LATEX Shelf Data Report

Drifters and Miscellaneous Instruments

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TAMU Oceanography
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Texas-Louisiana Shelf Circulation and Transport Processes Study
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1. Introduction

1.1 Background

Texas A&M University conducted the Texas-Louisiana Shelf Circulation and Transport Processes Study (LATEX A). LATEX A was one of three study units of the Louisiana-Texas Shelf Physical Oceanography Program (LATEX) sponsored by the U. S. Minerals Management Service (MMS) of the U. S. Department of the Interior. The study area encompassed the Texas-Louisiana continental shelf offshore of approximately the 10-m isobath, from the Mississippi River to the Rio Grande. Figure 1 shows the study area. The LATEX A field program ran from April 1992 to December 1994. The five major field components were drifting buoys, moored current meter measurements, hydrography, acoustic doppler current profiling (ADCP), and meteorological buoys.

Our principal goal in this report is to describe the availability, processing, and quality of data collected by the drifting buoys and several miscellaneous instruments not included in any other LATEX A Data Report. These instruments include: expendable bathythermographs, expendable sound velocity profilers, expendable current profilers, thermosalinograph, and CTD data collected during the current meter mooring maintenance cruises.

Additional data reports cover the other four LATEX A field components (DiMarco et al. 1997 for moored current meter; Jochens et al. 1998 for hydrography; Bender and Kelly 1998 for ADCP; and Wang et al. 1996 for meteorology). The measurement of surface waves, which are part of the moored current meter task, are presented in DiMarco et al. (1995), DiMarco and Kelly (1995), and DiMarco (1996). All data have been submitted to the National Oceanographic Data Center (NODC) of the National Oceanic and Atmospheric Administration (NOAA); the LATEX A project number with NODC is 0212.

All data files described in this report are in ASCII column format and contain metadata detailing the instrument type, date/time/location, data FORTRAN format descriptors,

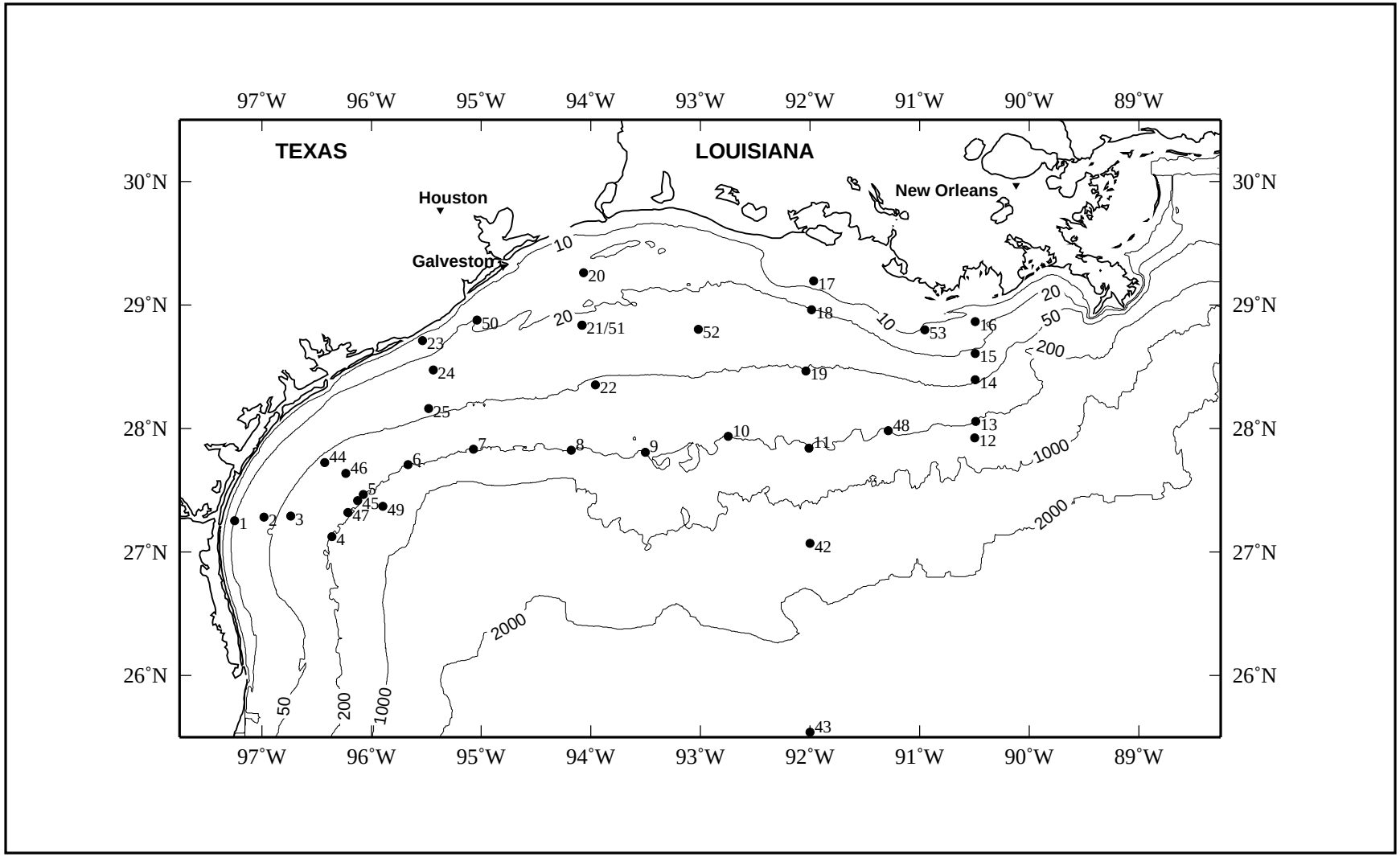

Figure 1. LATEX A study area with mooring locations for LATEX A current measurement moorings.

and special quality control notes. The quality control notes follow the same convention used in other LATEX A data files and is designated by the following character string: "$LATEX VERSION:". These notes contain information pertaining to the date and time of the file's last modification and to special circumstances encountered while processing and analyzing the data. These notes should be read carefully prior to using any LATEX data to ensure maximum usefulness of the data. The last line of metadata is a single "^" character. Following the metadata are columns of processed data.

1.2 Data Report Overview

Section 2 documents the collection and processing of the LATEX A drifting buoys. Section 3 describes the collection, processing, and availability of data collected from the various expendable instruments and the thermosalinograph. Section 4 discusses the collection and processing of the CTD casts taken during the LATEX A current meter mooring maintenance cruises.

2. Drifting Buoys

2.1 Introduction

Nineteen satellite-tracked drifting buoys (henceforth drifters) were deployed in the northwest Gulf of Mexico between August 1992 and November 1994 by LATEX A. This section documents the LATEX A drifting buoy program including: equipment used, program administration, data handling, and results. Data from the LATEX A drifter program were sent to NODC for long term archiving.

The original plan called for 16 drifters, four per cruise, to be deployed on either side of the coastal frontal zone, mid-shelf, and near the shelf break. This plan was modified as shown in Section 2.3. During the program, three additional drifters were donated and deployed.

Data from the drifters were disseminated to users in several ways. Data appeared on the global telecommunications system (GTS) in near real-time for use by the international community. Twice a month drifter trajectories were posted to the GULF.MEX bulletin board of the OMNET electronic mail service which, among others, was accessible to members of the oceanographic community and oil and gas industry. The same two-week collection of drifter trajectories also was plotted on a basemap and printed in the *LATEX Fortnightly* newsletter that was published every two weeks during most of 1992-1994. The aforementioned data were the raw positions edited only for wild-points. The drifter data, presented in this report and subsequently sent to NODC, are spline-fitted 6-hourly data derived from the raw positions. The file naming convention for the drifters is given in Table 1.

Two other MMS-sponsored drifting buoy programs were conducted in the northwest Gulf of Mexico during the same time period encompassed by the LATEX A program. The first, conducted by Science Applications International Corporation (SAIC) of

Raleigh, North Carolina, was a part of another LATEX study unit (LATEX C). SAIC deployed a number of drifters from aircraft into Loop Current eddies at or near the shelf break (Berger et al. 1996). The second program, not affiliated with LATEX, but also sponsored by MMS, was the Surface Current Lagrangian Program (SCULP), conducted by Dr. Peter Niiler of Scripps Institution of Oceanography. SCULP released approximately 400 surface-drogued drifters from oil platforms located within a rectangular subregion of the central part of the Texas-Louisiana shelf. These two programs are not discussed further in this report.

Table 1. Drifting buoy file naming convention

Character	Description
1	always "D" for drifter
2-6	drifter number
extension	"drf" for processed drifter data
extension	"raw" for raw drifter data

2.2 Methodology

2.2.1 Drifter Description

All drifters deployed by the LATEX A program were manufactured by Clearwater Instrumentation, Inc., of Wellesley, MA. The drifters conform to the specifications of the World Ocean Circulation Experiment (WOCE) except that the 6-m drogues and the tethers between the surface float and the drogue were shorter than WOCE drifters.

The drifters consisted of a spherical, 33.7-cm diameter, foam-filled fiberglass surface float attached by a tether to a 91-cm diameter hoop which supported a 6-m cylindrical drogue made of heavy canvas. The canvas cylinder had a series of circular holes in it, which is why this type of drogue is commonly referred to as a "holey-sock". Eighteen

drifters had a 3-m tether which placed the bottom of the 6-m drogue at 9-m depth. Two drifters (07834 and 07833) had longer tethers which placed the drogue bottom at 50-m depth and one (07839) had an even longer tether which placed the drogue bottom at 100-m depth. The surface float, which also housed the electronics, was designed to float with the waterline at its equator. The float was sealed at the factory. Except for the thermistor probe and two unpainted bolt heads (submergence detector), the float surface was smooth to minimize wind drag. The radio transmitter inside the drifter was activated by removing a magnet that was affixed on the drifter instrument housing by tape. The float was painted blue and gray to avoid undue attention and was difficult to see when deployed.

The instrument package contains: the radio transmitter and antenna, the thermistor and submergence sensors, a battery supply sufficient for approximately 1 year of operation, and associated electronic circuitry. The submergence detector consists of two unpainted metal bolts heads located on the upper half of the surface float. When the float is submerged a circuit is completed through the sea water from bolt head to bolt head and a timer begins to accumulate seconds. The time spent submerged is transmitted to the satellite as data. Long periods of submergence indicate that the drogue is becoming heavily fouled by marine organisms. Long periods of time without submergence indicate that the tether has parted and the drogue is no longer attached. The temperature range for the Clearwater WOCE drifter thermistor is 0 to 37^{o}C with an accuracy of $\pm$ 0. 1^{o}C.

2.2.2 The Tracking System

Location (tracking) services were provided by Service ARGOS, Inc., a commercial company based in France with offices in Landover, MD. The ARGOS system employs a pair of NOAA satellites in low polar orbit. To determine the drifter's location, the system uses the Doppler shift of the frequency of the drifter's radio signal due to the satellite's motion - not the drifter's drift. The accuracy of the location fix depends on the number of

signals received, the spread in the angles from which the signal is received (or equivalently, the time between signals received during a satellite pass), and the ability of the electronics to generate a stable frequency. Accuracies can be as good as 150-m (one standard deviation). A quality flag accompanying each locational fix is included in the data returned by Service ARGOS. One of three accuracy flags (3, 2, or 1) is reported corresponding to an accuracy of 150 m, 350 m, or 1 km, respectively. More detailed information on the method, accuracies, and services offered can be found in the Service ARGOS, Inc., *User's Manual* and *System Guide* each available from Service ARGOS.

While each satellite orbits with a regular period, the two periods differ so the appearance of either satellite overhead does not occur at equally-spaced time intervals. Sometimes satellites pass overhead within 1-2 minutes of each other, at other times the interval between passes may be 3 to 4 hours. The total number of passes per day depends on the latitude. For the LATEX region, 8 to 12 passes occurred each day with a mean number equal to nine. Passes that were separated by only a few minutes were considered to be redundant. Thus, typically, there were only 6-8 useful locations per day for transmitters in the LATEX region. This is partly the reason for using 6 hours as the interval for the spline-fit data in our final data product.

2.2.3 Pre-deployment Tasks

Pre-deployment preparations included: securing a service agreement and setting-up the program with Service ARGOS, registration of the drifters with the World Meteorological Organization (WMO), and marking and bench testing the drifters.

A service contract was purchased from Service ARGOS through NOAA to provide location and data services for each of the LATEX A drifters. Location services provided tracking information, data services covered the retrieval of the data, i.e. temperature, submergence time, battery voltage, etc. This contract was made under the Joint Tarrif

Agreement which allows government-sponsored users to obtain special rates. The cost covers data backup, periodic delivery of data on magnetic media, and unit conversion. For additional fees, near real-time access to data is made available through user-initiated modem or TELNET access or daily by ARGOS-generated Internet mail. Evans-Hamilton, Inc., a private subcontractor with offices in Houston, TX, initiated this contract on behalf of the LATEX program. Subsequent arrangements for data delivery were made by the LATEX program office at Texas A&M University.

Service ARGOS requires some initial information to process the sensor data and determine drifter locations. Auxiliary data, temperature for example, are transmitted to the satellite as counts. Service ARGOS will convert the counts into physical units before disseminating the data if given the conversion formula and coefficients. This information was obtained from Clearwater, Inc., the drifter manufacturer, and conveyed to Service ARGOS prior to deployment.

The method used by Service ARGOS to determine a transmitter's location yields a pair of widely-separated positions which are symmetrical about the satellite's ground track. Service ARGOS resolves this ambiguity by using a known initial position. Subsequent locations are determined to be the one solution of the pair that is closest to the previous location. Initial locations were determined by Global Positioning Satellite (GPS) receivers during the pre-deployment bench tests and were passed to Service ARGOS prior to deployment.

To make drifter locations and data available to the general community in near real-time, arrangements were made with the Drifting Buoy Coordinator at the offices of Service ARGOS in Landover, MD, and with the offices of the National Data Buoy Center (NDBC) to have the data injected into the Global Telecommunications System (GTS) data stream. The GTS is the mechanism by which the global weather observations are shared among members of the world weather community. When drifter locations appear in the GTS data stream they appear under identification numbers assigned by the WMO

through the NDBC. The linkage between each drifter's data and its WMO number and the injection of these data into the GTS is made by the Drifting Buoy Coordinator at the offices of Service ARGOS.

Before a drifter was deployed it was activated and placed outside in an area free of overhead obstructions at facilities of Texas A&M University. GPS receivers were used to determine the geographic coordinates of the test location and a laboratory-grade thermometer was placed nearby and read periodically. The recorded temperatures from the thermometer were compared to those measured by the drifter's thermistor and GPS-determined locations were compared to those determined by Service ARGOS. These tests were designed to determine whether the drifters were functioning normally, not to calibrate any of the sensors. Each drifter was marked with a toll-free phone number, a statement of ownership, and instructions to leave the drifting buoys alone. Markings were made in both Spanish and English. The first eight drifters deployed were marked by hand with an indelible marker. Subsequent markings were made using water-proof self-adhesive placards.

2.2.4 Data Recovery

Initially, drifter data were obtained directly from Service ARGOS via modem through the Telenet dial-in service. This quickly proved to be expensive, time consuming, and prone to errors due to line noise. Subscription to Service ARGOS's Automated Delivery Service (ADS), in which the data are mailed daily via Internet email, was less expensive, more efficient, and error-free. Daily, rather than continuous updates from Service ARGOS were deemed sufficient for our needs. Also, we developed computer routines to trap and decode the drifter data hourly as it appeared in the GTS stream. The GTS stream was not the best source for the data due to gaps which resulted from infrequent network outages. Only data delivered by email were used in the production of subsequent data products presented here and sent to NODC. This set was the most complete

and closest to the source. An example of a portion of a typical ADS message is given in Table 2. It is formatted in a format Service ARGOS calls the "TX" format. In Table 2, the first column is the drifter ID number, columns two and three are the latitude and longitude, respectively, column four is the location class, column five is the calendar day/time of the data collection in UTC, and the calendar day/time of the last location, column six is the compression index, columns seven through ten are physical values for sensors one through four. In the example shown, sensor one is 10s of seconds the drifter was submerged in the prior 30 minutes, sensor two is battery level where 0 means the level was OK and 3 corresponded to low voltage, and sensor three is temperature in degrees Celsius. The channel for sensor four was not used.

Table 2. Example of Service ARGOS "TX" format

```
06938 26.618N 94.468W 3 131/0222Z-131/0220 ( 4) 05 00 0.24824E+2 00
06938 26.618N 94.468W 3 131/0858Z-131/0220 ( 1) 06 00 0.24724E+2 00
06939 28.655N 93.988W 2 130/1058Z-130/1052 ( 3) 05 00 0.23370E+2 00
06939 28.666N 93.982W 1 130/1331Z-130/1327 ( 3) 02 00 0.23220E+2 00
```

2.2.5 Deployment

Drifters are shipped from the manufacturer to the customer in cardboard containers. Packaging includes a sturdy outer box designed to withstand the rigors of shipping and an inner box held together at the seams by paper tape with a water soluble glue backing. The drifter and drogue are inside the inner box. The drogue is held in the collapsed position with strips of water soluble paper tape. Paper tape also holds the deactivation magnet in place. The outer box is to be discarded just prior to deployment and the inner box, containing the drifter, is to be thrown into the sea from either a ship or aircraft. After an hour or less, the glue will dissolve, the inner box will fall away from the drifter, the

drogue will deploy, and the magnet will fall away thereby activating the transmitter. Alternatively, when deployed from a ship, the drifter may be removed from the inner box, all paper tape and the magnet removed, and the drifter simply thrown over the side.

During bench testing, and on more than one occasion, we noticed that the water soluble tape on the magnet, the drogue, or inner box had been augmented or replaced with duct tape. This tape, if not removed prior to deployment prevents the drifter from deploying properly. Drifters delivered to Texas A&M University did not come directly from the manufacturer but had been held in a storage facility used in common by a variety of contractors. These drifters had probably been opened by others at some point for testing, display, or any number of reasons and re-taped with duct tape by someone who did not realize the role paper tape played in the deployment process. For this reason, and because we did not want to discard cardboard waste at sea, we removed all packing materials from the drifters prior to deployment.

Despite the simplicity of throwing a drifter over the ship's side, we encountered two problems during deployment which resulted in the loss of two drifters. During the first deployment, all drifters were deployed when the ship was stopped at a CTD station. At one station, the deployed drifter dragged along the ship's side, was drawn into the ship's screws, and destroyed. All subsequent deployments were made as the ship accelerated away from a station and had reached a speed of a couple of knots. Because the drogue takes 15-30 s to fully extend, this procedure ensured that the ship and drifter would not interact. This method worked very well and is highly recommended.

The second incident occurred on the same cruise when an electronics failure in a drifter went undetected. This drifter suffered an electronics failure some time after the pre-deployment tests and prior to deployment. Because there were no visible or audible indications that the drifter was not functioning, the failure went undetected by the shipboard personnel. This non-functioning drifter was deployed and lost. Before the next cruise, we purchased an inexpensive radio signal detection unit from Telonics, Inc., a

major manufacturer of the type of radio transmitters used in the ARGOS system. The test unit is turned on and held near an active buoy just prior to deployment. A light flash and audible tone indicate the radio transmitter in the drifter is active. Beginning with the second deployment cruise (May 1993), the hand-held transmitter test unit was used immediately prior to the release of each drifter to verify that the transmitters were active. No other drifters were found to have defective transmitters and no other problems were encountered.

2.2.6 Data Processing

Processing drifter data begins by collecting the email messages into a single file and presenting this file to the drifter data processing software written by us. The software parses the multi-line mail messages and stores the variables into internal arrays. Date and time strings in the data were decoded and checked against internal calendar functions. This permits the data to be ordered correctly across year boundaries (year is not included in the returned data) or when duplicate mail messages are received. Duplicate messages are identified and eliminated automatically. As noted previously, satellite passes may be separated in time by only a few minutes. Pairs closer in time than 15 minutes are eliminated by removing the observation with the lowest quality locational fix. Data gaps greater than 3 hours are filled using linear interpolation. Finally, cubic-splines were used to generate a uniform time series of locations from which east-west and north-south components of speed were produced. Speed was formed from first-difference formulas. Plots of speed were produced and used to visually detect wild-points. Data generated while active drifters were still onboard the deployment vessel were eliminated through a knowledge of the deployment time recorded by ship's personnel. Often this could be verified from drifter temperature records as well. Occasionally a drifter was captured by unknown vessels at times which were not exactly known. At such times, unreasonable data such as rectilinear tracks, speeds in excess of 5 knots, or excessively high

temperatures would occur. These were located through inspection of the associated plots and eliminated.

Occasionally, temperature data were reported without an associated location. This occurred when signals did not meet Service ARGOS's criteria for location determination. However, all temperatures, even those without locations were used to produce the 6-hourly temperature record, except that temperature data after the final location were not used.

2.3 Deployment

For each drifter deployed by the LATEX A field program, Table 3 shows the time and location of the first and last message received, the number of days active, and the drifter's ultimate fate, if known. Drifting buoys are identified by their transmitter identification numbers (PTT ID). Several drifters were captured by persons unknown and subsequently released. In such cases, trajectories following the original deployment are labelled "a", trajectories following releases by captors are labelled "b". Note that the records sent to NODC may not span the times given in table 3. Data are retained only when the drifter is thought to be drifting freely (not captured) and when the signal quality is sufficiently good for Service ARGOS to generate a location. Often, near the end of a drifters life, only temperature and auxillary data are received.

Table 3. Start/stop times and fate of LATEX A drifting buoys

PTT ID	Date	Time (UTC)	Latitude	Longitude	Event
03583	03-Aug-92	11:50	29°04.8'N	92°00.2'W	Deployed
	08-Aug-92	09:00	29°13.0'N	92°03.1'W	Captured-lost 5 days
02446	03-Aug-92	14:38	28°53.3'N	91°59.8'W	Deployed
	13-Aug-92	14:32	28°23.6'N	91°27.7 W	Captured-lost 10 days
03582	03-Aug-92	20:14	28°26.6'N	91°59.8'W	Deployed
	04-Sep-92	15:06	28°00.1'N	93°58.0'W	Lost 32 days
02447	04-Aug-92	00:55	27°59.8'N	92°00.0'W	Deployed
	07-Feb-93	11:05	24°47.8'N	97°02.8'W	Captured-lost 185 days
06932	08-Nov-92	02:16	28°26.8'N	91°59.9'W	Deployed
	02-Dec-92	02:44	28°51.4'N	93°23.0'W	Lost 24 days
06934a	10-Nov-92	05:46	28°52.9'N	90°30.8'W	Deployed
	15-Nov-92	20:51	28°48.2'N	91°24.4'W	Captured - 5 days
06934b	17-Apr-92	20:46	30°05.1'N	86°08.5'W	Released
	03-Aug-93	02:17	26°03.2'N	79°57.5'W	Lost 108 days
06933	10-Nov-92	07:19	28°46.4'N	90°30.4'W	Deployed
	08-Jan-93	13:39	25°07.7'N	97°19.9'W	Lost 59 days
06931					Destroyed
03585					Deployed dead
06938	02-May-93	06:04	27°51.0'N	94°10.5'W	Deployed
	17-Oct-93	23:13	28°20.5'N	86°54.3'W	Lost 168 days
06935	02-May-93	07:44	27°57.1'N	94°08.3'W	Deployed
	02-Nov-93	10:18	26°09.4'N	80°02.3'W	Lost 184 days
06937	02-May-93	10:13	28°09.0'N	94°03.7'W	Deployed
	08-Jan-94	14:41	26°45.6'N	83°56.9'W	Lost 251 days
06939	02-May-93	13:10	28°22.0'N	93°59.7'W	Deployed
	12-Jul-93	14:12	29°19.4'N	94°06.4'W	Lost 71 days
06940	01-May-94	07:15	27°59.6'N	94°02.1'W	Deployed
	26-May-94	15:04	28°14.0'N	93°21.9'W	Lost 25 days
03584	01-May-94	10:08	27°47.6'N	94°11.9'W	Deployed
	29-Jun-94	02:07	29°15.7'N	93°11.4'W	Lost 59 days
06936	01-May-94	08:29	27°54.5'N	94°10.1'W	Deployed
	11-Jun-94	23:27	28°45.7'N	91°46.1'W	Lost 343 days
07839	03-Nov-94	11:53	27°56.7'N	91°32.3'W	Deployed
	17-Apr-95	15:28	43°50.0'N	42°52.9'W	Lost 165 days
07834	03-Nov-94	19:29	28°02.6'N	90°38.5'W	Deployed
	19-Nov-94	12:53	27°36.3'N	90°08.3'W	Captured 16 days
07833a	03-Nov-94	15:41	28°00.7'N	91°05.5'W	Deployed
	07-Nov-94	07:00	28°03.8'N	91°04.2'W	Captured 4 days
07833b	10-Nov-94	14:28	28°01.3'N	94°06.7'W	Released
	26-Dec-94	00:26	26°54.8'N	79°56.9'W	Lost 47 days

2.4 Drifter trajectories, velocities, and temperatures

Figures 2-20 show graphs of the LATEX A drifter trajectories, velocity components, and temperature records. The plots are organized with one drifter per page. Section 2.2.6 of this report and Jochens and Nowlin (1994) document the processing of these data.

