CSDL Informal Technical Note No. 9

NOS HISTORICAL CIRCULATION SURVEY DATA RESTORATION: CHESAPEAKE BAY (1981-1983), COLUMBIA RIVER (1981), SAN FRANCISCO BAY (1979-1980), AND NEW YORK HARBOR (1980-1981)

Silver Spring, Maryland
November 2008

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service
Coast Survey Development Laboratory

Office of Coast Survey
National Ocean Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

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ABSTRACT

The purpose of this report is to document the restoration of the National Ocean Service (NOS) historical circulation survey data in Chesapeake Bay (1981-1983), Columbia River (1981), San Francisco Bay (1979-1980), and New York Harbor (1980-1981). Previous computer programs developed for Delaware River and Bay circulation survey data (2006) were used to analyze the conductivity-temperature-depth (CTD) and (conductivity-temperature and current) CT/Current data (Loeper, 2006; Richardson and Schmalz, 2006). Based on a review of the plotted CTD profiles, selected profiles were edited or discarded. Based on plots of salinity, temperature, current speed and direction at CT/Current moorings, temperature, salinity and current speed and direction spikes were filtered out of the record. Next current direction data were further clipped. Two new computer programs, largely based on the previous time series programs, were developed in this effort to consider the meteorological data (sea level atmospheric pressure, air temperature, and wind speed and wind direction).

Herein the data processing algorithms are first described. Each estuary is next presented in a separate chapter, including data inventories of both raw and processed data files, discussion of CTD, CT/current, and meteorological data processing followed by oceanographic considerations. Major data preservation and data use issues are then addressed. In conclusion, an overall summary is provided along with recommendations for additional data analysis tasks. The shell scripts required to run the programs along with sample input/output files are presented in Appendix A

1. INTRODUCTION

From 1979 through 1983, the National Ocean Service (NOS) conducted circulation surveys in the Chesapeake Bay (Browne and Fisher, 1986), Columbia River (Frey, 1984), San Francisco Bay (Welch et al., 1985), and New York Harbor (Browne and Dingle, 1983). To support the Model Evaluation Environment Project within NOS's Coast Survey Development Laboratory and the further development of the nowcast/forecast systems in these estuaries the conductivity-temperature-depth (CTD), conductivity-temperature and current (CT/Current), as well as meteorological data collected during these surveys were obtained from the Center for Operational Oceanographic Products and Services (CO-OPS) and then quality controlled and analyzed.

This report first reviews the data quality control and analysis programs in Chapter 2. In Chapters 3-6, the Chesapeake Bay, Columbia River, San Francisco Bay, and New York Harbor circulation survey data processing and analysis are considered, respectively. In each chapter, raw and processed data inventories, CTD vertical profiles, CT and current and meteorological data are presented. Time series of salinity, water temperature, current speed and direction data at CT/Current moorings are plotted. Water temperature, salinity, and current speed and direction spikes were filtered out of the record. Next current direction data were further clipped. Sea level atmospheric pressure, air temperature, and wind speed and direction data at meteorological stations are plotted. Sea level atmospheric pressure, air temperature, and wind speed and direction spikes were filtered out of the record. In Chapter 7, data preservation and data use issues are considered. In Chapter 8, conclusions and recommendations for future work are advanced. The shell scripts required to run each program along with sample input/output files are provided in Appendix A.

2. DATA PROCESSING ALGORITHMS

CTD Analysis

CTD casts were plotted using the CTD cast plot program entitled ctdcast_plot.f developed during the Delaware Bay circulation survey data restoration (Loeper, 2006). A revision added is the ability to plot the entire directory of CTD data casts, or only a set number of desired casts. This option was extremely helpful when observing CTD plots (then editing the CTD data files) using the DISPLAY graphics viewer.

Current and CT Analysis

The quality control of the current and CT data was performed using the program currnt.f developed during the Delaware Bay circulation survey data restoration (Richardson and Schmalz, 2006). The first use of this program is to plot salinity, temperature, current speed, and current direction data. After these plots have been observed, it can be determined which data sets require clipping, and which require editing.

The first variable read from the control file is initplot. With initplot set to 1, the program will plot the unfiltered, unedited data. For any changes, brought about either through filtering or through editing, to be observed in the plots, initplot must be set to 0. With initplot equal to 0, the program will automatically eliminate (filter) spikes in current speed data. However, the program will not automatically handle bad portions (multiple spikes or noise) of current speed data. When multiple spikes occur, the nedit option must be used.

The nedit portion of the program substitutes a null value for bad data. With nedit equal to 0, no editing will occur. If there are n segments of data requiring editing, then nedit will be set to n. The parameters which are required in the control file for a segment of data to be edited include: the station name, the depth of the reading, and the year in which the data was recorded. Also required are the start and stop dates for the bad data segment, and the integer indicator for each data type. If the salinity data is good, iedt_s is set to 0. If the salinity data requires editing, iedt_s is set to 1. The indicator for temperature data is iedt_t, the indicator for current data is iedt_cur.

For this usage, only those data segments of 15 days or longer are plotted. Also, information was printed to output file time.out2 for data segments of 15 days or longer. The information printed to time.out2 is particularly useful when editing data plots. This information includes the station number, the depth of the reading, the year of the reading, and the start and stop dates (Julian days) for the data segment. Also printed to time.out2 is the plot number. The plot number is particularly useful when using display to observe the plots, and from there, to edit data.

Meteorological Data Analysis

All meteorological data were from the AANDERAA instrument, so all data formats should be identical. After the identifying header information - station number, time, and

station location, the data fields are read in the order of temperature, wind stress, air pressure, wind gust speed, and average wind speed.

The program meteor.f was used to plot meteorological data including air temperature, air pressure, wind speed, and wind direction. The plots were used to further quality control and remove bad data. Filtering is performed by the subroutine filt. This routine seeks to remove outliers by use of a statistical method, involving breaking the data set down into smaller subsets, calculating the mean of the subset, then calculating the probability distribution of that subset. Outliers which exceed xbar by more than three standard deviations, or outliers which fall below xbar by more than three standard deviations, are replaced by non-outlier points. A second process for the removal of outliers has been added. This method simply compares the magnitude of adjacent data points. If the difference in magnitude is larger than a user set value, the point is considered to be an outlier. Used together, these two methods provide a very effective process for the filtering of data.

3. CHESAPEAKE BAY

The datasets obtained from CO-OPS on compact disc are listed in Table 3.1. It was necessary to carefully inventory these datasets and determine their data quality. *Several datasets were duplicated and a large portion of the CTD data was not further processed due to lack of time stamp information.*

Table 3.1. Chesapeake Bay Circulation Survey Raw Data Inventory.
Italicized Directories were processed.

Directory Name	Number of Files	Data Period	Data Description	Data Quality
CHES1	59	1981, 1982	Grundy Current Meter	OK
CHES1	92	1981, 1982	Aanderaa Current Meter	OK
CHES2	143	1983	Aanderaa Current Meter	OK
CHES2-1	137	1983	Aanderaa Current Meter	OK
CHES2-2	115	1982, 1983	Aanderaa Current Meter	OK
CHES3	96	1981	Grundy Current Meter	OK
Current-CTD-MET	2 *	1981, 1983	Grundy CTD, AML CTD	OK
Current-CTD-MET	6 **	1981, 1982	Grundy Current Meter	OK
Current-CTD-MET	14 **	1981, 1982, 1983	Aanderaa Current Meter	OK
CTD-MET/CRAZY1	289	No Time Stamp	Grundy CTD	Not Processable
CTD-MET/CRAZY2	6	1981	Aanderaa MET	OK
CTD-MET/CRAZY3	11	1982	Aanderaa MET	OK
CTD-MET/CRAZY4	300	No Time Stamp	Grundy CTD	Not Processable
CTD-MET/CRAZY5	77	No Time Stamp	Grundy CTD	Not Processable
CTD-MET/CRAZY6	18	1983	Aanderaa MET	Not Processable Bad Format
CTD-MET/CRAZY7	179	No Time Stamp	Grundy CTD	Not Processable

Notes: * Contains 289 and 180 casts, files1 and 2, respectively. Duplicated in CRAZY1 and CRAZY7, ** Duplicated in other directories

In Table 3.2, the raw, edited, and final quality controlled datasets are given along with their location in the CSDL/MMAP SAN. The general processing approach was to keep the same file structures as the original datasets. Each dataset was plotted, edited if necessary, and then written to output files in exactly the same format as the original data. Under this approach data for a given station are often available over several different datasets.

Table 3.2. Chesapeake Bay Circulation Survey Processed Data File Inventory

Data Type	Location	Filename
CTD Raw	~/ctd/profile/CTDraw/	CHCT01_clean, chct03_clean
CTD Edited	~/ctd/profile/CTD_edit/	CHCT01_ed (Grundy), chct03_aml.ed,chct03_Grndy.ed
CTD Qc	~/ctd/profile/final/	CHCT01.final, CHCT03_aml.fin, CHCT03_grn.fin
CT/Current Raw	~/CHES1/ches1raw/, ~/CHES2/ches2raw,/ ~/CHES3/ches3raw/, ~/CHES2-1/ches2-1raw/, ~/CHES2-2/ches2-2raw/	FILE1 - FILE192, FILE1 - FILE143, FILE1 - FILE96, FILE1 - FILE137, FILE1 – FILE115
CT/Current Edited	~/CHES1/, ~/CHES2/, ~/CHES3/, ~/CHES2-1/, ~/CHES2-2/	file_ches1, file_ches2, FILE_all, file_ches2.1, file_ches2.2
CT/Current Qc	~/current/qc/	ches1.qc, ches2.qc, ches3.qc, ches2-1.qc, ches2-2.qc
Met Raw	~/metdata/	metfile.6, metfile11.raw
Met Edited	~/metdata/	metfile.6, metfile.11ed
Met Qc	~/meteor/	ches1981.qc, ches1982.qc

~ = /disks/NASUSER/philr/chesappeak

CTD Data

The CTD dataset includes CTD casts from both 1981 and 1983. No data from 1982 were processed due to time stamp errors which occurred with each cast. A total of 468 CTD casts were quality controlled from the 1981-1983 circulation survey. Approximately 10% of the casts required editing with most of the editing required at either the top points of the cast, or the very bottom points. The 1981 data includes 288 Grundy casts at station locations shown in Figure 3.1. Cast dates and times are as given in Table 3.3. The 1983 data includes a total of 180 casts. Grundy CTD station locations are shown in Figure 3.2 with cast dates and times given in Table 3.4, while AML station locations are shown in Figure 3.3 with cast dates and times given in Table 3.5. The AML cast datasets were truncated and contained information only over the top few meters.

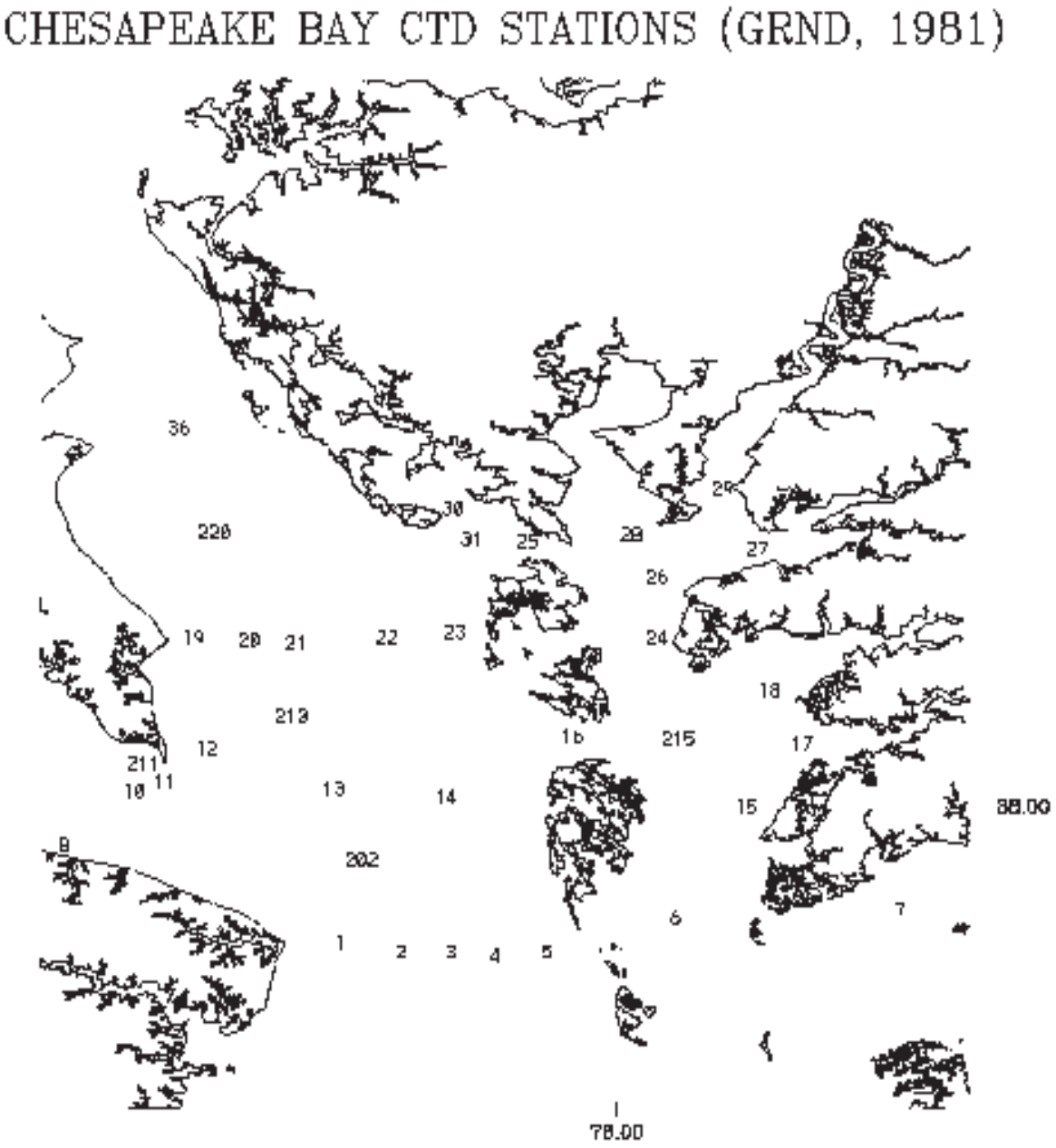

Figure 3.1. Chesapeake Bay CTD Station Locations (GRNDY, 1981)

Table 3.3. Chesapeake Bay Circulation Survey (1981) Grundy CTD Casts
Note the casts are given in the order they appear on file CHCT01.final and are not grouped by station.

Station Name	Cast Dates and Times
7	9/02/1981 (1608, 1620)
36	9/03/1981 (1754)
10	9/08/1981 (1722)
5	9/08/1981 (2014)
4	9/08/1981 (2124)
15	9/09/1981 (1325)
6	9/09/1981 (1458)
3	9/09/1981 (1815)
2	9/09/1981 (1903)
1	9/09/1981 (1950)
5	9/11/1981 (1624)
4	9/11/1981 (1638)
10	9/17/1981 (0000, 0030, 0100, 0130, 0200, 0230, 0300, 0330, 0400, 0430, 0500, 0530, 0600, 0630, 0700, 0800, 0830, 0900, 0930, 1000, 1030, 1100, 1130, 1200, 1230)
5	9/17/1981 (1548)
4	9/17/1981 (1606)
3	9/17/1981 (1622)
2	9/17/1981 (1637)
36	9/22/1981 (0000, 0030, 0100, 0130, 0200, 0230, 0300, 0330, 0430, 0500, 0530, 0600, 0630, 0700, 0730)
4	9/22/81 (2022)
3	9/22/1981 (2126)
2	9/22, 23 (2200, 2230, 2300, 2330, 0000, 0030, 0100, 0130, 0200, 0230, 0300, 0330, 0400, 0430, 0500, 0530, 0600, 0630)
11	9/23/1981 (1459)
9	9/23.1981 (1546)
2	9/24/1981 (1626)
3	9/24/1981 (1644)
4	9/24/1981 (1658)
5	9/24/1981 (1716)
8	9/24/1981 (2032)
2	9/25/1981 (0020, 0050, 0120, 0150, 0220, 0250, 0320, 0350, 0420, 0450, 0520, 0550, 0620, 0650, 0720, 0750, 0820, 0850, 0920, 0950, 1020, 1050, 1120, 1150, 1220, 1250, 1320)

Table 3.3. (Cont.) Chesapeake Bay Circulation Survey (1981) Grundy CTD Casts
Note the casts are given in the order they appear on file CHCT01.final and are not grouped by station.

16	9/25/1981 (1526)
7	9/29/1981 (2012)
6	9/30/1981 (0020, 0050, 0120, 0150, 0220, 0250, 0320, 0350, 0420, 0450, 0520, 0550, 0620, 0650, 0720, 0750, 0820, 0850, 0920, 0950, 1020, 1050, 1120, 1150, 1220, 1250, 1320)
15	9/30/1981 (1504)
36	10/08/1981 (1110)
8	10/08/1981 (1430)
9	10/08/1981 (1453)
10	10/08/1981 (1506)
11	10/08/1981 (1520)
211	10/08/1981 (1535)
8	10/08/1981 (2220)
9	10/08/1981 (2240)
11	10/08/1981 (2334)
4	10/09/1981 (1254)
2	10/13/1981 (1633)
3	10/13/1981 (1706)
14	10/13/1981 (1940)
13	10/13/1981 (2036)
12	10/13/1981 (1935)
211	10/14/1981 (0232)
11	10/14/1981 (0247)
10	10/14/1981 (0300)
9	10/14/1981 (0318)
8	10/14/1981 (0338)
20	10/14/1981 (1512)
21	10/14/1981 (1610)
22	10/14/1981 (1710)
16	10/14/1981 (1839)
6	10/14, 15 (2100, 2130, 2200, 2230, 2300, 2330, 0000, 0030, 0100, 0130, 0200, 0230, 0300, 0330, 0400, 0430, 0500, 0530)
15	10/15/1981 (1433)
215	10/15/1981 (1506, 2117)
24	10/15/1981 (1545, 2156)
26	10/15/1981 (1608, 2225)
6	10/15/1981 (1952)
15	10/15/1981 (2040)
2	10/21/1981 (1410)

Table 3.3. (Cont.) Chesapeake Bay Circulation Survey (1981) Grundy CTD Casts
Note the casts are given in the order they appear on file CHCT01.final and are not grouped by station.

202	10/21/1981 (1555, 2110)
13	10/21/1981 (1525, 2140)
213	10/21/1981 (1555, 2205)
20	10/21/1981 (1630, 2245)
220	10/21/1981 (1705, 2324)
36	10/21/1981 (1745)
2	10/21/1981 (2030)
36	10/22/1981 (0005)
36	10/27/1981 (1415)
20	10/27/1981 (1552)
11	10/27/1981 (1806)
10	10/27/1981 (1839)
9	10/27/1981 (1914)
21	10/27/1981 (2042)
22	10/27/1981 (1645)
19	10/29/1981 (1526, 1625, 2205)
20	10/29/1981 (1644, 2222)
21	10/29/1981 (1701, 2239)
22	10/29/1981 (1730, 2309)
23	10/29/1981 (1753, 2340)
31	10/29/1981 (1910)
30	10/29/1981 (1944)
12	10/30/1981 (1335)
13	10/30/1981 (1441)
14	10/30/1981 (1530)
24	10/30/1981 (1750)
10	11/01/1981 (1631, 1645)
36	11/11/1981 (1440)
10	11/11/1981 (1615)
17	11/12/1981 (1450)
18	11/12/1981 (1610)
24	11/12/1981 (1803)
26	11/12/1981 (1852)
27	11/12/1981 (1942)
29	11/12/1981 (2052)
28	11/12/1981 (2210)
25	11/13/1981 (1415)
19	11/13/1981 (1620)
20	11/13/1981 (1650)
21	11/13/1981 (1744)
22	11/13/1981 (1837)
23	11/13/1981 (1907)

Table 3.3. (Cont.) Chesapeake Bay Circulation Survey (1981) Grundy CTD Casts
Note the casts are given in the order they appear on file CHCT01.final and are not grouped by station.

31	11/13/1981 (2015)
30	11/13/1981 (2051)
17	11/16/1981 (1652)
13	11/16/1981 (1924)
12	11/16/1981 (2012)
10	11/16/1981 (2103)
36	11/30/1981 (1435)
22	11/30/1981 (1625)
25	11/30/1981 (1808)
28	11/30/1981 (1856)
29	11/30/1981 (1955)
27	11/30/1981 (2130)
26	12/01/1981 (1305)
24	12/01/1981 (1345)
18	12/01/1981 (1550)
17	12/01/1981 (1700)
13	12/01/1981 (1925)
10	12/02/1981 (2013)
12	12/02/1981 (1415)
36	12/07/1981 (1500)
6	12/15/1981 (0630, 0700, 0730, 0800, 0830, 0900, 0930, 1000)

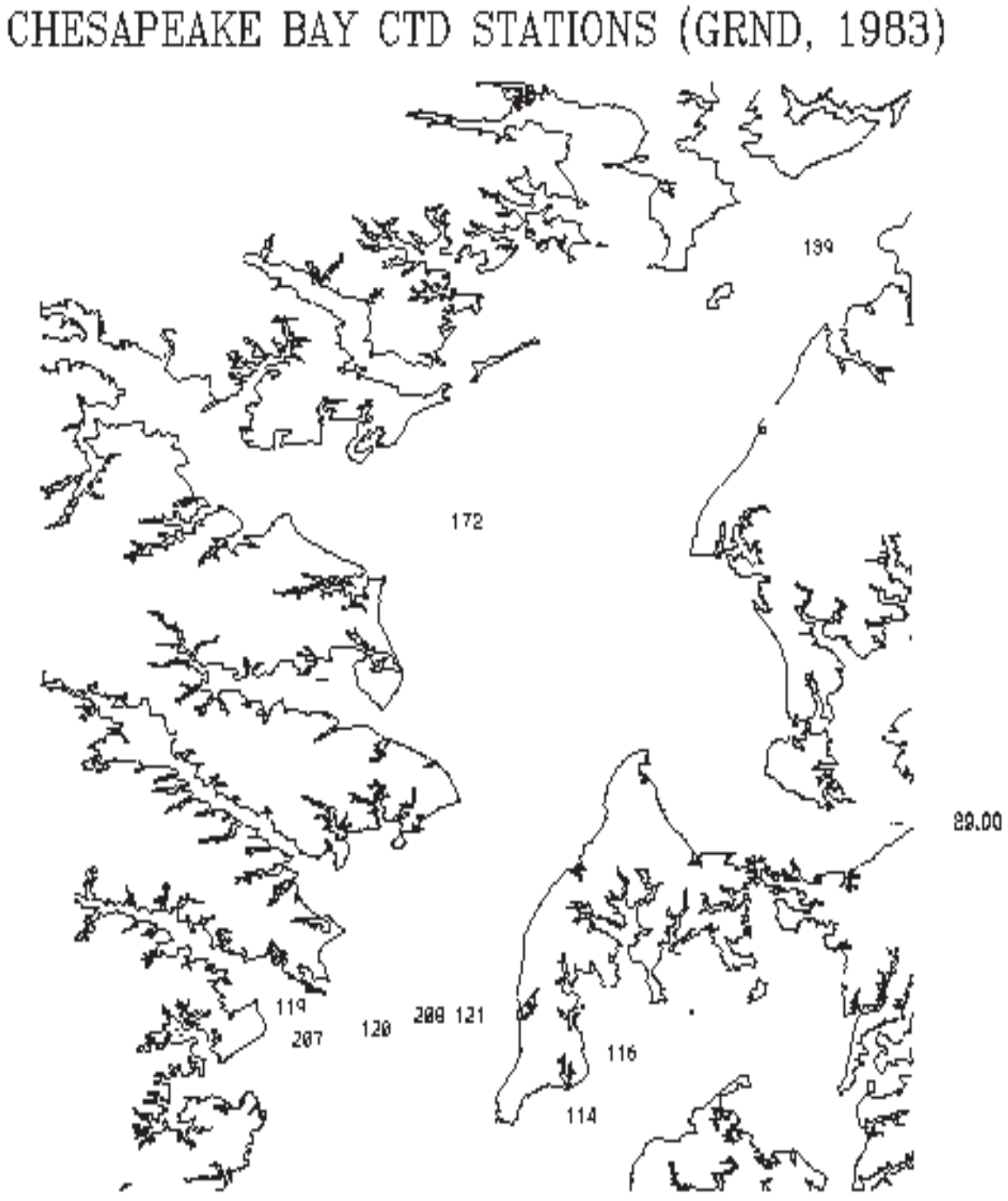

Figure 3.2. Chesapeake Bay CTD Station Locations (GRNDY, 1983)
Note some stations in the Chesapeake and Delaware Canal are not shown.

Table 3.4. Chesapeake Bay Circulation Survey (1983) Grundy CTD Casts
Note the casts are given in the order they appear on file CHCT03_grn.fin.

Station Name	Cast Dates and Times
172	7/18/1983 (1410)
172	7/19/1983 (1640)
114	8/04/1983 (1605)
116	8/04/1983 (2055)
36	9/12/1983 (0100, 0130, 0200, 0230, 0300, 0330, 0400, 0430, 0500, 0530, 0600, 0630, 0700, 0730, 0800, 0900)
119	9/12/1983 (1442, 2126)
207	9/12/1983 (1458, 2155)
120	9/12/1983 (1515, 2209)
208	9/12,1983 (1529, 2232)
121	9/12/1983 (1551, 2248)
121	10/13/1983 (1100, 1130, 1200, 1230)
139	10/13/1983 (1800, 1830, 1900, 1930, 2000, 2030, 2100, 2130, 2200, 2230, 2300, 2330)
	10/14/1983 (0000, 0030, 0100, 0130, 0200)
154	10/14/1983 (1230)
53	10/14/1983 (1303)
161	10/14/1983 (1325, 1907)
162	10/14/1983 (1358, 1947)
152	10/14/1983 (1420, 1815)
151	10/14/1083 (1452)
154	10/14/1983 (1813)
153	10/14/1983 (1845)
171	11/07/1983 (1405)

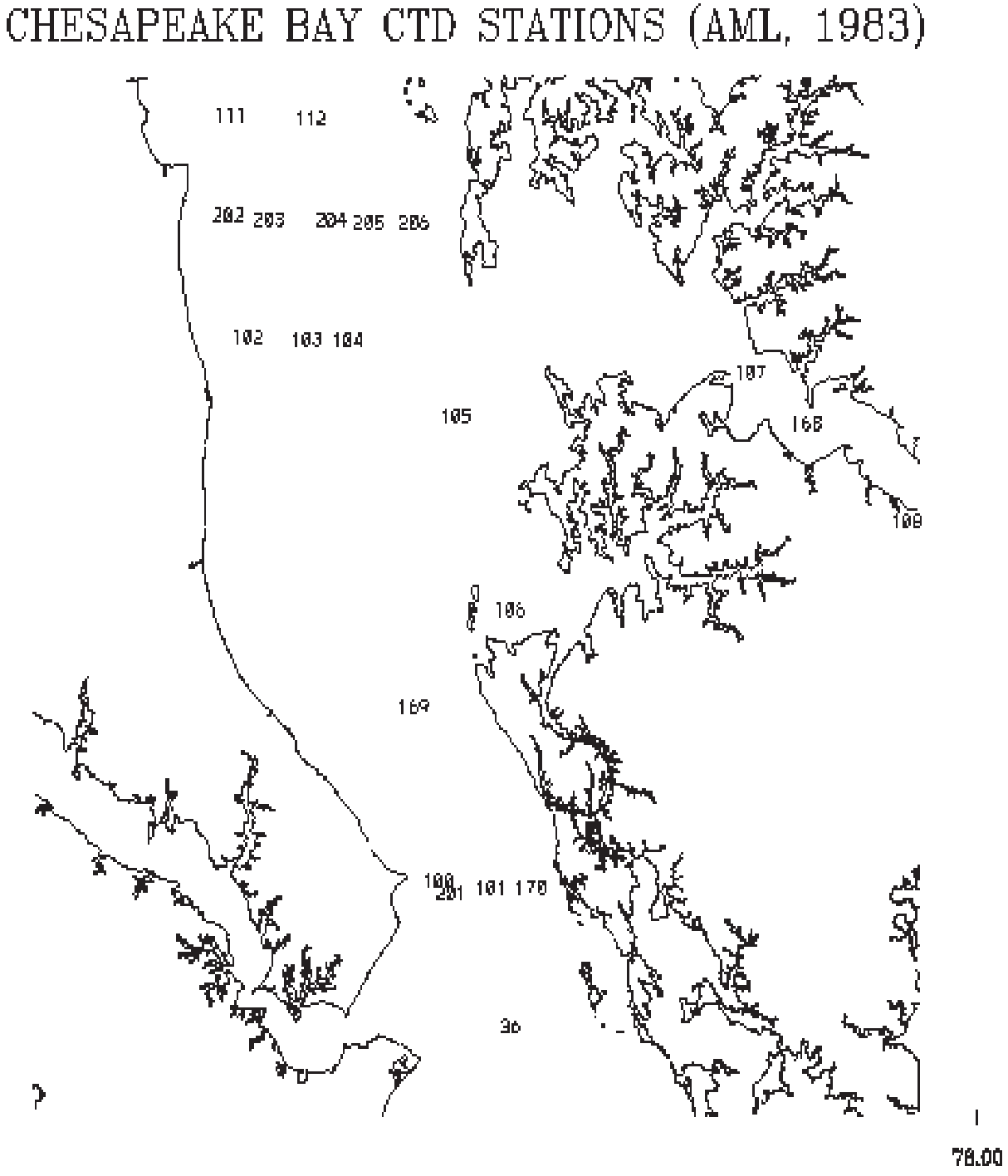

Figure 3.3. Chesapeake Bay (lower bay) CTD Station Locations (AML, 1983)

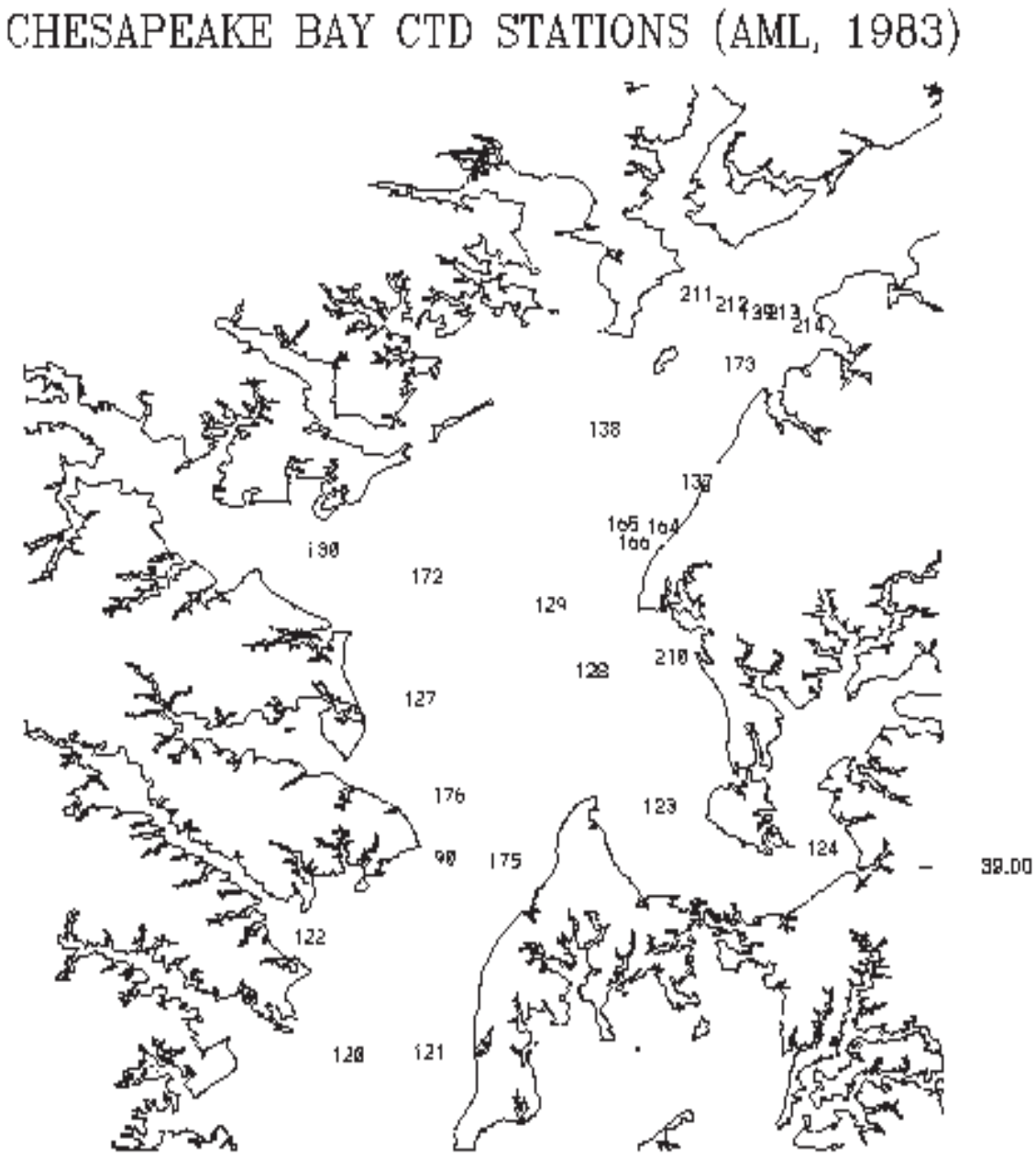

Figure 3.4. Chesapeake Bay (upper bay) CTD Station Locations (AML, 1983)

Table 3.5. Chesapeake Bay Circulation Survey AML (1983) CTD Casts
Note the casts are given in the order they appear on file CHCT03_aml.fin and are not grouped by station. Note all casts were short extending to only order the top 5m.

Station Name	Cast Dates and Times
172	6/21/1983 (1647)
129	6/21/1983 (1720)
166	6/21/1983 (1737)
164	6/21/1983 (1807)
137	6/21/1983 (1816)
138	6/21/1983 (1840)
173	6/21/1983 (1914)
139	6/21/1983 (1925)
120	7/25/1983 (1324)
90	7/25/1983 (1423)
176	7/25/1983 (1439)
127	7/25/1983 (1521)
123	7/26/1983 (0902)
124	7/26/1983 (1335)
122	7/27/1983 (1350)
129	7/11/1983 (1257)
130	7/11/1983 (1340)
166	7/11/1983 (1405)
165	7/11/1983 (1423)
137	7/11/1983 (1513)
138	7/11/1983 (1612)
173	7/11/1983 (1634)
139	7/11/1983 (1648)
175	7/12/1983 (1504)
36	9/11/1983 (2030, 2100, 2128, 2159, 2229, 2259, 2329)
	9/12/1983 (0000, 0029, 0102)
100	9/12/1983 (1230, 1842)
201	9/12/1983 (1238, 1849)
101	9/12/1983 (1244, 1857)
170	9/12/1983 (1254, 1905)
206	9/12/1983 (1421)
205	9/12/1983 (1430, 2037)
204	9/12/1983 (1444, 2043)
203	9/12/1983 (1453, 2053)
202	9/12/1983 (1507, 2058)

Table 3.5. (Cont.) Chesapeake Bay Circulation Survey (1983) AML CTD Casts
Note the casts are given in the order they appear on file CHCT01.final and thus casts are not grouped by station. Note all casts were short extending to only order the top 5m.

121	9/12, 13 (2357, 0034, 0105, 0133, 0203, 0230, 0259, 0333, 0400, 0428, 0458)
1	9/13/1983 (0528, 0557, 0627, 0657, 0726, 0757, 0825, 0856, 0929, 0956, 1028, 1159, 1231)
2	9/13/1983 (1218)
210	9/13/1983 (1250)
214	9/13/1983 (1350)
213	9/13/1983 (1404)
139	9/13/1983 (1414)
212	9/13/1983 (1435)
211	9/13/1983 (1444)
127	9/14/1983 (1825)
209	9/14/1983 (1842)
128	9/14/1983 (1901)
139	9/14/1983 (1952)
105	9/27/1983 (1430)
104	9/27/1983 (1455)
102	9/27/1983 (1533)
111	9/27/1983 (1543)
112	9/27/1983 (1612)
106	10/13/1983 (1525)
107	10/13/1983 (1558)
167	10/13/1983 (1619)
168	10/13/1983 (1645, 1705)
169	11/01/1983 (1411)
108	11/01/1983 (1528)
100	11/19/1983 (1354)
101	11/19/1983 (1420)
170	11/19/1983 (1435)
103	11/19/1983 (1554)
104	11/19/1983 (1619)

CT/Current

The salinity and temperature and current data were distributed amongst five directories: CHES1, CHES2, CHES2-1, CHES2-2, and CHES3. The data files in these directories (FILE1 through FILEn) were concatenated to create cumulative data files; e.g., file_ches1, file_ches2, FILE_all, file_ches2.1, file_ches2.2. The data in each individual data file (FILE1 through FILEn) represent current and CT data at one specific station location, over a given time period.

Locations for stations in file CHES1 are given in Figure 3.5 with station stop and start Julian Day in 1982 given in Table 3.6.

