APPENDIX A:
DATA REDUCTION DETAILS
AND
DATA PRESENTATION

Data Reduction Details

Basic data and equipment descriptions, formats, and data processing procedures are discussed by data type beginning with ADCP data. Specifications for all in situ instruments used are listed in table 2.

Acoustic Doppler Current Profiler Data

An ADCP determines water-current-velocity profiles by transmitting sound pulses at a fixed frequency into the water column and measuring the frequency (or phase) shift in acoustic echoes reflected from inorganic and organic material (scatterers) in the water. The frequency or phase shift provides Doppler information used to determine current-velocity components along the axes of the acoustic beams; typically, four transducers project sound into the water column at 20 degrees from the vertical. Trigonometric relations convert three of the four velocity measurements along the acoustic beams into three orthogonal velocity components (the fourth transducer is for redundancy). The velocity profile is determined by sampling the reflected acoustic signals at discrete time intervals that correspond to depth intervals (also called bins). The ADCPs used in this study were SC-1200 narrow-band and broad-band units manufactured by R.D. Instruments, Inc. The SC-1200 ADCP transmits an acoustic signal at 1,229 kilohertz (kHz), is self contained, and is capable of storing data in internal memory. A complete description of ADCP principles of operation is given by R.D. Instruments, Inc. (1989). In practice, the upper 15 percent (6 percent for the broad-band with 20 degrees transducer beam angles) of the water column cannot be sampled accurately because of parasitic acoustic side lobes that interfere with the primary acoustic signals. The center of the first measured bin above the transducers is equal to the transmit pulse plus the blanking distance (1.5 m for the narrow-band ADCP and 1.2 m for the broad-band ADCP). Blanking distance is that time necessary for transducers and associated electronics to recover before receiving reflected acoustic signals.

For this study, the ADCPs were suspended from metal (nonmagnetic materials such as aluminum, monel, or stainless steel) platforms to protect the transducers and to keep the transducer head level at 0.7 m above the bed. In the case of the narrow-band ADCP instruments, the bin width was set to 1 m; velocity profiles include data starting at 2.2 m (center of BIN 1) above the estuary bed. In the case of the broad-band ADCP, the bin width was set at 50 centimeters (cm); the center of the first bin was 1.9 m above the bed. The sampling interval was 10 minutes and each data sample (ensemble) was an average of a sufficient number of acoustic pings such that the standard deviation (short-term random error) of the ensemble was less than 1 cm/s. Complete descriptions of velocity errors in ADCPs are given by Chereskin and others (1989) and Burau and others (1993).

Sea-Level Data

Sea-level data at Stations MART and MAL, (fig. 2) were obtained from DWR. At these stations, a JGS model SE-104 incremental encoder with a float and tape is used to measure sea level to an accuracy of 0.3 cm. Sea-level data at Station WICK is measured using a surface float in a 20-cm stilling well and shaft encoder data logger to an accuracy of 1.5 cm.

Salinity Data

Salinity is a computed quantity derived from conductivity and temperature measurements. Salinities given in this report were computed using the 1985 UNESCO standard (UNESCO, 1985) and a low salinity (<2) correction as reported by Hill and others (1986). Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993). The sensors and the computational details are presented in this appendix.

Conductivity-Temperature Sensors

The in situ conductivity-temperature sensor (CT) data-loggers used in this study were the Seabird seacat CT, digital recording, water-quality instruments. This instrument is self-contained and is capable of storing as much as 60 days of data when recording at the 15-minute sample interval used in this study.

For completeness, CT data collected by USGS at Wickland Pier (WICK) and by DWR at Martinez, Mallard Island, and Antioch also are presented in this report. The CT sensors at Station WICK are YSI model 33 with the following specifications: (1) temperature range –2°C–50°C and accuracy ±0.15°C; (2) conductivity range 0–50,000 microsiemens per centimeter (µS/cm) and accuracy ±2.5; and (3) salinity range 0–40 and accuracy 0.2. Station WICK is serviced monthly.

The data for Stations MART, MAL, and ANTCH were obtained from DWR. The near-surface CT sensors at Stations MART, MAL, and ANTCH were Schneider Instruments model RM25-C, and the near-bed conductivity sensors were Foxboro model 872. These stations were visited about every 14 days. During these visits, all probes were cleaned and the data were verified.

Conductivity-Temperature-Depth-Optical Backscatterance Sensors

Ocean Sensors OS200 CTD instrument, some of which included OBS sensors, also were used in this study. This instrument is self-contained and was set up to record date, time, pressure, temperature, conductivity, salinity, and OBS output at 15-minute intervals. Specifications for the OS200 are listed in table 2. These instruments are able to sample at very high frequencies [as much as 100 hertz (Hz)] which is very useful for some applications such as profiling or wind wave burst sampling, however, the disadvantage of this is that instrument calibrations should be performed in a pressure tank to eliminate the formation of micro bubbles on the conductivity sensor. Prior to and after the completion of the study, the instruments were sent to the manufacturer to be calibrated and tested. During the study, the CTDO instruments were routinely serviced in the field to reduce biofouling. The deployment configuration figures for each station provide the exact servicing dates. Comparisons then were made with the conductivity data collected at the nearest land station (MART, MAL, and ANTCH) to verify that biofouling effects were being minimized and, in some cases, were edited out of the final data sets.

Salinity Computation

Conductivity and temperature measured by the water-quality sensors were converted to salinity following the 1985 UNESCO standard (UNESCO, 1985) in the range of 2–42. Salinities below 2 were computed using the extension of the practical salinity scale proposed by Hill and others (1986). The relations used to convert measured temperatures, T (°C), and conductivities, $C_{S,T,P}$ into the salinities presented in this report are as follows:

$$S = \sum_{i=0}^{5} (a_i + b_i f(T)) R_t^{\frac{i}{2}} - \frac{a_0}{1 + 1.5x + x^2} - \frac{b_0 f(T)}{1 + y^{\frac{1}{2}} + y + y^{\frac{3}{2}}} \tag{1}$$

where $C_{S,\,T,\,P}$ is the reciprocal of the resistivity, in ohms, normalized to a 1-cm cube of a liquid at a specified temperature. $C_{S,\,T,\,P}$ has the units ohm^{-1} cm^{-1}. The reciprocal of the ohm was formerly called a “mho.” Thus, units of conductivity were mhos cm^{-1}, or, in estuarine waters, millimhos per centimeter (mmohs/cm)$^{-1}$. Present Systems International (SI) usage is the microsiemens per centimeter. The first term represents the 1985 practical salinity scale and the second and third terms are the low salinity extension where

$$f(T) = \frac{(T-15)}{1+k(T-15)} \tag{2}$$

$$x = 400R_t, y = 100R_t, k = 0.0162 \tag{3}$$

$$a_0 = 0.0080, a_1 = -0.1692, a_2 = 25.3851 \tag{4}$$

$$a_3 = 14.0941, a_4 = -7.0261, a_5 = 2.7081 \tag{5}$$

$$b_0 = 0.0005, b_1 = -0.0056, b_2 = -0.0066 \tag{6}$$

$$b_3 = -0.0375, b_4 = 0.0636, b_5 = -0.0144 \tag{7}$$

where R_t is the ratio between the conductivity of some unknown sample and the standard sea water conductivity at some constant temperature T °C and zero pressure.

R_t is computed as

$$R_t = \frac{C_{S,\,T,\,P}}{C_{35,\,T,\,P}} \tag{8}$$

where:

$C_{S,\,T,\,P}$ is the conductivity of water with S salinity;
T is temperature, in degrees Celsius; and
P is pressure, in bars.

$C_{35,\,T,\,P}$ is computed using methods reported by Kjerfve (1979) as

$$C_{35,\,T,\,0} = \sum_{i=0}^{3} c_i T^i \tag{9}$$

$$c_0 = 29.03916, c_1 = 8.6297124 \times 10^{-1}, c_2 = 4.515879 \times 10^{-3} \tag{10}$$

$$c_3 = 2.291189 \times 10^{-5} \tag{11}$$

To compute salinity, $C_{35,\,T,\,O}$ is first computed with the measured temperature, T, using equation 9. R_t is then computed from equation 8 using the measured conductivity $C_{S,\,T,\,P}$ and $C_{35,\,T,\,P}$. R_t and the measured temperature, T, are substituted into equation 1 to compute the measured salinity.

Finally, the term "specific conductance" (SC) is used in this report when measurements are made at or corrected to a standard temperature, typically 25°C. To compute SC from the measured electrical conductivity, the following relation may be used (Miller and others, 1988):

$$SC = \frac{C_{S,\,T,\,O}}{1 + 0.0191(T - 25)} \tag{12}$$

Suspended-Solids Concentration Computation

Water samples were collected to calibrate the output of the OBS sensors to SSC, as is done by the USGS at other sites in San Francisco Bay (Buchanan and Ruhl, 2000). A weighted Van Dorn bottle was used to collect water samples. The Van Dorn bottle is a plastic tube with rubber stoppers at each end that snap shut when triggered by a small weight dropped down the suspension cable. Water samples were usually collected before and after the sensors were cleaned and sometimes water samples were collected at a site without recovering the instrument. With the optical sensors deployed, the sampler was lowered to the depth of the sensor by a reel and crane assembly and the sample was collected.

Samples were sent to the USGS Sediment Laboratory in Salinas, California, for analysis to determine SSC. Each sample was mixed well and a suitable volume was quickly poured into a graduated cylinder. The suspended solids were collected on a 0.45-micrometer (μm) membrane filter, the filter was rinsed to remove salts, and the insoluble material was dried at 103°C and weighed (Fishman and Friedman, 1989).

The OBS sensor data were visually edited to remove invalid data. Invalid data included rapidly increasing voltage outputs and unusually high voltage outputs of short duration (Buchanan and Ruhl, 2000). As biological growth occurred on the optical sensors, the voltage output of the sensors increased rapidly. Thus, data collected during the period prior to sensor cleaning sometimes were unusable and were removed from the record. Spikes in the data, which are anomalously high voltages probably caused by debris temporarily wrapping around the sensor or by large marine organisms (fish, crabs) on or near the sensor, also were removed from the raw data record. For calibration of each sensor the best-fit line to relate output of the OBS sensor to SSC was determined with the robust, nonparametric, repeated median method (Siegel, 1982). For more details on this method see Buchanan and Ruhl (2000).

File Formats

Two file formats are described in the following sections to facilitate data transfers: (1) time-series and (2) ADCP data.

Time-Series File Format

The time-series format is used to store all the data described in this report except the ADCP data. Figure A1 shows an example time series. In this format, the header information describes the number of channels, which data are stored in the various channels and in what order. Each line in this example is described in detail in what follows:

```
Station name: HDOL                                                     LINE   1
Position: 38 02.896, 122 06.019                                        LINE   2
start:-yr-mn-dy---hr-----days----------dt-nchan-mxdig                  LINE   3
   1995   7 17  910   -1826  10.00000       6       6                  LINE   4
                                                                       LINE   5
ch----------------name-digit-dtype-isens--ivec--iblg                   LINE   6
 1CONDUCT, mS/CM   2      8      1     0     0                         LINE   7
 2TEMP, DEG. C.    2      6      1     0     0                         LINE   8
 3DEPTH, M         2      4      1     0     0                         LINE   9
 4SALINITY         2      5      1     0     0                         LINE  10
 5OBS VOLT         2     18      1     0     0                         LINE  11
 6FLOUR VOLT       3     29      1     0     0                         LINE  12
--------days--------ch1-----ch2--ch4------ch5--ch6                     LINE  13
 19838208   -11 2114     76    0      132  366                         LINE  14
 19838875   -12 2111     72    0      132  368                         LINE  15
 19839583   -12 2112     73    0      122  362                         LINE  16
 19840292   -12 2116     65    0      130  370                         LINE  17
   .      .  .   .   .   .   .   .    .  .  .
   .      .  .   .   .   .   .   .    .  .  .
   .      .  .   .   .   .   .   .    .  .  .
```

Figure A1. Example time-series file format.

LINE 1: Station name.
LINE 2: Header information, stored as a character variable.
LINE 3: Header that gives a description for the next line of data.
LINE 4:*yr*: Start year of time series xxxx, where xxxx is the year; columns 8–9.
mn: Start month of time series; columns 11–12.
dy: Start day of series; columns 14–15.
hr: Start hour of series in decimal hours*100 (for example, 3:45pm is 1575); columns 17–20.
days: Represents the number of days referenced to the year 2000 to the first day of the year or record (for example, days = 0 on January 1, 2000). This allows for absolute time referencing when time series are compared with differing deployment start years; columns 25–30.
dt: Sampling interval, in minutes; columns 31–40.
nchan: Number of data channels (excluding time information); columns 41–46.
mxdig: Maximum number of digits used for end data channel; columns 47–52.
LINE 5: Header information stored as a character variable.
LINE 6: Header that gives a description for the next line of data.
LINES 7 through 12:

ch: Channel number represents the column number to the right of time column in lines 13 forward (for example, for the data set pictured, ch1 is conductance, ch2 is temperature, and so forth). The assignment of these data columns is completely flexible and will change depending on the data type; columns 1–2.

name: The name of the channel and the units the data are collected in. The name is used for plotting and output of data; column 3–22.

digit: All data are stored as integers to reduce the size of the files. *Digit* represents the location of the decimal place. The actual data are obtained by dividing the integer values in a given column by 10^{digit}; columns 23–28.

dtyp*e*: Data type code. This code (a two-digit integer) allows the same data types to be overlaid on the same plot. Examples of data type codes are conductivity=8, water temperature=6, and so forth; columns 29–34.

isens: Sensor number, where isens=1 is the bottom sensor; columns 36–40.

ivec: Indicates whether data are scalar (0) or vector quantity (1); columns 41–46.

iblg: Associates two parts of a vector quantity, *iblg*=1 is direction and *iblg*=2 is speed; columns 47–52.

LINE 13: Header that gives a description for the next line of data.

LINE 14: Number of days since the beginning of the start year $*10^5$. Absolute referencing to the year 2000 is obtained by adding days in **LINE 4** to the days in this column. Note: January 1, 19xx, equals calendar day 1. The days field takes nine spaces (columns).

The next six columns of data are defined by the header information. There are six columns because, in this case, there are six data channels. The number of data channels is defined by the value of **NCHAN**. Each data channel takes six spaces (or columns).

Acoustic Doppler Current Profiler File Format

The ADCP file format described below applies to the raw data and the low-pass-filtered data. The ADCP file format begins with header information that describes the station name, start and end dates, the number of samples in the vertical (bins), the time step, and the station location. An example of this format is given in figure A2. After the header is a time series of profiles that begins with a time stamp followed by the profile information.

```
CUT                          station name                   LINE   1
 2119931101993               Start and stop dates           LINE   2
38 3441220415                latitude and longitude         LINE   3
   1       9      0.16667    first BIN, last BIN Delta T    LINE   4
 1993    1   21  771         start date and time of series  LINE   5
  0.00000   0.00000   93   1    21    771                   LINE   6
   1     -2.95     -1.20                                    LINE   7
   2     -2.10     -0.60                                    LINE   8
   3     -2.50      0.30                                    LINE   9
   4     -2.80      0.10                                    LINE   10
   5     -1.65      1.10                                    LINE   11
   6     -2.40      1.40                                    LINE   12
   7     -0.85      1.05                                    LINE   13
   8     -2.20      1.85                                    LINE   14
   9     -1.75      1.25                                    LINE   15
  0.17000   0.00000   93   1    21    788                   LINE   16
   1     -4.43     -1.80                 .       .
   2     -3.15     -0.90                 .       .
   3     -3.75      0.45                 .       .
   4     -4.20      0.15
   5     -2.47      1.65
   6     -3.60      2.10
   7     -1.28      1.57
   8     -3.30      2.78
   9     -2.63      1.88
  0.3400   0.00000   93   1    21    805
   1     -5.16     -2.10
   2     -3.67     -1.05
   .      .        .
   .      .        .
   .      .        .
   .      .        .
```

Figure A2. Example acoustic Doppler current profiler file format.

LINE 1: Station name.
LINE 2:Columns 1–3: starting calendar day of the time series.
Columns 4–7: starting year of the time series.
Columns 8–10: ending calendar day of the time series.
Columns 11–14: ending calendar year of the time series.
LINE 3:Latitude: degrees (columns 1–2), minutes (columns 3–4), seconds (columns 6–7).
Longitude: degrees (columns 7–9), minutes (columns 10–11), seconds (columns 12–13).
LINE 4:Columns 1–5: first bin in profile.

Columns 11–15: last bin in profile.

Columns 21–30: time step in decimal hours (in this case 10 minutes).

LINE 5: Columns 1–5: start year, xxxx.

Columns 6–10: start month.

Columns 11–15: start day.

Columns 16–20: start hour in decimal hour*100 (for example, 3:45 p.m. is 1575).

LINES 6–15: Contain the first velocity profile where **LINE 6** is the time when the profile was taken and **LINES 7–15** contain the velocity data. In this case, nine bins make up the velocity profile, as specified in **LINE 4** of the header.

LINE 6: Columns 1–10: elapsed time, in decimal hours.

Columns 11–20: zero (not used).

Columns 21–25: year (19xx) of sample.

Columns 26–30: month of sample.

Columns 31–35: day of sample.

Columns 36–70: decimal hour*100 of sample (for example, 3:45 p.m. is 1575).

LINES 7–15: Contain the profile data.

Columns 1–6: bin number where BIN 1 is near the ADCP transducer.

Columns 7–16: U or east velocity component.

Columns 17–26: V or north velocity component.

Data Presentation

A standard suite of data-processing procedures was applied to each type of hydrodynamic data. This section describes the products from these processing procedures. For each station (location), data are presented in appendices as follows:

(a) Deployment schematic;
(b) Time-series plots of sea level, temperature, and salinity;
(c) Time-series plots of low-pass-filtered sea level, temperature, and salinity;
(d) Time-series plots of suspended-solids concentration (SSC);
(e) Time-series plots of velocity measurements;
(f) Time-series plots of low-pass-filtered longitudinal and transverse velocity components;
(g) Stick plots of low-pass-filtered velocity time series;
(h) Calibration curve for suspended-solids concentration;
(i) Harmonic analysis results from sea-level (depth or pressure) measurements; and
(j) Harmonic analysis results from velocity measurements.

Not all types of data were collected at each station. In these cases, a subset of the previous list is presented in the indicated order. For the measurment of velocity, ADCPs were deployed at several sites. An ADCP determines the velocity profile by sampling reflected acoustic signals at discrete time intervals that correspond to depth intervals (bins). Therefore, when ADCP data are presented, the bottom and near-surface depth cell (bin) for each velocity profile is presented as an individual time series.

The deployment schematic (a) shows the equipment used, deployment configuration, relevant depths, and any other pertinent site-specific information. Time-series plots of sea level, temperature, and salinity (b), SSC (d), and current speed and direction (e) depict the raw data. Low-pass filtering (c), (f), and (g) removes the high-frequency variability caused by the tides from the time series. Delta outflow, spring-neap tidal variations, and meteorological forcing often produce a low-frequency response in hydrodynamic variables that can be observed more easily in the filtered time series. Harmonic analysis (i) and (j) (Cheng and Gartner, 1984a) provides a useful synopsis of the tidal time scale character of sea-level and velocity measurements, respectively, at a given location.

Plotting of Oceanographic Data

There generally are two philosophies regarding the presentation of oceanographic data that depend on the intent of the data analysis. The first philosophy emphasizes the details of each sampling location by selecting the plot scales to bracket only each data set. Using this approach, however, one cannot easily compare information between locations. The second philosophy, which is used in this report, plots the data on a consistent set of scales. This philosophy allows the comparison of data from different locations and, therefore, emphasizes basin-scale phenomena.

In this report, data are plotted from Julian day 150 to Julian day 300 (May 30 to October 27, 1995) referenced to January 1, 1995. The data at some of the locations do not cover this entire range and (or) have gaps due to equipment problems, these areas are shown by straight lines that do not reflect true readings. The currents are plotted using a scale of 0–175 cm/s (0–50 cm/s for the shallow sites). The residual (or low-pass-filtered) currents are plotted using a consistent scale of –30 to +20 cm/s (negative values are in the seaward or ebb direction). Depth (CTDs deployed near the bed) and sea level (water level measured by a surface float) data are plotted using a range custom to each site with an increment of 2.0. Temperature and salinity data are plotted using scales of 14–26^{o}C and 0–25^{o}C, respectively. Finally, suspended-solids concentrations are plotted using a scale of 0–600 milligrams per liter (mg/L).

Low-Pass Filter

Applying a low-pass filter to the data selectively removes frequencies that are greater than a specified cutoff value. In the analysis of data from tidally affected waters like San Francisco Bay, the objective is to remove signals in the data with periods less than 30 hours (most importantly, the tides). The data in this report were filtered using a discrete Fourier transform filter similar to that described by Walters and Heston (1982). A cosine taper was applied between a stop frequency of 30 hours and a pass frequency of 40 hours to reduce "ringing" in the results (Burau and others, 1993).

Low-pass-filtered velocity data are presented in time-series and stick-plot formats. In both formats, the currents have been rotated onto their principal direction. Because the currents are bidirectional, the principal direction is given as the flood direction, by convention. Two velocity components are generated by this rotation: the longitudinal component that is aligned with the principal direction and the transverse component that is perpendicular to the principal direction. In general, most tidal and residual currents are contained in the longitudinal component: the transverse component usually is small. These components are plotted directly in the time-series format. In the stick-plot format, residual velocities are represented by a “stick” diagram. Sticks directed above zero on the horizontal axis represent landward net flow. Conversely, sticks pointing below the zero axis represent seaward residual currents. The transverse component is seen in the angling of the sticks where sticks angled to the left are indicative of a positive transverse velocity (a right-hand coordinate system is used). The magnitude of the transverse currents in the stick plots are proportional to the angling of the sticks.