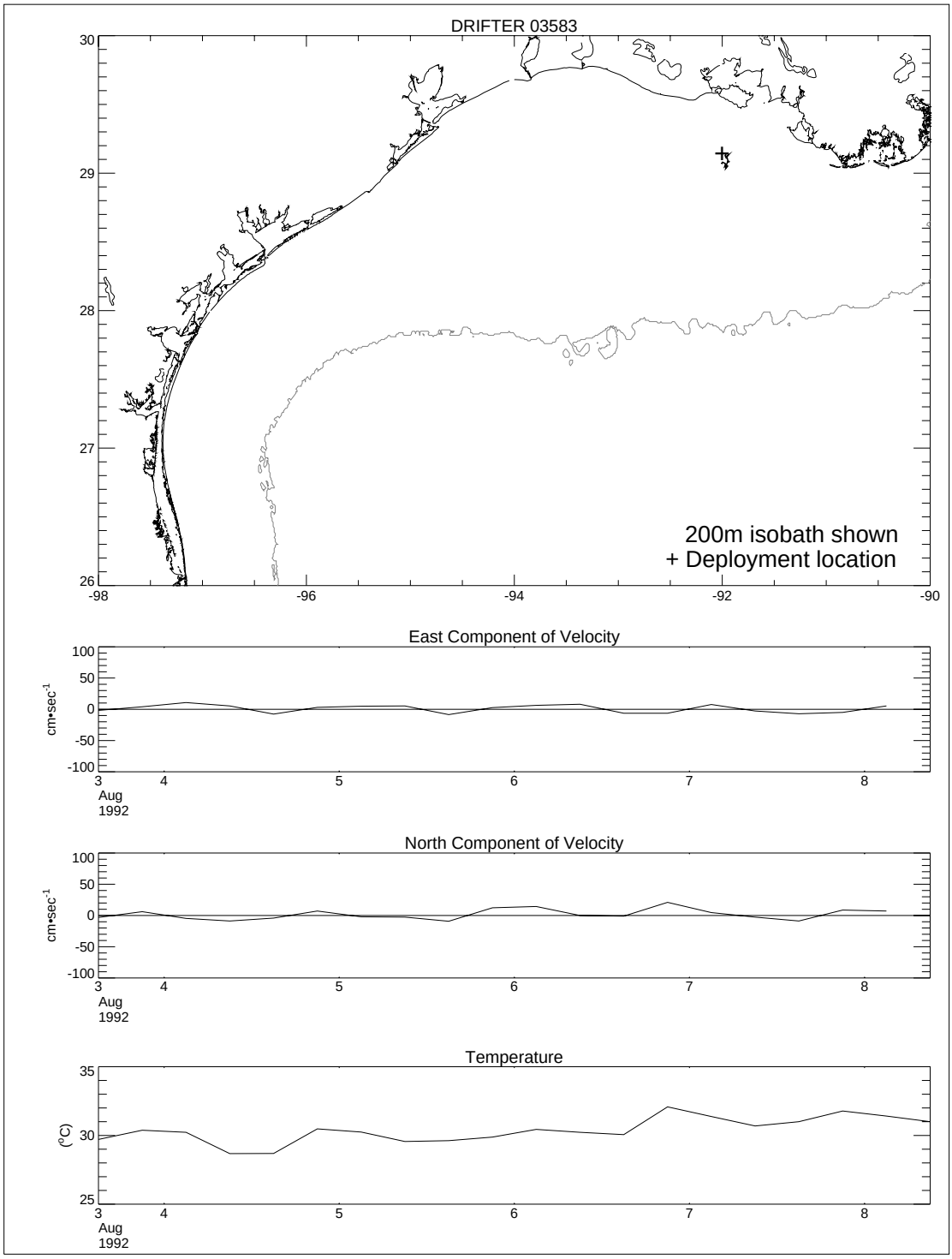

Figure 2. Drifter 03583 trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

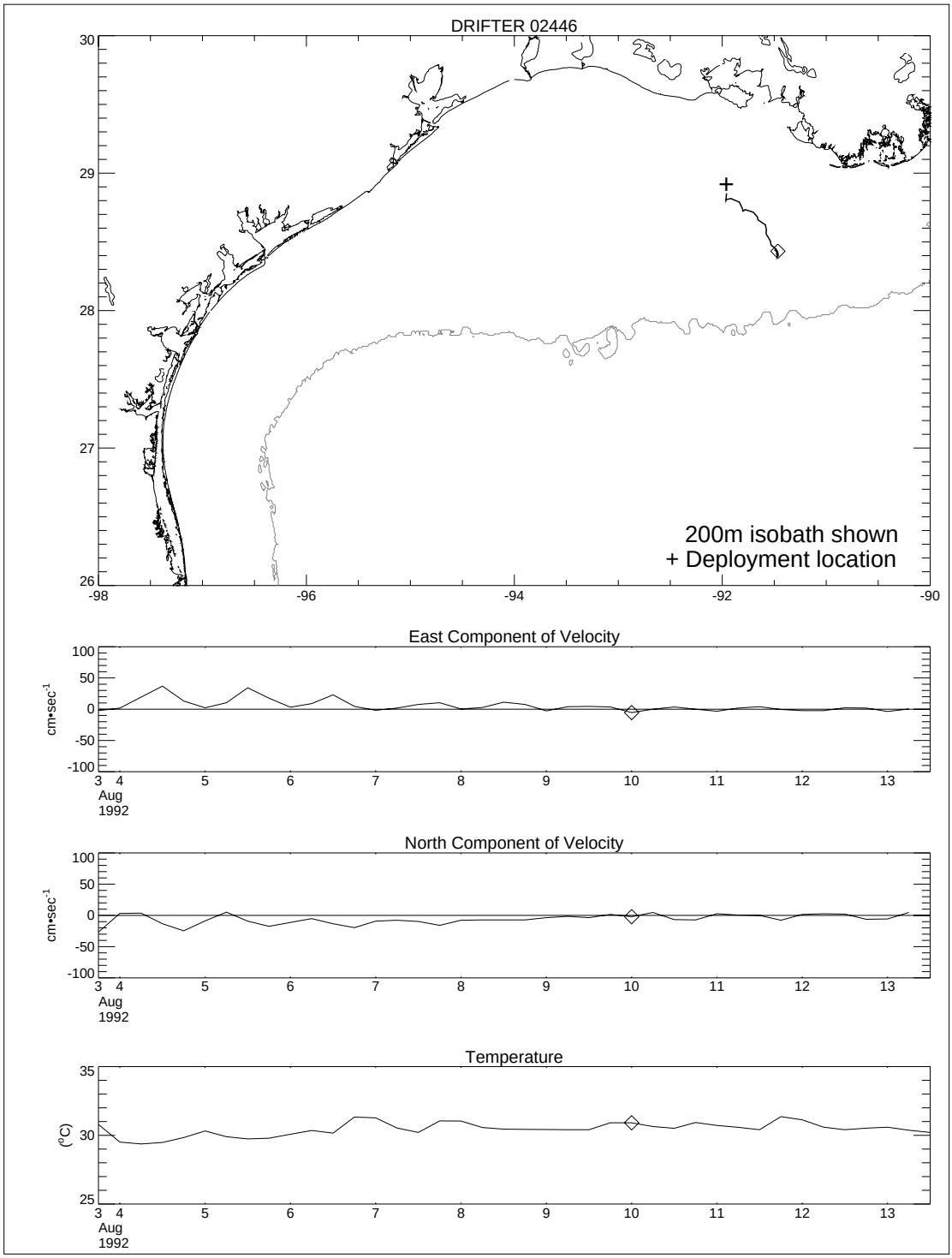

Figure 3. Drifter 02446 trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

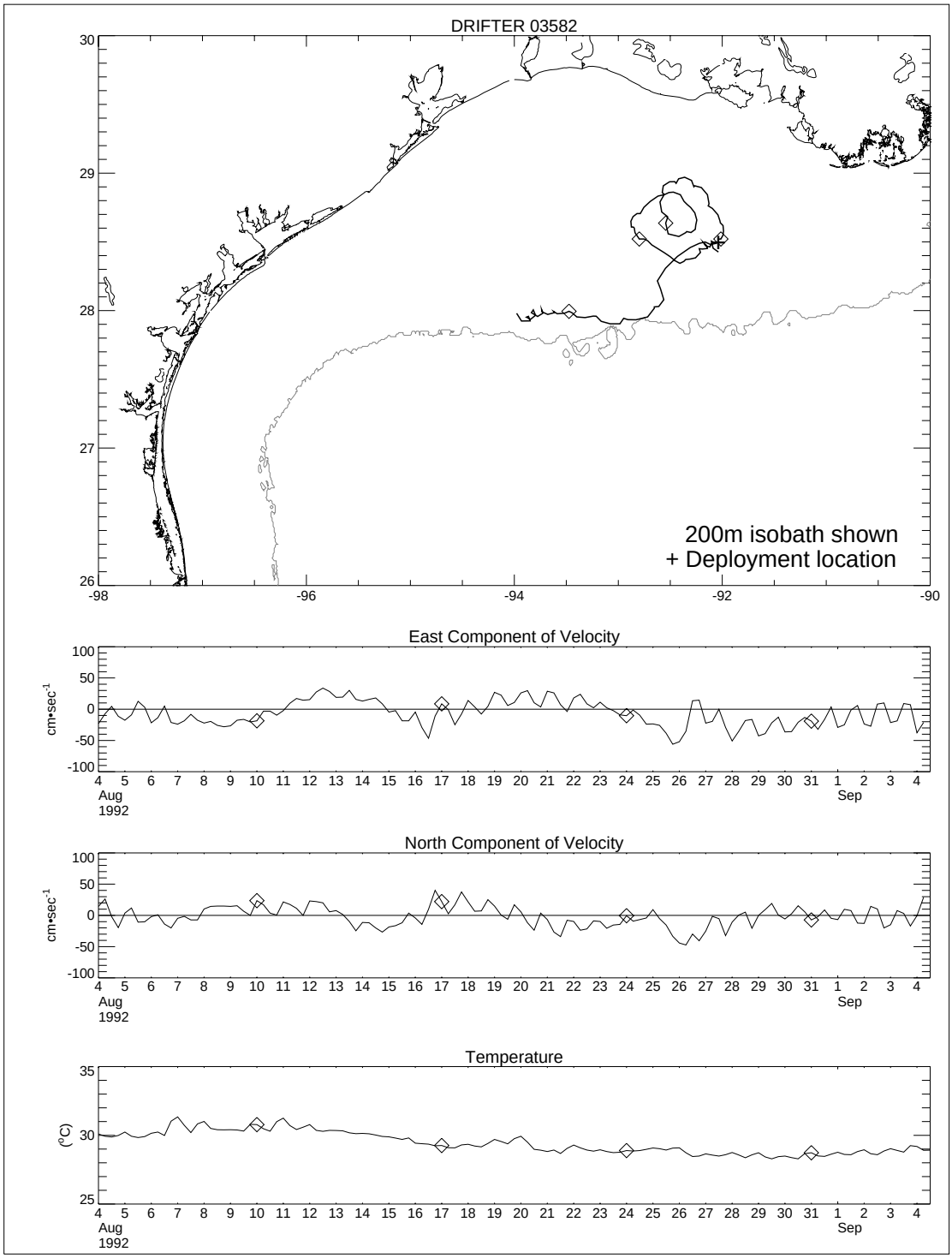

Figure 4. Drifter 03582 trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

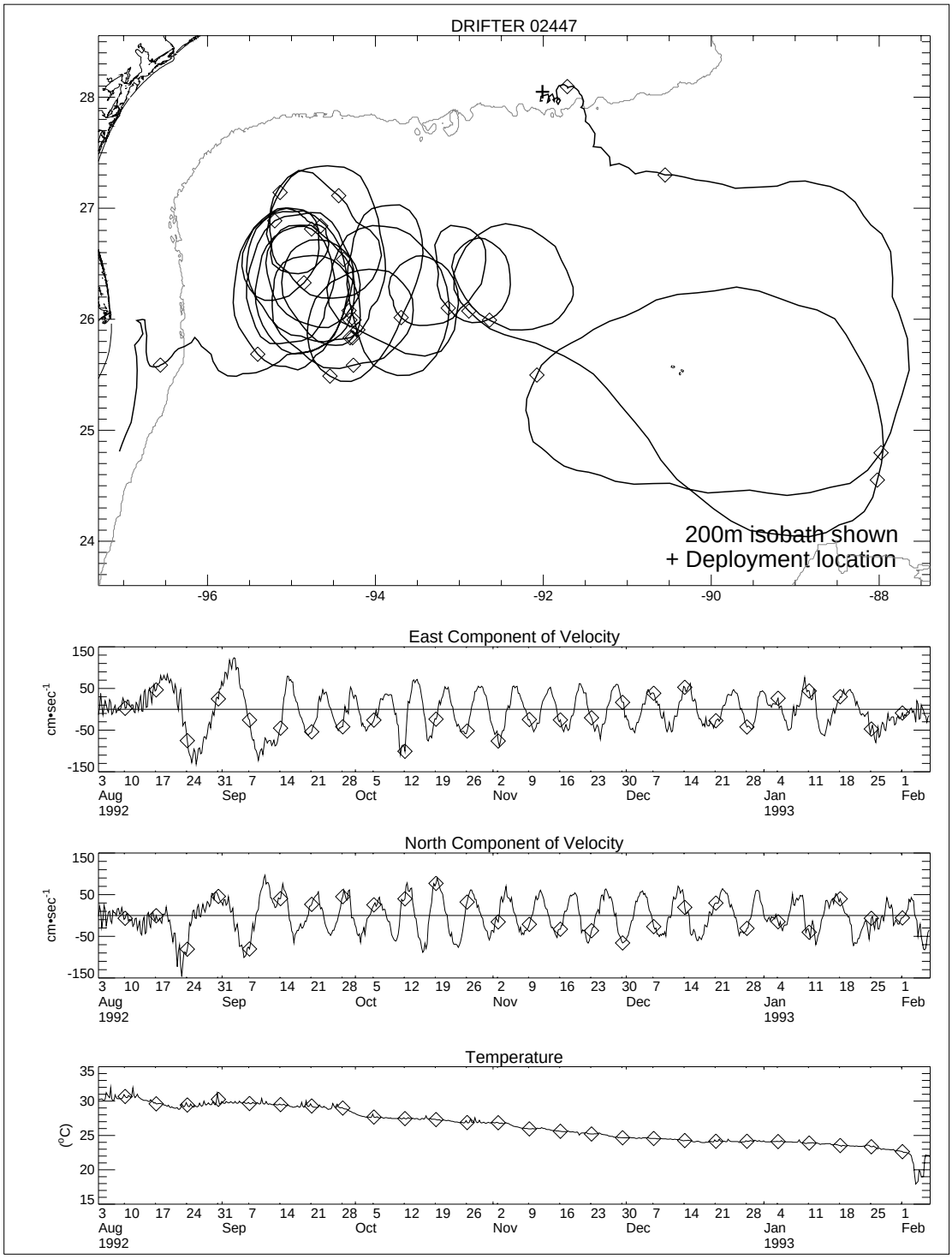

Figure 5. Drifter 02447 trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

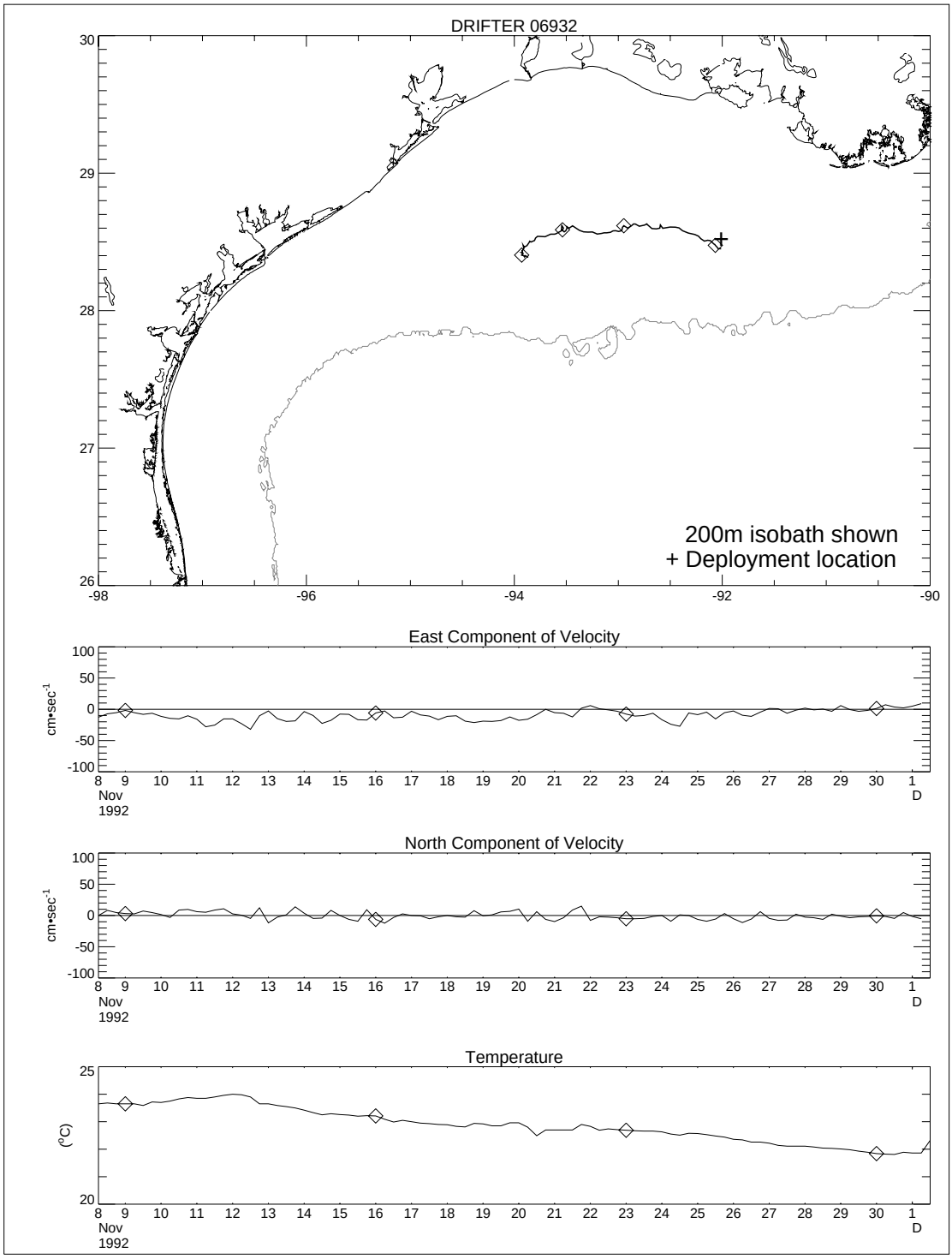

Figure 6. Drifter 06932 trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

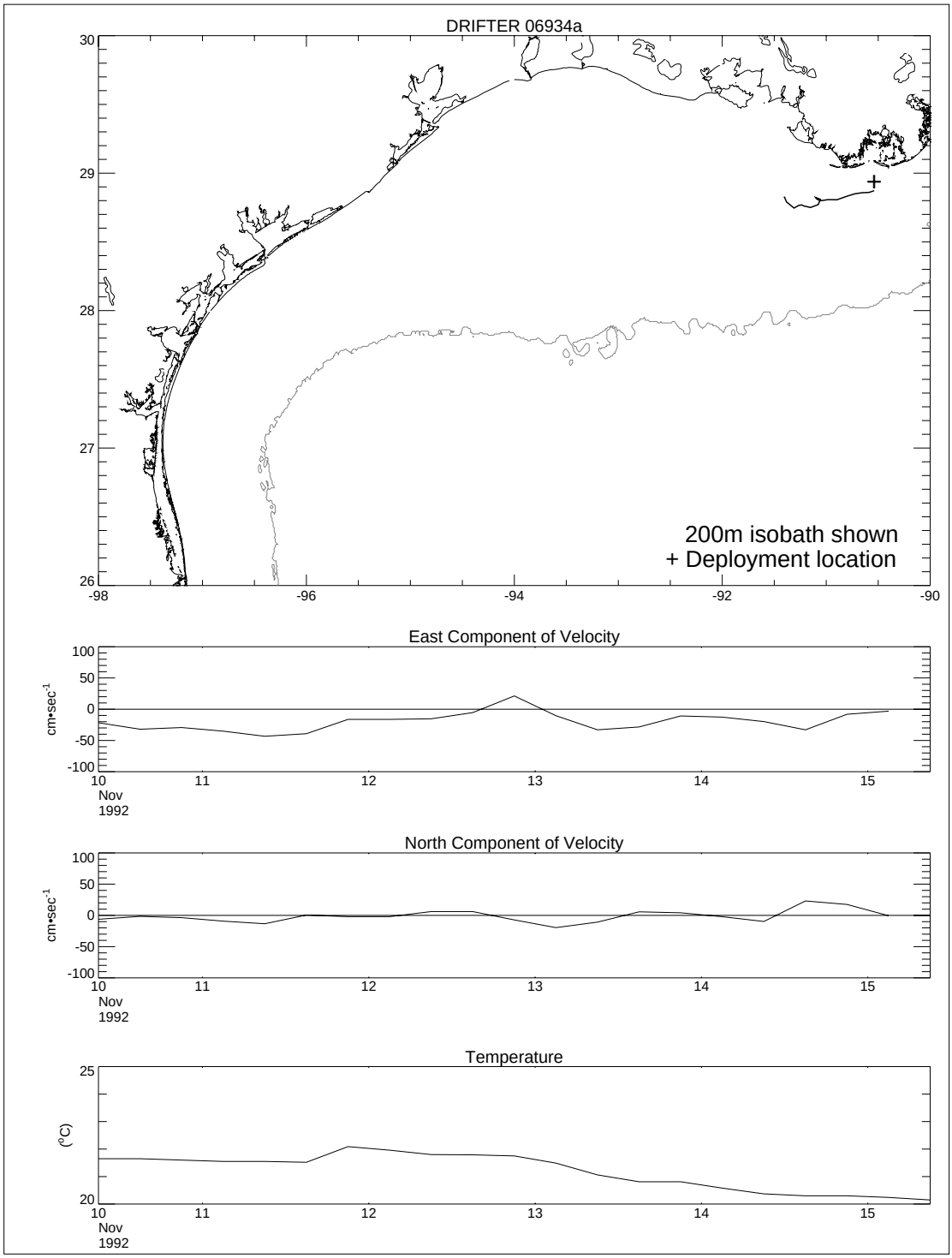

Figure 7. Drifter 06934a trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

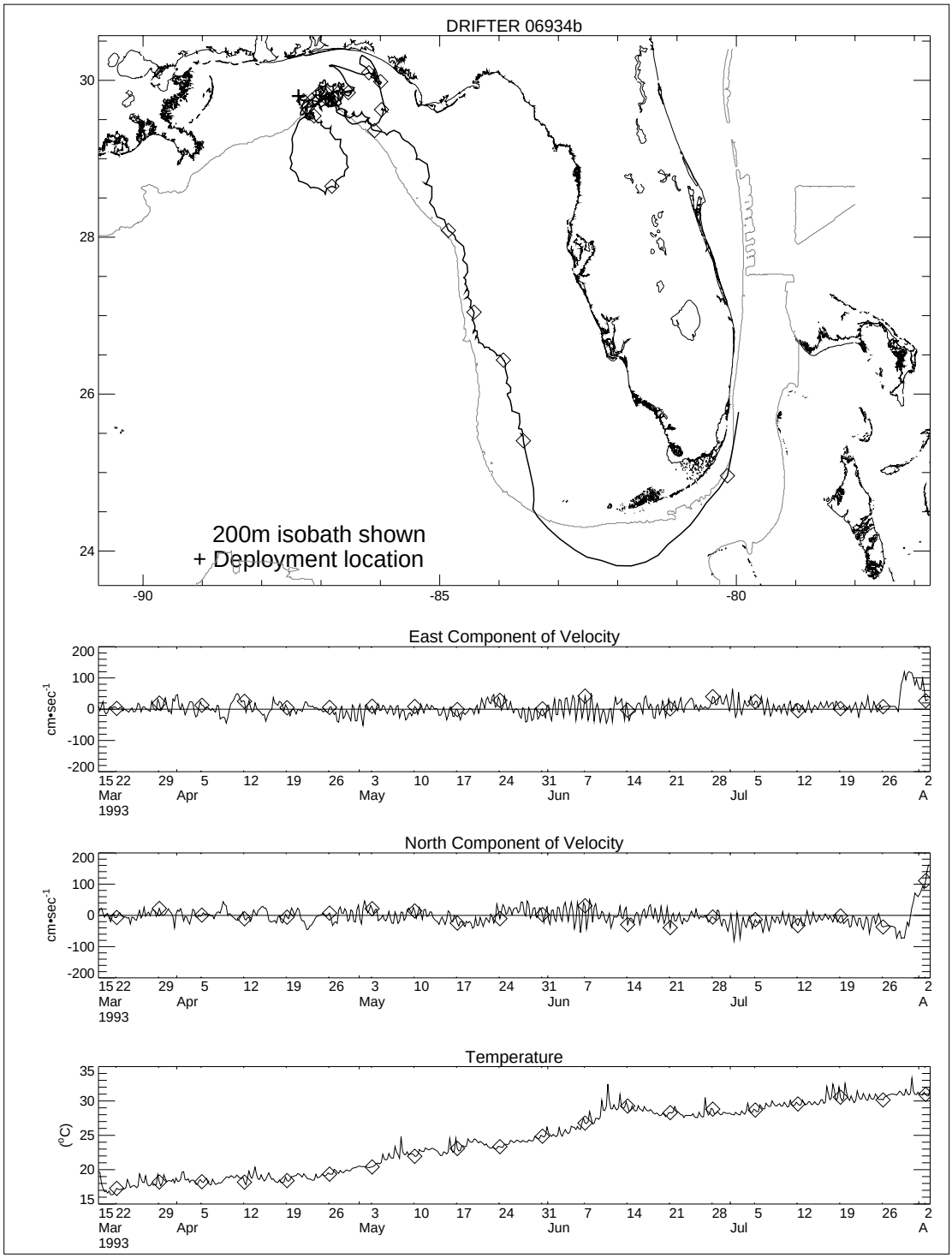

Figure 8. Drifter 06934b trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

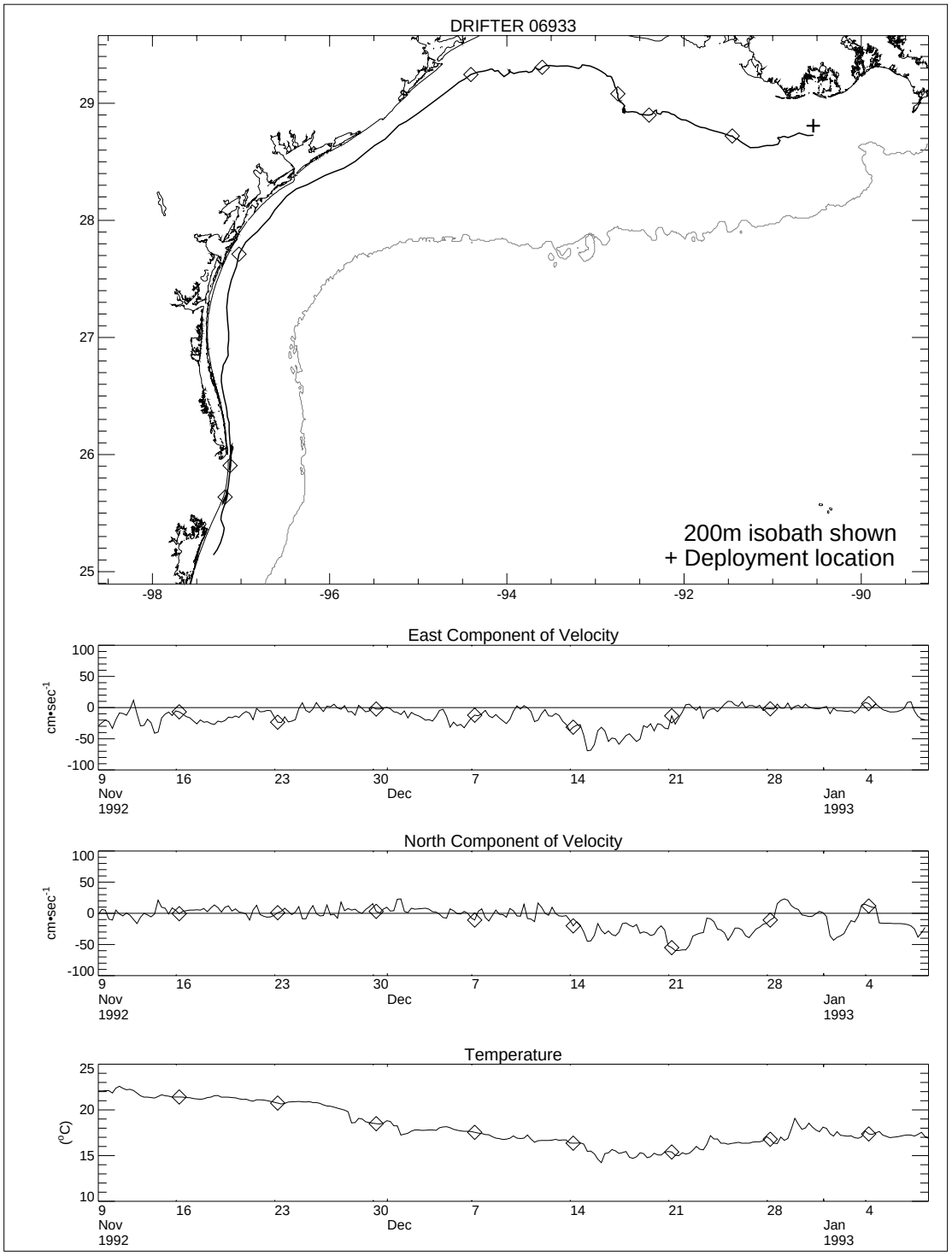

Figure 9. Drifter 06933 trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

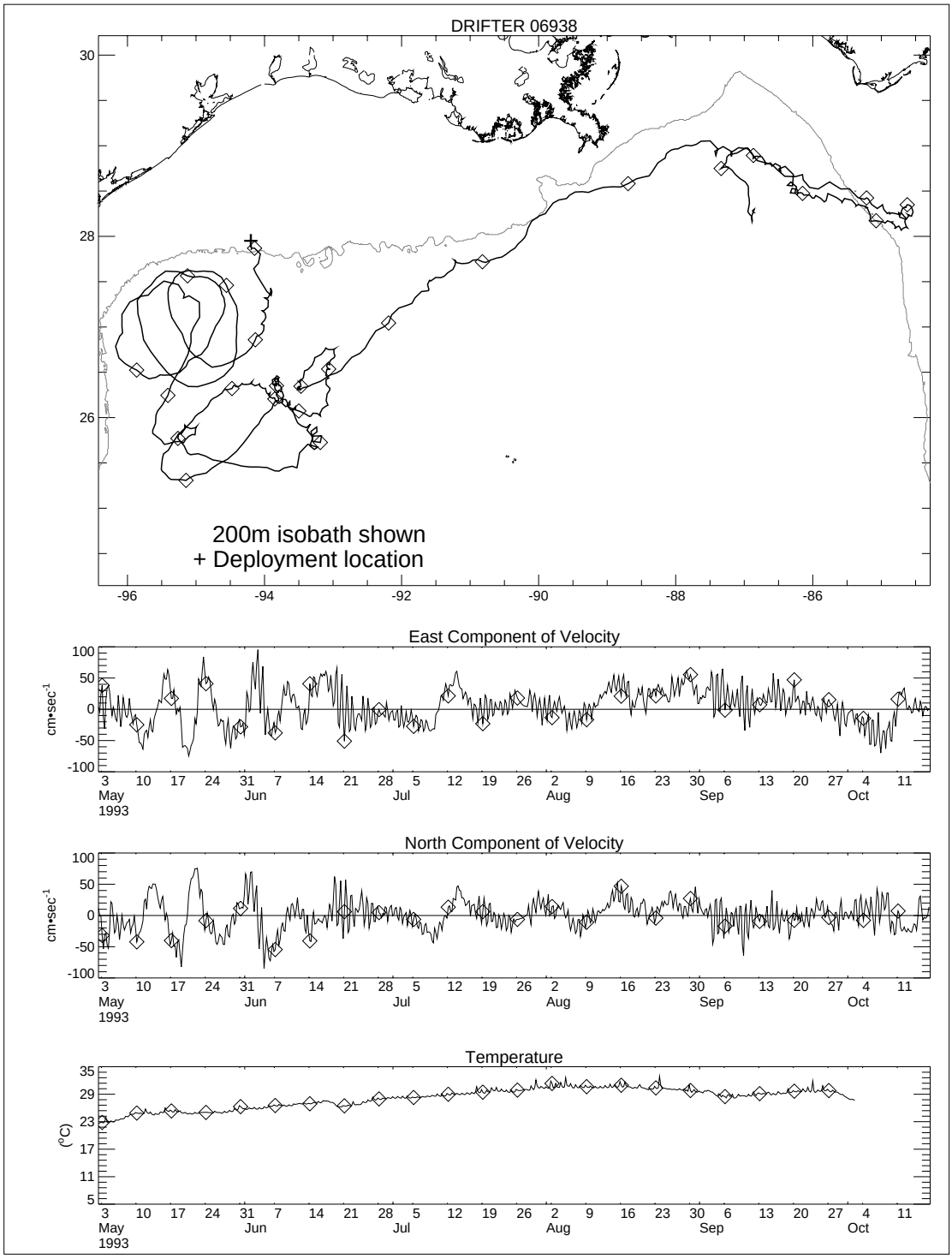

Figure 10. Drifter 06938 trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

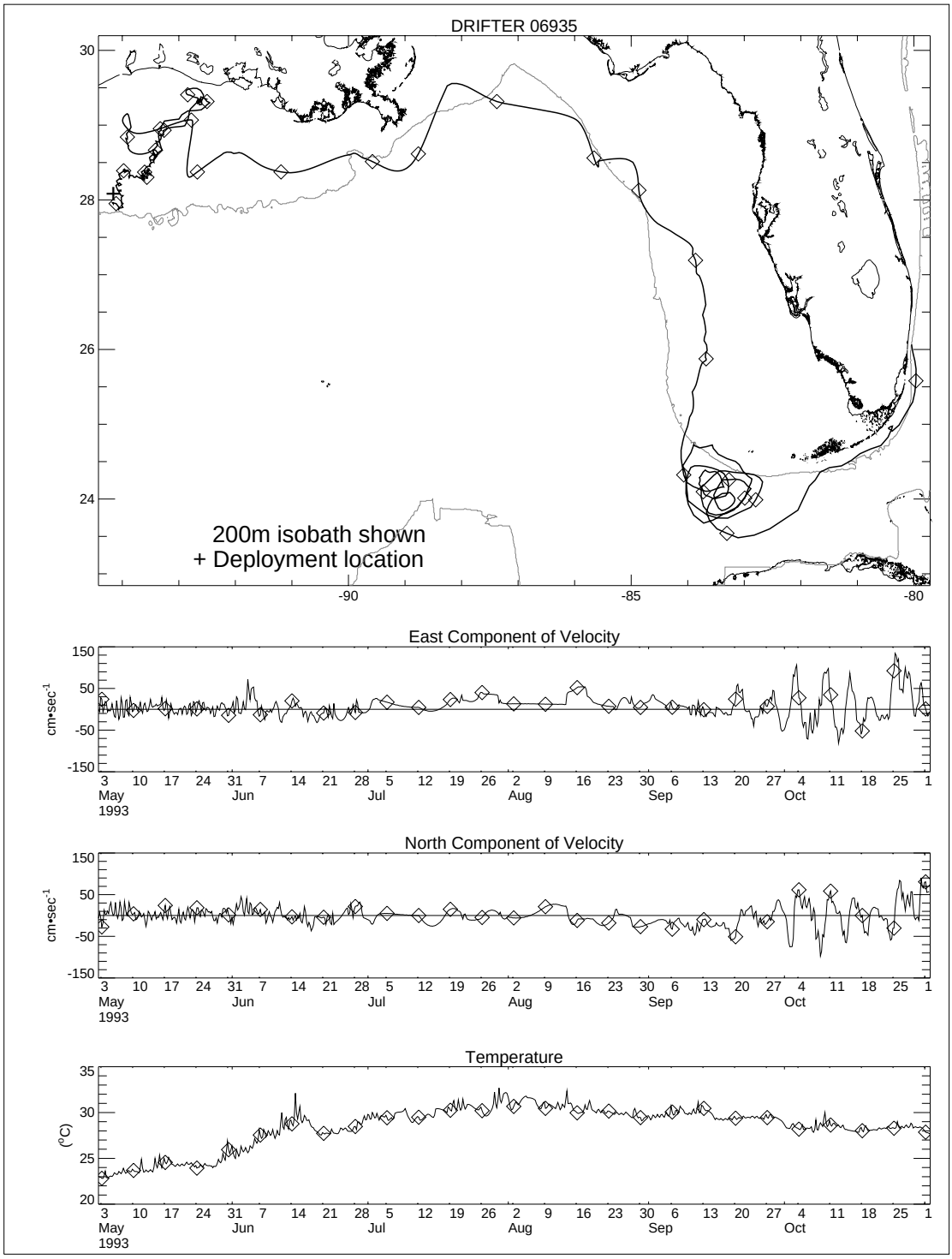

Figure 11. Drifter 06935 trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

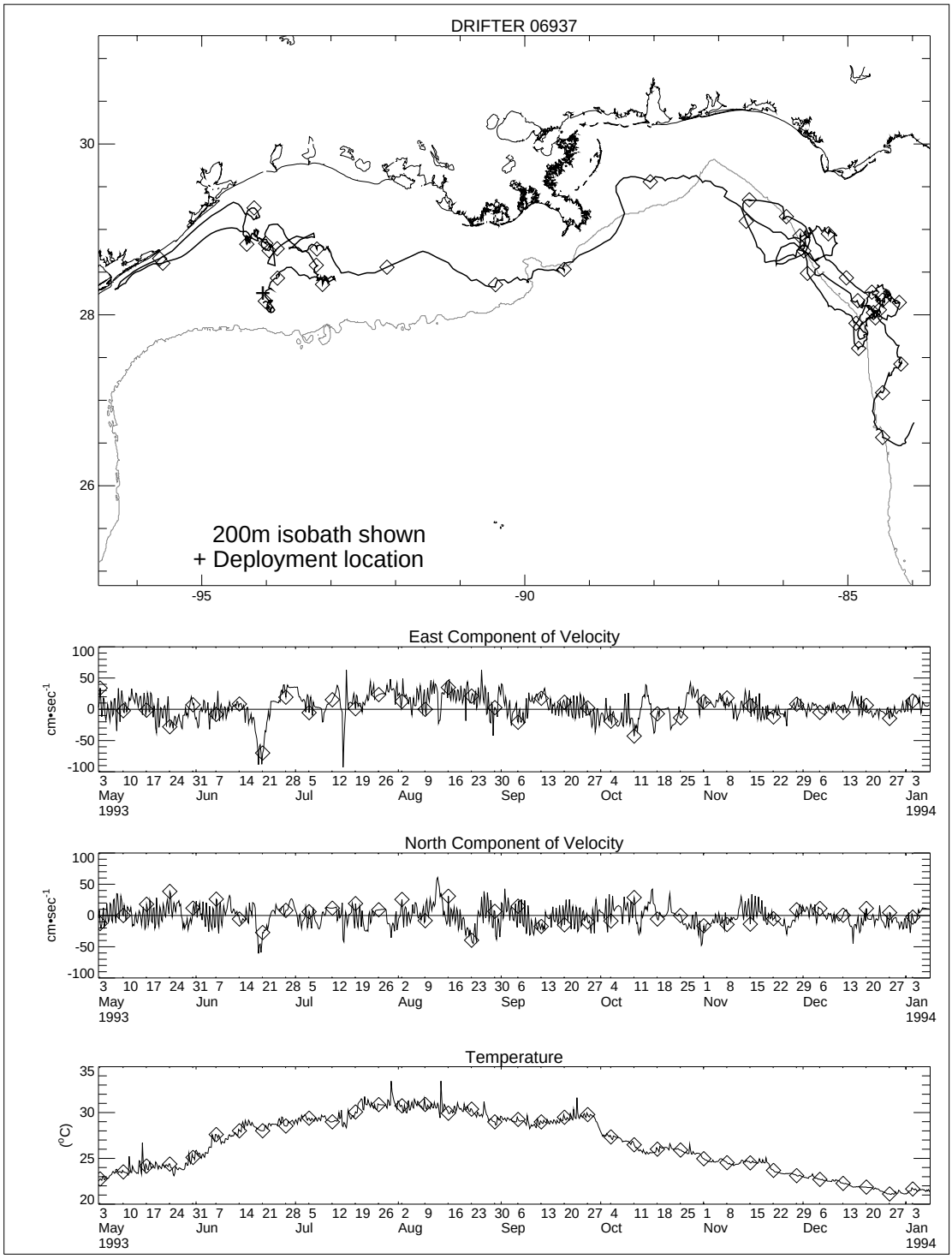

Figure 12. Drifter 06937 trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

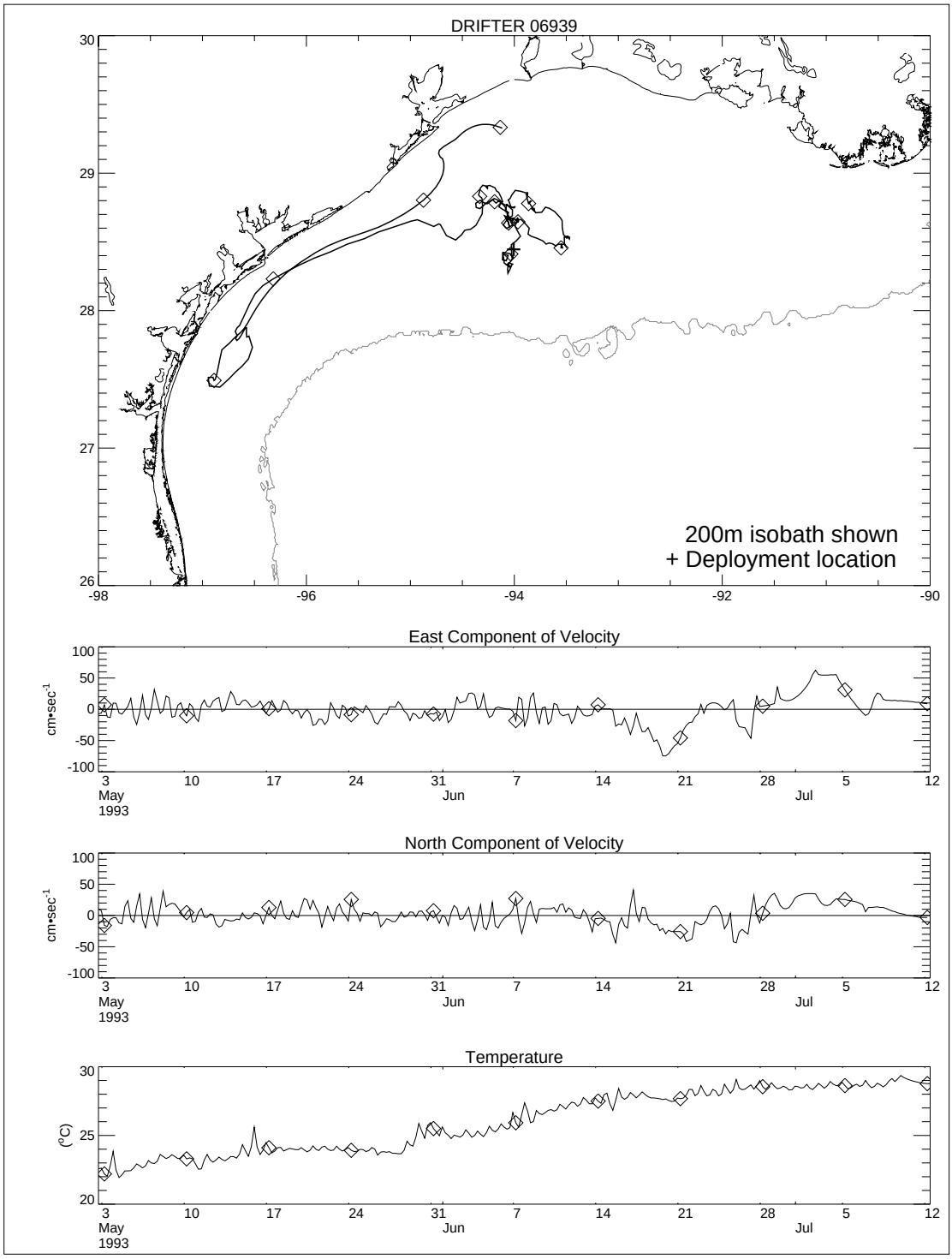

Figure 13. Drifter 06939 trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

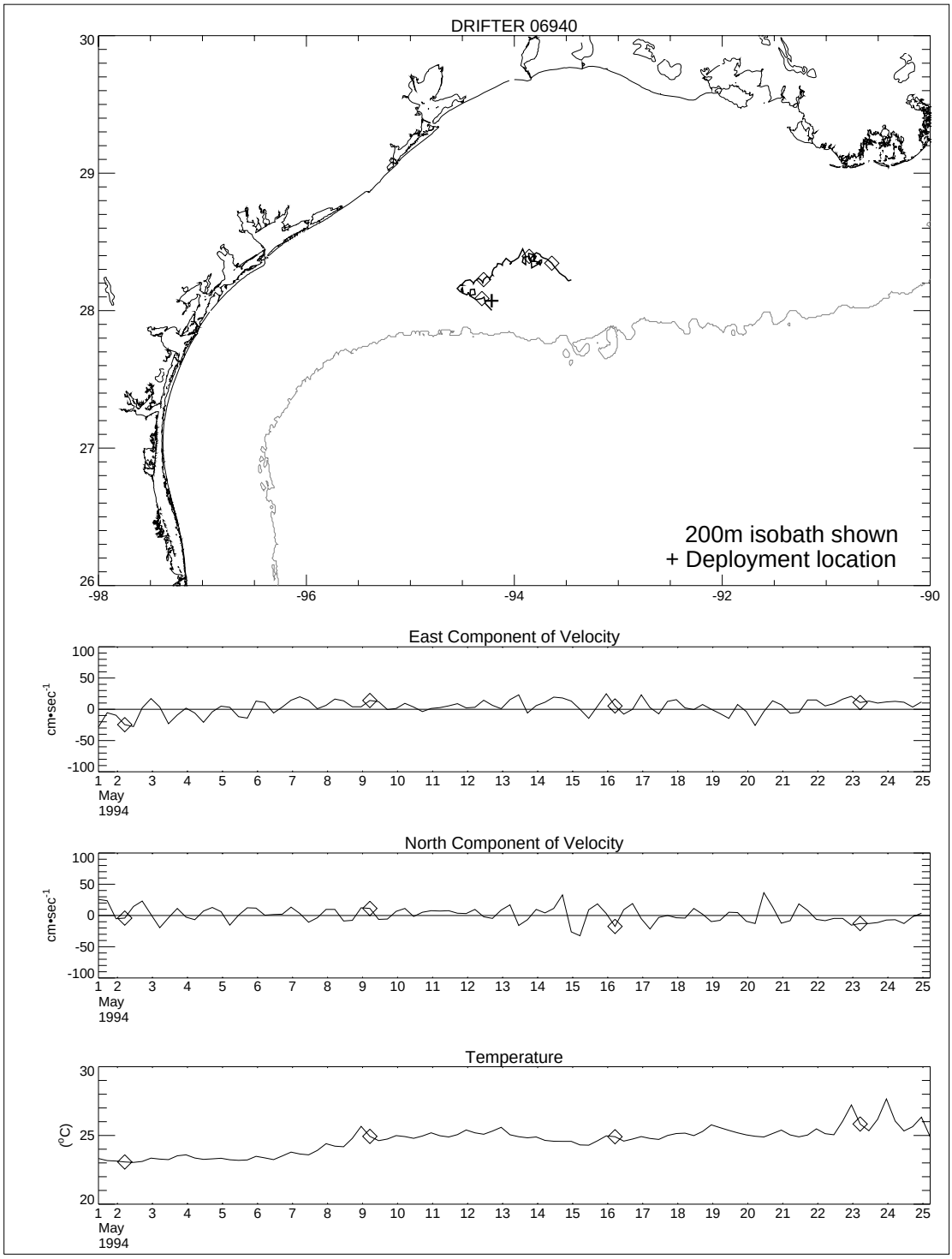

Figure 14. Drifter 06940 trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

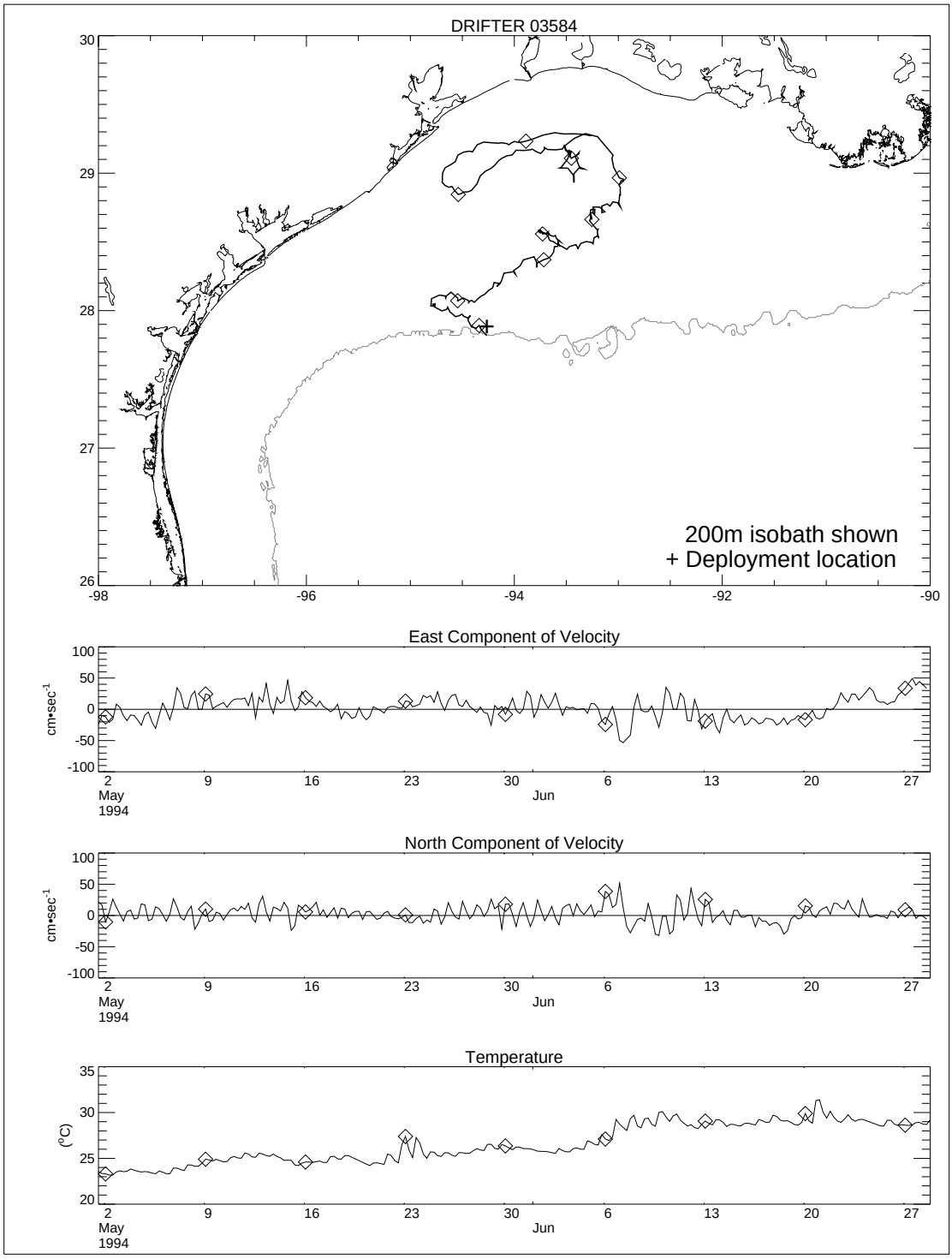

Figure 15. Drifter 03584 trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

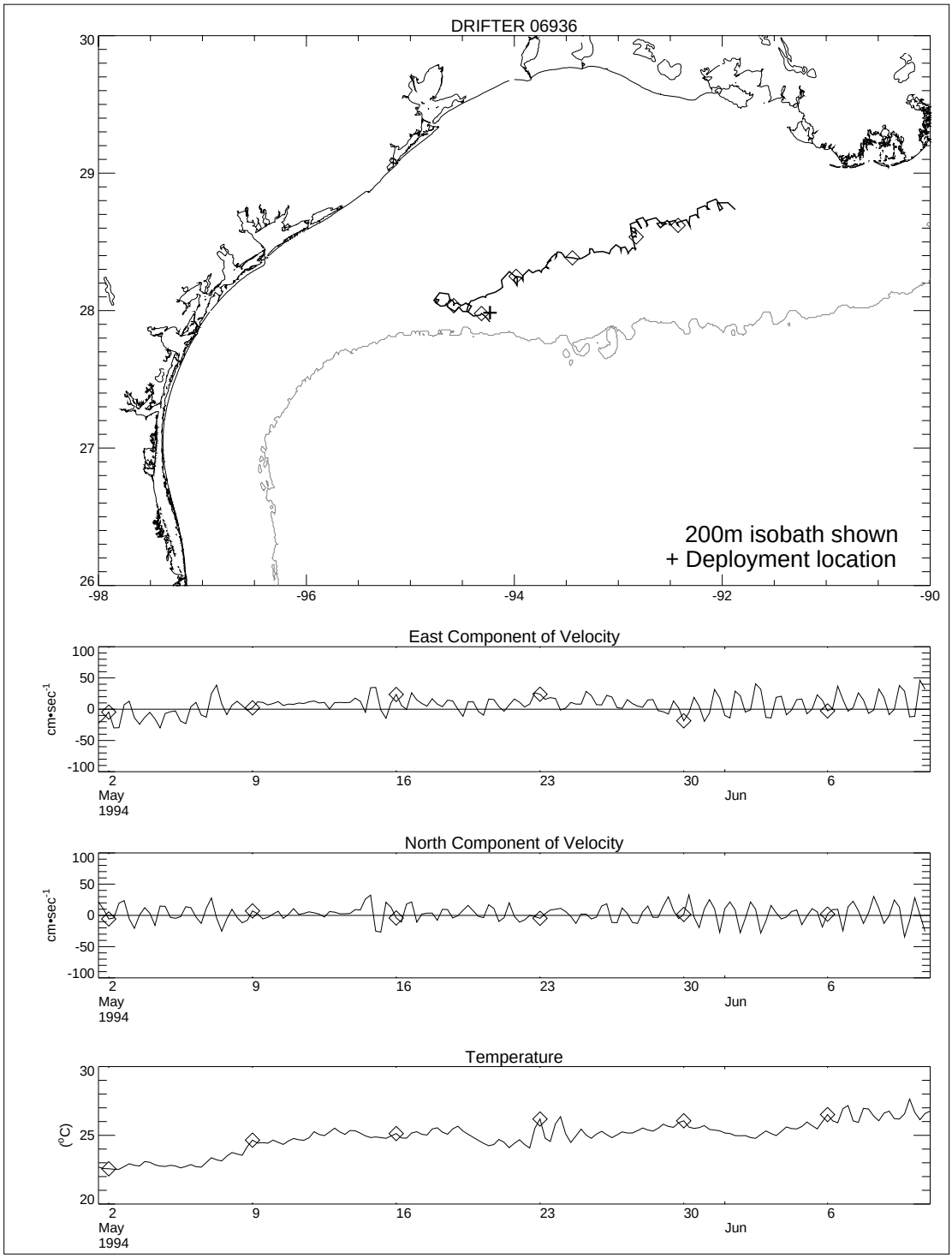

Figure 16. Drifter 06936 trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

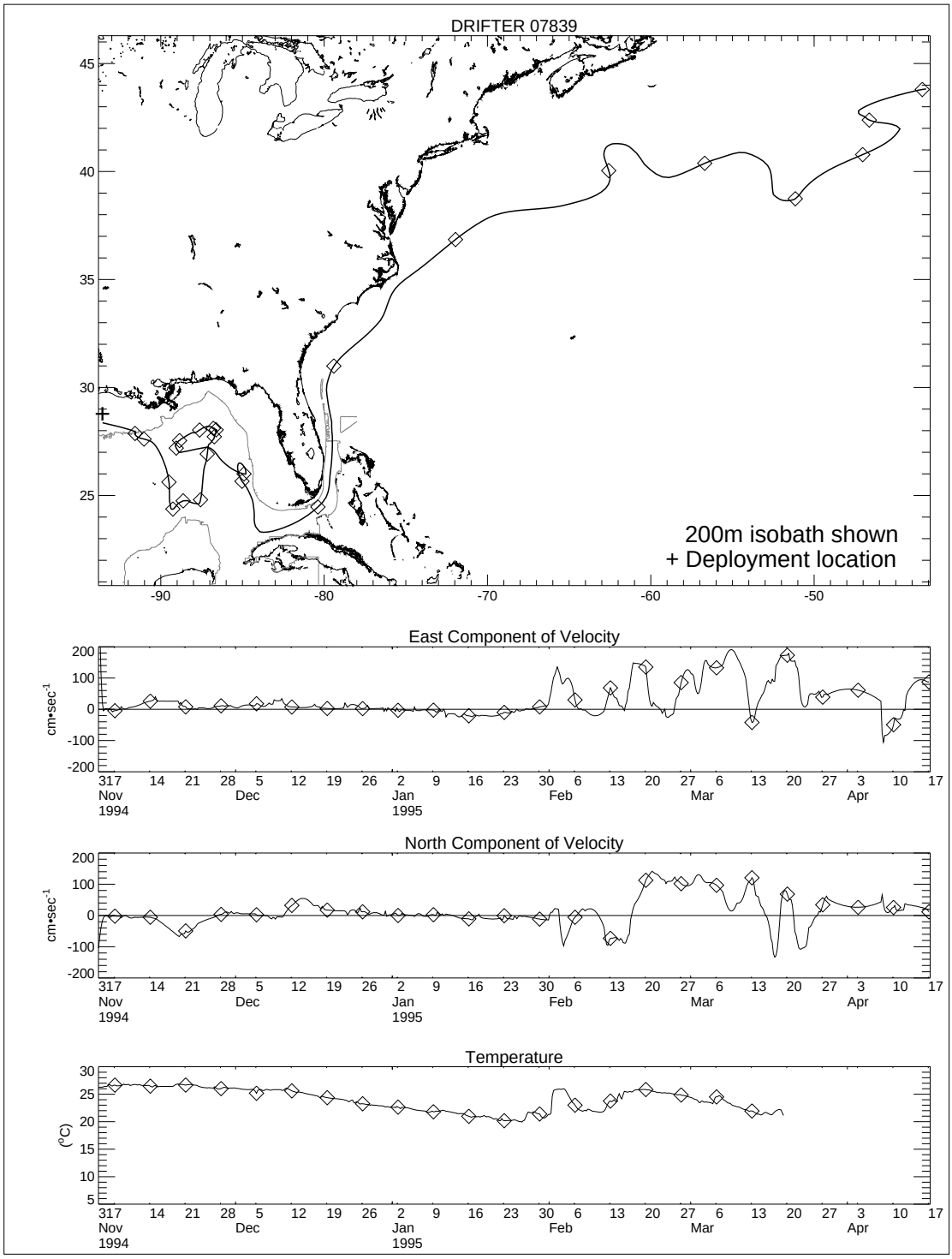

Figure 17. Drifter 07839 trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

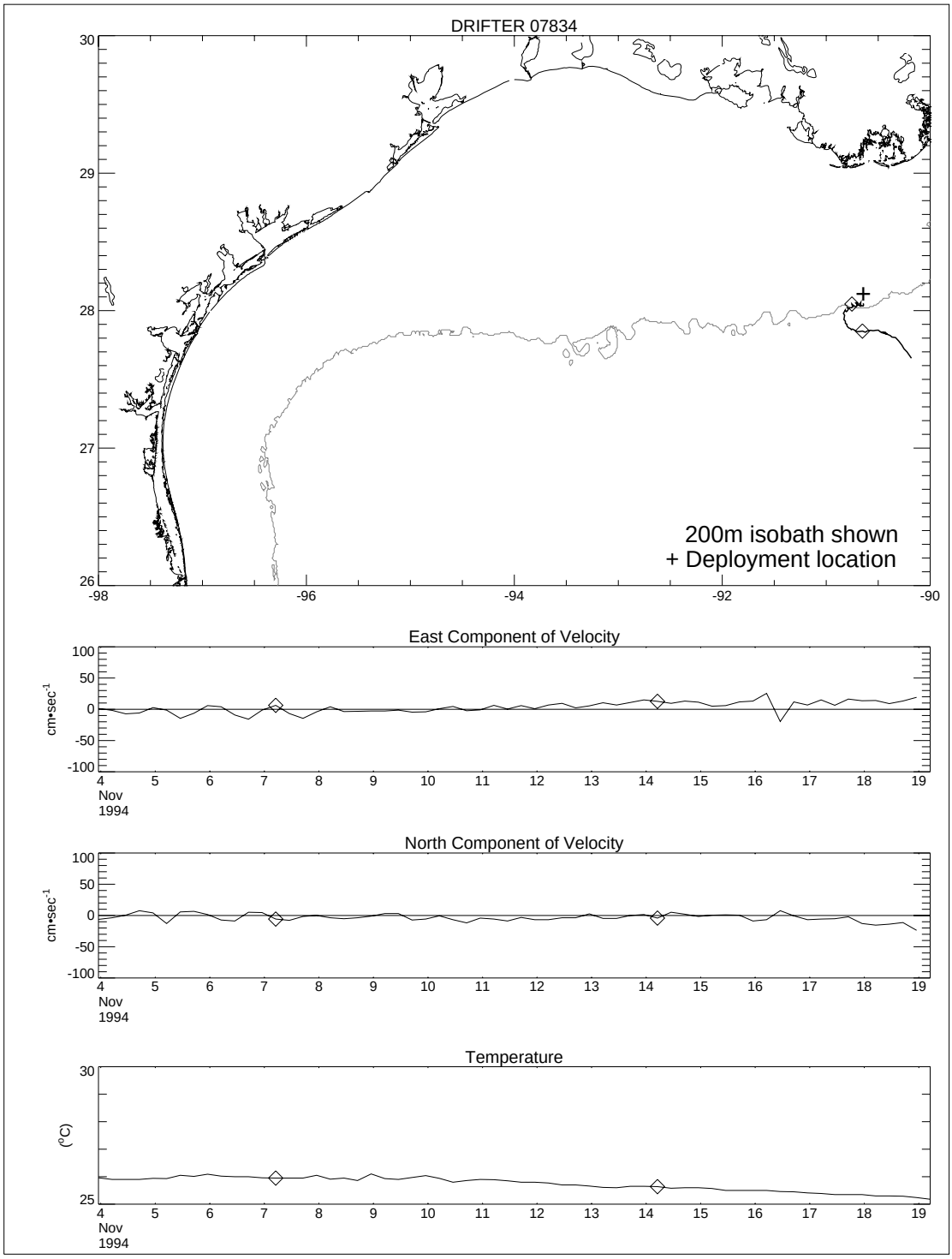

Figure 18. Drifter 07834 trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

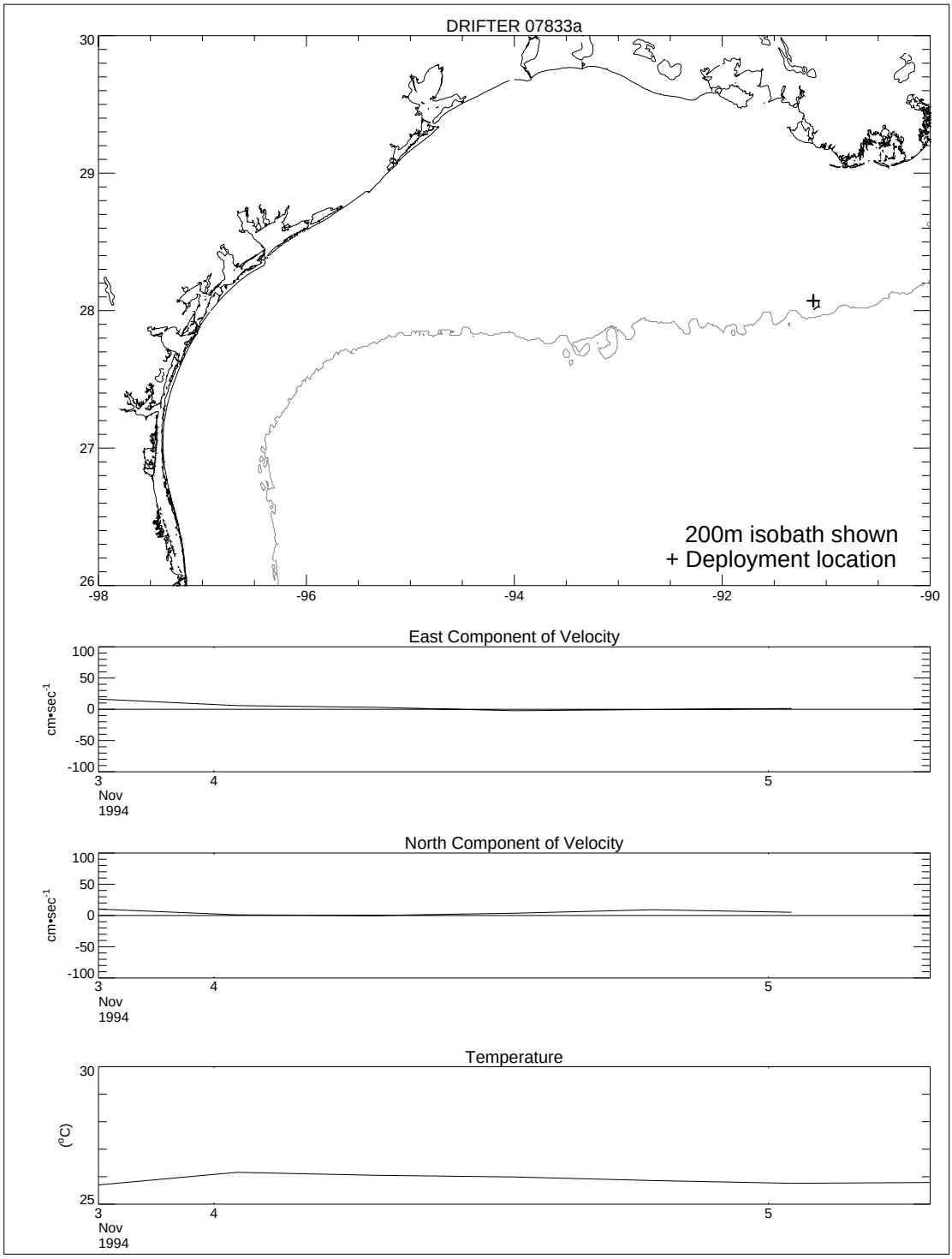

Figure 19. Drifter 07833a trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

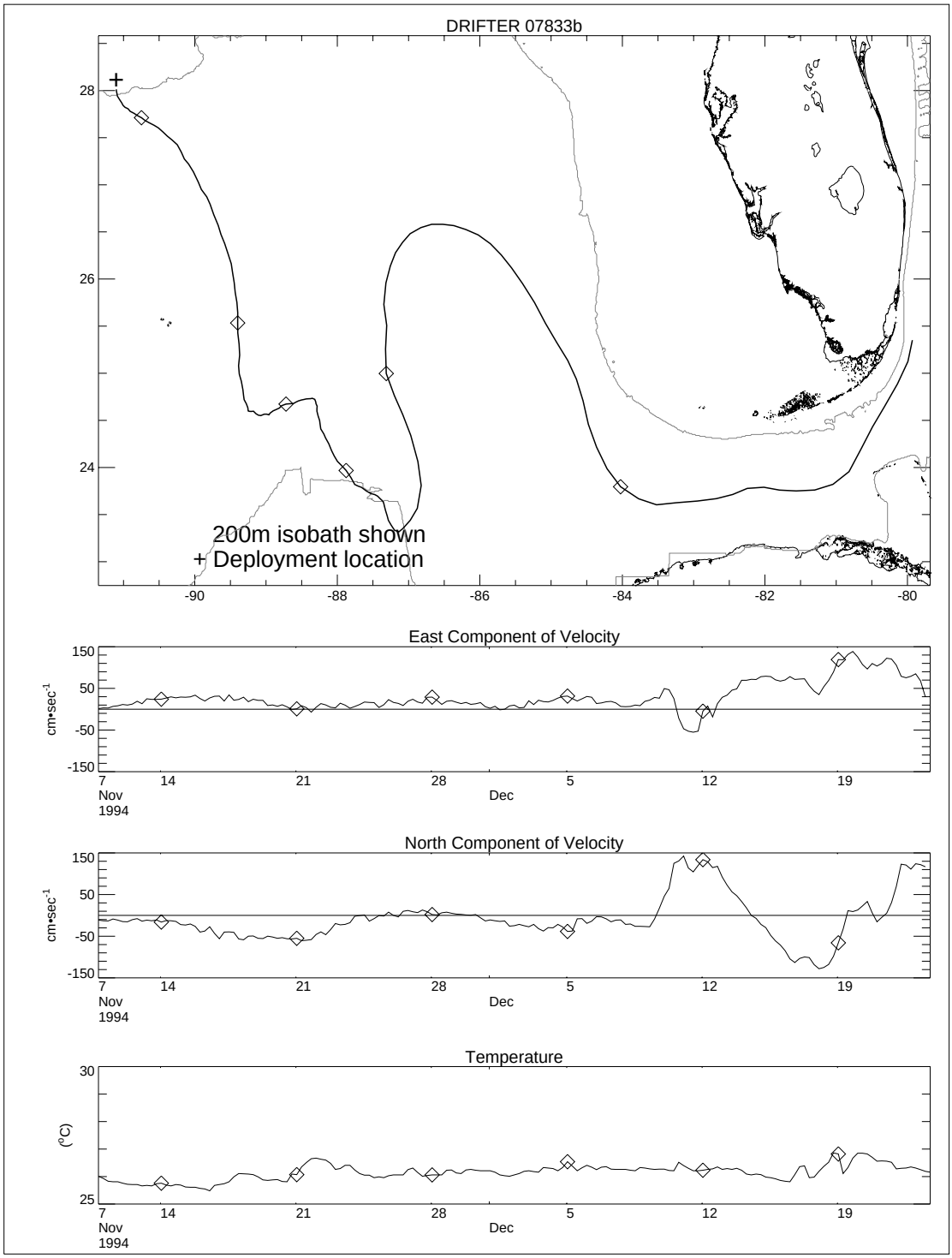

Figure 20. Drifter 07833b trajectory, east and north velocity components, and surface temperature from 6-hourly samples of splined observations. North and east are positive. Diamonds mark first value on each Monday.

3. Expendable instruments and thermosalinograph data

3.1 Introduction

Three types of expendable profiling instruments were deployed during the LATEX A field program. These are expendable bathythermograph (XBT), expendable sound velocity profilers (XSV), and expendable current profiler (XCP). This section documents the collection and processing of each expendable instrument type and the hull-mounted thermosalinograph.

Naming conventions of the expendable instrument data files are different for each instrument type. The three character suffix of each data file signifies the instrument type: xbt, xcp, xsv. The first three to four characters signify the current meter or hydrographic cruise designator for the cruise on which the instrument was deployed. Table 4 summarizes the file naming conventions for the instruments discussed in this section.

Table 4. Expendable instruments file naming convention

Character	Description
XBT	example: H07S001.xbt; M10S019.xbt
1	H or M for hydrography or current meter cruise
2 & 3	cruise designator (01 to 18)
4	always S
5, 6, & 7	drop sequence
extension	always xbt
XCP	example: CM10M42.xcp
1 & 2	always CM for current meter cruise
3 & 4	current meter cruise designator (01 to 18)
5	always M for mooring
6 & 7	LATEX mooring location designator (01 to 25, 44 to 49)
extension	always xcp
XSV	example: M16S001.xsv
1	always M for current meter cruise
2 & 3	current meter cruise designator (01 to 18)
4	always S
5, 6, & 7	cast number
extension	always xsv

Table 4. (continued) Expendable instruments file naming convention

Character	Description
TSG	(thermosalinograph) example: H08_sail.tsf
1	always H for hydrographic cruise
2 & 3	cruise designator (01 to 10)
4 - 8	always _sail
extension	always tsf (temperature, sail, full compliment)

3.2 Expendable Bathythermograph

Sippican, Inc., ship-deployed Model T-7 XBTs, were deployed on four LATEX A current meter mooring maintenance cruises (CM03, CM10, CM16, and CM18) and two LATEX A hydrography cruises (H07 and H10). Table 5 shows the cruise identifier, date of XBT deployments, approximate deployment locations, and number of XBTs deployed with usable (and bad) data. XBTs were deployed along the 200-m isobath during hydrographic cruises and one current meter cruise and along 92°W en route to servicing the inverted echo sounders (IES) deployed at moorings 42 and 43 (Figure 1). IES data are documented in the LATEX A Current Meter Data Report (DiMarco et al. 1997). Figure 21 shows a map of the Texas-Louisiana continental shelf with associated bathymetry and the location of every usable LATEX A XBT cast. The latitude and longitude for each XBT are given in the data file.

Table 5. LATEX A XBT Deployment Summary

Cruise	Date	Location	Number (bad)
CM03	23-24 July 1992	92°W	20
CM10	23-24 July 1993	92°W	20 (3)
CM16	25 July 1994	92°W	5
CM18	1-6 December 1994	200 m isobath	32 (1)
H07	10-21 November 1993	200 m isobath	52
H10	2-10 November 1994	200 m isobath	62 (1)

The XBTs record temperature as a function of depth. Temperature was recorded at 0.1-s intervals. Depths then were determined from manufacturer-supplied coefficients of

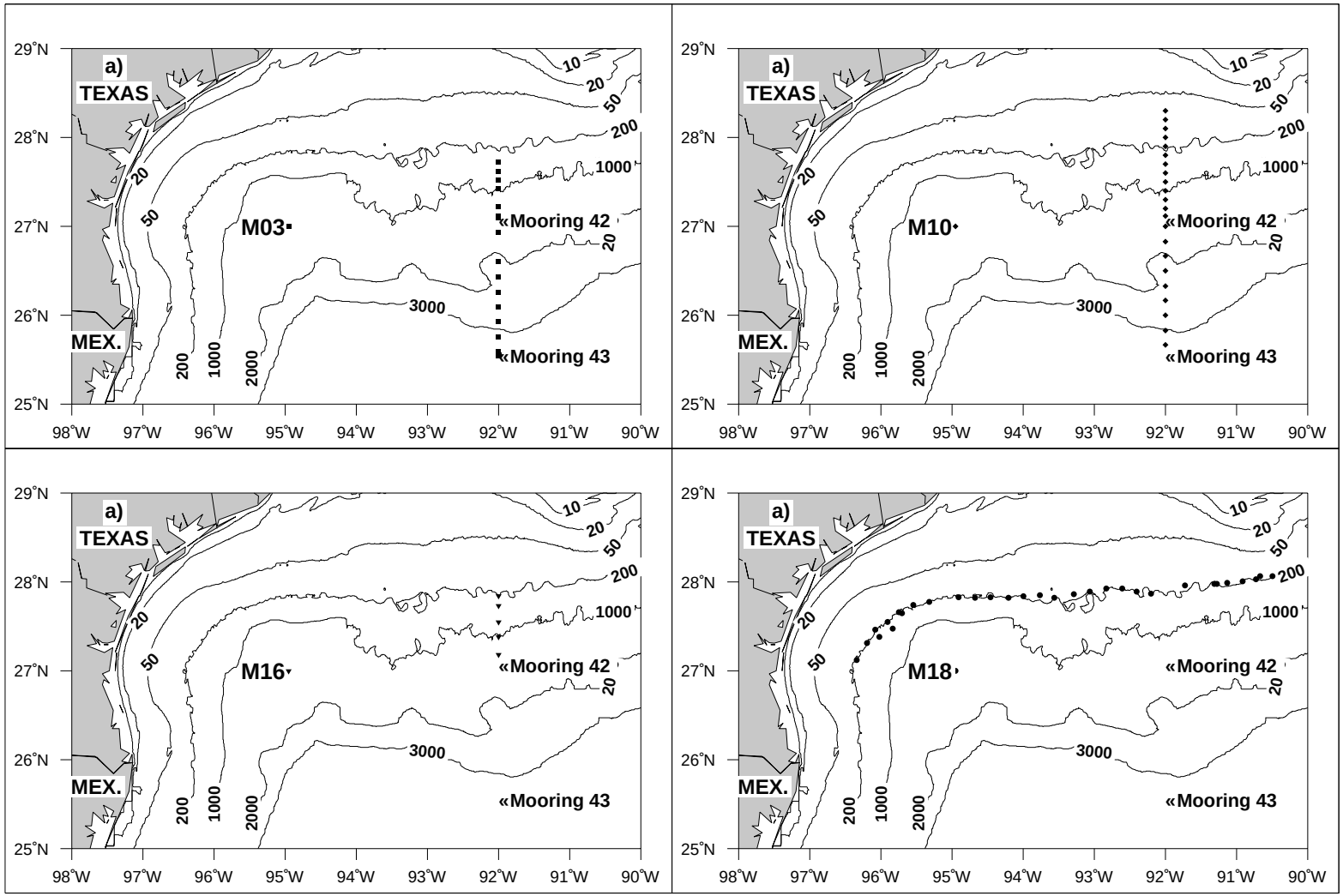

Figure 21. Map of southern Texas-Louisiana shelf region showing local bathymetry (m) and LATEX/A XBT deployment locations for cruise (a) M03, (b) M10, (c) M16, and (d) M18.

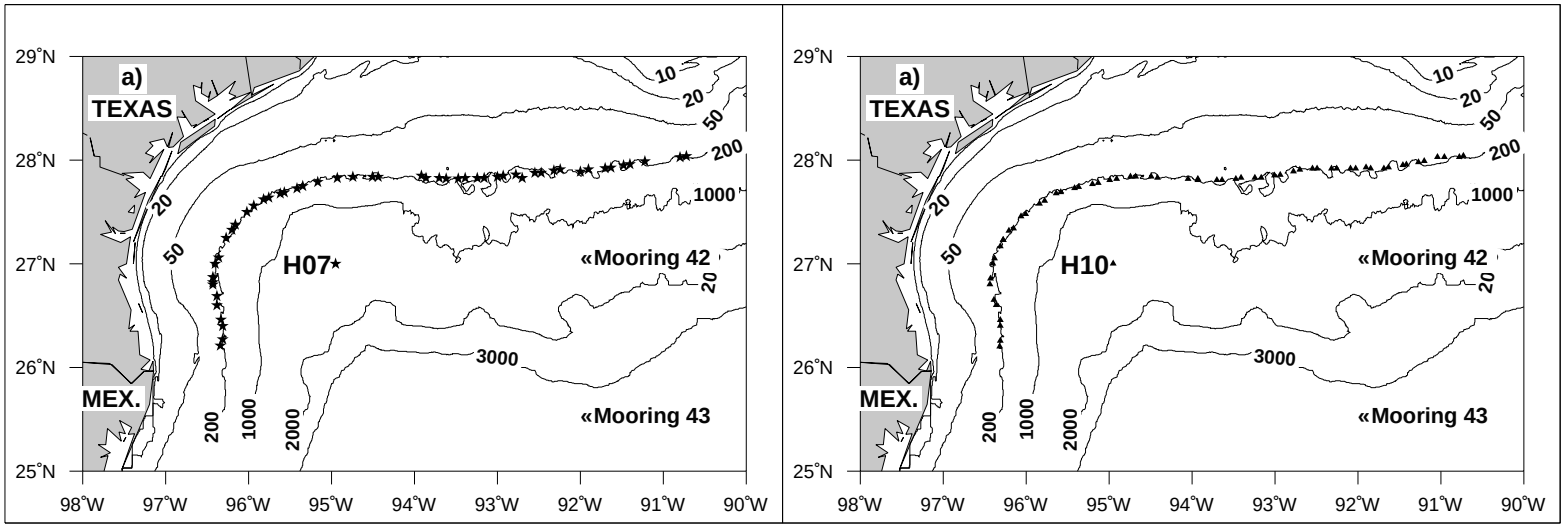

Figure 21. (continued) Map of southern Texas-Louisiana shelf region showing local bathymetry (m) and LATEX/A XBT deployment locations for cruise (e) H07 and (f) H10.

drop rates for each XBT model. The depth calculation for Sippican Model T-7 is:

$$D = 6.472\ t - 0.00216\ t^2 \quad (1)$$

where t is seconds and D is the calculated depth. A correction was applied to depths greater than 100 m (Singer 1990). The functional form of this correction is given by:

$$z = 1.0435\ D - 4.262 \quad (2)$$

where z is the corrected depth in meters and D is the depth from (1) calculated from the manufacturer supplied drop rate.

Figures 22-27 show the vertical temperature profiles as a function of depth for each XBT deployed during LATEX A current meter cruises CM03, CM10, CM16, and CM18, and LATEX A hydrographic cruises H07 and H10, respectively. The filename corresponding to each profile is given above each plot.

The data were examined for outliers, which then were removed and gaps filled with linearly interpolated values. If a probe reached the seafloor while recording, the data were truncated at the point when the probe reached bottom.

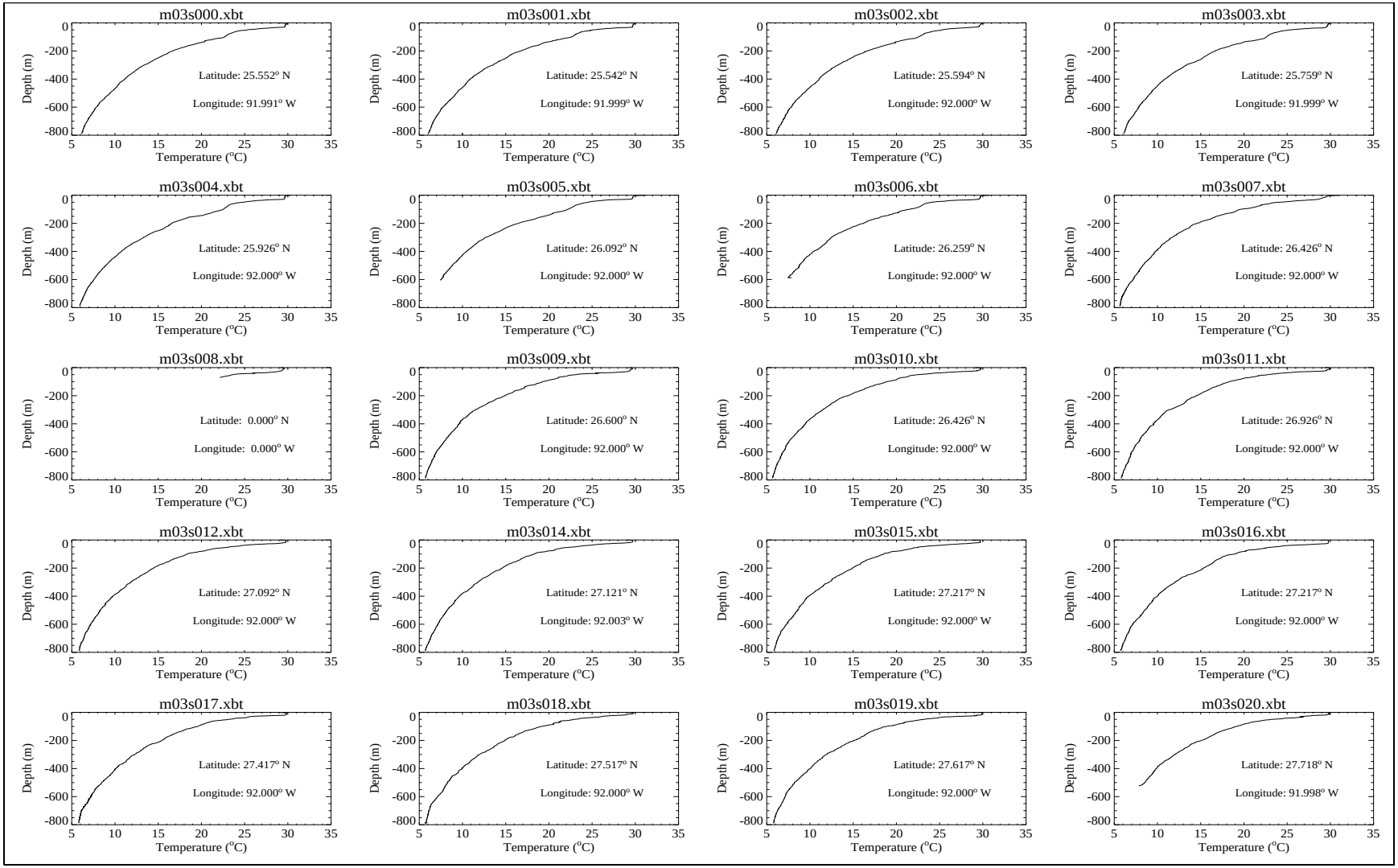

Figure 22. Vertical temperature profiles from XBT data collected on LATEX A current meter cruise M03.

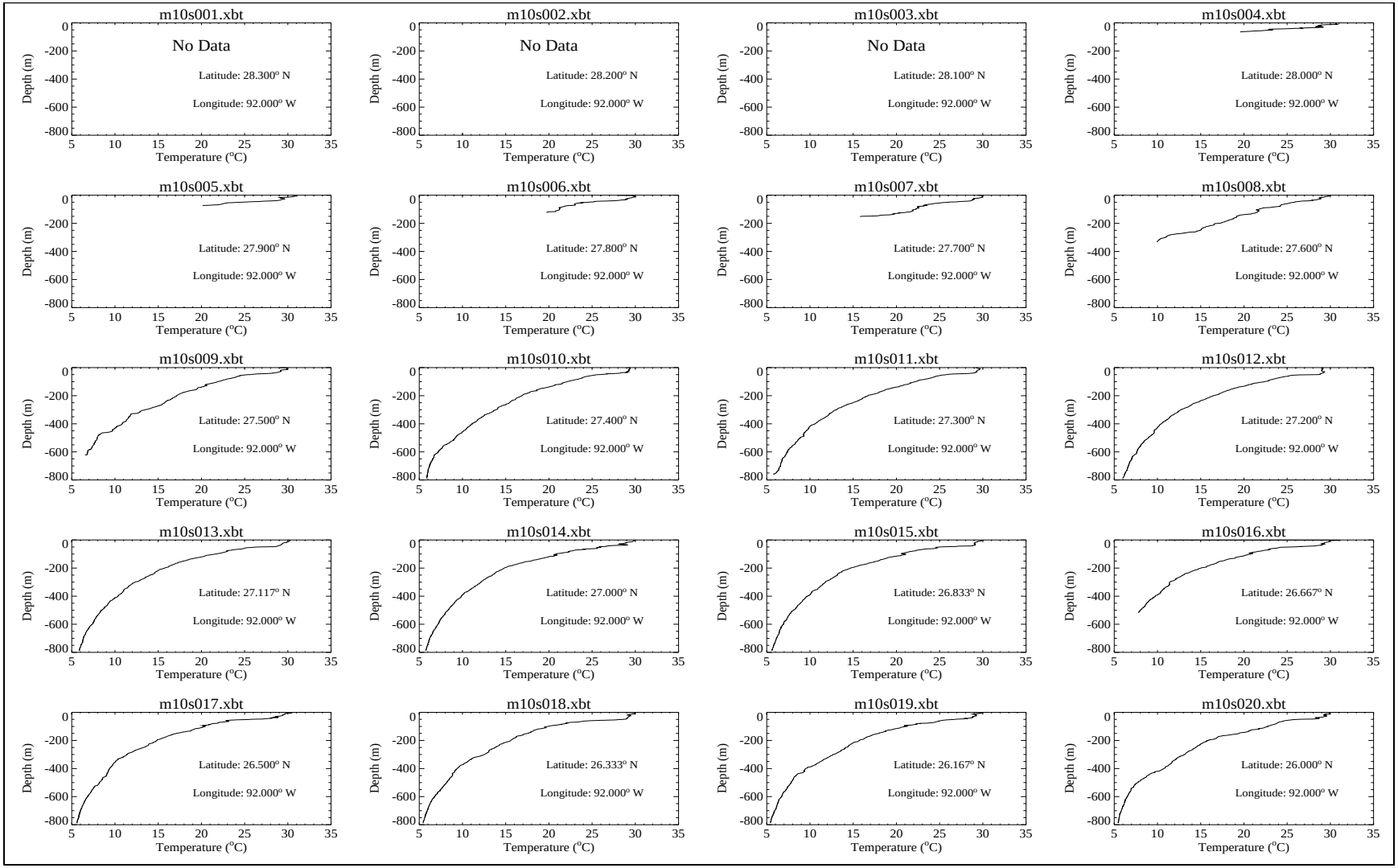

Figure 23. Vertical temperature profiles from XBT data collected on LATEX A current meter cruise M10.

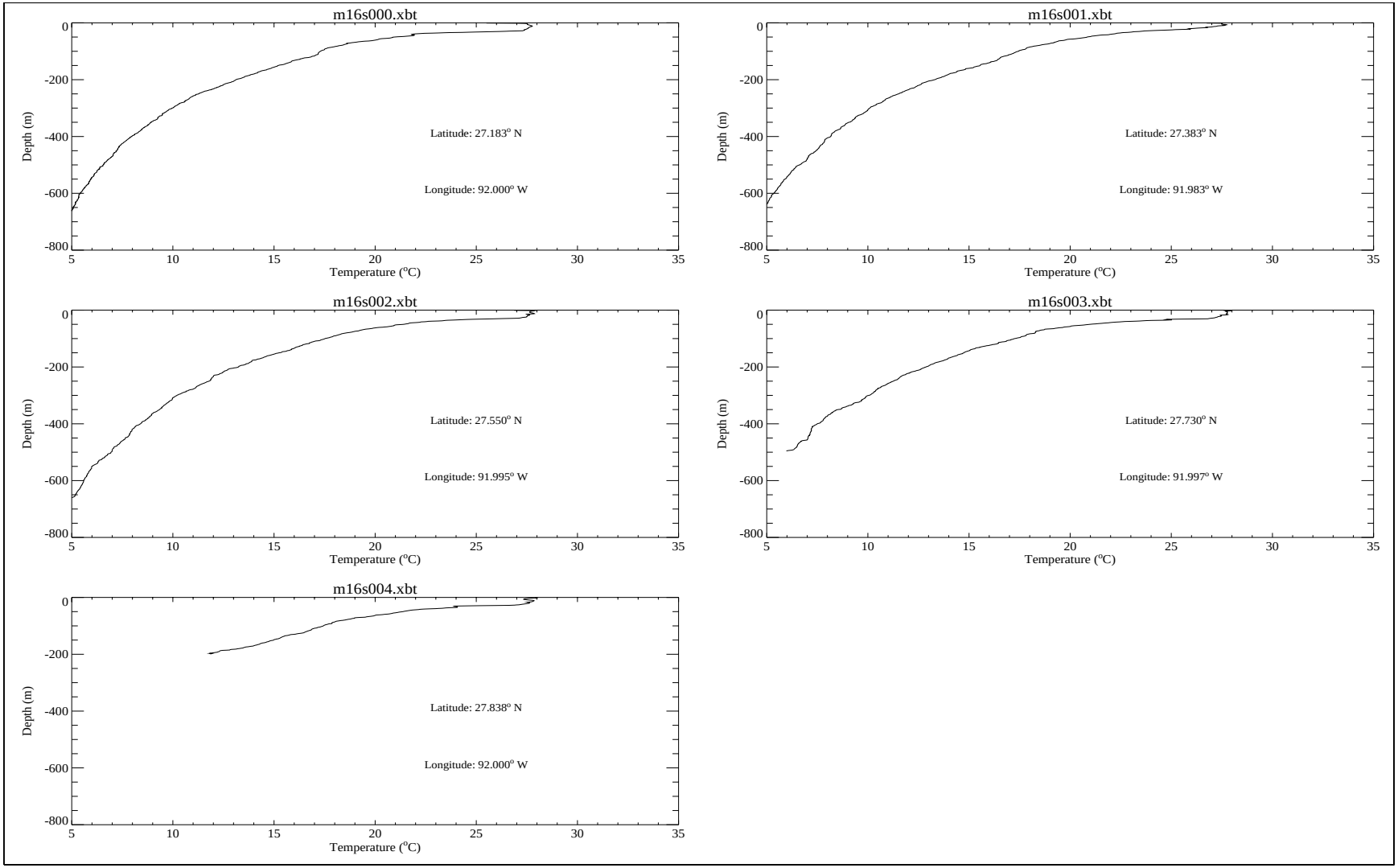

Figure 24. Vertical temperature profiles from XBT data collected on LATEX A current meter cruise M16.

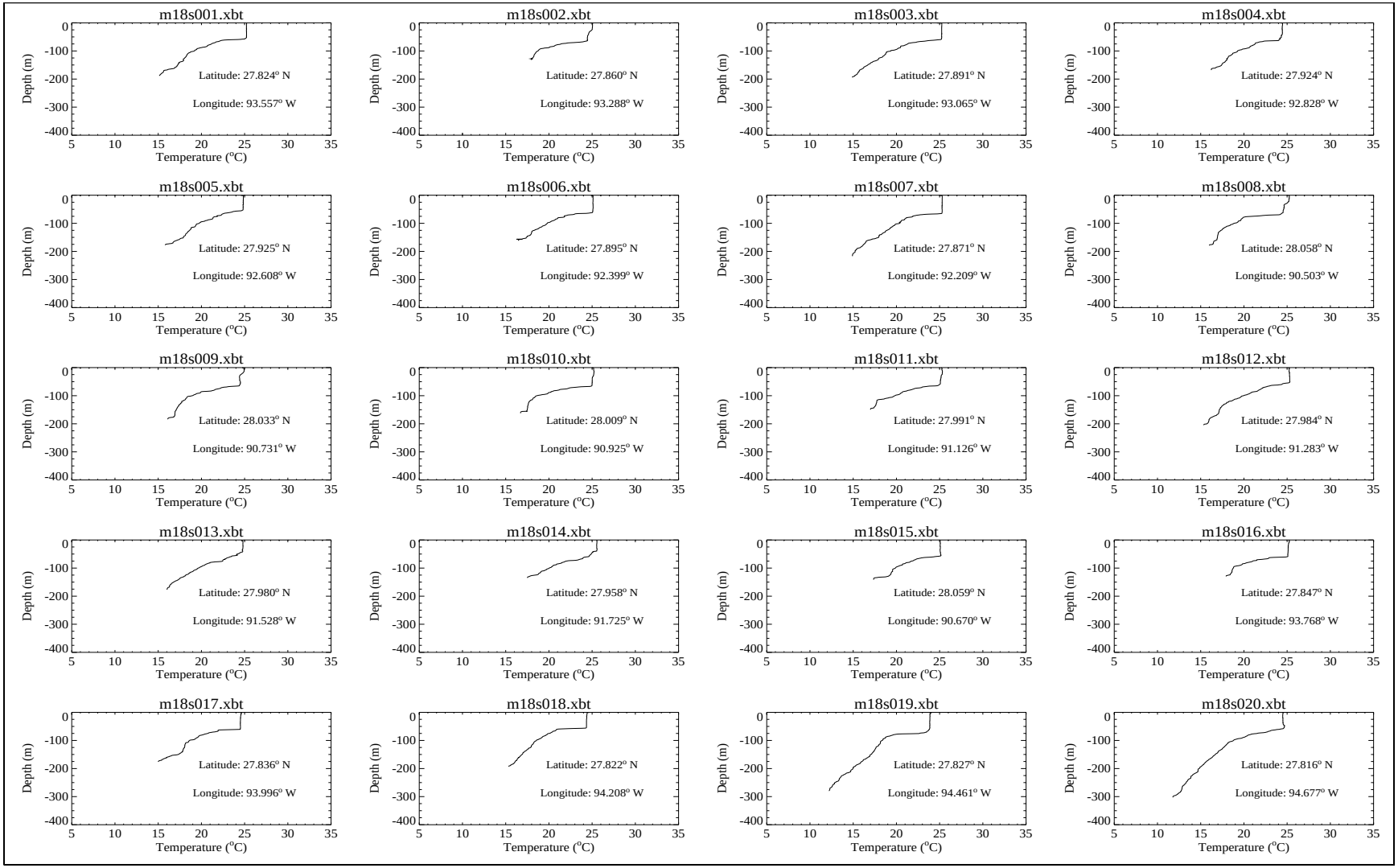

Figure 25. Vertical temperature profiles from XBT data collected on LATEX A current meter cruise M18.

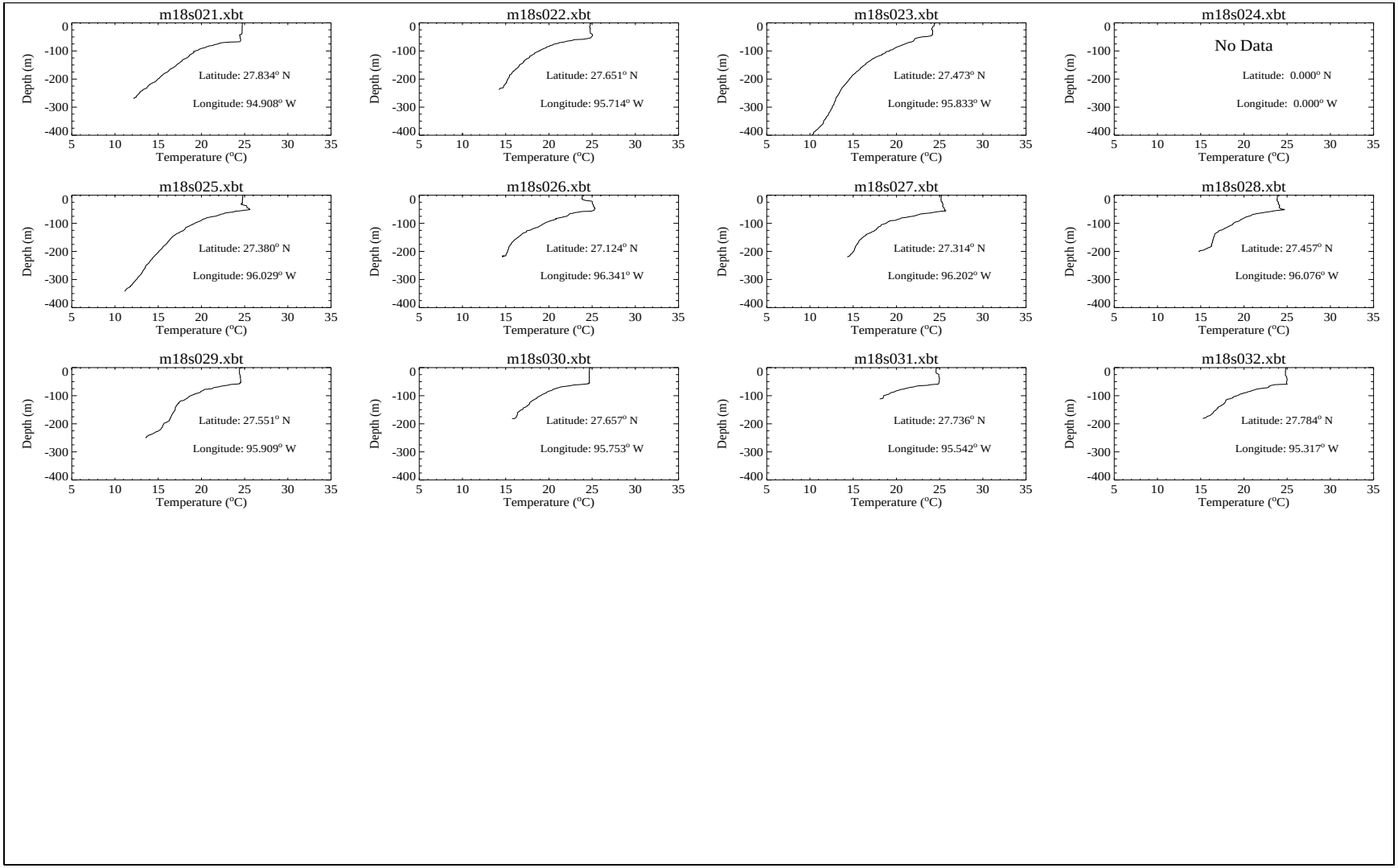

Figure 25 (continued). Vertical temperature profiles from XBT data collected on LATEX A current meter cruise M18.

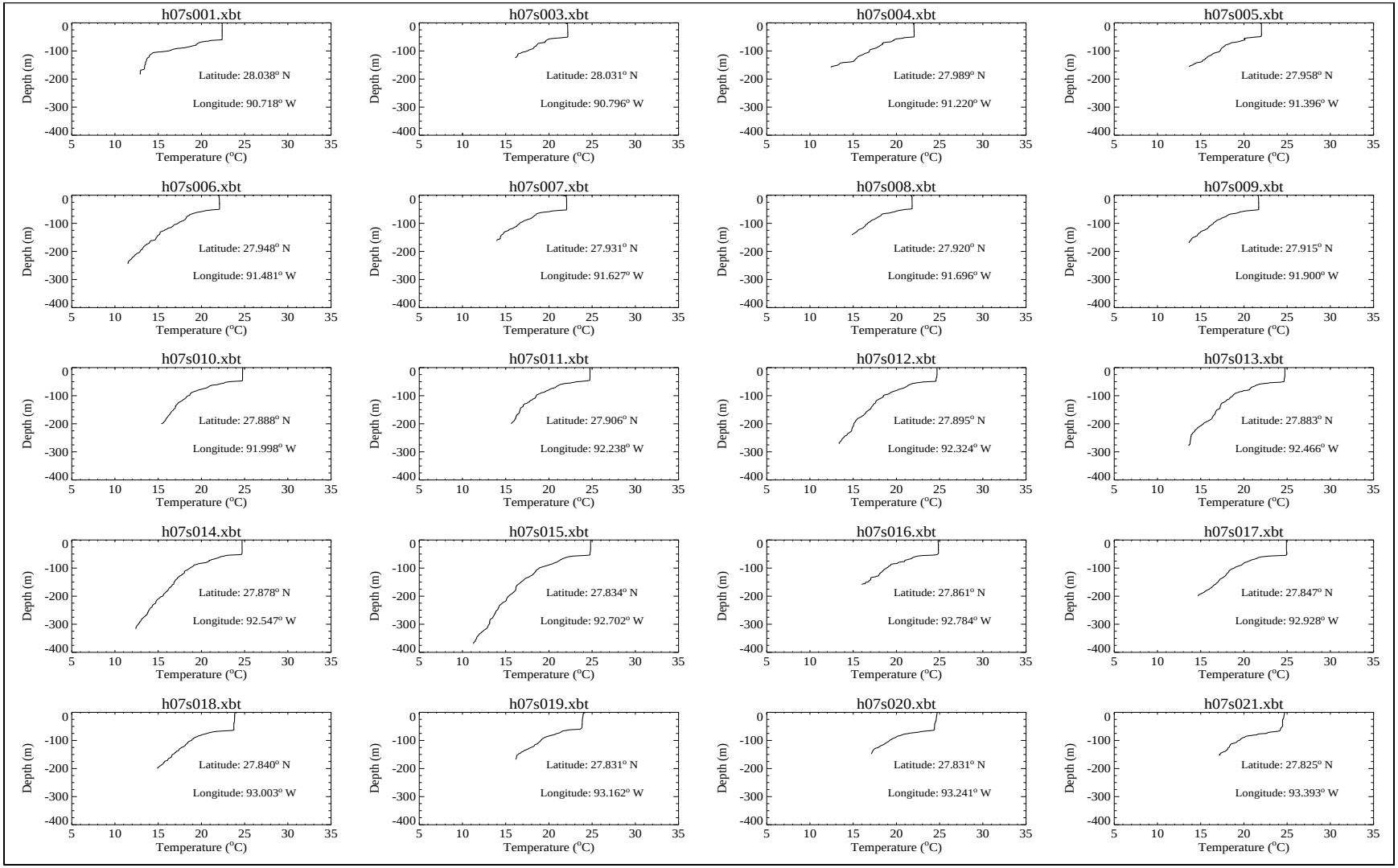

Figure 26. Vertical temperature profiles from XBT data collected on LATEX A hydrographic cruise H07.

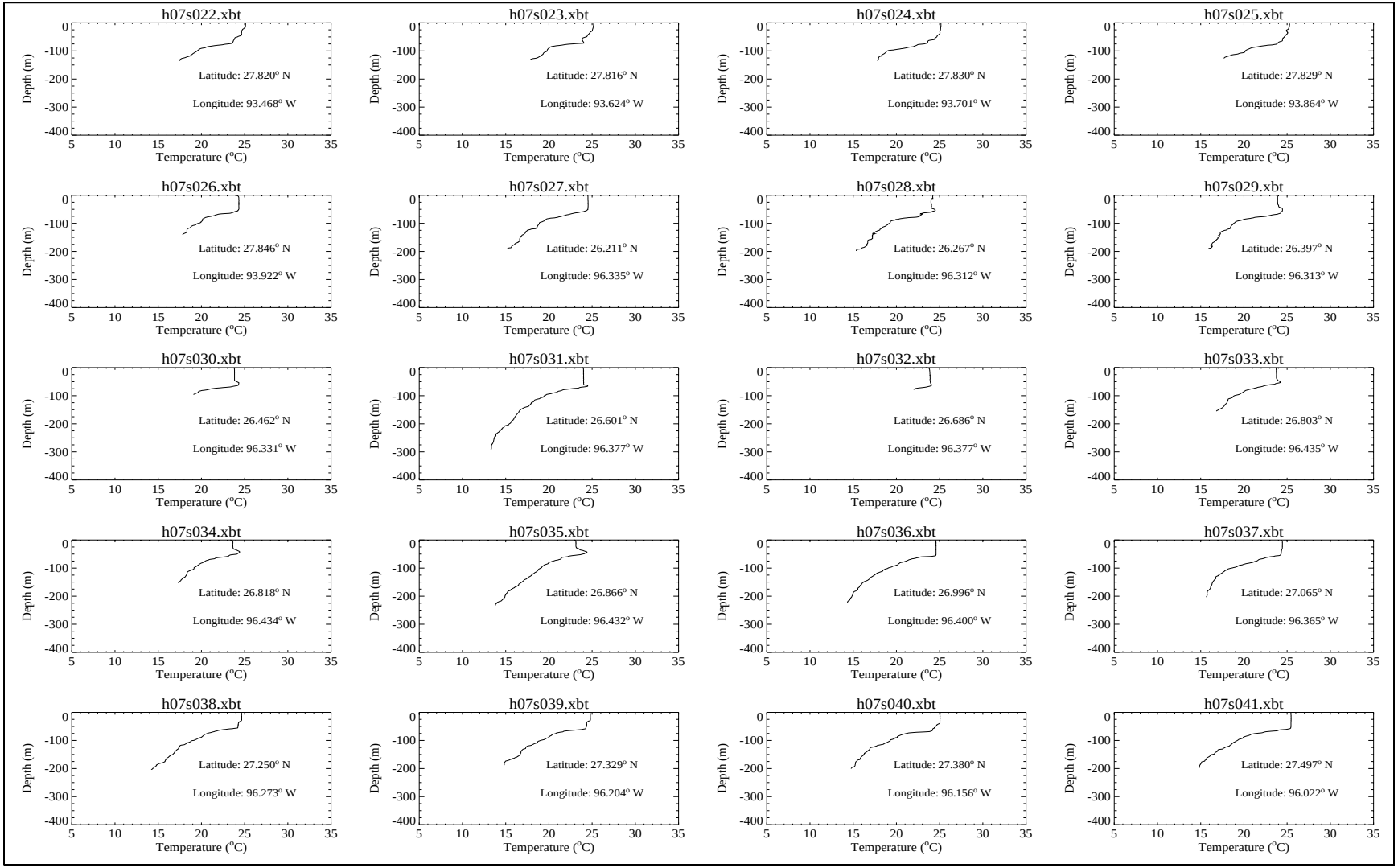

Figure 26 (continued). Vertical temperature profiles from XBT data collected on LATEX A hydrographic cruise H07.

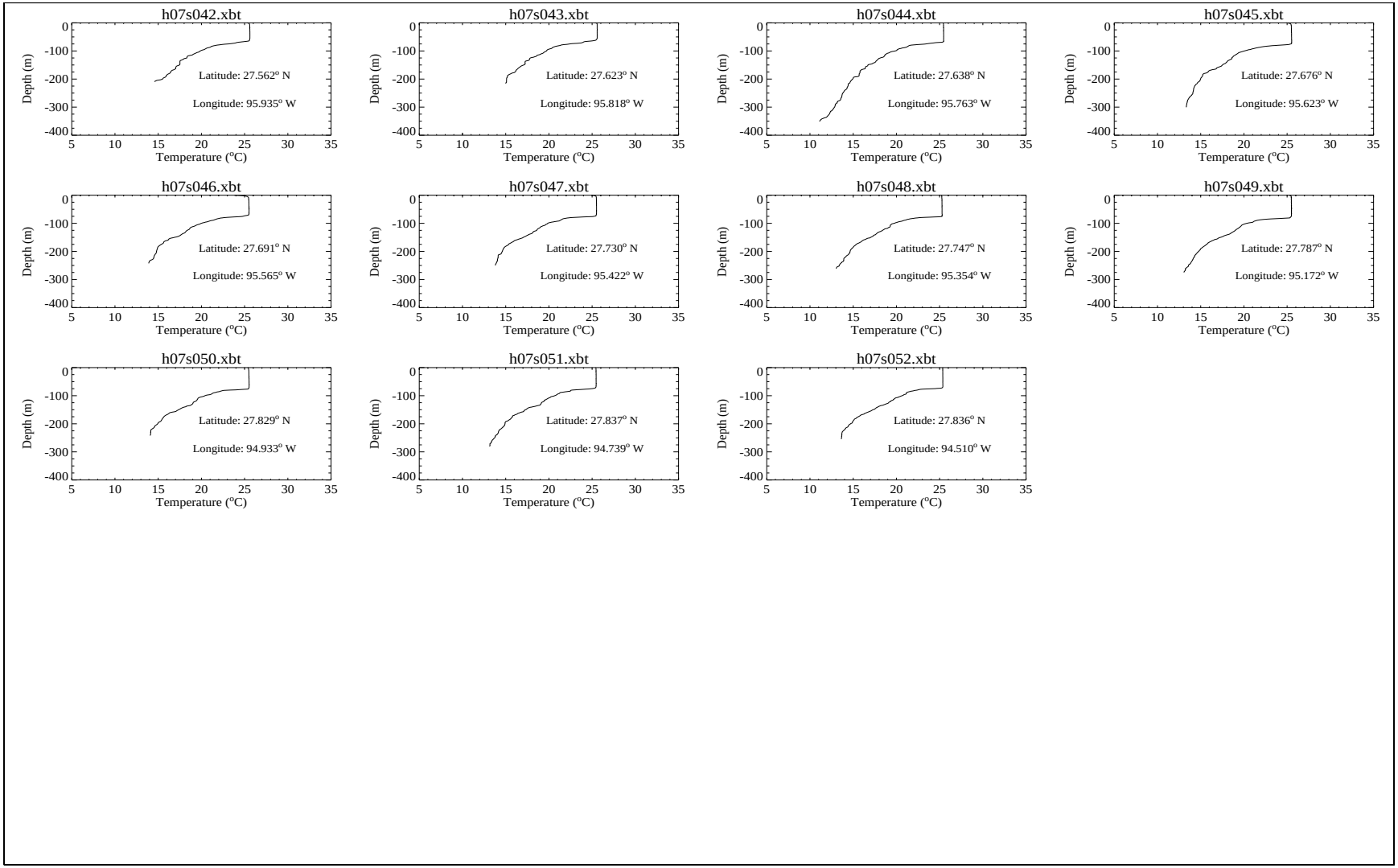

Figure 26 (continued). Vertical temperature profiles from XBT data collected on LATEX A hydrographic cruise H07.

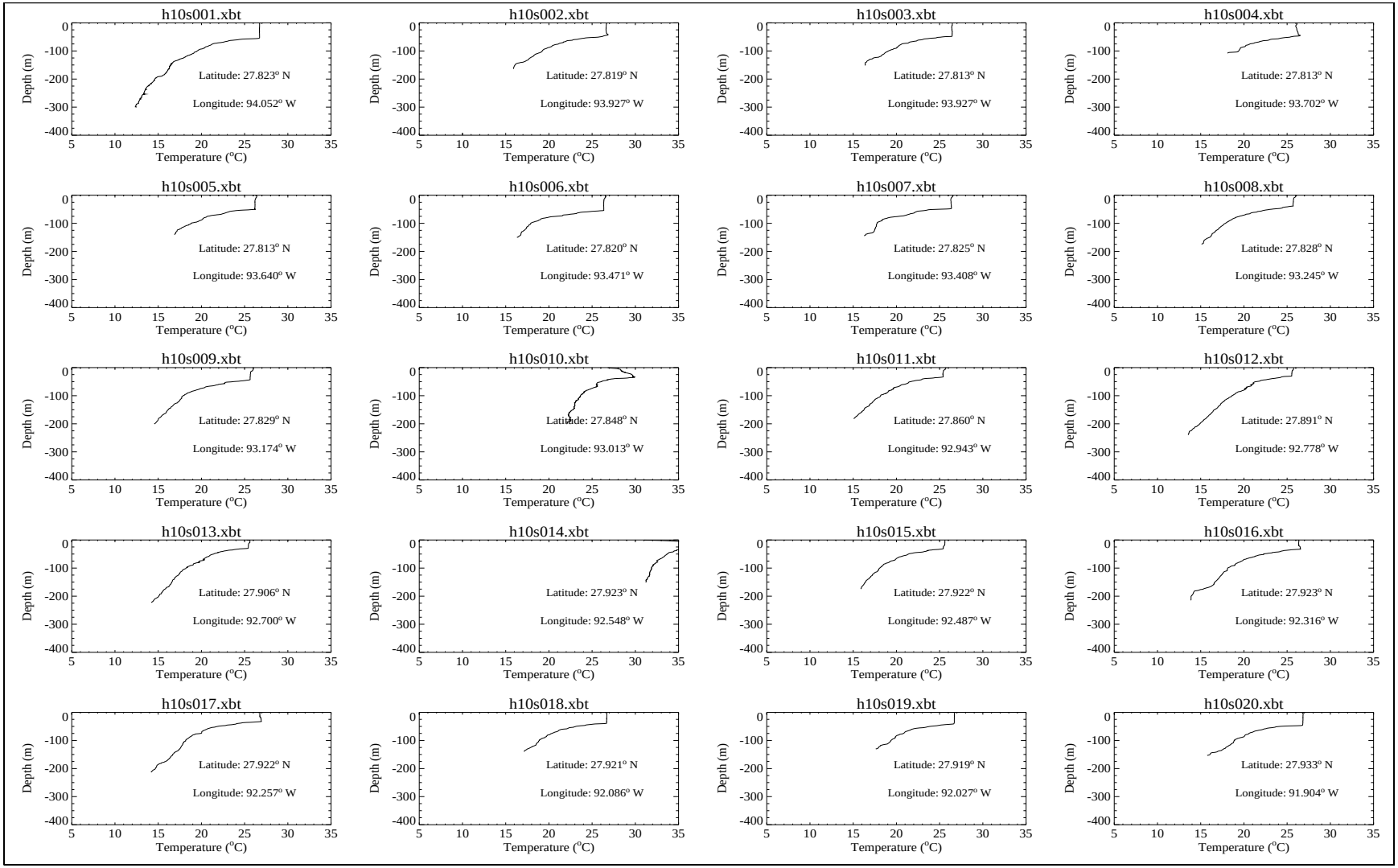

Figure 27. Vertical temperature profiles from XBT data collected on LATEX A hydrographic cruise H10.

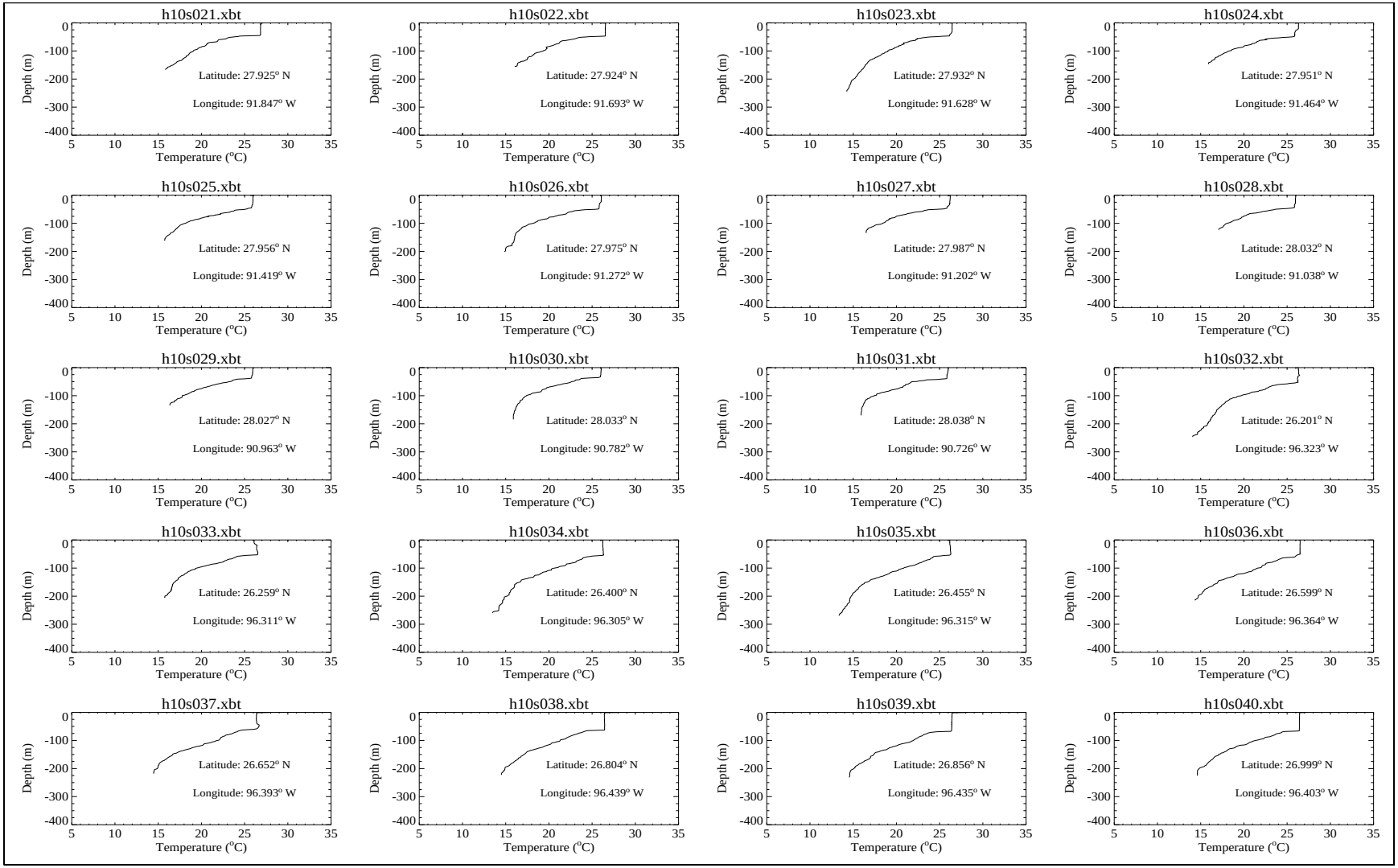

Figure 27 (continued). Vertical temperature profiles from XBT data collected on LATEX A hydrographic cruise H10.

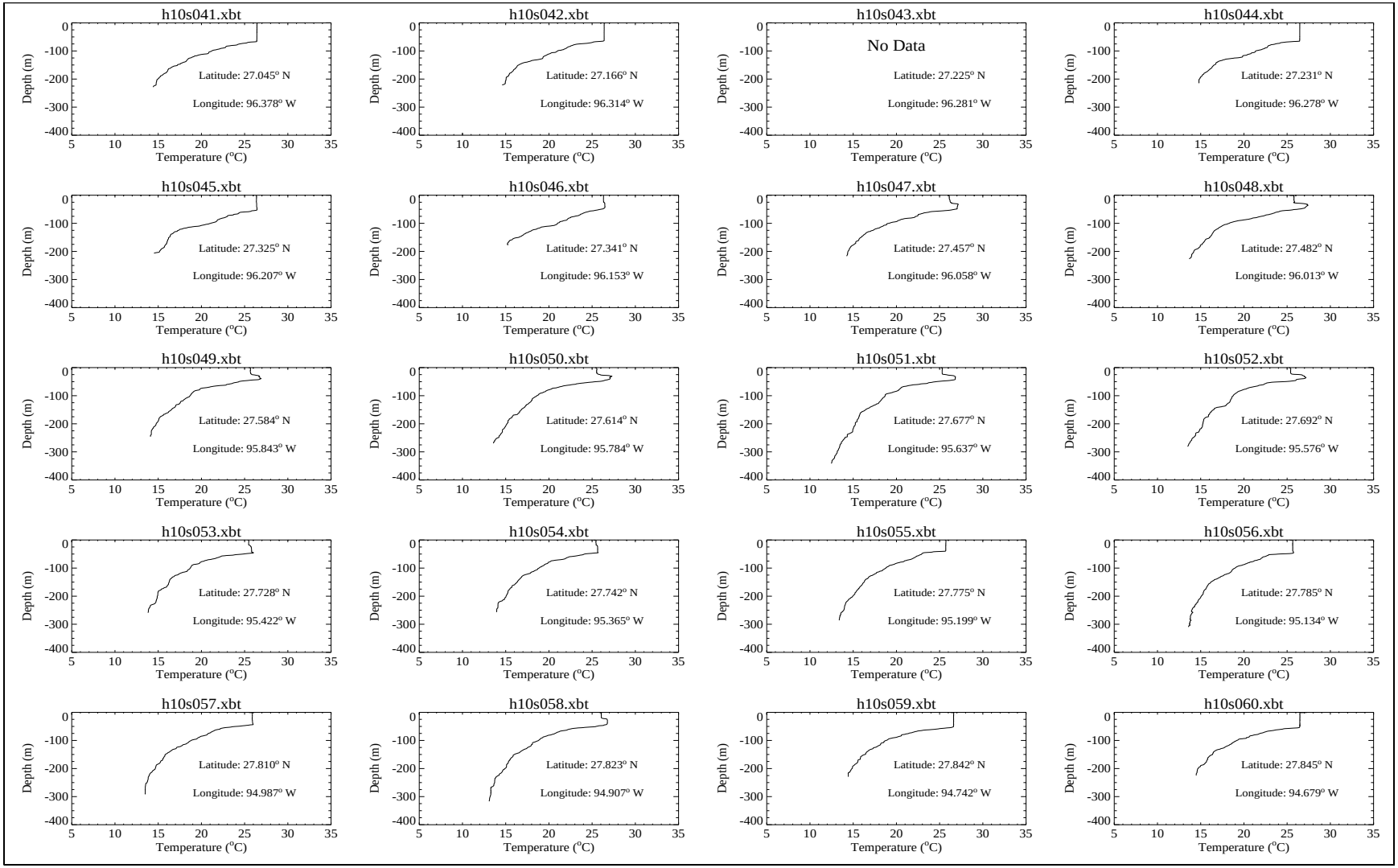

Figure 27 (continued). Vertical temperature profiles from XBT data collected on LATEX A hydrographic cruise H10.

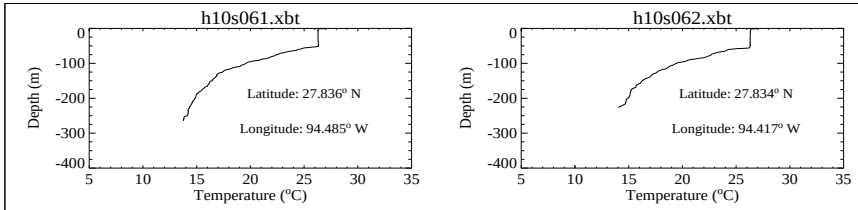

Figure 27 (continued). Vertical temperature profiles from XBT data collected on LATEX A hydrographic cruise H10.

3.3 Expendable Sound Velocity Profilers

Four Sippican Inc. model MK-12 XSV-02 XSVs were deployed on two LATEX A current meter maintenance cruises: three during CM03 and one during CM16. The instruments record sound velocity (cm s^{-1}) as a function of depth. Depth is calculated in a manner similar to that of the XBTs by using manufacturer supplied drop rate equations. The drop rate equation for the XSV Model MK-12 is:

$$D = 5.5895\ t - 0.001476\ t^2, \quad \text{during CM03,} \tag{3a}$$

$$D = 5.3671\ t - 0.001476\ t^2, \quad \text{during CM16.} \tag{3b}$$

Of the three CM03 deployments, one XSV was test-deployed near mooring 43 to test the equipment and software. The data returned from this deployment were very noisy (see m03s000 in Figure 28). The next XSV was deployed at mooring 43, and the third was deployed at mooring 42. The XSV deployed during CM16 was deployed near mooring 42. Table 6 summarizes the XSV deployment dates and locations. Figure 28 shows the XSV data from each deployment as a function of depth. The filename corresponding to each profile is shown above each plot.

Data processing included applying the drop rate equation to determine depths, and examining the data for outliers, which then were removed and the gap filled with linearly interpolated values.

Table 6. LATEX A XSV Deployment Summary

Cruise	Cast No.	Date	Location
CM03	0	23 July 1992	near Mooring 43 (25°32.97'N 91°59.56'W)
CM03	1	23 July 1992	at Mooring 43 (25°32.53'N 91°59.99'W)
CM03	2	24 July 1992	at Mooring 42 (27°07.12'N 91°59.99'W)
CM16	1	25 July 1993	at Mooring 42 (27°07.14'N 92°00.07'W)

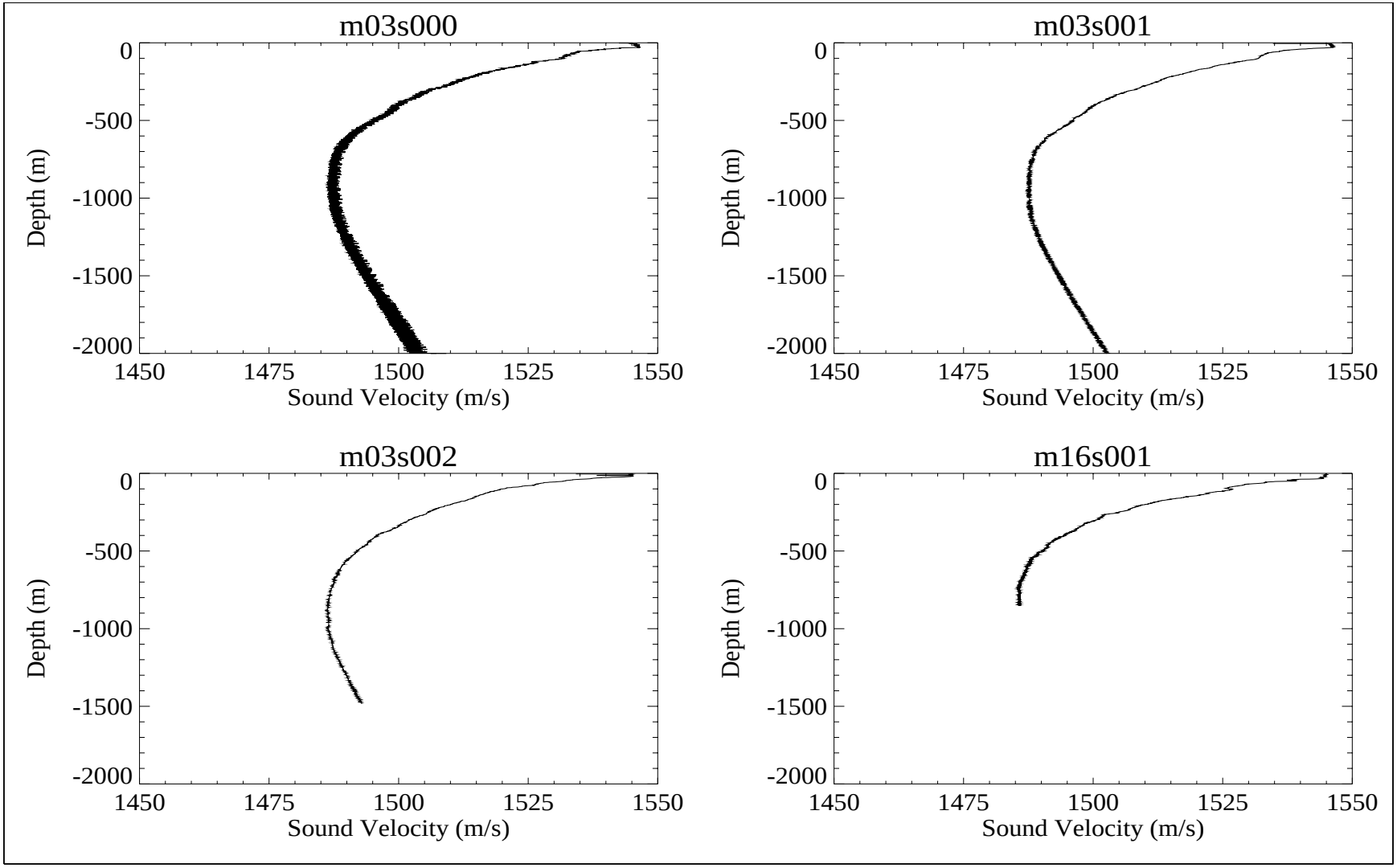

Figure 28. Vertical sound velocity profiles from XSV data collected on LATEX A cruises M03 and M16.

3.4 Expendable Current Profilers (XCP)

Three Sippican, Inc., Model MK-10 XCPs were deployed on two LATEX A current meter maintenance cruises: two during CM03 and one during CM16. The instruments record current velocity (m s^{-1}) and temperature (^{o}C) as a function of depth. Depth is calculated in a manner similar to that of the XBTs by using manufacturer supplied drop rate equations. The two XCP deployments during CM10 were made near moorings 42 and 43. The XCP deployment during CM16 was made near mooring 42. Figures 29-31 show the XCP profiles of temperature and current velocity components, i.e., east-west and north-south components. Positive velocities indicate east or north directions.