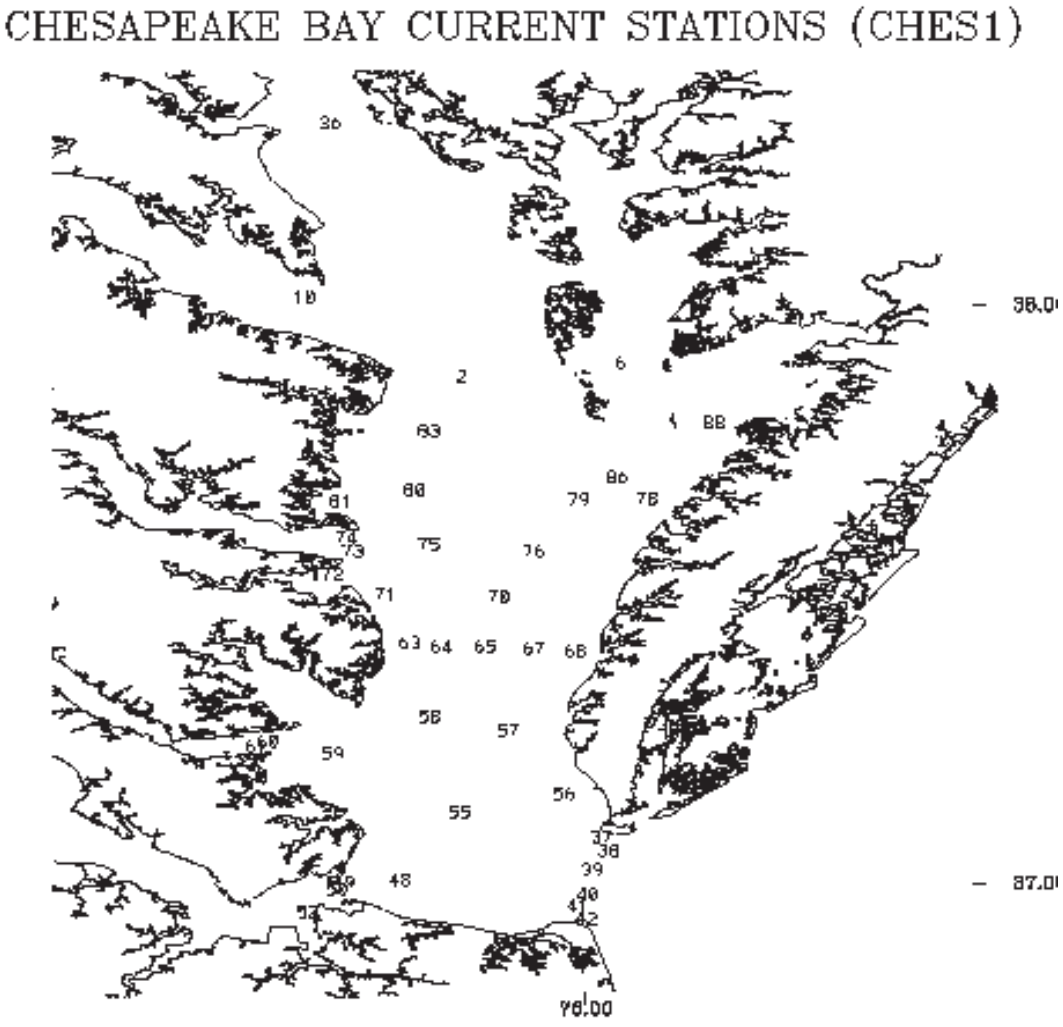

Figure 3.5. Chesapeake Bay Current Station Locations: CHES1 (1982)

Table 3.6. Chesapeake Bay Circulation Survey (1981-1982) CT/Current: CHES1
Note the order of the stations is as they appear in the file.

Station Name	Distance Above Bottom(ft) - denotes depth (ft)	Start and Stop Julian Day
36	-15	1981: 356-365 1982: 1-19, 104-126, 126-141
	40	1982: 195-210, 210-230
	8	1982: 195-210
50	8	1982: 168-188
55	27	1982: 168-188
	8	1982: 168-188
65	26	1982: 167-189, 148-167, 203-222, 289-308
	8	1982: 167-189, 148-167, 203-222
	-36	1981 : 343-365, 1982: 1-26, 55-70
	-15	1981: 343-365 1982: 1-26, 55-70, 99-117
56	9	1982: 169-188
70	23	1982: 173-189
	8	1982: 203-223
68	5	1982: 189-204
66	31	1982: 189-204, 204-222
	8	1982: 204-222
	56	1982: 204-222
	-40	1982: 99-117
49	81	1982: 154-170
	46	1982: 154-170
	8	1982: 154-170
67	23	1982: 189-204, 204-222
	8	1982: 204-222
	-15	1982: 99-118
	-35	1982: 99-118
48	36	1982: 154-170
40	27	1982: 196-211
	8	1982: 196-211
	37	1981: 352-365 1982: 1-19,38-56
	-15	1981: 352-365 1982: 1-19,30-47, 47-71, 89-106, 106-125
59	8	1982: 204-222

Table 3.6. (Cont.) Chesapeake Bay Circulation Survey (1981-1982) CT/Current: CHES1
Note the order of the stations is as they appear in the file.

65B	11 17 -22 -28	1982: 204-222 1982: 204-222 1982: 99-118 1982: 99-118
71	6	1982: 203-223
63	5	1982: 203-221
64	16	1982: 203-222
73	8	1982: 222-237
75	8 29	1982: 223-238 1982: 223-238
76	8	1982: 223-238
77	9	1982: 223-238
78	5	1982: 224-239
79	8	1982: 224-239
81	11	1982: 223-238
6	54 79	1982: 288-307 1982: 288-307
86	86	1982: 288-307
83	87 62	1982: 287-306 1982: 287-306
80	28	1982: 287-306
2	58 33	1982: 287-307 1982: 287-307
10	38	1982: 288-307
88	66 41	1982: 288-309 1982: 288-309

Locations for stations in file CHES2 are given in Figure 3.6 with station stop and start times in 1983 given in Table 3.7.

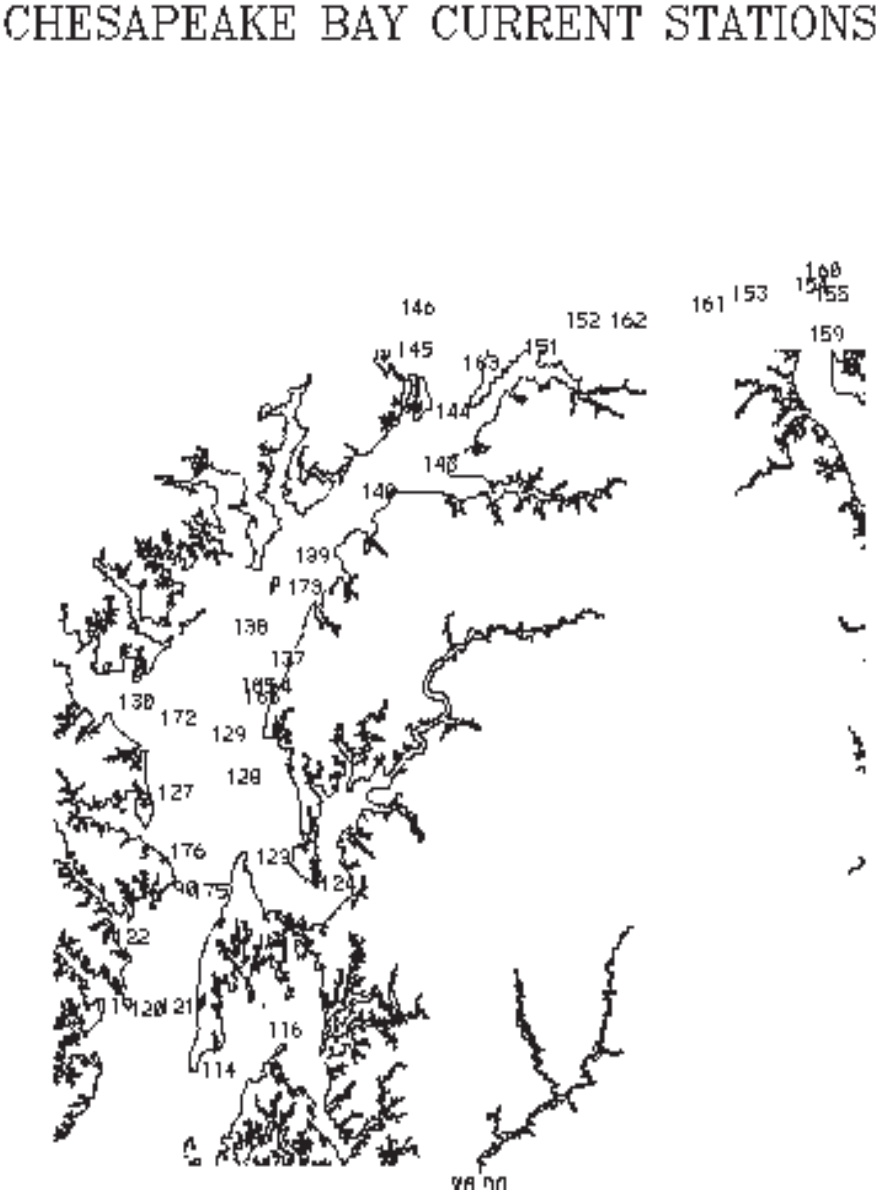

Figure 3.6. Chesapeake Bay Current Station Locations: CHES2 (1983)

Table 3.7. Chesapeake Bay Circulation Survey (1983) CT/Current: CHES2
Note the order of the stations is as they appear in the file.

Station Name	Distance above bottom (ft)	Start and Stop Julian Day
40	27	83-112, 112-132, 165-193, 193-214
	8	112-132, 132-157, 165-193, 193-213
162	9	103-118
	20	103-118
151	21	103-118, 132-152
	9	103-118, 132-152
121	59	109-127, 127-147, 172-187
	41	109-127, 127-146, 172-187, 201-217
	8	109-127, 127-147, 172-187
161	26	118-133
	9	118-133
36	40	123-138, 169-187, 187-204
	8	169-187, 187-204
65	26	95-121, 132-161, 195-210
	8	95-113, 113-132, 132-161, 161-179, 179-195, 195-211
155	5	123-145, 145-166
	32	123-145, 145-165
140	16	134-152
143	9	134-152
159	30	132-153
160	20	125-145
152	26	133-152
138	6	167-182, 182-200
166	18	181-200
	10	181-200
130	5	181-199
137	25	181-200
	5	181-200
129	14	182-200, 200-216
139	8	181-200
175	5	181-201
	31	181-201
123	5	201-216, 216-232
176	28	201-216
	5	201-216
122	5	202-217
124	29	201-216
	5	201-216

Table 3.7. (Cont.) Chesapeake Bay Circulation Survey (1983) CT/Current: CHES2
Note the order of the stations is as they appear in the file.

90	33 5	201-217 201-217
120	22 5	201-217 201-217
121	41	201-217
114	24	217-235
127	25	216-231
145	5	146-161
116	27	217-235

Locations for stations in file CHES3 are given in Figure 3.7 with station stop and start times in 1981 given in Table 3.8.

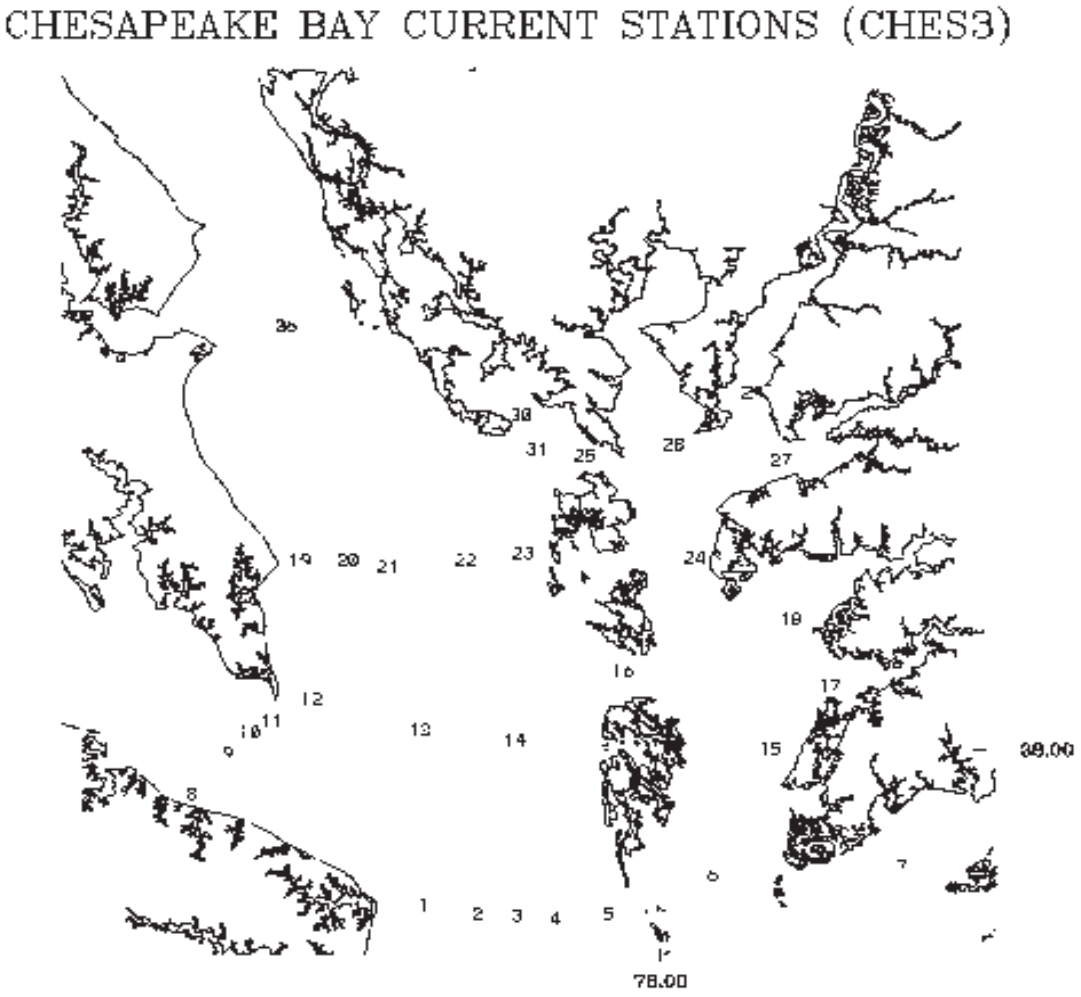

Figure 3.7. Chesapeake Bay Current Station Locations: CHES3 (1981)

Table 3.8. Chesapeake Bay Circulation Survey (1981) CT/Current: CHES3
Note the order of the stations is as they appear in the file.

Station Name	- denotes depth (ft)	Start and Stop Julian Day (1981)
1	-8	253-268
5	-9	252-268
36	-48	281-301
	-15	247-265, 265-281
	-14	281-301
	-50	247-265
	-16	316-335
	-49	265-281
6	-15	253-274, 274-289
	-40	253-274, 274-289
	-89	253-274, 274-289
7	-9	246-273
15	-14	253-274
	-39	253-274
	-92	253-274
4	-24	266-283
9	-14	267-282
	-33	267-282
	-15	282-301
	-34	282-301
10	-14	265-282
	-46	265-282
	-15	282-301
	-47	316-337
11	-15	267-282, 282-301
	-43	267-282
	-42	282-301
16	-12	269-288
8	-13	268-288
2	-14	266-287
	-39	266-287
	-67	266-287
3	-14	266-287
	-33	266-287
40	-15	259-295, 295-352
	-37	259-295, 295-352
12	-28	287-304
	-30	321-337
	-16	321-337

Table 3.8. (Cont.) Chesapeake Bay Circulation Survey (1981) CT/Current: CHES3
Note the order of the stations is as they appear in the file.

13	-15	287-304
	-58	287-304
	-41	321-336
	-59	321-336
14	-15	287-304
19	-17	303-318
20	-15	301-318
	-39	301-318
21	-17	301-318
	-41	301-318
	-96	301-318
30	-26	303-318
31	-15	303-318
17	-12	317-336
18	-20	317-336
22	-16	318-335
24	-14	317-336
	-41	317-336
25	-14	318-335
28	-20	317-335
	-15	317-335
29	-18	317-335
	-37	317-335
27	-9	317-335

Locations for stations in file CHES2-1 are given in Figure 3.8 with station stop and start times in 1983 given in Table 3.9.

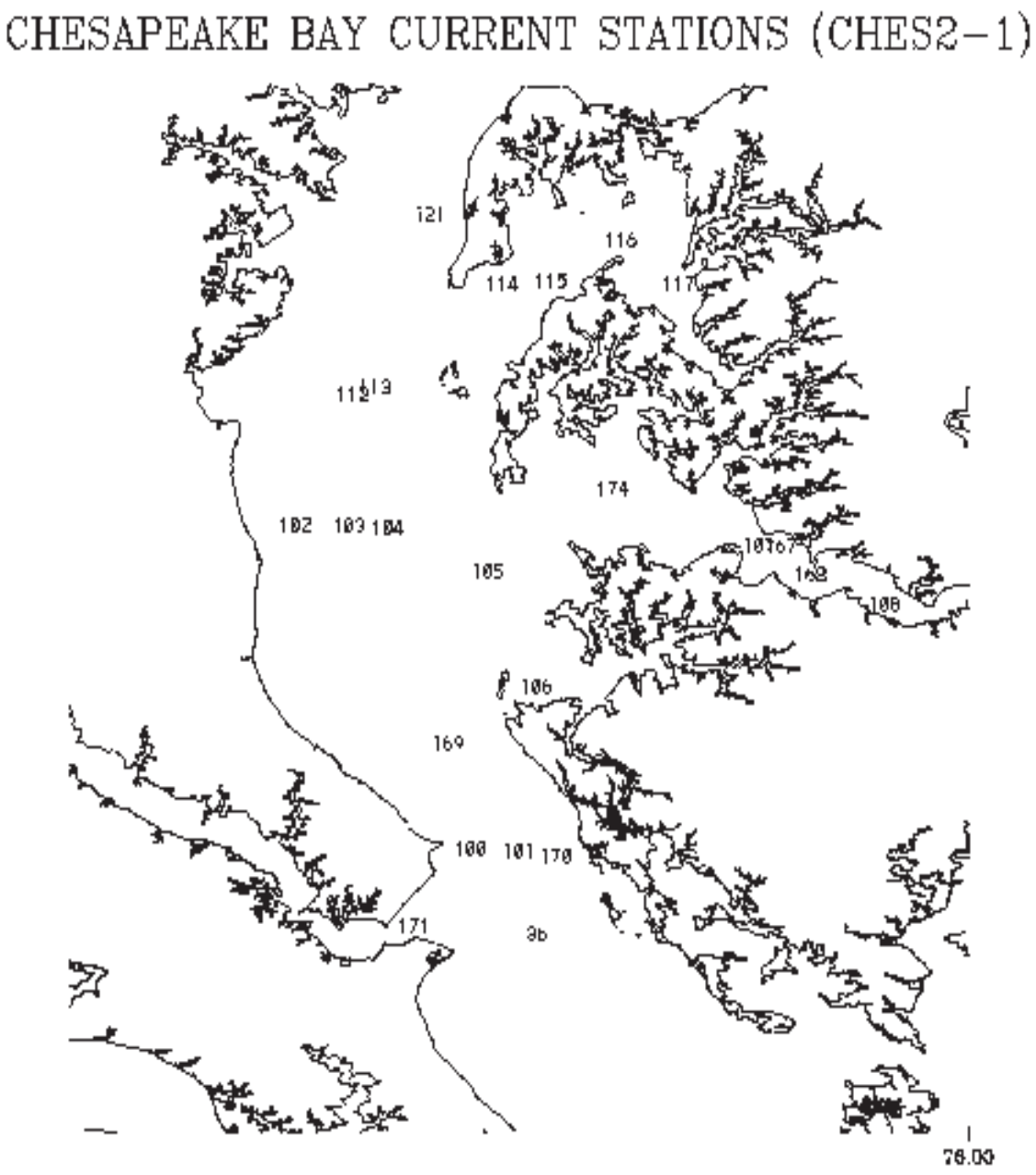

Figure 3.8. Chesapeake Bay Current Station Locations: CHES2-1 (1983)

Table 3.9. Chesapeake Bay Circulation Survey (1983) CT/Current: CHES2-1
Note the order of the stations is as they appear in the file.

Station Name	Distance above bottom (ft)	Start and Stop Julian Day (1983)
36	40	231-250, 264-281, 294-312, 320-340
	8	231-250, 264-281, 294-310, 11-36, 312-339
123	5	232-251
121	59	235-251, 279-298
	41	235-251, 279-298, 306-327
	8	235-251, 279-298
90	5	235-251
	33	235-251
113	8	235-252
	83	266-292
	48	266-289
117	5	236-252
65	8	222-237, 290-306, 322-342
	26	322-342, 306-322
40	27	228-243, 257-276, 323-343, 298-323
	8	83-112, 257-291, 323-343
115	10	235-252
114	24	235-252
	5	235-252
116	27	235-252
	5	235-252
152	9	251-266
154	28	251-266
112	38	265-280
	5	265-280
102	18	264-280, 313-333
	5	313-333
111	10	265-280
105	12	264-280
103	22	264-280, 313-333
174	5	265-280
171	33	281-298
	5	281-298
107	12	279-299
	5	279-299
104	65	277-294, 313-333
	40	313-329
	5	313-333

Table 3.9. (Cont.) Chesapeake Bay Circulation Survey (1983) CT/Current: CHES2-1
Note the order of the stations is as they appear in the file.

101	88 63 5	294-312, 312-330 294-312, 312-330 294-312, 312-330
170	5	294-312, 312-333
168	5	279-299
106	35	280-298
167	18	279-298
169	57 32 5	294-312 294-312 294-312
108	22 5	299-315 299-315
106	35	298-320
100	32	281-298, 324-340
139	6	251-266

Locations for stations in file CHES2-2 are given in Figure 3.9 with station stop and start times in 1982-1983 given in Table 3.10.

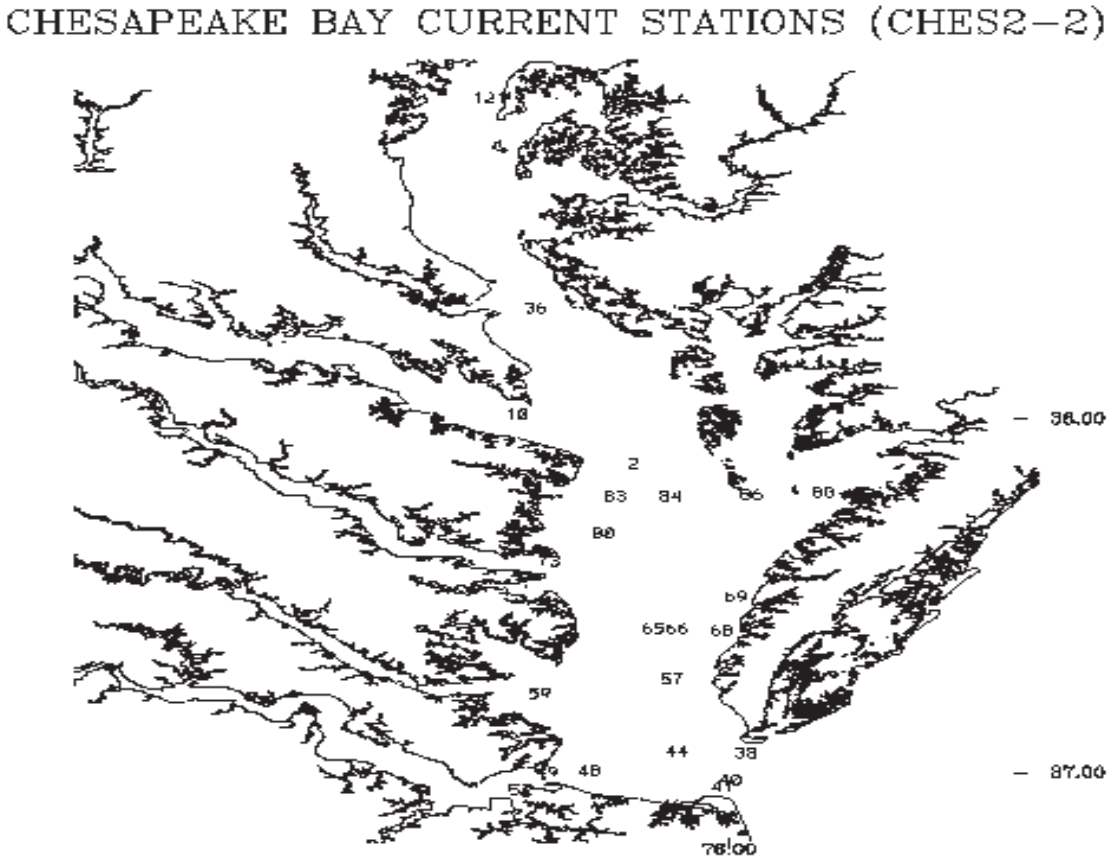

Figure 3.9. Chesapeake Bay Current Station Locations: CHES2-2 (1982-1983)

Table 3.10. Chesapeake Bay Circulation Survey (1982-1983) CT/Current: CHES2-2
Note the order of the stations is as they appear in the file.

Station Name	Distance above bottom (ft)	Start and Stop Julian Day
84	21	1982: 306-322
86	86	1982: 307-322
	61	1982: 307-322
	8	1982: 288-307
57	86	1982: 313-335
	61	1982: 313-335
	8	1982: 313-335
36	40	1982: 141-159, 240-257, 273-288, 314-343, 343-374, 1983: 49-78
	8	1982: 257-273,141-159, 176-195, 314-343, 343-365, 1983: 1-8, 49-78
65	26	1982: 237-255, 255-271, 271-289, 336-370 1983: 7-25, 56-71, 71-90
	8	1982: 210-230, 237-255, 255-271, 271-289, 343-365, 1983: 1-28
40	8	1982: 225-241, 256-272, 272-293, 335-357 1983: 42-64, 64-83
	27	1982: 226-241, 256-272, 272-293, 293-308, 335-356, 357-365 1983: 1-42, 42-64
121	8	1982: 314-341, 341-372
	57	1982: 314-341, 341-367 1983: 11-40, 47-72, 81-96
	5	1983: 11-34, 47-63, 63-81
	39	1982: 314-341, 341-365 1983: 1-7, 81-96
73	24	1982: 100-118
38	8	1982: 133-155
44	29	1982: 132-148
48	8	1982: 154-170
49	46	1982: 170-188
59	23	1982: 167-182
68	5	1982: 204-222
69	8	1982: 203-223
66	8	1982: 189-204
46	5	1982: 135-156

Meteorological Data

The 1981 and 1983 meteorological station locations are shown in Figures 3.10 and 3.11, respectively, while height above ground (HGL) and start and stop times are given in Table 3.11 and 3.12, respectively. The 1983 dataset was problematic. The temperature values were entered as ****, and the other fields of data appear to make no sense and therefore the dataset was not further processed.

Table 3.11. Chesapeake Bay Circulation Survey (1981) Meteorological Data

Station Name	HGL (m)	Start and Stop Julian Day
M1	11.0	247-278, 278-310, 310-330
M2	10.5	242-280, 278-310, 310-337

Table 3.12. Chesapeake Bay Circulation Survey (1982) Meteorological Data

Station Name	HGL (m)	Start and Stop Julian Day
M3	10	166-192, 142-166, 192-225, 225-251, 251-286, 286-313, 313-329
M4	13	138-166, 166-192, 221-251, 251-271

Based on the wind comparison of wind directions with nearby land stations, the wind directions appear to be in the standard meteorological convention with respect to degrees true north. Wind speed as reported in CO-OPS (1999) were measured in cm/s, but appear to have been converted to other unknown units, since the actual values were order 5 or less. *As a result, wind data were not further processed.*

Oceanographic Considerations

At Station 36 in central Chesapeake Bay salinity and temperature vertical profiles are shown in Figure 3.12 on 3 September, in Figure 3.13 on 8 October, and in Figure 3.14 on 7 December 1981. Note that the large stratification (order 8 PSU and 6 ^{o}C) and upper mixed layer occupying the top 10m shown in Figure 3.12 on 3 September is completely eroded and well mixed conditions with temperature near 19 ^{o}C and salinity near 20 PSU are present as shown in Figure 3.13 on 8 October and in Figure 3.14 for 7 December with temperature 7.5 ^{o}C and salinity near 20 PSU. The stratification and mixed layer are present again in September 1983 at Station 36 as shown in Figure 3.16. Note all AML CTD cast are short as indicated by the comparison of Figure 3.16 and Figure 3.15 at Station 36.

For CT/Current we consider the following four long term stations:

1) Station 121 in the upper Bay during April 1983 at 59 ft (Figures 3.17 and 3.18), 41 ft (Figures 3.19 and 3.20), and 8 ft (Figures 3.21 and 3.22) above the bottom,

2) Station 36 in the central Bay during June 1983 at 40 ft (Figures 3.23 and 3.24) and 8 ft (Figures 3.25 and 3.26) above the bottom,

3) Station 65 in the lower Bay during May 1983 at 8 ft (Figures 3.27 and 3.28) above the bottom, and
4) Station 40 at the entrance at 8 ft (Figures 3.29 and 3.30) above the bottom.

As one proceeds from Station 121 to Station 40 one notes the increase of near bottom salinity from order12 PSU in April 1983 at Station 121 to order 28 PSU in June 1983 at Station 40. The stratification (bottom – top) ranges from 6 to 8 PSU and -5 to -2 ^{o}C at Station 121 and is order 10 PSU and 6 ^{o}C at Station 36. Note the general increase in current strength at larger distances above the bottom as shown in Figure 3.18 at 59 ft, Figure 3.20 at 41 ft, and Figure 3.22 at 8 ft at Station 121 and in Figure 3.24 at 40 ft and Figure 3.26 at 8 ft at Station 36.

Atmospheric pressure and air temperature during December 1981 at 11m above the ground at Station M1 are shown in Figure 3.31. Note the 5 to 7 day meteorological band fluctuations in pressure and daily temperature variation with freezing conditions noted near the end of the month. Wind speed data and large sections of the atmospheric pressure data could not be recovered.