Harmonic Analysis

Sea level (*h*) and each velocity component (*u*, *v*) can be represented by a sum of cosine functions,

$$h = H_o + \sum f_i H_i \cos[\omega_i t - (\kappa_i - E_i)] \tag{13}$$

$$u = U_o + \sum f_i U_i \cos\{\omega_i t - [(\kappa_u)_i - E_i]\} \tag{14}$$

$$v = V_o + \sum f_i V_i \cos\{\omega_i t - [(\kappa_v)_i - E_i]\}, \tag{15}$$

each with known frequency (ω_i) of astronomical origin (table A1), defined by a unique amplitude (H_i, U_i, V_i) and phase [κ_i, $(\kappa_u)_i$, $(\kappa_v)_i$] (or local epoch), where t is time reconciled to a known reference, E_i is the equilibrium argument at the reference time, and f_i is the node factor reciprocal. The E_i's and f_i's are straightforwardly calculated following the relations given in Schureman (1976). In this report, the modified epoch (κ_i') also is presented. The modified epoch is used for predictions and basically is the local epoch, κ, plus a longitude and time meridian correction,

$$\kappa'_i = \kappa + pL - \frac{aS}{15}, \tag{16}$$

where p is the subscript of the partial tide (1 for diurnal, 2 for semidiurnal), L is the longitude, a is the hourly angular frequency, and S is the longitude of the time meridian (120 degrees for San Francisco Bay). Methods for determining the phase and amplitude (harmonic constants) of these cosine functions are well documented (Schureman, 1976; Foreman, 1977). In this report, results are presented from a least-squares method described in detail by Cheng and Gartner (1984a,b; 1985). This method minimizes the squared differences between the sum of a fixed number of cosine functions (16 in this report) with observed data, the principal astromomical tidal frequencies for Suisun Bay are shown in table A1. In the case of a short time series of sea level and velocity data (<120 days), the harmonic constants for six partial tides (O_1, K_1, N_2, M_2, S_2, M_4) are determined by the least-squares method. For data records of less than 120 days, the remaining nine partial tides (Q_1, M_1, P_1, J_1, μ_2, ν_2, L_2, T_2, K_2) are determined by inference (Cheng and Gartner, 1984a). In the case of velocity data, harmonic constants from the two velocity components are combined in the form of a tidal-current ellipse for each tidal constituent (cosine function). The primary flood and ebb directions are determined from the orientation of the major axis of the ellipse: the maximum tidal-current speed is determined from the magnitude of the semimajor axis; and the phase angle can be compared with the modified epoch (phase) of the corresponding partial tide obtained in a sea-level harmonic analysis (Cheng and Gartner, 1984b).

Harmonic analysis summaries for sea-level and velocity data are reported in the appendices. These summaries include the mean amplitude, local epoch, and modified epoch (harmonic constants) for each major astronomical tidal constituent. General properties of tidal currents, including the root-mean-squared (RMS) current speed, spring-tide current maximum, neap-tide current minimum, principal current direction, and tidal current form number (F) were calculated from the harmonic constants. The principal direction (assumed positive in the landward direction) was computed using the semimajor axis weighted average of the major axis directions from the M_2, S_2, K_1, and O_1 partial tides. The tidal current form number is defined as the ratio of the sums of the amplitudes of the diurnal tidal species over the sum of the amplitudes of the semidiurnal species. Defant's (1958) simplified definition was used where

$$F = \frac{O_1 + K_1}{M_2 + S_2} \tag{17}$$

If F is less than 0.25, the tide is referred to as semidiurnal, and if F is greater than 3.0, the tide is diurnal. Values of F between 0.25 and 3.0 are considered mixed tides.

Table A1. Principal astronomical tidal frequencies, Suisun Bay, California

Tidal symbol	Period (hours)	Angular frequency (degrees per hour)	Origin and name
		Diurnal Species	
K_1	23.93	15.0411	Luni-solar
O_1	25.82	13.9430	Principal lunar
P_1	24.07	14.9589	Principal solar
Q_I	26.87	13.3987	Larger lunar elliptic
J_I	23.10	15.5854	Small lunar elliptic
M_I	24.83	14.4967	Smaller lunar elliptic
		Semidiurnal Species	
M_2	12.42	28.9841	Principal lunar
S_2	12.00	30.0000	Principal solar
N_2	12.66	28.4397	Larger lunar elliptic
K_2	11.97	30.0821	Luni-solar
V_2	12.63	28.5126	Larger lunar evectional
L_2	12.19	29.6285	Smaller lunar elliptic
T_2	12.02	29.9589	Larger solar elliptic
$\mu 2$	12.87	27.9682	Variational
		Terdiurnal Species	
Mk_3	8.18	44.0252	M_2-K_1 interaction
		Quarter Diurnal Species	
M_4	6.21	57.9682	Lunar quarter diurnal

APPENDIX B—STATION BEN

Station Name: **BEN**
(Near Mallard Island)
Position: Lat. 38° 02' 37"
Long. 122°07' 25"
Depth: 18.6 (MLLW)

	Manufacturer	*Serial Number*	*Deployment Dates*
CT_t :	Seabird	Seacat NA	5/20/95(140) - 10/31/95(304)
CTD_m:	Ocean Sensors	OS200 224	6/1/95(152) - 7/7/95(188)
	Ocean Sensors	OS100 48	7/7/95(188) - 9/20/95(263)
	Ocean Sensors	OS200 302	9/20/95(263) - 10/23/95(296)
CT_b:	Seabird	Seacat NA	5/20/95(140) - 10/31/95(304)
ADCP:	RDI	NB 600khz	5/20/95(140) - 10/31/95(304)

CT Sensors Serviced: 6/1/95(152), 7/7/95(188), 9/20/95(263), 10/23/95(296)

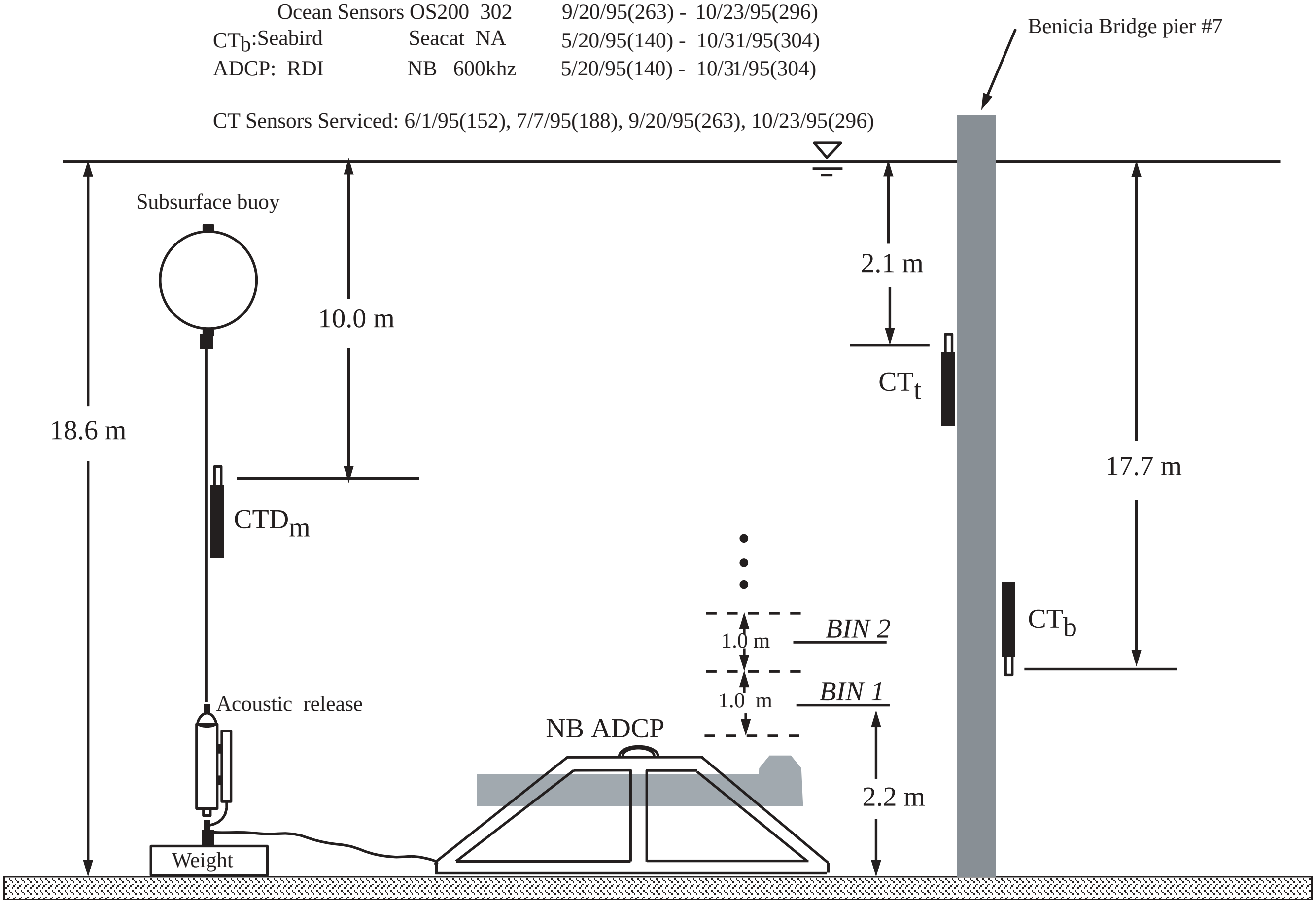


Figure B1. Configuration of instrument deployment, Station BEN, May 20 through October 31, 1995, Suisun Bay, California. lat, latitude; long, longitude; m, meters; MLLW, mean lower low water; ADCP, acoustic Doppler current profiler; NB ADCP, narrow-band acoustic Doppler current profiler; RDI, R.D. Instruments, Inc.; CT, conductivity-temperature; CTD, conductivity-temperature-depth; *BIN*, a discrete measurement location in the vertical.

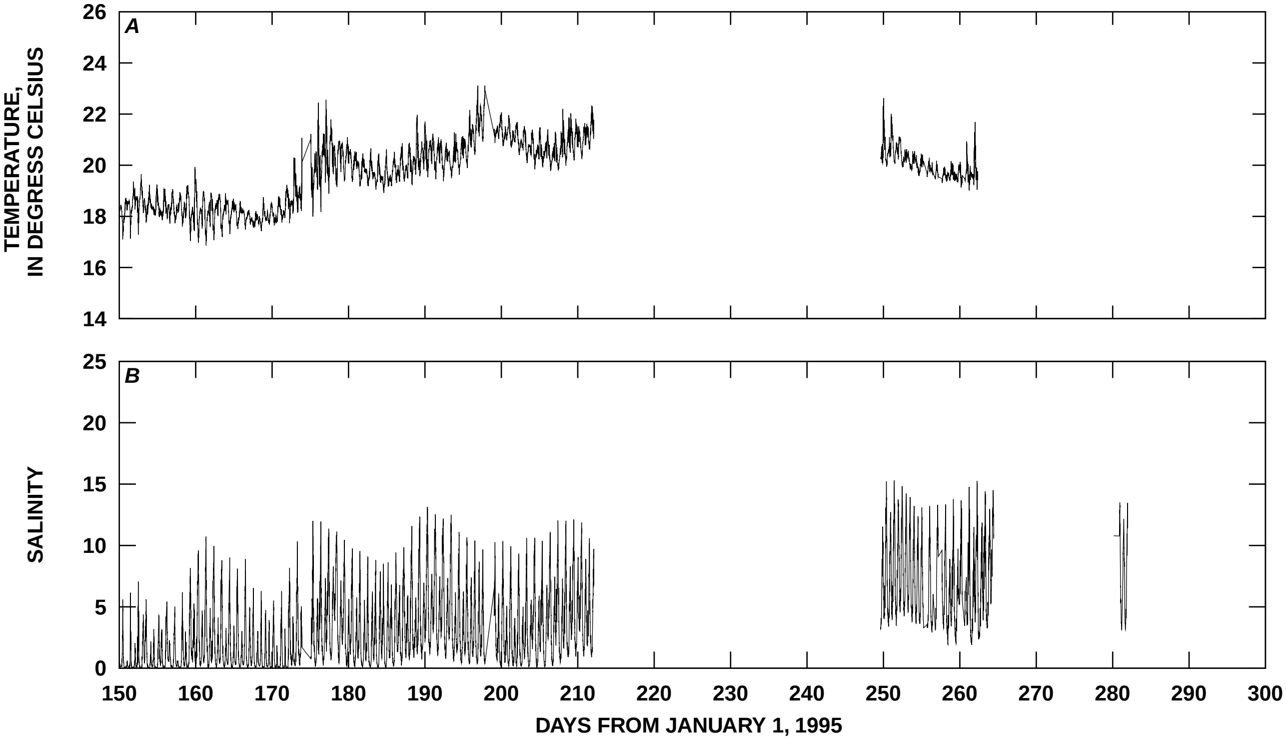


Figure B2. Time-series plots of *A*, temperature; and *B*, salinity, Station BEN, May 20 through October 31, 1995, Suisun Bay, California. Near-surface sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

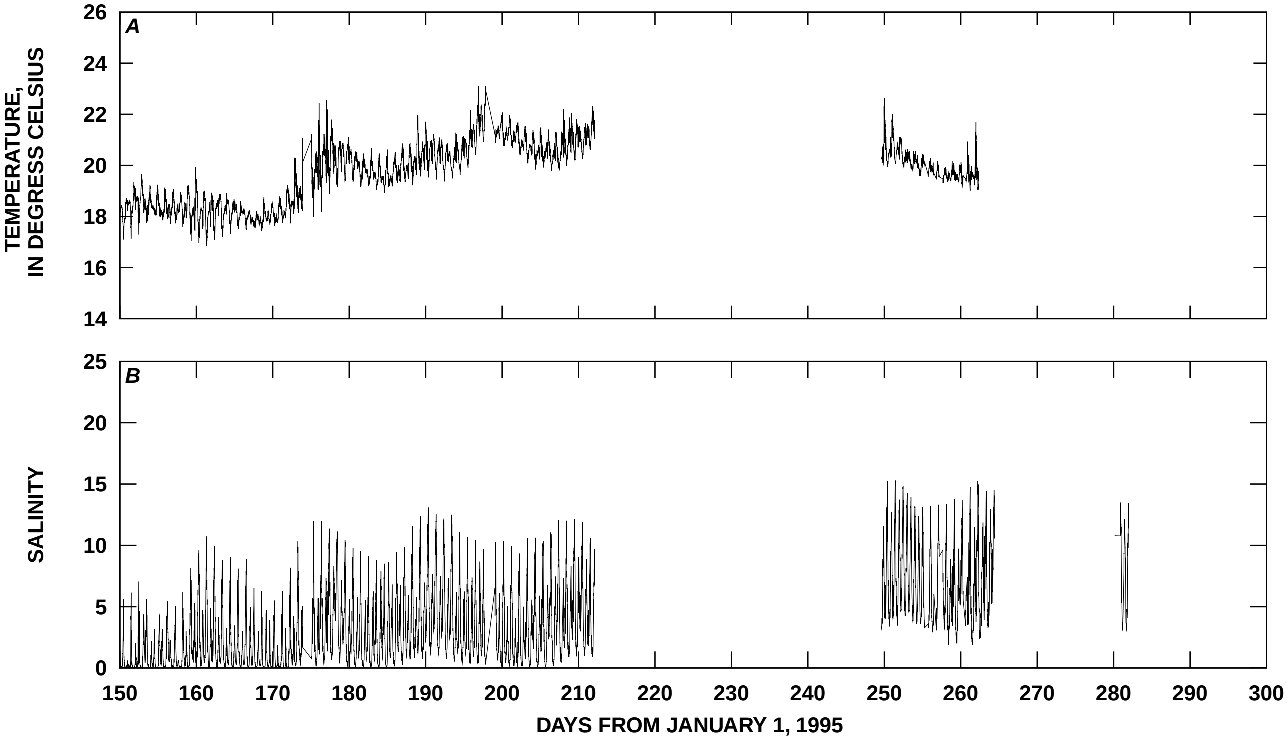


Figure B3. Time-series plots of low-pass-filtered *A*, temperature; and *B*, salinity, Station BEN, May 20 through October 31, 1995, Suisun Bay, California. Near-surface sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

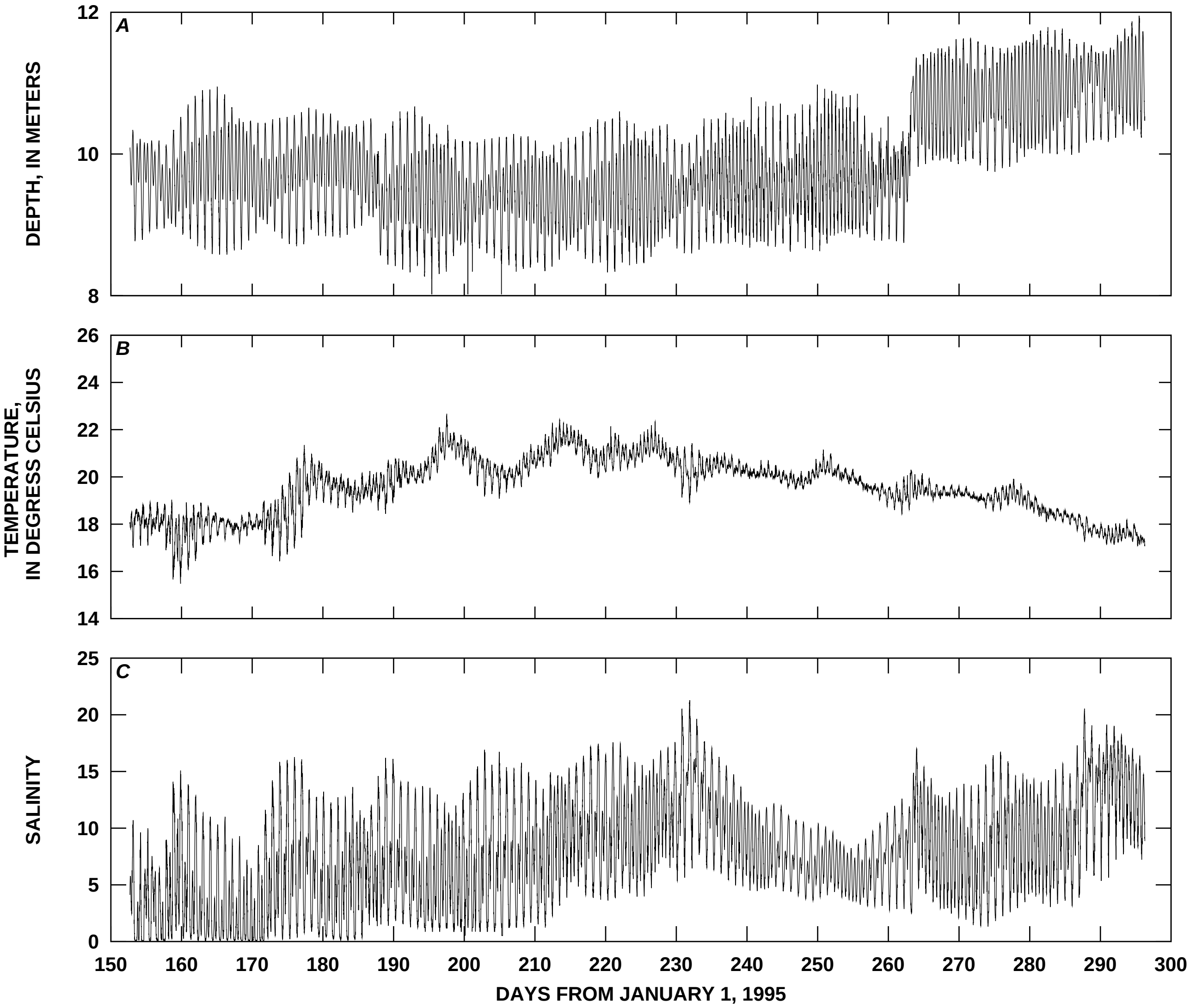


Figure B4. Time-series plots of *A*, depth; *B*, temperature; and *C*, salinity, Station BEN, June 1 through October 23, 1995, Suisun Bay, California. Mid-depth sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

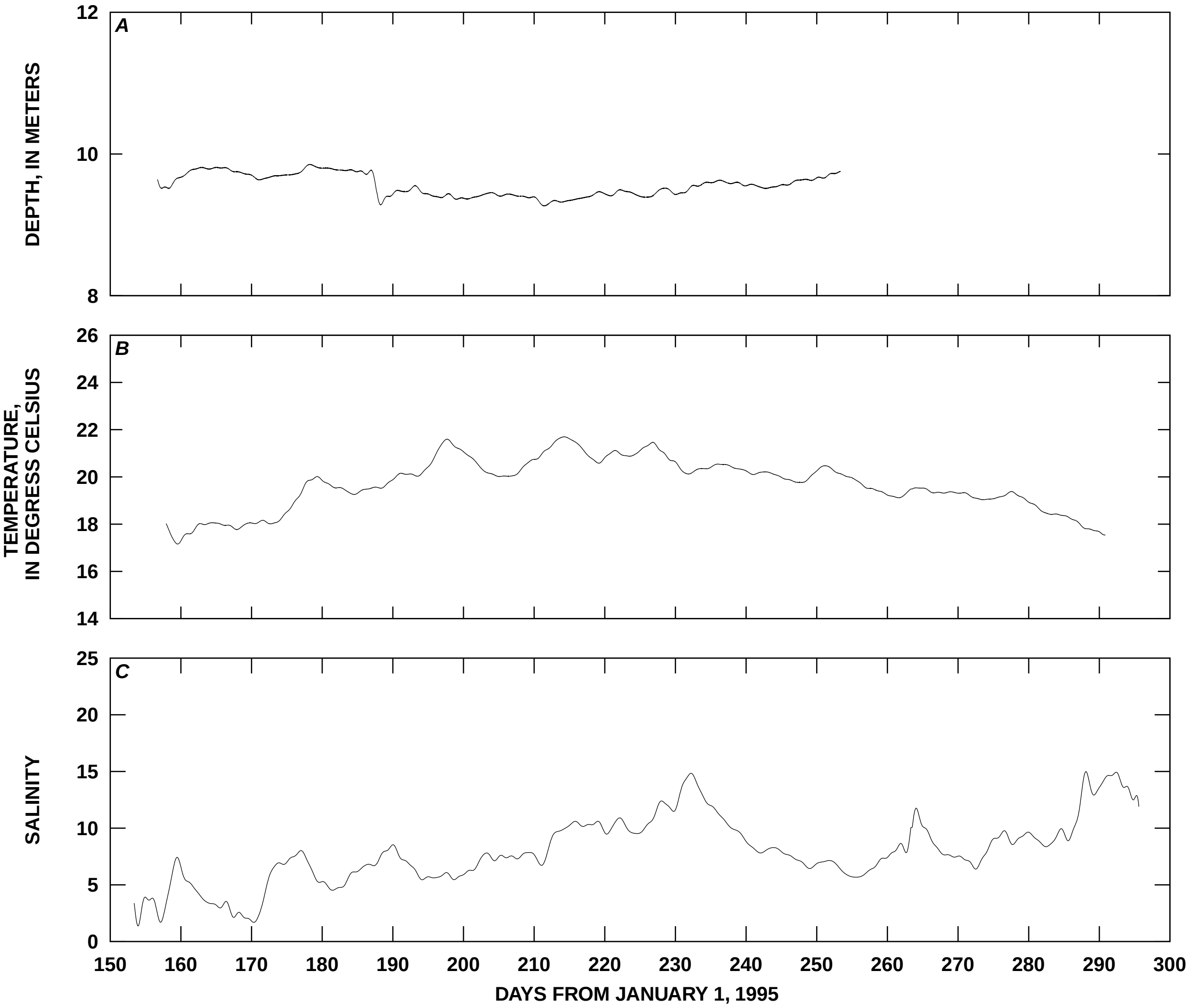


Figure B5. Time-series plots of low-pass-filtered *A*, depth; *B*, temperature; and *C*, salinity, Station BEN, June 1 through October 23, 1995, Suisun Bay, California. Mid-depth sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