The drop equation for the Sippican XCP Model MK-10 probe was simply given by:

$$D = -3.168\,t. \tag{4}$$

As with other expendable type instruments, data processing consisted of applying the above drop rate equation and examining the data for outliers, which then were removed and the gap filled with linearly interpolated values. Table 7 provides a summary of the dates and locations of each XCP deployment.

Table 7. LATEX A XCP Deployment Summary

Cruise	Cast No.	Date	Location
CM10	1	23 July 1993	near Mooring 42 (27^{o}07.33’N, 92^{o}00.00’W)
CM10	2	24 July 1993	near Mooring 43 (25^{o}32.05’N, 92^{o}00.00’W)
CM16	1	25 July 1994	near Mooring 42 (27^{o}07.20’N, 92^{o}00.00’W)

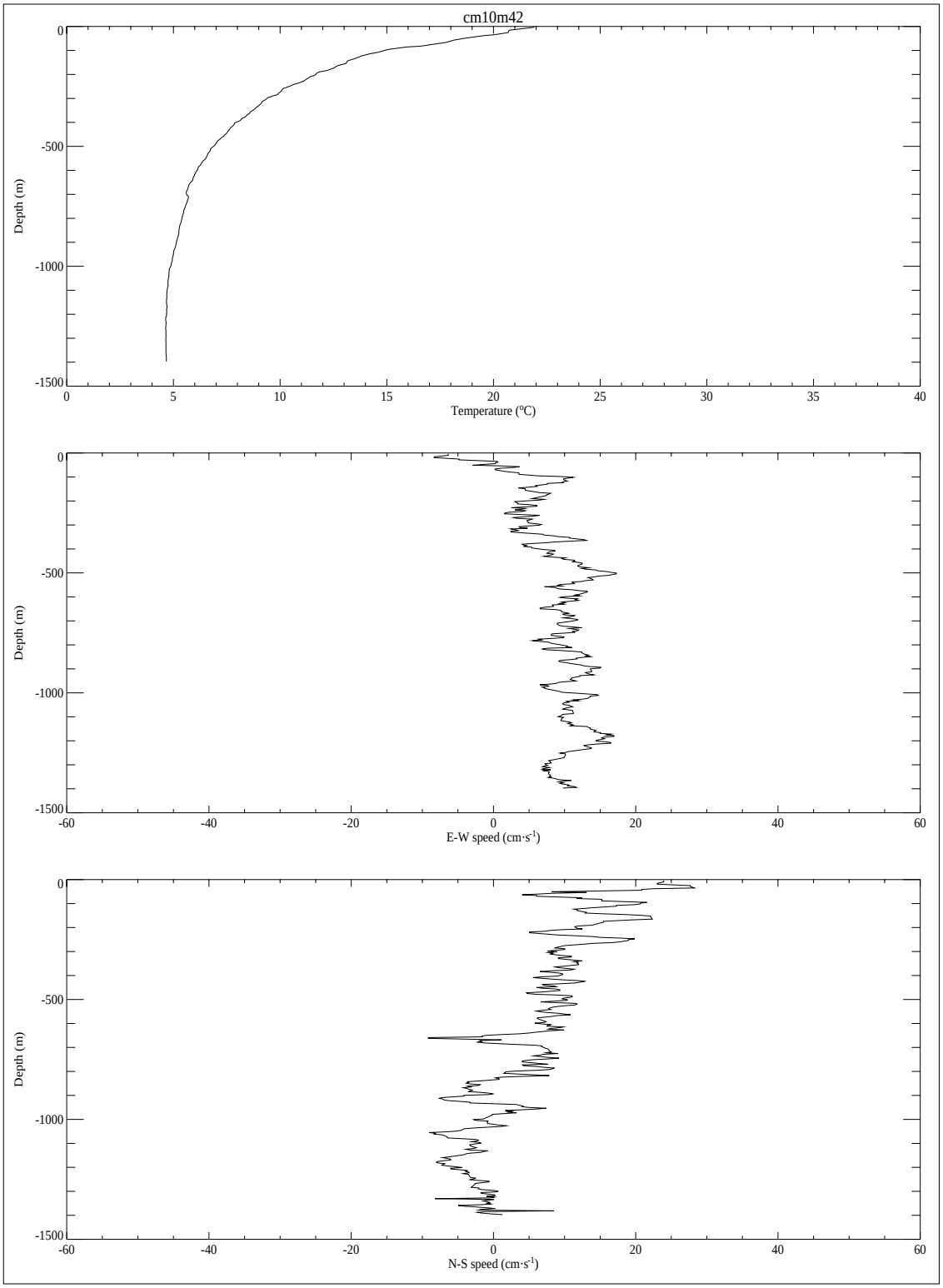

Figure 29. Vertical temperature and current velocity profiles from XCP data collected on LATEX A cruise M10 near mooring 42.

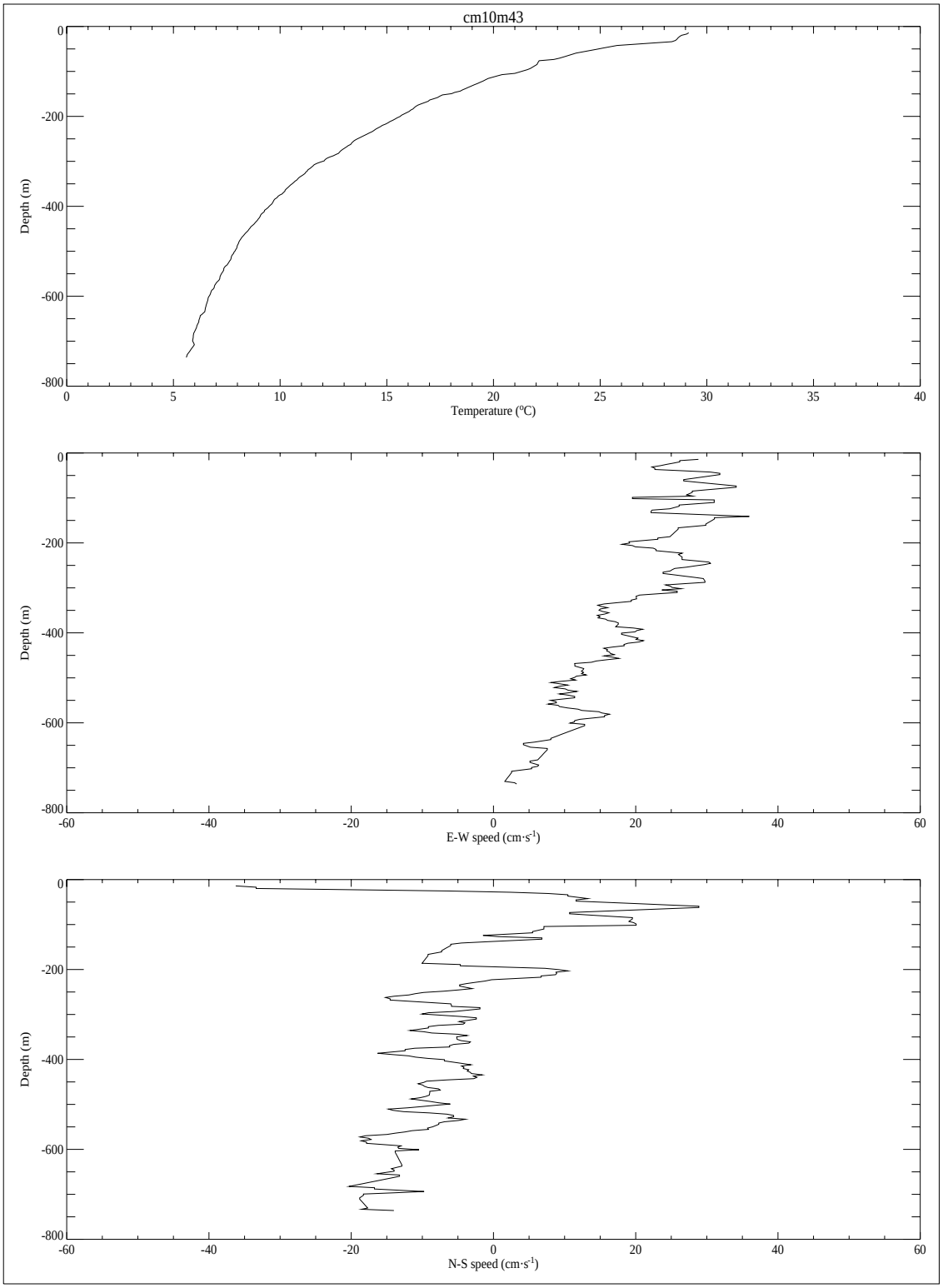

Figure 30. Vertical temperature and current velocity profiles from XCP data collected on LATEX A cruise M10 near mooring 43.

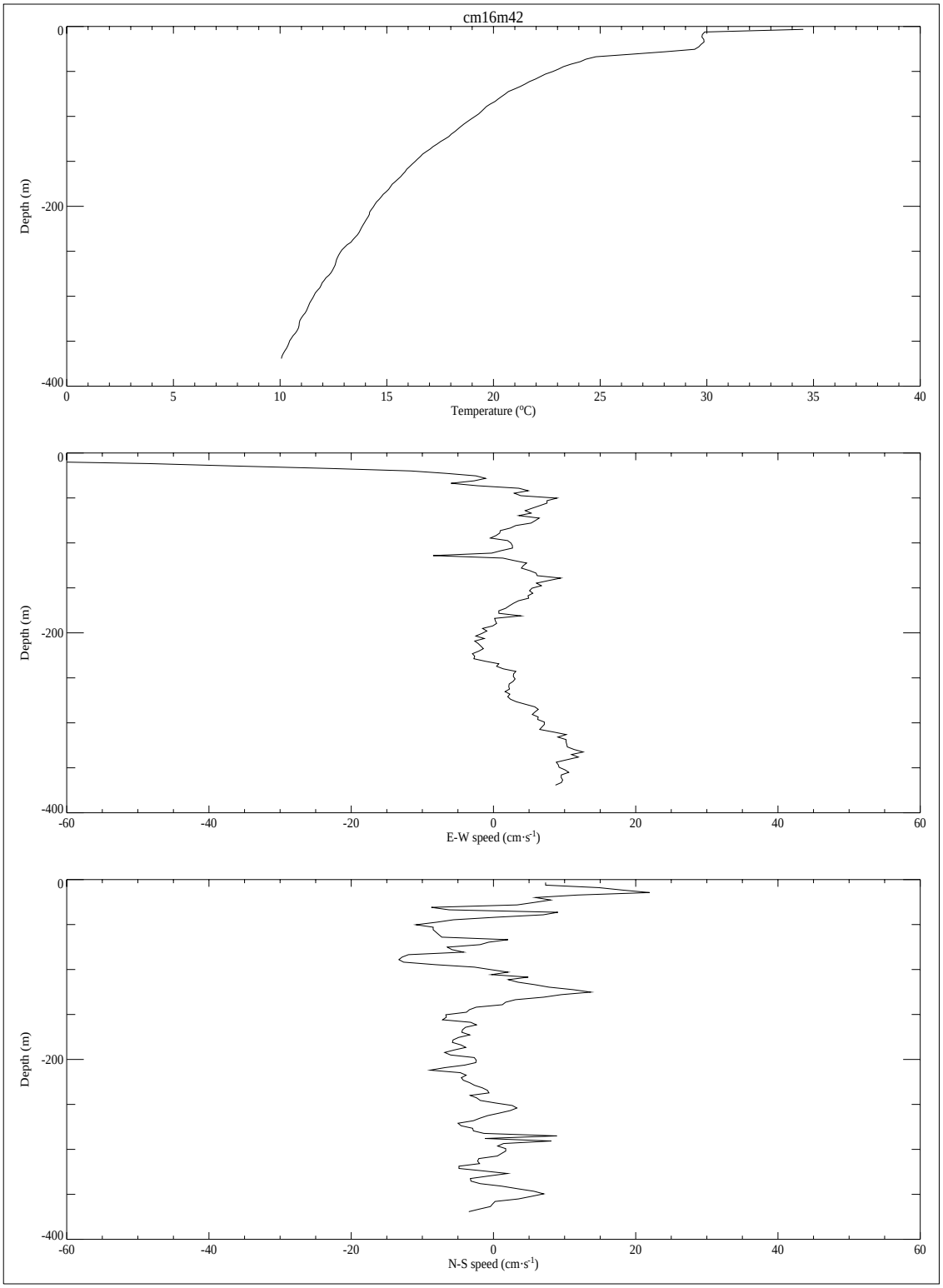

Figure 31. Vertical temperature and current velocity profiles from XCP data collected on LATEX A cruise M16 near mooring 42.

3.5. Thermosalinograph

Four cruises measured surface temperature and salinity using a ship-board thermosalinograph which was permanently mounted in the ship's hull. The thermosalinograph was operated on LATEX A hydrographic cruises aboard the *R/V Gyre*. The four hydrographic cruises were H01, H02, H08, and H10. Table 8 summarizes dates of collection of thermosalinograph data. Figures 32-34 show the observation locations and the surface temperature and salinity time series for H01, H08, and H10. The quality control of these data consisted of removal of outliers and bad data points, and then linearly interpolating between adjacent points. One entire dataset, H02, was discarded as unrecoverable.

Table 8. LATEX A Thermosalinograph data collection summary

Cruise	Date Start	Date End	Comment
H01	01 May 1992	09 May 1992	eastern shelf only
H02	NA	NA	data unrecoverable
H08	24 April 1994	07 May 1994	full shelf
H10	02 November 1994	13 November 1992	full shelf

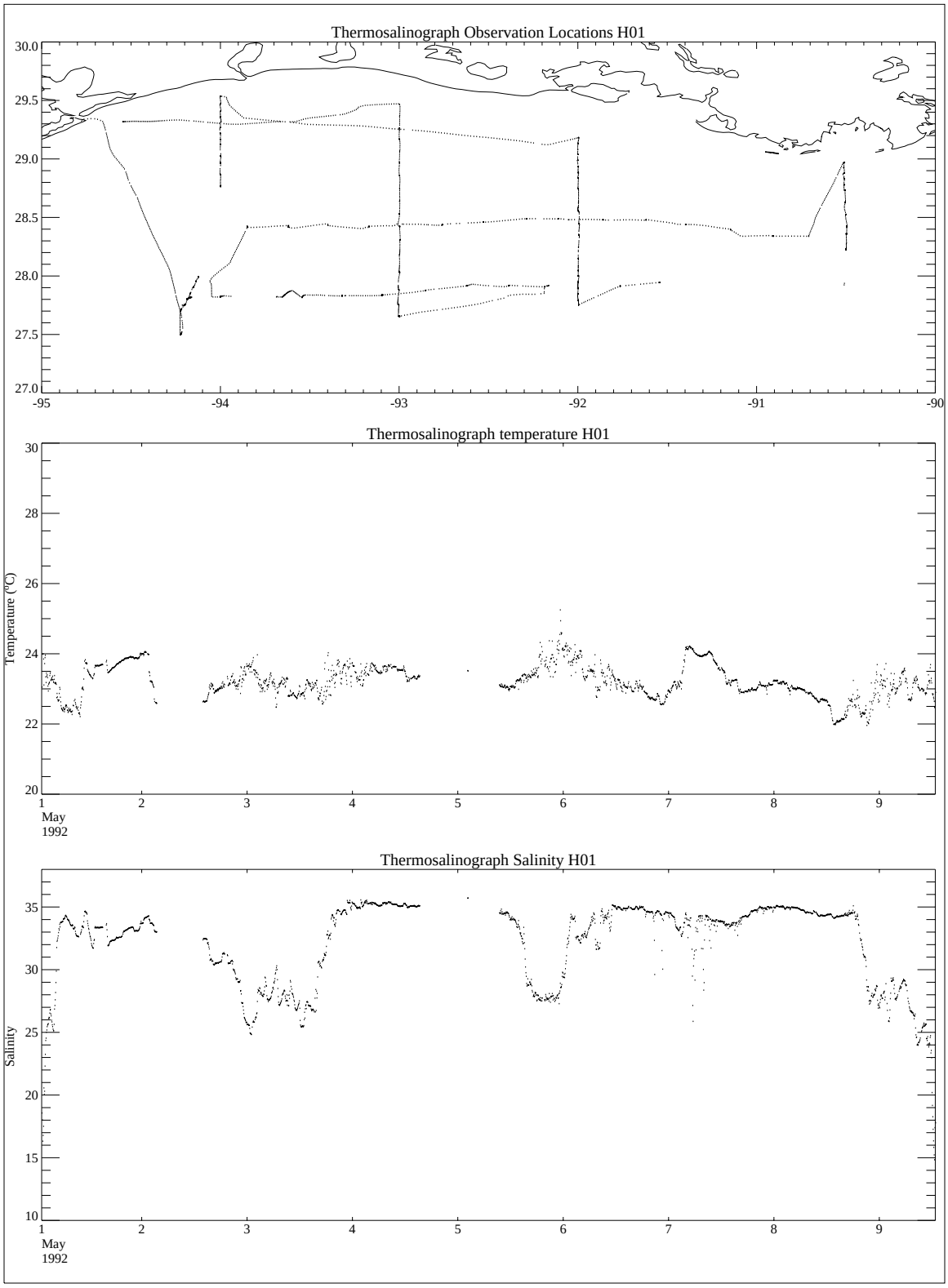

Figure 32. Thermosalinograph observation locations (top), temperature (middle), and salinity (bottom) during LATEX A hydrographic cruise H01.

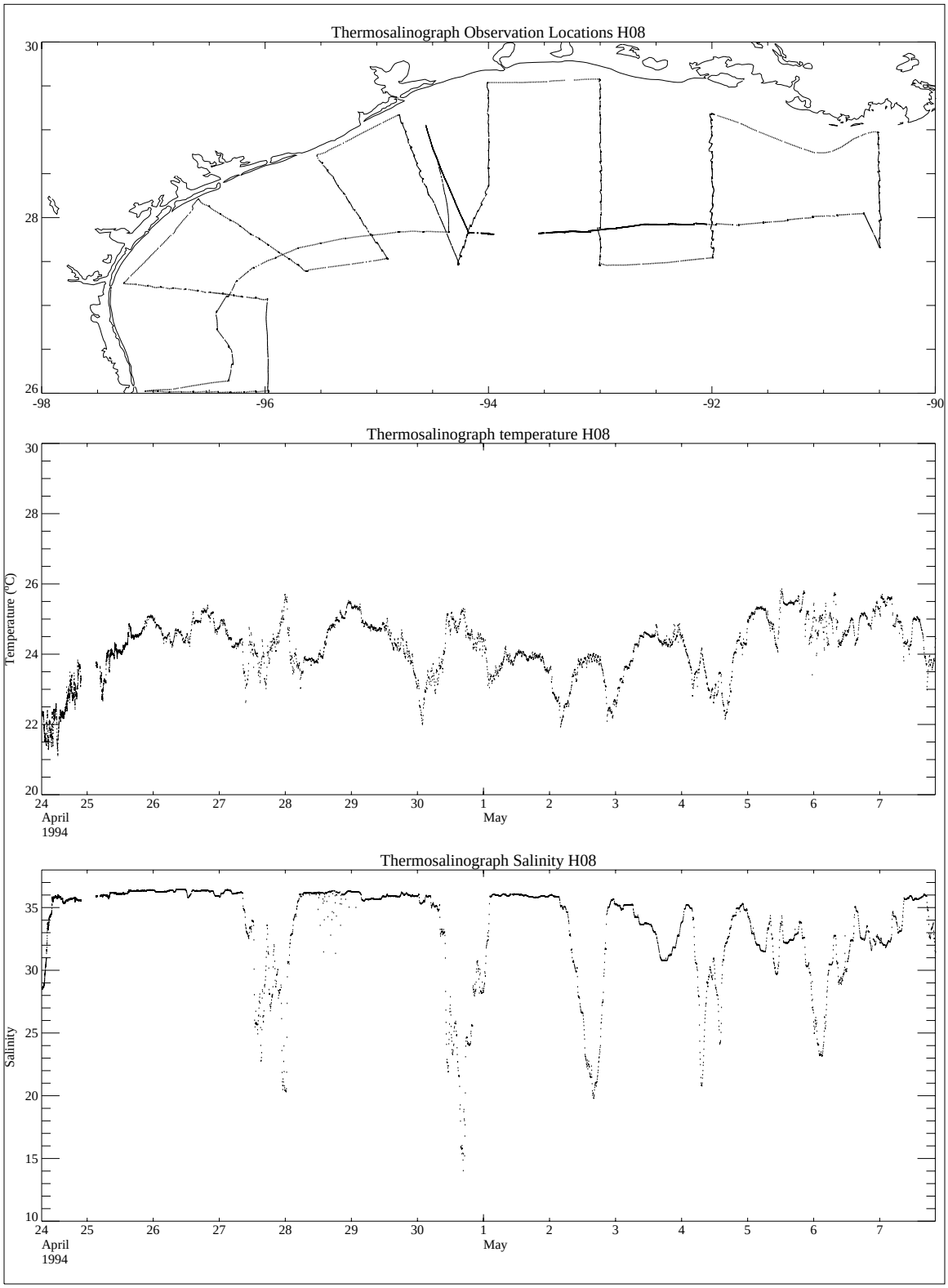

Figure 33. Thermosalinograph observation locations (top), temperature (middle), and salinity (bottom) during LATEX A hydrographic cruise H08.

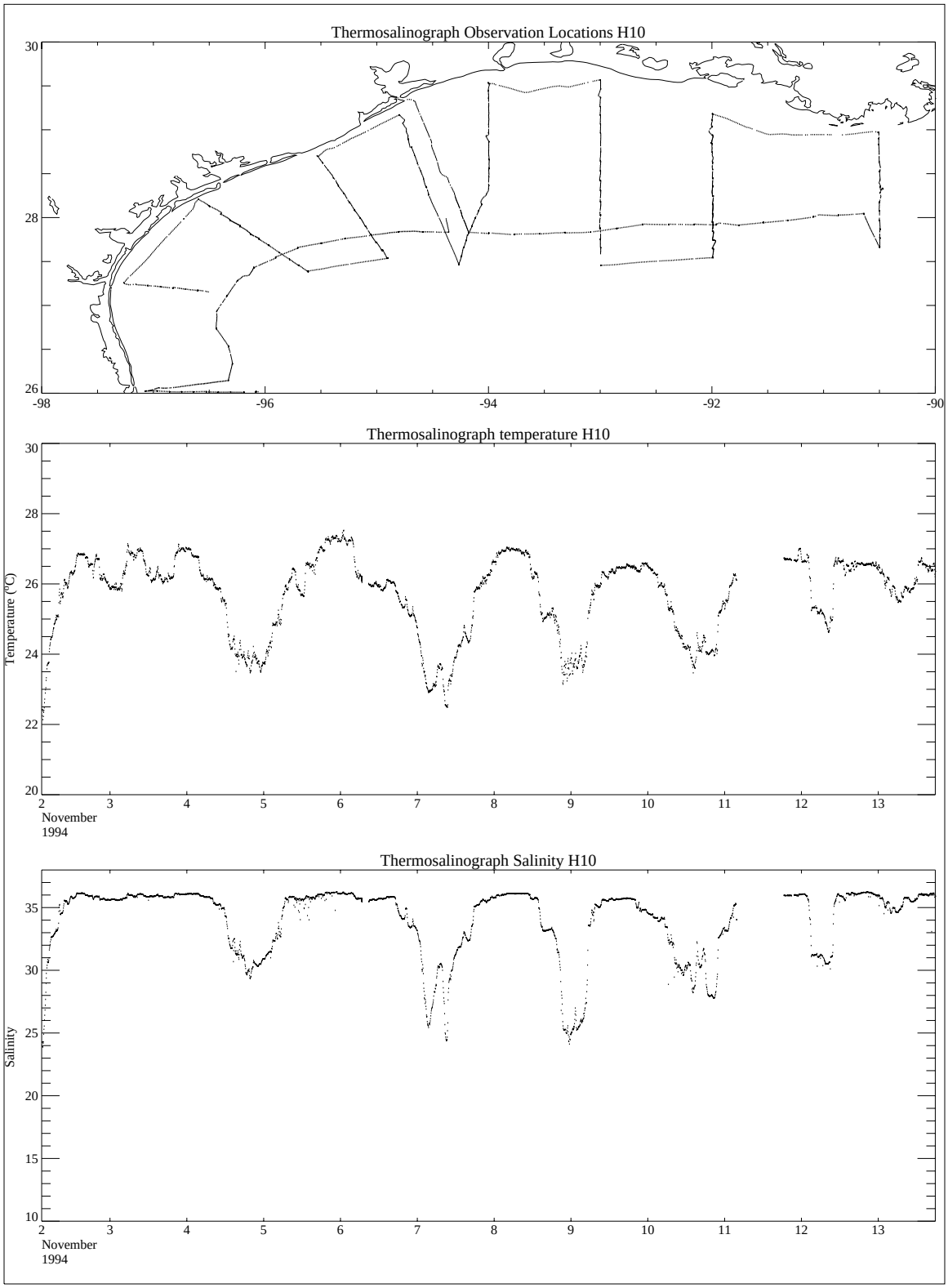

Figure 34. Thermosalinograph observation locations (top), temperature (middle), and salinity (bottom) during LATEX A hydrographic cruise H10.

4. CTDs from mooring maintenance cruises

4.1 Introduction

CTD casts were taken during the eighteen current meter mooring maintenance cruises using a Sea-Bird SBE 19 self-contained CTD profiling instrument. These casts were usually taken prior to recovering and after deploying mooring instruments. Therefore, as many as two hydrographic CTD casts could be made in the vicinity of a mooring during any given deployment. A maximum of four CTD casts were then available to correct the temperature and conductivity time series measured by the current meters (one as the instrument is deployed, one as the instrument is recovered, and up to two mid-deployment from any of the hydrographic surveys in the mooring's vicinity). Jochens et al. (1998) document the CTD data collected during hydrographic cruises. DiMarco et al. (1997) detail how the corrections to the current meter temperature and conductivity time series were made using the CTD cast measurements. Also see DiMarco et al. (1997) for detailed maps of current meter mooring locations and current meter data availability.

4.2 CTD data description

This section documents the CTD casts taken during the LATEX A mooring servicing cruises. A total of 460 casts were taken. Each CTD data file is in ASCII format and contains metadata detailing the instrument type, date/time/location of cast, data format descriptors, and special data quality control notes. Following the metadata are columns of depth, temperature, conductivity, and salinity measured during each cast. The naming convention for the CTD data files is shown in Table 9. See Figure 1 for mooring locations. Table 10 lists the number of CTD casts taken at each mooring location by cruise number.

The quality control for these data consisted of visually assessing plots of the raw temperature and salinity data to ensure that the profiles were within acceptable historical limits. Gross outliers were removed and filled with linear interpolation.

Table 9. Current meter mooring CTD file naming convention

Character	Description
1 & 2	always CM for current meter
3 & 4	current meter cruise designator (01 to 18)
5	always M for mooring
6 & 7	LATEX mooring location designator (01 to 25, 44 to 49)
8	A, B, or C if more than one cast was taken
extension	always CTD

Table 10. Number of CTD casts at each mooring location by cruise

Mooring	Cruise Number																	
No.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
01	1	1	2	2	2	1	1	1	1	0	2	1	0	1	0	1	0	1
02	1	1	2	2	1	1	1	1	1	0	2	1	0	1	0	1	0	1
03	1	0	1	0	2	0	1	0	1	0	2	2	0	1	0	2	0	1
04	1	0	2	0	0	0	1	0	1	0	2	2	0	1	0	1	0	1
05	1	0	3	0	0	0	1	0	1	0	2	2	0	1	0	1	0	1
06	0	0	1	0	0	0	1	0	1	0	2	2	0	1	0	0	1	1
07	1	0	1	0	0	0	1	0	1	0	2	2	0	1	0	1	0	1
08	1	0	0	0	1	0	1	0	1	0	2	2	0	1	0	2	0	1
09	1	0	0	2	0	0	1	0	1	0	2	2	0	1	0	1	0	1
10	1	0	0	2	0	0	1	0	1	0	2	2	0	1	0	2	0	1
11	1	0	0	2	0	0	1	0	1	1	0	1	0	1	0	2	1	1
12	1	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0
13	1	0	1	0	2	0	1	0	1	0	2	2	0	1	0	2	0	1
14	1	1	2	2	2	1	1	1	2	1	2	2	2	2	2	2	2	1
15	1	1	1	2	1	1	1	1	1	1	1	1	1	1	2	2	1	1
16	1	1	3	1	1	1	1	1	1	1	2	2	1	1	1	2	1	1
17	1	1	2	2	1	1	1	0	0	0	2	2	2	2	2	1	1	1
18	1	1	1	2	1	1	1	1	1	1	1	1	2	1	1	2	1	1
19	1	1	1	2	1	1	1	1	1	1	2	1	2	2	1	2	1	1
20	1	1	2	2	1	1	1	0	1	1	2	2	2	1	2	2	1	1
21	1	1	1	2	1	1	1	0	1	1	2	2	0	1	1	2	2	1
22	1	1	1	2	1	1	1	1	1	1	2	2	2	1	1	2	2	1
23	0	2	0	2	1	1	1	1	1	1	1	1	2	2	1	1	2	1
24	1	1	2	1	2	0	1	1	1	1	2	1	1	1	1	2	1	1
25	0	1	2	2	1	1	1	1	1	1	2	1	0	0	0	0	0	0
44	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
45	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
47	1	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0
48	1	0	0	1	0	0	1	0	1	0	0	2	0	1	0	2	0	1
49	1	0	0	0	2	0	1	0	1	0	0	1	0	1	0	2	0	1

4.3 Vertical profiles of temperature and salinity from CTD casts

Plots of each cast are shown in Figures 35-149. These show the vertical profile of temperature (bold) and salinity as well as the date/time/location, bottom depth, and data file name of the cast. Date/time is given in UTC.