Figure 3.10. Chesapeake Southern Bay Meteorological Station Locations

Figure 3.11. Chesapeake Northern Bay Meteorological Station Locations

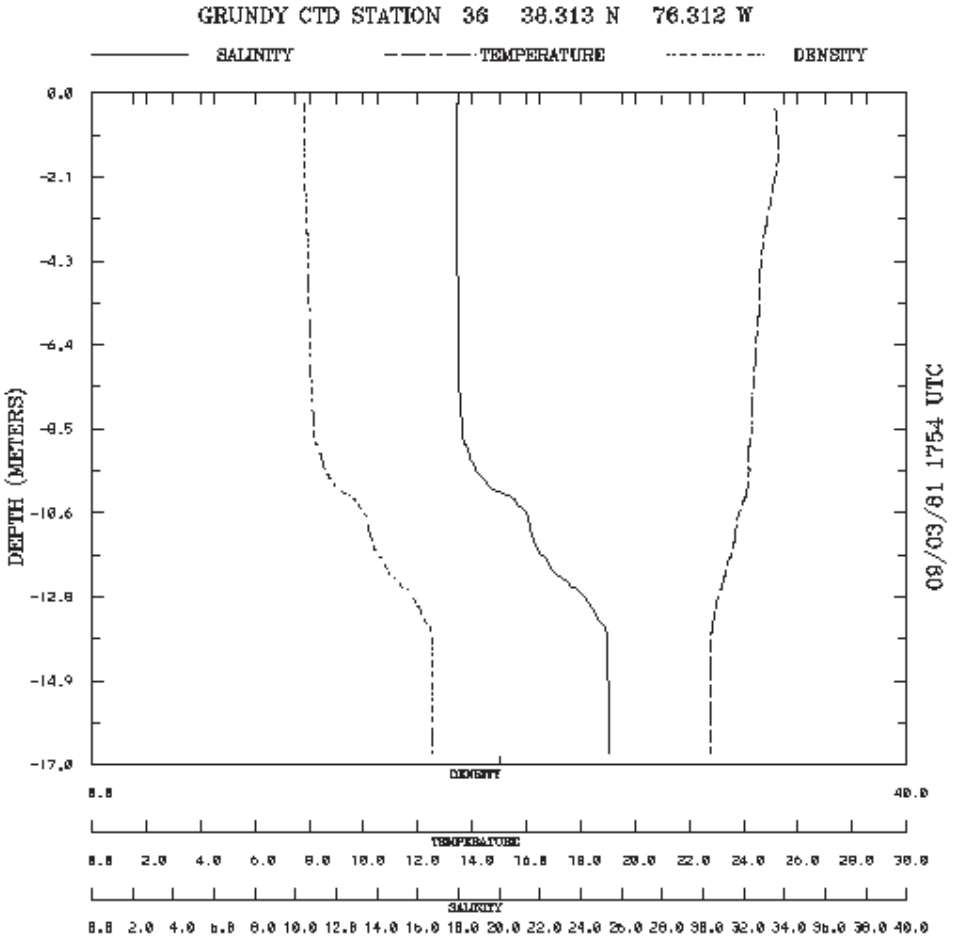

Figure 3.12. Central Chesapeake Bay CTD cast at Station 36 on 9/3/1981

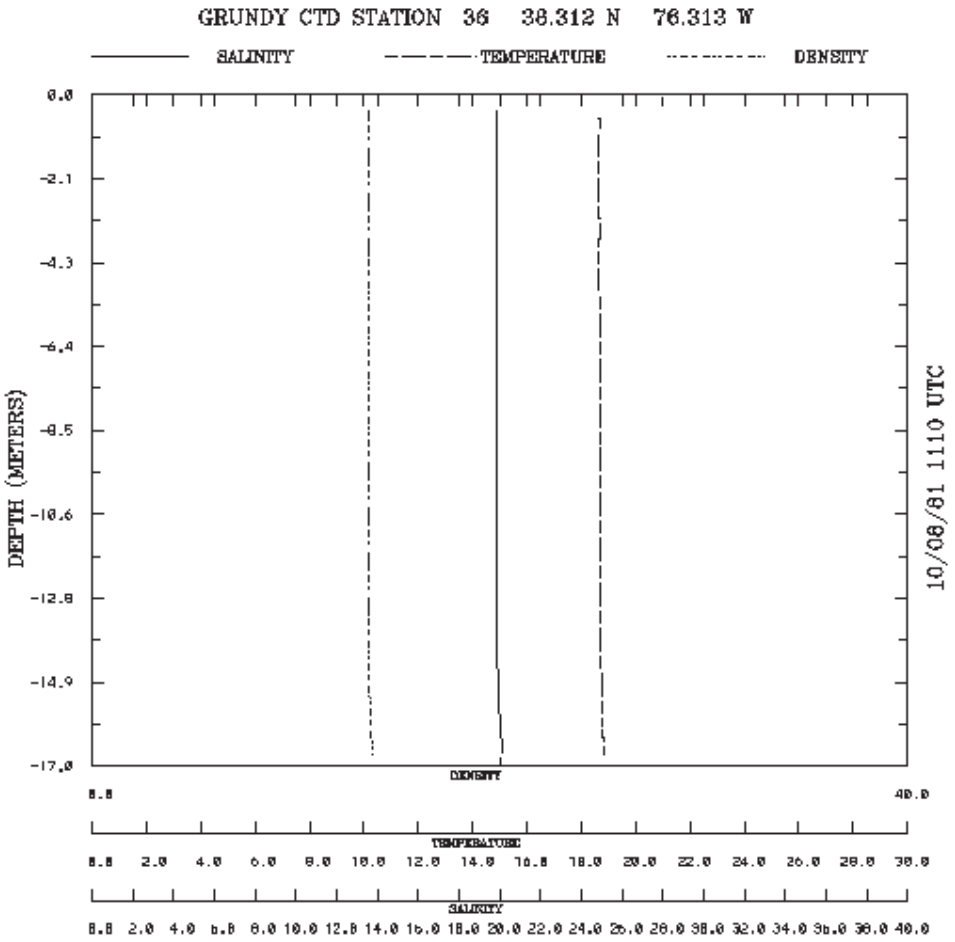

Figure 3.13. Central Chesapeake Bay CTD cast at Station 36 on 10/8/1981

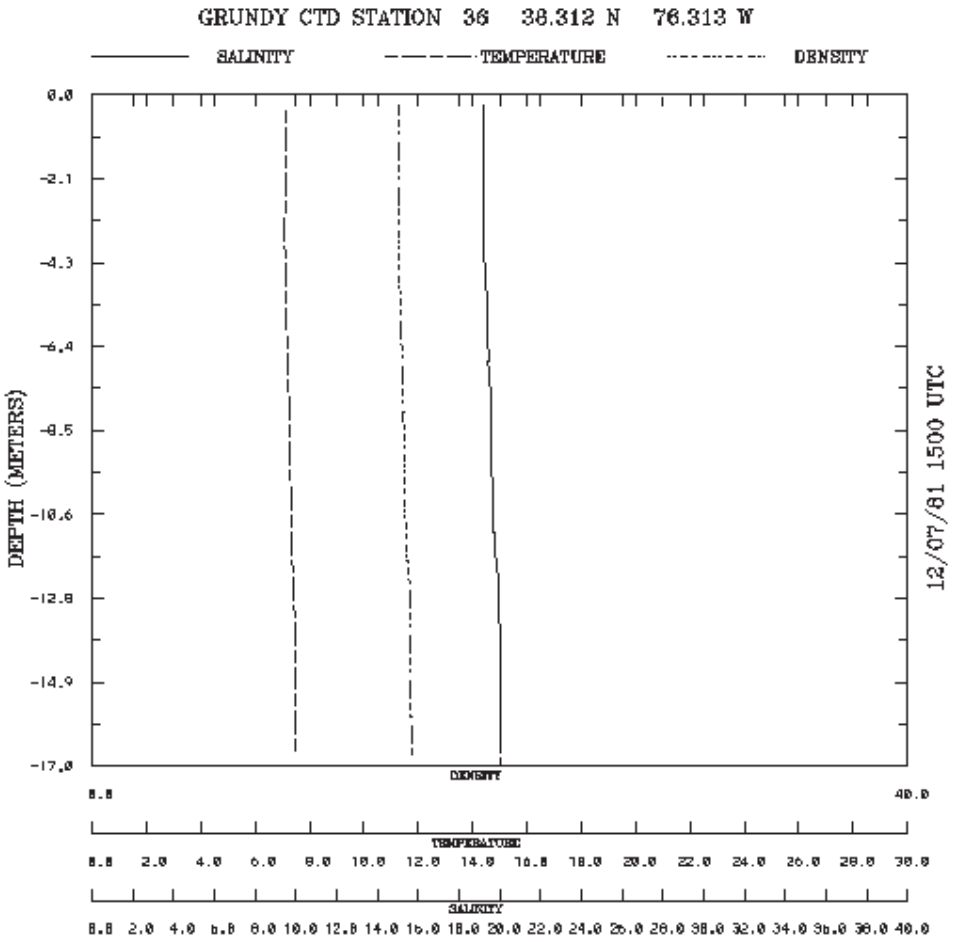

Figure 3.14. Central Chesapeake Bay CTD cast at Station 36 on 12/7/1981

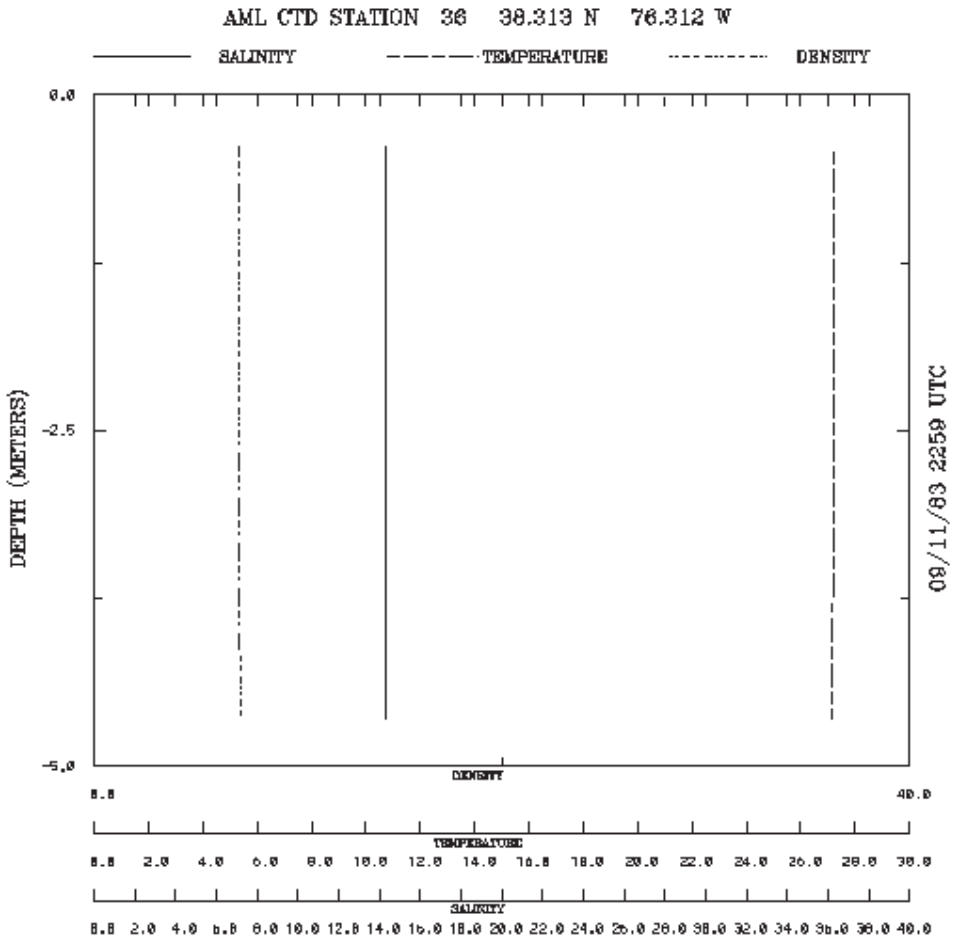

Figure 3.15. Central Chesapeake Bay AML CTD cast at Station 36 on 9/11/1983

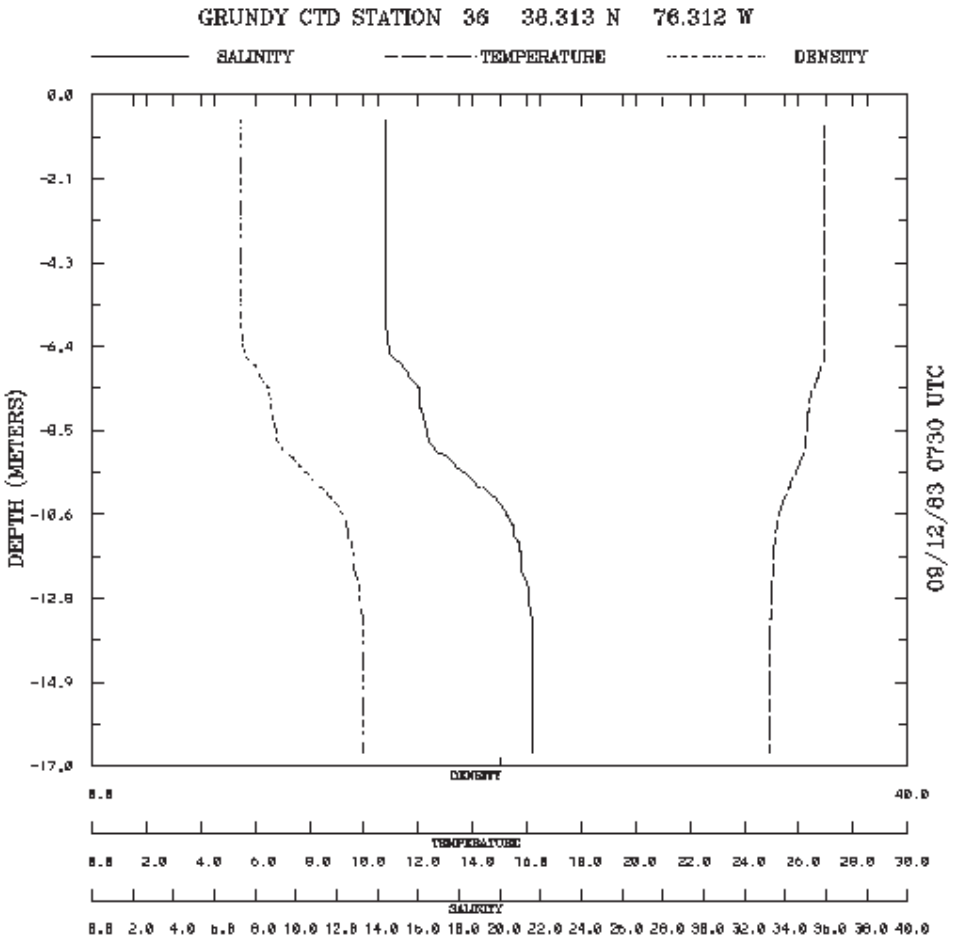

Figure 3.16. Central Chesapeake Bay GRUNDY CTD cast at Station 36 on 9/12/1983

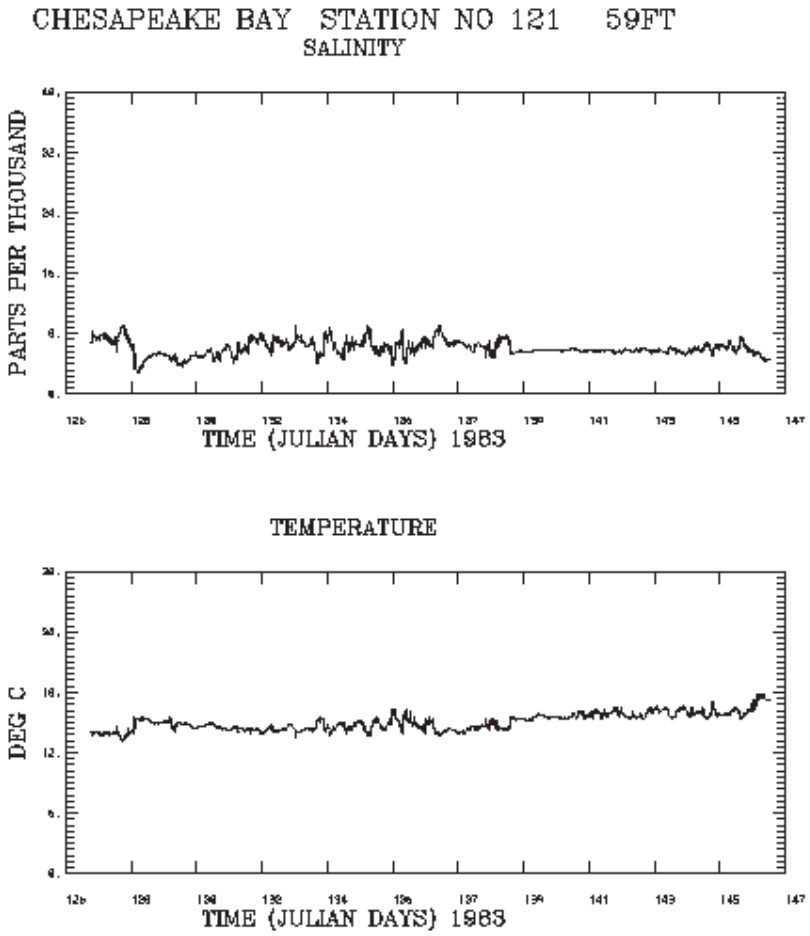

Figure 3.17. Station 121 Upper Chesapeake Bay Salinity and Temperature at 59 ft above the bottom in April 1983

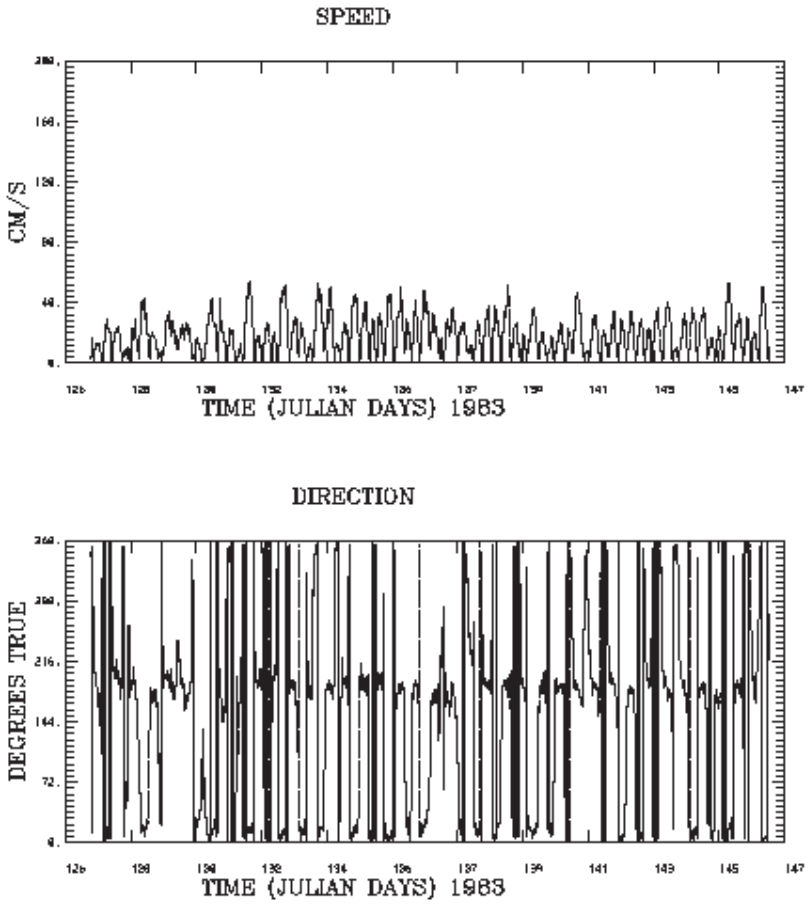

Figure 3.18. Station 121 Upper Chesapeake Bay Current Speed and Direction at 59 ft above the bottom in April 1983

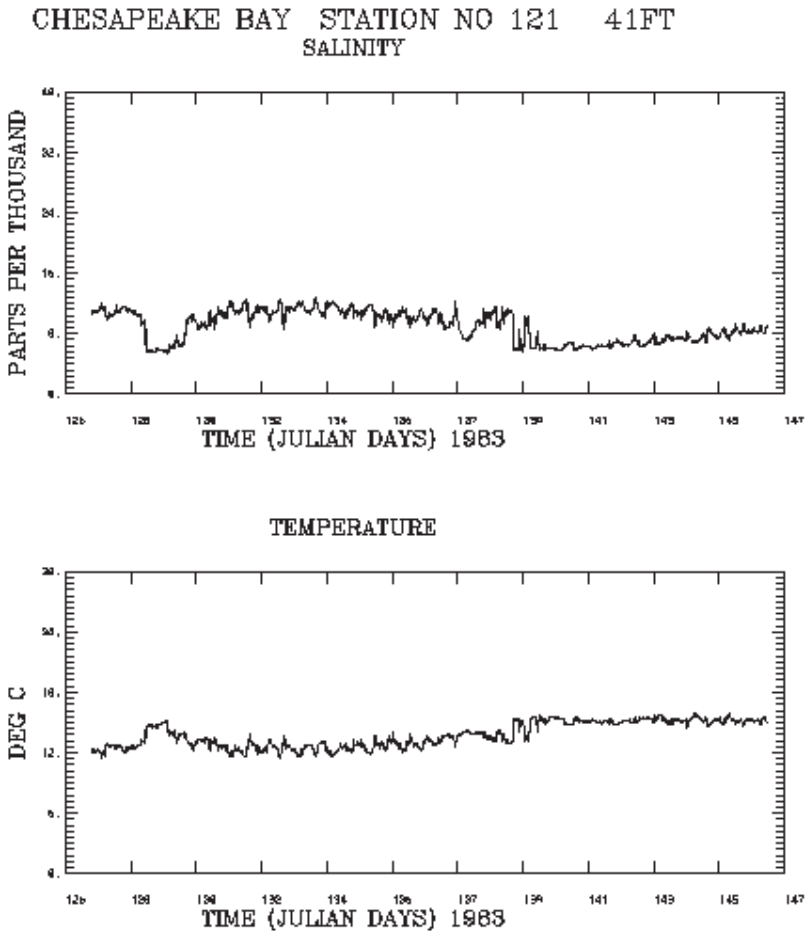

Figure 3.19. Station 121 Upper Chesapeake Bay Salinity and Temperature at 41 ft above the bottom in April 1983

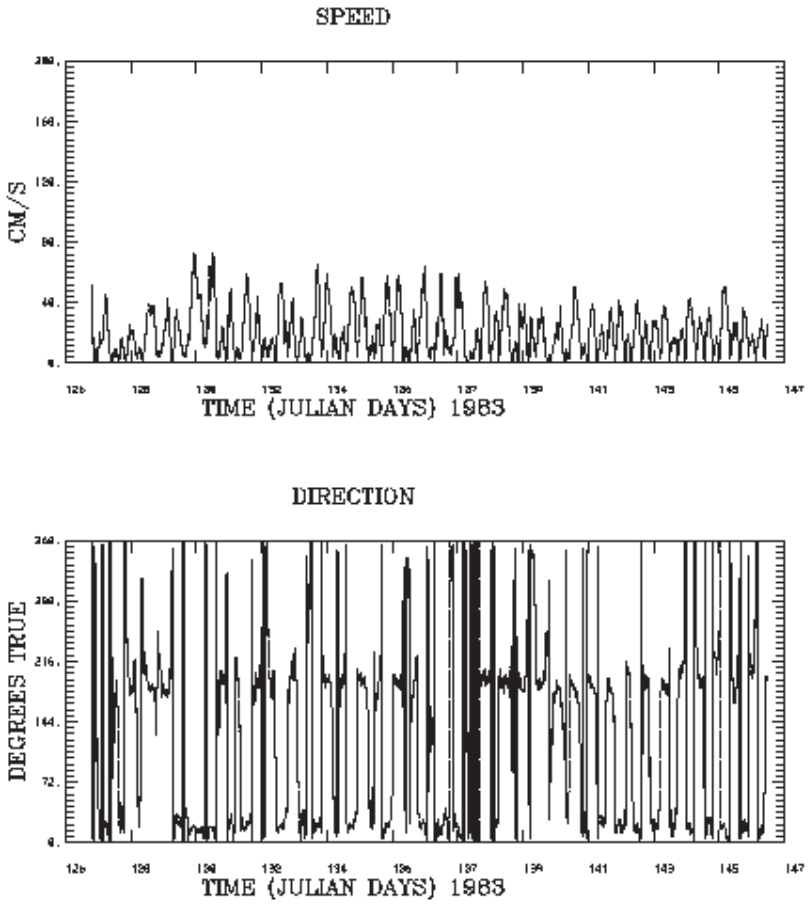

Figure 3.20. Station 121 Upper Chesapeake Bay Current Speed and Direction at 41 ft above the bottom in April 1983

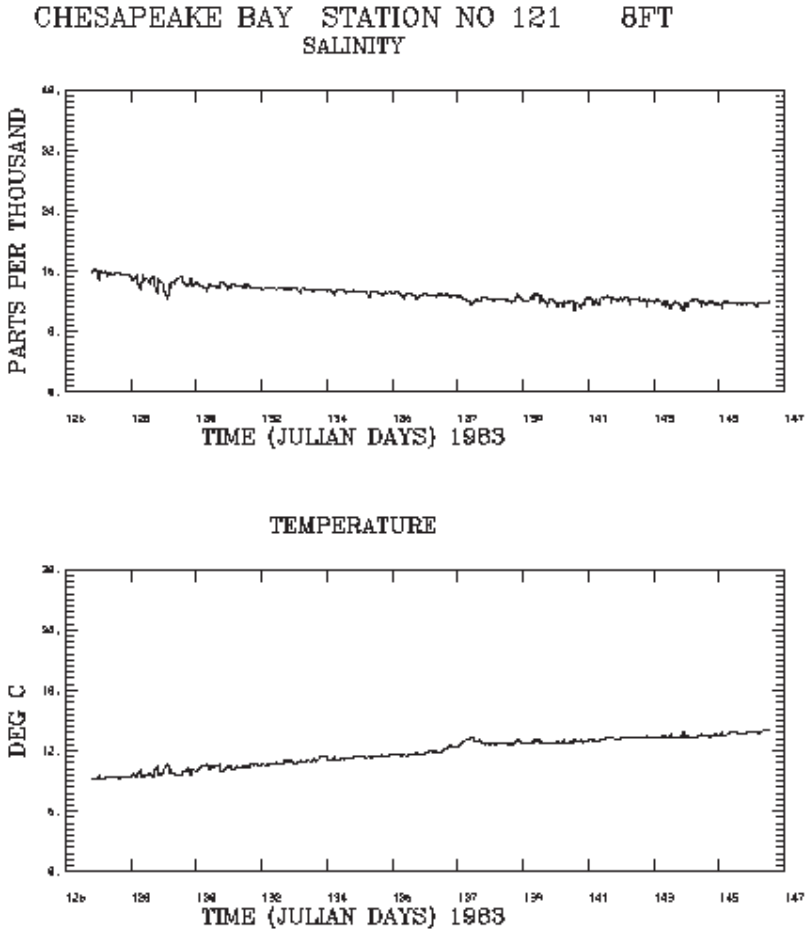

Figure 3.21. Station 121 Upper Chesapeake Bay Salinity and Temperature at 8 ft above the bottom in April 1983

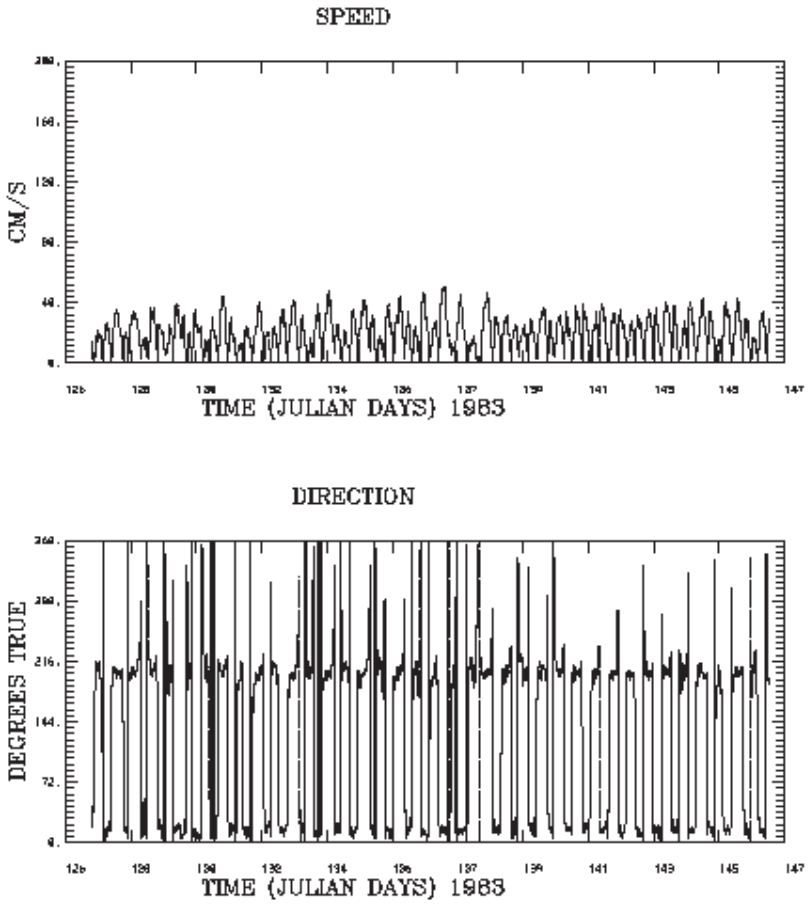

Figure 3.22. Station 121 Upper Chesapeake Bay Current Speed and Direction at 8 ft above the bottom in April 1983

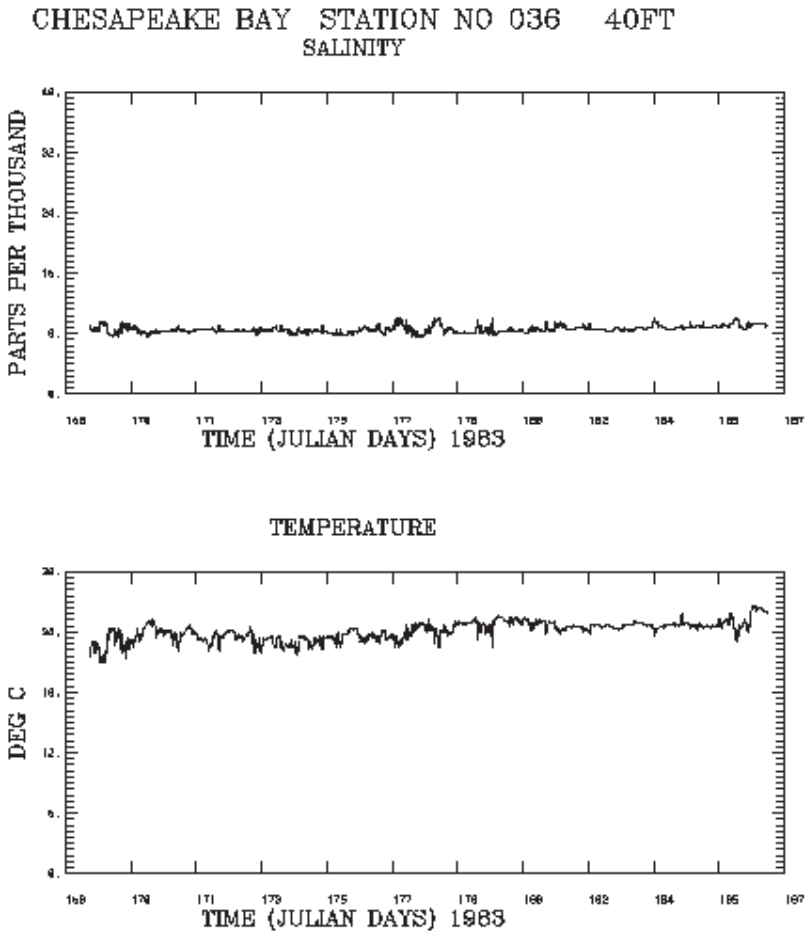

Figure 3.23. Station 36 Central Chesapeake Bay Salinity and Temperature at 40 ft above the bottom in June 1983

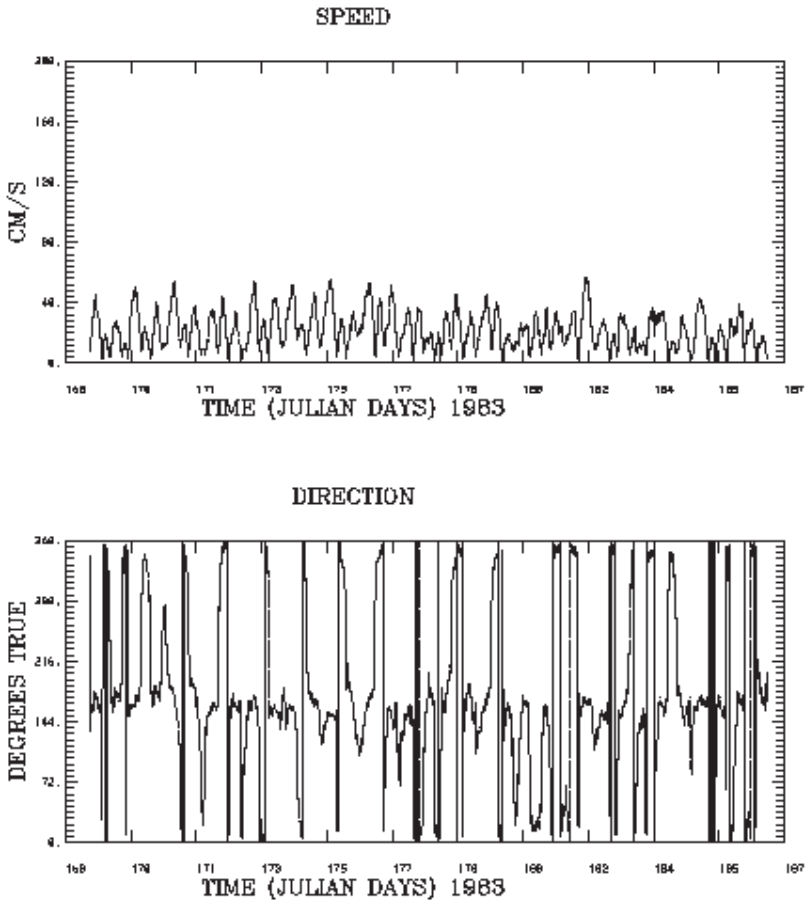

Figure 3.24. Station 36 Central Chesapeake Bay Current Speed and Direction at 40 ft above the bottom in June 1983

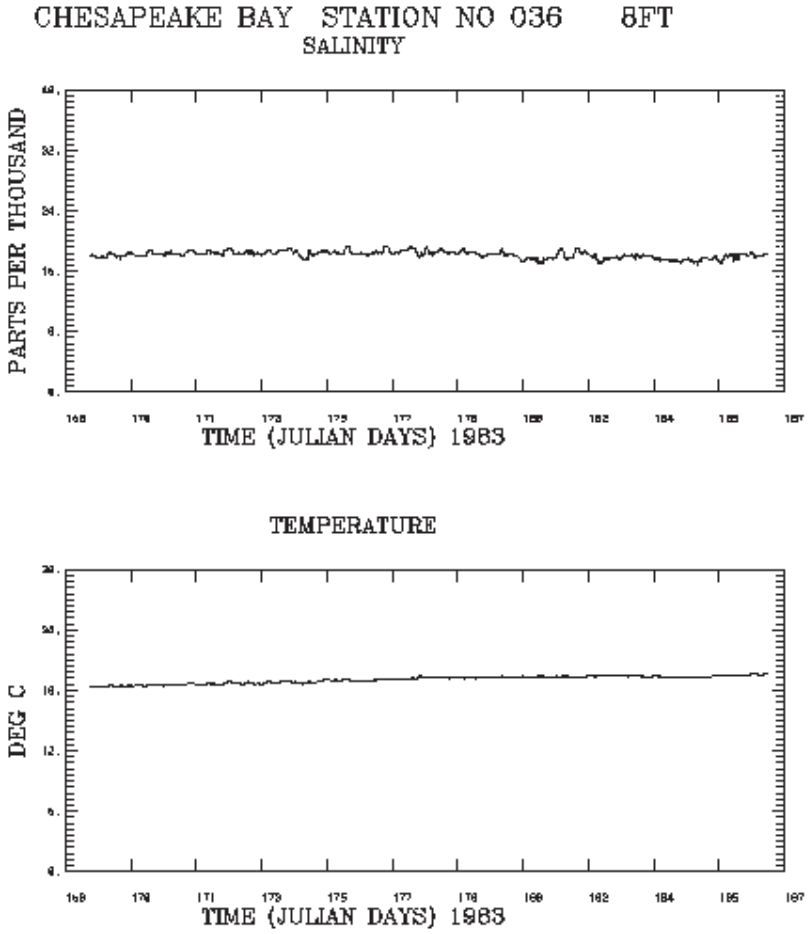

Figure 3.25. Station 36 Central Chesapeake Bay Salinity and Temperature at 8 ft above the bottom in June 1983

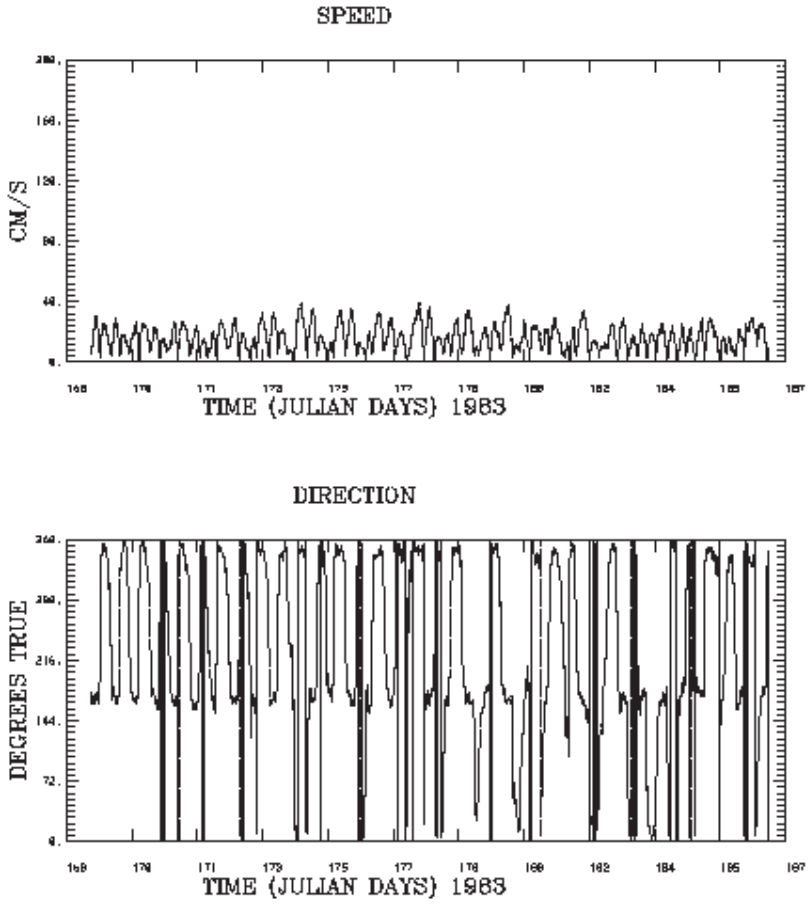

Figure 3.26. Station 36 Central Chesapeake Bay Current Speed and Direction at 8 ft above the bottom in June 1983

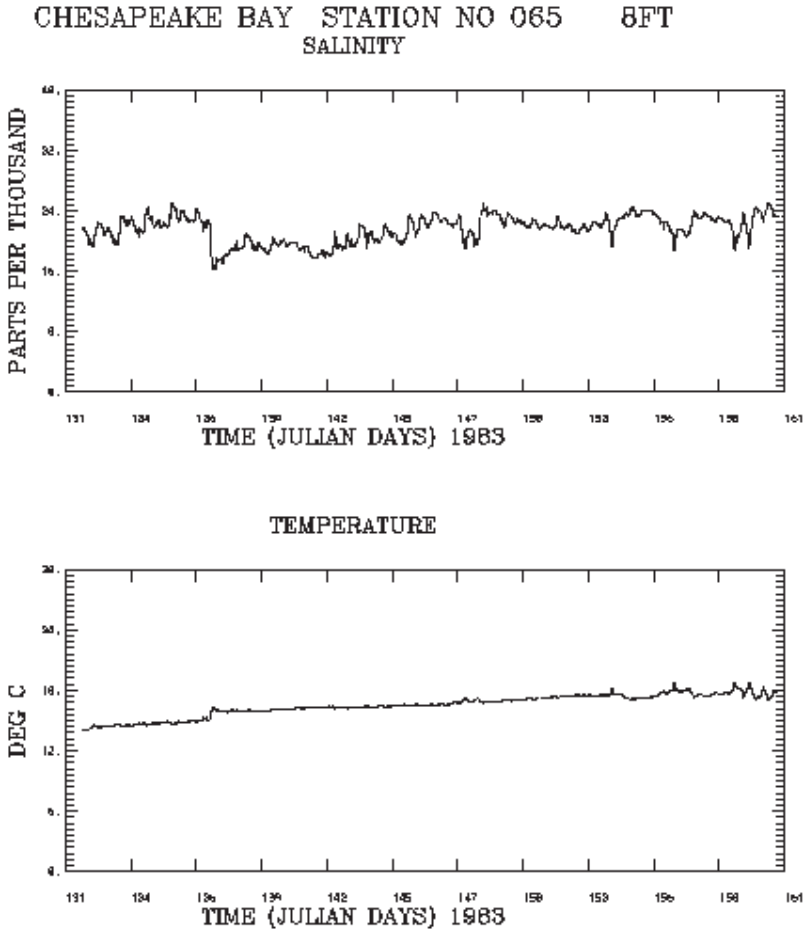

Figure 3.27. Station 65 Lower Chesapeake Bay Salinity and Temperature at 8 ft above the bottom in May 1983

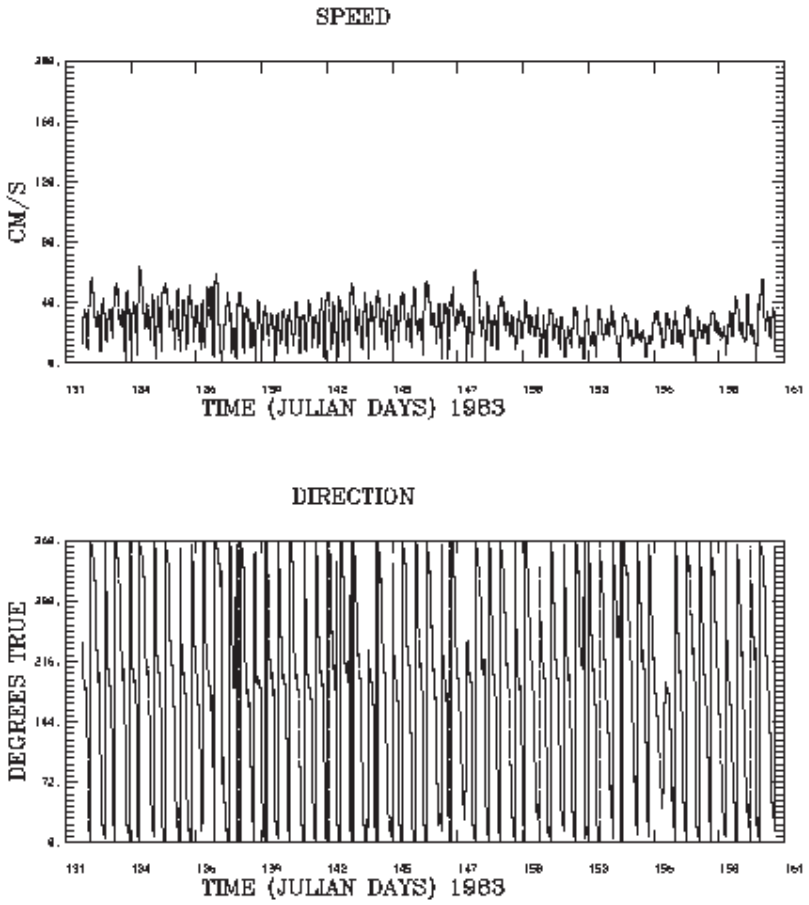

Figure 3.28. Station 65 Lower Chesapeake Bay Current Speed and Direction at 8 ft above the bottom in May 1983

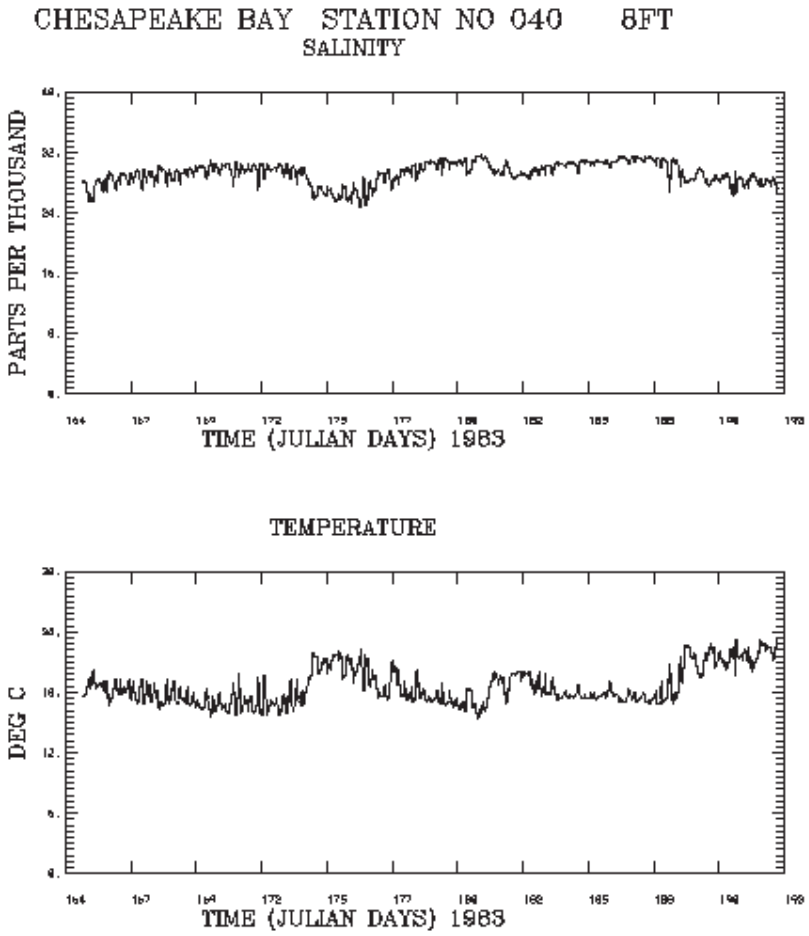

Figure 3.29. Station 40 Chesapeake Bay Entrance Salinity and Temperature at 8 ft above the bottom in June 1983

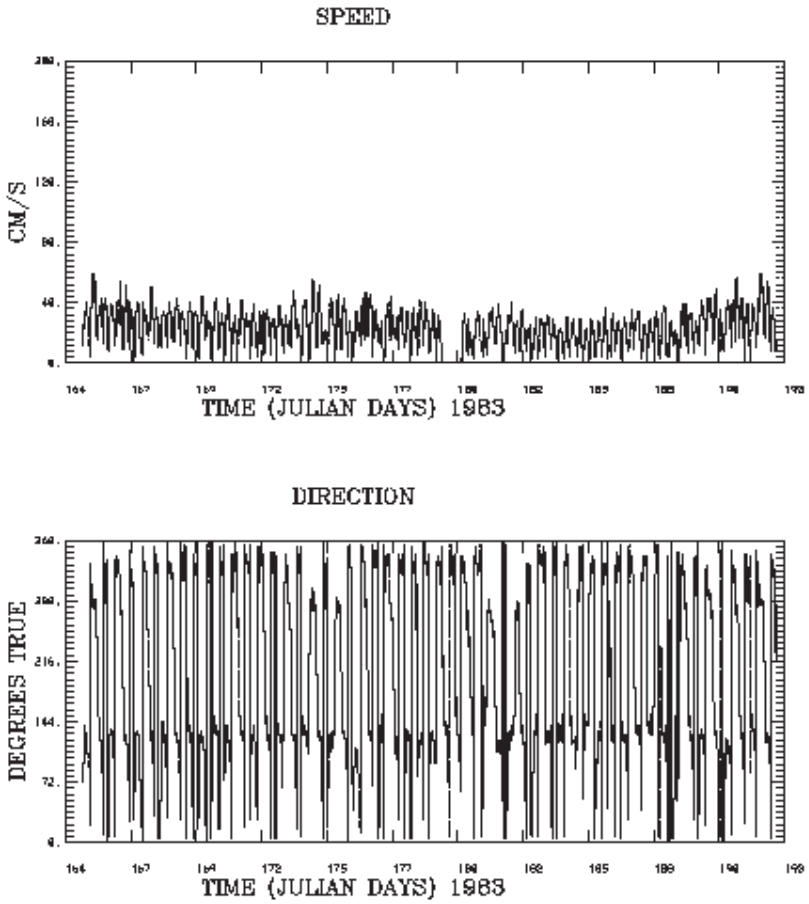

Figure 3.30. Station 40 Chesapeake Bay Entrance Current Speed and Direction at 8 ft above the bottom in June 1983

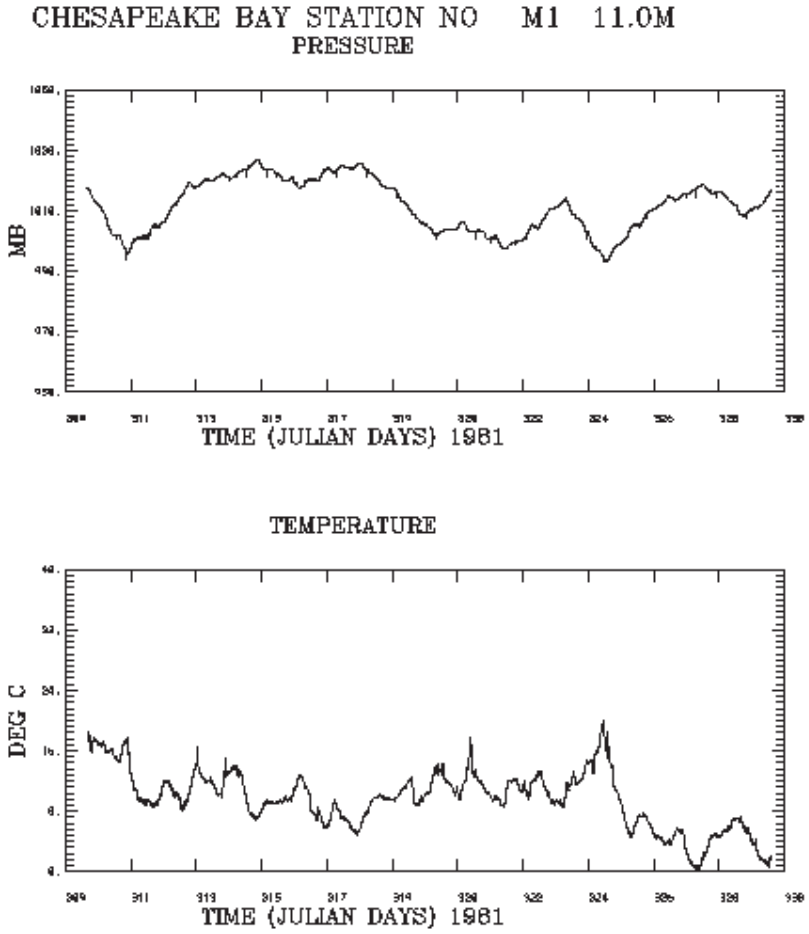

Figure 3.31. Chesapeake Bay Atmospheric Pressure and Air Temperature at M1 at 11m in December 1981

4. COLUMBIA RIVER

The datasets obtained from CO-OPS on compact disc are listed in Table 4.1. It was necessary to carefully inventory these datasets and determine their data quality. Several datasets were duplicated. *Due to lack of time stamps none of the CTD data were further processed.*

Table 4.1. Columbia River Circulation Survey Raw Data Inventory

Directory Name	Number of Files	Data Period	Data Description	Data Quality
COLUMBI1	52	1981	Aanderaa Current Meter	OK
COLUMBI2	51	1981	Aanderaa Current Meter	OK
COLUMBI3	51	1981	Aanderaa Current Meter	OK
HORSE1	1	1981	WL	(Not Processed)*
HORSE2	169	1981	CTD	Corrupted
HORSE3	2̃0	1981	Aanderaa Met	7/20 OK
HORSE4	193	1981	CTD	Corrupted

*Use CO-OPS qc-ed water level data

In Table 4.2, the raw, edited, and final quality controlled datasets are given along with their location in the CSDL/MMAP SAN.

