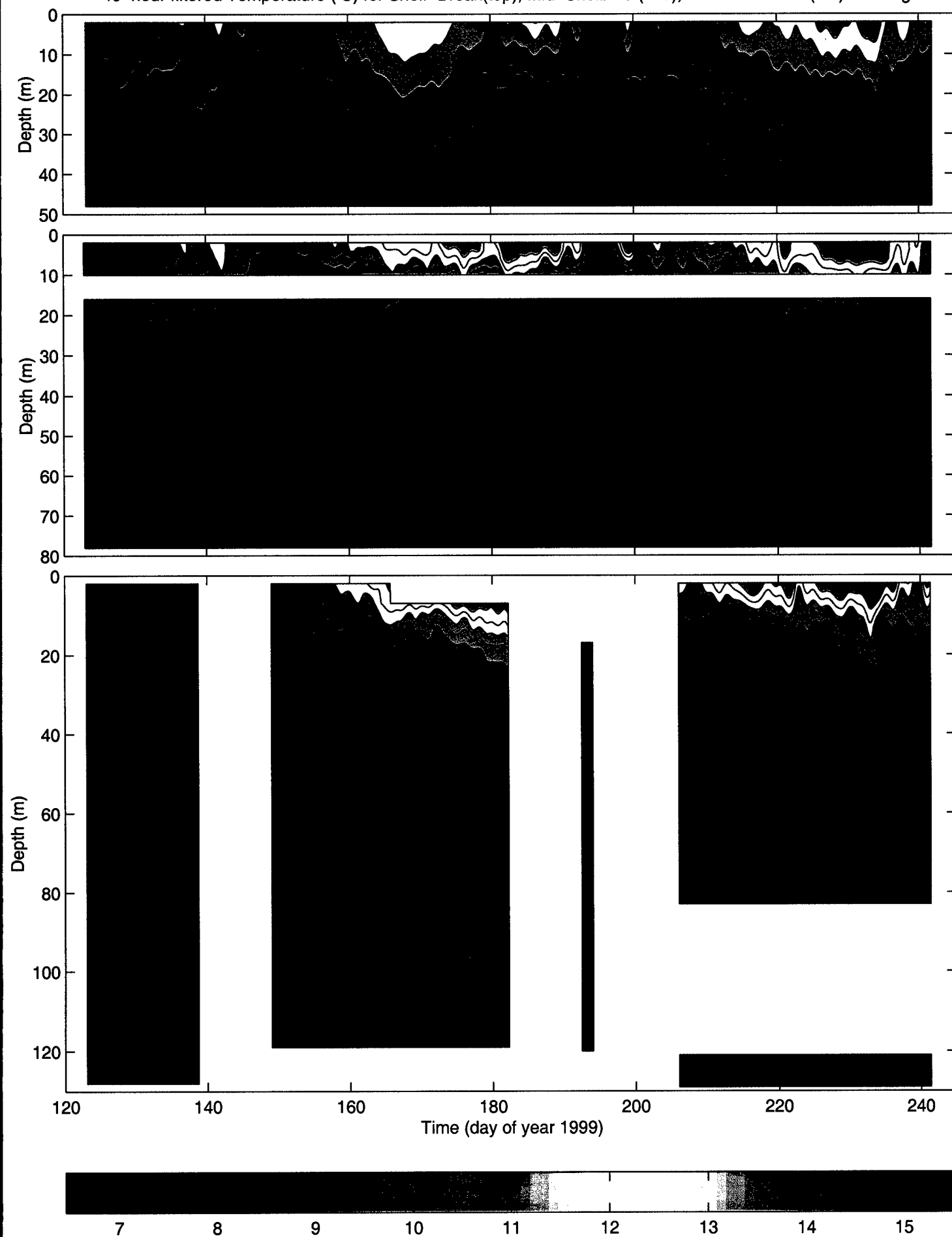
East Component of Velocity (cm/s) for Inshore(top), Mid-Shelf(mid), and Shelf-Break(bot) Moorings



North Component of Velocity (cm/s) for Inshore(top), Mid-Shelf(mid), and Shelf-Break(bot) Moorings





40-hour filtered Temperature ( $^{\circ}\text{C}$ ) for Shelf-Break(top), Mid-Shelf/Met(mid), and Inner-Shelf(bot) Moorings



## **VELOCITY Time Series**

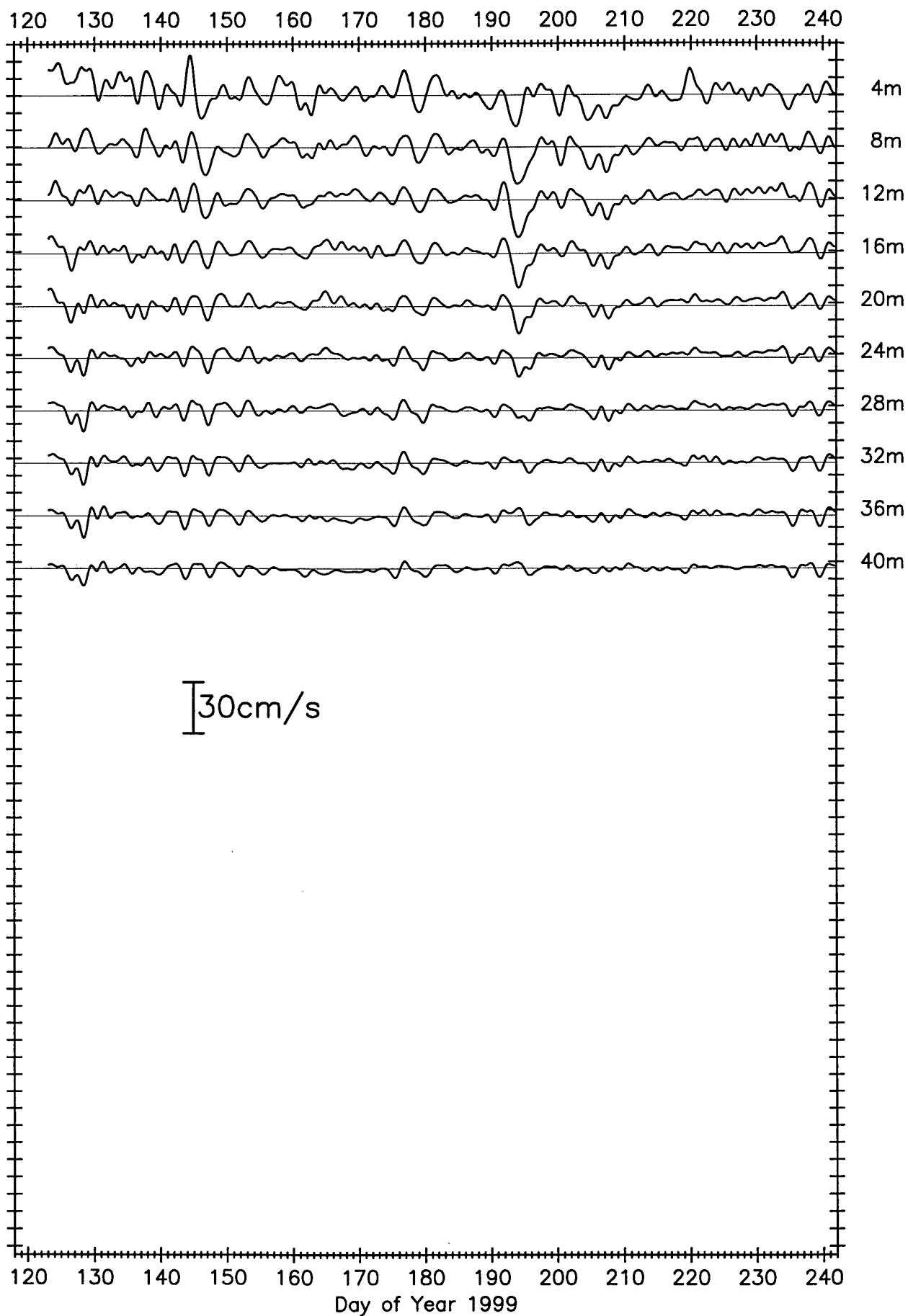
### **40-hour Low-pass Filtered**

Plots of east and north components of velocity from the Inshore, Mid-Shelf, and Shelf-Break moorings. Velocity components from each mooring are shown every 4 m (every other depth bin), offset by 30 cm/s. Although velocity signals from depths less than 10 m should be regarded with caution, we show filtered velocity components from depths less than 10m for both the Mid-Shelf and Shelf-Break moorings. Velocity from the Shelf-Break mooring period A is shown only for the depth range over which the mean vertical velocity is under 1 cm/s. Velocity components from each mooring are also shown separately for depths 10, 20, 30, 40, 50, 60, and 70 m. Note that the Mid-Shelf bins are actually at 9, 19, 29, 39, 49, 59, and 69 m.

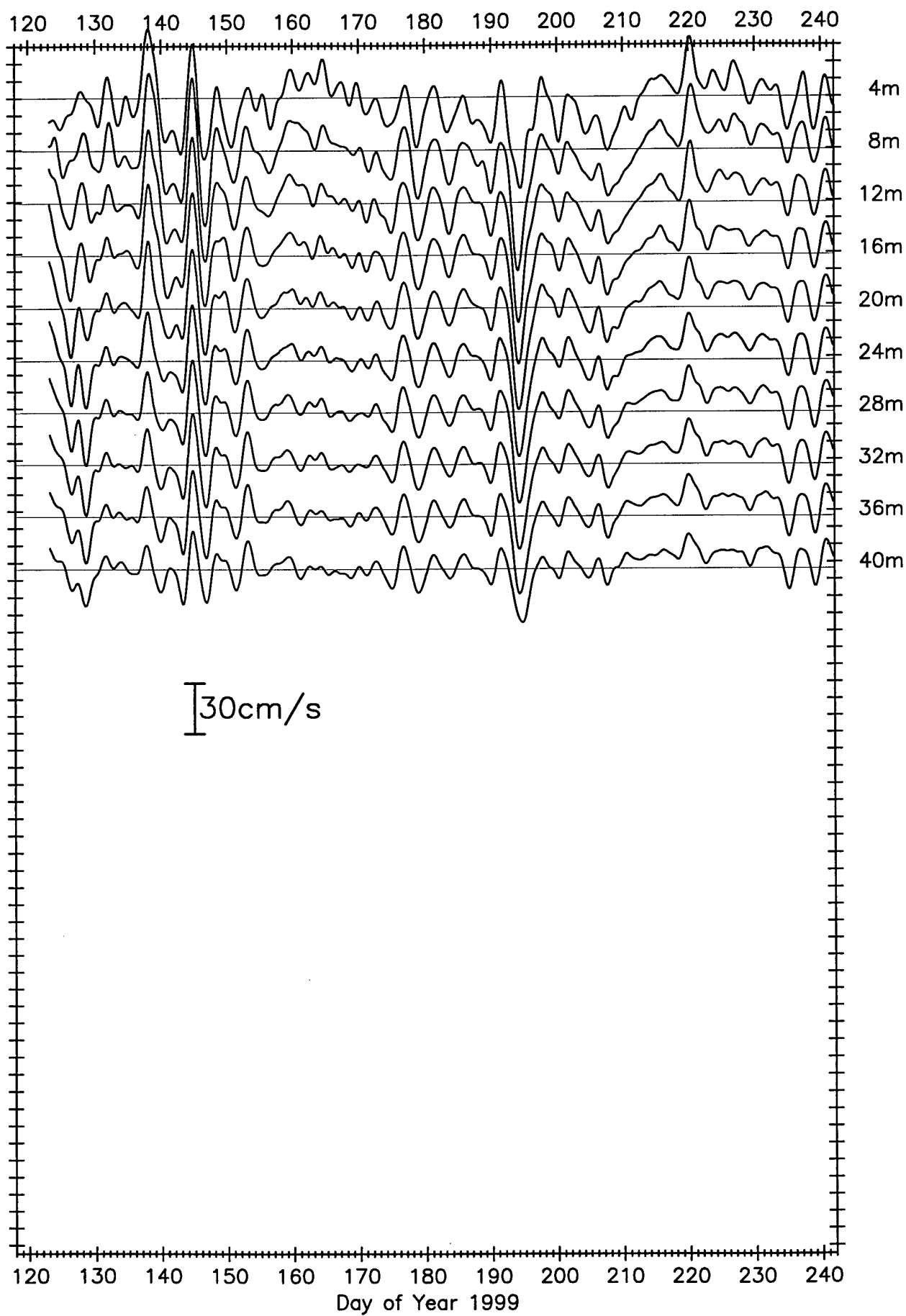




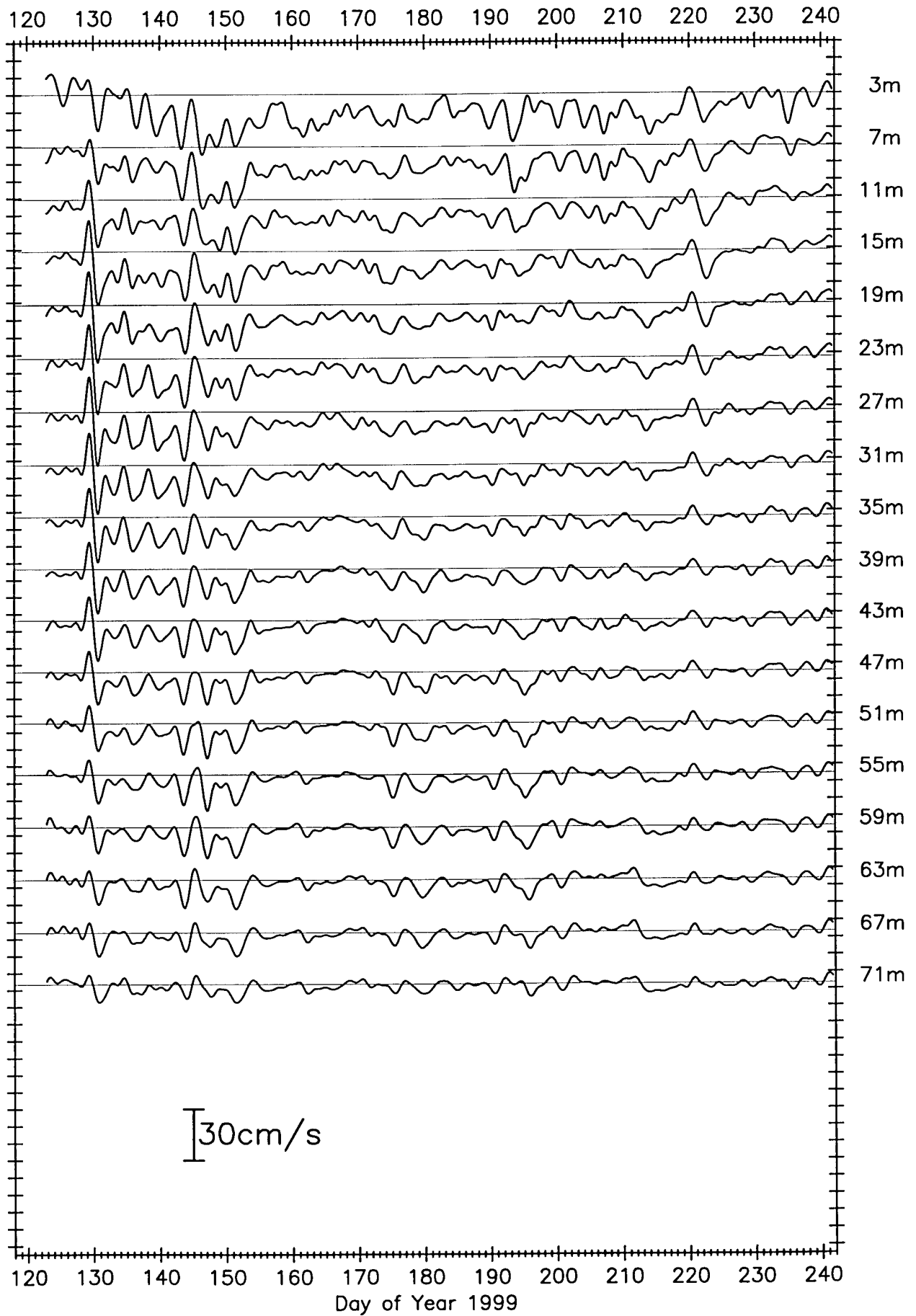
## NOPP Inshore 40 Hour Filtered ADCP U Velocity (cm/s)



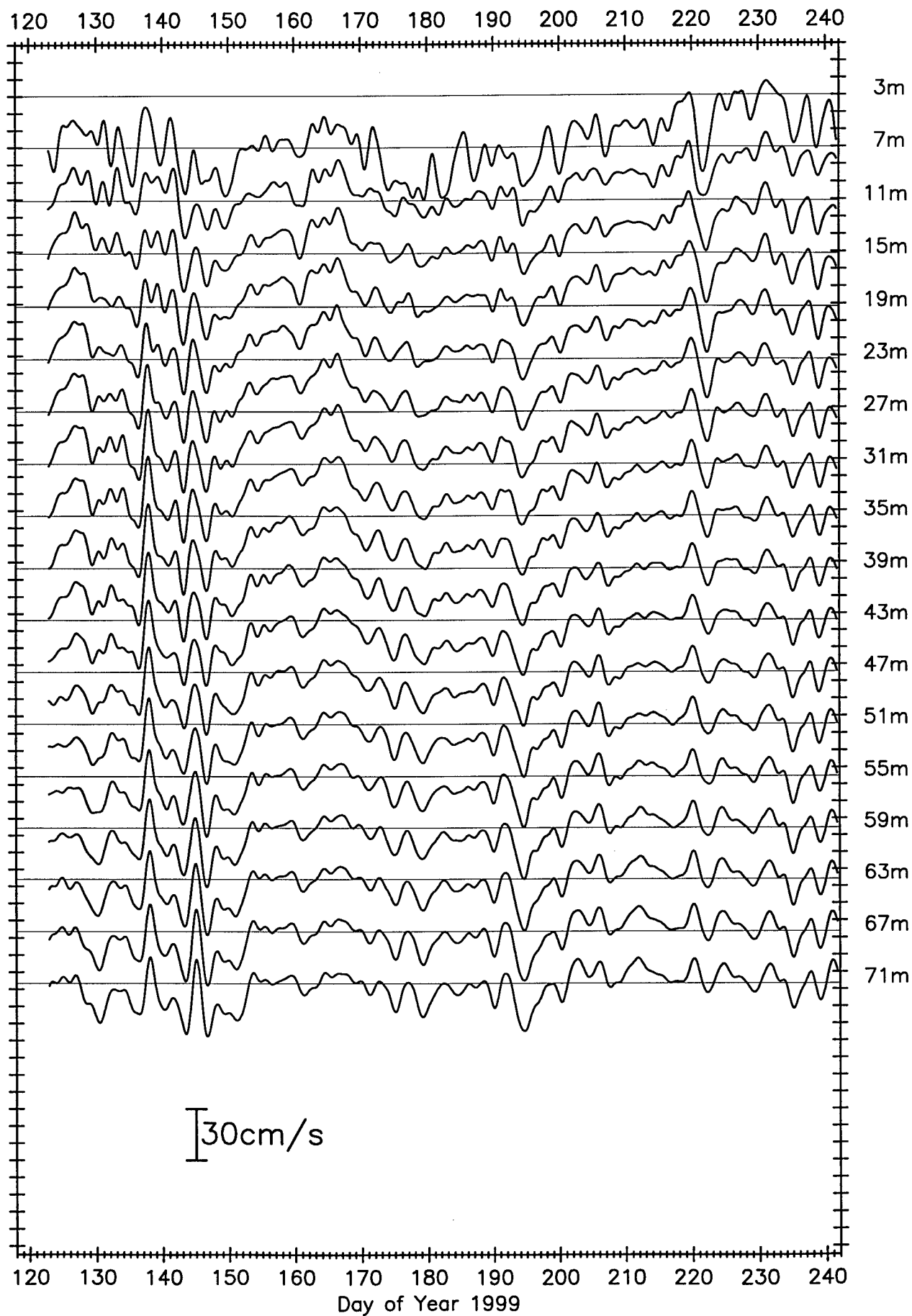
## NOPP Inshore 40 Hour Filtered ADCP V Velocity (cm/s)



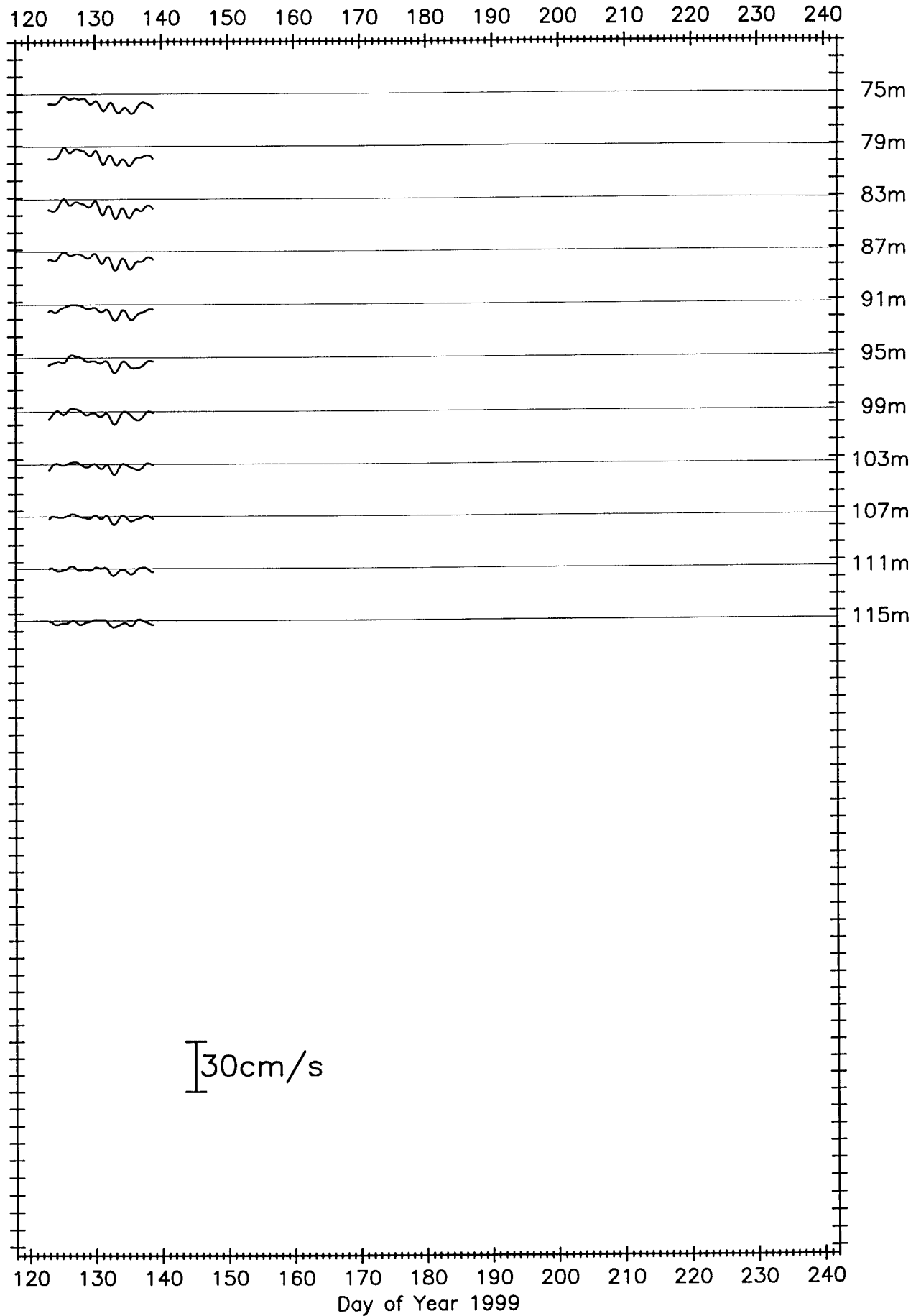
## NOPP Mid-Shelf 40 Hour Filtered ADP U Velocity (cm/s)



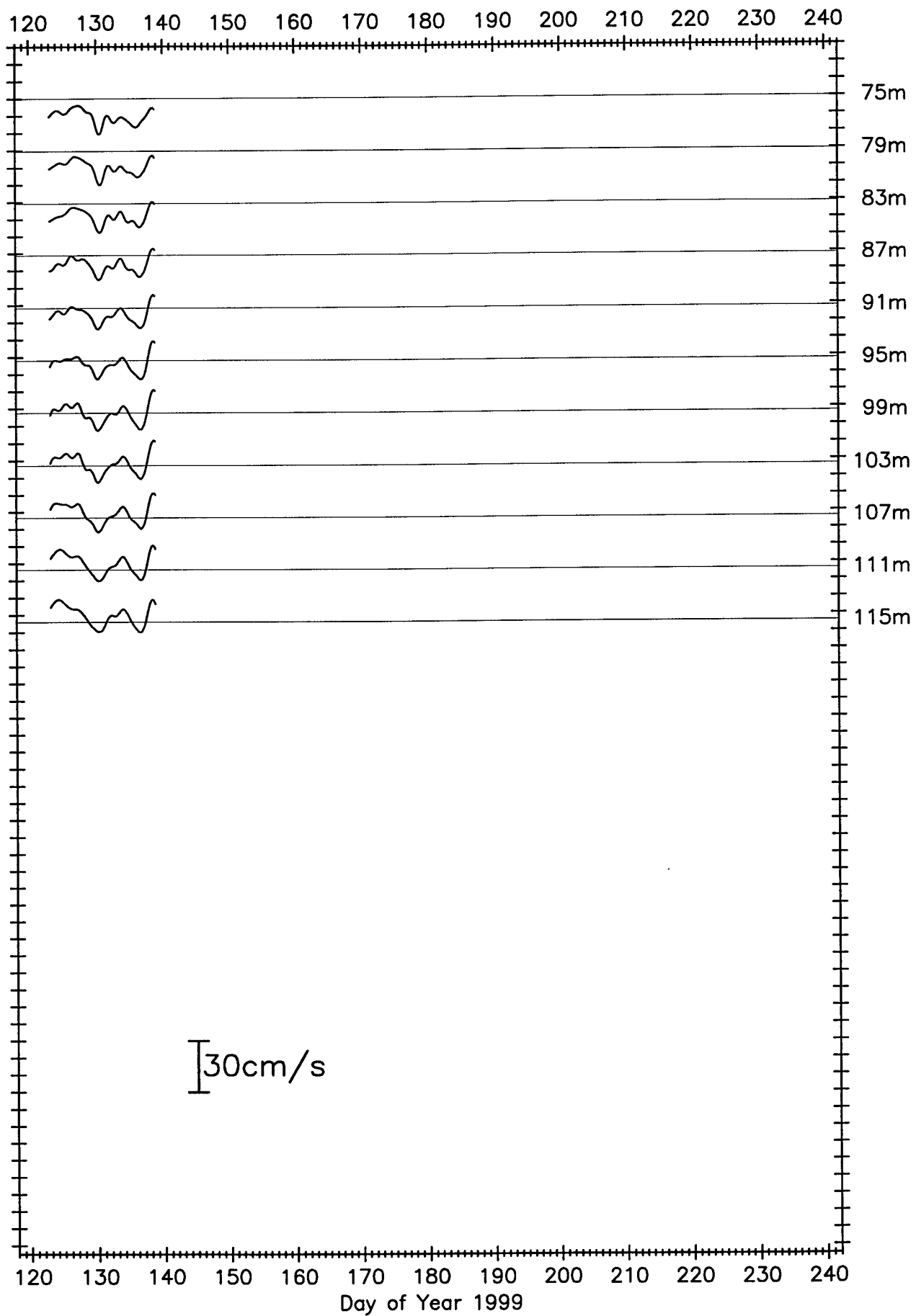
## NOPP Mid-Shelf 40 Hour Filtered ADP V Velocity (cm/s)



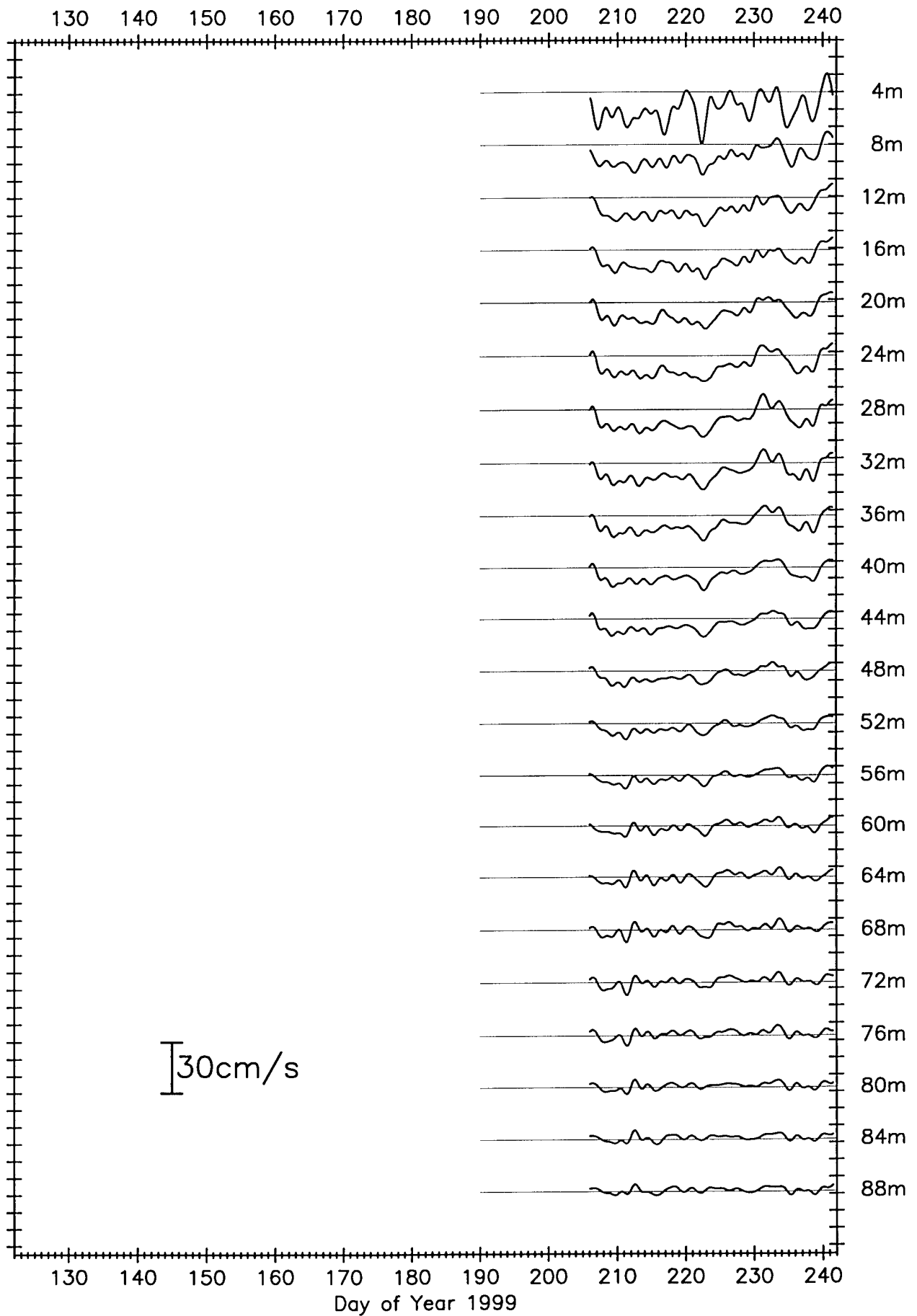
## NOPP Shelf-Break period A 40 Hour Filtered ADP U Velocity (cm/s)



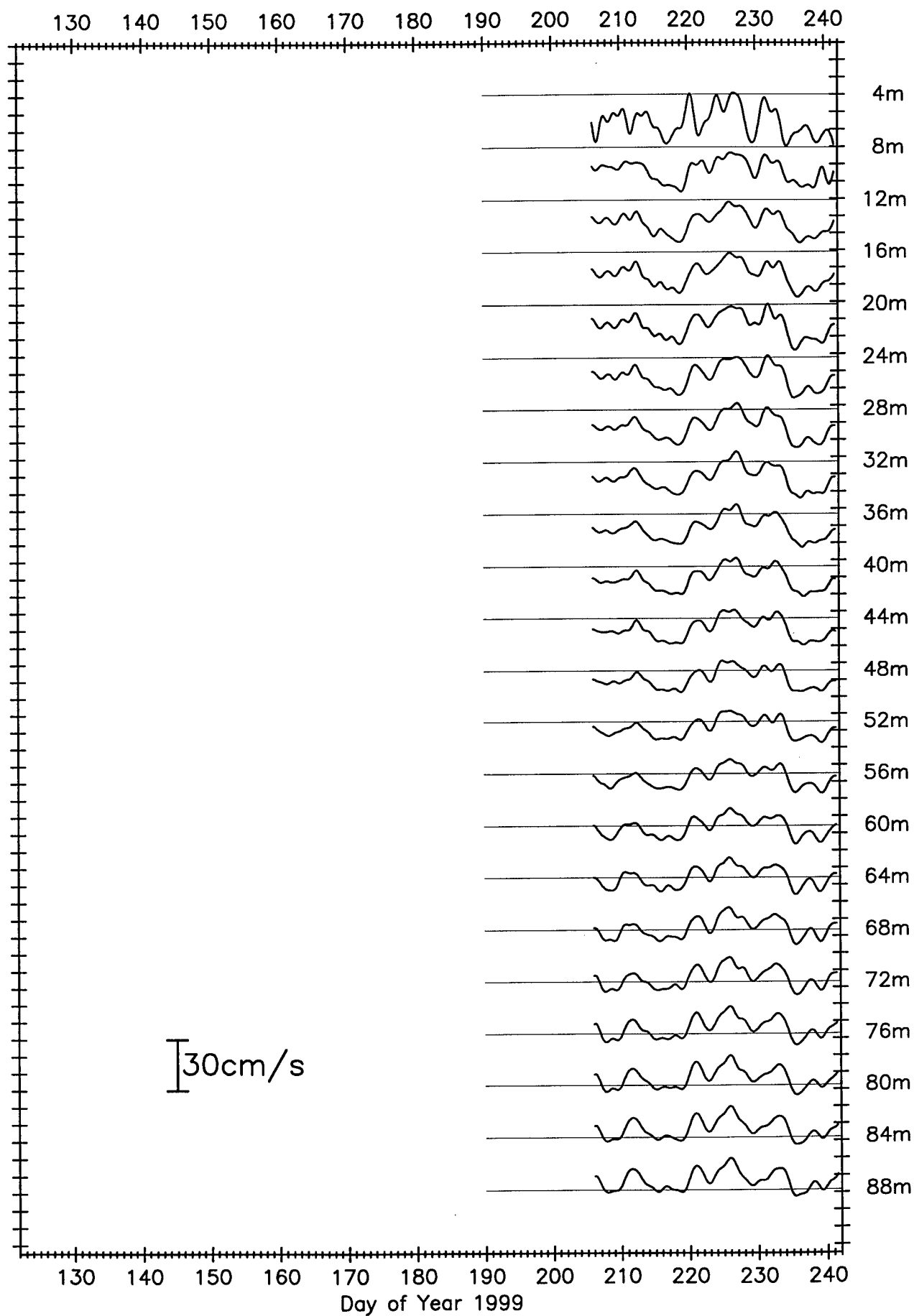
## NOPP Shelf-Break period A 40 Hour Filtered ADP V Velocity (cm/s)



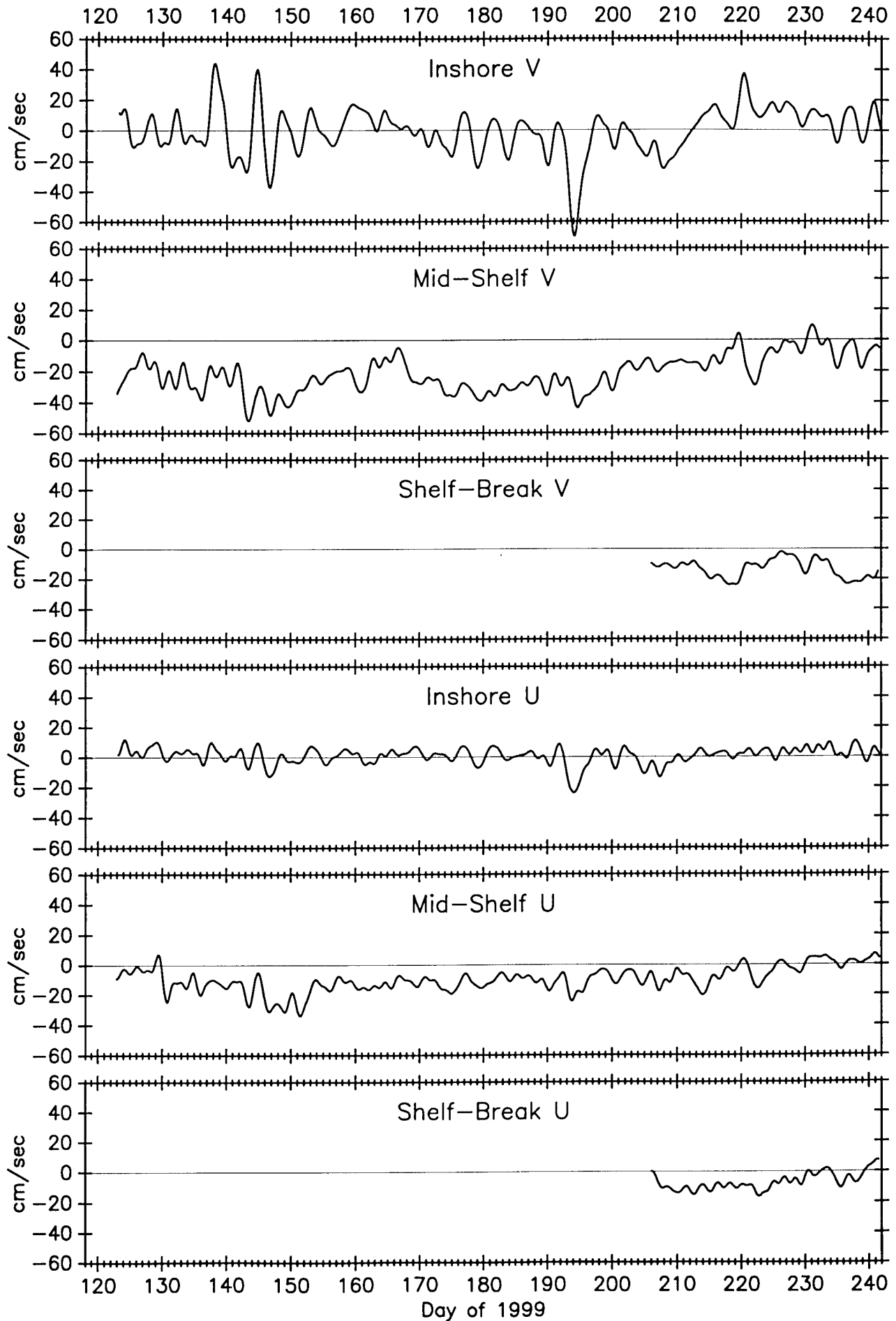
## NOPP Shelf-Break period D 40 Hour Filtered ADP U Velocity (cm/s)



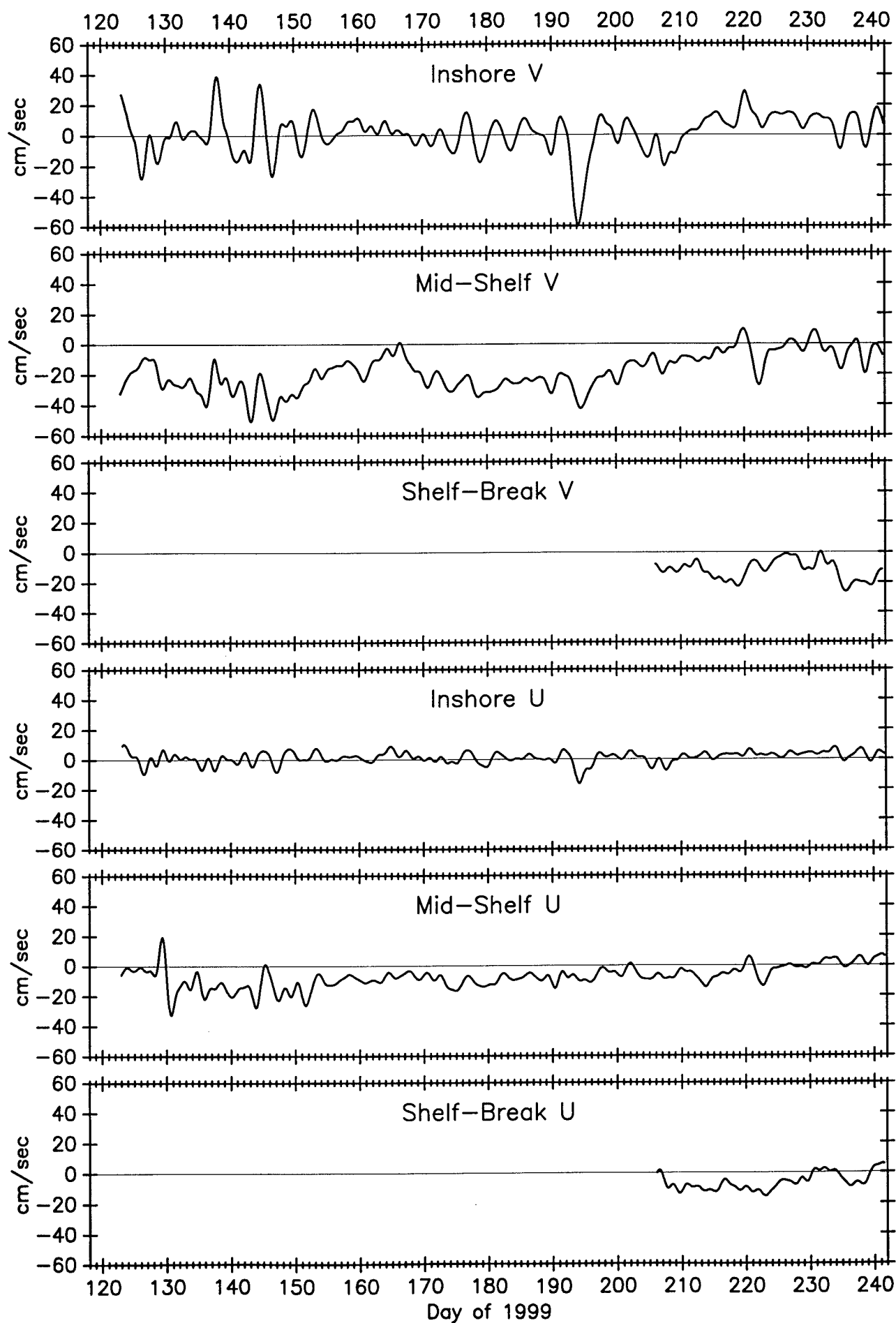
## NOPP Shelf-Break period D 40 Hour Filtered ADP V Velocity (cm/s)



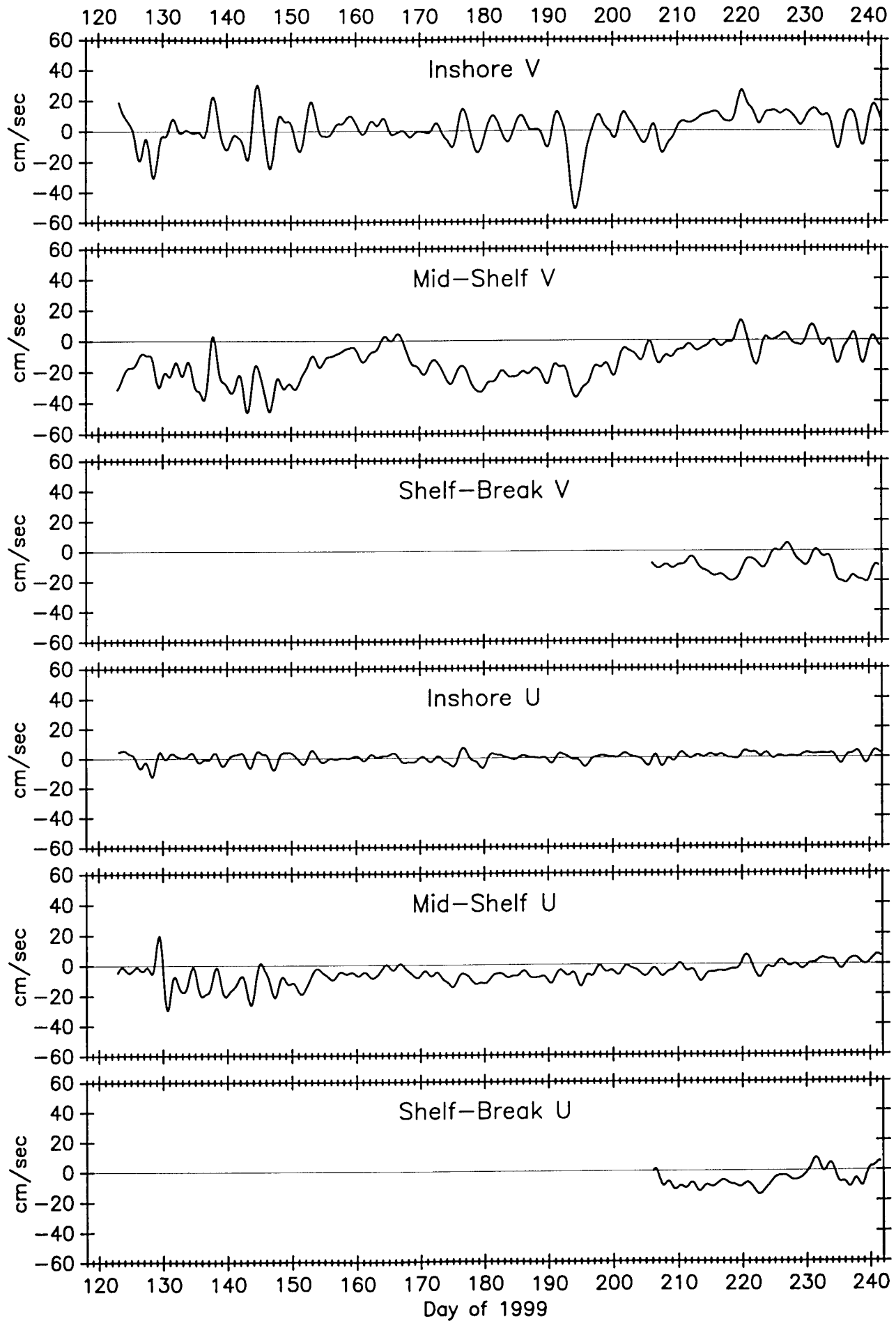
## NOPP 40 Hour Filtered 10m Velocity



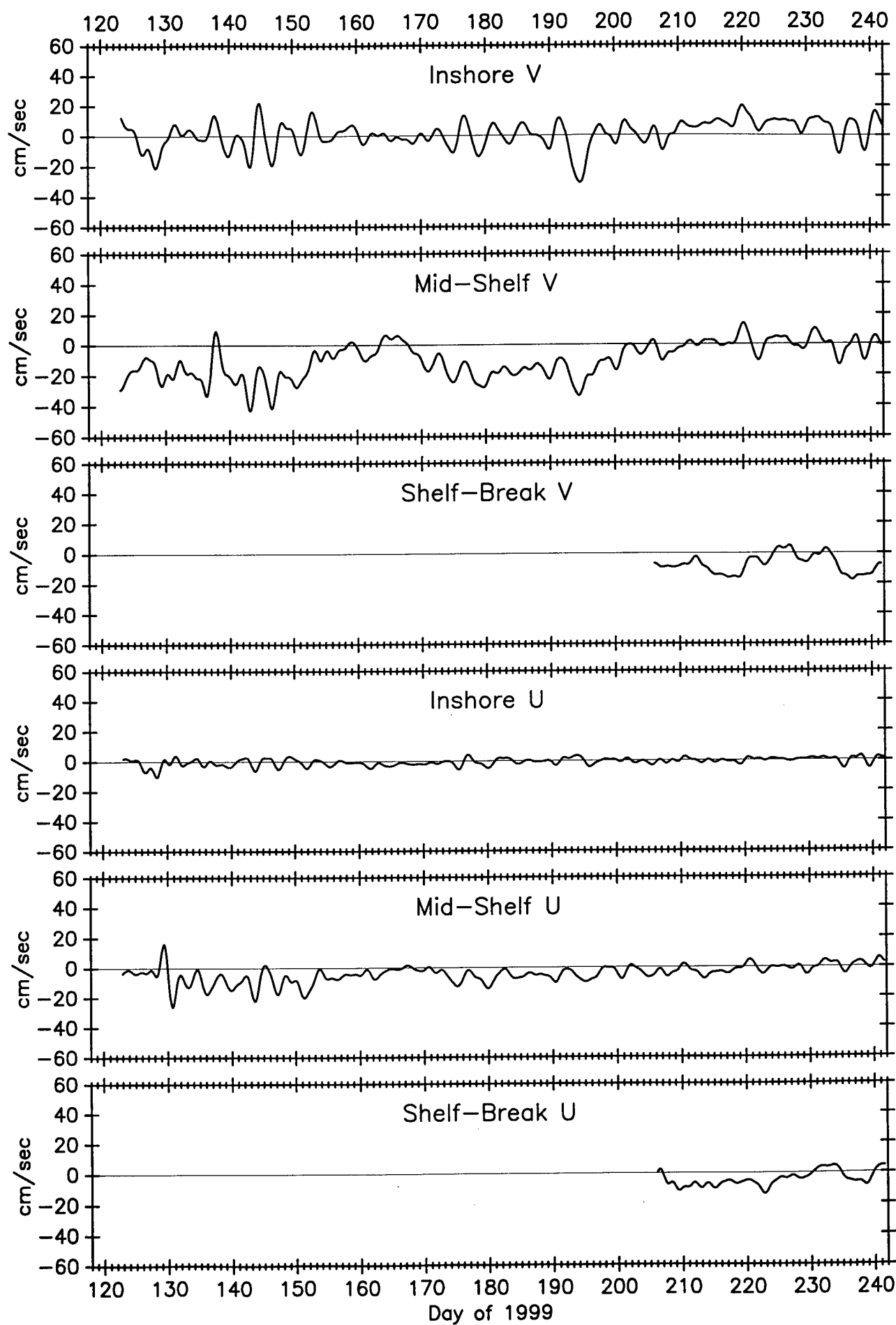
## NOPP 40 Hour Filtered 20m Velocity



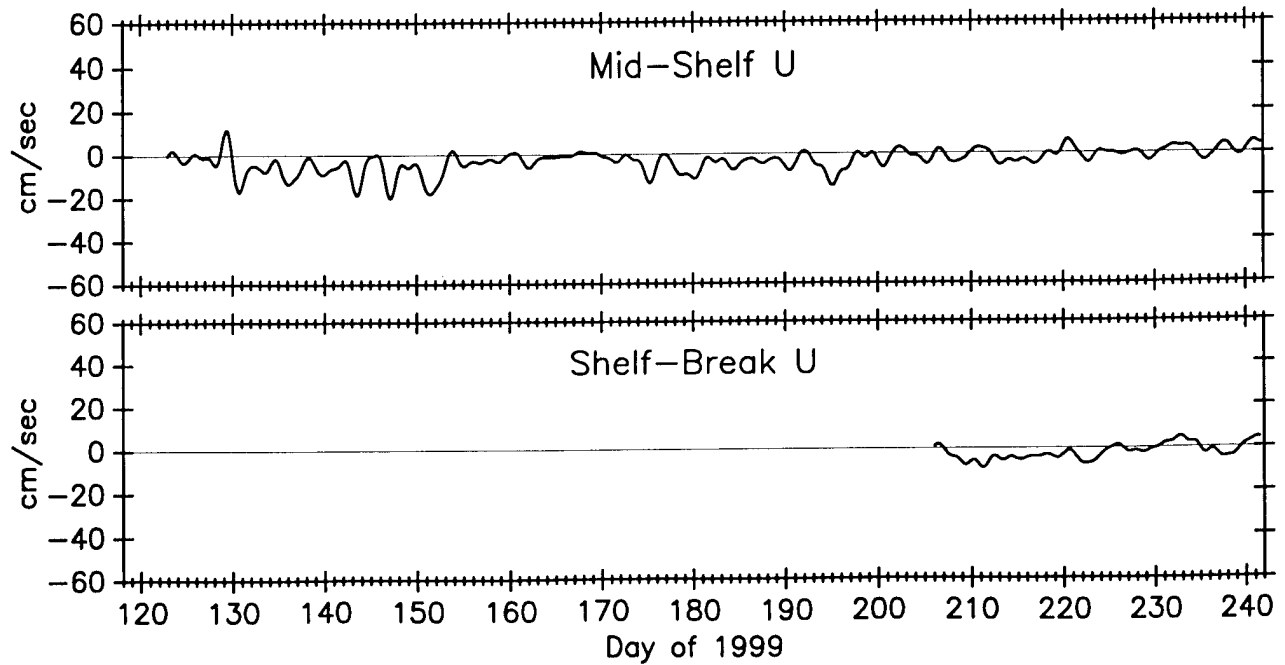
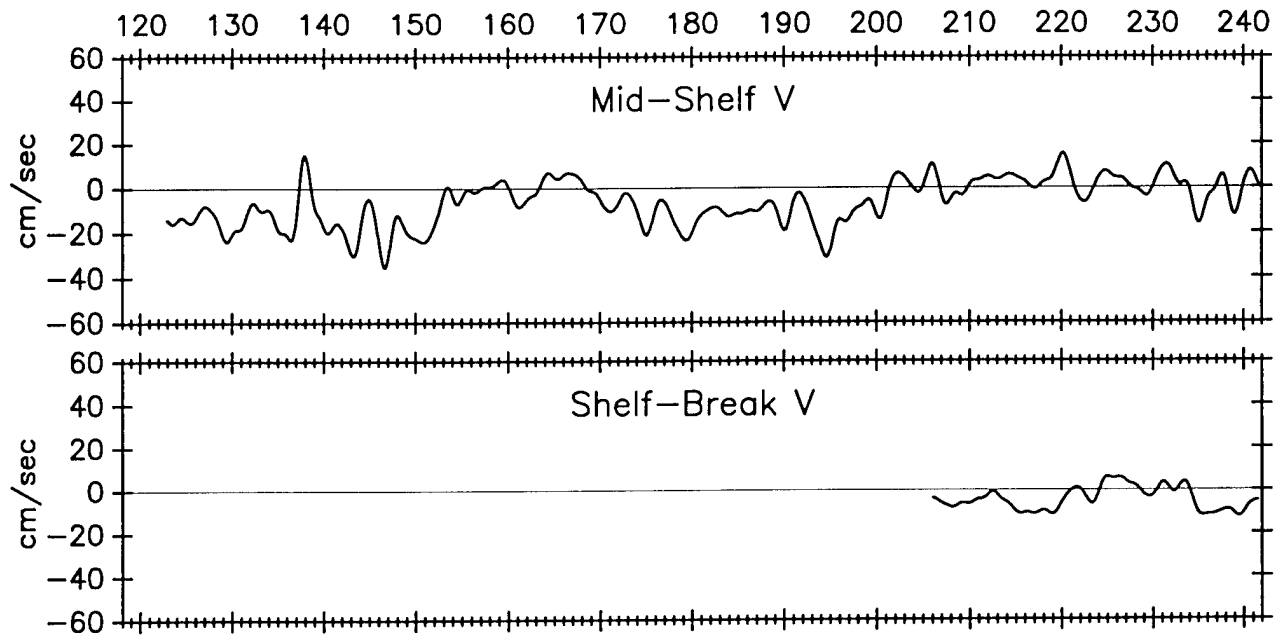
## NOPP 40 Hour Filtered 30m Velocity



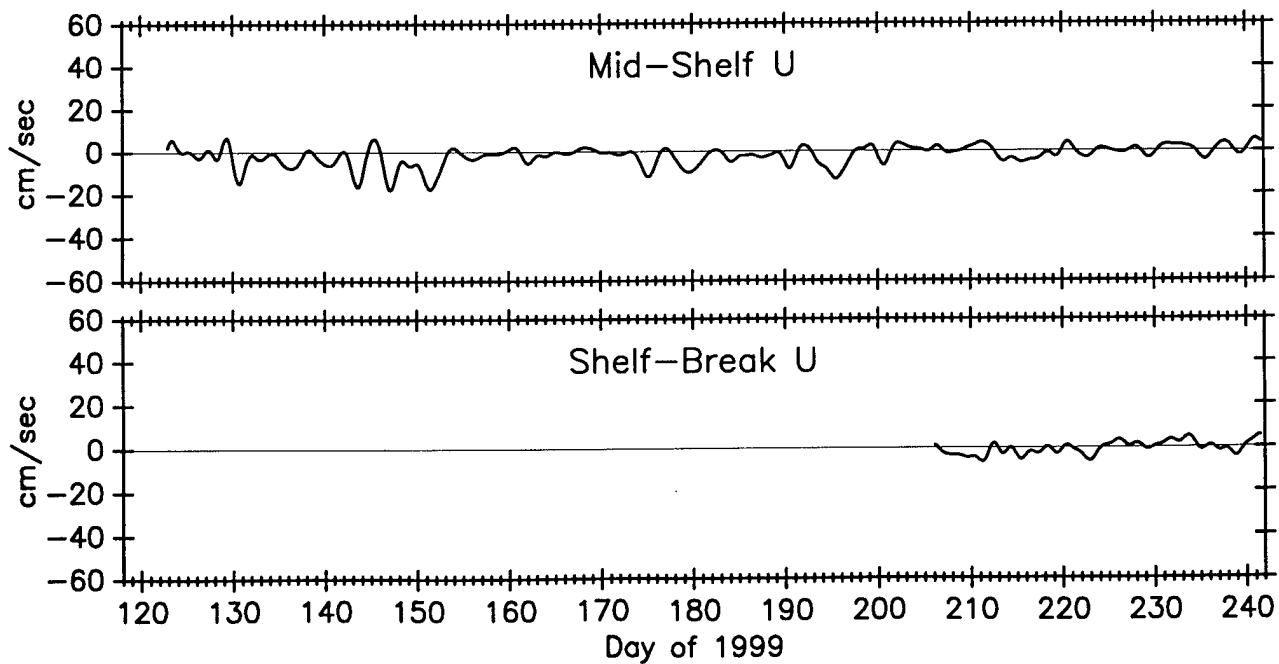
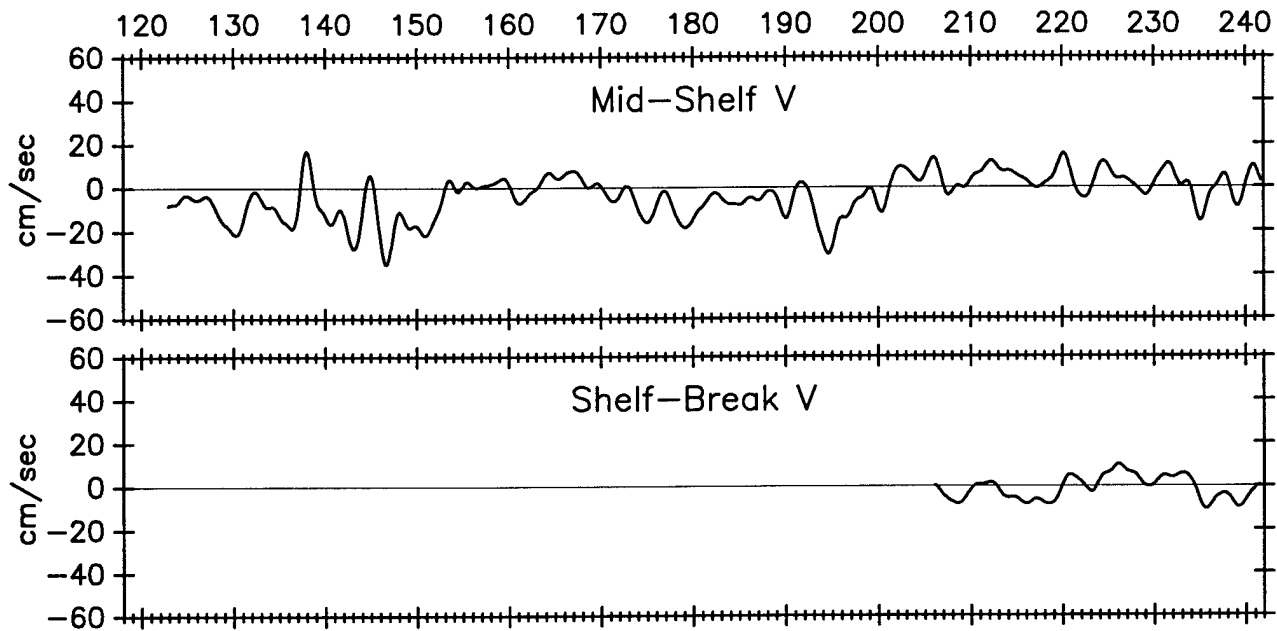
## NOPP 40 Hour Filtered 40m Velocity



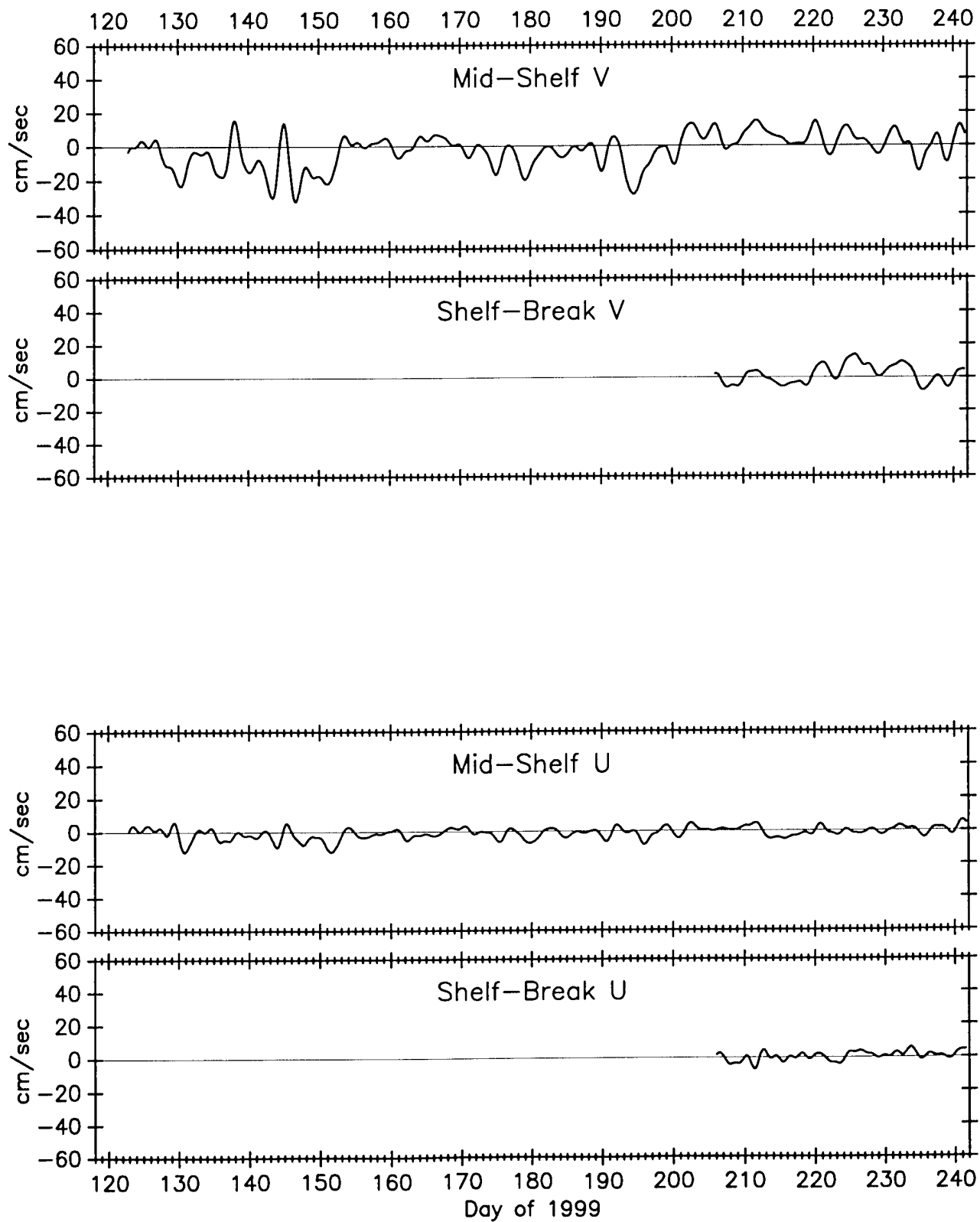
## NOPP 40 Hour Filtered 50m Velocity



## NOPP 40 Hour Filtered 60m Velocity



## NOPP 40 Hour Filtered 70m Velocity



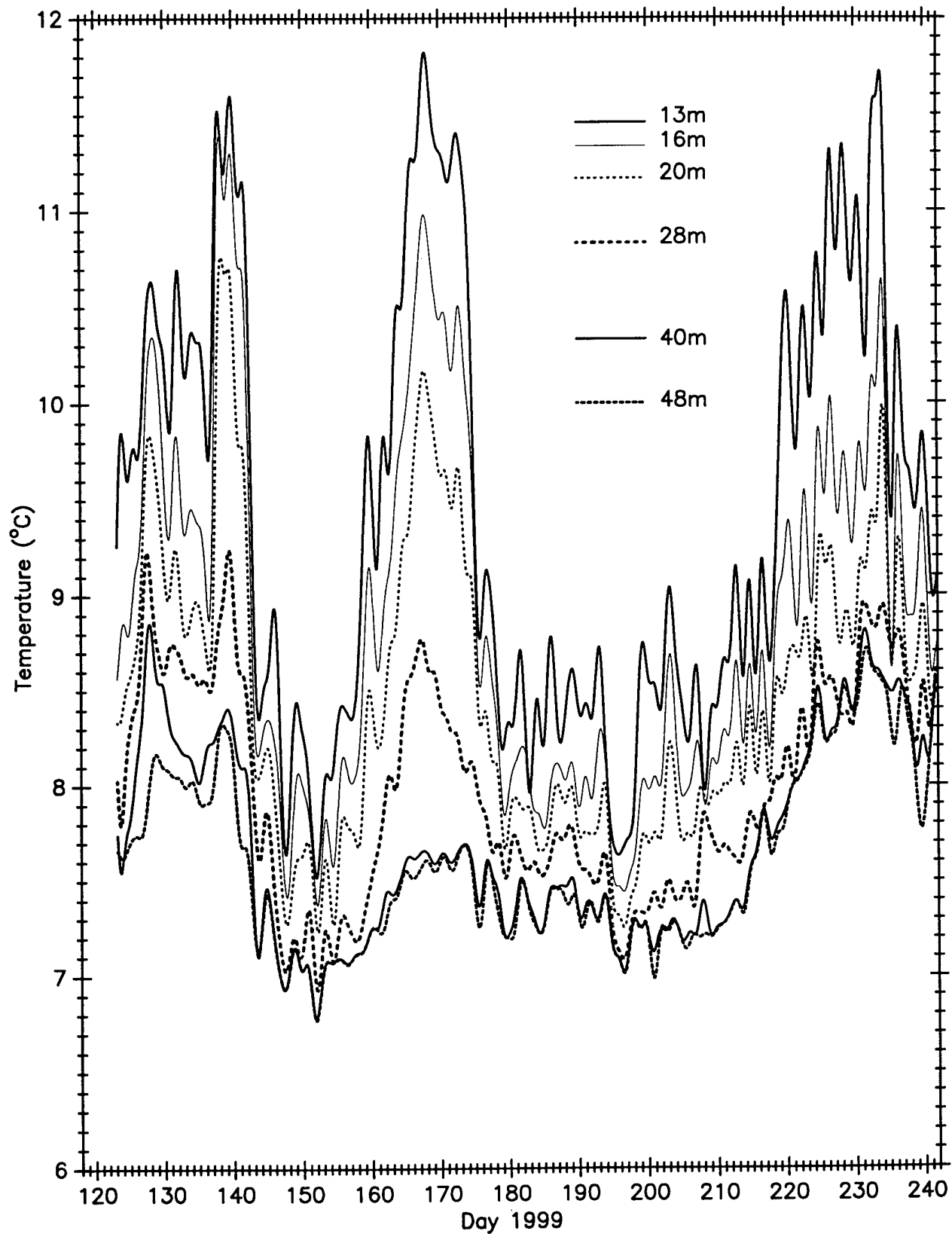
## **TEMPERATURE Time Series**

### **40-hour Low-Pass Filtered**

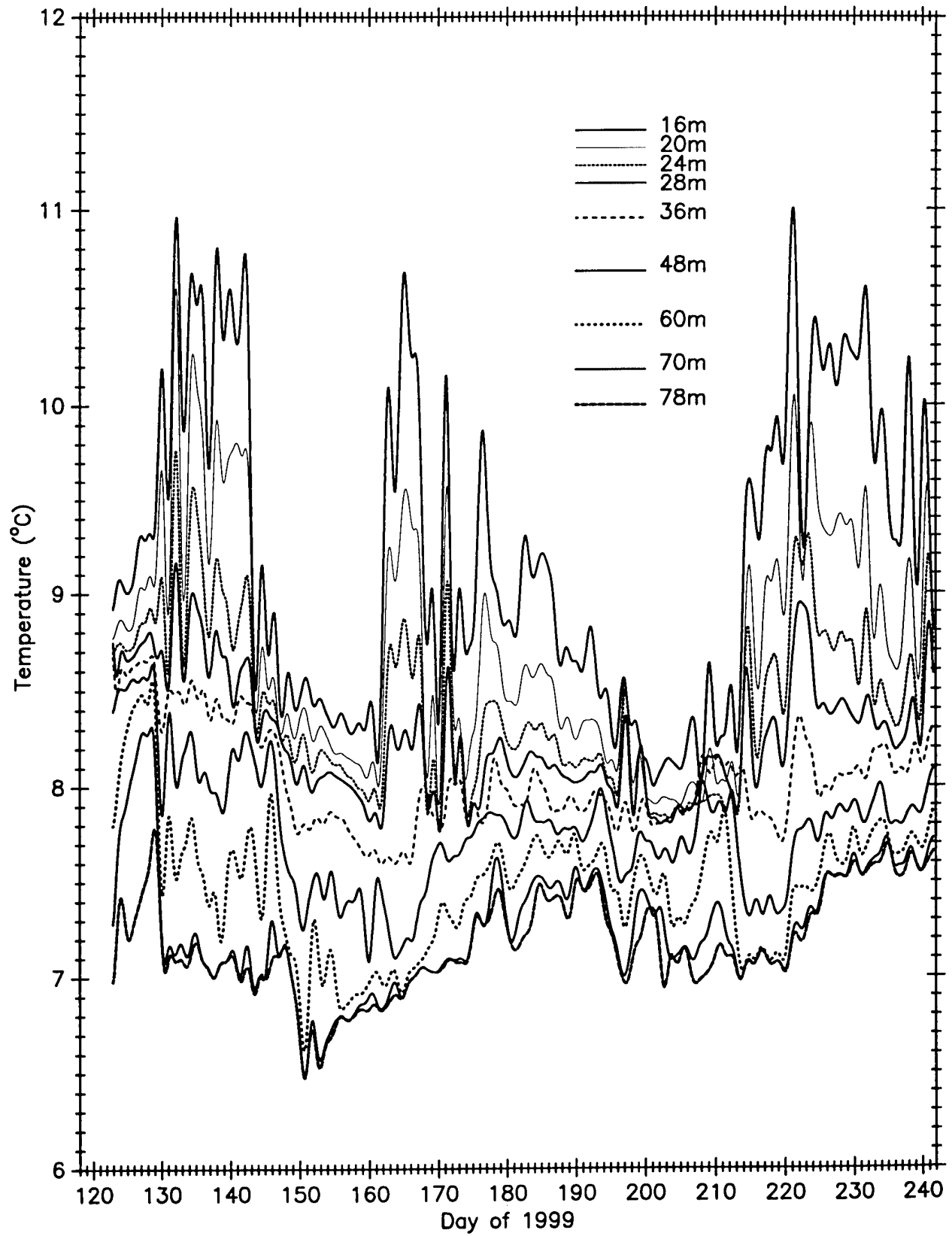
Plots of water temperature from the Inshore, Mid-Shelf, Met, and Shelf-Break moorings. Note that both the temperature scale and range are different for the Met mooring. Temperature is shown for every depth except from 2m on the Inshore and Shelf-Break moorings. Temperatures from each mooring are also shown separately for depths near 2, 16, 20, 28, 48, 60, 72, and 82 m, where available.