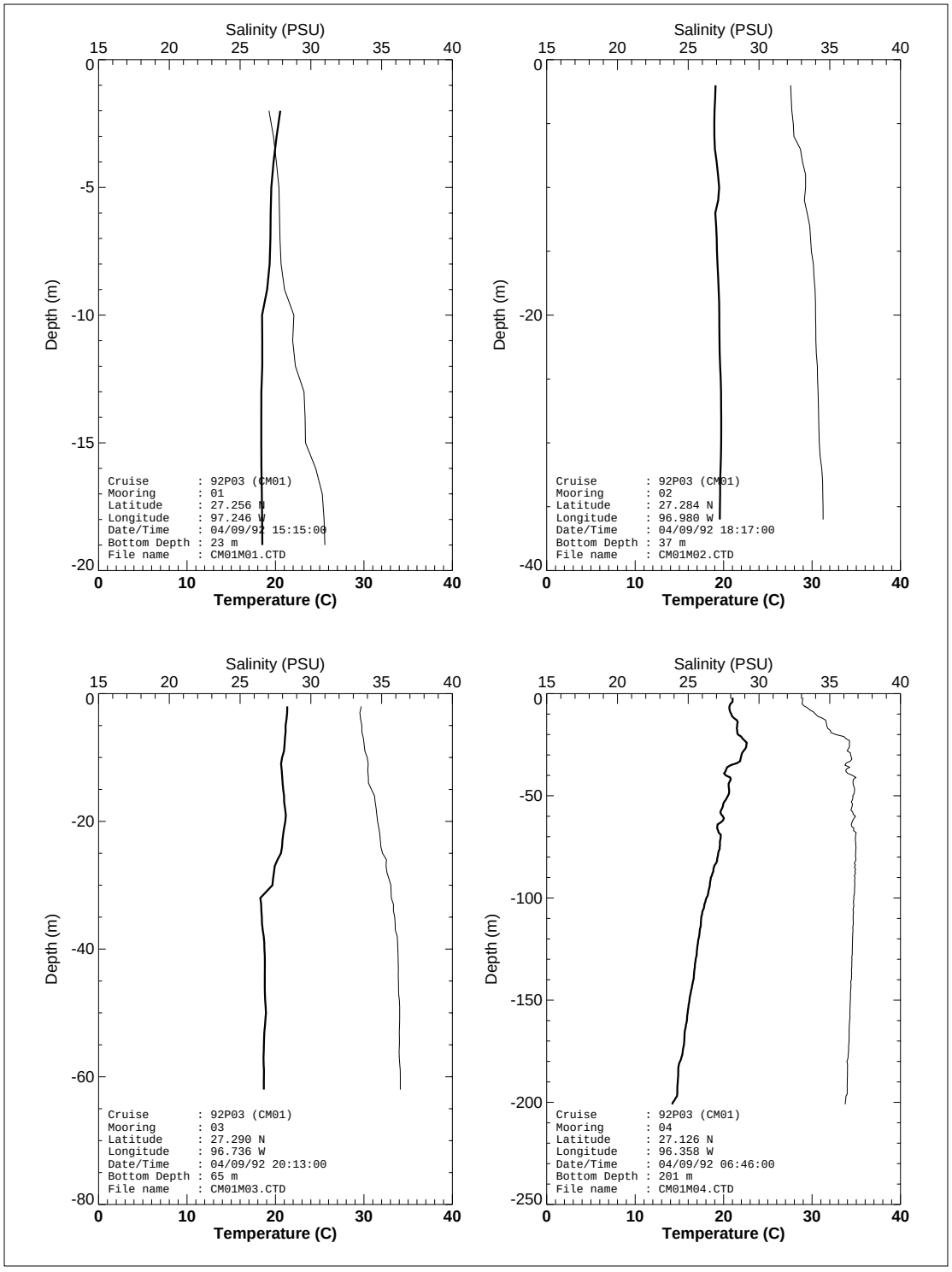

Figure 35. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

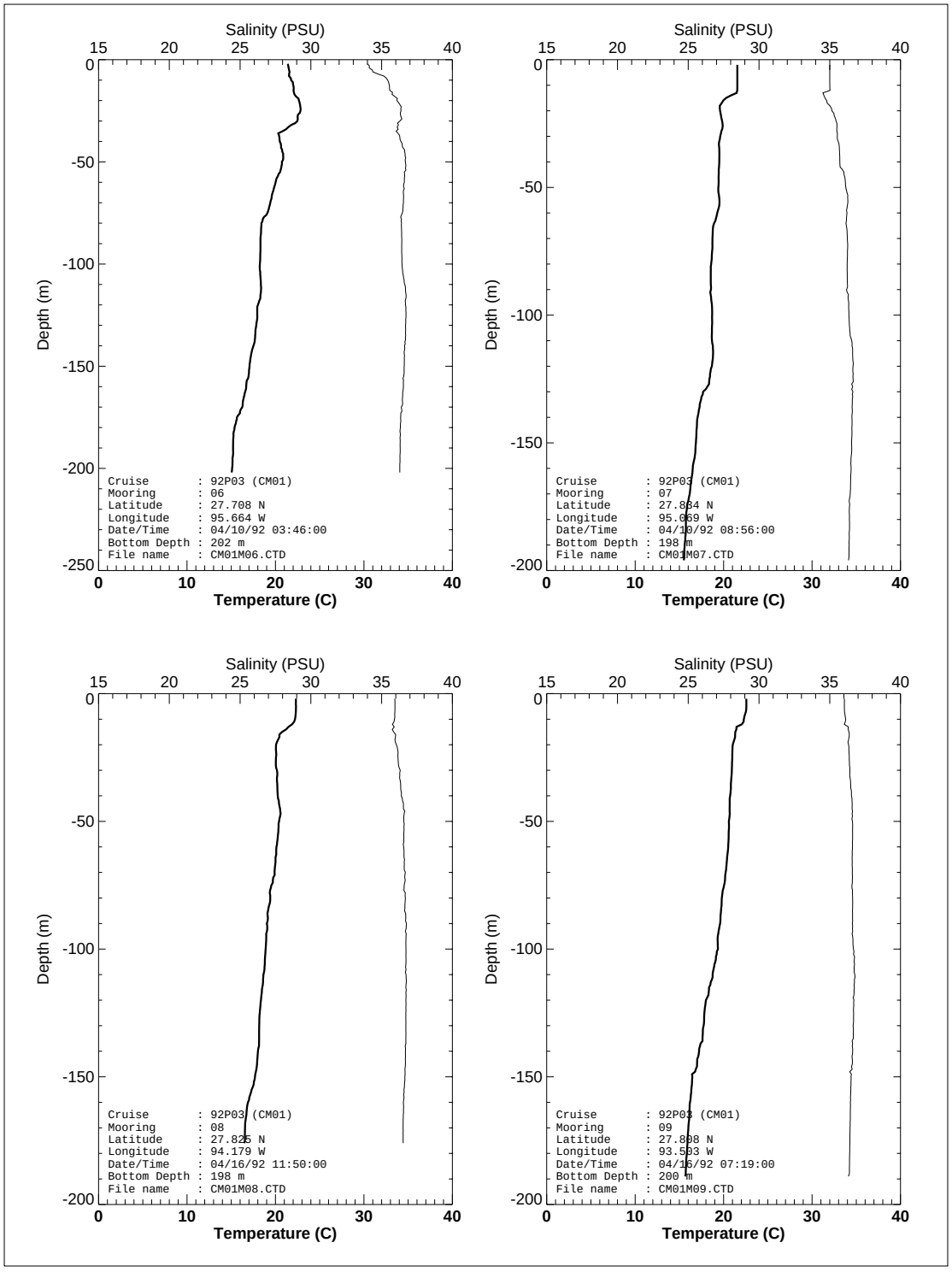

Figure 36. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

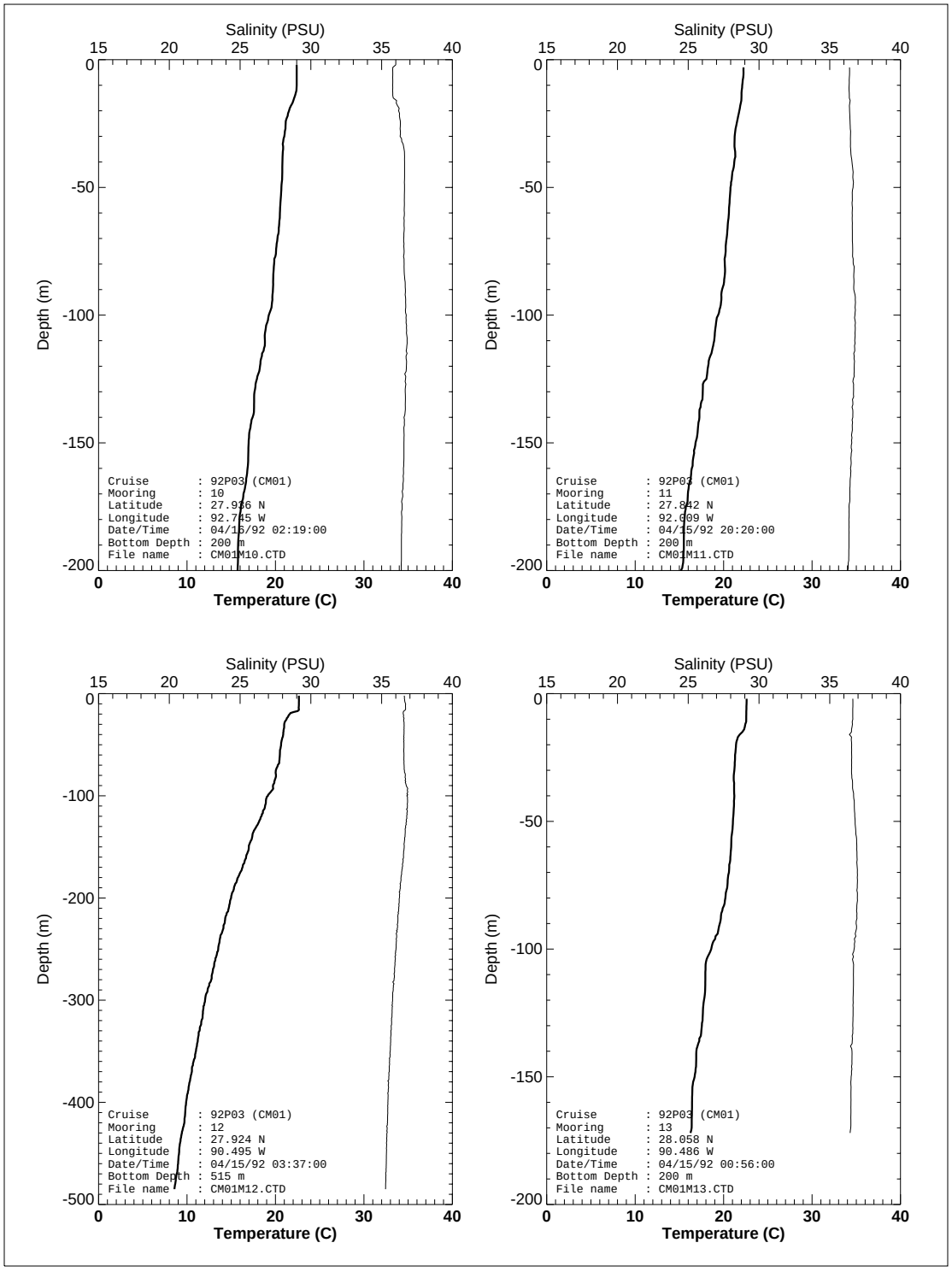

Figure 37. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

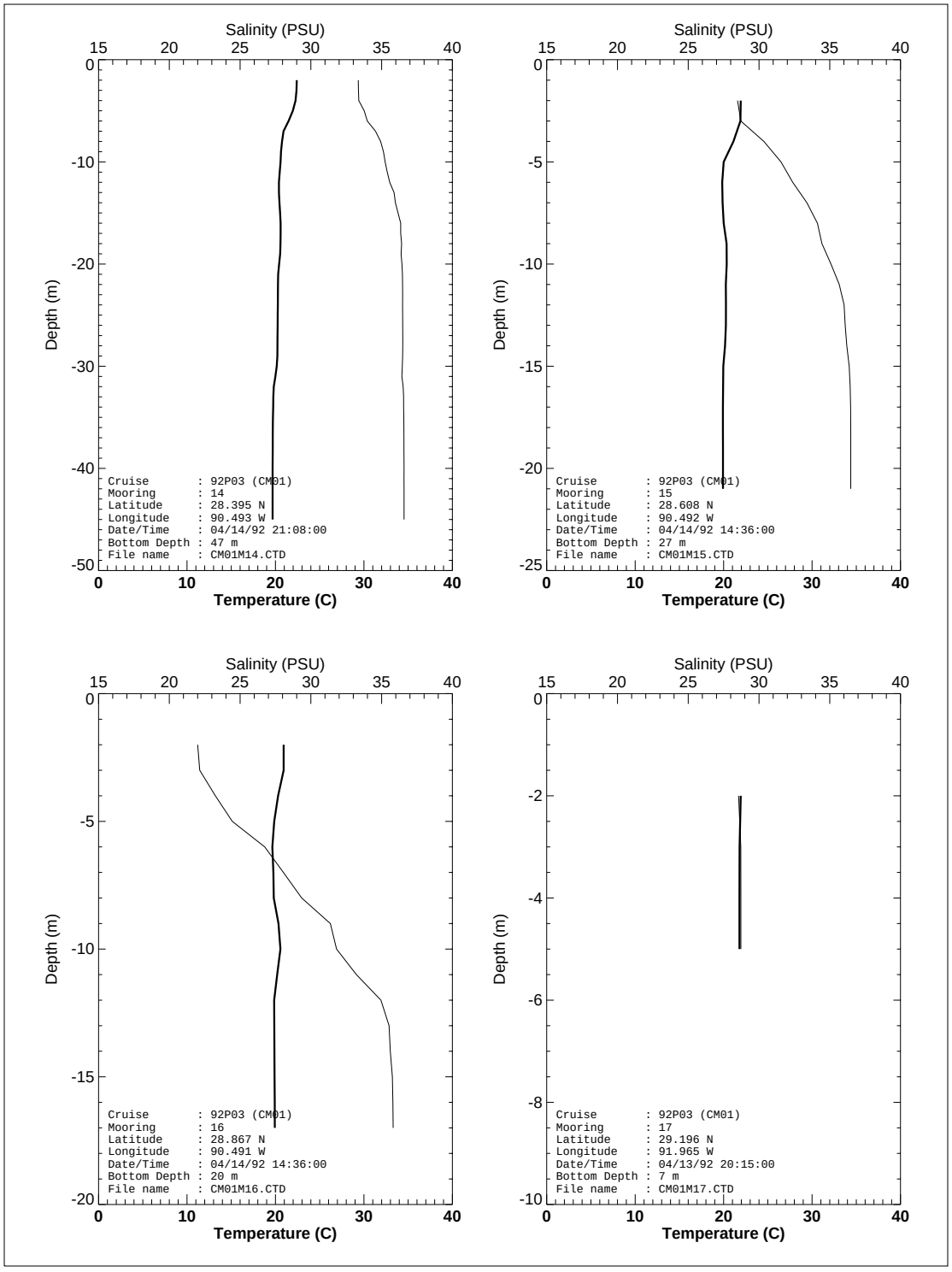

Figure 38. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

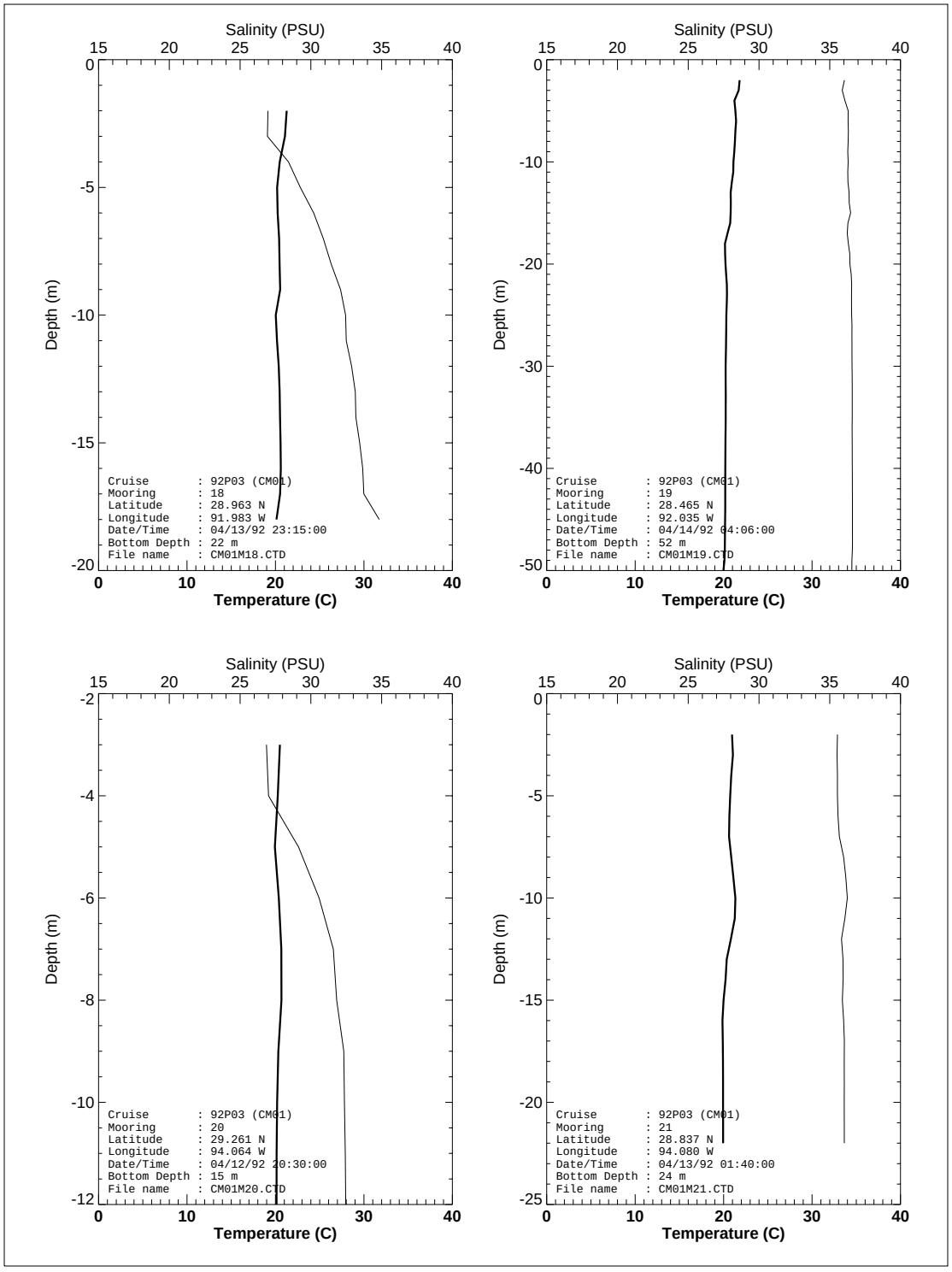

Figure 39. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

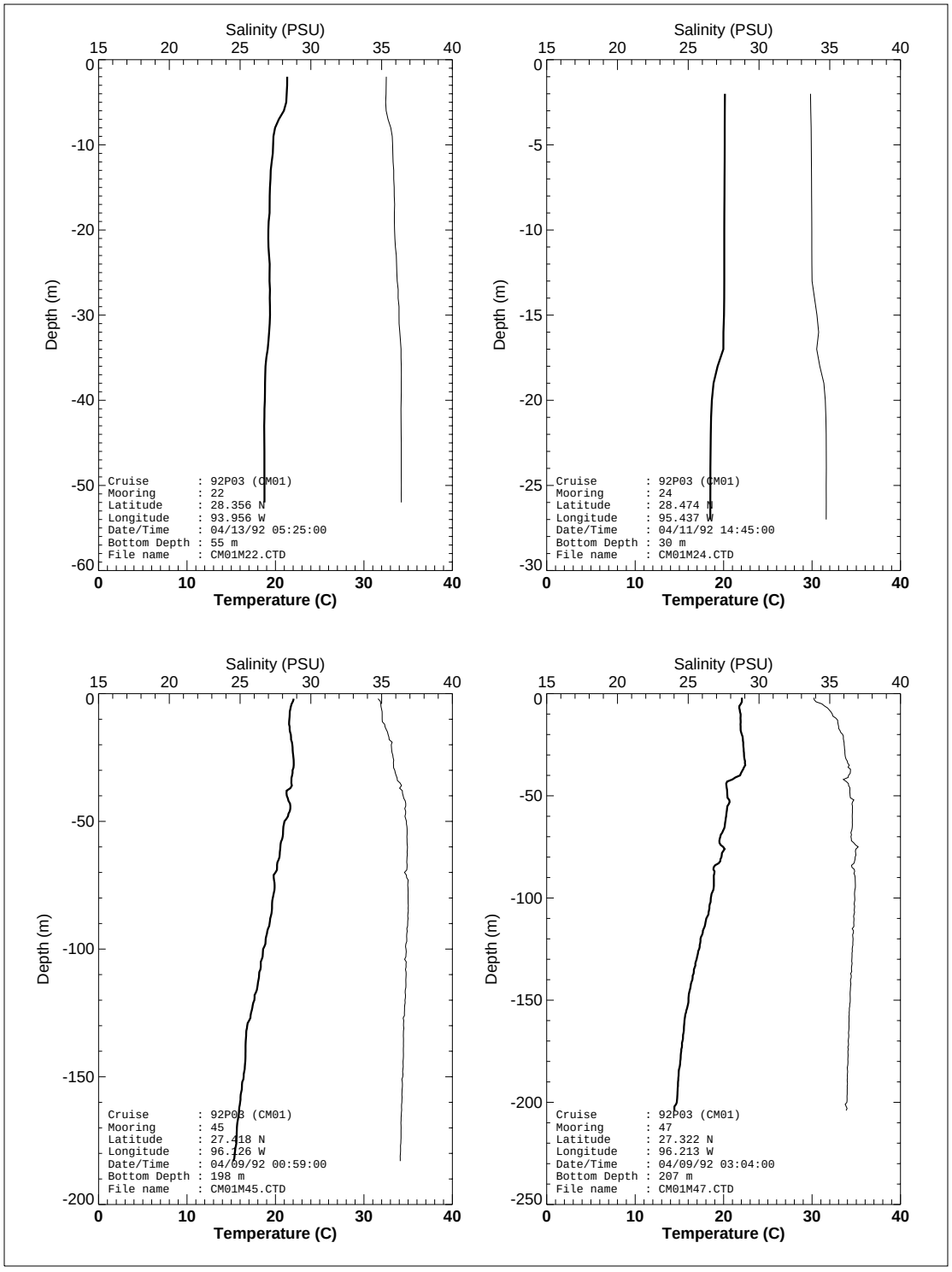

Figure 40. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

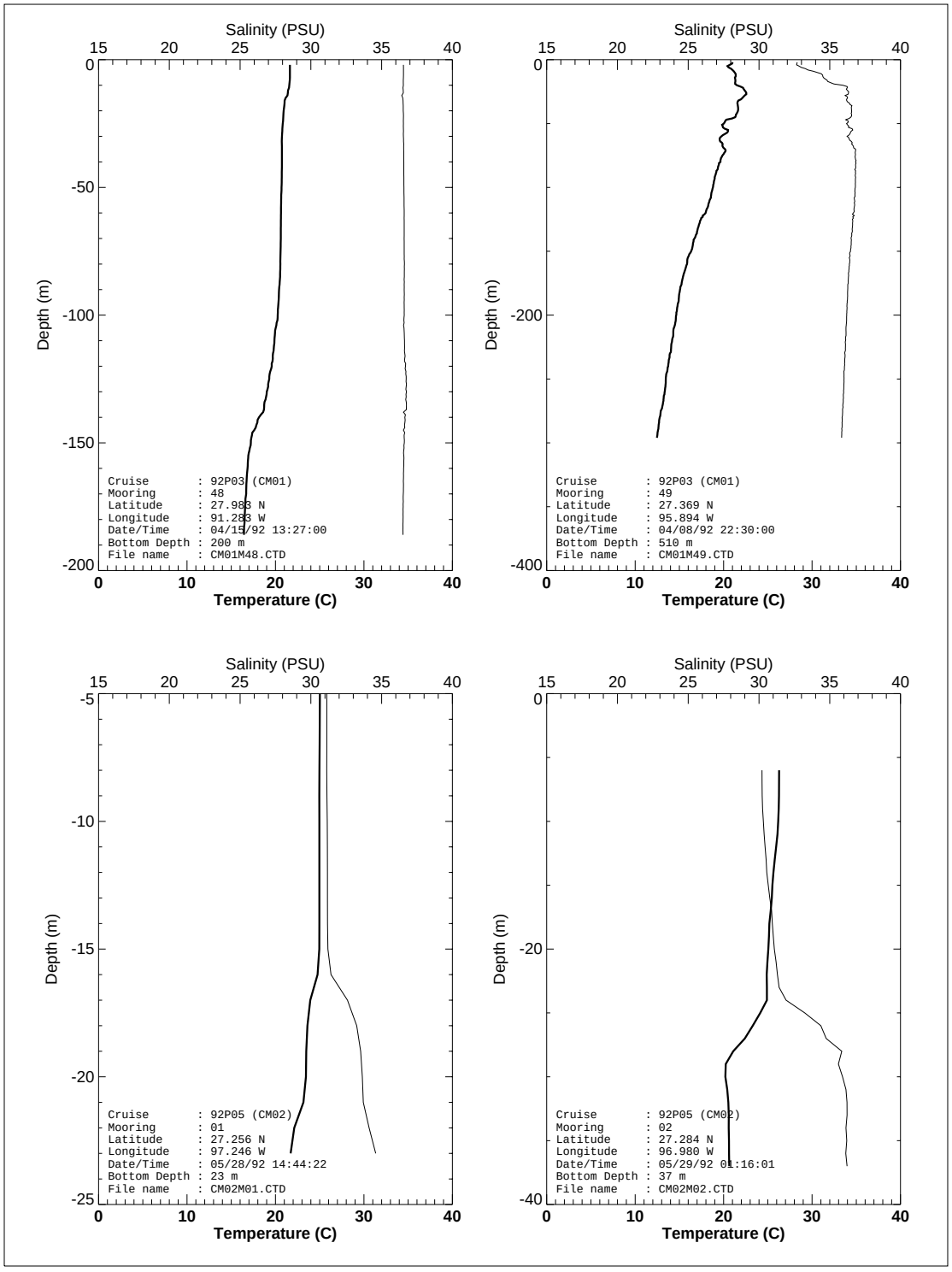

Figure 41. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

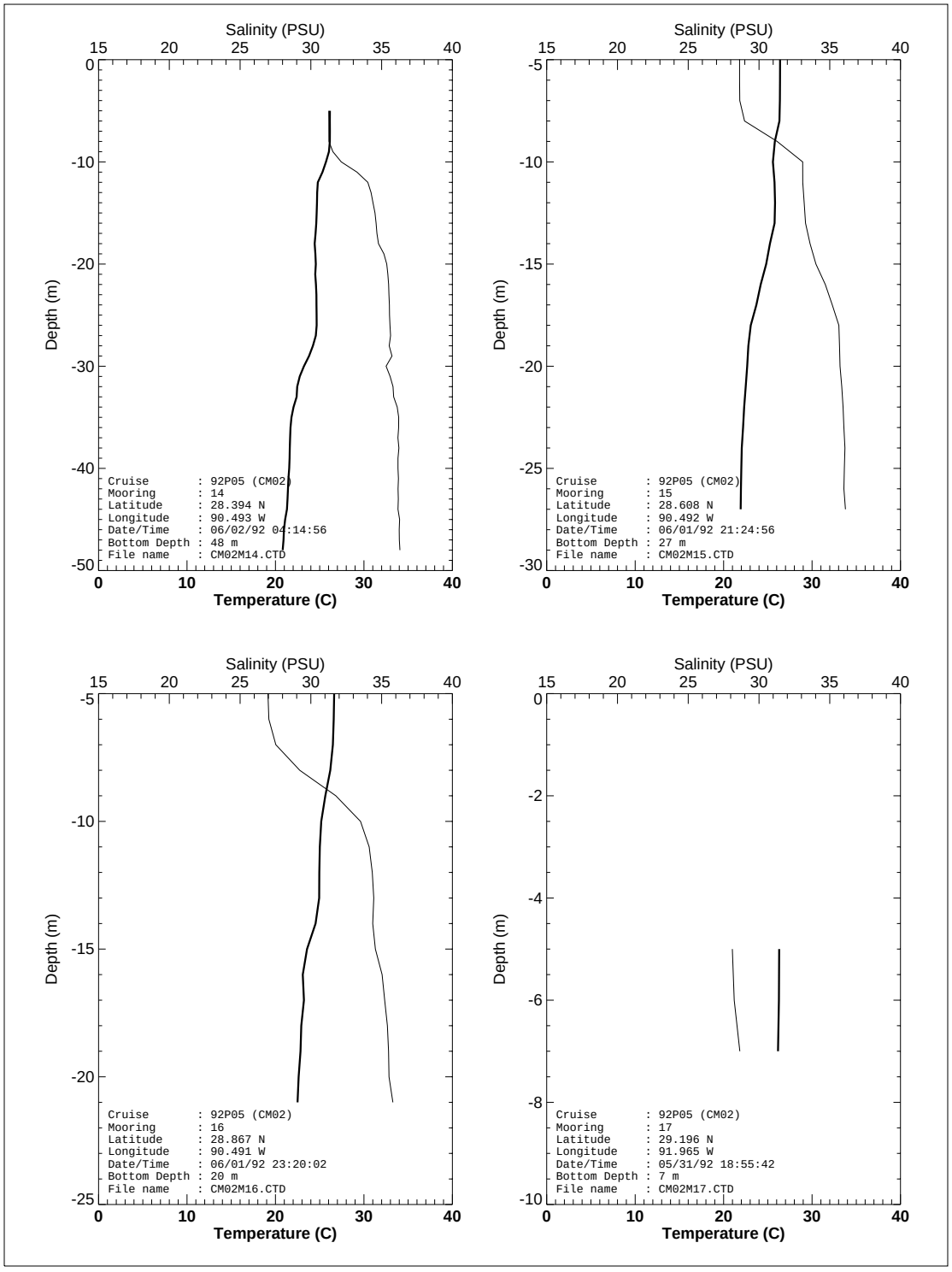

Figure 42. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

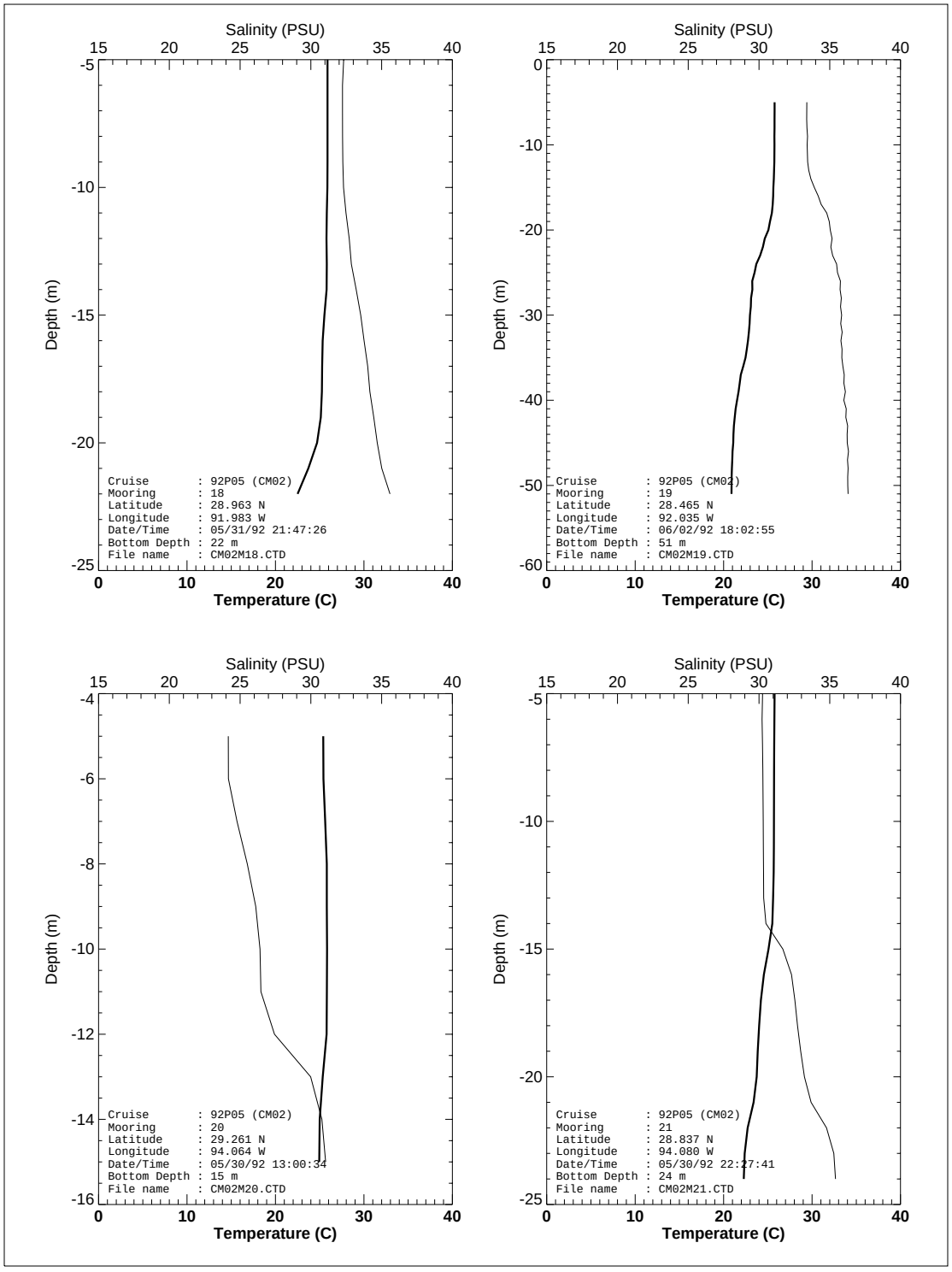

Figure 43. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

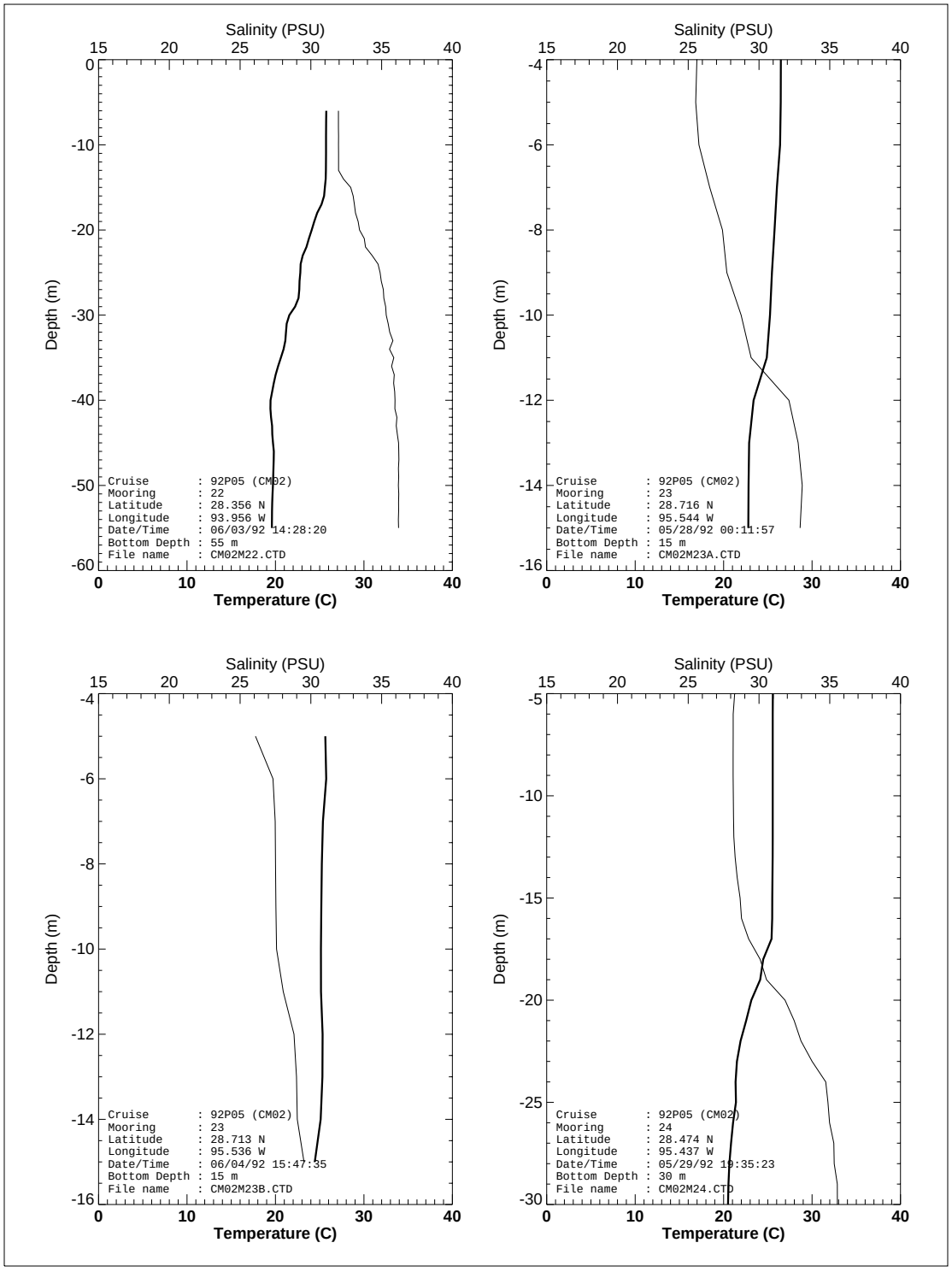

Figure 44. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

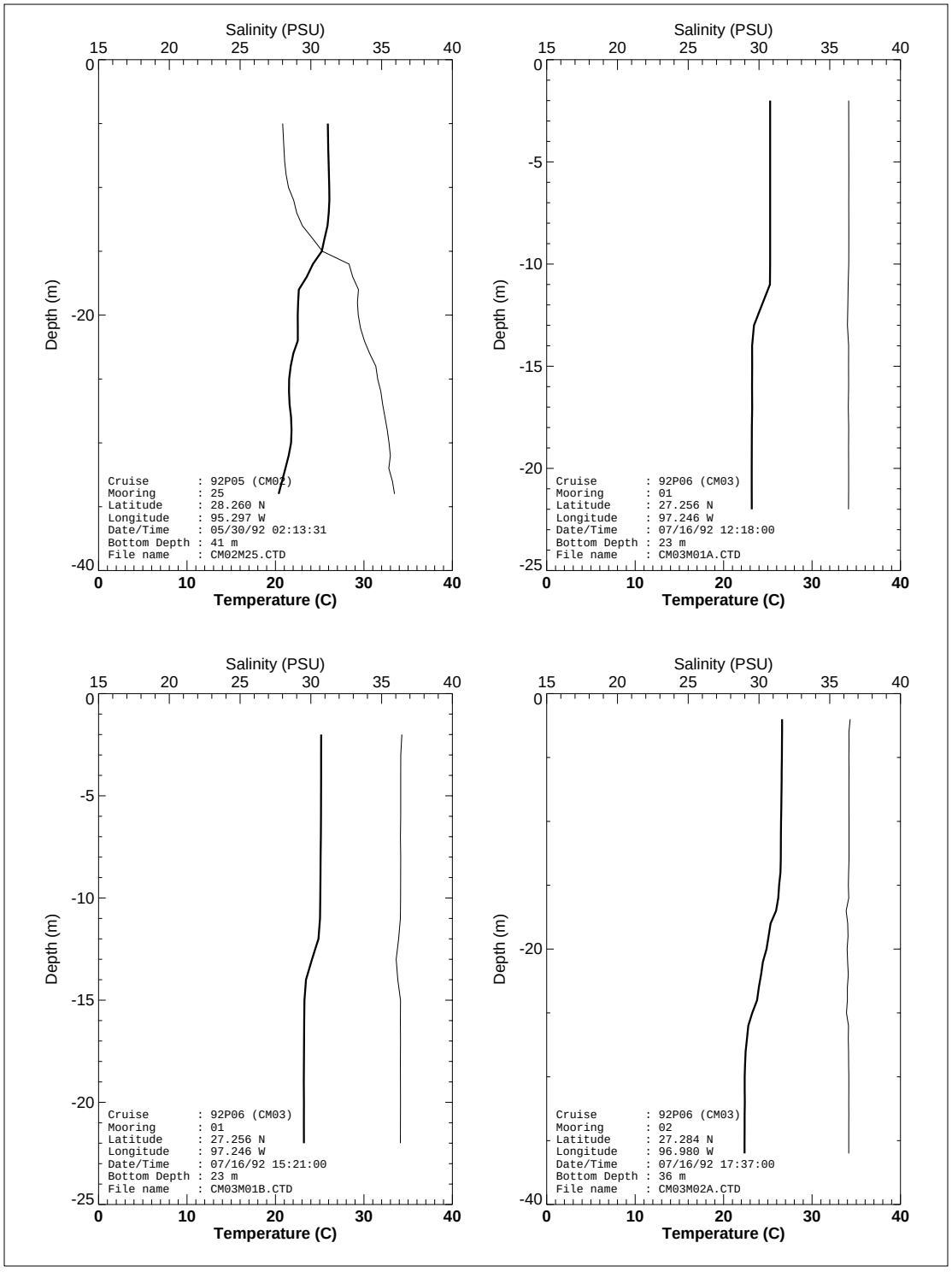

Figure 45. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

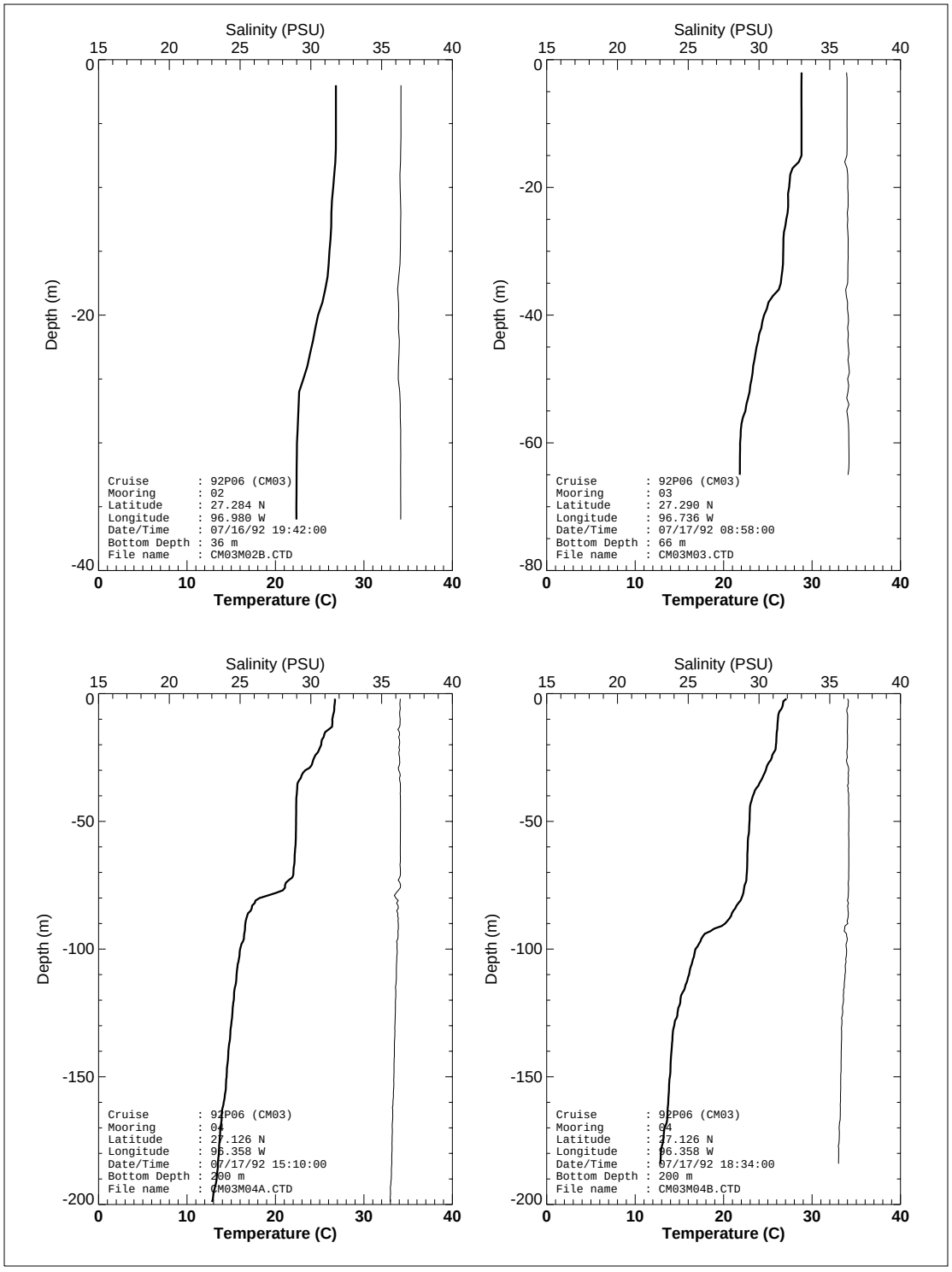

Figure 46. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

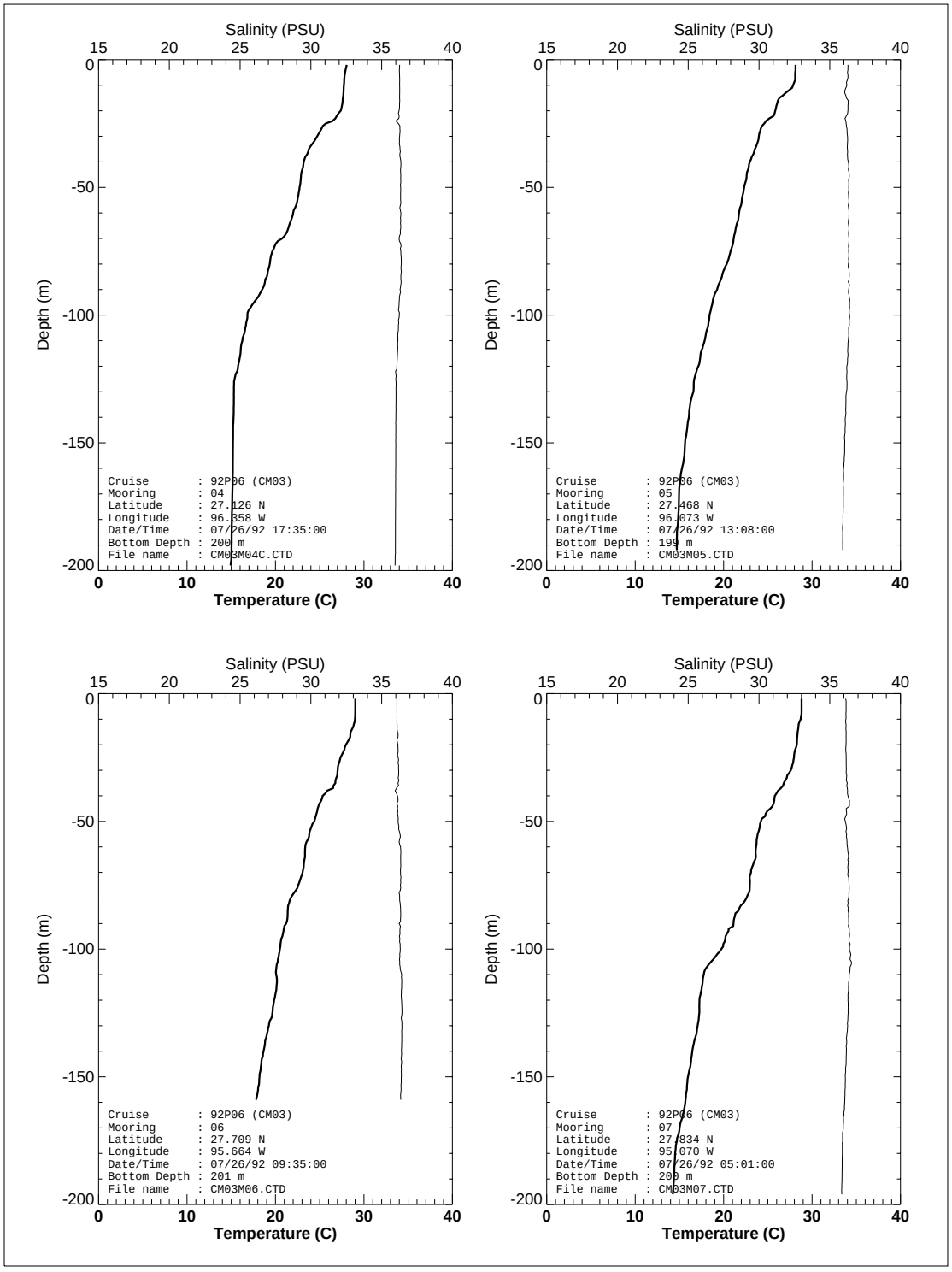

Figure 47. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

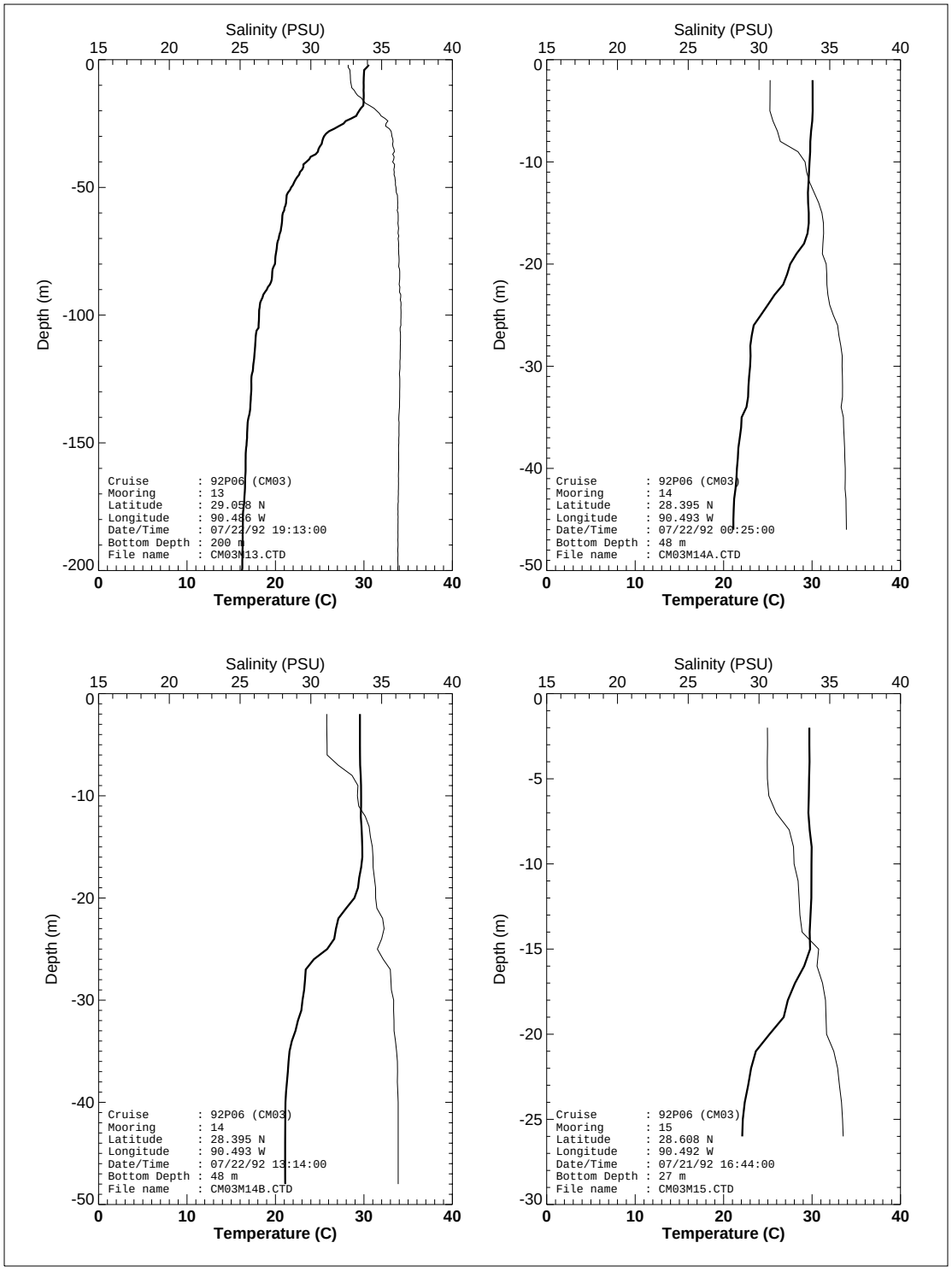

Figure 48. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

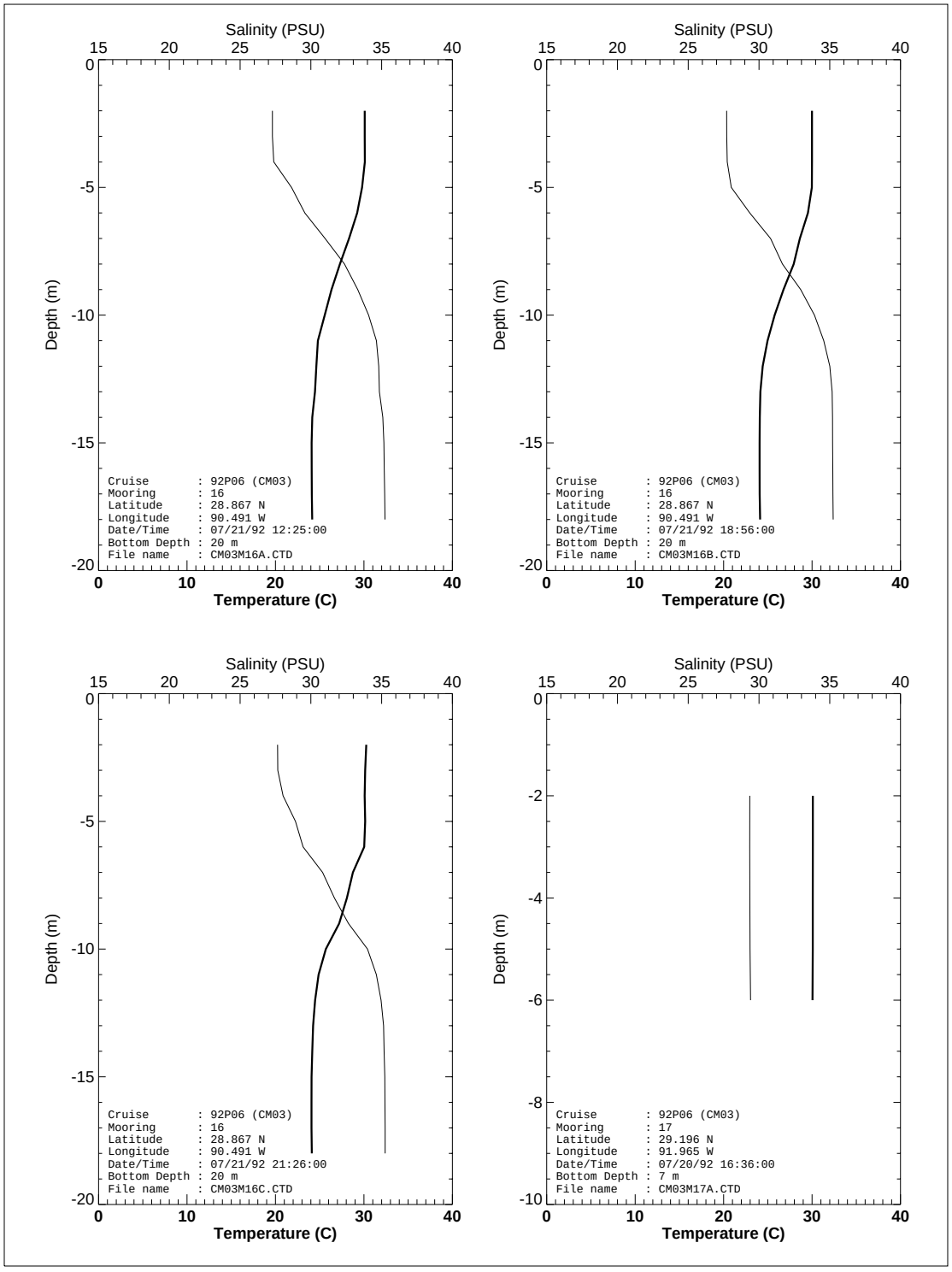

Figure 49. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

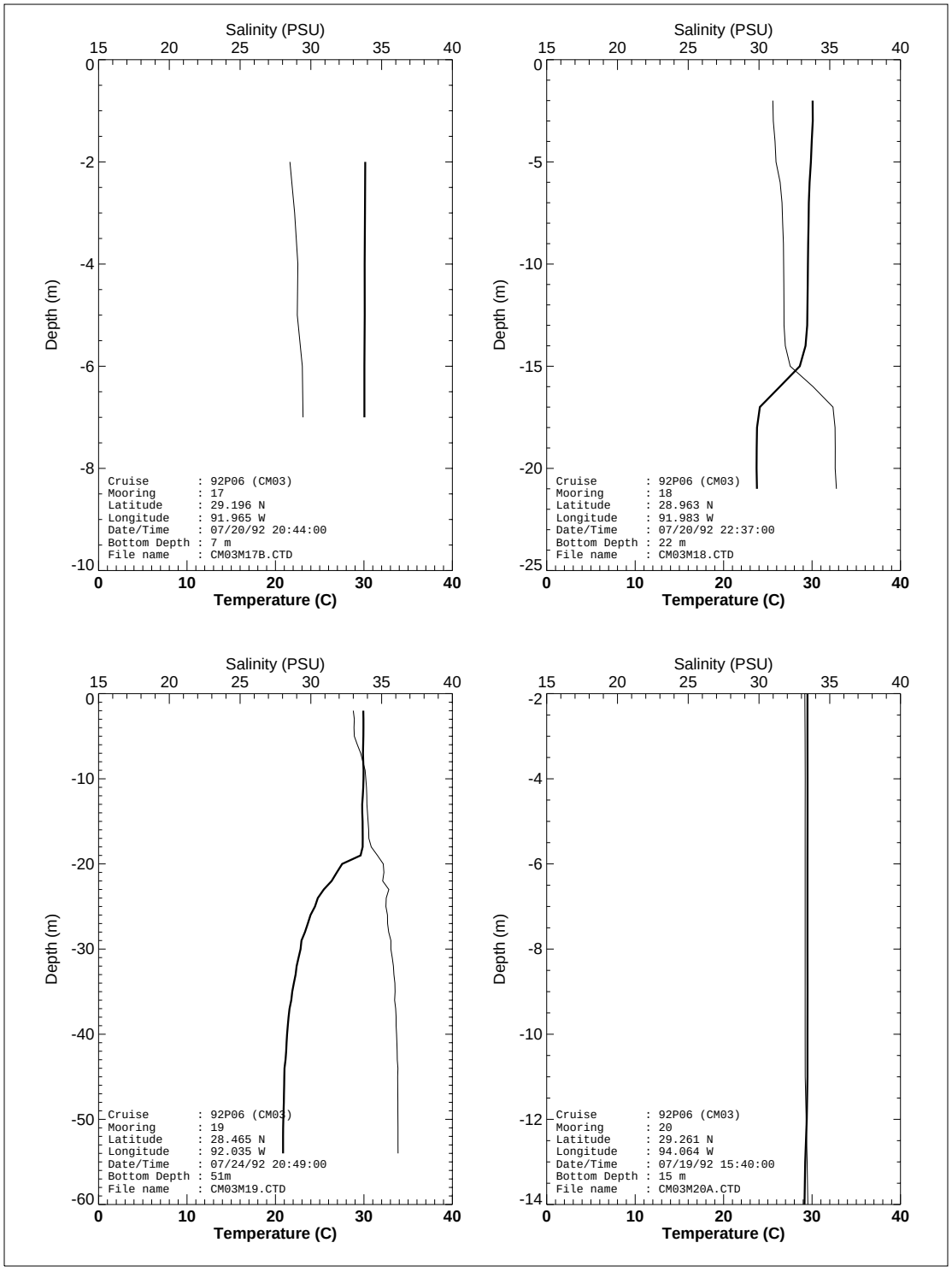

Figure 50. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

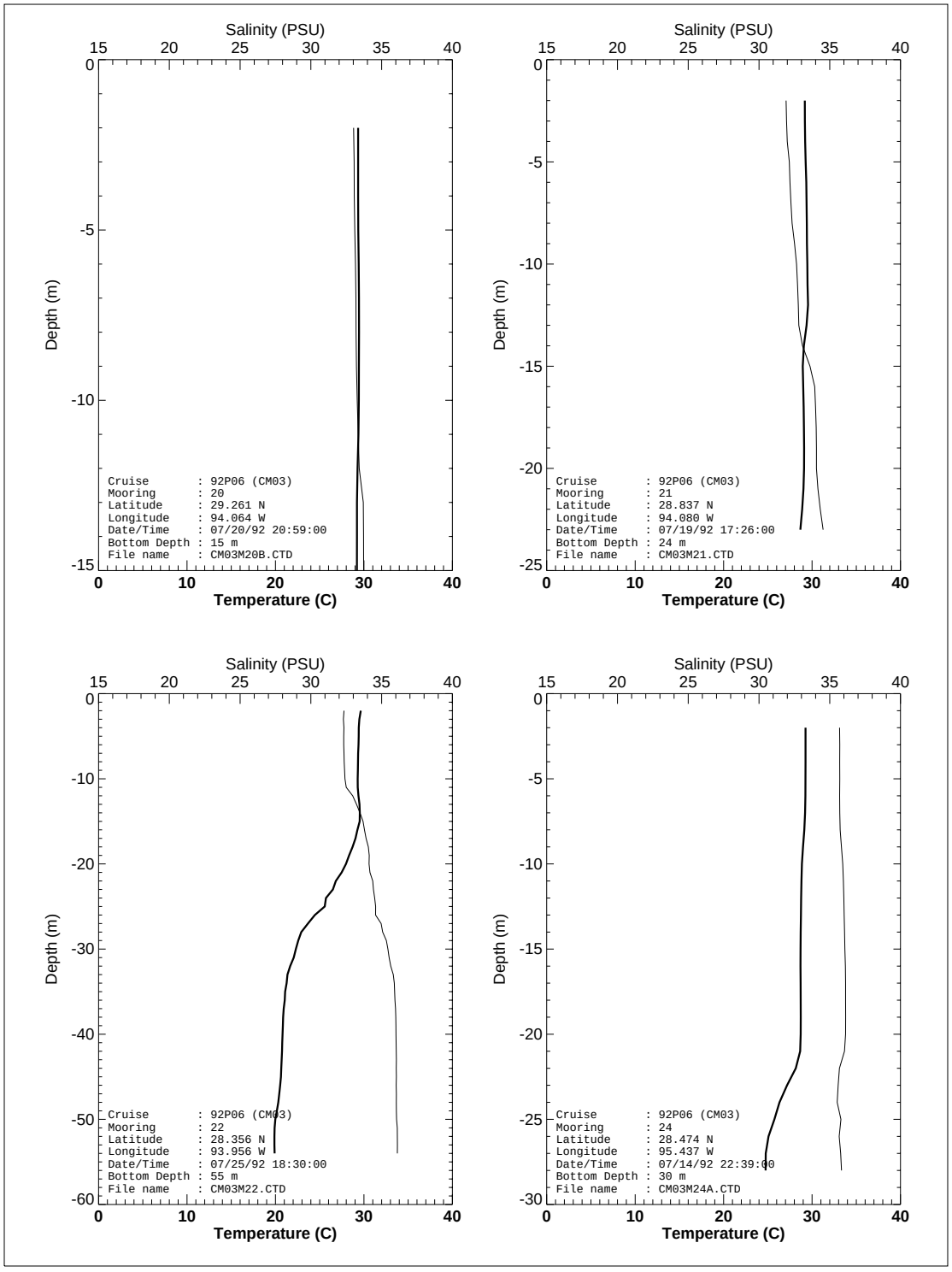

Figure 51. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

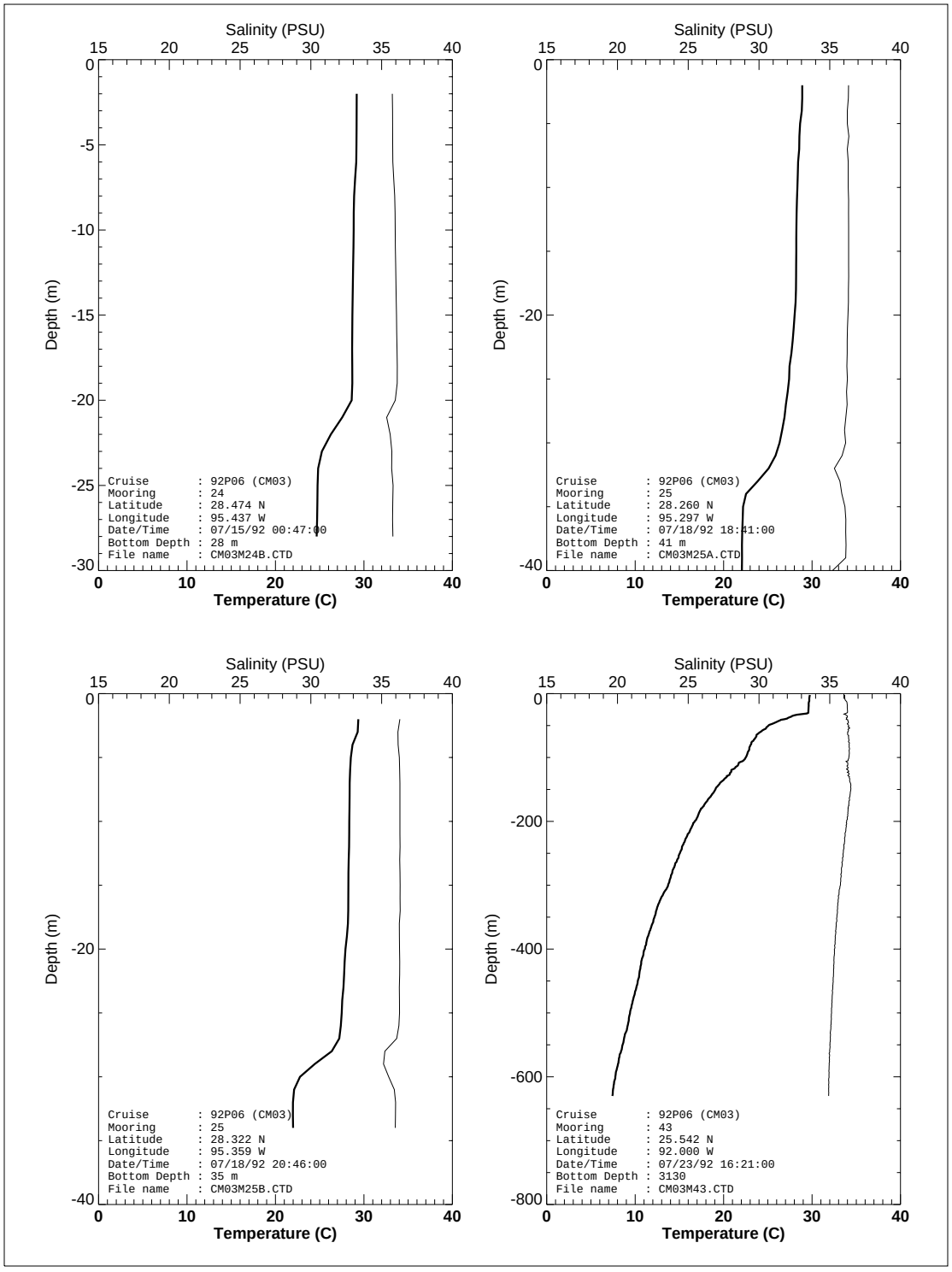

Figure 52. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

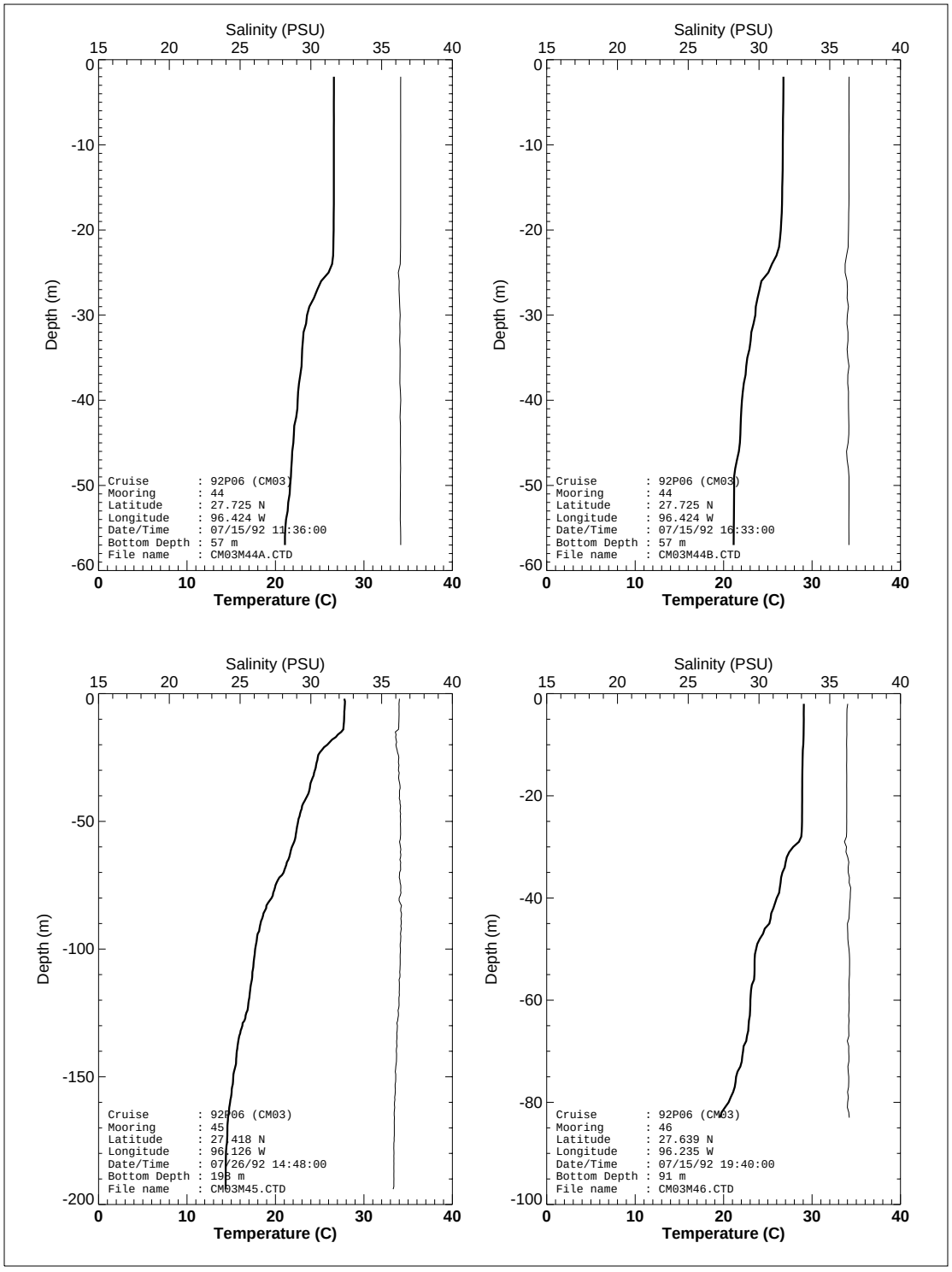

Figure 53. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

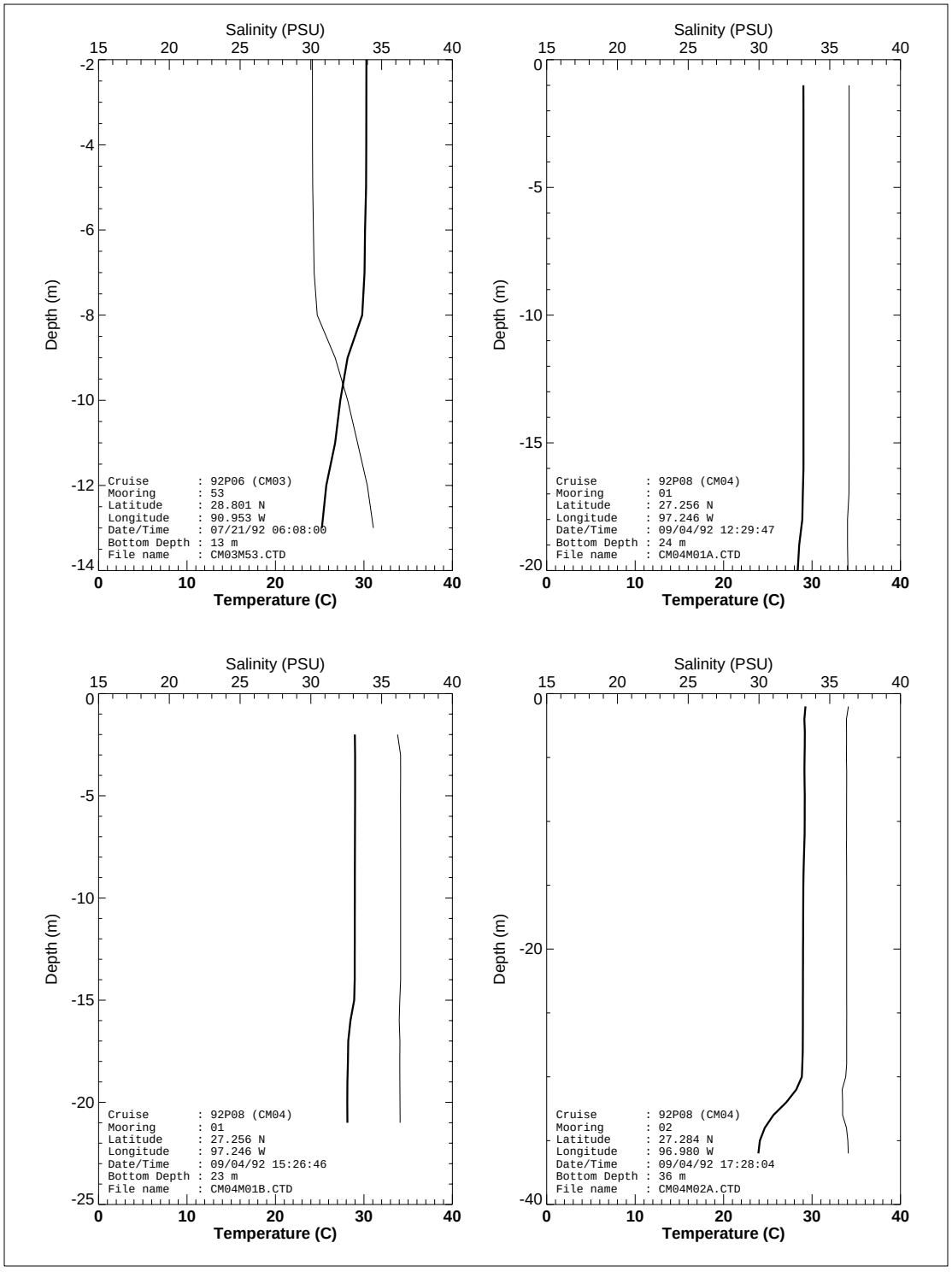

Figure 54. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

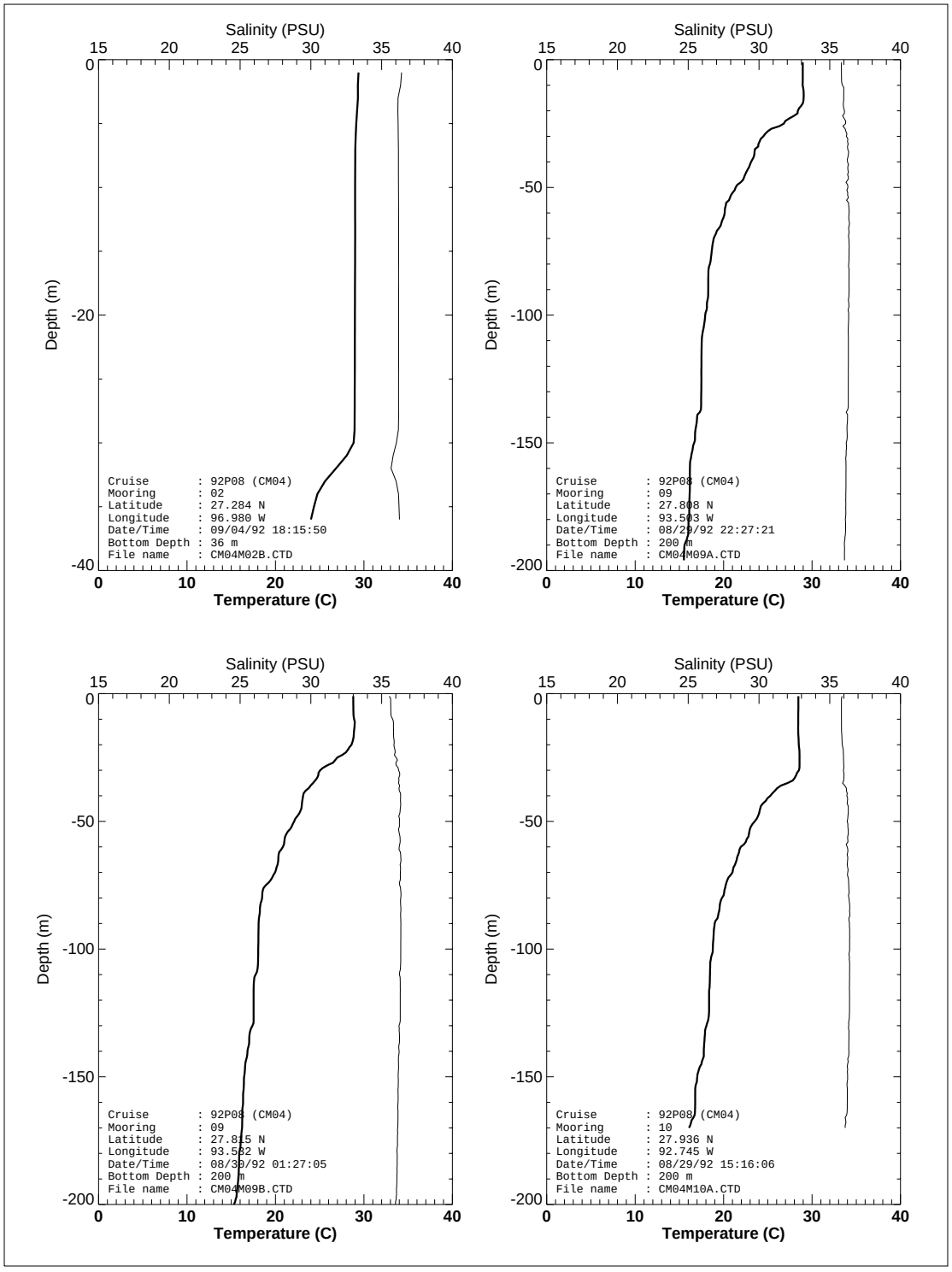

Figure 55. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

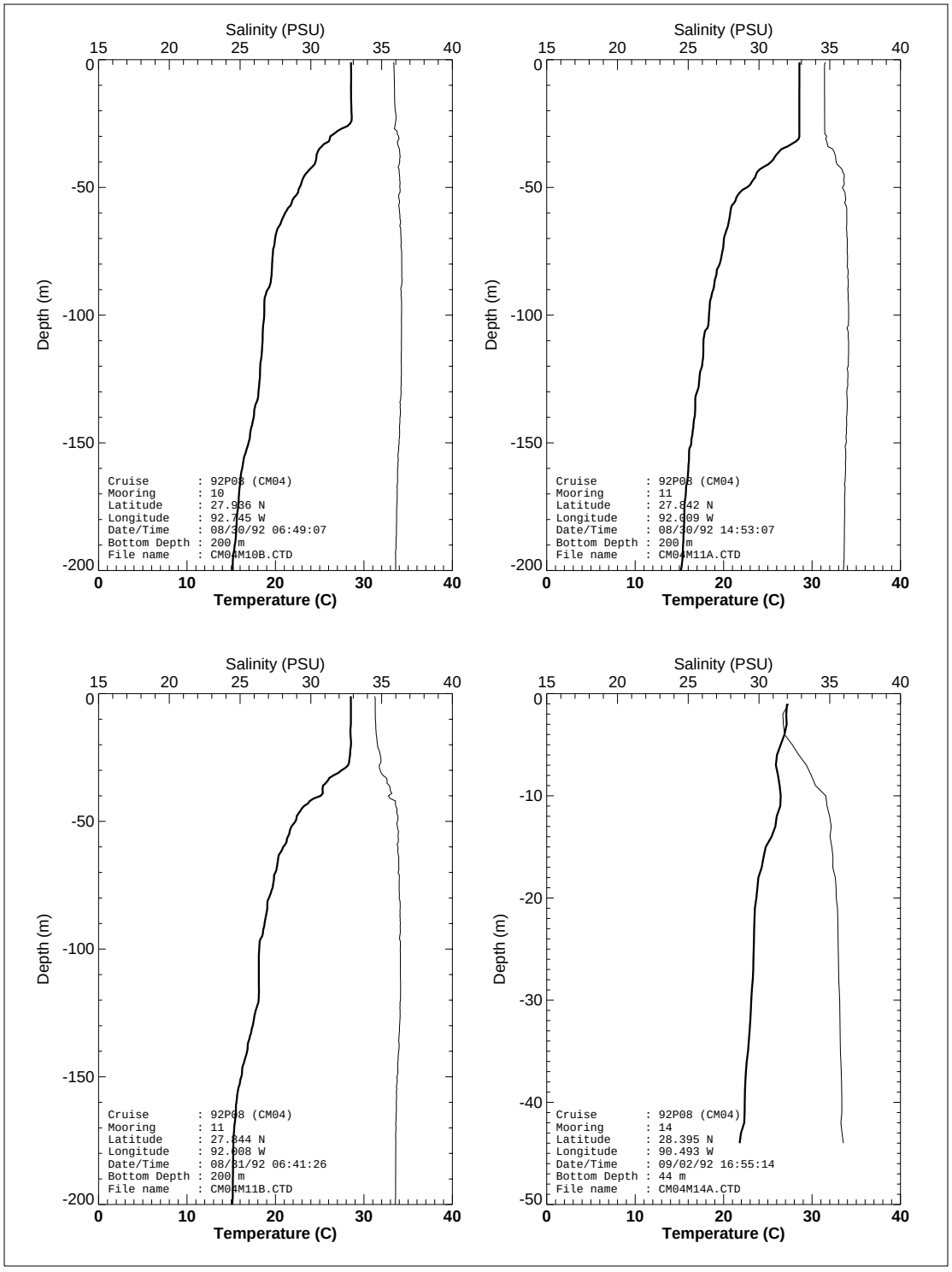

Figure 56. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

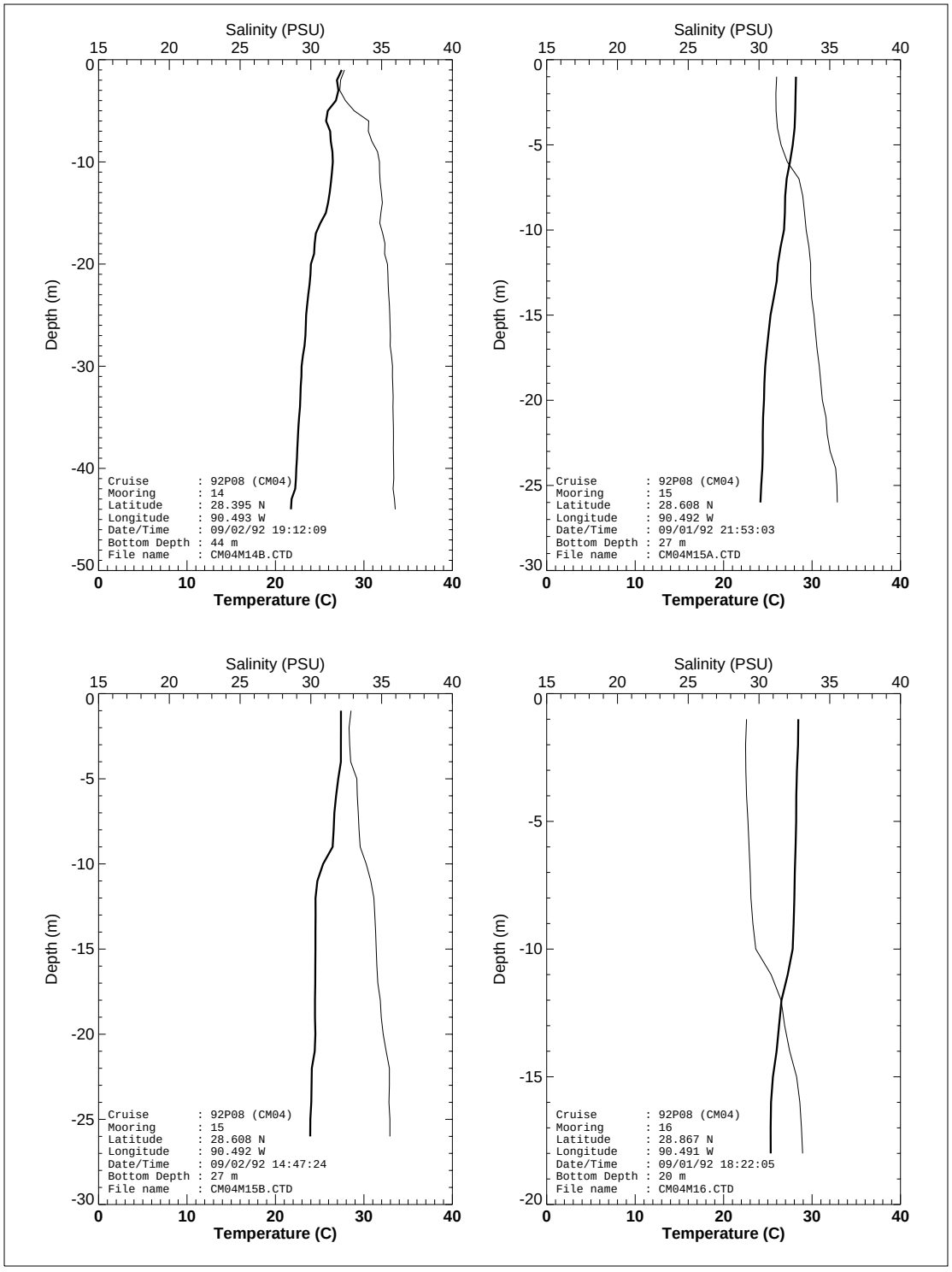

Figure 57. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

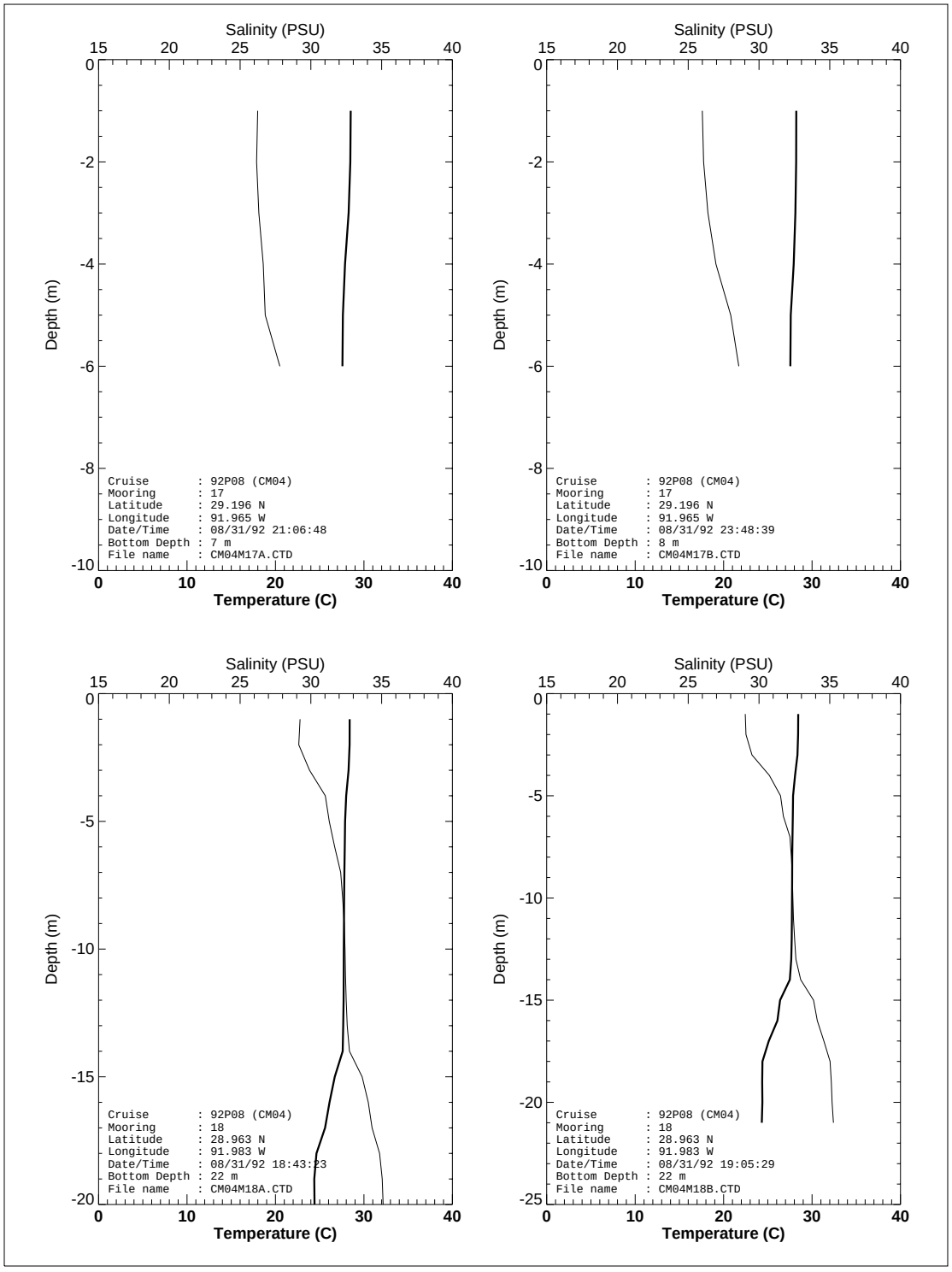