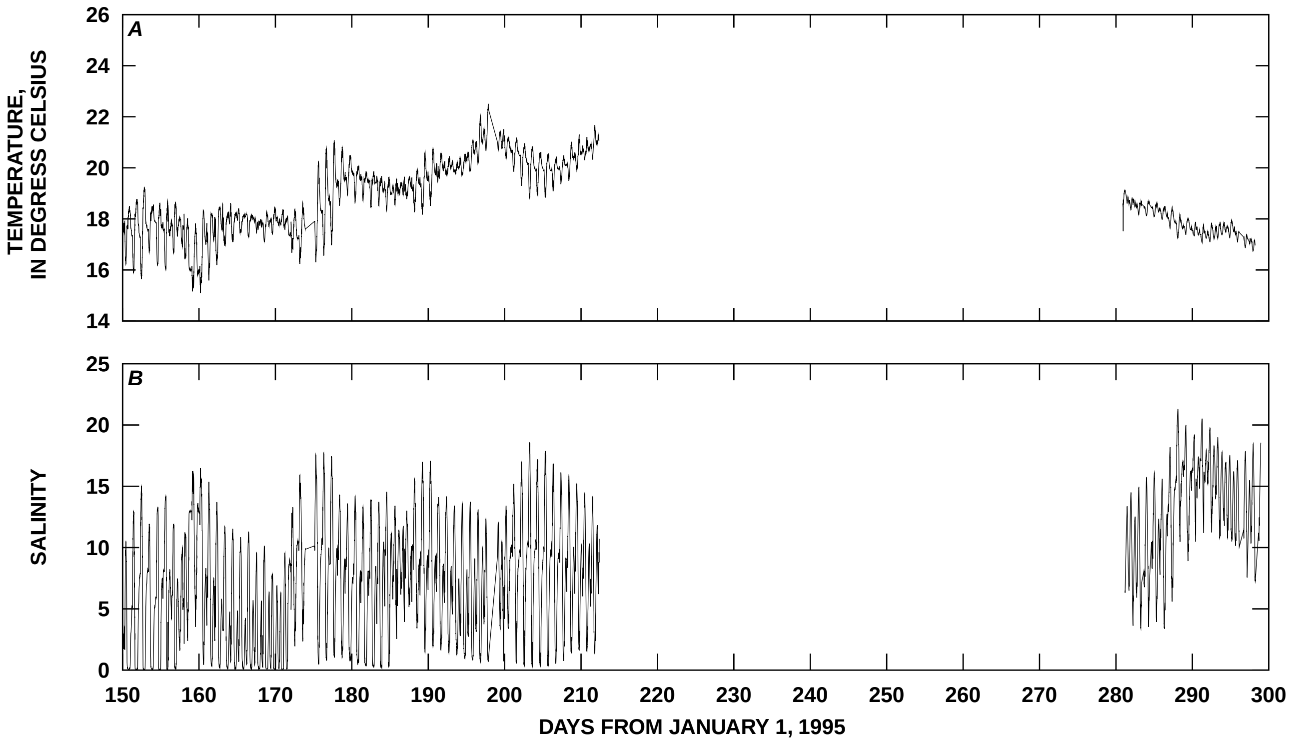


Figure B6. Time-series plots of *A*, temperature; and *B*, salinity, Station BEN, May 20 through October 31, 1995, Suisun Bay, California. Near-bed sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

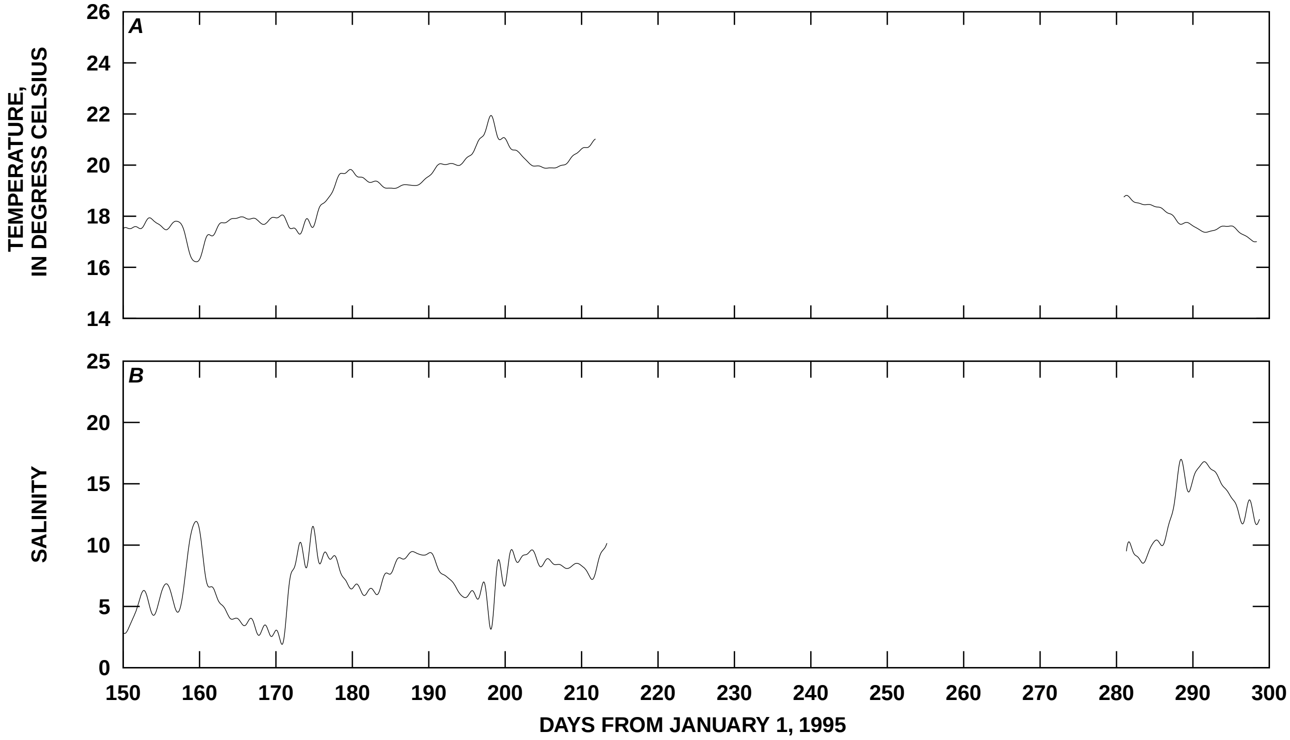


Figure B7. Time-series plots of low-pass-filtered *A*, temperature; and *B*, salinity, Station BEN, May 20 through October 31, 1995, Suisun Bay, California. Near-bed sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

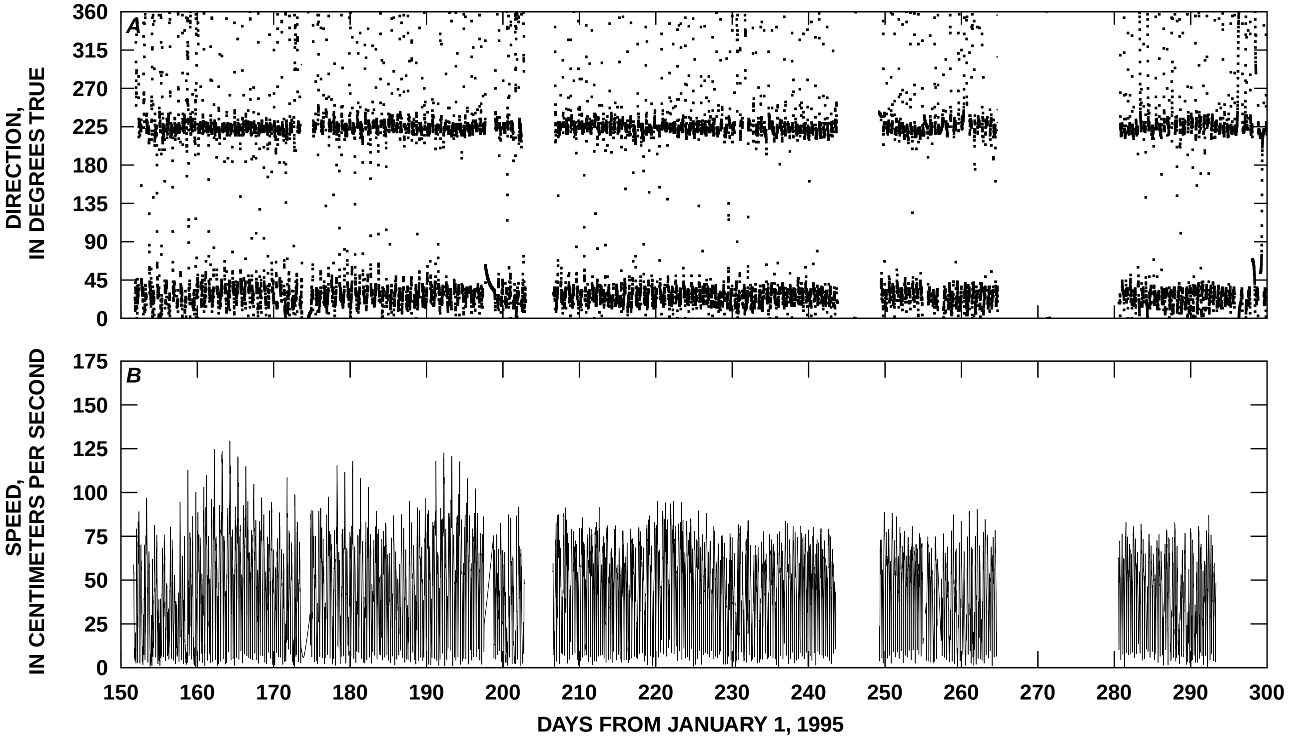


Figure B8. Time-series plots of tidal currents, Station BEN, May 20 through October 31, 1995, BIN 1 near-bottom BIN, Suisun Bay, California. BIN refers to a discrete measurement location in the vertical.

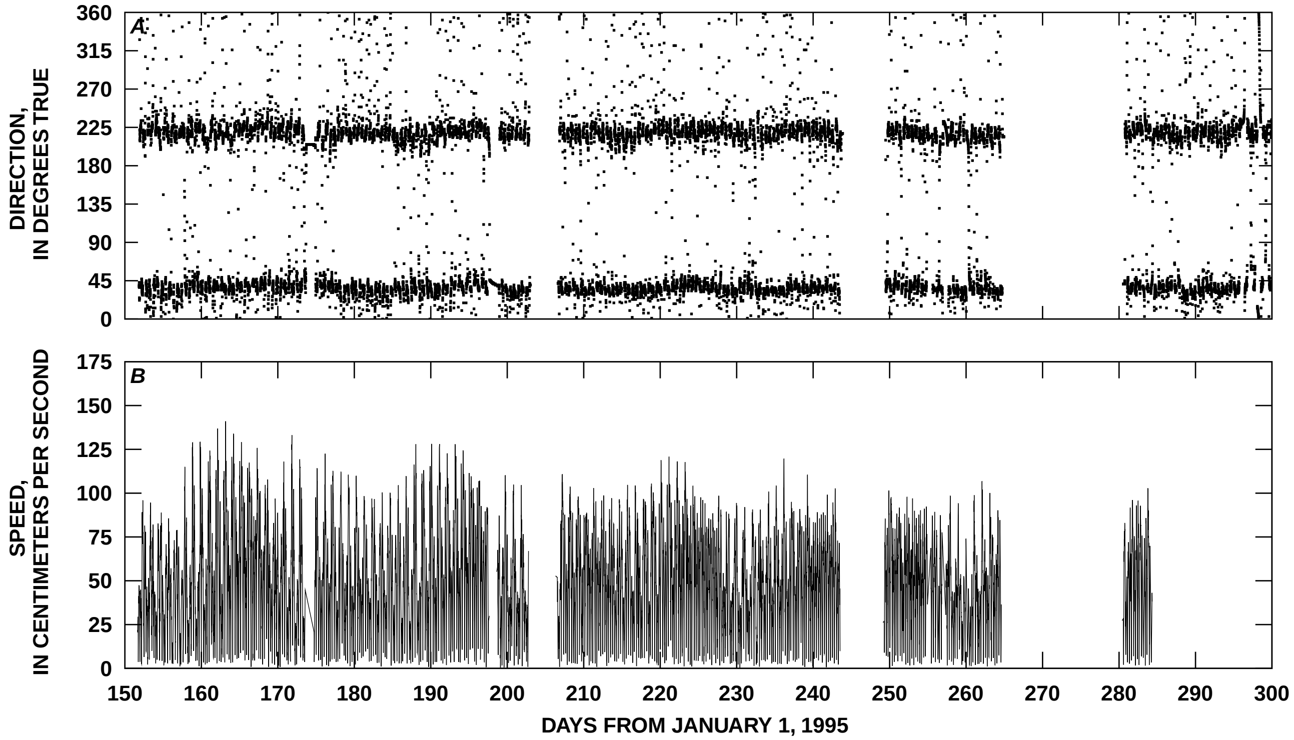


Figure B9. Time-series plots of tidal currents, Station BEN, May 20 through October 31, 1995, BIN 9 near-surface BIN, Suisun Bay, California. BIN refers to a discrete measurement location in the vertical.

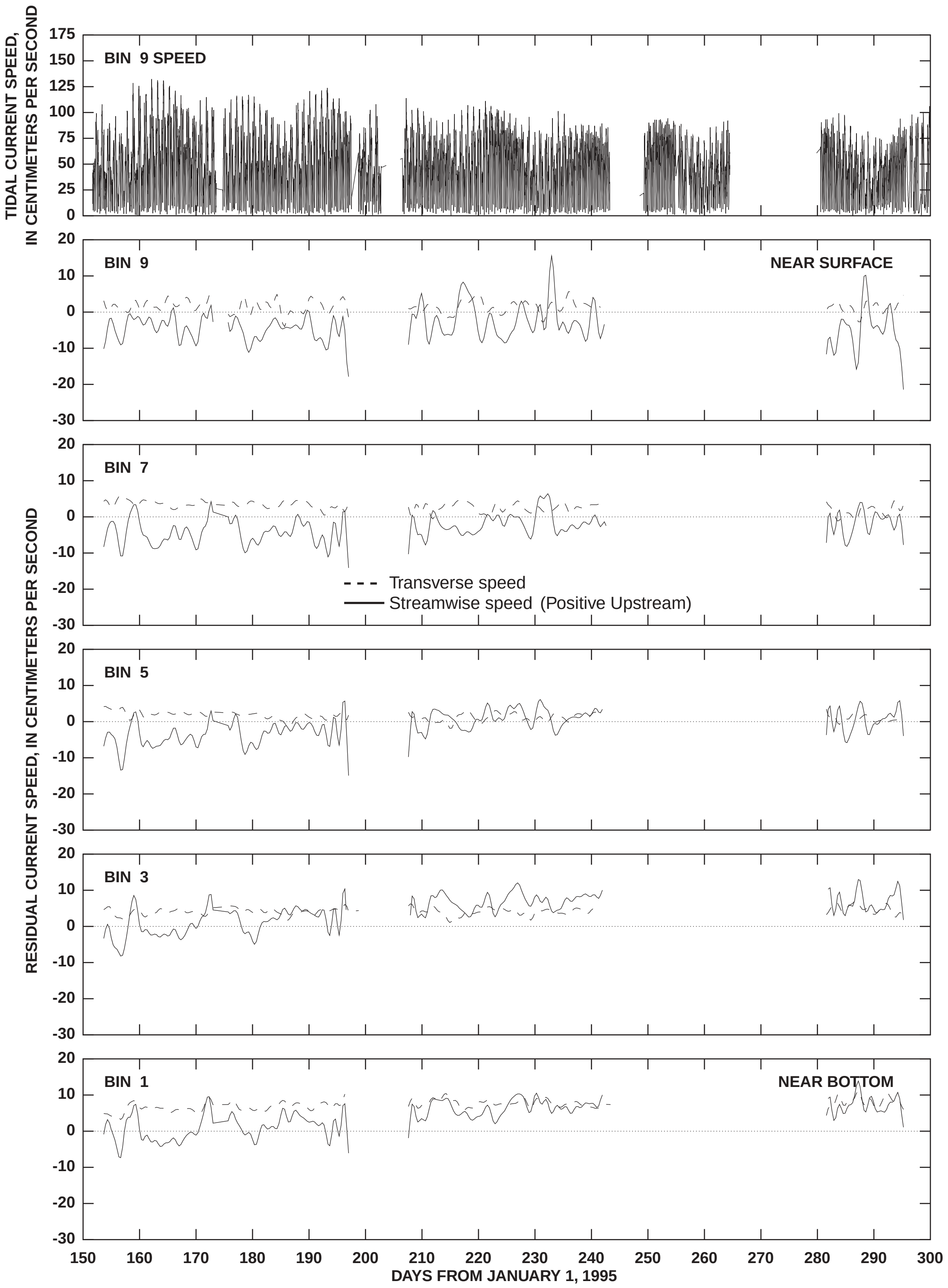


Figure B10. Longitudinal and transverse residual currents, Station BEN, May 20 through October 31, 1995, Suisun Bay, California. Tidal current speed at BIN 9 near-surface BIN is shown in the top panel for reference. BIN refers to a discrete measurement location in the vertical. Principal direction is 42.5 degrees true.

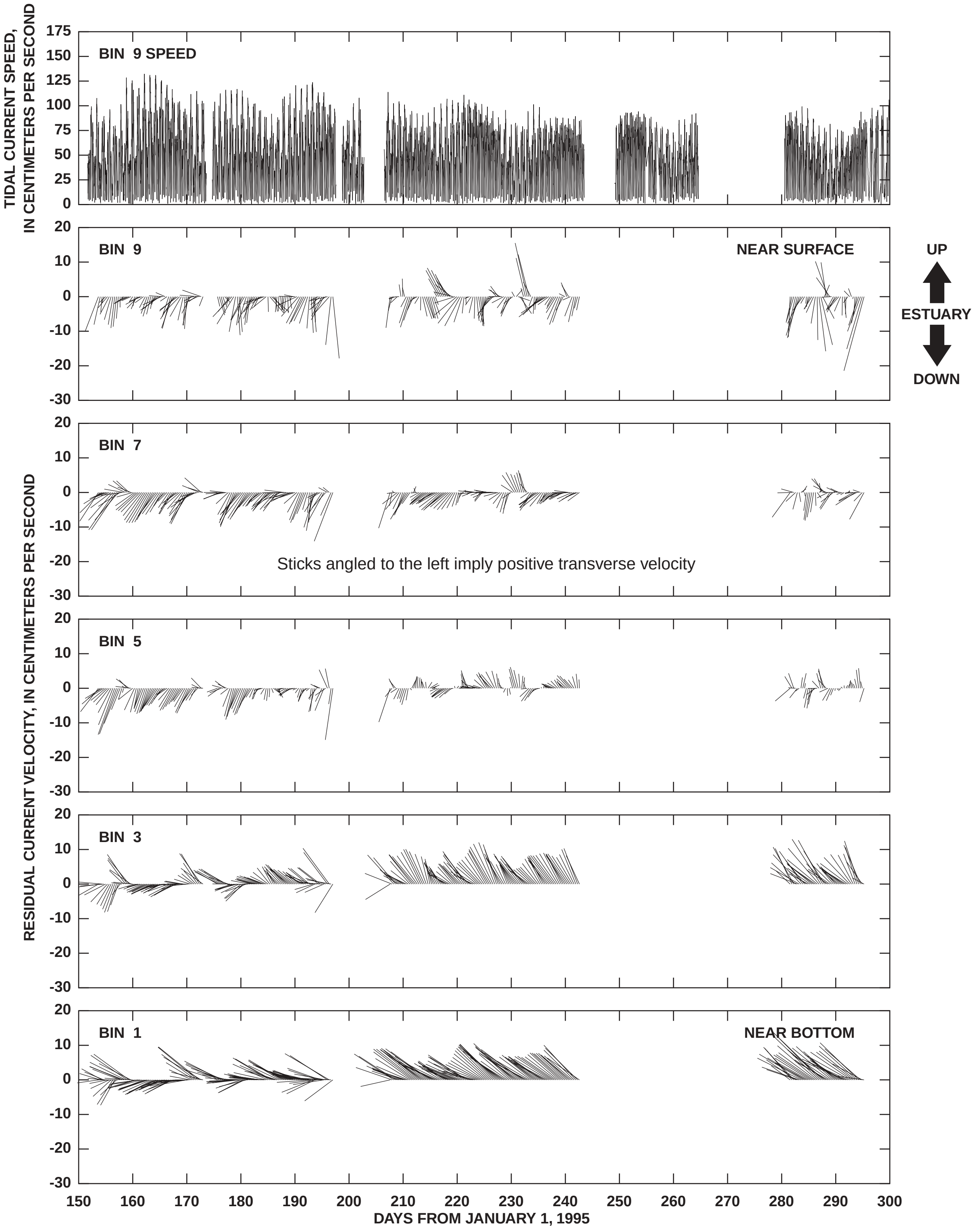


Figure B11. Residual currents, Station BEN, May 20 through October 31, 1995, Suisun Bay, California. Tidal current speed at BIN 9 near-surface BIN is shown in the top panel for reference. *BIN* refers to a discrete measurement location in the vertical. Principal direction is 42.5 degrees true.