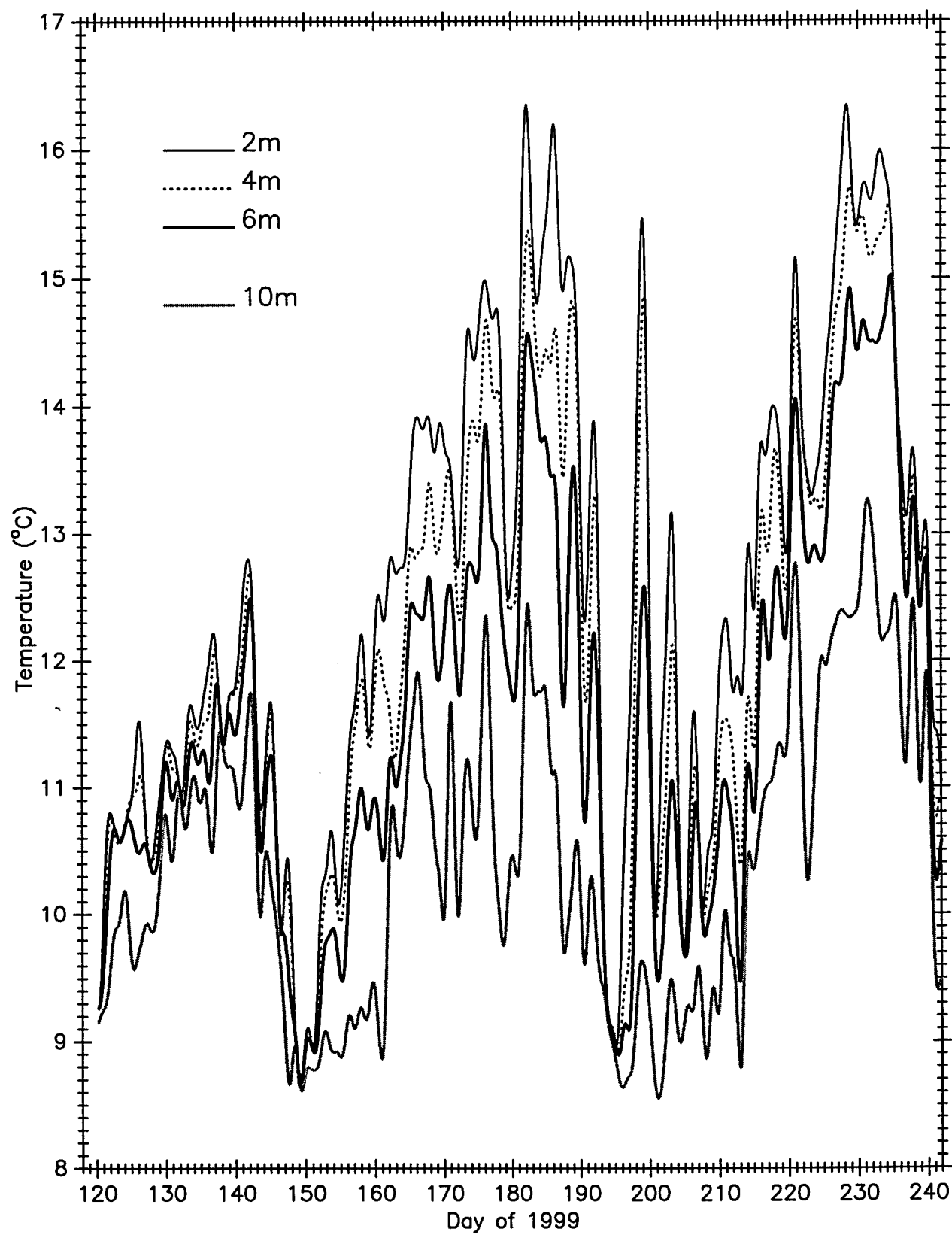
## NOPP Inshore 40 Hour Filtered Temperatures



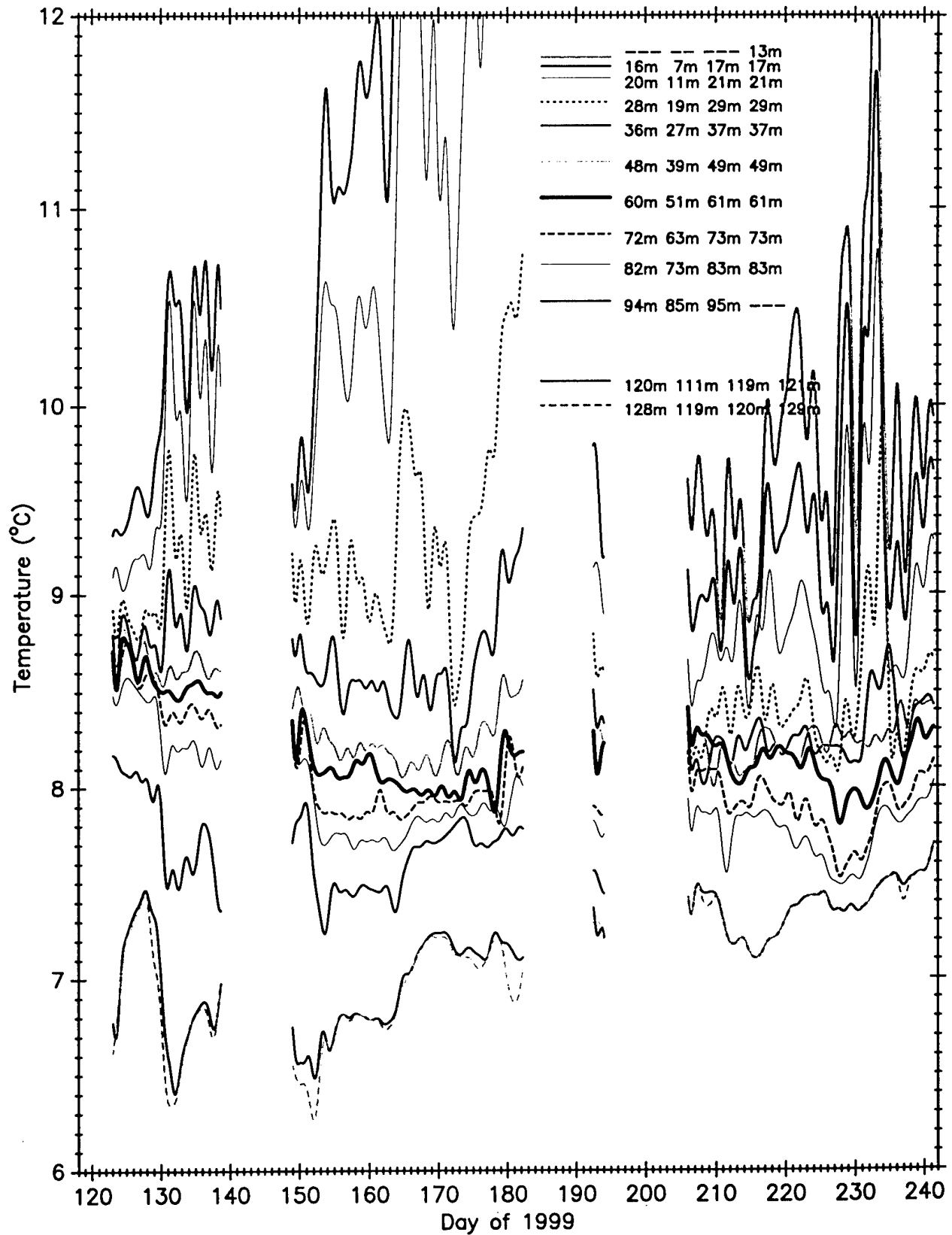
## NOPP Mid Shelf 40 Hour Filtered Temperatures



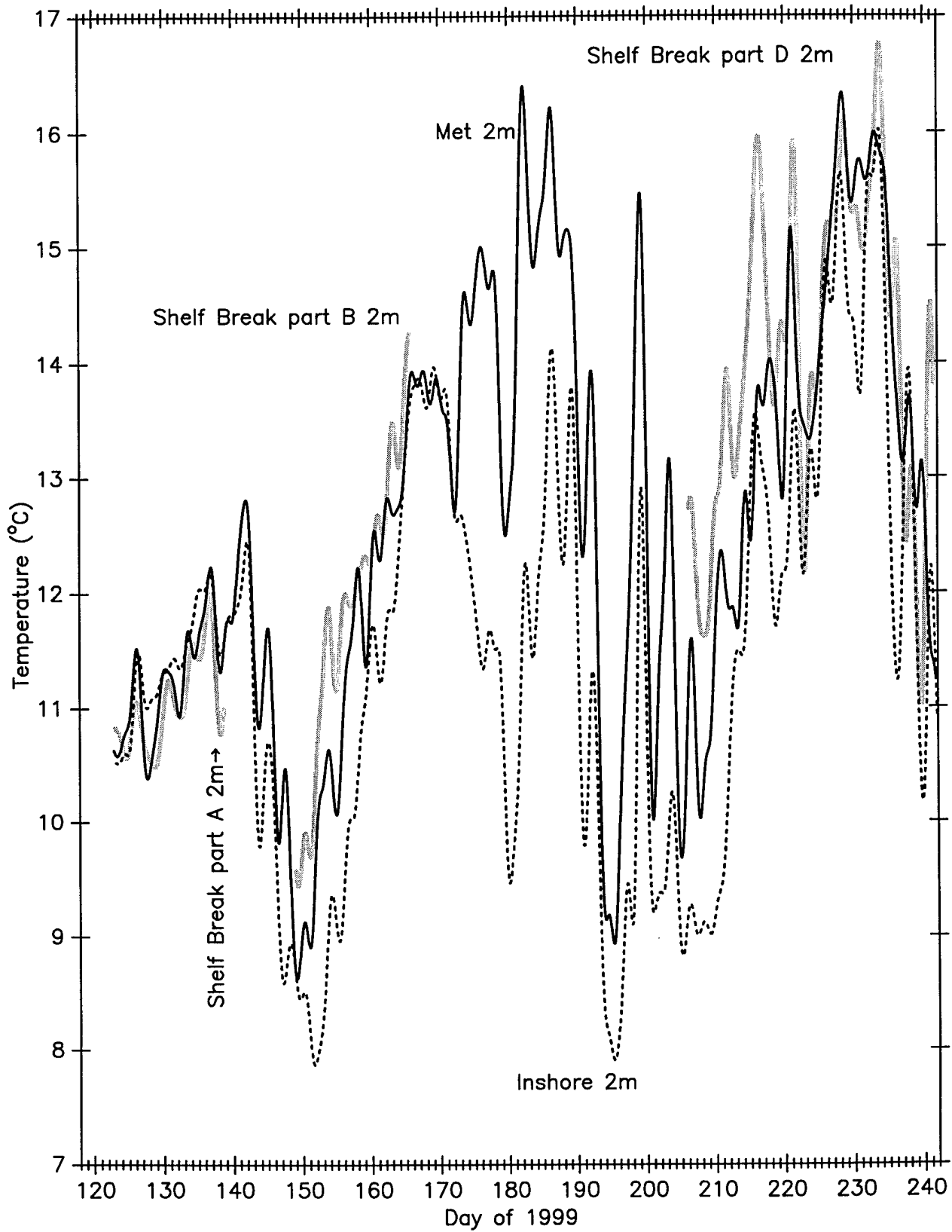
## NOPP Meteorological Mooring 40 Hour Filtered Temperatures



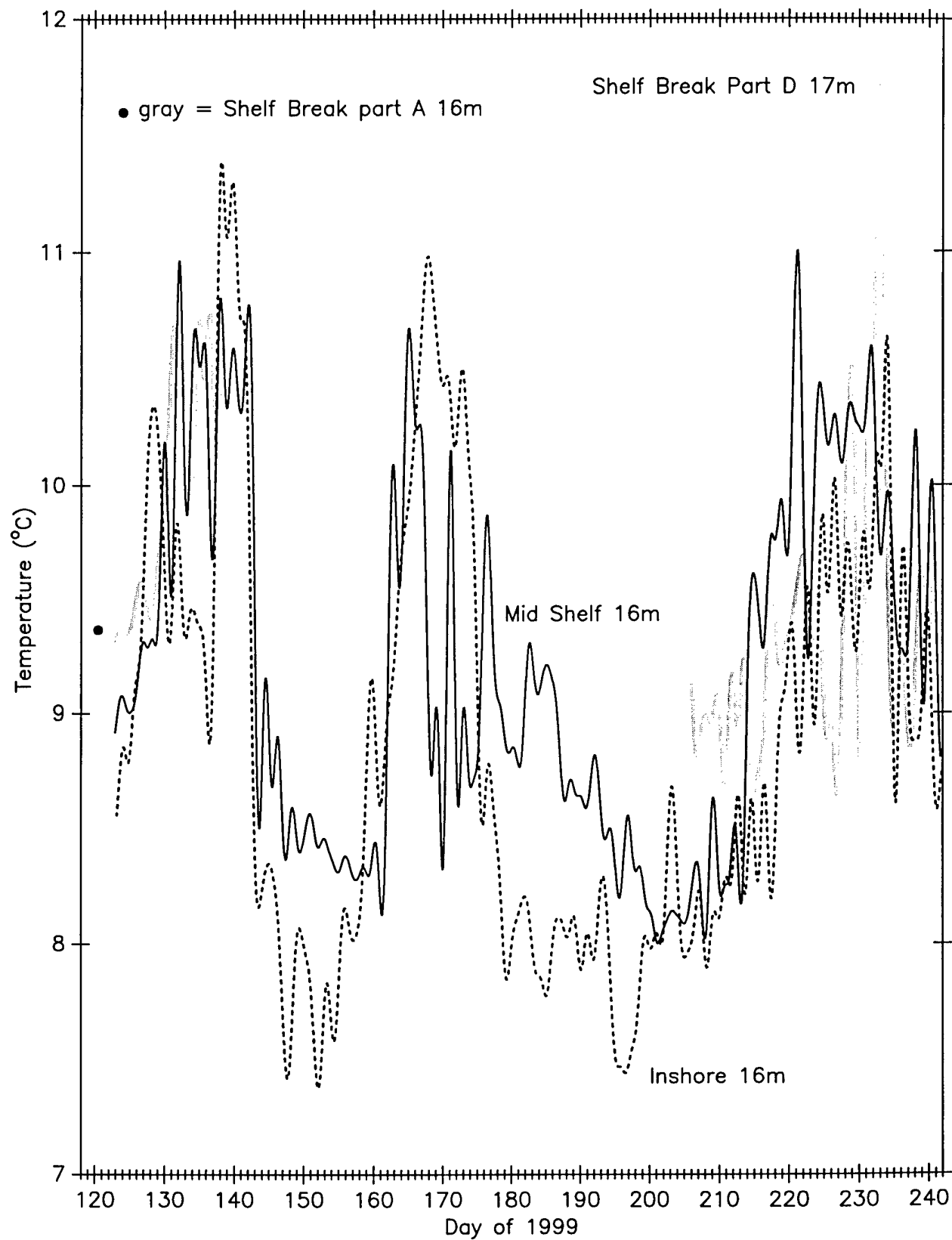
# NOPP Shelf Break 40 Hour Filtered Temperatures



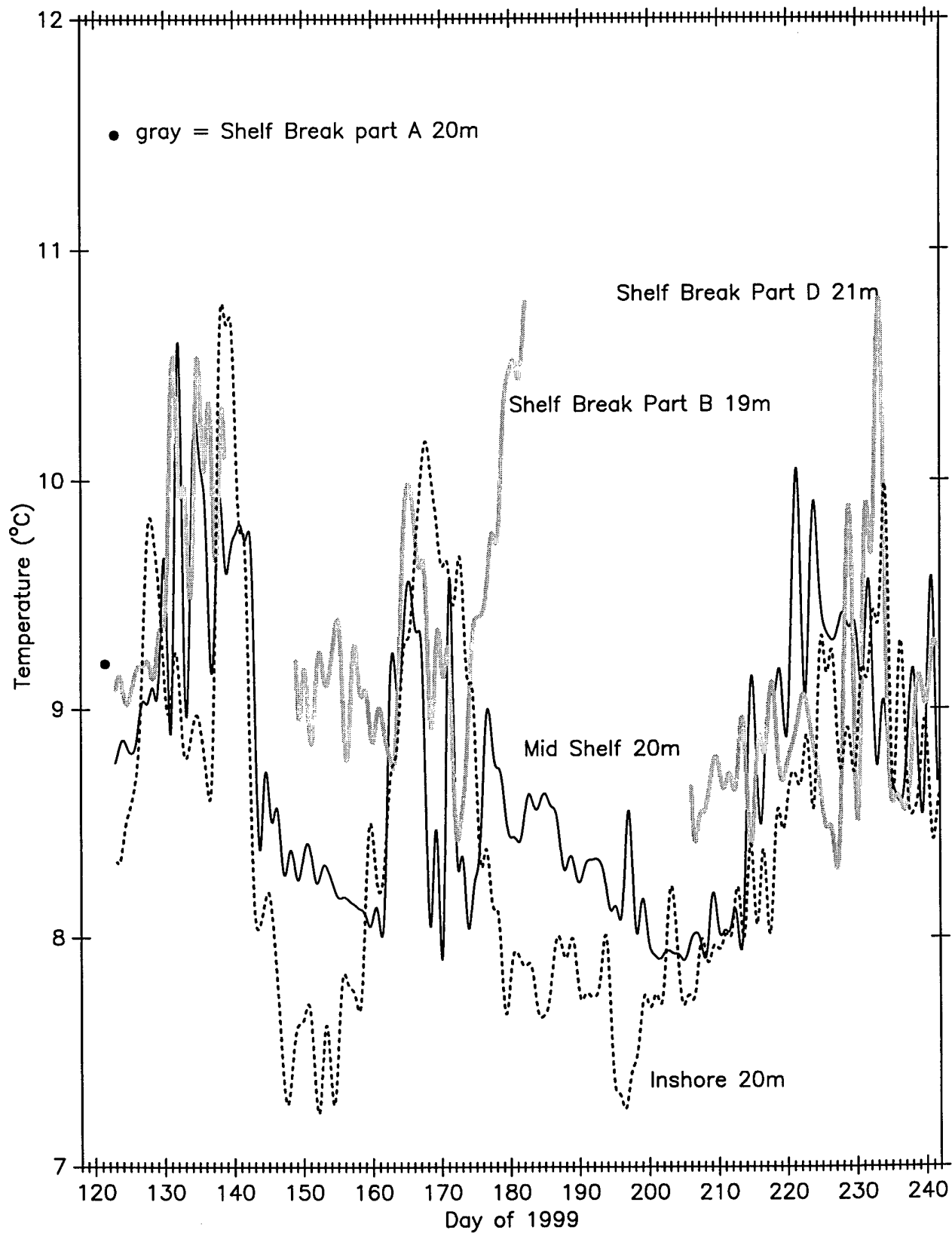
## NOPP 40 Hour Filtered Temperatures near 2m



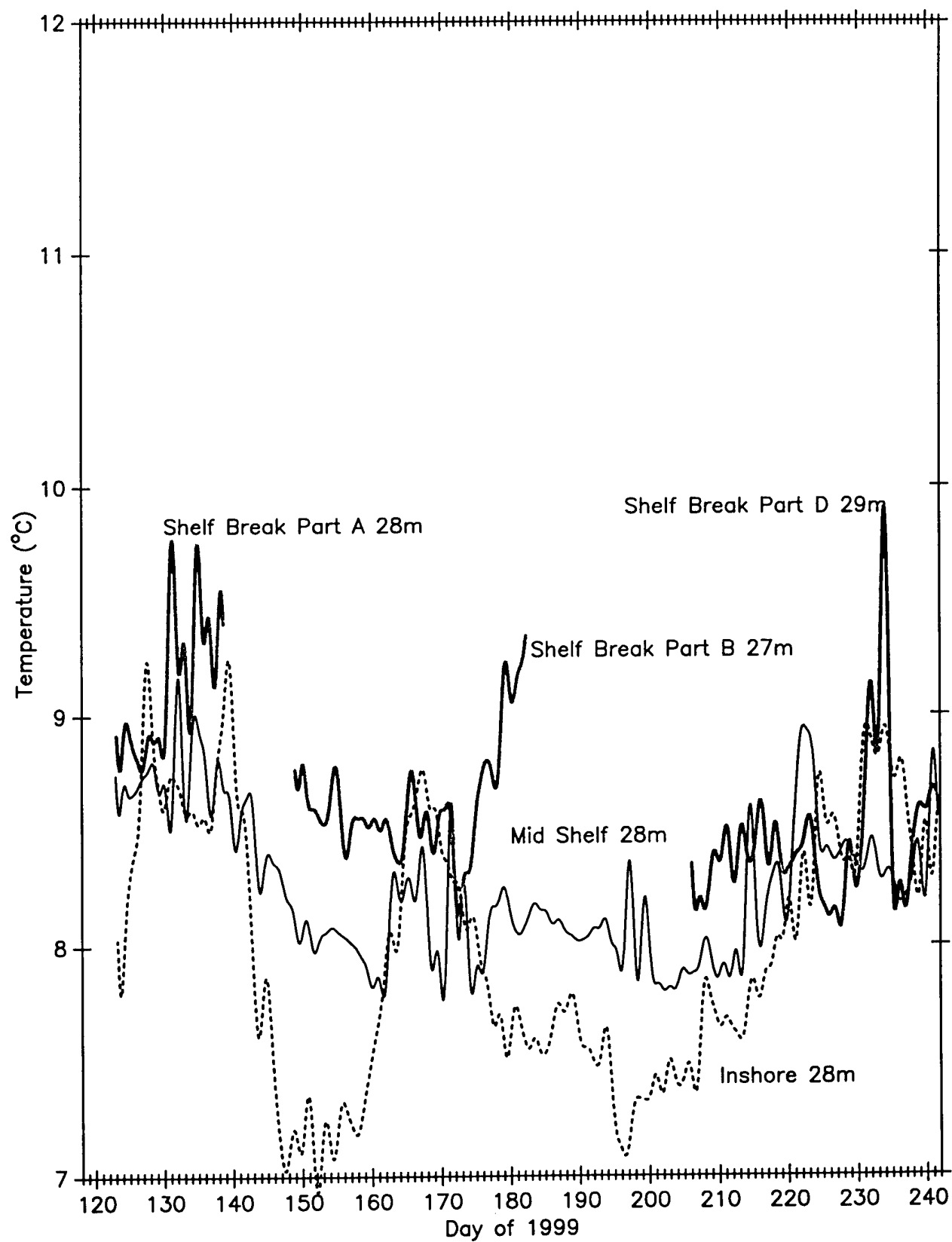
## NOPP 40 Hour Filtered Temperatures near 16m



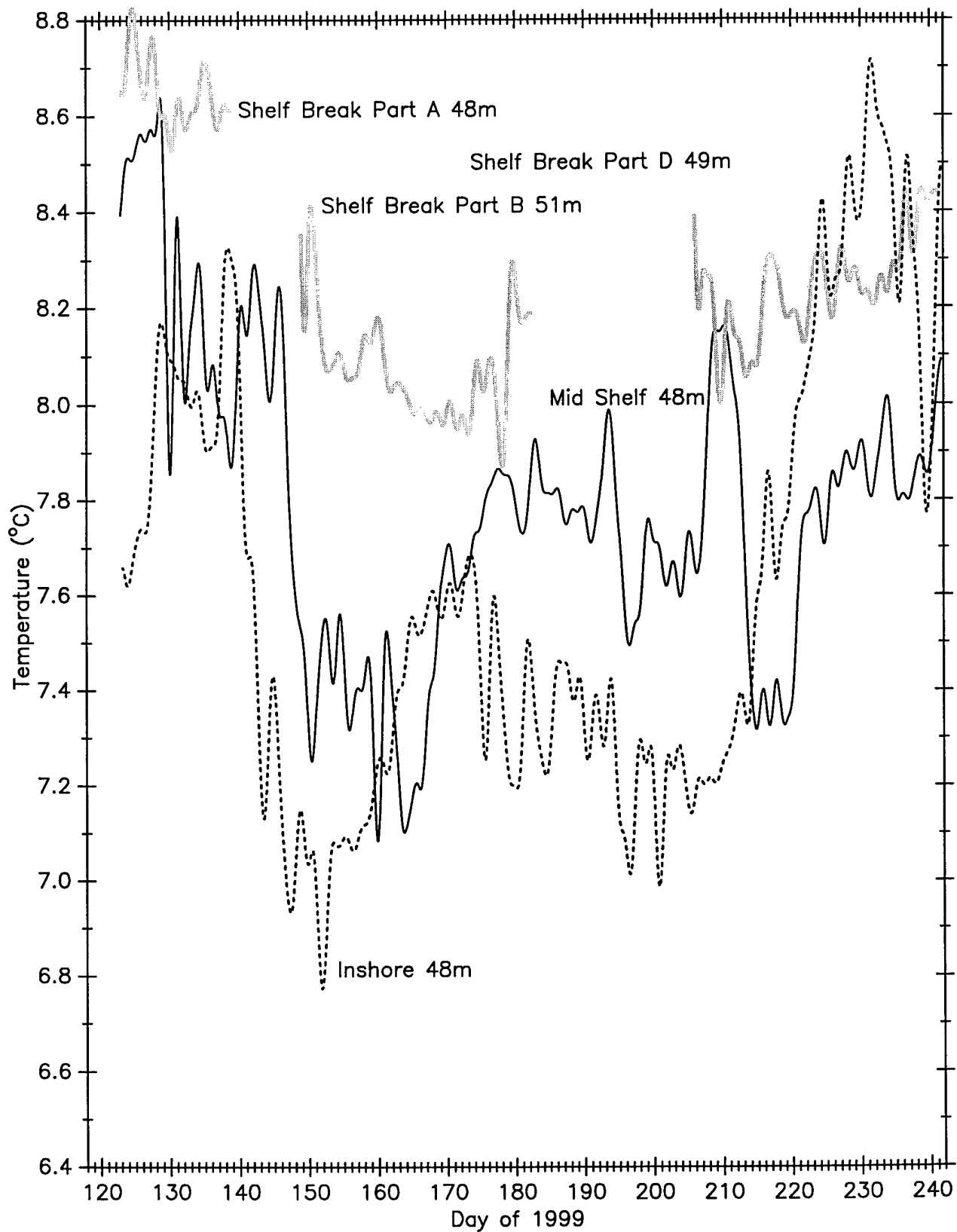
## NOPP 40 Hour Filtered Temperatures near 20m



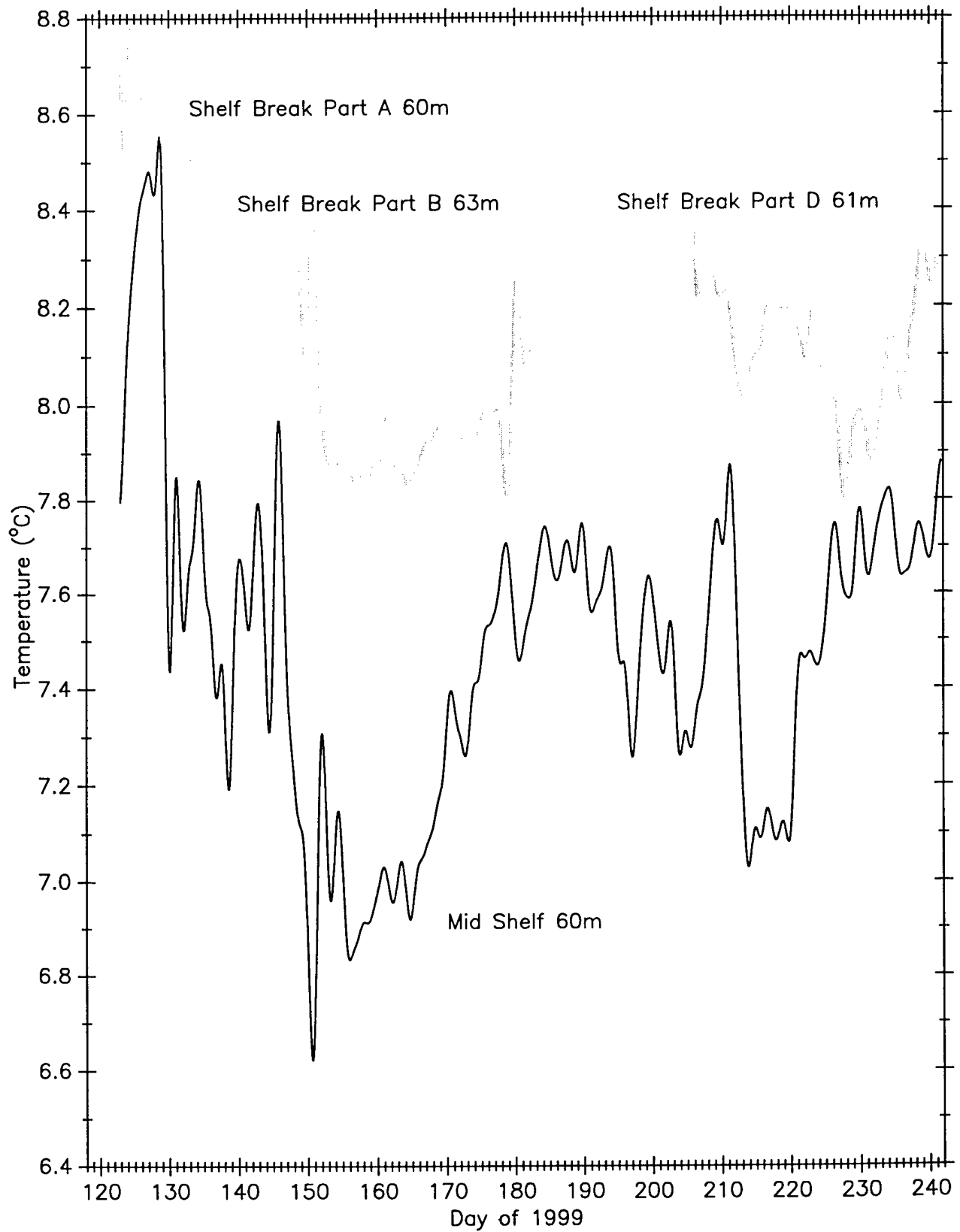
## NOPP 40 Hour Filtered Temperatures near 28m



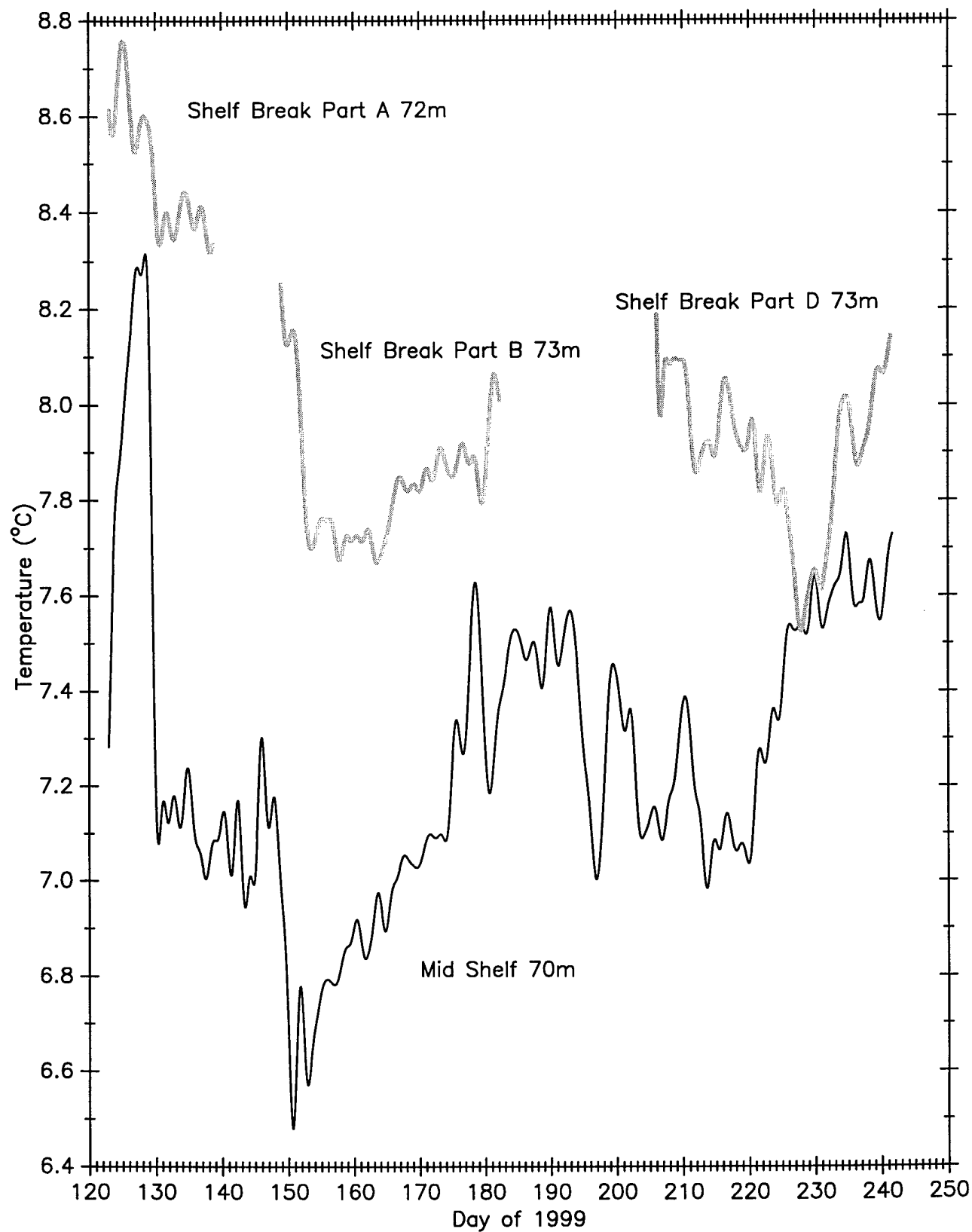
## NOPP 40 Hour Filtered Temperatures near 48m



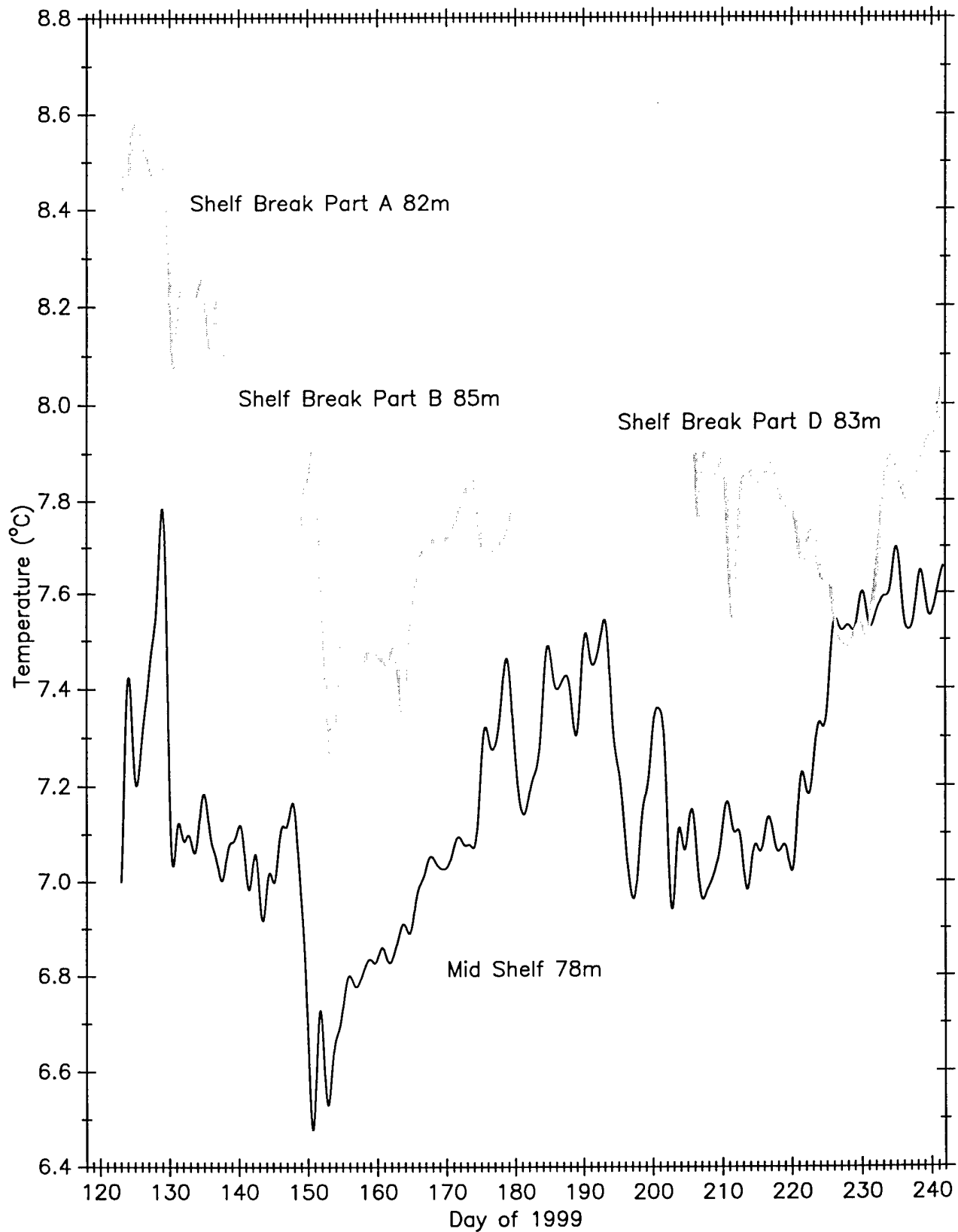
## NOPP 40 Hour Filtered Temperatures near 60m



## NOPP 40 Hour Filtered Temperatures near 72m



## NOPP 40 Hour Filtered Temperatures near 82m

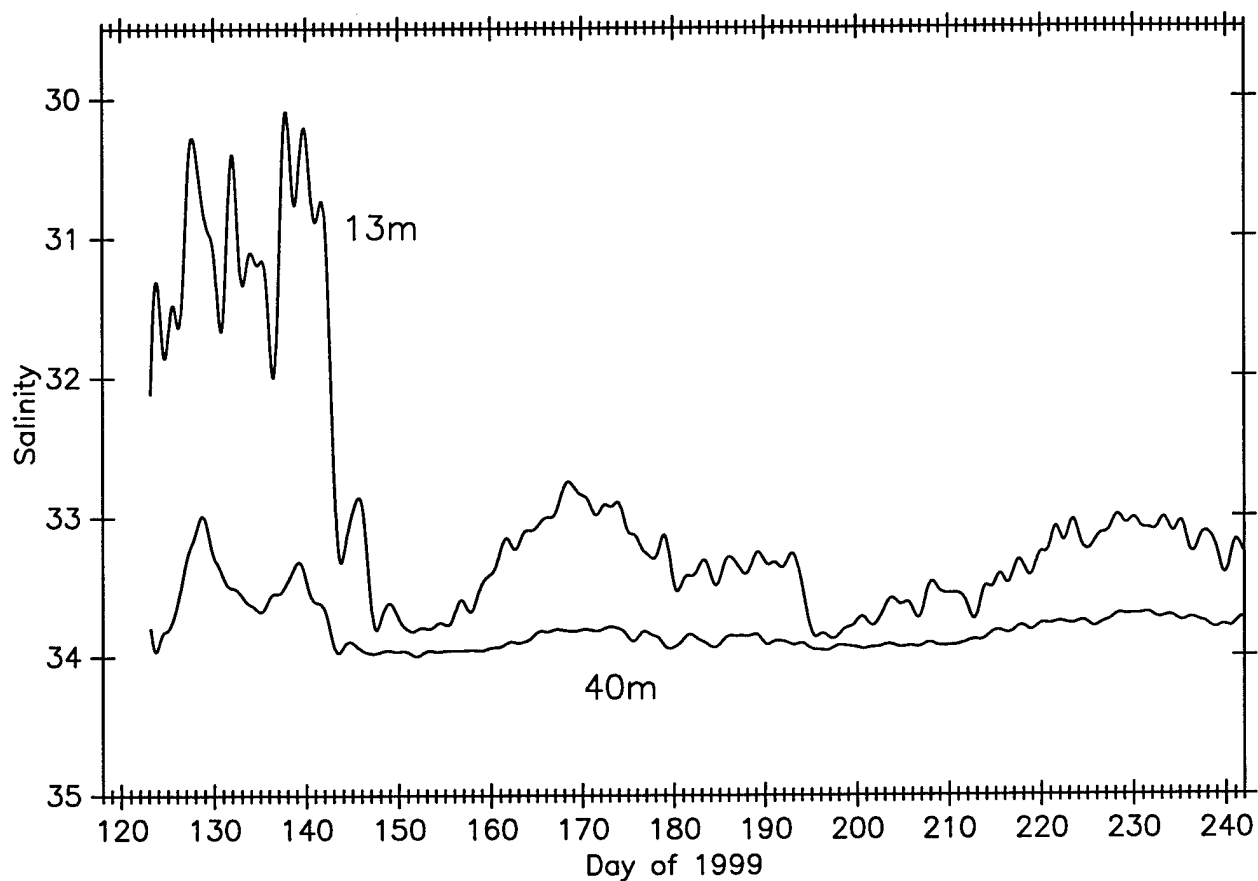
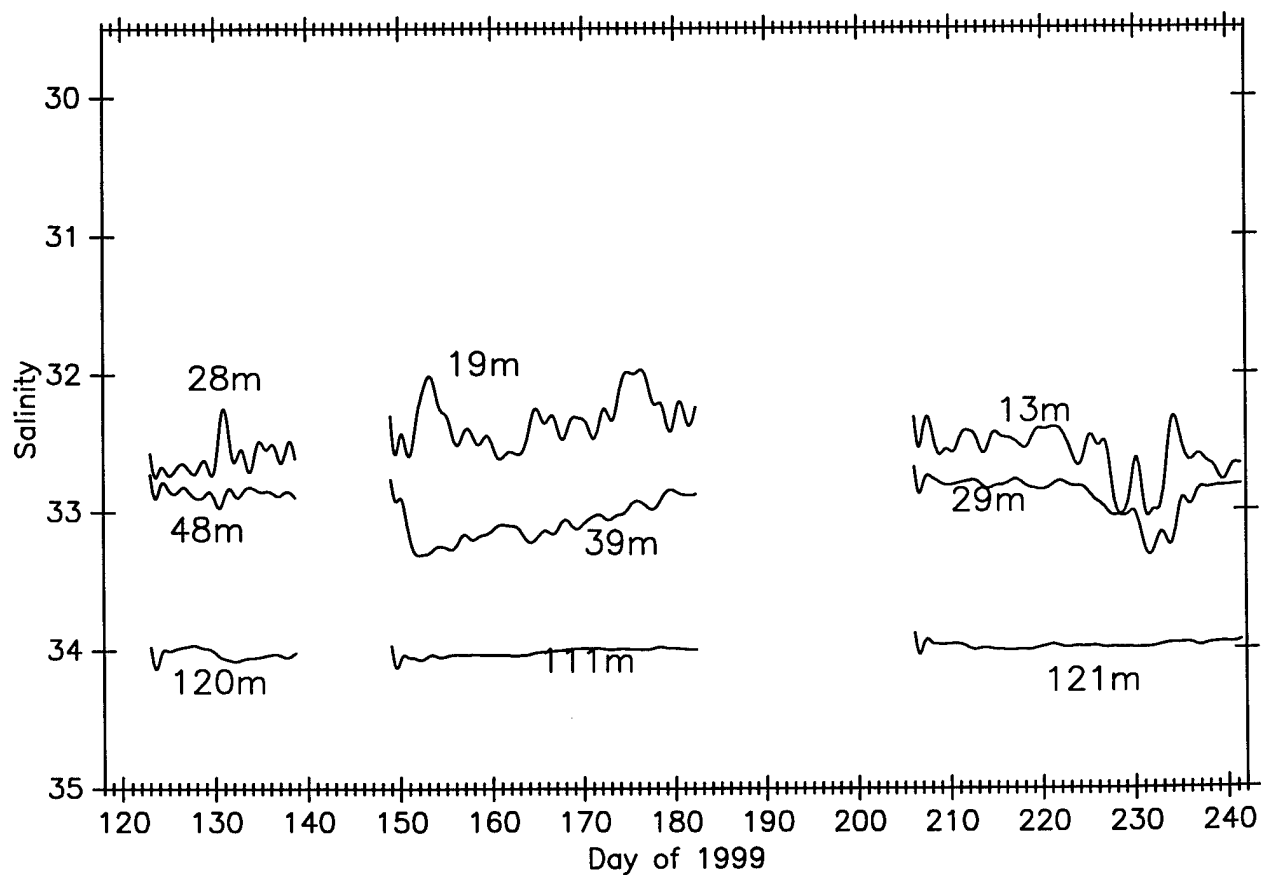


## **SALINITY Time Series**

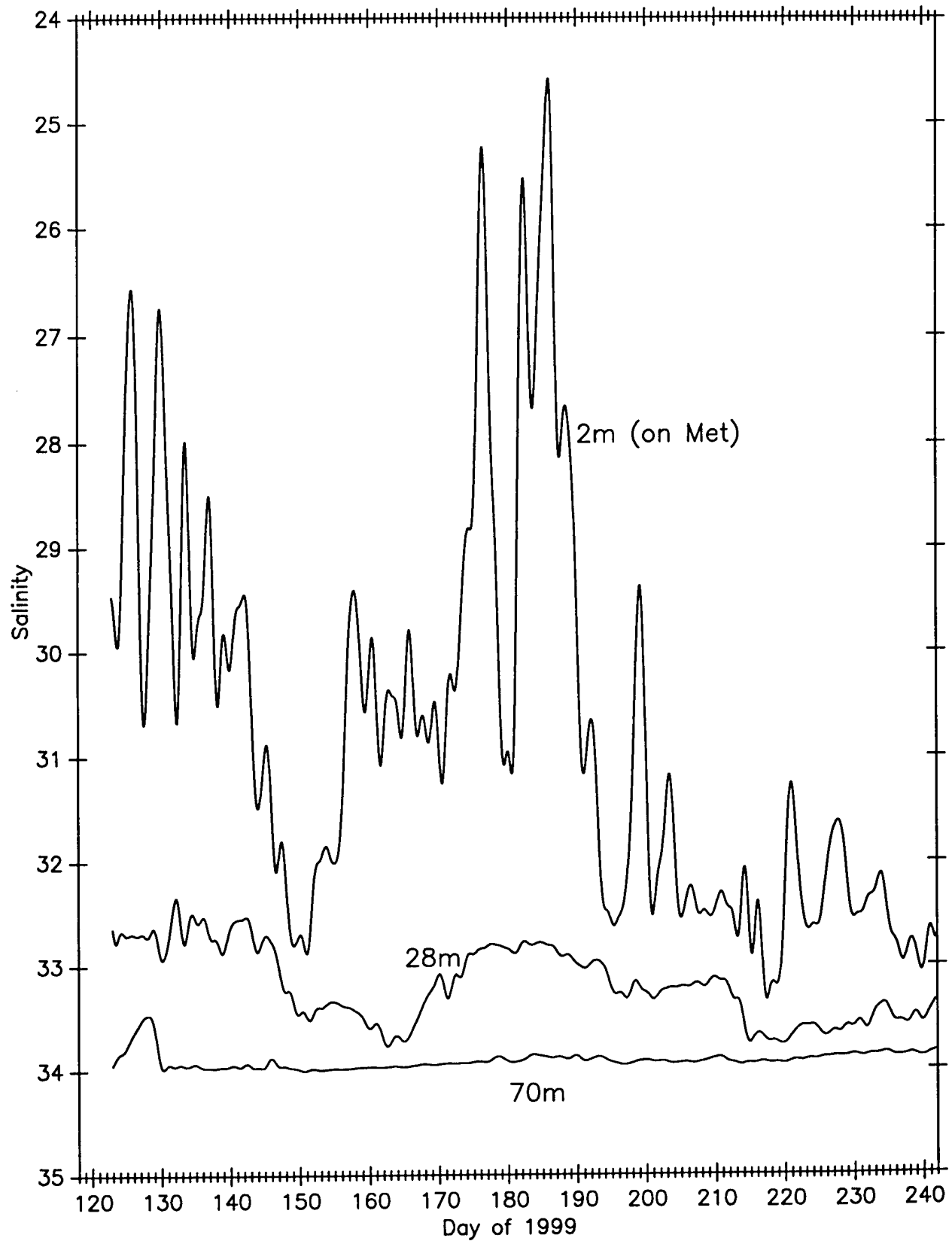
### **40-hour Low-Pass Filtered**

Plots of salinity from the Inshore, Mid-Shelf, Met, and Shelf-Break moorings. Note that the salinity scale is the same on all plots, although the range is greater for the combined plot of Mid-Shelf & Met mooring salinities. Note the gap in Shelf-Break mooring salinity records after day 143, corresponding to the changes of depth associated with the mooring being hit by the trawler. Salinities are not presented for the entire duration of period C, following the loss of buoyancy from the Shelf-Break mooring on day 186.



**NOPP Inshore 40 Hour Filtered Salinities****NOPP Shelf Break 40 Hour Filtered Salinities**

## NOPP Mid Shelf 40 Hour Filtered Salinities



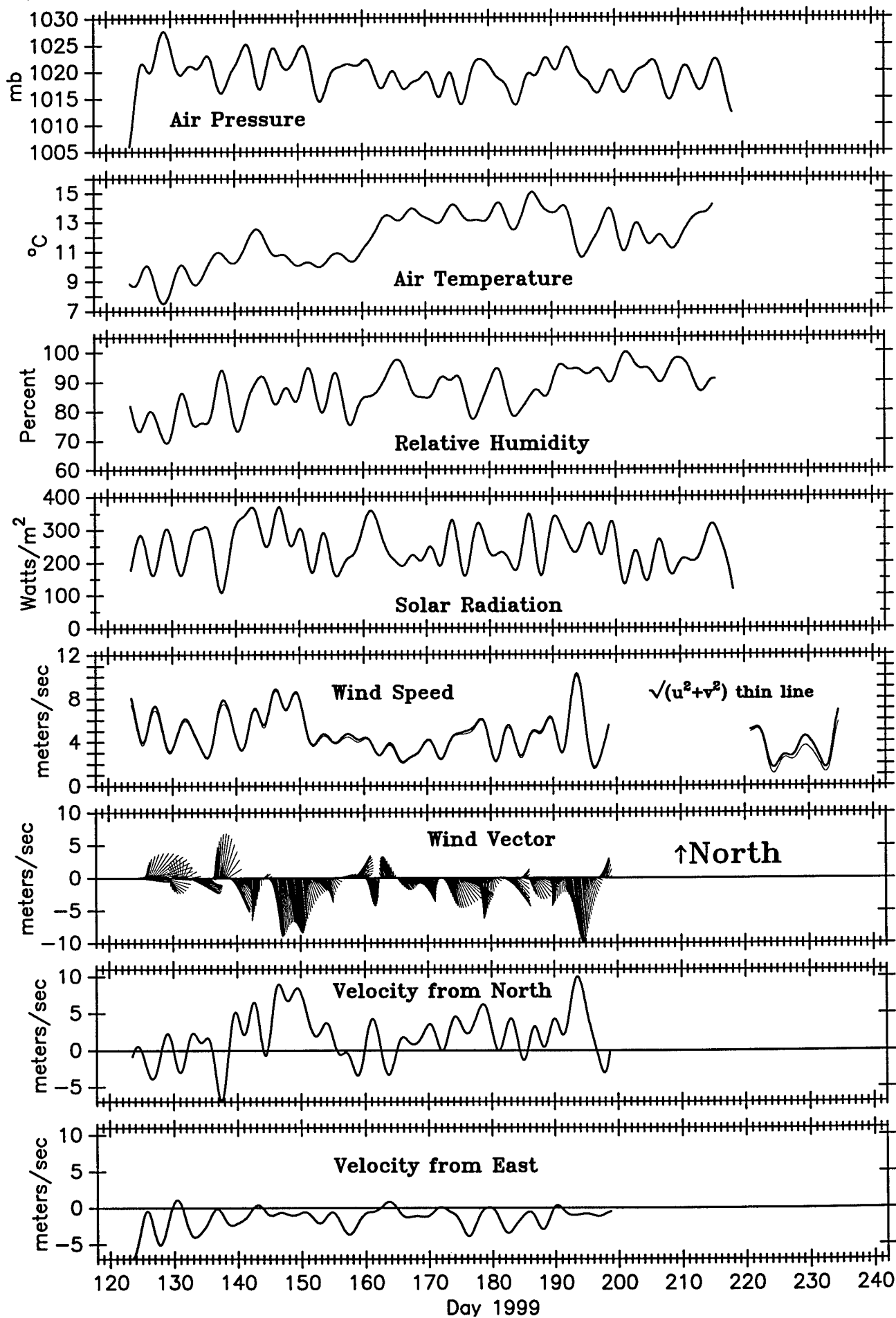
## **METEOROLOGICAL Time Series**

### **40-hour Low-Pass Filtered**

Plots of air pressure, air temperature, relative humidity, solar radiation, wind speed, wind vectors and velocity components. Wind velocity components are presented in the meteorological convention: velocity from north and from east. Wind velocity vectors are shown at 4-hourly intervals. Wind speed is plotted both as converted anemometer rotor counts (bold line) and as magnitude of the vector-averaged velocity (light line). No wind data is available for the period between loss of the anemometer on day 203 and replacement of the anemometer on day 215. Wind direction is not provided for the period following the anemometer replacement due to ambiguity in the orientation of the replacement anemometer.



## NOPP Met Mooring 40 Hour Filtered Meteorological Data





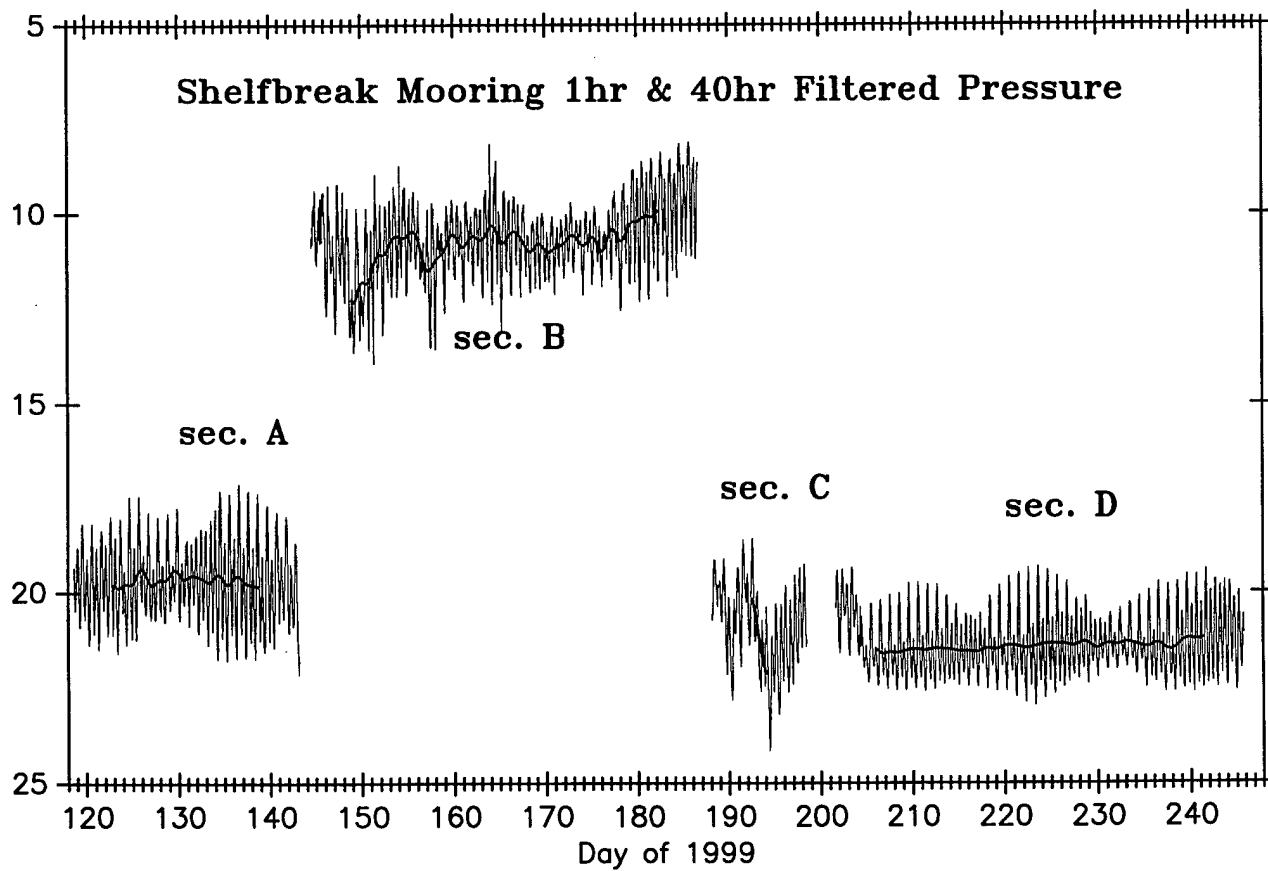
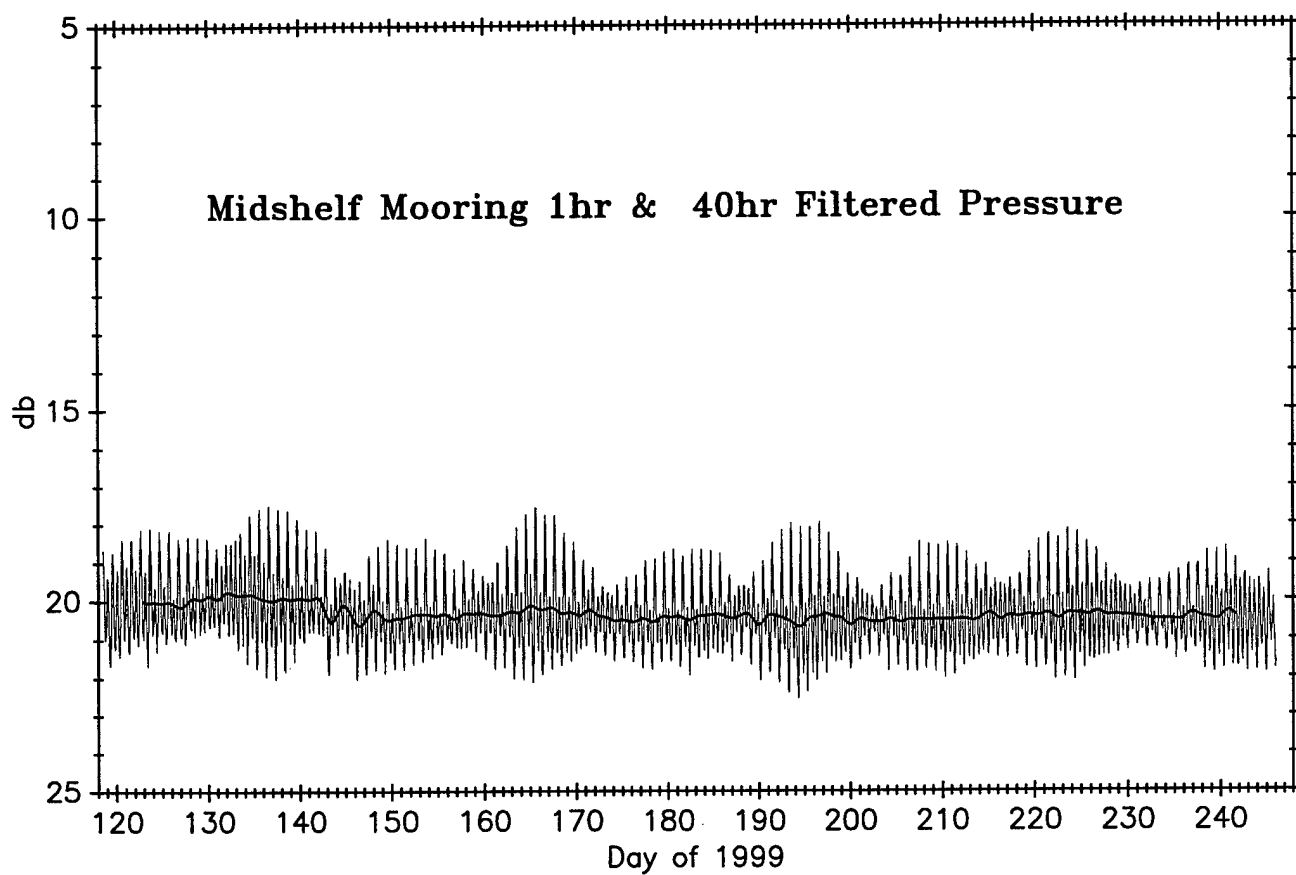
## **PRESSURE Time Series**

### **40-hour & 1-hour Low-Pass Filtered**

Plots of pressure from the Mid-Shelf and Shelf-Break moorings. The trawler impact of the Shelf-Break mooring on day 143 is evident in the pressure signal as a nearly 10 m upward displacement. Subsequent loss of buoyancy by the Shelf-Break mooring on day 186 is evident in the displacement down to about 21 m. The unfiltered pressure signal also suggests that the Shelf-Break mooring was hit again on day 191. The 1-hour filtered pressure signal from the Mid-Shelf mooring and parts of the Shelf-Break mooring (period A, prior to trawler impact, and period D, following redeployment), show clear semidiurnal signals.



## NOPP Pressure Data





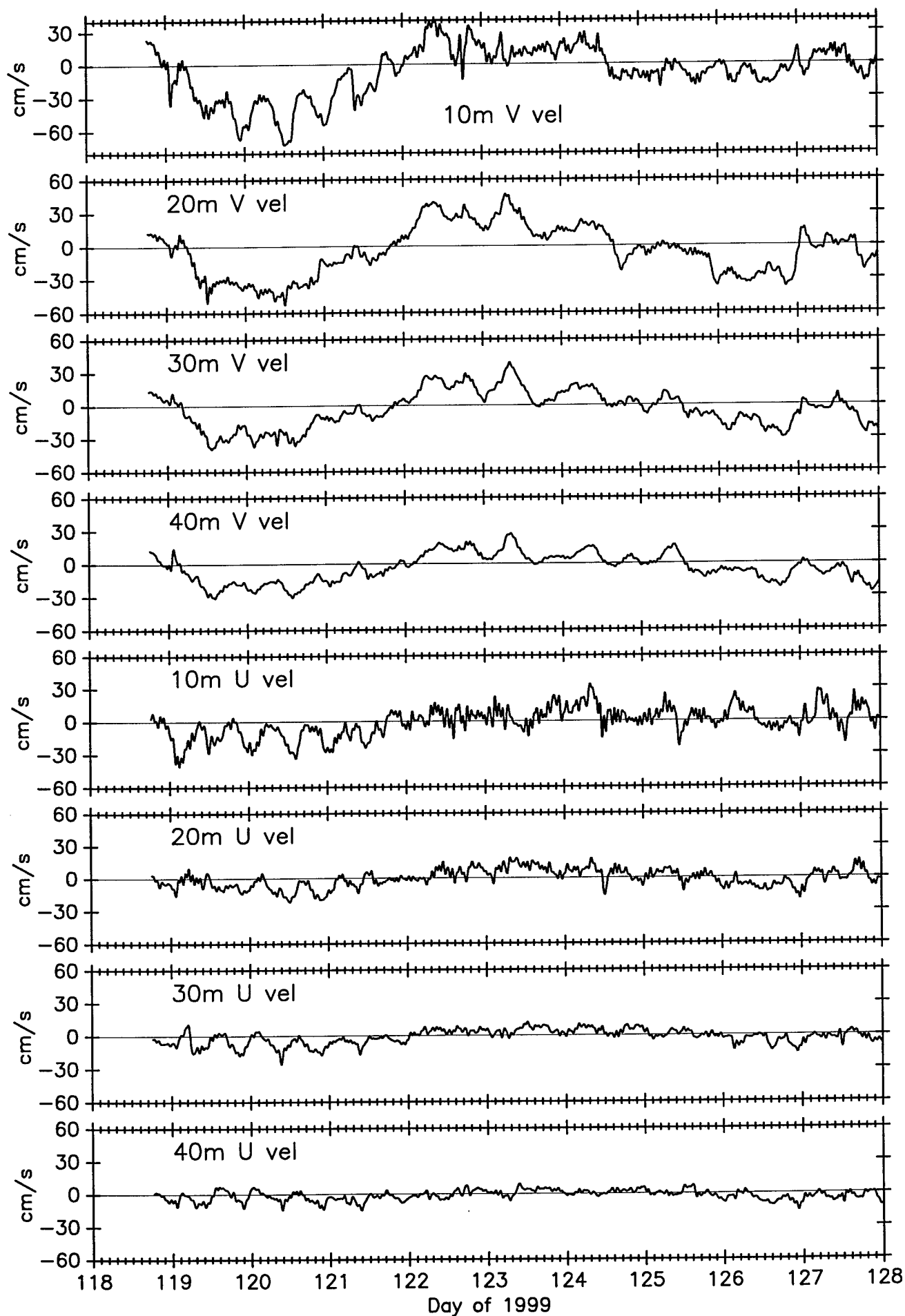
## **VELOCITY Time Series**

### **1-hour Low-pass Filtered**

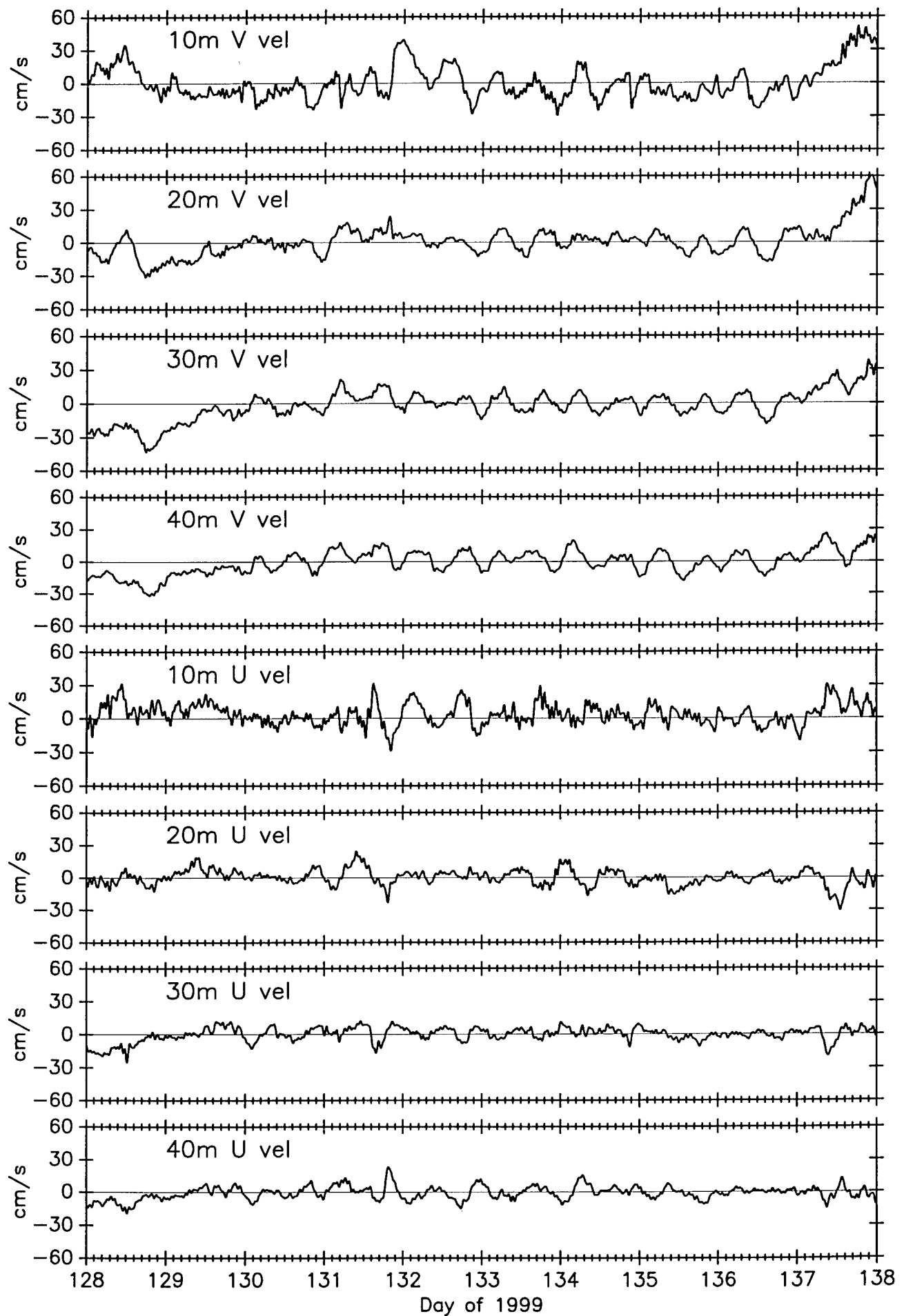
Plots of east and north components of velocity from the Inshore, Mid-Shelf, and Shelf-Break moorings. Velocity components from the Inshore mooring are shown for 10, 20, 30, and 40 m. Velocity components from the Mid-Shelf mooring are shown for 11, 31, 51, and 71 m. Velocity components from the first deployment (period A) of the Shelf-Break mooring are shown for 79, 91, 103, and 115 m. Velocity components from the second deployment (period D) of the Shelf-Break mooring are shown for 28, 48, 68, and 88 m.



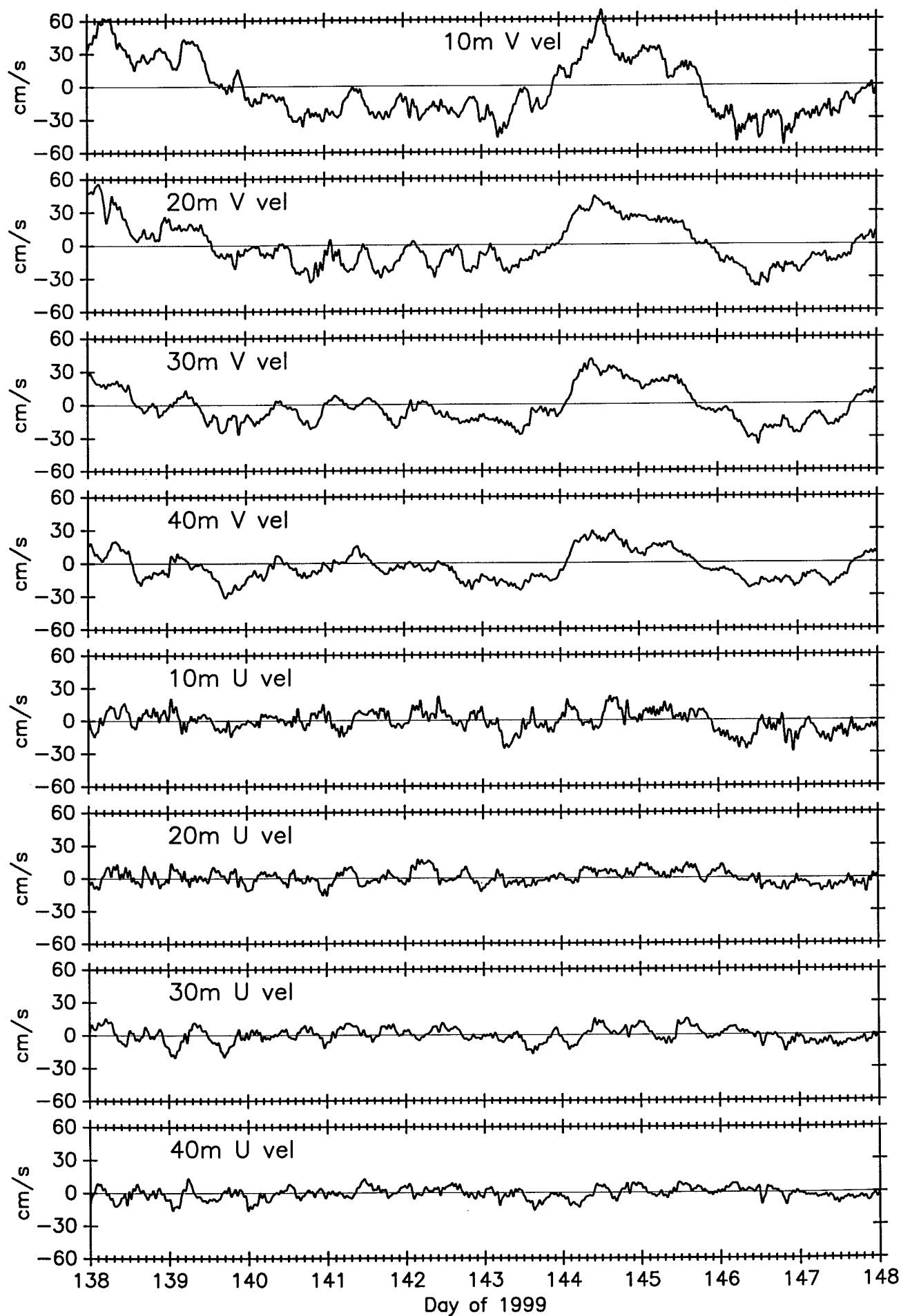
## NOPP Inshore Mooring 1 hour Lowpass Filtered Velocities



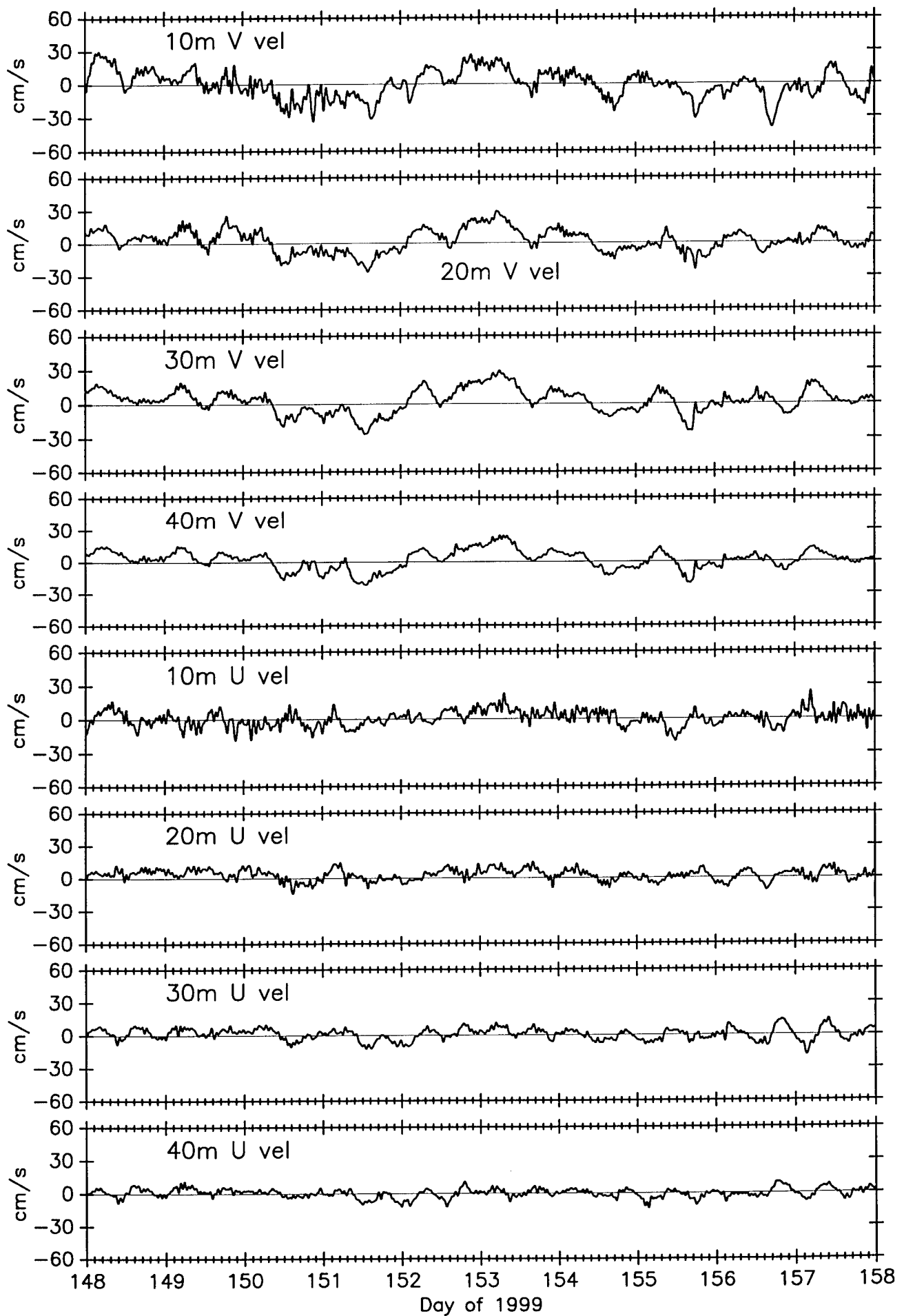
## NOPP Inshore Mooring 1 hour Lowpass Filtered Velocities



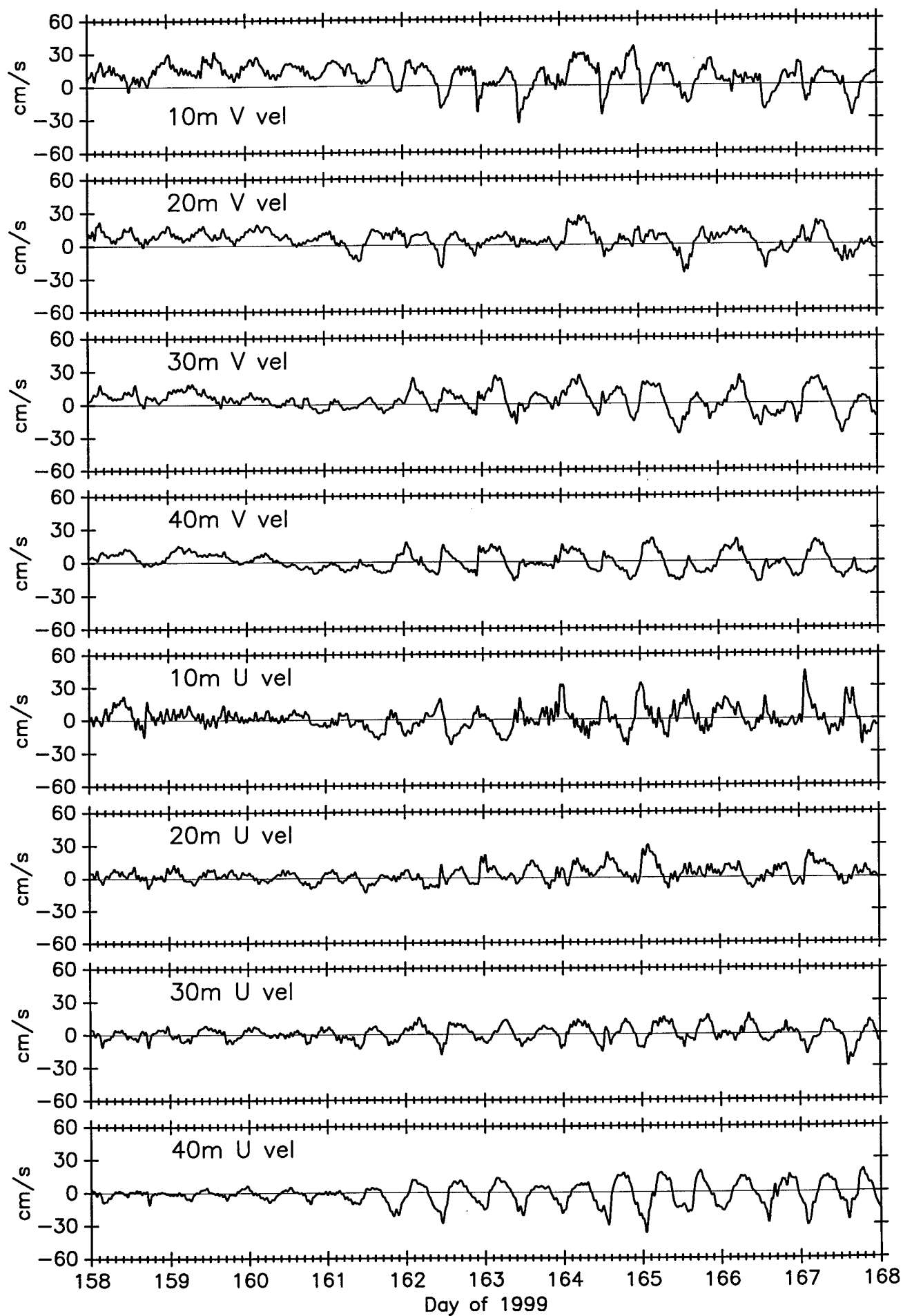
## NOPP Inshore Mooring 1 hour Lowpass Filtered Velocities