Table 4.2. Columbia River Circulation Survey Processed Data File Inventory

Data Type	Location	Filename
CT/Current Raw	~/current/COLUMBI1/, ~/current/COLUMBI2/, ~/current/COLUMBI3/	file_COLUM1, file_COLUM2, file_COLUM3
CT/Current Edited	~/current/COLUMBI3/	File_COLUM3.r
CT/Current Qc	~/current/qc/	file.qc1, file.qc2, file.qc3
Met Raw	~/meteor/HORSE3/	horse3_all
Met Edited	~/meteor/HORSE3/	horse3_all.r
Met Qc	~/meteor/HORSE3/	columbi_met.qc

~ = /disks/NASUSER/philr/Columbia

CT/Current

The salinity and temperature and current data were distributed amongst three directories: COLUMBI1, COLUMBI2, and COLUMBI3. The data files in these directories (FILE1 through FILEn) were concatenated to create cumulative data files: such as file_COLUM1, file_COLUM2, and file_COLUM3. The data in each individual data file (FILE1 through FILEn) represent current and CT data at one specific station location, over a given time period.

Locations for stations in file_COLUM1 are given in Figure 4.1 with station stop and start times in 1981 given in Table 4.3.

Figure 4.1. Columbia River Current Station Locations: COLUMBI1 (1981)

Table 4.3. Columbia River Circulation Survey (1981) CT/Current: COLUMBI1
Note the order of the stations is as they appear in the file.

Station Name	Distance above bottom (ft)	Start and Stop Julian Day (1981)
C-8	18	121-140
C-3	53	226-245
C-20	20	142-169, 322-339
	30	322-339
C-37	18	197-217
	5	197-217
C-43	25	197-216
	18	197-216, 216-233
	5	197-216
C-35	5	198-217
C-38	5	198-217
C-46	25	198-216, 216-232
	18	198-216
	5	193-211
C-31	23	198-217
	5	198-217
C-9	25	209-225
	18	209-225, 225-241
	5	192-209, 241-261
C-39	35	211-233
C-42	15	212-232
	5	212-232
C-41	18	212-233
	5	212-233
C-23	18	260-276, 293-314
C-10	23	318-336
C-4	31	318-337
	21	318-337
C-17	20	318-336
C-16	15	323-342
C-14	27	323-339
C-18	25	226-244
C-24	5	255-270

Locations for stations in file_COLUMBI2 are shown in Figure 4.2 with station start and stop times in 1981 given in Table 4.4.

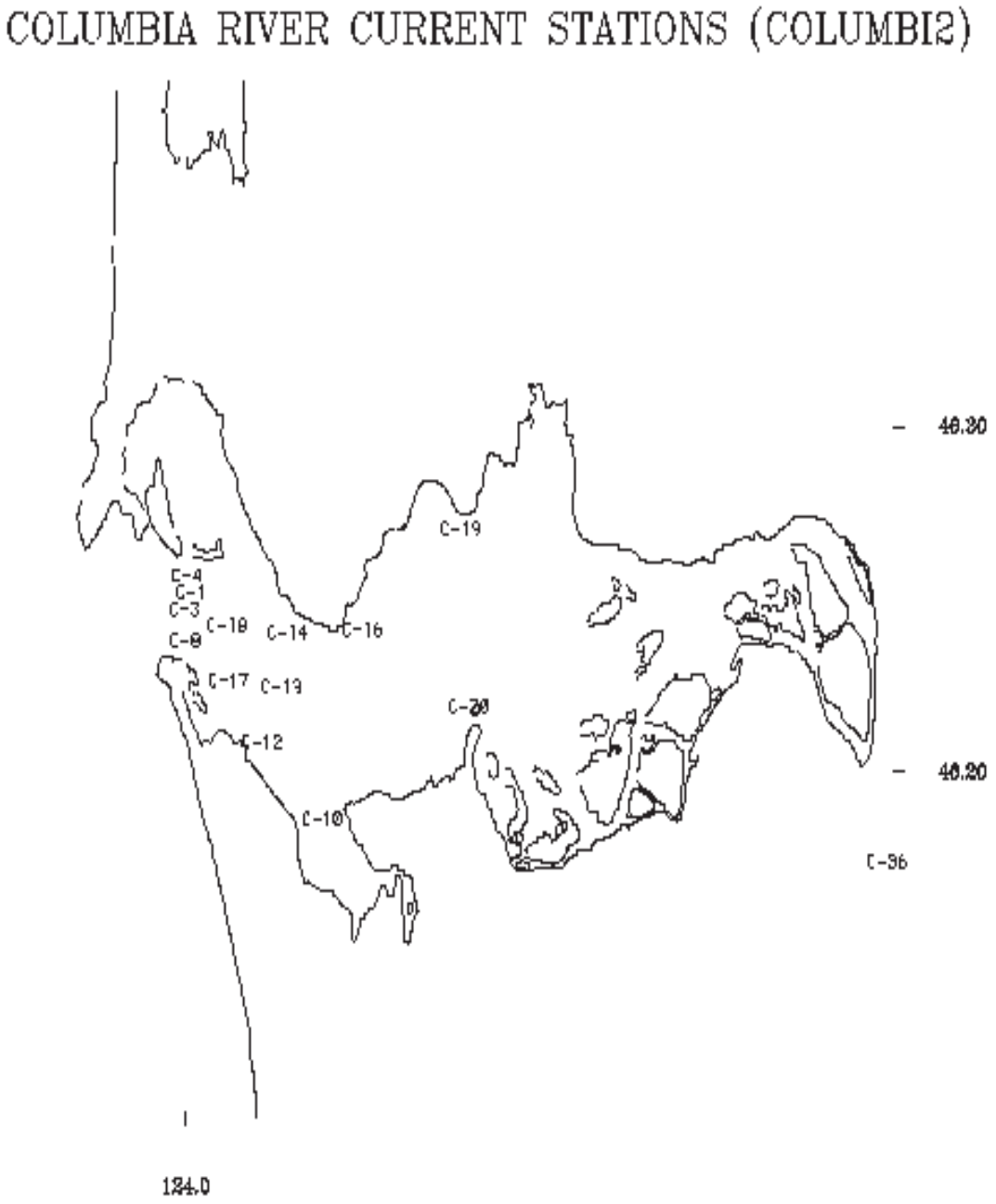

Figure 4.2. Columbia River Current Station Locations: COLUMBI2 (1981)

Table 4.4. Columbia River Circulation Survey (1981) CT/Current: COLUMBI2
Note the order of the stations is as they appear in the file.

Station Name	Distance above bottom (ft)	Start and Stop Julian Day (1981)
C-16	5	323-342, 162-188, 140-162
C-14	5	322-329
	27	140-156
	17	156-175
C-17	20	244-261
C-18	18	244-261
	5	244-261
C-1	25	244-262, 140-157, 157-175
	35	226-244, 140-157, 121-140
	5	226-244
C-8	5	244-260
C-4	21	245-261, 226-245
	5	245-261
	31	226-245
C-43	5	216-233
C-46	5	216-232
C-9	5	149-164, 225-241
	18	163-192, 192-209
C-3	43	226-245
C-19	50	167-184
C-37	25	182-197
	18	182-197
C-36	5	182-198
C-8	5	141-161
C-39	35	190-207
C-20	5	142-169
C-12	5	142-161

Locations for stations in file_COLUMBI3 are shown in Figure 4.3 with station start and stop times in 1981 given in Table 4.5.

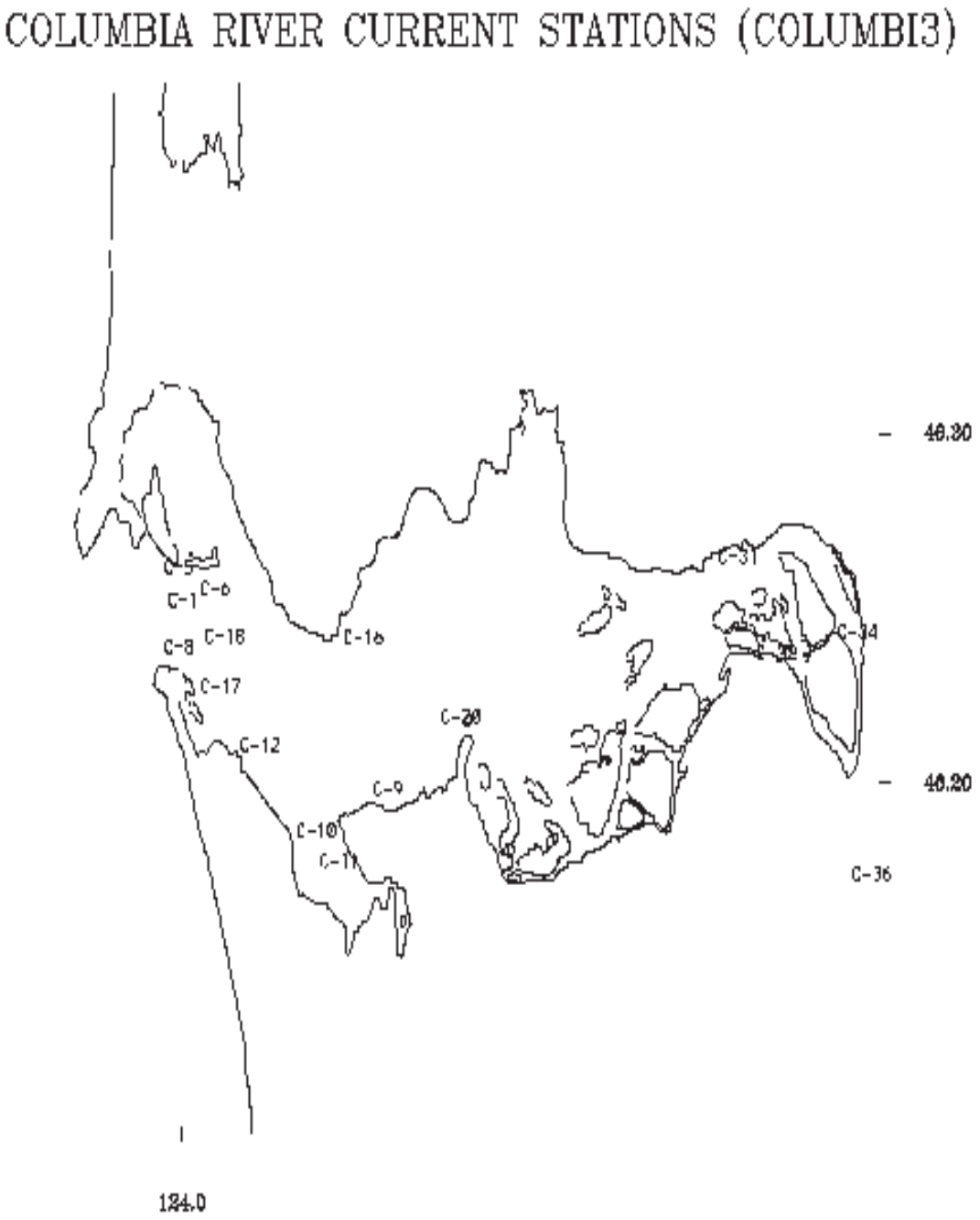

Figure 4.3. Columbia River Current Station Locations: COLUMBI3 (1981)

Table 4.5. Columbia River Circulation Survey (1981) CT/Current: COLUMBI3
Note the order of the stations is as they appear in the file.

Station Name	Distance above bottom (ft)	Start and Stop Julian Day (1981)
C-14	17	125-140, 140-156
	5	140-156, 156-175
	27	156-173
C-9	25	125-141
	18	125-141
	23	141-163
	17	141-163
C-39	35	126-141, 155-171
	45	155-171, 174-190, 190-211
C-16	15	120-140, 140-162, 163-188
C-1	25	121-140
	5	121-140
	35	157-175
C-18	25	121-139, 139-156
	18	121-139, 139-156
	5	121-139, 139-156
C-10	5	134-153
	23	161-178
C-5	5	139-154
C-17	5	140-156
C-8	18	140-161
C-20	30	142-169
C-6	5	157-178
C-11	5	169-184
C-31	34	181-198
	23	181-198
C-34	18	181-197
	5	181-197
C-36	25	198-216
	18	198-216

Meteorological Data

The 1981 meteorological station locations are shown in Figure 4.4. The height above ground (HGL) and start and stop times are given in Table 4.6. The Columbia River Circulation Survey was included in the directory HORSE3, which consisted of 20 individual files. The 20 files were concatenated into one large cumulative file, horse3_all.

The program meteor.f was used to plot air temperature, air pressure, wind speed, and wind direction. For this usage, the routine filt.pp.f was revised to make certain a "bad" point is not persisted. For a point to be persisted, it must first be determined to be a "good" point, that is, it must fall within a designated range of accepted values. *Wind speed units in either cm/s or knots did not appear reasonable and as a result all wind data were not further processed.*

Figure 4.4. Columbia River Meteorological Station Locations

Table 4.6. Columbia River Circulation Survey (1981) Meteorological Data

Station Name	HGL (m)	Start and Stop Julian Day
M1	10	171-192, 209-224, 224-239, 283-301, 301-315, 315-330, 330-344

Oceanographic Considerations

No CTD data were recovered and one must rely on the CT/Current data to provide the vertical structure. In addition, no reliable atmospheric pressure and wind speed data could be recovered. Air temperature data are available for use in numerical computation of surface fluxes.

Here we examine CT/Current time series in June 1981 at Station C-1 at the Columbia River entrance at 35 ft (Figures 4.5 and 4.6), 25 ft (Figures 4.7 and 4.8), and 5 ft (Figures 4.9 and 4.10) above the bottom. One notes the tremendous range in near surface salinity from 0 to 24 PSU while temperature variations of order 2^{o}C are less pronounced as shown during May 1981 in Figure 4.5. Note as shown in Figure 4.6 near surface current strengths often exceed 300 cm/s. One notes as one nears the bottom current strengths remain strong (order 150 cm/s at 25 ft above the bottom in Figure 4.8 and order 80 cm/s at 5 ft above the bottom in Figure 4.10. At Station C34 in the lower Columbia River above the channel bifurcation salinity and temperature in July 1981 are shown in Figure 4.11 at 18 ft above the bottom and in Figure 4.13 at 5 ft above the bottom. Note freshwater (0 PSU) throughout the water column and uniform temperature at 15 ^{o}C. Note ebb currents tend to predominate at both 18 ft (Figure 4.12) and at 5 ft (Figure 4.14) above the bottom with maximum current strengths decreasing from 120 cm/s to 90 cm/s.

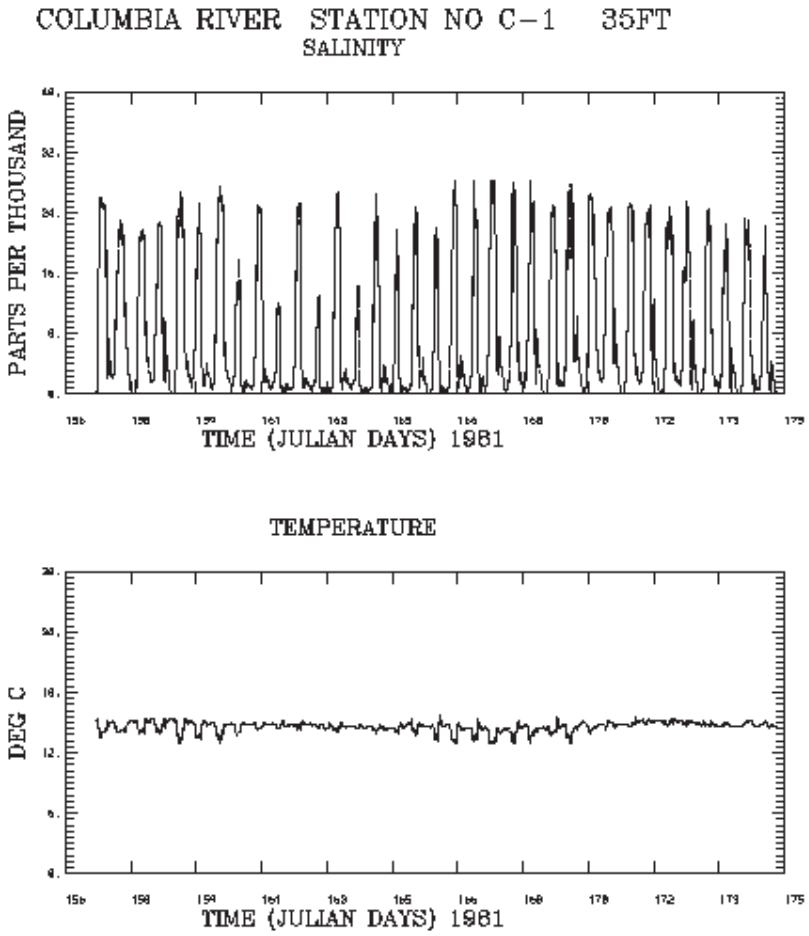

Figure 4.5. C-1 at the Columbia River Entrance Salinity and Temperature at 35 ft above the bottom in June 1981

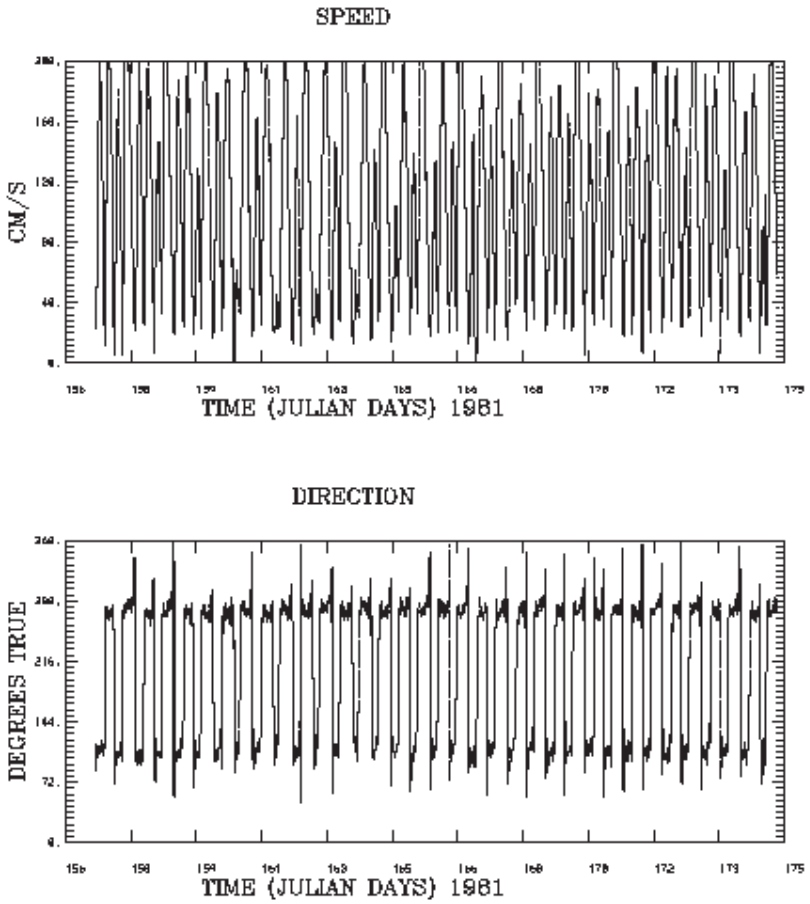

Figure 4.6. C-1 at the Columbia River Entrance Current Speed and Direction at 35 ft above the bottom in June 1981

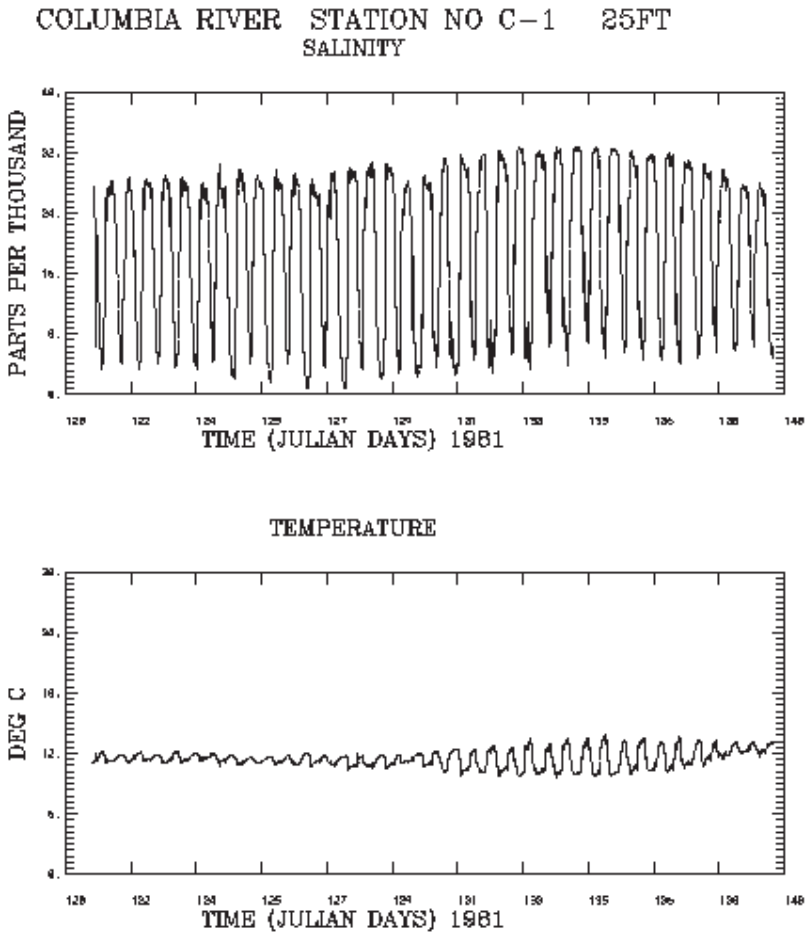

Figure 4.7. C-1 at the Columbia River Entrance Salinity and Temperature at 25 ft above the bottom in June 1981

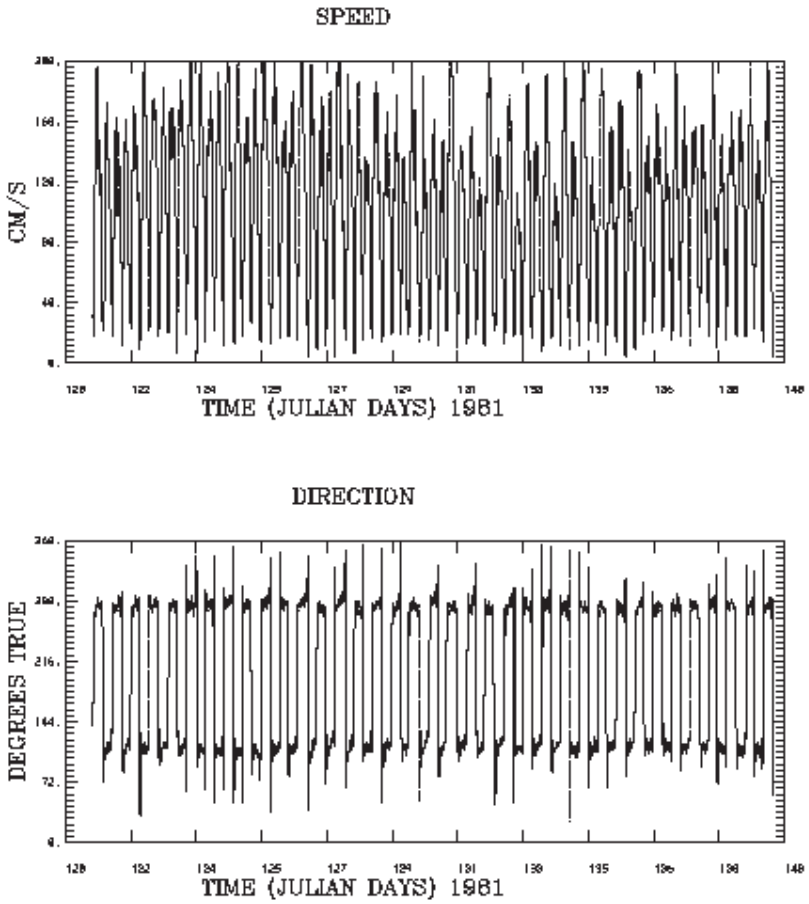

Figure 4.8. C-1 at the Columbia River Entrance Current Speed and Direction at 25 ft above the bottom in June 1981

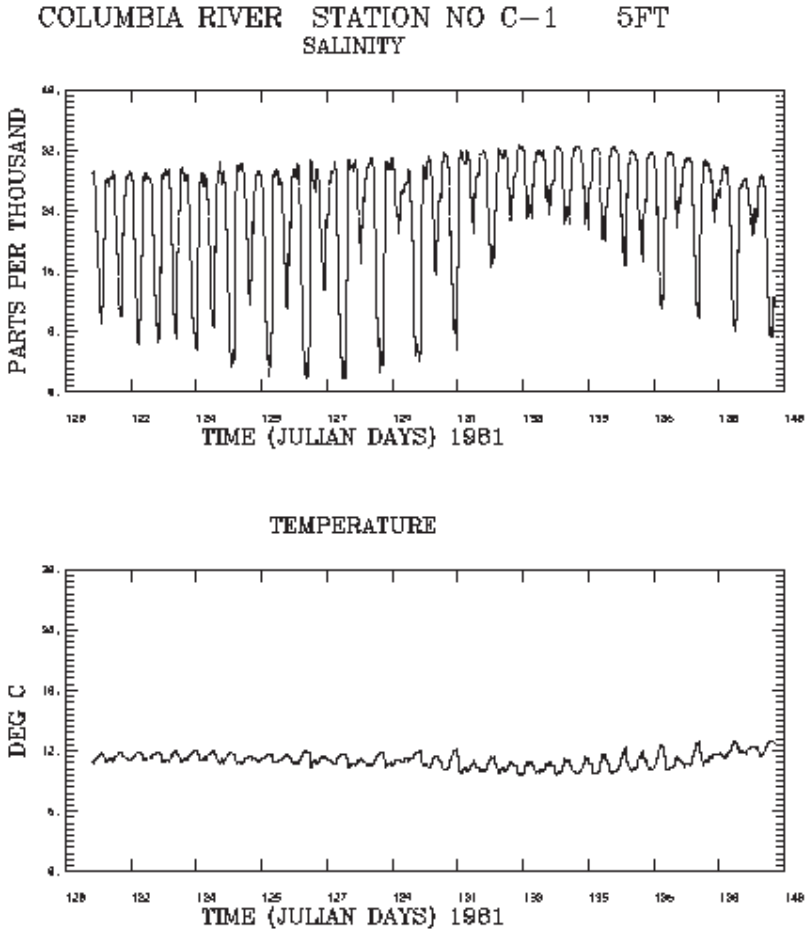

Figure 4.9. C-1 at the Columbia River Entrance Salinity and Temperature at 5 ft above the bottom in June 1981

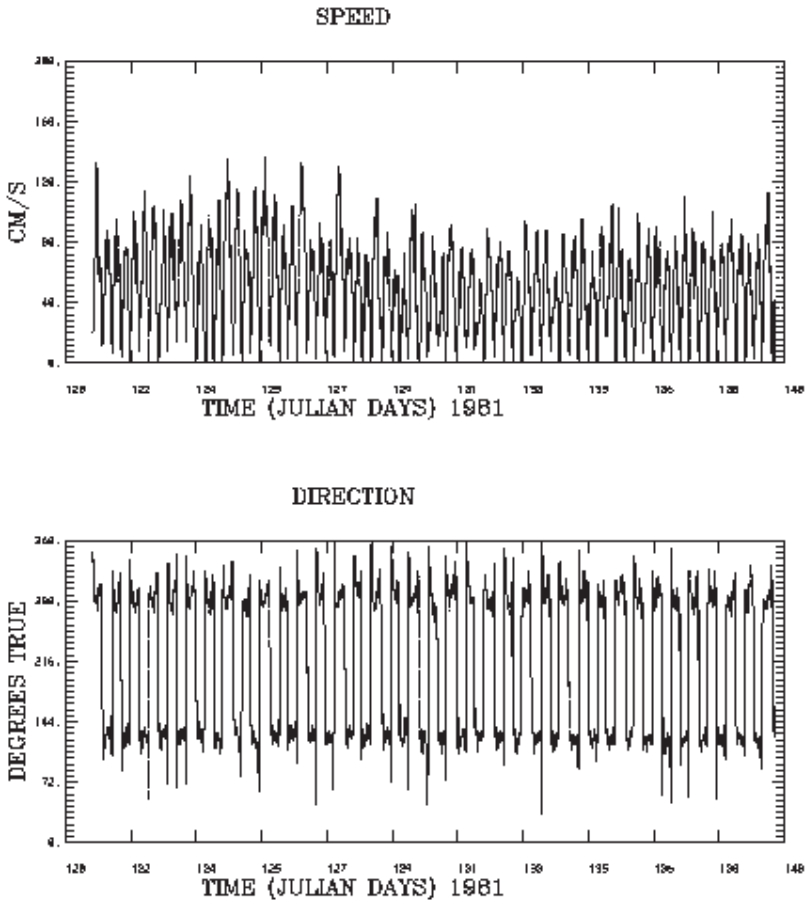

Figure 4.10. C-1 at the Columbia River Entrance Current Speed and Direction at 5 ft above the bottom in June 1981

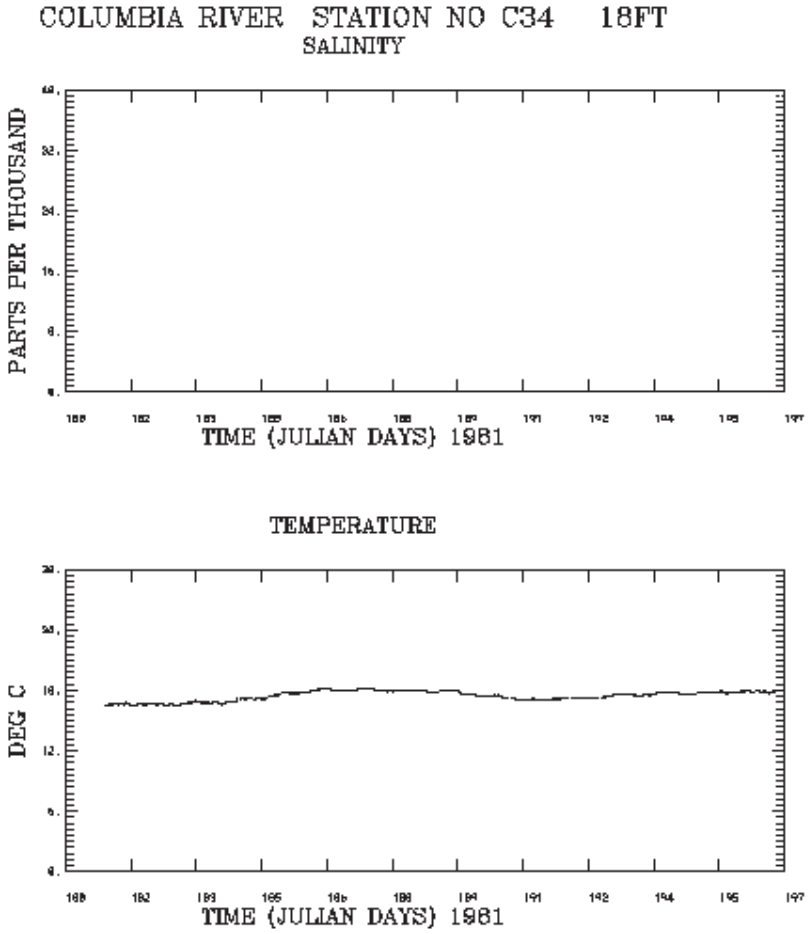

Figure 4.11. C34 in Lower Columbia River Salinity and Temperature at 18 ft above the bottom in July 1981

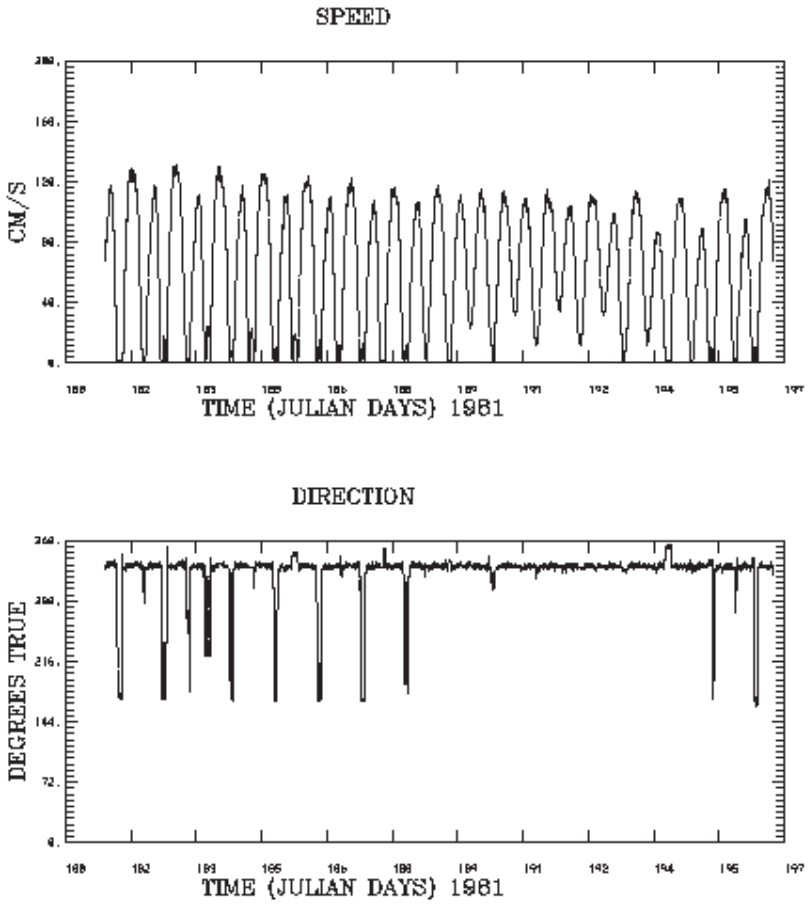

Figure 4.12. C34 in Lower Columbia River Current Speed and Direction at 18 ft above the bottom in July 1981

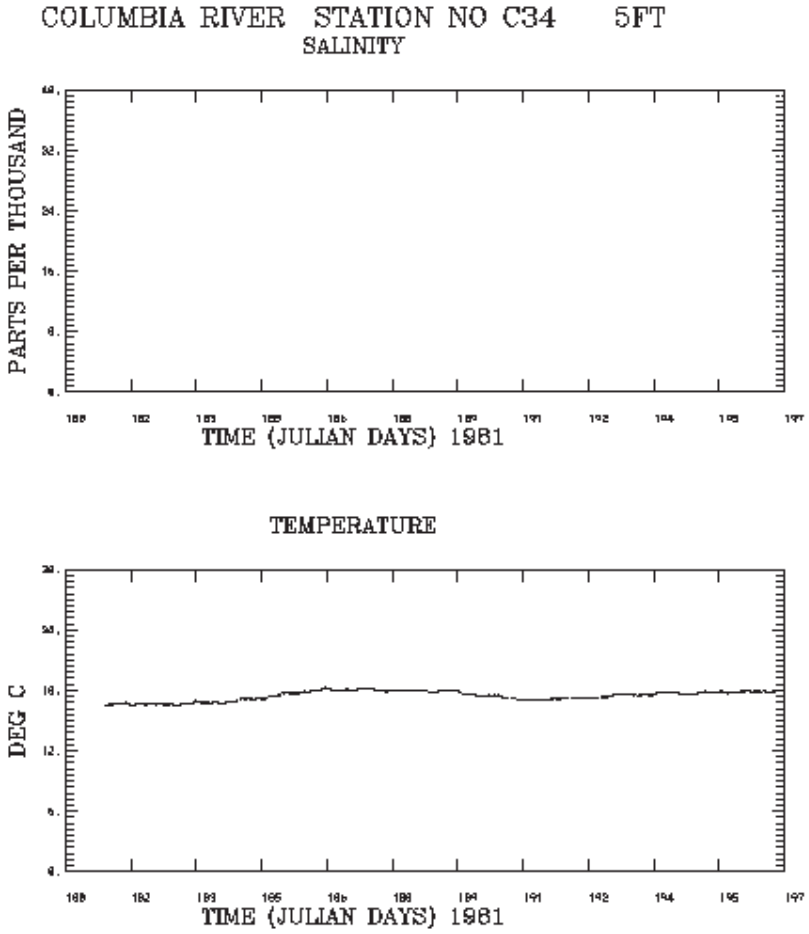

Figure 4.13. C34 in Lower Columbia River Salinity and Temperature at 5 ft above the bottom in July 1981

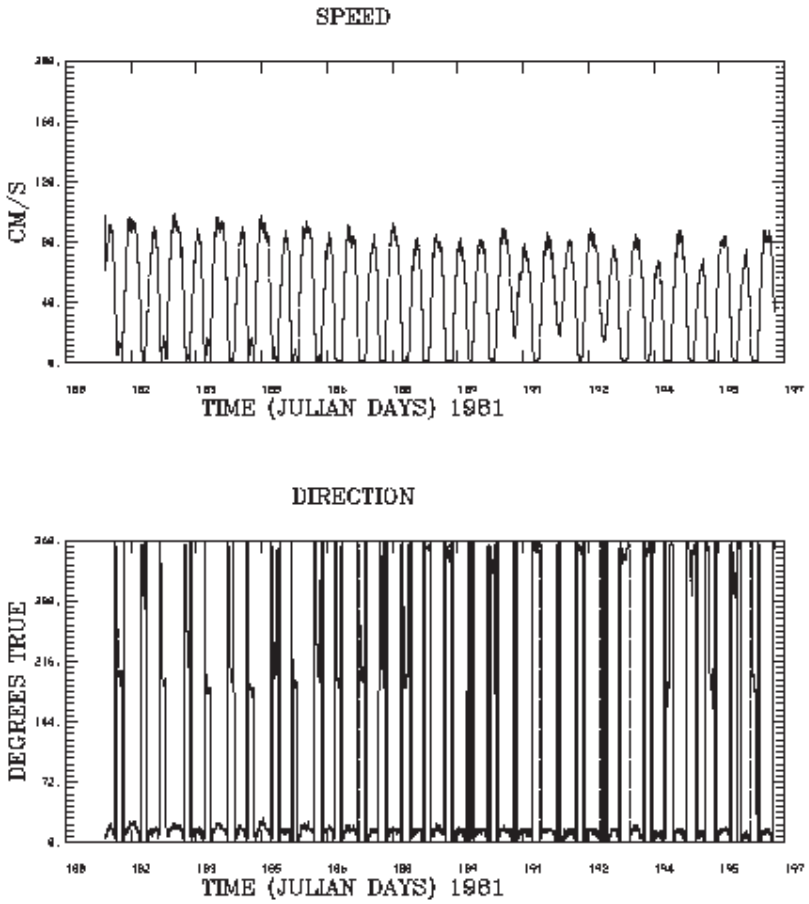

Figure 4.14. C34 in Lower Columbia River Current Speed and Direction at 5 ft above the bottom in July 1981

5. SAN FRANCISCO BAY

The datasets obtained from CO-OPS on compact disc are listed in Table 5.1. It was necessary to carefully inventory these datasets and determine their data quality. *Several datasets were duplicated and a large portion of the CTD data was not able to be processed due to lack of time stamp information.*

Table 5.1. San Francisco Bay Circulation Survey Raw Data Inventory

Directory Name	Number of Files	Data Period	Data Description	Data Quality
SANFR1-1	105	1980	Aanderaa Current Meter	OK
SANFR1-2	106	1980	Aanderaa Current Meter	OK
SANFR1-3	41	1980	Aanderaa Current Meter	OK
SANFR2-1	159	1979	Aanderaa Current Meter	OK
HEEP1	23	1979-80	Aanderaa Met	OK (22 out of 23 were good)
HEEP2	144	1980	CTD	OK

In Table 5.2, the raw, edited, and final quality controlled datasets are given along with their location in the CSDL/MMAP SAN.