Table B1. Harmonic analysis results from depth measurements, Station BEN, June 1 through October 31, 1995, Suisun Bay, California. Mid-depth sensor

```
Station: BEN
Time series mean:   9.86474
Standard deviation:   0.56871
Hamonic constants: No tidal inference

                         Mean         Local     Modified
Tidal   Cycles        amplitude      epoch       epoch
symbol (per day)      (meters)     (degrees)   (degrees)
Q1      0.89324        0.03729   148.24556   163.17987
O1      0.92954        0.17422   120.20449   130.78381
M1      0.96645        0.01004   285.63983   291.78989
P1      0.99726        0.10244   125.01701   127.46916
K1      1.00274        0.29662   108.26772   110.06278


Mu2     1.86455        0.01554   187.40408   207.90564
N2      1.89598        0.11984   337.01611   353.74548
Nu2     1.90084        0.01975   263.22662   279.37317
M2      1.93227        0.56380   334.32825   346.70264
L2      1.96857        0.01987   156.37440   164.39380


S2      2.00000        0.13819     2.67805     6.92526
K2      2.00548        0.04858   149.31035   152.90048
M4      3.86455        0.04800   219.18755   243.93629
Mk3     2.93501        0.04764     8.86391    23.03337
```

Table B2. Harmonic analysis results for velocity, Station BEN, May 20 through October 31, 1995, BIN 1 near-bottom BIN, Suisun Bay, California

[BIN refers to a discrete measurement location in the vertical, cm/s, centimeter per second; deg. T, degrees true; deg, degrees; E, equilibrium argument]

```
BIN number:  1
Station: BEN
Start time of the series (local time): Year, 1995; Month, 5; Day,31; Hour,16: 3
Time meridian: 120 W
Station position: 38 237N 122 725W
Record length: 352  M2 cycles: 21861 data points

 Tidal   Major axis  Minor axis  Direction  Phase     E    Rotation
 Symbol    (CM/S)      (CM/S)     (deg. T)  (deg)   (deg)
   Q1        2.04        0.12        29.1   107.3   178.3  Counterclockwise
   O1       11.17        0.70        32.7   103.7    18.6  Counterclockwise
   M1        1.64        0.08        35.8   304.7   225.8  Clockwise
   P1        7.24        0.58        37.5    97.1    82.2  Counterclockwise
   K1       20.37        0.57        37.6    94.2    45.0  Counterclockwise
   J1        1.40        0.04        47.6   299.5   248.1  Counterclockwise
   MU2       2.06        0.11        43.2   311.2    10.0  Counterclockwise
   N2        5.58        0.07        33.3    10.7   226.1  Clockwise
   NU2      10.30        0.36        36.0    26.4   210.2  Clockwise
   M2       45.36        0.88        35.9     2.1    66.4  Clockwise
   L2        6.27        0.56        29.2    27.0    86.1  Clockwise
   T2        1.34        0.60        40.5   218.5   336.0  Clockwise
   S2        9.49        0.44        40.1    22.1   121.8  Counterclockwise
   K2        4.79        0.95        29.5   346.0   269.2  Counterclockwise
   M4        1.07        0.24       164.9   100.6   132.9  Counterclockwise
   MK3       2.92        0.63        18.1   133.9   111.5  Clockwise

Root-mean-square speed (cm/s):           47.82
Standard deviation, U series (cm/s):     14.77
Standard deviation, V series (cm/s):     21.23
Tidal form number:                        0.57
Spring-tidal current maximum (cm/s):     86.39
Neap-tidal current maximum (cm/s):       26.67
Pricipal current direction (deg. T):     36.34
```

Table B3. Harmonic analysis results for velocity, Station BEN, May 20 through October 31, 1995, BIN 9 near-surface BIN, Suisun Bay, California

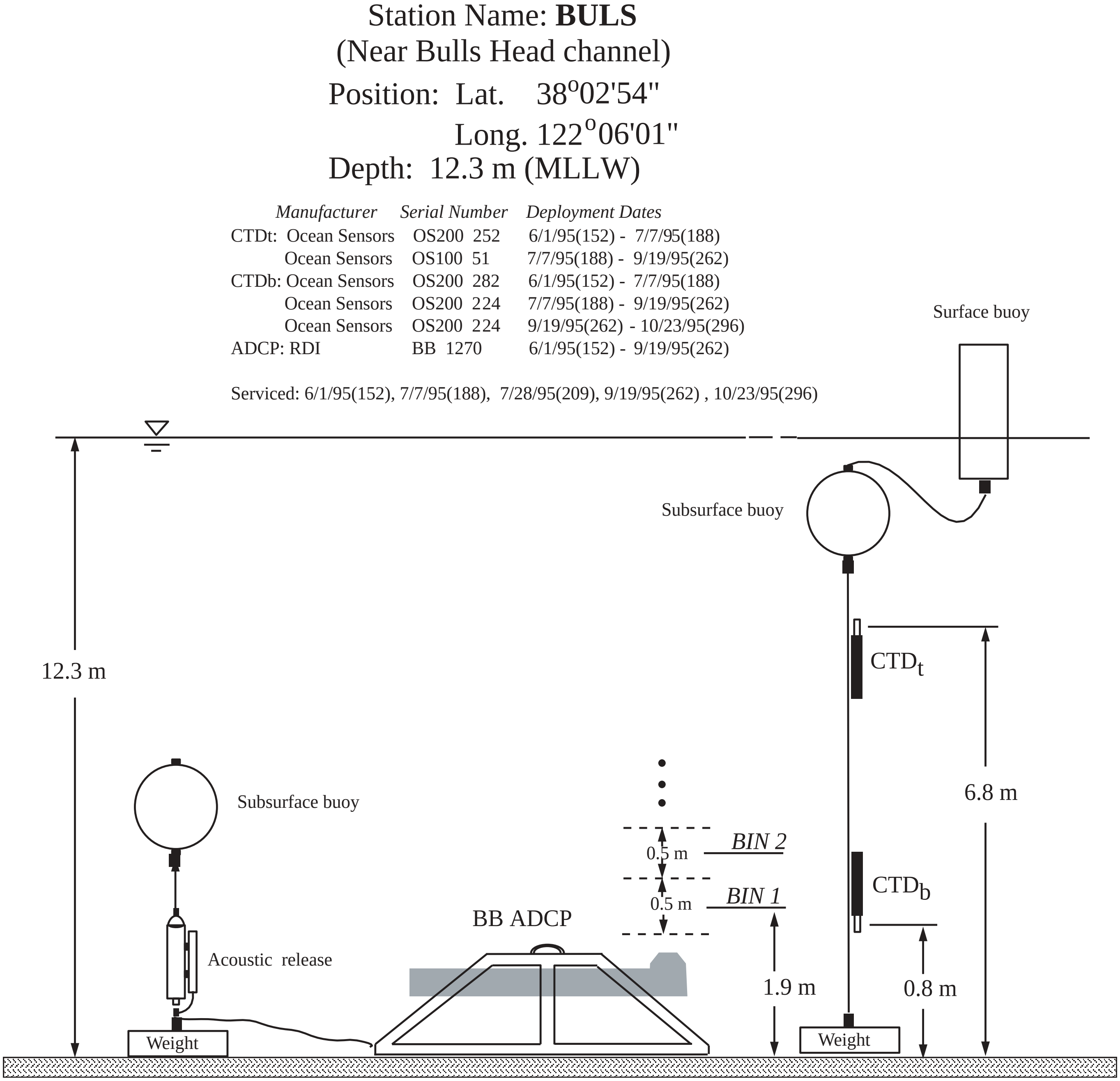
[BIN refers to a discrete measurement location in the vertical; cm/s, centimeter per second; deg. T, degrees true; deg, degrees; E, equilibrium argument]

```
BIN number:  9
Station: BEN
Start time of the series (local time): Year, 1995; Month, 5; Day,31; Hour,16: 3
Time meridian: 120 W
Station position: 38 237N 122 725W
Record length: 352  M2 cycles: 21861 data points

 Tidal   Major axis  Minor axis  Direction  Phase     E    Rotation
 Symbol    (CM/S)      (CM/S)     (deg. T)  (deg)   (deg)
   Q1        2.86        0.22        41.7     95.0   178.3  Counterclockwise
   O1        5.60        0.24        45.8    115.7    18.6  Counterclockwise
   M1        1.16        0.37        27.9    293.9   225.8  Clockwise
   P1        8.52        0.03        39.0     98.6    82.2  Counterclockwise
   K1       20.97        0.97        40.9     95.9    45.0  Counterclockwise
   J1        2.19        0.30        28.7    327.5   248.1  Clockwise
   MU2       4.10        1.00        43.6    281.2    10.0  Clockwise
   N2        4.94        0.26        48.9    354.3   226.1  Counterclockwise
   NU2      11.37        0.37        38.4     33.6   210.2  Counterclockwise
   M2       51.42        0.26        39.1      9.1    66.4  Counterclockwise
   L2        7.47        0.08        32.2     67.4    86.1  Counterclockwise
   T2        2.34        0.01        23.5    228.2   336.0  Counterclockwise
   S2       11.29        0.33        41.7      9.6   121.8  Clockwise
   K2        2.65        0.15        41.0    343.4   269.2  Counterclockwise
   M4        0.94        0.51       168.3    186.5   132.9  Clockwise
   MK3       3.71        0.60        45.9    173.5   111.5  Clockwise

Root-mean-square speed (cm/s):           51.19
Standard deviation, U series (cm/s):     17.85
Standard deviation, V series (cm/s):     21.50
Tidal form number:                        0.42
Spring-tidal current maximum (cm/s):     89.28
Neap-tidal current maximum (cm/s):       24.76
Pricipal current direction (deg. T):     40.29
```

APPENDIX C—STATION BULLS



Station Name: **BULS**
(Near Bulls Head channel)
Position: Lat. 38°02'54"
Long. 122°06'01"
Depth: 12.3 m (MLLW)

	Manufacturer	*Serial Number*	*Deployment Dates*
CTDt:	Ocean Sensors	OS200 252	6/1/95(152) - 7/7/95(188)
	Ocean Sensors	OS100 51	7/7/95(188) - 9/19/95(262)
CTDb:	Ocean Sensors	OS200 282	6/1/95(152) - 7/7/95(188)
	Ocean Sensors	OS200 224	7/7/95(188) - 9/19/95(262)
	Ocean Sensors	OS200 224	9/19/95(262) - 10/23/95(296)
ADCP:	RDI	BB 1270	6/1/95(152) - 9/19/95(262)

Serviced: 6/1/95(152), 7/7/95(188), 7/28/95(209), 9/19/95(262) , 10/23/95(296)

Figure C1. Configuration of instrument deployment, Station BULLS, June 1 through October 23, 1995, Suisun Bay, California. lat, latitude; long, longitude; m, meters; MLLW, mean lower low water; ADCP, acoustic Doppler current profiler; BB ADCP, broad-band acoustic Doppler current profiler; RDI, R.D. Instruments, Inc.; CTD, conductivity-temperature-depth; BIN, a discrete measurement location in the vertical.

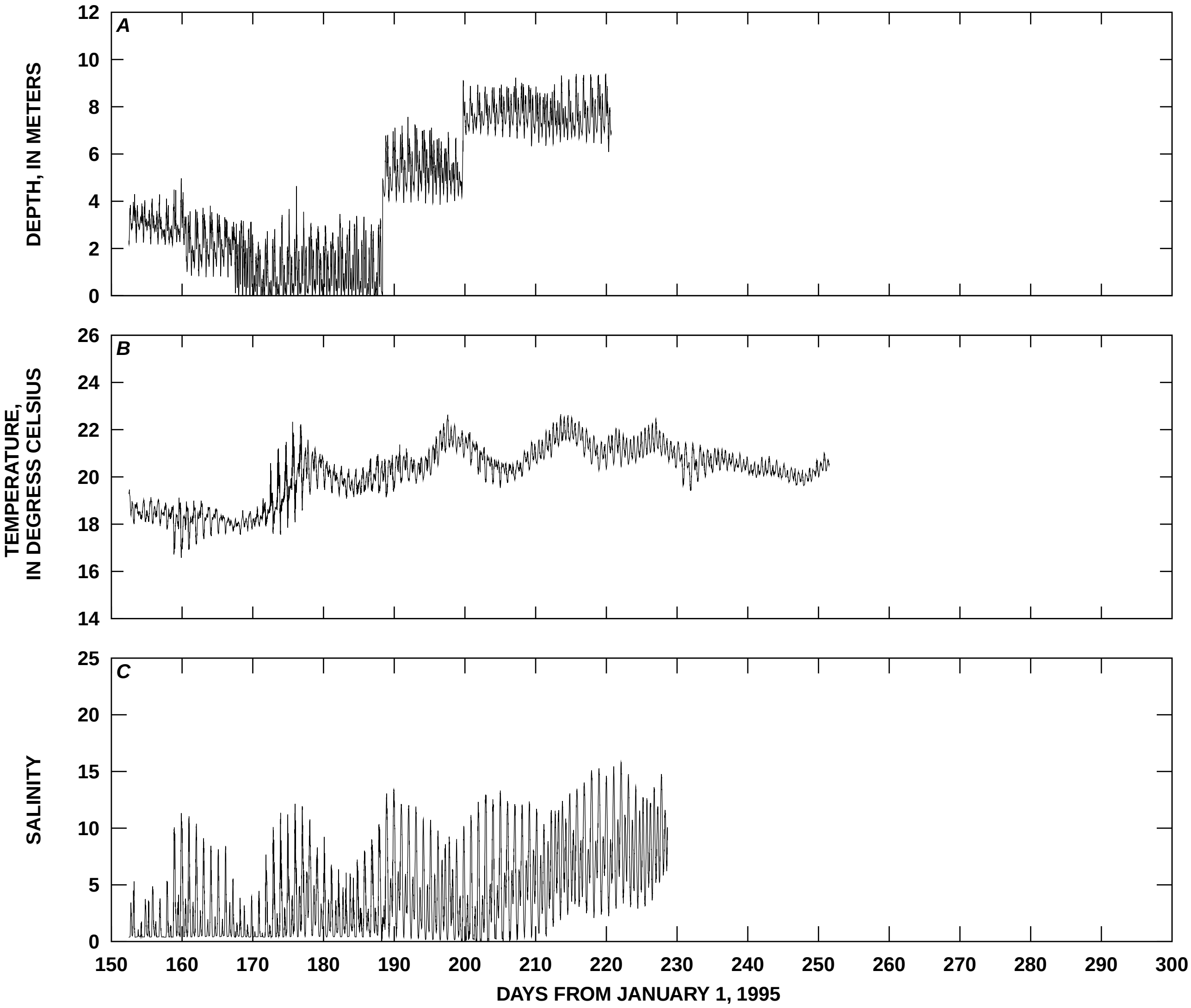


Figure C2. Time-series plots of *A*, depth; *B*, temperature; and *C*, salinity, Station BULLS, June 1 through September 19, 1995, Suisun Bay, California. Near-surface sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

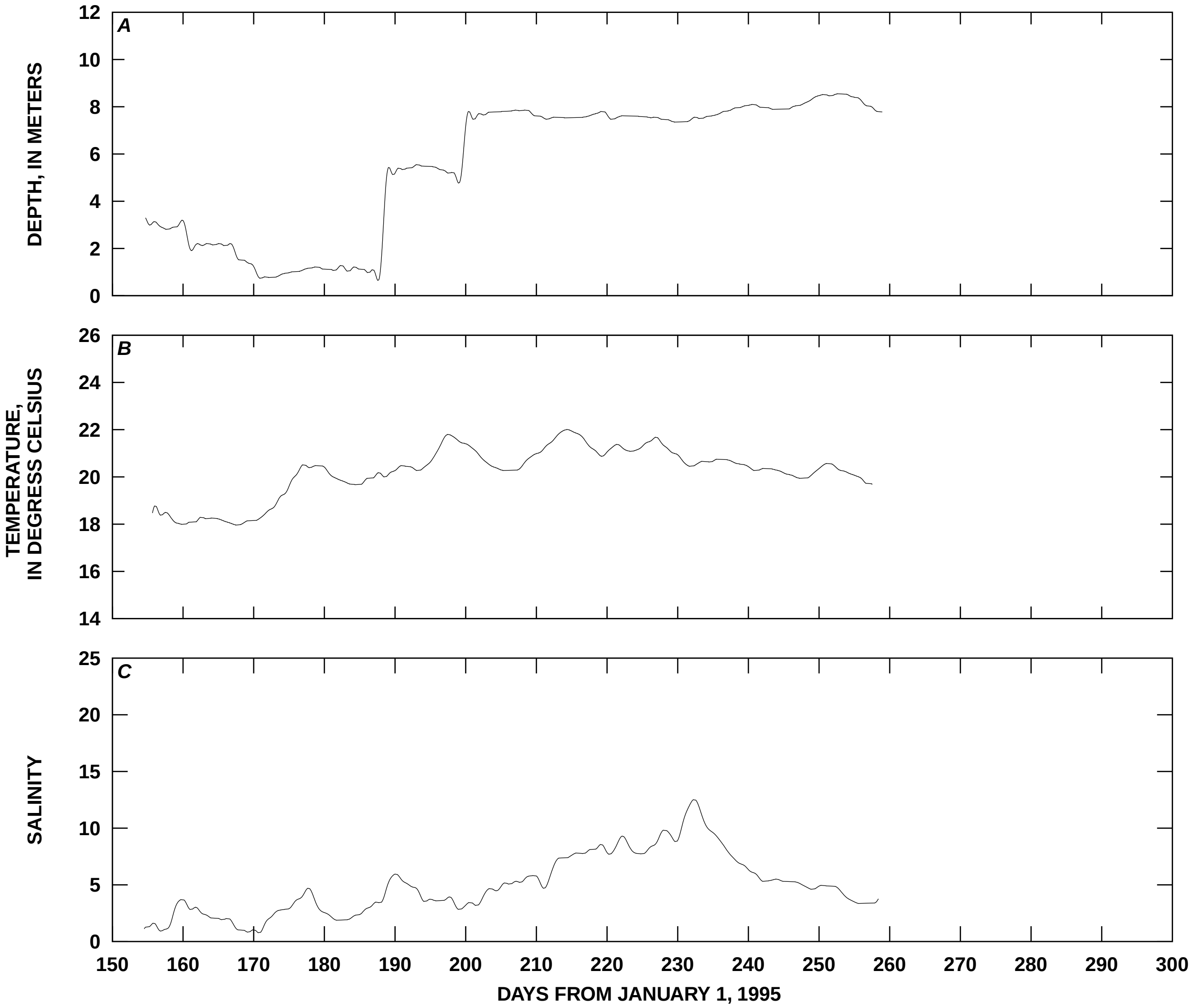


Figure C3. Time-series plots of low-pass-filtered *A*, depth; *B*, temperature; and *C*, salinity, Station BULLS, June 1 through September 19, 1995, Suisun Bay, California. Near-surface sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero,1993).