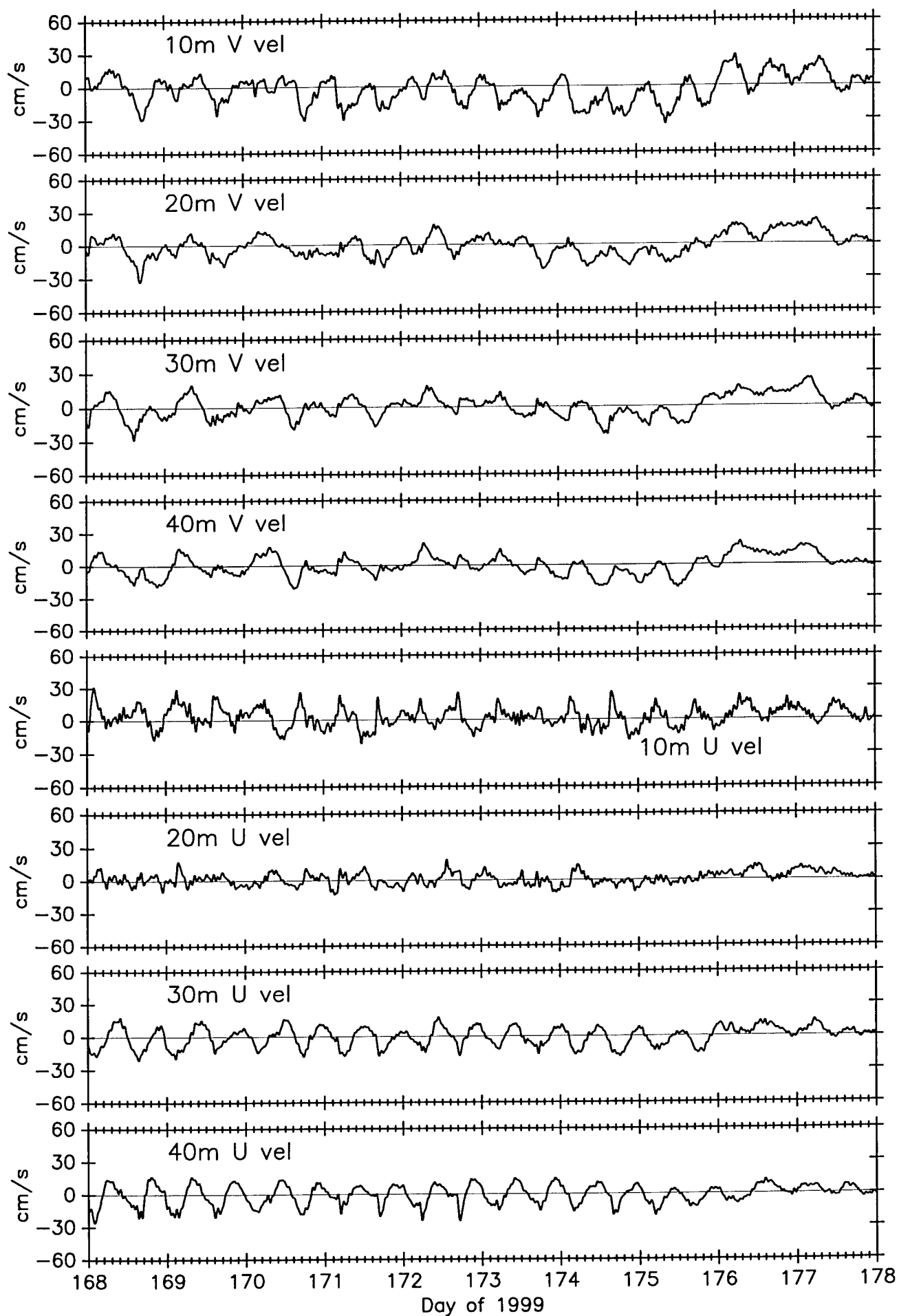
## NOPP Inshore Mooring 1 hour Lowpass Filtered Velocities



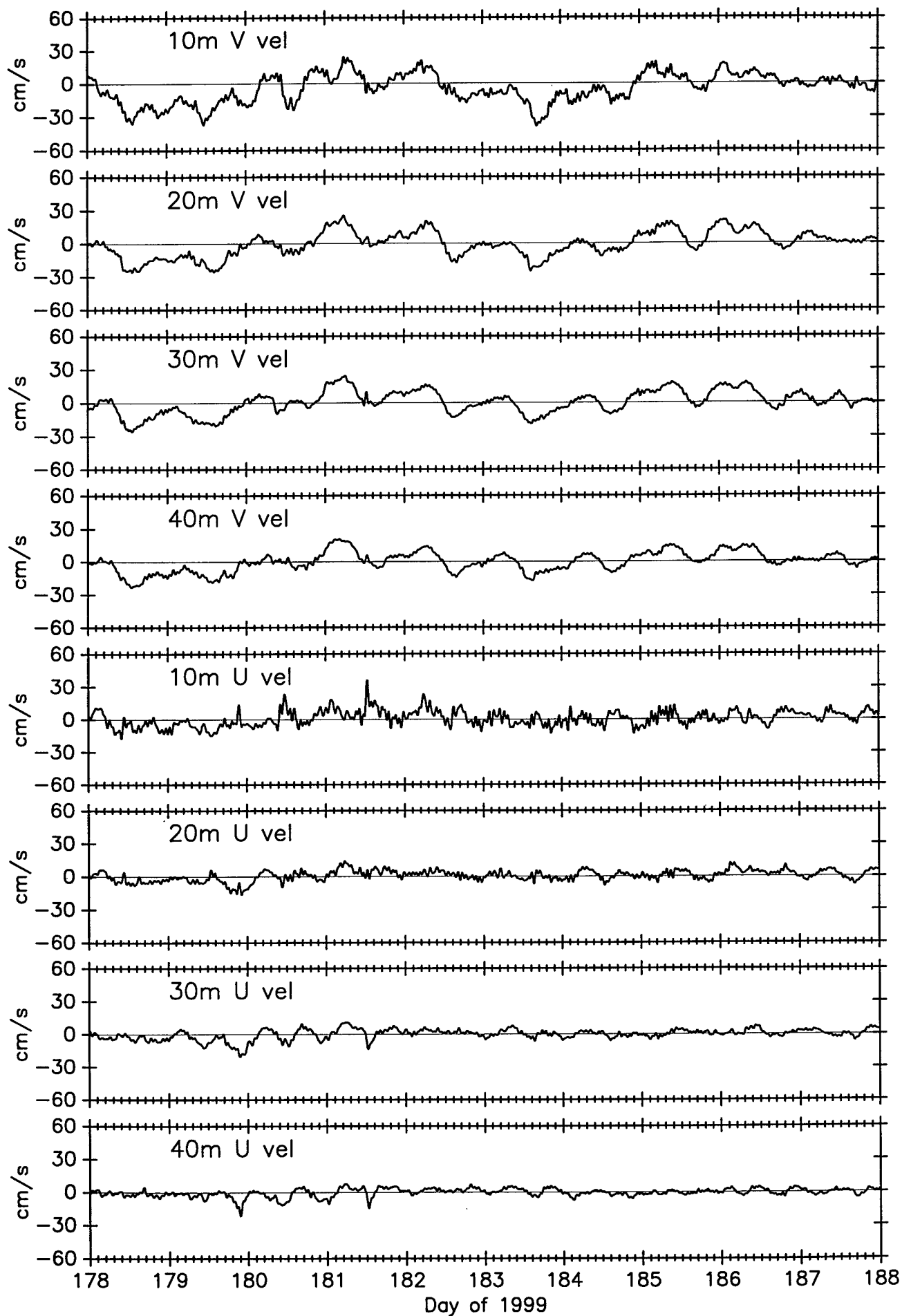
## NOPP Inshore Mooring 1 hour Lowpass Filtered Velocities



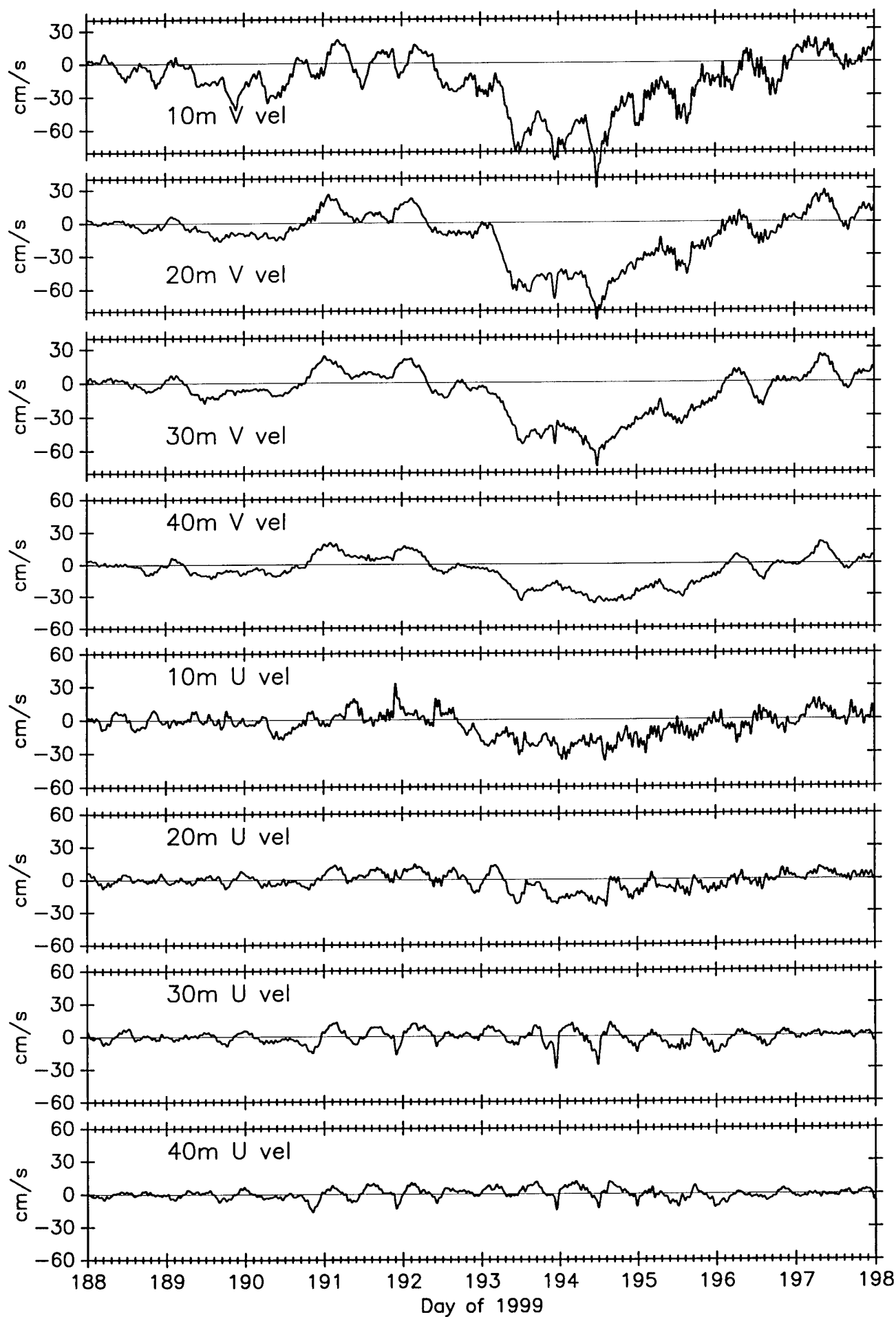
## NOPP Inshore Mooring 1 hour Lowpass Filtered Velocities



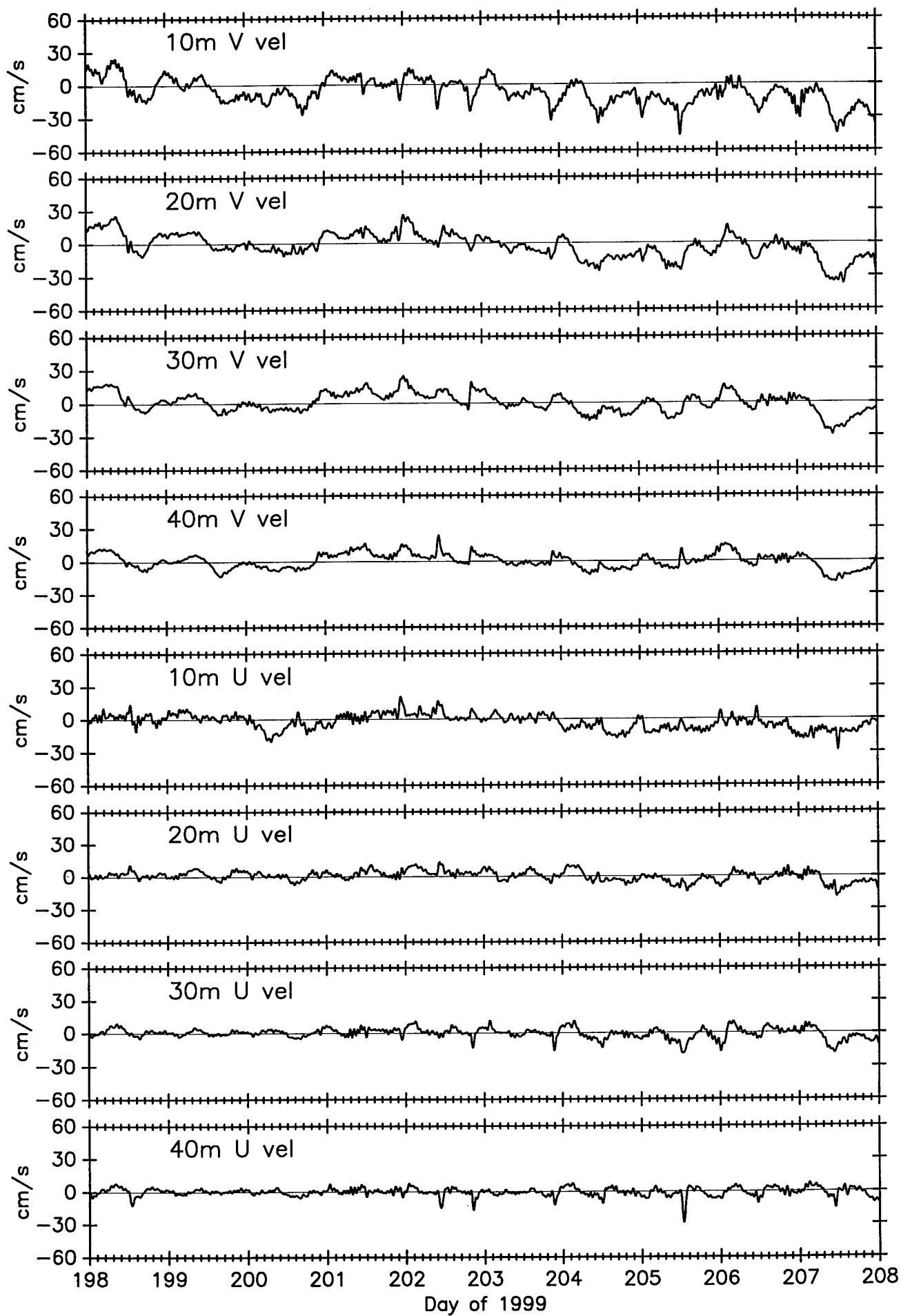
## NOPP Inshore Mooring 1 hour Lowpass Filtered Velocities



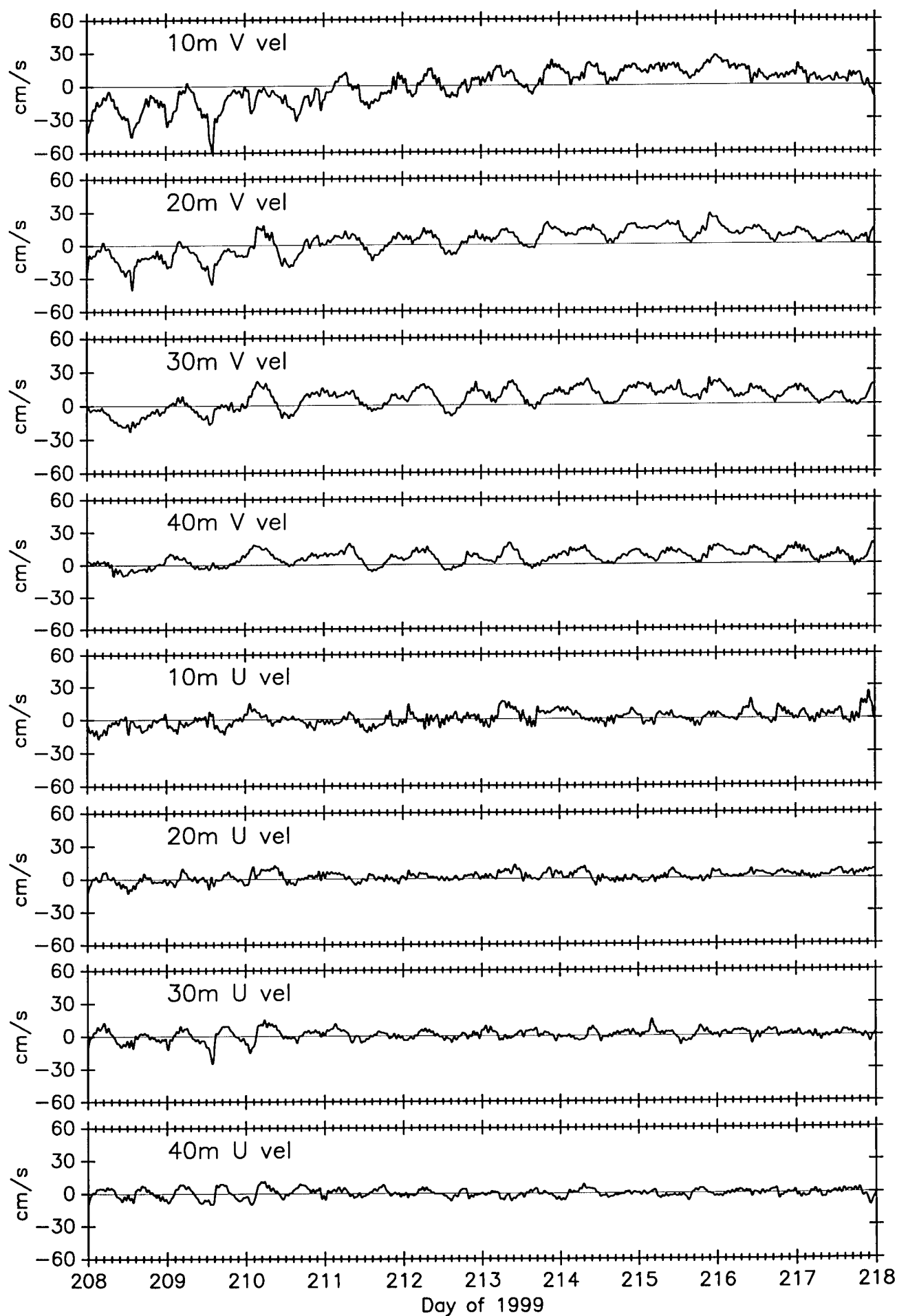
## NOPP Inshore Mooring 1 hour Lowpass Filtered Velocities



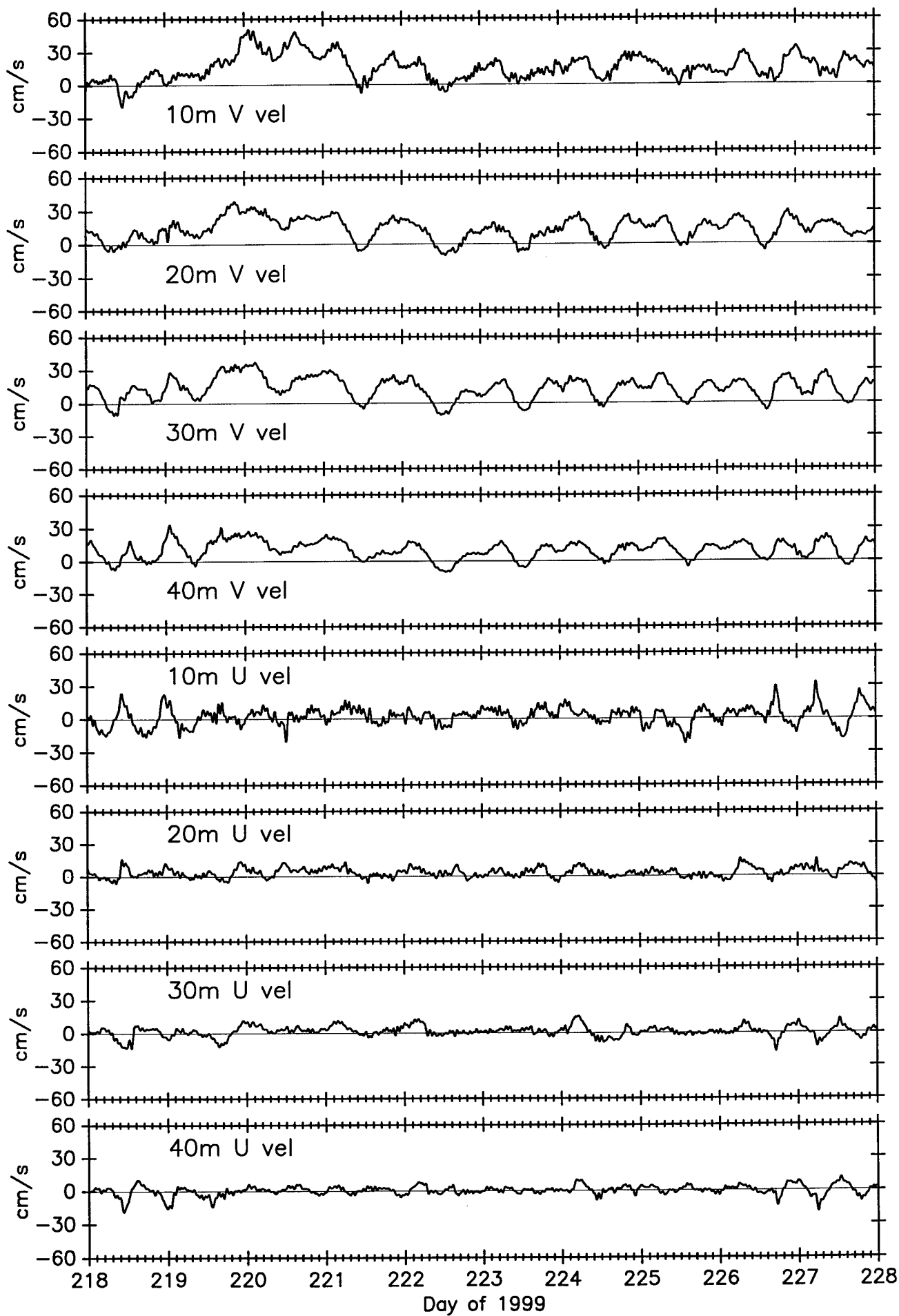
## NOPP Inshore Mooring 1 hour Lowpass Filtered Velocities



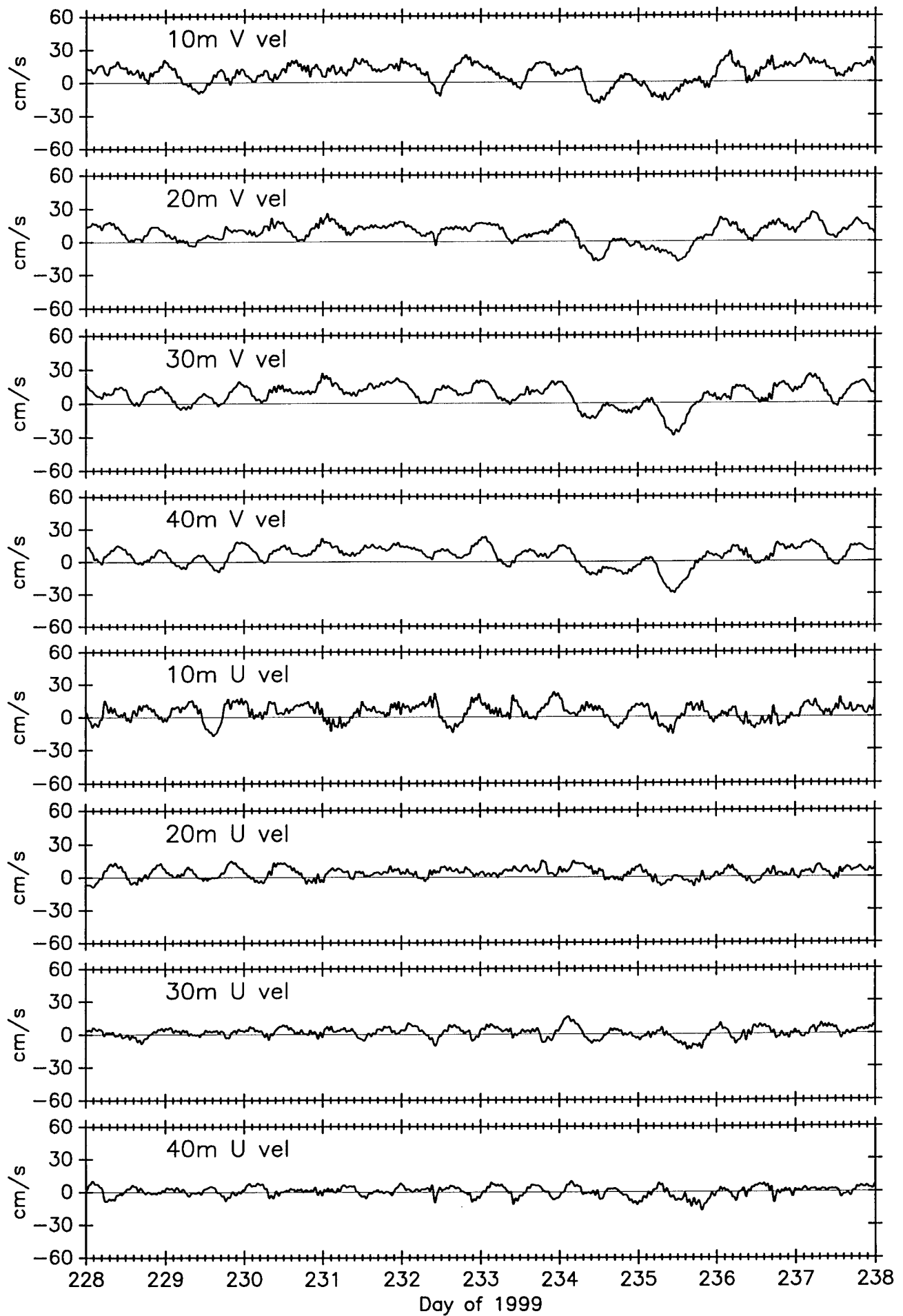
## NOPP Inshore Mooring 1 hour Lowpass Filtered Velocities



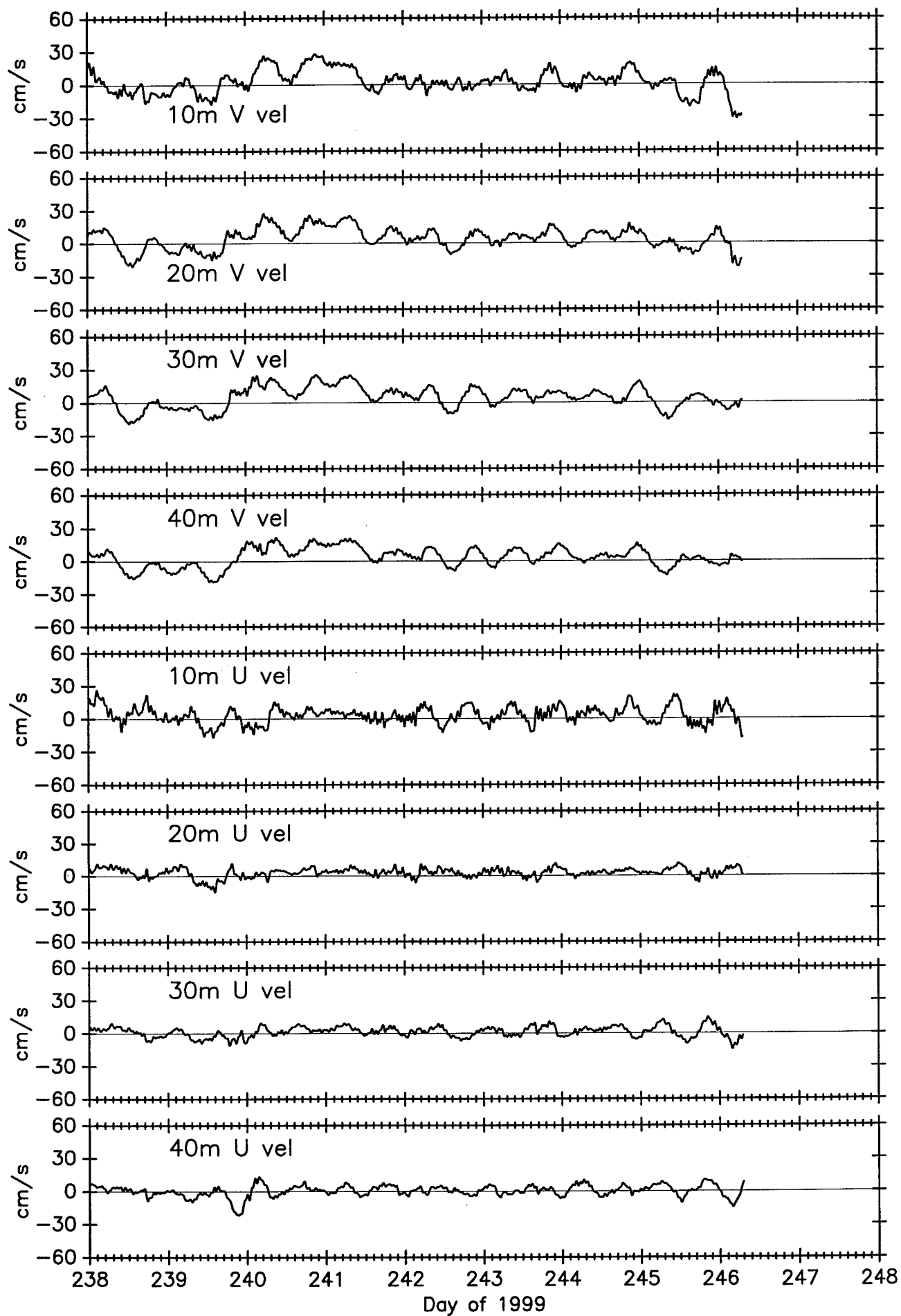
## NOPP Inshore Mooring 1 hour Lowpass Filtered Velocities



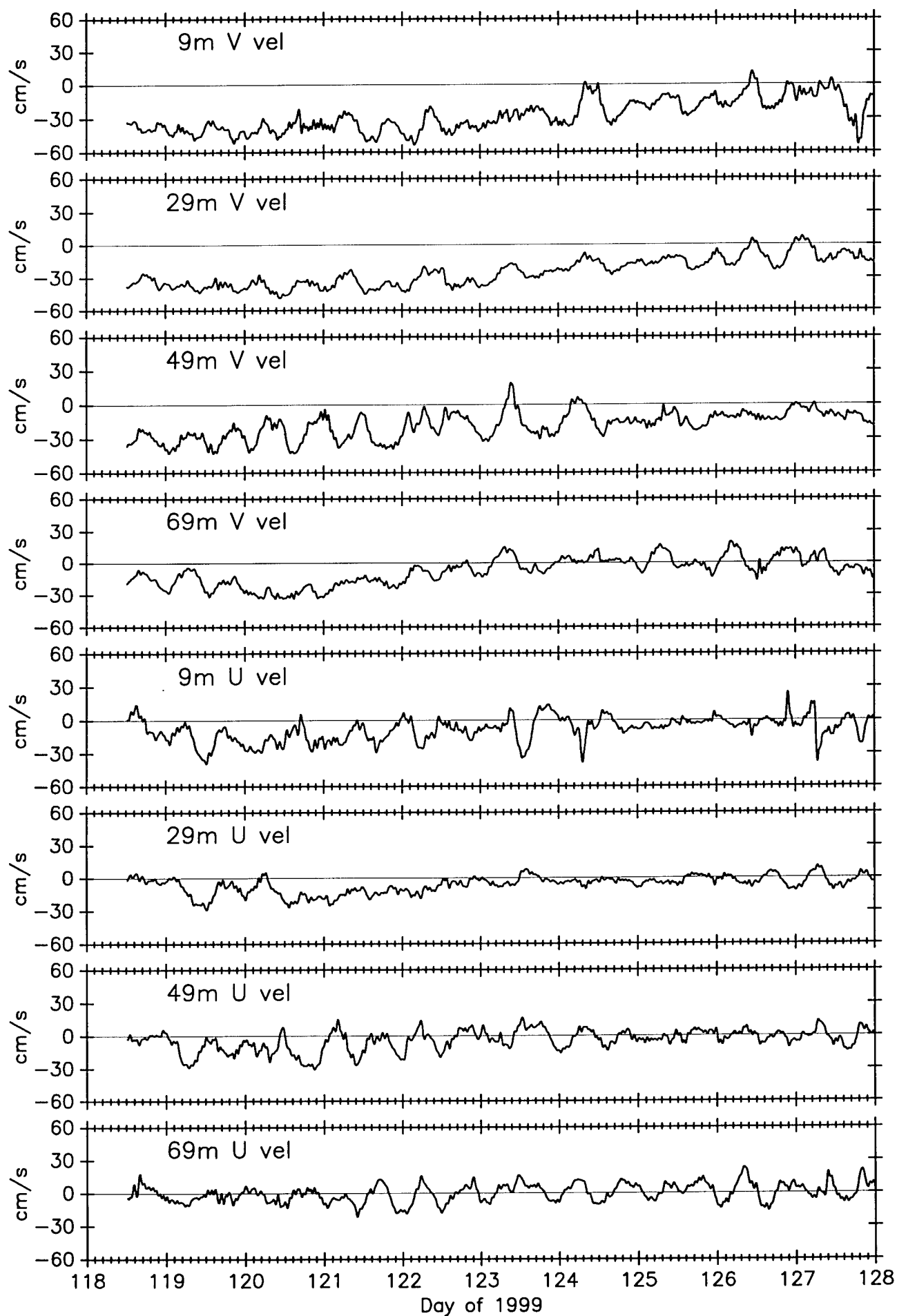
## NOPP Inshore Mooring 1 hour Lowpass Filtered Velocities



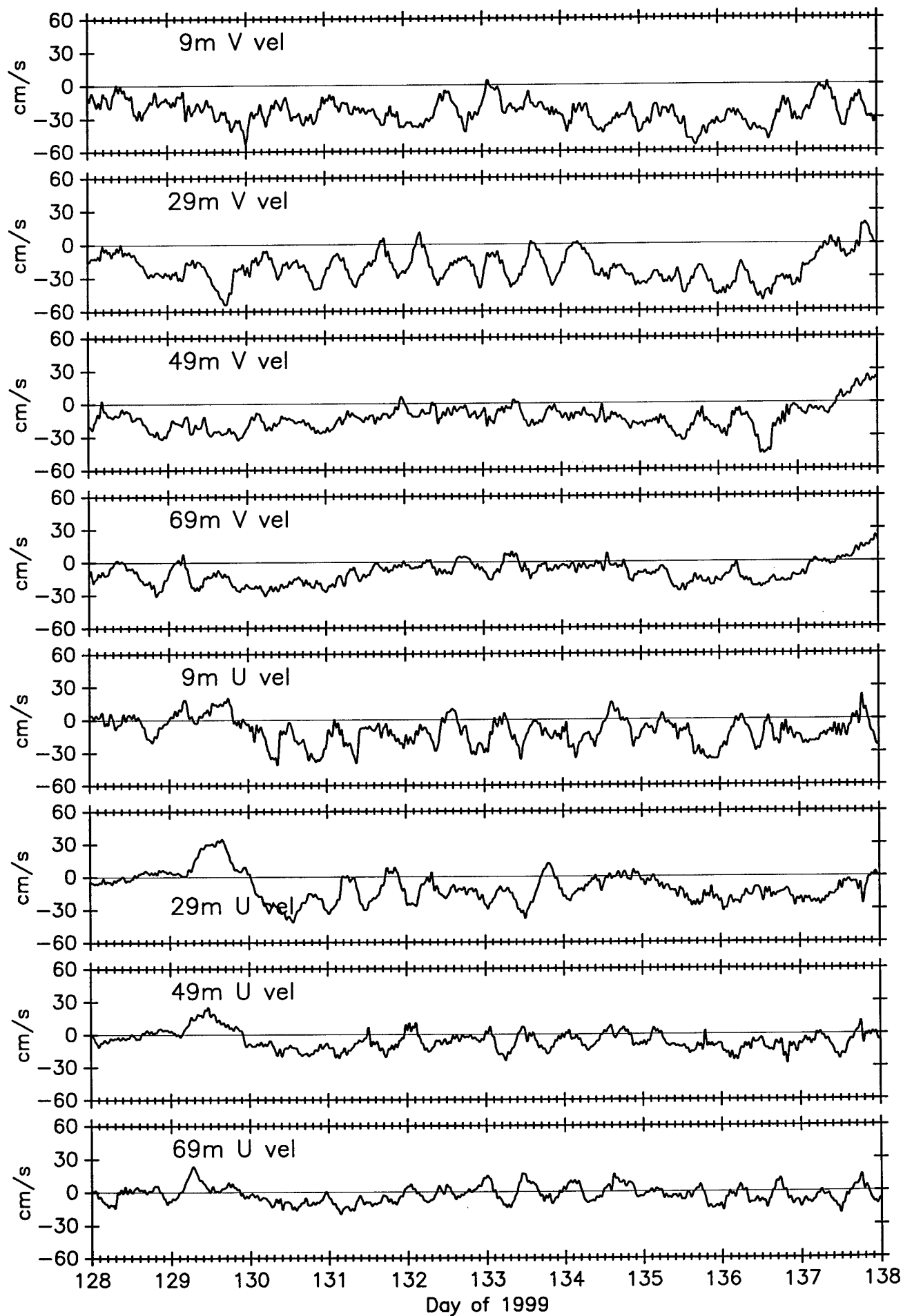
## NOPP Inshore Mooring 1 hour Lowpass Filtered Velocities

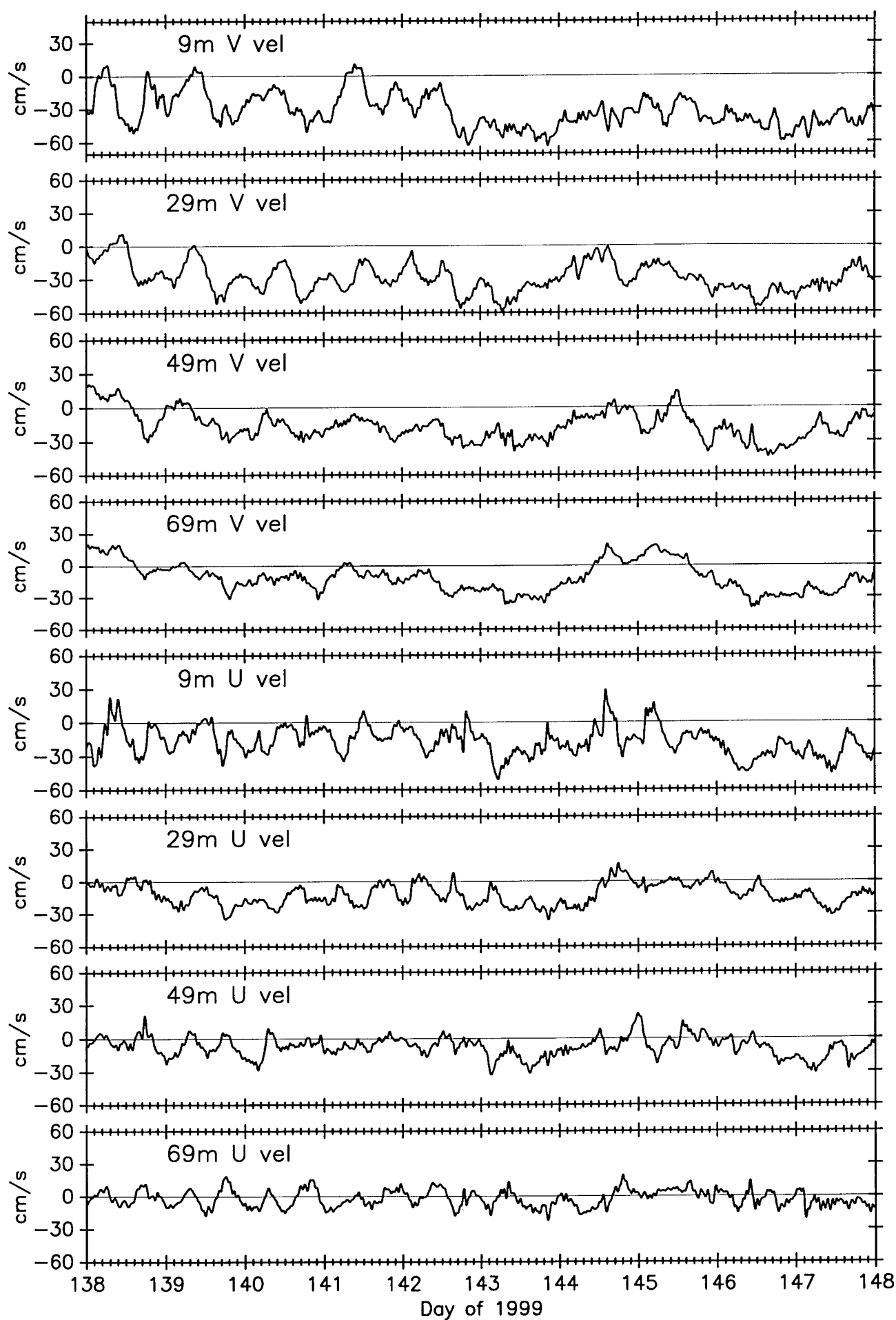


## NOPP Mid-Shelf Mooring 1 hour Lowpass Filtered Velocities

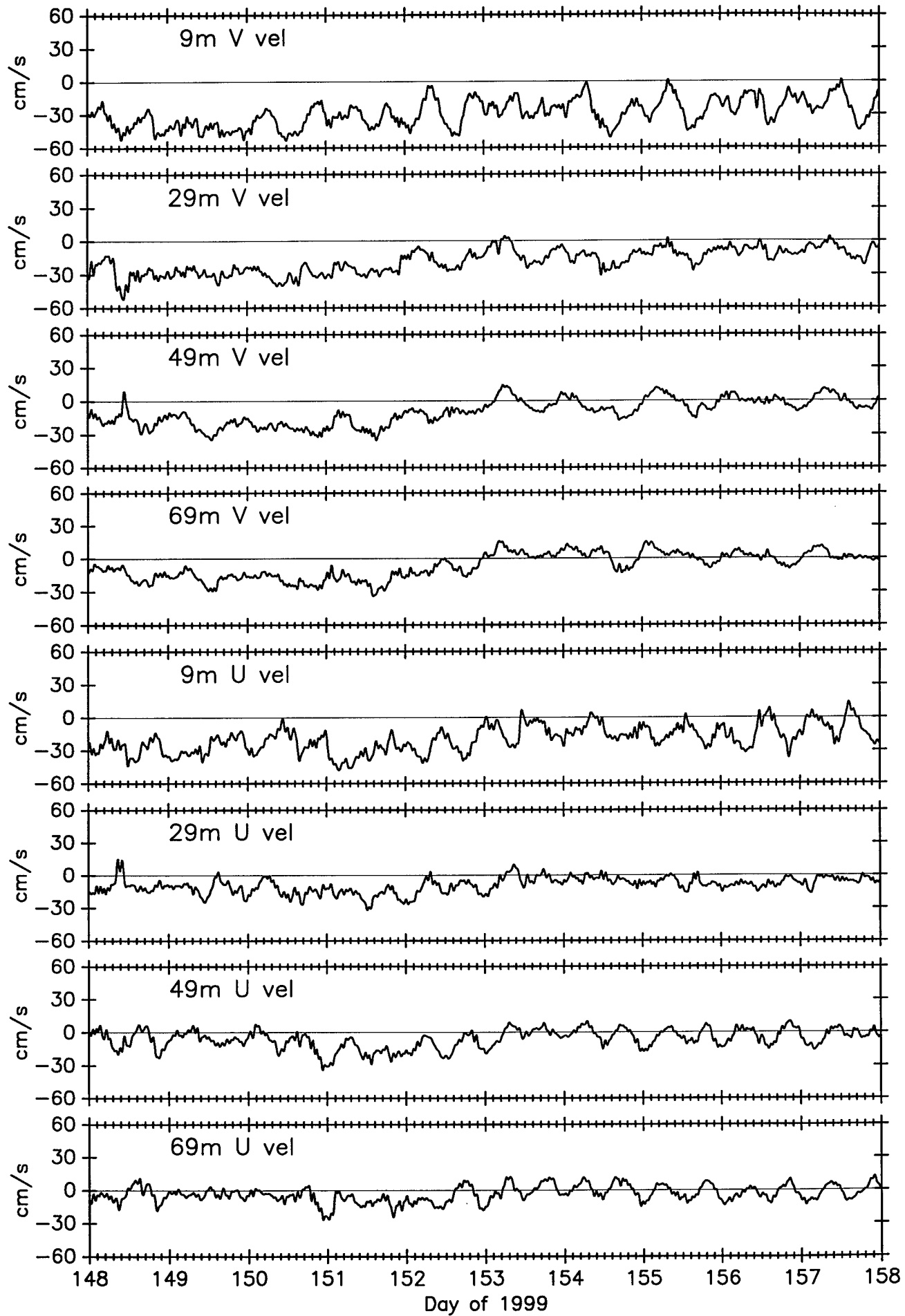


## NOPP Mid-Shelf Mooring 1 hour Lowpass Filtered Velocities

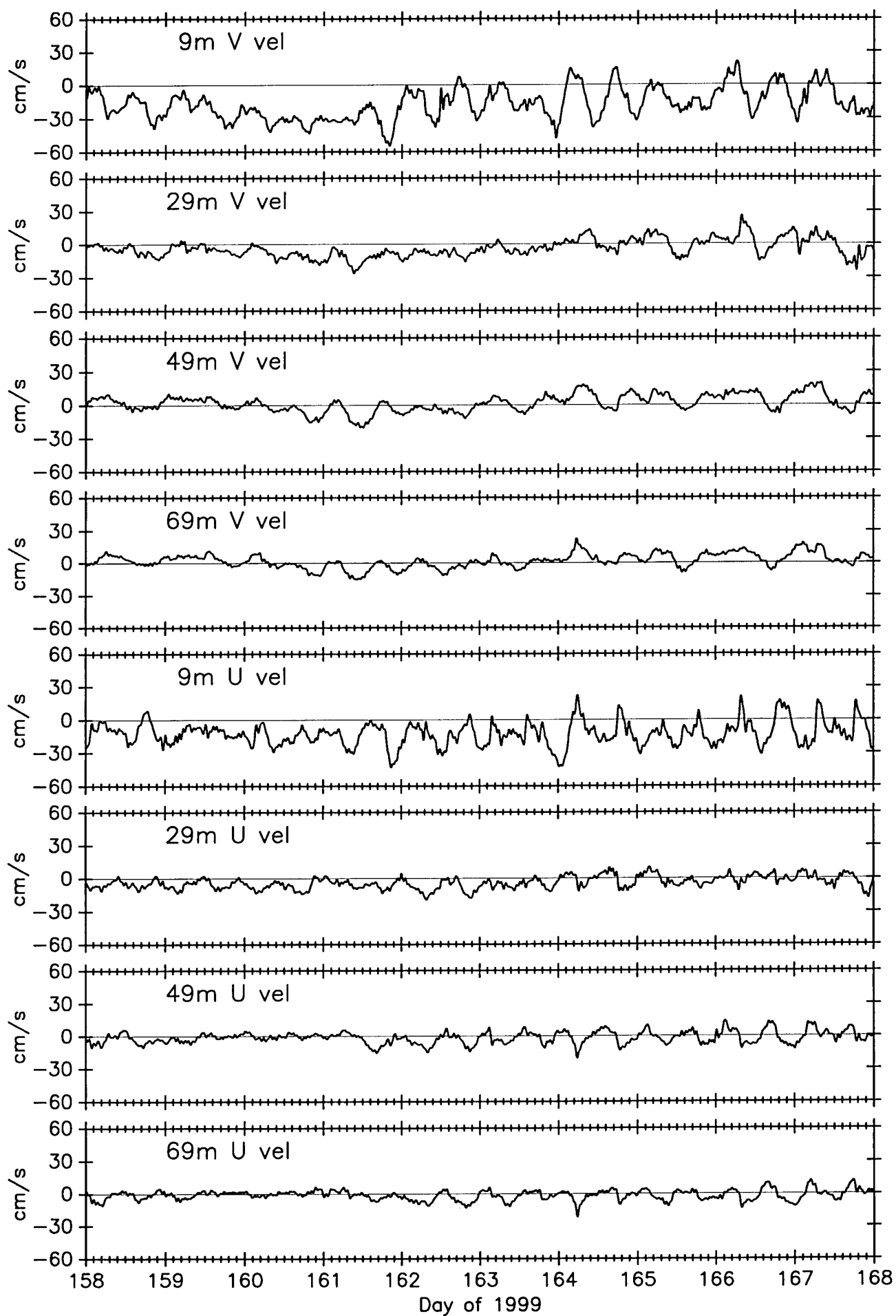




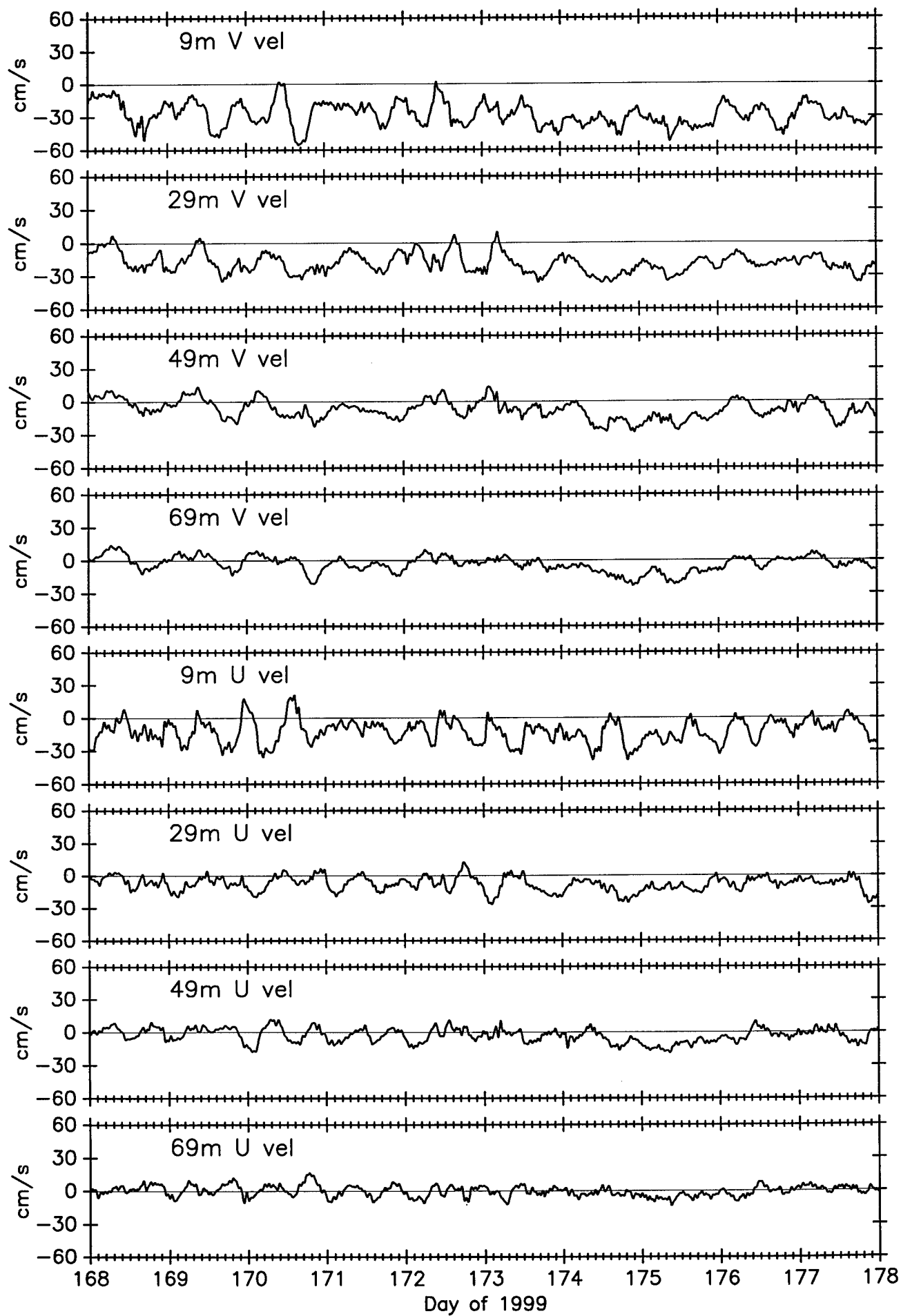
## NOPP Mid-Shelf Mooring 1 hour Lowpass Filtered Velocities

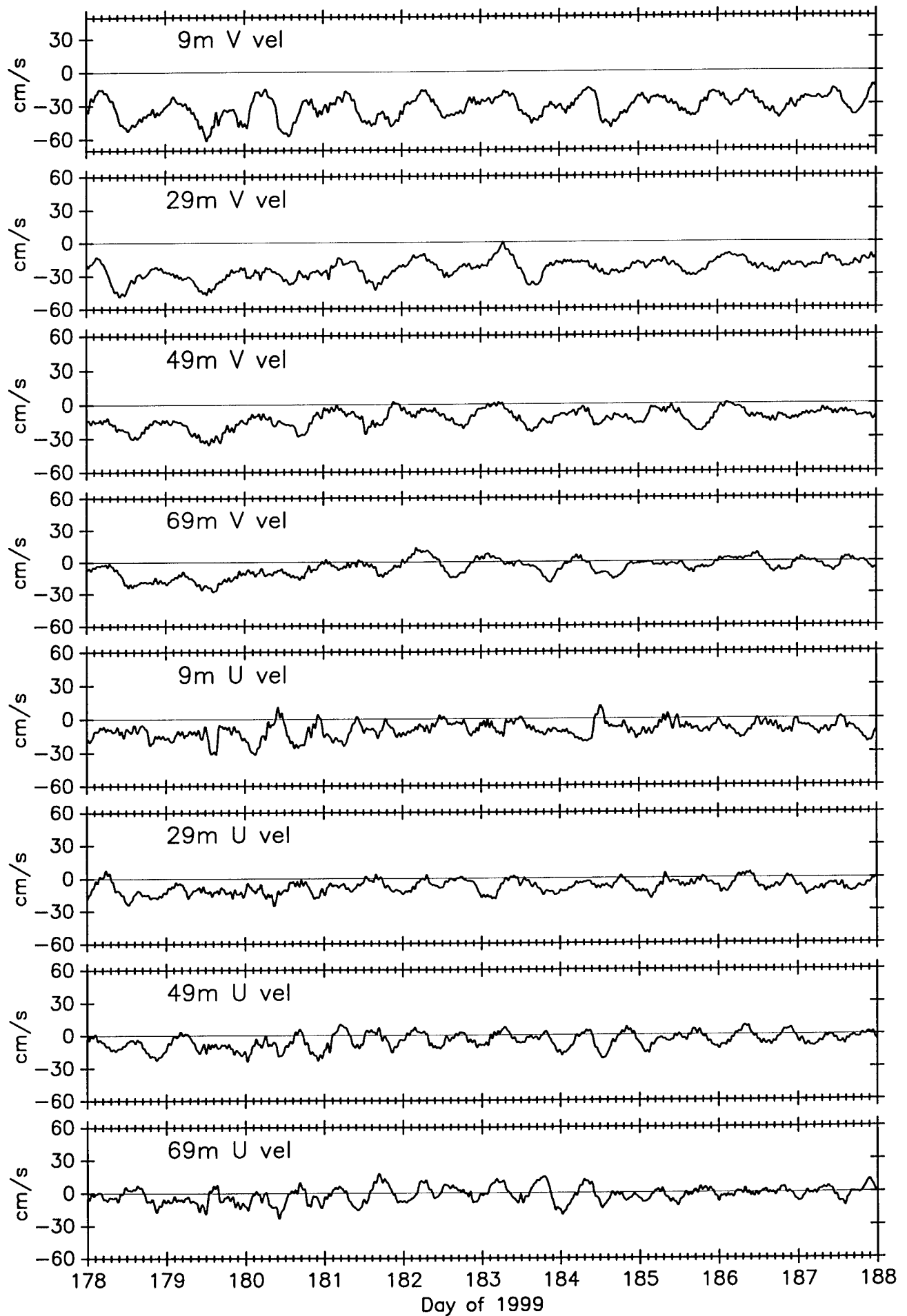


## NOPP Mid-Shelf Mooring 1 hour Lowpass Filtered Velocities

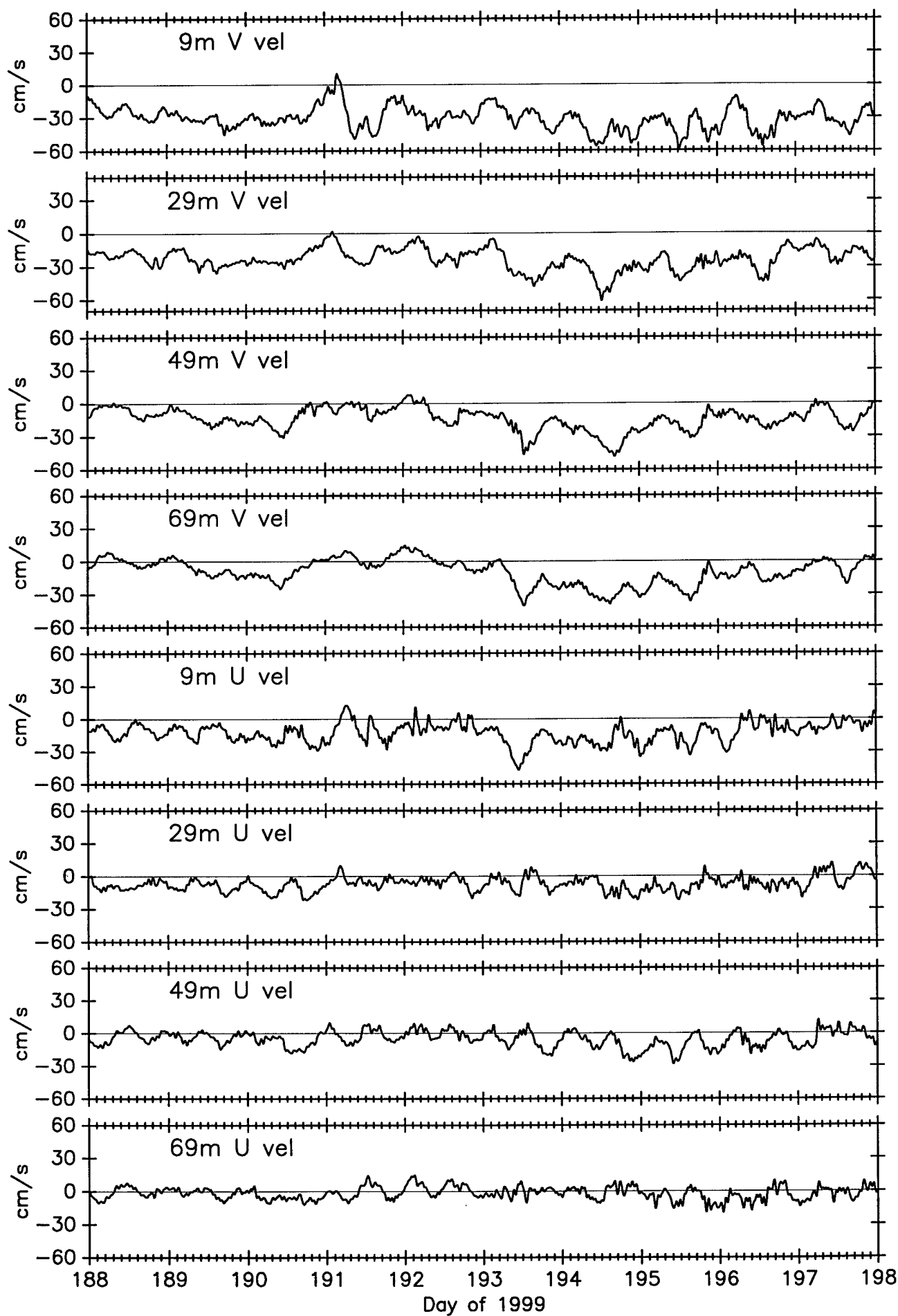


## NOPP Mid-Shelf Mooring 1 hour Lowpass Filtered Velocities

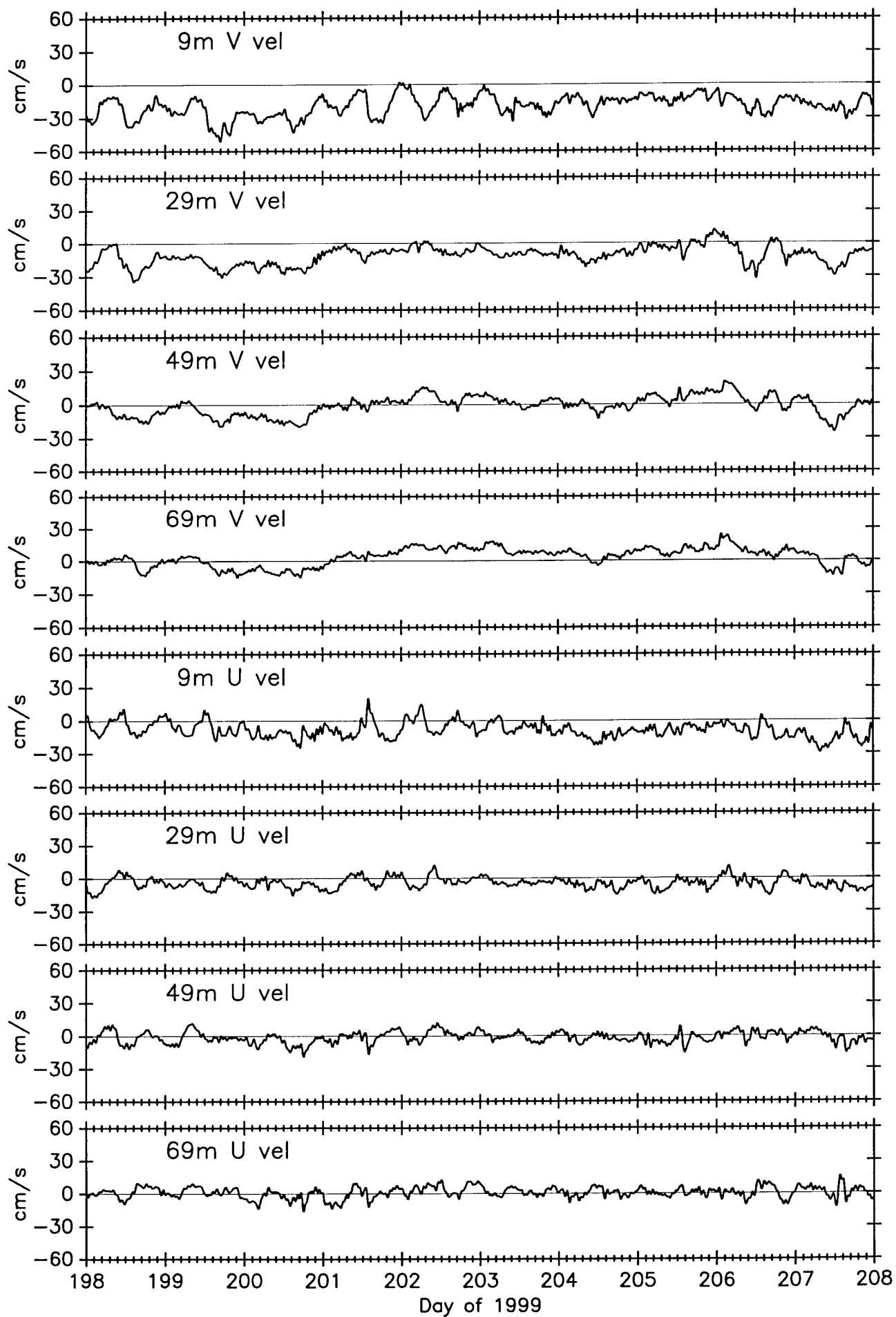




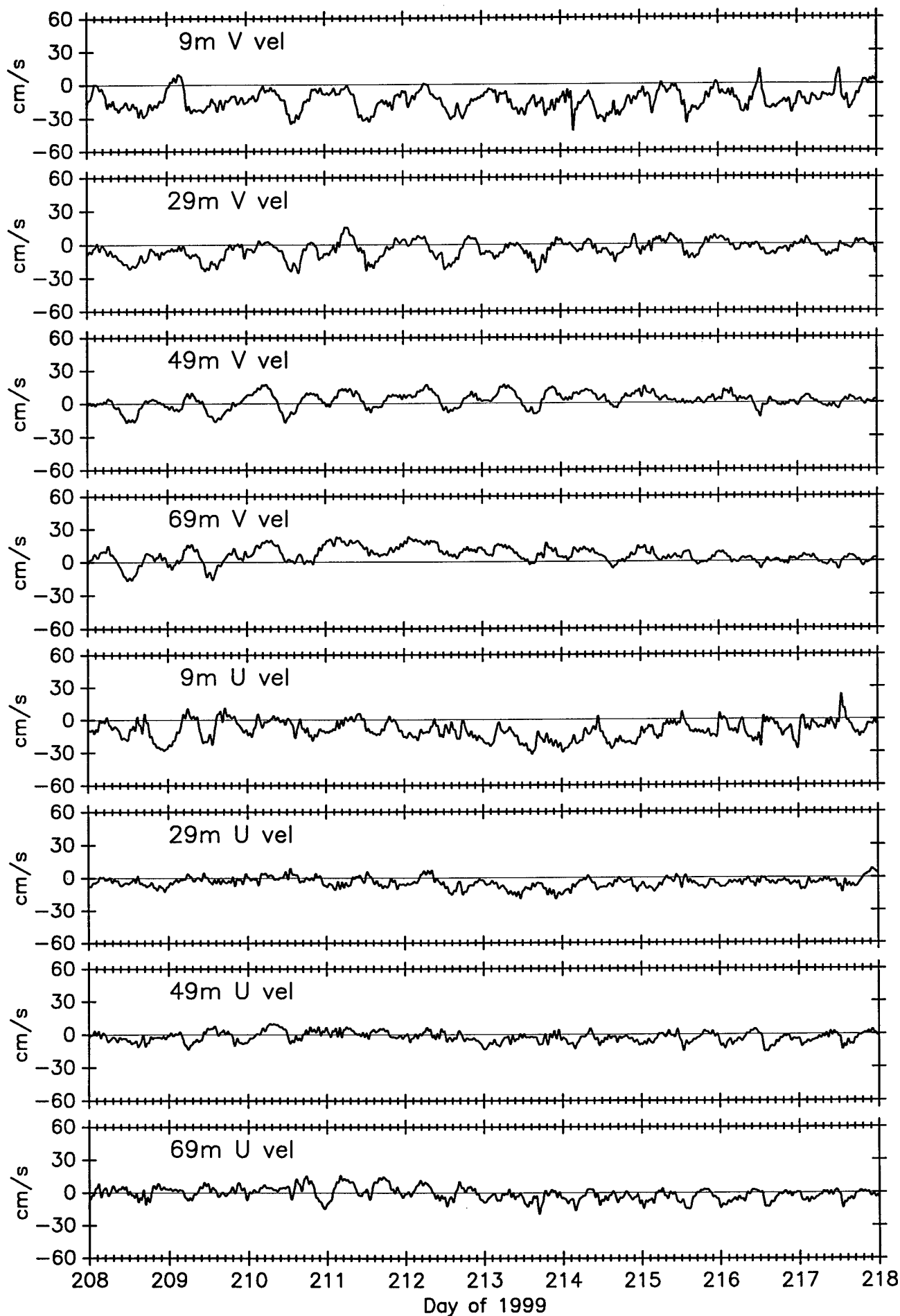
## NOPP Mid-Shelf Mooring 1 hour Lowpass Filtered Velocities



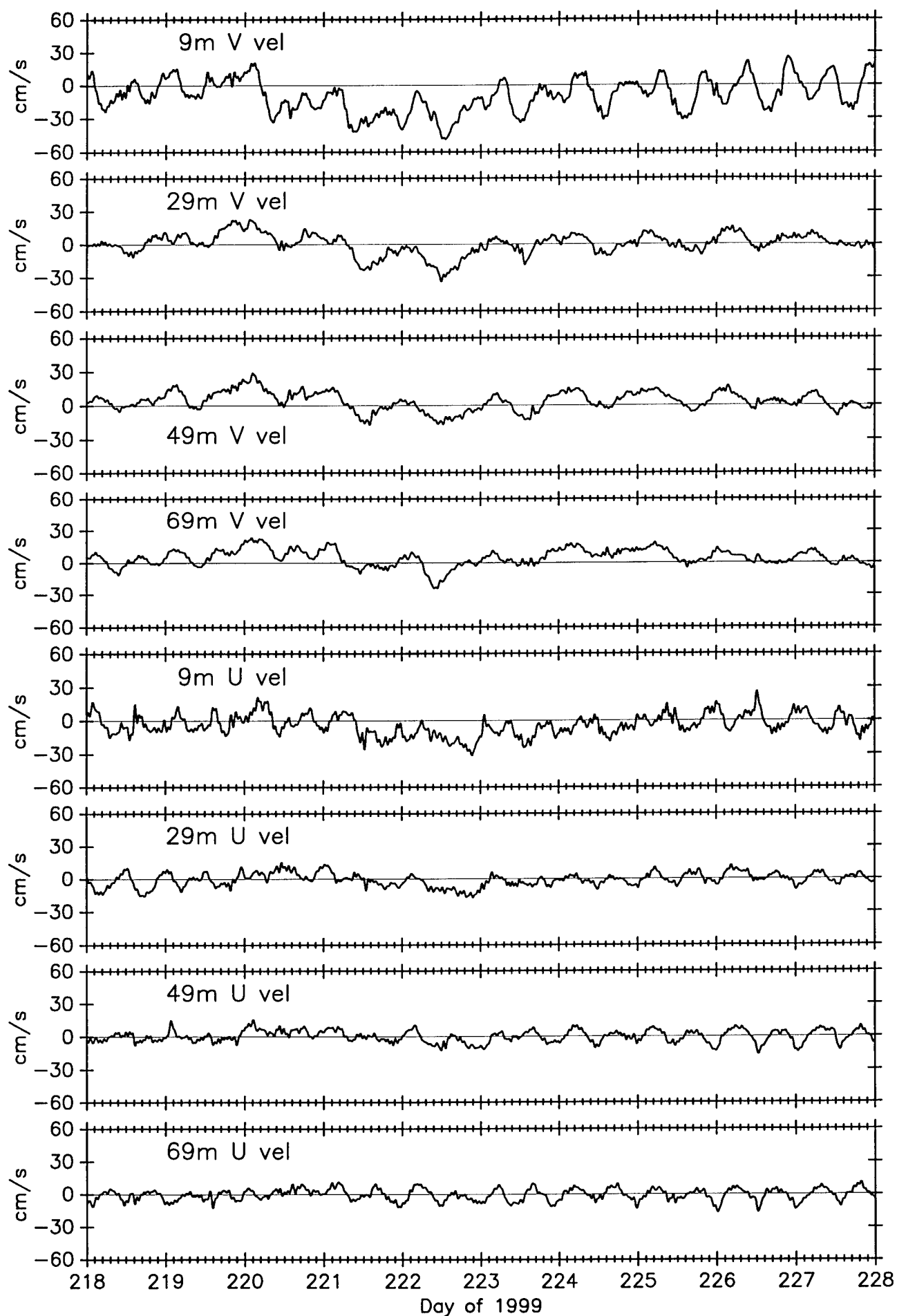
## NOPP Mid-Shelf Mooring 1 hour Lowpass Filtered Velocities



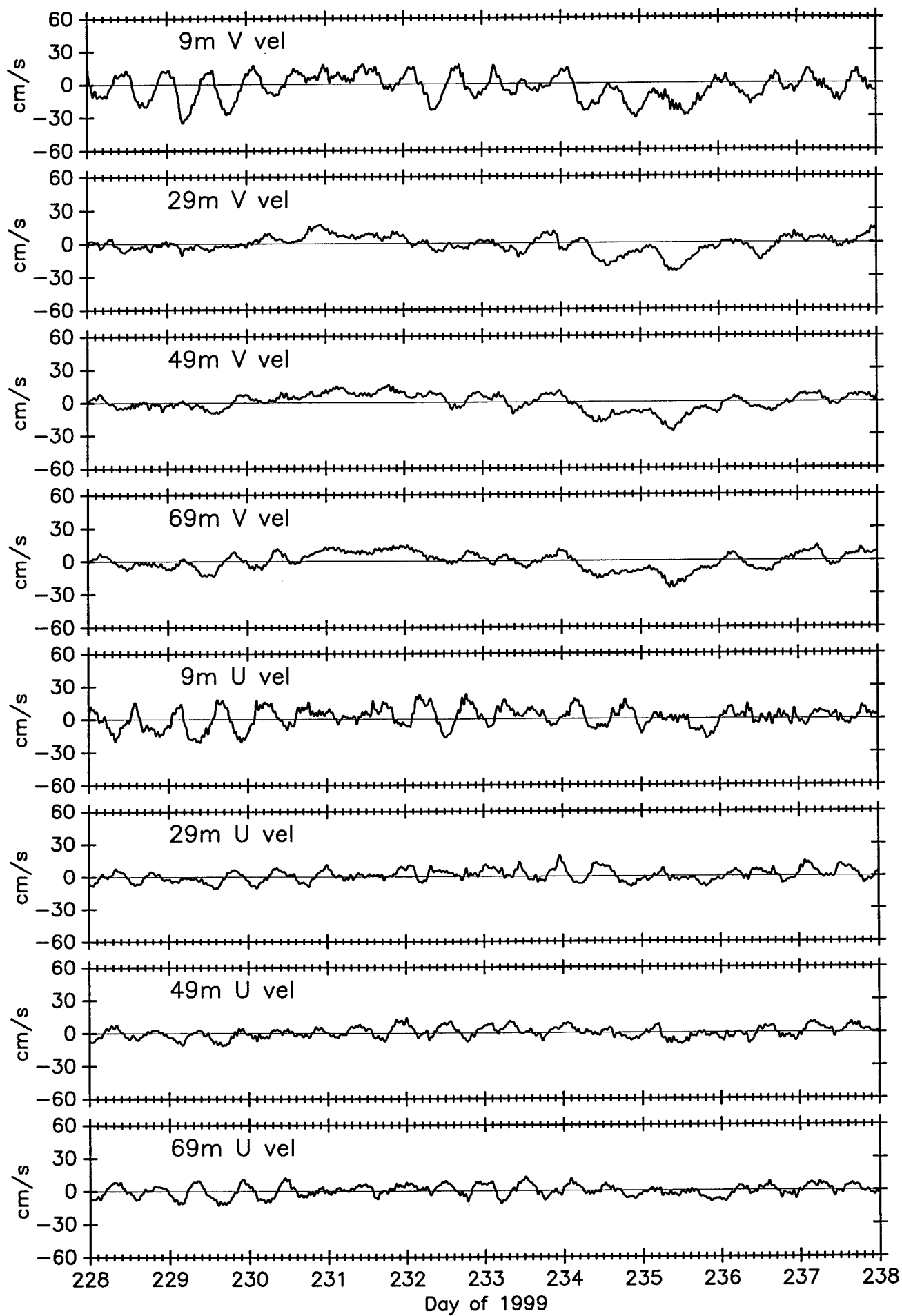
## NOPP Mid-Shelf Mooring 1 hour Lowpass Filtered Velocities



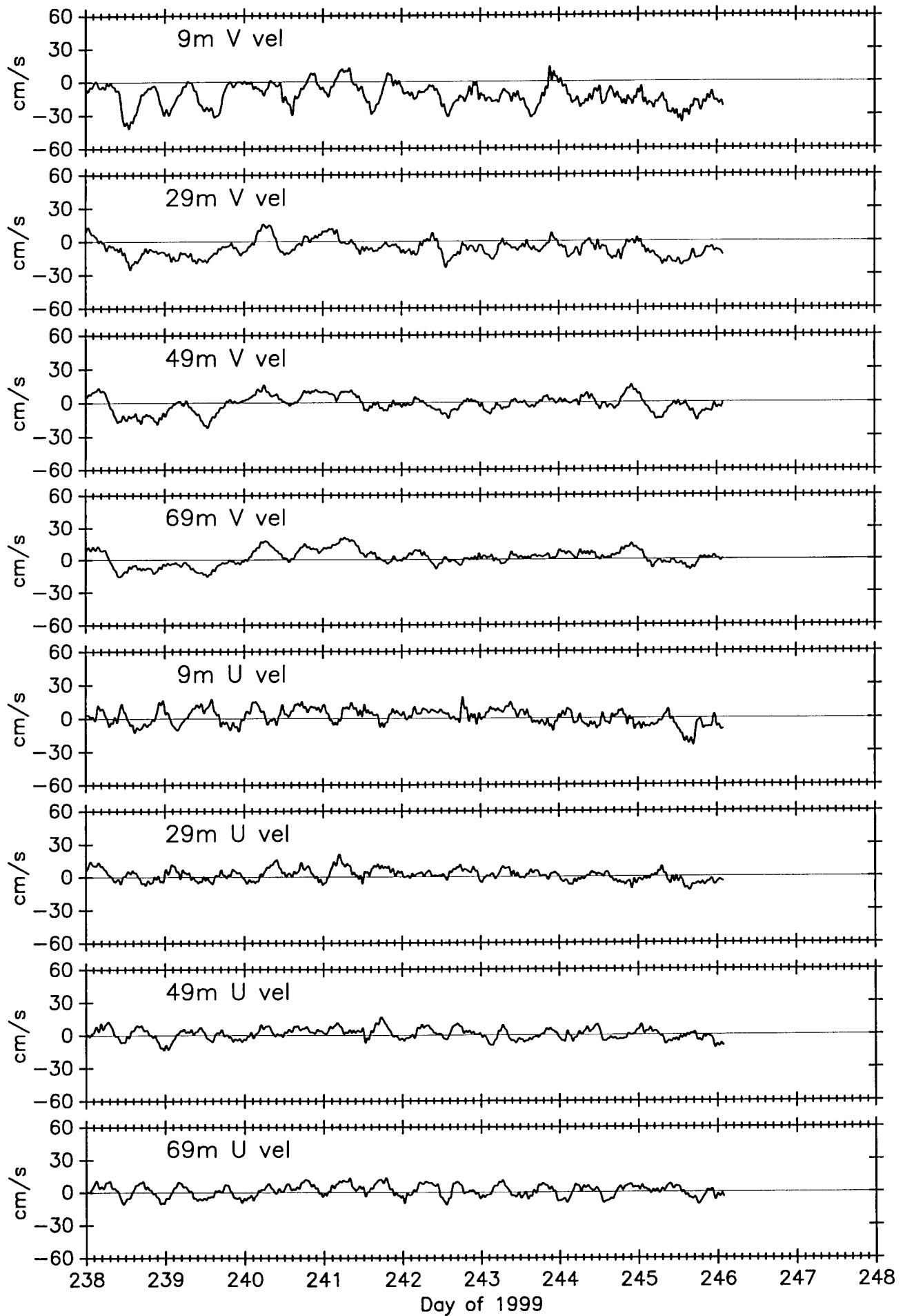
## NOPP Mid-Shelf Mooring 1 hour Lowpass Filtered Velocities