Figure 58. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

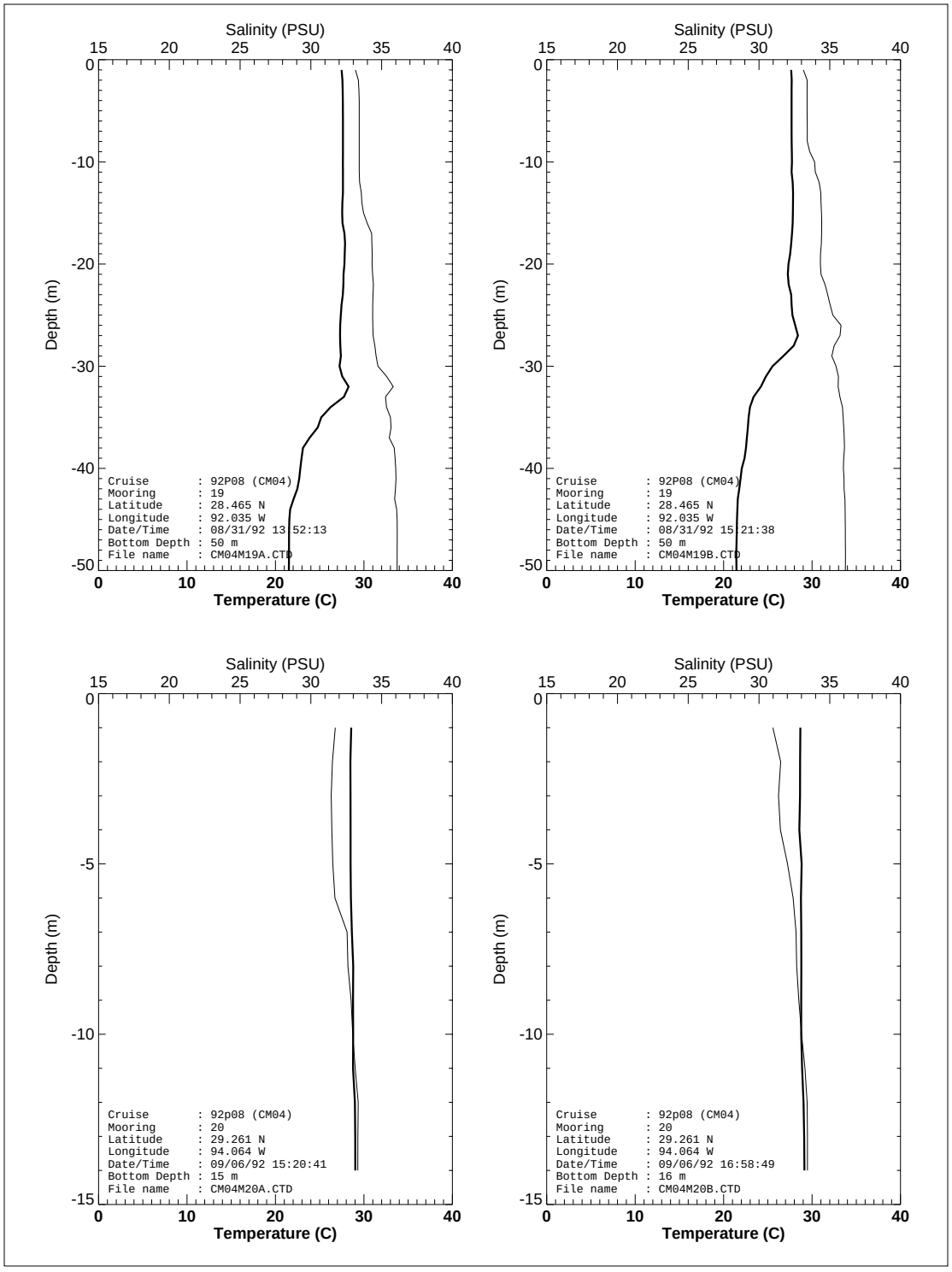

Figure 59. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

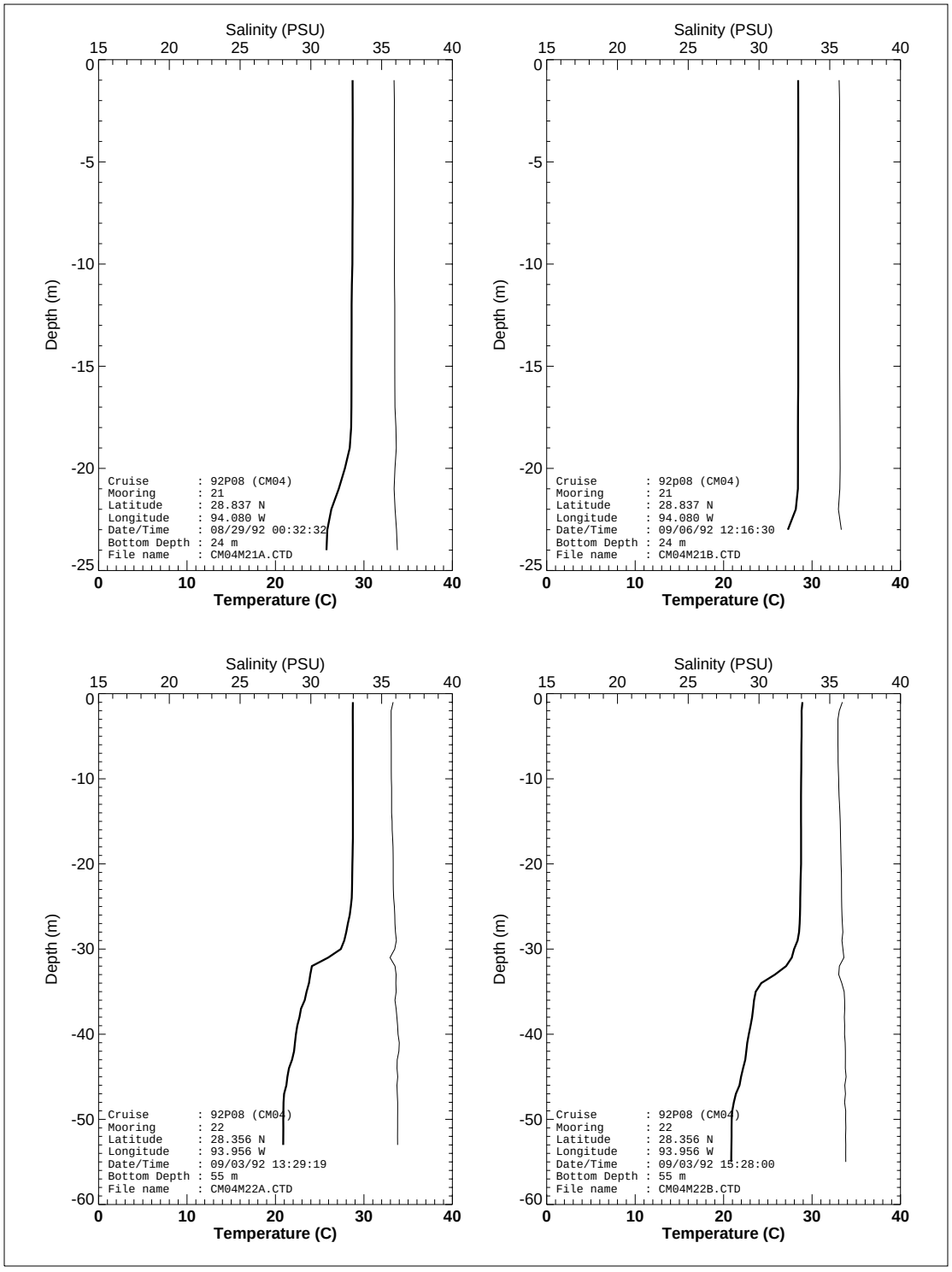

Figure 60. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

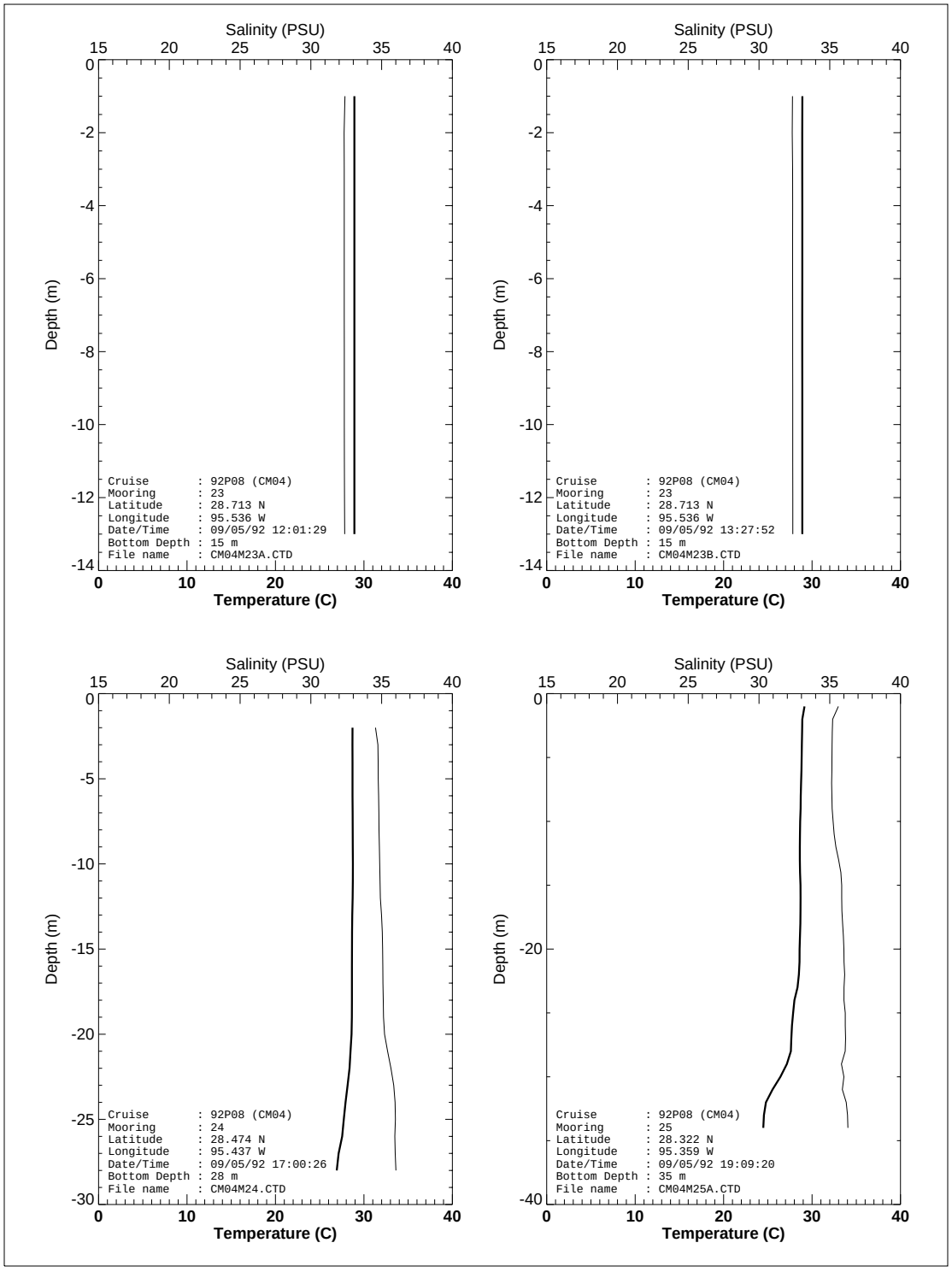

Figure 61. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

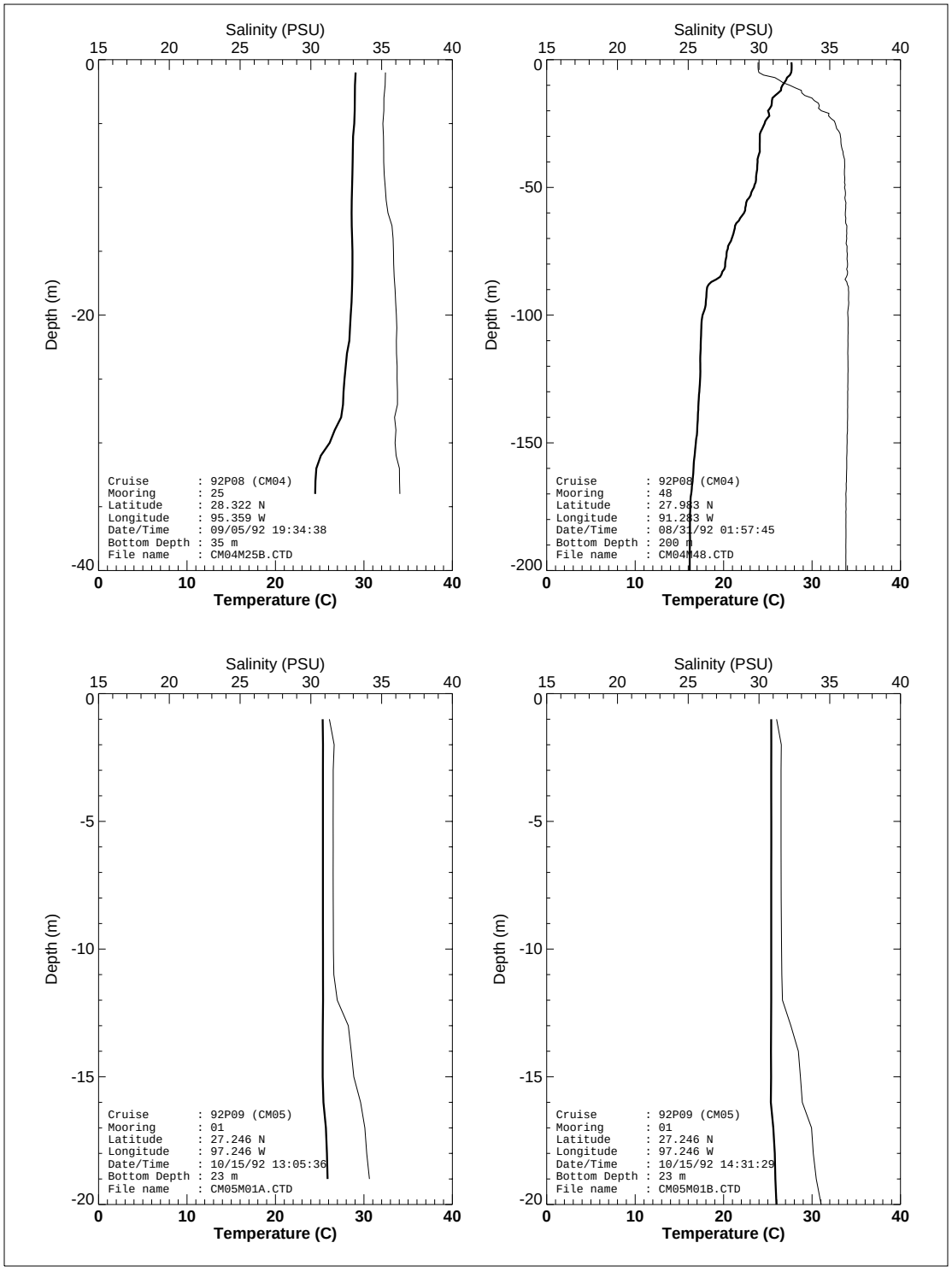

Figure 62. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

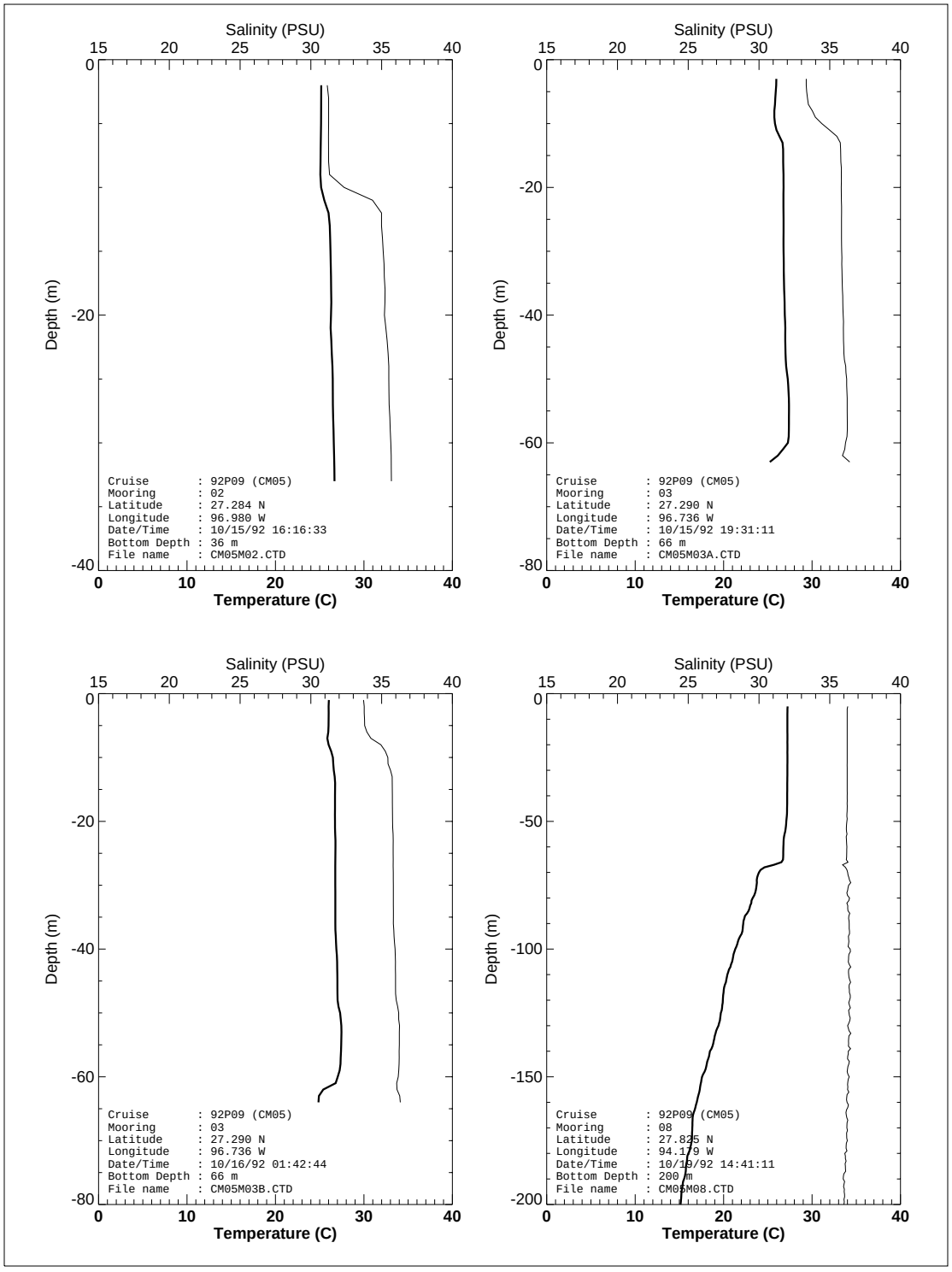

Figure 63. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

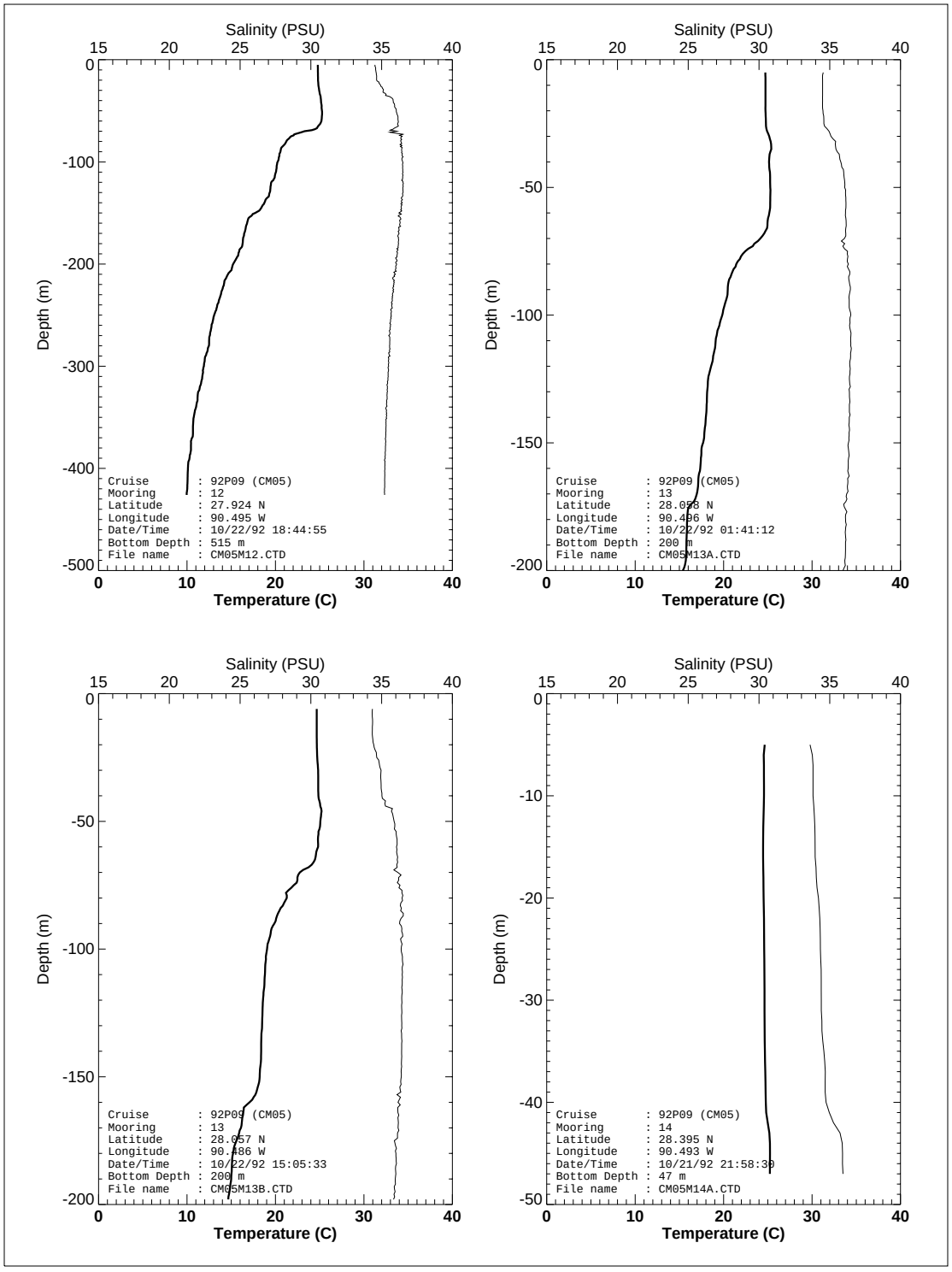

Figure 64. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

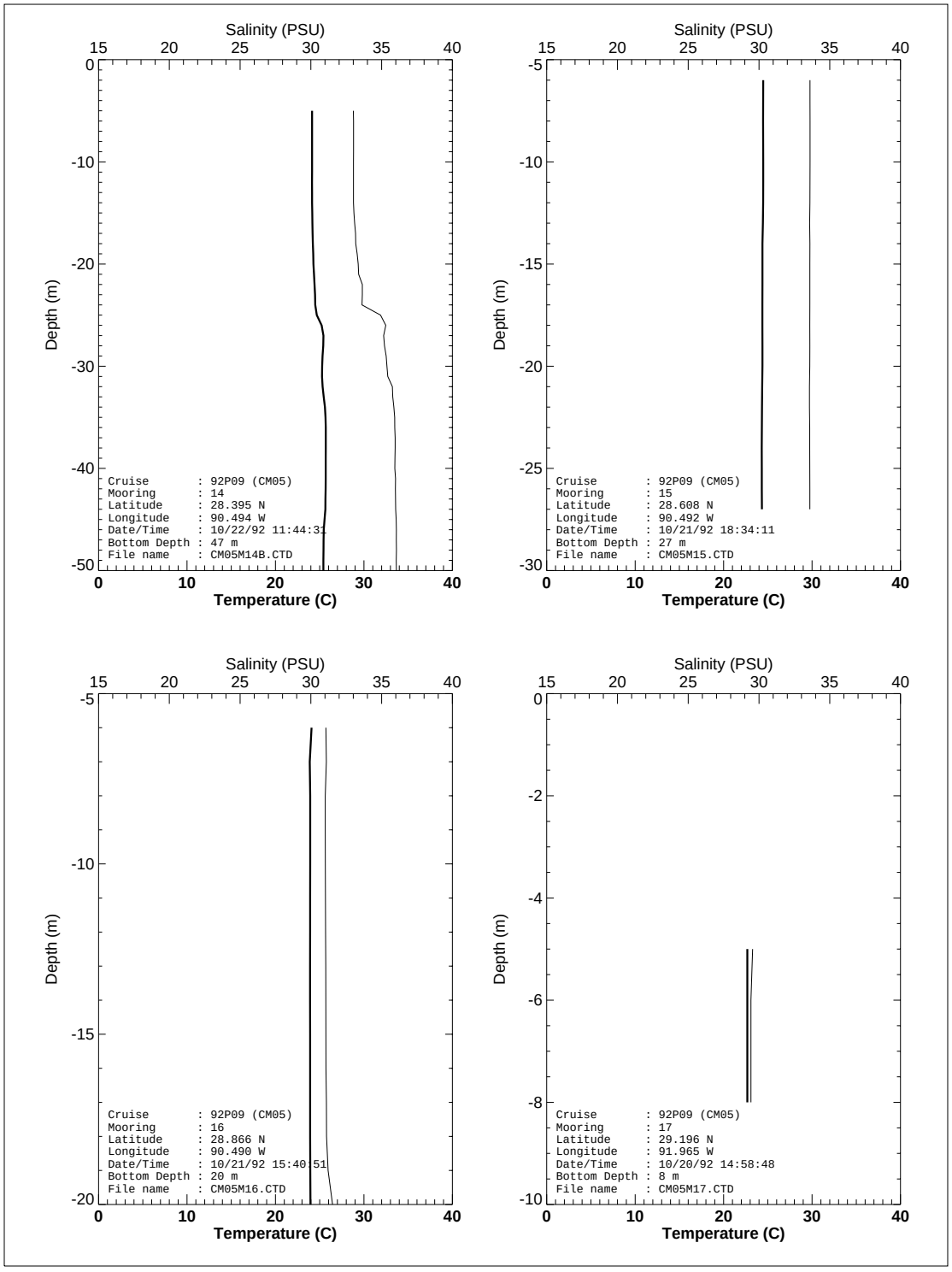

Figure 65. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

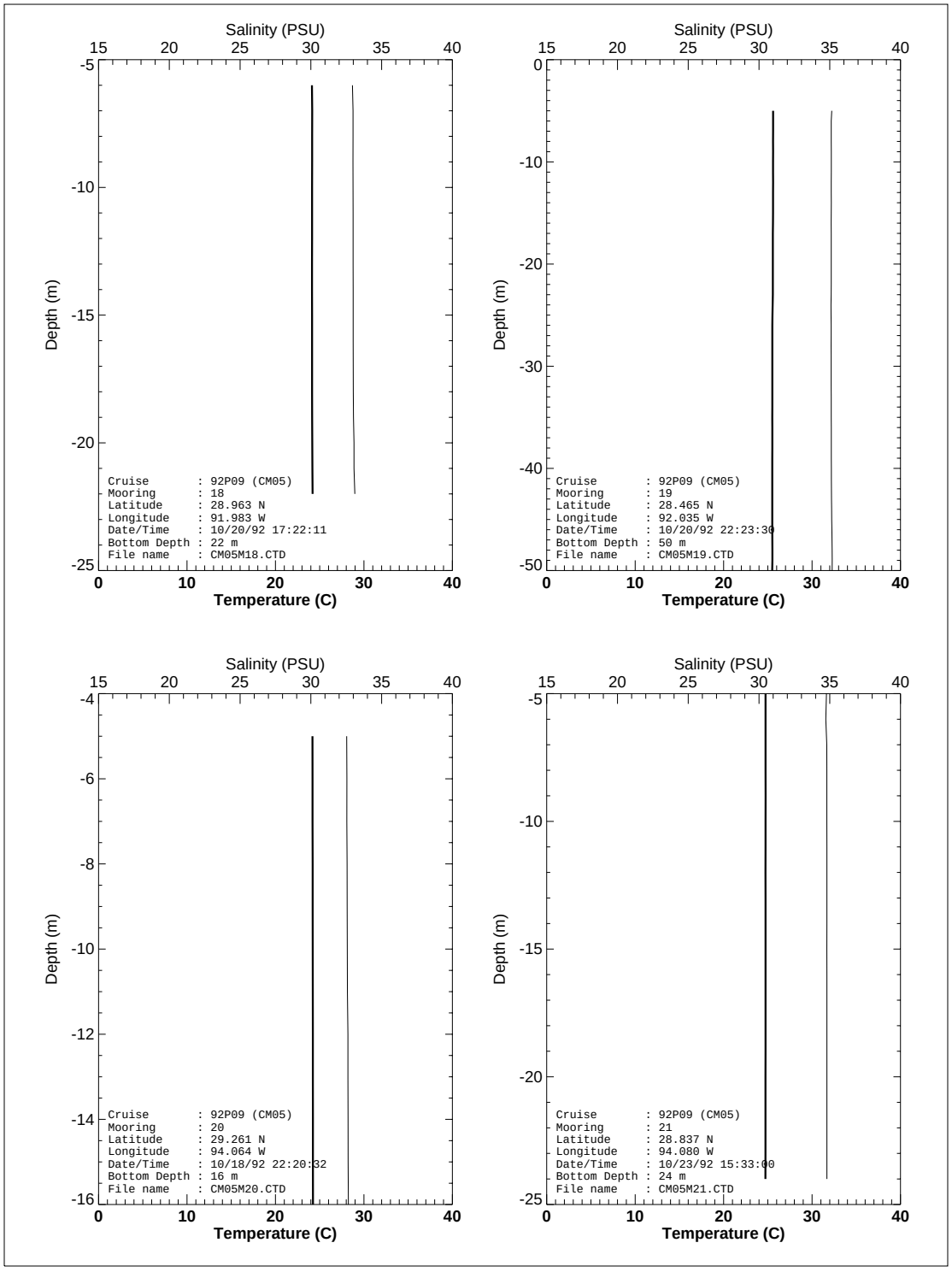

Figure 66. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

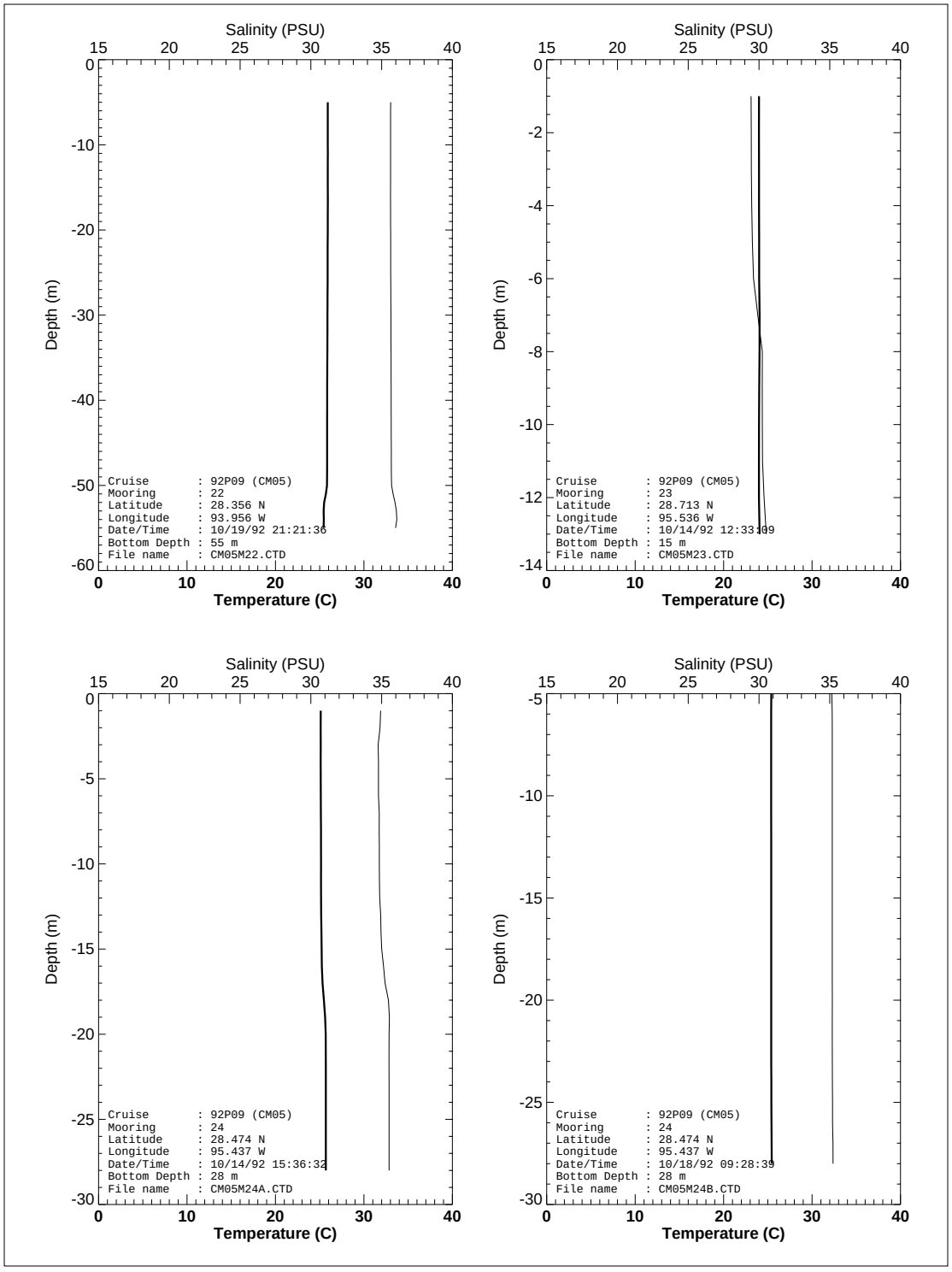

Figure 67. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

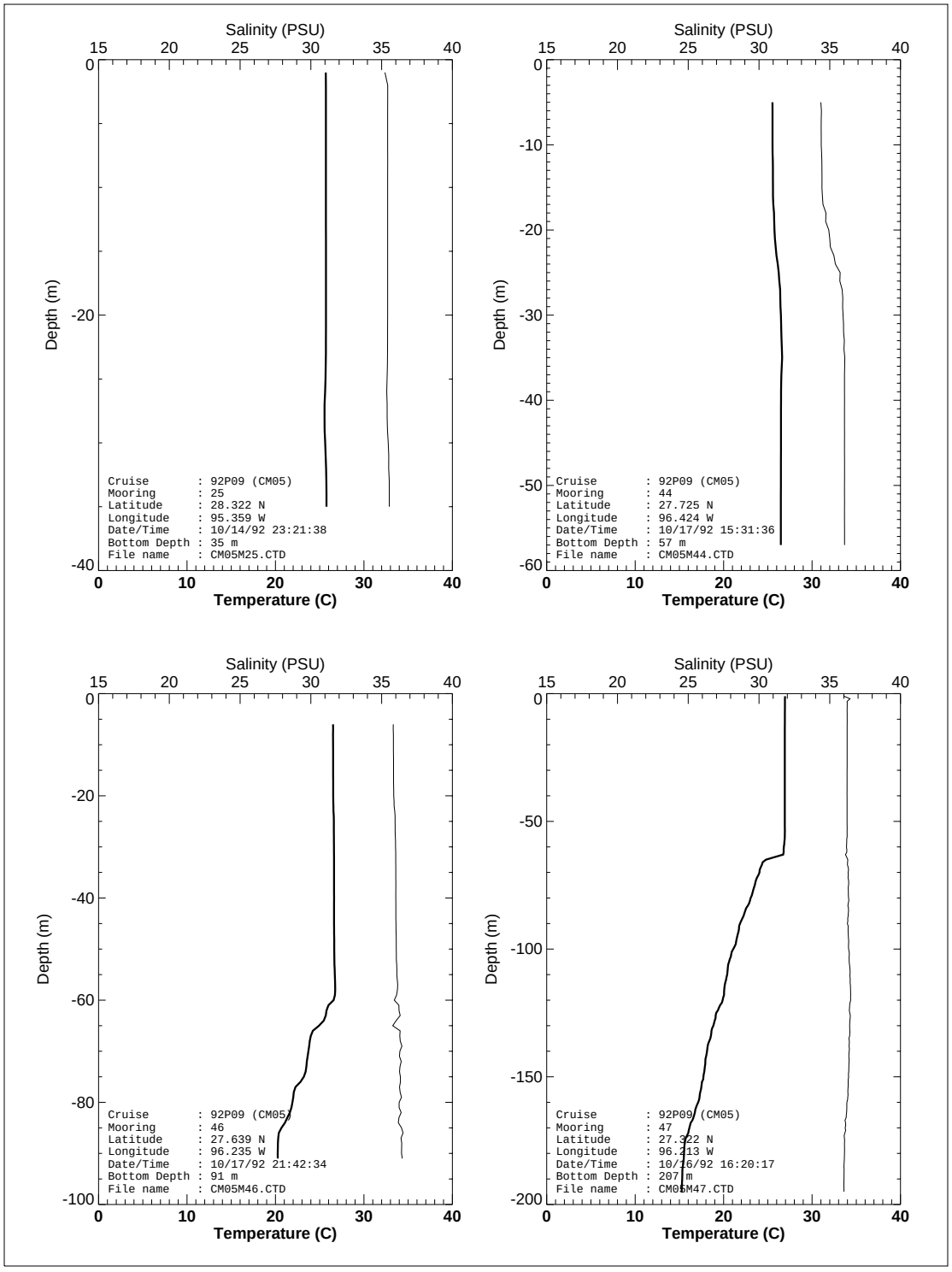

Figure 68. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

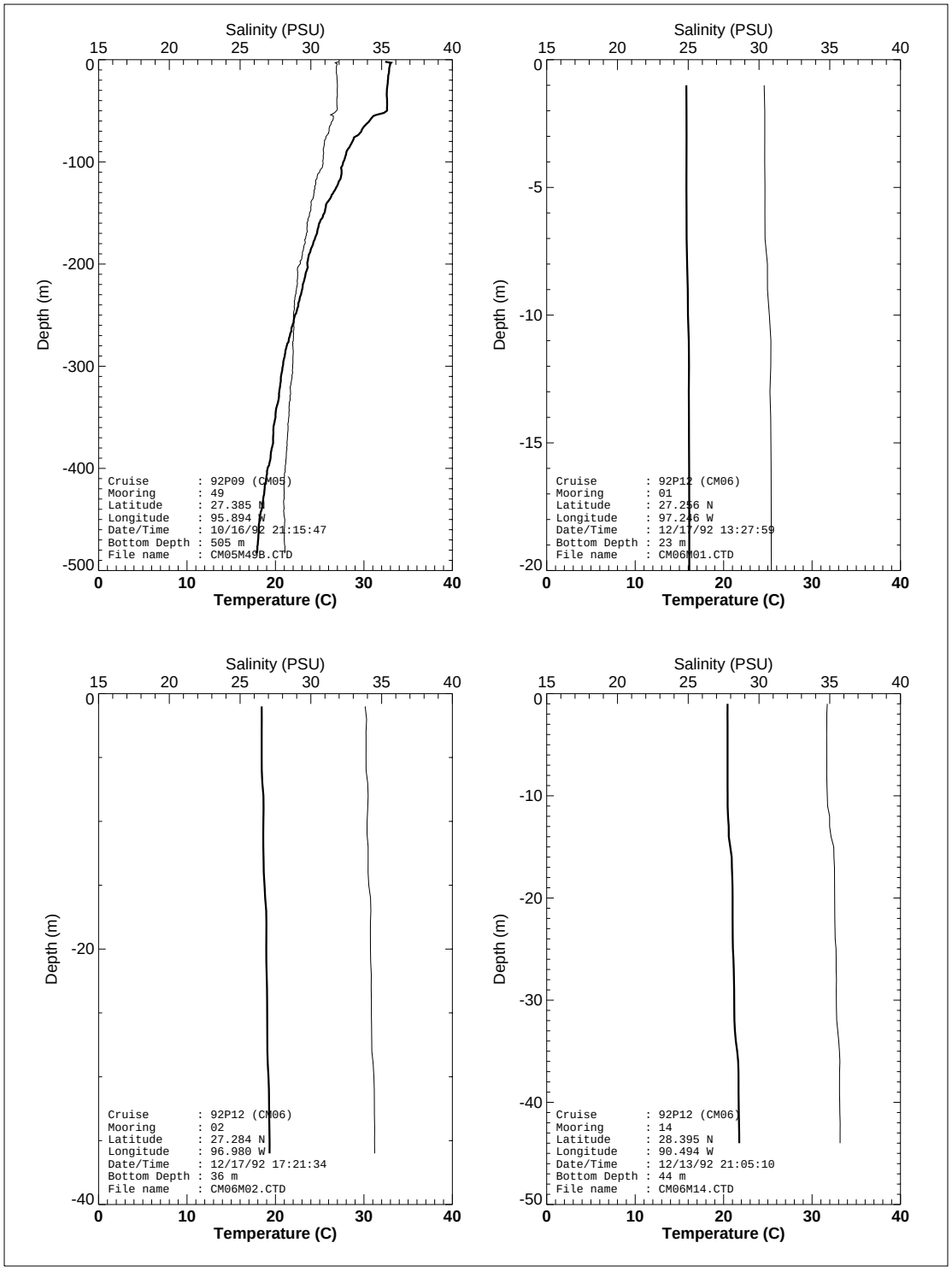

Figure 69. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

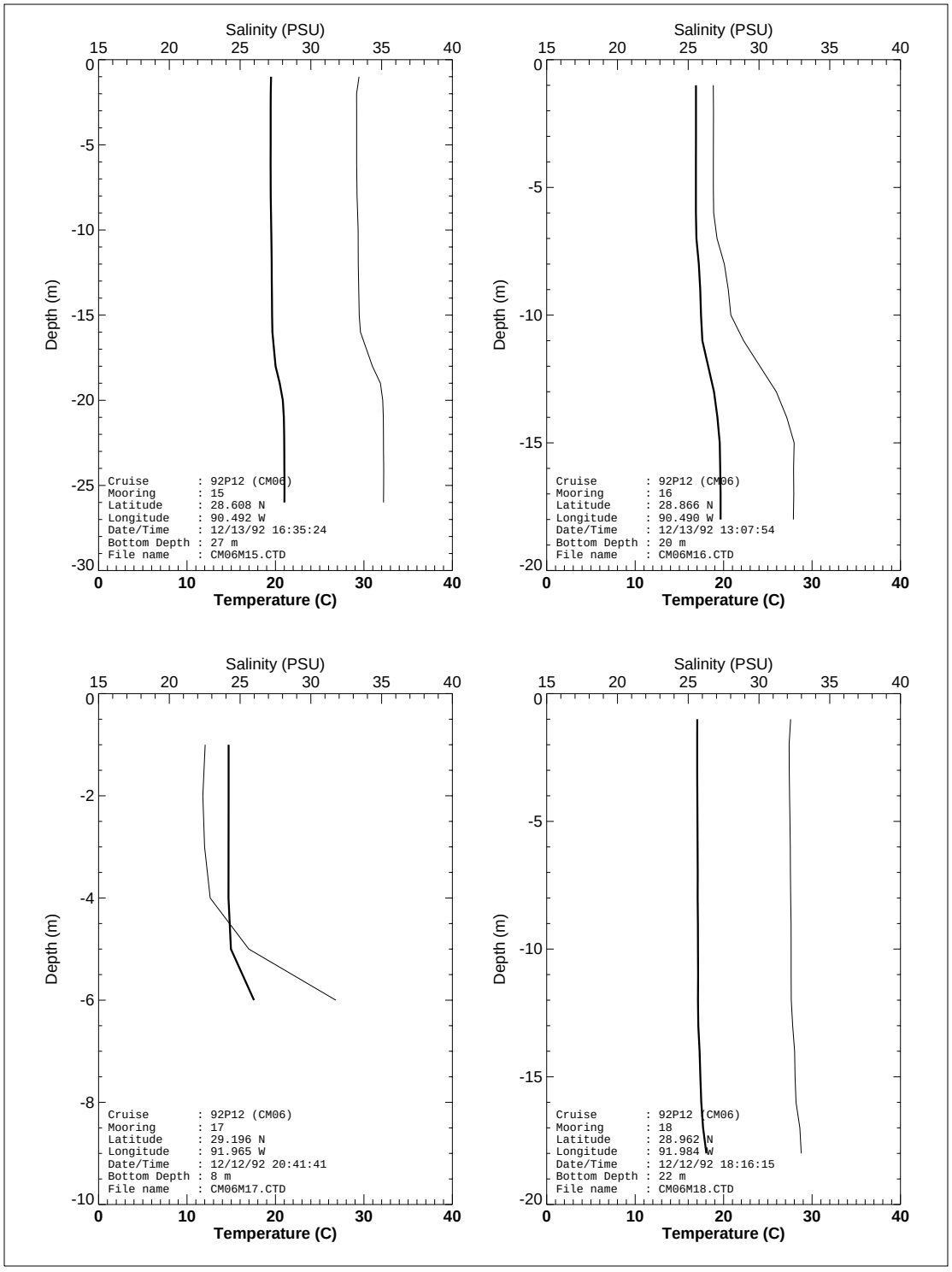

Figure 70. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

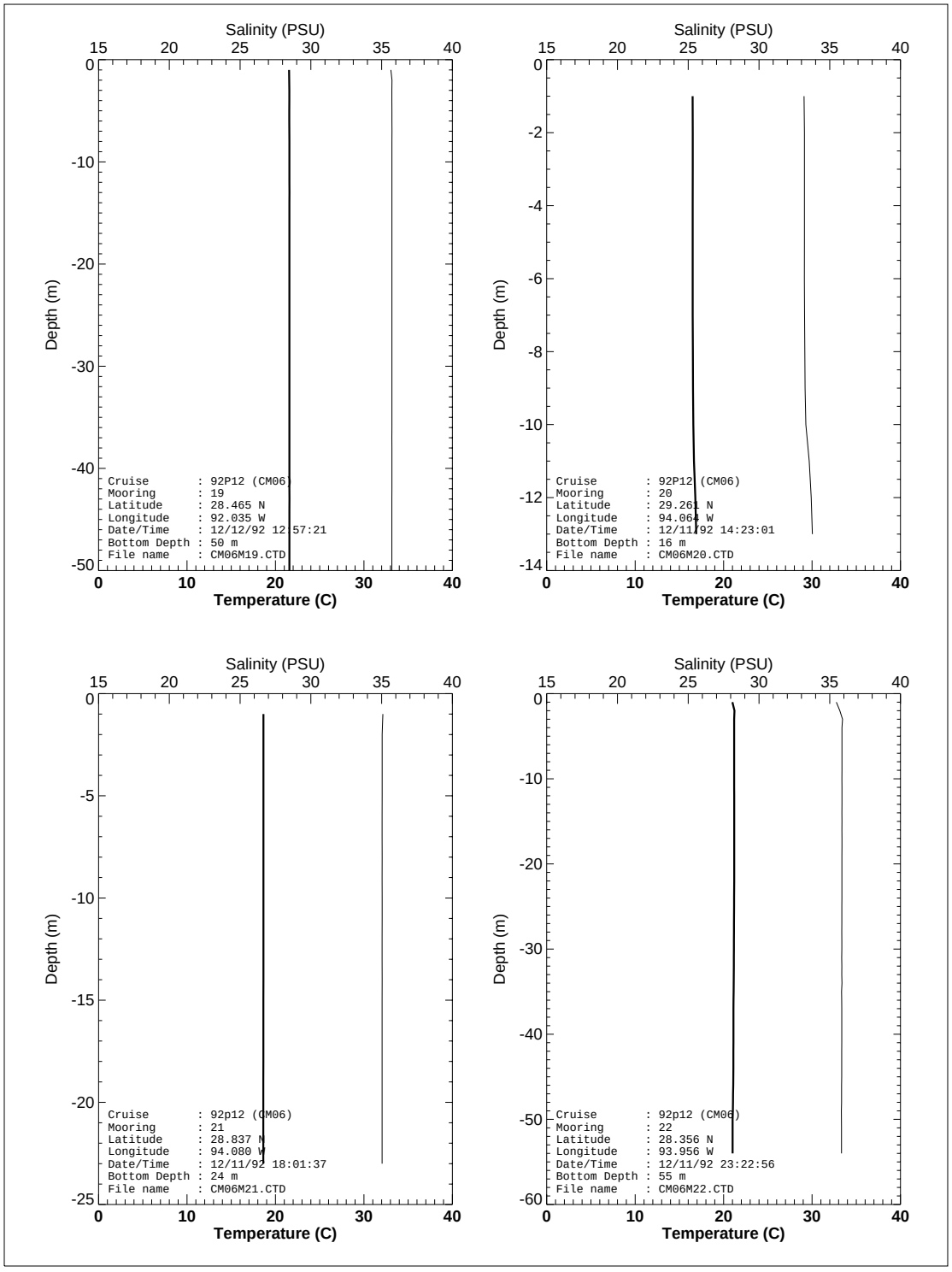

Figure 71. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

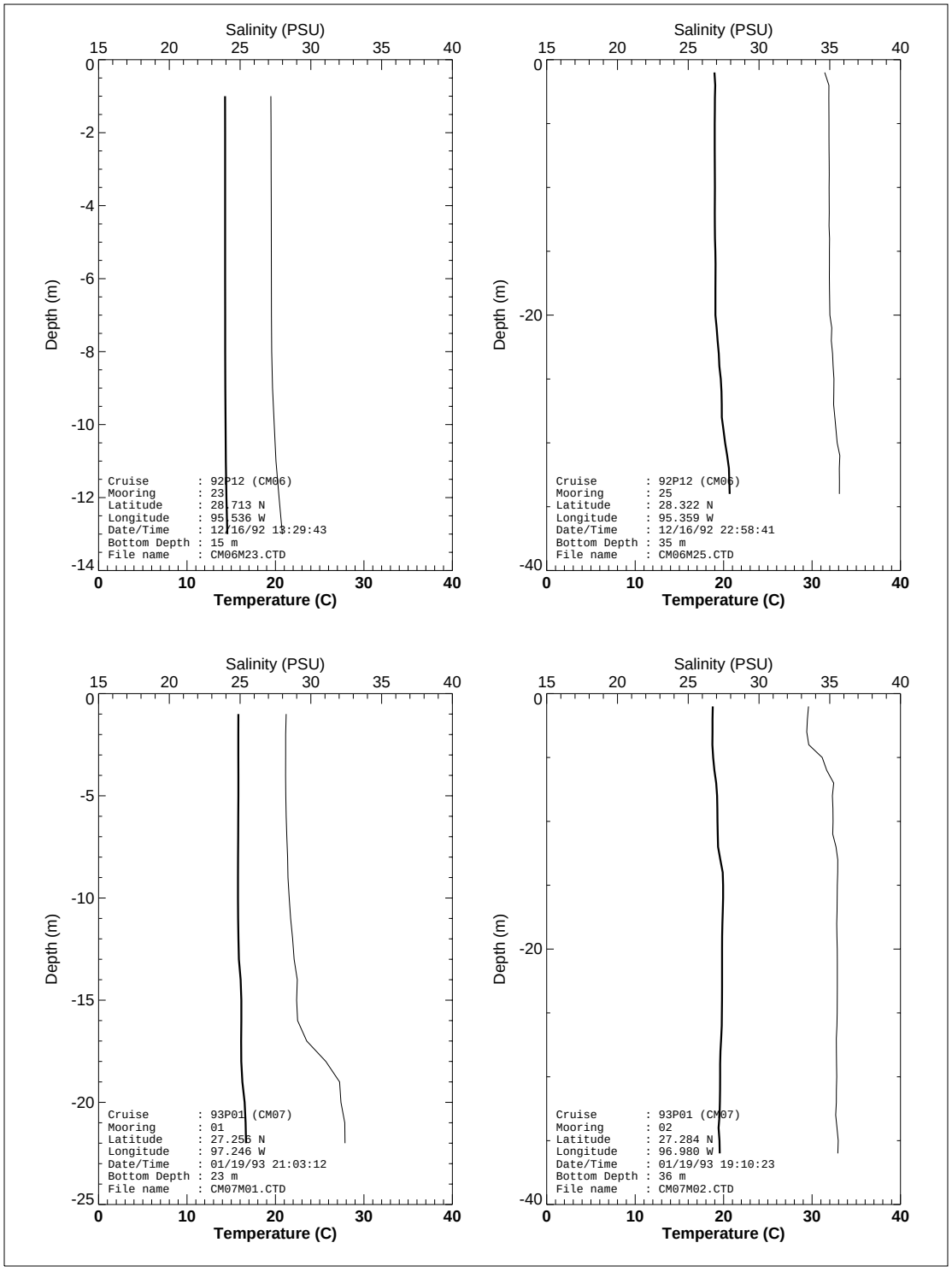

Figure 72. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

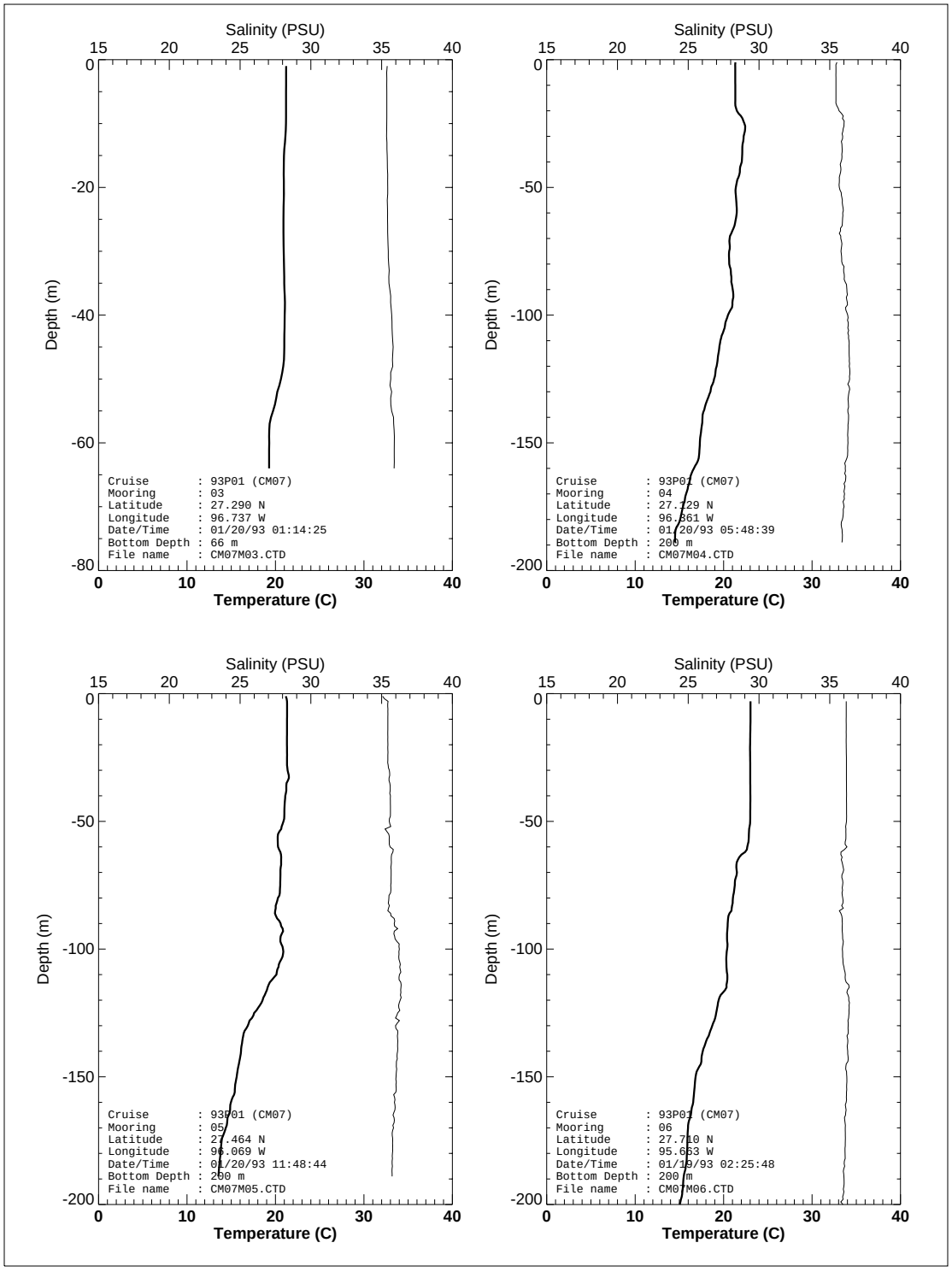

Figure 73. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

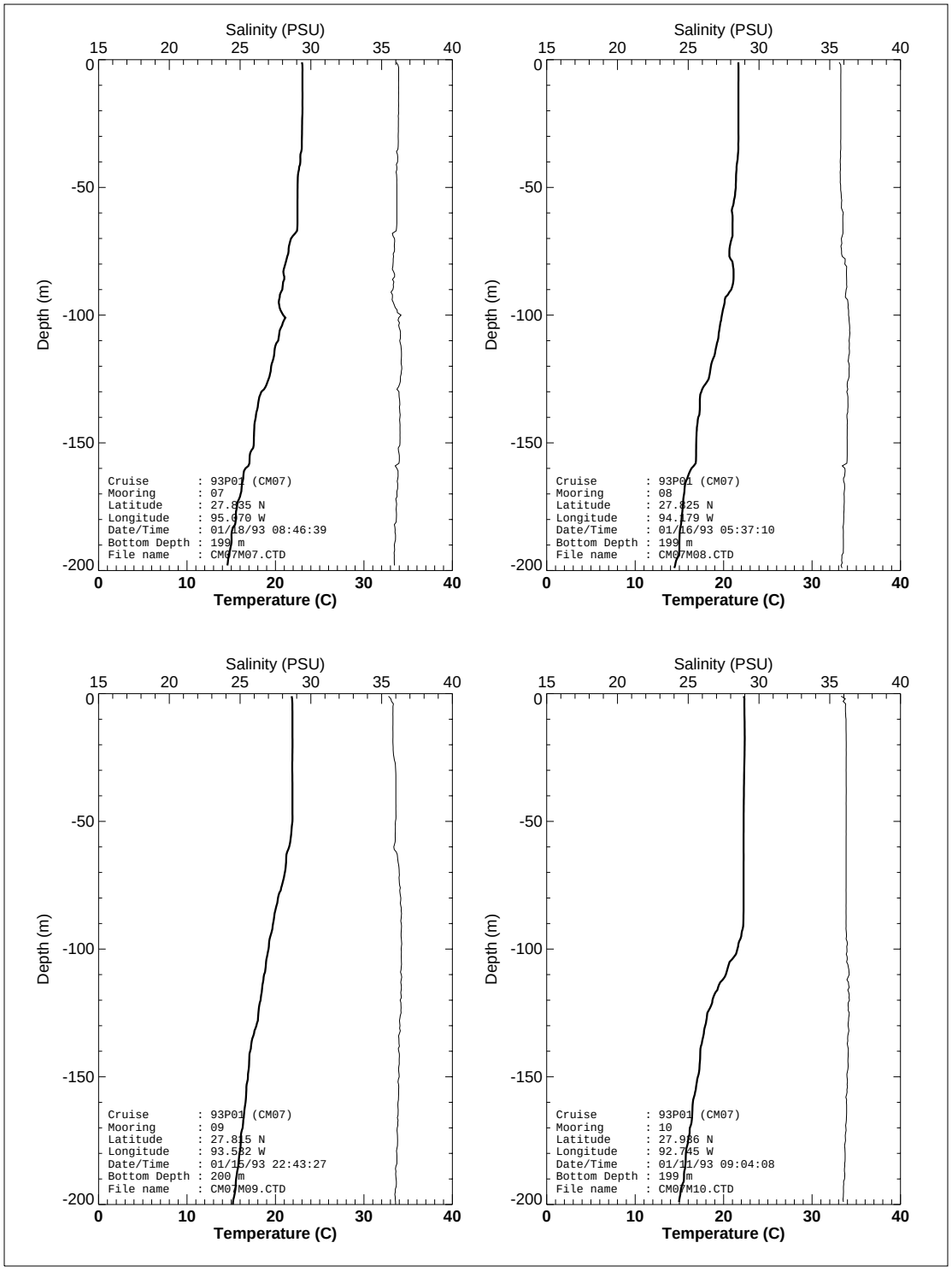

Figure 74. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

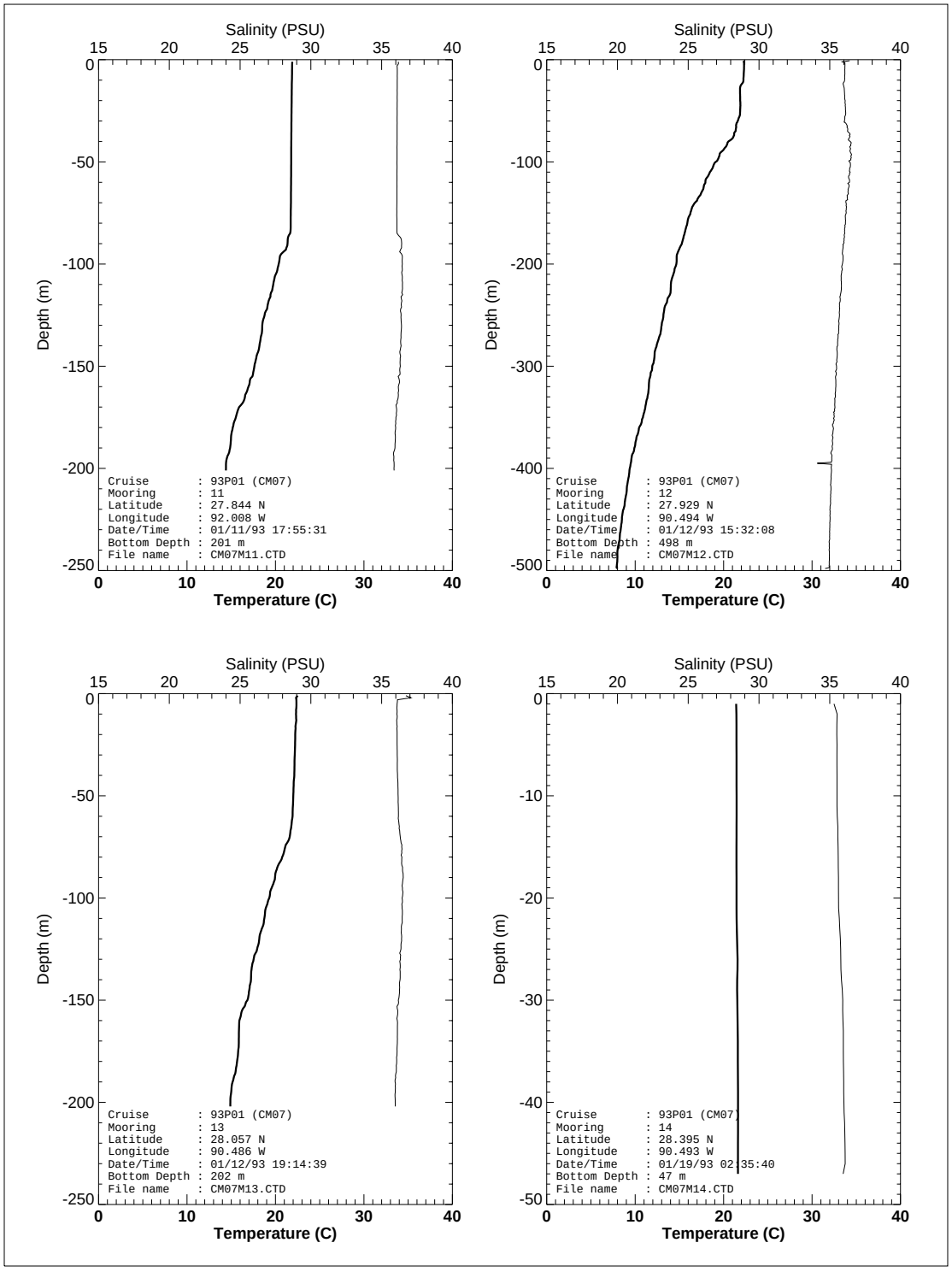

Figure 75. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

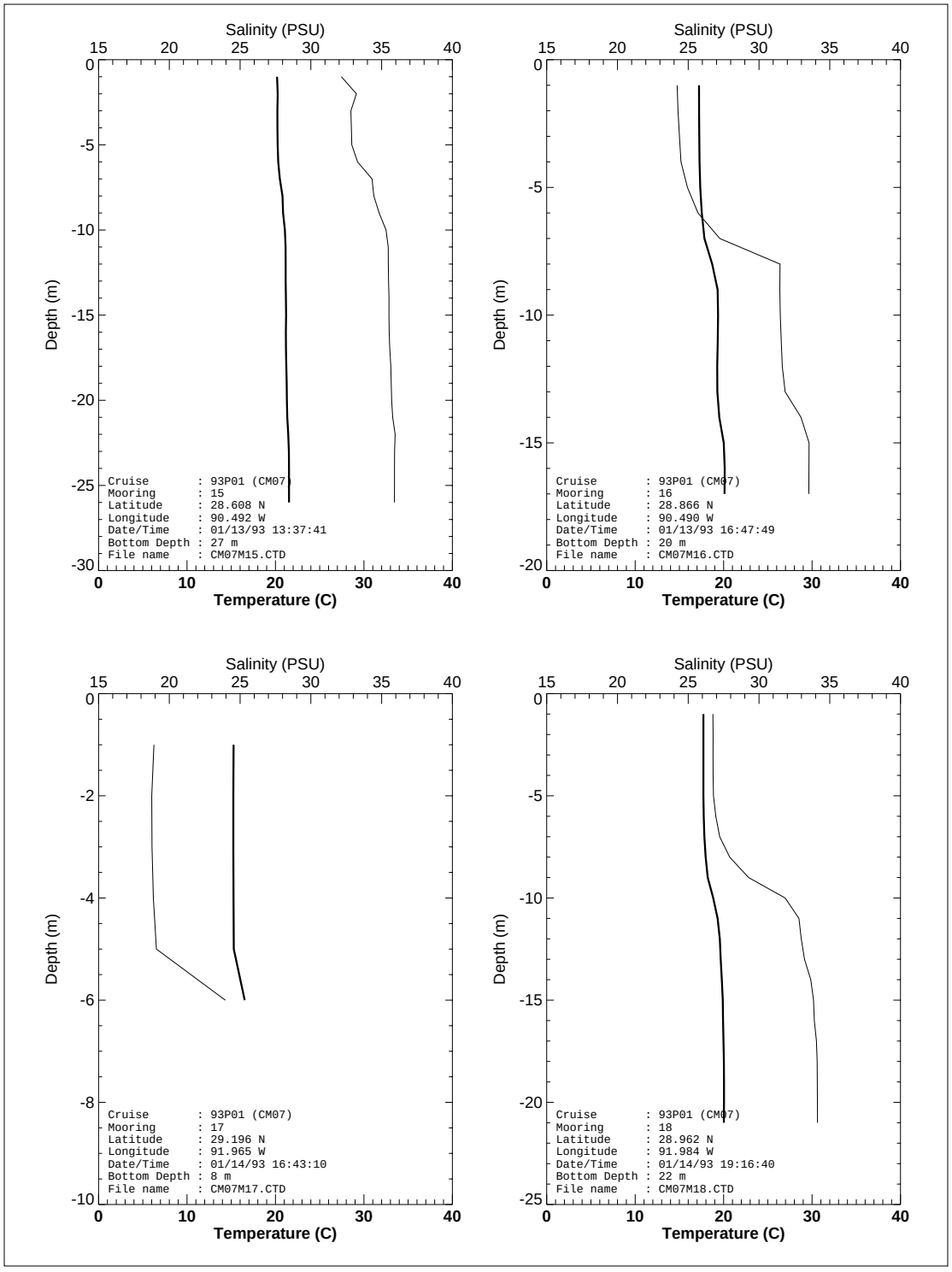

Figure 76. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

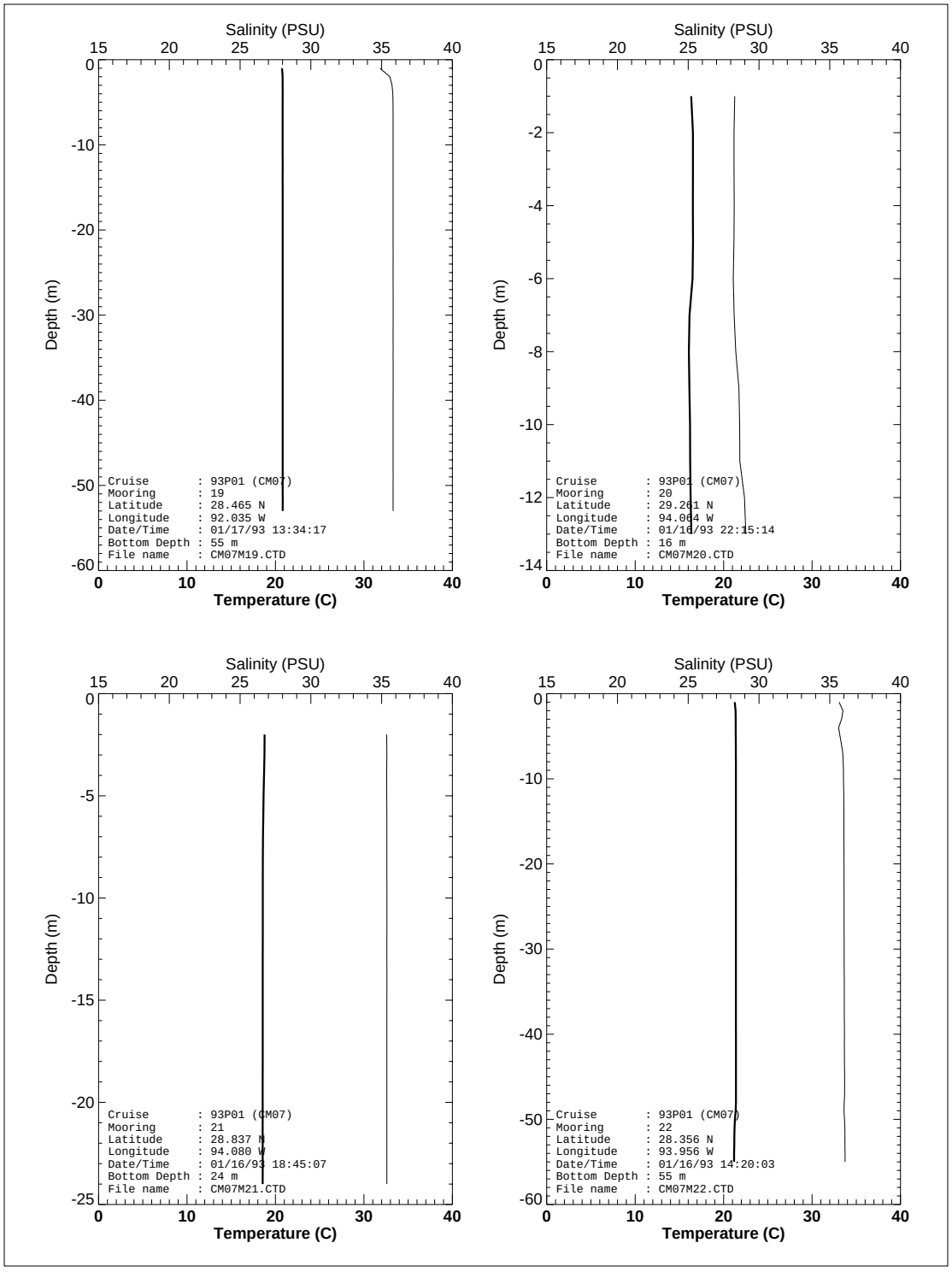

Figure 77. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

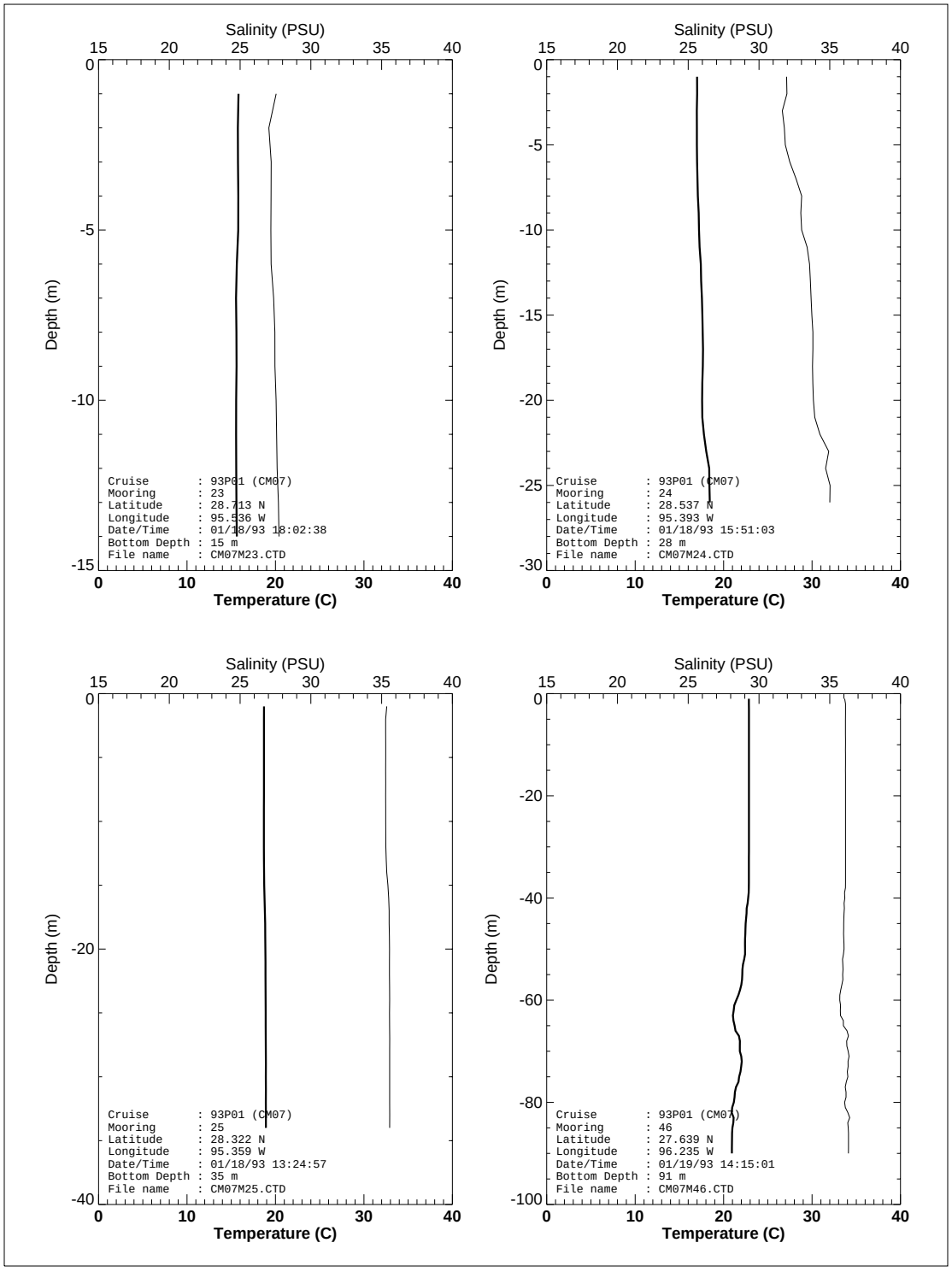

Figure 78. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

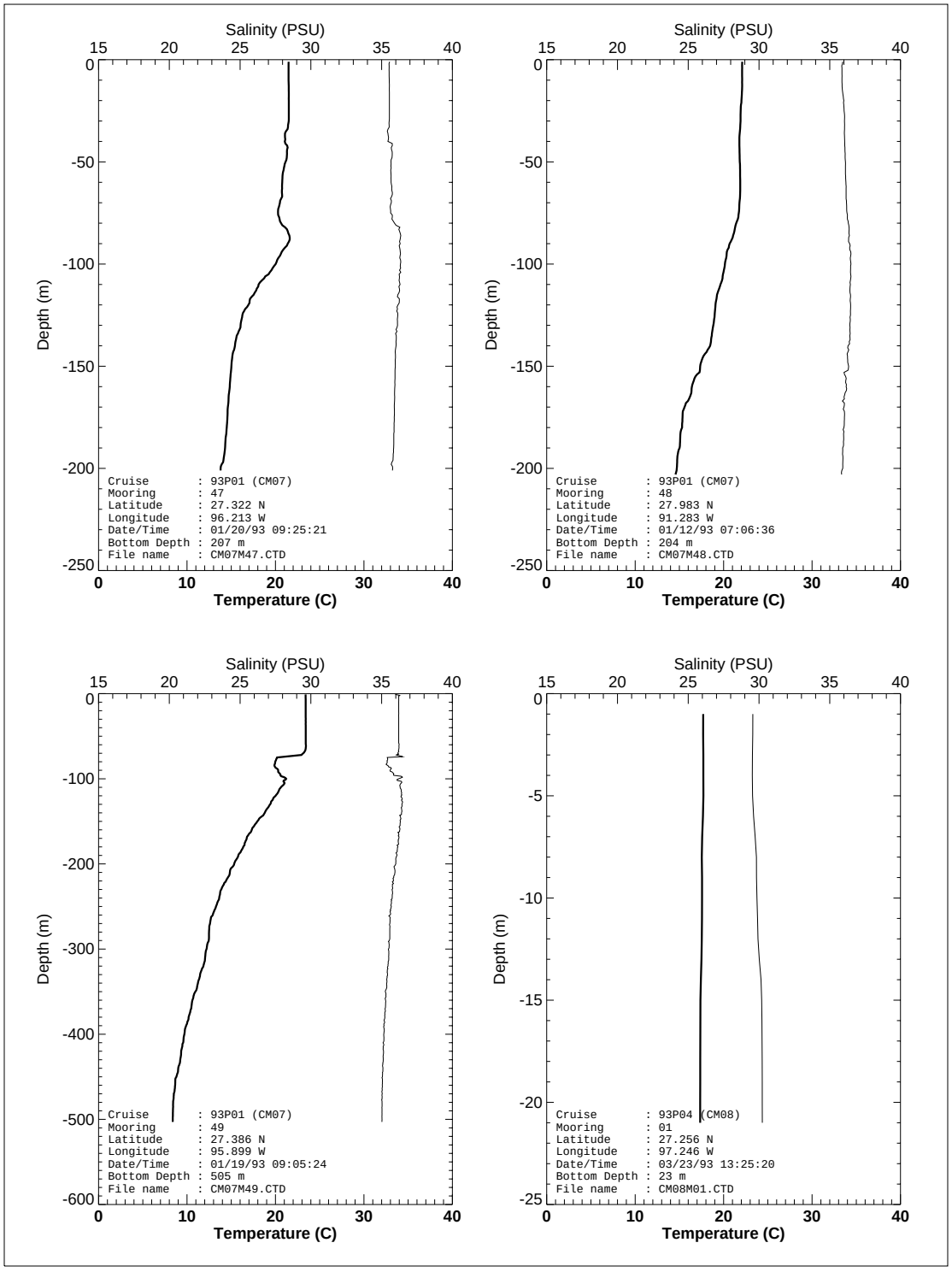

Figure 79. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

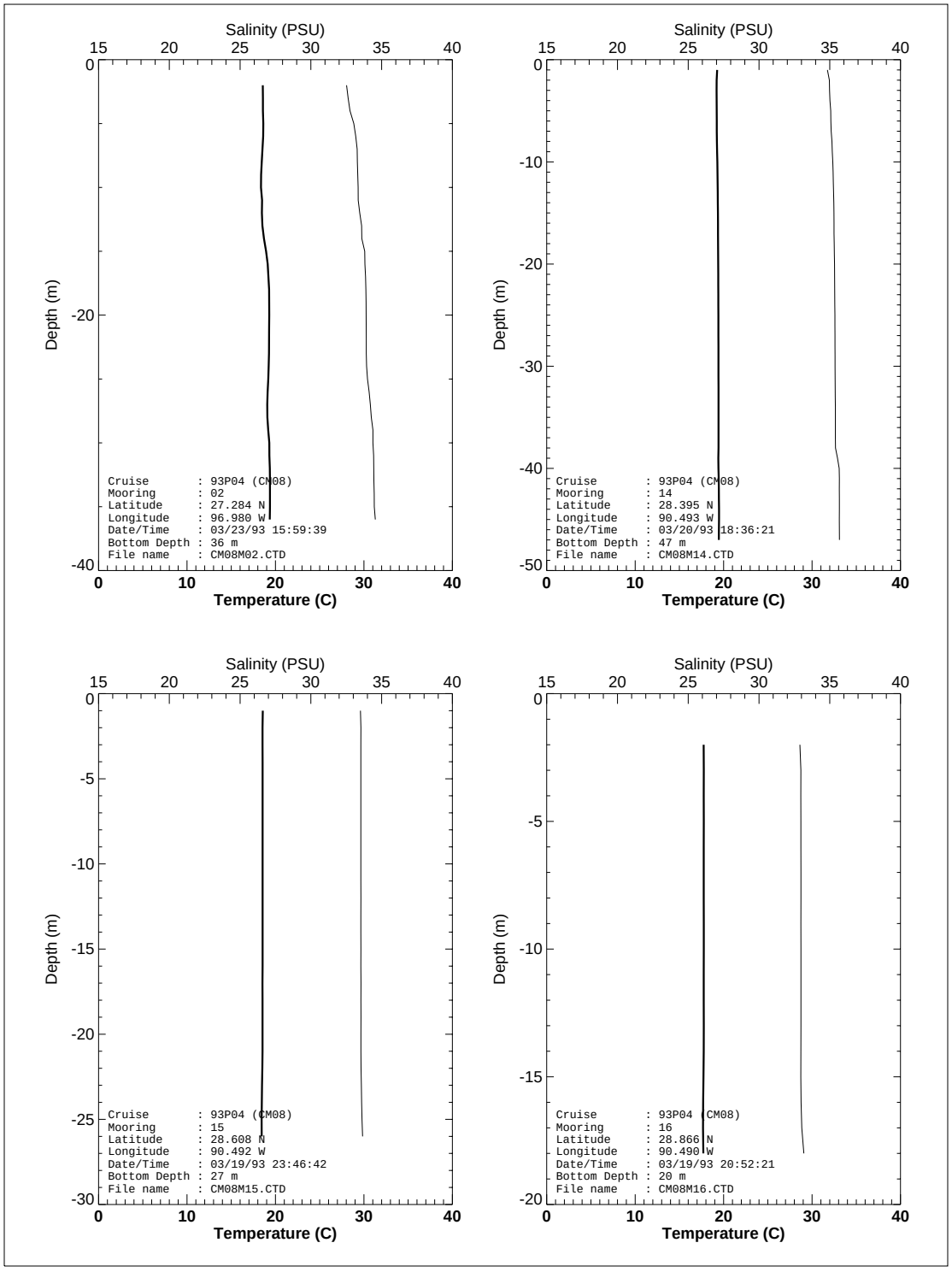

Figure 80. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

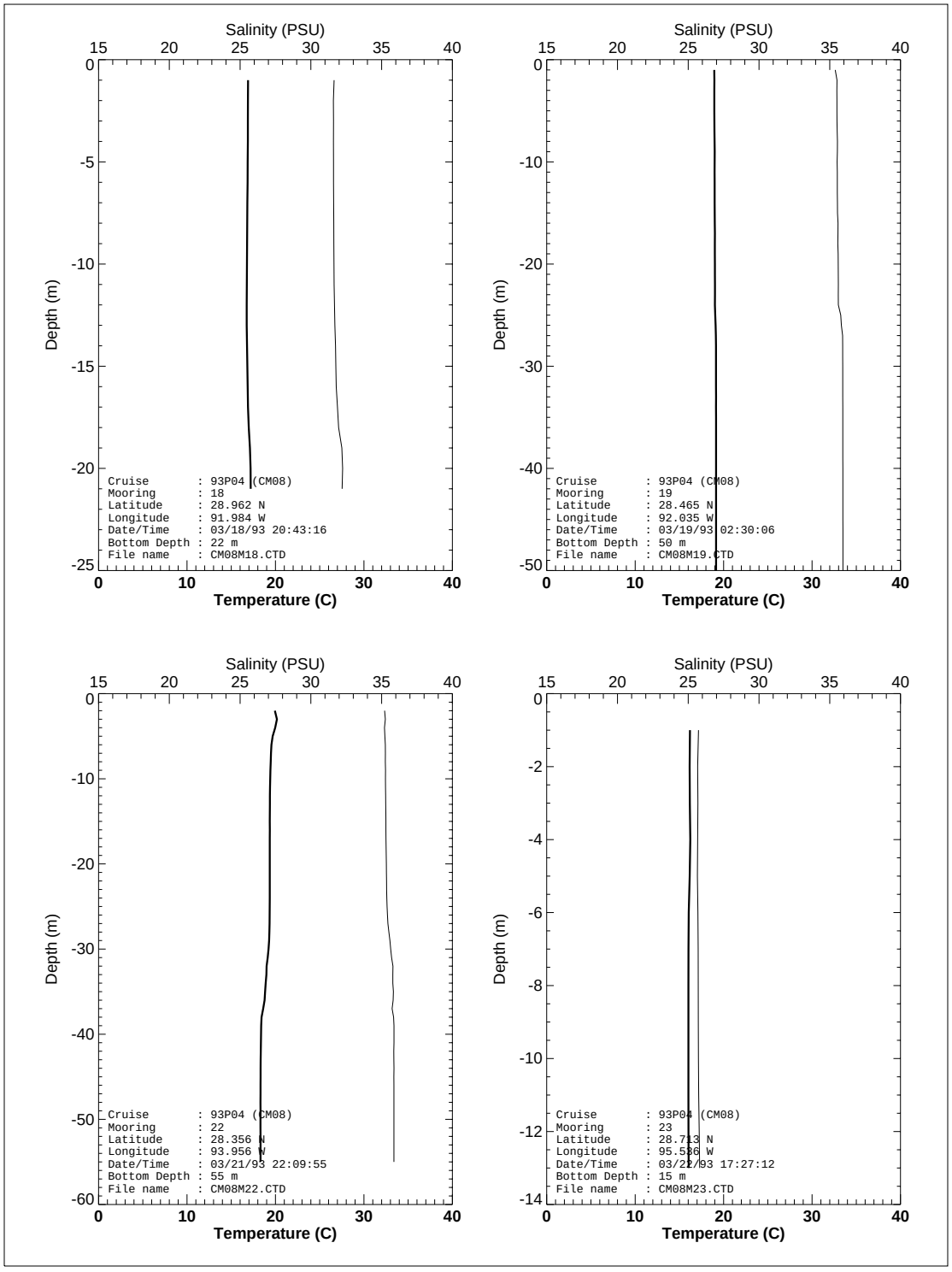

Figure 81. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