Table 5.2. San Francisco Bay Circulation Survey Processed Data File Inventory

Data Type	Location	Filename
CTD Raw	~/ctd/HEEP2/	CTD_raw
CTDEdited	~/ctd/HEEP2/	CTD_edit
CTD Qc	~/ctd/	sfctd.final
CT/Current Raw	~/current/SanFr1/SANFR1-1/raw/ ~/current/SanFr1/SANFR1-2/raw/ ~/current/SanFr1/SANFR1-3/raw ~/current/SanFr2/SANFR2-1/raw/	sanfr1-1.all sanfr1-2.all sanfr1-3.all sanfr2-1.all
CT/Current Edited	~/current/SanFr1/SANFR1-1/, ~/current/SanFr1/SANFR1-2/, ~/current/SanFr2/SANFR2-1/	sanfr1-1.ed sanfr1-2.ed sanfr2-1.ed

Table 5.2. (Cont.) San Francisco Bay Circulation Survey Processed Data File Inventory

CT/Current Qc	~/current/qc/	file_1-1.qc, file_1-2.qc, file_1-3.qc, file_2-1.qc
Met Raw	~/HEEP1/raw/	heep1_raw
Met Edited	~/HEEP1/	heep1.ed
Met Qc	~/qc/	sanfran_met.qc

~ = /disks/NASUSER/philr/sanfranbay_pr

CTD

The dataset includes 144 Grundy CTD casts from 1980. Overall order 20 percent of the casts required editing with most of the bad data in the near surface or near bottom sections of the cast. Station locations of the CTD casts are shown in Figures 5.1 and 5.2.

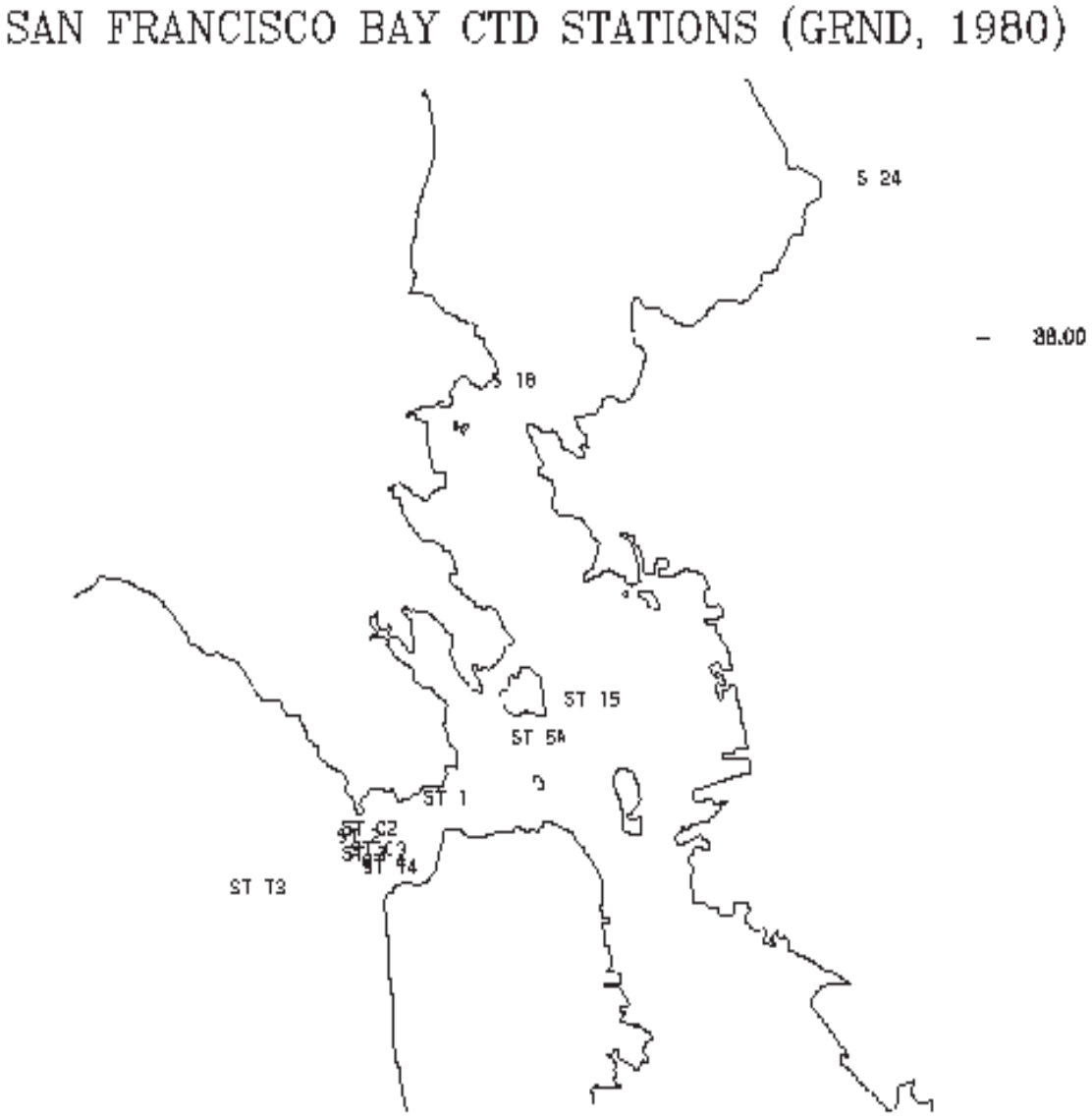

Figure 5.1. San Francisco Bay CTD Station Northern Locations (GRNDY, 1980)

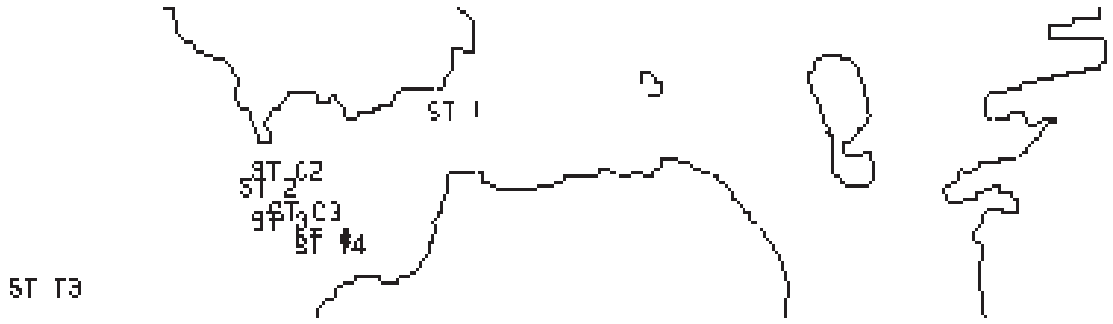

Figure 5.2. San Francisco Bay CTD Station Entrance Locations (GRNDY, 1980)

Cast dates and times are given in Table 5.3.

Table 5.3. San Francisco Bay Circulation Survey Grundy (1980) CTD Casts
Note the casts are given on the order they appear in file sfctd.final.

Station Name	Cast Dates and Times
S18	9/11/80 (0001, 0431, 0500, 0530, 0600, 0630, 0700, 0730, 0800, 0831, 0900, 0930, 1000, 1030, 1100, 1130, 1200, 1230, 1300, 1330, 1400, 1430, 1500, 1631, 1700, 1730, 1801, 1830, 1900, 1930, 2000, 2030, 2100, 2131, 2200, 2230, 2330)
S18	9/12/80 (0000, 0030, 0055)
S18	10/20/80 (1747, 1801, 1830, 1901, 1930, 2000, 2030, 2100, 2131, 2159, 2230, 2300, 2330)
S18	10/21/80 (0001, 0032, 0100, 0130, 0200, 0230, 0300, 0330, 0400, 0430, 0459, 0530, 0600, 0630, 0700, 0730, 0800, 0830, 0900, 0930, 1000, 1730, 1755, 1831)
ST T3	10/21/80 (2038)
ST 4	10/21/80 (2148)
ST 3	10/21/80 (2209)
ST 2	10/21/80 (2230)
ST 1	10/21/80 (2310)
ST 5A	10/21/80 (2352)
ST 15	10/22/80 (0018)
S 24	10/22 (1930, 2000, 2030, 2200, 2115, 2130, 2230, 2300, 2330)

Table 5.3. (Cont.) San Francisco Bay Circulation Survey Grundy (1980) CTD Casts
Note the casts are given on the order they appear in file sfctd.final.

S24	10/23/80 (0000, 0030, 0100, 0130, 0201, 0230, 0300, 0330, 0400, 0430, 0500, 0530, 0600, 0630, 0700, 0730, 0800, 0830, 0900, 0930, 1000, 1030, 1101, 1130, 1200, 1230, 1300, 1330, 1400, 1430, 1500, 1530, 1600, 1630, 1700, 1731, 1800, 1830, 1900, 1930, 2000, 2030)
ST T3	10/29/80 (1901)
ST T4	10/29/80 (1948)
ST C3	10/29/80 (2002)
ST C2	10/29/80 (2014)
ST 1	10/29/80 (2039)
ST 5A	10/29/80 (2104)
ST 15	10/29/80 (2124)

CT/Current

The salinity and temperature and current data were distributed amongst four directories: SANFR1-1, SANFR1-2, SANFR1-3, and SANFR2-1. These data files (FILE1 through FILEn) were concatenated to create cumulative data files: file_1-1.qc, file_1-2.qc, file_1-3.qc and file_2-1.qc. The data in each individual data file (FILE1 through FILEn) represent current and CT data at one specific station location, over a given time period. Station locations in SanFr1-1 are shown in Figure 5.3 with start and stop times given in Table 5.4.

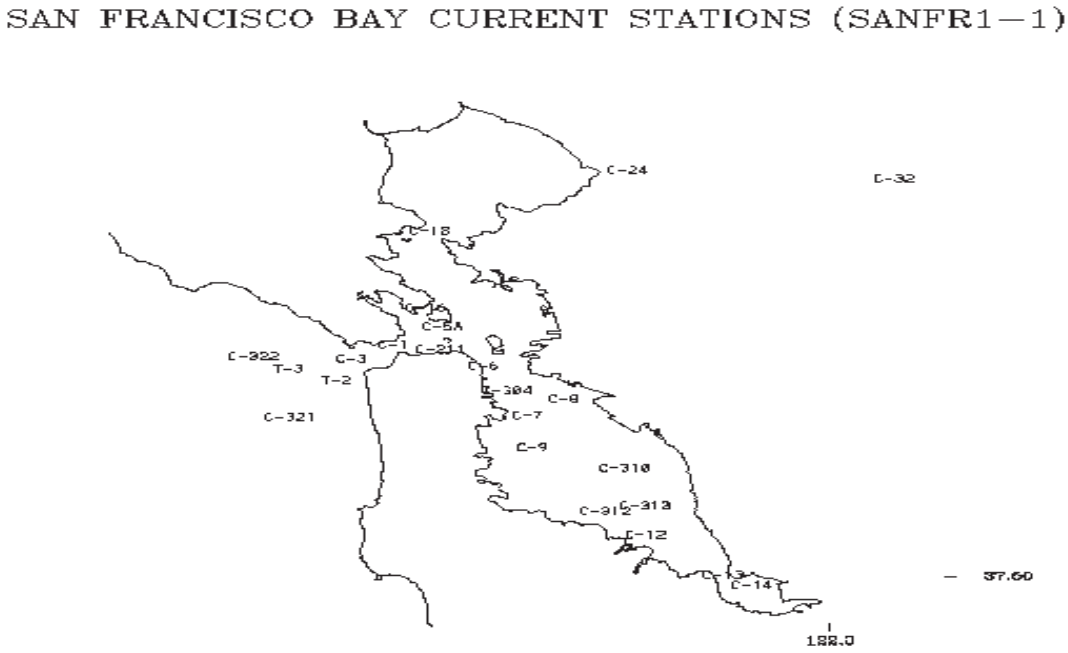

Figure 5.3. San Francisco Bay Current Station Locations: SanFr1-1 (1980)

Table 5.4. San Francisco Bay Circulation Survey (1980) CT/Current: SanFr1-1
Note the order of the stations is as they appear in the file.

Station Name	Distance above bottom (ft)	Start and Stop Julian Day
C-16	75	93-117, 117-136, 136-163
	55	93-117, 117-136, 136-163, 165-184
	25	93-117
C-24	39	103-124, 170-191, 191-212, 124-143, 151-170
	19	102-123, 124-143, 151-170
	7	124-143, 151-170
C-18	50	103-124, 163-184, 184-200, 124-143, 143-163
	7	103-124, 124-143, 163-184, 184-200
	30	163-184, 124-143, 143-162
C-1	150	107-128
	25	107-128, 150-169, 169-192
	250	150-169
T-2	5	106-131
C-211	51	107-131, 155-176, 192-213
	31	107-131, 150-176
	5	107-131
	35	176-192
C-3	102	108-135
	82	108-135
C-9	5	74-102, 102-141, 173-205
C-13	5	74-103, 128-155, 155-192
C-7	20	193-212
	5	193-212
C-304	7	191-207
C-6	45	157-176, 176-192
	25	176-192
	7	176-192
C-312	37	158-177, 177-193
	27	158-177, 177-192, 142-157
	8	142-157
C-310	3	164-183, 183-199
C-32	5	159-184, 131-156
C-321	25	109-141
C-12	28	142-158
	5	142-158
C-14	5	149-165
C-5A	25	152-169
	5	152-167
	85	152-169

Station locations in SanFr1-2 are shown in Figure 5.4 for the northern stations and in Figure 5.5 for the southern stations. Start and stop measurement times are given in Table 5.5.

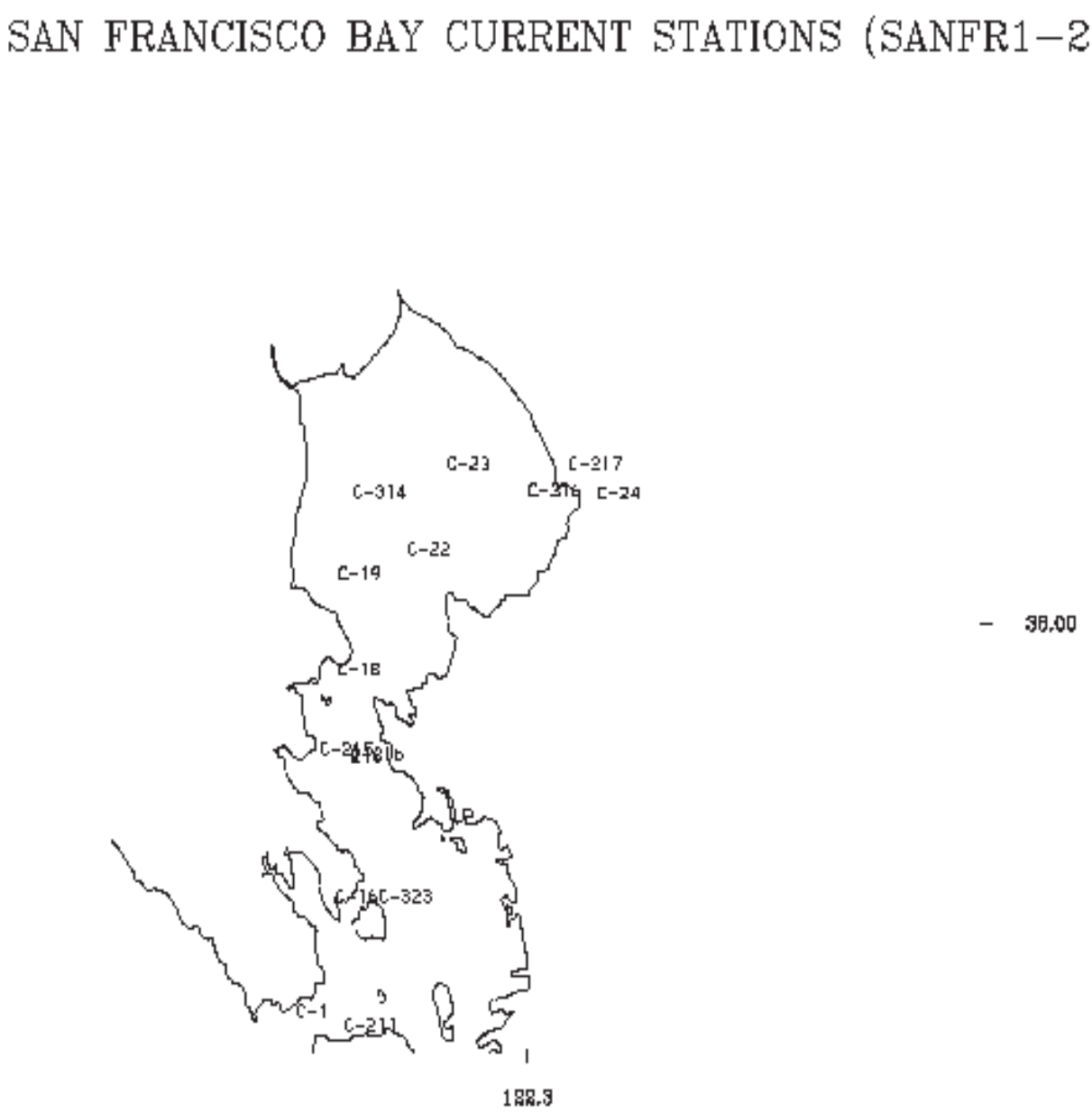

Figure 5.4. San Francisco Bay Northern Current Station Locations: SanFr1-2 (1980)

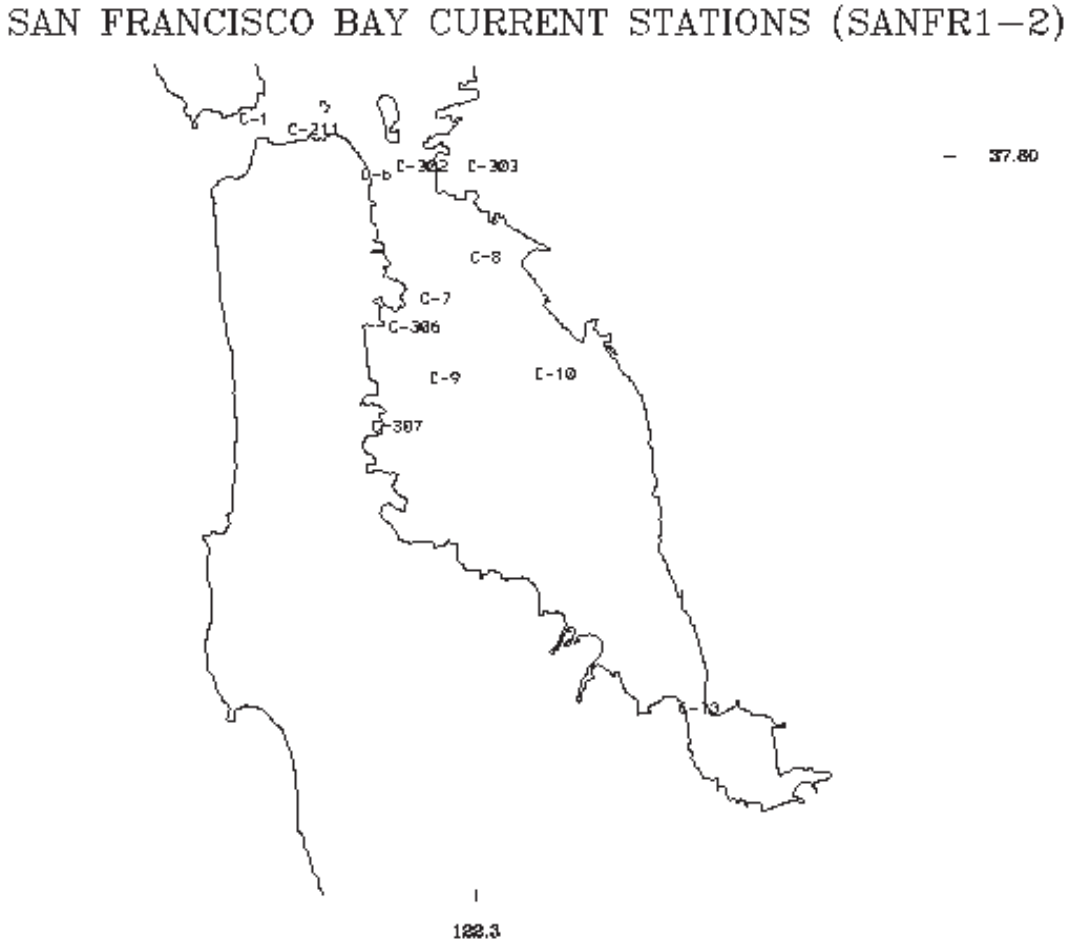

Figure 5.5. San Francisco Bay Southern Current Station Locations: SanFr1-2 (1980)

Table 5.5. San Francisco Bay Circulation Survey (1980) CT/Current: SanFr1-2
Note the order of the stations is as they appear in the file.

Station Name	Distance above bottom (ft)	Start and Stop Julian Day
C-1	150 25 250	197-213, 274-290 197-213, 274-290 242-261
C-306	17 5	197-214 197-214, 214-233
C-16	55 25 75	200-218, 218-234, 253-269, 269-291 200-218, 253-269, 269-291 218-234, 234-253, 253-269, 269-291

Table 5.5. (Cont.) San Francisco Bay Circulation Survey (1980) CT/Current: SanFr1-2
Note the order of the stations is as they appear in the file.

C-18	50	200-218, 218-234, 234-253, 253-270, 270-291
	30	200-218, 218-234, 253-270, 270-291
	7	200-218, 218-234, 234-253, 253-270, 270-291
C-302	5	205-223
C-303	5	205-223
C-6	45	207-226, 226-242
	25	207-226, 226-242
C-8	3	208-227
C-7	20	212-228
C-24	39	212-228, 228-247, 247-262, 262-281
	7	212-228, 228-247, 262-281, 281-297, 103-124
	19	228-247, 262-281, 281-297
C-211	5	213-233, 248-267
	51	248-267, 277-293
	31	248-267, 277-293
C-215	5	219-236, 255-276
	20	236-255, 255-276
C-307	5	219-236
C-323	5	219-235, 254-270
	26	235-255
C-10	5	232-248
C-316	18	241-262, 262-281, 281-298
	5	241-262, 262-281, 281-298
	28	262-281
C-216	5	241-260
	26	260276
C-13	5	192-222
C317	5	250-268, 268-285, 285-303
C-22	10	254-270
	9	270-292
C-19	5	256-277, 277-295
C-23	3	275-291
C-314	3	284-302

Station locations in SanFr1-3 are shown in Figure 5.6. Start and stop measurement times are given in Table 5.6.

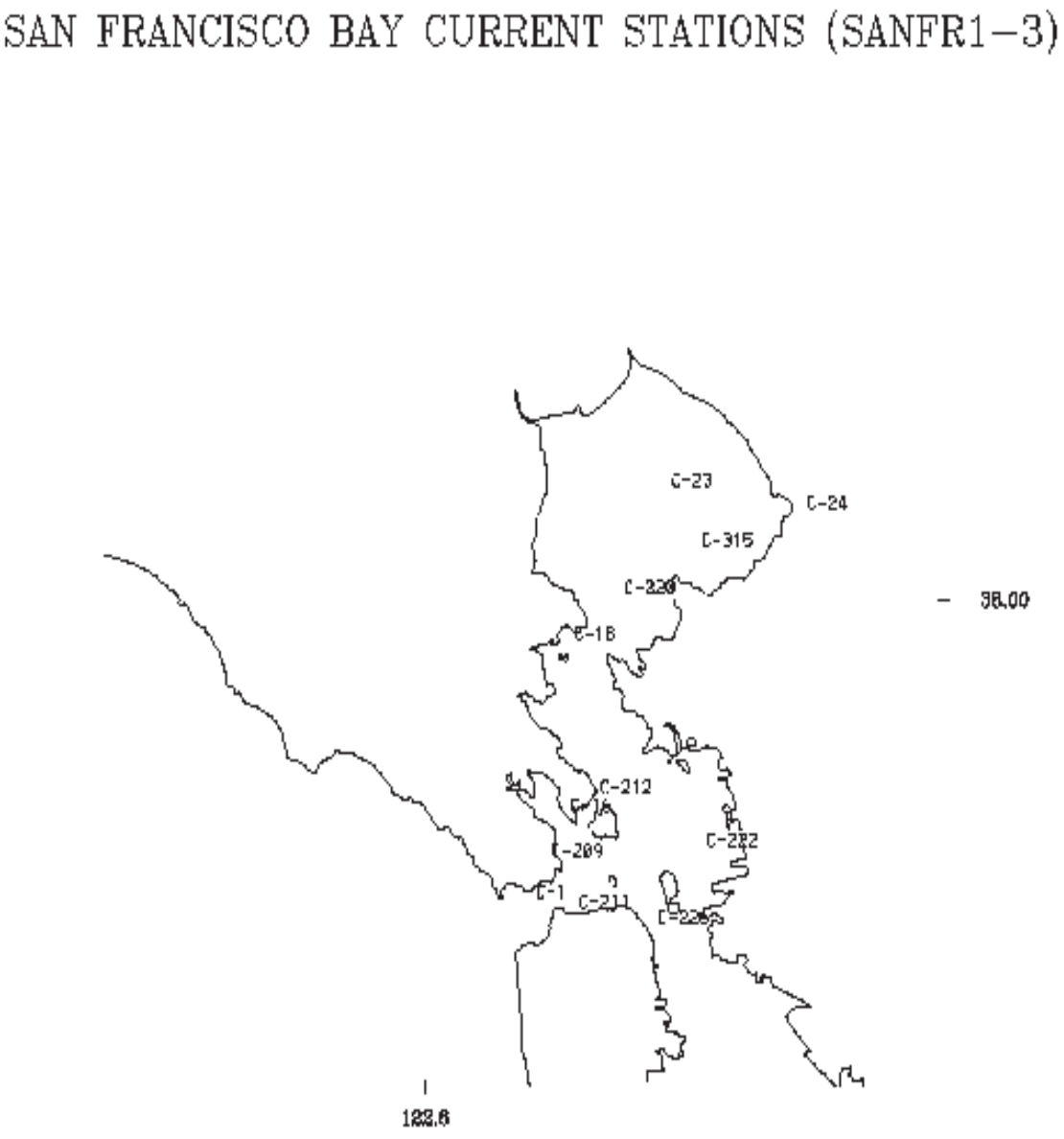

Figure 5.6. San Francisco Bay Current Station Locations: SanFr1-3 (1980)

Table 5.6. San Francisco Bay Circulation Survey (1980) CT/Current: SanFr1-3
Note the order of the stations is as they appear in the file.

Station Name	Distance above bottom (ft)	Start and Stop Julian Day
C-18	30	311-330, 291-311
	7	291-311
	50	311-330
C-23	3	291-310
C-315	5	291-310
C-16	75	291-311
	55	291-311, 311-330
	25	291-311, 311-330
C-211	51	297-312, 312-330
	31	297-312, 312-330
C-24	19	297-316, 318-337
	7	297-318, 318-337
	39	297-318, 318-337
C-237	5	306-323
C-26	5	303-323
	15	303-323
C-34	13	304-320
	5	304-320
C-1	250	304-325
	150	304-325
	25	304-325
C-246	10	305-325
C-13	5	318-338
C-212	19	319-337
C-209	5	318-337
	37	318-337
C-226	5	320-340
C-222	3	316-334
C-211	55	176-192
C-320	5	277-297

Station locations in SanFr2-1 are shown in Figure 5.7 for the northern stations and in Figure 5.8 for the southern stations. Start and stop measurement times are given in Table 5.7.

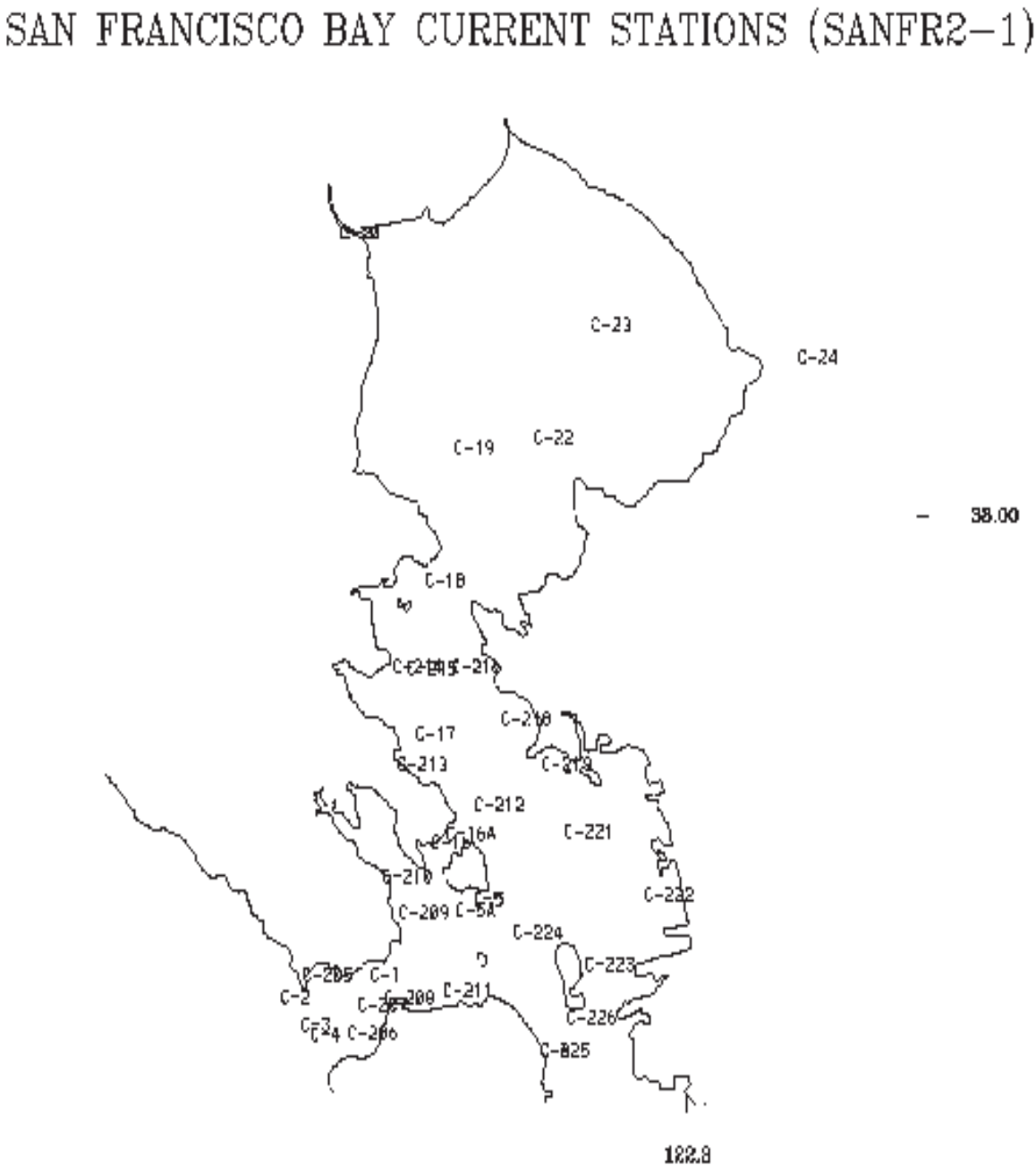

Figure 5.7. San Francisco Bay Northern Current Station Locations: SanFr2-1 (1980)

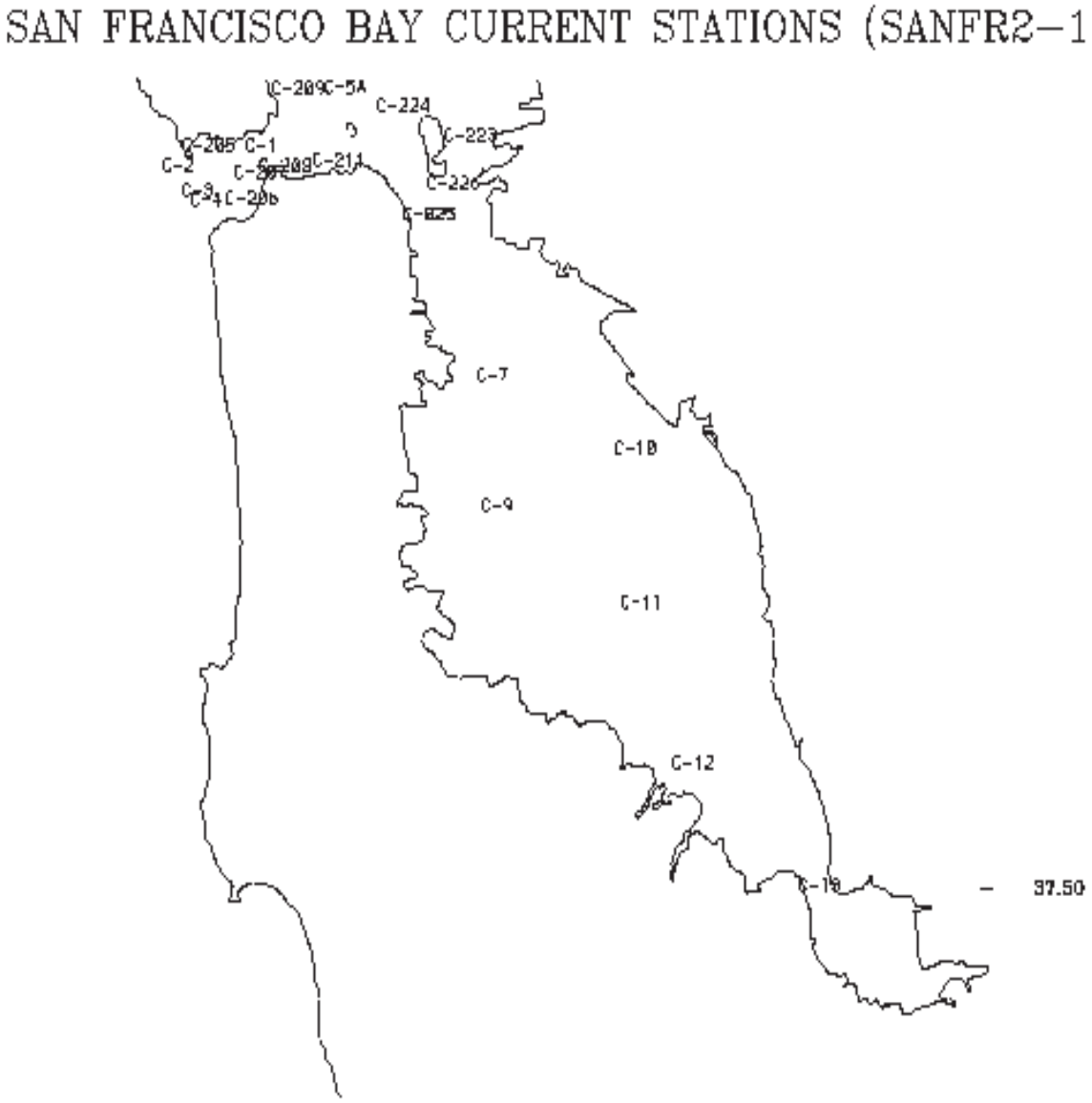

Figure 5.8. San Francisco Bay Southern Current Station Locations: SanFr2-1 (1980)

Table 5.7. San Francisco Bay Circulation Survey (1979-1980) CT/Current: SanFr2-1
Note the order of the stations is as they appear in the file.