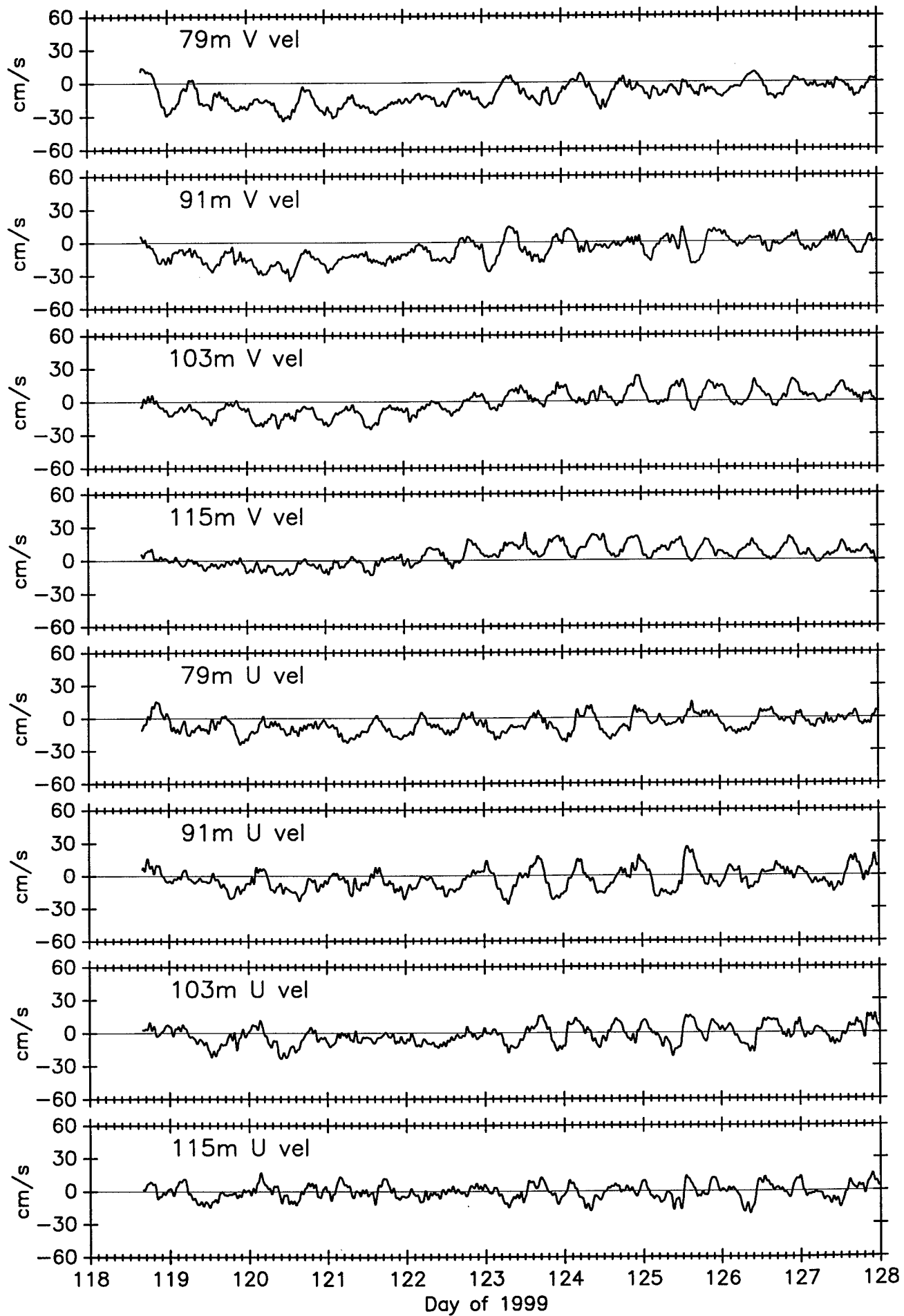
## NOPP Mid-Shelf Mooring 1 hour Lowpass Filtered Velocities



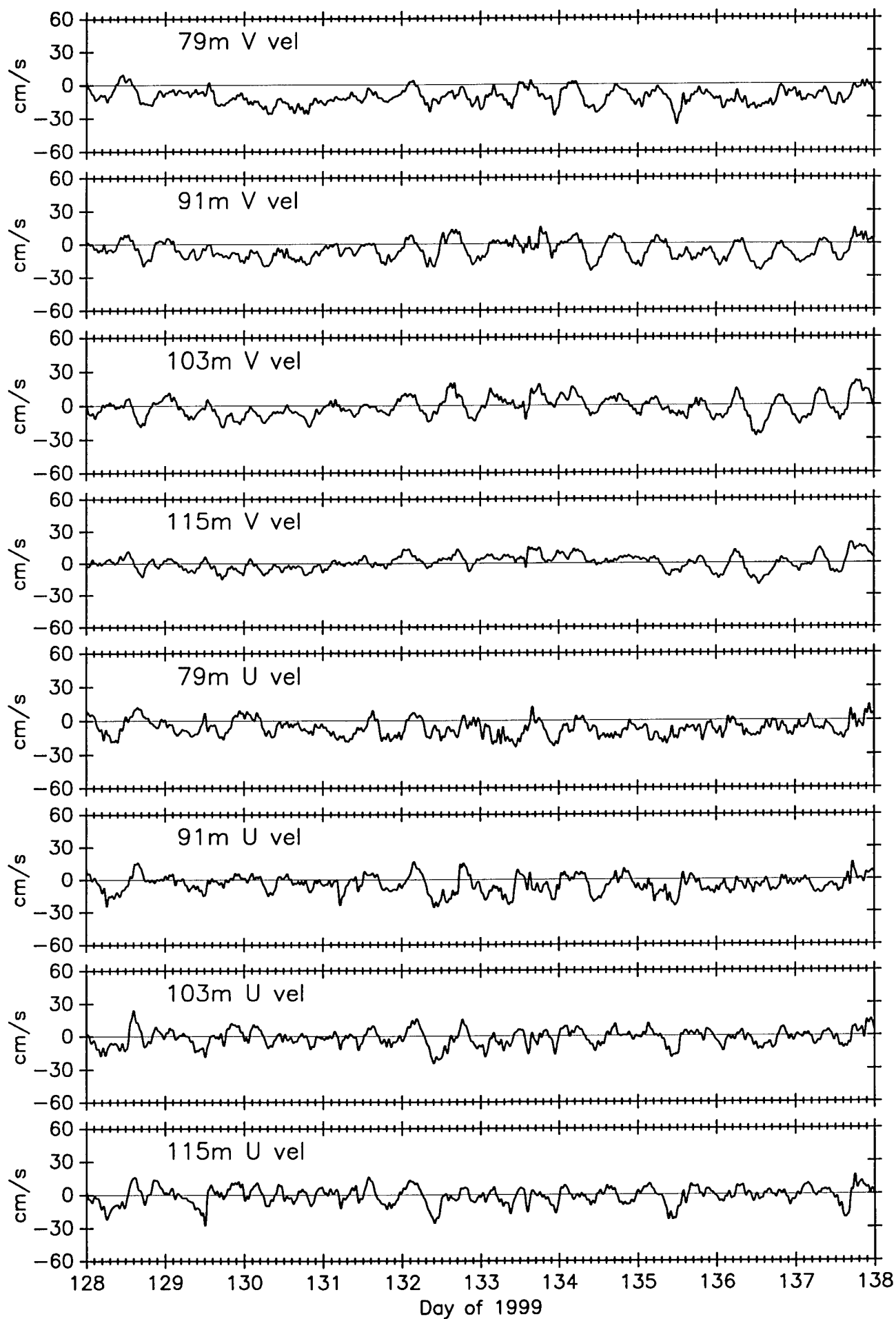
## NOPP Mid-Shelf Mooring 1 hour Lowpass Filtered Velocities



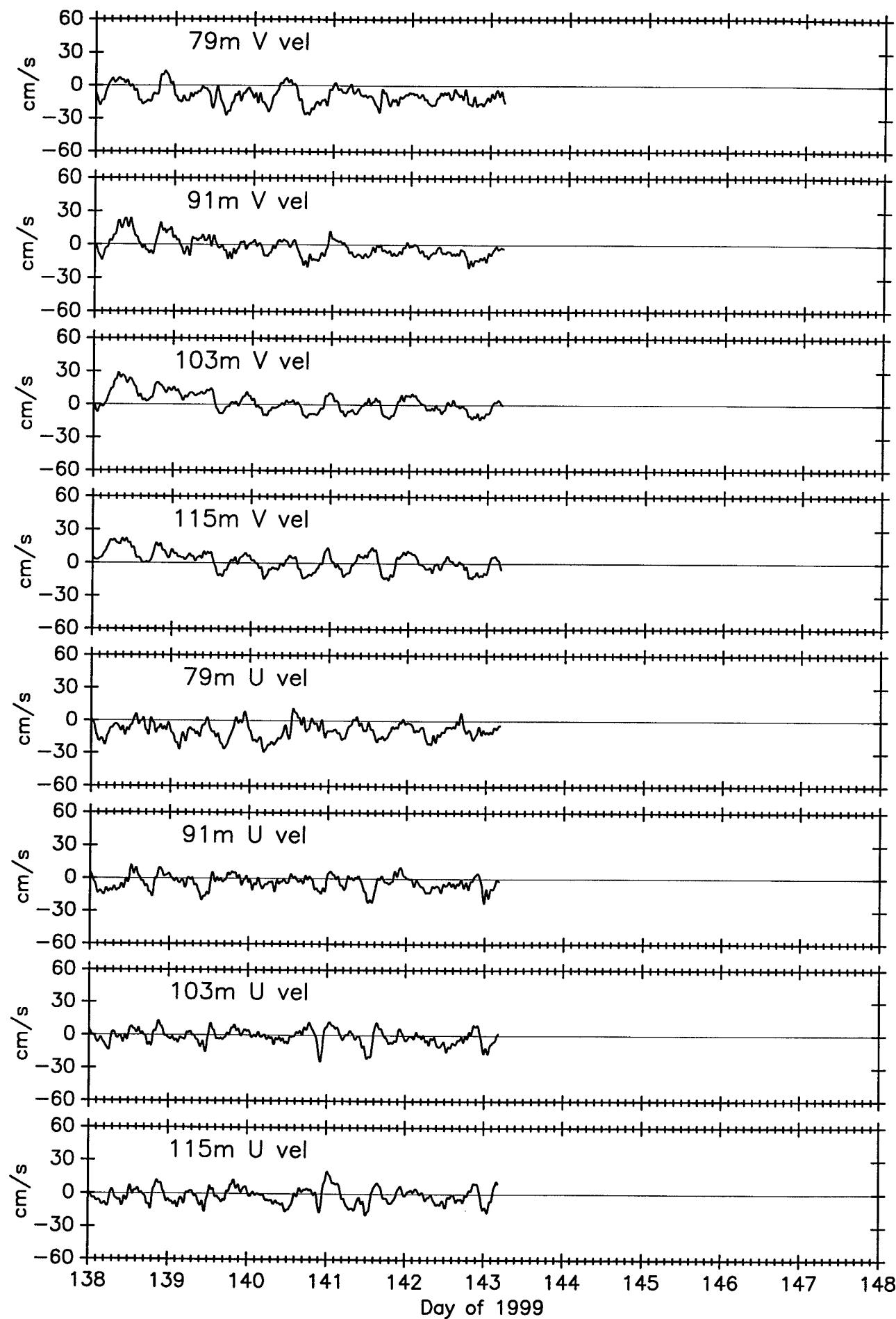
## NOPP Shelf-Break Mooring period A 1 hour Lowpass Filtered Velocities



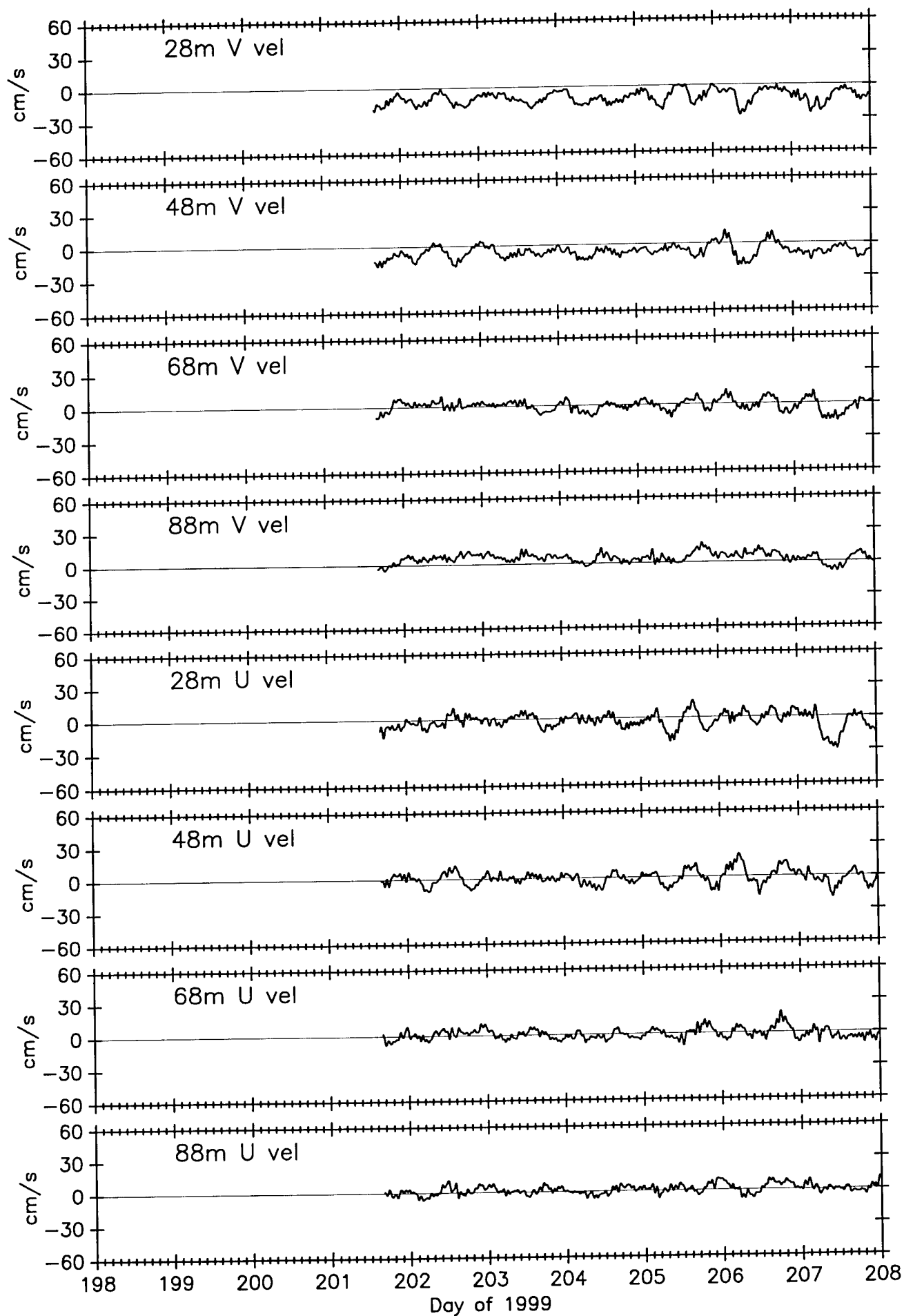
## NOPP Shelf-Break Mooring period A 1 hour Lowpass Filtered Velocities



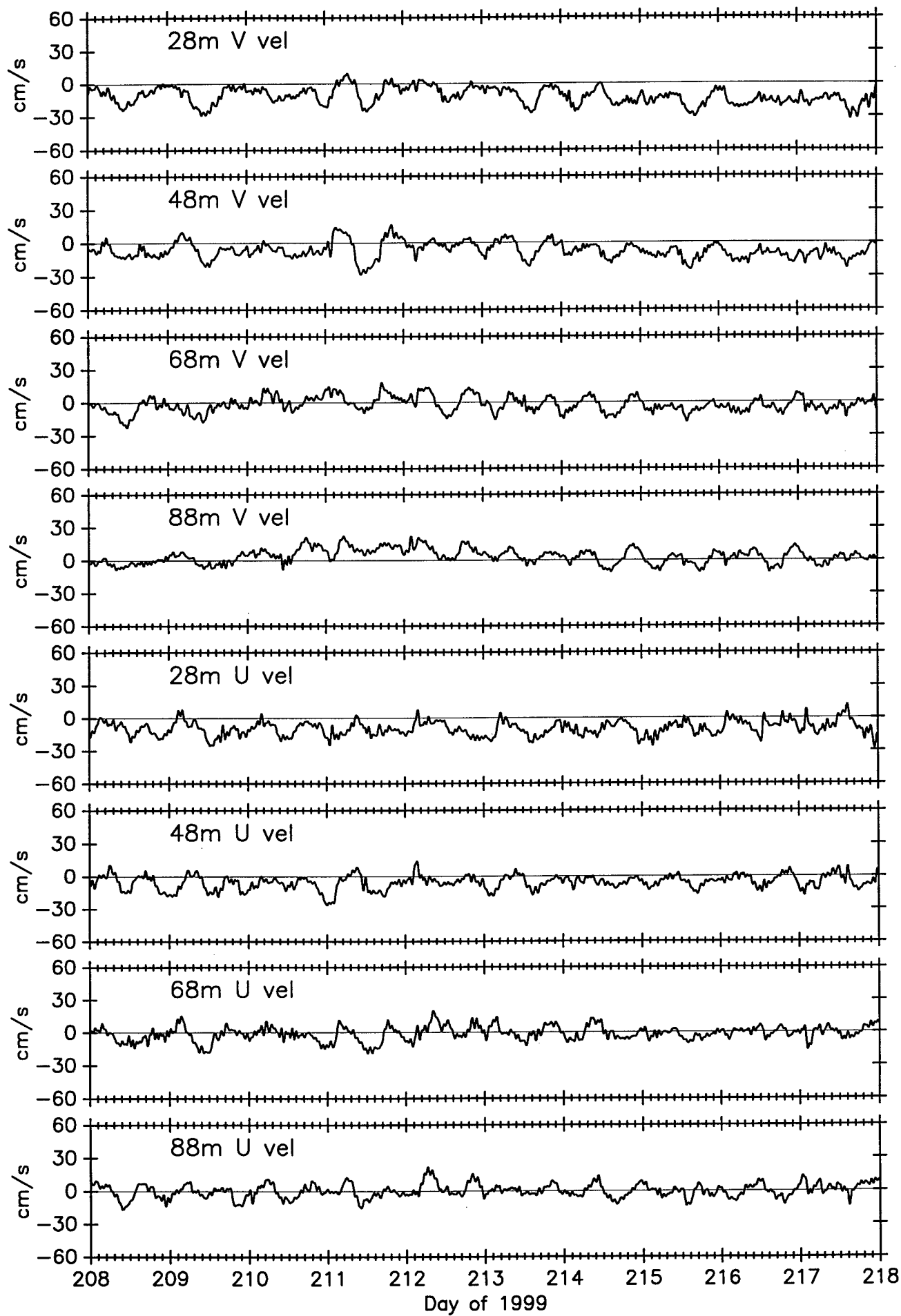
## NOPP Shelf-Break Mooring period A 1 hour Lowpass Filtered Velocities

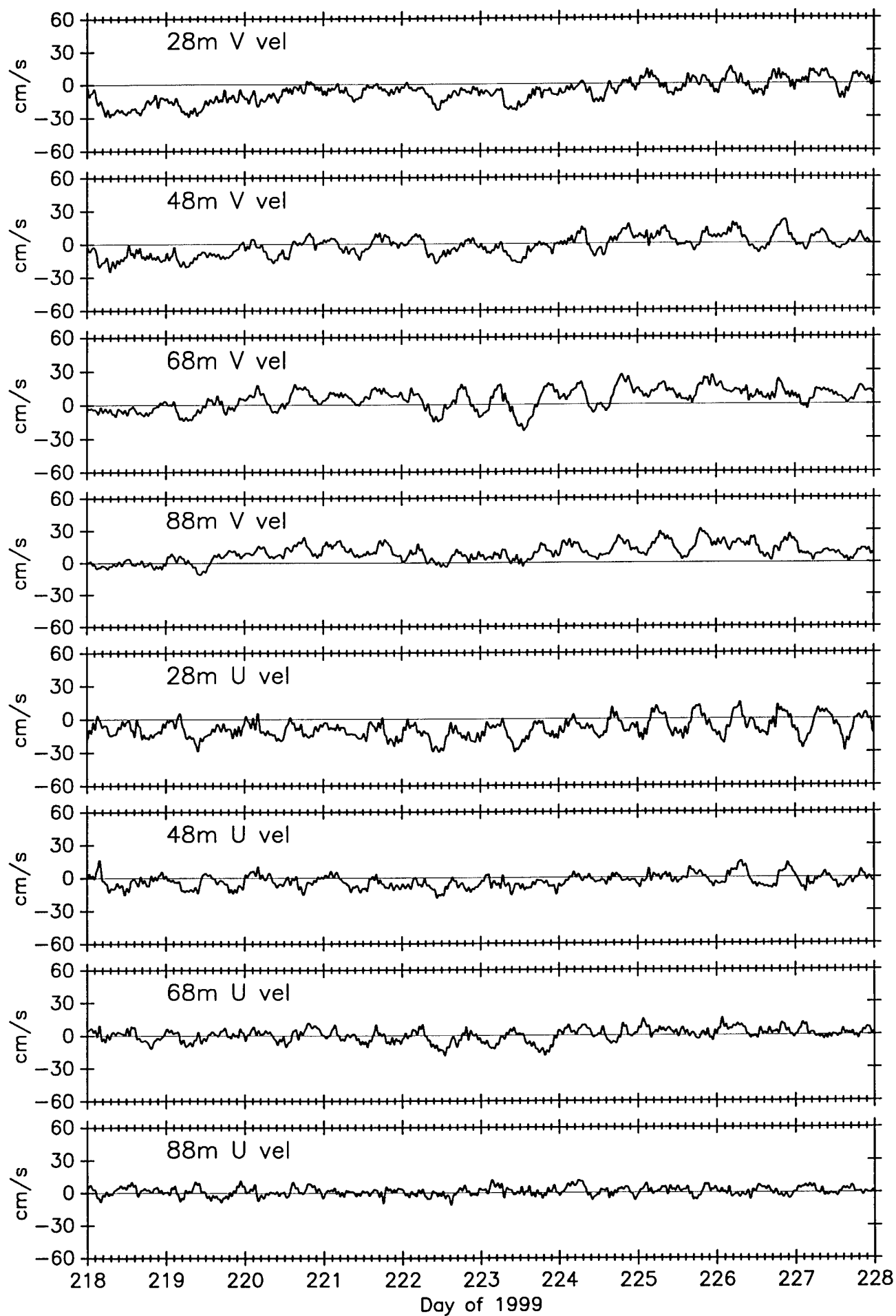


## NOPP Shelf-Break Mooring period D 1 hour Lowpass Filtered Velocities

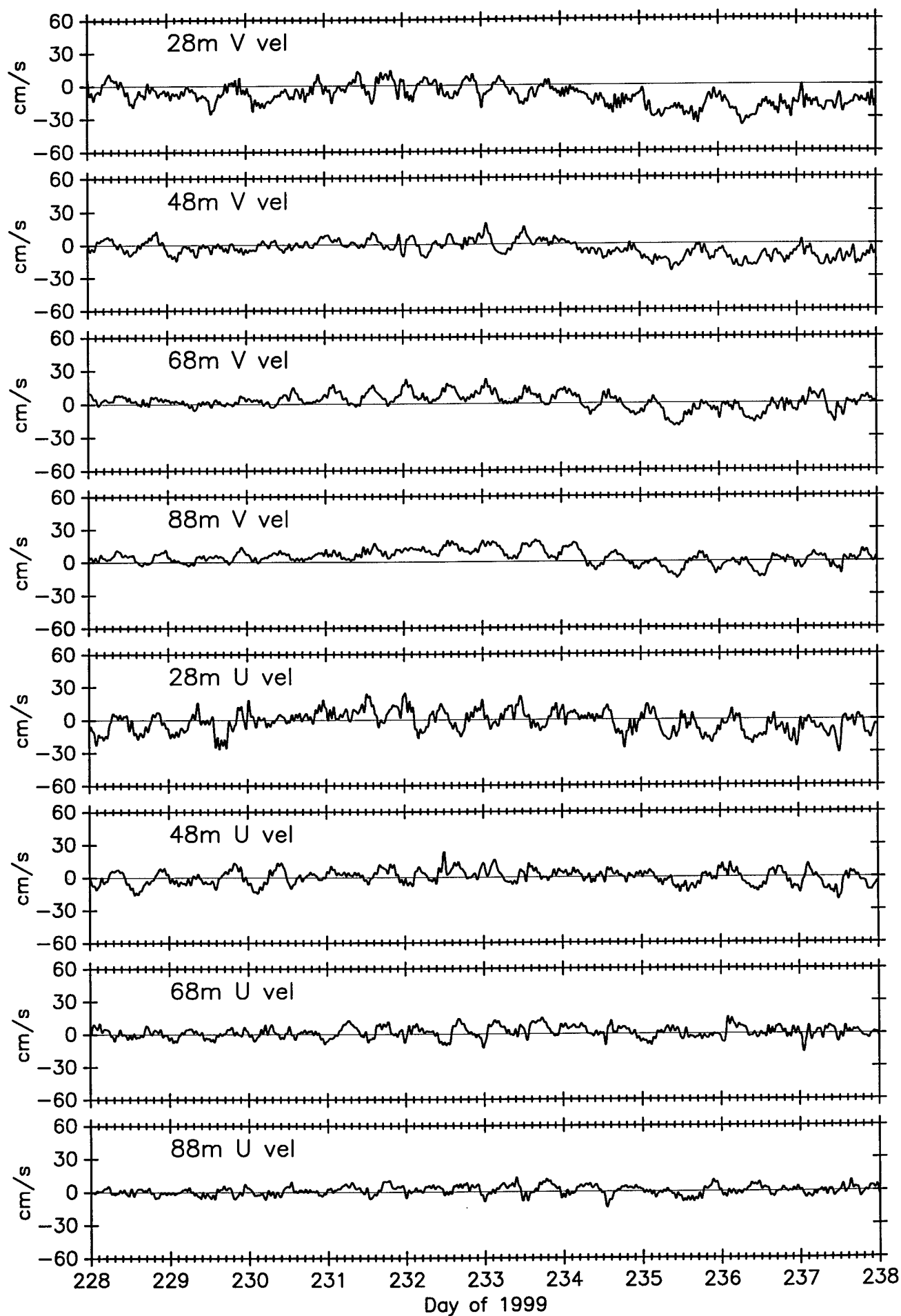


## NOPP Shelf-Break Mooring period D 1 hour Lowpass Filtered Velocities

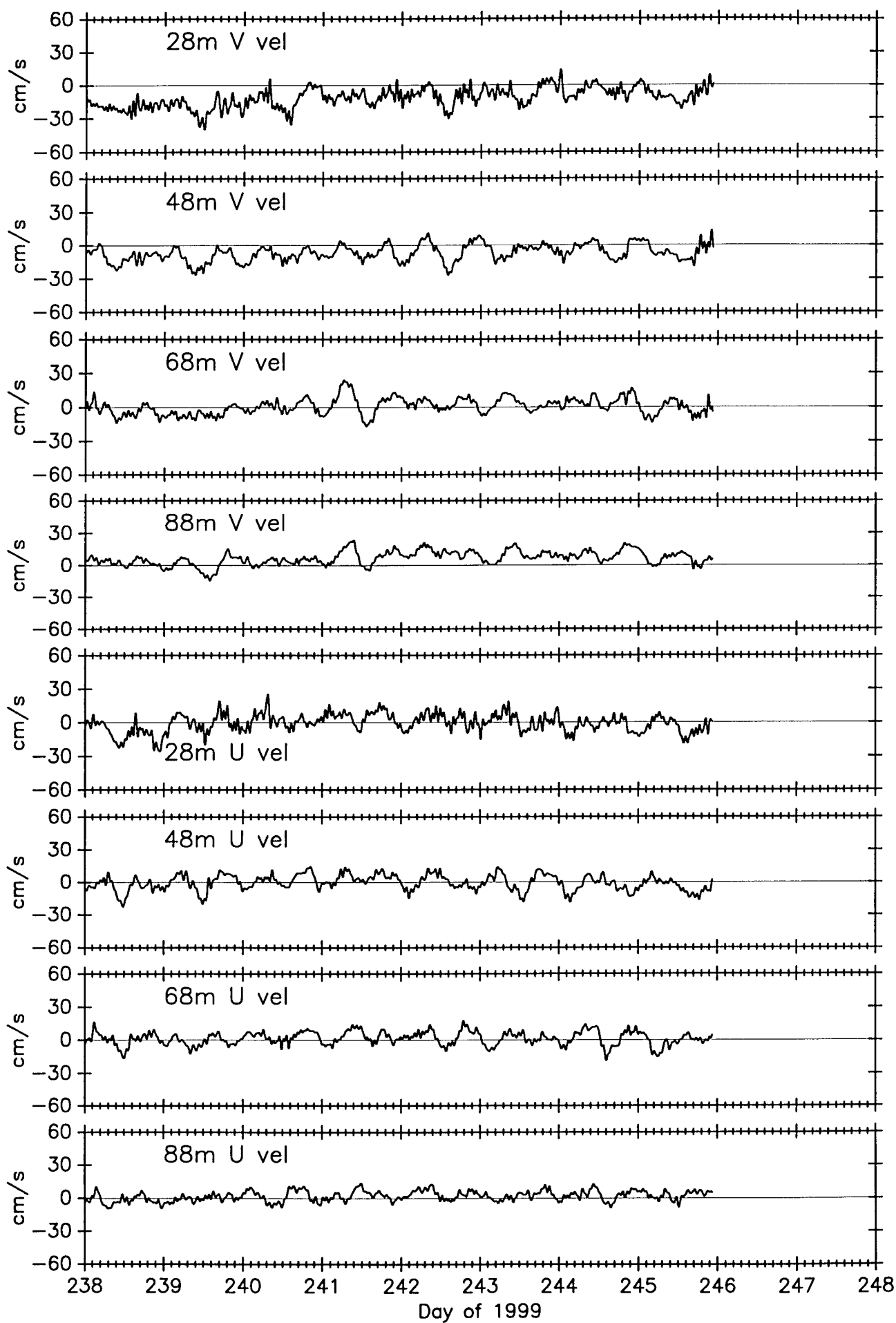




## NOPP Shelf-Break Mooring period D 1 hour Lowpass Filtered Velocities



## NOPP Shelf-Break Mooring period D 1 hour Lowpass Filtered Velocities



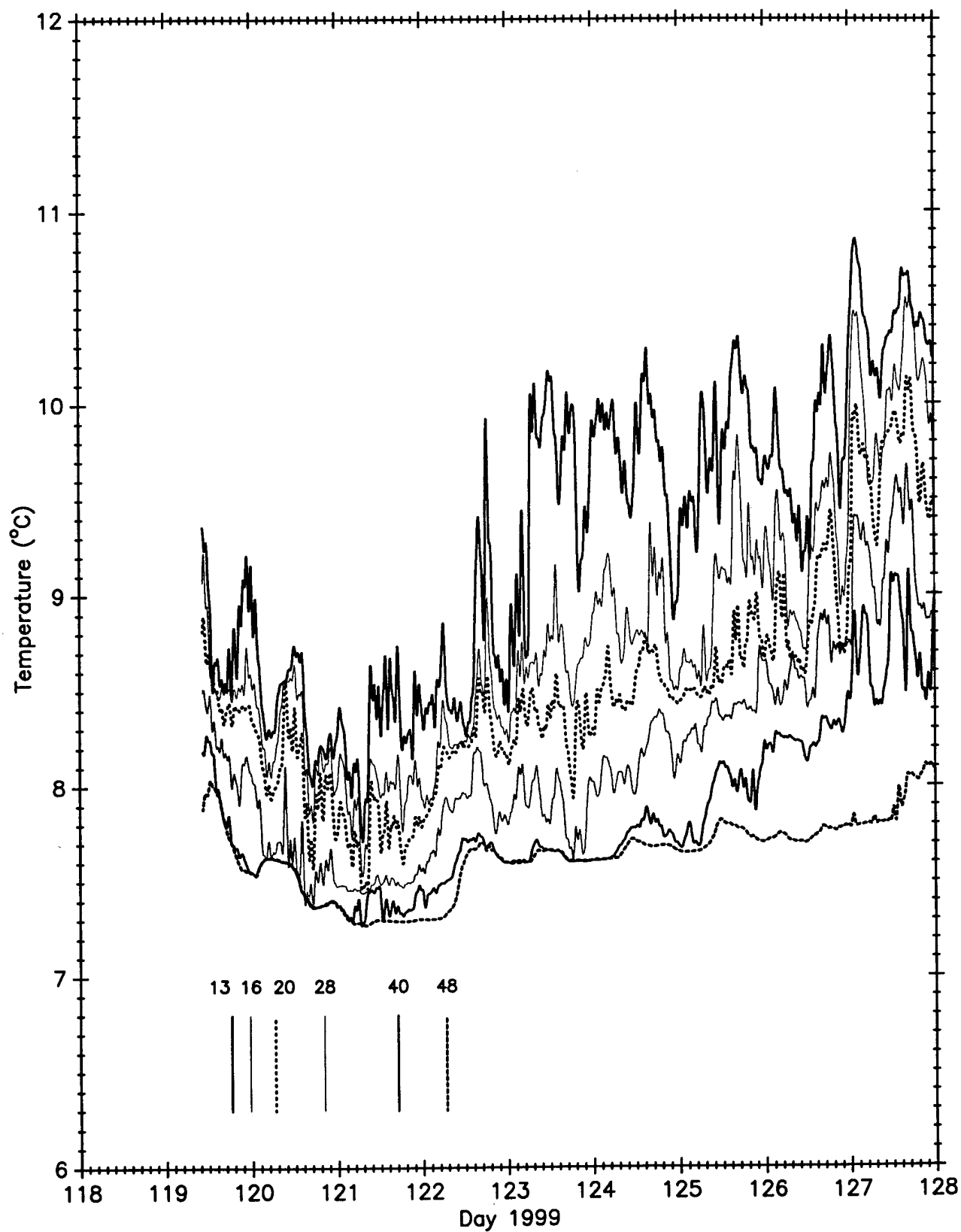
## **TEMPERATURE Time Series**

### **1-hour Low-Pass Filtered**

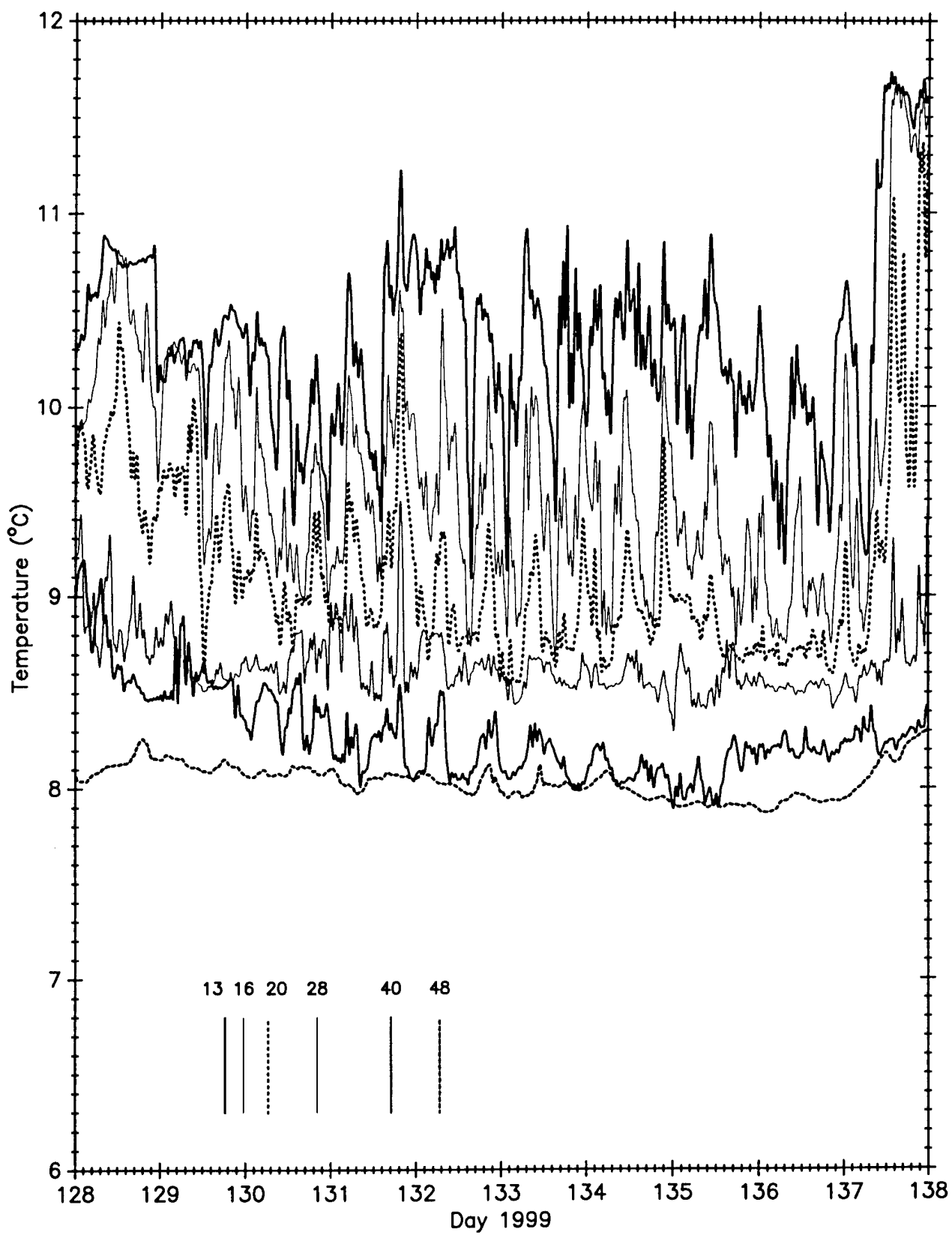
Plots of water temperature from the Inshore, Mid-Shelf, Met, and Shelf-Break moorings. Note that both the temperature scale and range are different for the Met mooring than the Inshore, Mid-Shelf, and Shelf-Break moorings. Temperature is shown for every depth except 2m on the Inshore and Shelf-Break moorings.



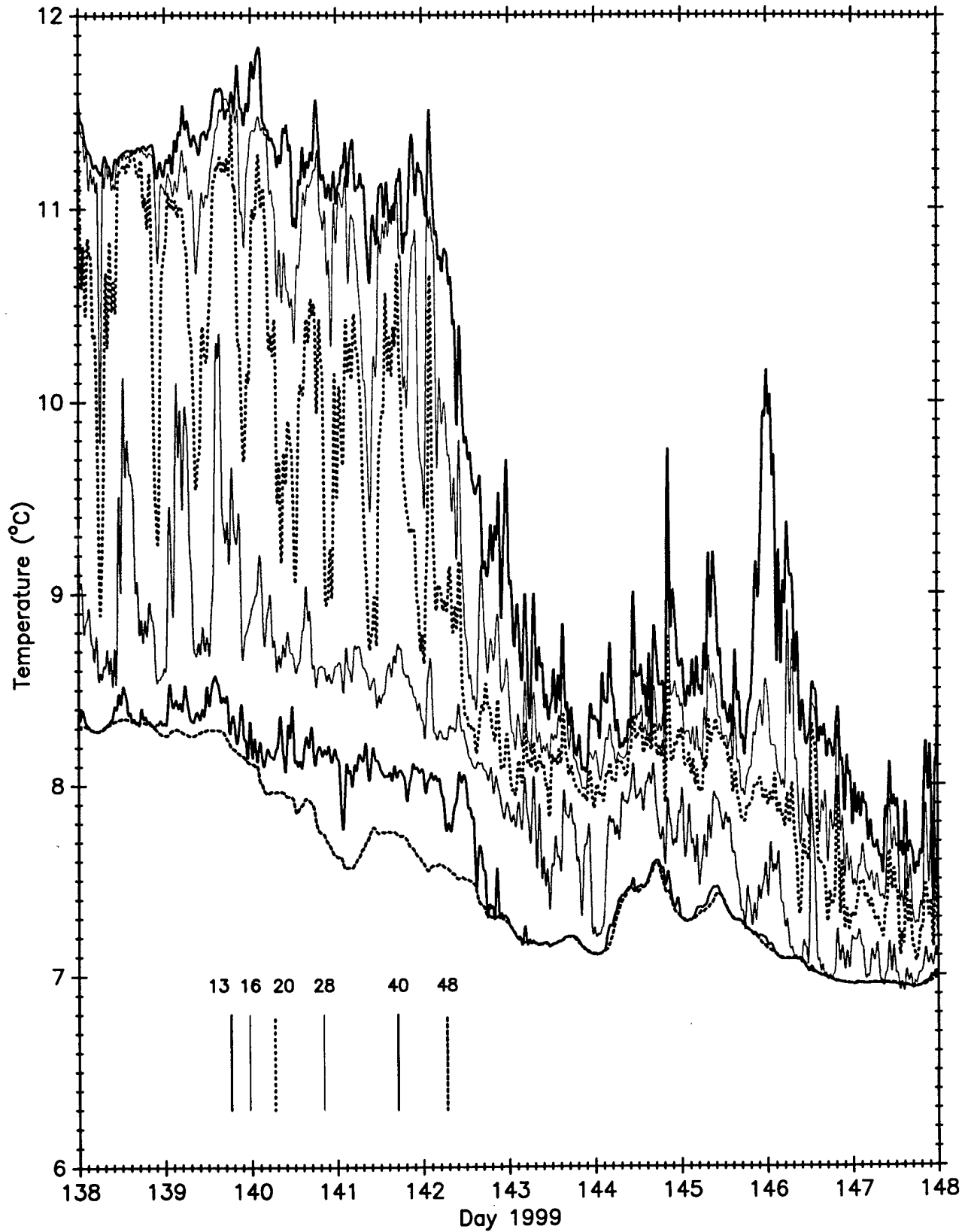
## NOPP Inshore 1 Hour Filtered Temperatures



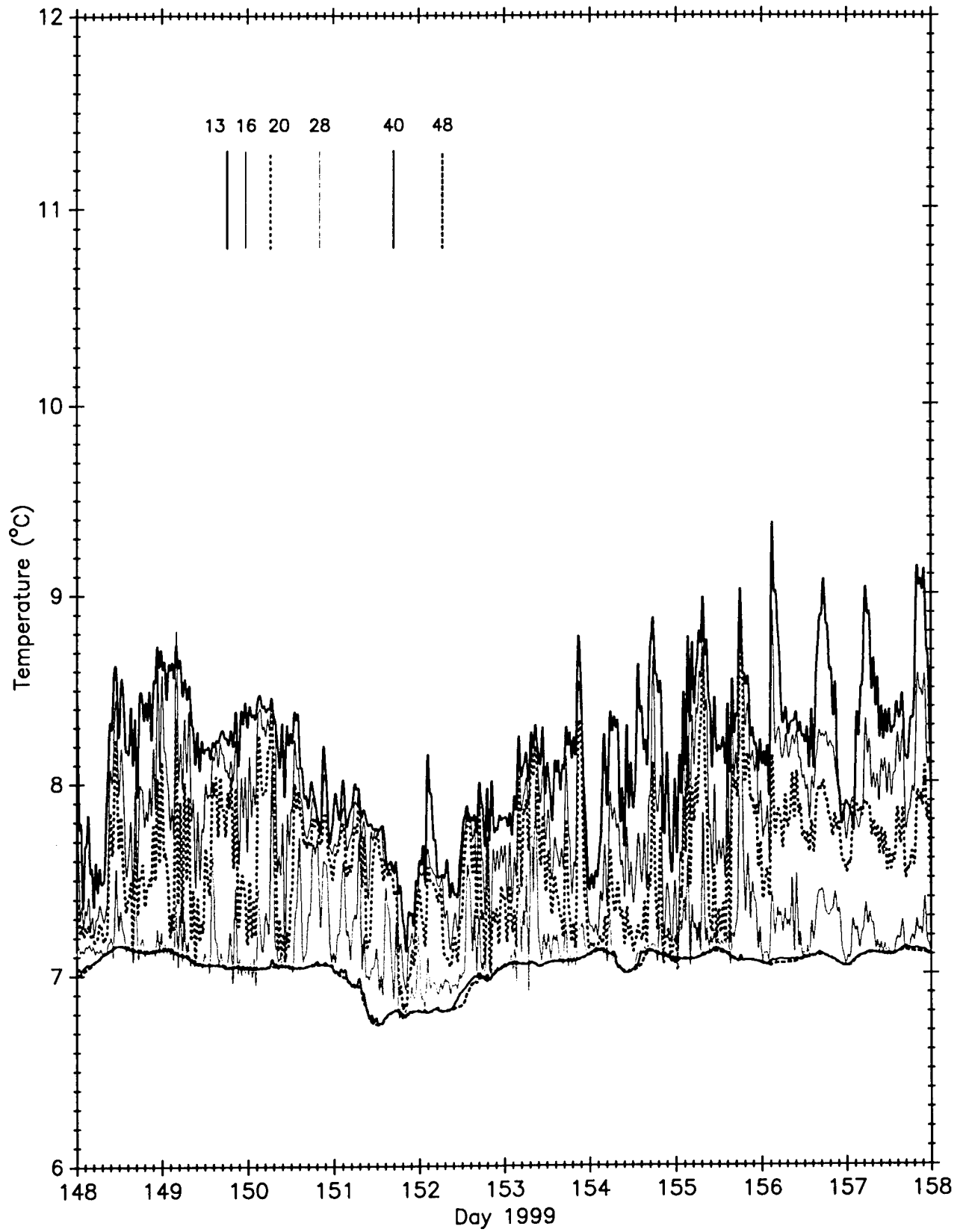
## NOPP Inshore 1 Hour Filtered Temperatures



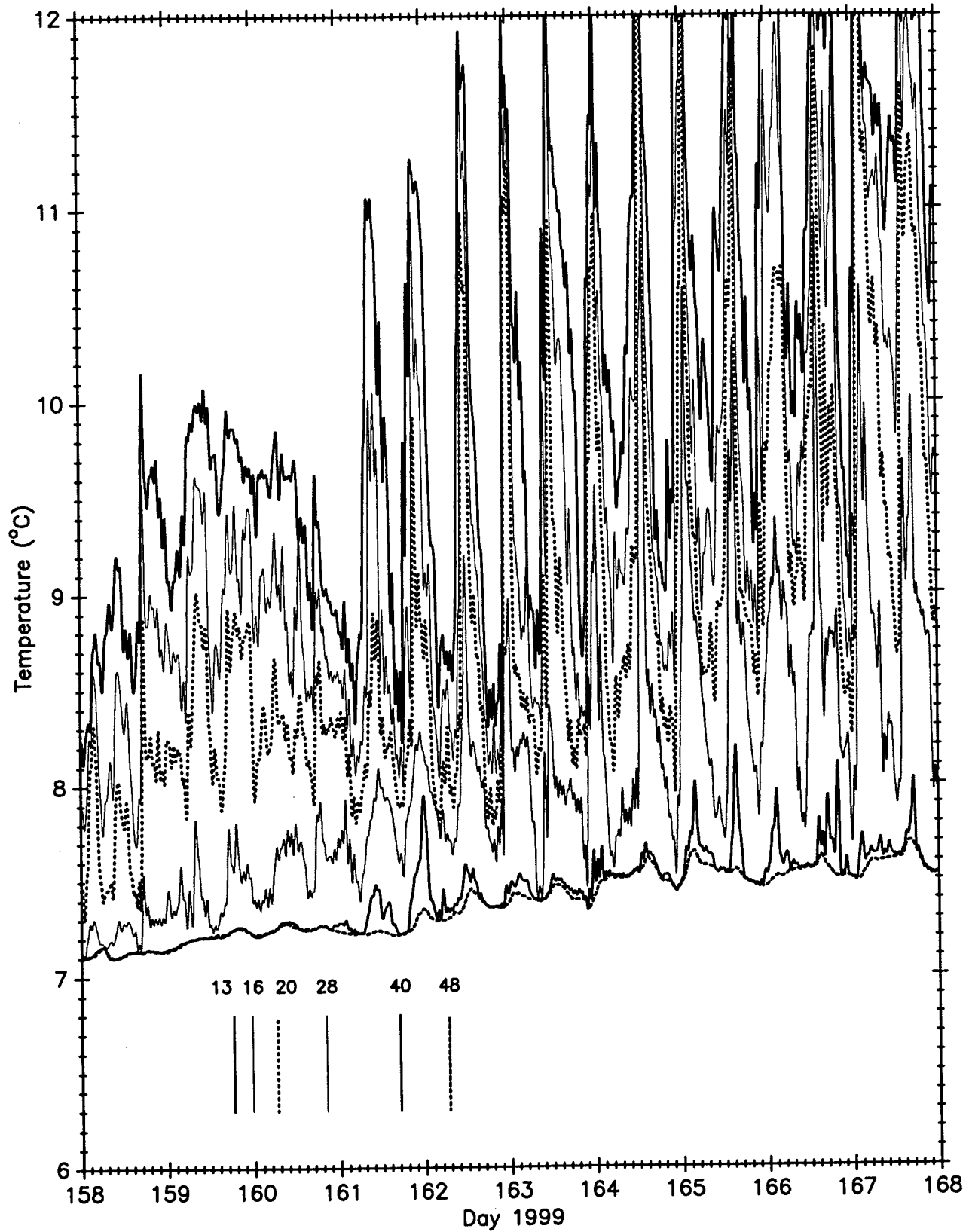
## NOPP Inshore 1 Hour Filtered Temperatures



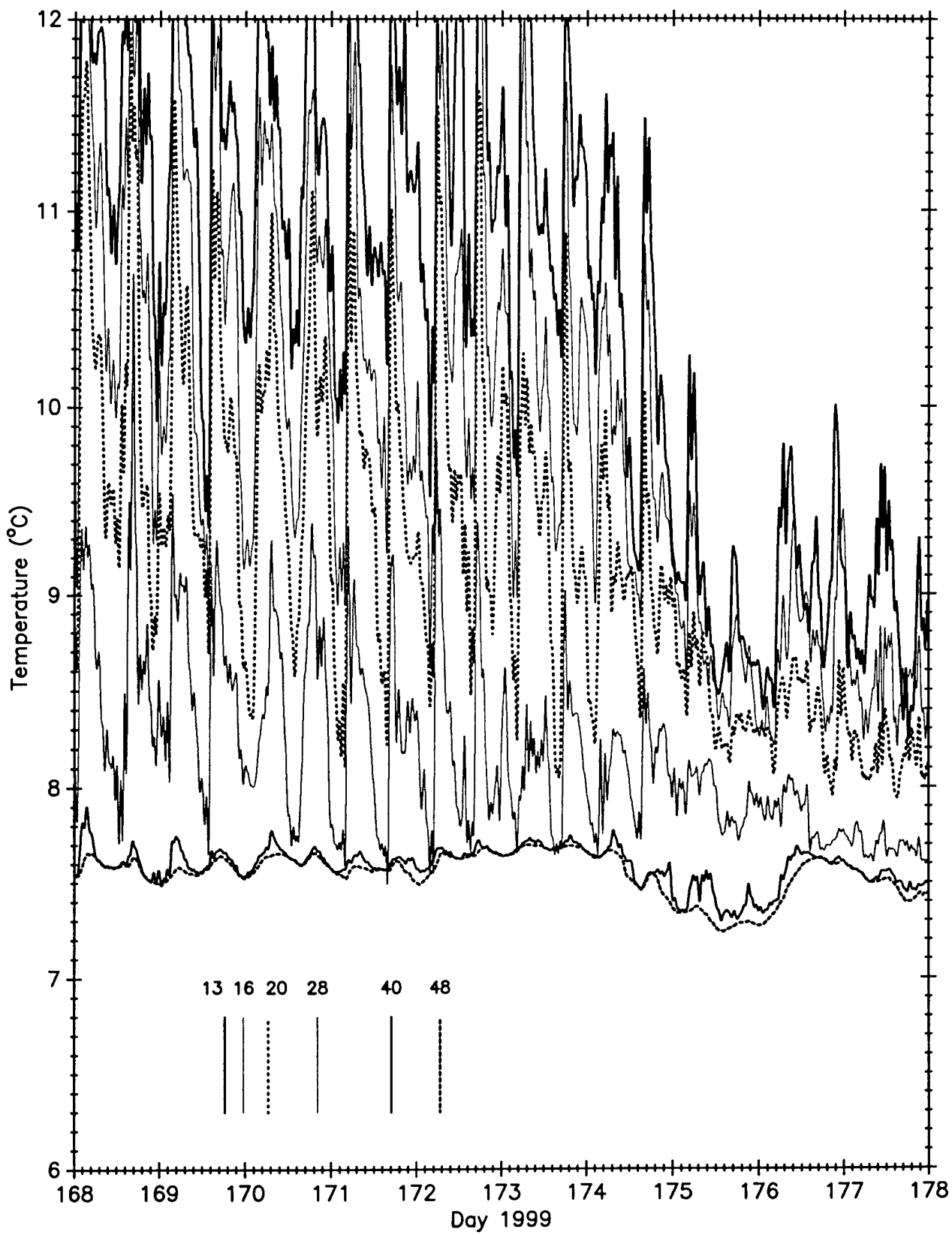
## NOPP Inshore 1 Hour Filtered Temperatures



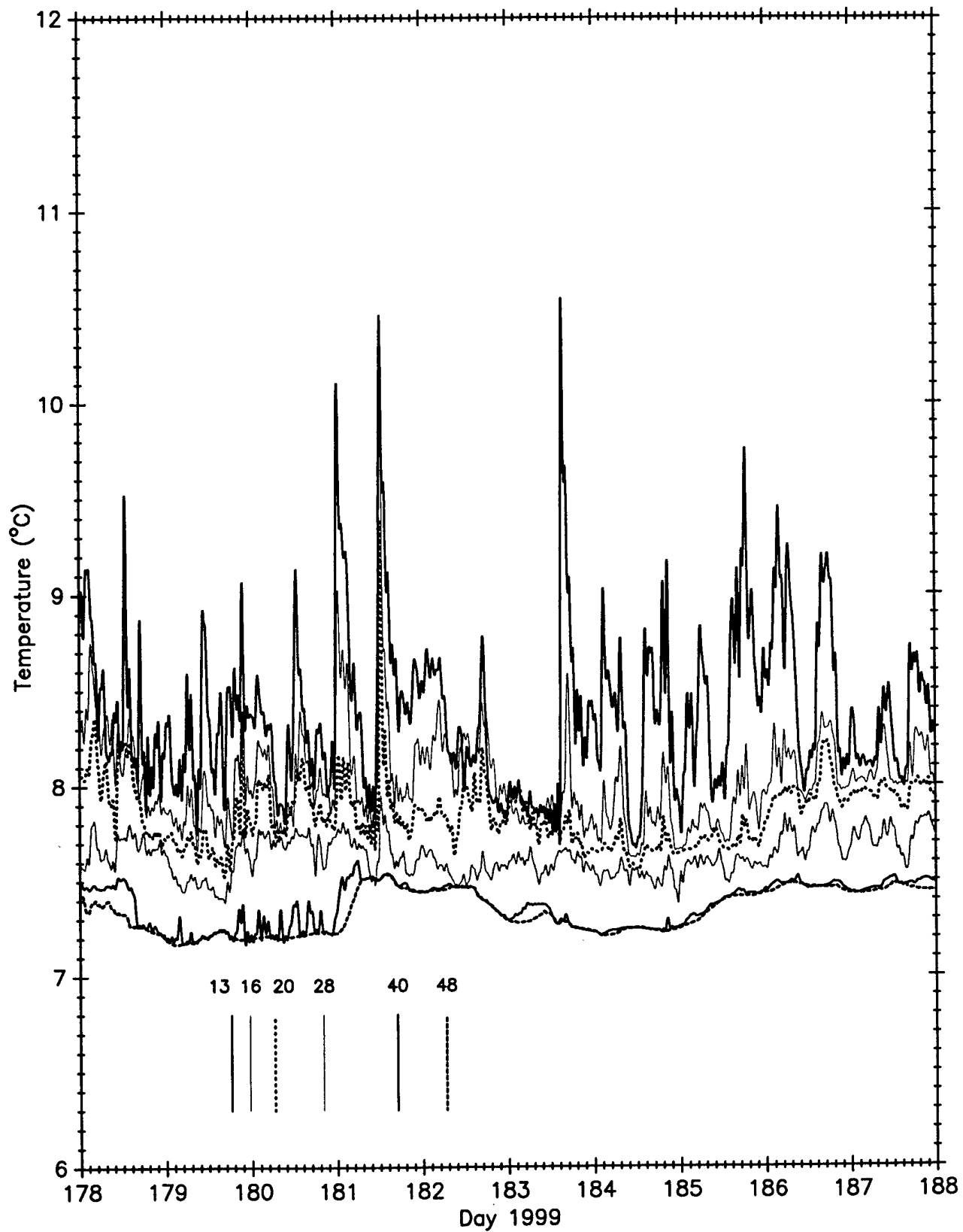
## NOPP Inshore 1 Hour Filtered Temperatures



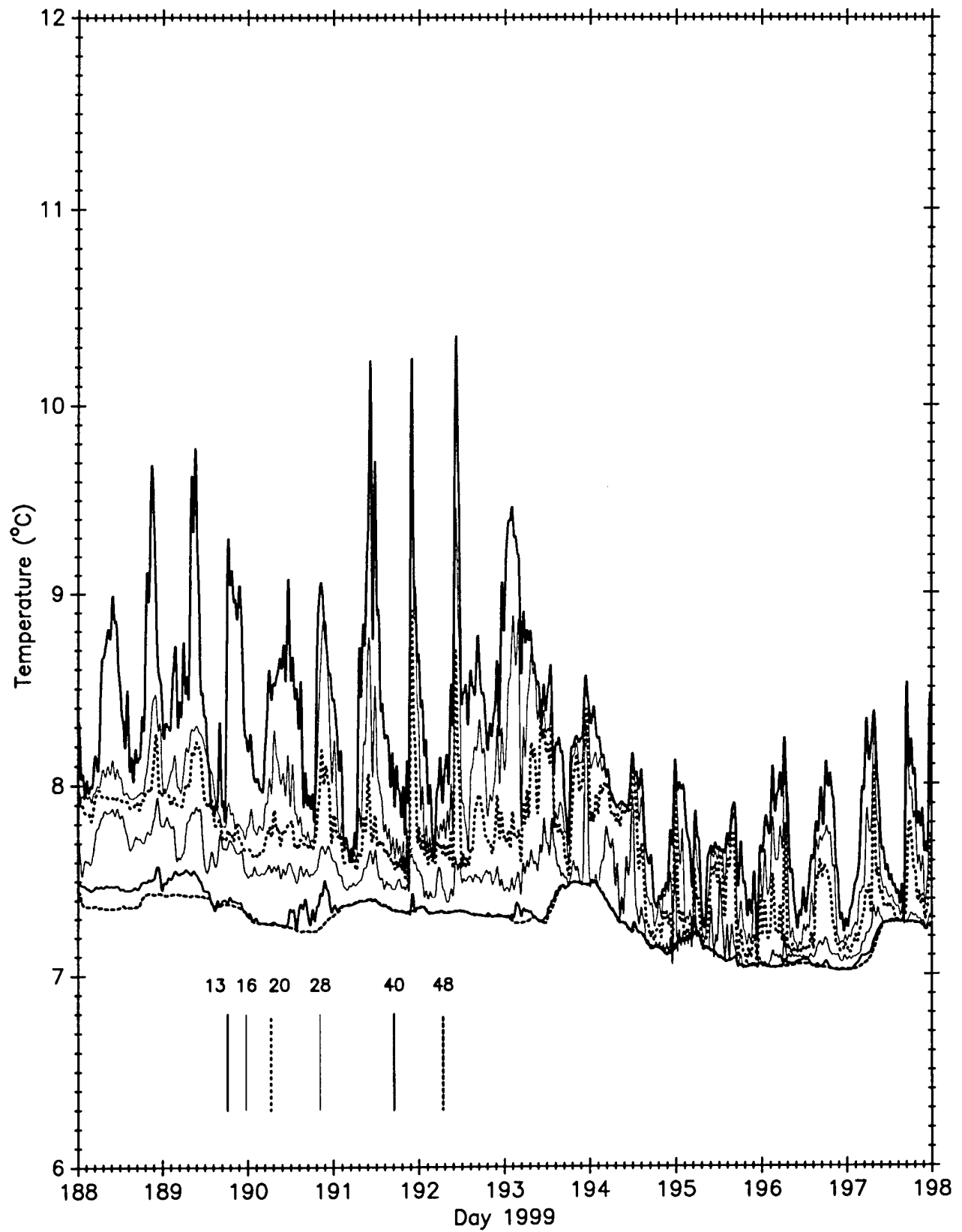
## NOPP Inshore 1 Hour Filtered Temperatures



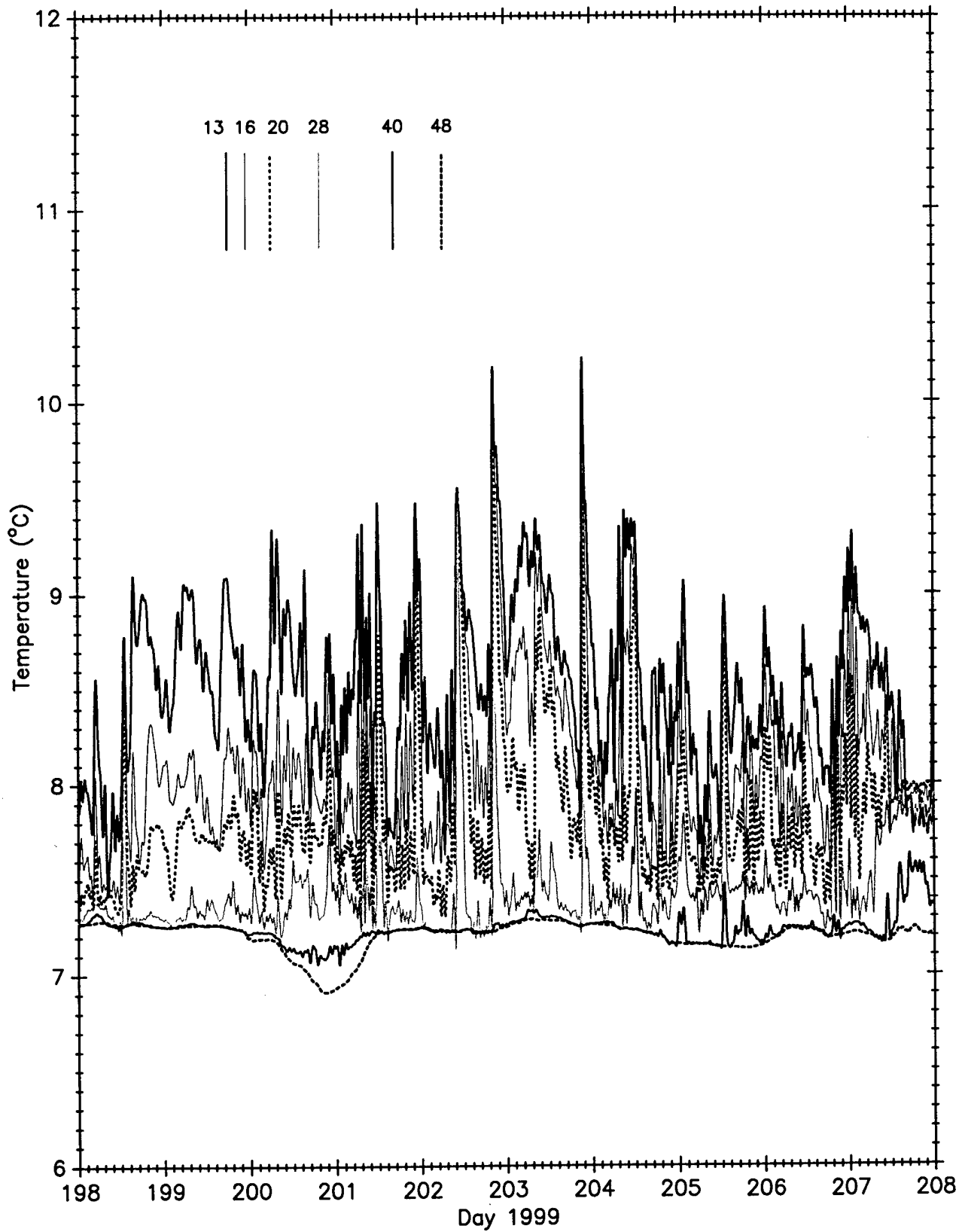
## NOPP Inshore 1 Hour Filtered Temperatures



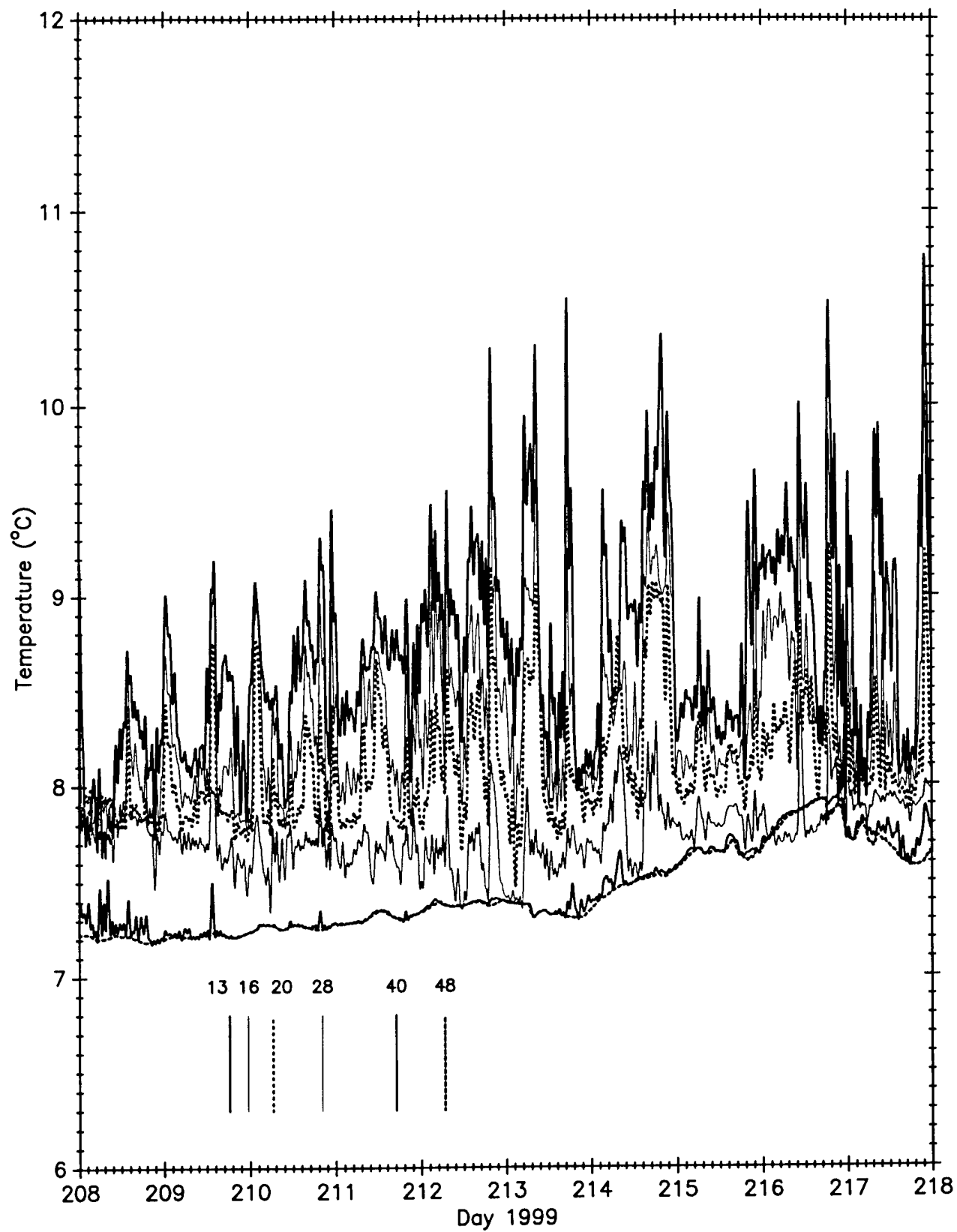
# NOPP Inshore 1 Hour Filtered Temperatures



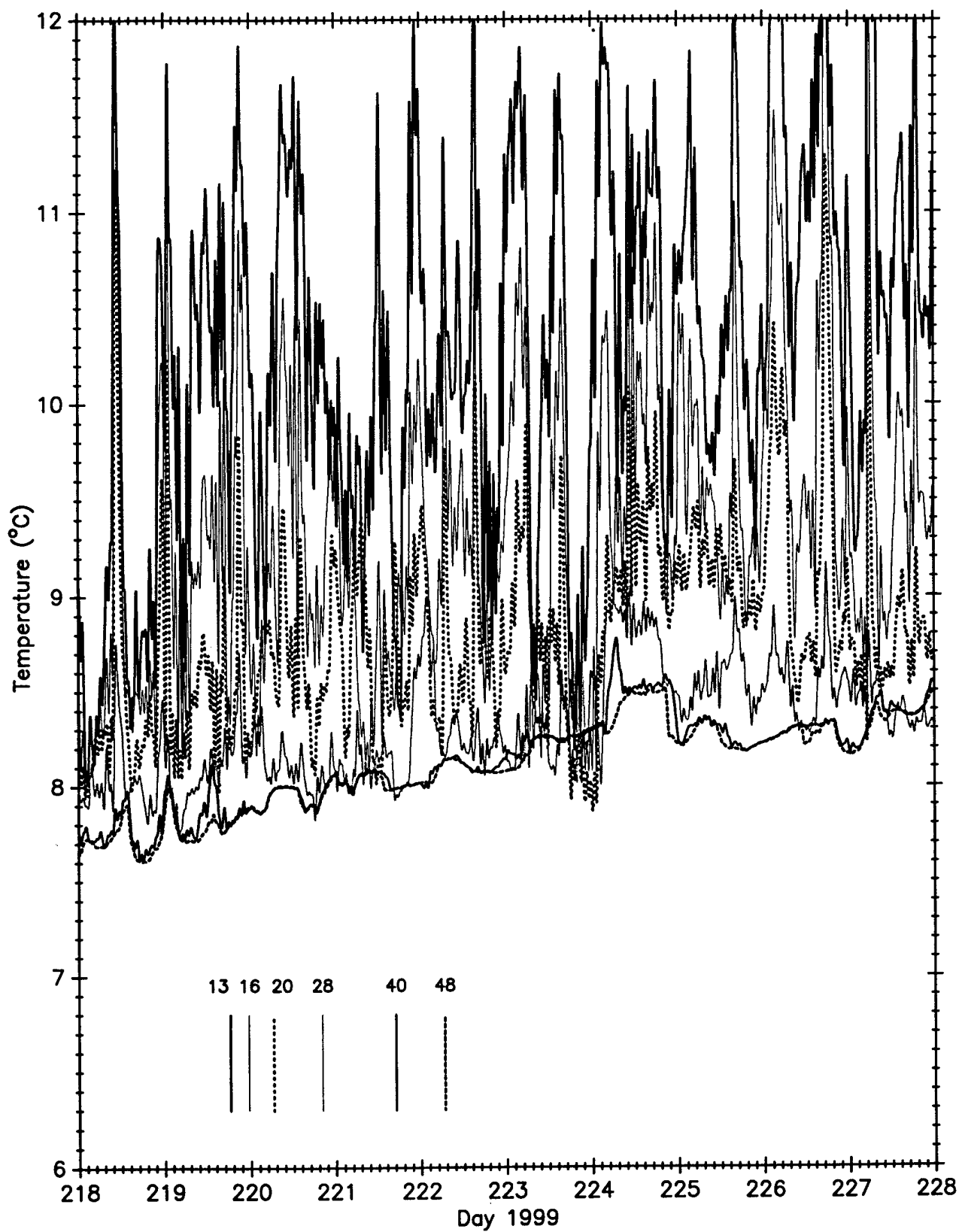
## NOPP Inshore 1 Hour Filtered Temperatures



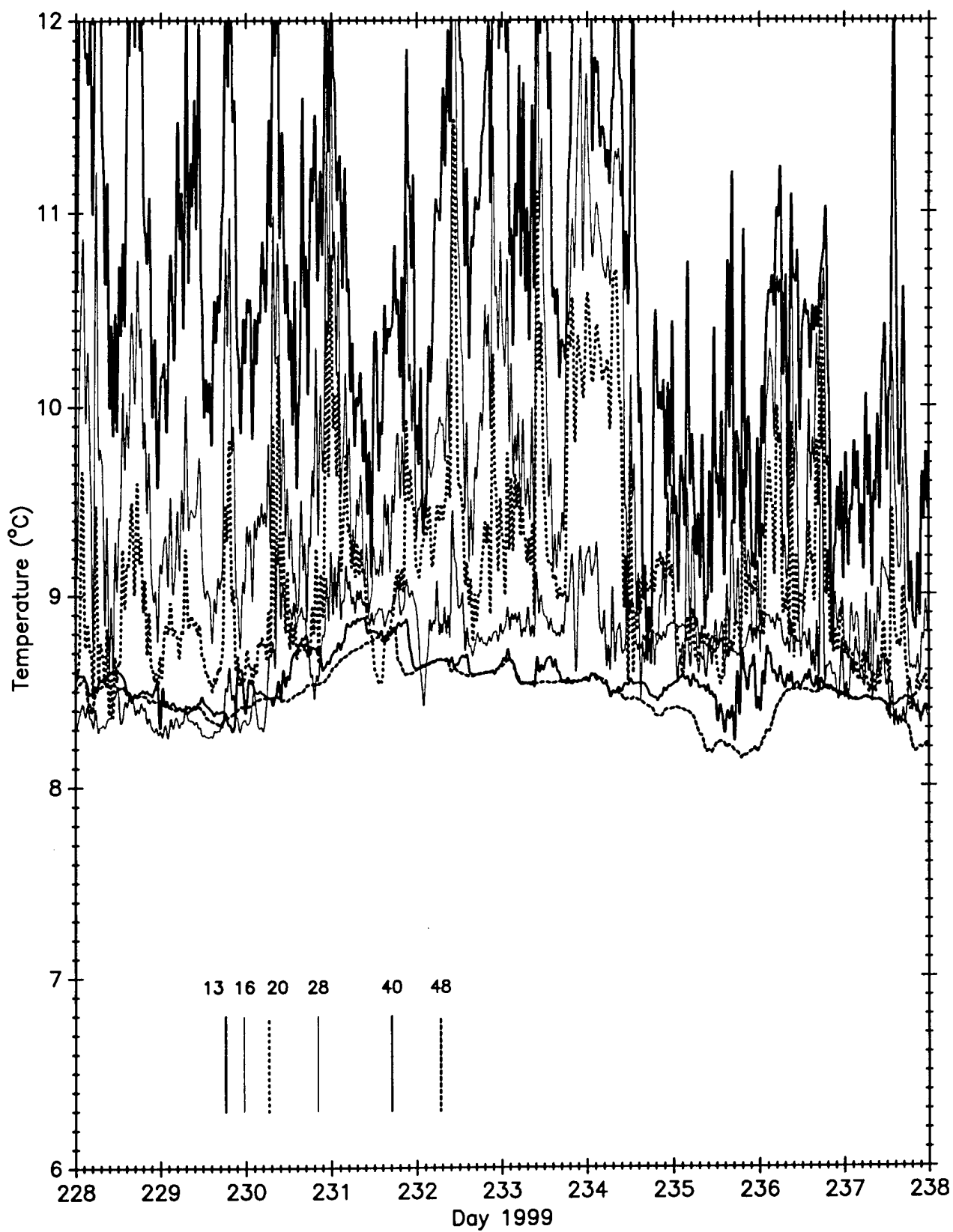
## NOPP Inshore 1 Hour Filtered Temperatures