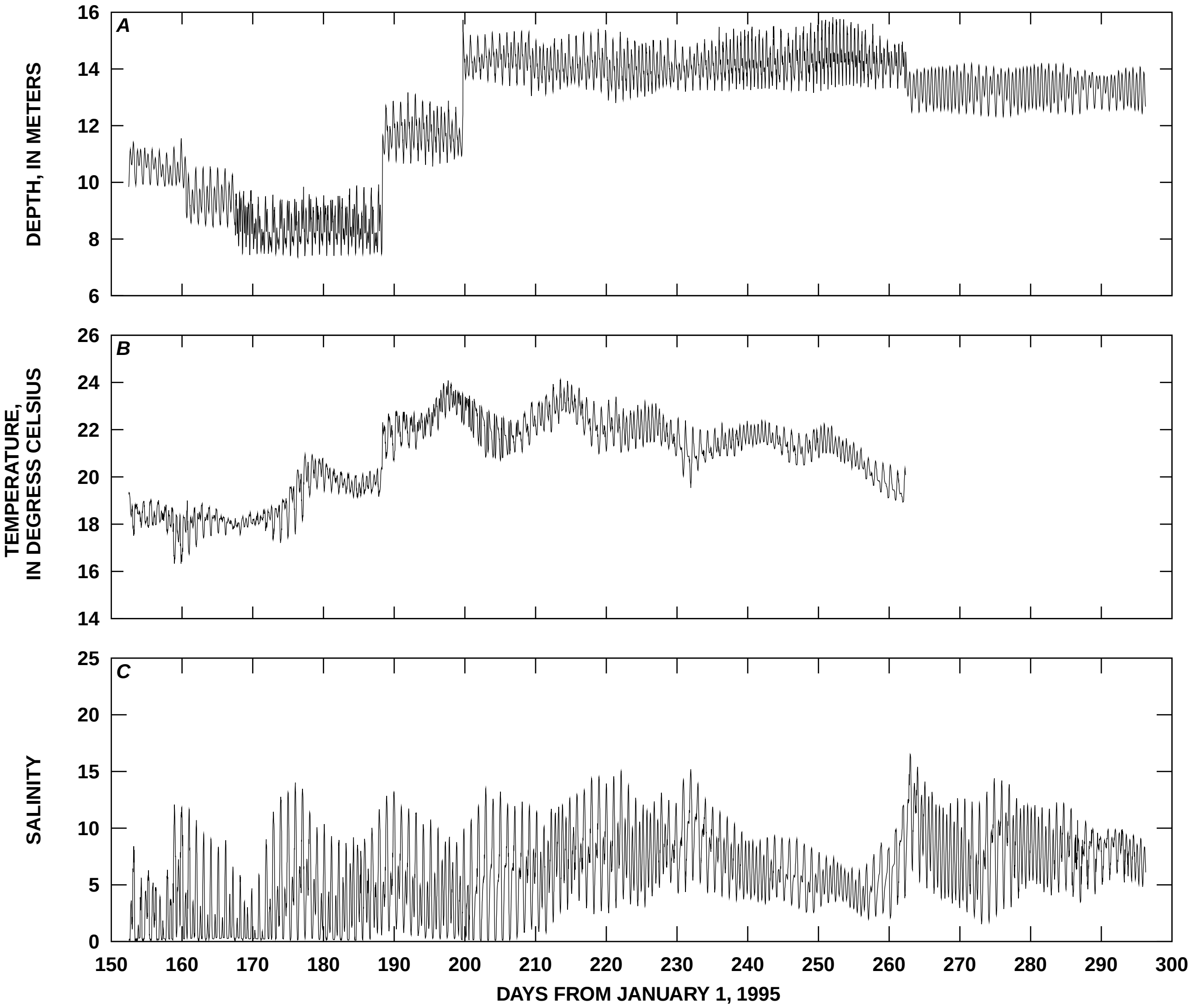


Figure C4. Time-series plots of *A*, depth; *B*, temperature; and *C*, salinity, Station BULLS, June 1 through October 23, 1995, Suisun Bay, California. Near-bed sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

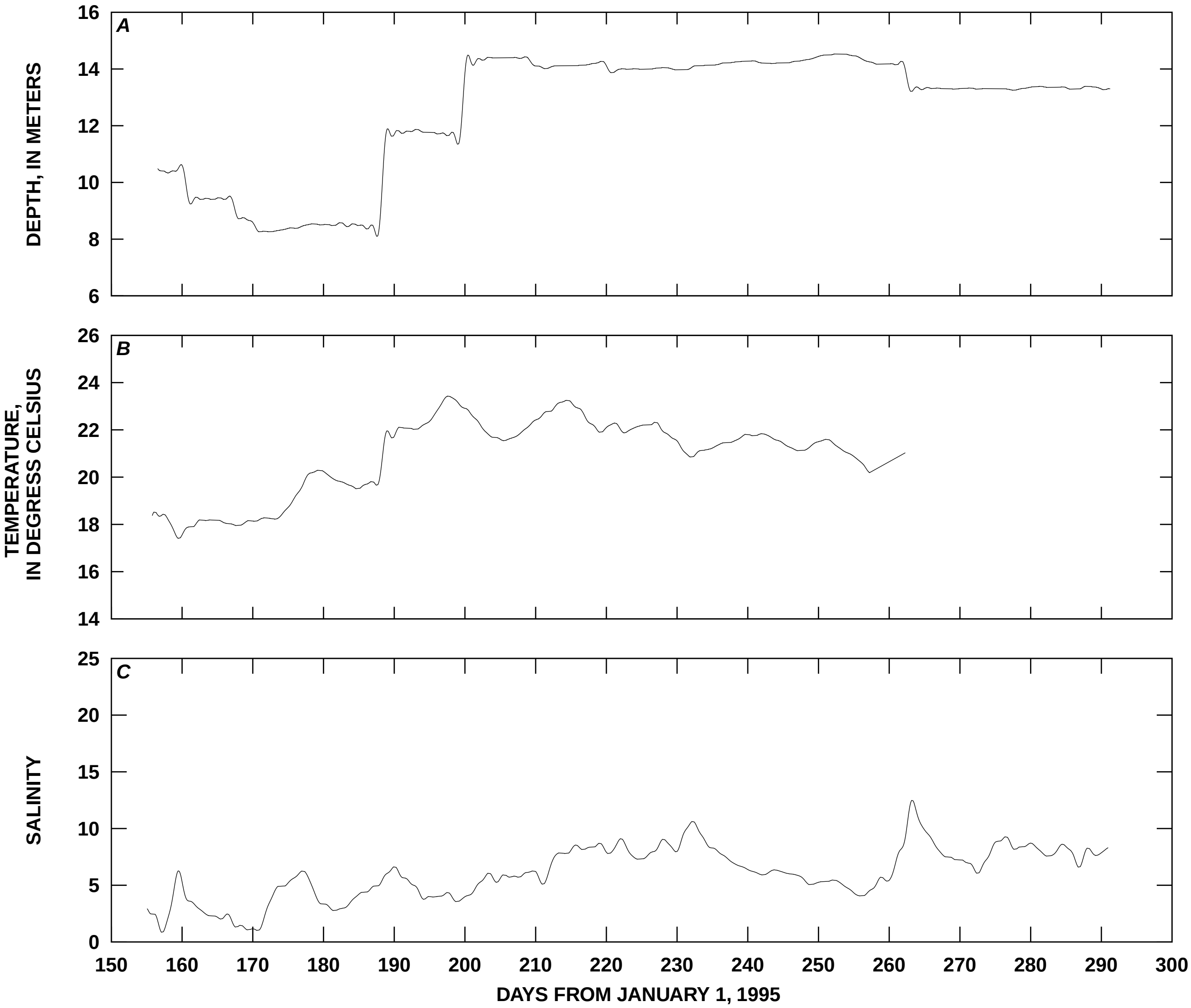


Figure C5. Time-series plots of low-pass-filtered *A*, depth; *B*, temperature; and *C*, salinity, Station BULLS, June 1 through October 23, 1995, Suisun Bay, California. Near-bed sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

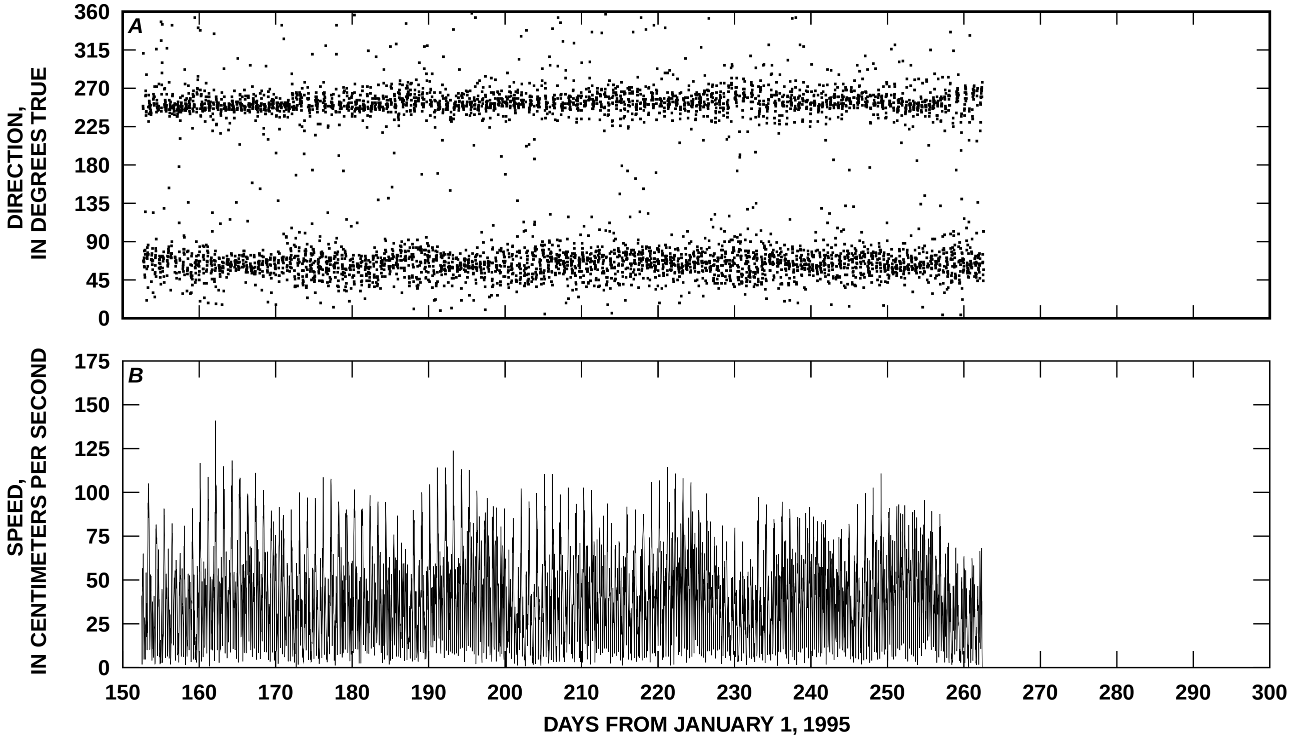


Figure C6. Time-series plots of tidal currents, Station BULLS, June 1 through September 19, 1995, BIN 1 near-bottom BIN, Suisun Bay, California. *BIN* refers to a discrete measurement location in the vertical.

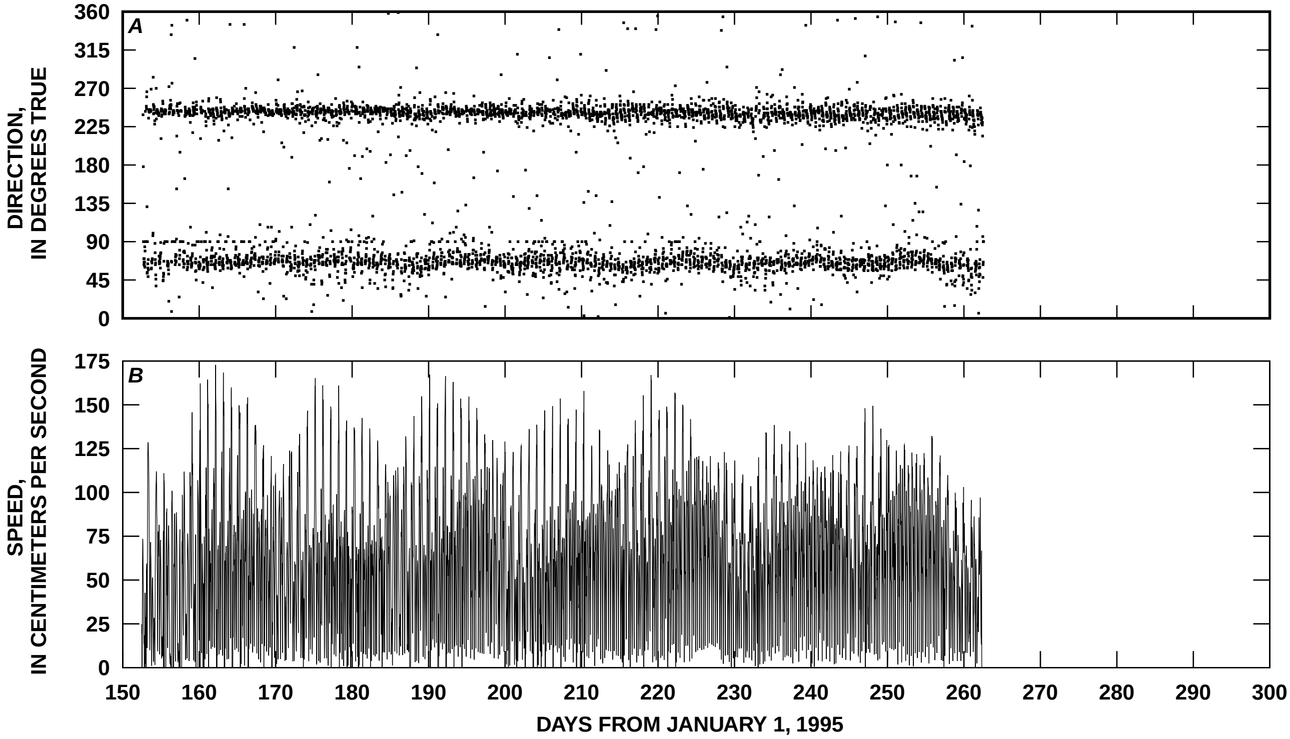


Figure C7. Time-series plots of tidal currents, Station BULLS, June 1 through September 19, 1995, BIN 19 near-surface BIN, Suisun Bay, California. *BIN* refers to a discrete measurement location in the vertical.

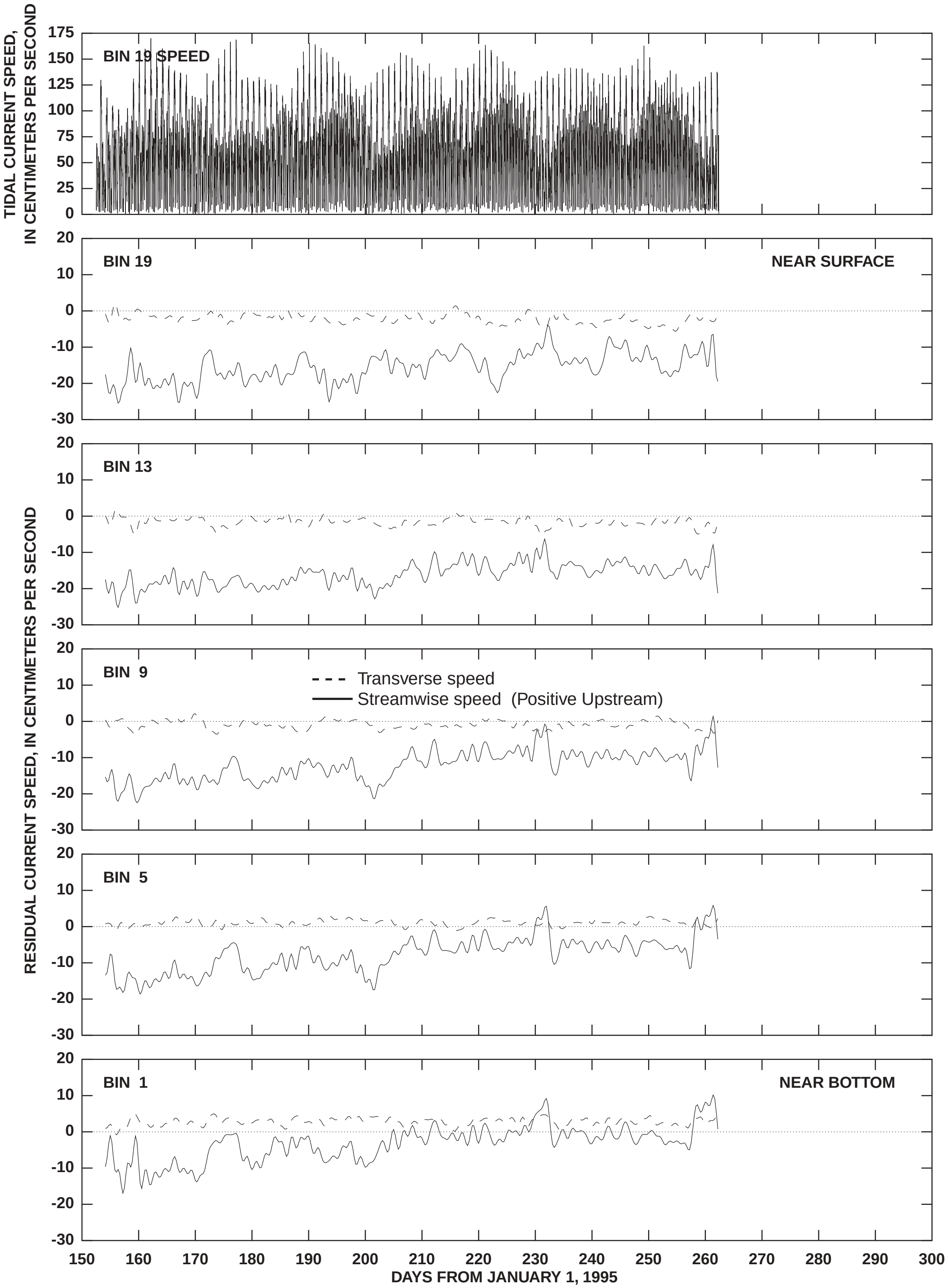


Figure C8. Longitudinal and transverse residual currents, Station BULLS, June 1 through September 19, 1995, Suisun Bay, California. Tidal current speed at BIN 19 near-surface BIN is shown in the top panel for reference. *BIN* refers to a discrete measurement location in the vertical. Principal direction is 65 degrees true.

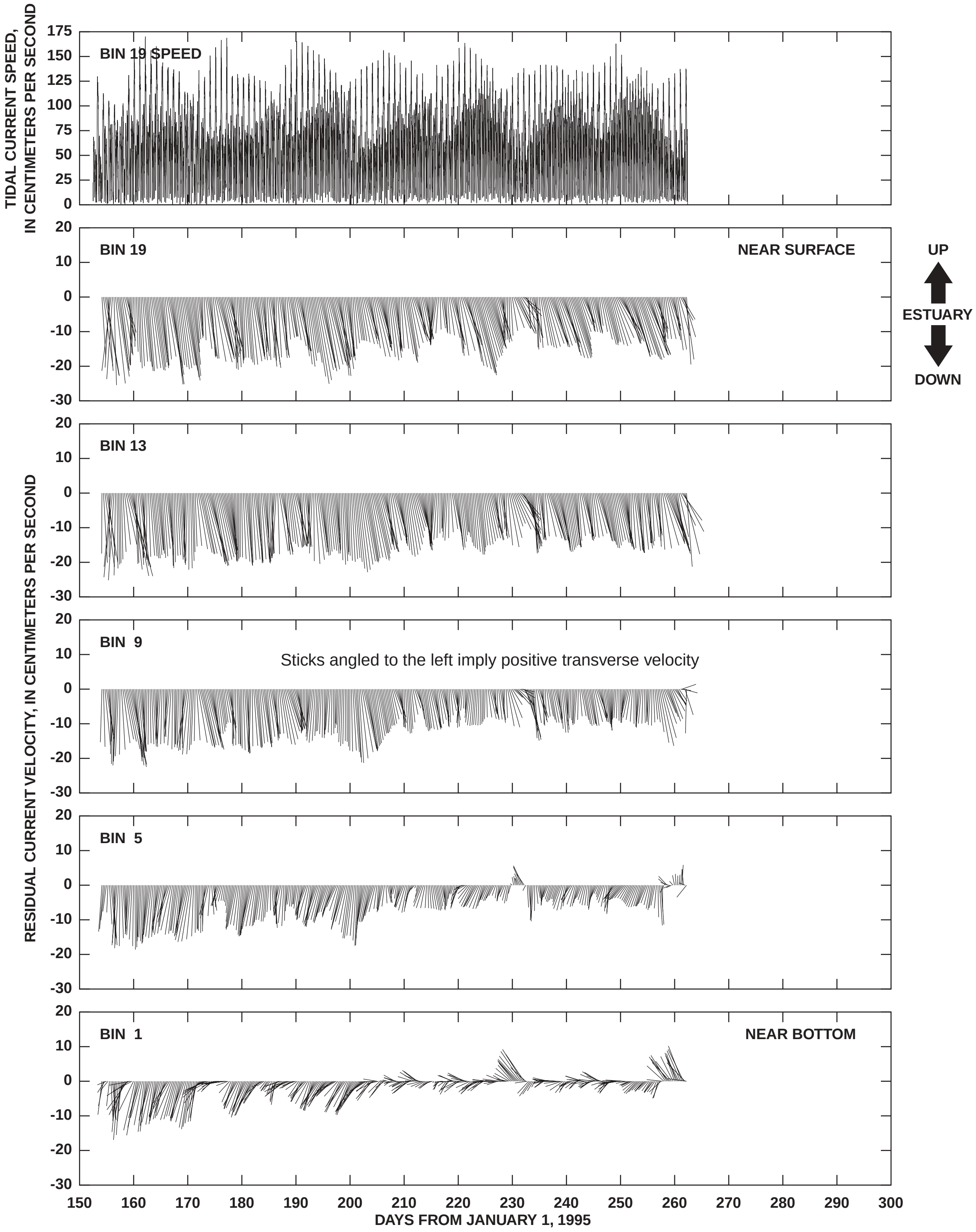


Figure C9. Residual currents, Station BULLS, June 1 through September 19, 1995, Suisun Bay, California. Tidal current speed at BIN 19 near-surface BIN is shown in the top panel for reference. *BIN* refers to a discrete measurement location in the vertical. Principal direction is 65 degrees true.