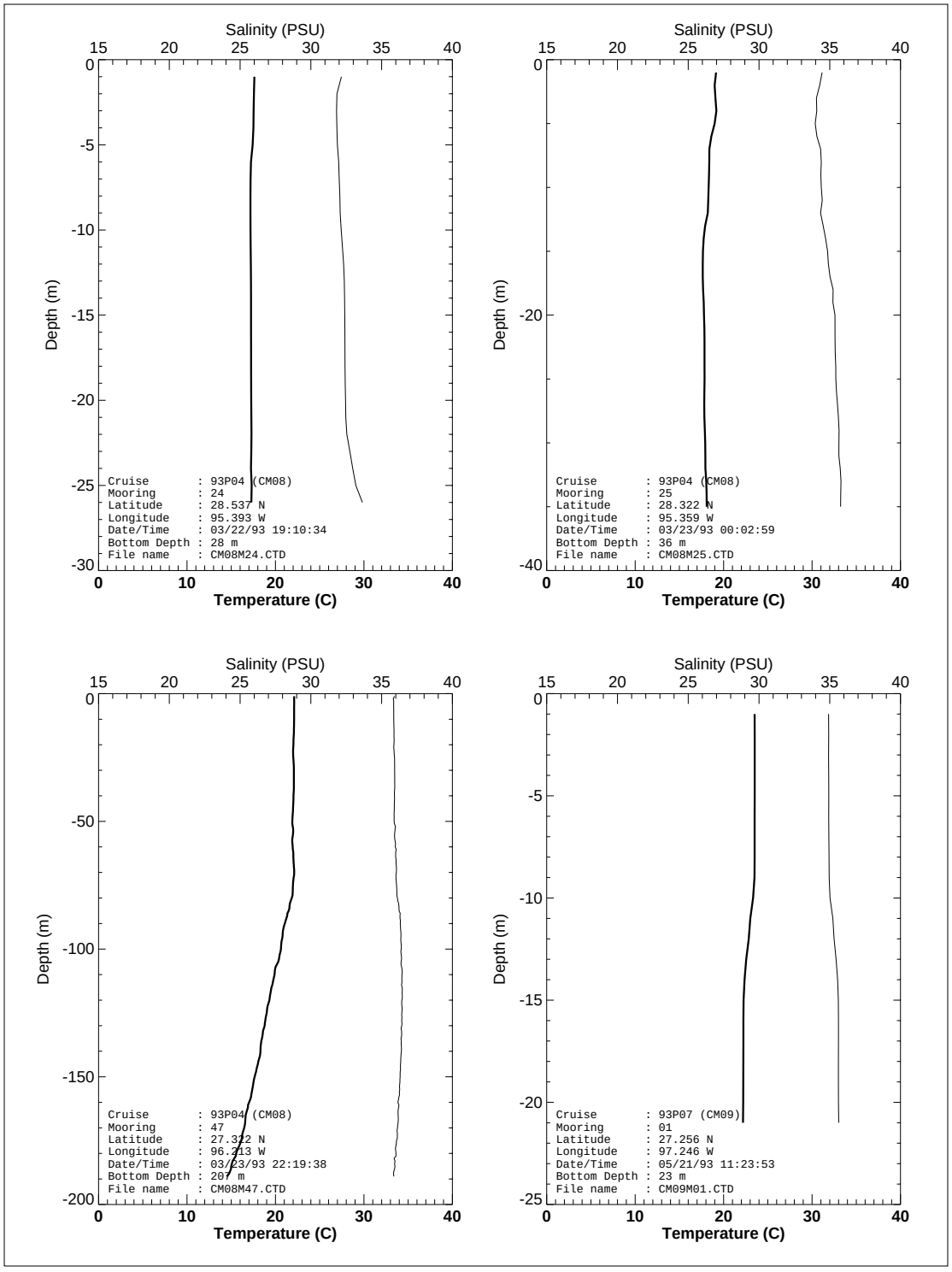

Figure 82. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

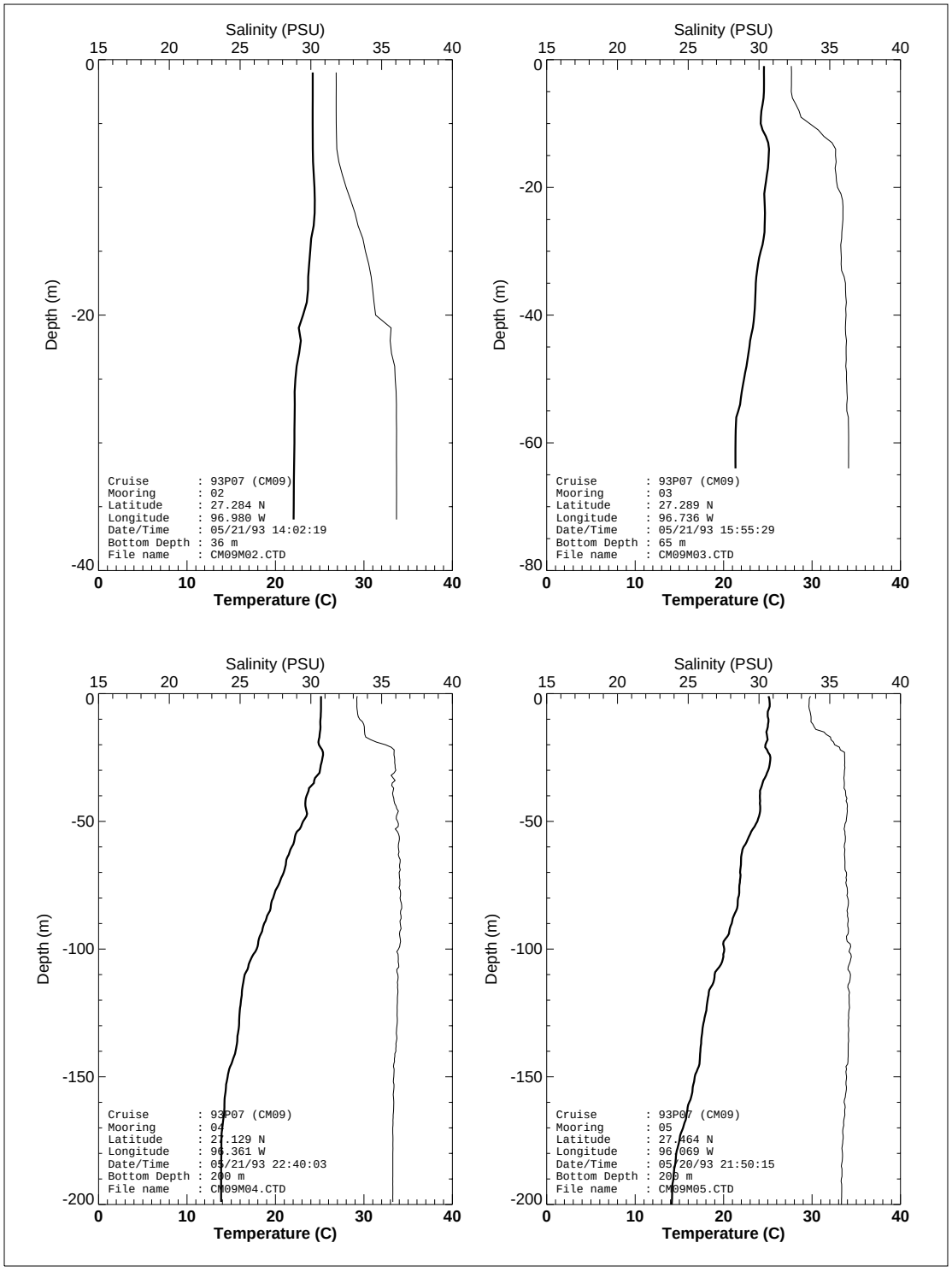

Figure 83. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

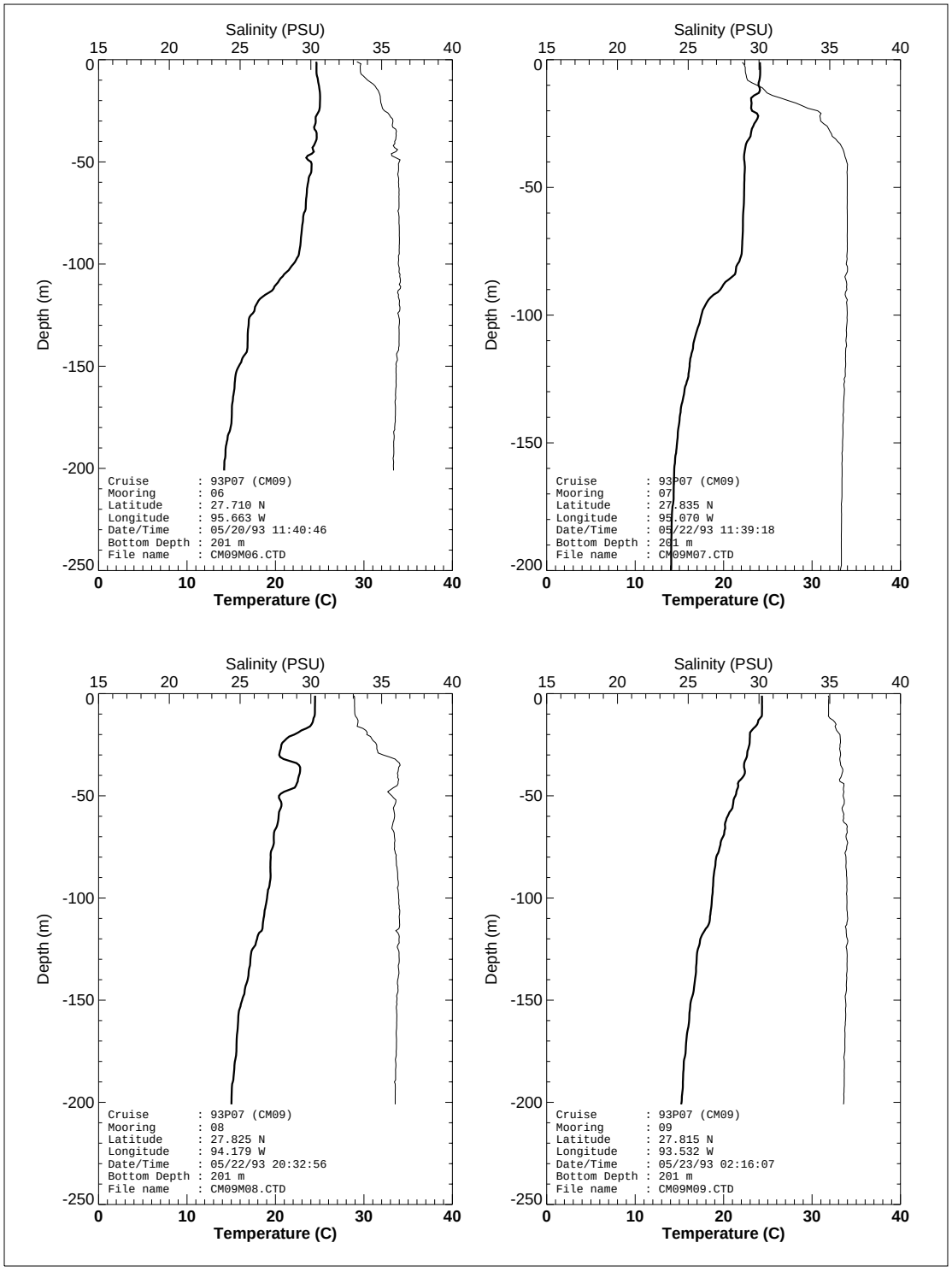

Figure 84. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

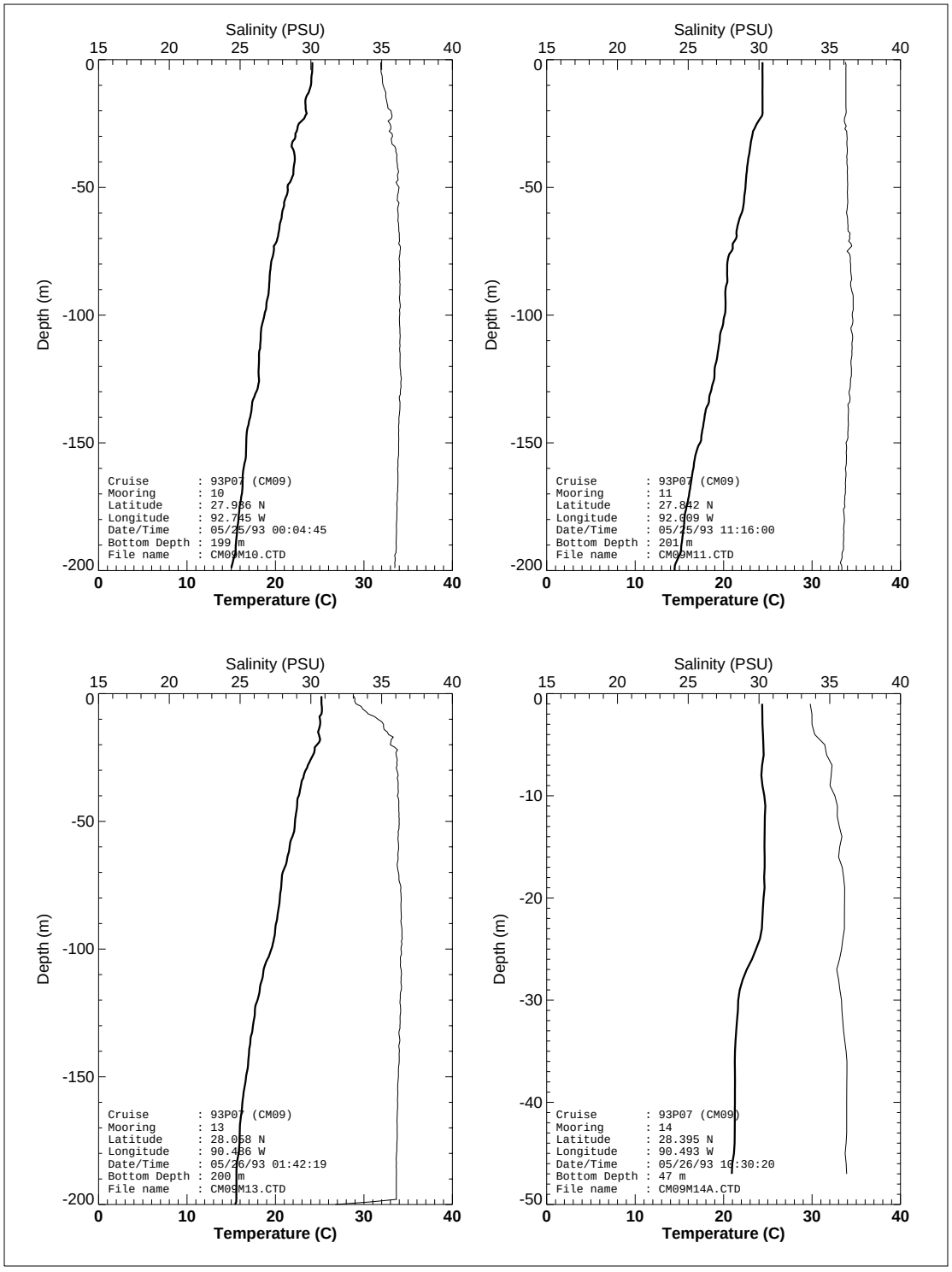

Figure 85. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

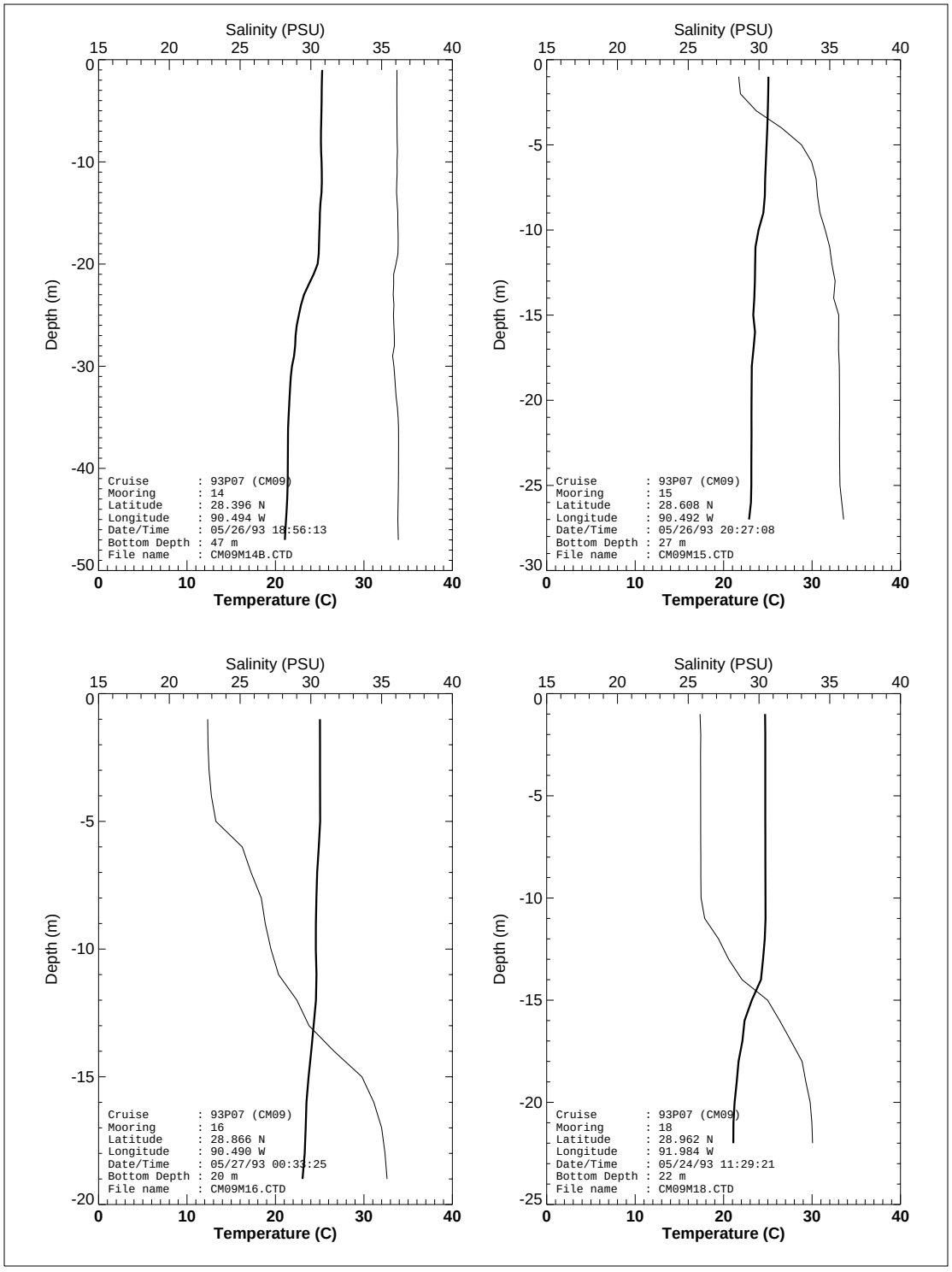

Figure 86. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

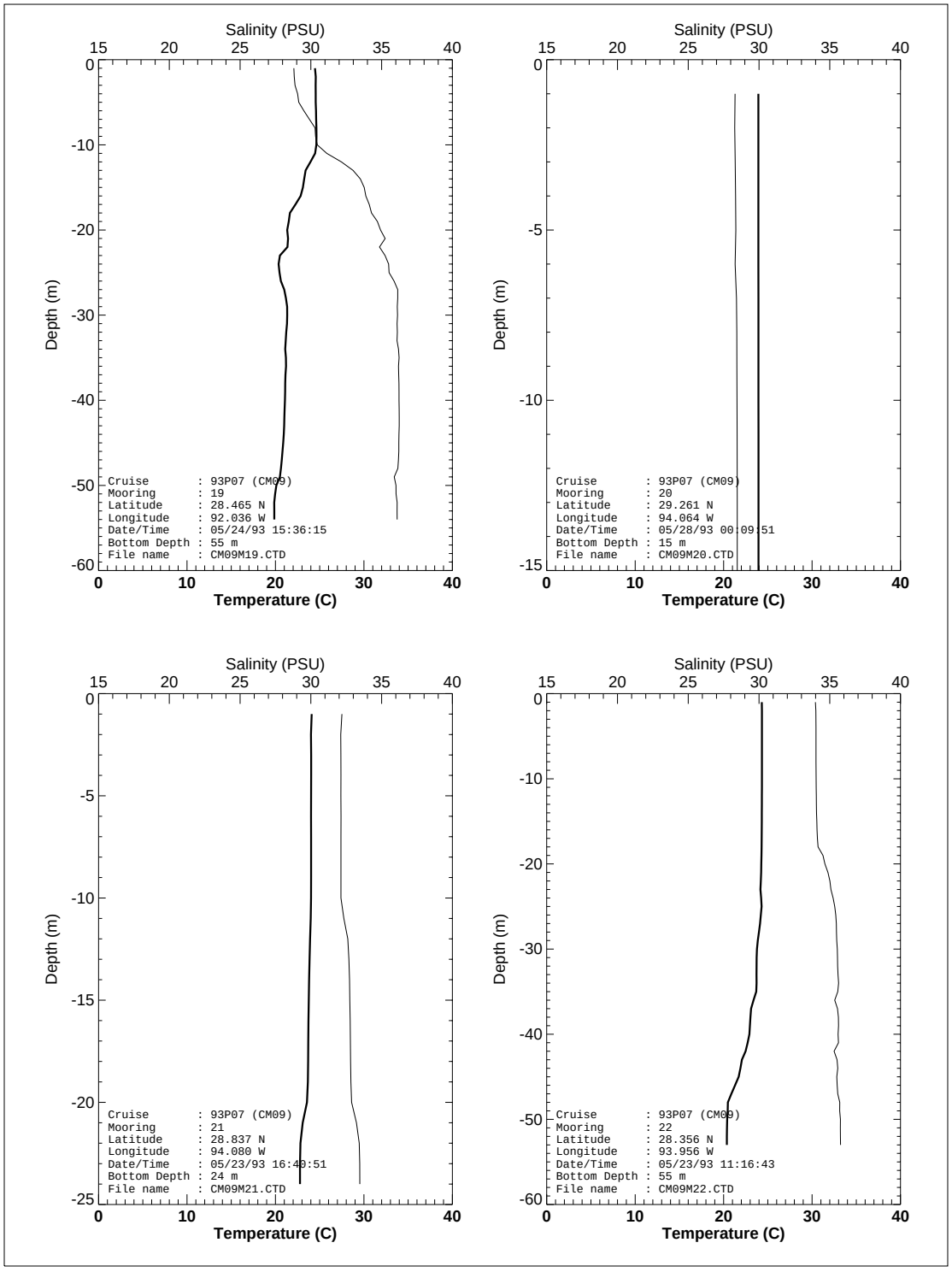

Figure 87. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

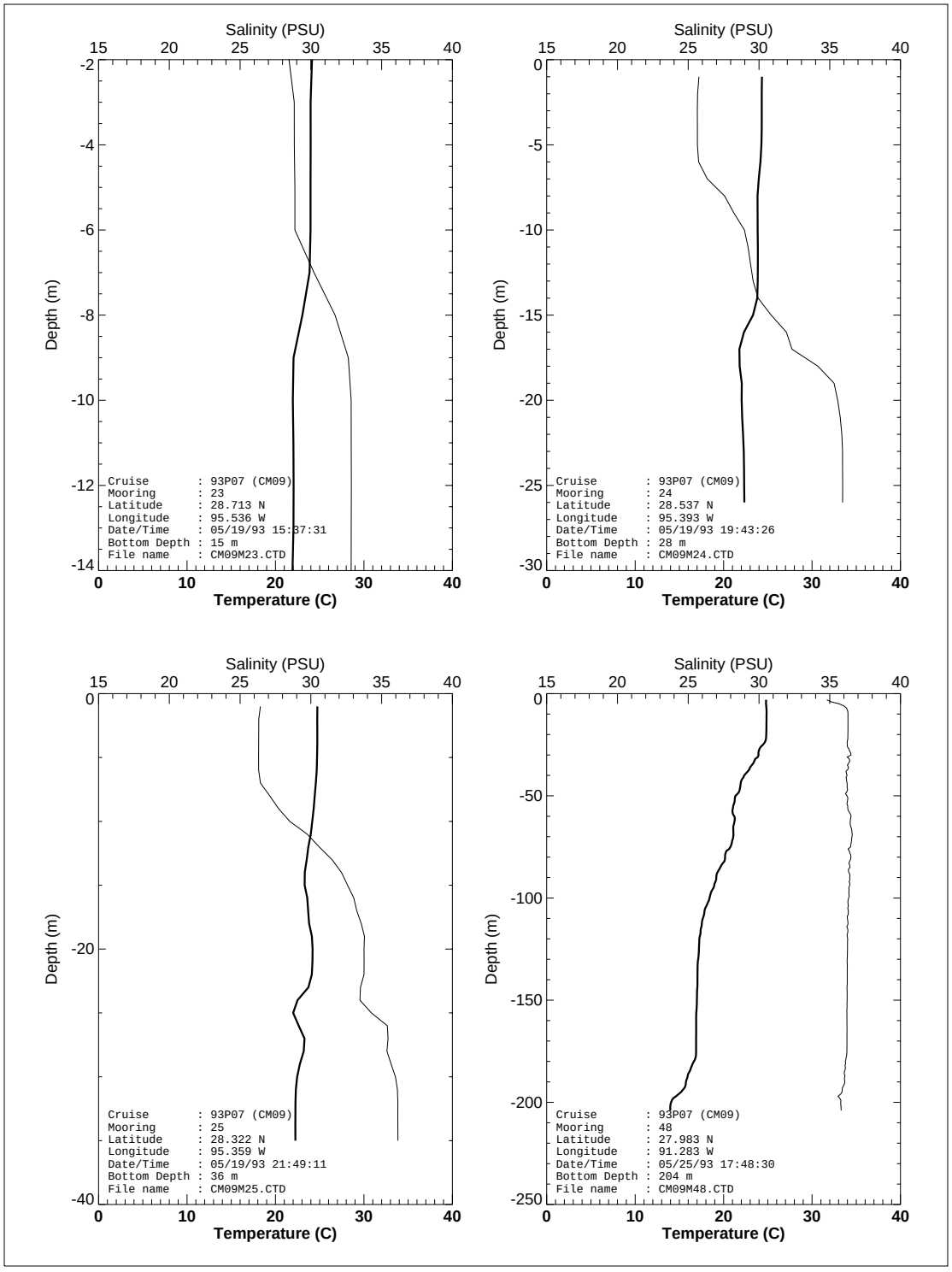

Figure 88. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

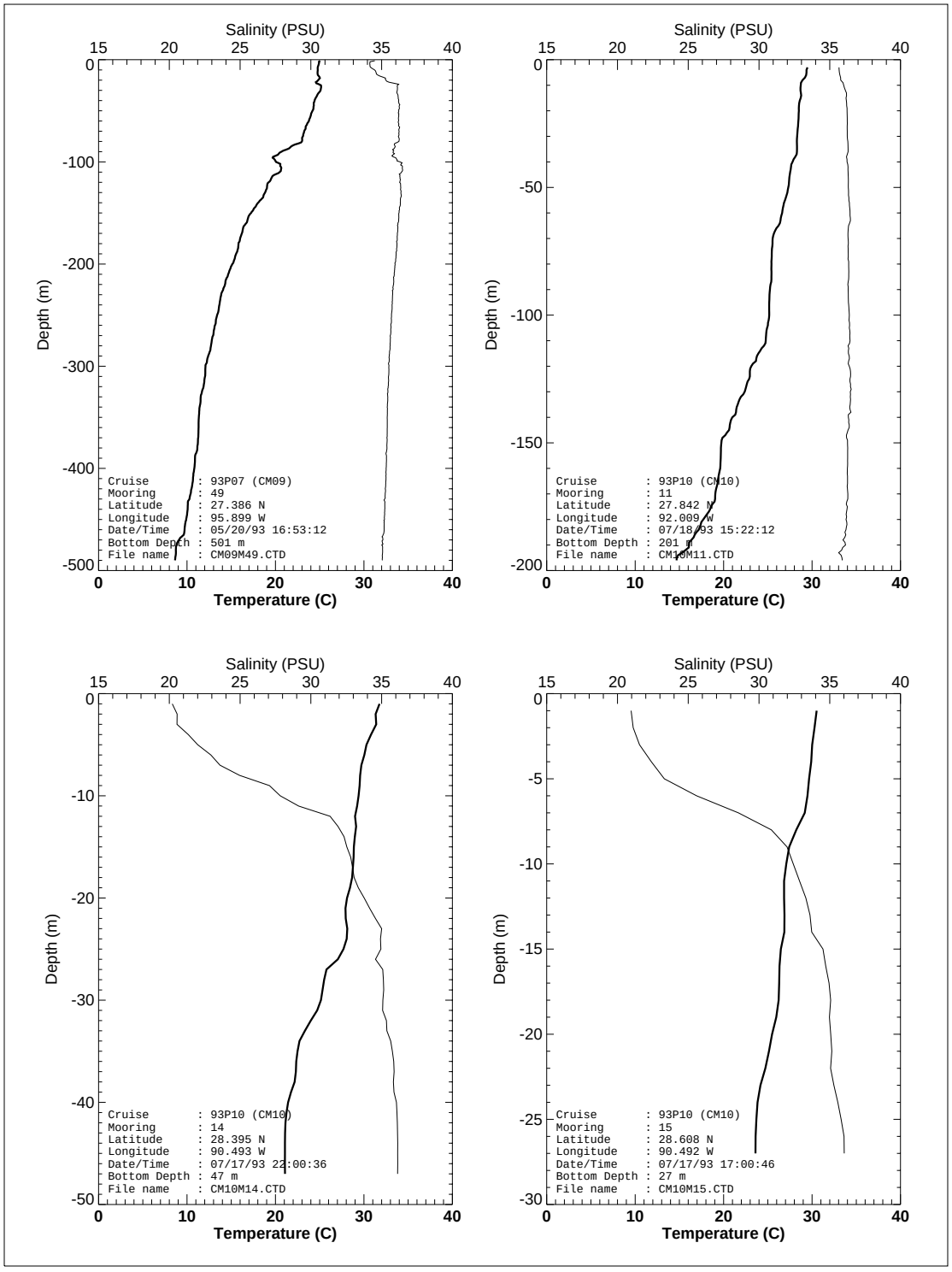

Figure 89. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

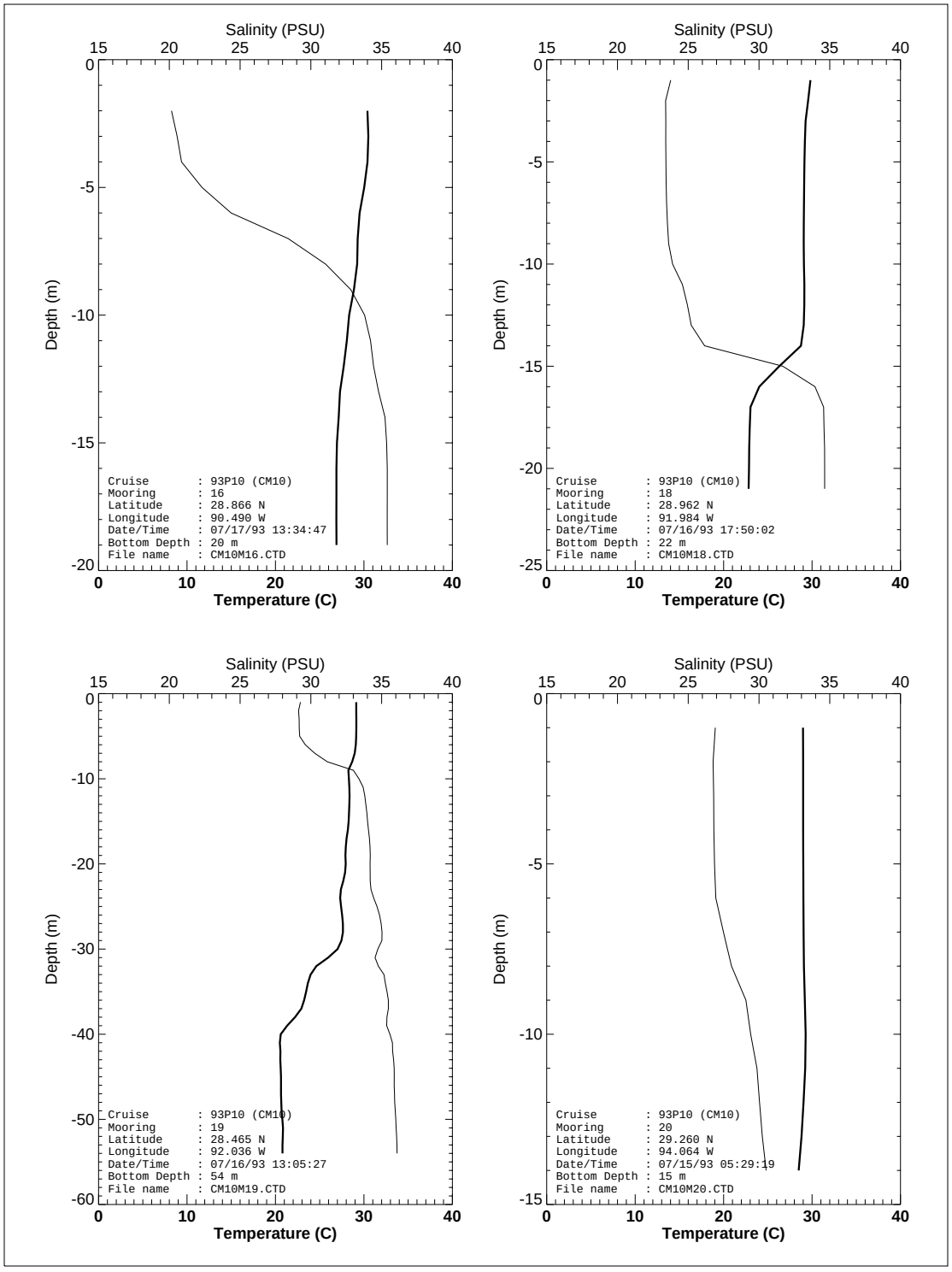

Figure 90. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

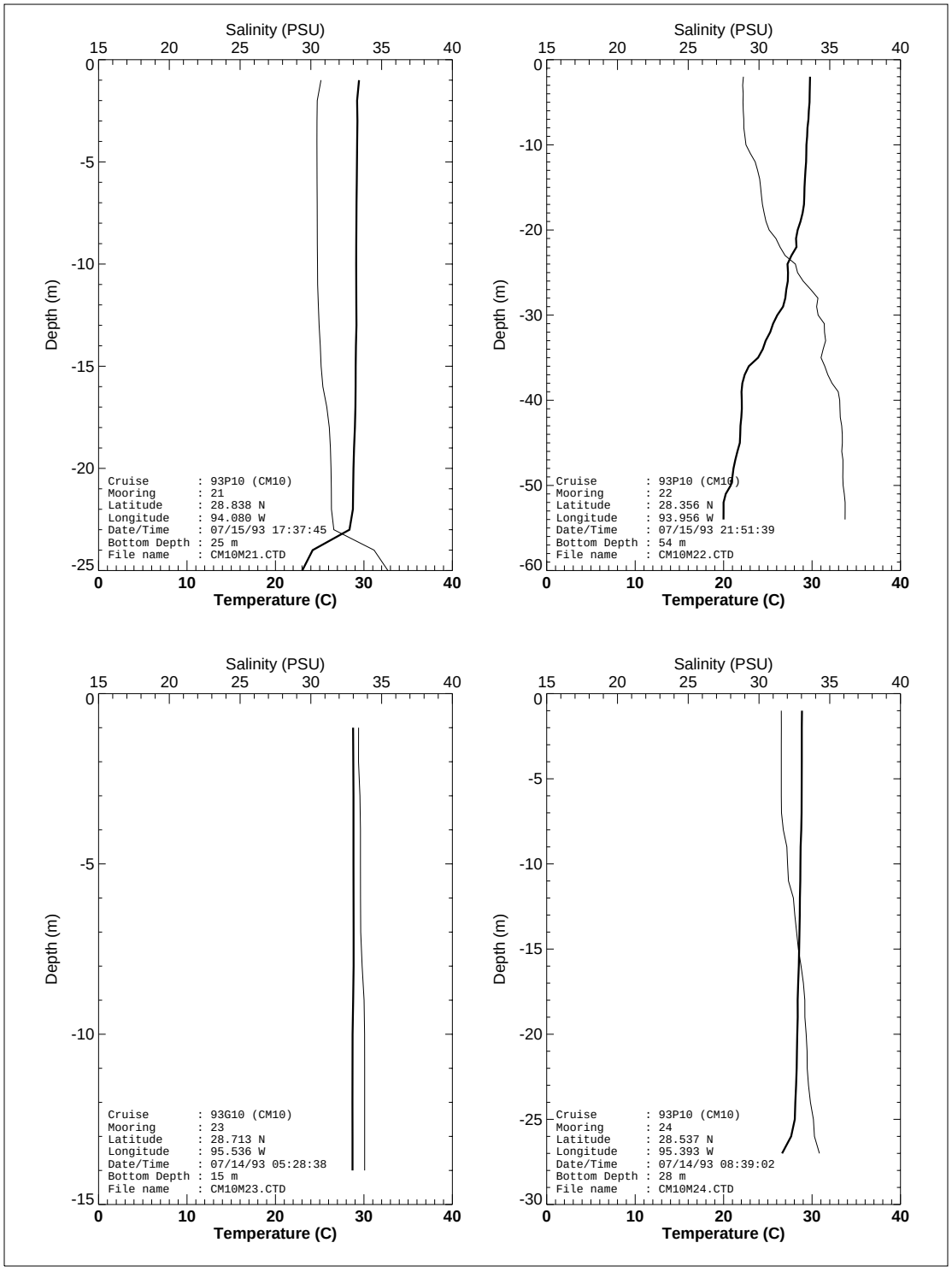

Figure 91. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

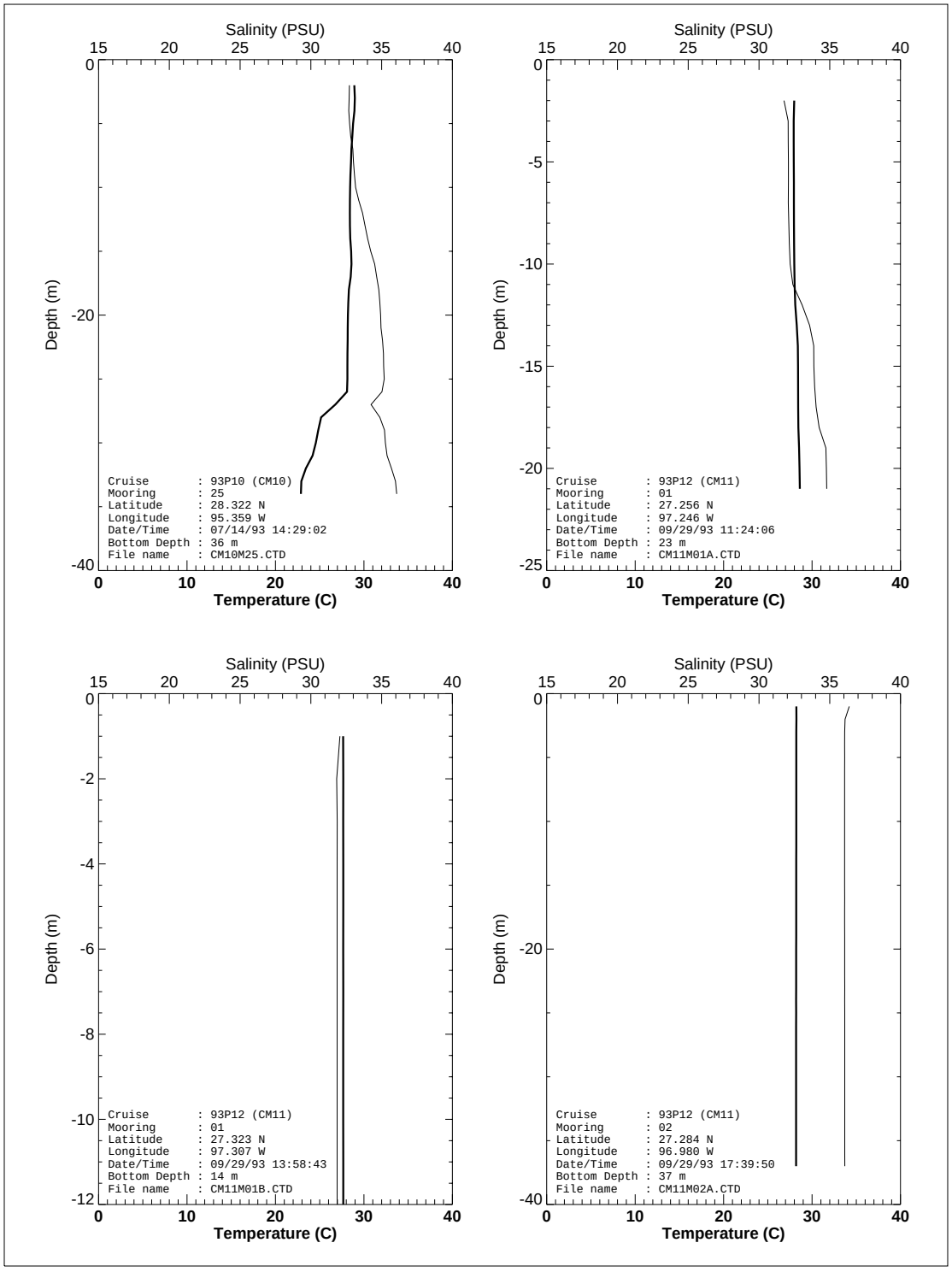

Figure 92. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

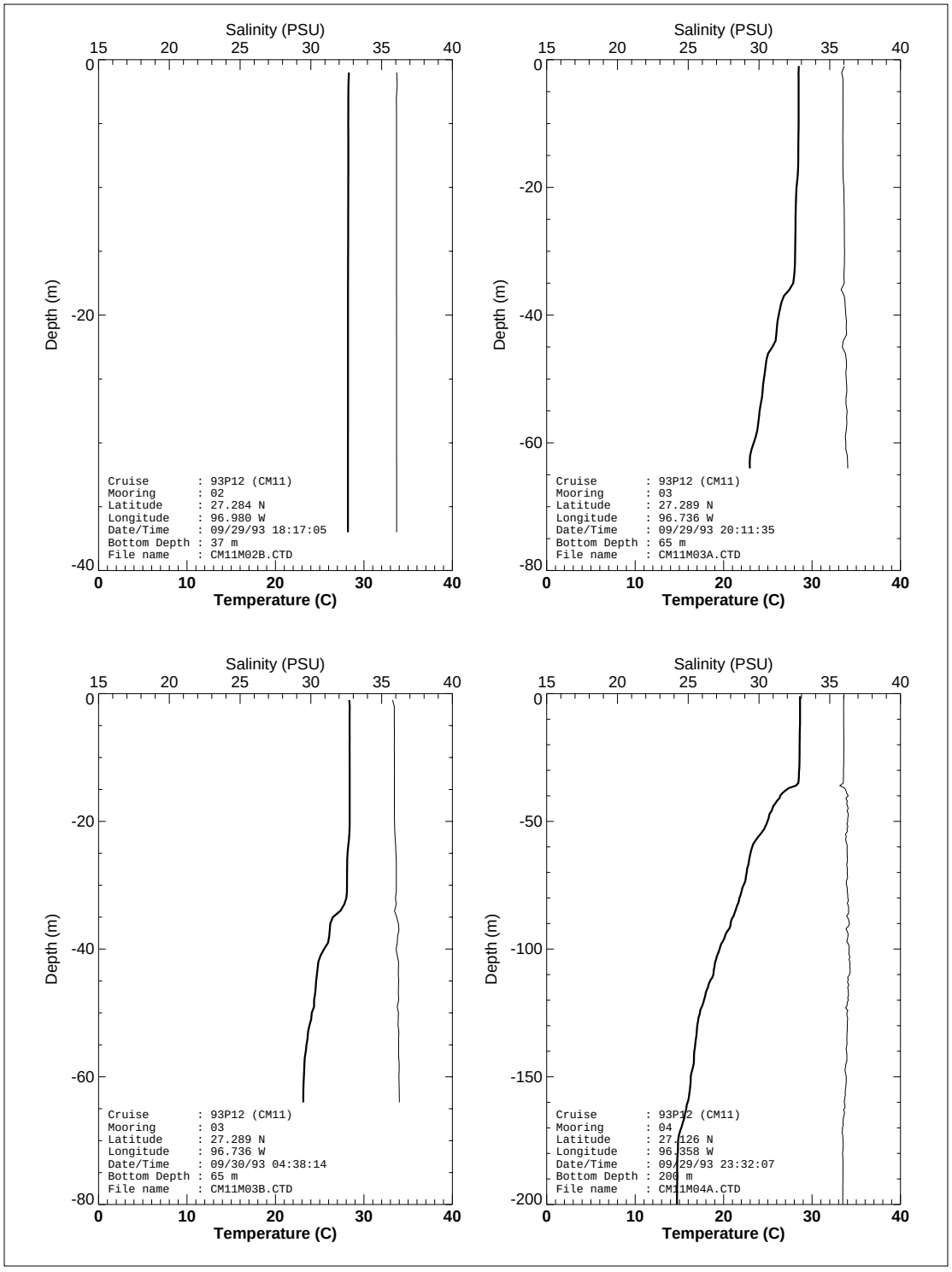

Figure 93. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

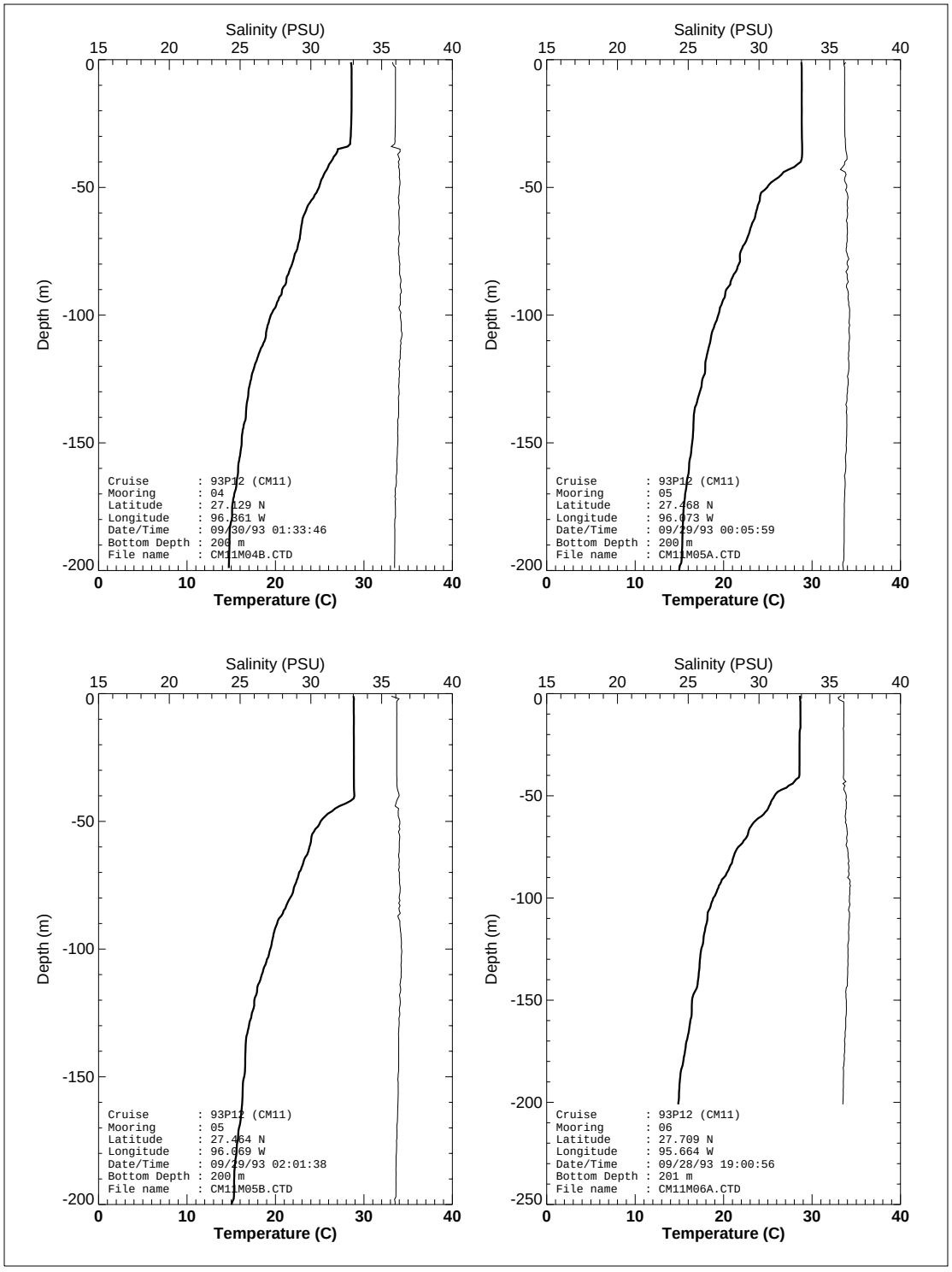

Figure 94. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

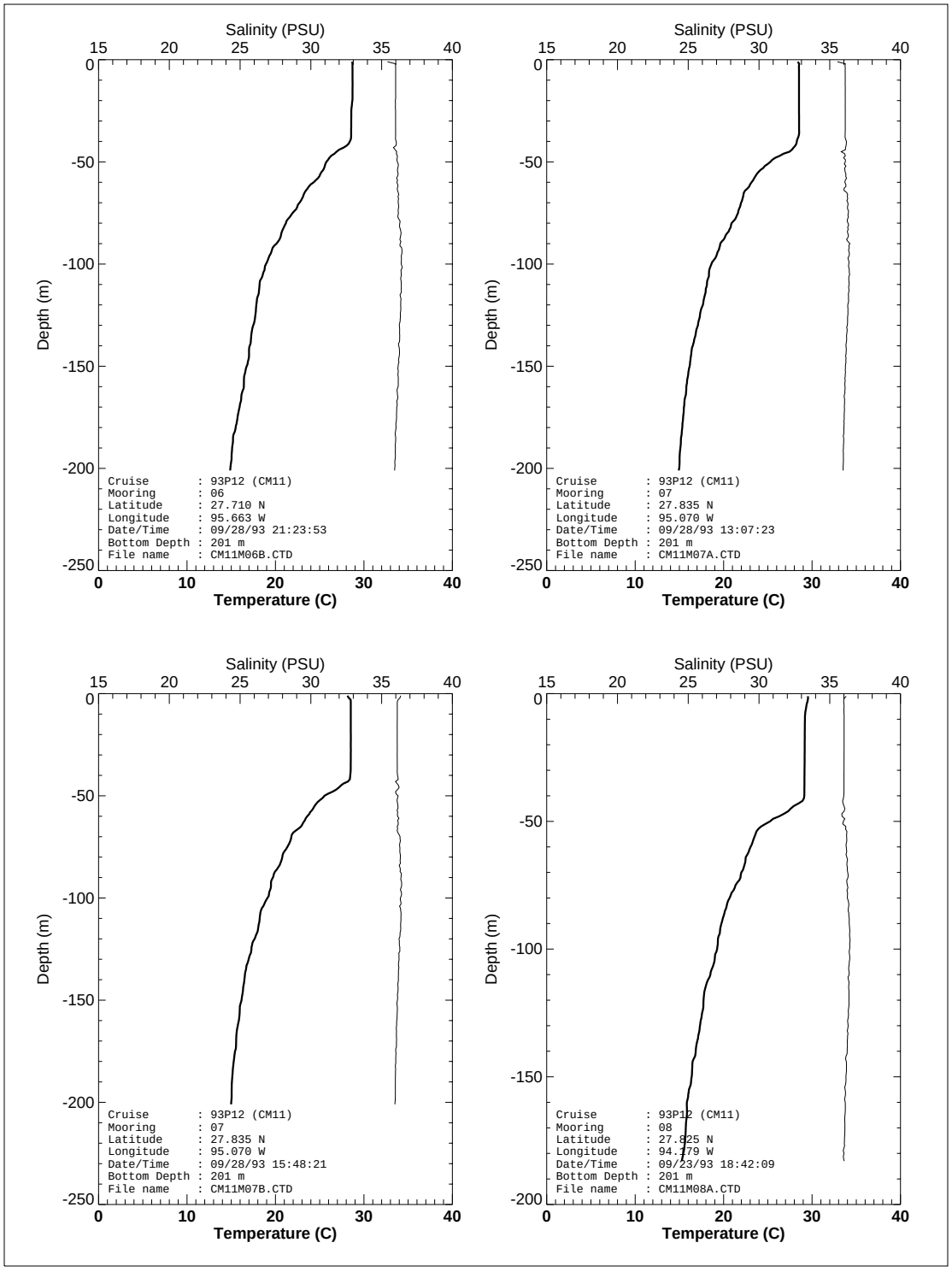

Figure 95. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

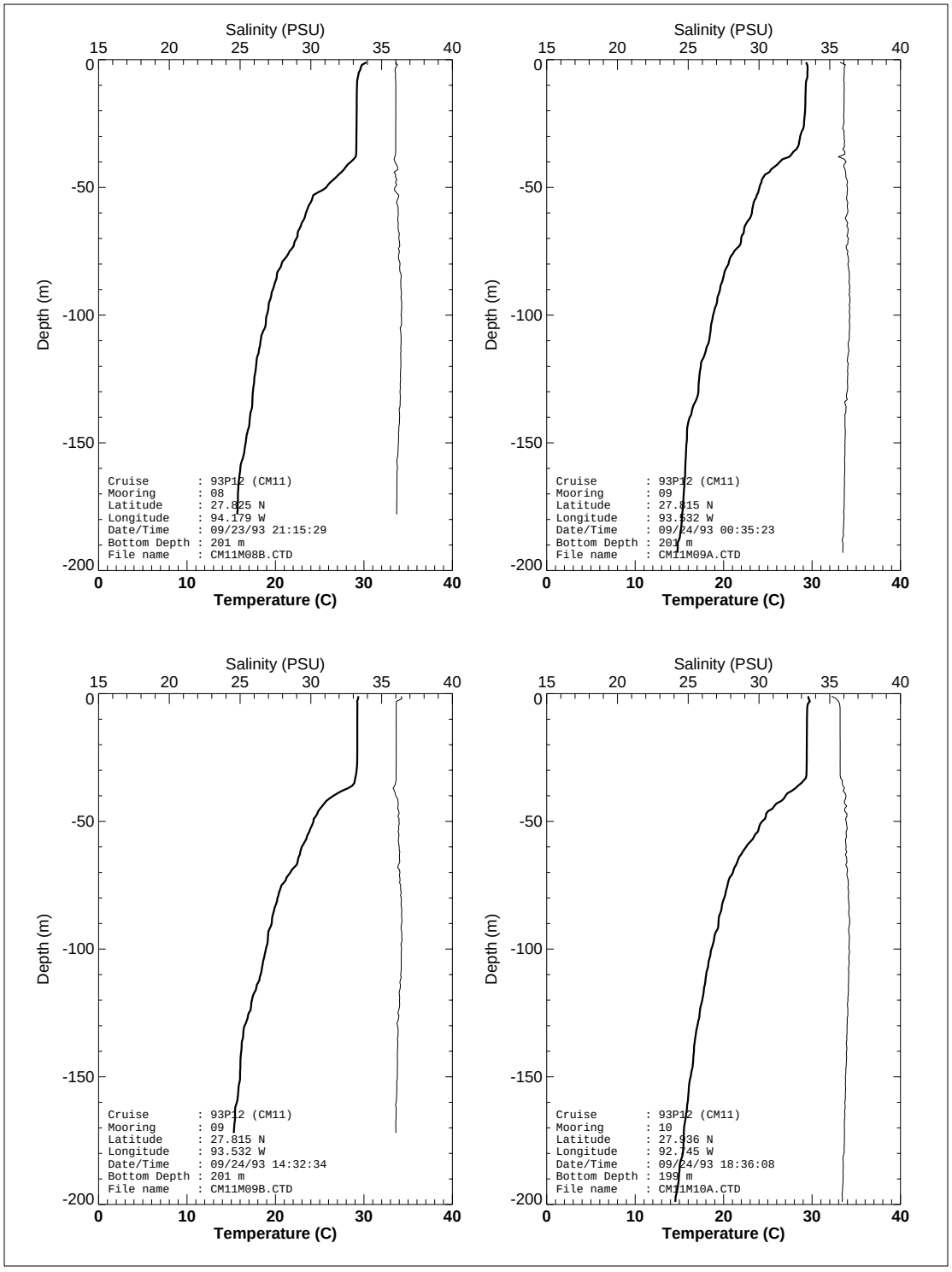

Figure 96. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

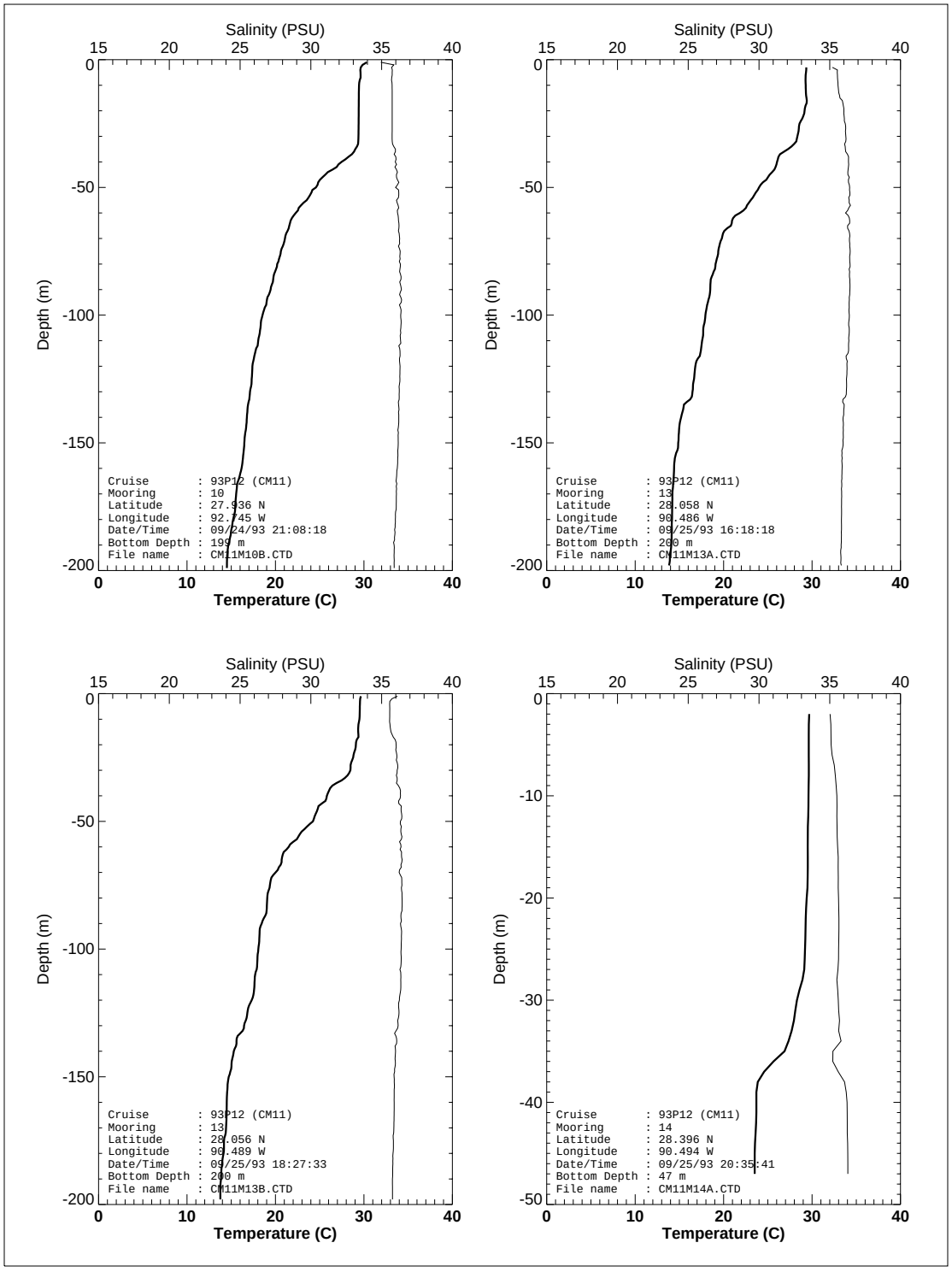

Figure 97. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

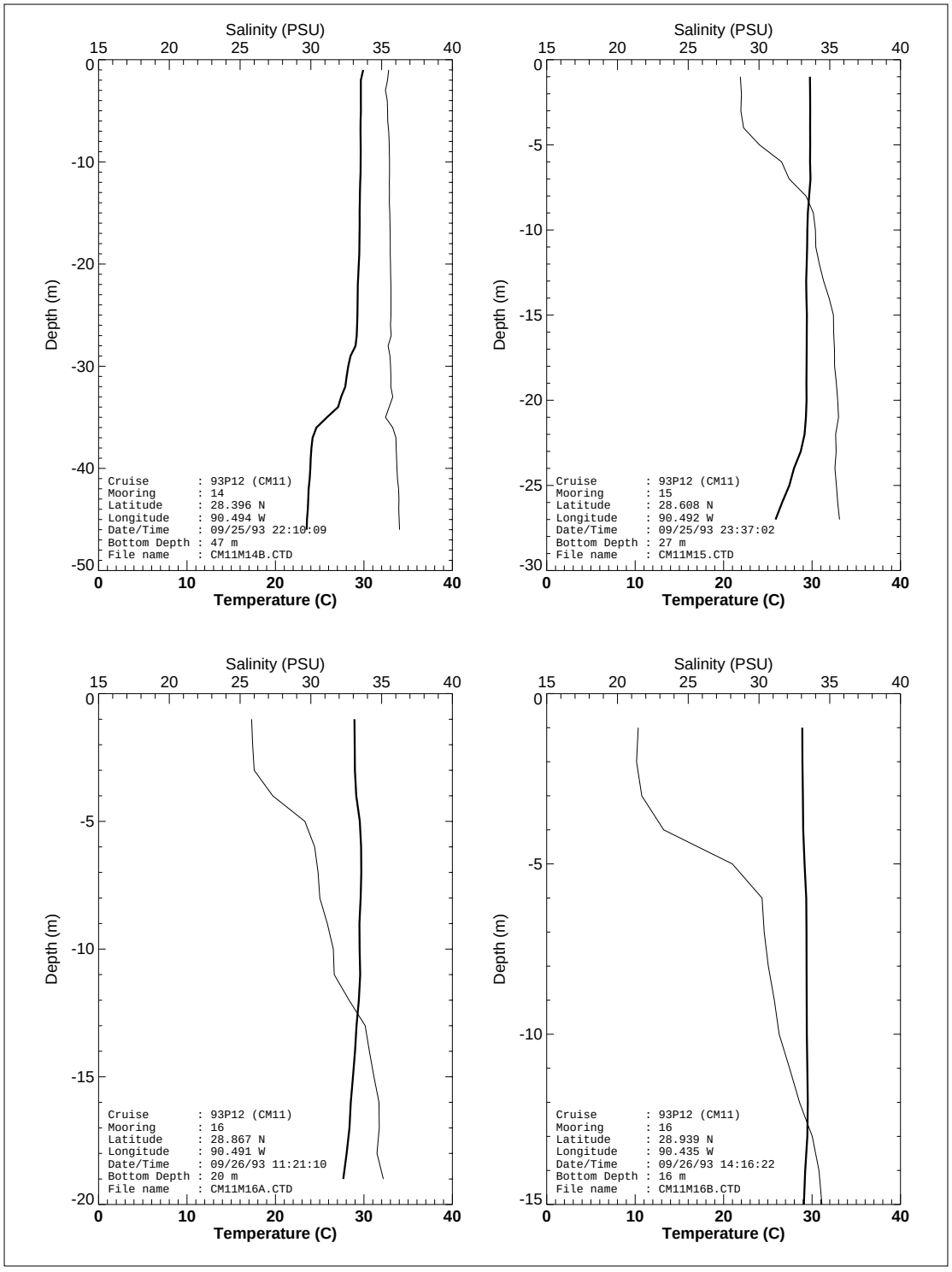

Figure 98. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

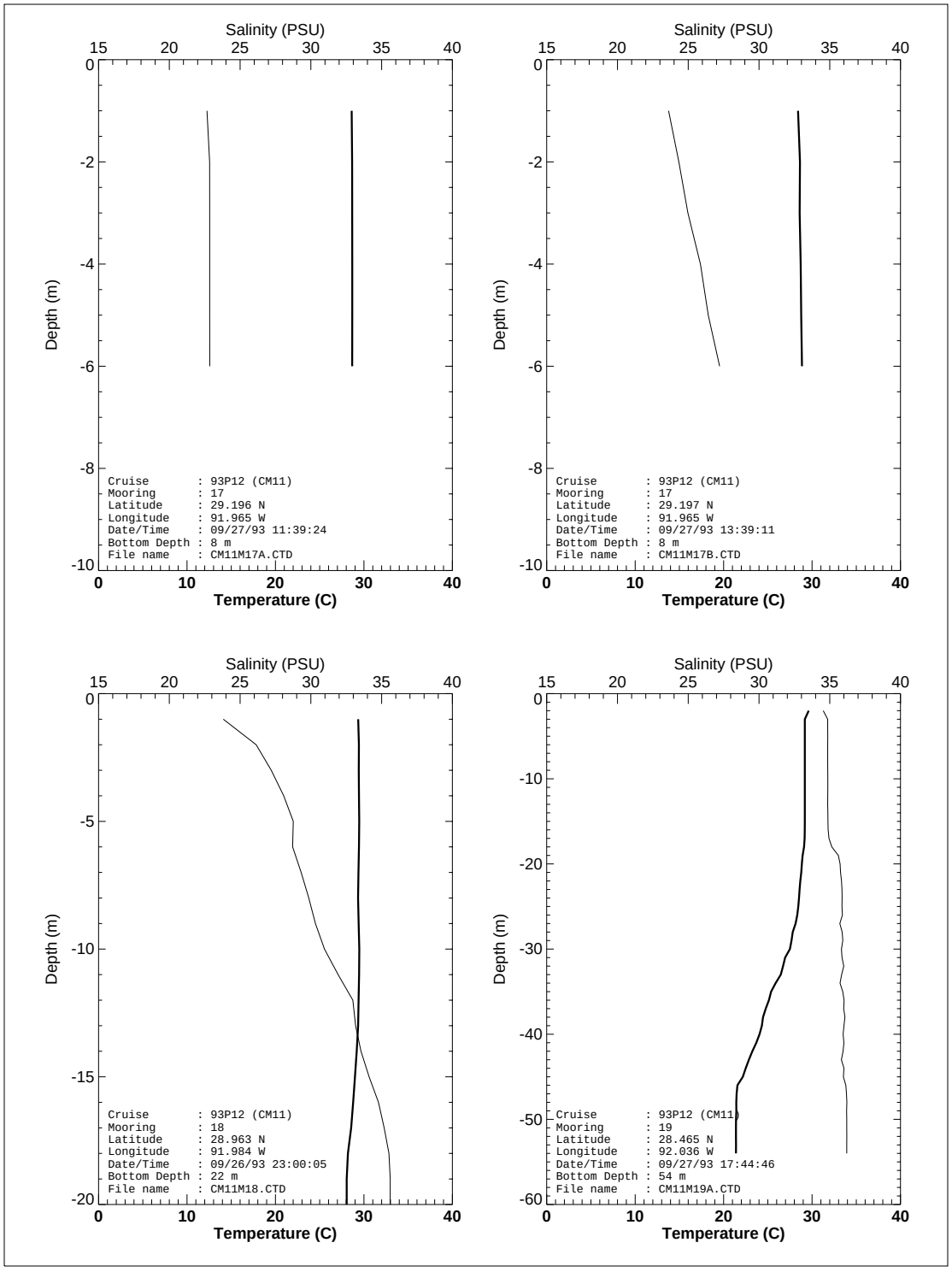

Figure 99. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

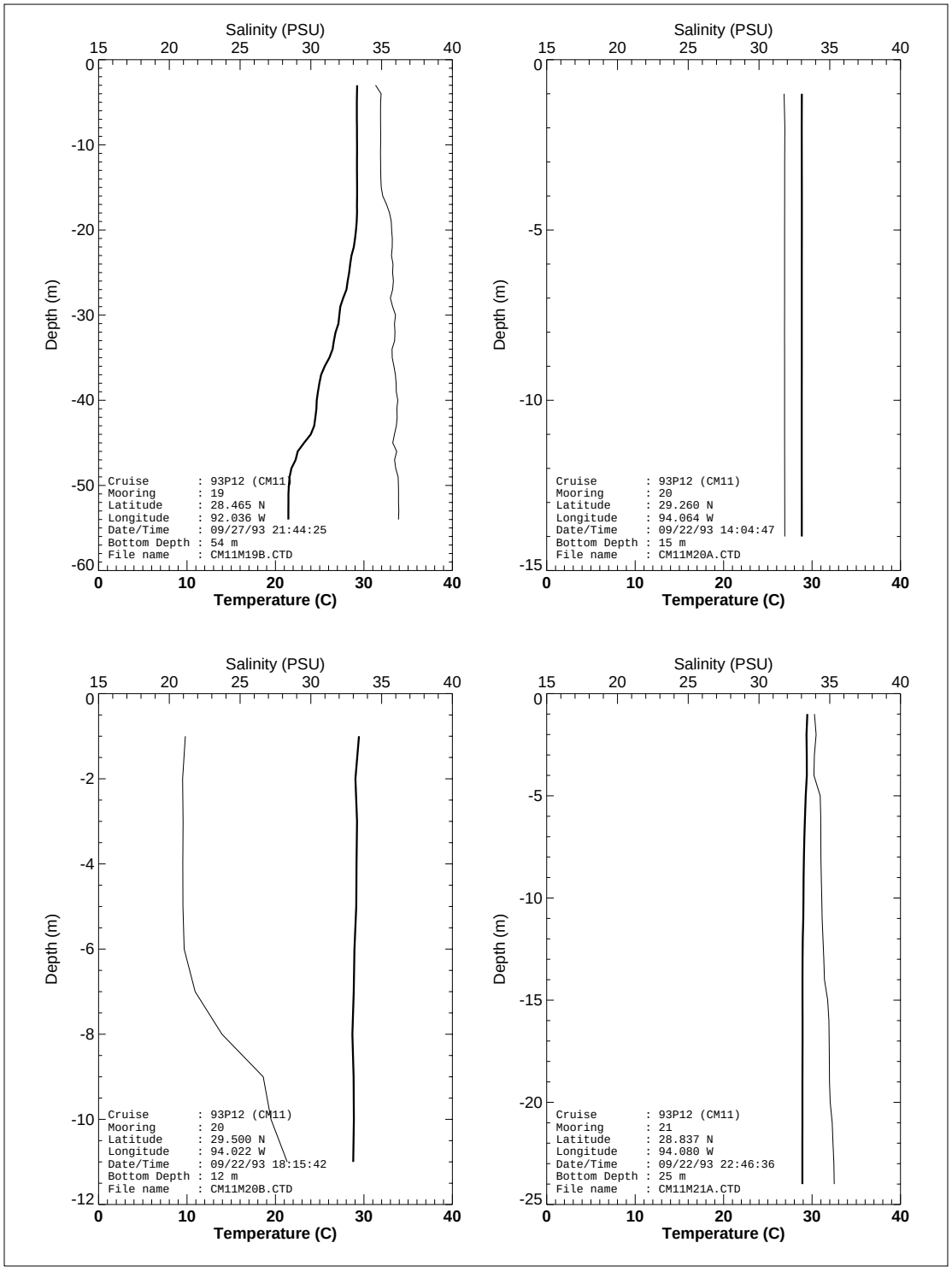

Figure 100. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

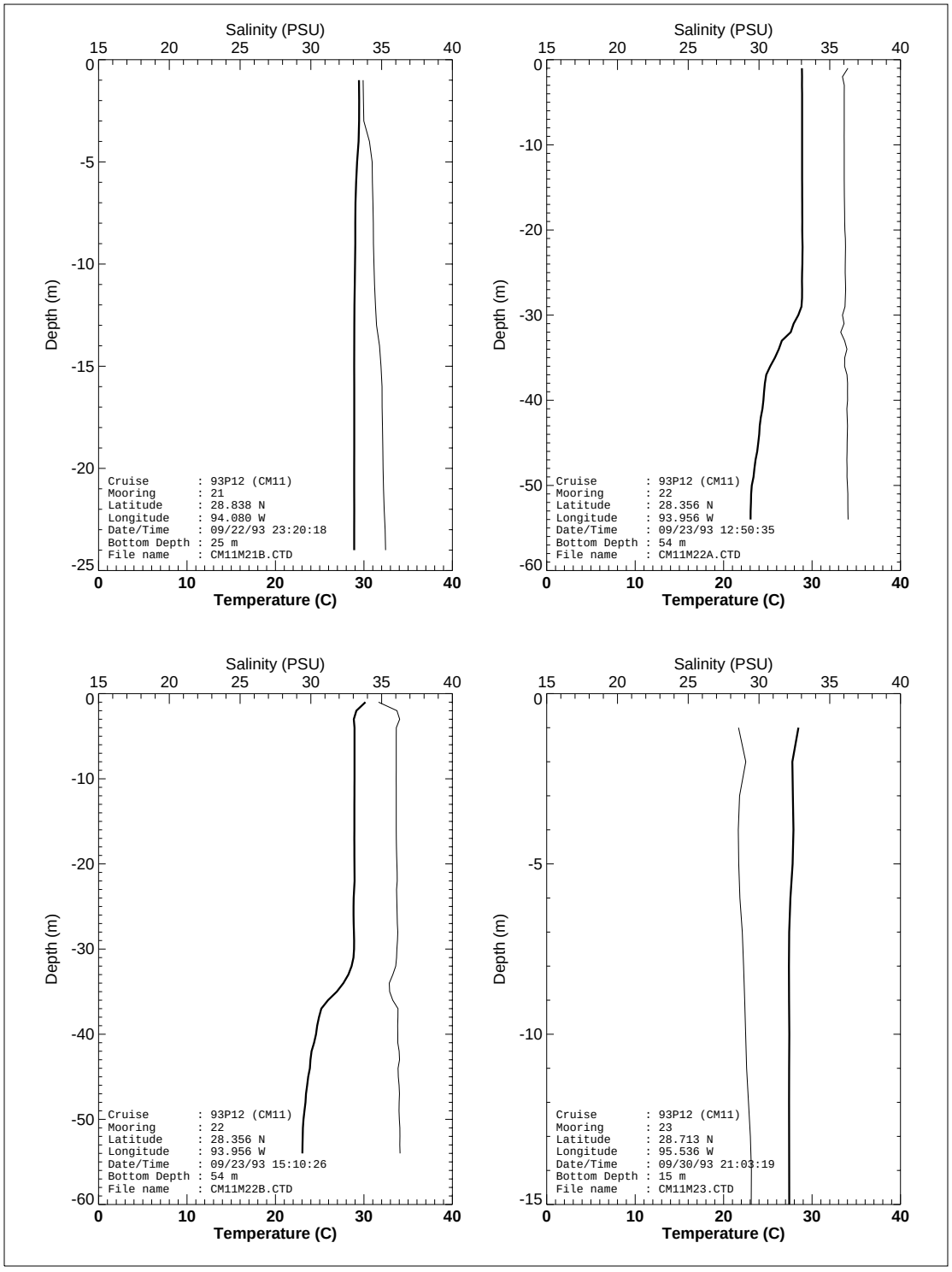

Figure 101. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

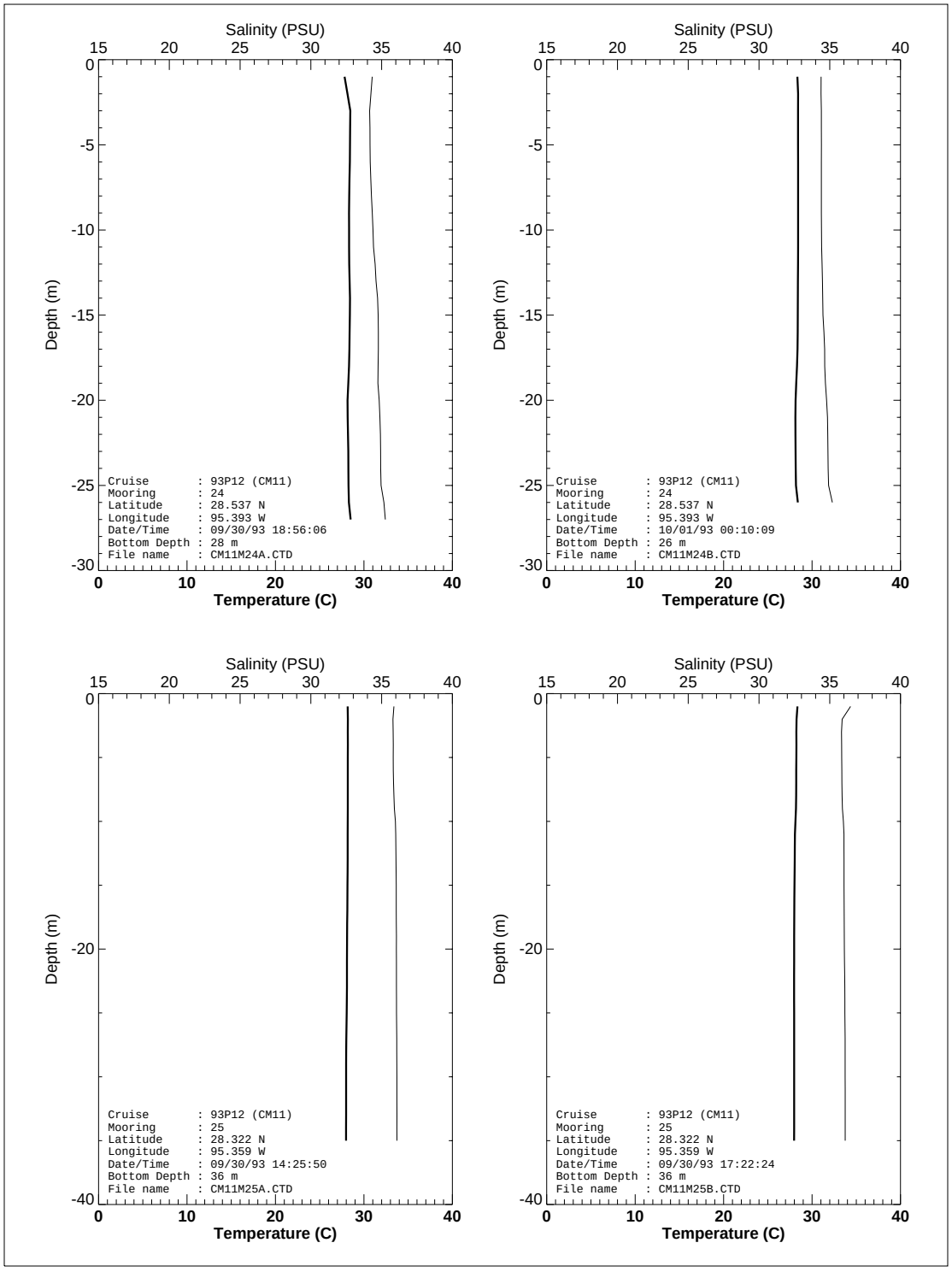

Figure 102. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

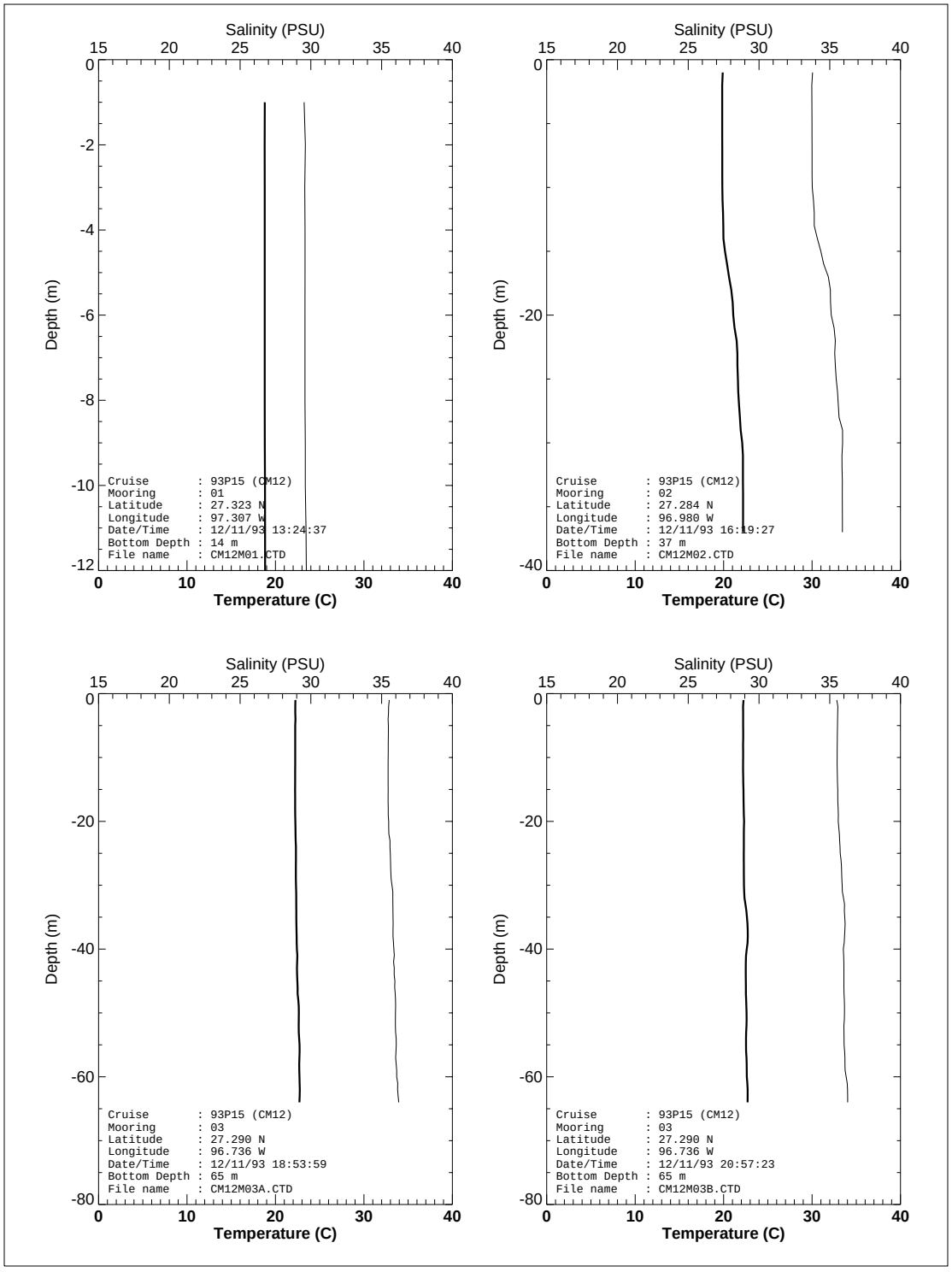

Figure 103. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

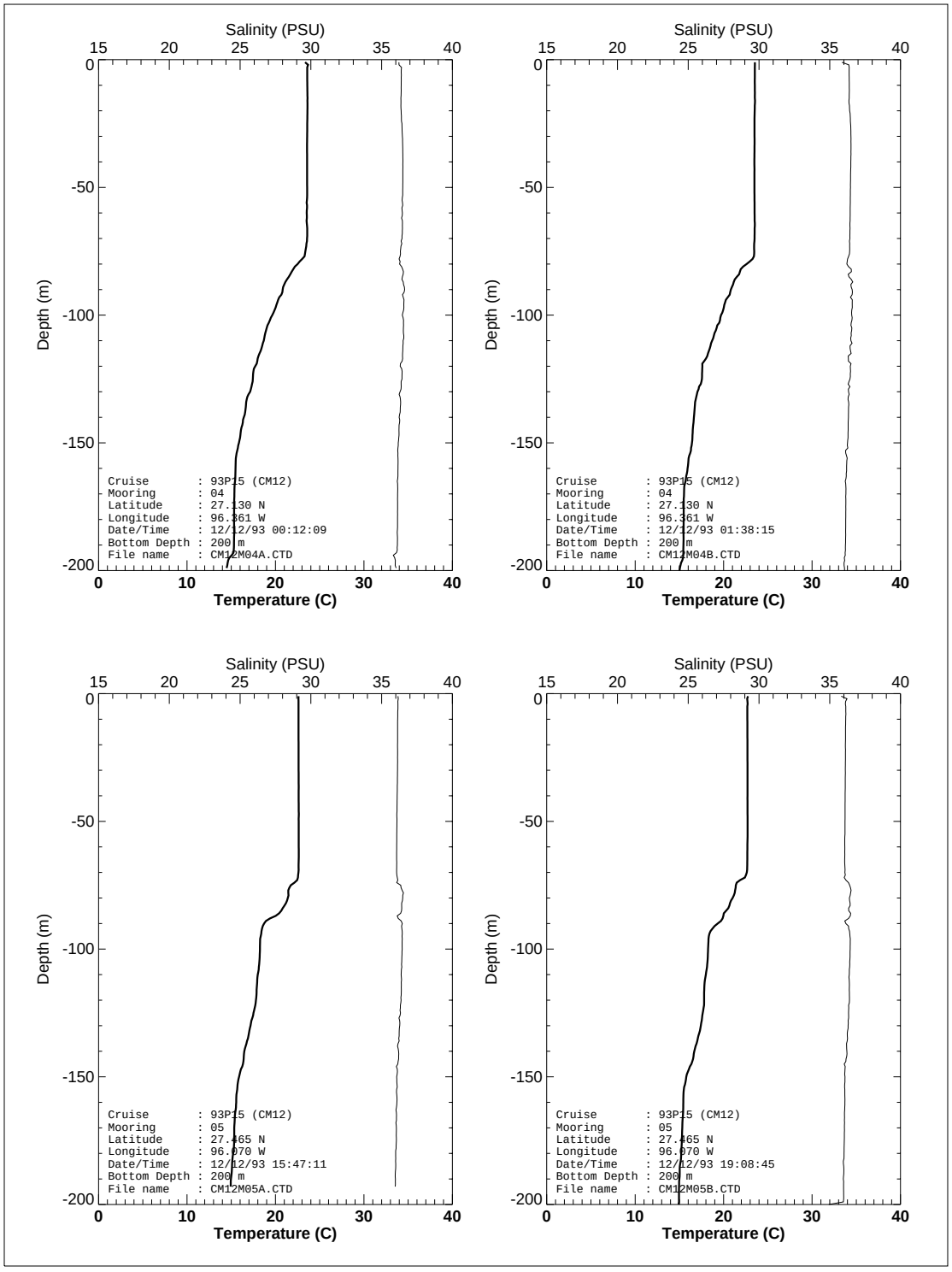

Figure 104. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

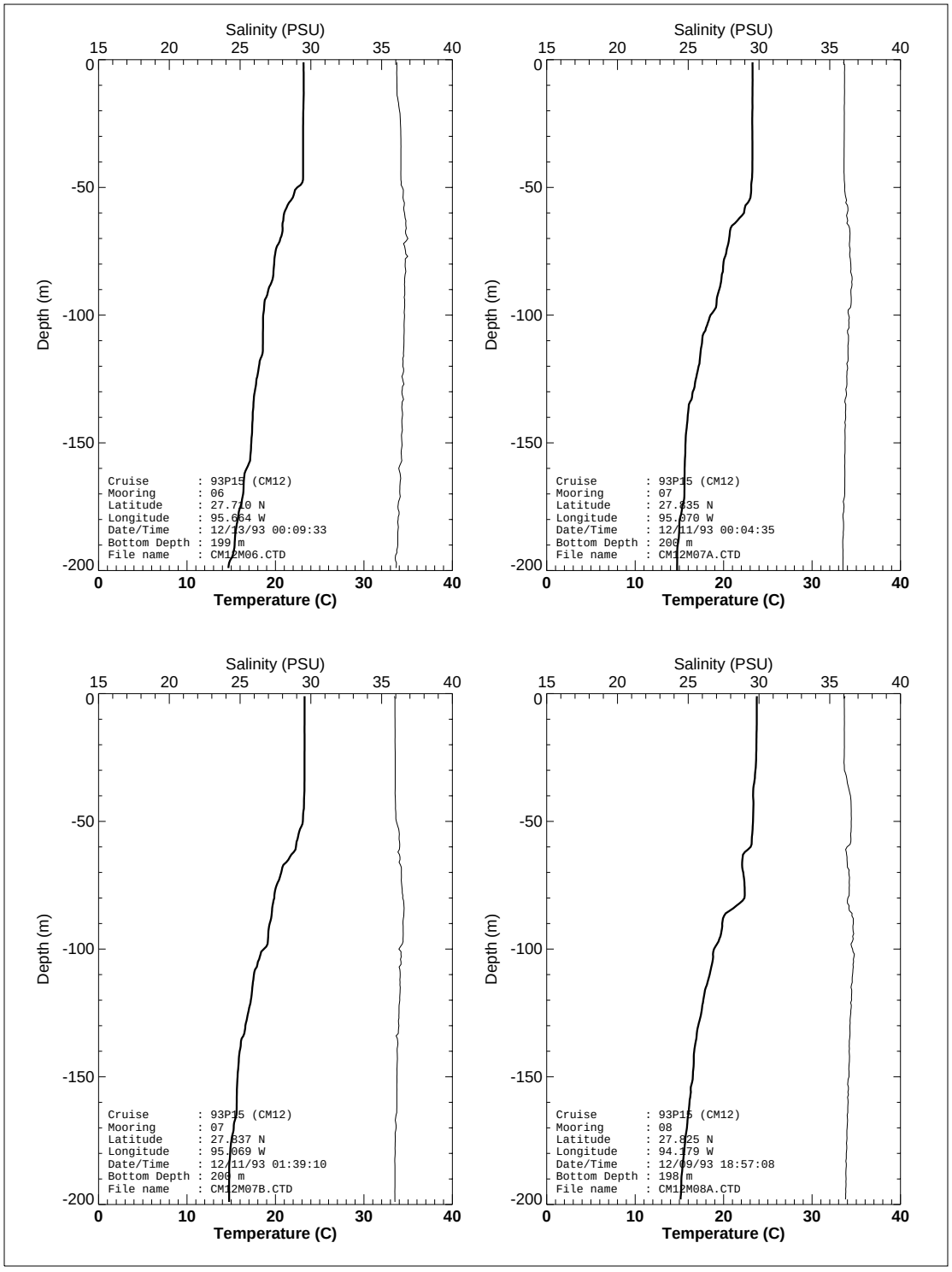