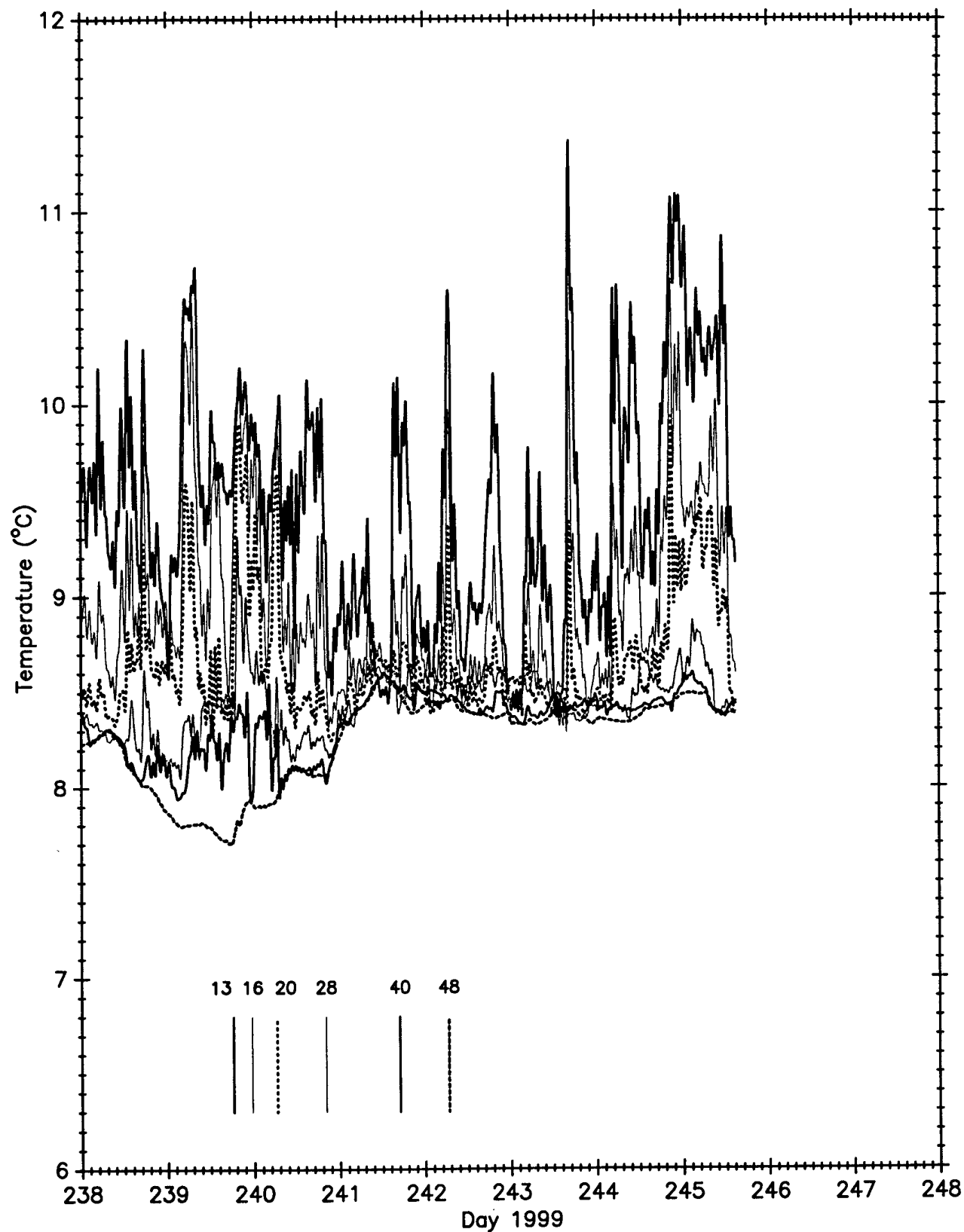
## NOPP Inshore 1 Hour Filtered Temperatures



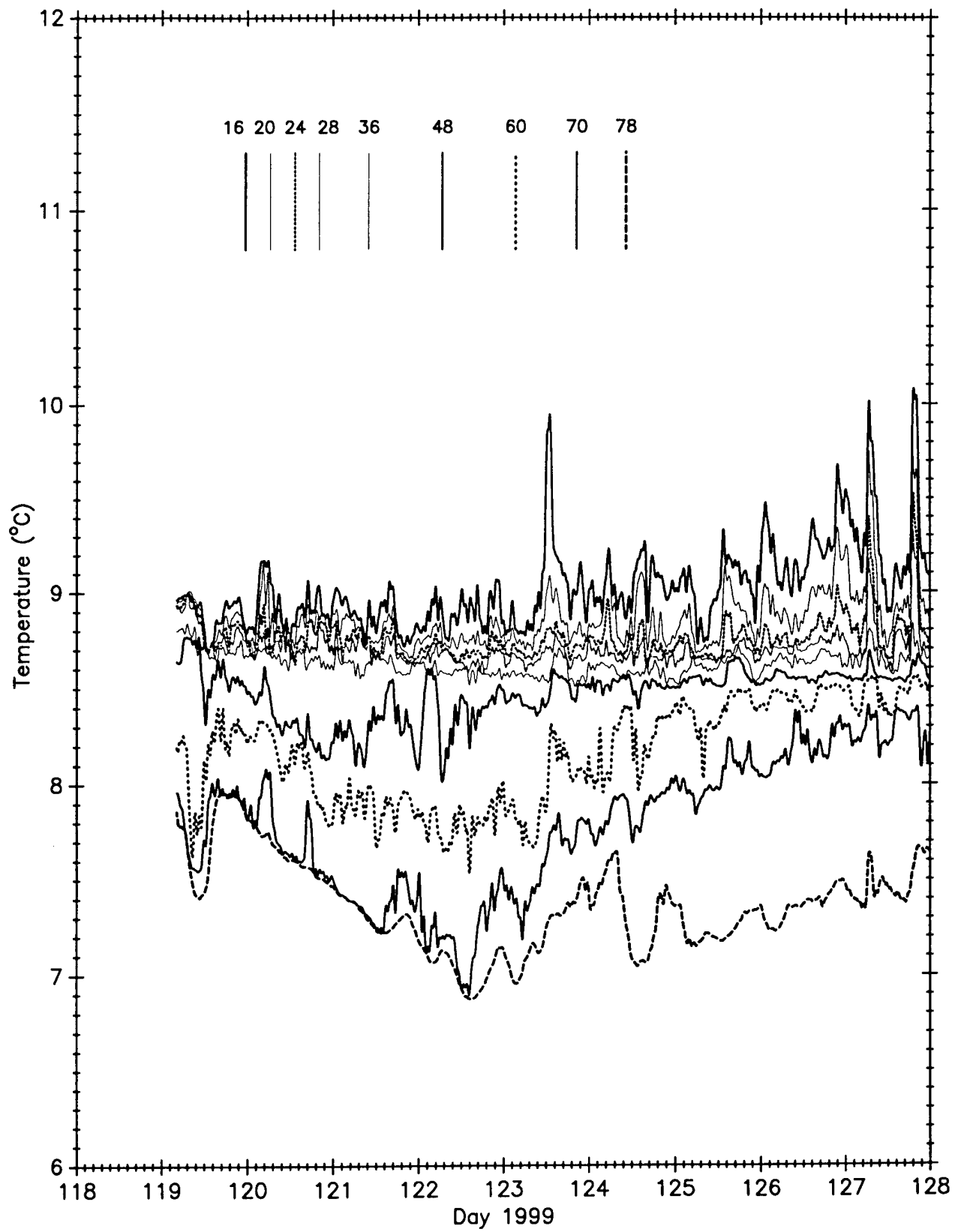
## NOPP Inshore 1 Hour Filtered Temperatures



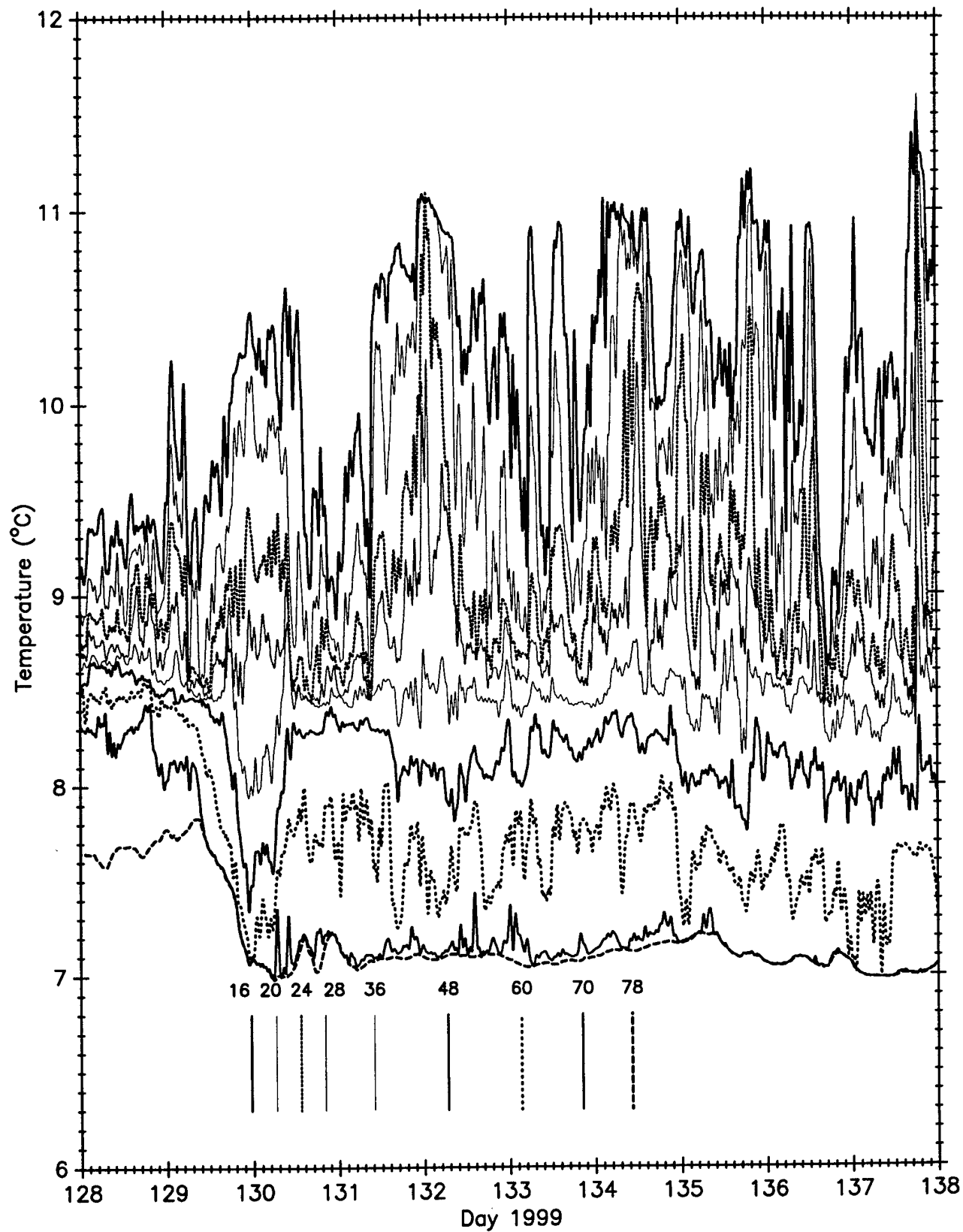
## NOPP Inshore 1 Hour Filtered Temperatures



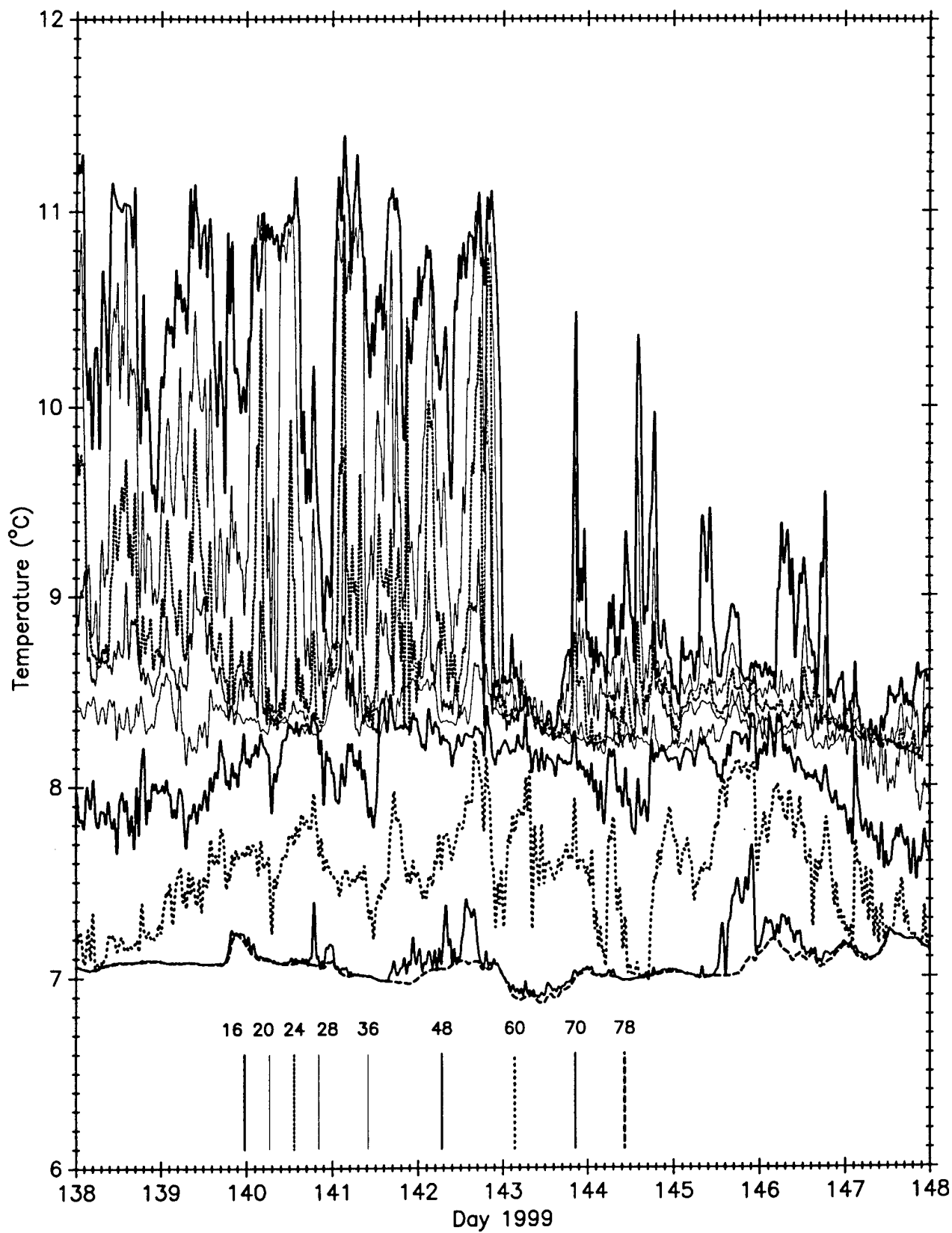
## NOPP Mid Shelf 1 Hour Filtered Temperatures



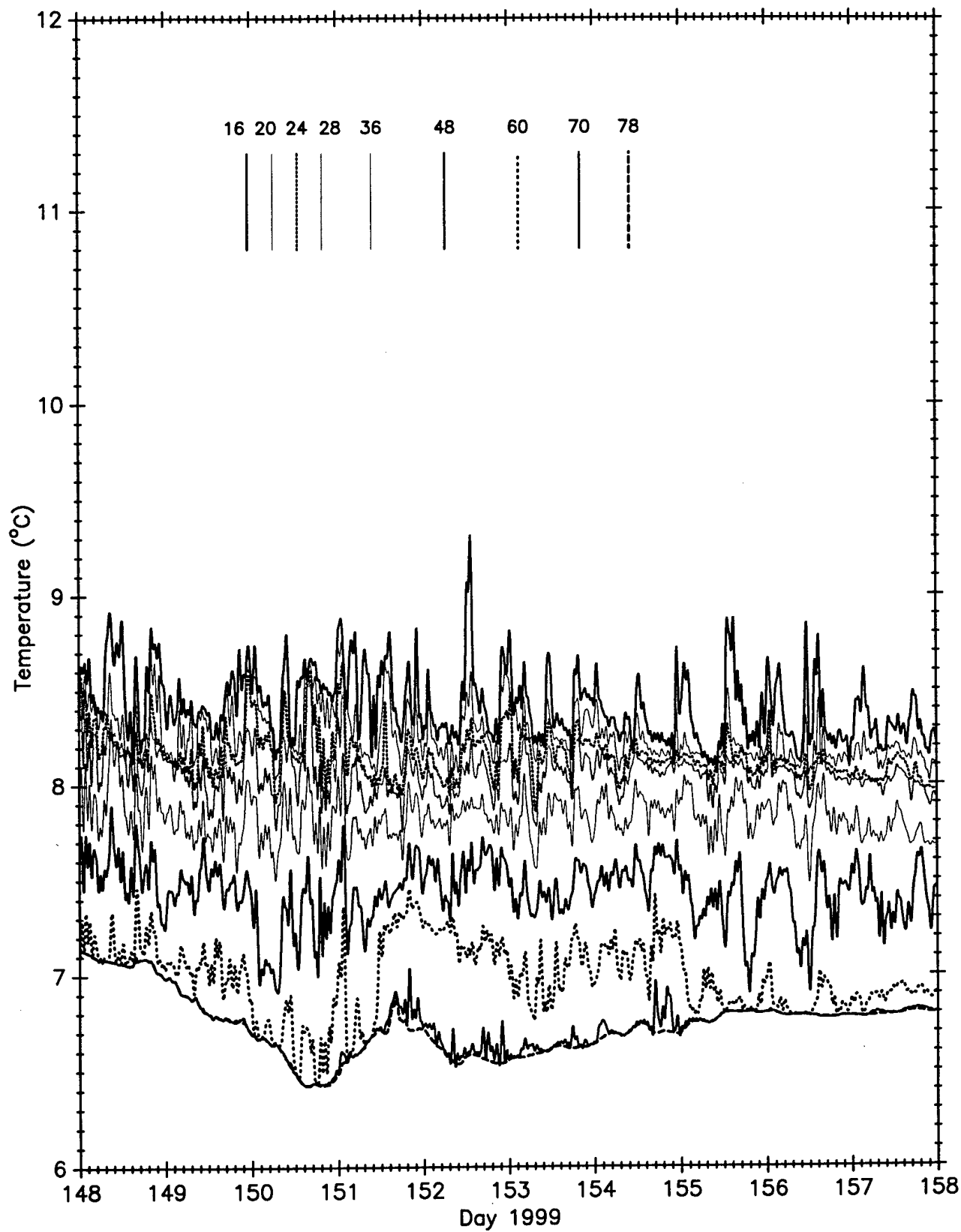
## NOPP Mid Shelf 1 Hour Filtered Temperatures



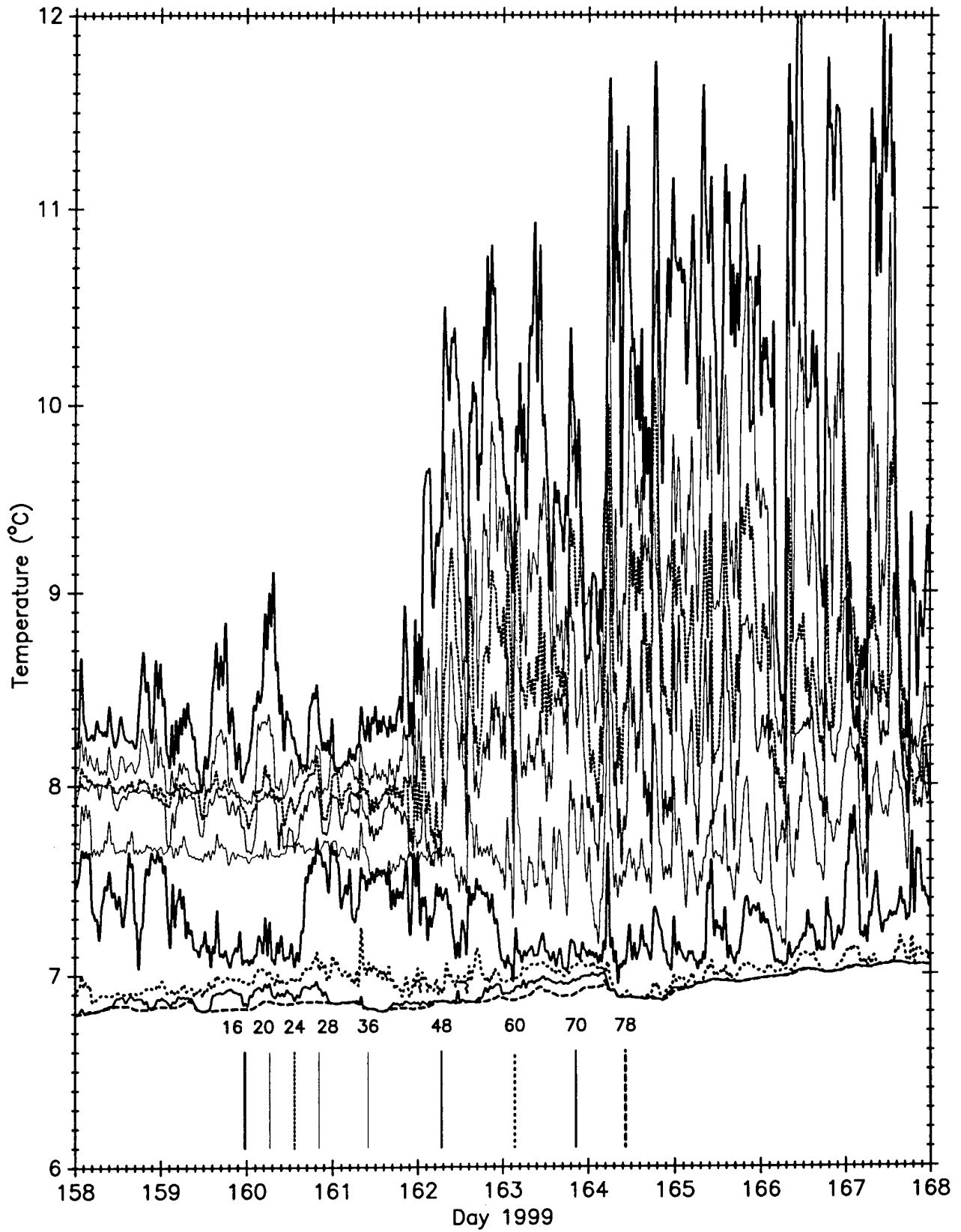
## NOPP Mid Shelf 1 Hour Filtered Temperatures



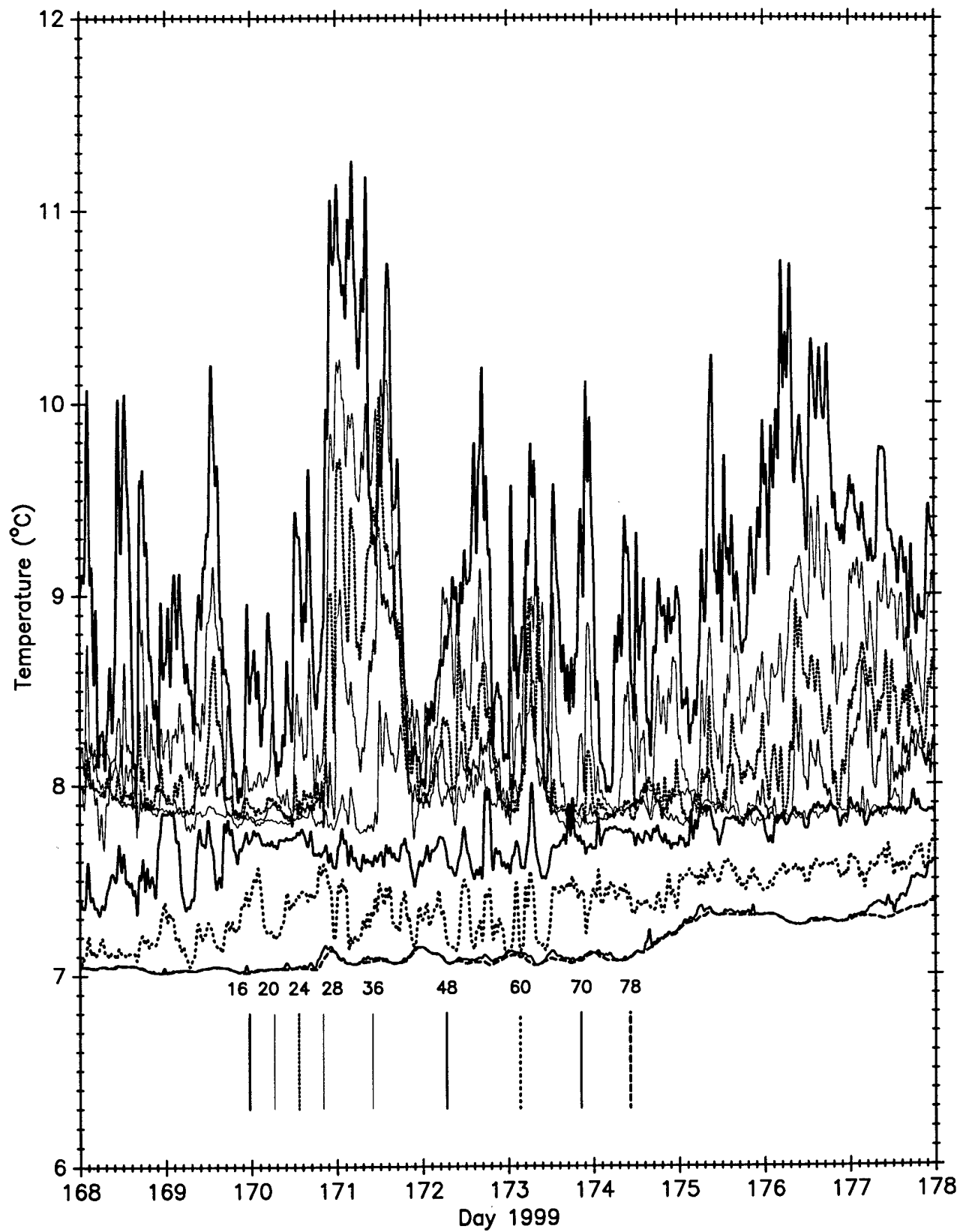
## NOPP Mid Shelf 1 Hour Filtered Temperatures



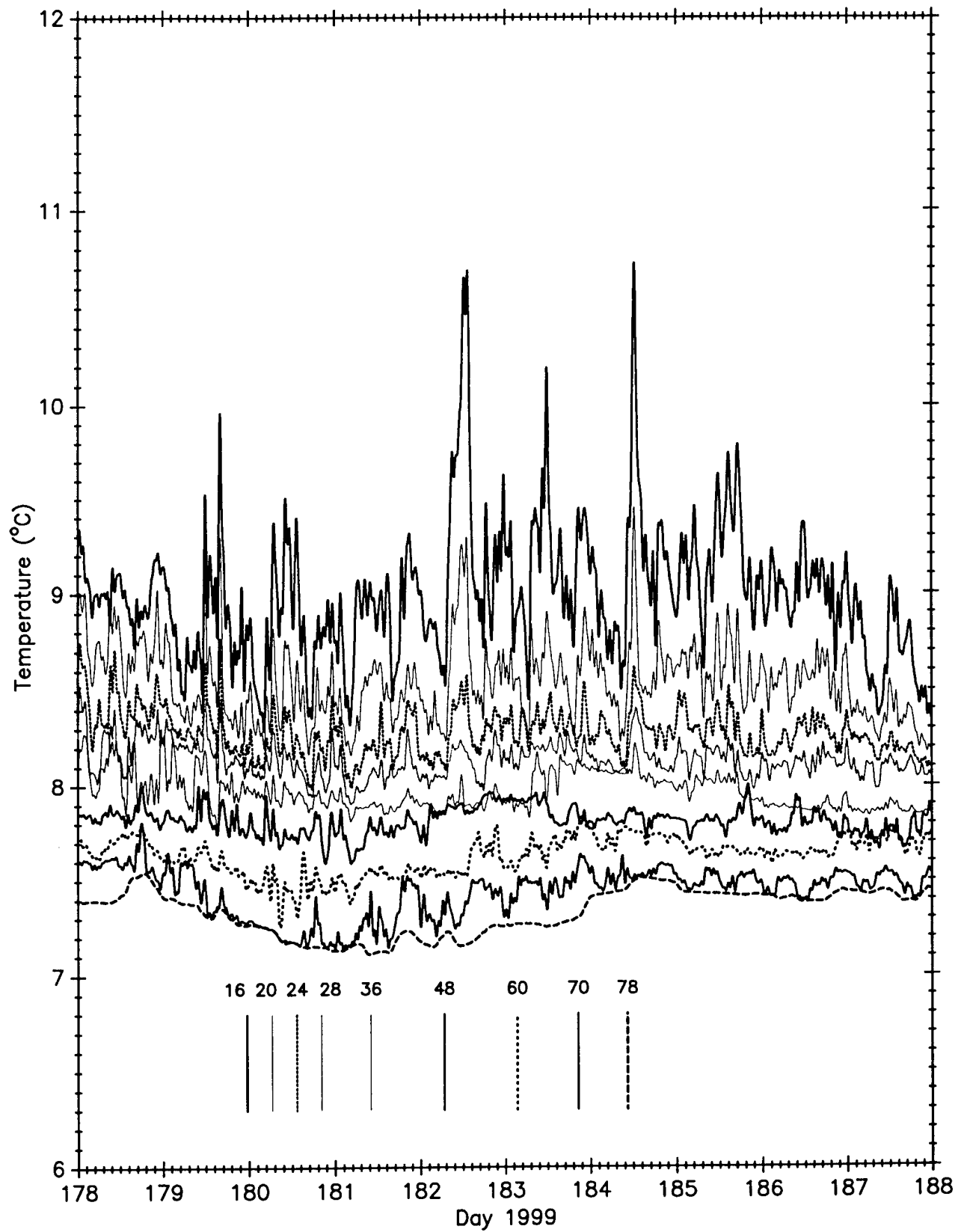
## NOPP Mid Shelf 1 Hour Filtered Temperatures



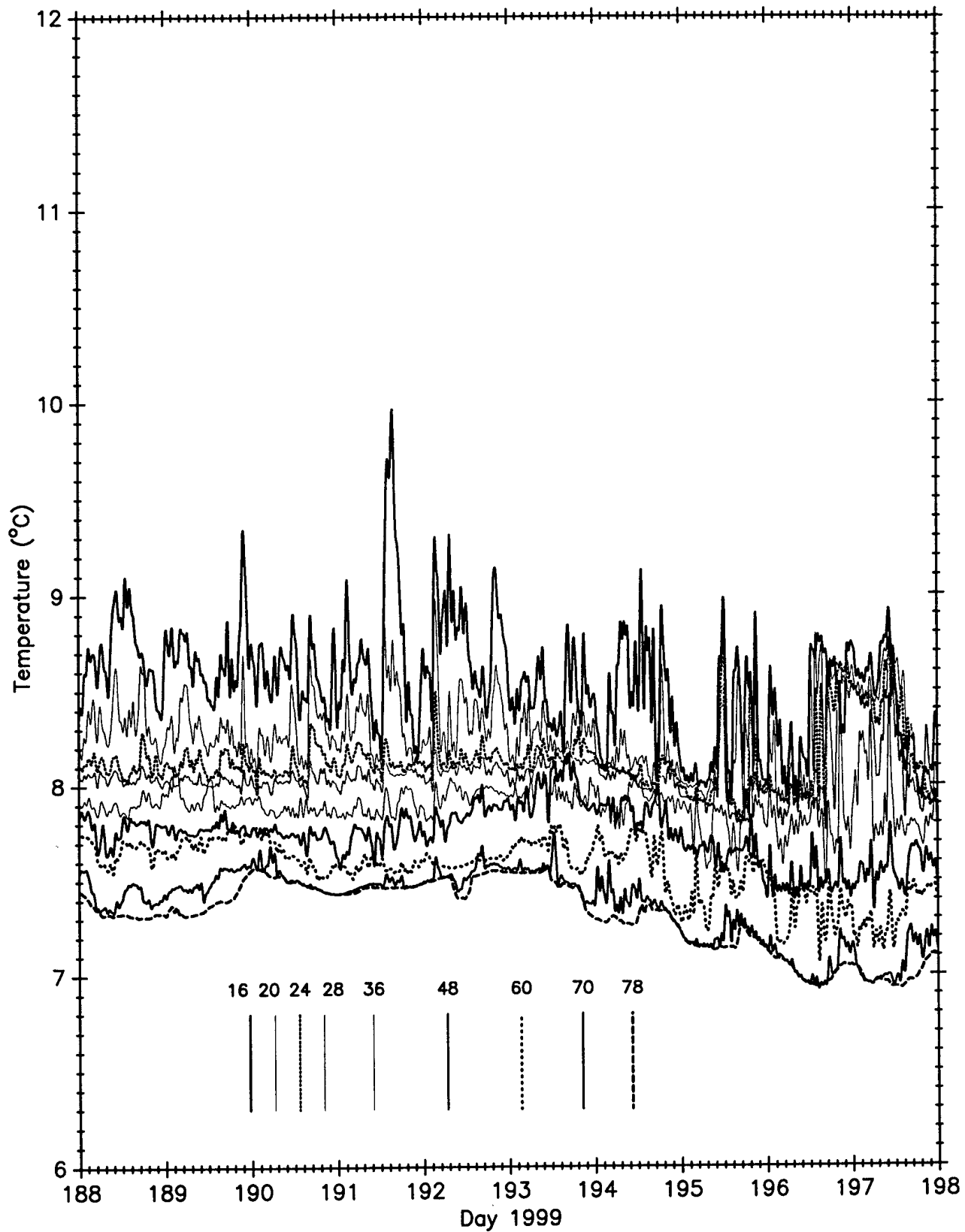
## NOPP Mid Shelf 1 Hour Filtered Temperatures



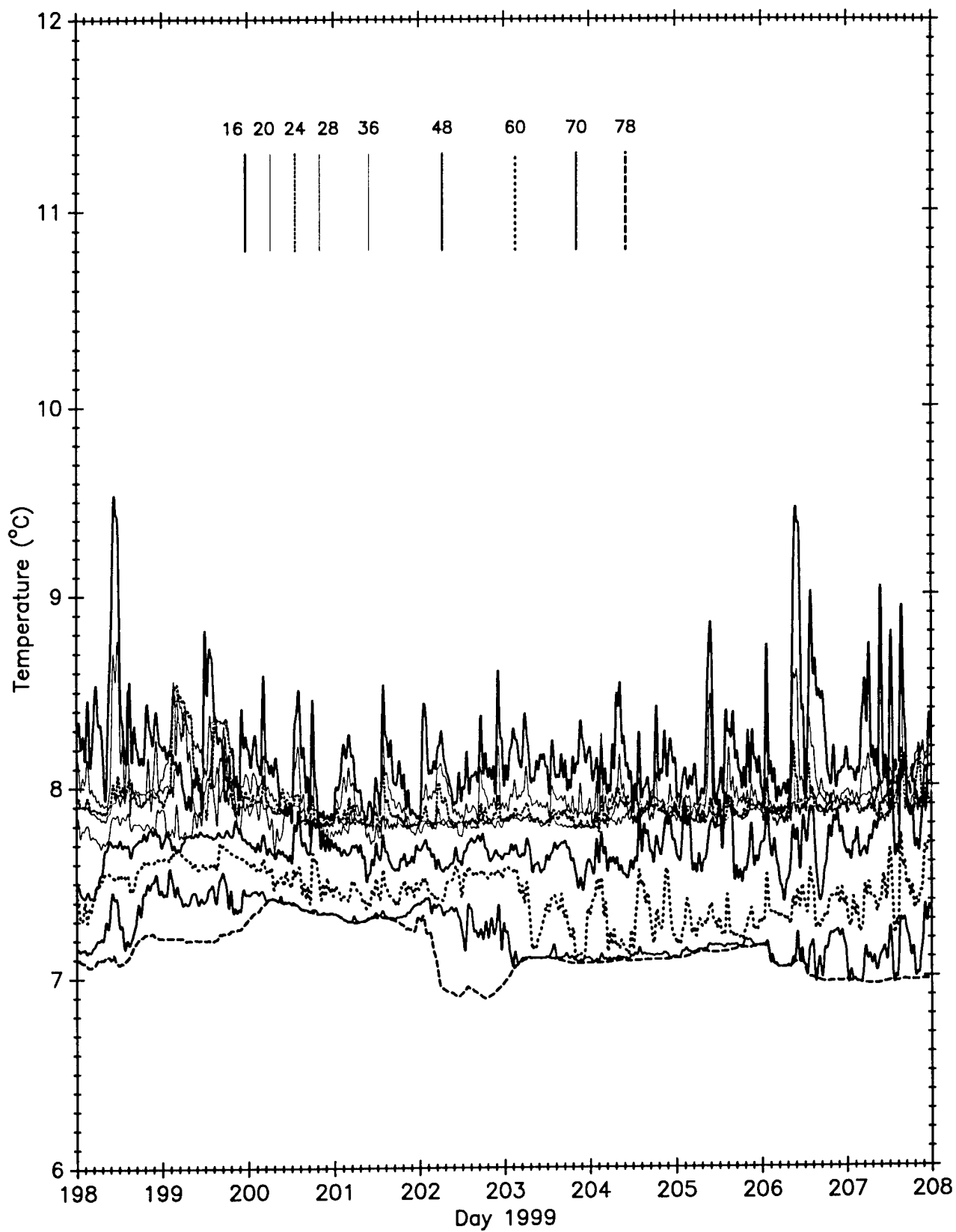
## NOPP Mid Shelf 1 Hour Filtered Temperatures



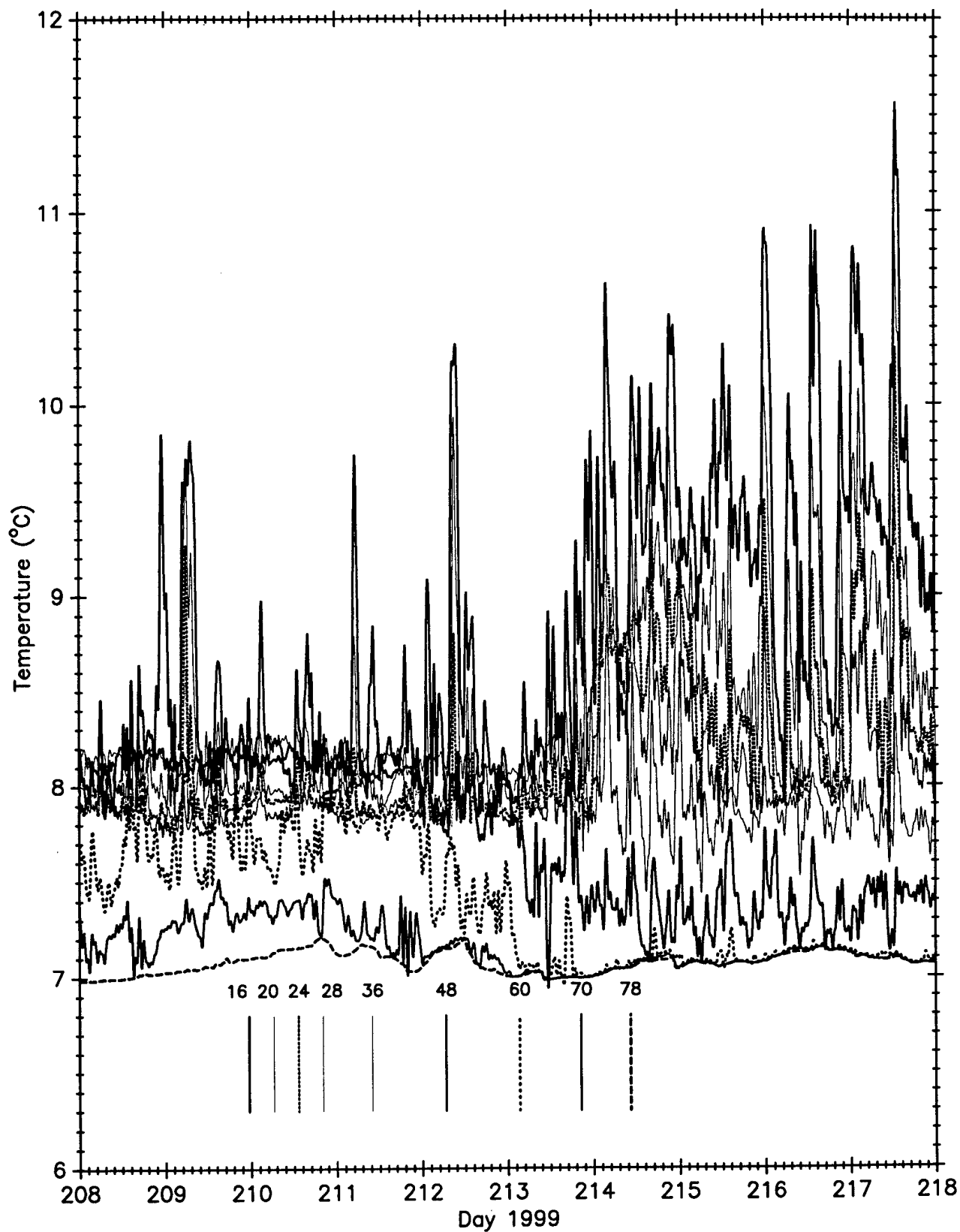
## NOPP Mid Shelf 1 Hour Filtered Temperatures



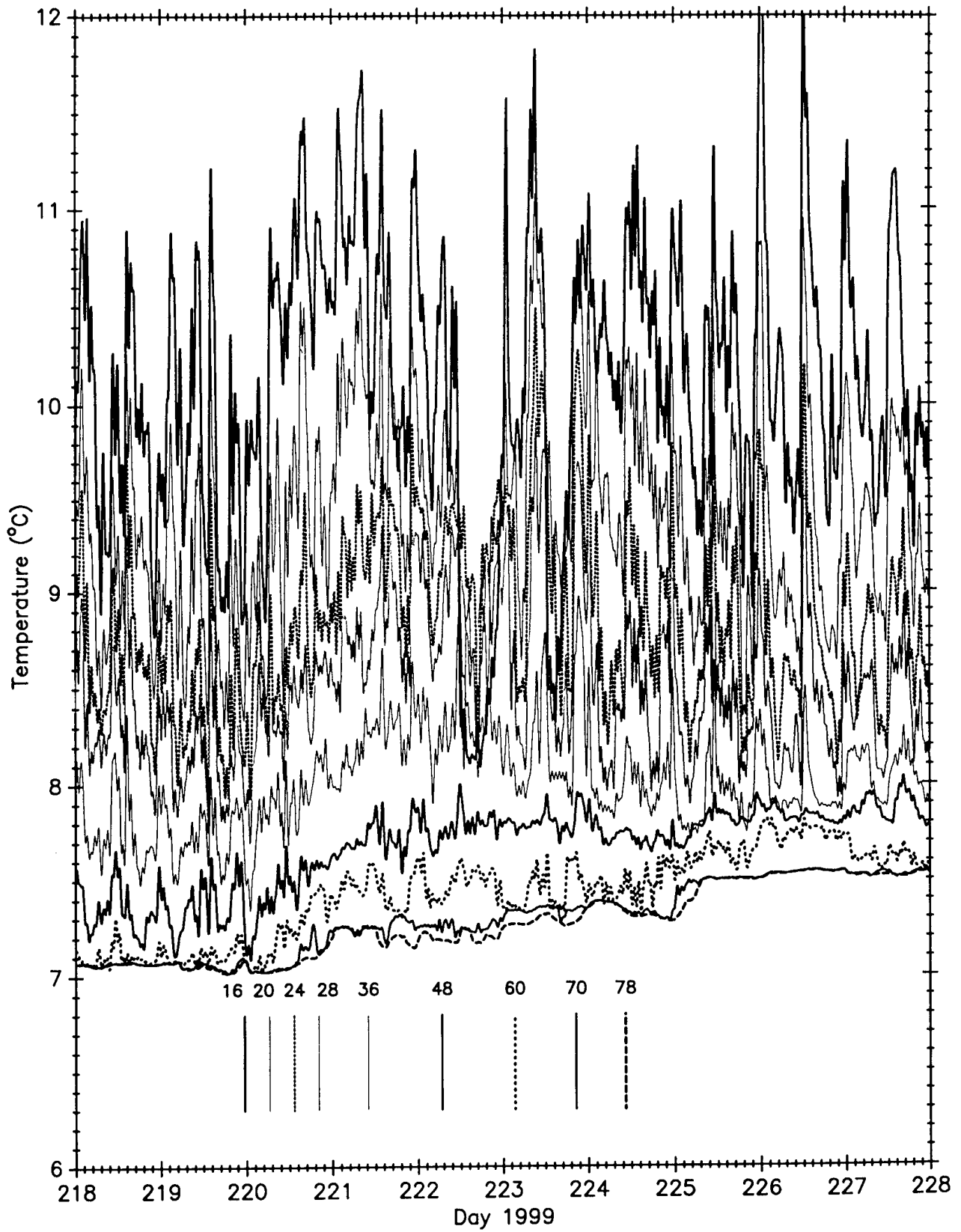
## NOPP Mid Shelf 1 Hour Filtered Temperatures



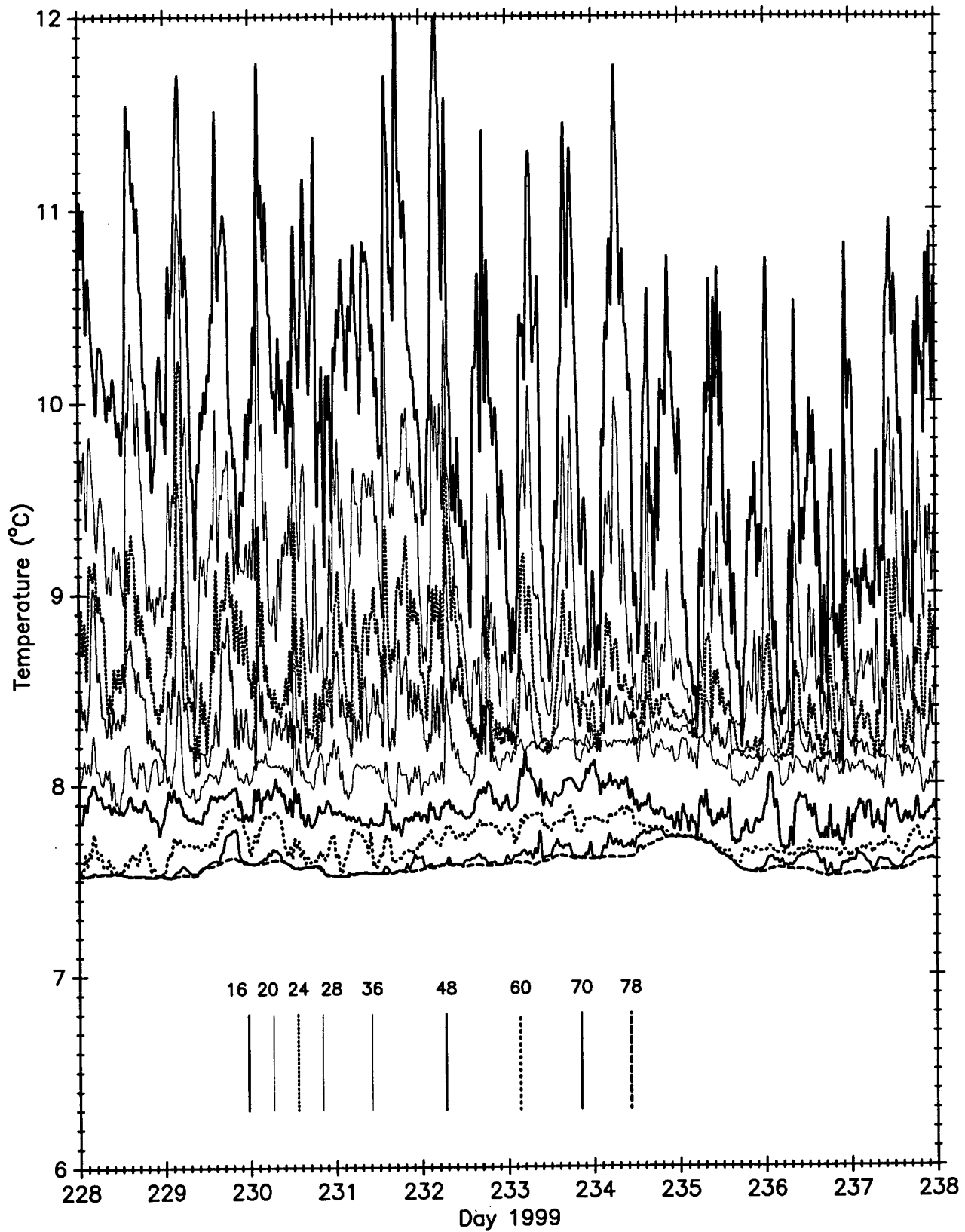
## NOPP Mid Shelf 1 Hour Filtered Temperatures



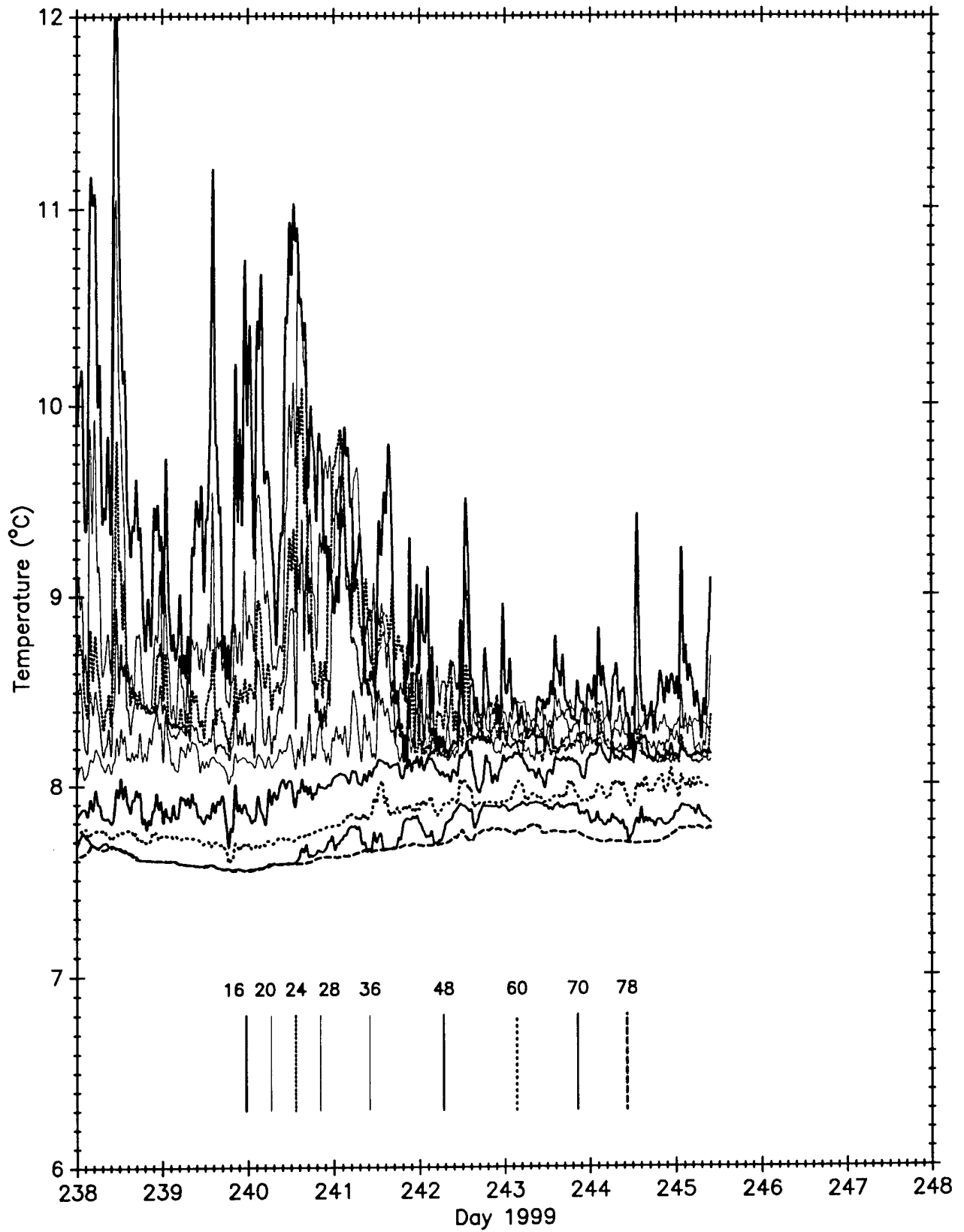
## NOPP Mid Shelf 1 Hour Filtered Temperatures



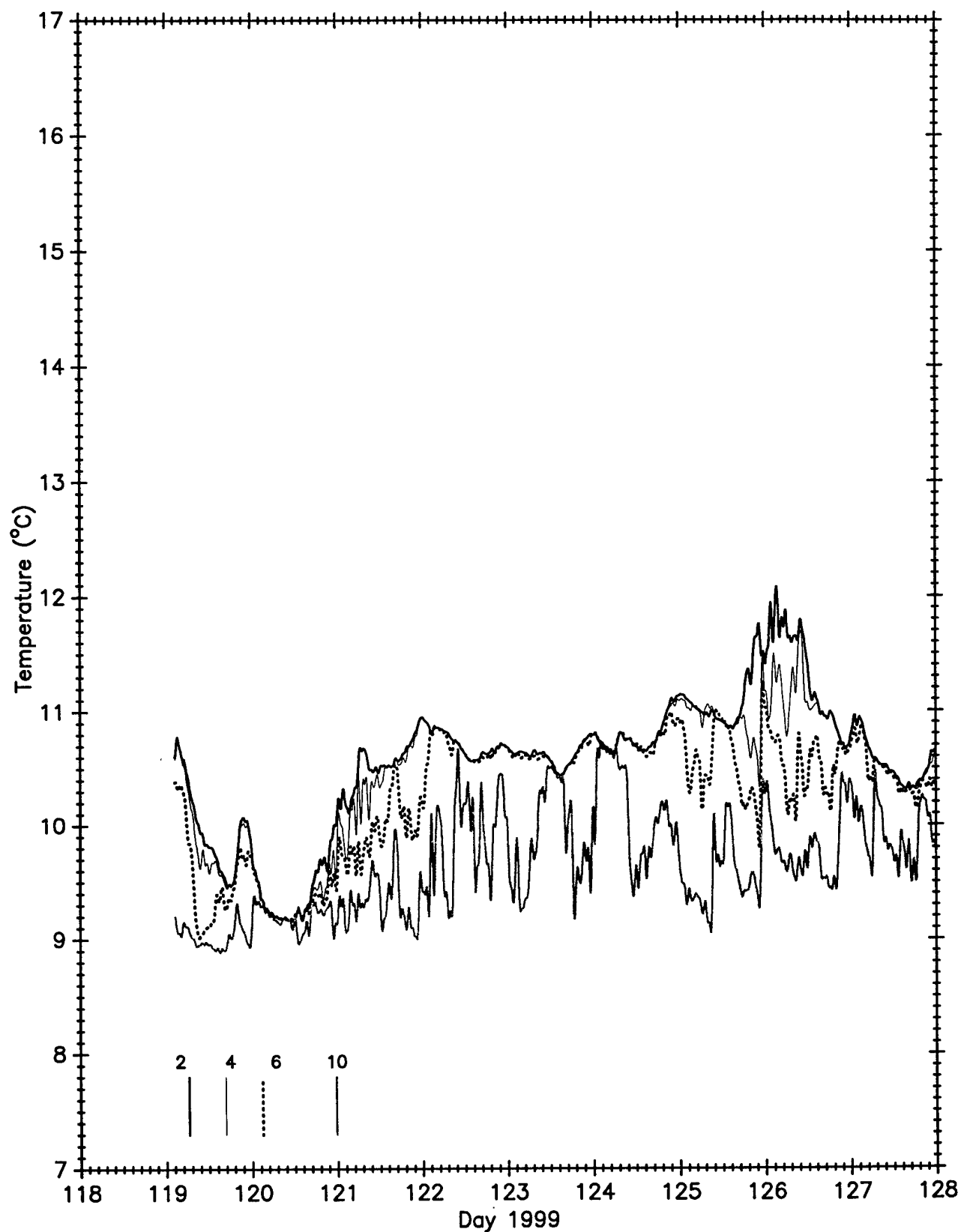
## NOPP Mid Shelf 1 Hour Filtered Temperatures



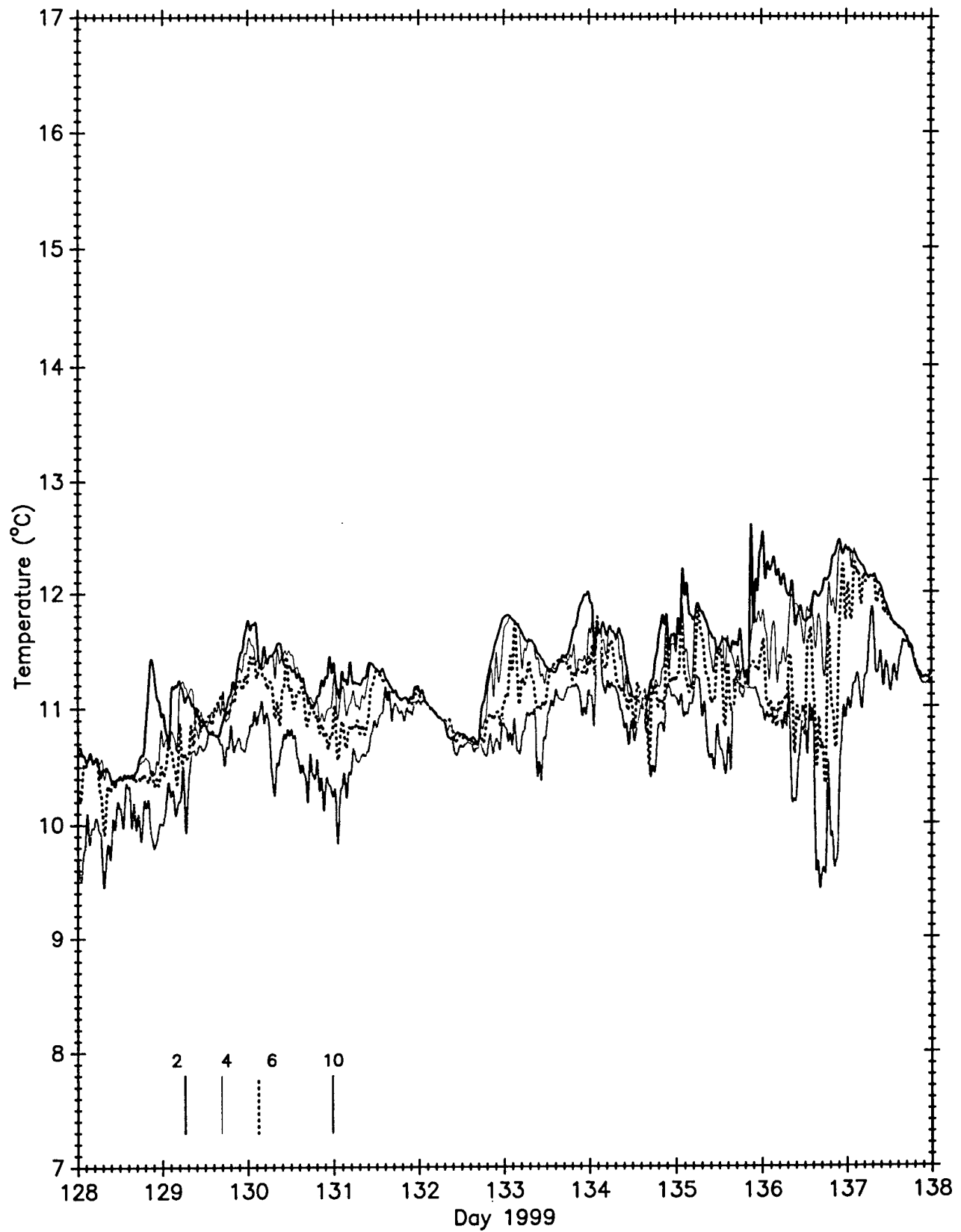
## NOPP Mid Shelf 1 Hour Filtered Temperatures



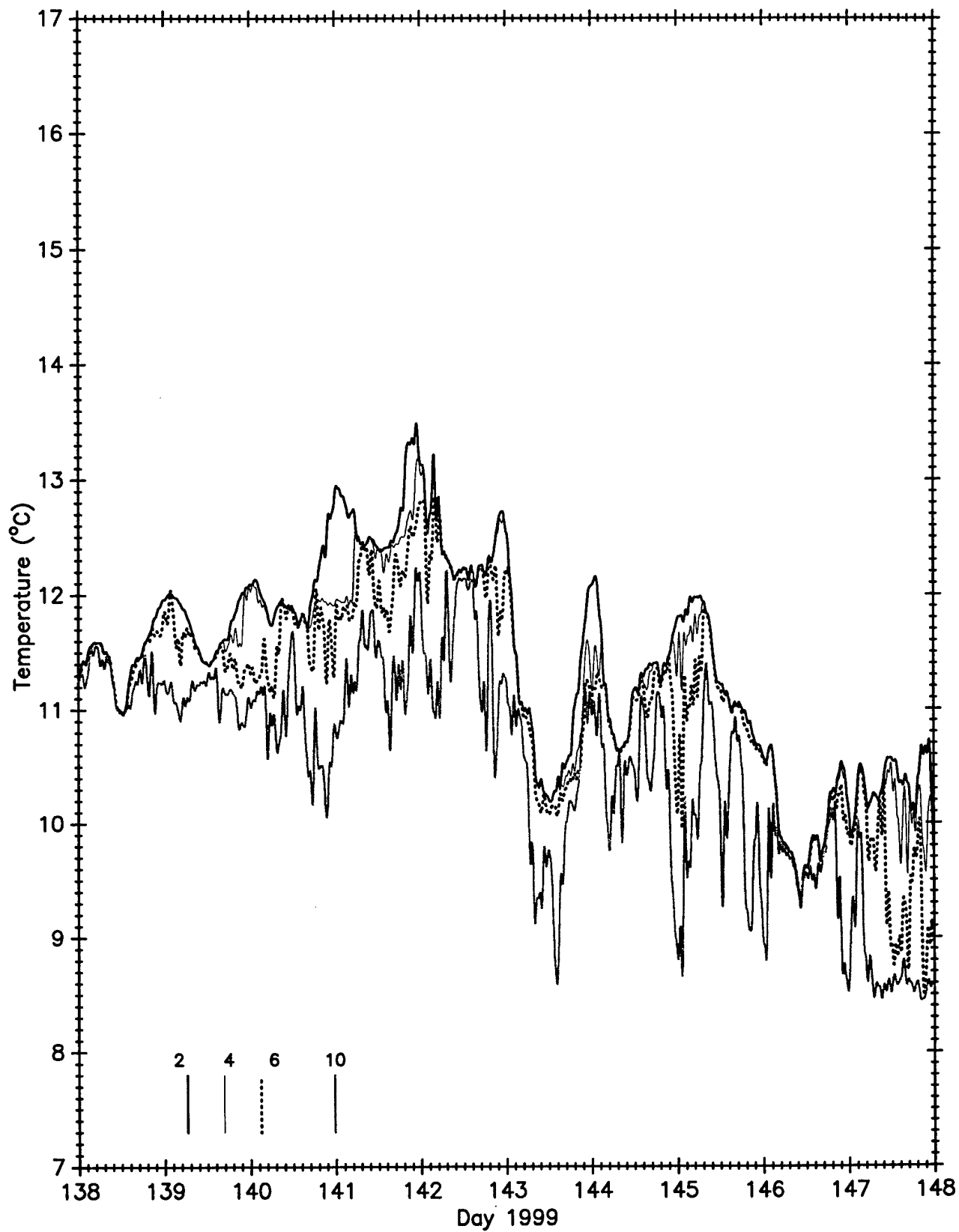
## NOPP Meteorological Mooring 1 Hour Filtered Temperature



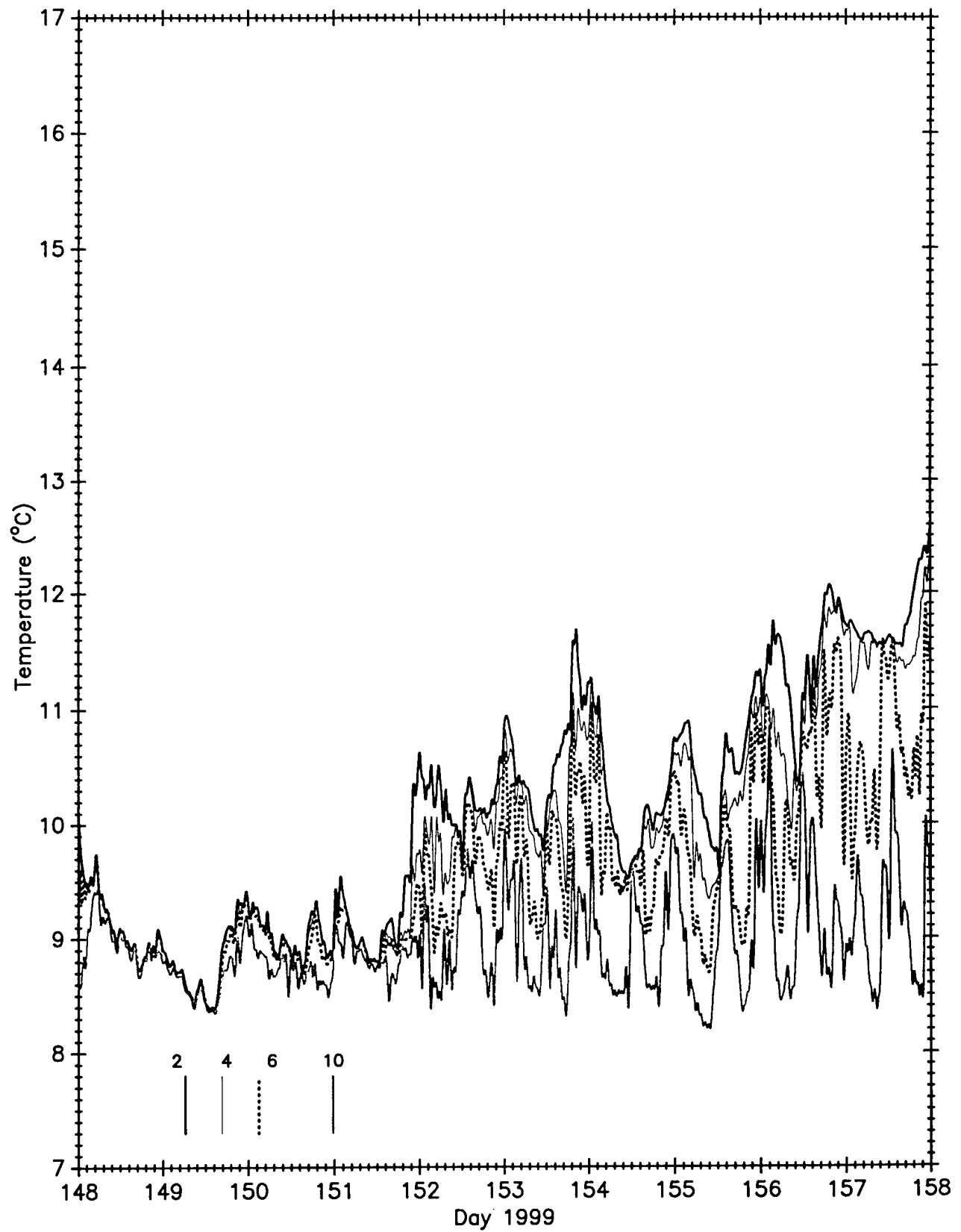
## NOPP Meteorological Mooring 1 Hour Filtered Temperature



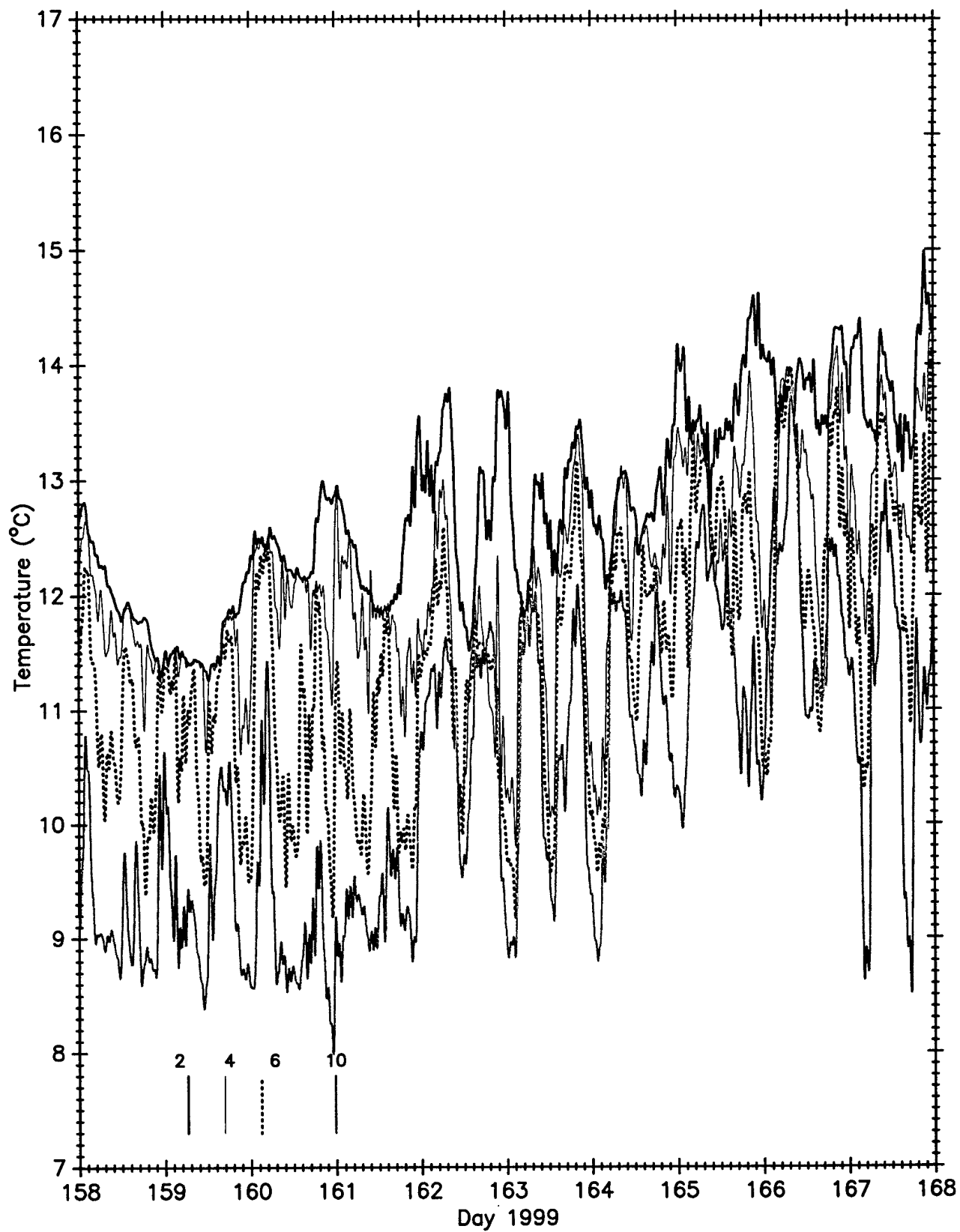
## NOPP Meteorological Mooring 1 Hour Filtered Temperature



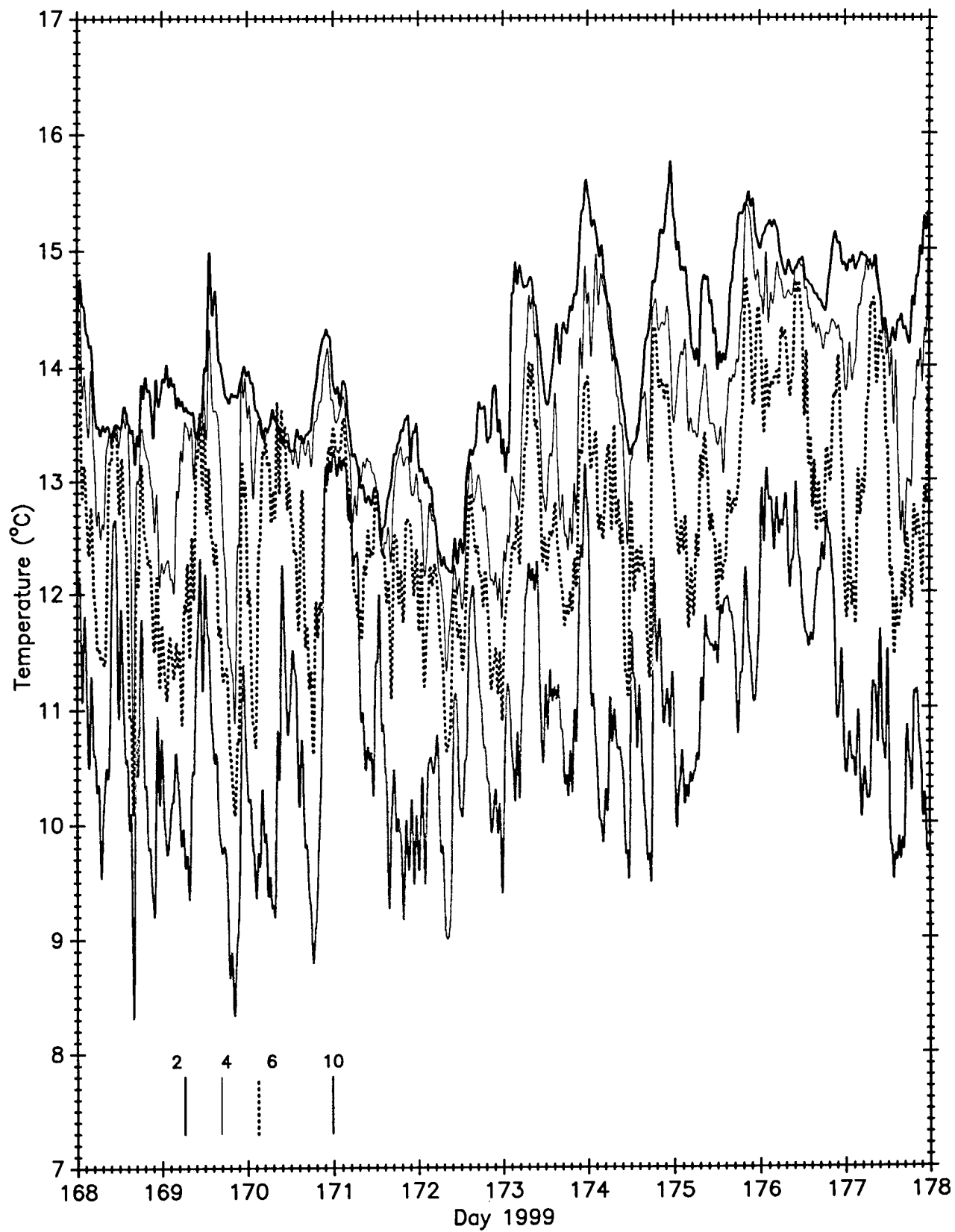
## NOPP Meteorological Mooring 1 Hour Filtered Temperature