Station Name	Distance above bottom (ft)	Start and Stop Julian Day
C-1	300	1979: 37-56, 60-89, 89-116
	150	1979: 37-59, 89-118
	25	1979: 37-59, 89-118, 254-286, 293-313
	280	1979: 254-286, 293-313, 60-89, 313-334
	250	1979: 254-286, 293-313, 313-334
C-2	40	1979: 37-54
	20	1979: 37-54
	77	1979: 256-290
	25	1979: 256-290
	6	1979: 256-290
C-5	82	1979: 37-53, 60-89, 89-104
	25	1979: 37-53, 89-104
	5	1979: 37-53, 89-104
C-12	3	1979: 38-60
C-3	102	1979: 59-89
	25	1979: 59-89
	82	1979: 256-290
	39	1979: 256-290
C-4	138	1979: 37-67
	118	1979: 37-67, 256-290
	25	1979: 37-67, 256-290
C-6	6	1979: 72-88
C-7	20	1979: 68-86
C-11	3	1979: 55-70
C-13	22	1979: 38-68
	5	1979: 38-68
C-16	64	1979: 67-82
	25	1979: 67-82, 289-310
	5	1979: 67-82
	73	1979: 289-310
	55	1979: 289-310
C-9	5	1979 : 68-90, 353-365 1980: 1-37
C-17	17	1979: 67-97
	5	1979: 67-97
C-19	3	1979: 81-96
C-20	3	1979: 88-103
C-22	5	1979: 82-101
C-23	3	1979: 81-96

Table 5.7. (Cont.) San Francisco Bay Circulation Survey (1979-1980) CT/Current: SanFr2-1

Note the order of the stations is as they appear in the file.

C-24	55	1979: 80-109
	7	1979: 80-114
	41	1979: 109-125
	21	1979: 109-125
	51	1979: 297-314
	31	1979: 297-314
	36	1979: 307-339
	16	1979: 307-339
	6	1979: 307-339
C-18	50	1979: 97-128
	30	1979: 97-128
C-25	26	1979: 95-115
	6	1979: 95-115
C-26	5	1979: 95-111, 303-319
	10	1979: 321-338
C-28	3	1979: 95-111, 306-321
C-29	5	1979: 108-124
C-30	5	1979: 109-124, 304-341
C-31	3	1979: 109-124
C-32	20	1979: 95-125, 298-319
	6	1979: 95-125, 298-319
C-33	20	1979: 107-124
	5	1979: 108-124
	70	1979: 311-331
C-208	25	1979: 254-269
C-5A	5	1979: 255-284
C-205	25	1979: 255-270
	6	1979: 255-270
C-206	25	1979: 255-270
	6	1979: 255-270
C-210	5	1979: 258-275
C-222	3	1979: 263-279
C-207	25	1979: 255-272
C-218	3	1979: 263-279
C-214	5	1979: 264-279
C-215	20	1979: 265-283
C-216	20	1979: 265-283
C-225	43	1979: 269-287, 290-310
C-221	5	1979: 276-291
C-226	5	1979: 276-291
C-219	5	1979: 279-296
C-223	3	1979: 279-296

Table 5.7. (Cont.) San Francisco Bay Circulation Survey (1979-1980) CT/Current: SanFr2-1
Note the order of the stations is as they appear in the file.

C-211	31 5 50	1979: 286-313, 255-286 1979: 286-313, 342-365 1980: 1-18 1979: 313-342
C-213	15	1979: 285-304
C-224	20 10	1979: 285-300 1979: 285-300
C-239	23 5	1979: 298-319 1979: 298-319
C-238	5	1979: 304-319
C-27	5	1979: 303-341
C-25A	20 6	1979: 305-321 1979: 306-321
C-228	12	1979: 305-321
C-243	50	1979: 318-325
C-13	5	1979: 353-365 1980: 1-15, 19-39

Meteorological Data

Station locations are shown in Figure 5.9 with the station data from 1979-1980 itemized in Table 5.8. The program meteor.f was used to plot meteorological data including air temperature, air pressure, wind speed, and wind direction After examining the filtered, edited data, it was determined that all air pressure data were bad (all 22 files), and all wind speed data were bad. The wind data was not believable due to the very small wind speed values recorded. Wind speed had been recorded in cm/s, and after we performed the conversion to knots, it was felt that the speed values were not believable. The air pressure data were determined to be bad due to the frequency and the size of the changes in air pressure. *Thus, no further processing of meteorological data was conducted.*

Table 5.8. San Francisco Bay Circulation Survey (1979-1980) Meteorological Data

Station Name	HGL (m)	Start and Stop Julian Day
W0	10	1979: 69-100, 100-125
W1	10	1980: 103-120, 122-137, 137-165, 166-184, 184-207, 208-225, 227-242, 242-264, 284-305, 306-323
W2	10	1979: 325-357 1980: 24-55, 87-103, 120-138, 166-186, 208-225, 227-242, 268-283, 284-305, 306-323

Figure 5.9. San Francisco Bay Meteorological Station Locations

Oceanographic Considerations

A near surface layer is shown in the CTD cast at Station S18 near the entrance to San Pablo Bay on 21 October 1980 (Figure 5.10), while at Station ST T3 (Figure 5.11) the CTD cast is short and indicates a depth uniform salinity and temperature of 33 PSU and 13^{o}C, respectively. In mid-Central San Francisco Bay at Station ST 15 (Figure 5.12), conditions are again well mixed with salinity near 30 PSU and temperature order 15 ^{o}C, respectively. One notes a large bottom layer salinity change from 33 PSU to 30 PSU to 26 PSU as one progresses from the offshore through the entrance to the central bay and up to the lower portion of San Pablo Bay. Note no CTD data are available in South San Francisco Bay due to time stamp issues.

CT/Current time series at 5 ft above the bottom are examined at Station C-13 at the lower end of South San Francisco Bay during March 1980 in Figure 5.13. Note the gradual increase in salinity and horizontal salinity gradient shown in the upper panel and the constant temperature. In Figure 5.14 one notes the Spring-Neap tidal modulation in current speed and a channelized flow. In Figures 5.15 and 5.16 conditions are shown at 39 ft above the bottom during April 1980 at Station C-24 in eastern San Pablo Bay. Note the large amplitude tidal cycle oscillation in salinity indicating the presence of large horizontal salinity gradients. Note in Figure 5.16 a strong channelized flow of order 140 cm/s. Corresponding conditions at 19 ft above the bottom are shown in Figure 5.17 for salinity and temperature and in Figure 5.18 for currents. Note that while currents speeds are reduced at 19 ft relative to 39 ft above the bottom, the magnitude of the tidal cycle salinity oscillations are not. CT time series near the Golden Gate Bridge are shown in Figures 5.19 and 5.21 for salinity and temperature at 150 ft and 25 ft above the bottom. Current time series are shown in Figures 5.20 and 5.22. Note the strong currents at 25 ft above the bottom.

In Figure 5.23, air temperature time series are shown at Station W2 during December 1980. Atmospheric pressure and wind speed data are corrupted and were not processed. Note the much larger variation of temperature in air versus water. These differences play an important role in surface heat and momentum fluxes.

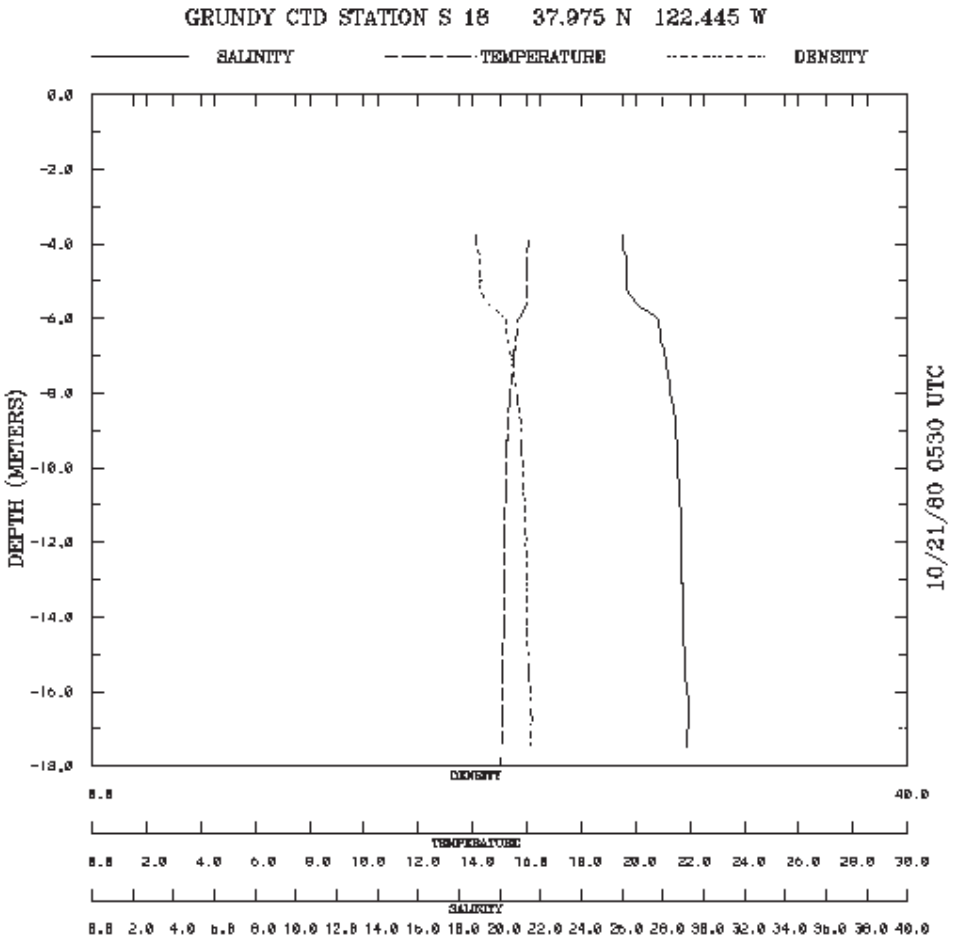

Figure 5.10. Upper San Francisco Bay CTD cast at Station S18 on 10/21/1980

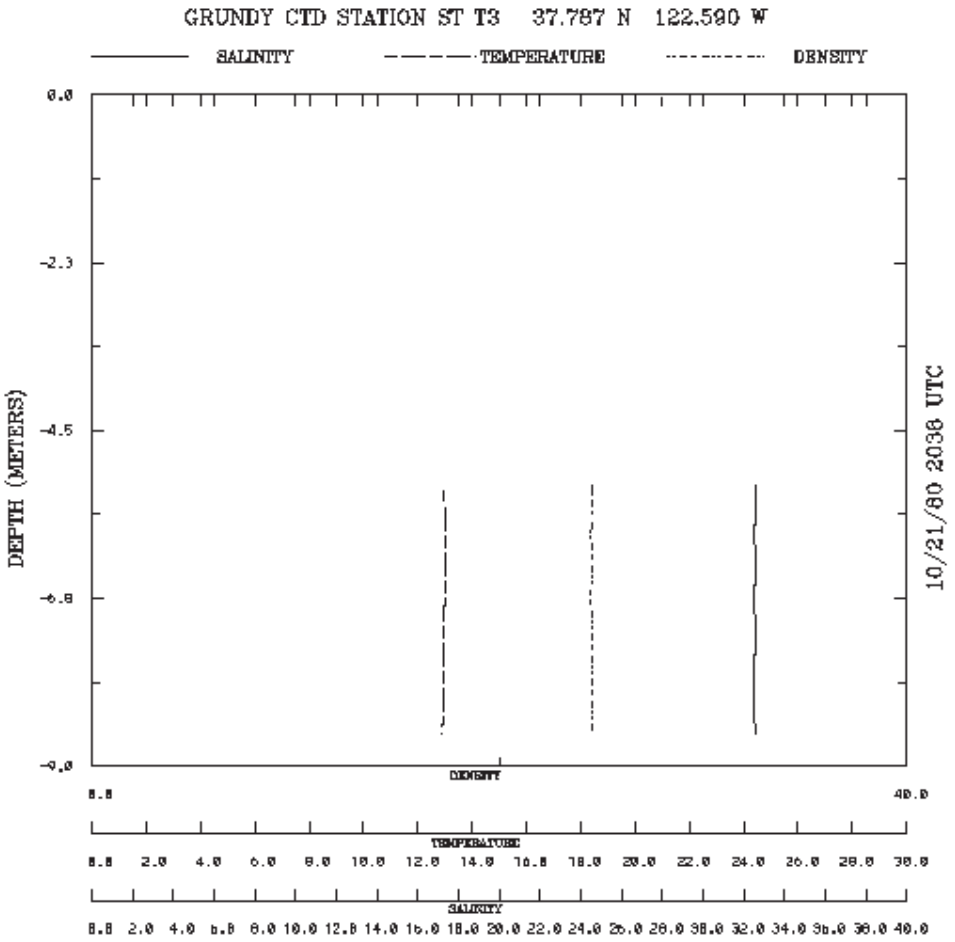

Figure 5.11. Entrance to San Francisco Bay CTD cast at Station T3 on 10/21/1980

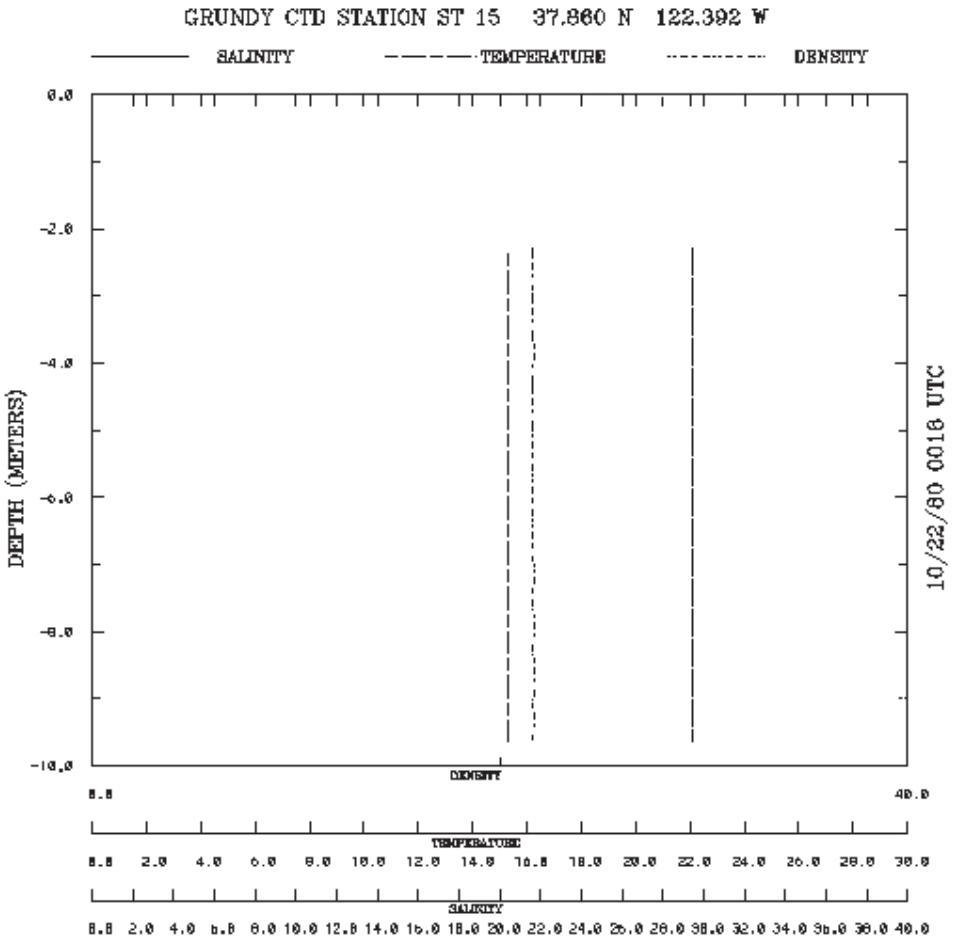

Figure 5.12. Central San Francisco Bay CTD cast at Station 15 on 10/22/1980

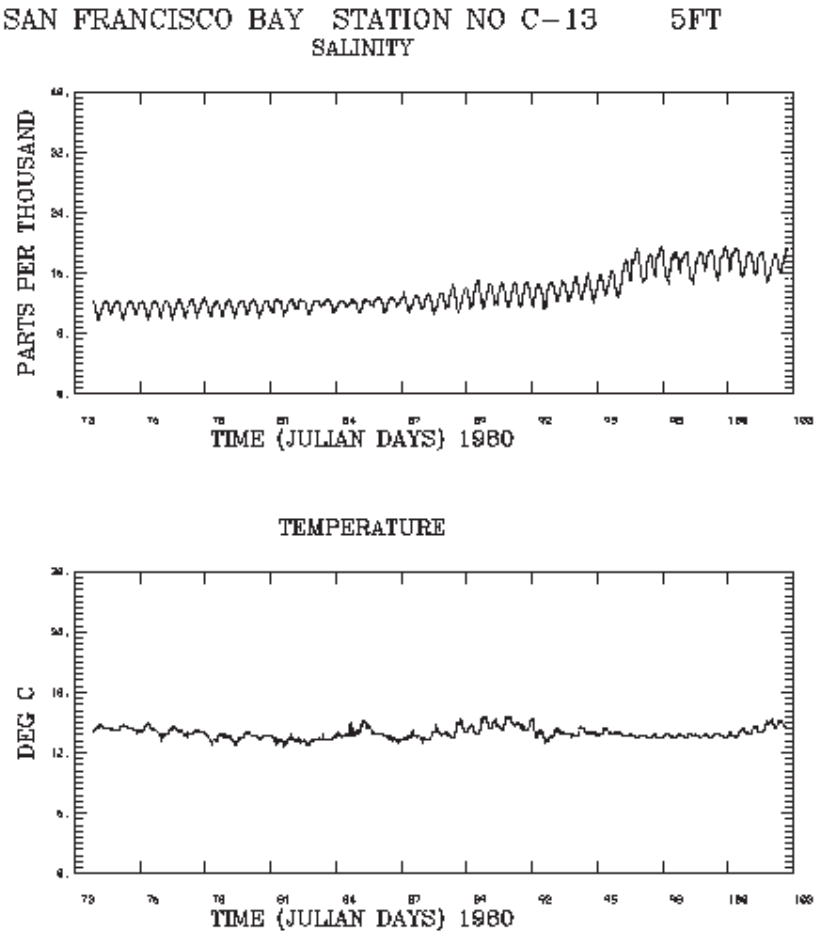

Figure 5.13. Lower Southern San Francisco Bay Salinity and Temperature at C-13 5 feet above the bottom in March 1980

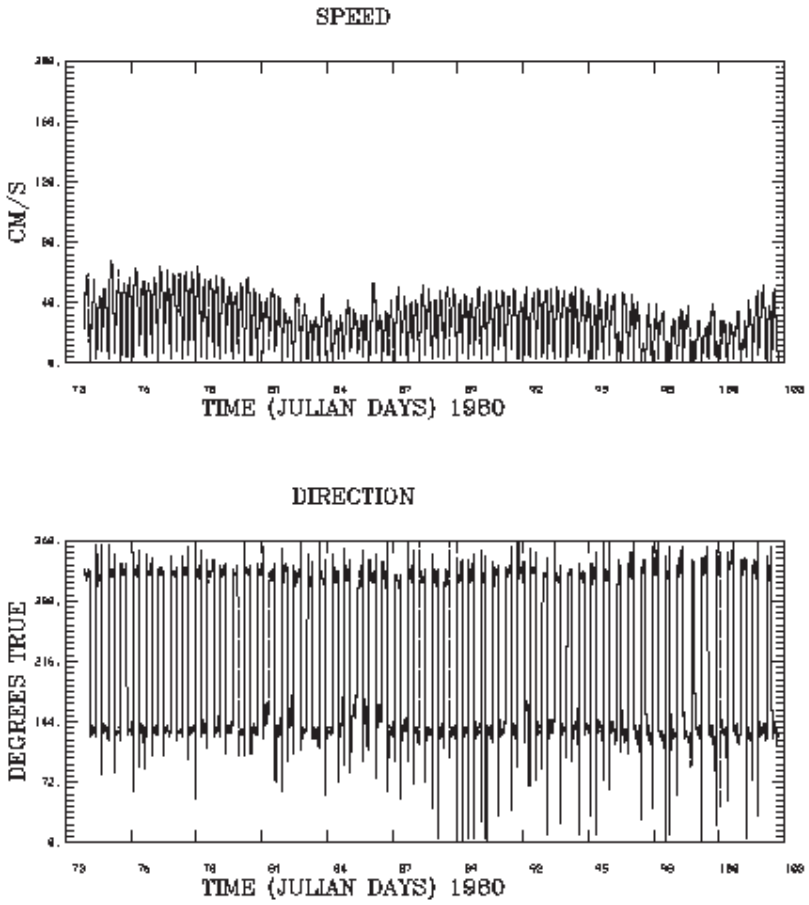

Figure 5.14. Lower Southern San Francisco Bay Current Speed and Direction at C-13 5 feet above the bottom in March 1980

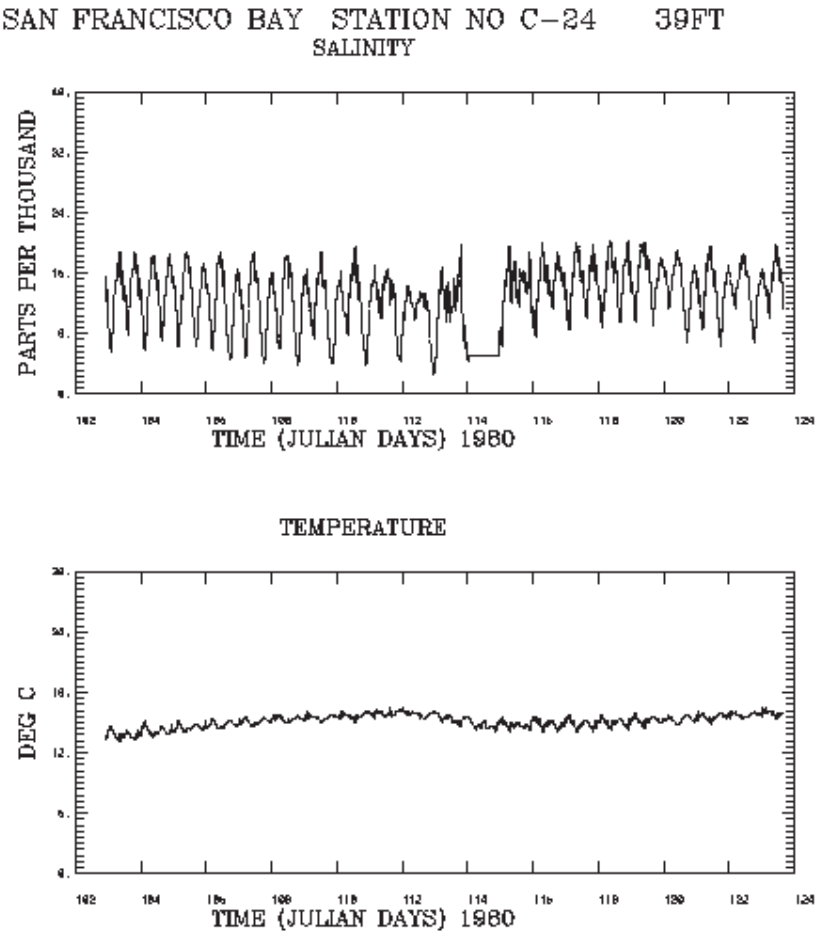

Figure 5.15. Upper Northern Central San Francisco Bay Salinity and Temperature at C-24 at 39 feet above the bottom in April 1980

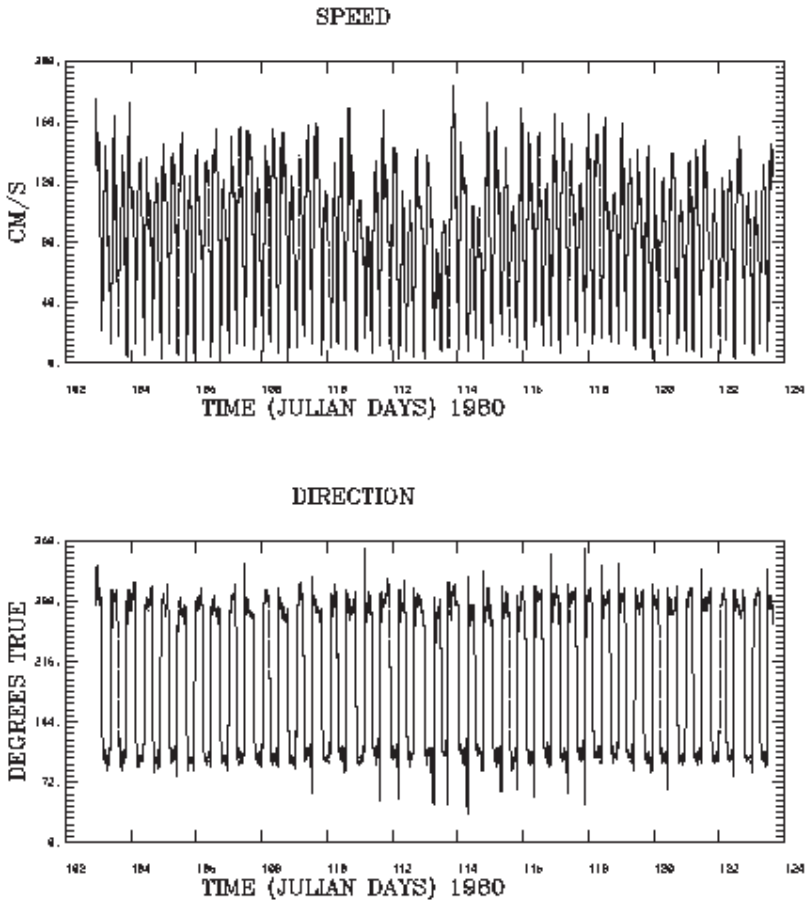

Figure 5.16. Upper Northern Central San Francisco Bay Current Speed and Direction at C-24 39 feet above the bottom in April 1980

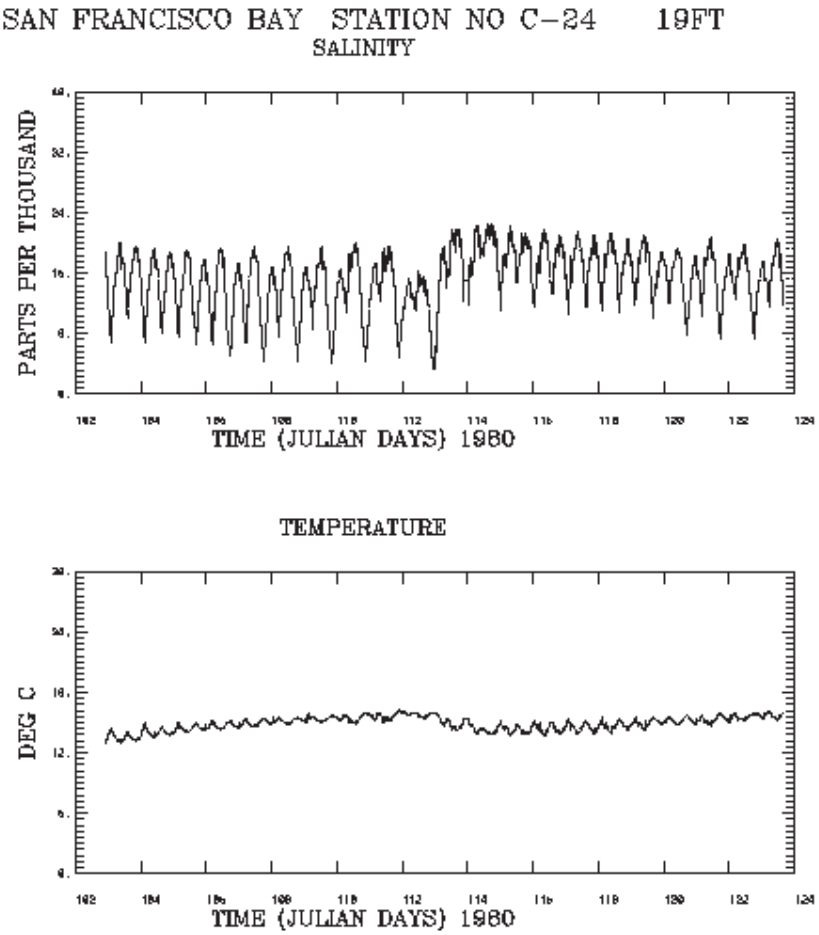

Figure 5.17. Upper Northern Central San Francisco Bay Salinity and Temperature at C-24 at 19 feet above the bottom in April 1980

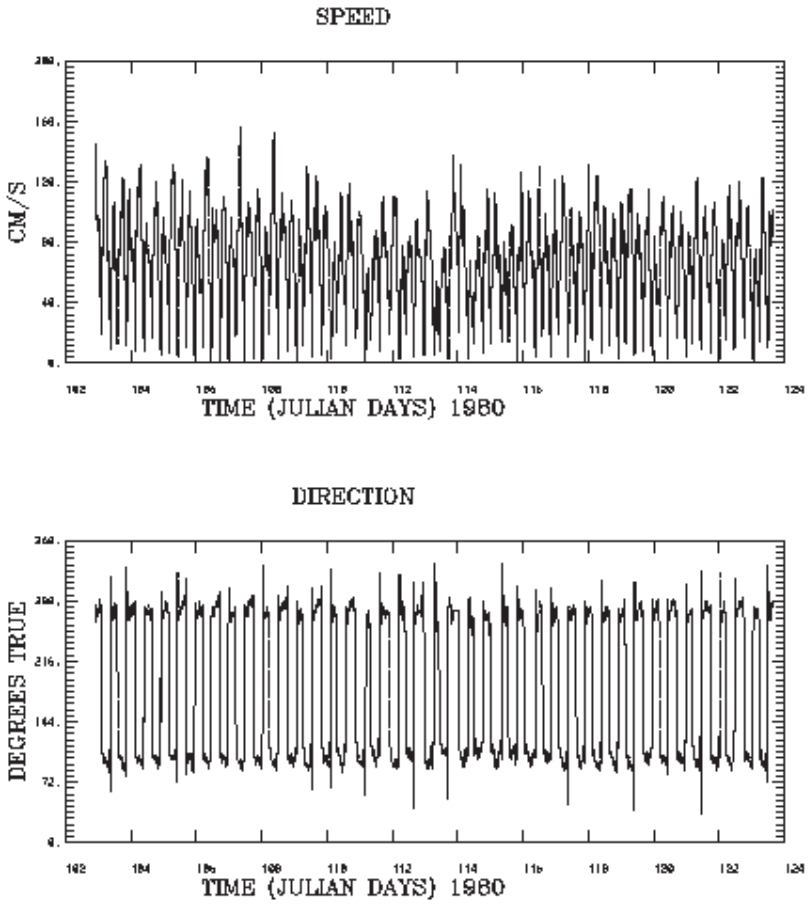

Figure 5.18. Upper Northern Central San Francisco Bay Current Speed and Direction at C-24 at 19 feet above the bottom in April 1980

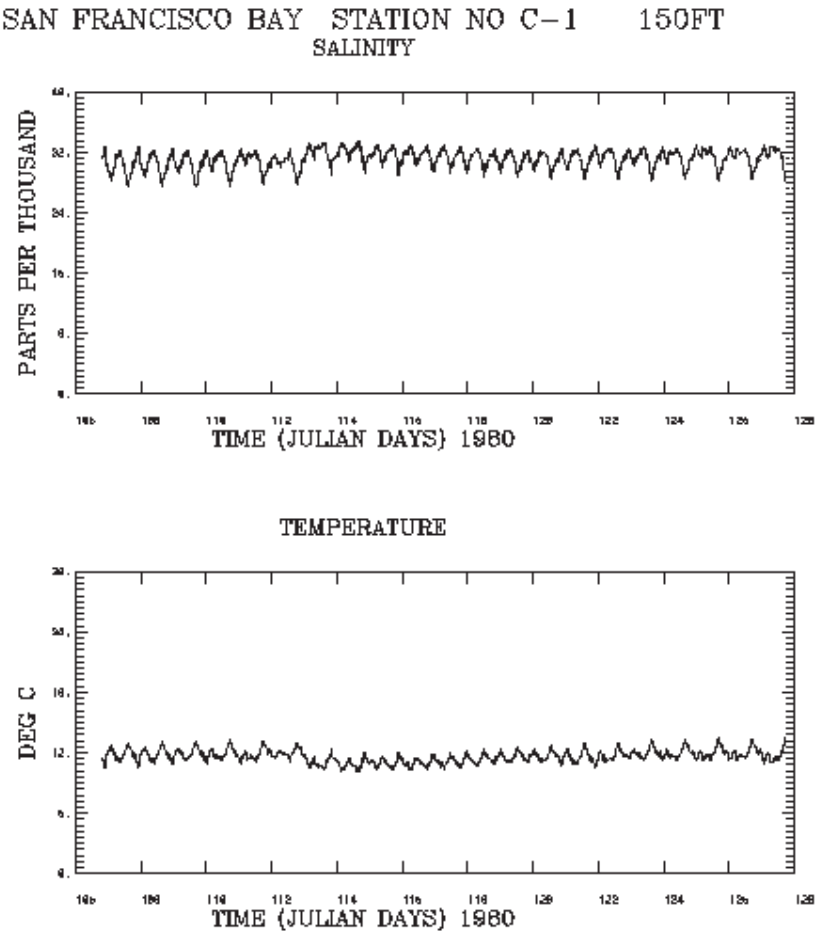

Figure 5.19. Entrance to San Francisco Bay Salinity and Temperature at C-1 at 150 feet above the bottom in April 1980

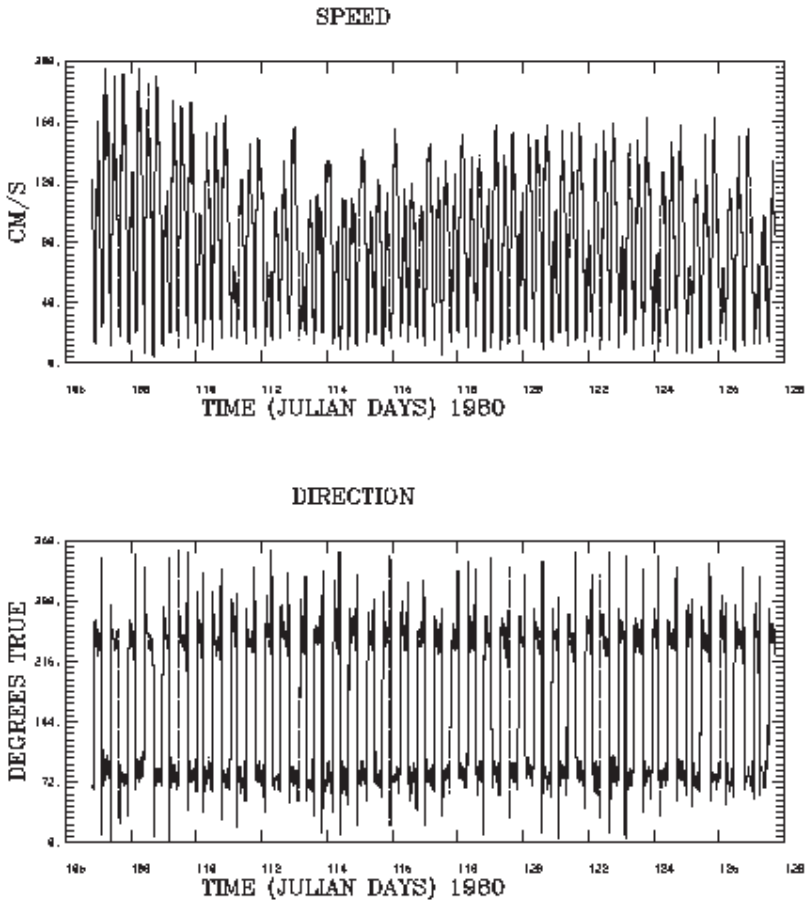

Figure 5.20. Entrance to San Francisco Bay Current Speed and Direction at C-1 at 150 feet above the bottom in April 1980