Table C1. Harmonic analysis results from depth measurements, Station BULLS, June 1 through October 23, 1995, Suisun Bay, California. Near-bed sensor

```
Station: BULLS
Time series mean:  12.53152
Standard deviation:   2.14089
Hamonic constants: No tidal inference

                      Mean        Local     Modified
Tidal   Cycles      amplitude     epoch      epoch
symbol (per day)   (meters)    (degrees)  (degrees)
Q1       0.89324     0.05538   186.44434   201.35532
O1       0.92954     0.16166   170.34158   180.89758
M1       0.96645     0.04487   109.74458   115.87131
P1       0.99726     0.07768   163.70201   166.13083
K1       1.00274     0.26093   135.77985   137.55157


Mu2      1.86455     0.00728   277.36328   297.81818
N2       1.89598     0.10380    12.60371    29.28644
Nu2      1.90084     0.02836   315.22388   331.32376
M2       1.93227     0.51330     4.00462    16.33237
L2       1.96857     0.02645   222.25134   230.22408


S2       2.00000     0.11381    21.93611    26.13666
K2       2.00548     0.06044   186.73833   190.28180
M4       3.86455     0.16020   292.77866   317.43408
Mk3      2.93501     0.15416    51.47977    65.57922
```

Table C2. Harmonic analysis results for velocity, Station BULLS, June 1 through September 19, 1995, BIN 1 near-bottom BIN, Suisun Bay, California

[BIN refers to a discrete measurement location in the vertical; cm/s, centimeter per second; deg. T, degrees true; deg, degrees; E, equilibrium argument]

```
BIN number:  1
Station: BULLS
Start time of the series (local time): Year, 1995; Month, 6; Day, 1; Hour,11:30
Time meridian: 120 W
Station position: 38 3 1N 122 6 2W
Record length: 212  M2 cycles: 15799 data points

 Tidal   Major axis  Minor axis  Direction  Phase     E    Rotation
 Symbol    (CM/S)      (CM/S)     (deg. T)  (deg)   (deg)
   O1       13.84       0.45        70.7     90.4   289.6  Clockwise
   K1       23.74       0.15        70.0    106.3   337.4  Counterclockwise
   N2       11.22       0.45        66.7    346.1    59.1  Clockwise
   M2       52.55       0.11        67.5     10.2   269.9  Clockwise
   S2       11.33       0.21        63.9     34.7   345.0  Counterclockwise
   M4        3.65       0.93        85.3    226.0   179.8  Clockwise

Root-mean-square speed (cm/s):            46.44
Standard deviation, U series (cm/s):      12.77
Standard deviation, V series (cm/s):       8.81
Tidal form number:                         0.59
Spring-tidal current maximum (cm/s):     101.46
Neap-tidal current maximum (cm/s):        31.33
Pricipal current direction (deg. T):      68.14
```

Table C3. Harmonic analysis results for velocity, Station BULLS, June 1 through September 19, 1995, BIN 19 near-surface BIN, Suisun Bay, California

[BIN refers to a discrete measurement location in the vertical; cm/s, centimeter per second; deg. T, degrees true; deg, degrees; E, equilibrium argument]

```
BIN number: 19
Station: BULLS
Start time of the series (local time): Year, 1995; Month, 6; Day, 1; Hour,11:30
Time meridian: 120 W
Station position: 38 3 1N 122 6 2W
Record length: 212  M2 cycles: 15153 data points

 Tidal   Major axis  Minor axis  Direction  Phase     E    Rotation
 Symbol    (CM/S)      (CM/S)     (deg. T)  (deg)   (deg)
   O1       15.33       1.04        58.7    103.0   289.6  Counterclockwise
   K1       32.75       1.47        62.7    105.7   337.4  Counterclockwise
   N2       17.38       0.39        64.7    336.4    59.1  Counterclockwise
   M2       88.17       1.22        63.2     13.7   269.9  Counterclockwise
   S2       15.75       0.46        67.6     15.8   345.0  Clockwise
   M4        3.45       2.20        74.4     39.3   179.8  Clockwise

Root-mean-square speed (cm/s):            72.85
Standard deviation, U series (cm/s):      15.72
Standard deviation, V series (cm/s):       9.79
Tidal form number:                         0.46
Spring-tidal current maximum (cm/s):     152.00
Neap-tidal current maximum (cm/s):        55.00
Pricipal current direction (deg. T):      63.11
```

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APPENDIX D—STATION CARQ

Station Name: **CARQ**
(Carquinez Strait)
Position: Lat. 38°02'35"
Long. 122°10'31"
Depth: 17.5m (MLLW)

	Manufacturer	*Serial Number*	*Deployment Dates*
CT :	Datasonde	07150	7/7/95(188) - 8/27/95(239)
CTD :	Ocean Sensors	OS200-301	6/5/95(156) - 7/7/95(188)
	Ocean Sensors	OS200-49	7/7/95(188) - 11/1/95(305)

Serviced: 6/5/95(156), 7/7/95(188), 8/8/95(220), 8/27/95(239), 11/1/95(305)

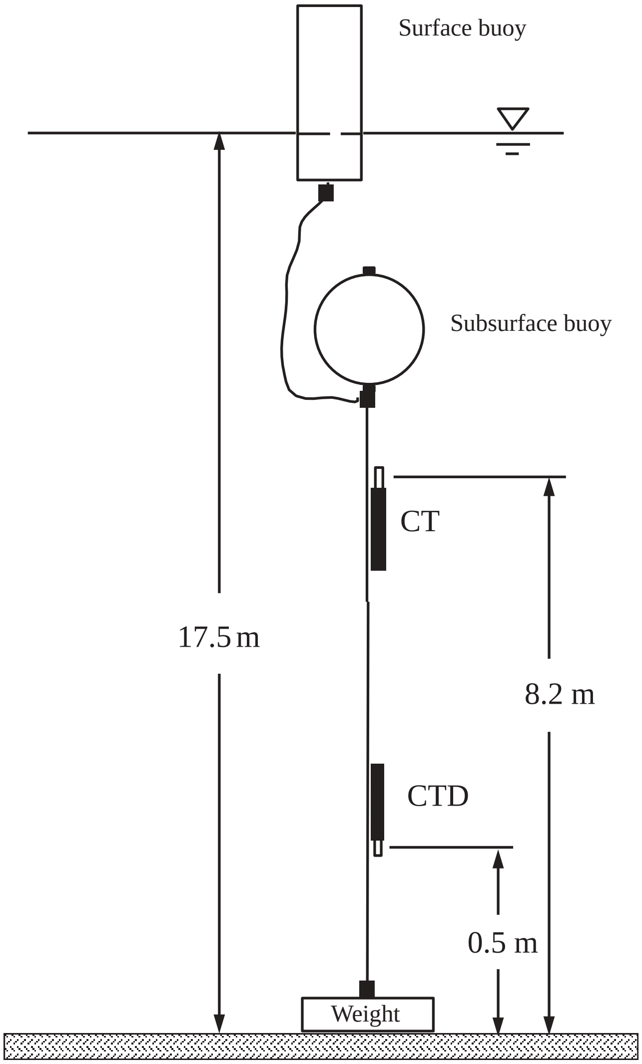

Figure D1. Configuration of instrument deployment, Station CARQ, June 5 through November 1, 1995, Suisun Bay, California. m, meters; MLLW, mean lower low water; CT, conductivity-temperature; CTD, conductivity-temperature-depth.

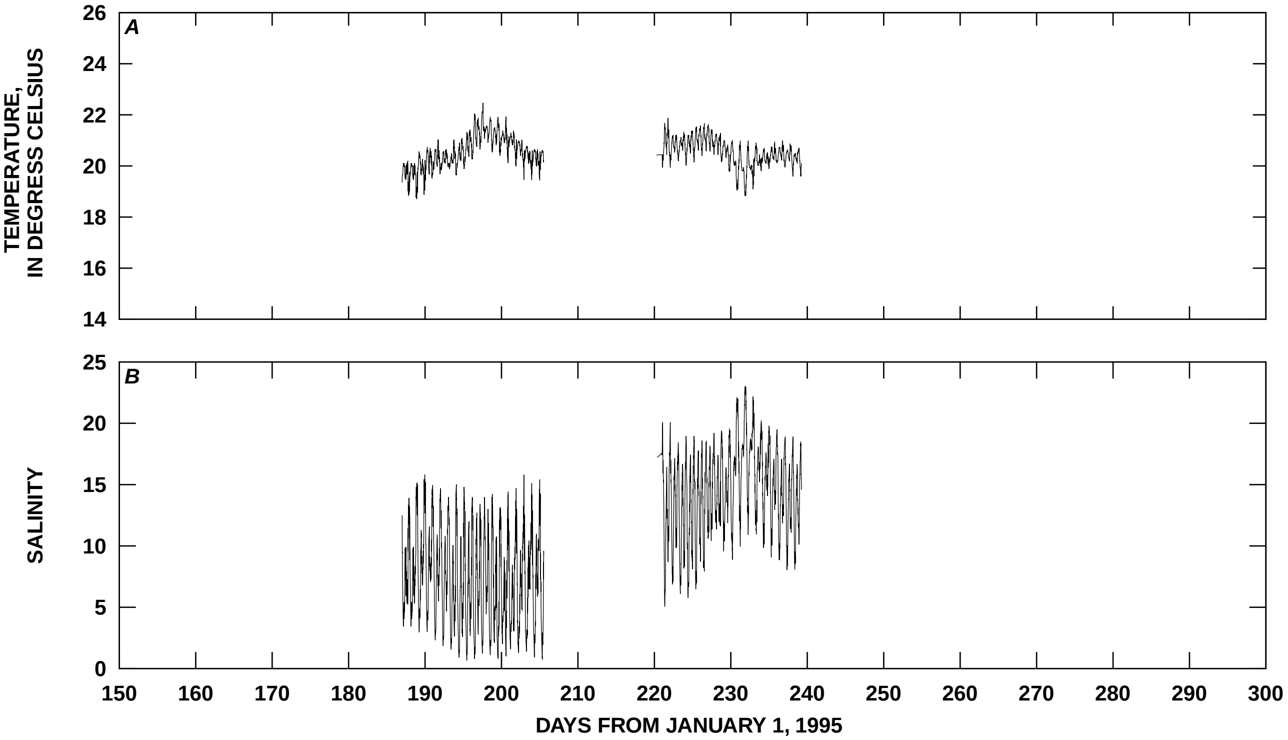

Figure D2. Time-series plots of *A*, temperature; and *B*, salinity, Station CARQ, July 7 through August 27, 1995, Suisun Bay, California. Near-surface sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

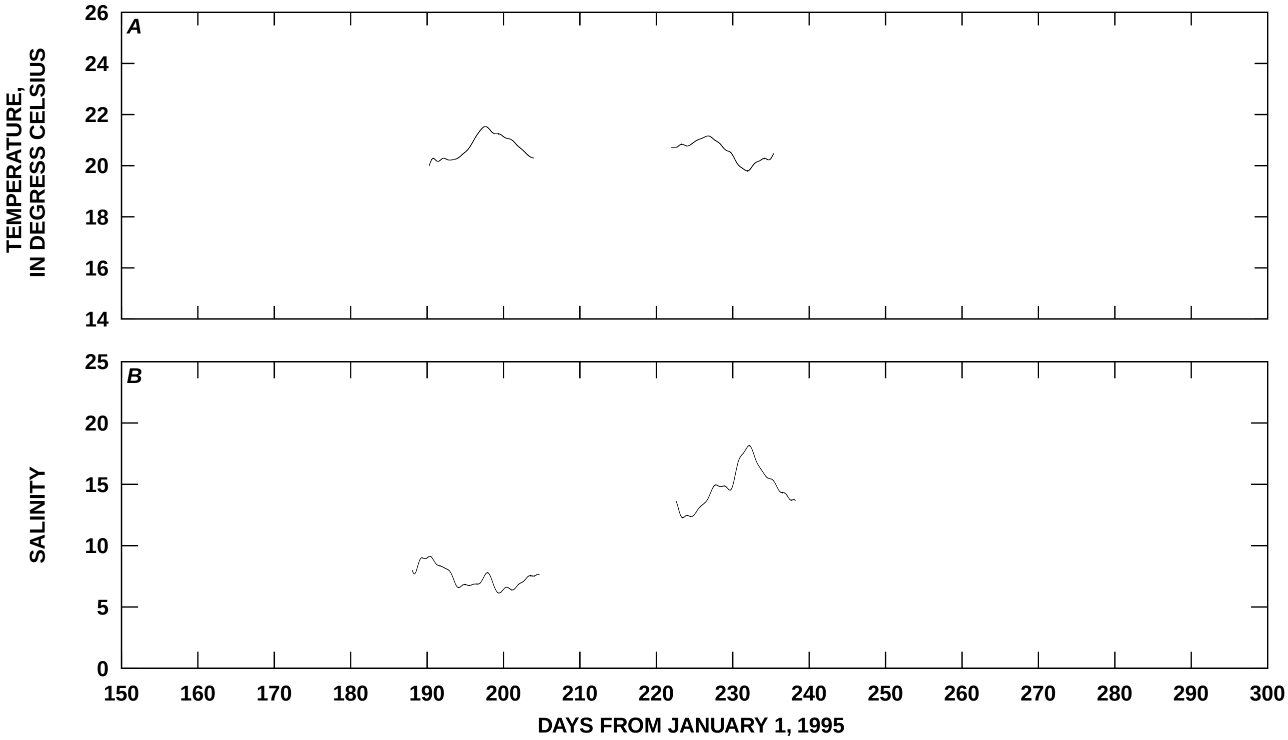

Figure D3. Time-series plots of low-pass-filtered *A*, temperature; and *B*, salinity, Station CARQ, July 7 through August 27, 1995, Suisun Bay, California. Near-surface sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

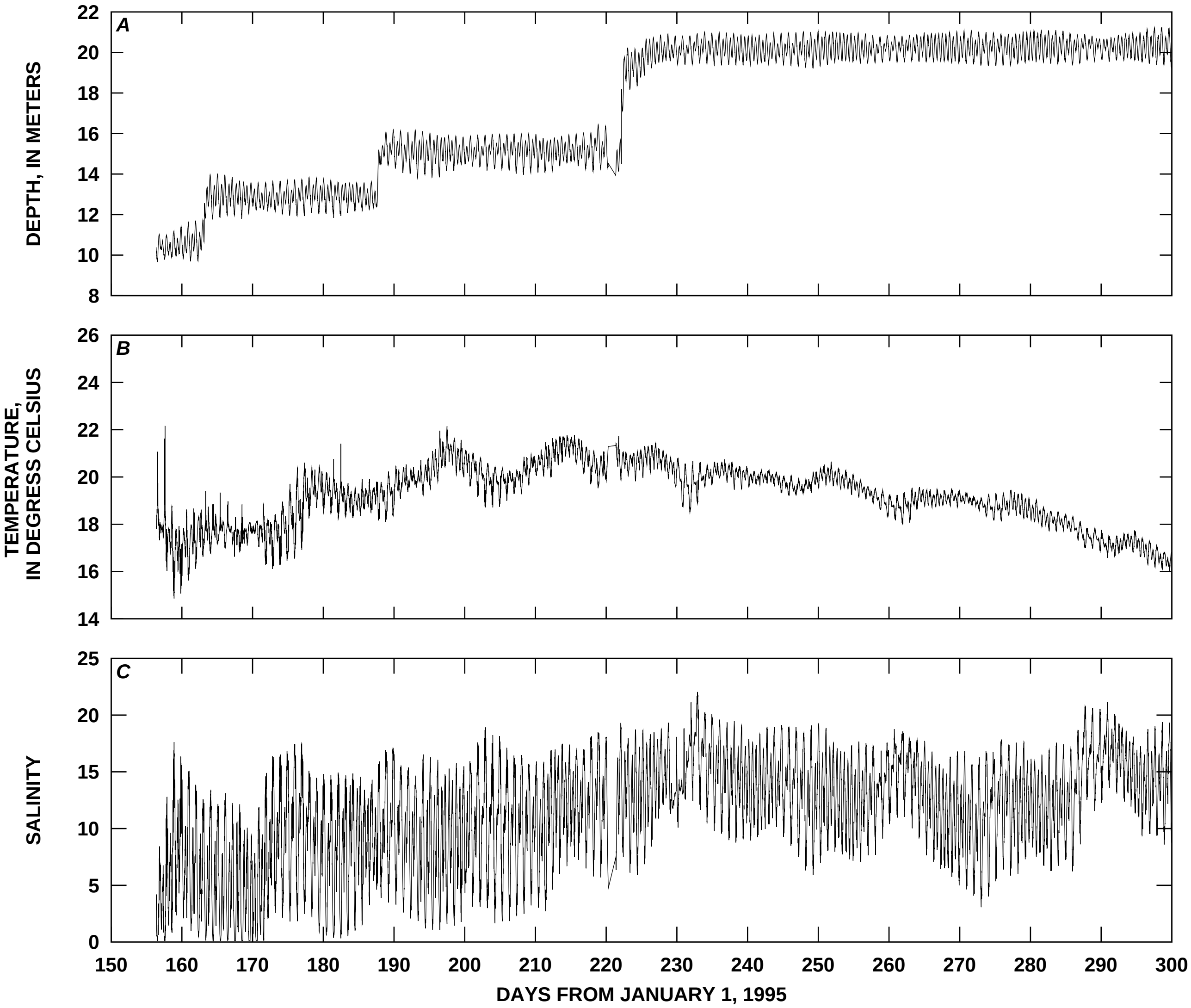

Figure D4. Time-series plots of *A*, depth; *B*, temperature; and *C*, salinity, Station CARQ, June 5 through November 1, 1995, Suisun Bay, California. Near-bed sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

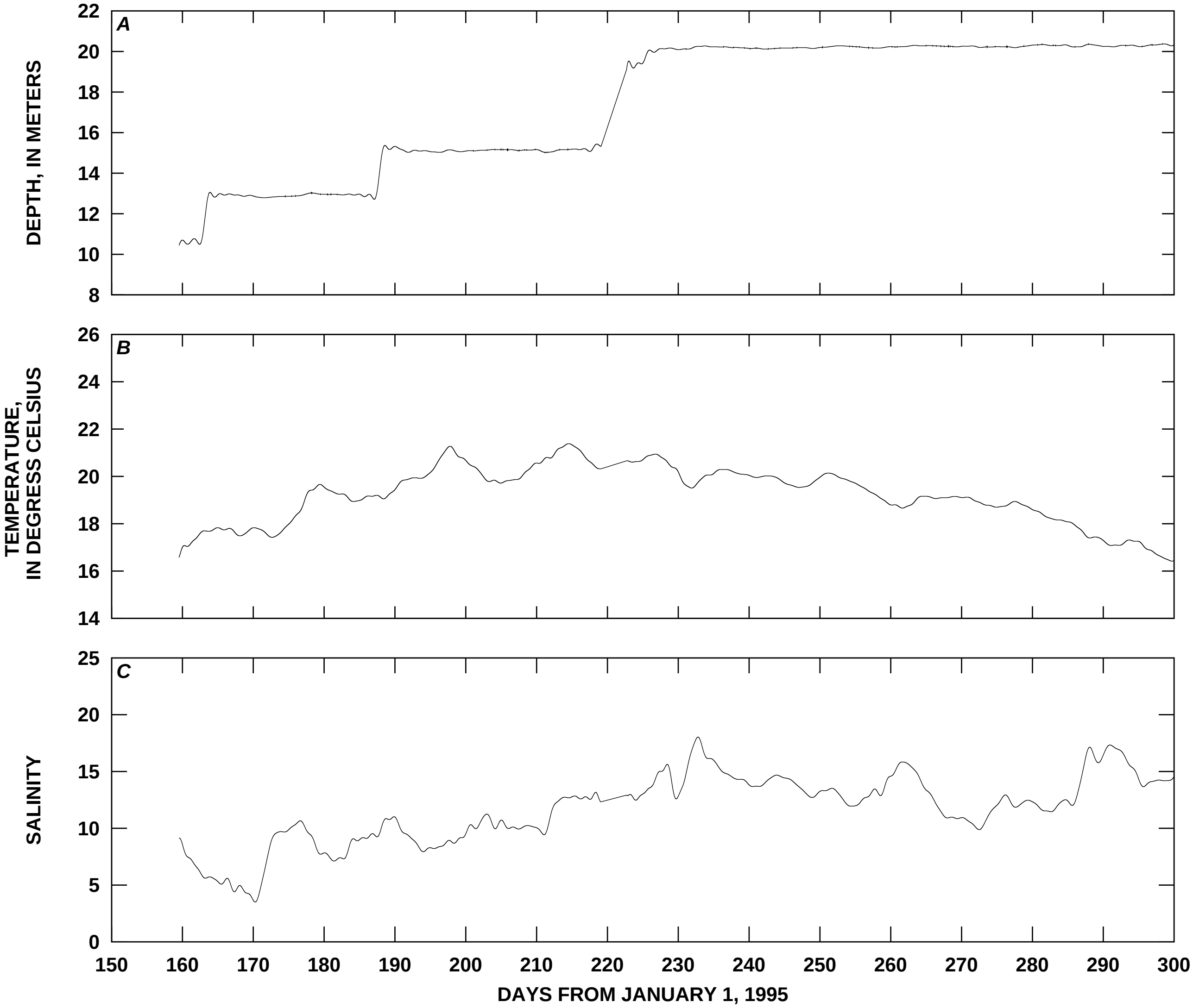

Figure D5. Time-series plots of low-pass-filtered *A*, depth; *B*, temperature; and *C*, salinity, Station CARQ, June 5 through November 1, 1995, Suisun Bay, California. Near-bed sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

Table D1. Harmonic analysis results from depth measurements, Station CARQ, June 5 through November 1, 1995, Suisun Bay, California. Near-bed sensor

```
Station: CARQ
Time series mean:  17.40290
Standard deviation:   3.33483
Hamonic constants: No tidal inference

                        Mean        Local      Modified
Tidal   Cycles       amplitude      epoch       epoch
symbol (per day)     (meters)    (degrees)   (degrees)
Q1      0.89324       0.03955    176.50633   191.49231
O1      0.92954       0.16522    116.99245   127.62344
M1      0.96645       0.04880    312.85547   319.05719
P1      0.99726       0.08489    137.96292   140.46674
K1      1.00274       0.30995    115.37034   117.21707


Mu2     1.86455       0.02245    133.39749   154.00238
N2      1.89598       0.11041    352.64948     9.48218
Nu2     1.90084       0.02637    271.25909   287.50897
M2      1.93227       0.52325    344.84851   357.32623
L2      1.96857       0.03234    170.48299   178.60571


S2      2.00000       0.10702     28.40050    32.75104
K2      2.00548       0.04403    136.69954   140.39301
M4      3.86455       0.03037    243.35141   268.30682
Mk3     2.93501       0.03186     21.00293    35.32736
```

APPENDIX E—STATION CHANNEL MARKER 27

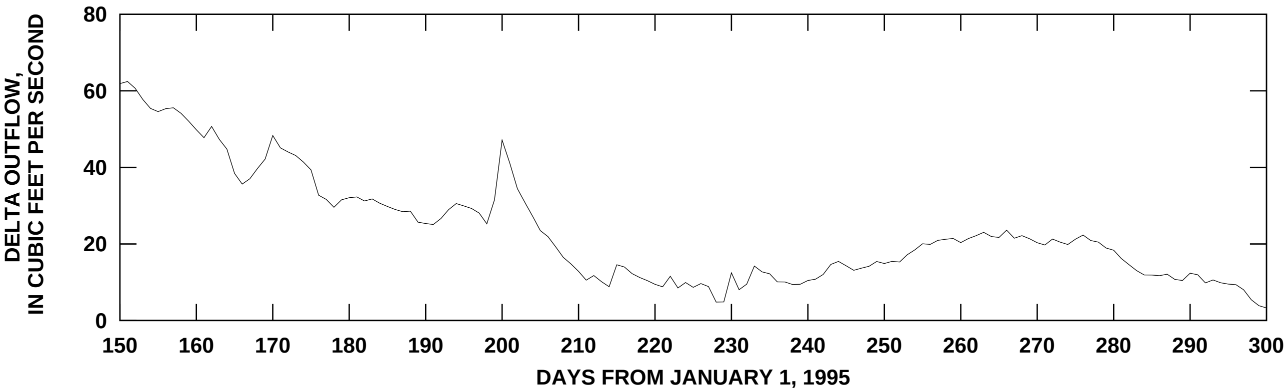

Figure E1. Time-series plot of Delta outflow (California Department of Water Resources computed this plot using DAYFLOW), May 30 through October 27, 1995, Suisun Bay, California.