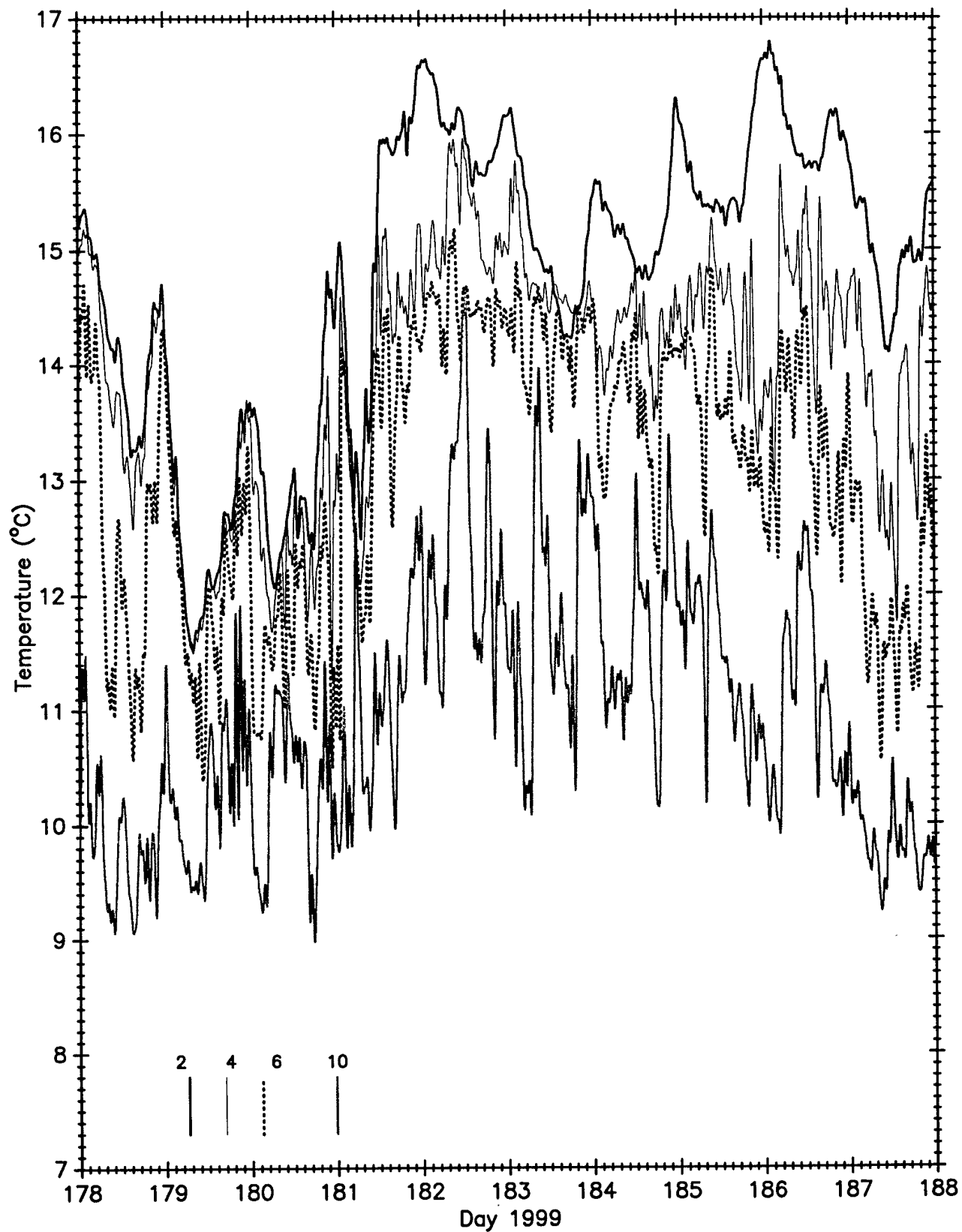
## NOPP Meteorological Mooring 1 Hour Filtered Temperature



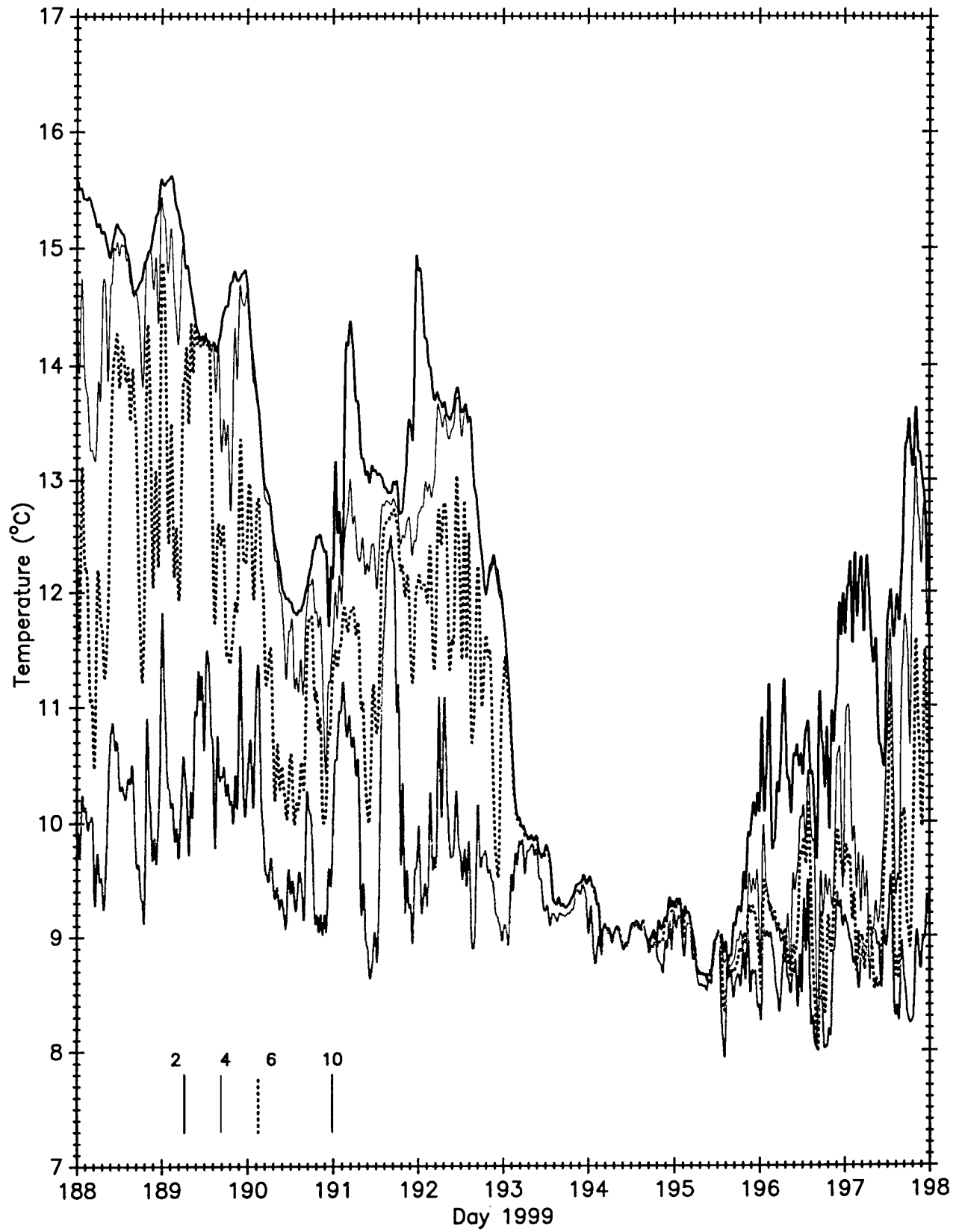
## NOPP Meteorological Mooring 1 Hour Filtered Temperature



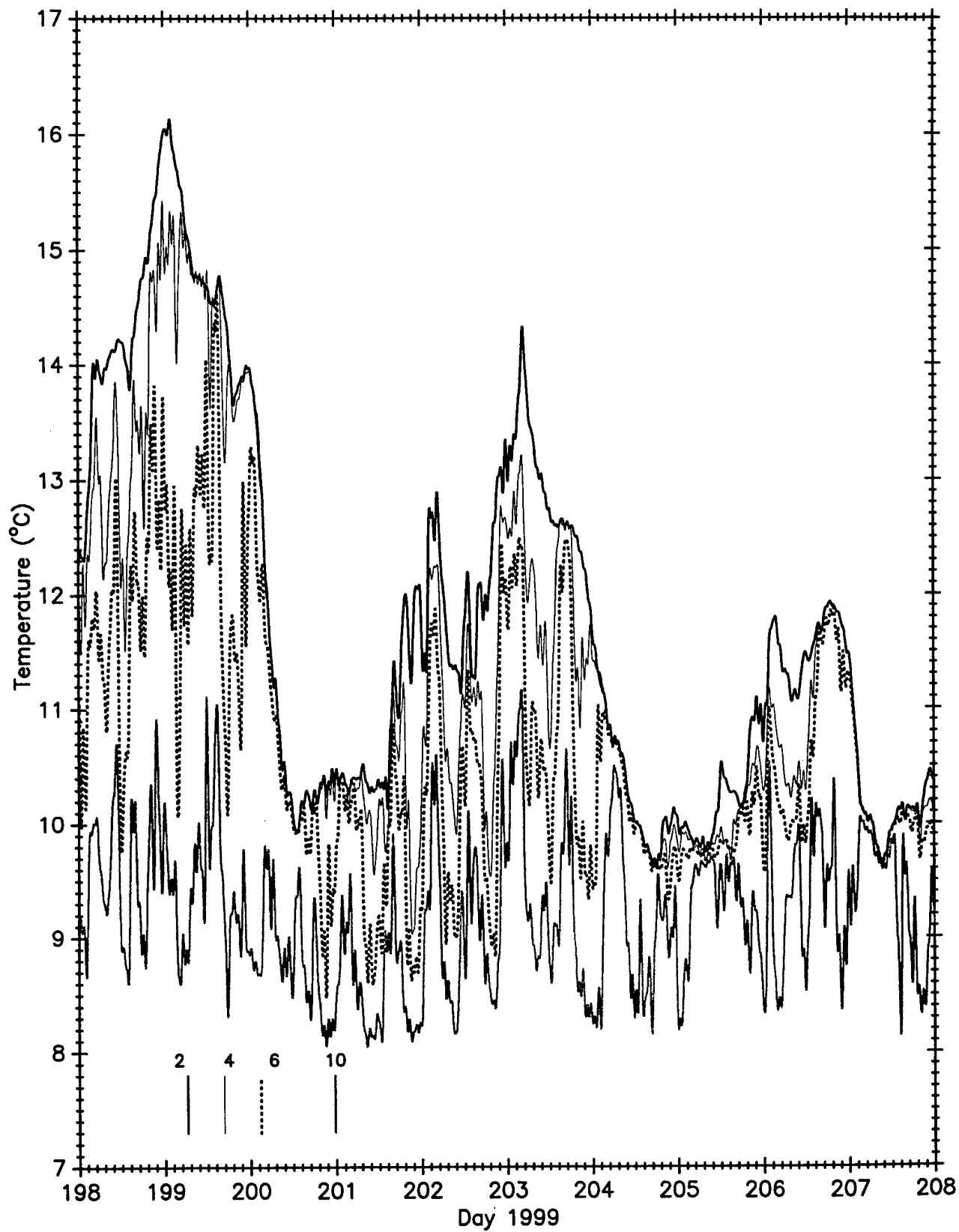
## NOPP Meteorological Mooring 1 Hour Filtered Temperature



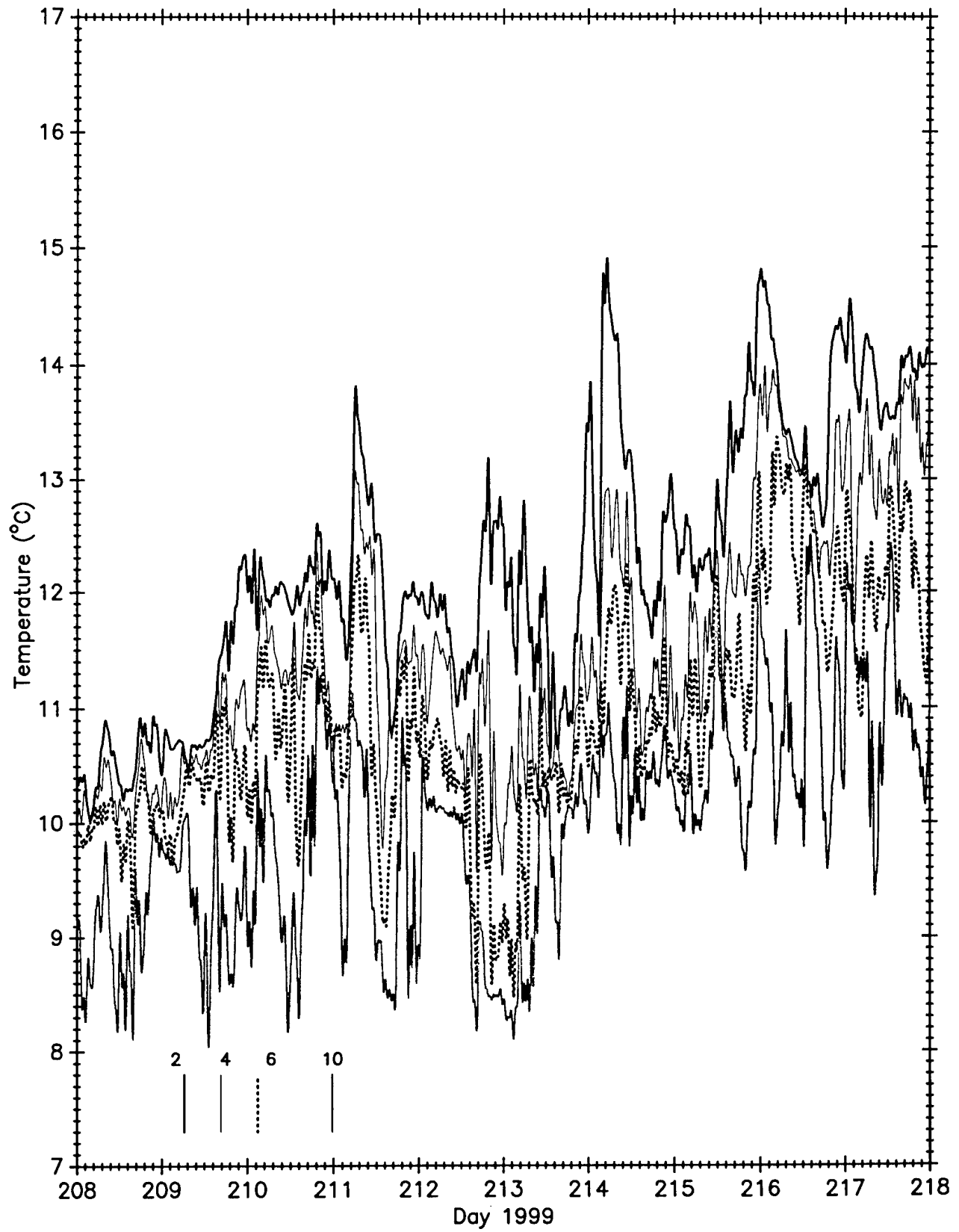
## NOPP Meteorological Mooring 1 Hour Filtered Temperature



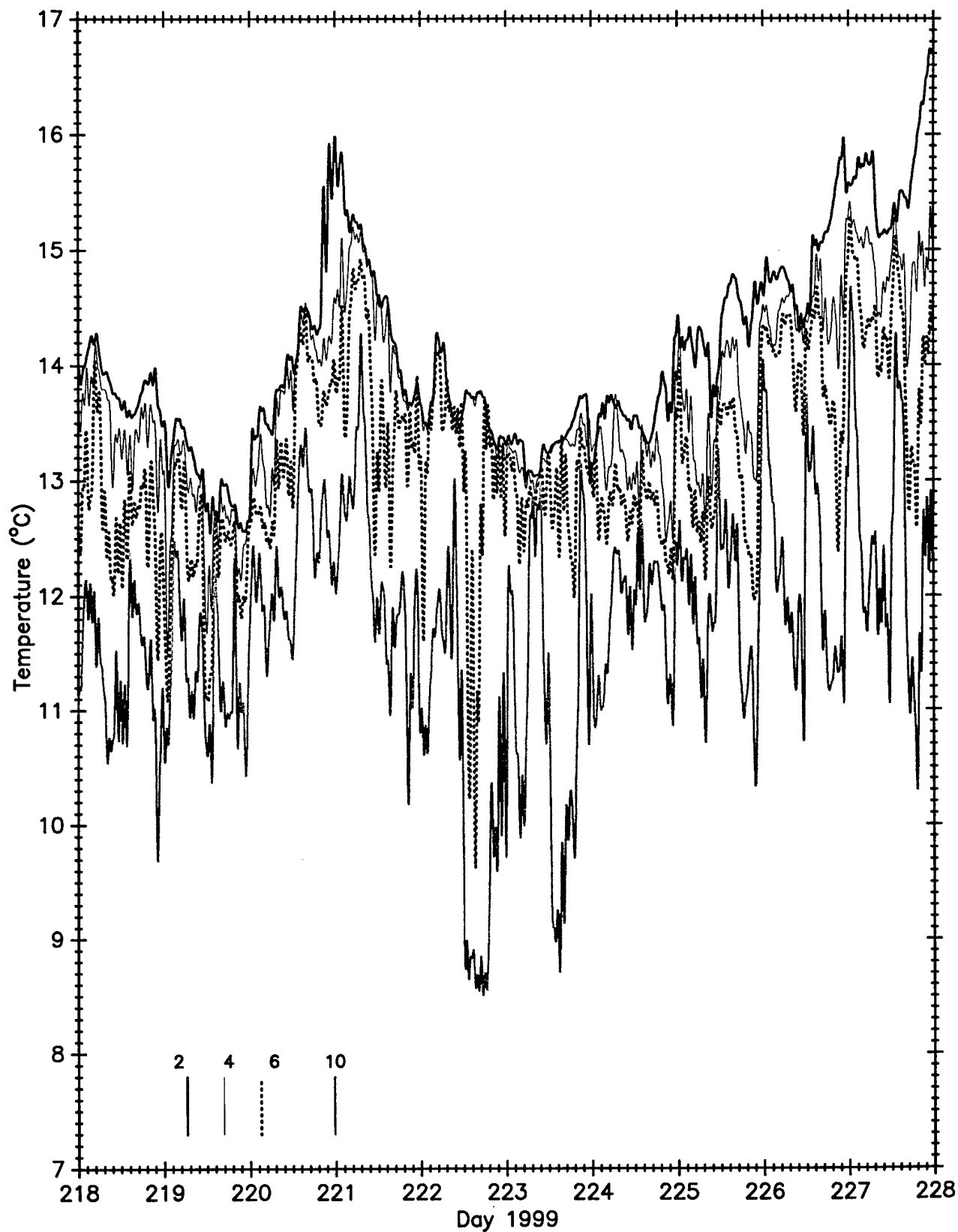
## NOPP Meteorological Mooring 1 Hour Filtered Temperature



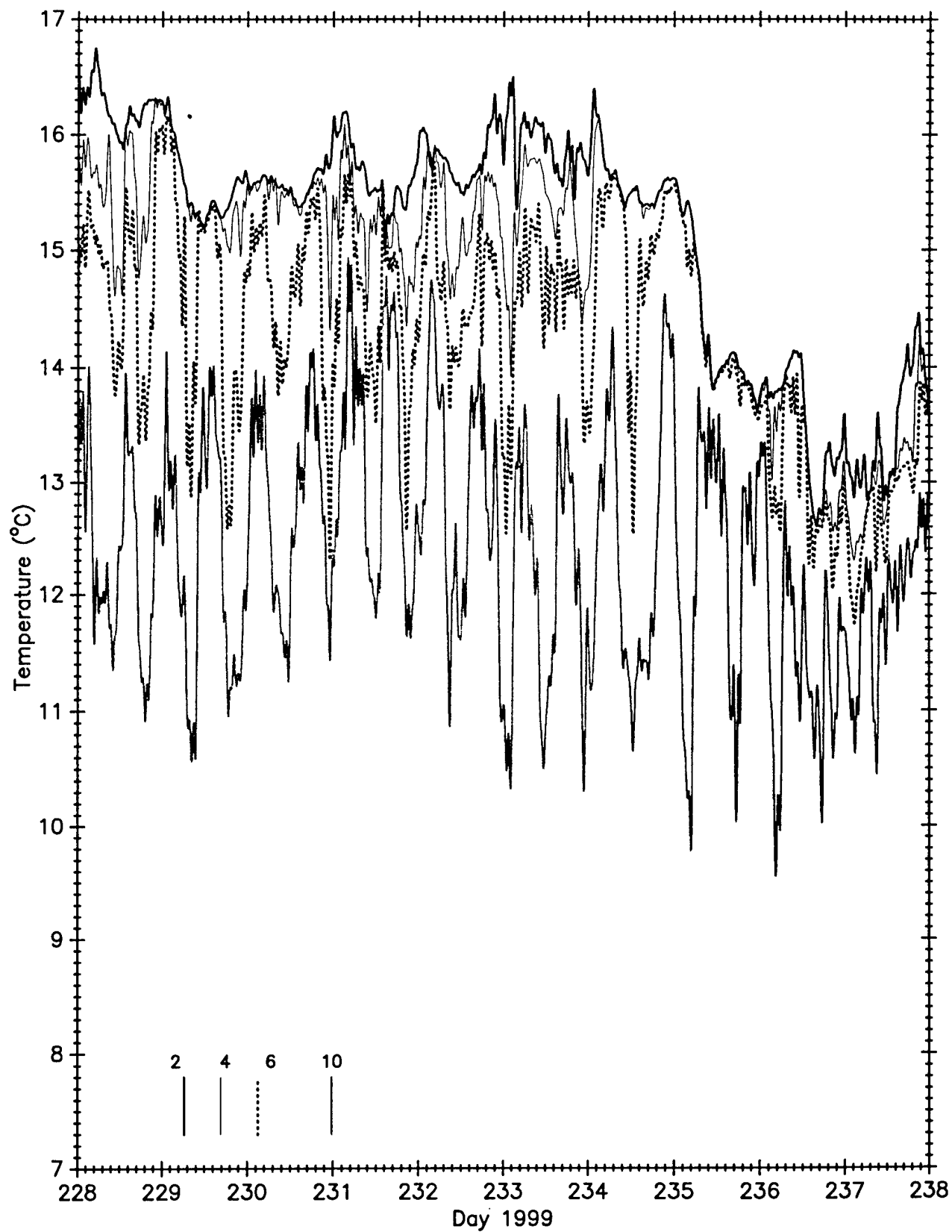
## NOPP Meteorological Mooring 1 Hour Filtered Temperature



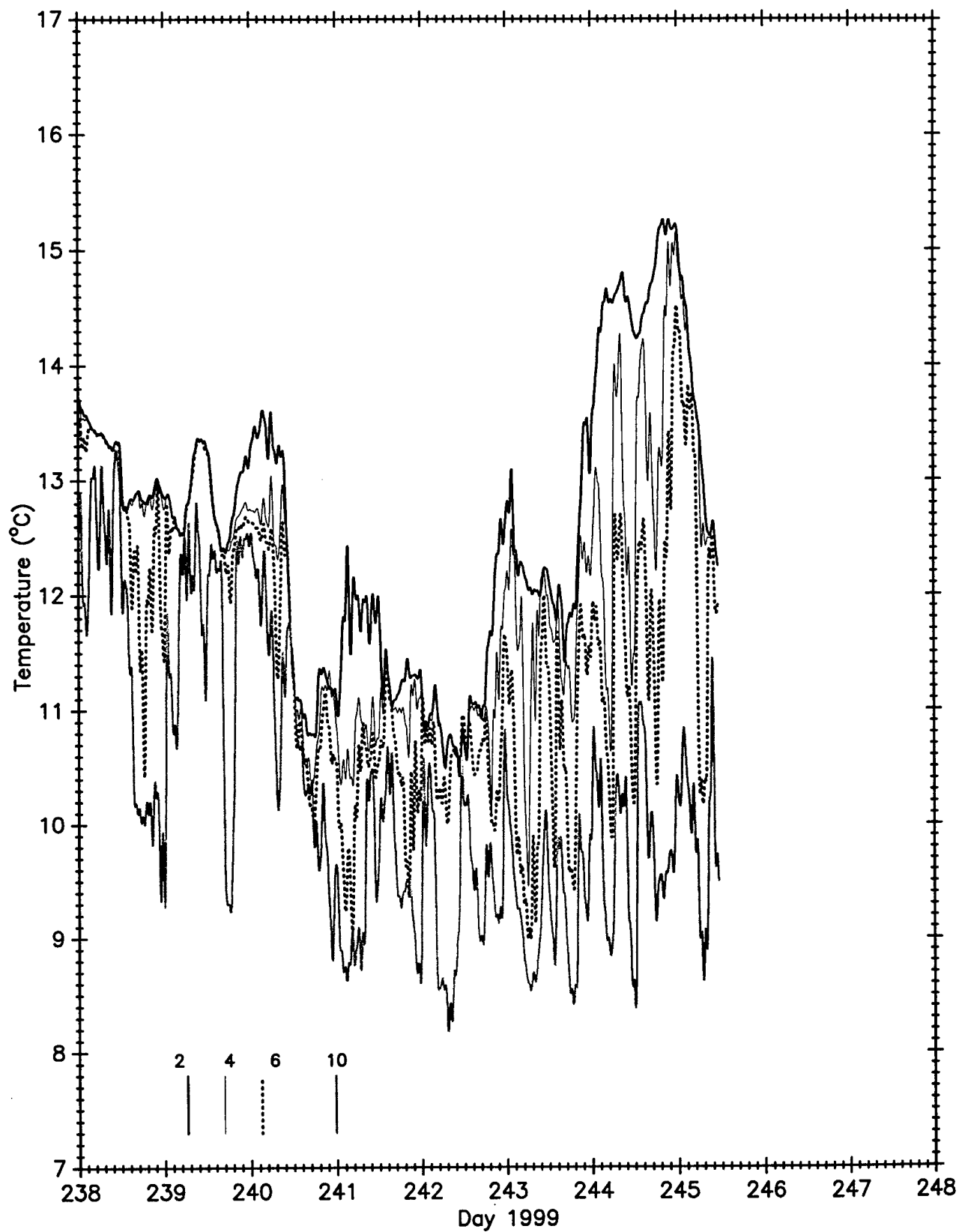
## NOPP Meteorological Mooring 1 Hour Filtered Temperature



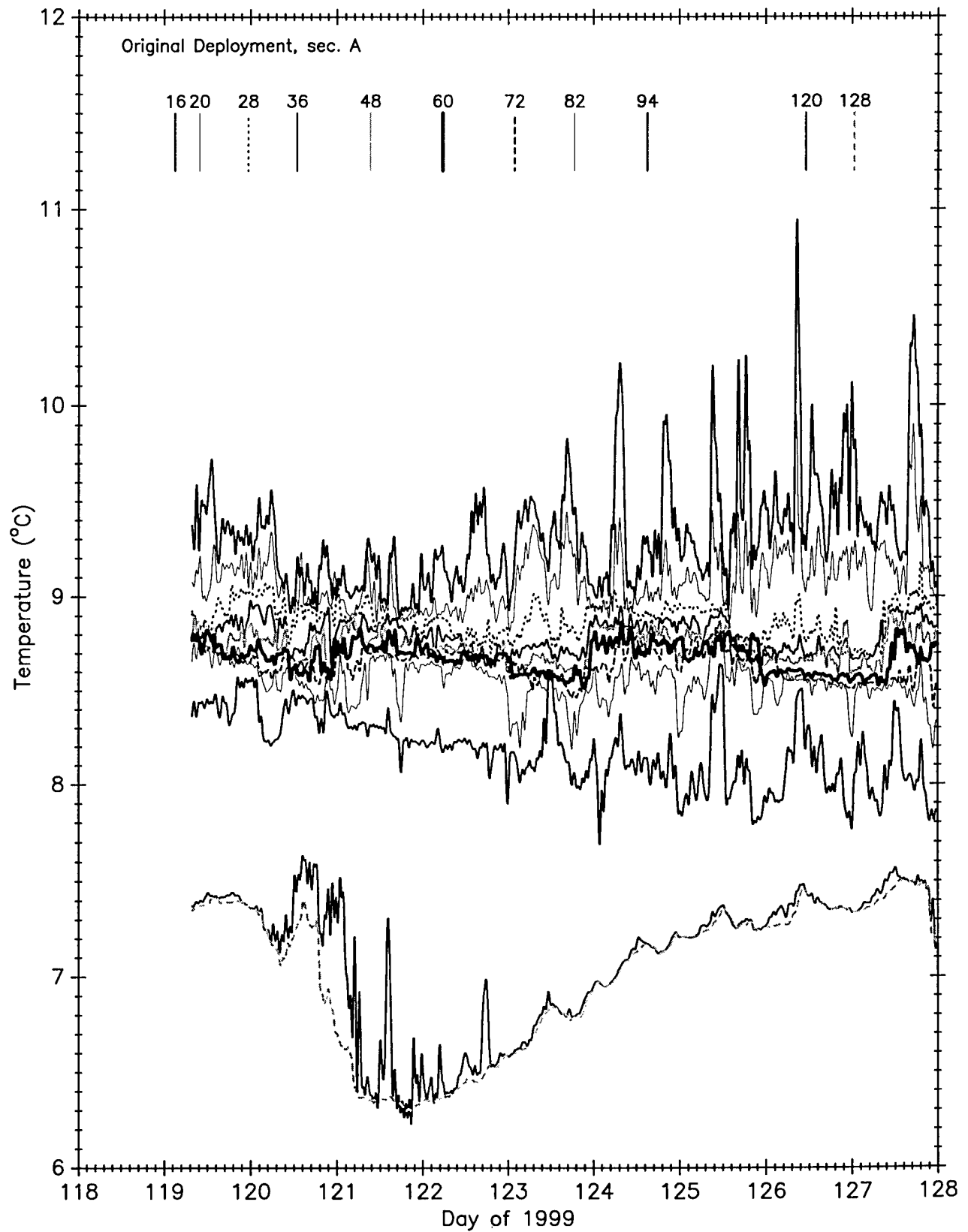
## NOPP Meteorological Mooring 1 Hour Filtered Temperature



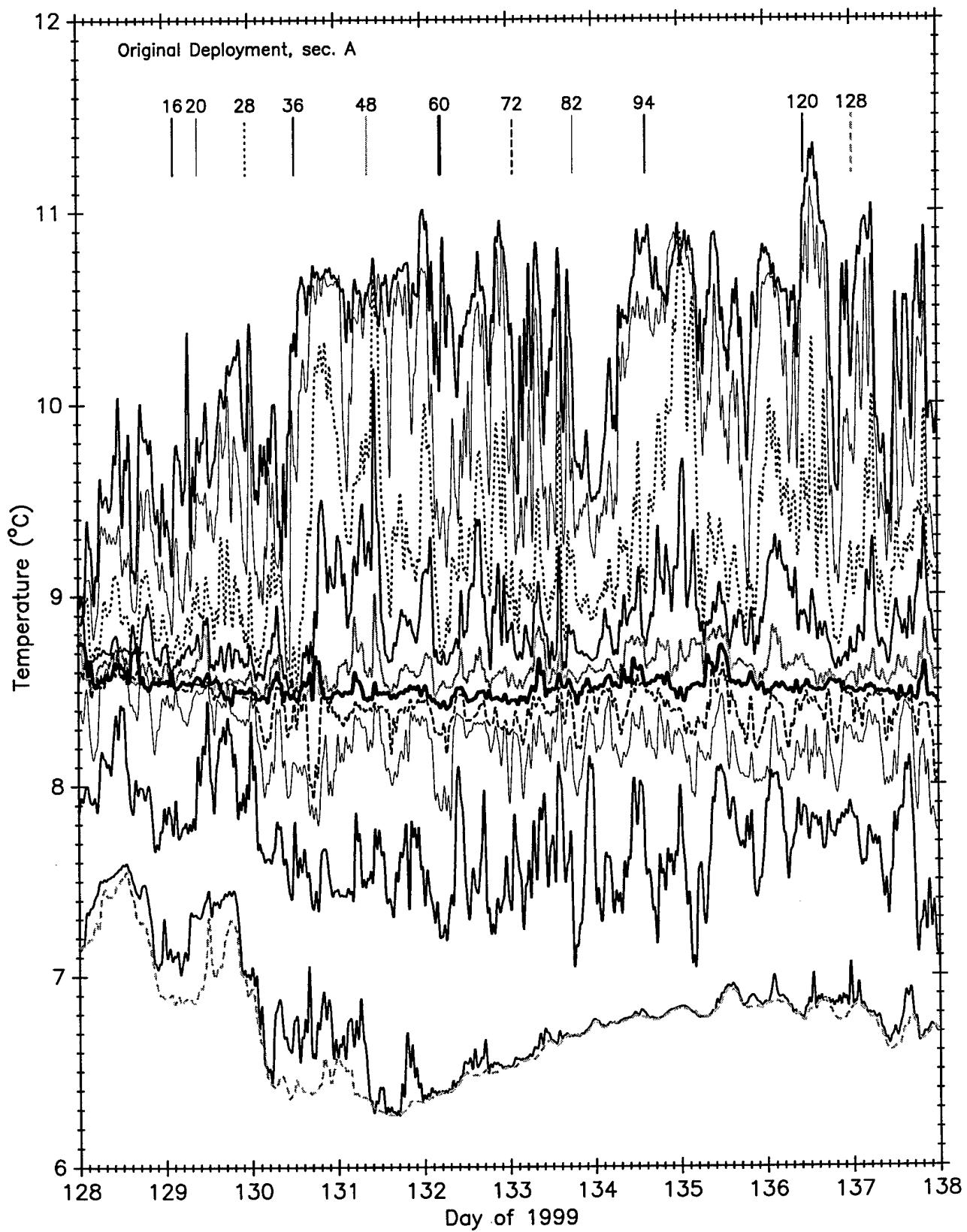
## NOPP Meteorological Mooring 1 Hour Filtered Temperature



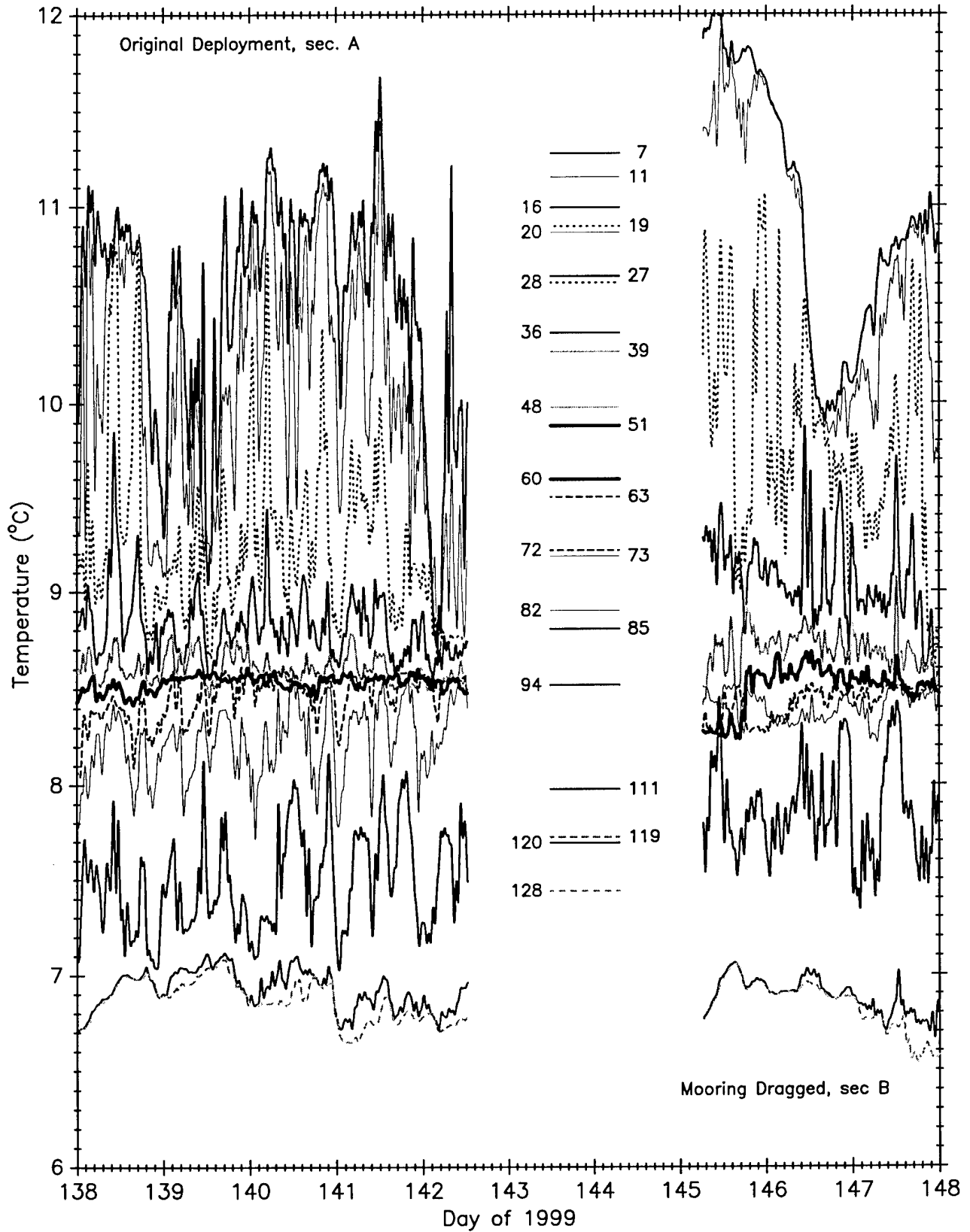
## NOPP Shelf Break 1 Hour Filtered Temperatures



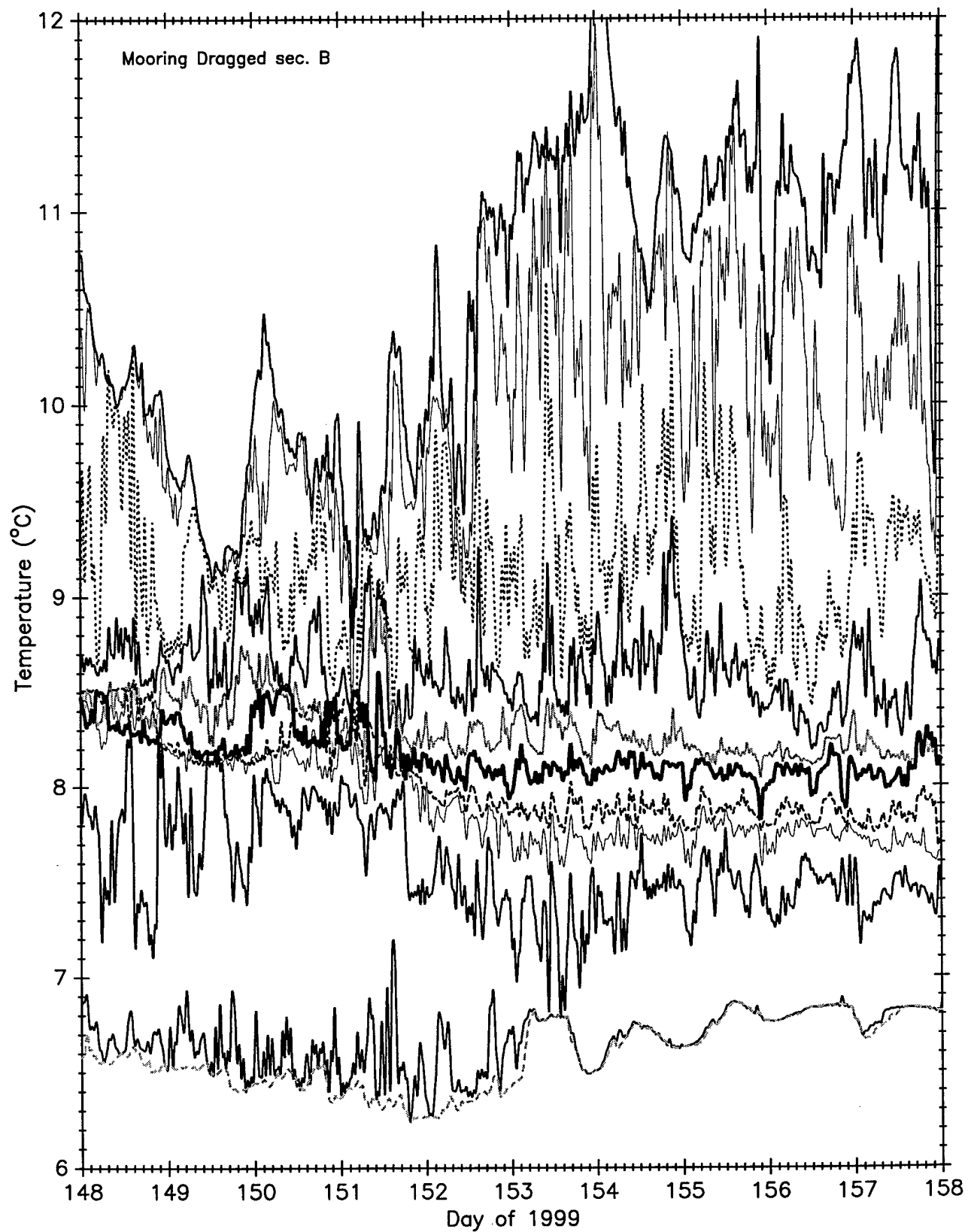
## NOPP Shelf Break 1 Hour Filtered Temperatures



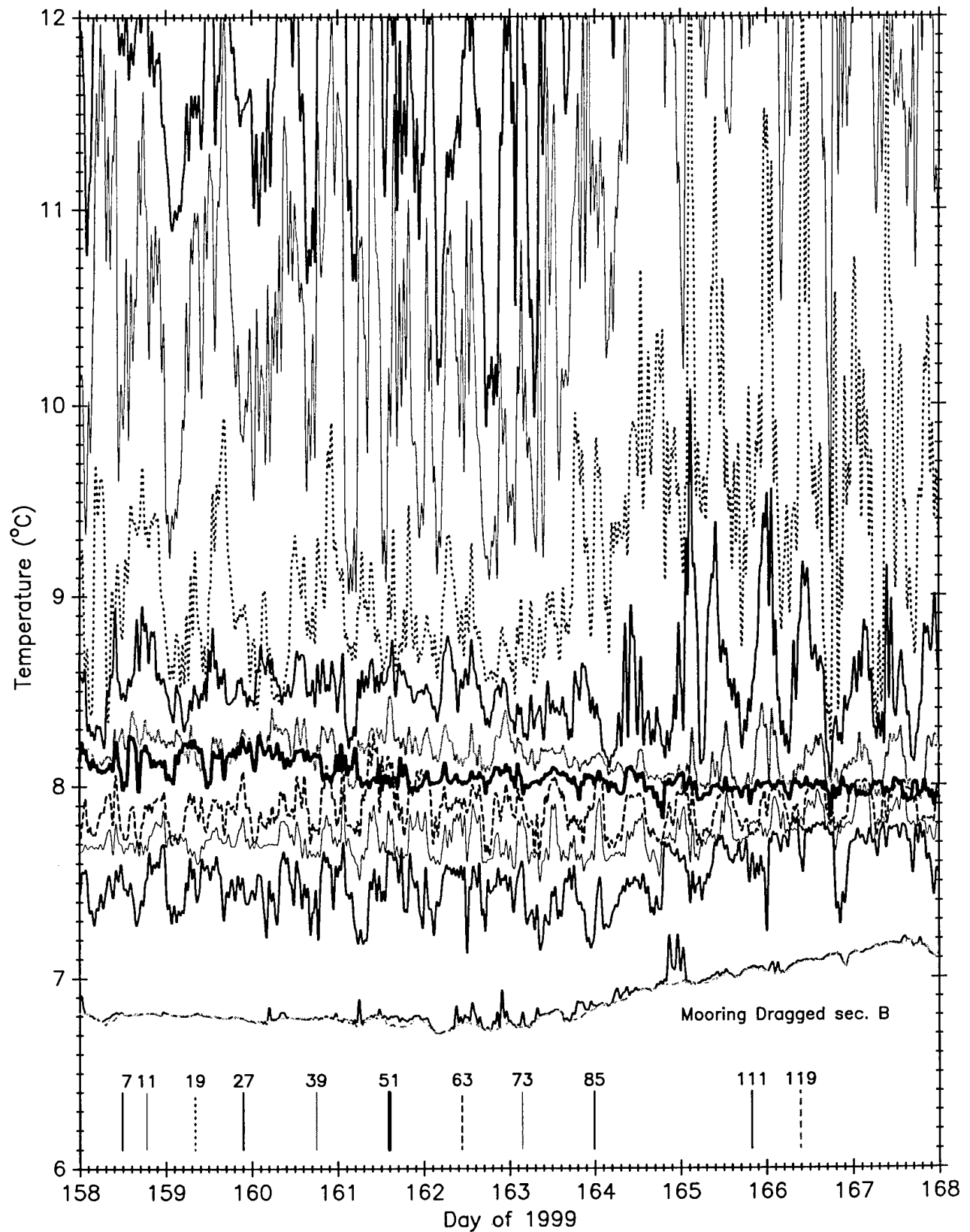
## NOPP Shelf Break 1 Hour Filtered Temperatures



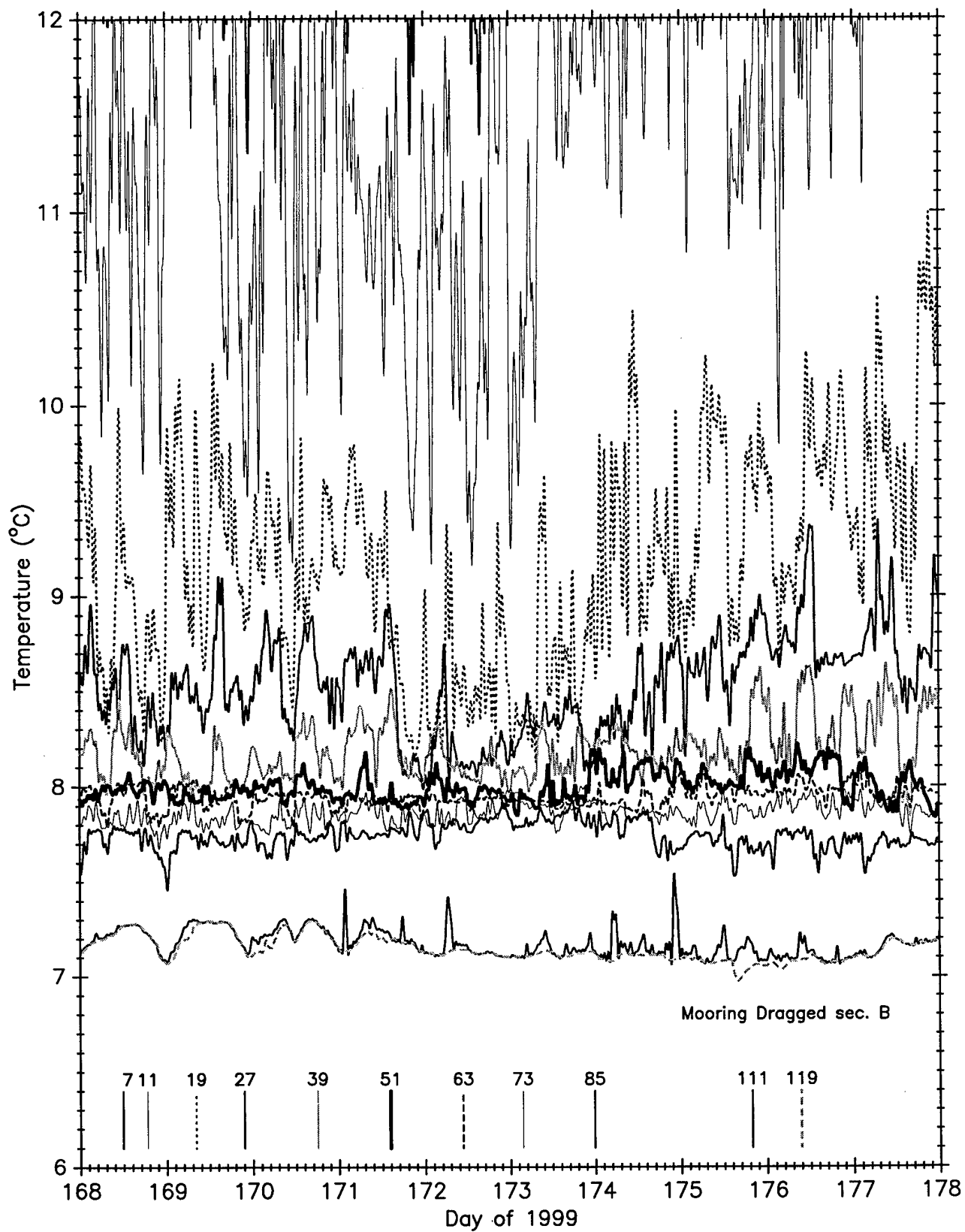
## NOPP Shelf Break 1 Hour Filtered Temperatures



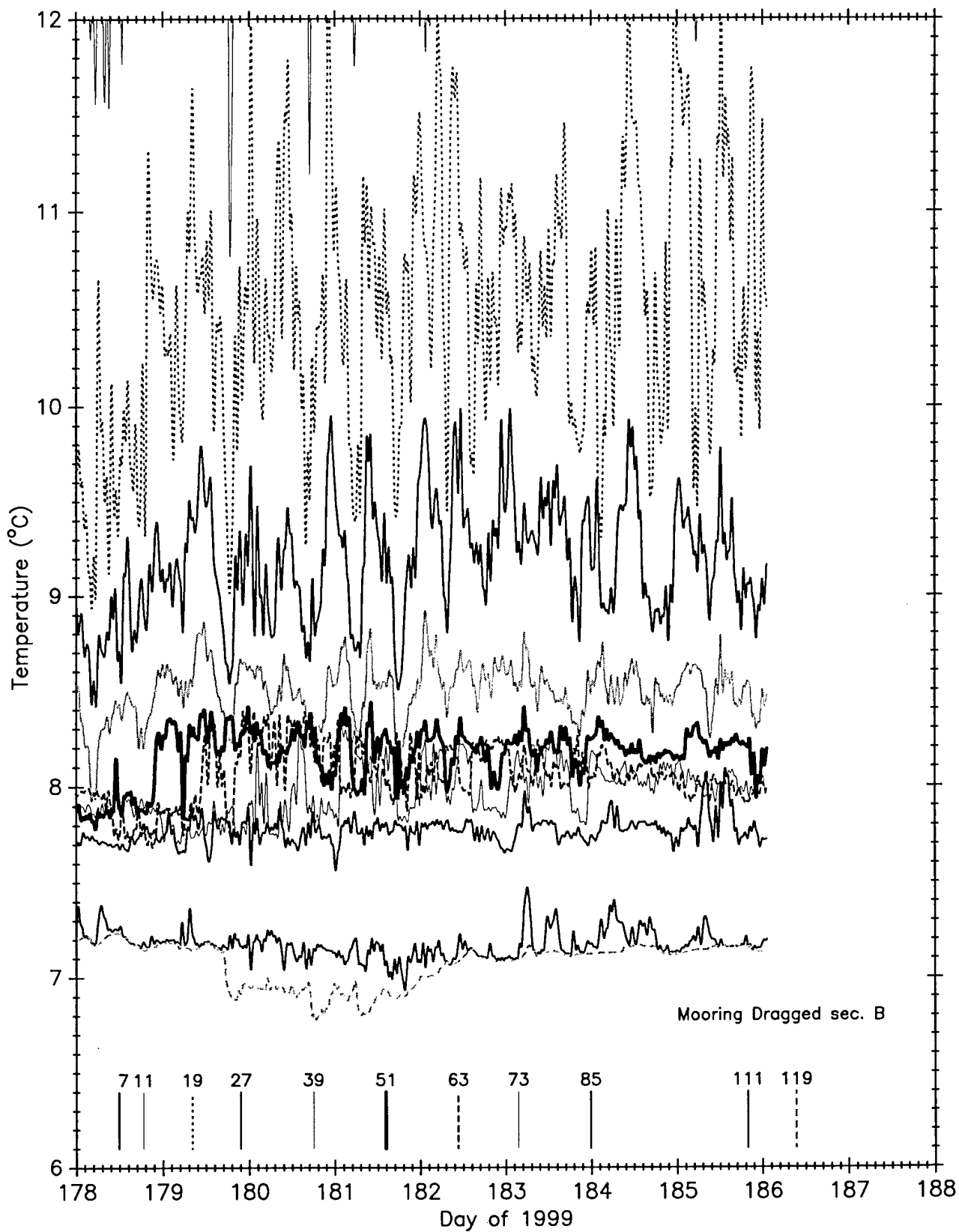
## NOPP Shelf Break 1 Hour Filtered Temperatures



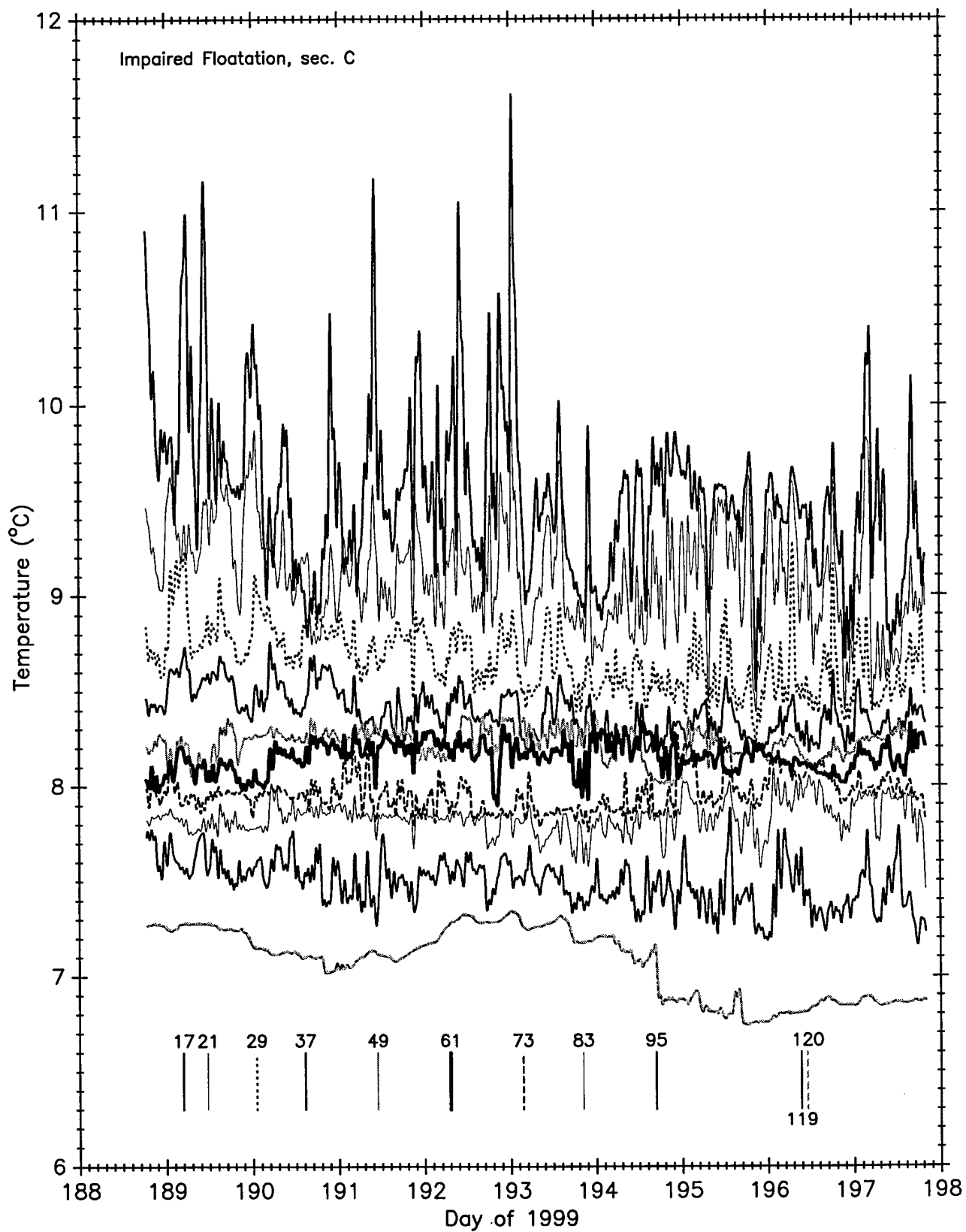
## NOPP Shelf Break 1 Hour Filtered Temperatures



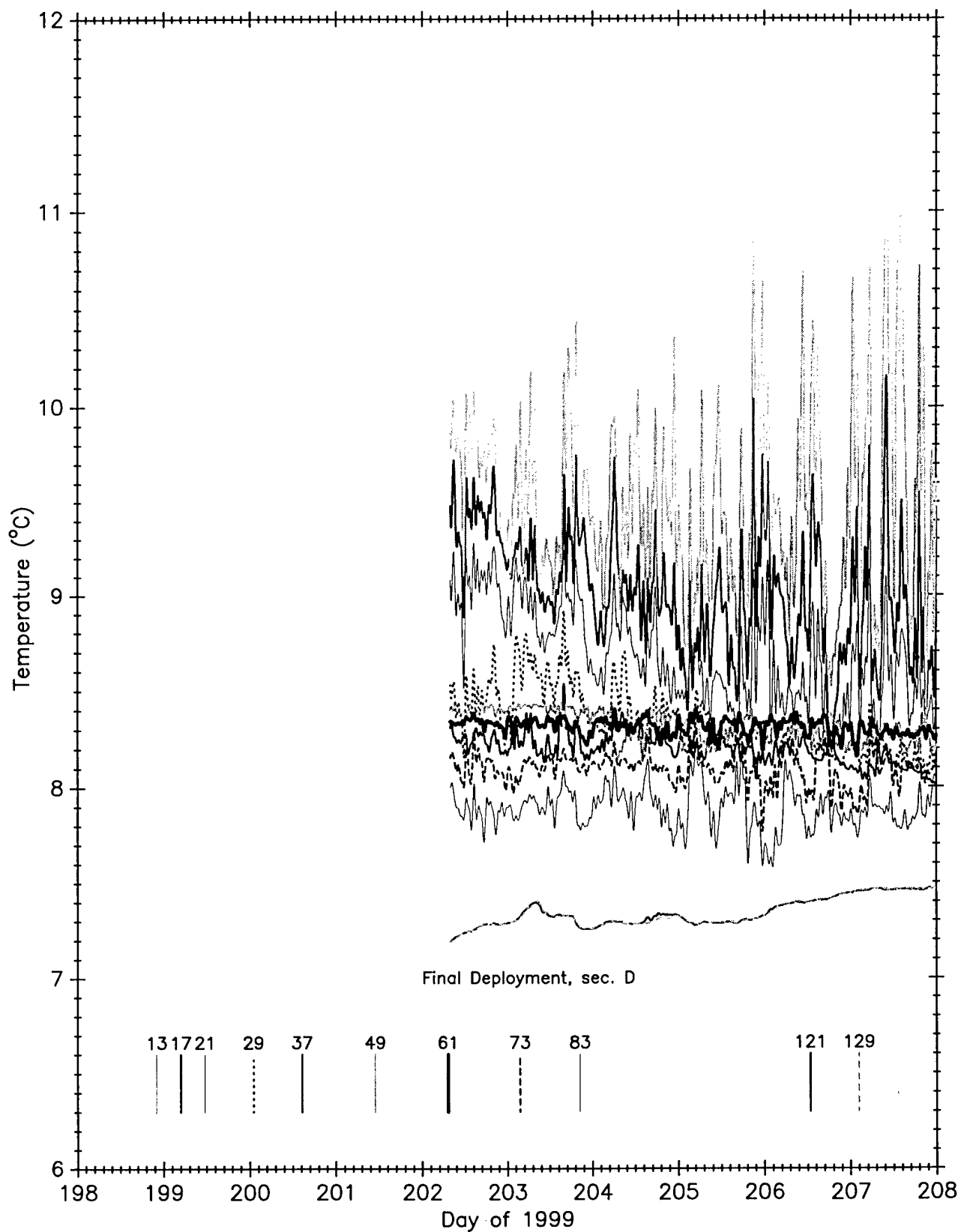
## NOPP Shelf Break 1 Hour Filtered Temperatures



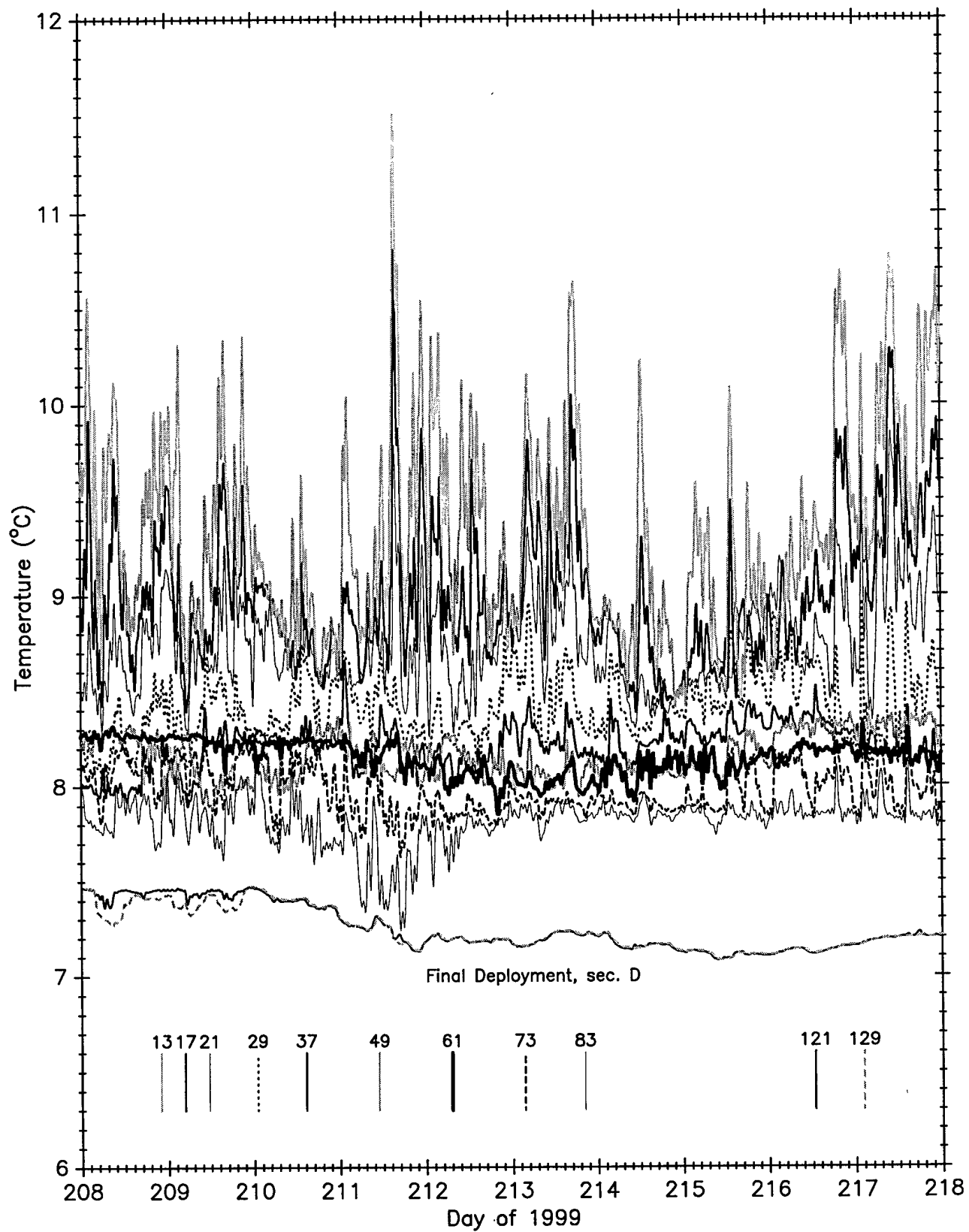
## NOPP Shelf Break 1 Hour Filtered Temperatures



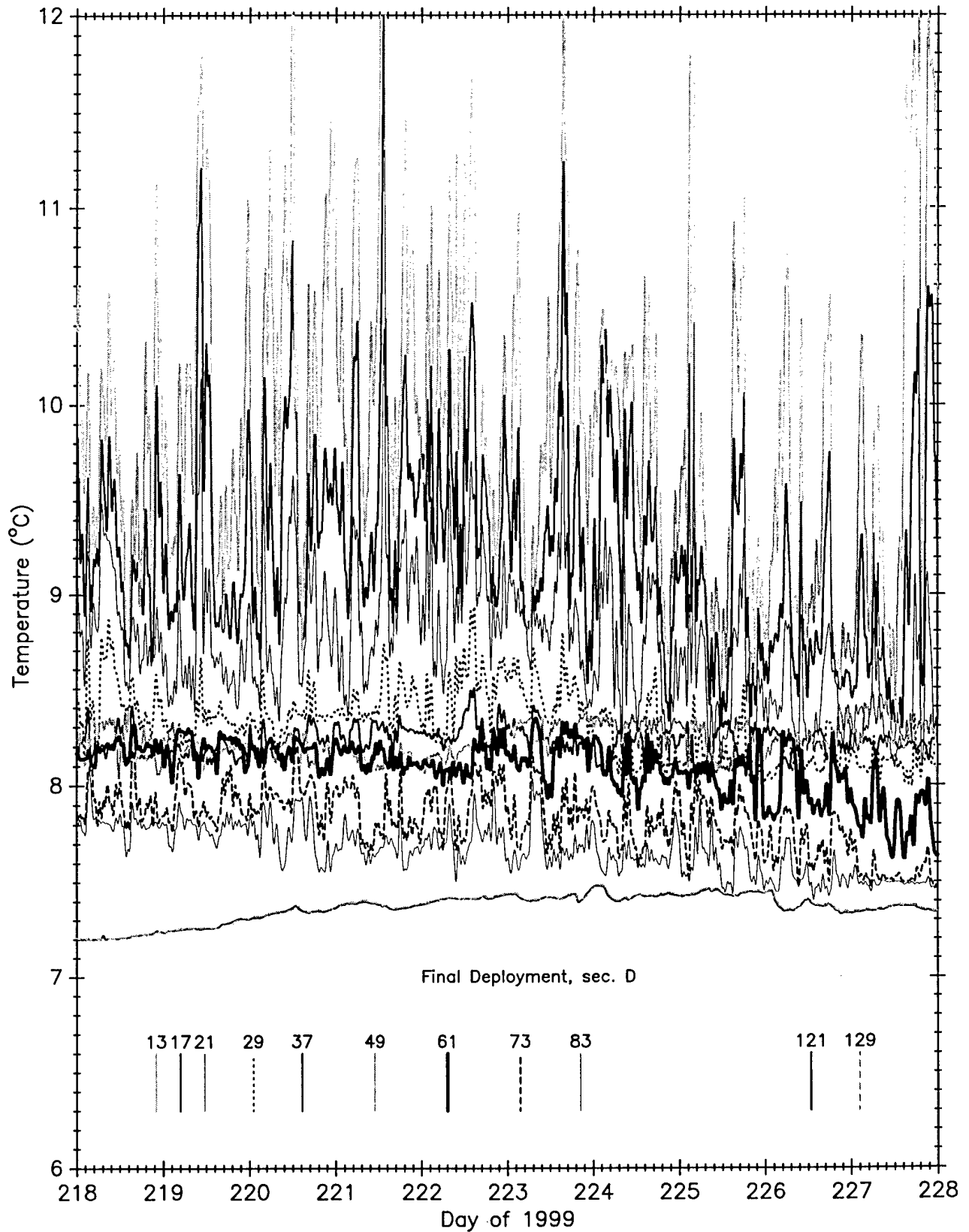
## NOPP Shelf Break 1 Hour Filtered Temperatures



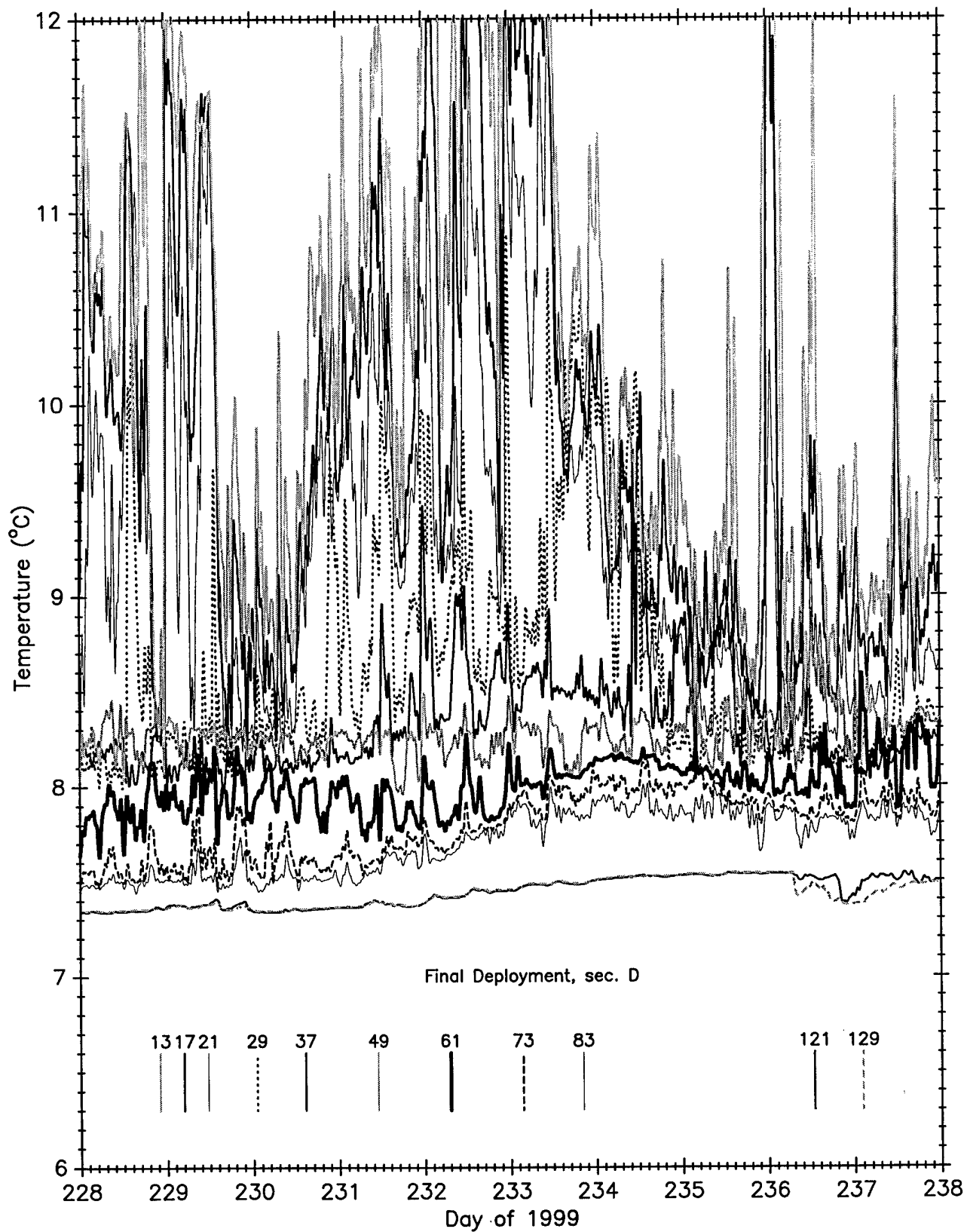
## NOPP Shelf Break 1 Hour Filtered Temperatures



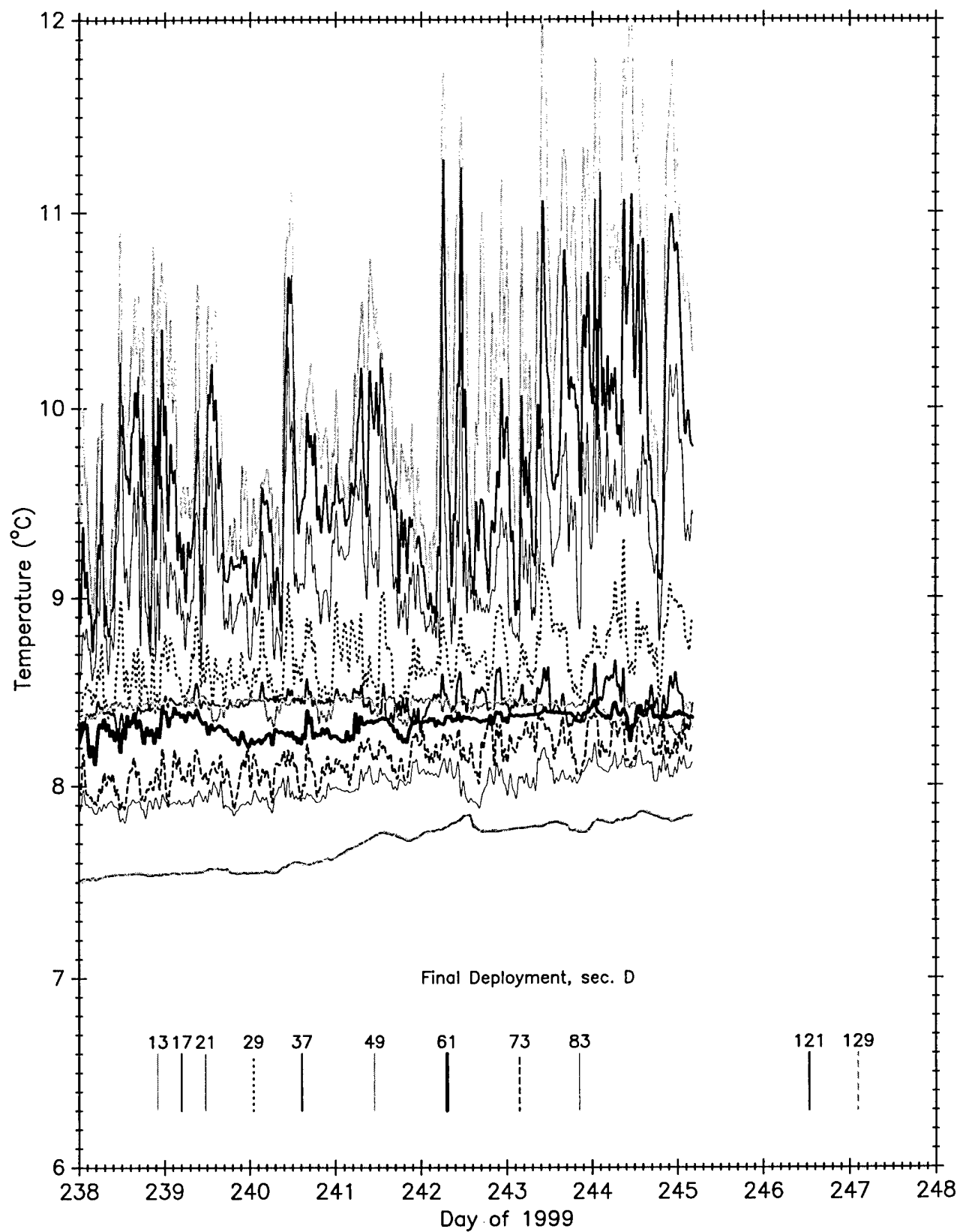
## NOPP Shelf Break 1 Hour Filtered Temperatures



## NOPP Shelf Break 1 Hour Filtered Temperatures



## NOPP Shelf Break 1 Hour Filtered Temperatures



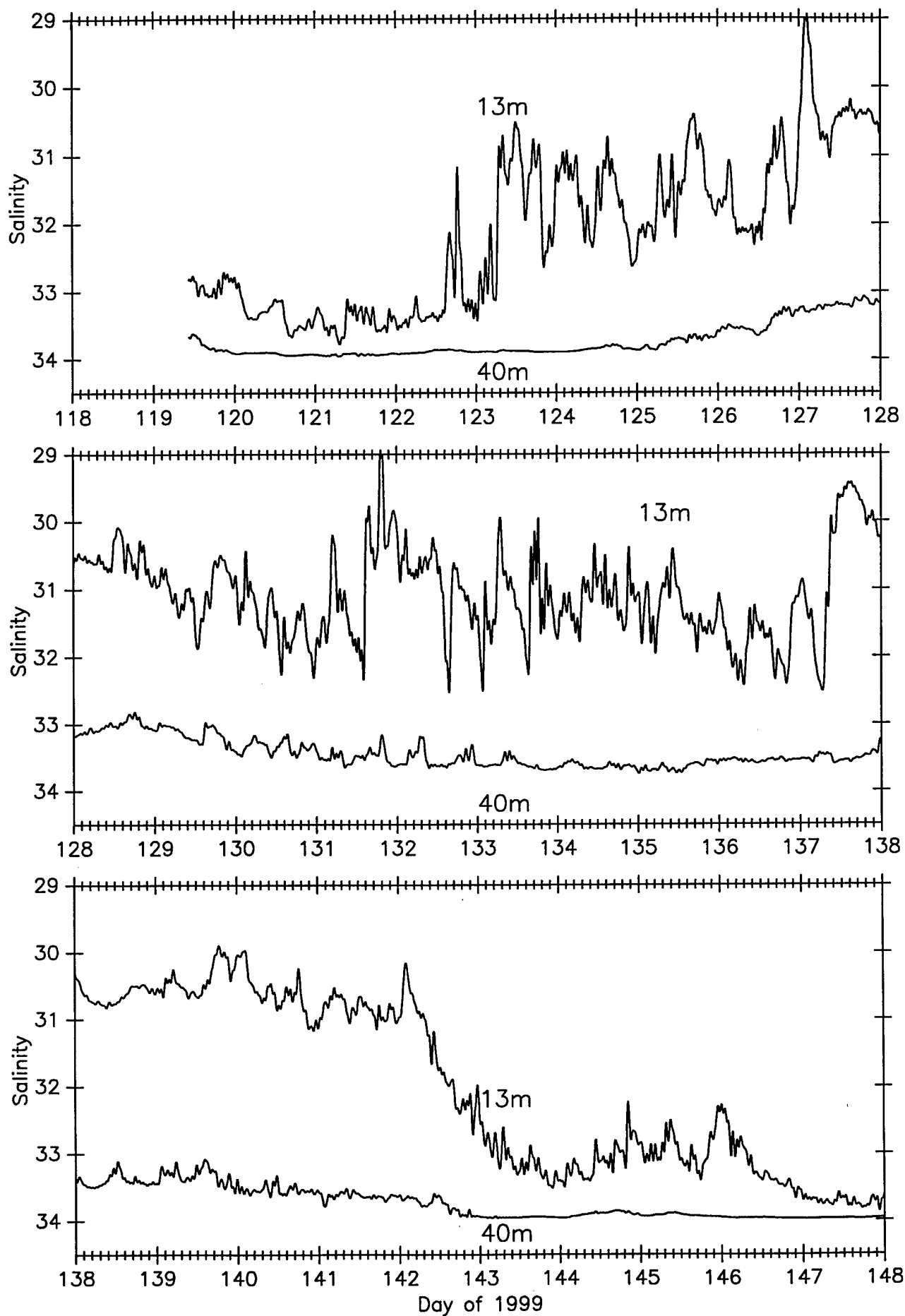
## **SALINITY Time Series**

### **1-hour Low-Pass Filtered**

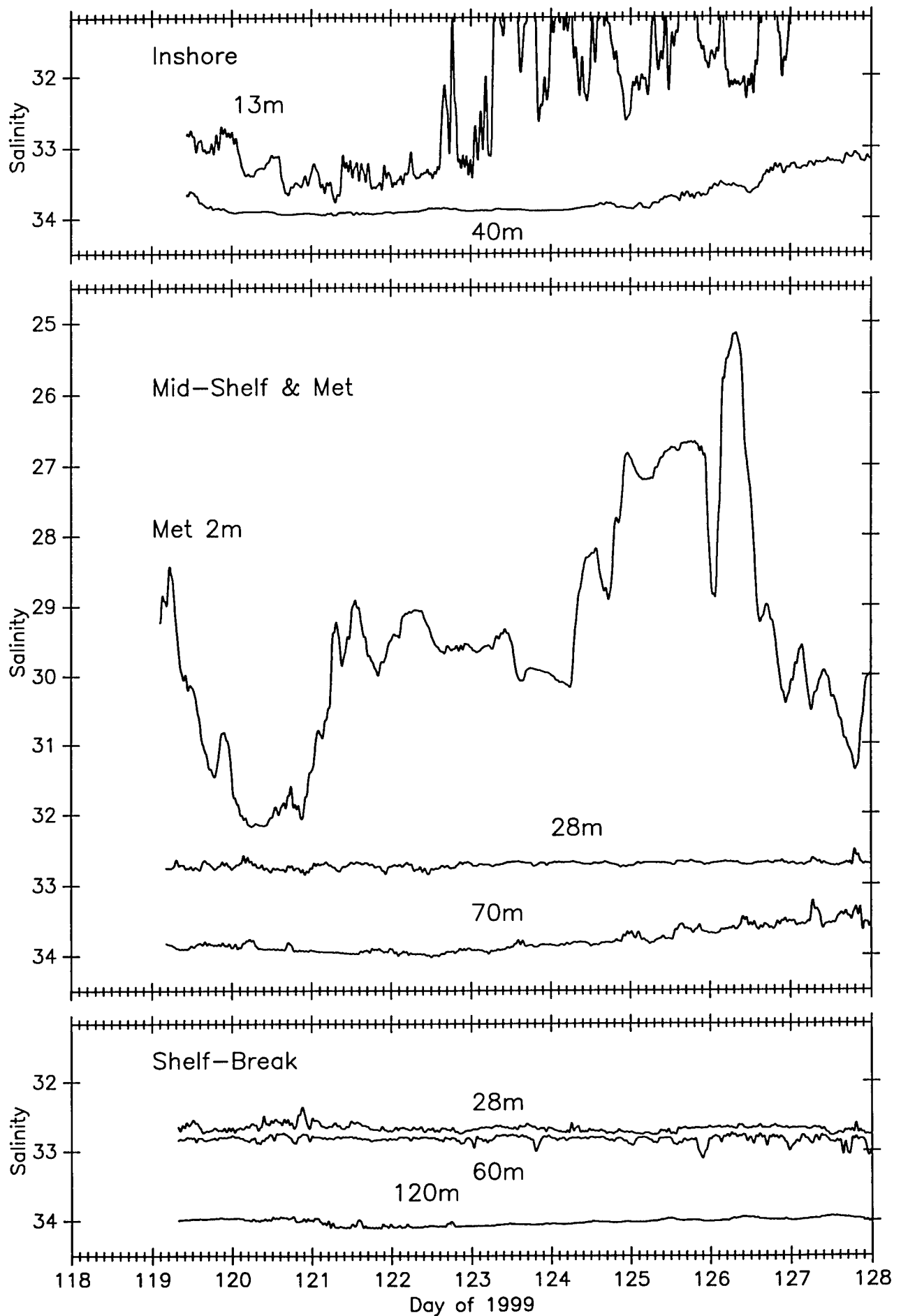
Plots of salinity from the Inshore, Mid-Shelf, Met, and Shelf-Break. Note that the salinity scale is the same on all plots, although the range is greater for the combined plot of combined Mid-Shelf & Met mooring salinities. Note the gap in Shelf-Break mooring salinity records after day 143, corresponding to the changes of depth associated with the mooring being hit by the trawler. Plots of salinity from 29 m and 61 m are presented for the duration of period C, following the loss of buoyancy from the Shelf-Break mooring on day 186. Salinity from 119 m during this period is omitted as unreliable. Inshore mooring salinity is also plotted separately for the period prior to day 148, to accommodate the low near-surface values near the beginning of the record.