Figure 105. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

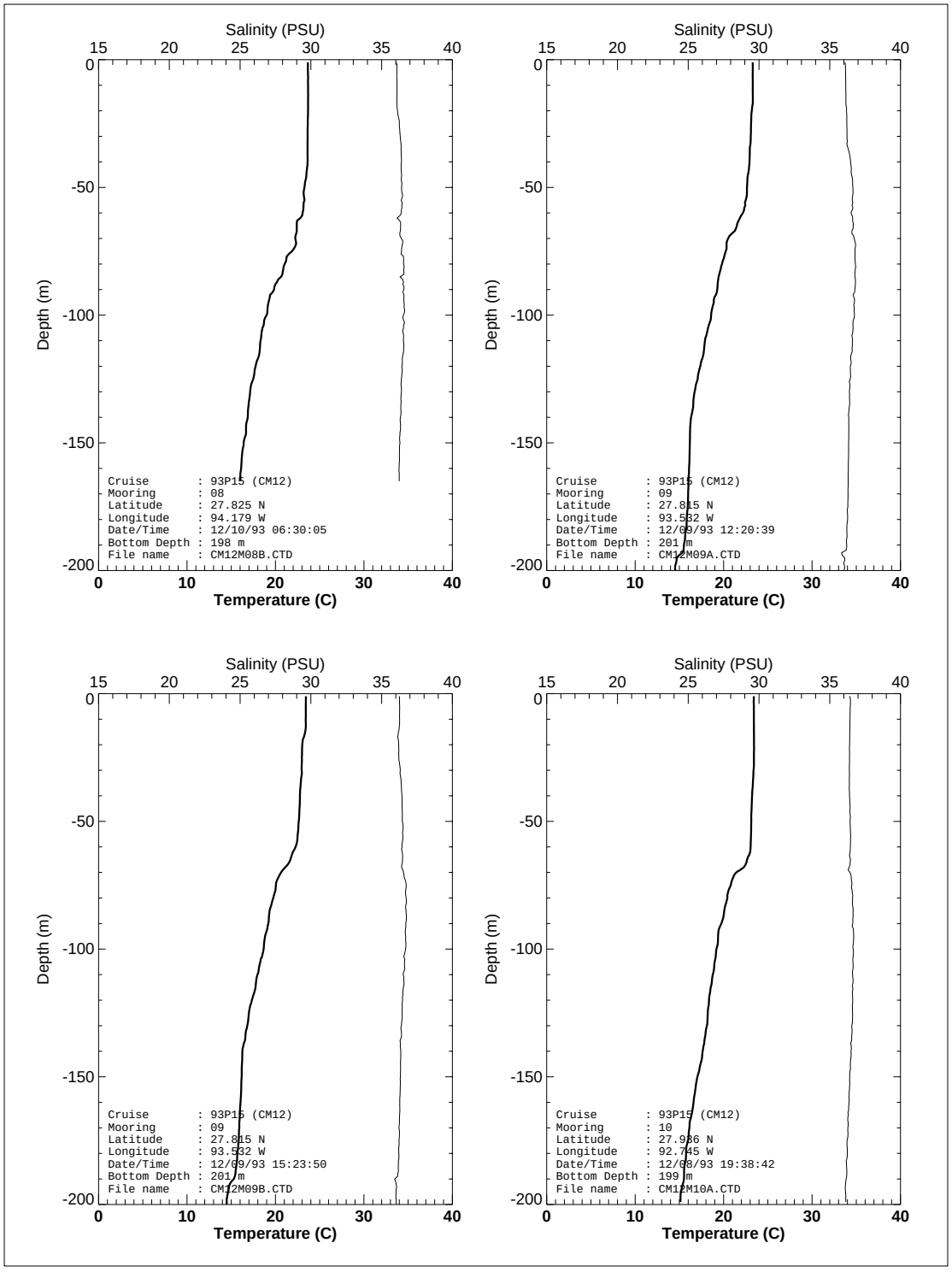

Figure 106. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

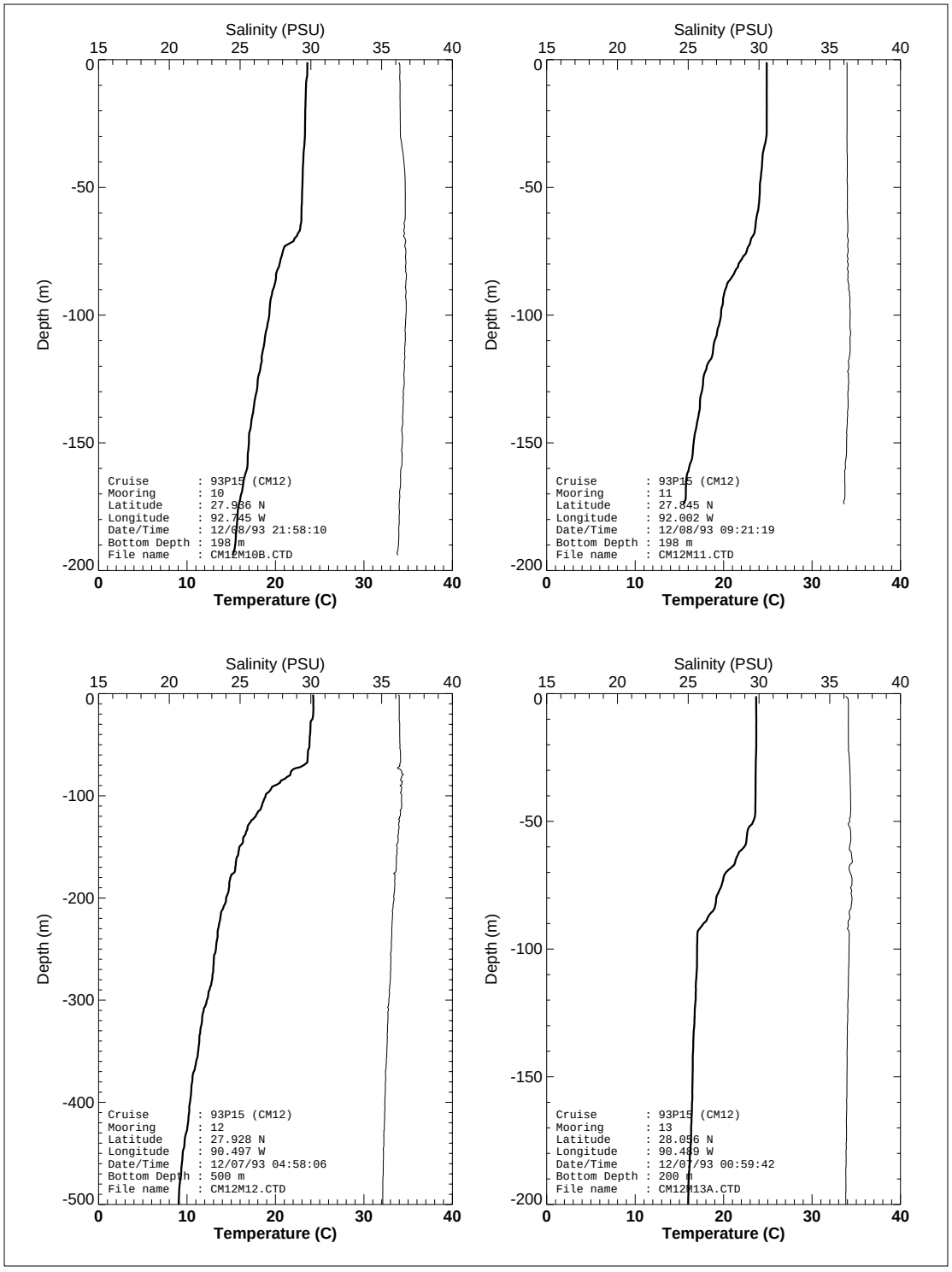

Figure 107. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

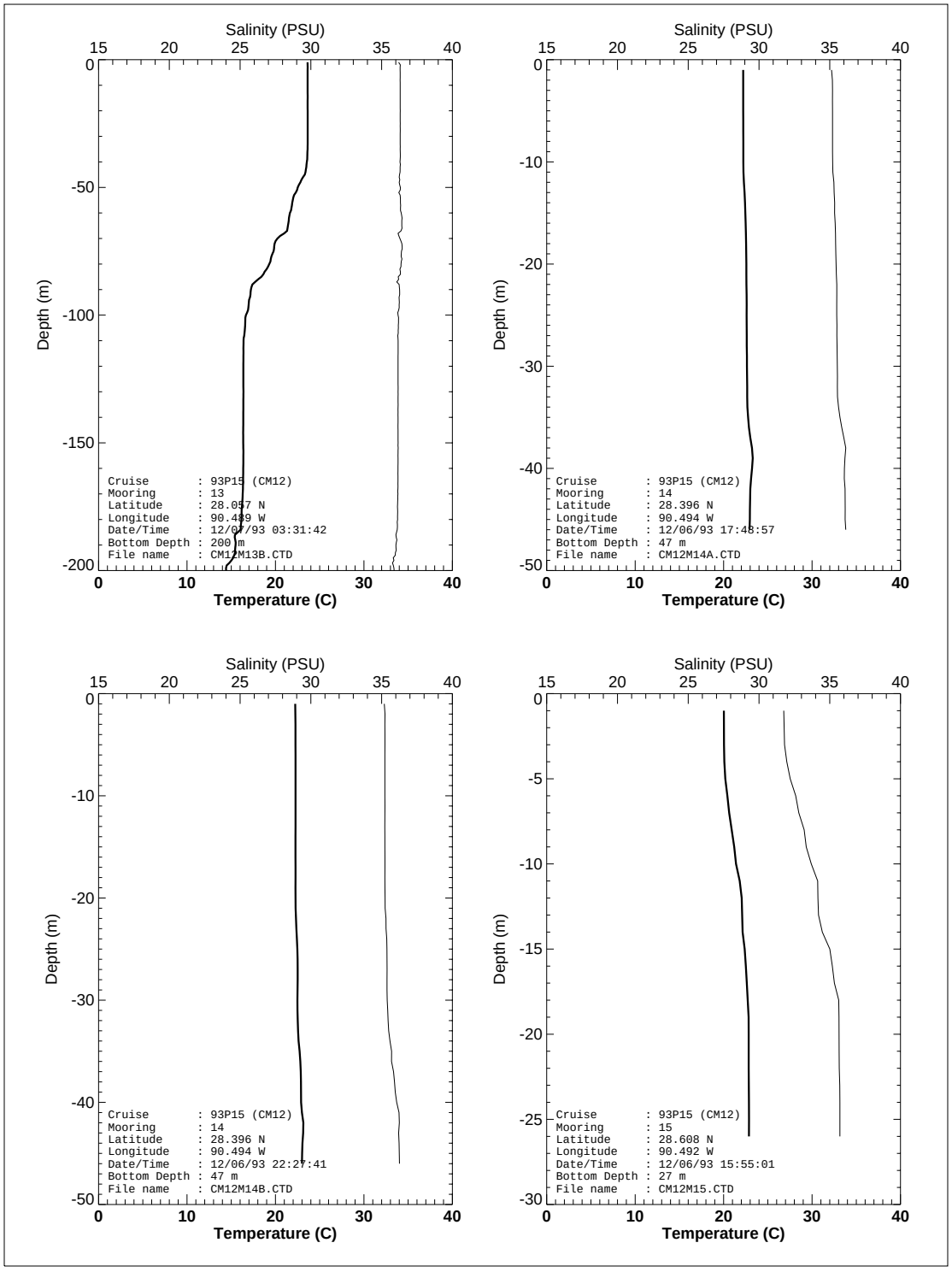

Figure 108. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

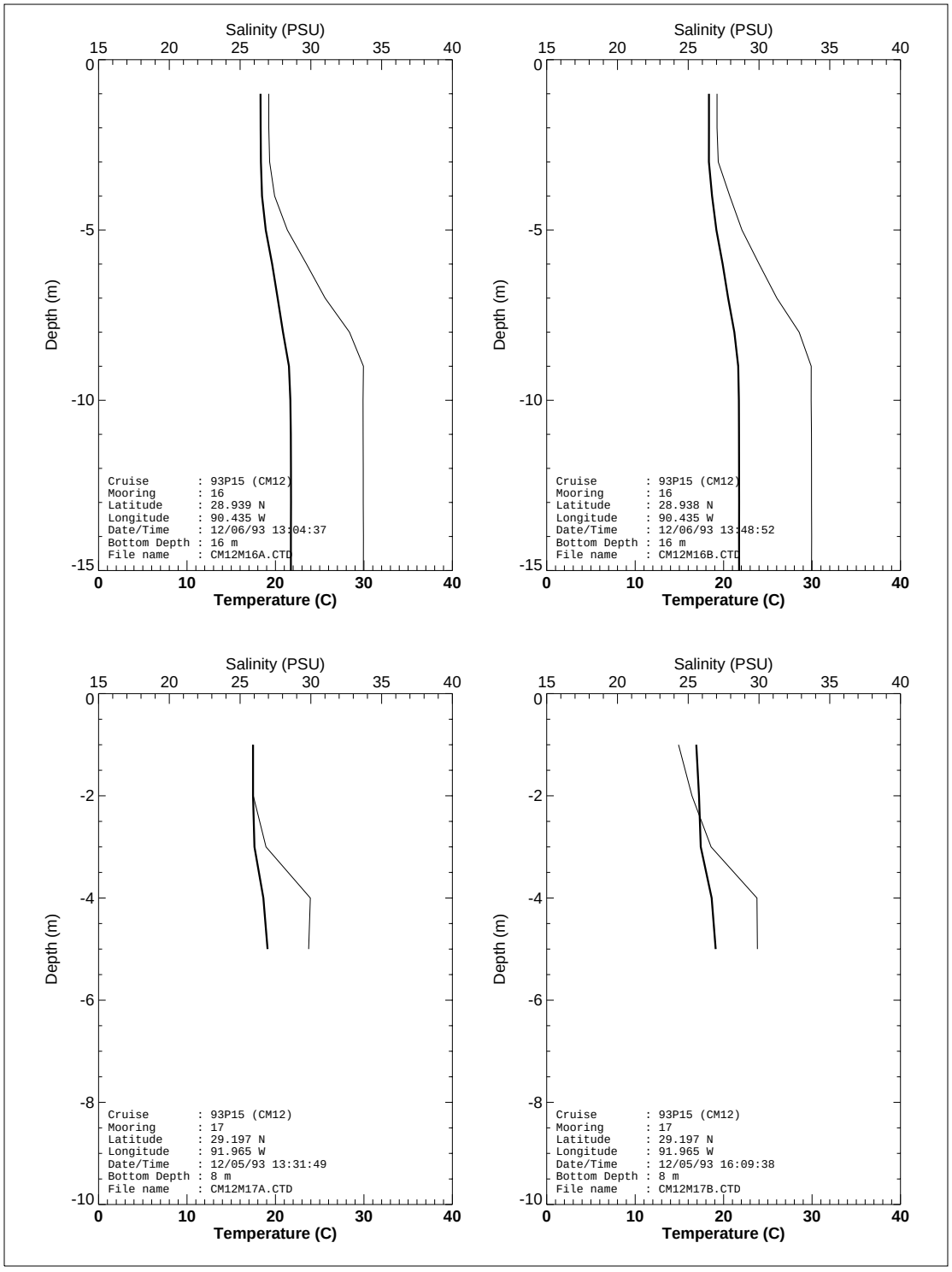

Figure 109. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

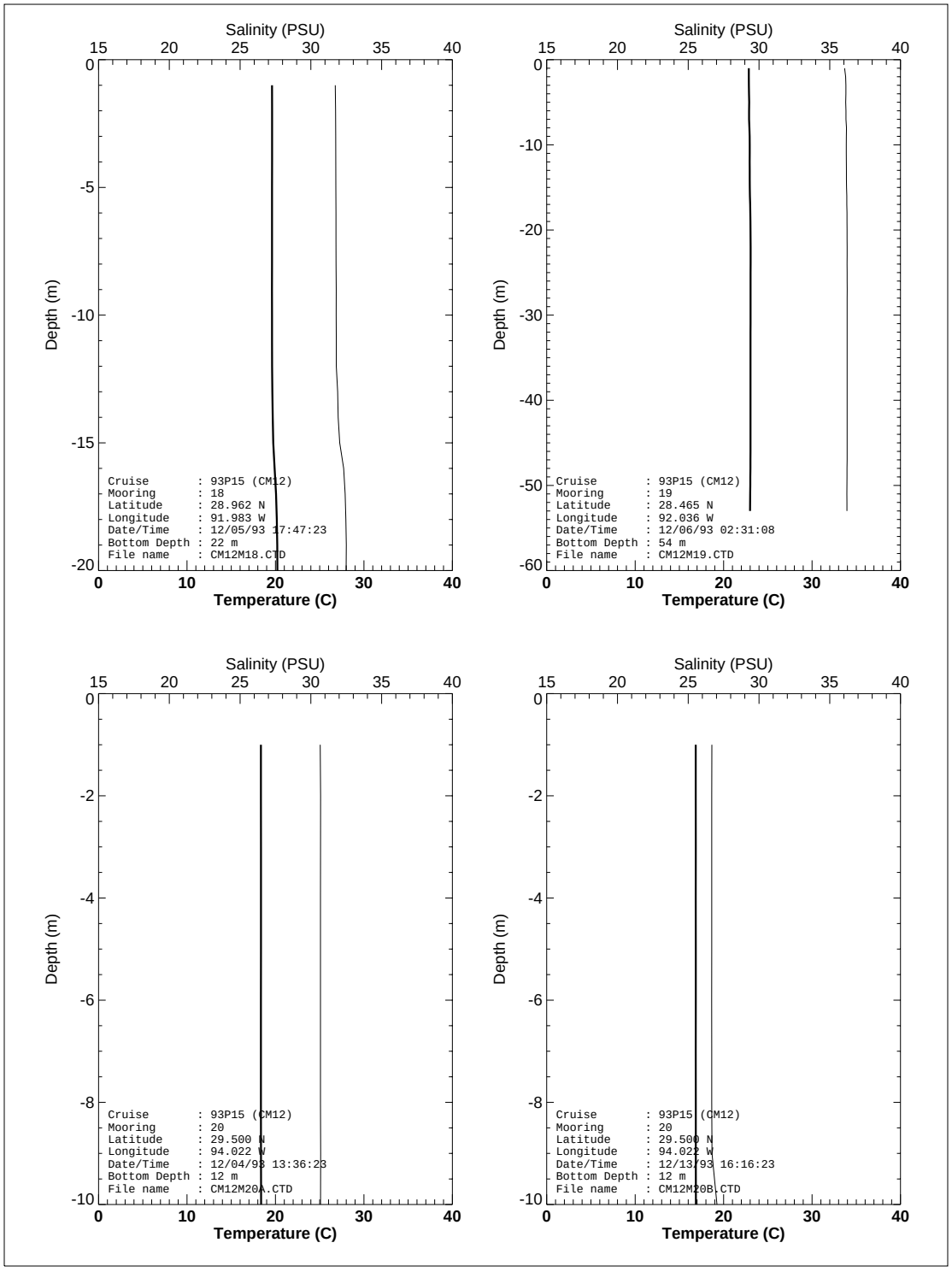

Figure 110. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

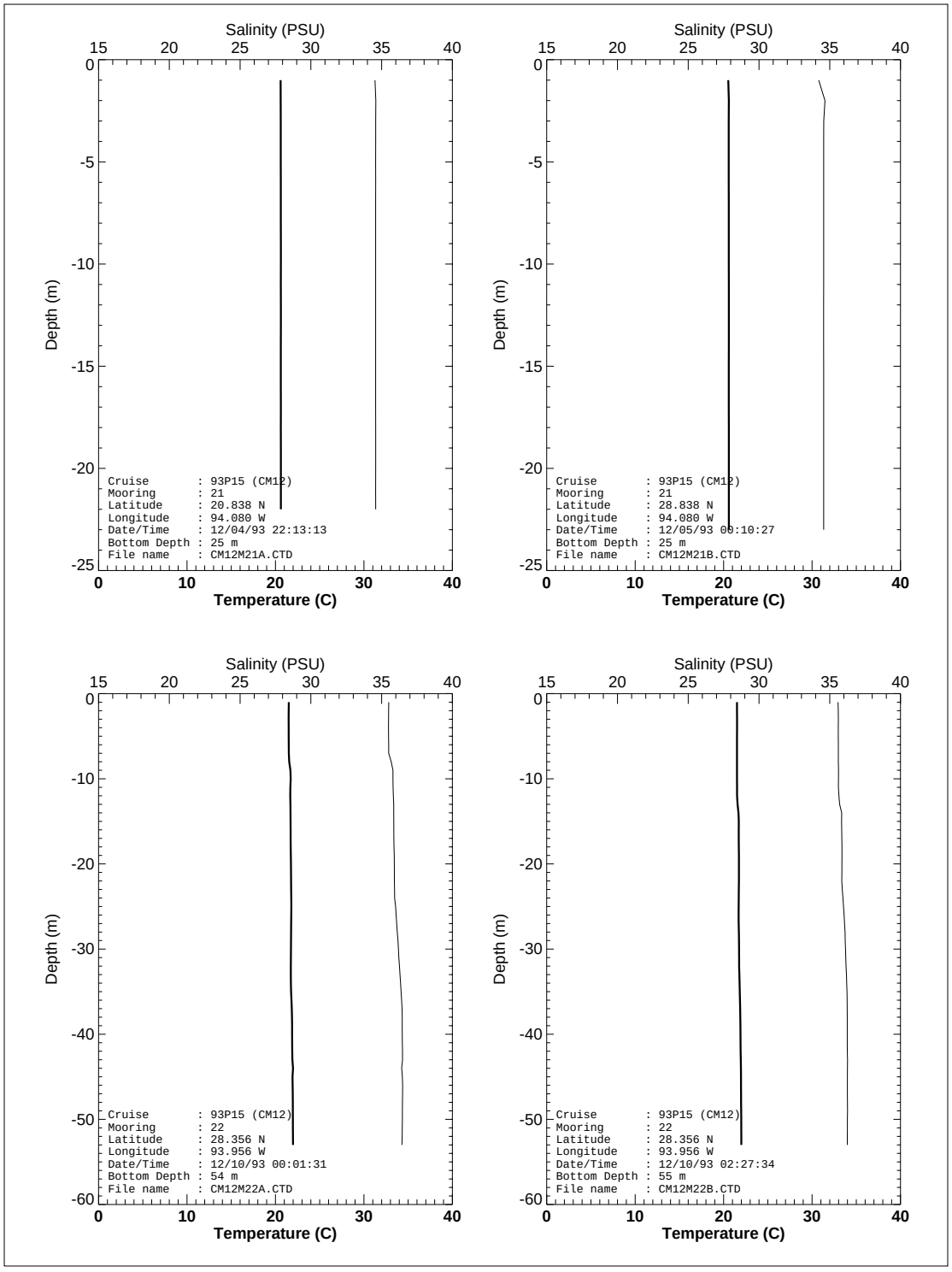

Figure 111. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

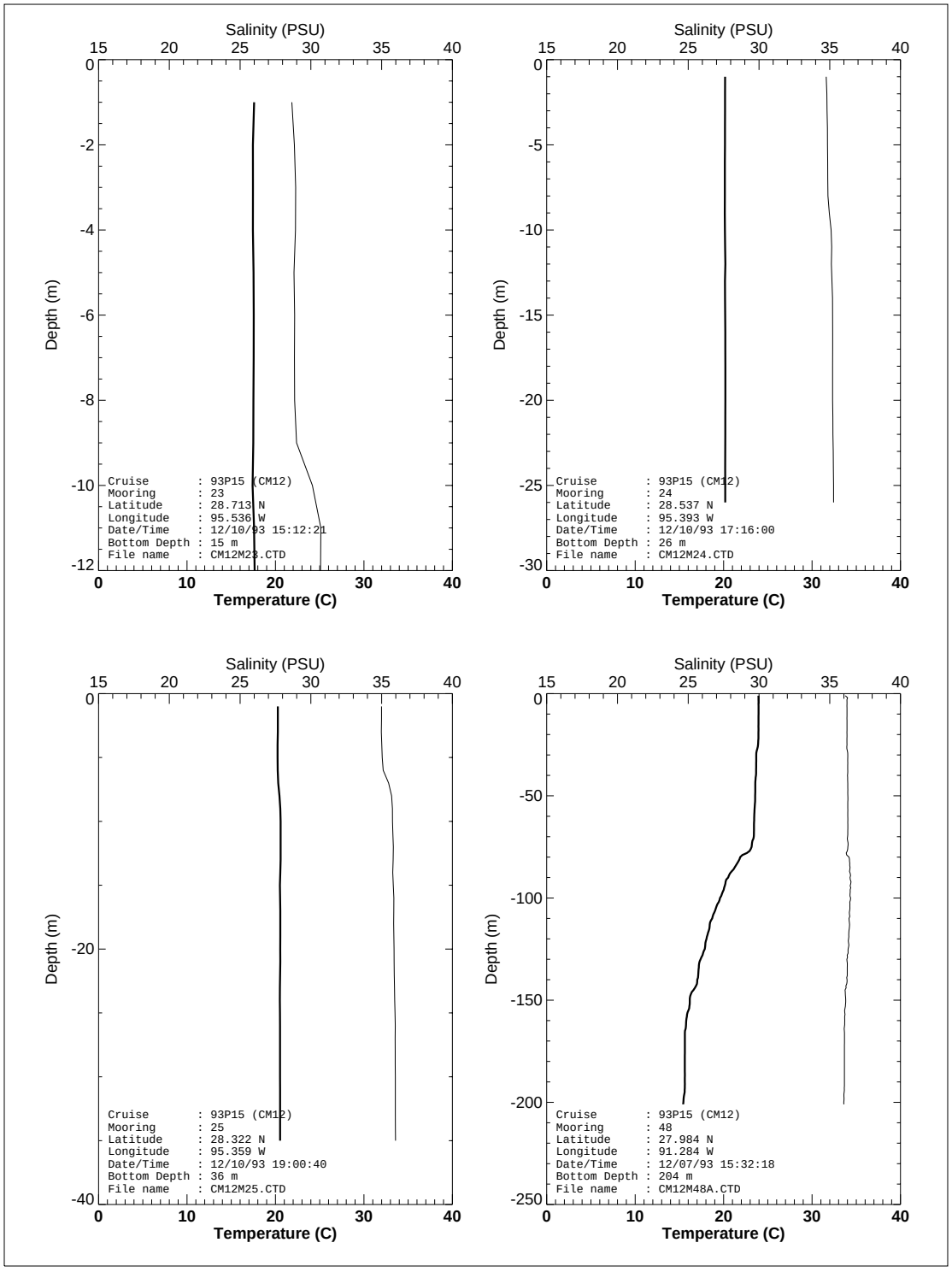

Figure 112. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

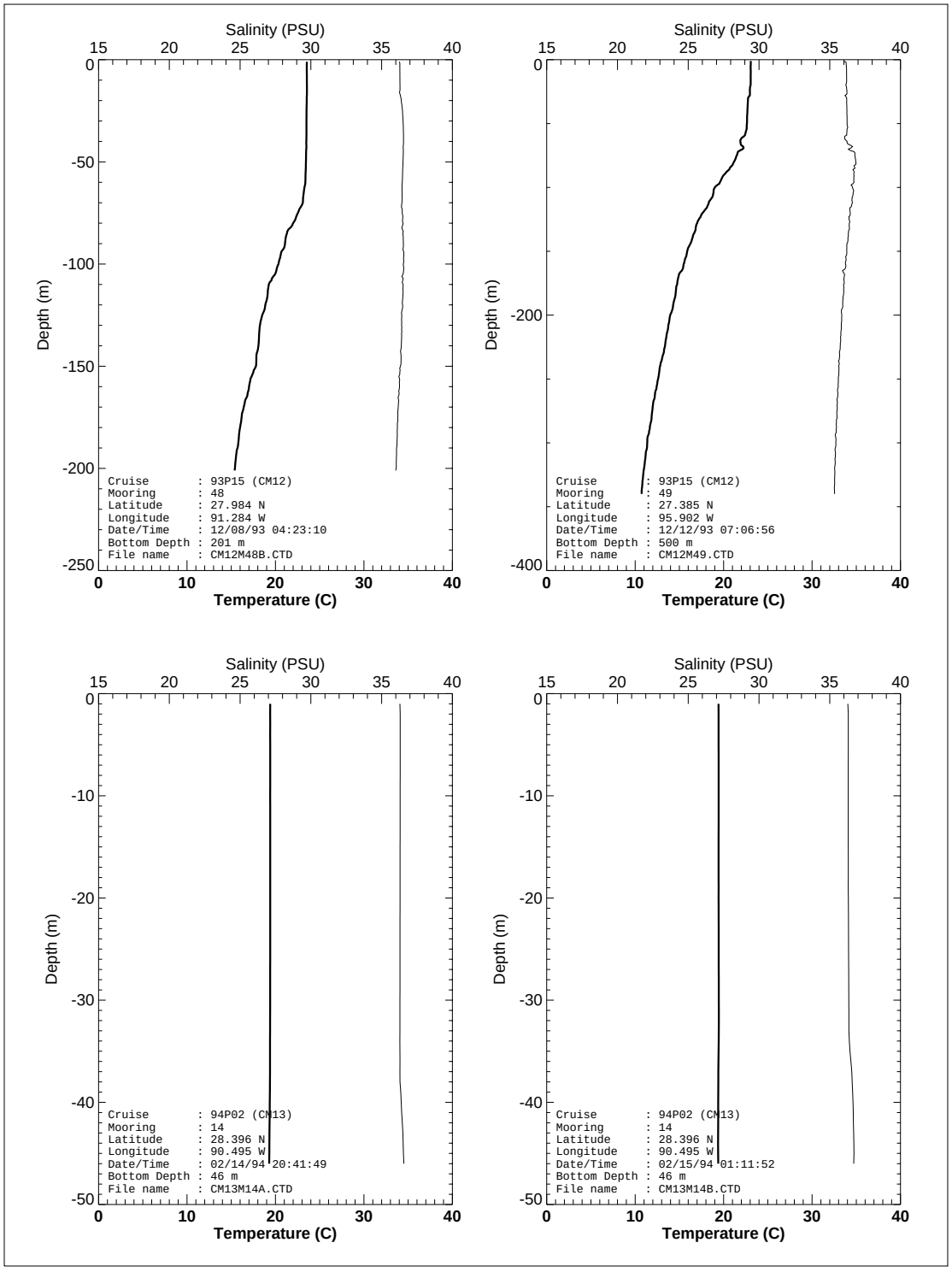

Figure 113. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

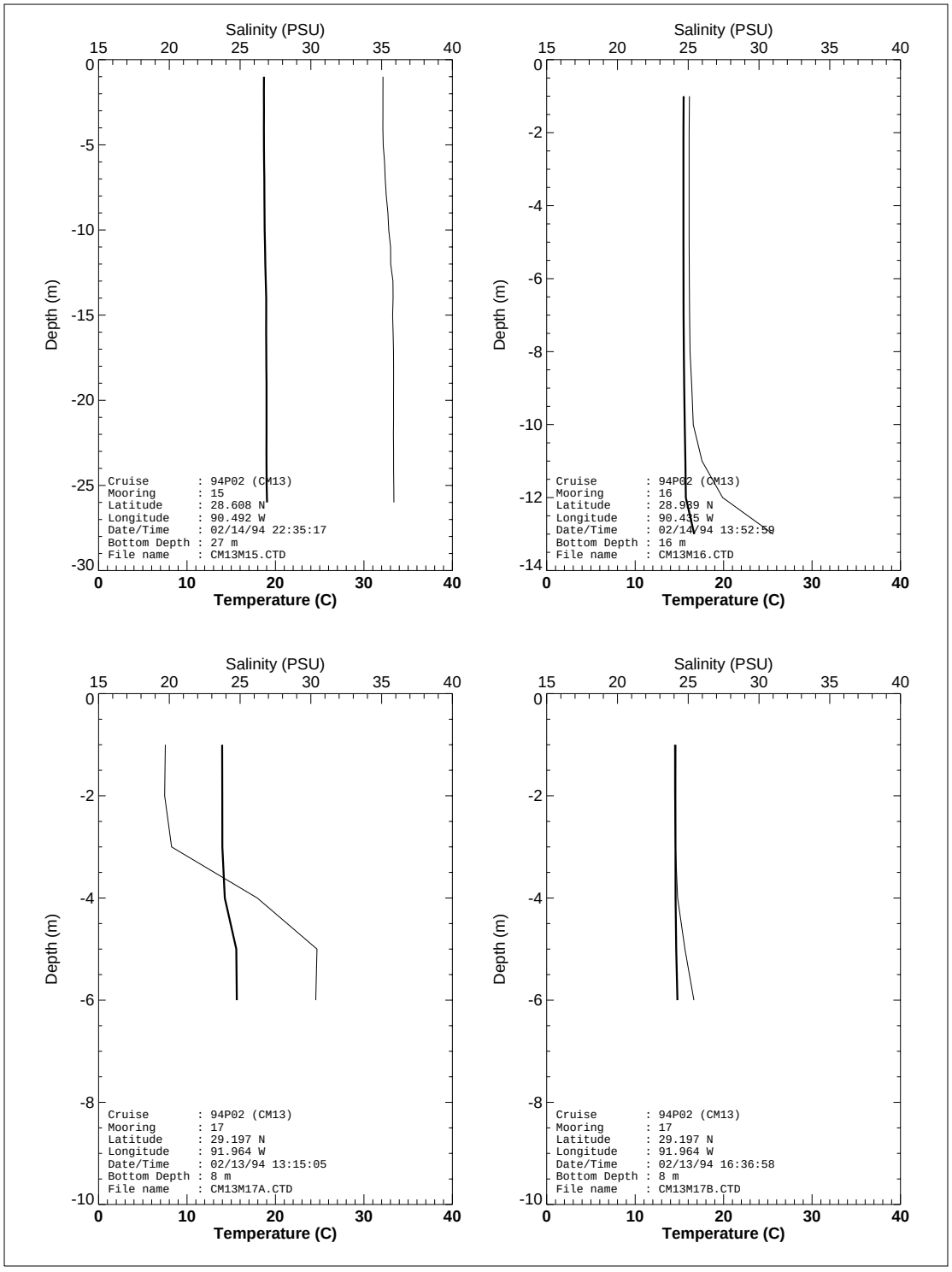

Figure 114. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

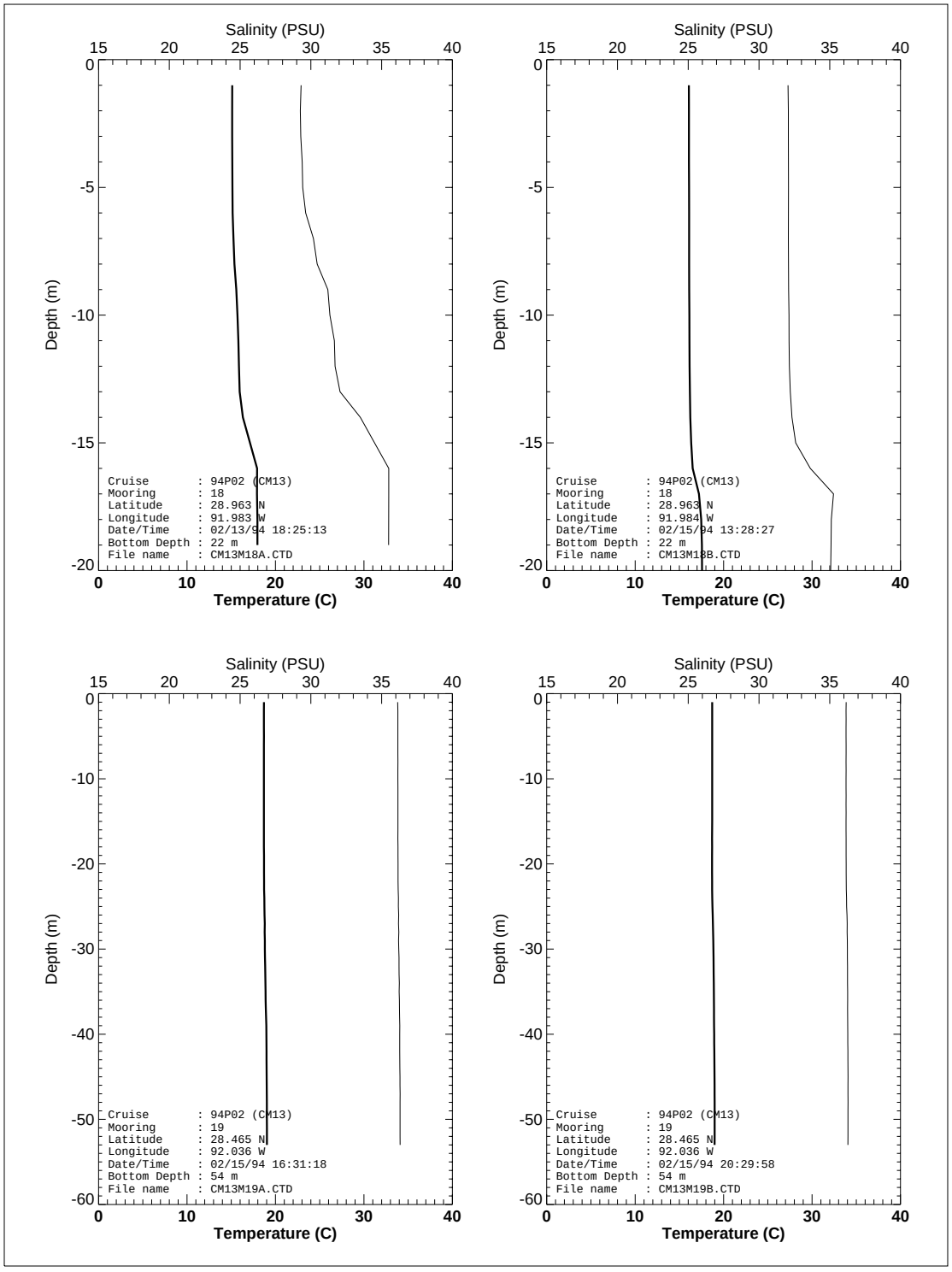

Figure 115. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

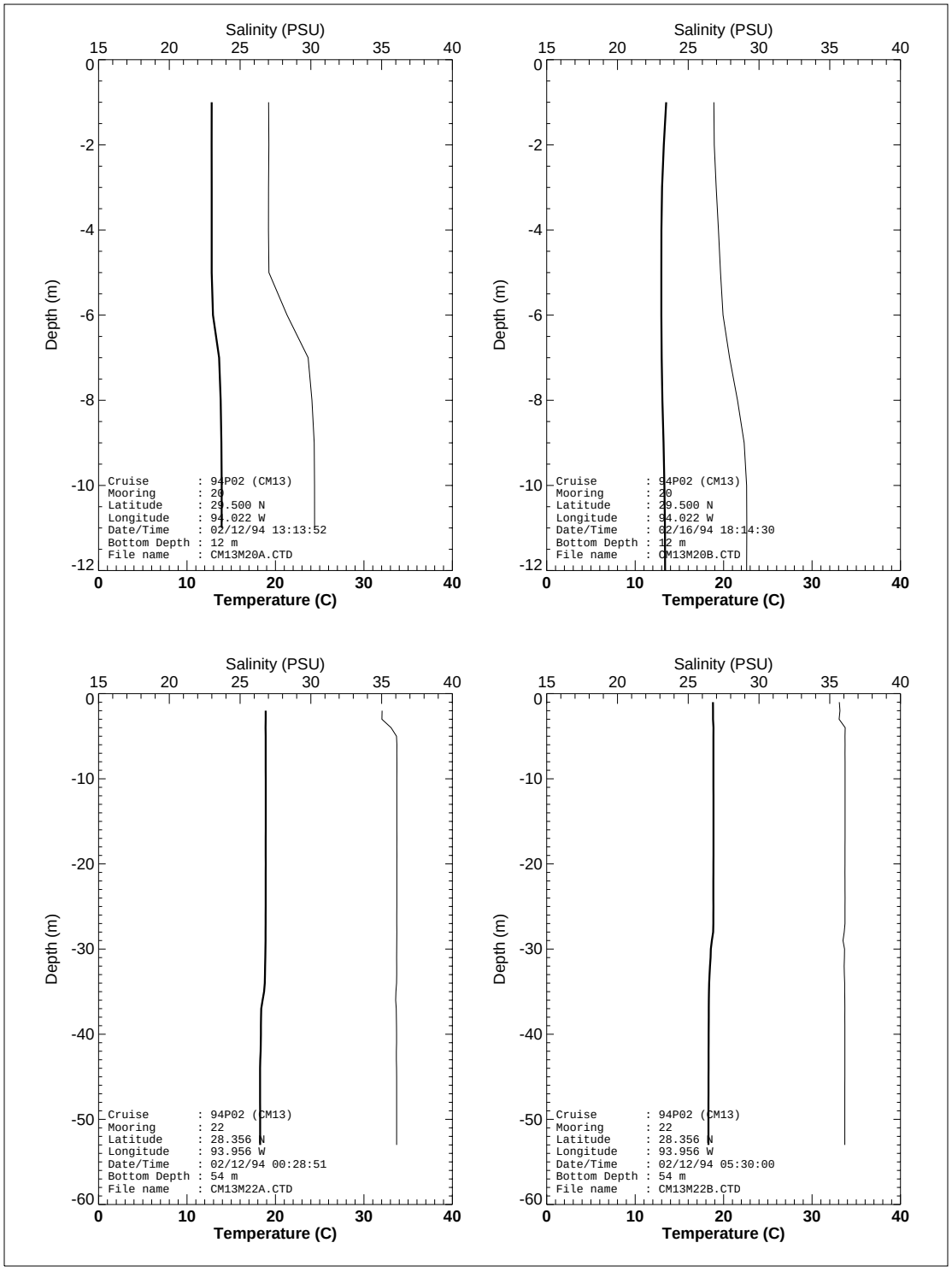

Figure 116. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

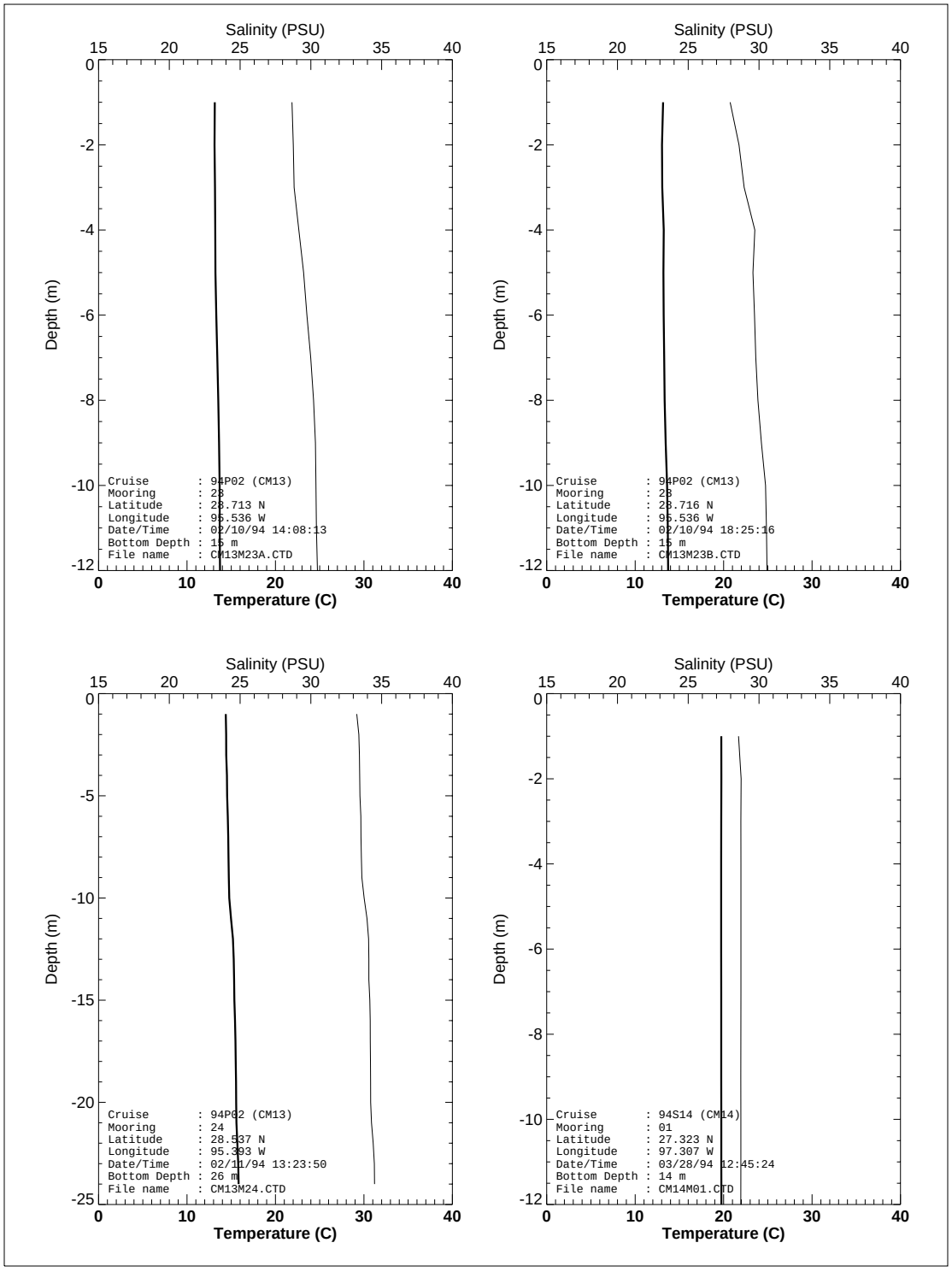

Figure 117. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

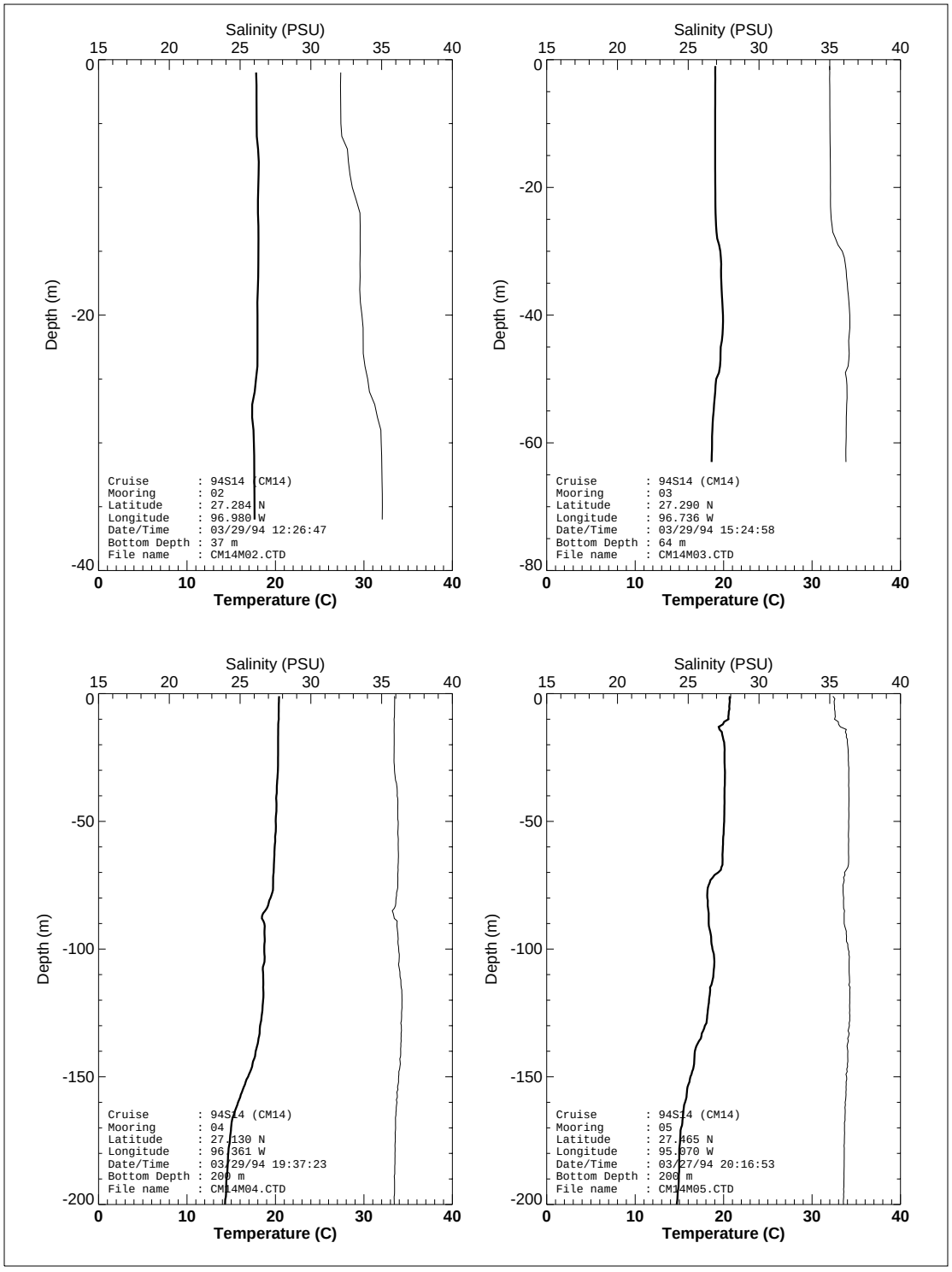

Figure 118. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

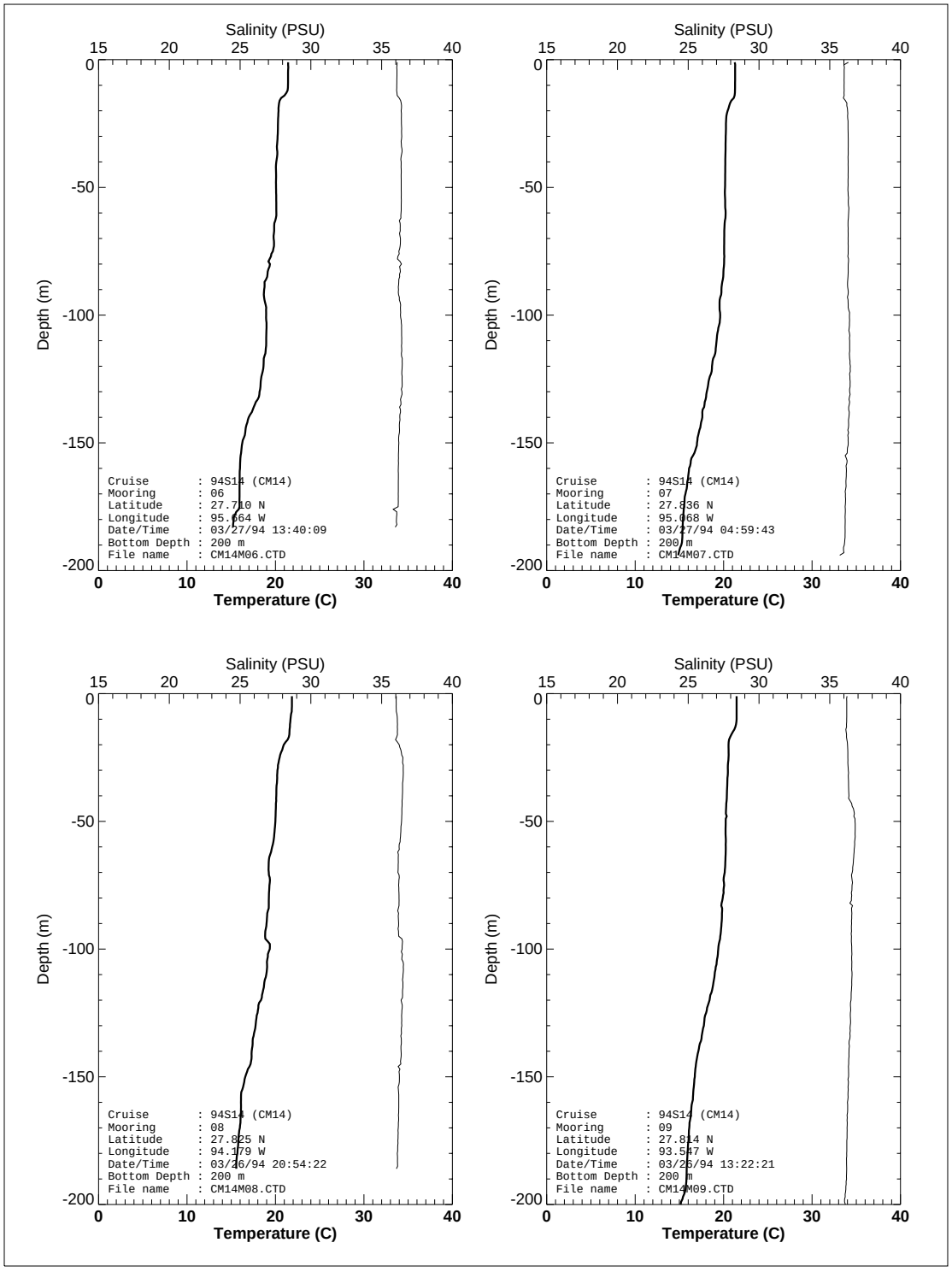

Figure 119. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

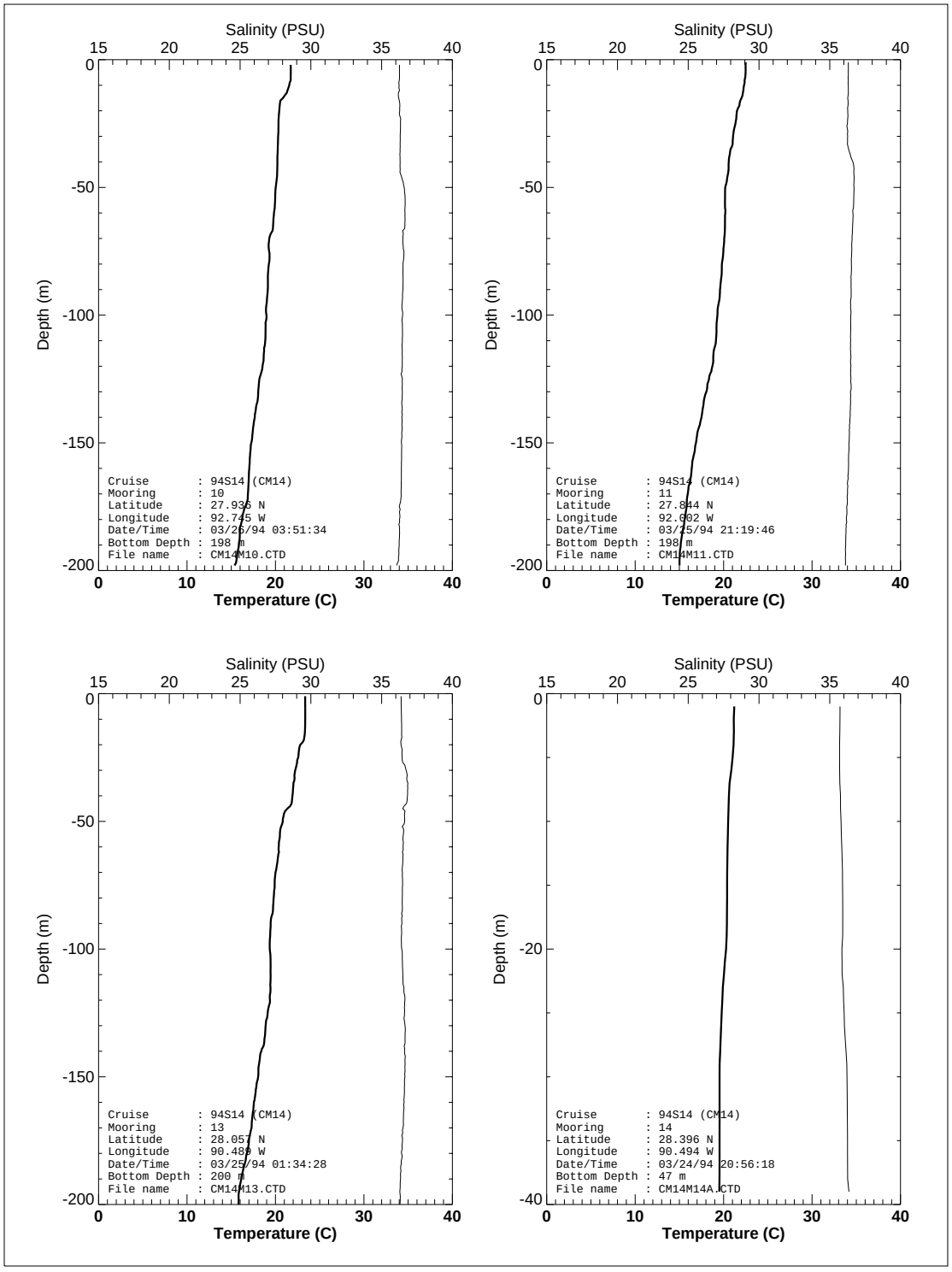

Figure 120. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

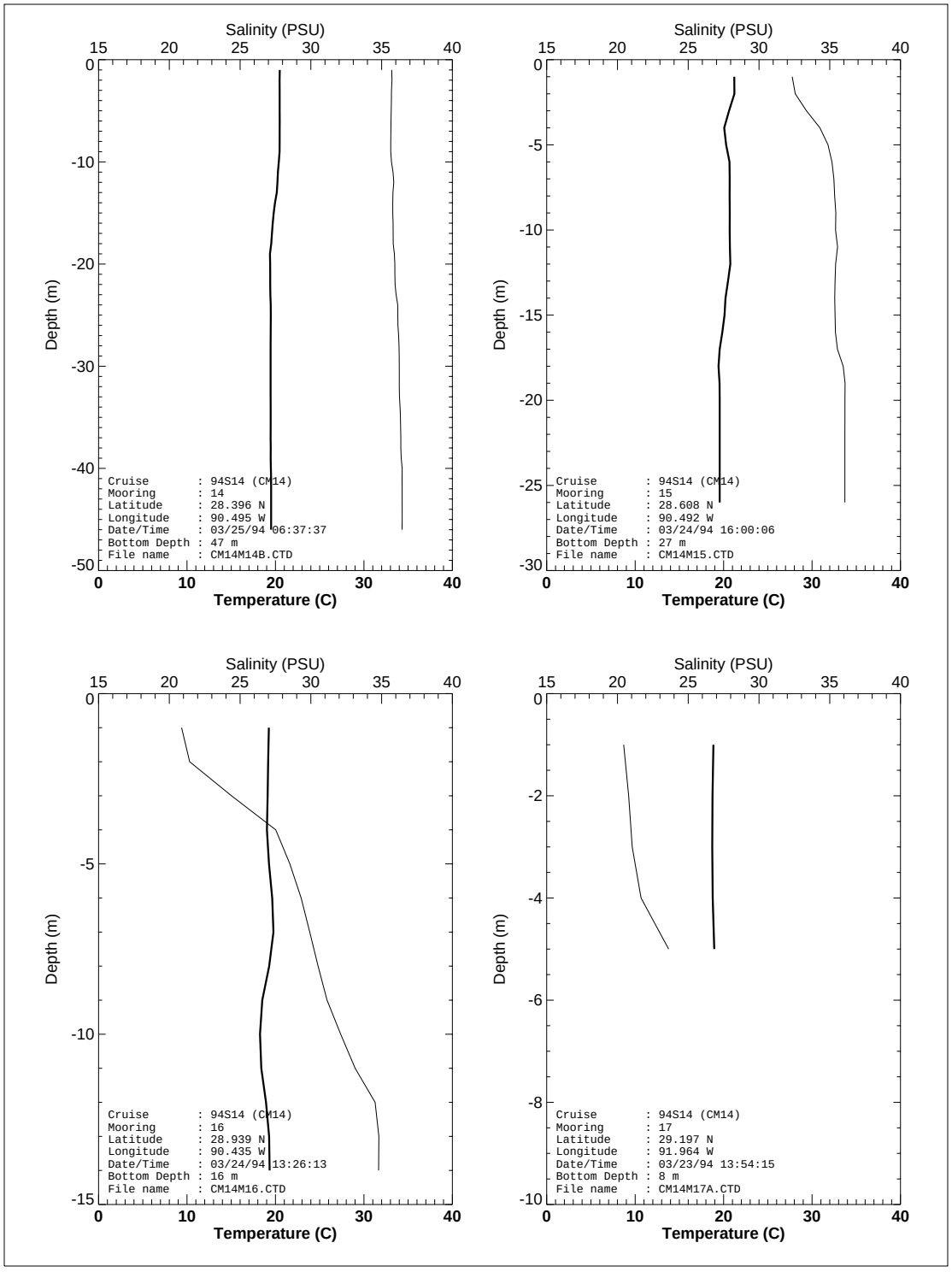

Figure 121. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

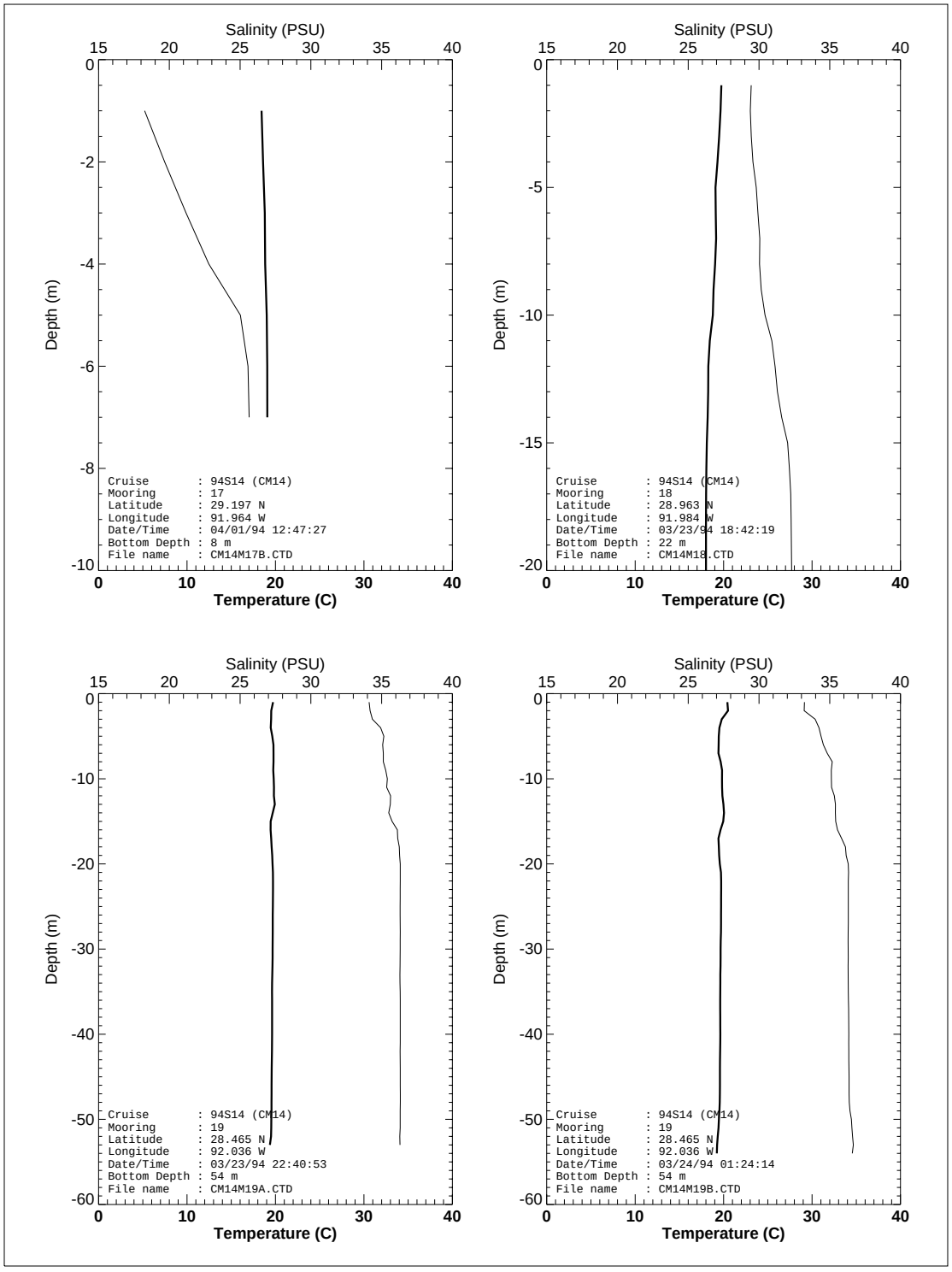

Figure 122. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

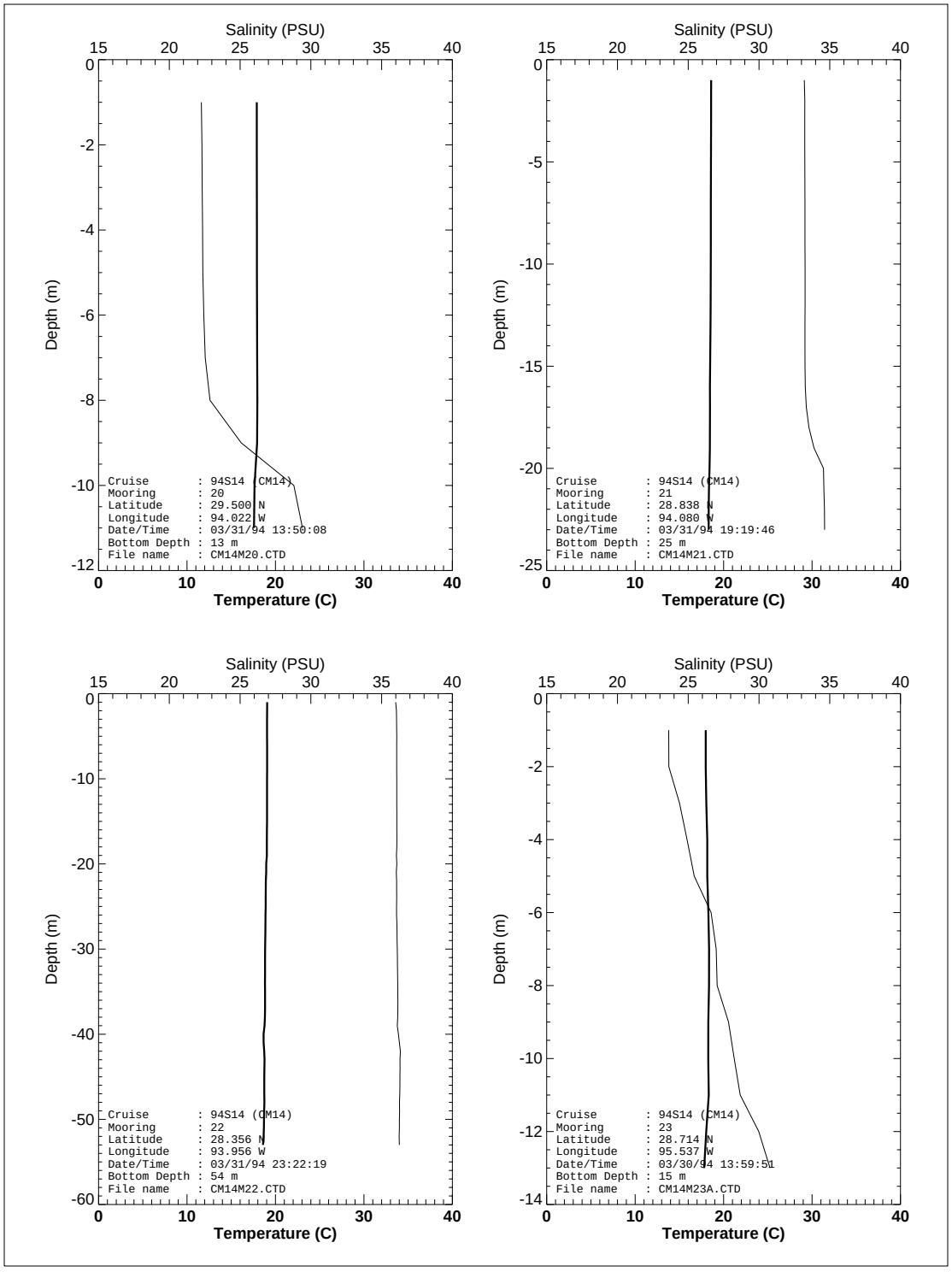

Figure 123. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

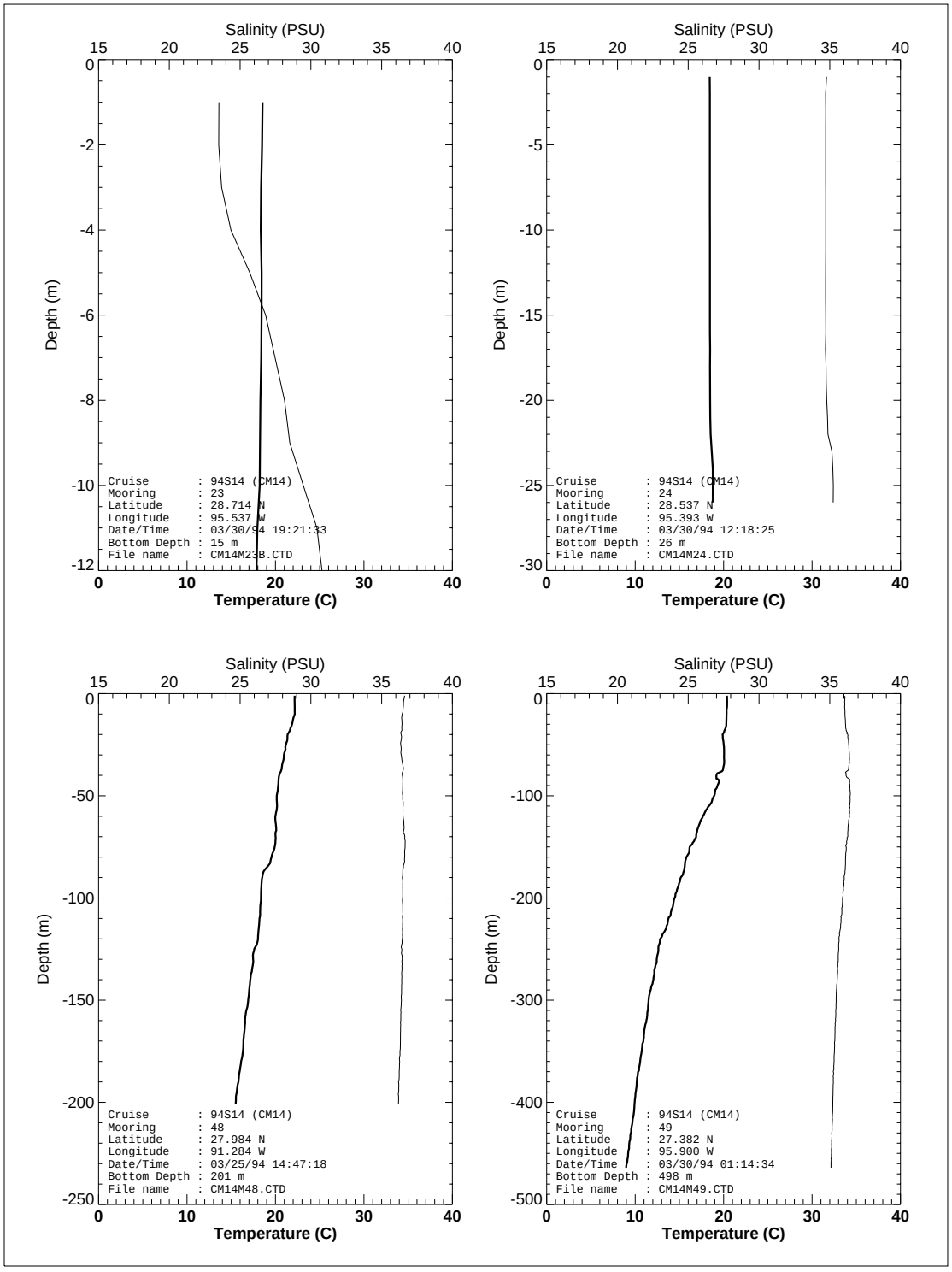

Figure 124. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

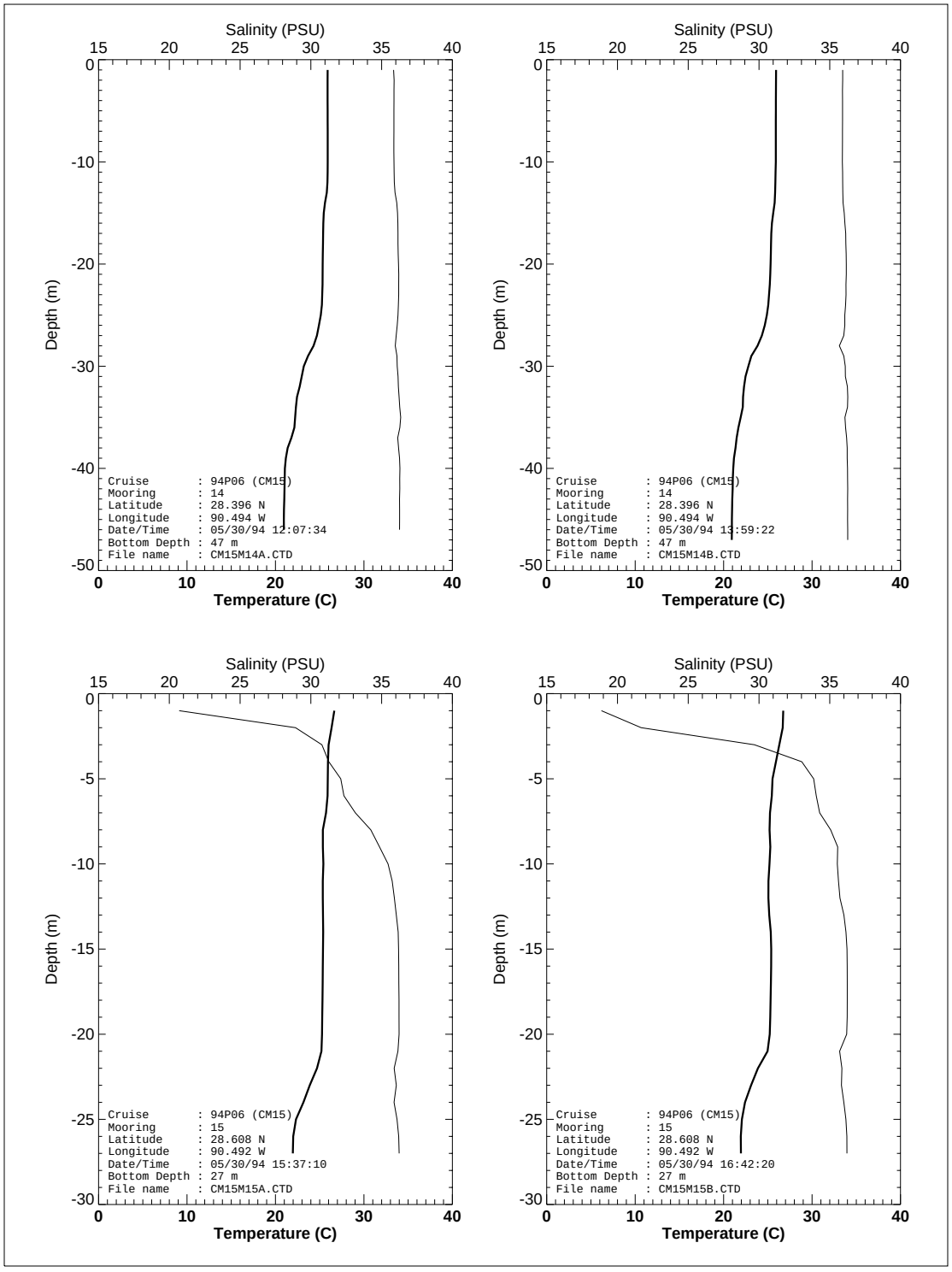

Figure 125. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

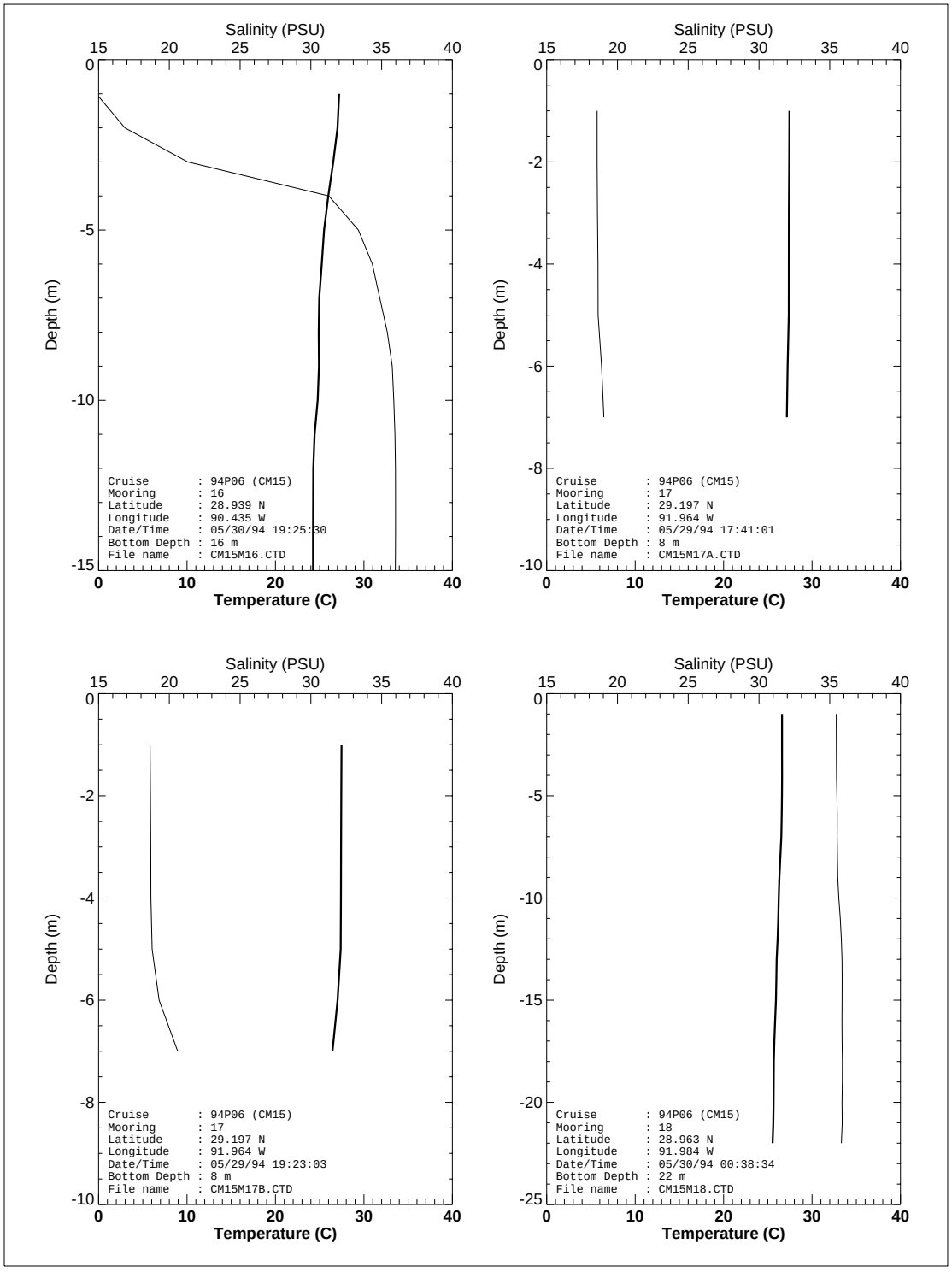

Figure 126. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

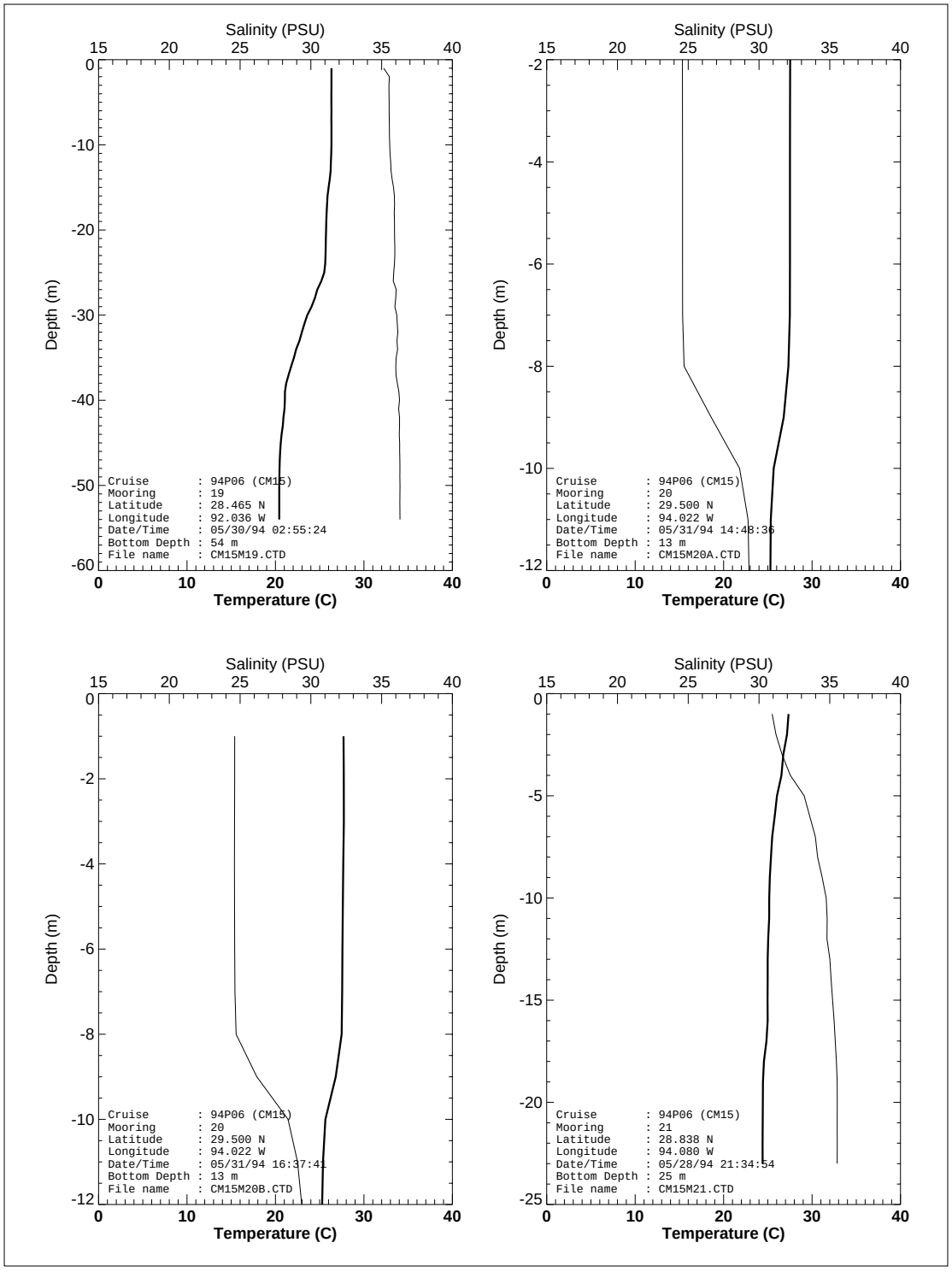

Figure 127. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

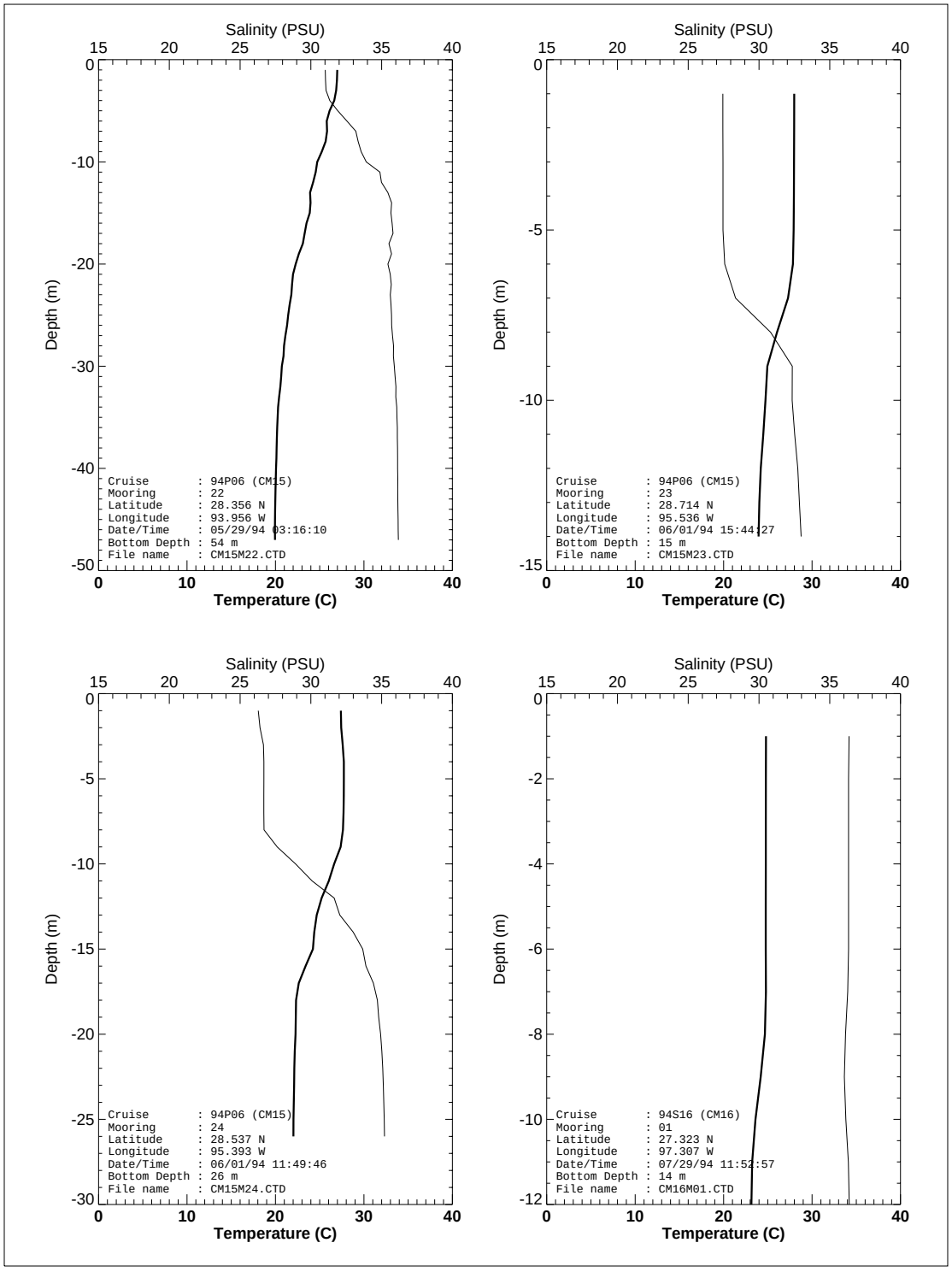

Figure 128. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