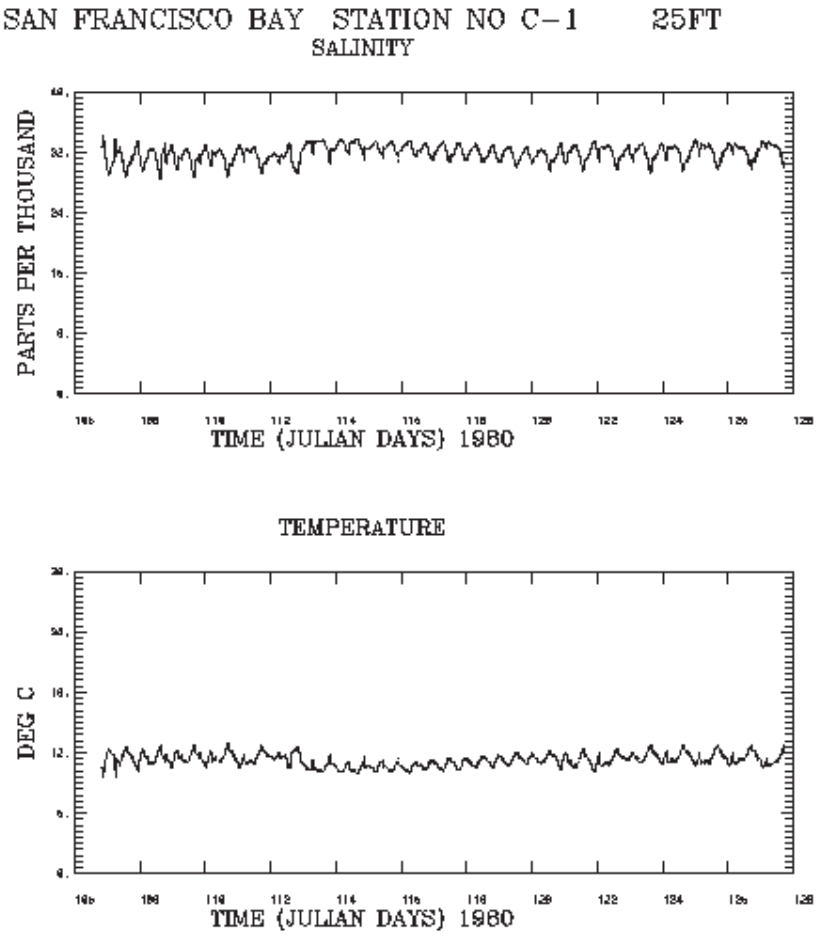

Figure 5.21. Entrance to San Francisco Bay Salinity and Temperature at C-1 at 25 feet above the bottom in April 1980

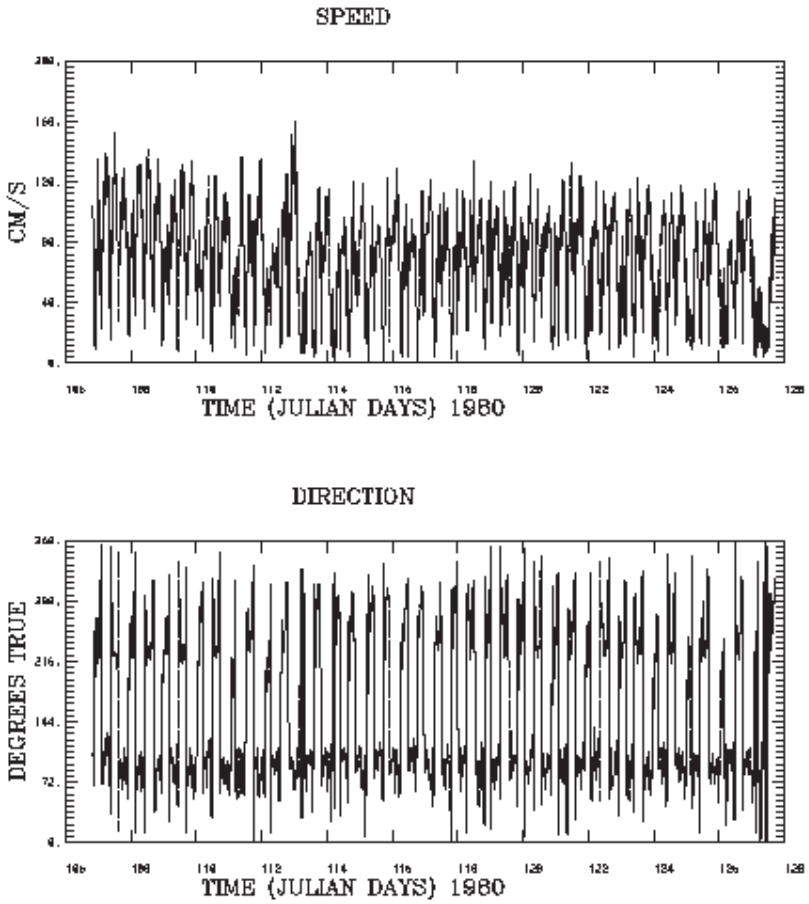

Figure 5.22. Entrance to San Francisco Bay Current Speed and Direction at C-1 at 25 feet above the bottom in April 1980

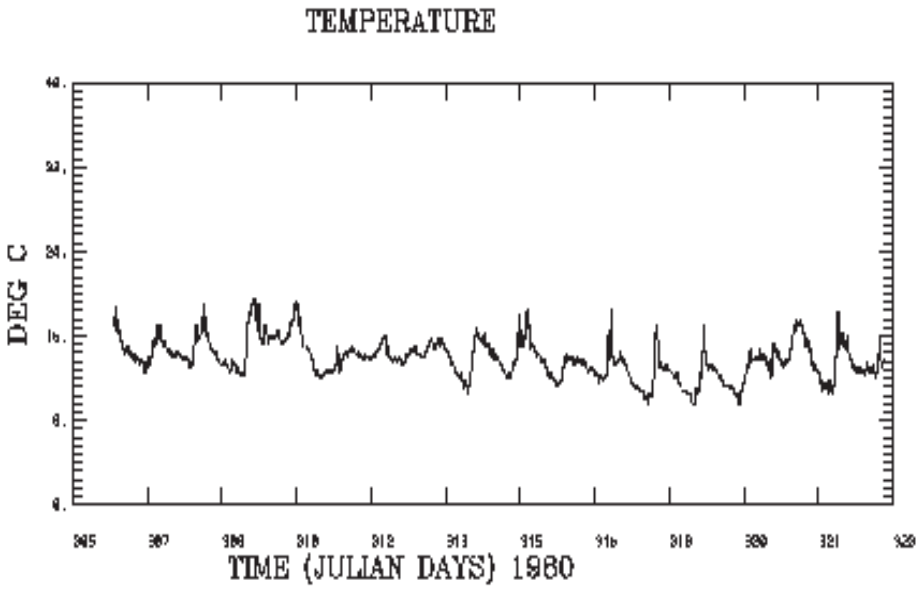

Figure 5.23. San Francisco Bay Air Temperature at W2 at 10m in December 1980

6. NEW YORK HARBOR

The datasets obtained from CO-OPS on compact disc are listed in Table 6.1. It was necessary to carefully inventory these datasets and determine their data quality. *Several datasets were duplicated and all CTD data had to be discarded from further processing due to lack of time stamps.*

Table 6.1. New York Harbor Circulation Survey Dataset Inventory

Directory Name	Number of Files	Data Period	Data Description	Data Quality
NYHAR2-1	122	1981	Aanderaa Current Meter	OK
NYHAR2-2	121	1980	Aanderaa Current Meter	OK
NYHAR2-3	15	1981	Aanderaa Current Meter	OK
FAGG1	6	1981	Aanderaa Met	OK
FAGG2	3	1980	Aanderaa Met	OK

In Table 6.2, the raw, edited, and final quality controlled datasets are given along with their location in the CSDL/MMAP SAN.

Table 6.2. New York Harbor Circulation Survey Processed Data File Inventory

Data Type	Location	Filename
CT/Current Raw	~/current/*/raw/	nyharb_2-1.raw, nyharb_2-2.raw, nyharb_2-3.raw
CT/Current Edited	~/current/*/	nyharb_2-1.edt, nyharb_2-2.edt, nyharb_2-3.edt
CT/Current Qc	~/current/qc/	file_2-1.qc, file_2-2.qc, file_2-3.qc
Met Raw	~/nymet/FAGG1/	nymeteor.all1 nymeteor.all2
Met Edited	-	-
Met Qc	~/nymet/qc/	nyharb_nymet1.qc nyharb_nymet2.qc

~ = /disks/NASUSER/philr/nyharbor, *=NYHAR2-1, NYHAR2-2, NYHAR2-3

CT/Current

The salinity and temperature and current data were distributed amongst three directories: NYHAR2-1, NYHAR2-2, and NYHAR2-3. These data files (FILE1 through FILEn) were concatenated to create cumulative data files: file_2-1.qc, file_2-2.qc, file_2-3.qc. The data in each individual data file (FILE1 through FILEn) represent current and CT data at one specific station location over a given time period. Station locations in NY2-1 are shown in Figure 6.1 for the southern stations and in Figure 6.2 for the northern stations. Measurement start and stop times are given in Table 6.3.

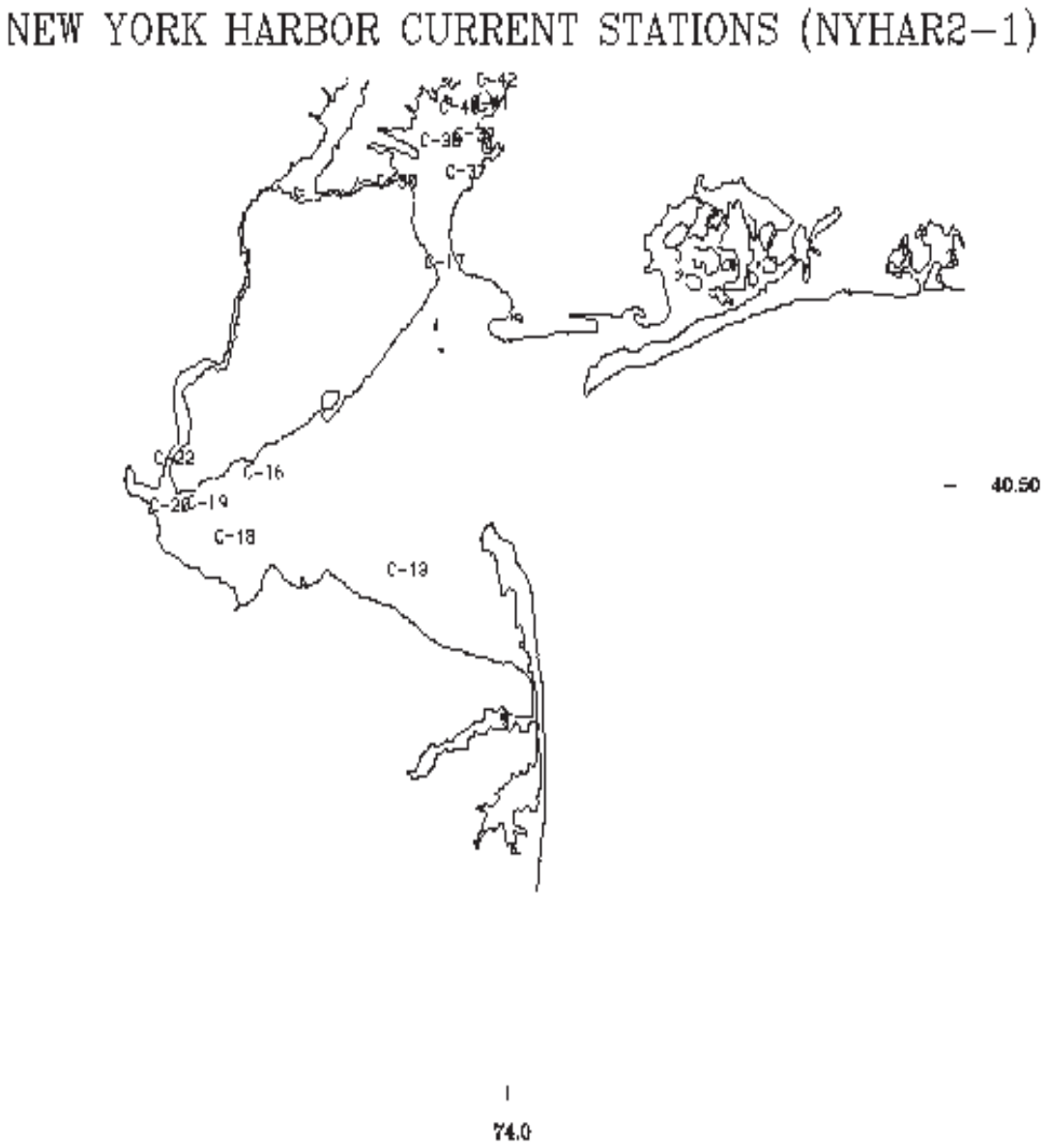

Figure 6.1. New York Harbor Southern Current Station Locations: Nyhar2-1 (1980)

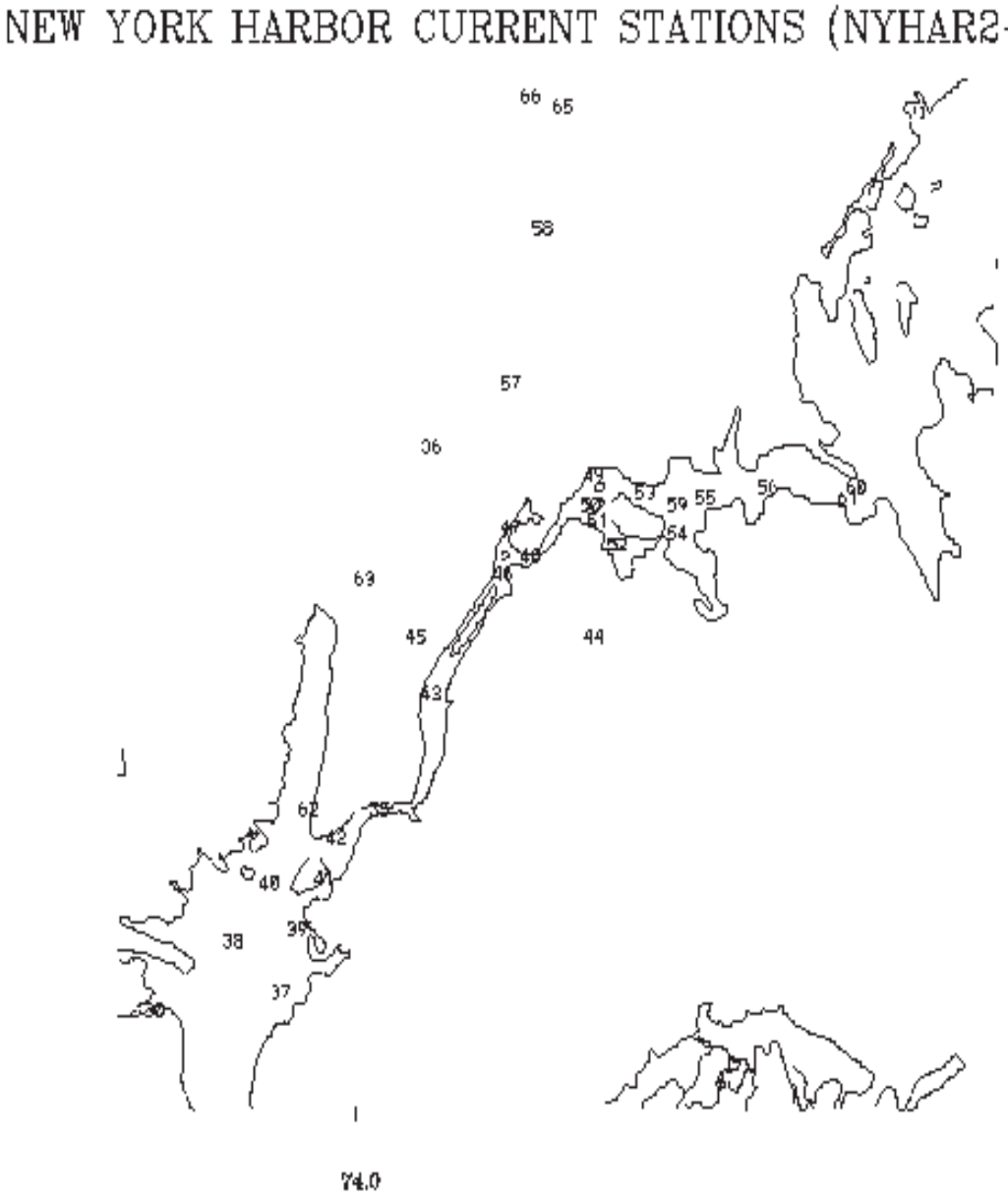

Figure 6.2. New York Harbor Northern Current Station Locations: Nyhar2-1 (1981)

Table 6.3. New York Harbor Circulation Survey (1981) CT/Current: NY2-1
Note the order of the stations is as they appear in the file.

Station Name	Depth (ft)	Start and Stop Julian Day
C-13	-18	69-86
C-16	-14	69-86
	-34	69-86
C-17	-14	100-119
	-15	69-84
	-52	85-100
C-18	-9	69-86, 86-104
C-19	-14	69-86
	-37	69-86
C-20	-16	69-86
C-22	-15	69-86
	-32	69-86
C-37	-15	70-86
	-36	70-86
C-38	-15	70-86
	-27	70-86
C-36	-16	83-102
	-15	102-118
	-48	102-118,118-136
	-49	118-136
C-39	-15	83-98
	-36	83-102
C-63	-15	87-102, 104-119
	-41	104-119
C-66	-15	100-119
C-30	-17	99-119
	-36	99-119
C-35	-40	99-118, 134-149, 149-166
	-39	118-134
	-14	118-134
	-15	149-166, 166-182
C-40	-55	102-119
C-42	-16	104-119
	-15	120-136
C-58	-15	102-118
	-16	118-136
C-62	-17	101-121
	-56	101-121
C-65	-15	102-118
C-42	-38	120-136

Table 6.3. (Cont.) New York Harbor Circulation Survey (1981) CT/Current: NY2-1 Note the order of the stations is as they appear in the file.

C-45	-62	118-134, 134-150
	-16	134-165
C-46	-43	134-150, 168-184
	-52	134-150
	-15	150-168
	-63	168-184
C-47	-15	149-167
C-48	-16	135-163
	-18	139-162
C-51	-12	135-151, 168-184
	-41	135-151, 168-184
C-50	-15	150-167
	-17	167-182
C-53	-49	151-167
C-55	-15	149-166, 166-182
	-65	166-182
C-56	-34	151-167
	-14	151-167
	-58	151-167
C-60	-15	147-167
C-59	-15	167-182
	-27	167-182
C-61	-45	150-166
	-14	150-166
	-70	150-166
	-46	166-182
	-71	166-182
C-49	-42	169-184
C-54	-29	167-188
C-44	-31	118-135
	-16	118-135
C-43	-28	119-134

Station locations in NY2-2 are shown in Figure 6.3 with measurement start and stop times given in Table 6.4.

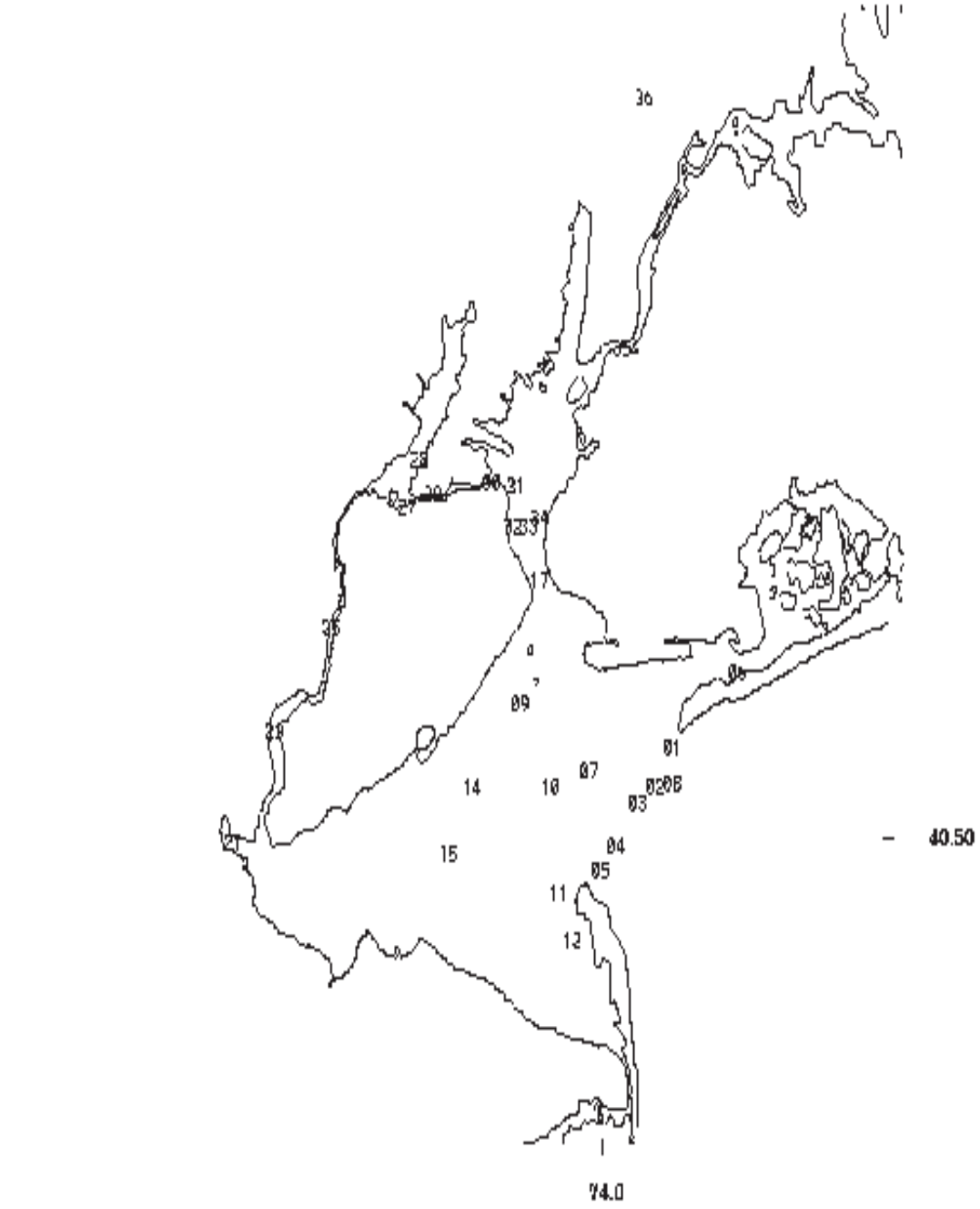

Figure 6.3. New York Harbor Current Station Locations: Nyhar2-2 (1980)

Table 6.4. New York Harbor Circulation Survey (1980) CT/Current: NY2-2
Note the order of the stations is as they appear in the file.

Station Name	Distance above bottom (ft) - denotes depth (ft)	Start and Stop Julian Day
02	4	217-235
	9	218-235
03	26	218-235
	4	278-296
	27	249-282
	34	256-272
	32	296-313
04	4	218-235, 290-306
	11	290-306
05	31	218-235
	4	218-235, 247-266, 290-306
	30	247-267
	29	290-307
11	15	218-235, 235-251
	4	218-235, 235-251
12	4	218-235
28	24	236-251
	4	236-251
	22	251-269
	20	269-285
36	39	234-249, 249-270
	-43	271-286
	41	286-303, 303-321
	9	286-303
01	4	260-275, 235-253
	11	290-306
	9	218-235
06	4	251-269, 306-321, 234-251
	22	306-321, 234-251
17	71	250-267
	29	250-267, 267-284, 284-303, 303-321
	69	303-321, 284-303, 267-284
	4	234-250
	9	250-267
21	13	249-267
	4	249-267
	-13	267-284
	-4	267-284
25	-21	268-285

Table 6.4. (Cont.) New York Harbor Circulation Survey (1980) CT/Current: NY2-2
Note the order of the stations is as they appear in the file.

30	-24	269-286
	-4	269-286
35	27	276-291
23	23	268-296
	4	268-296
29	29	285-301, 285-301
27	-4	268-285
	11	306-325
	22	268-285
08	9	290-312
	18	299-325
	4	299-325
07	34	302-325
	4	310-325
09	13	304-320
10	12	305-320
14	3	302-320
15	22	302-320
31	23	306-321
	4	306-321
28	24	250-267
32	25	285-301
	4	285-301
33	31	285-302
	4	285-302
34	4	285-301

Station locations in NY2-3 are shown in Figure 6.4 with measurement start and stop times given in Table 6.5.

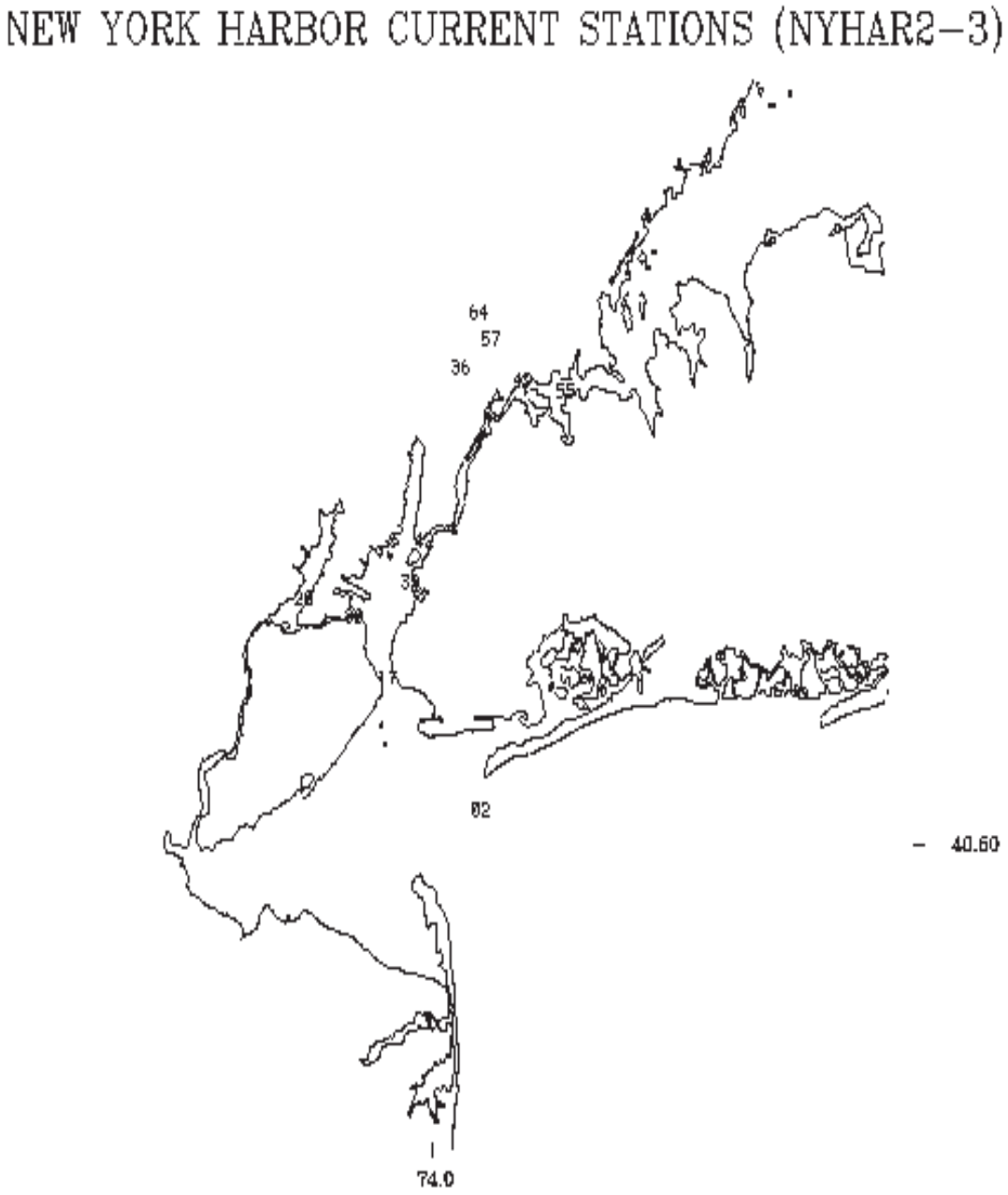

Figure 6.4. New York Harbor Current Station Locations: Nyhar2-3 (1981).

Table 6.5. New York Harbor Circulation Survey (1981) CT/Current: NY2-3
Note the order of the stations is as they appear in the file.

Station Name	Distance above bottom (ft) - denotes depth (ft)	Start and Stop Julian Day
49	-17	136-152
64	-60	85-102
17	-74 -73	100-119 85-100
39	-34	102-119
30	-17	104-119
55	-41	149-166
17	9 -75	303-321 69-85
28	-4	269-285
02	9	290-312
42	-39	104-119
36	9	303-321

Meteorological Data

Meteorological data at locations shown in Figure 6.5 and as given in Table 6.6 were concatenated into a file named nymeteor.all2. The program meteor.f was used to plot meteorological data including air temperature, air pressure, wind speed, and wind direction. After examining the filtered data, it was determined that, once again, the wind data was not believable. The wind speed values were recorded in cm/s, and were very small. If a conversion were made to knots, the speed values would not be believable. *As a result, wind data were not further processed.*

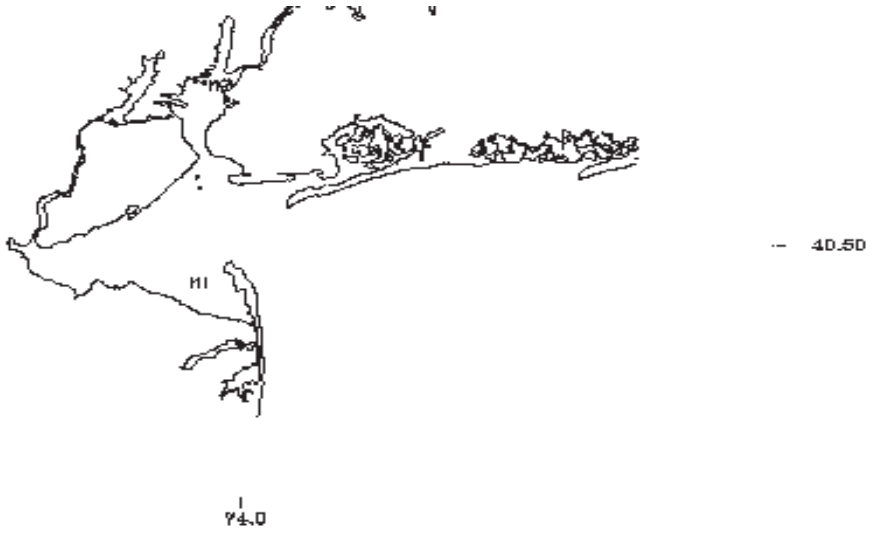

Figure 6.5. New York Harbor Meteorological Station Locations

Table 6.6. New York Harbor Circulation Survey (1980-1981) Meteorological Data

Station Name	HGL (m)	Start and Stop Julian Day
M1	10	1981: 69-106, 106-140, 140-179
M2	10	1981: 72-117, 117-149, 149-188
M2	10	1980: 211-236, 239-275, 275-320

Oceanographic Considerations

Due to time stamp issues no CTD data are available to develop the density structures, so one must totally rely on the CT/Current time series. Here we examine the response at Station C-19 at 14 ft below the water surface in lower New York Harbor in Figure 6.6 and in Figure 6.7 for salinity and temperature and current, respectively during March 1981. We note very small horizontal salinity gradients are indicated. Corresponding conditions in March 1981 at 37 ft below the water surface are shown for salinity and temperature in Figure 6.8 and for currents in Figure 6.9 and show well-mixed conditions. In contrast at Station C-36 in the lower Hudson River at 16 ft below the water surface during March-April 1981, we observe large horizontal salinity gradients as evidenced by the large amplitude oscillation in the top panel of Figure 6.10. Figure 6.11 indicates a strong channelized flow of order 100-120 cm/s. In the East River at Station C-55 during May-June 1981 at 15 ft below the water surface, a modest horizontal salinity and temperature gradients are indicated in Figure 6.12. Maximum current strengths are order 8c mc/s and the flow is unidirectional as shown in Figure 6.13. At station C-63 in upper New York Harbor (south of Station C-36) large horizontal salinity gradients are indicated at both 15 and 41 ft below the water surface as shown in Figures 6.14 and 6.16, respectively. Current strengths are reduced from order 100 cm/s at 15 ft to 50 cm/s at 41 ft below the water surface as shown in Figures 6.15 and 6.17, respectively. No turning of the channelized flow is indicated.

With respect to meteorological data, only air temperature measurements appear valid. These will be of great use in specifying the heat fluxes in numerical computation.

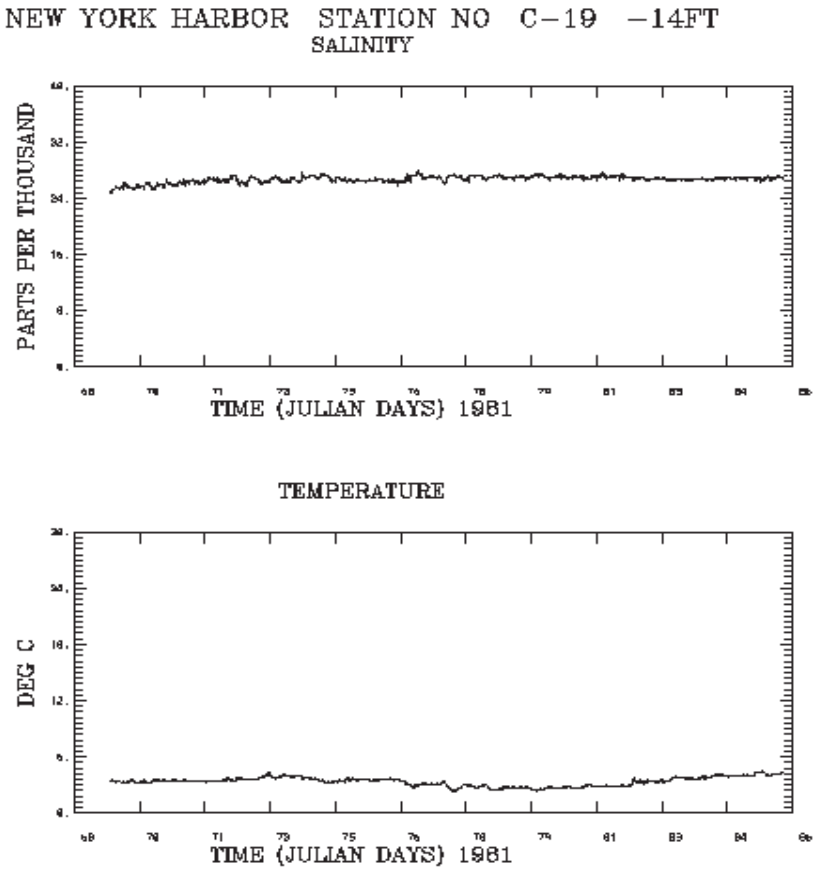

Figure 6.6. C-19 in lower New York Harbor Salinity and Temperature at 14 feet below the water surface in March 1981

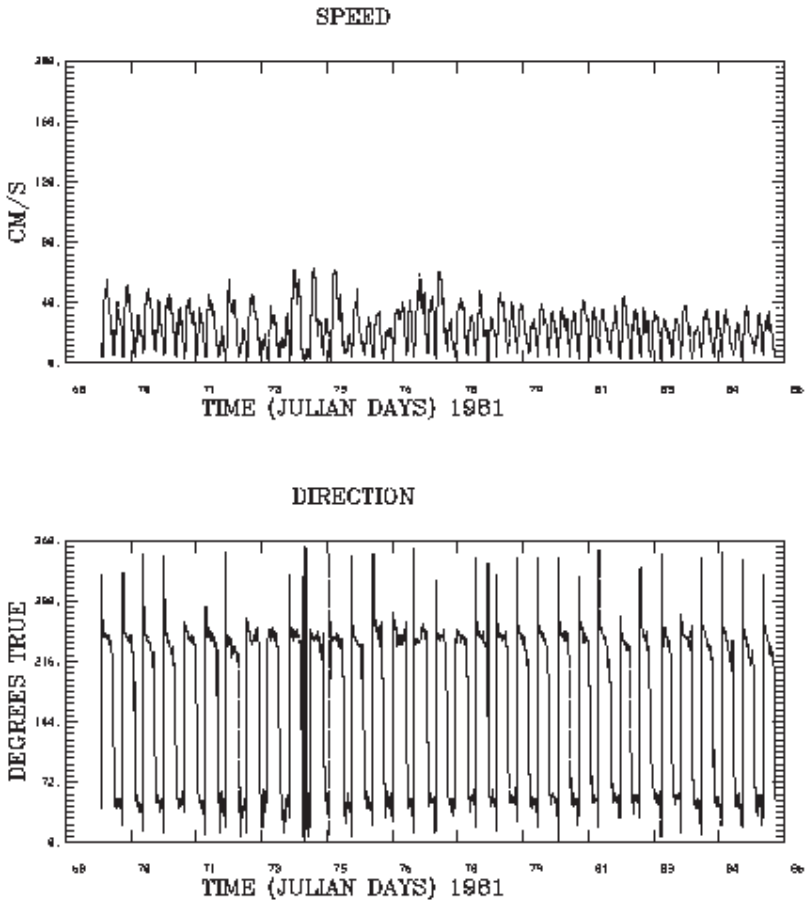

Figure 6.7. C-19 in lower New York Harbor Current Speed and Direction at 14 feet below the water surface in March 1981.