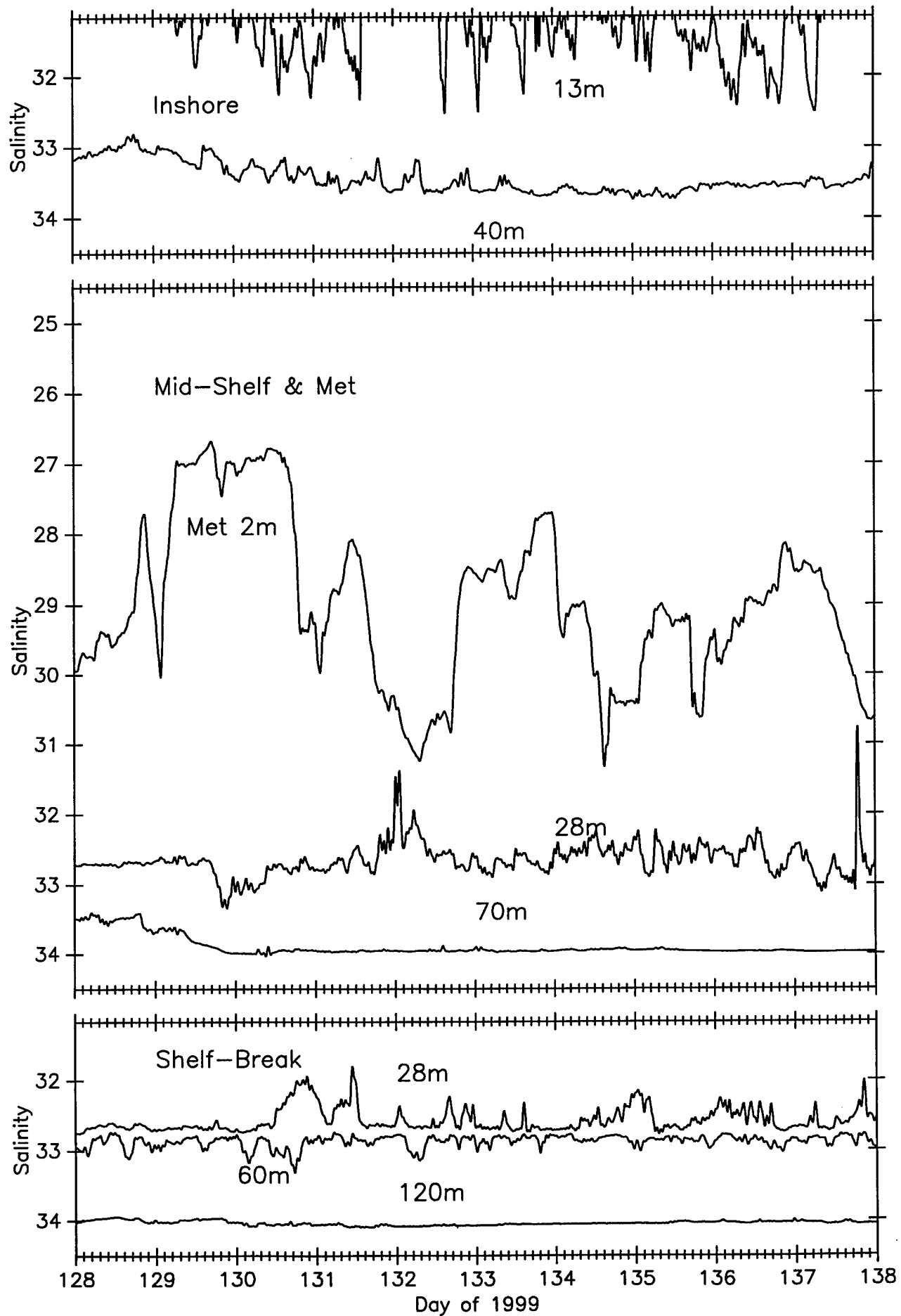
## NOPP Inshore Mooring 1 Hour Filtered Salinities



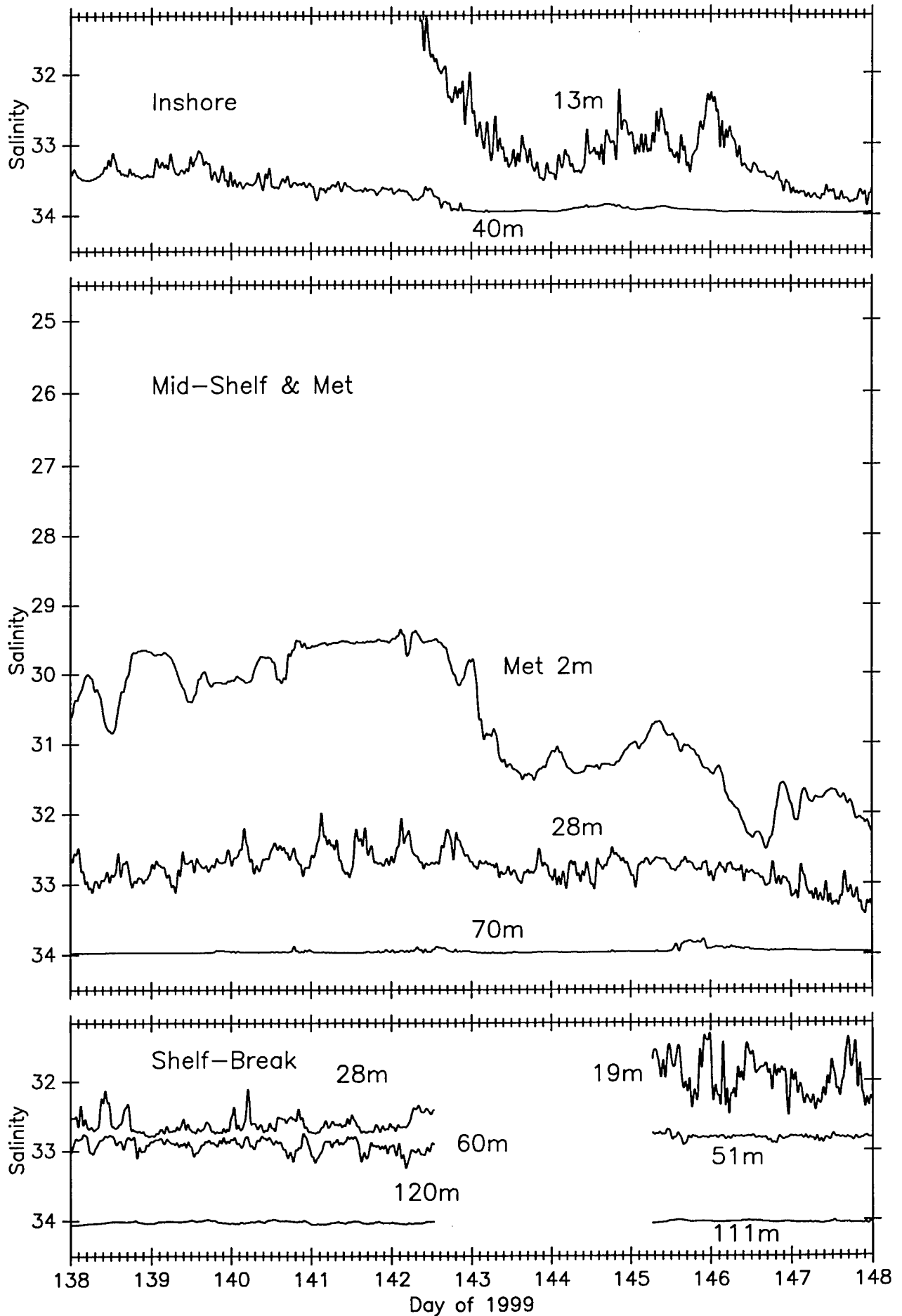
## NOPP 1 Hour Filtered Salinities



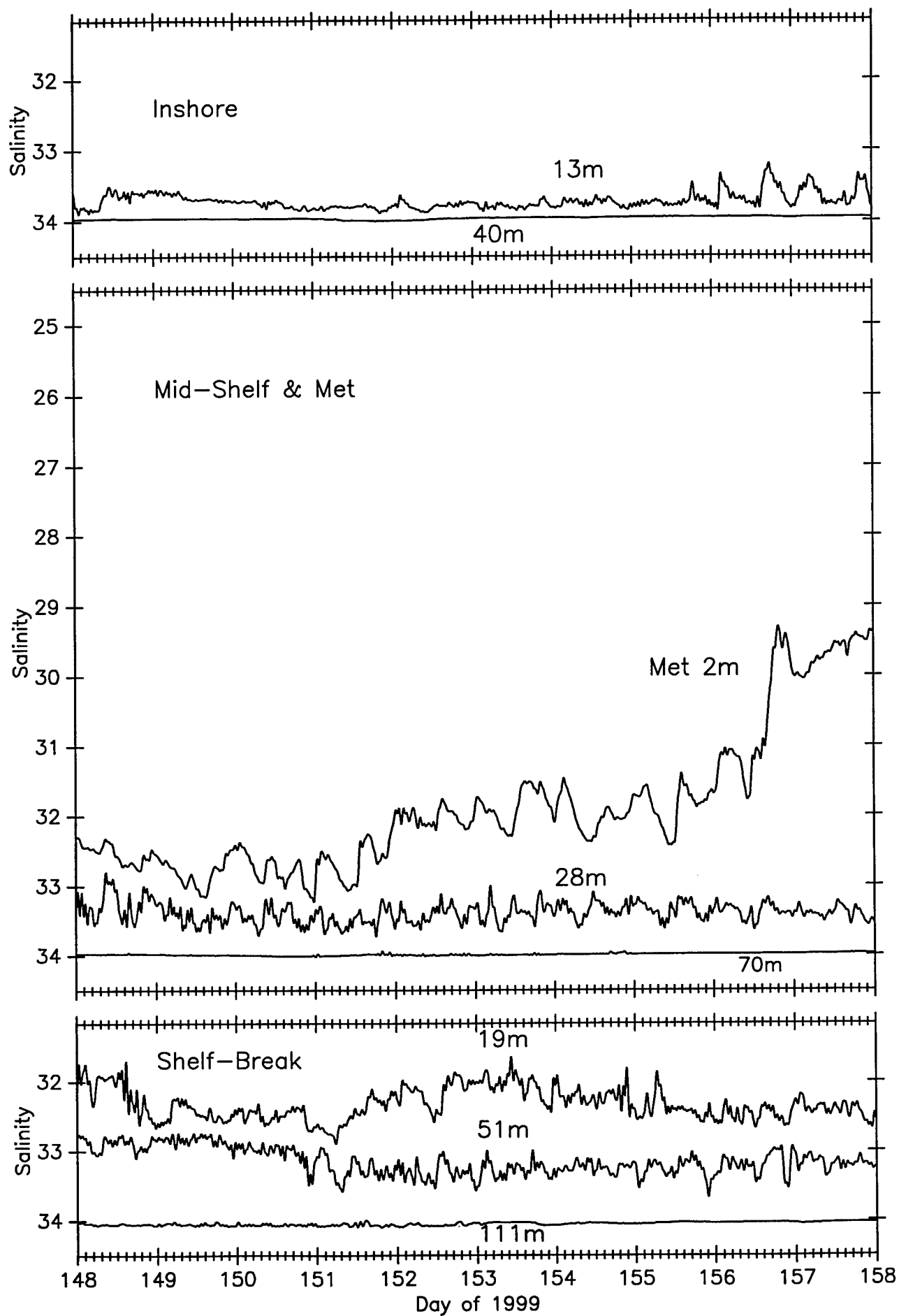
## NOPP 1 Hour Filtered Salinities



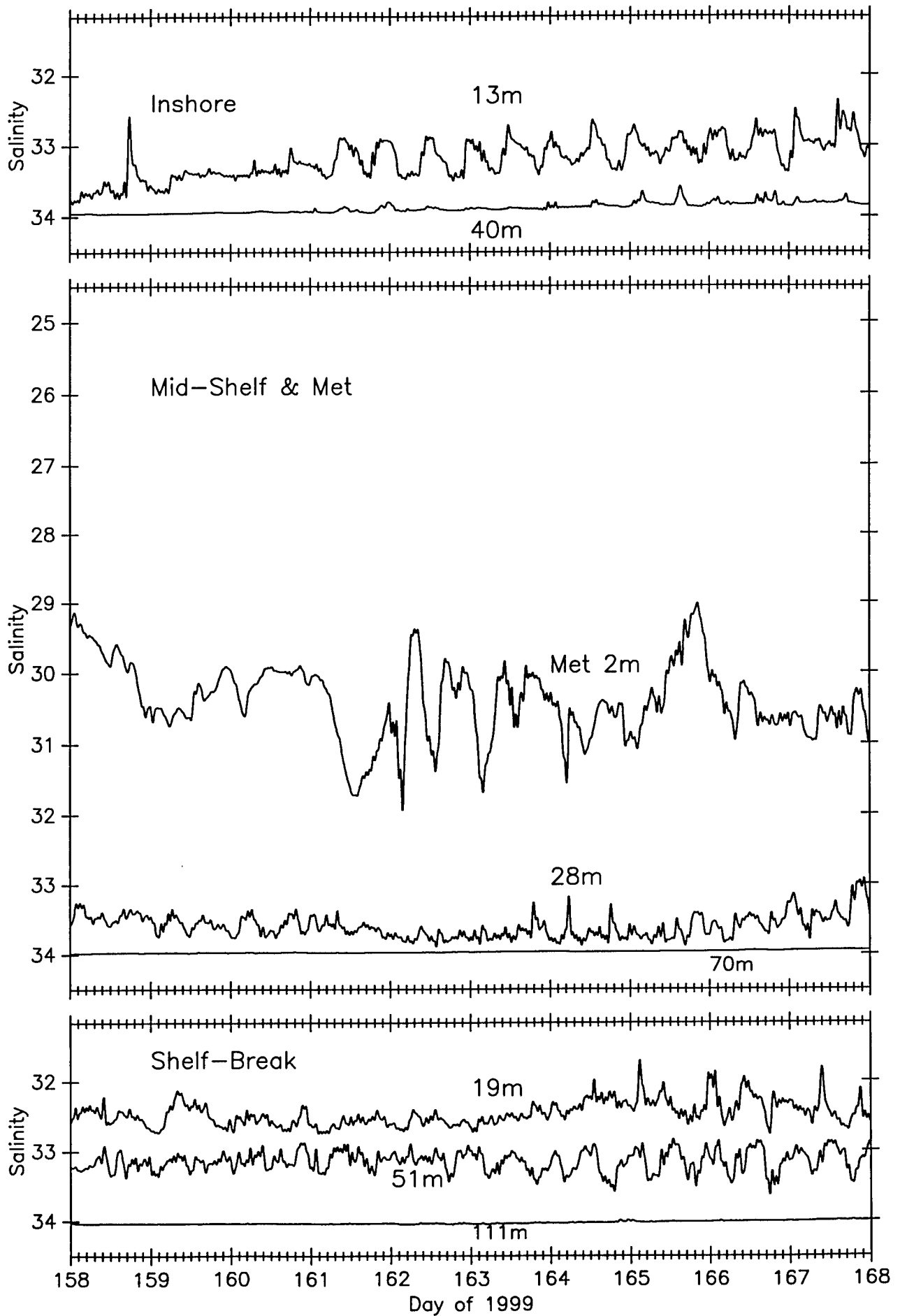
## NOPP 1 Hour Filtered Salinities



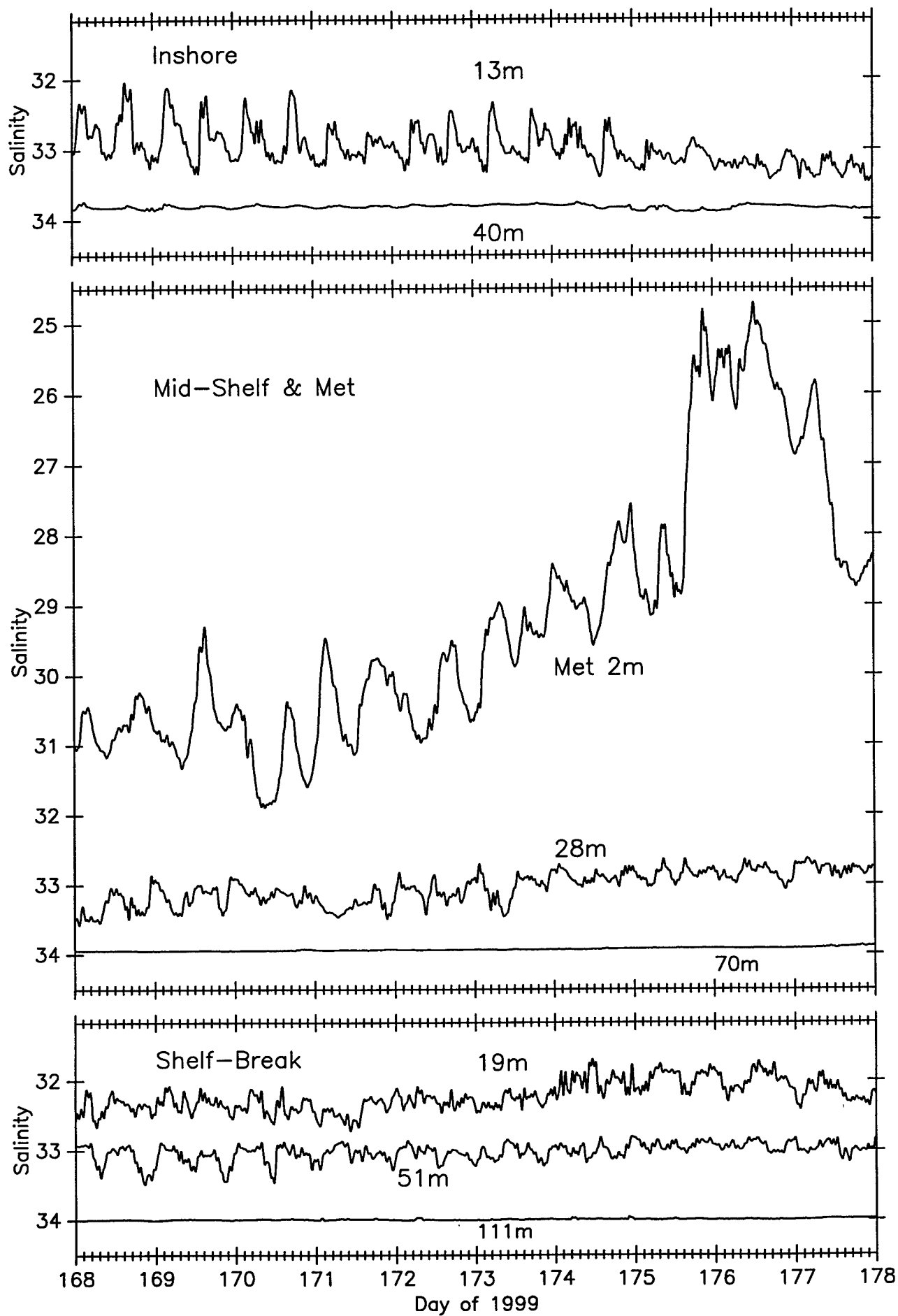
## NOPP 1 Hour Filtered Salinities



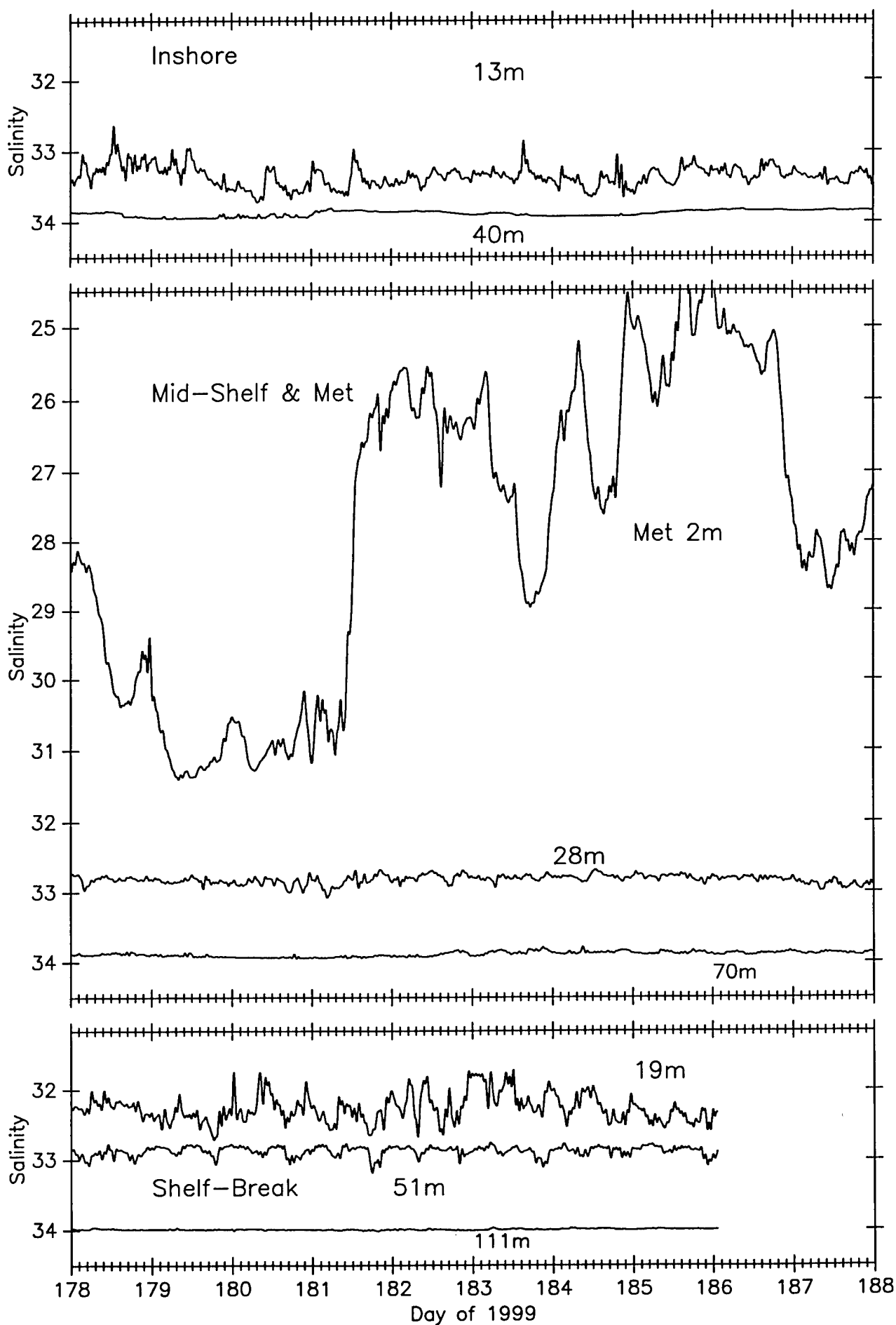
## NOPP 1 Hour Filtered Salinities



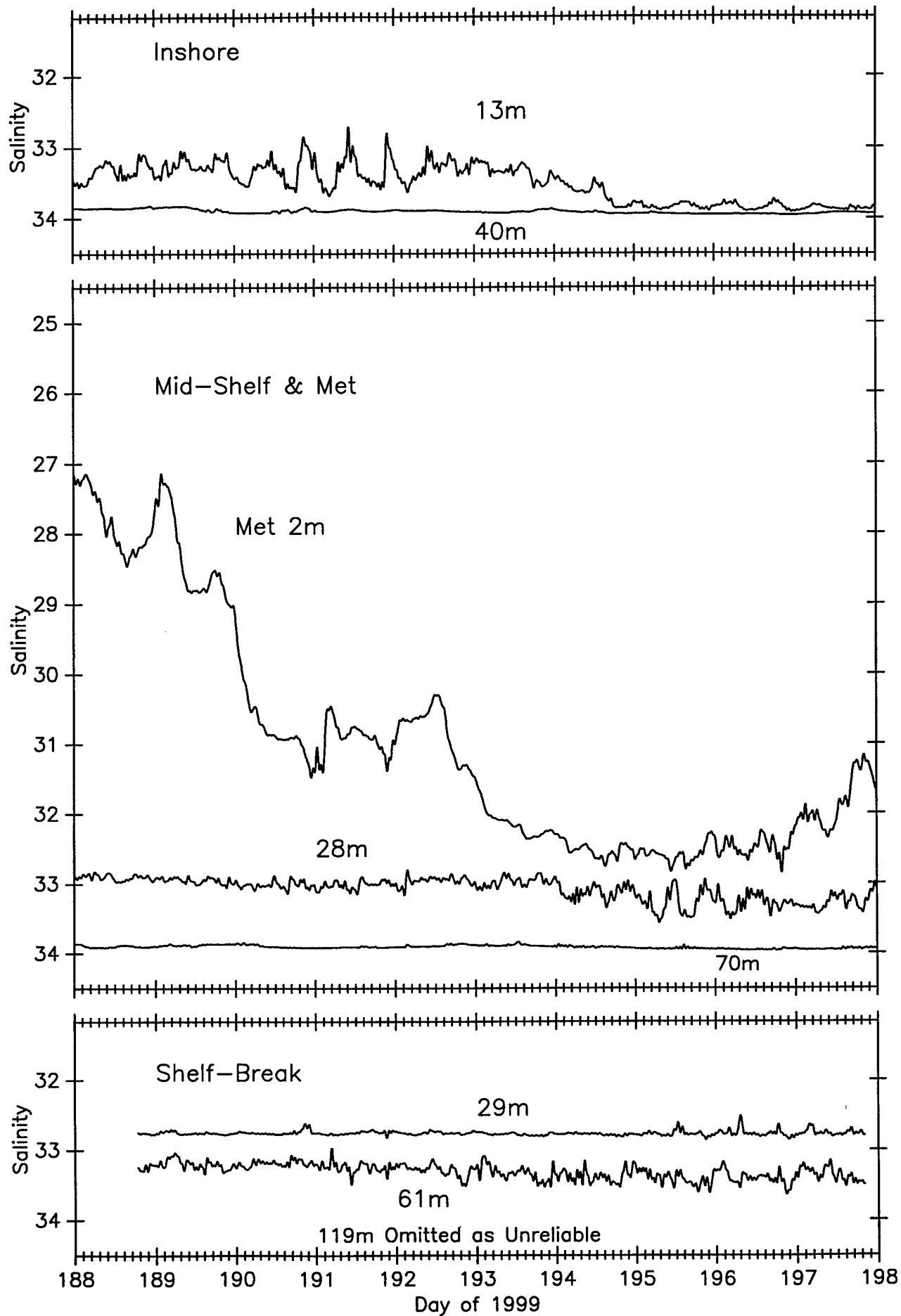
## NOPP 1 Hour Filtered Salinities



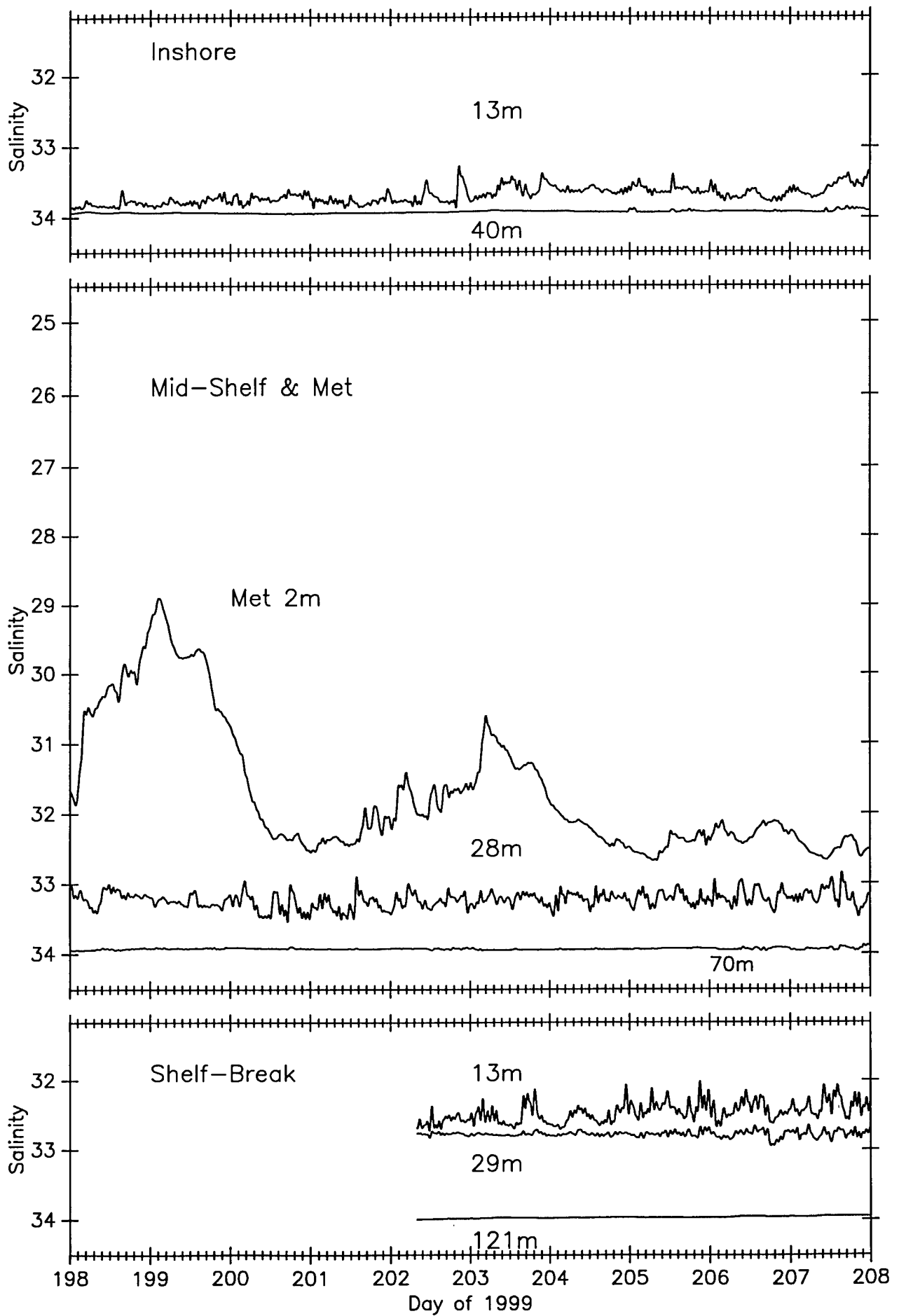
## NOPP 1 Hour Filtered Salinities



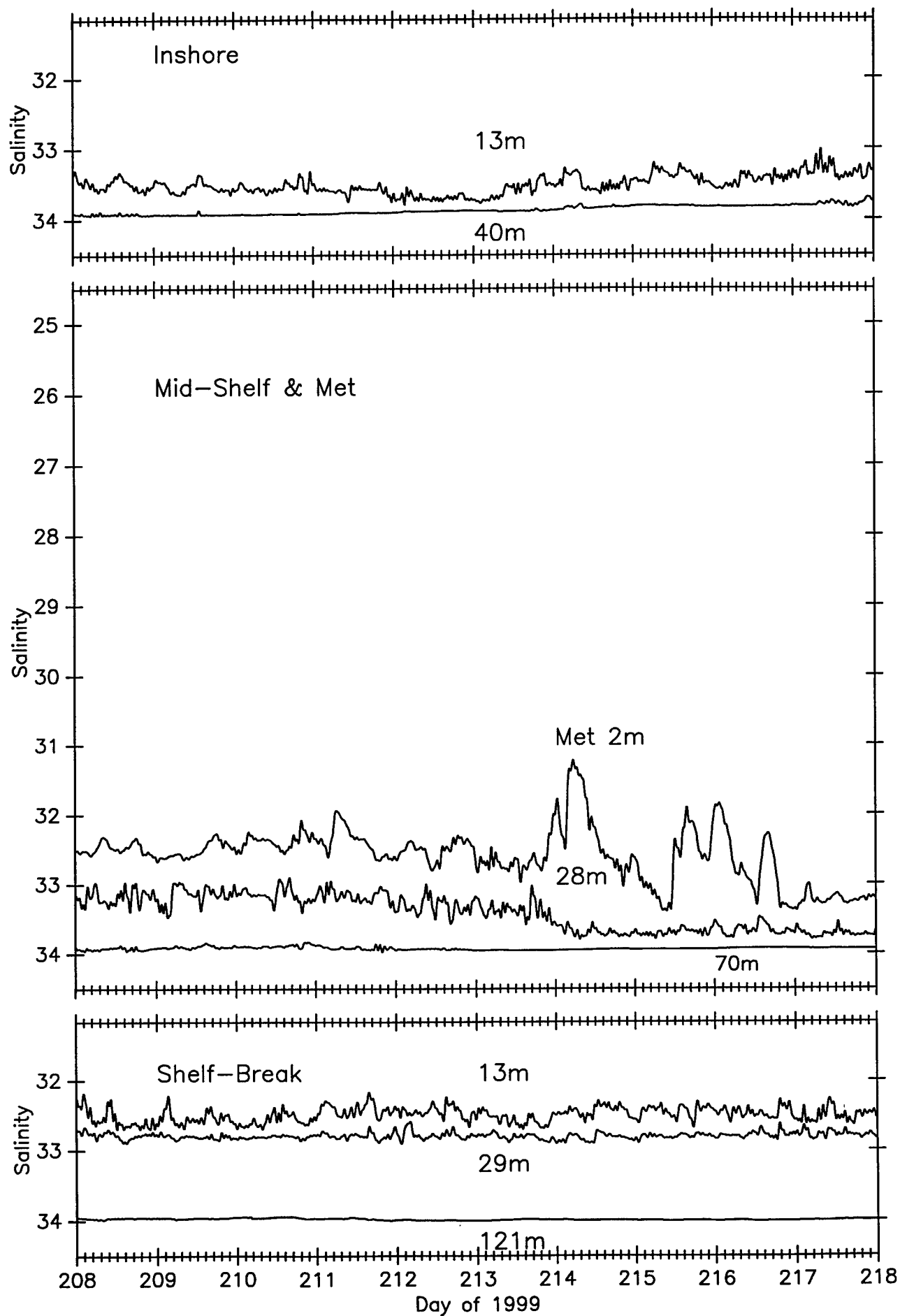
## NOPP 1 Hour Filtered Salinities



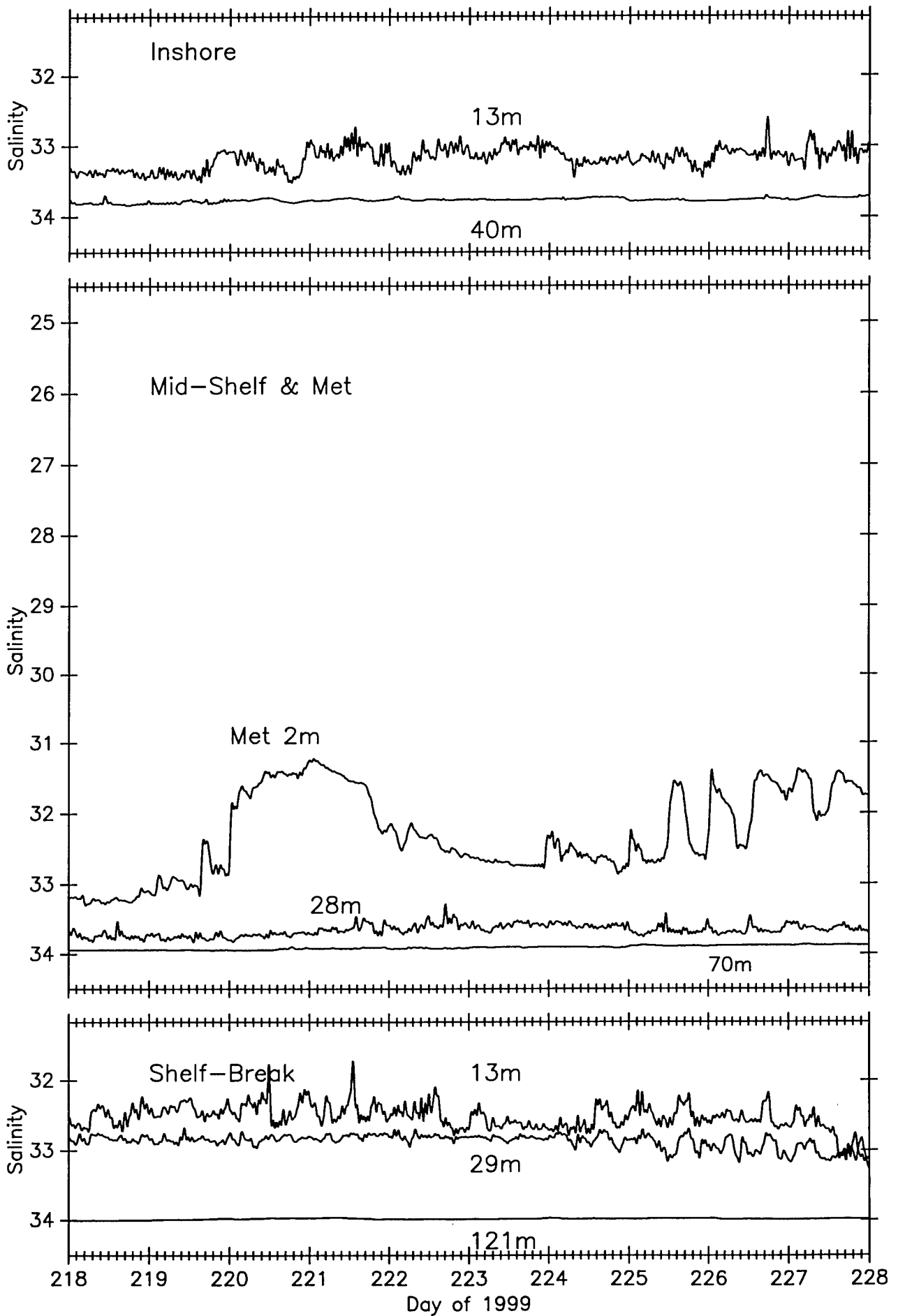
## NOPP 1 Hour Filtered Salinities



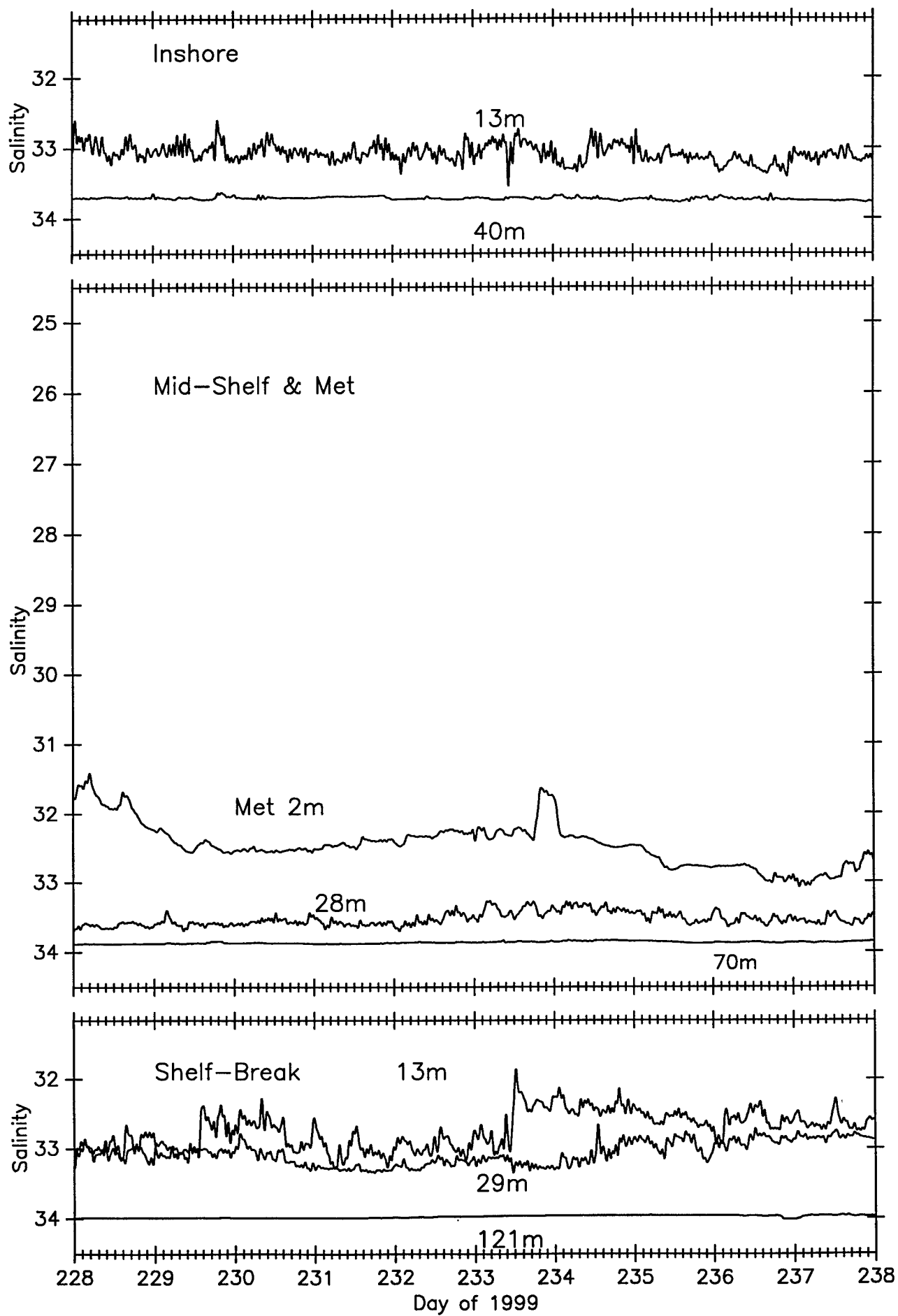
## NOPP 1 Hour Filtered Salinities



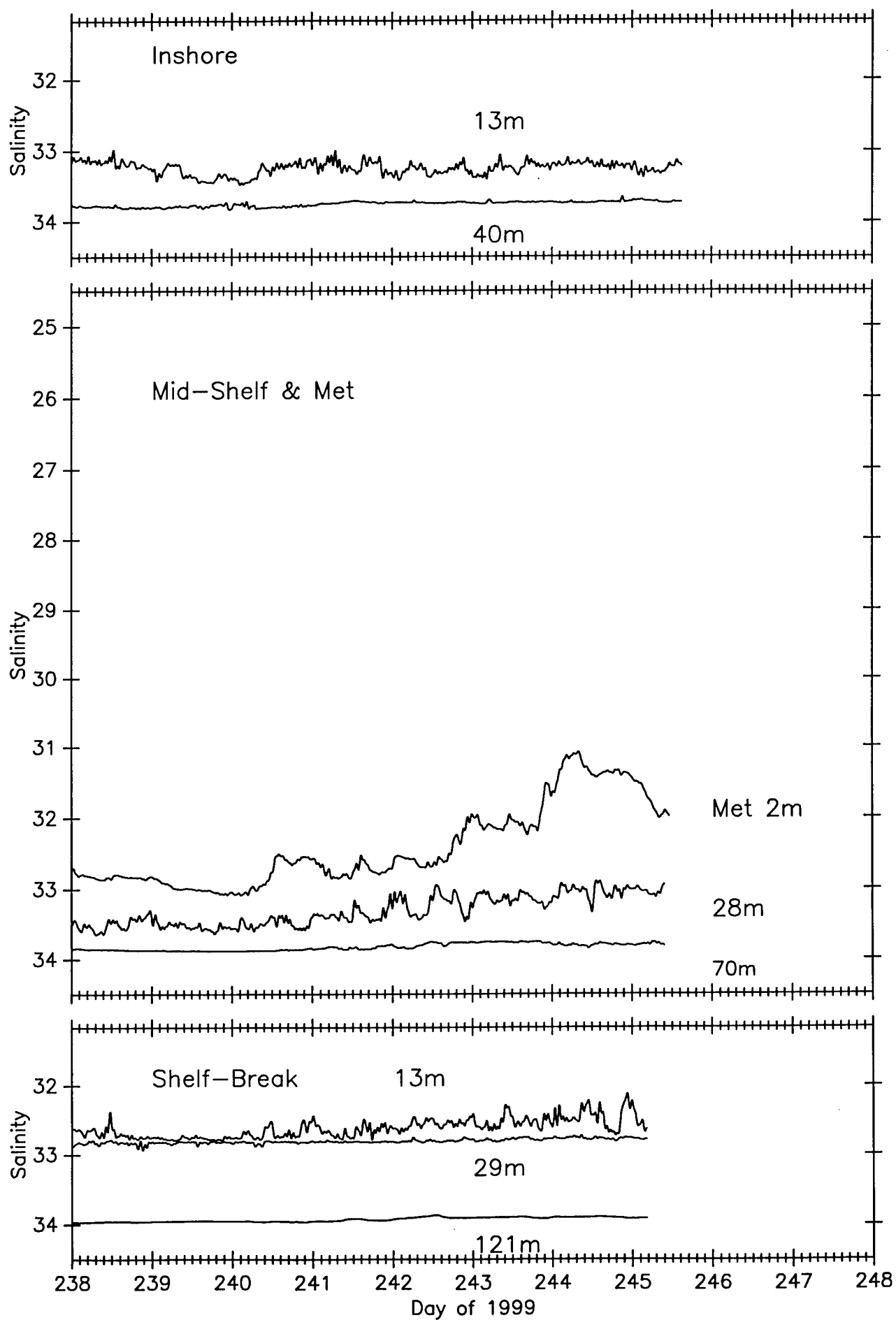
## NOPP 1 Hour Filtered Salinities



## NOPP 1 Hour Filtered Salinities



## NOPP 1 Hour Filtered Salinities



## **METEOROLOGICAL Time Series**

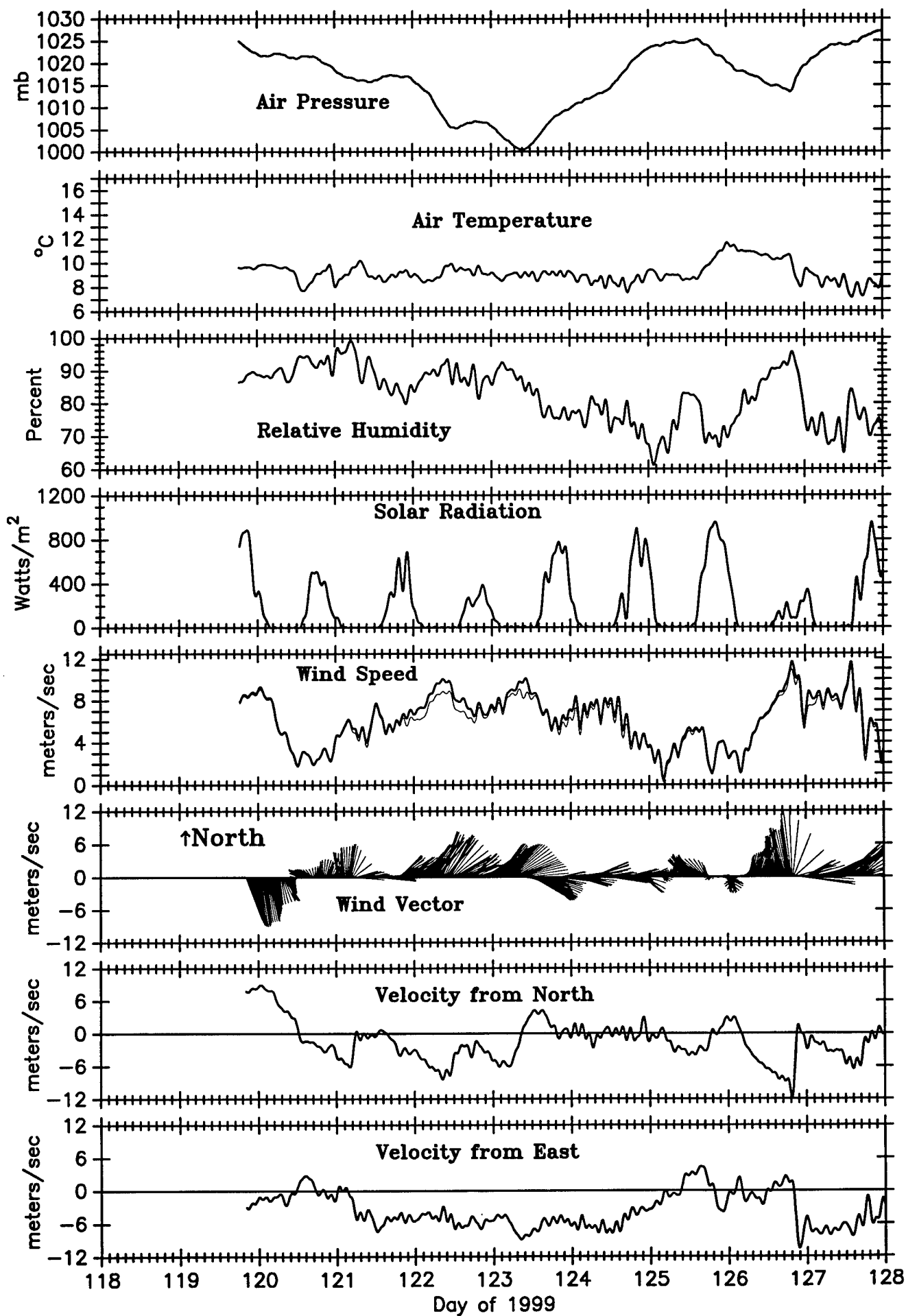
### **1-hour Low-Pass Filtered**

Plots of air pressure, air temperature, relative humidity, solar radiation, wind speed, wind vectors and velocity. Wind velocity components are presented in the meteorological convention: velocity from north and from east. Wind velocity vectors are shown at hourly intervals. Wind speed is plotted both as converted anemometer rotor counts (bold line) and as magnitude of the vector-averaged velocity (light line). No wind data is available for the period between loss of the anemometer on day 203 and replacement of the anemometer on day 215. Wind direction is not provided for the period following the anemometer replacement due to ambiguity in the orientation of the replacement anemometer.

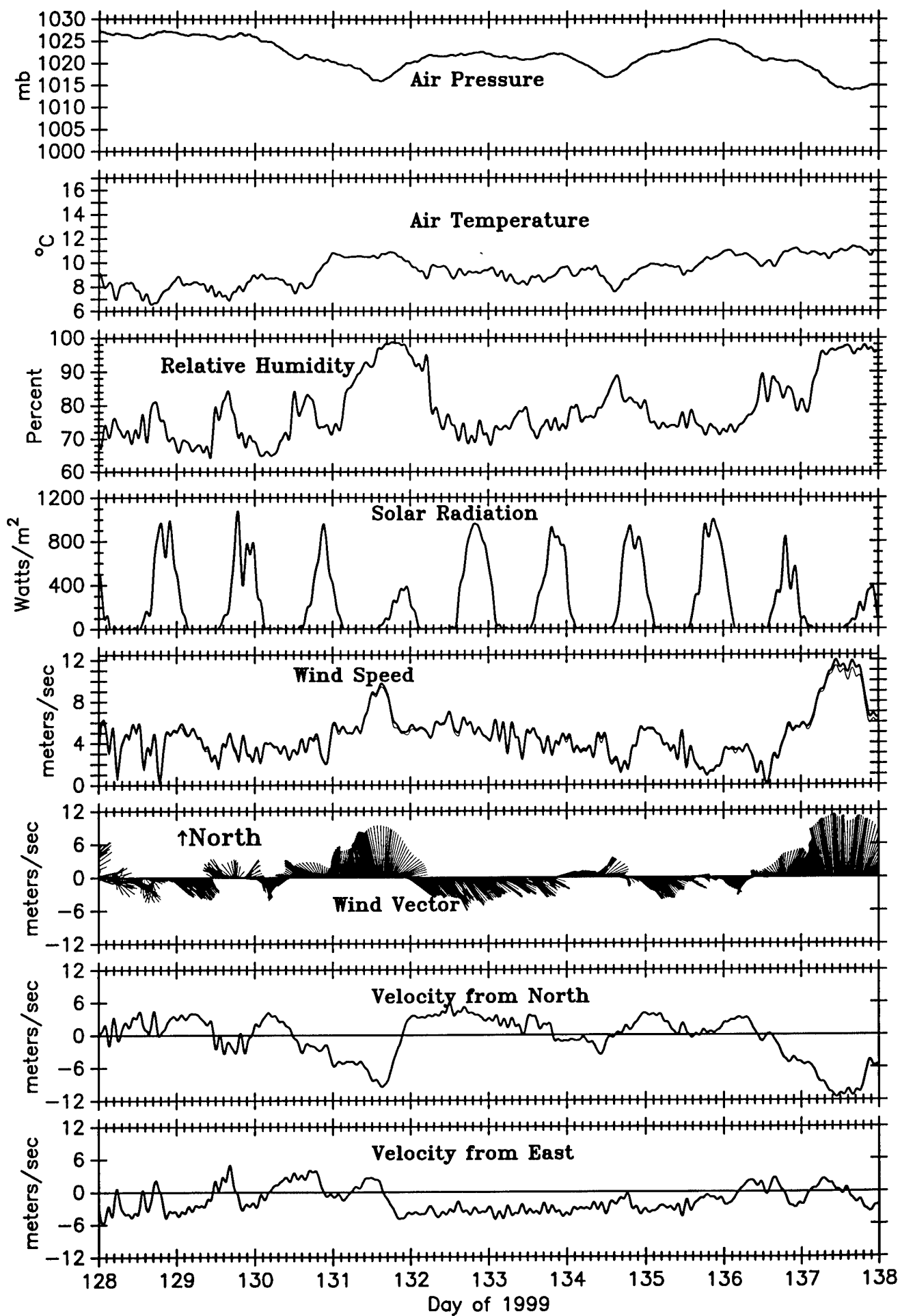
Plots of shortwave solar radiation, wind speed (magnitude of the vector-averaged velocity), and 2-m water temperature from the Met, Inshore, and Shelf-Break moorings.



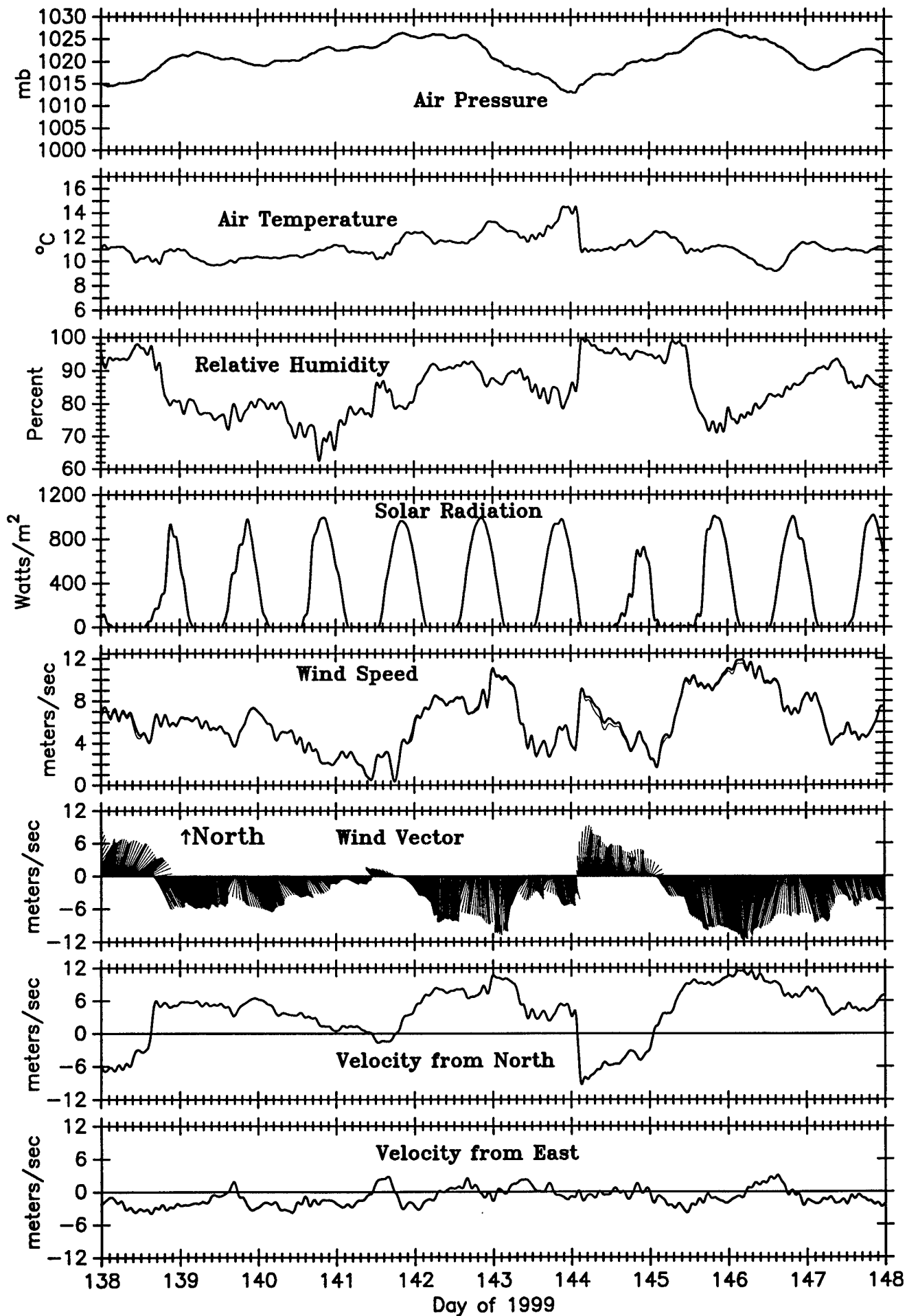
## Met Mooring 1 Hour Filtered Meteorological Data



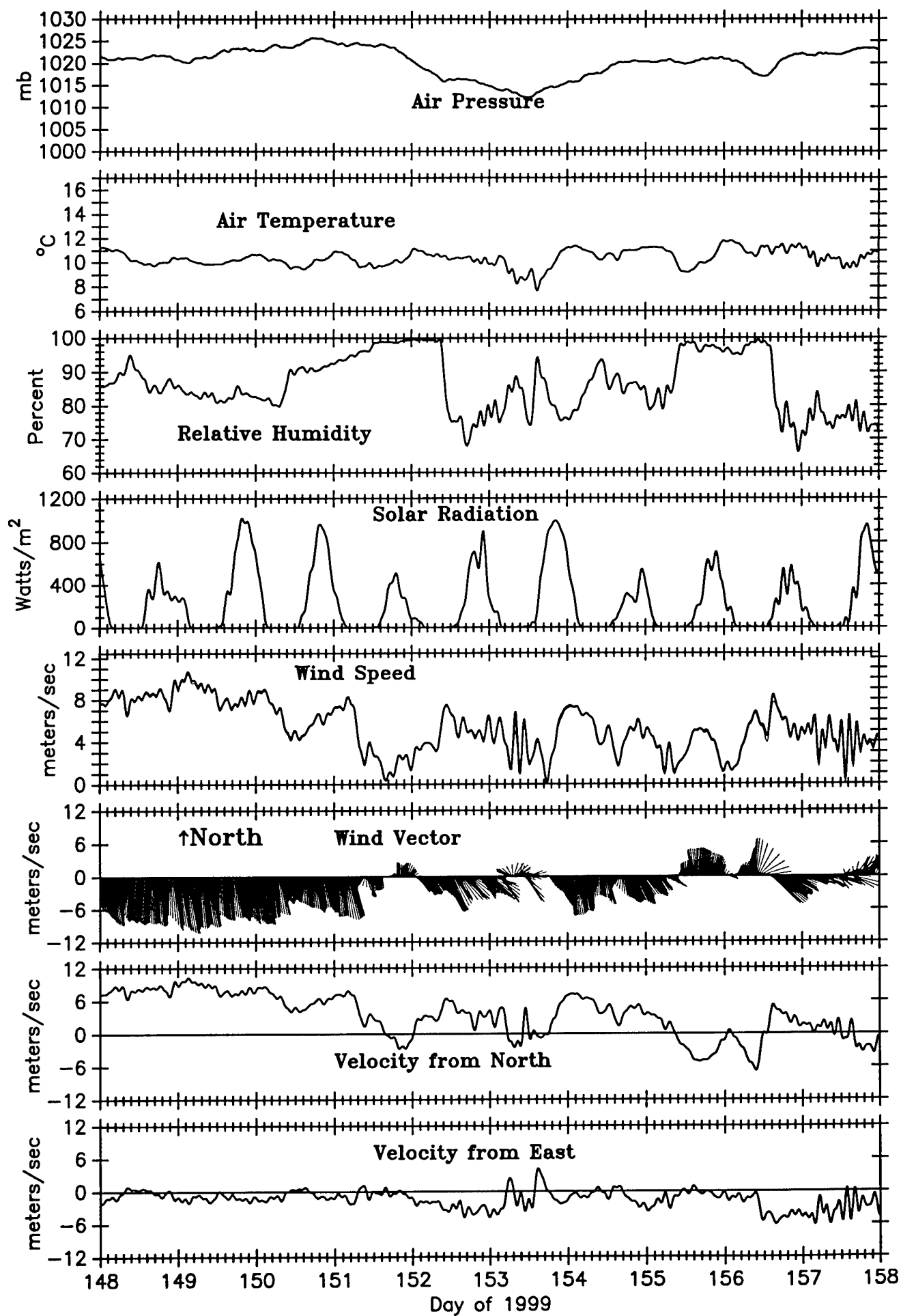
## Met Mooring 1 Hour Filtered Meteorological Data



## Met Mooring 1 Hour Filtered Meteorological Data

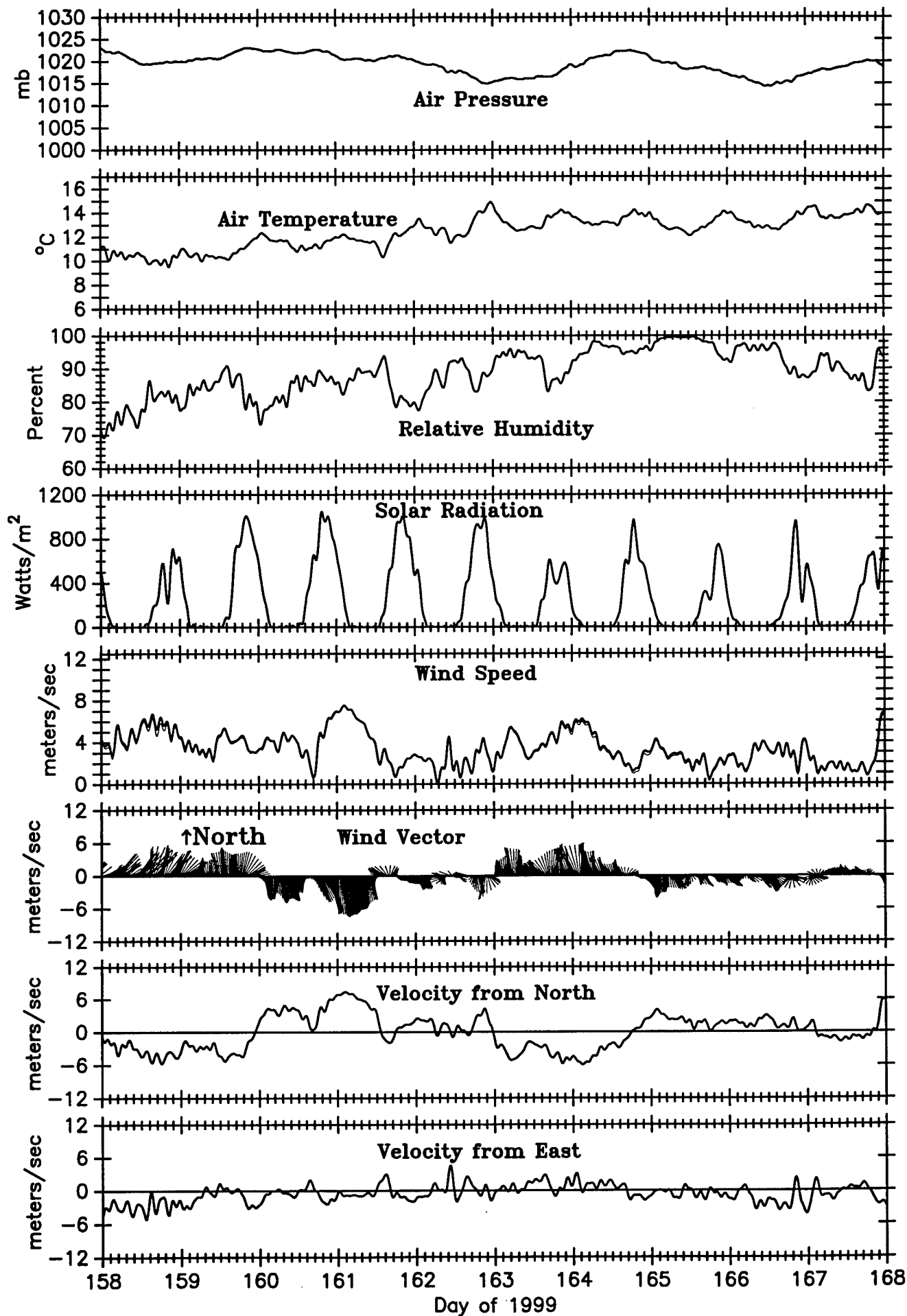


## Met Mooring 1 Hour Filtered Meteorological Data

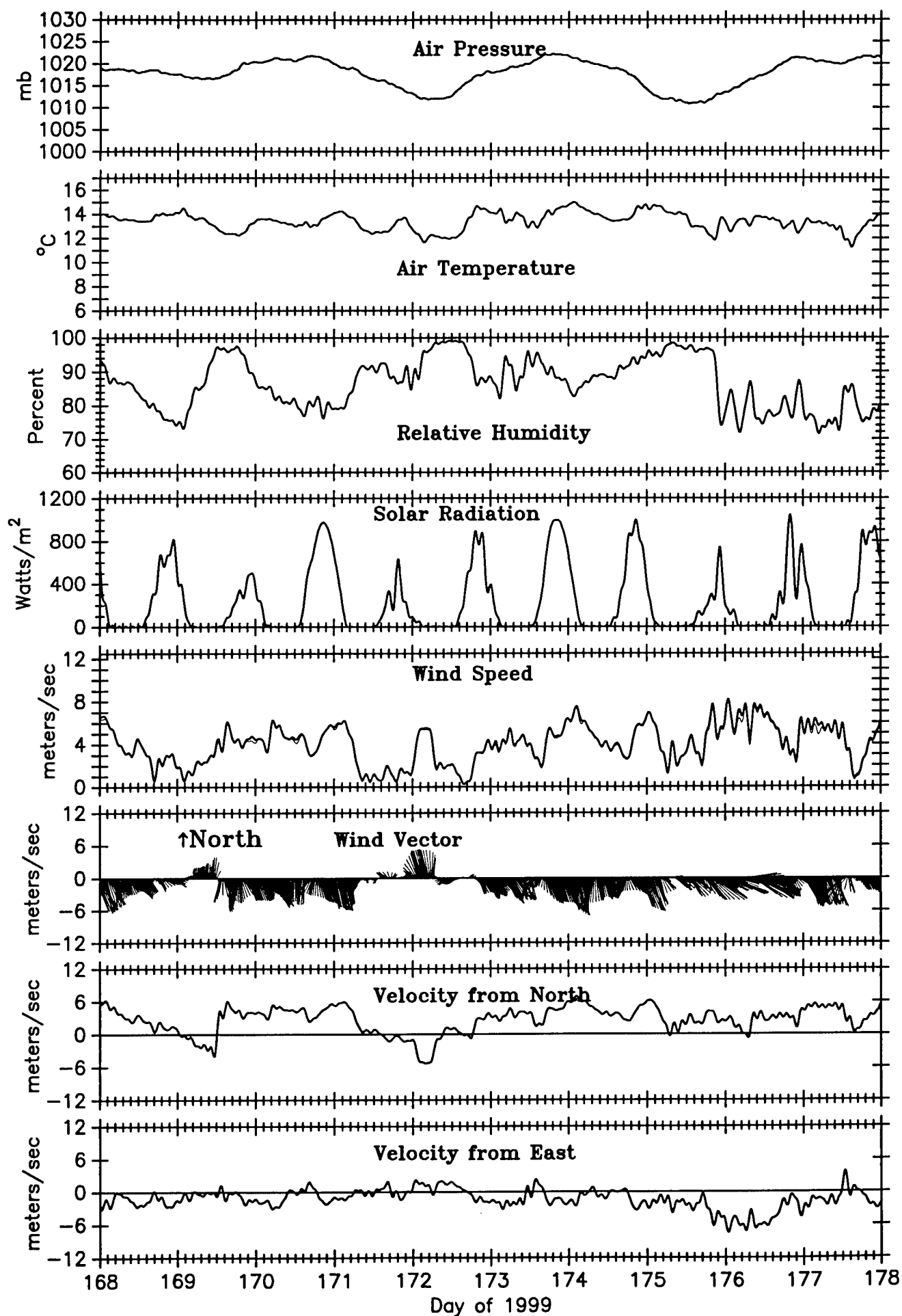


191

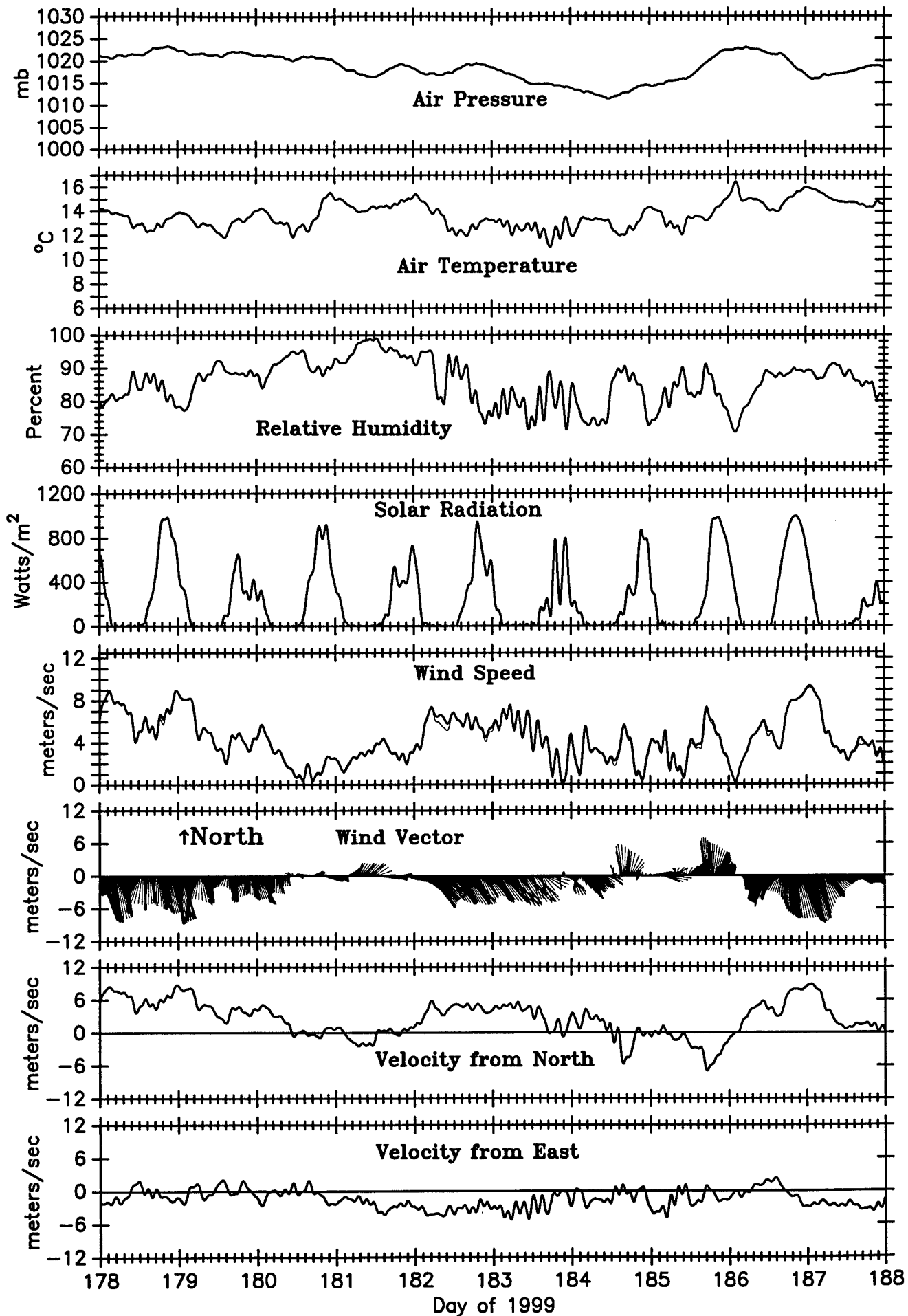
# Met Mooring 1 Hour Filtered Meteorological Data