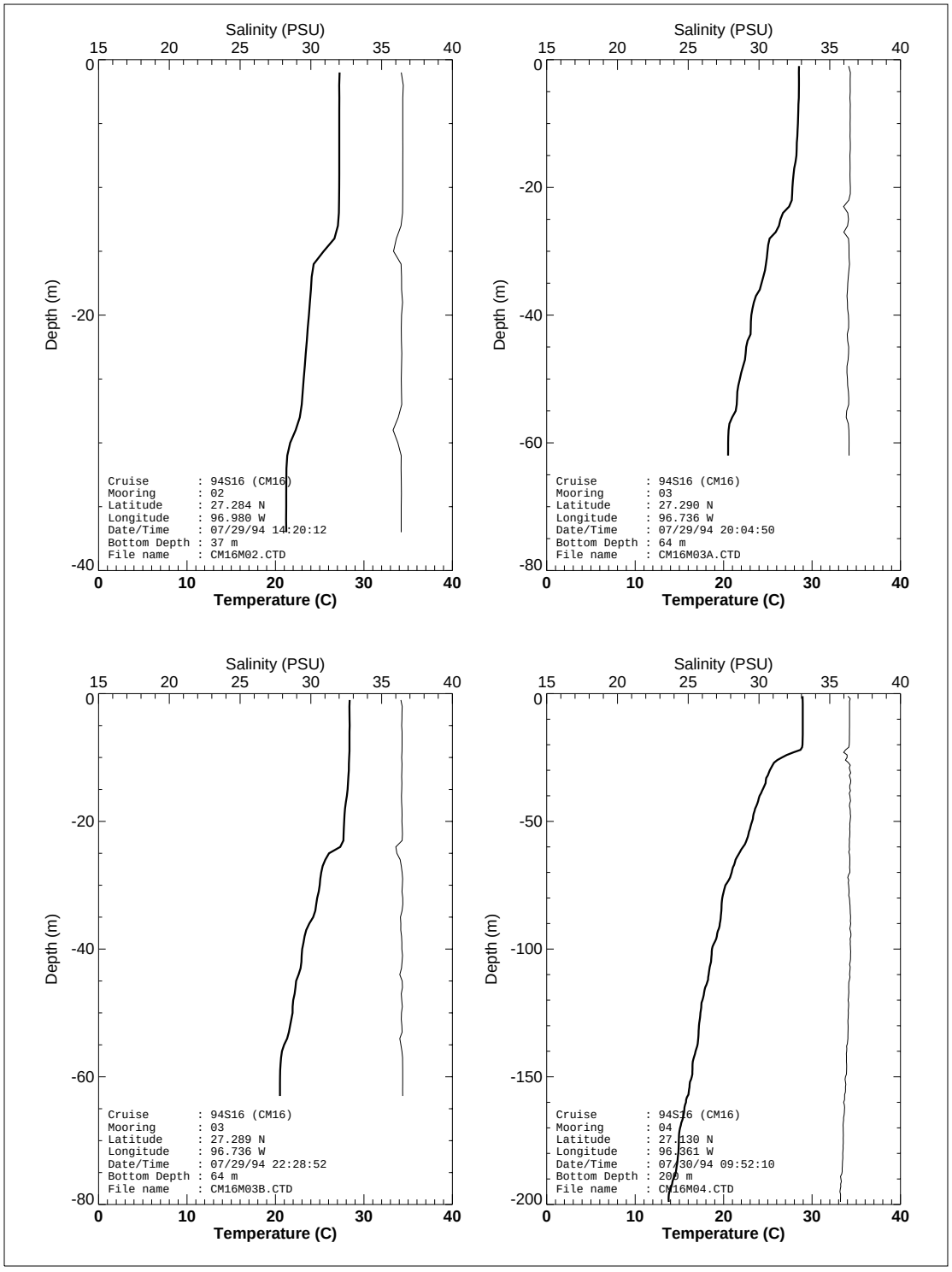

Figure 129. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

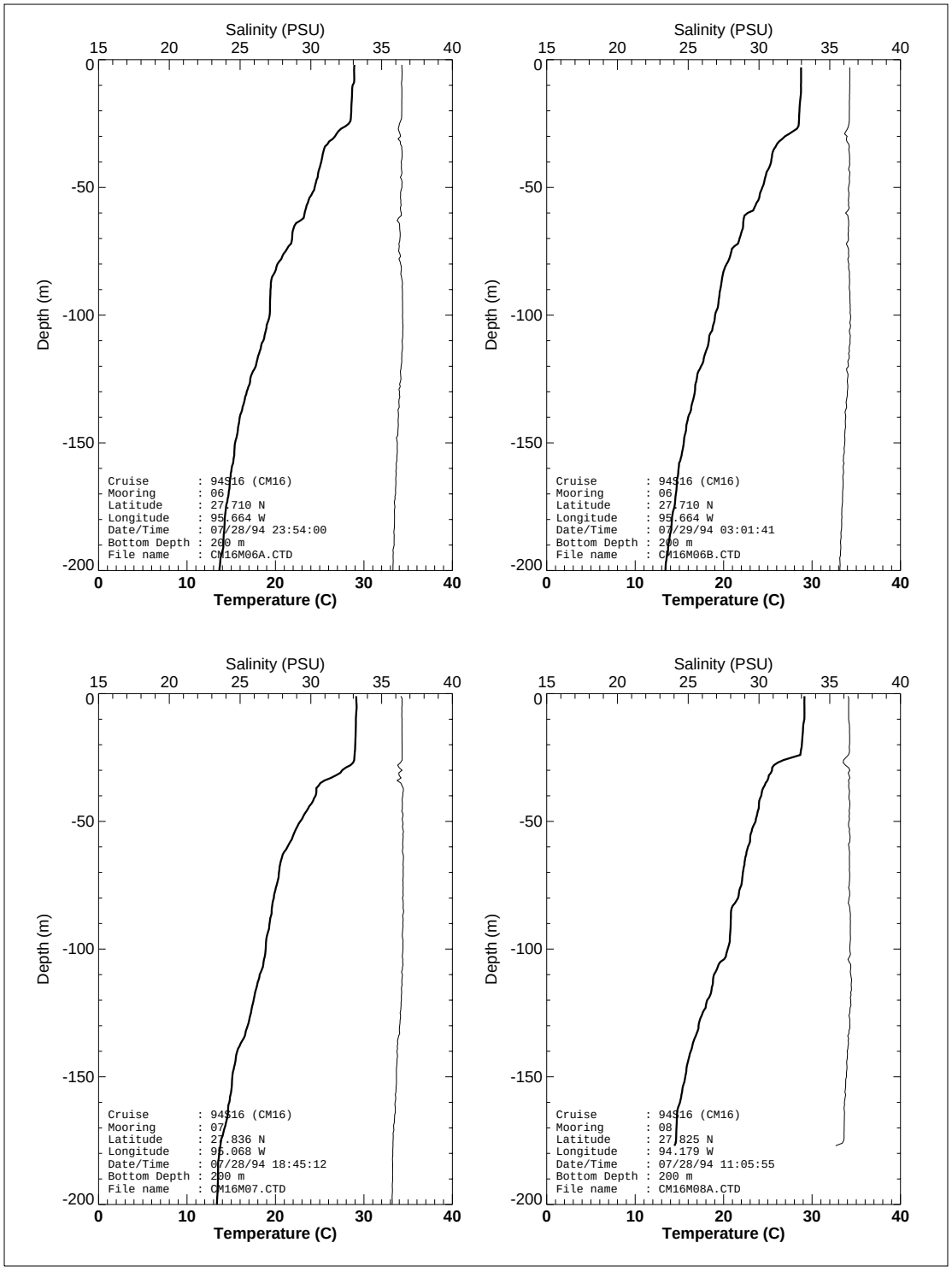

Figure 130. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

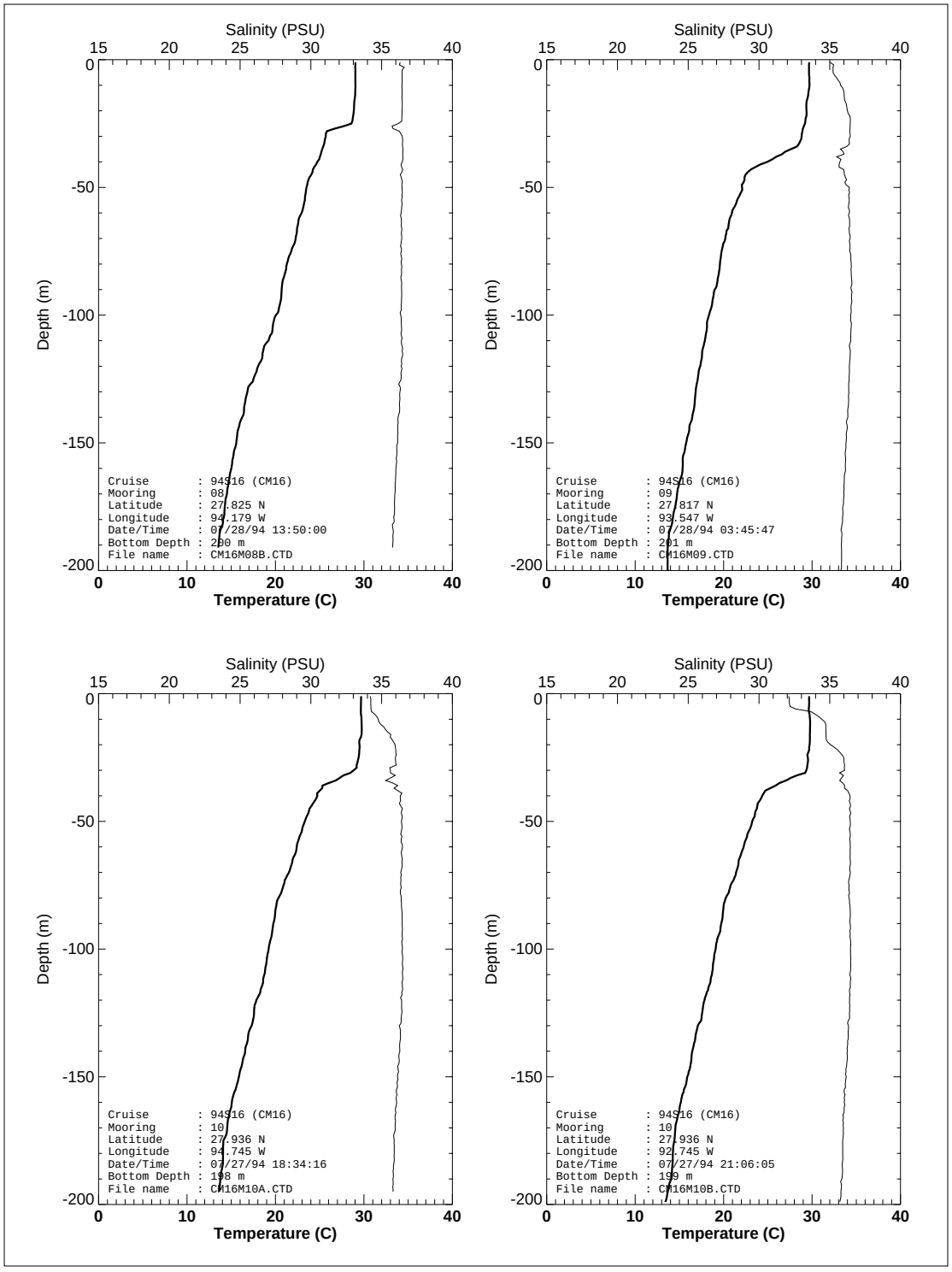

Figure 131. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

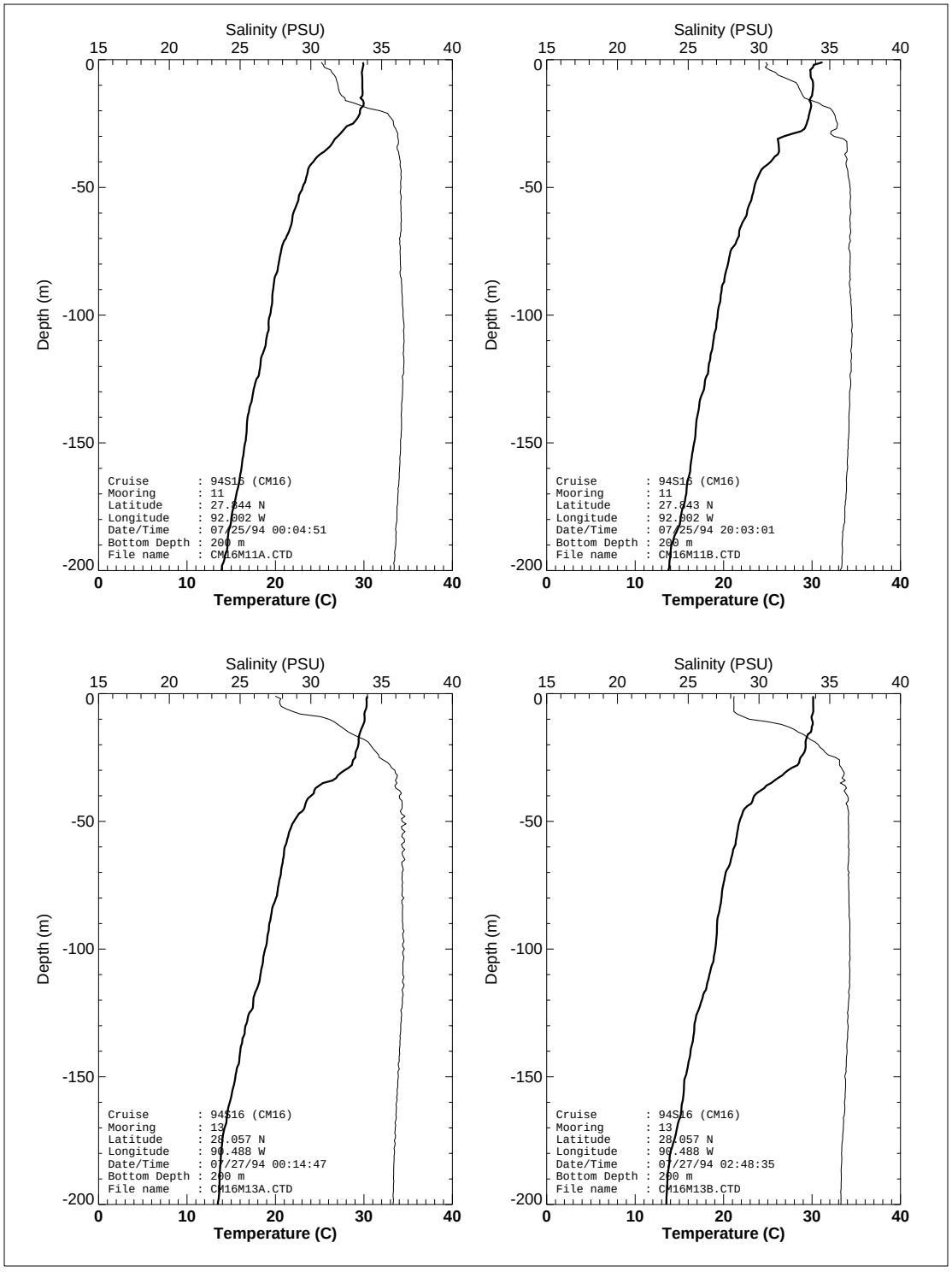

Figure 132. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

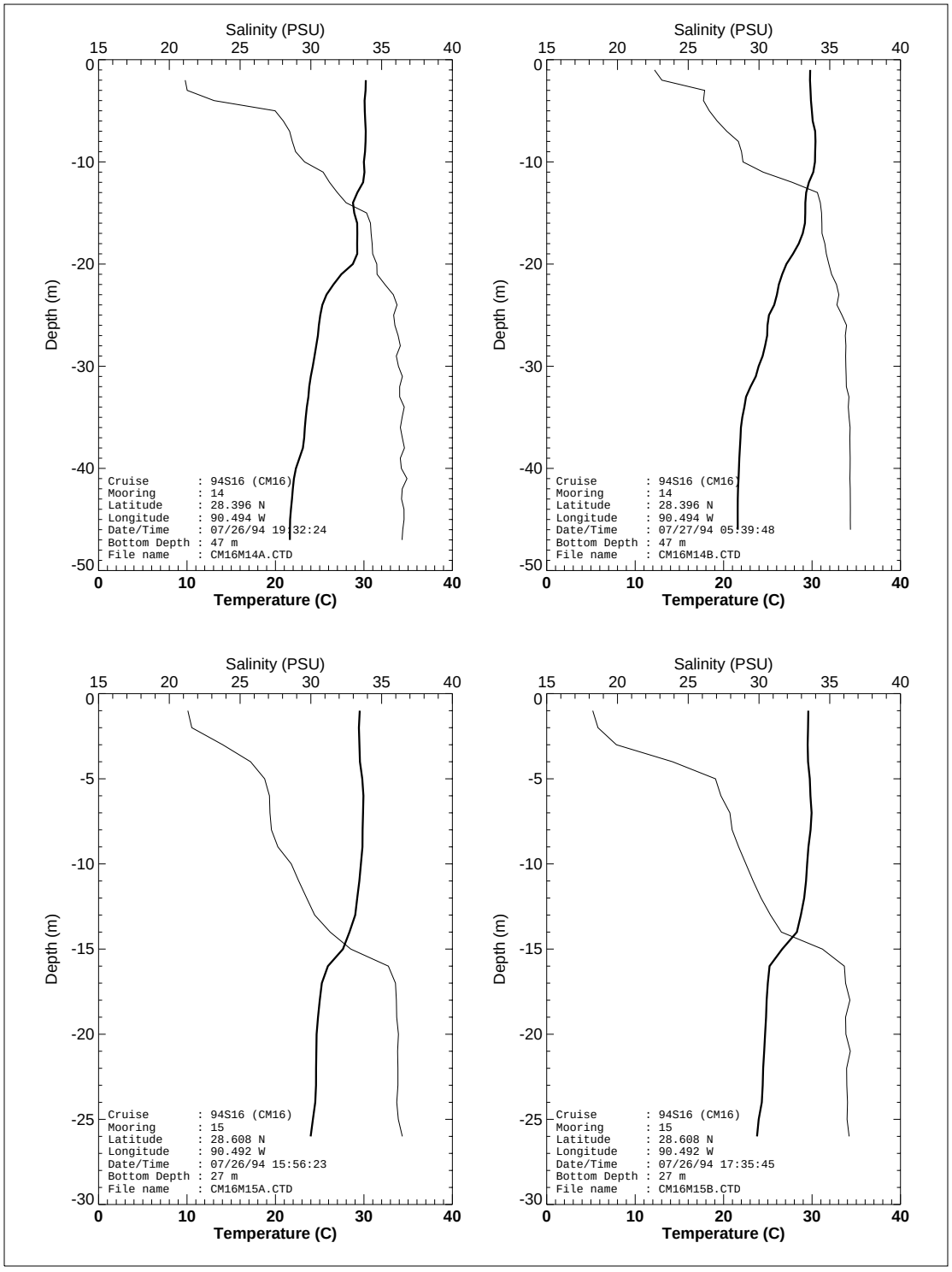

Figure 133. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

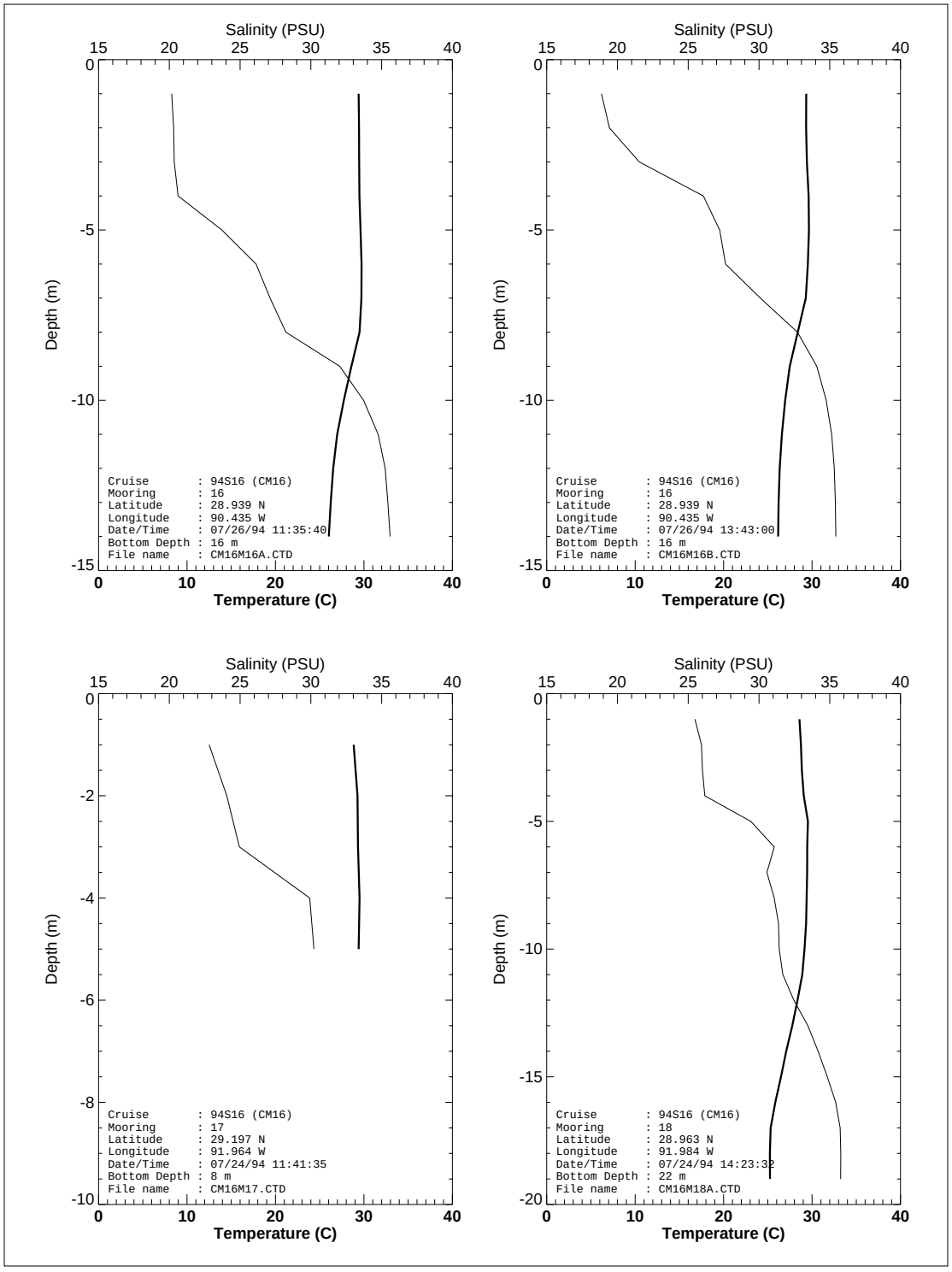

Figure 134. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

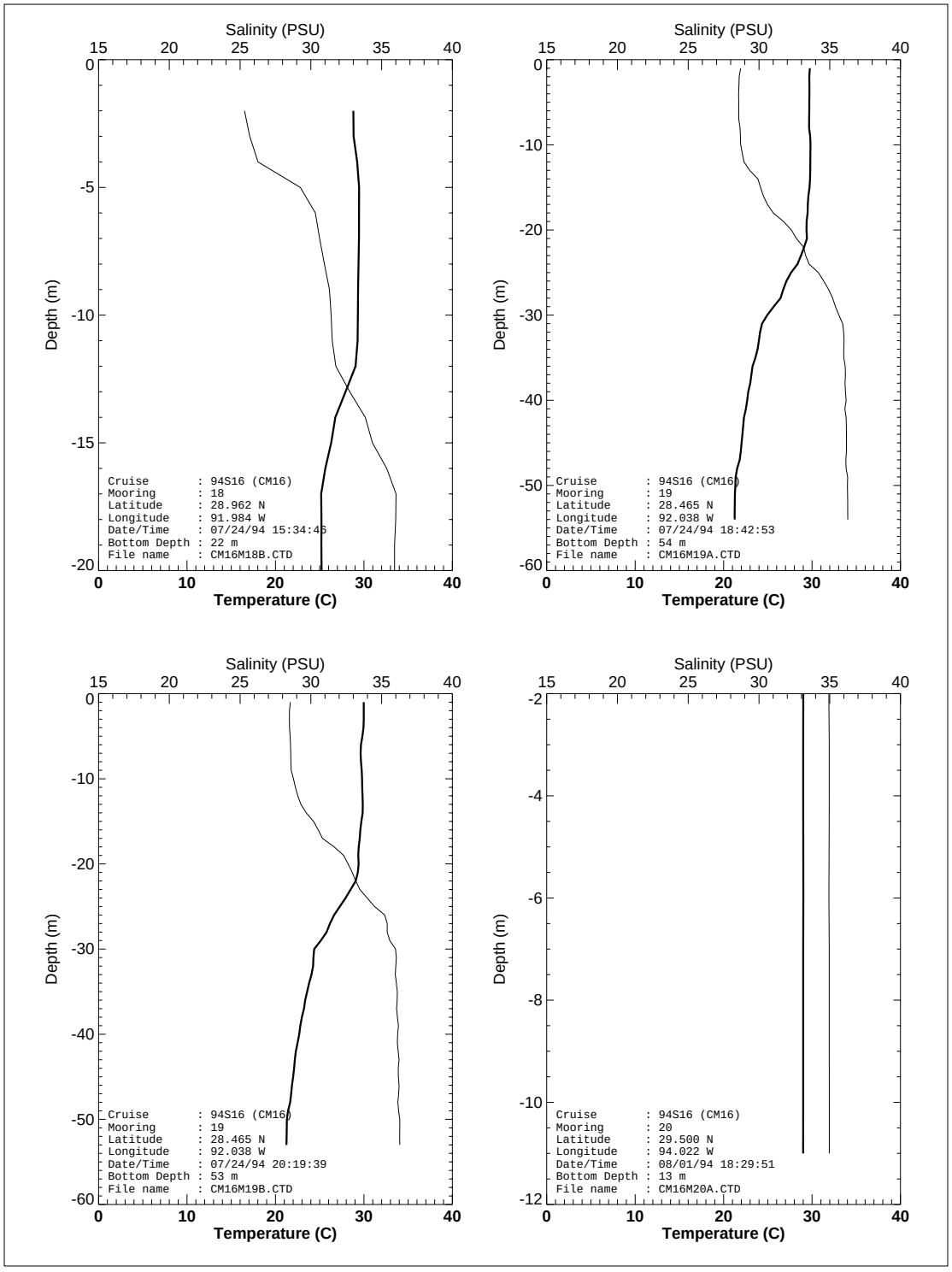

Figure 135. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

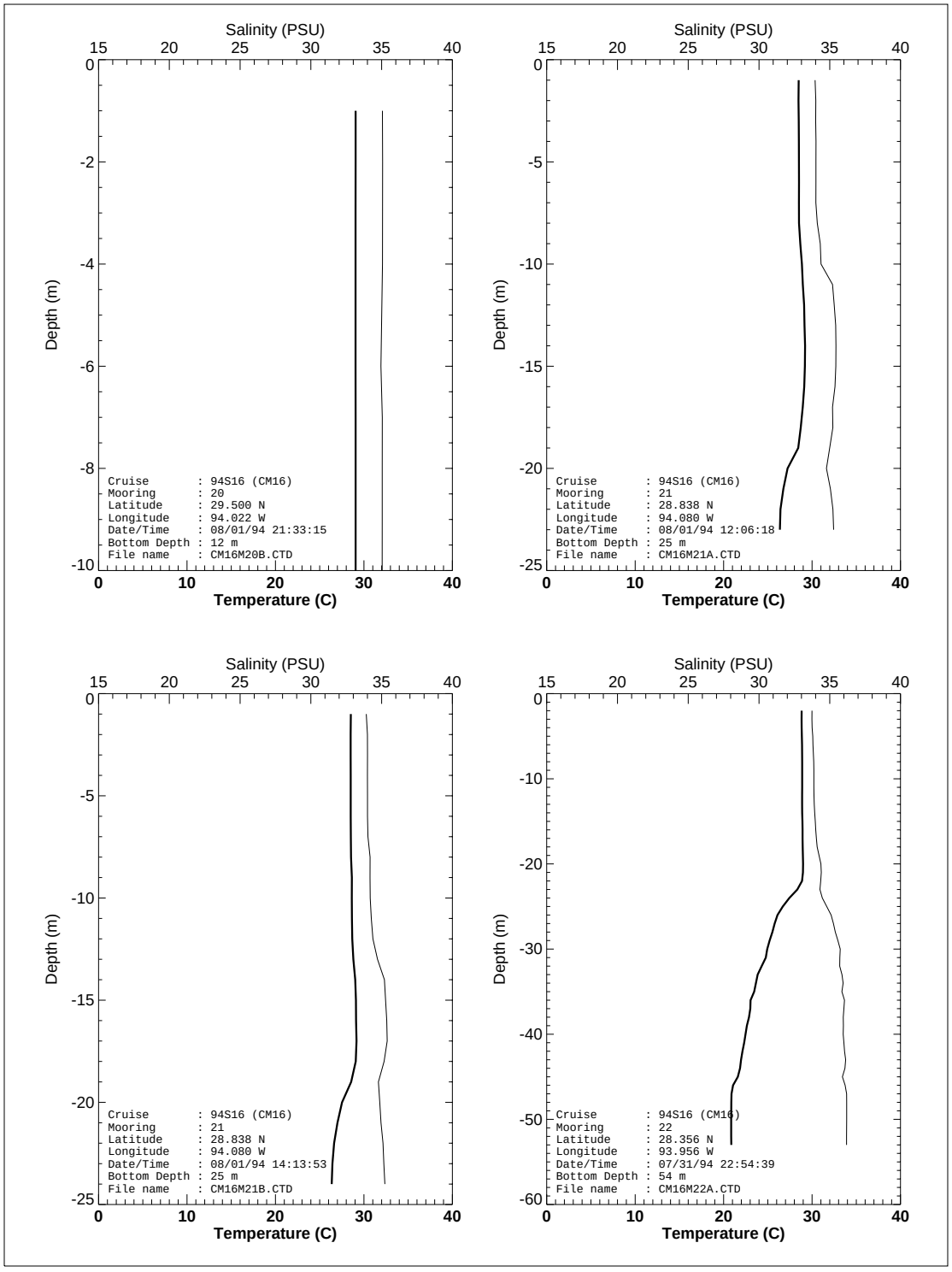

Figure 136. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

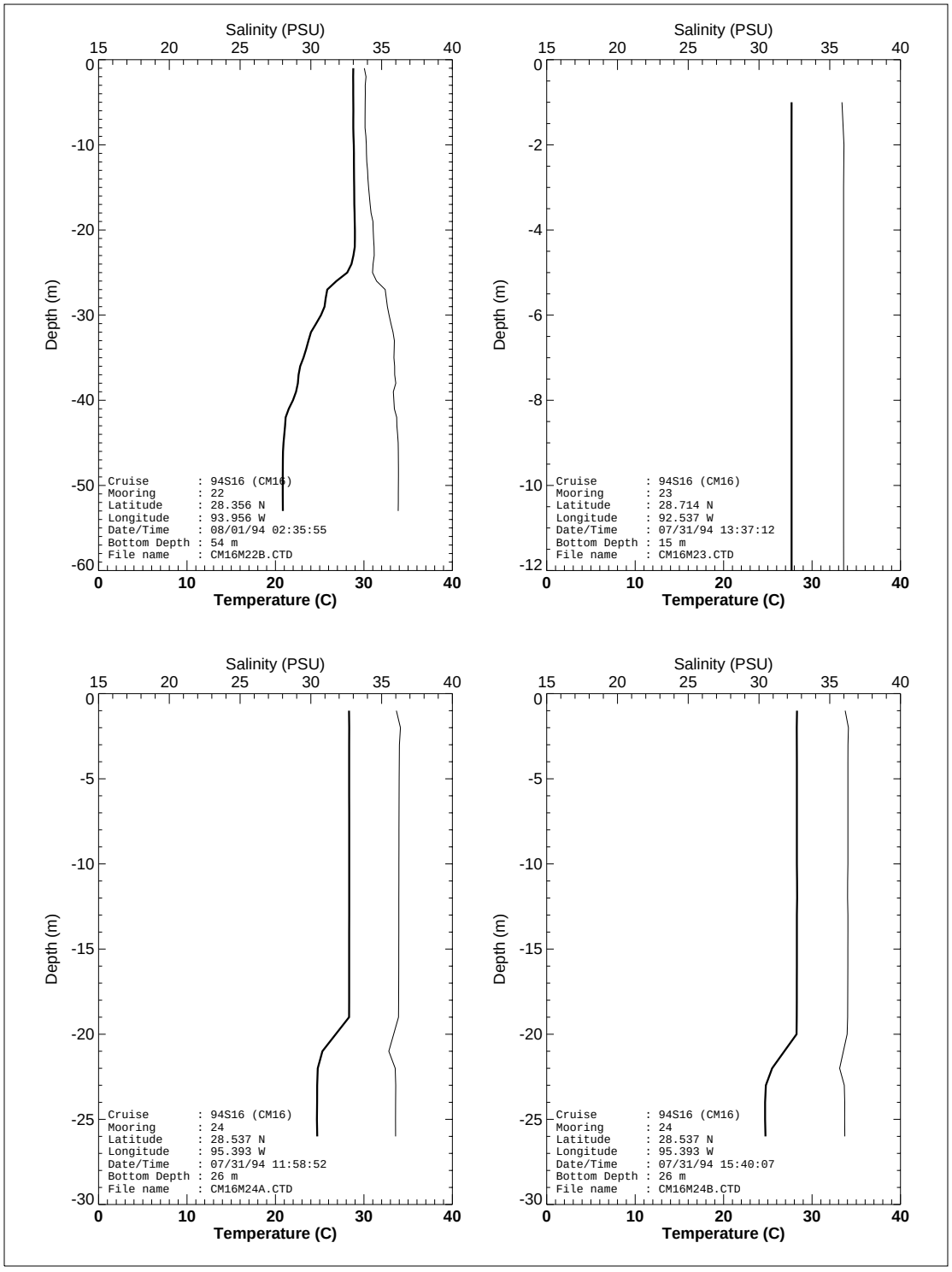

Figure 137. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

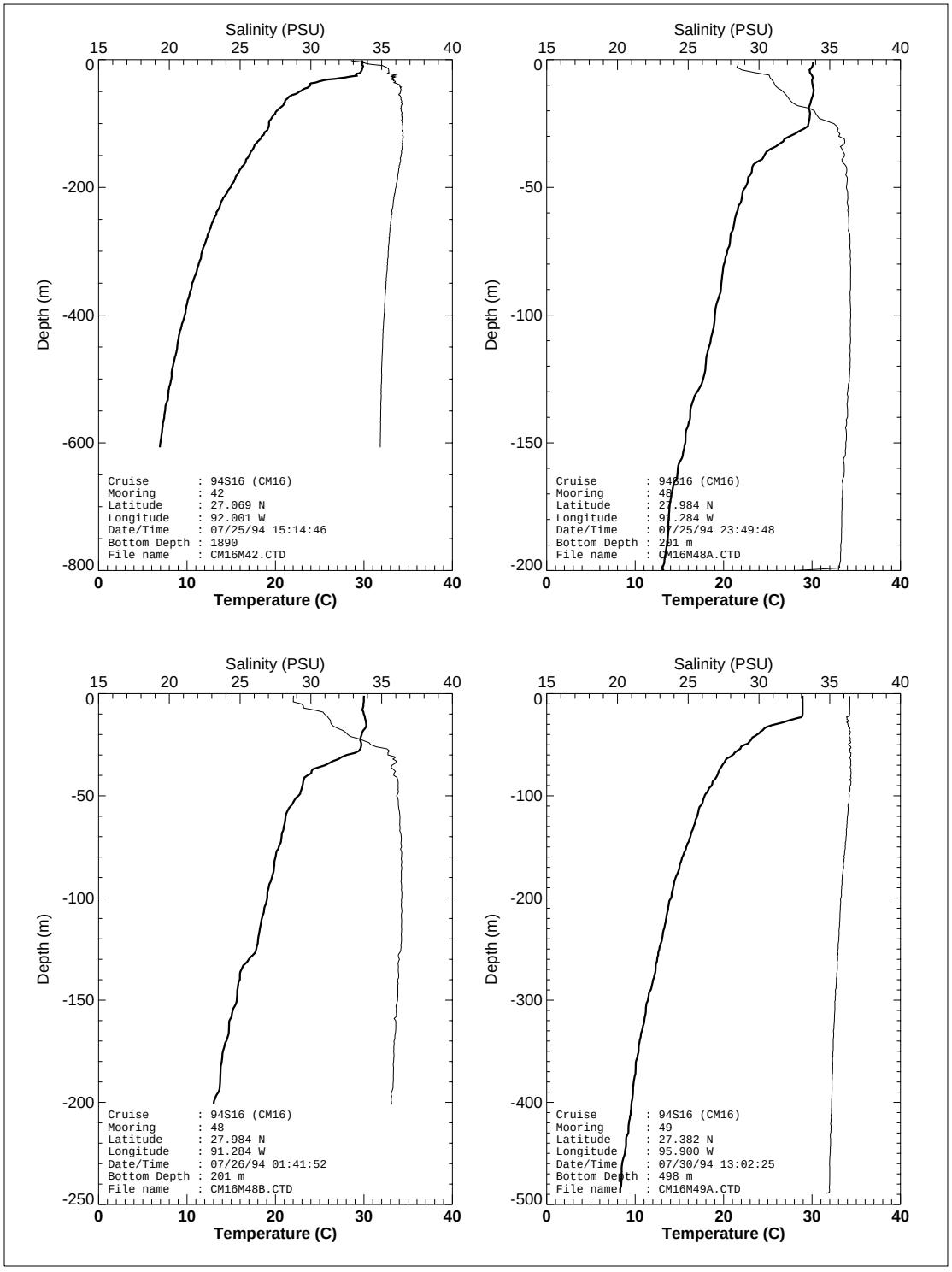

Figure 138. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

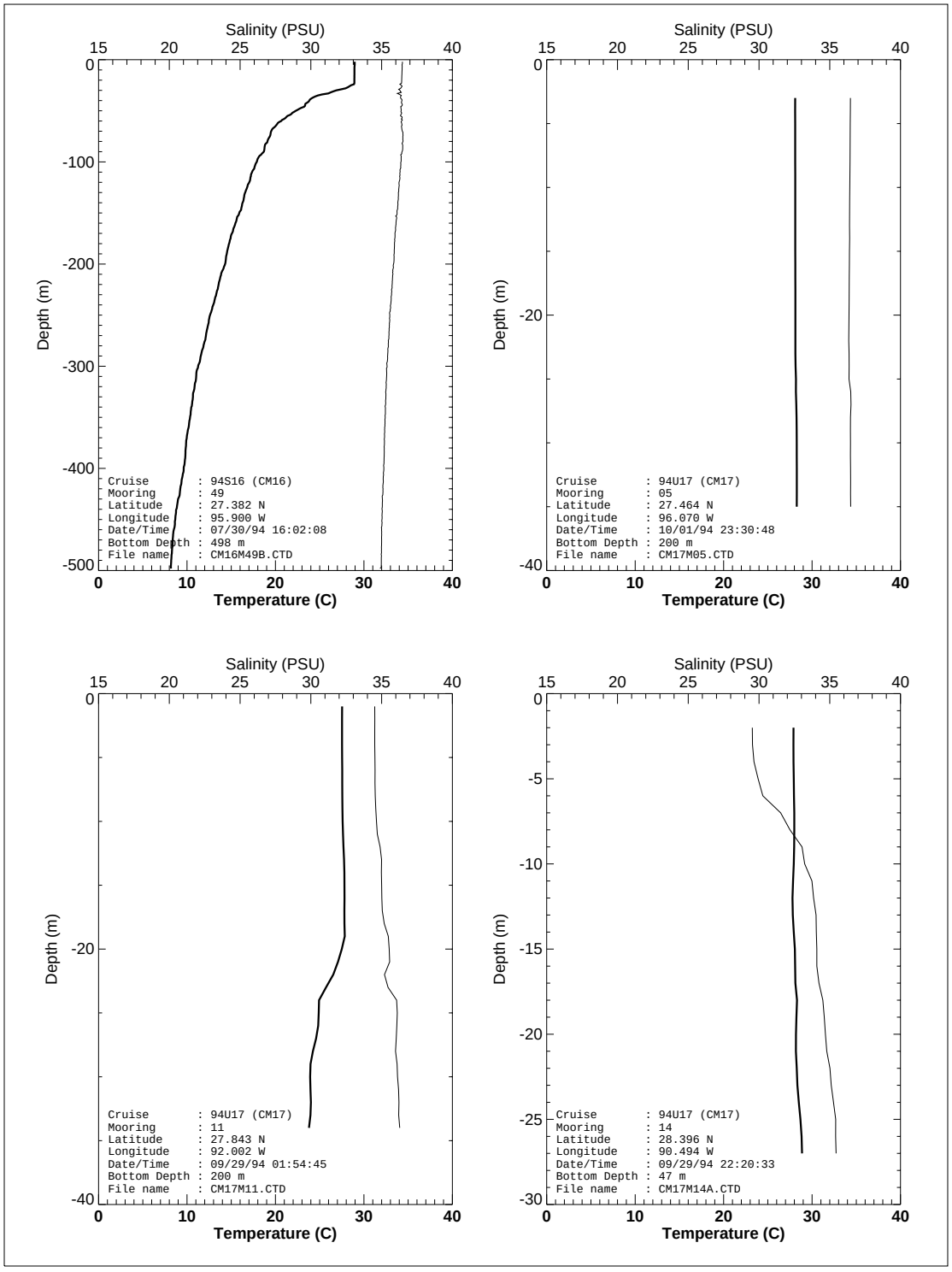

Figure 139. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

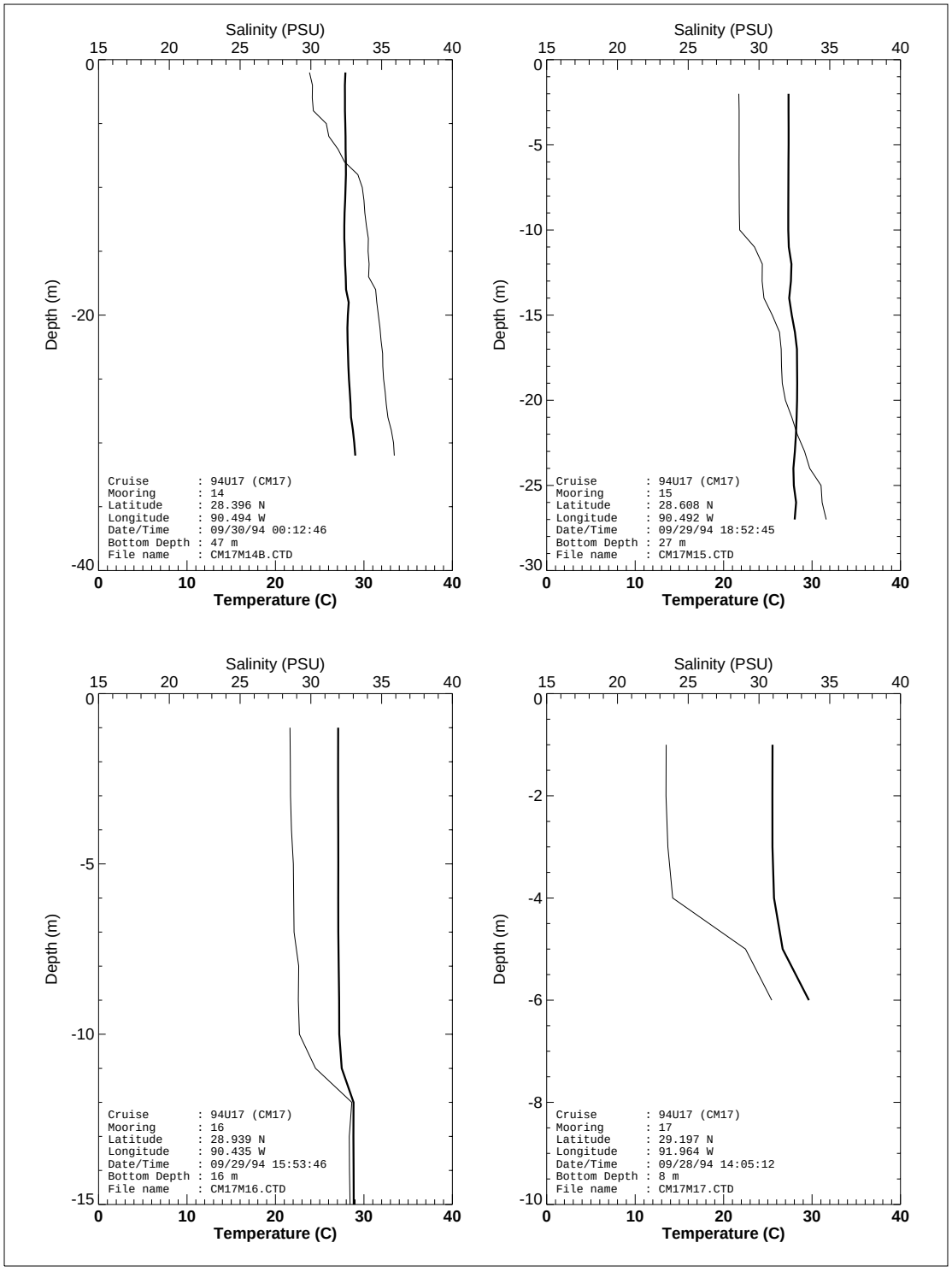

Figure 140. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

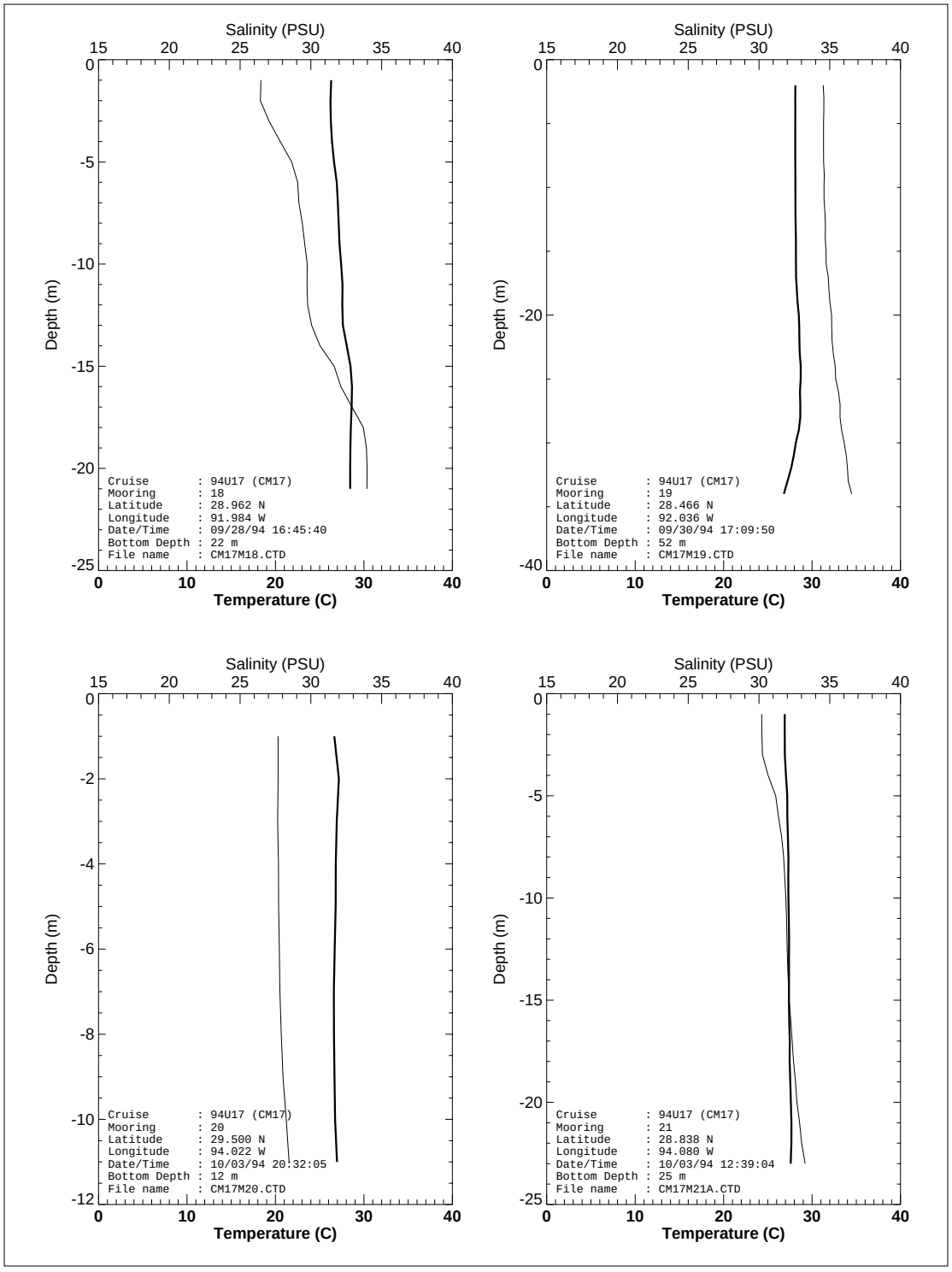

Figure 141. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

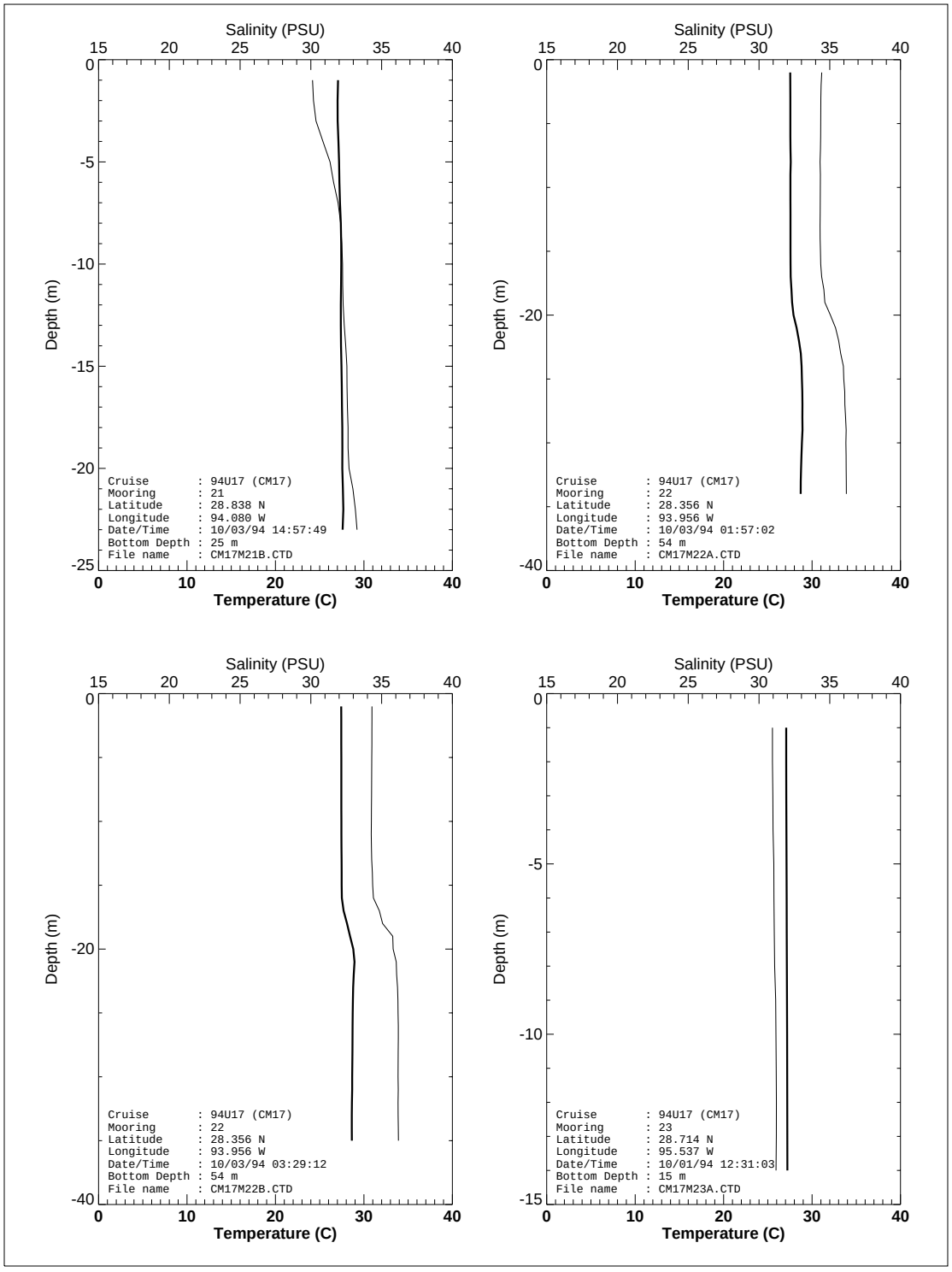

Figure 142. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

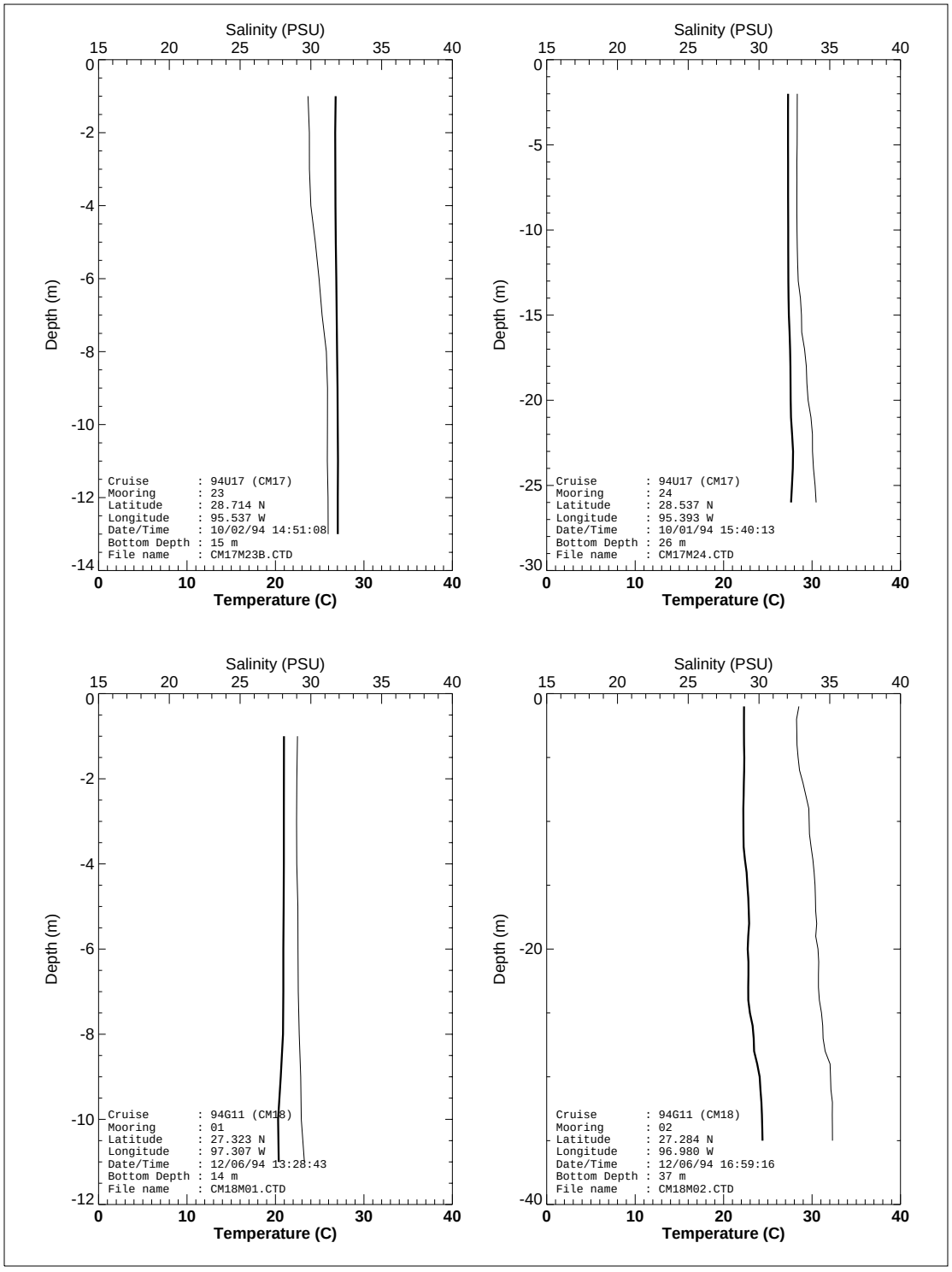

Figure 143. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

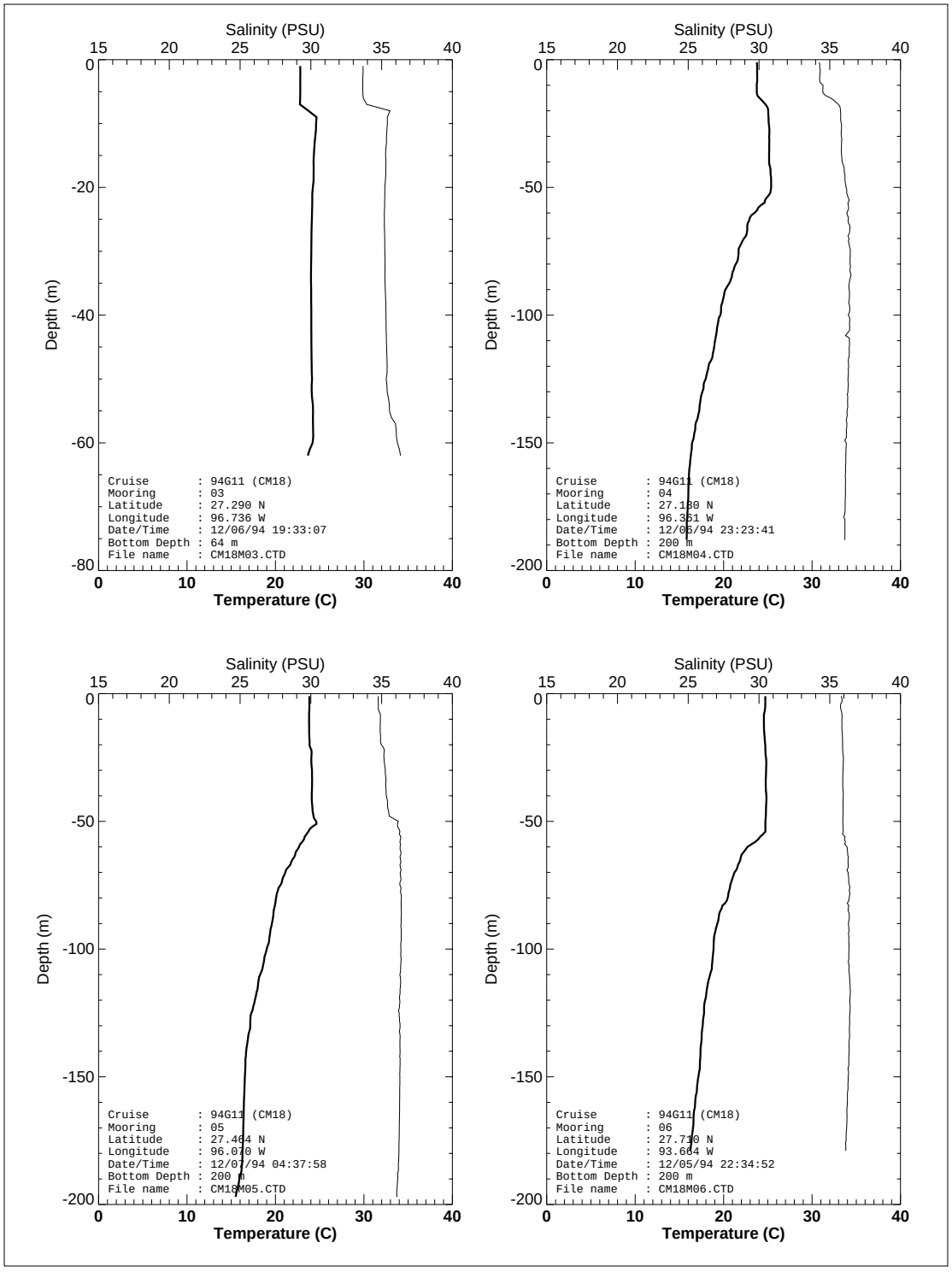

Figure 144. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

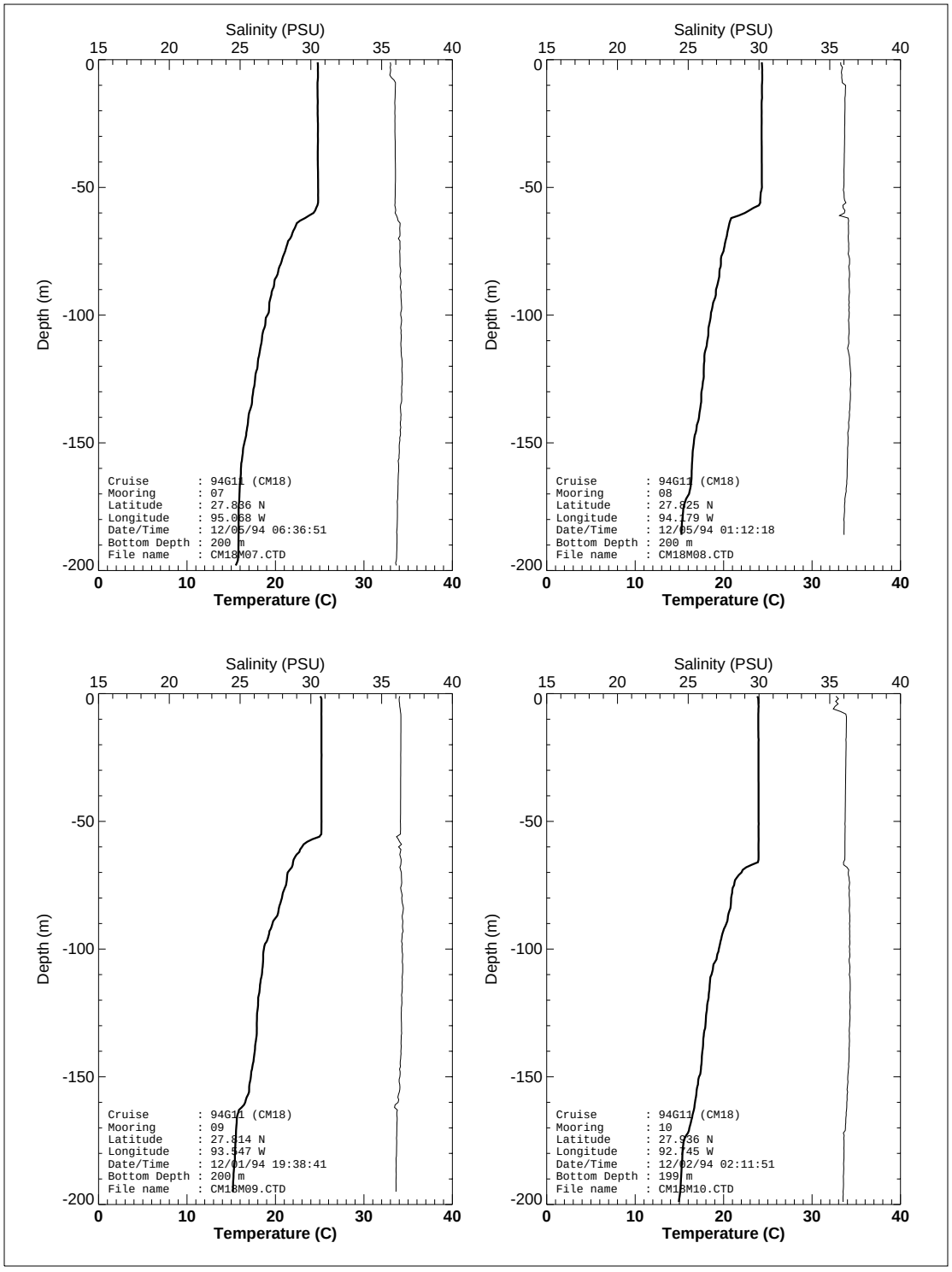

Figure 145. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

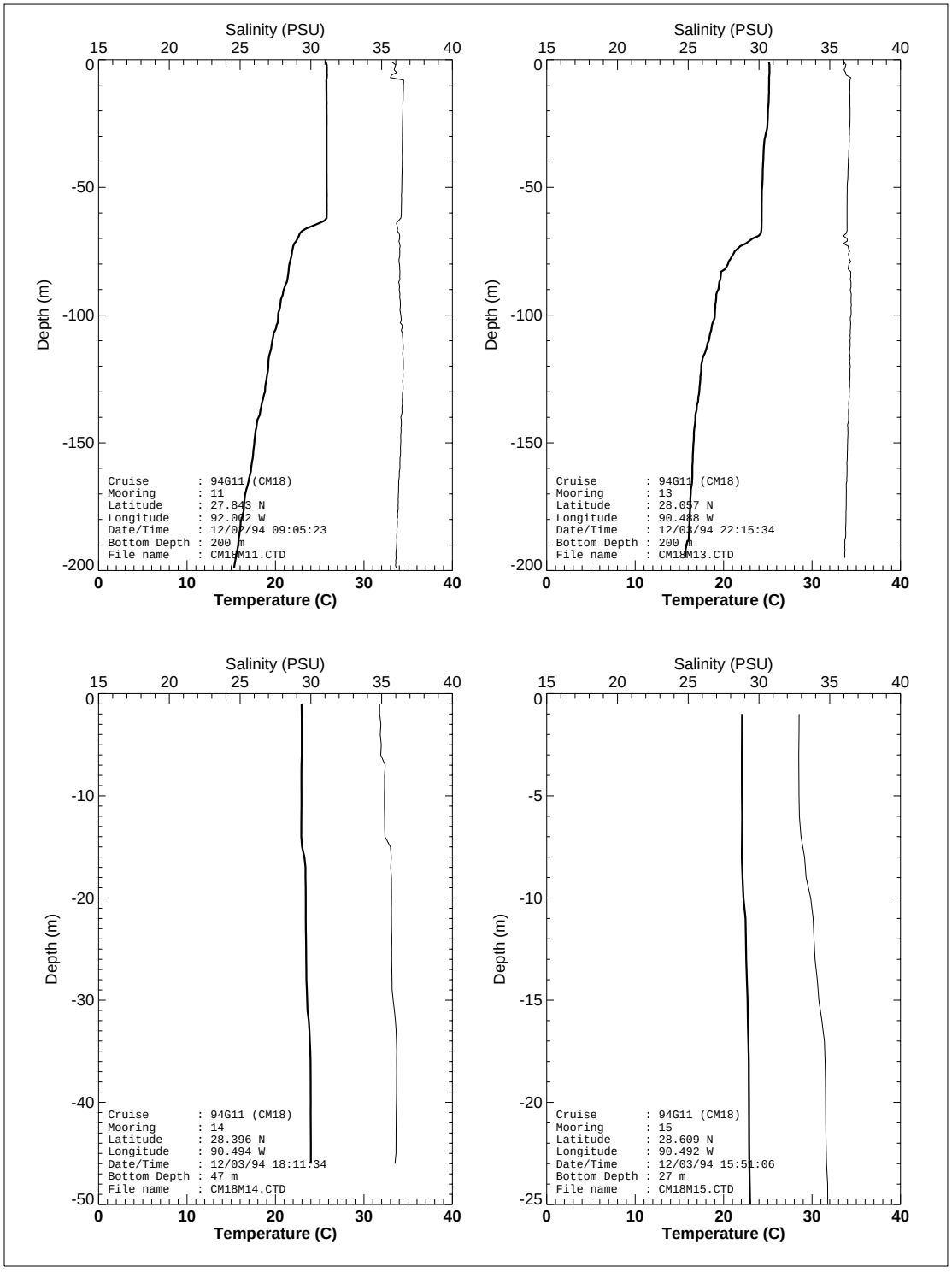

Figure 146. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

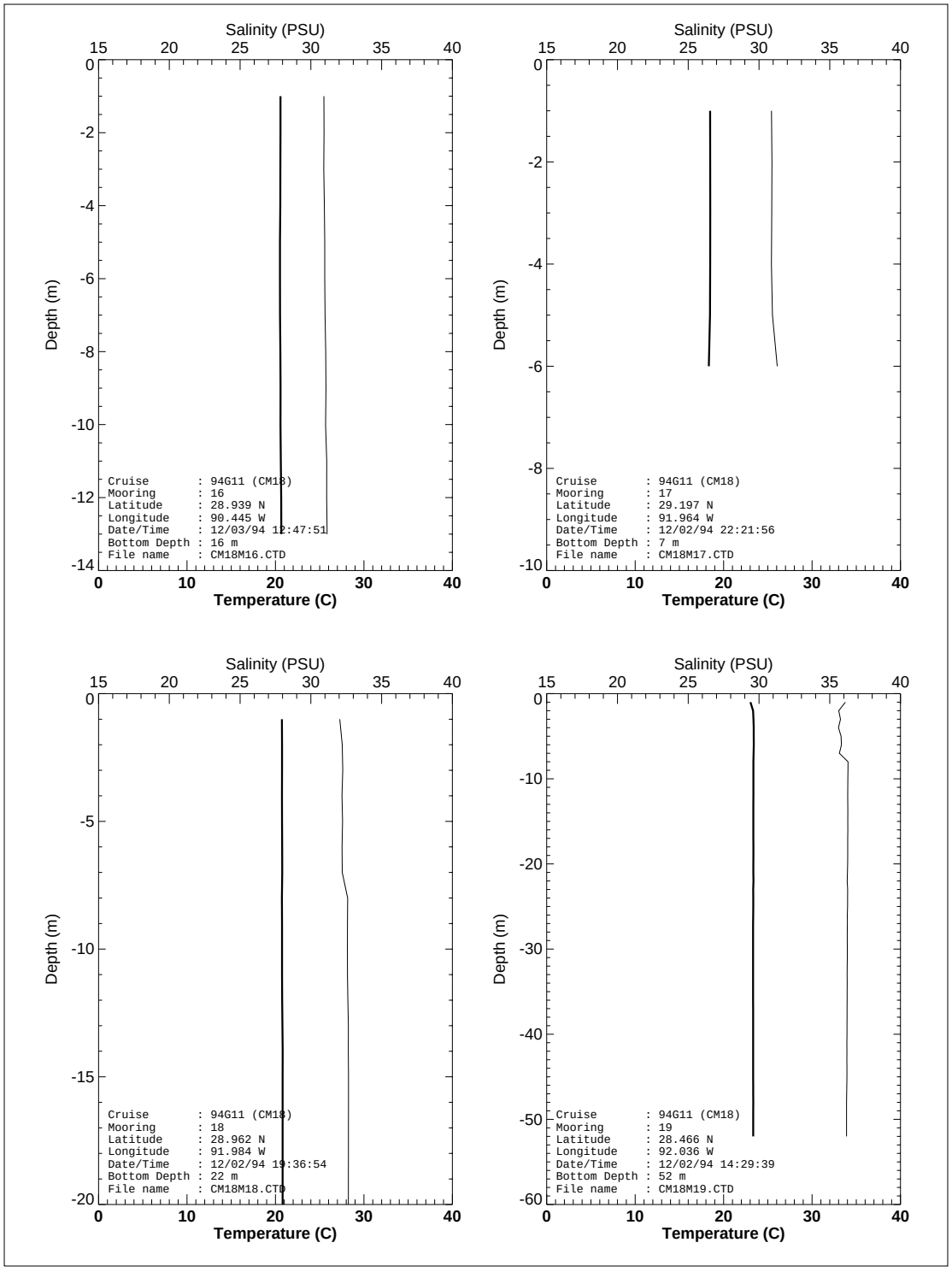

Figure 147. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

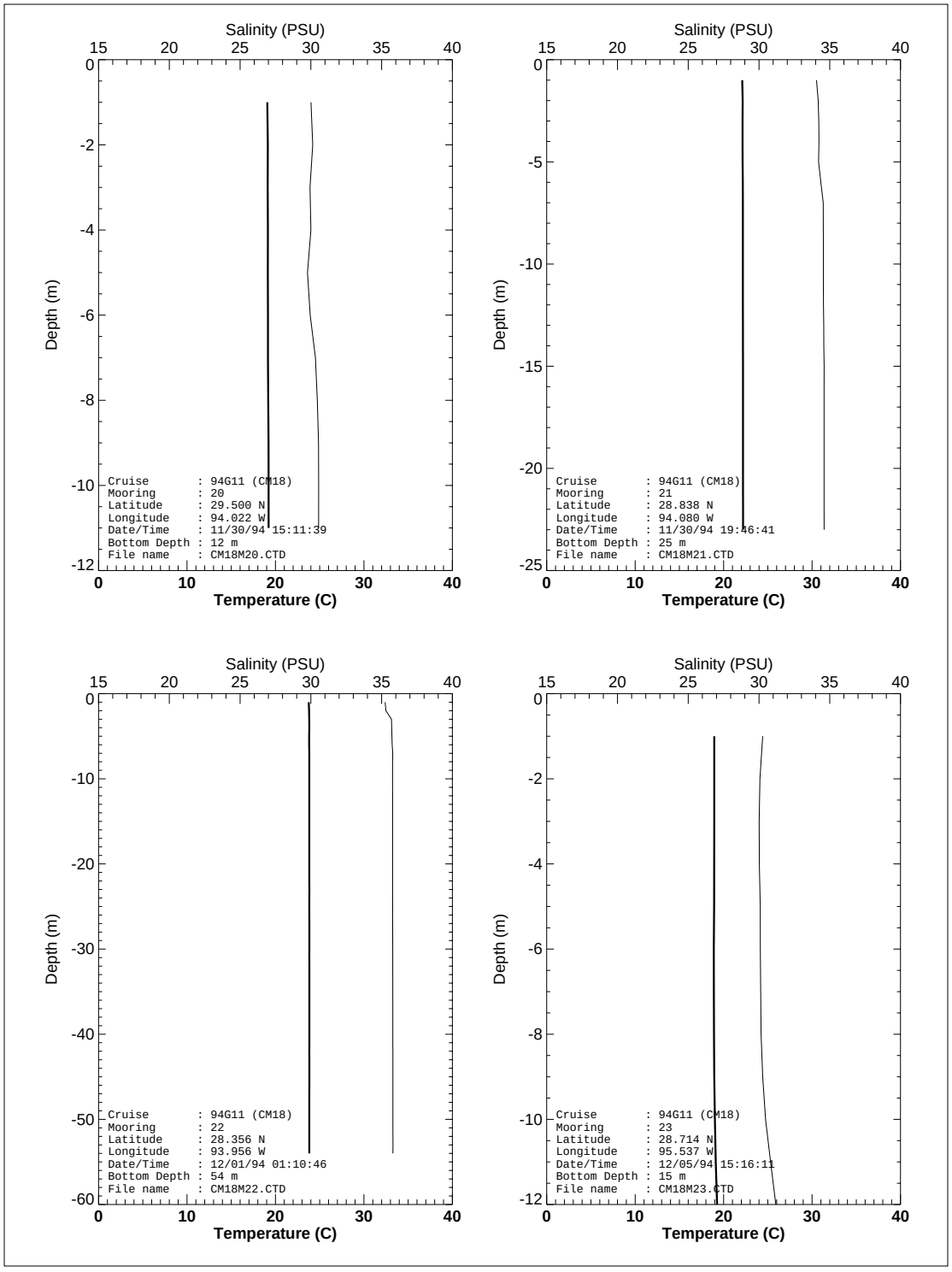

Figure 148. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

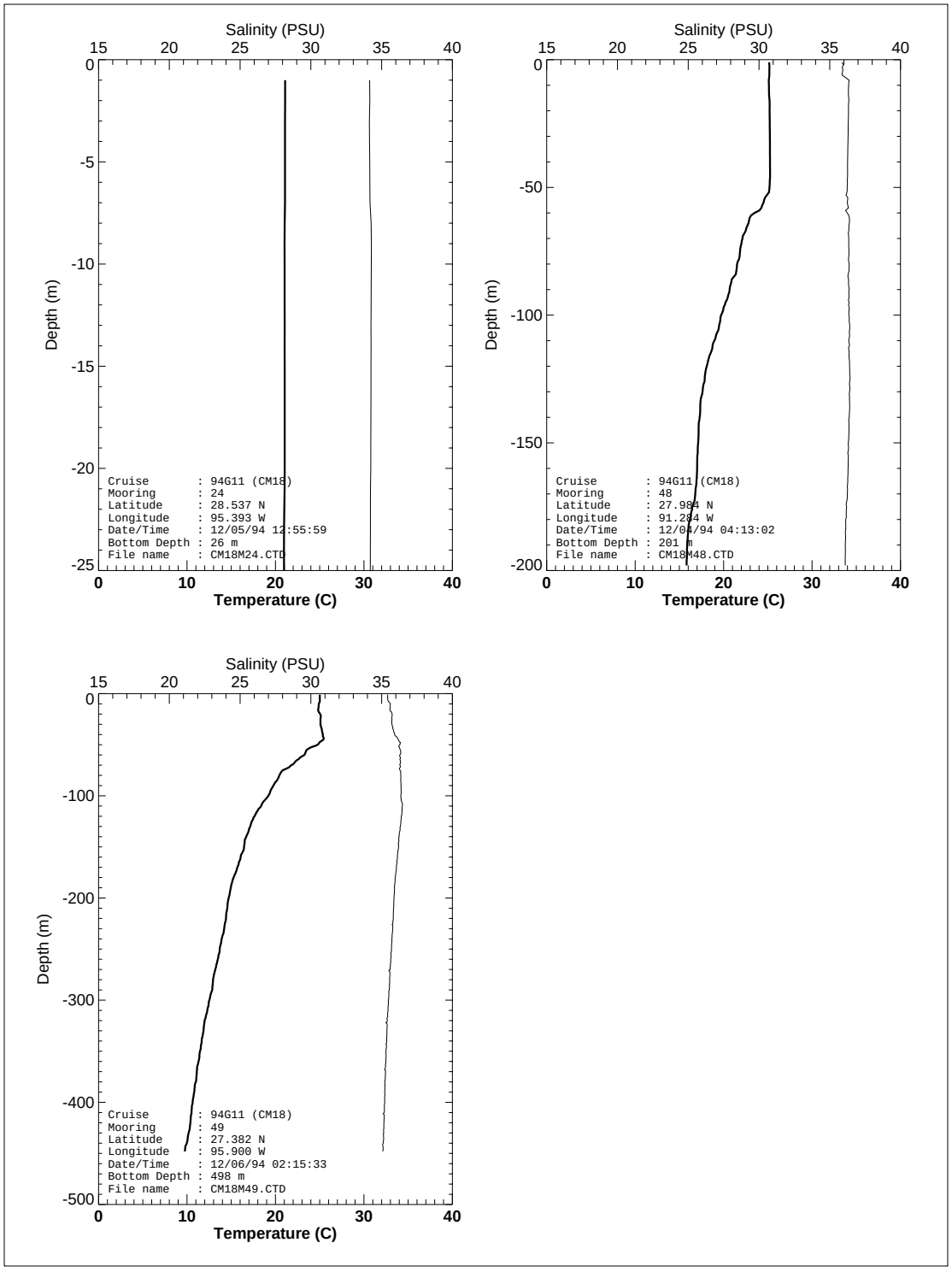

Figure 149. Temperature (bold) and salinity profiles for CTD casts during LATEX A current meter mooring maintenance cruises. Cruise number, mooring number, location, date/time (UTC), bottom depth, and file name are given on each plot.

Acknowledgments

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