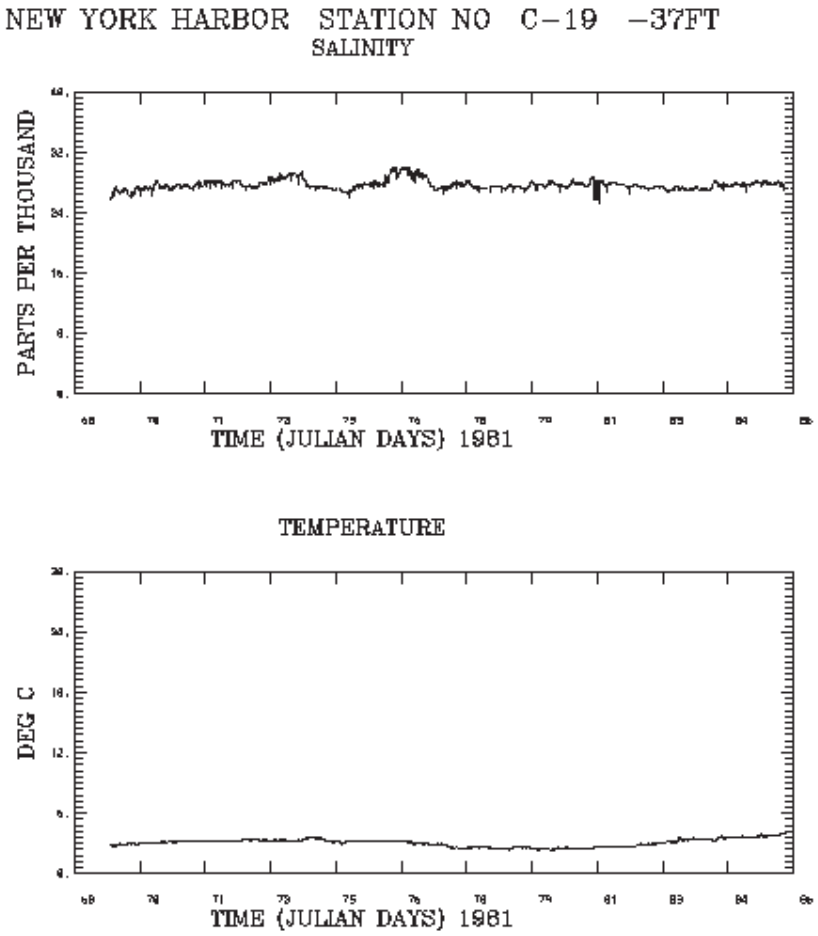

Figure 6.8. C-19 in lower New York Harbor Salinity and Temperature at 37 feet below the water surface in March 1981

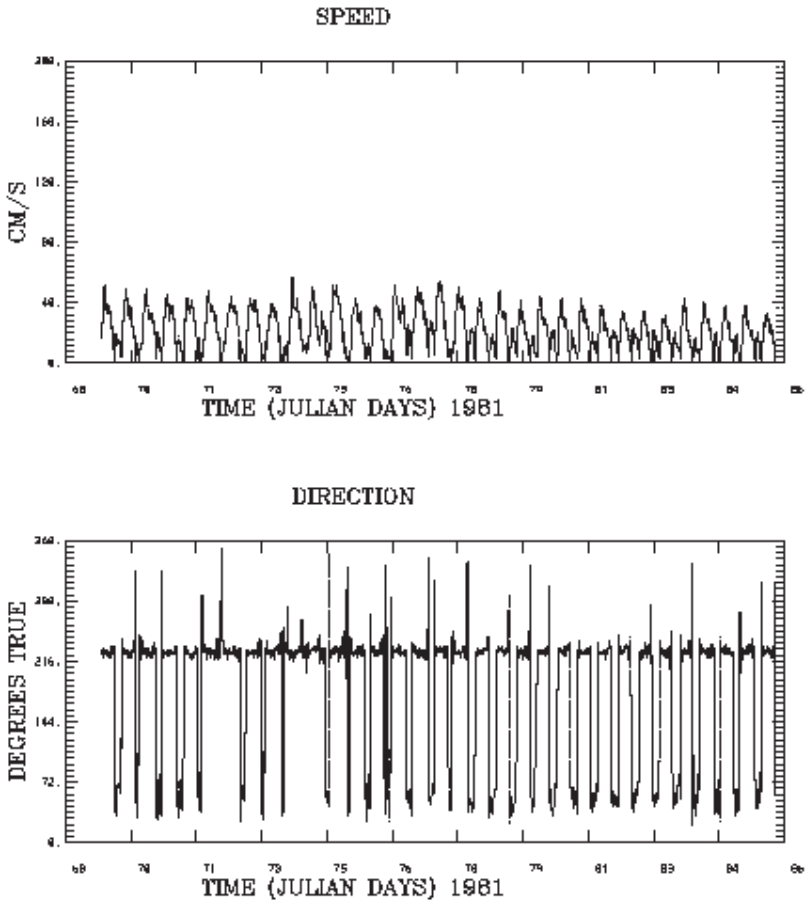

Figure 6.9. C-19 in lower New York Harbor Current Speed and Direction at 37 feet below the water surface in March 1981

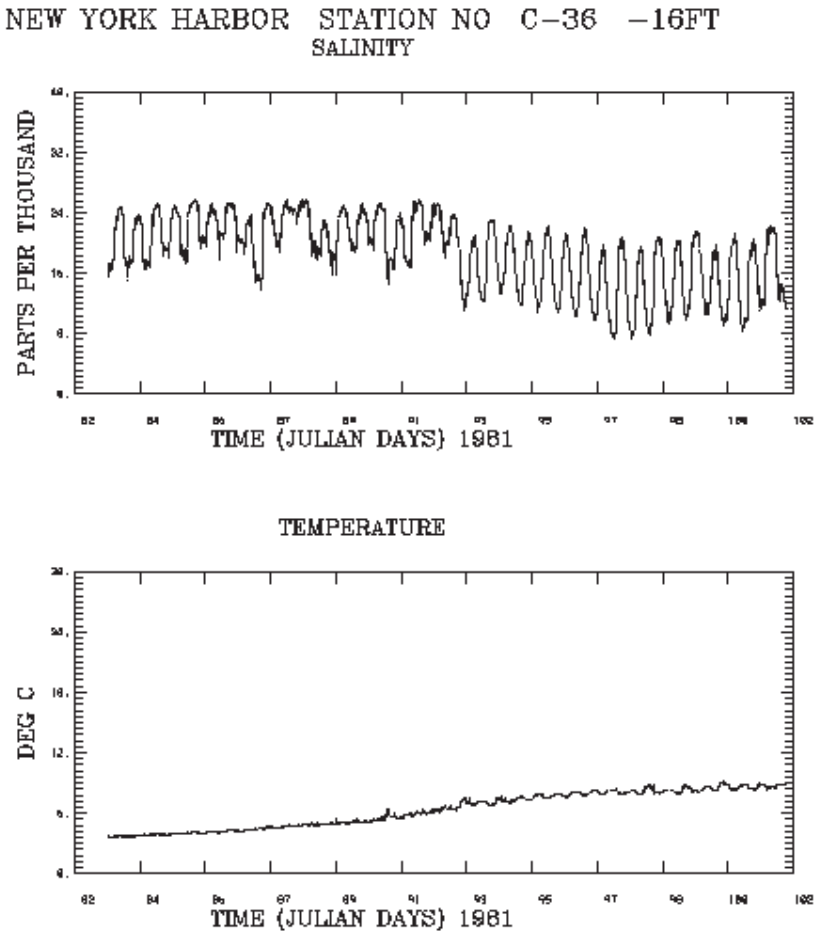

Figure 6.10. C-36 in lower Hudson River Salinity and Temperature at 16 feet below the water surface in March-April 1981.

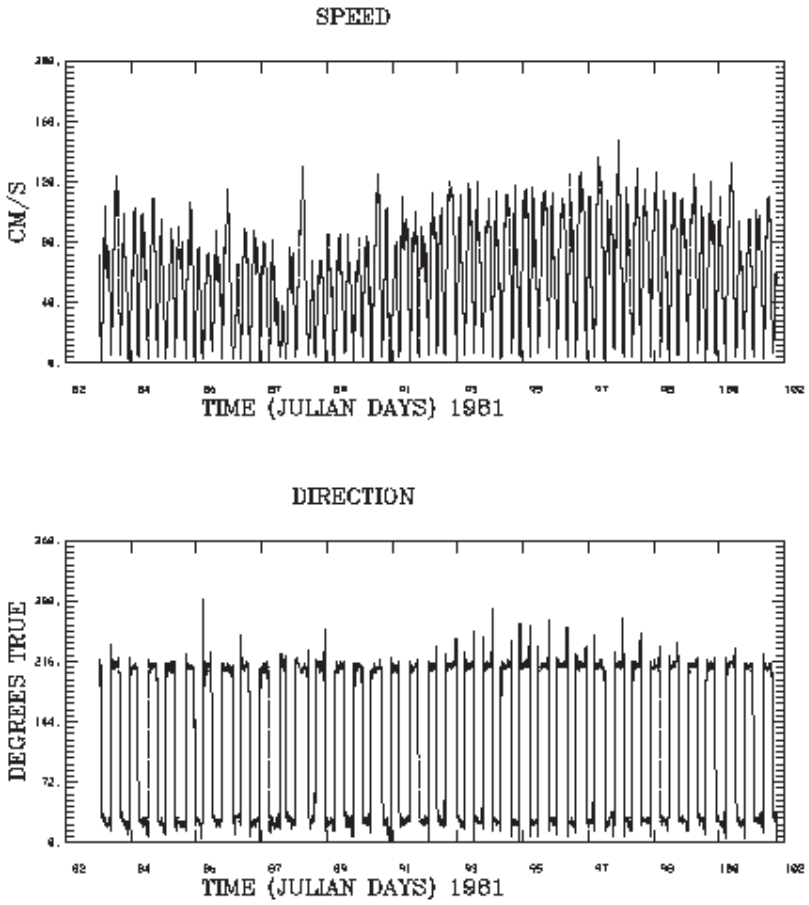

Figure 6.11. C-36 in lower Hudson River Current Speed and Direction at 16 feet below the water surface in March-April 1981

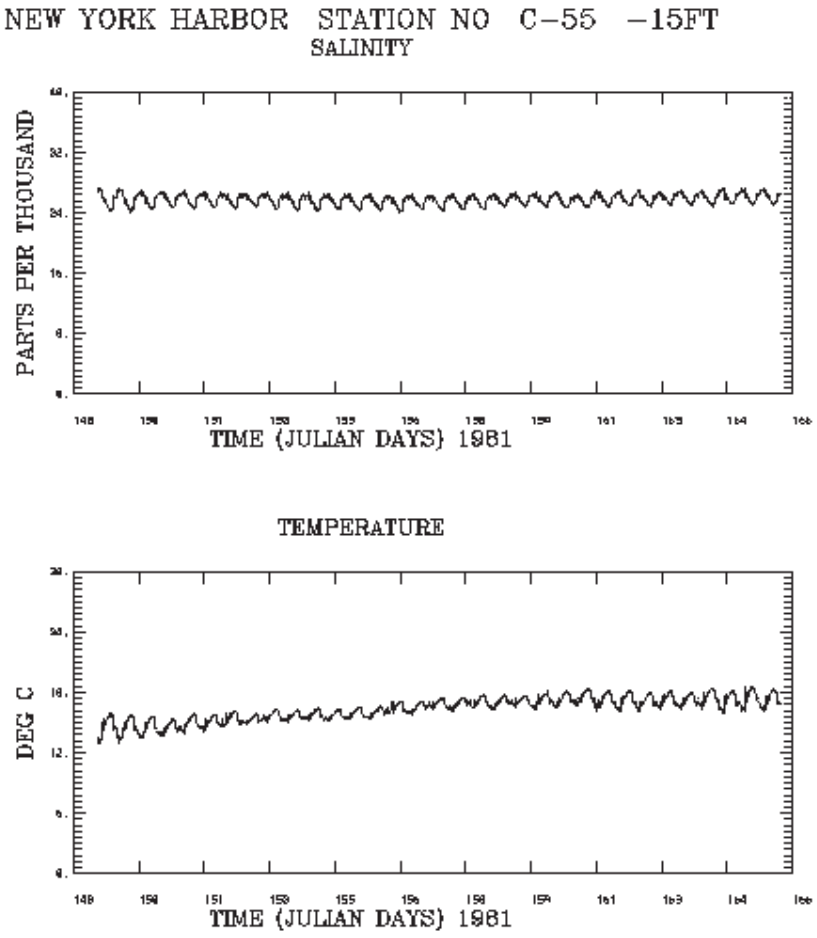

Figure 6.12. C-55 in eastern section of the East River Salinity and Temperature at 15 feet below the water surface in May-June 1981.

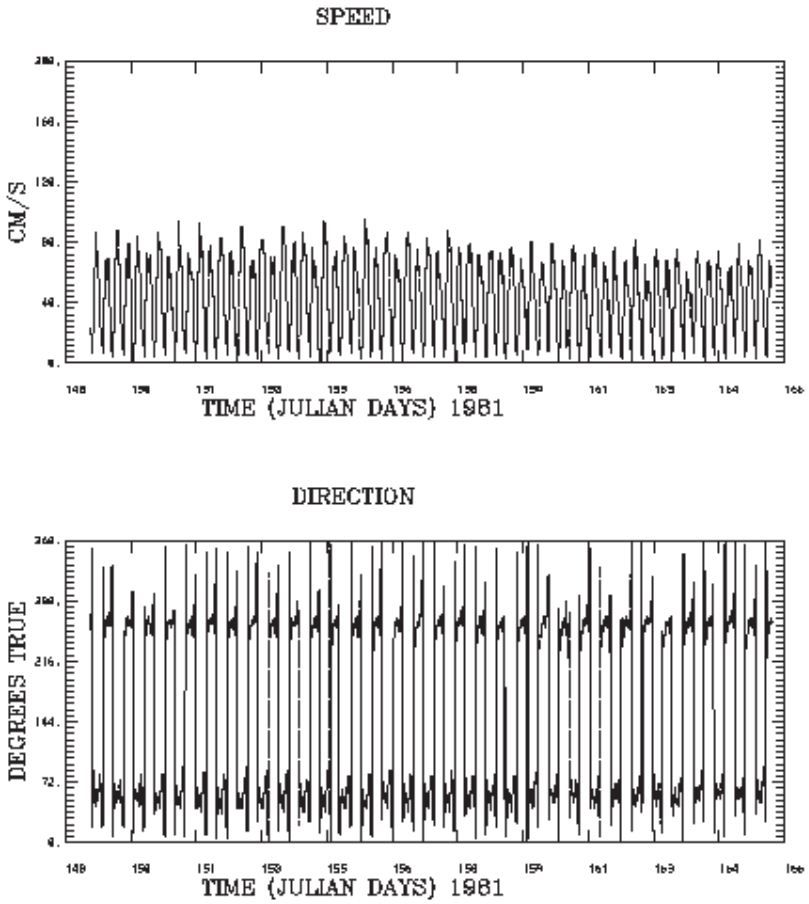

Figure 6.13. C-55 in eastern section of the East River Current Speed and Direction at 15 feet below the water surface in May-June 1981

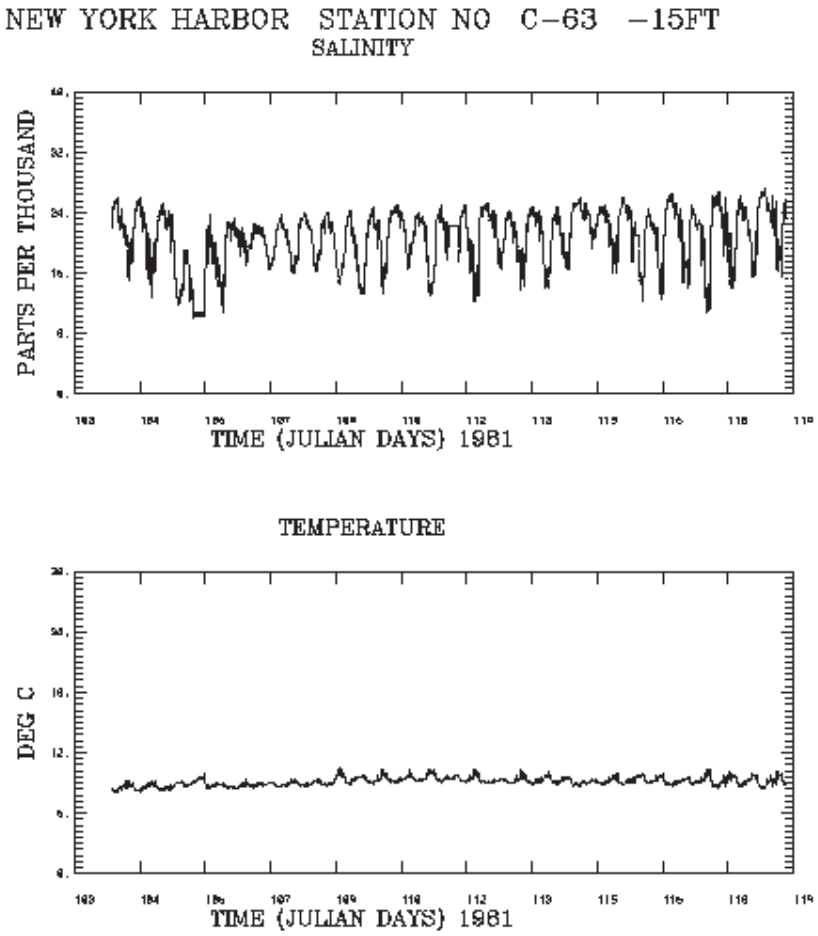

Figure 6.14. C-63 in upper New York Harbor Salinity and Temperature at 15 feet below the water surface in April 1981

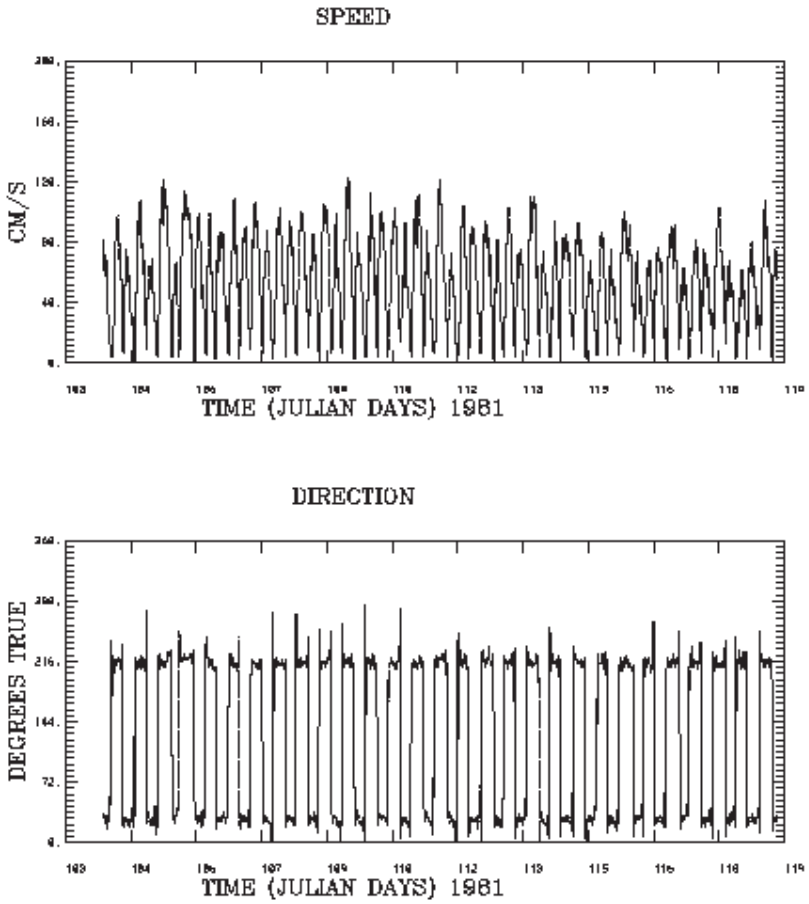

Figure 6.15. C-63 in upper New York Harbor Current Speed and Direction at 15 feet below the water surface in April 1981

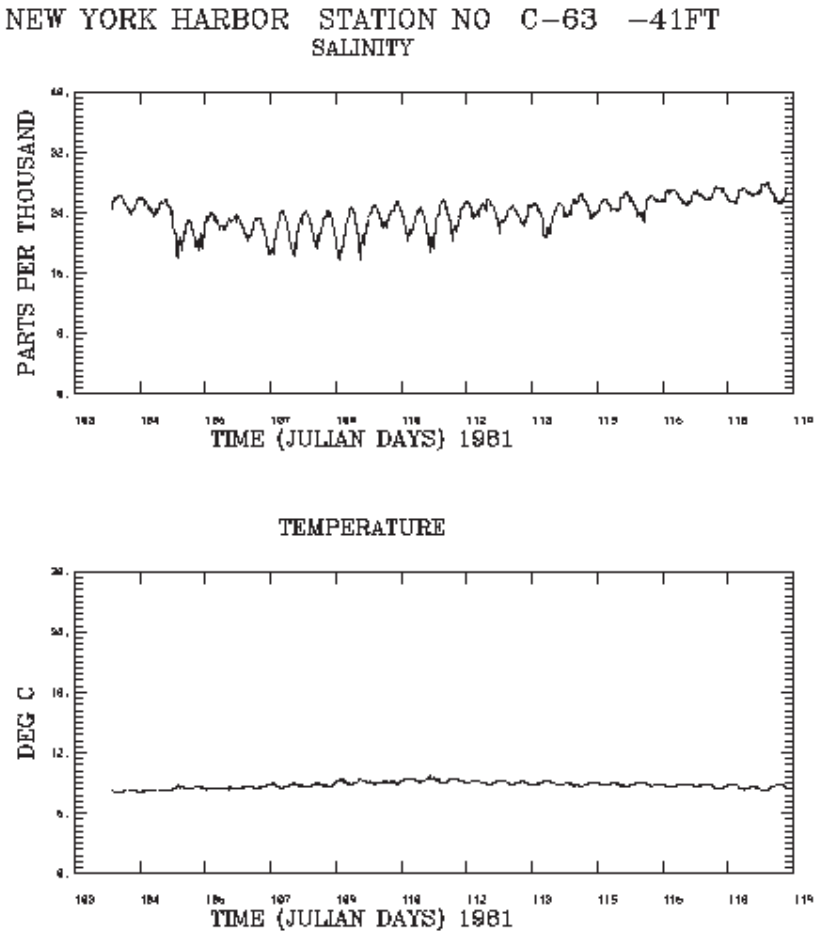

Figure 6.16. C-63 in upper New York Harbor Salinity and Temperature at 41 feet below the water surface in April 1981

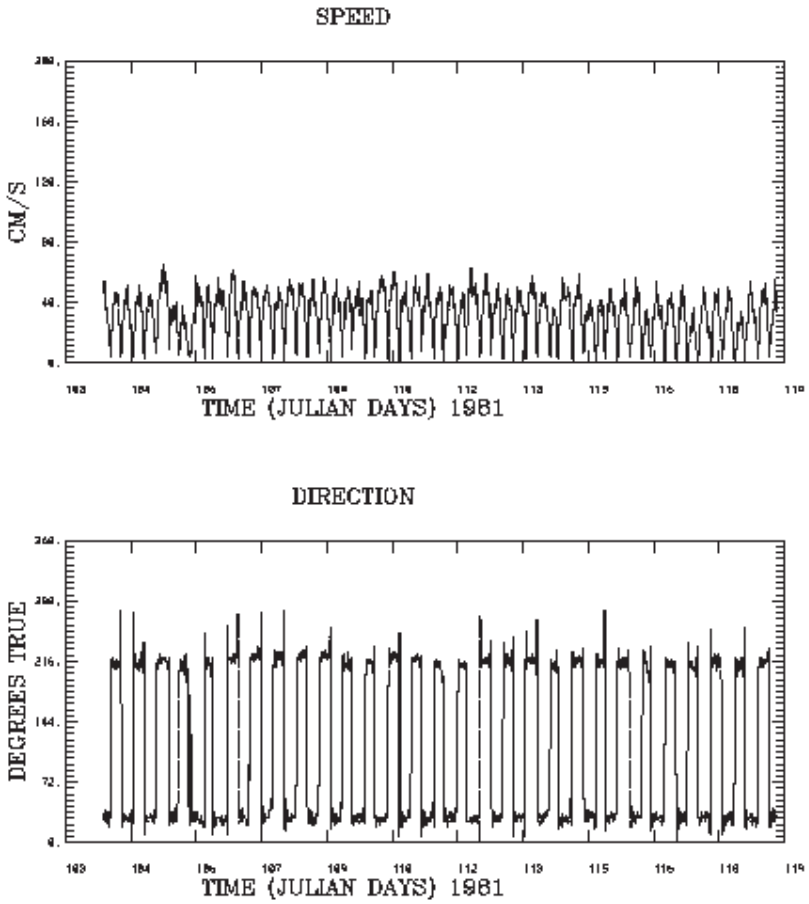

Figure 6.17. C-63 in upper New York Harbor Current Speed and Direction at 41 feet below the water surface in April 1981

7. DATA PRESERVATION AND USE ISSUES

Preservation

NOS circulation survey reports are available for the Chesapeake Bay (Browne and Fisher, 1986), San Francisco Bay (Welch et al., 1985), and New York Harbor (Browne and Dingel, 1983). A memorandum for the record is available for Columbia River (Frey, 1984). In each of these documents, data dissemination is addressed as well as a submittal to NODC for archiving and preservation. Consultations with NODC did not appear useful in obtaining the original datasets in uncorrupted format. The data corruption and preservation issues are discussed in CO-OPS (1999), particularly with respect to CTD time stamp corruption. In large measure data were corrupted in migration from storage media associated with each new computer system. To prevent this, data redundancy and backup procedures need to be addressed.

Because of these issues, the back cover contains a DVD which includes the data that has been described in this report.

Use

The primary use of these processed circulation survey datasets is anticipated to be in the support of model evaluation environments and in supporting the development of nowcast/forecast systems. This effort focused on the restoration and quality control of these datasets. It should be noted that the final processed data were written in the same format as the original data and no rearrangement of the data file structures was undertaken. Data editing and filtering were performed to remove bad portions of data. However, additional consistency checking should be performed by each user in consultation with the NOS circulation survey reports, which give exact station location and water depth.

In using the current meter data, computer programs were developed (Richardson and Schmalz, 2006) for the determination of the principal component directions using the Preisendorfer scheme after Zervas (1999). Control files and the input data file necessary for use in the NOS 29-day harmonic analysis programs as described by Zervas (1999) were then generated and the 29-day harmonic analysis was performed for all current meter stations in the Chesapeake Bay. These programs may be used to perform 29-day harmonic analysis of currents in the other estuaries. In addition, Lanerolle (2008) has developed a MATLAB programming script to inventory current meter data and plot East and North components at all depths to further assess data consistency.

8. SUMMARY AND RECOMMENDATIONS

Three sets of programs have been developed to analyze the circulation survey data in the Chesapeake Bay, Columbia River, San Francisco Bay, and New York Harbor. Prior to the analysis several reformatting steps were necessary to convert from DOS to UNIX file formats and to process single line files.

The first two programs are used to plot CTD vertical profiles and station locations. Noisy CTD profiles were then edited when possible. The AML CTD files were rewritten to remove the extraneous data at the end of the casts.

The second two programs are used to analyze the CT/Current meter files. The first program is used to plot station locations and filter the salinity and temperature time series as well as clip current directions. The second program was used for the Chesapeake Bay to determine the principal current direction using the Preisendorfer scheme and to prepare the control and data files for use in the NOS 29-day harmonic analysis program. A script was executed to perform the harmonic analysis for all current time series in one job. All constituent files were then combined into a single file.

The third two programs are used to plot the meteorological station locations as well as time series of sea level atmospheric pressure, air temperature, wind speed, and wind direction. Sea level atmospheric pressure data as well as wind information were largely corrupted.

With respect to future work, it is recommended that the following tasks be performed:

1) MMAP workstation backup of /disks/NASUSER be performed on all processed circulation survey files and that these files also be transferred to CO-OPS for redundancy.

2) All processed circulation survey data files be ingested in the MMAP/Oracle database.

3) Initial MATLAB programming scripts be further developed to improve current data consistency and quality control checks. In addition, the scripts might be expanded to include harmonic and spectral analysis for currents along major-minor or East-North current directions.

4) Additional MATLAB programming scripts be developed for salinity and temperature data consistency and quality control checks.

9. ACKNOWLEDGMENTS

Dr. Frank Aikman, Chief of Marine Modeling and Analysis Programs, Coast Survey Development Laboratory (CSDL) provided overall project direction and critical resources. Discussions with Richard Patchen, Chief Science Officer, CSDL, were instrumental in working with and reformatting the original CTD casts. Peter Stone, Center for Operational Oceanographic Products and Services (CO-OPS) provided the original circulation survey datasets.

10. REFERENCES

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8. Welch, J.M., J.W. Gartner, and S.K. Gill, 1985. San Francisco Bay Circulation Survey: 1979-1980, **NOS Oceanographic Circulation Survey Report No. 7**, Rockville, MD.

9. Zervas, C. E., 1999. Tidal Current Analysis Procedures and Associated Computer Programs, **NOAA Technical Report NOS CO-OPS 0021**, Silver Spring, MD.

APPENDIX A: CHESAPEAKE BAY SAMPLE SCRIPTS, CONTROL AND OUTPUT FILES

CTD Restoration

chesprofile.jcl

```
#!/bin/sh
# set -x
l='/disks/NASUSER/philr/delaware/parallel/CTD/profile'

# my version
# lf95 ctdcast_plot.f $l/jdconv.f $l/prof.sub.f hlrange.f $l/salin.f
$l/rho.f ctdplot.f -o delprof \
# -L/usr/lib/gcc-lib/i386-redhat-linux/3.2.3 -lg2c \
# -L/usr/local/ncarg/lib -lncarg -lncarg_gks -lncarg_c -
L/usr/X11R6/lib/ -lX11 \
# -I/usr/local/include -L/usr/local/lib -lnetcdf
# rm *.o


# rm *.final

# ./delprof < cntrl.file01_all.n > out.file01.cast
  ./delprof < cntrl.file01.n > out.file01.cast
# ./delprof < cntrl.file03_all.n > out.file03.cast
# ./delprof < cntrl.file03.n > out.file03
# ./delprof < cntrl.03_aml.n > out.03_aml
# ./delprof < cntrl.03_amlall.n > out.03_aml

# mv fort.66 debug.$1
# mv fort.67 station.file03
  mv fort.67 station.file01

# ctrans -d ps.mono gmeta > gmeta.$1.ps
# ctrans -d ps.mono gmeta > gmeta.03_aml.ps
  ctrans -d ps.mono gmeta > gmeta.file01.ps


  rm gmeta
  rm station.*
  rm out.file01.cast
  rm *.final
# rm *.fin
  rm fort.*
# rm fileout
# rm debug.*

# display gmeta.file03.ps
```

cntrl.file01.n

```
0    idebug
/disks/NASUSER/philr/chesapeak/ctd/profile/CTD_edit/CHCT01_ed
CHCT01.final
SOM
 1       nplot
246
 y
 -1.0 40.0    density min/max
 -1.0 30.0    temperature
 -1.0 40.0    salinity
  0.25         top and bottom cast depth boundary offset
```

cntrl.file03.n

```
0    idebug
/disks/NASUSER/philr/chesapeak/ctd/profile/CTD_edit/chct03_grndy.ed
CHCT03.final
SOM
 1            nplot
63
 y
 -1.0 40.0    density min/max
 -1.0 30.0    temperature
 -1.0 40.0    salinity
  0.25         top and bottom cast depth boundary offset
```

cntrl.03_aml.n

```
0    idebug
/disks/NASUSER/philr/chesapeak/ctd/profile/CTD_edit/chct03_aml.ed
CHCT03_aml.fin
SOM
 1         nplots
104
 y
 -1.0 40.0    density min/max
 -1.0 30.0    temperature
 -1.0 40.0    salinity
  0.25         top and bottom cast depth boundary offset
```

Current/CT Restoration

current.jcl

```
  lf95 del_currnt.f plt_ches.f jdconv.f filt.pp.f ncrght.f -o delcurrnt
-L/usr/lib/gcc-lib/i386-redhat-linux/3.2.3 -lg2c \
  -L/usr/local/ncarg/lib -lncarg -lncarg_gks -lncarg_c -
L/usr/X11R6/lib/ -lX11 \
  -I/usr/local/include -L/usr/local/lib -lnetcdf

  rm *.o


# delcurrnt < curr_ch3.n > out
  delcurrnt < curr_ch1.n > out
# delcurrnt < curr_ch2.n > out
# delcurrnt < curr_ch2_1.n > out
# delcurrnt < curr_ch2_2.n > out


# convert gmeta file to postscript
  ctrans -d ps.mono gmeta > gmeta.ps

# ictrans -d ps.mono -e "5 save 5frame" -e 'quit' gmeta
# ctrans -d ps.mono 5frame > gmeta5.ps

# rm delcurrnt
  rm gmeta
  rm file.qc
  rm fort.11
  rm fort.66
  rm time.out
  rm time.out2
  rm out
```

```
curr_ch1.n

0  0      initplot, idebug
/disks/NASUSER/philr/chesapeak/CHES1/file_ches1
file.qc
ALL
    0    nclip
    8    nedit
050    8 174.5 187.0 1982    0    0    1
078    5 225.5 238.5 1982    0    0    1
081   11 222.0 226.0 1982    1    0    0
040   37 356.5 382.0 1981    0    0    1
065   15  14.5  24.5 1982    0    0    1
065   36   8.5  25.0 1982    0    0    1
065   36  56.5  69.0 1982    0    0    1
067   35  99.0 117.0 1982    0    0    1



Note files curr_ch2.n, curr_ch3.n, curr_ch2_1.n, and curr_ch2_2.n are
similar.
```

Sample Output Files (time.out : current/CT)

ches1

```
1
tape number 005030
instrument type :  GRUND

Station number 036 ,  Depth = 15ft
 record starts at time 355.847, and ends at time 384.479
                      12/21/81    to   13/**/81
Length of record is  28.632 days

Station number 050 ,  Depth =  8ft
 record starts at time 167.702, and ends at time 187.827
                       6/16/82    to    7/ 6/82
Length of record is  20.125 days

Station number 055 ,  Depth = 27ft
 record starts at time 167.903, and ends at time 187.903
                       6/16/82    to    7/ 6/82
Length of record is  20.000 days ...




Station number 65B ,  Depth = 22ft
 record starts at time 117.938, and ends at time 130.771
                       4/27/82    to    5/10/82
Length of record is  12.833 days

Station number 067 ,  Depth = 15ft
```

```
 record starts at time 118.007, and ends at time 130.708
                       4/28/82    to    5/10/82
Length of record is  12.701 days

Station number 036 ,  Depth = 15ft
 record starts at time 125.674, and ends at time 140.681
                       5/ 5/82    to    5/20/82
Length of record is  15.007 days


 Note ches2, ches3, ches2-1, ches2-2 are similar.
```

Meteorological Restoration

meteor.jcl

```
# lf95 chs_meteor.f plt_met.f jdconv.f filt2.pprs.f ncrght.f -o
delmeteor -L/usr/lib/gcc-lib/i386-redhat-linux/3.2.3 -lg2c \
# -L/usr/local/ncarg/lib -lncarg -lncarg_gks -lncarg_c -
L/usr/X11R6/lib/ -lX11 \
# -I/usr/local/include -L/usr/local/lib -lnetcdf

# rm *.o
# rm *.qc


  delmeteor < met_1981.n > out
# delmeteor < met_mfile11.n > out


# convert gmeta file to postscript
  ctrans -d ps.mono gmeta > gmeta.ps

# ictrans -d ps.mono -e "5 save 5frame" -e 'quit' gmeta
# ctrans -d ps.mono 5frame > gmeta5.ps

# rm delcurrnt
  rm gmeta
# rm anderaa.qc
  rm fort.11
  rm time.out
# rm time.out2
# rm out

# display gmeta.ps
```

met_1981.n

```
0     idebug
 0     initplot
/disks/NASUSER/philr/chesapeak/metdata/metfile.6
anderaa.qc
ALL
    0    nclip
    6    nedit
  M1  11.0 246.0 278.0 1981    0    0    1
  M1  11.0 277.0 310.0 1981    0    0    1
  M1  11.0 309.0 330.0 1981    0    0    1
  M2  10.5 241.0 280.0 1981    0    0    1
  M2  10.5 277.0 310.0 1981    0    0    1
  M2  10.5 309.0 337.0 1981    0    0    1
```

met_mfile11.n

```
0     idebug
 0     initplot
/disks/NASUSER/philr/chesapeak/metdata/metfile.11ed
anderaa.qc
ALL
    0    nclip
   11    nedit
  M4  13   137.0 166.0 1982    0    0    1
  M3  10   165.0 192.0 1982    0    0    1
  M3  10   141.0 166.0 1982    0    0    1
  M4  13   165.0 192.0 1982    0    0    1
  M3  10   191.0 225.0 1982    0    0    1
  M3  10   224.0 251.0 1982    0    0    1
  M4  13   220.0 251.0 1982    0    0    1
  M3  10   250.0 286.0 1982    0    0    1
  M3  10   285.0 313.0 1982    0    0    1
  M3  10   312.0 329.0 1982    0    0    1
  M4  13   250.0 271.0 1982    0    0    1
```

Sample Output Files (time.out : meteorological)

time.1981

```
1
tape number 006233
instrument type :  12 CH

Station number   M1,  Depth = 11.0m
 record starts at time 246.611, and ends at time 277.556
                       9/ 3/81    to   10/ 4/81
Length of record is  30.944 days

Station number   M1,  Depth = 11.0m
 record starts at time 277.583, and ends at time 309.597
                      10/ 4/81    to   11/ 5/81
Length of record is  32.014 days

Station number   M1,  Depth = 11.0m
 record starts at time 309.632, and ends at time 329.604
                      11/ 5/81    to   11/25/81
Length of record is  19.972 days

Station number   M2,  Depth = 10.5m
 record starts at time 241.729, and ends at time 279.833
                       8/29/81    to   10/ 6/81
Length of record is  38.104 days

Station number   M2,  Depth = 10.5m
 record starts at time 277.840, and ends at time 309.667
                      10/ 4/81    to   11/ 5/81
Length of record is  31.826 days

Station number   M2,  Depth = 10.5m
 record starts at time 309.701, and ends at time 336.646
                      11/ 5/81    to   12/ 2/81
Length of record is  26.944 days
```

time.1982

```
1
tape number 003633
instrument type :  12 CH

Station number   M3,  Depth = 10  m
 record starts at time 165.583, and ends at time 191.556
                       6/14/82    to    7/10/82
Length of record is  25.972 days

Station number   M3,  Depth = 10  m
 record starts at time 141.701, and ends at time 165.549
                       5/21/82    to    6/14/82
Length of record is  23.847 days
```

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Station number   M4,  Depth = 13  m
 record starts at time 137.882, and ends at time 165.681
                       5/17/82    to    6/14/82
Length of record is  27.799 days

Station number   M4,  Depth = 13  m
 record starts at time 165.715, and ends at time 191.660
                       6/14/82    to    7/10/82
Length of record is  25.944 days

Station number   M3,  Depth = 10  m
 record starts at time 191.604, and ends at time 224.757
                       7/10/82    to    8/12/82
Length of record is  33.153 days

Station number   M3,  Depth = 10  m
 record starts at time 224.778, and ends at time 250.785
                       8/12/82    to    9/ 7/82
Length of record is  26.007 days

Station number   M4,  Depth = 13  m
 record starts at time 220.639, and ends at time 250.667
                       8/ 8/82    to    9/ 7/82
Length of record is  30.028 days

Station number   M3,  Depth = 10  m
 record starts at time 250.819, and ends at time 285.757
                       9/ 7/82    to   10/12/82
Length of record is  34.938 days

Station number   M3,  Depth = 10  m
 record starts at time 285.785, and ends at time 312.590
                      10/12/82    to   11/ 8/82
Length of record is  26.806 days

Station number   M3,  Depth = 10  m
 record starts at time 312.597, and ends at time 328.604
                      11/ 8/82    to   11/24/82
Length of record is  16.007 days

Station number   M4,  Depth = 13  m
 record starts at time 250.701, and ends at time 270.819
                       9/ 7/82    to    9/27/82
Length of record is  20.118 days
```