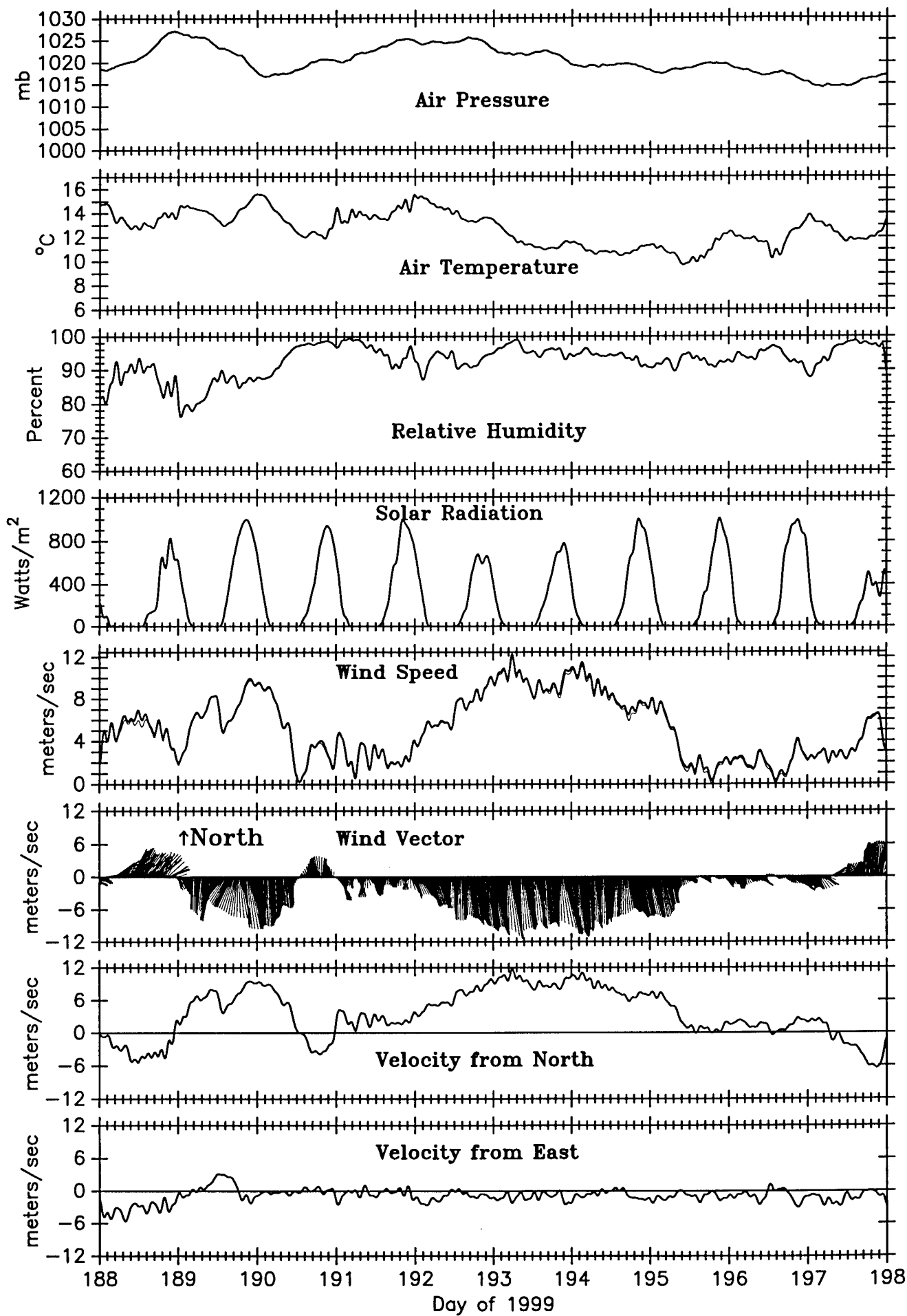
## Met Mooring 1 Hour Filtered Meteorological Data



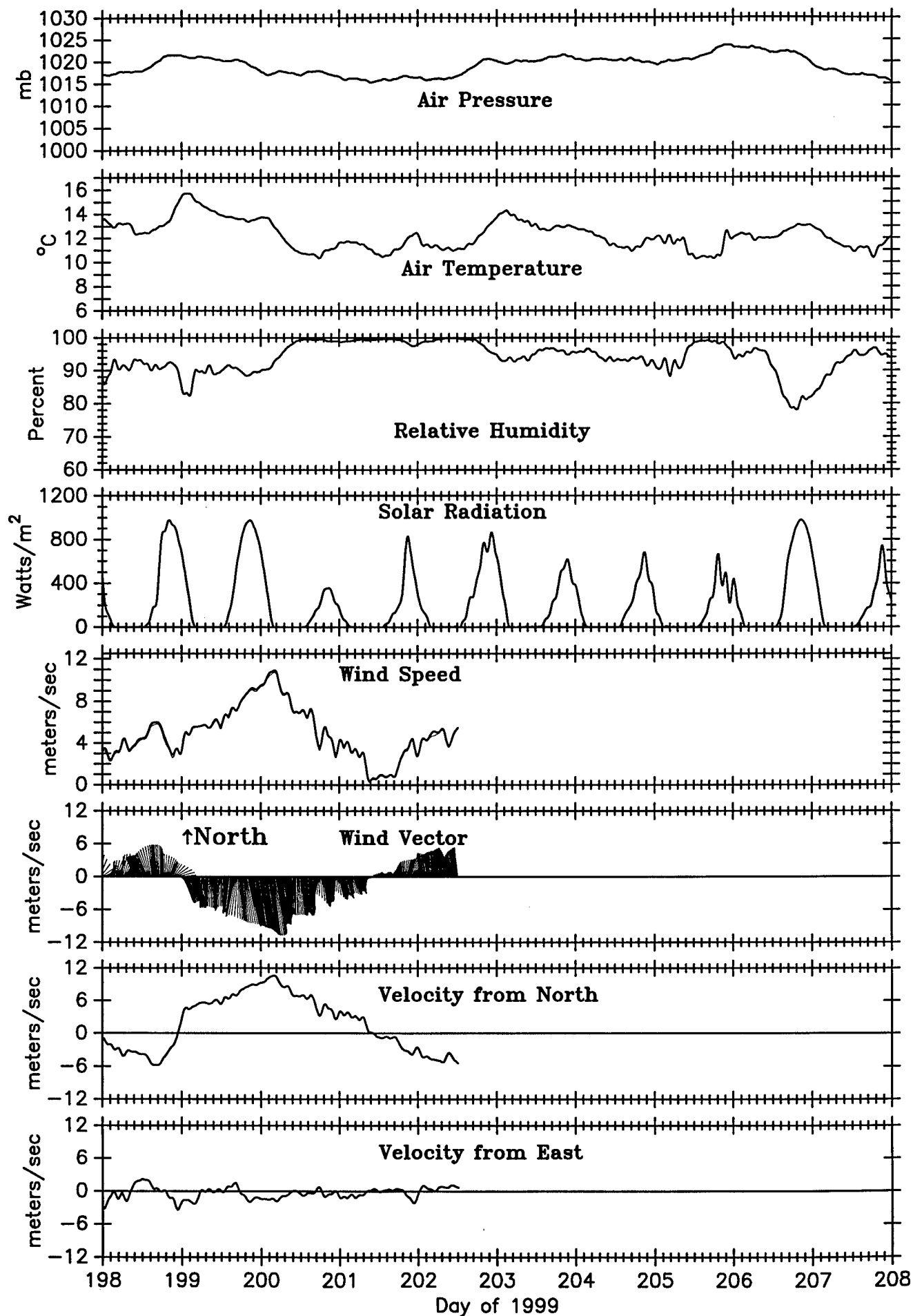
## Met Mooring 1 Hour Filtered Meteorological Data



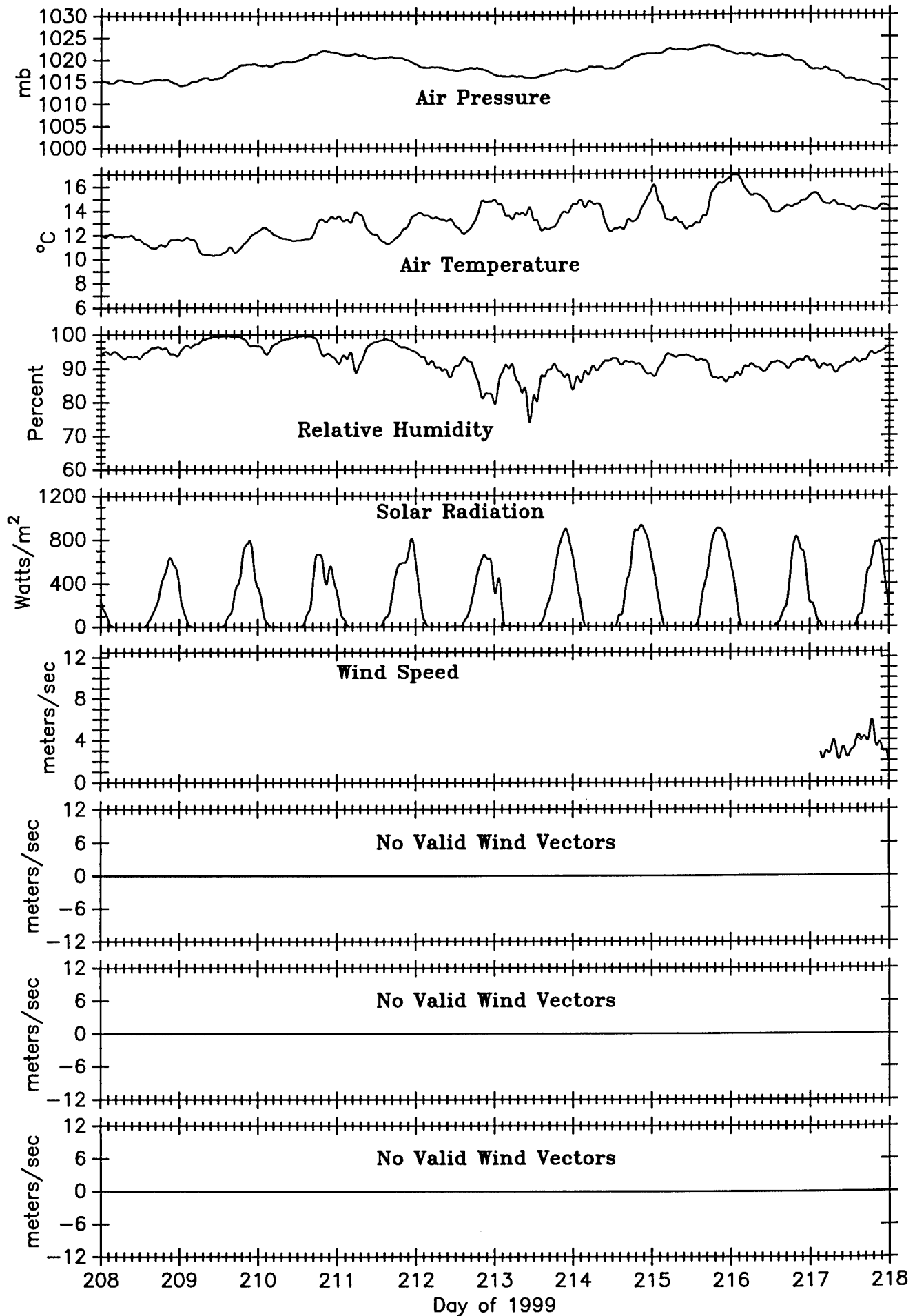
194  
**Met Mooring 1 Hour Filtered Meteorological Data**



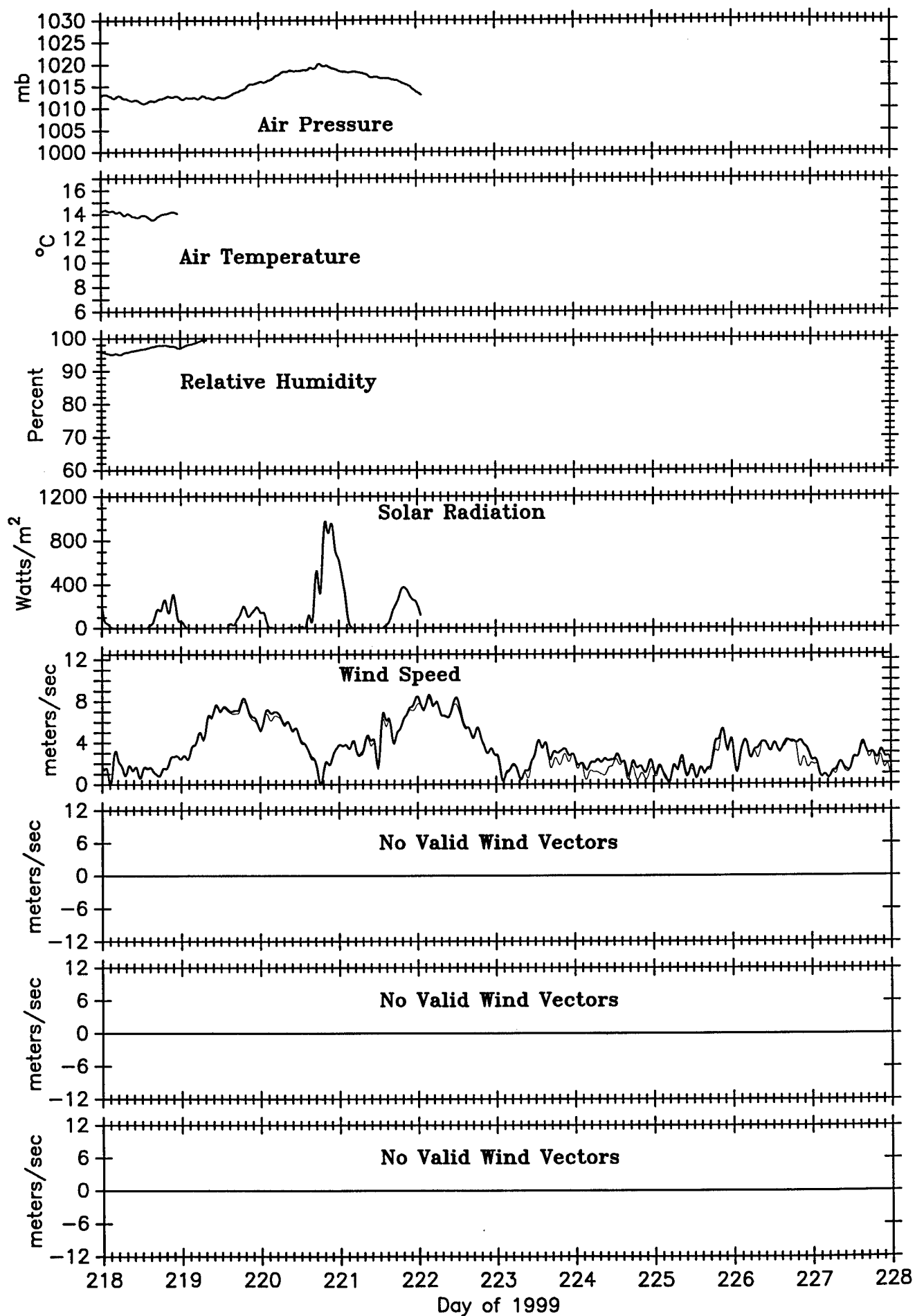
# Met Mooring 1 Hour Filtered Meteorological Data



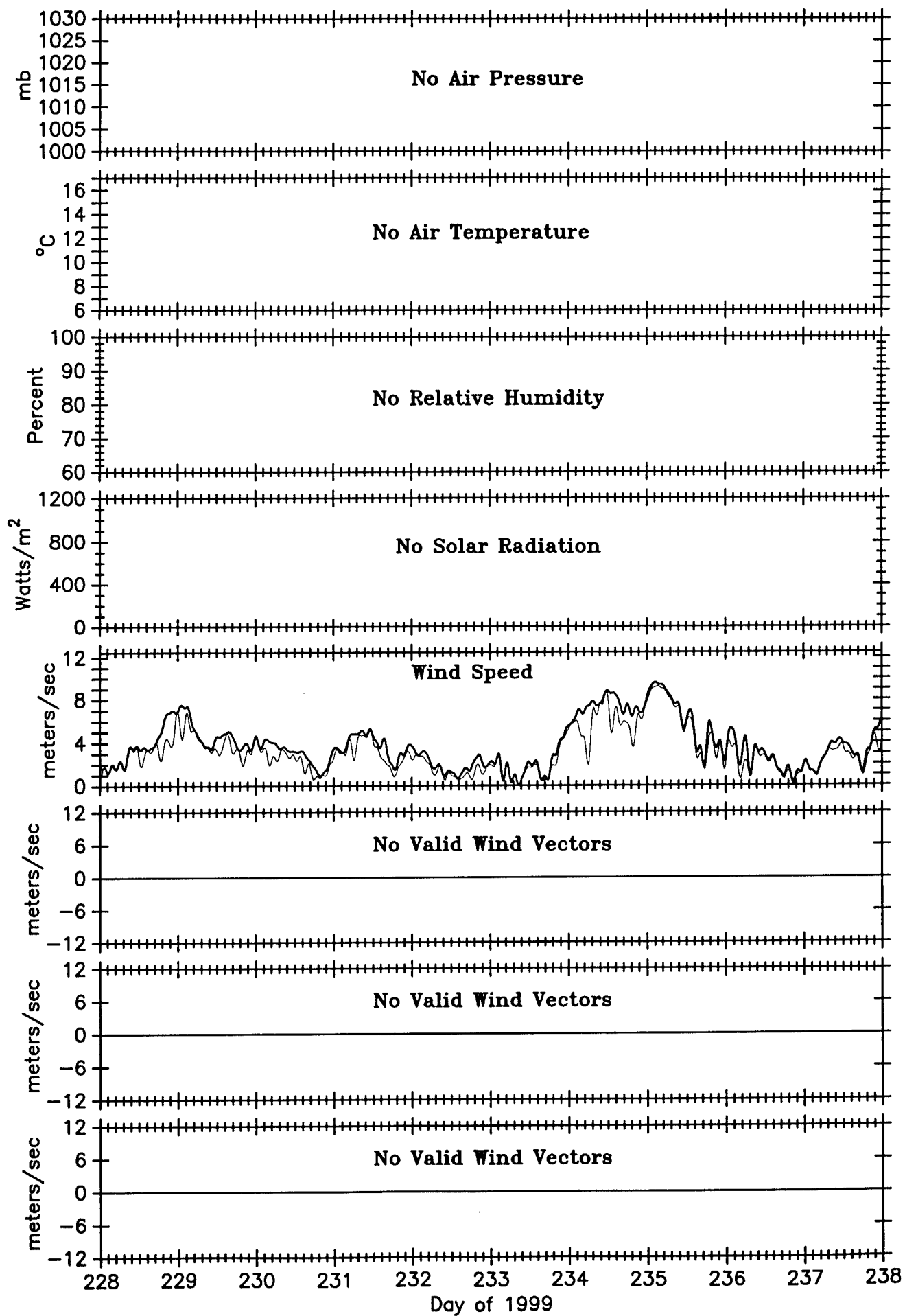
196  
**Met Mooring 1 Hour Filtered Meteorological Data**



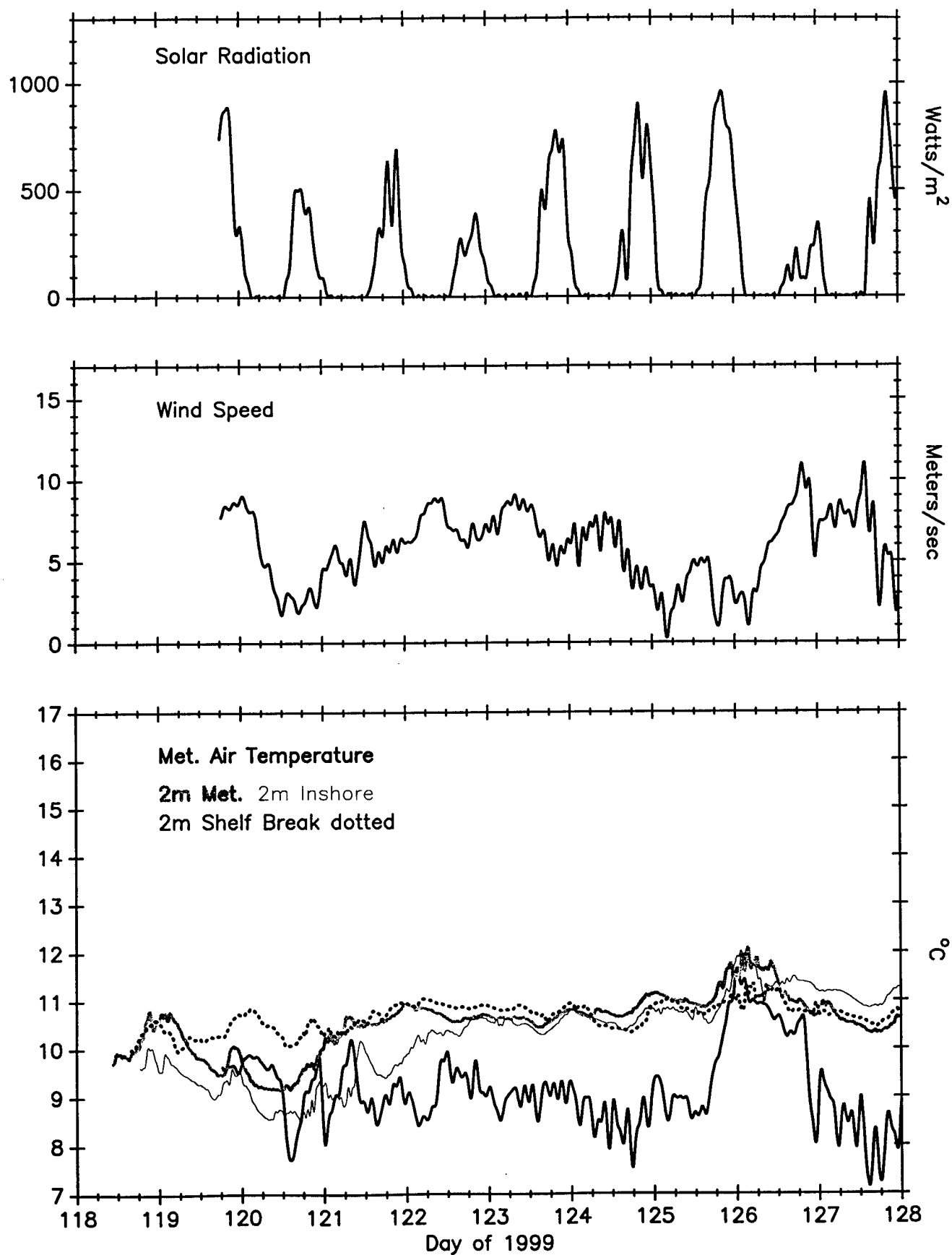
# Met Mooring 1 Hour Filtered Meteorological Data



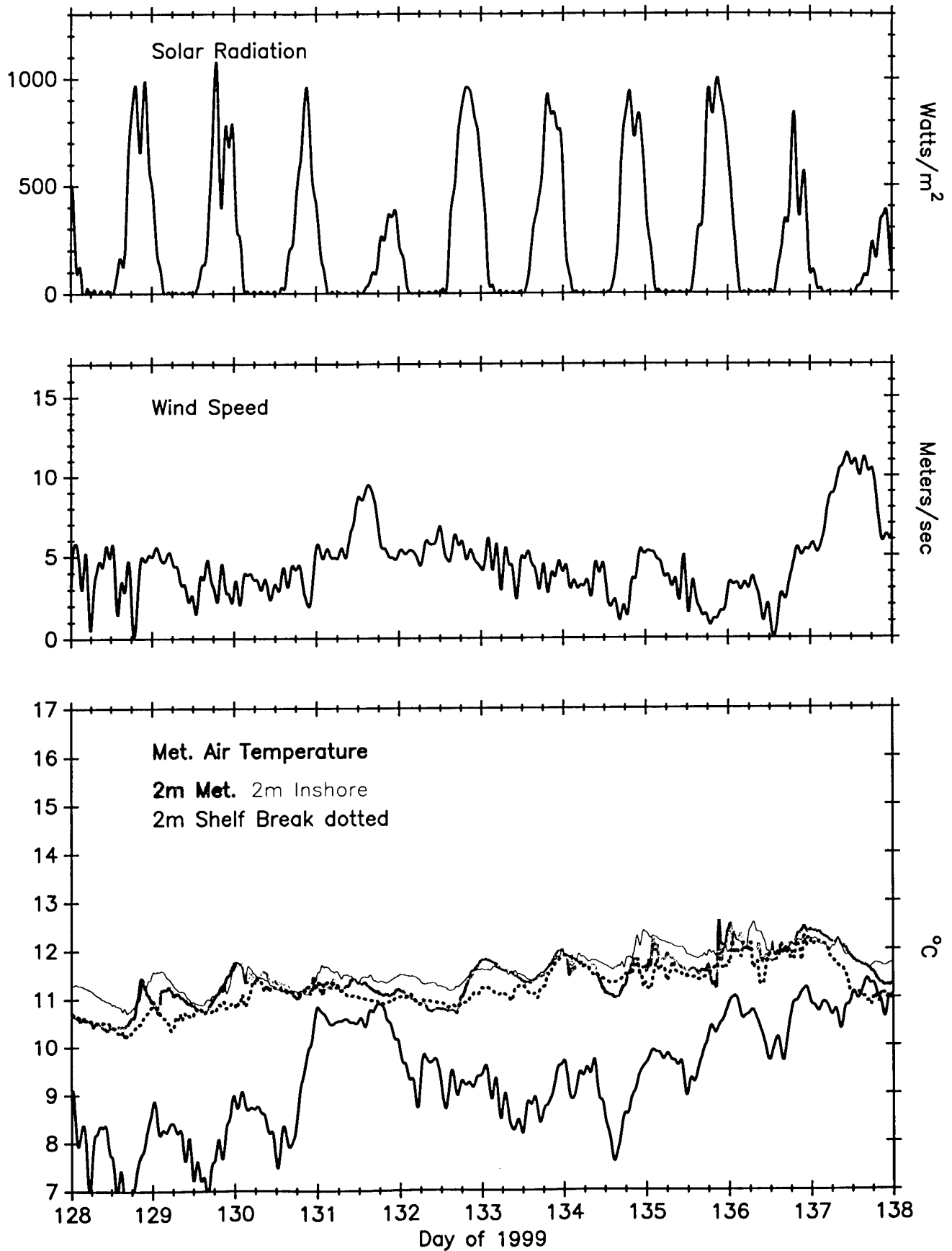
## Met Mooring 1 Hour Filtered Meteorological Data



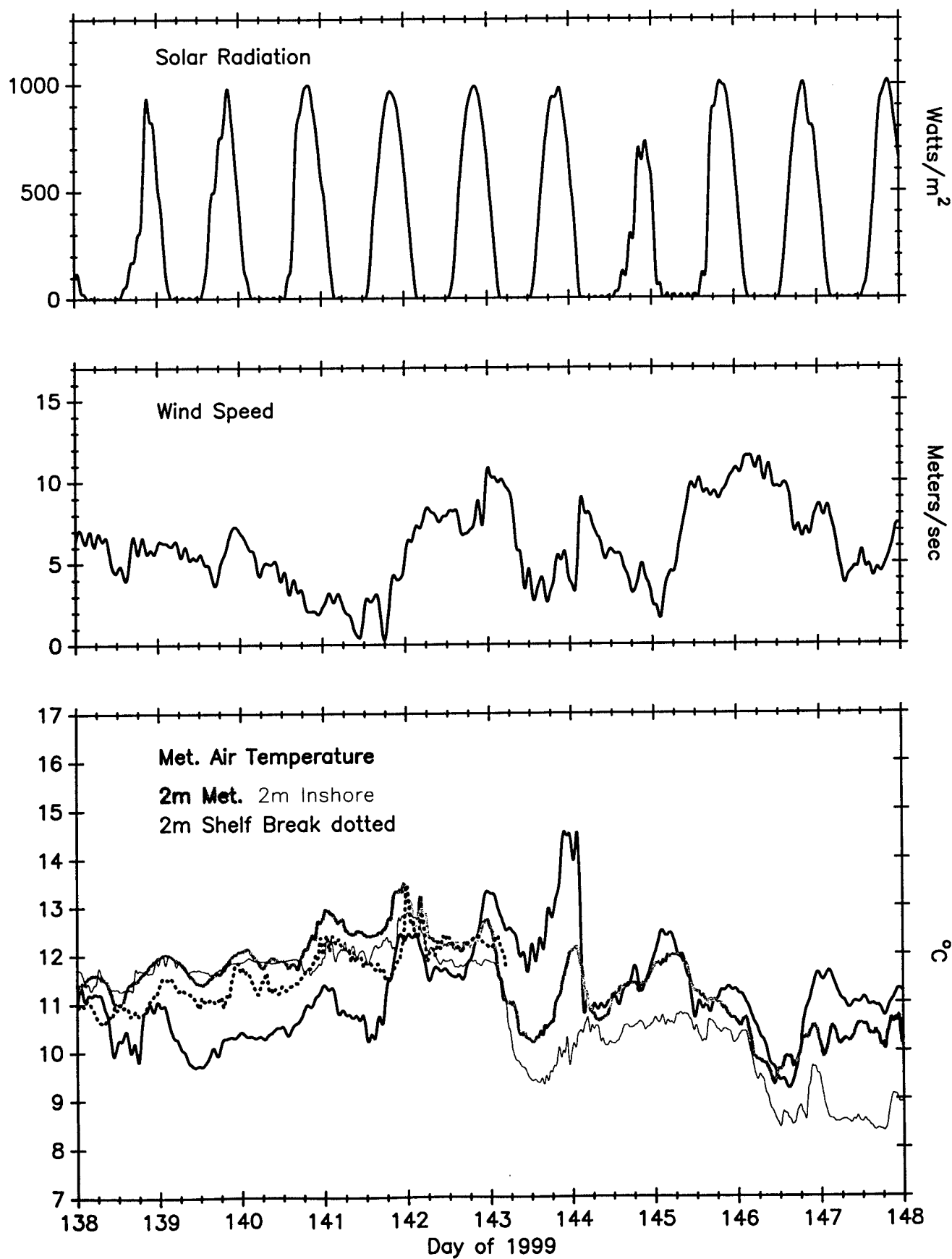
## NOPP 1hr Lowpass Filtered 2m Temperatures with Surface Data



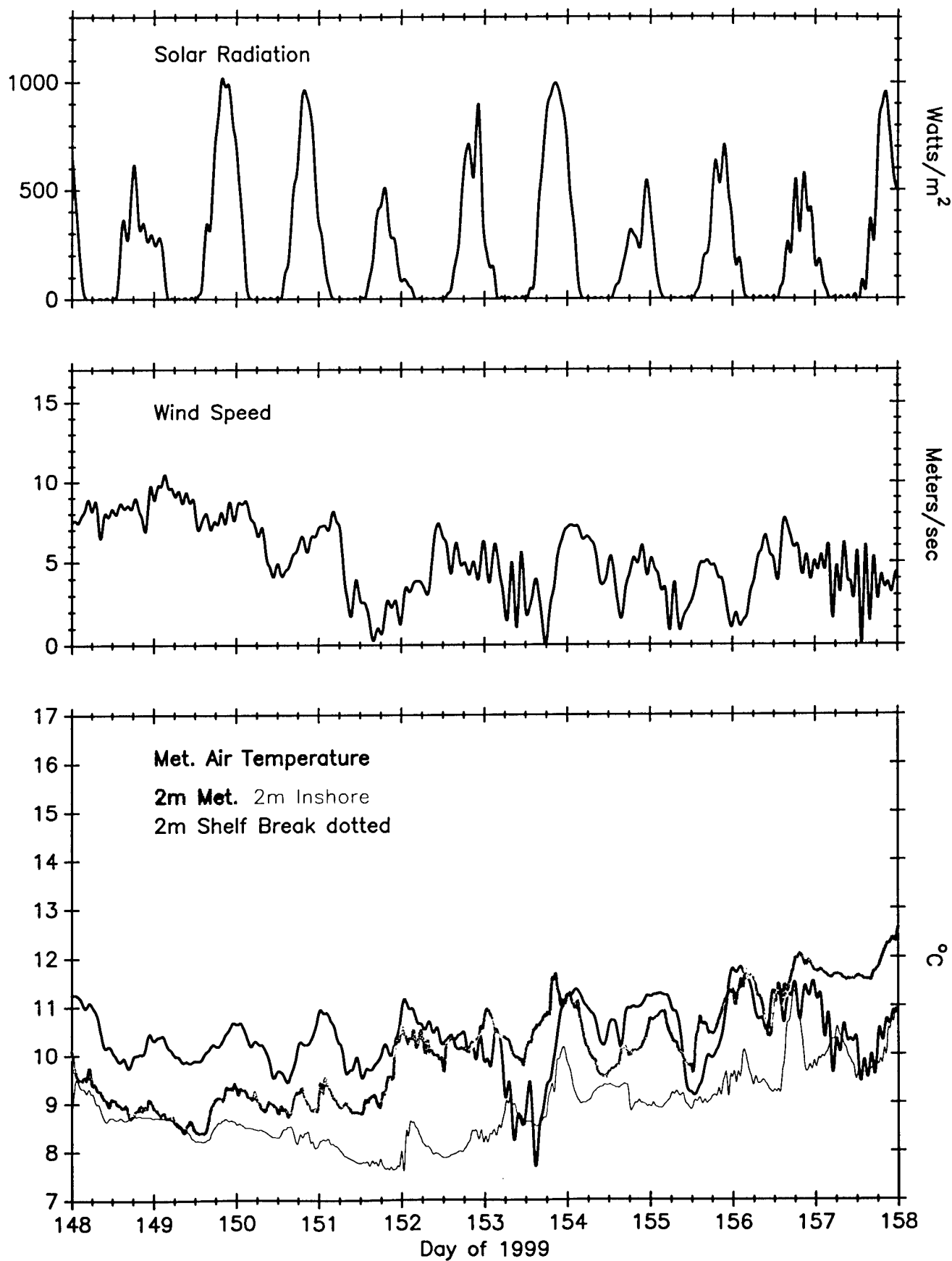
## NOPP 1hr Lowpass Filtered 2m Temperatures with Surface Data



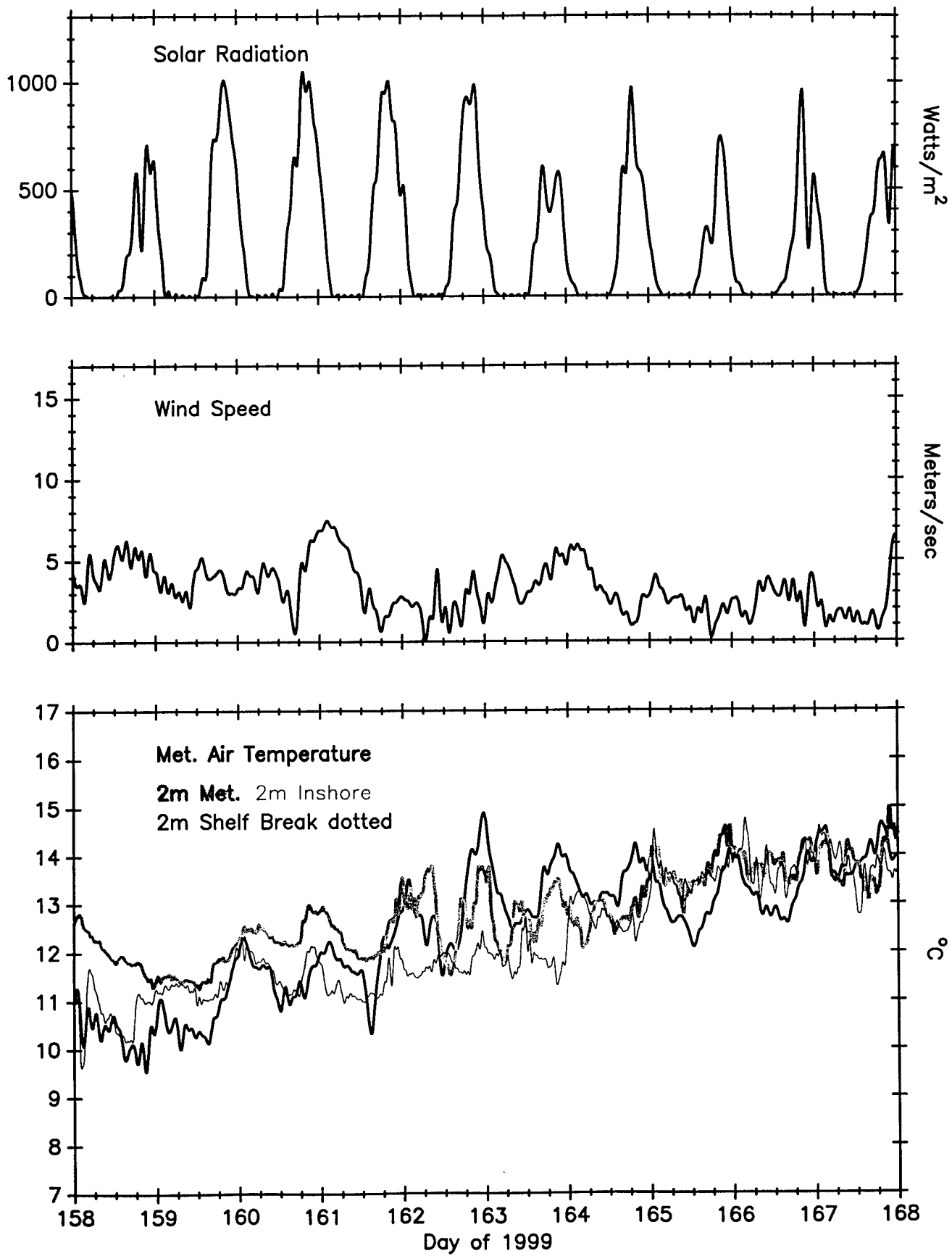
## NOPP 1hr Lowpass Filtered 2m Temperatures with Surface Data



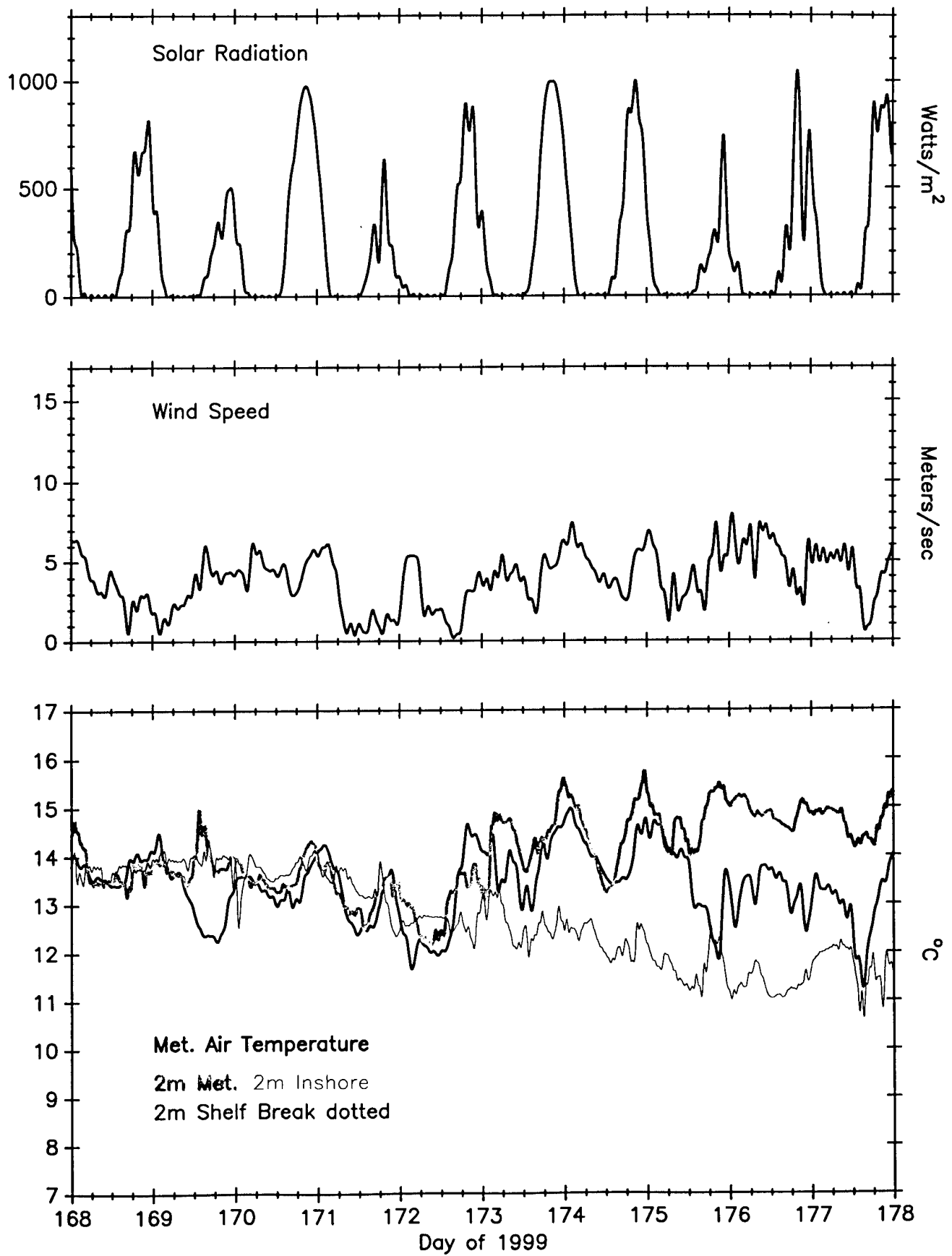
## NOPP 1hr Lowpass Filtered 2m Temperatures with Surface Data



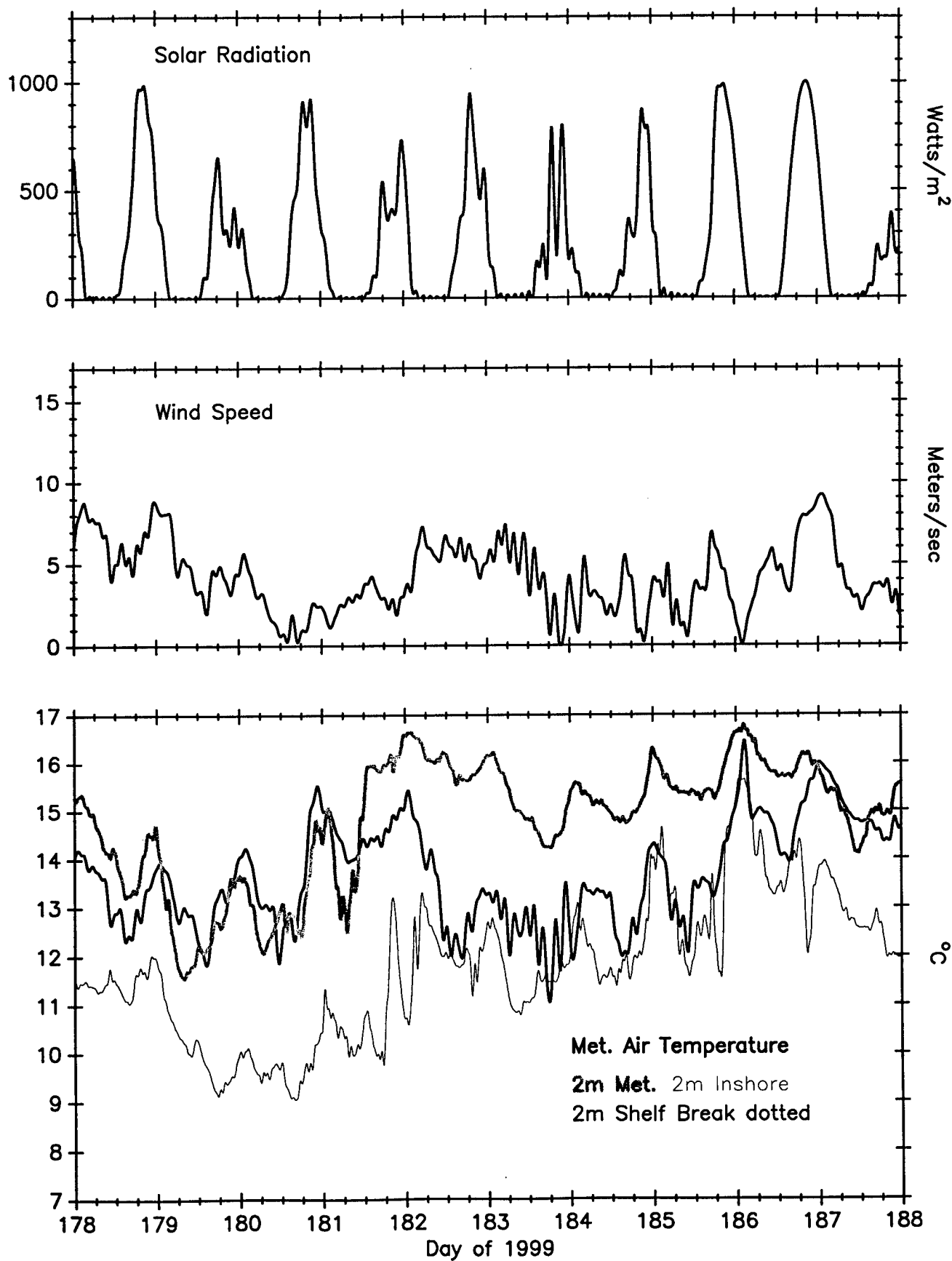
## NOPP 1hr Lowpass Filtered 2m Temperatures with Surface Data



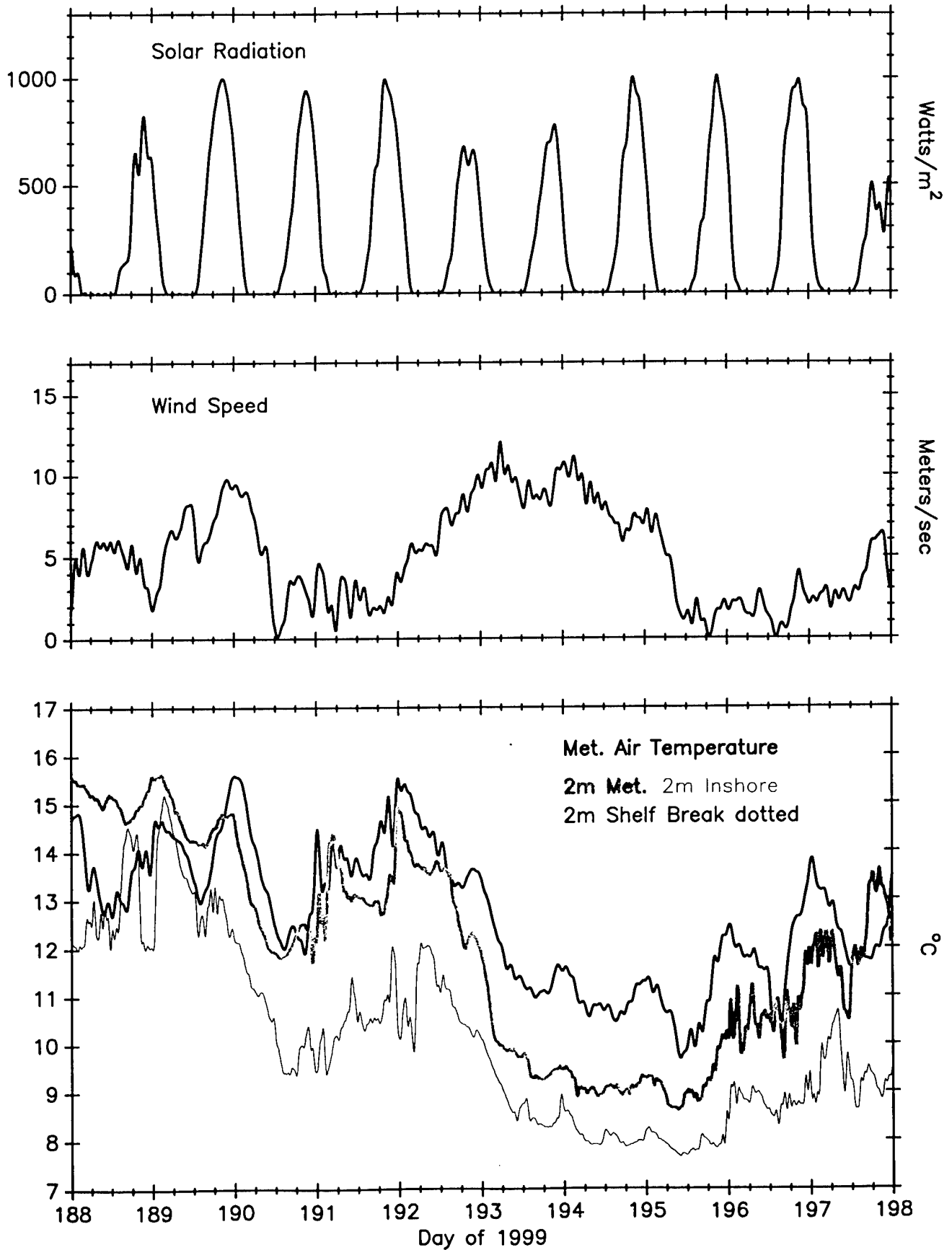
## NOPP 1hr Lowpass Filtered 2m Temperatures with Surface Data



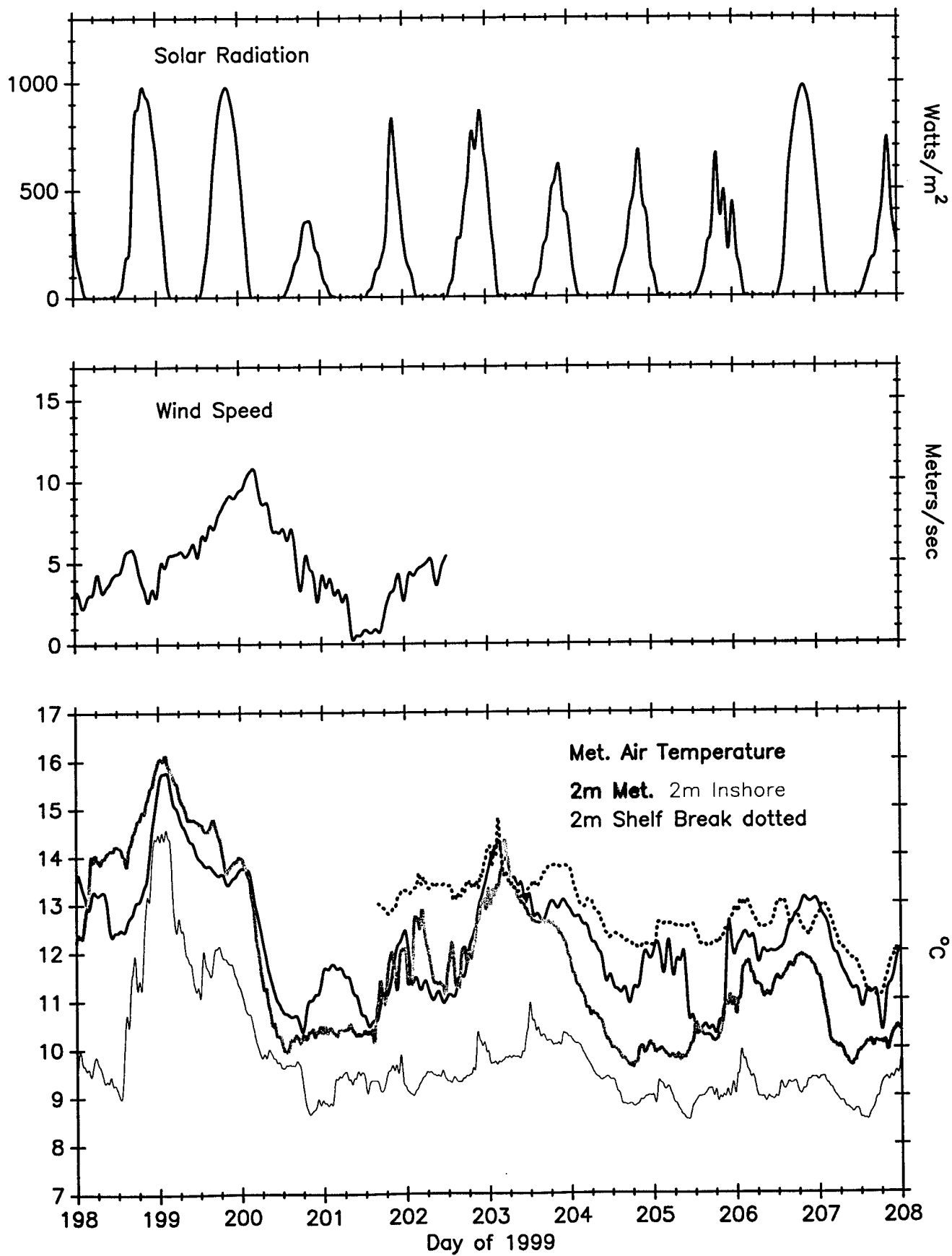
## NOPP 1hr Lowpass Filtered 2m Temperatures with Surface Data



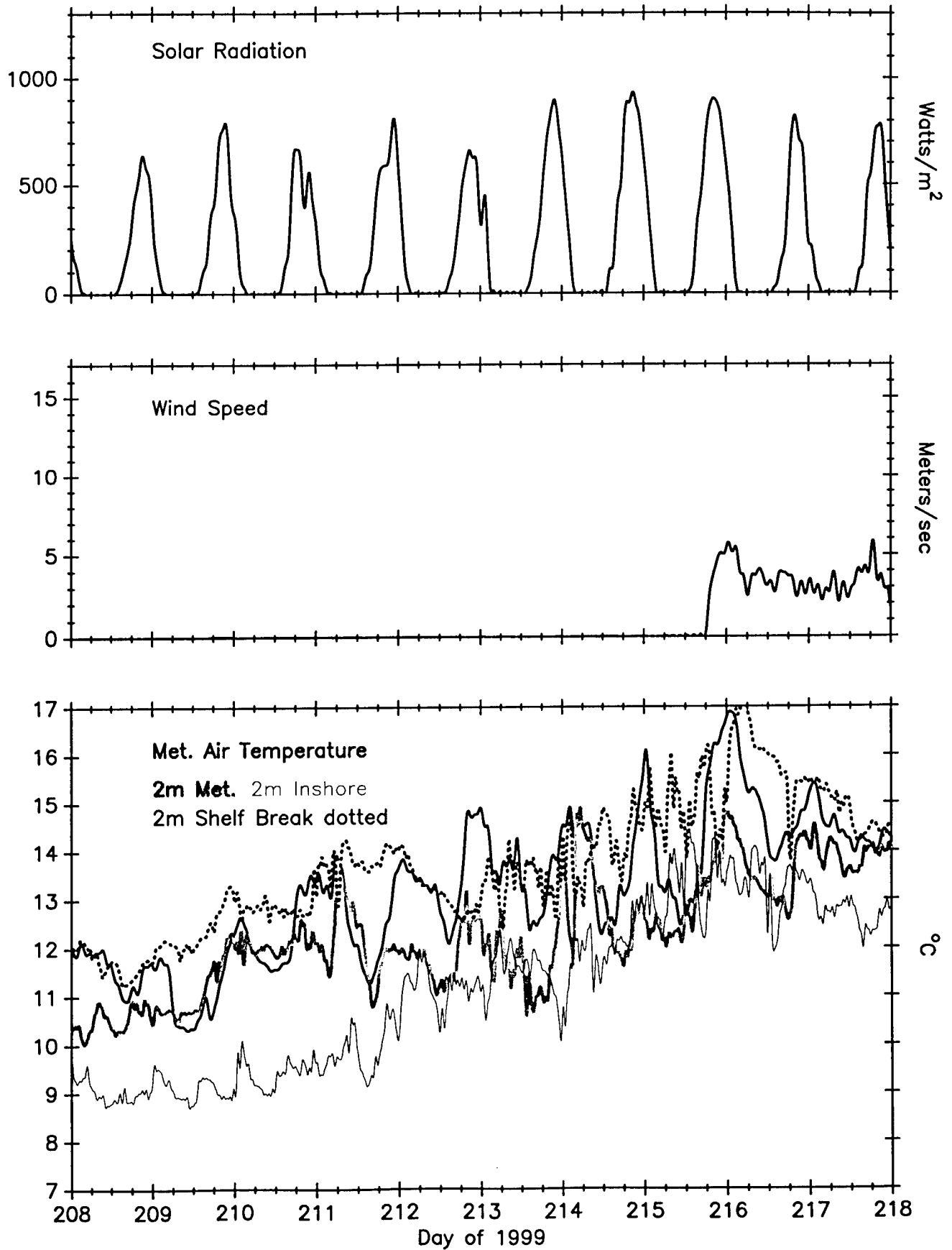
## NOPP 1hr Lowpass Filtered 2m Temperatures with Surface Data



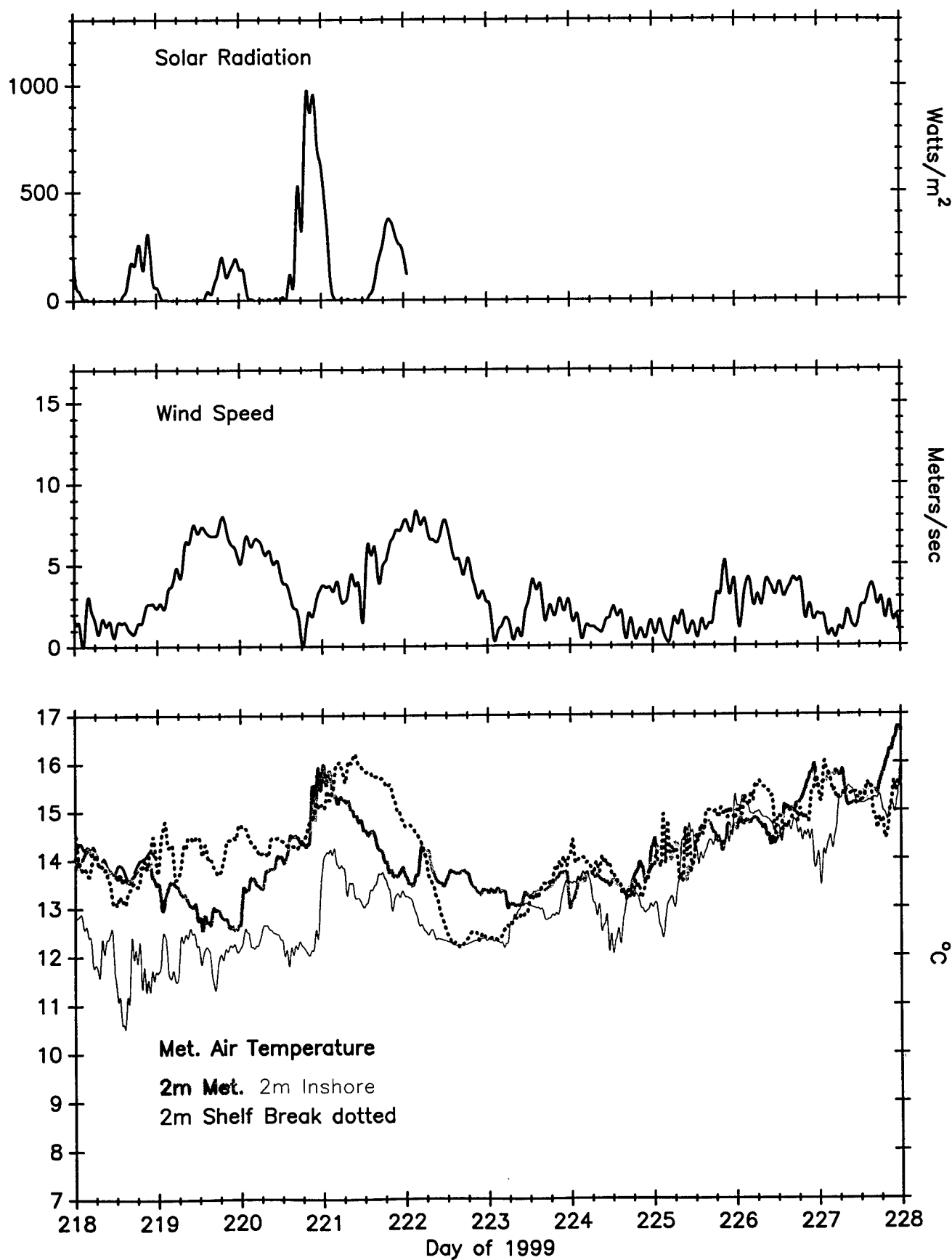
## NOPP 1hr Lowpass Filtered 2m Temperatures with Surface Data



## NOPP 1hr Lowpass Filtered 2m Temperatures with Surface Data



## NOPP 1hr Lowpass Filtered 2m Temperatures with Surface Data





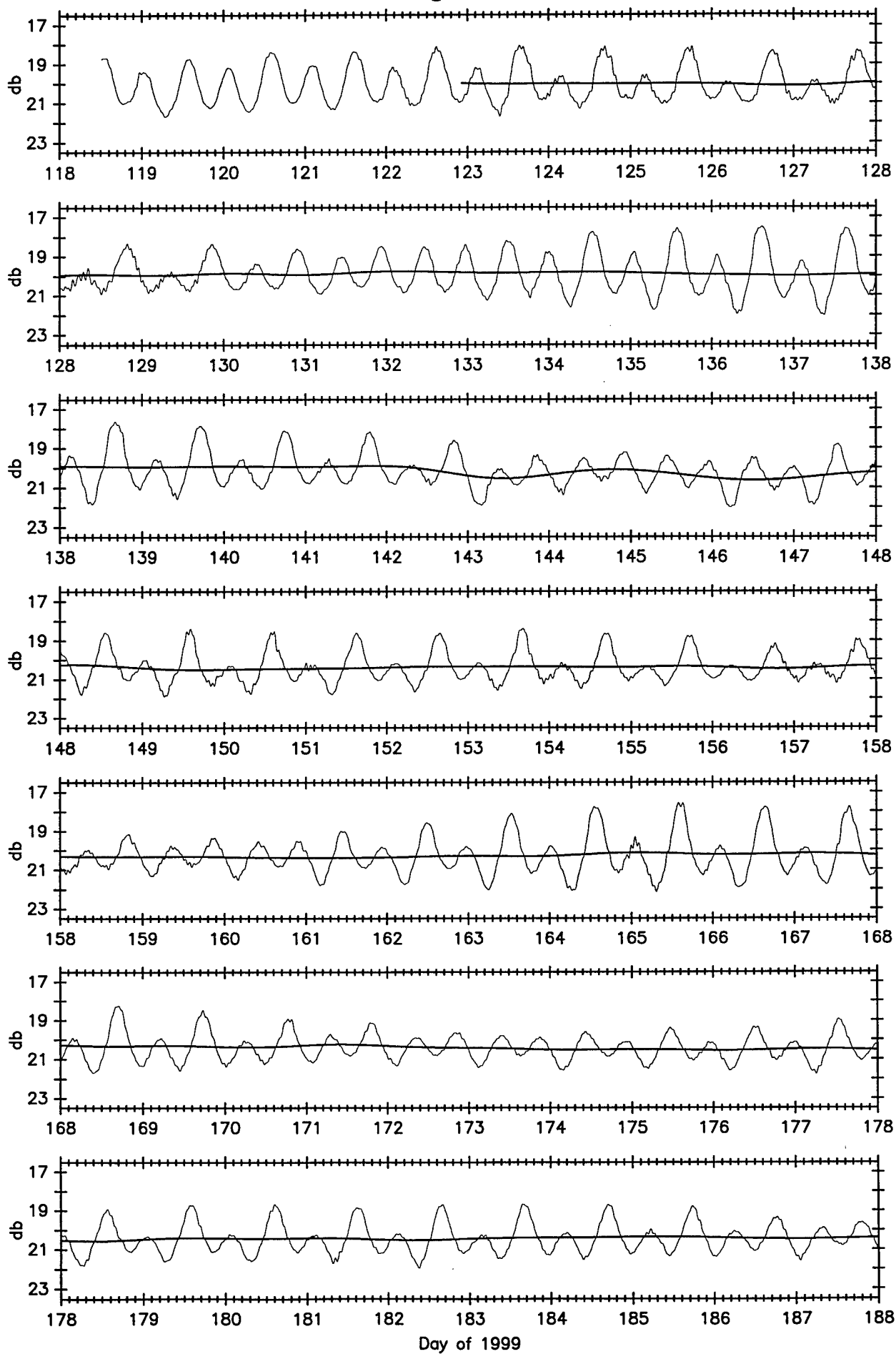
## **PRESSURE Time Series**

### **40-hour & 1-hour Low-Pass Filtered**

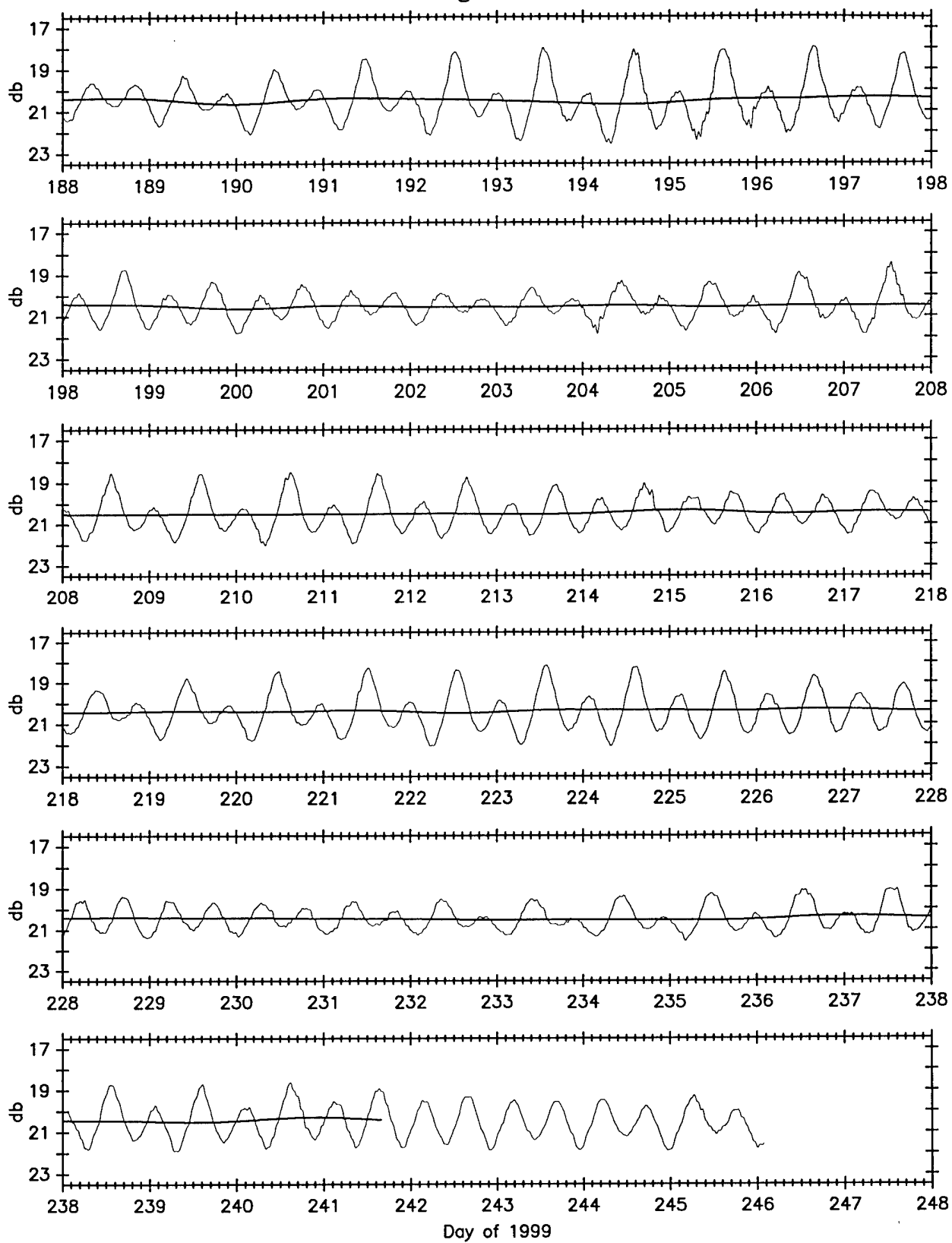
Plots of pressure from the Mid-Shelf and Shelf-Break moorings. The trawler impact of the Shelf-Break mooring on day 143 is evident in the pressure signal as a nearly 10 m upward displacement. Subsequent loss of buoyancy by the Shelf-Break mooring on day 186 is evident in the displacement down to about 21 m. The unfiltered pressure signal also suggests that the Shelf-Break mooring was hit again on day 191. The 1-hour filtered pressure signal from the Mid-Shelf mooring and parts of the Shelf-Break mooring (period A, prior to trawler impact, and period D, following redeployment), show clear semidiurnal signals.



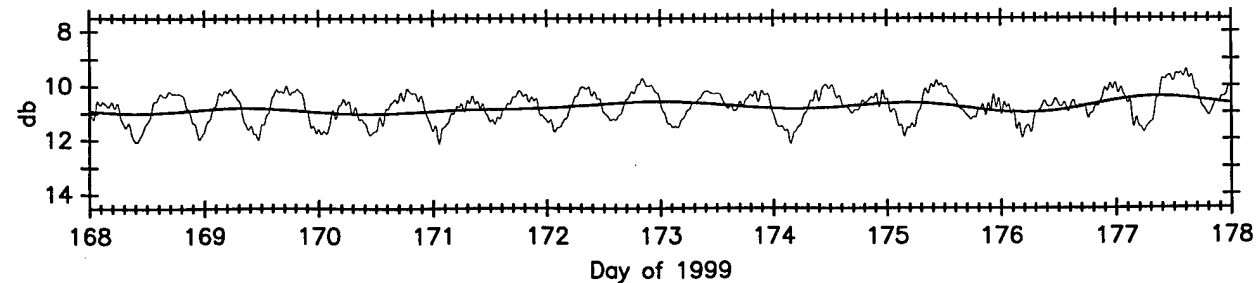
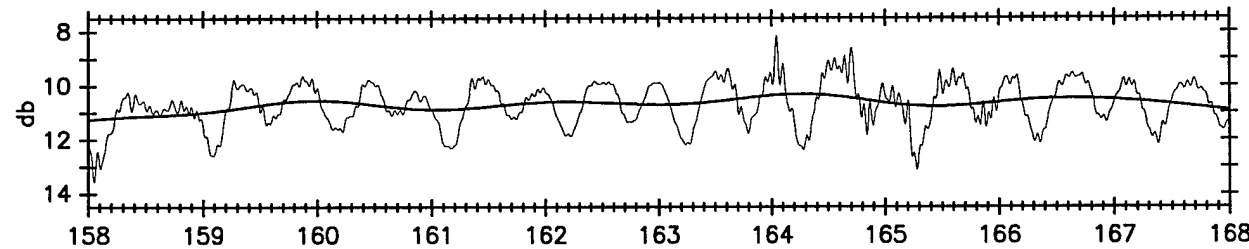
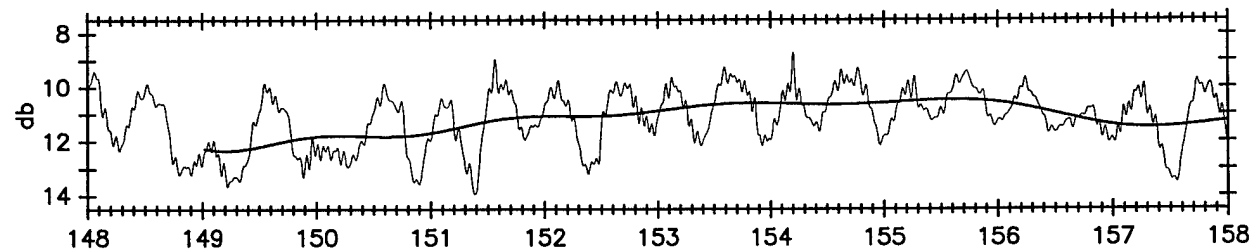
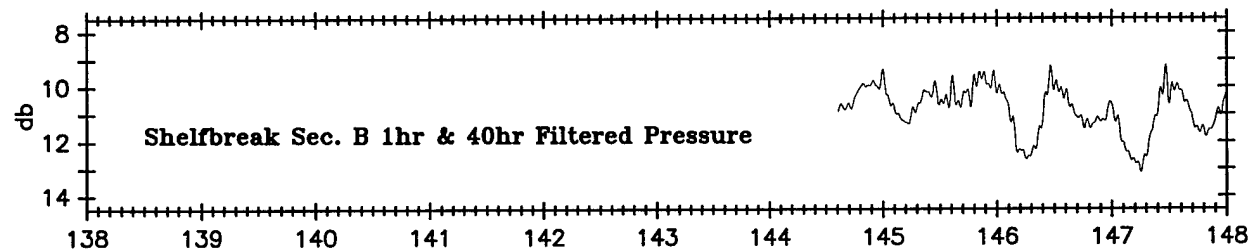
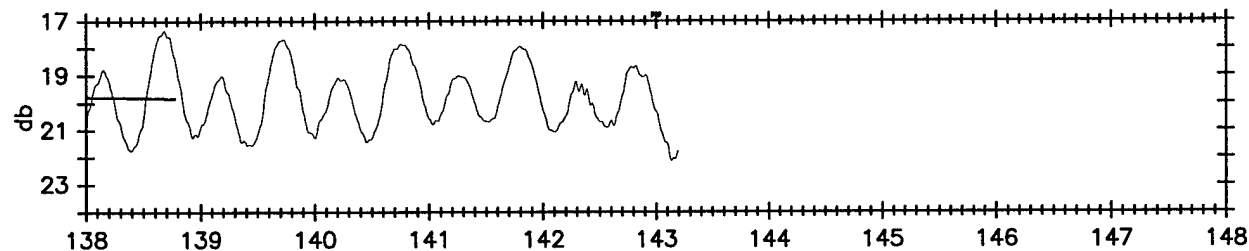
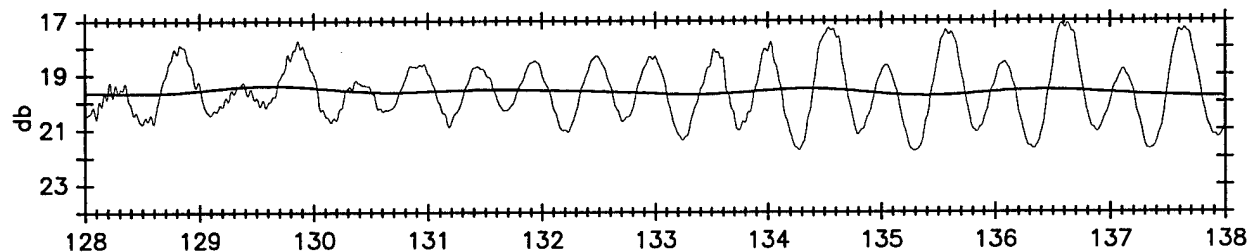
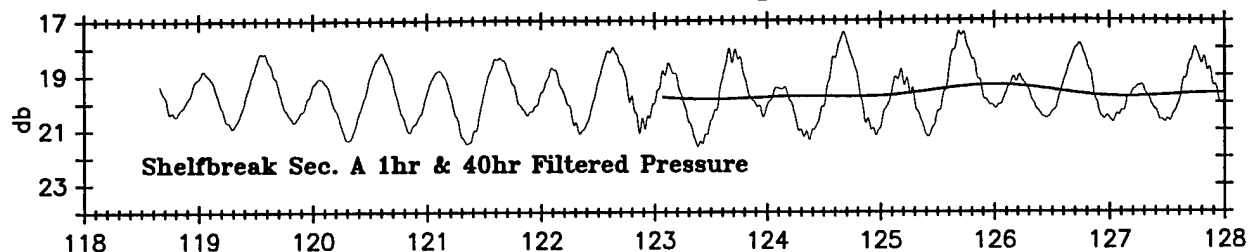
## NOPP Midshelf Mooring 1hr &amp; 40hr Filtered Pressure



## NOPP Midshelf Mooring 1hr &amp; 40hr Filtered Pressure



## NOPP Shelfbreak Mooring Pressure



## NOPP Shelfbreak Mooring Pressure