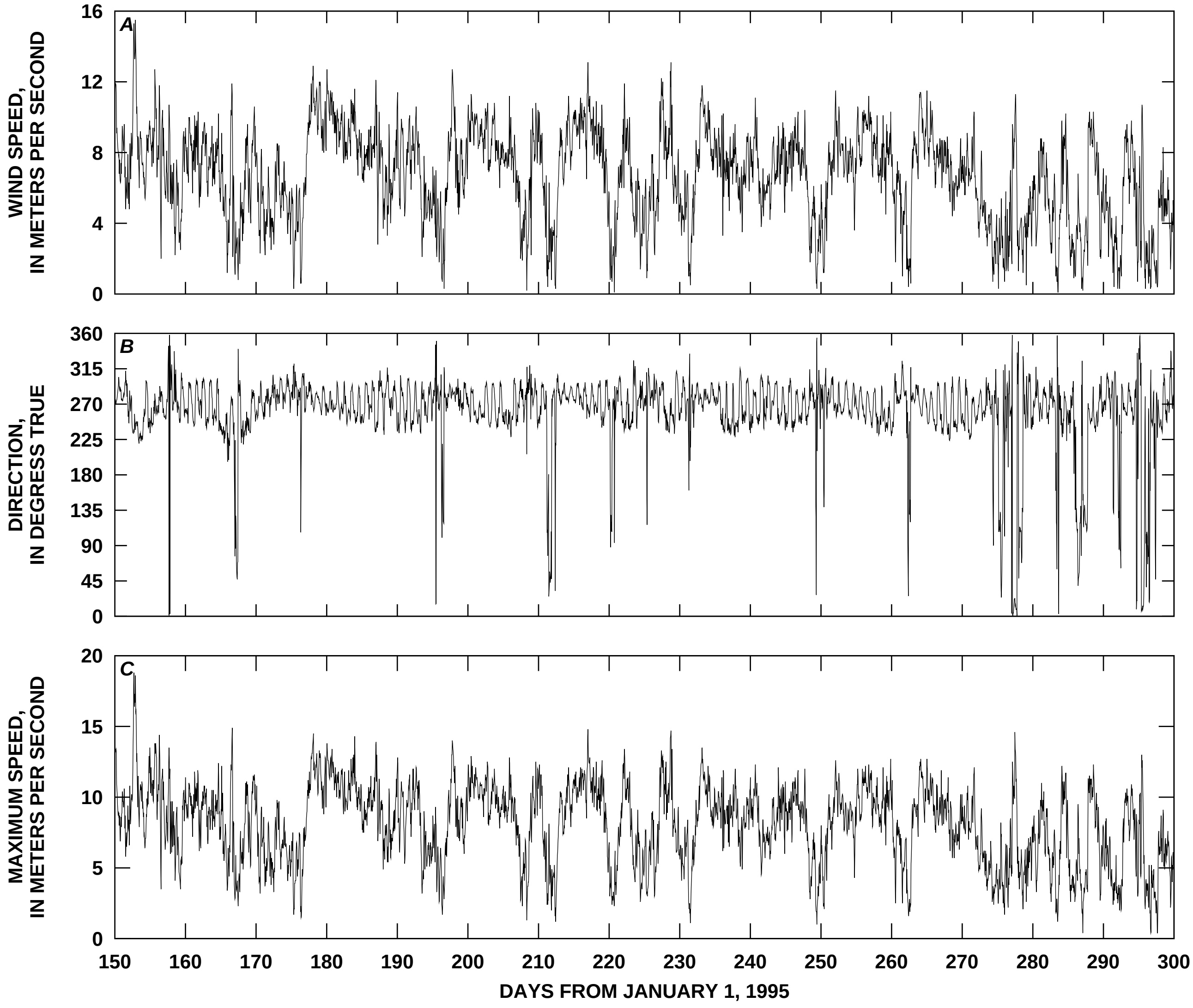

Figure E2. Time-series plots of *A*, wind speed; *B*, wind direction; and *C*, maximum wind speed, Station Channel Marker 27, May 30 through October 27, 1995, Suisun Bay, California.

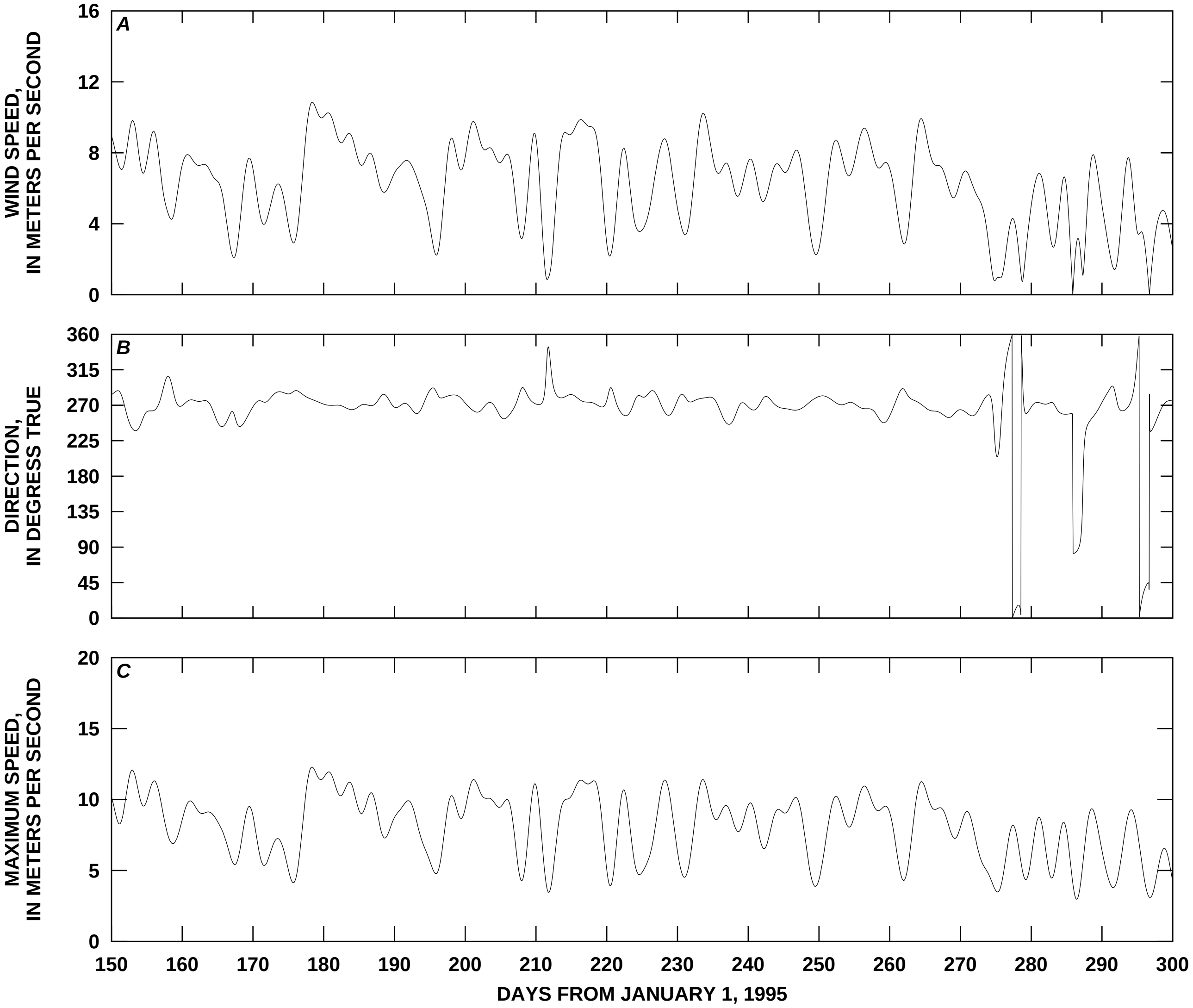

Figure E3. Time-series plots of low-pass-filtered *A*, wind speed; *B*, wind direction; and *C*, maximum wind speed, Station Channel Marker 27, May 30 through October 27, 1995, Suisun Bay, California.

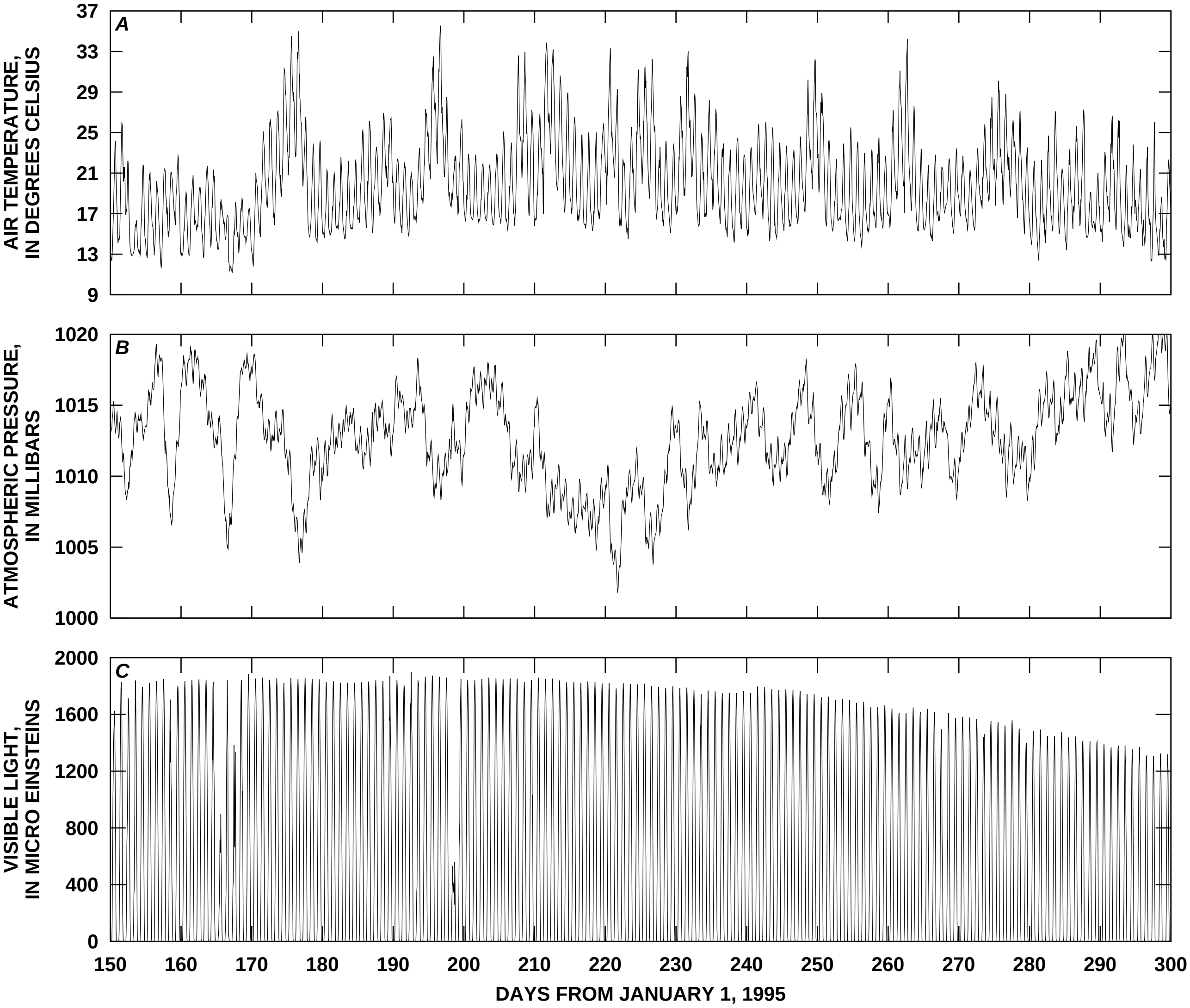

Figure E4. Time-series plots of *A*, air temperature; *B*, atmospheric pressure; and *C*, visible light, Station Channel Marker 27, May 30 through October 27, 1995, Suisun Bay, California.

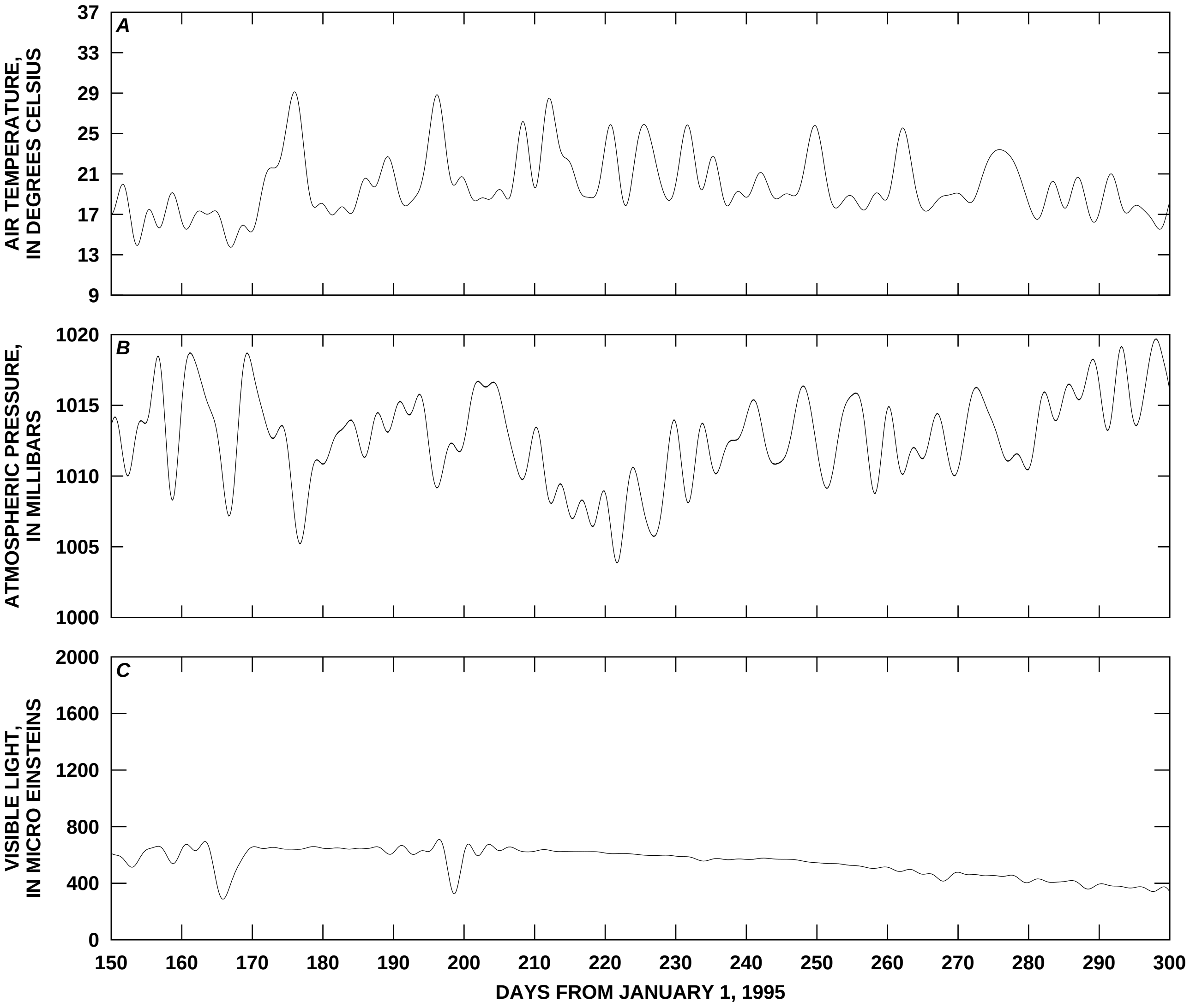

Figure E5. Time-series plots of low-pass-filtered *A*, air temperature; *B*, atmospheric pressure; and *C*, visible light, Station Channel Marker 27, May 30 through October 27, 1995, Suisun Bay, California.

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APPENDIX F—STATION CUT

Station Name: **CUT**
(Suisun Cutoff)
Position: Lat. 38°05'24"
Long. 122°00'20"
Depth: 8.3 m (MLLW)

	Manufacturer	*Serial Number*	*Deployment Dates*
CTDt:	Ocean Sensors	OS200 282	7/07/95(188) - 8/03/95(215)
	Ocean Sensors	OS200 307	8/03/95(215) - 10/23/95(296)
CTDb:	Ocean Sensors	OS200 303	7/07/95(188) - 7/20/95(201)
	Ocean Sensors	OS200 301	7/20/95(201) - 10/23/95(296)
OBSb:	D & A	OBS3 218	7/07/95(188) - 10/23/95(296)
ADCP:	RDI	NB 386	5/31/95(151) - 10/23/95(296)

Serviced: 7/07/95(188), 8/03/95(215), 8/09/95(221), 8/22/95(234), 9/20/95(263) 10/23/95(296)

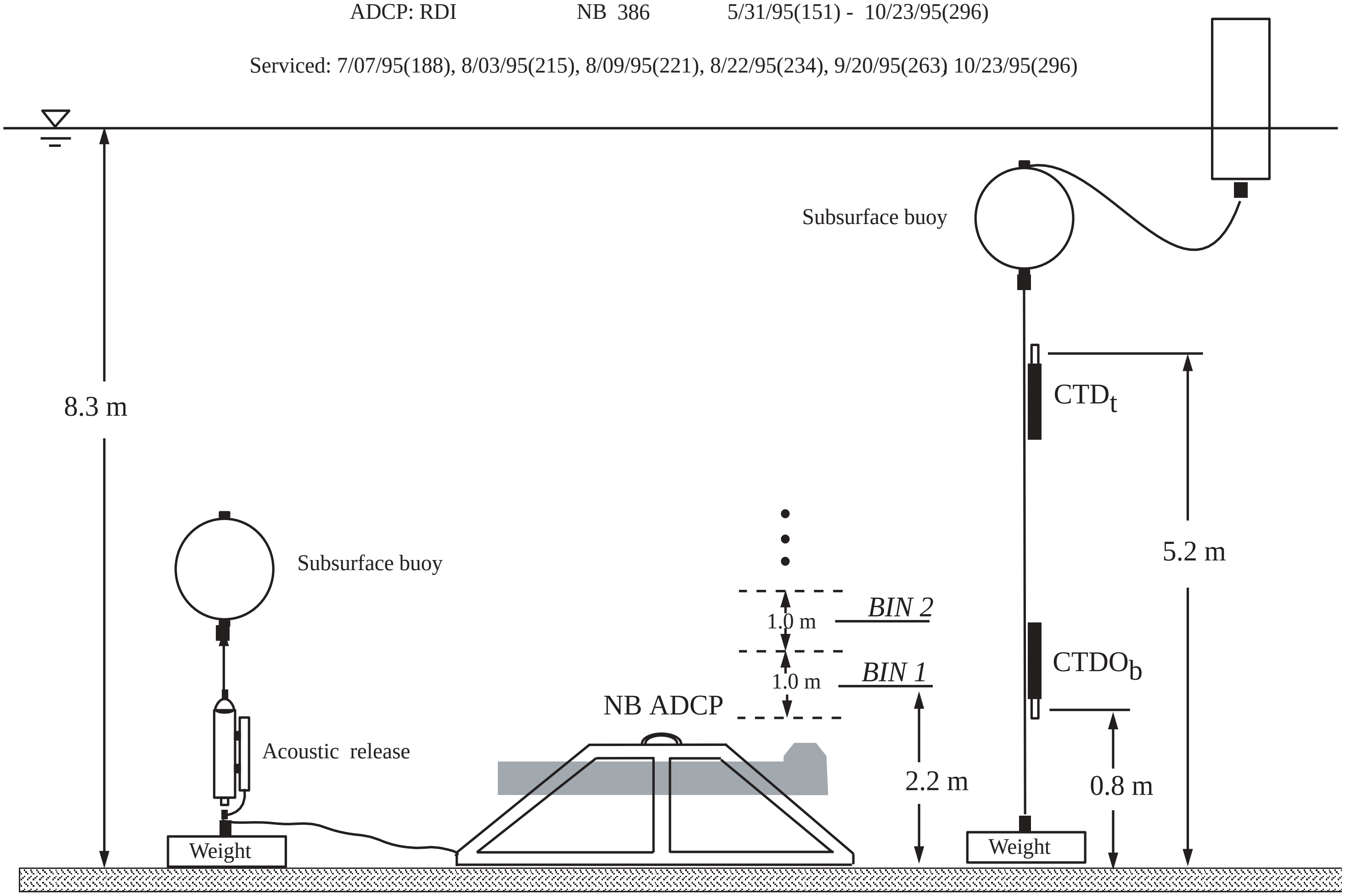

Figure F1. Configuration of instrument deployment, Station CUT, July 7 through October 23, 1995, Suisun Bay, California. m, meters; MLLW, mean lower low water; RDI, R.D. Instruments; OBS, optical backscatterance sensor; ADCP, acoustic Doppler current profiler; NB ADCP, narrow-band acoustic Doppler current profiler; CTD, conductivity-temperature-depth; CTDO, conductivity-temperature-depth-optical (backscatterance sensor); BIN, a discrete measurement location in the vertical.

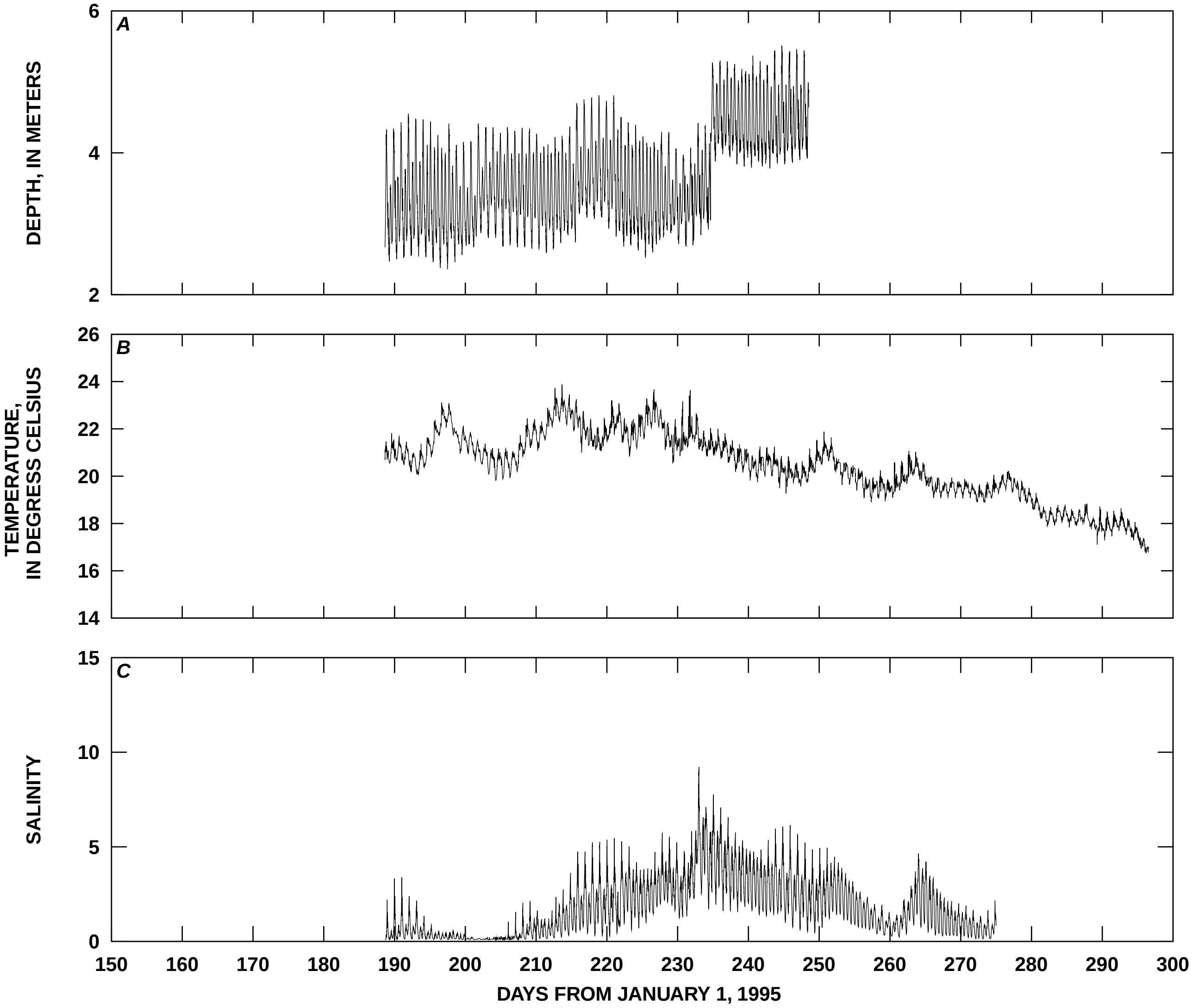

Figure F2. Time-series plots of *A*, depth; *B*, temperature; and *C*, salinity, Station CUT, July 7 through October 23, 1995, Suisun Bay, California. Near-surface sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

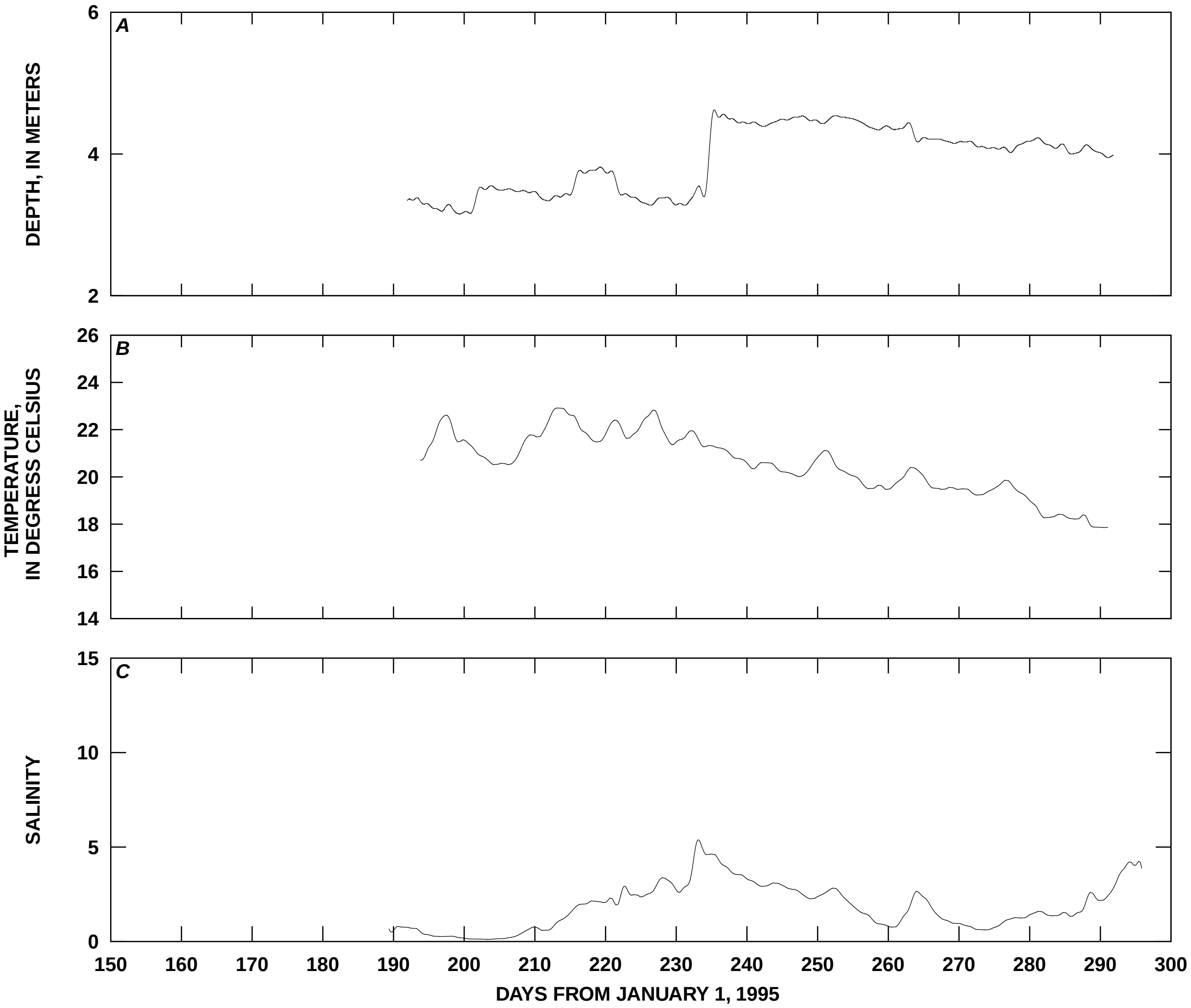

Figure F3. Time-series plots of low-pass-filtered *A*, depth; *B*, temperature; and *C*, salinity, Station CUT, July 7 through October 23, 1995, Suisun Bay, California. Near-surface sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

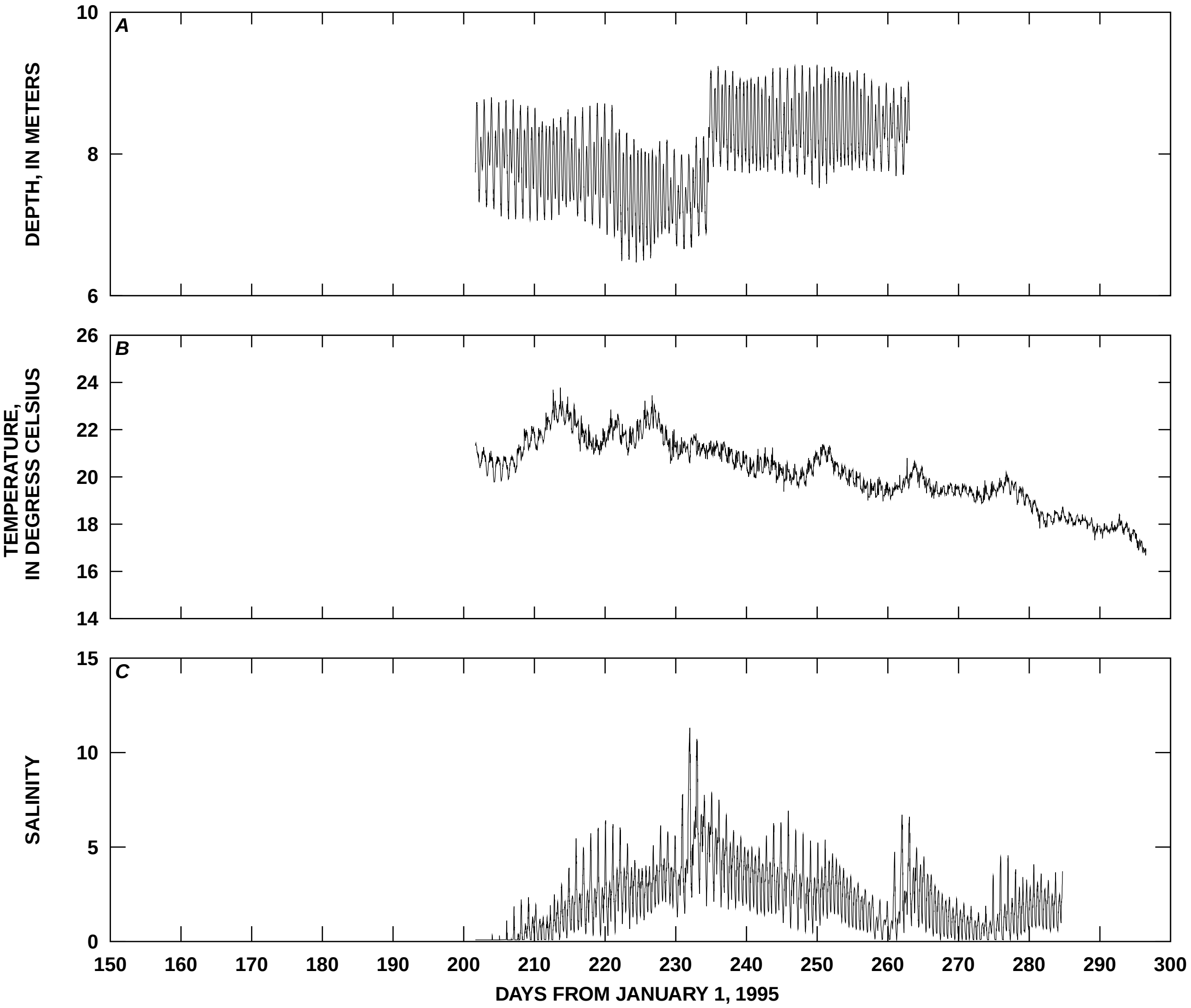

Figure F4. Time-series plots of *A*, depth; *B*, temperature; and *C*, salinity, Station CUT, July 7 through October 23, 1995, Suisun Bay, California. Near-bed sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

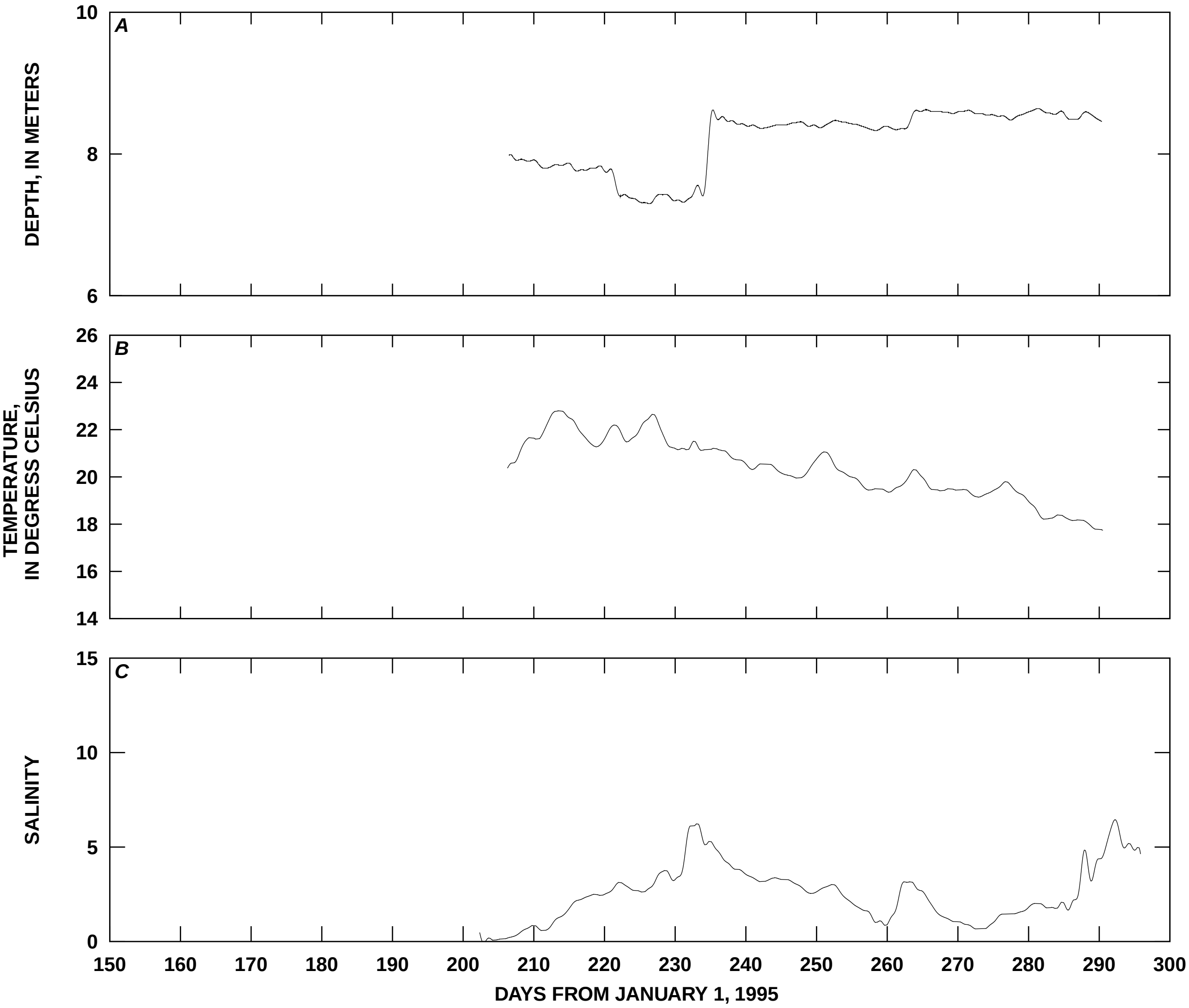

Figure F5. Time-series plots of low-pass-filtered *A*, depth; *B*, temperature; and *C*, salinity, Station CUT, July 7 through October 23, 1995, Suisun Bay, California. Near-bed sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

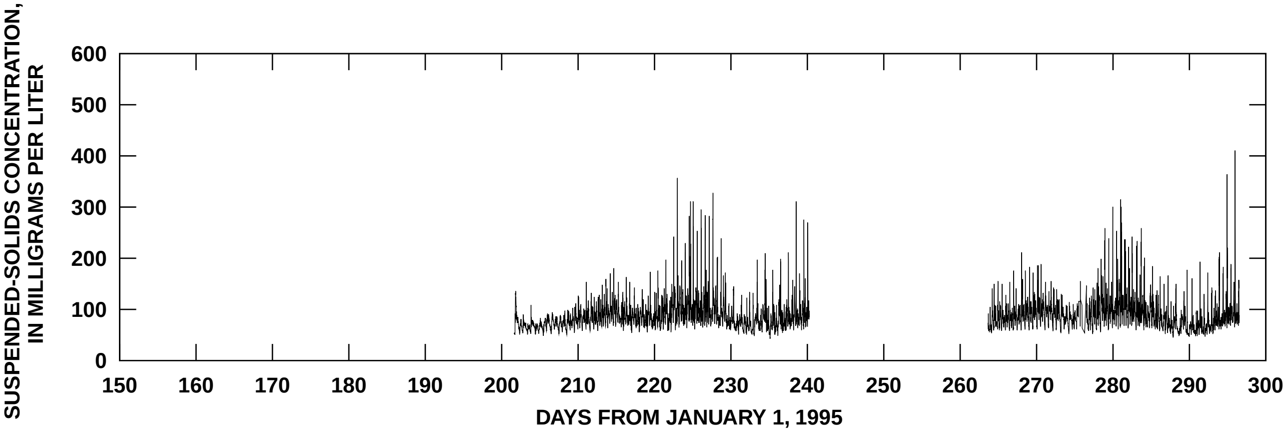

Figure F6. Time-series plot of suspended-solids concentration at Station CUT, July 7 through October 23, 1995, Suisun Bay, California. Near-bed sensor.

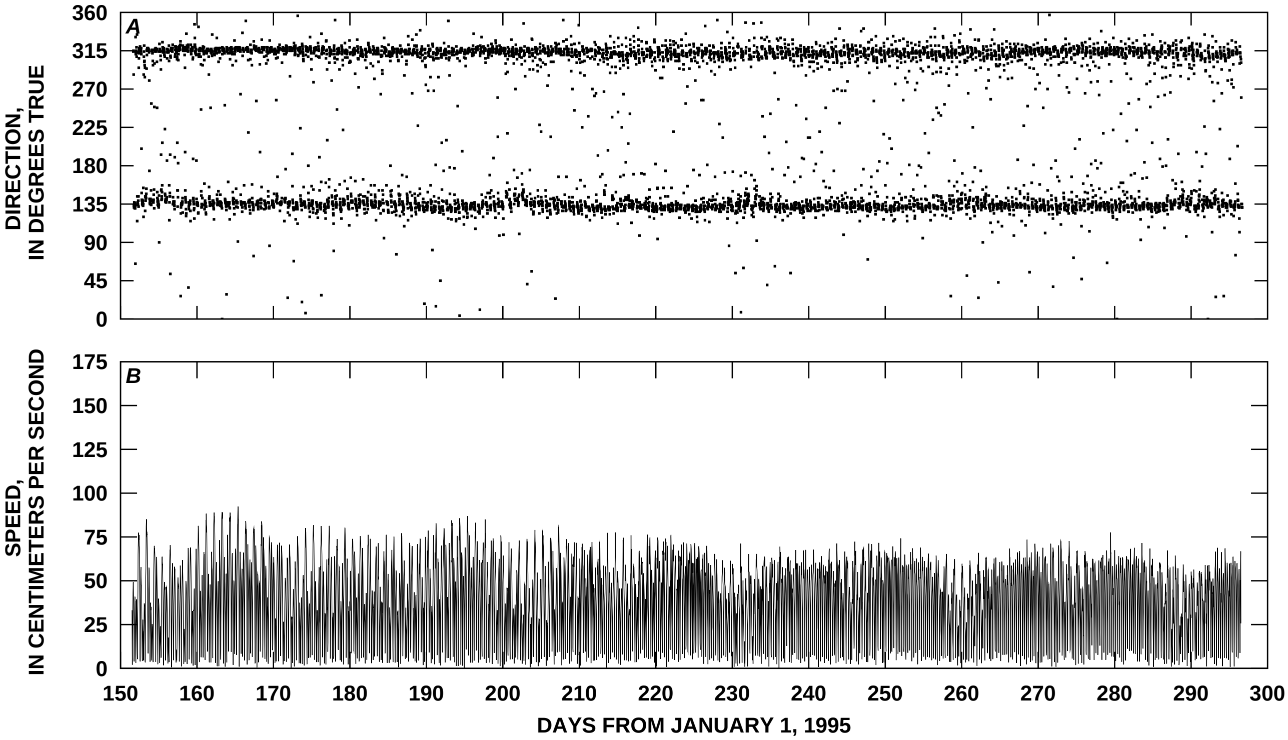

Figure F7. Time-series plots of tidal currents, Station CUT, May 31 through October 23, 1995, BIN 1 near-bottom BIN, Suisun Bay, California. BIN refers to a discrete measurement location in the vertical.

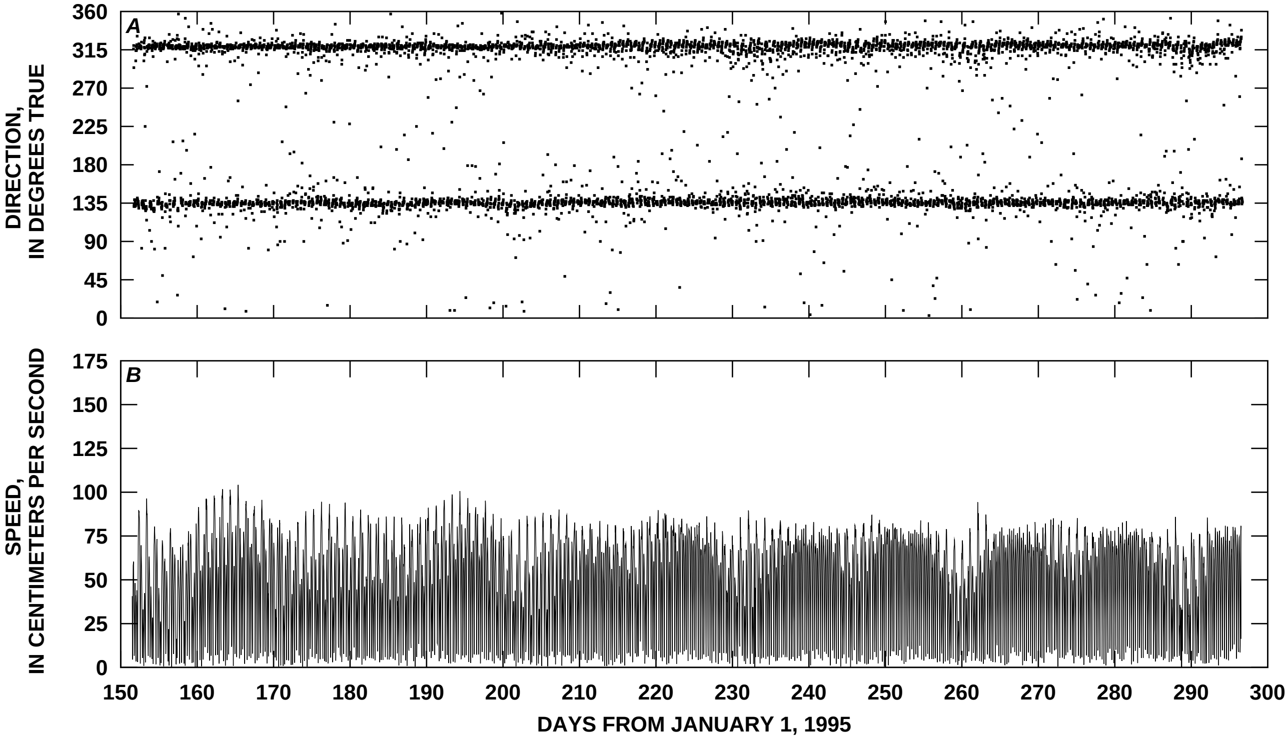

Figure F8. Time-series plots of tidal currents, Station CUT, May 31 through October 23, 1995, BIN 6 near-surface BIN, Suisun Bay, California. BIN refers to a discrete measurement location in the vertical.

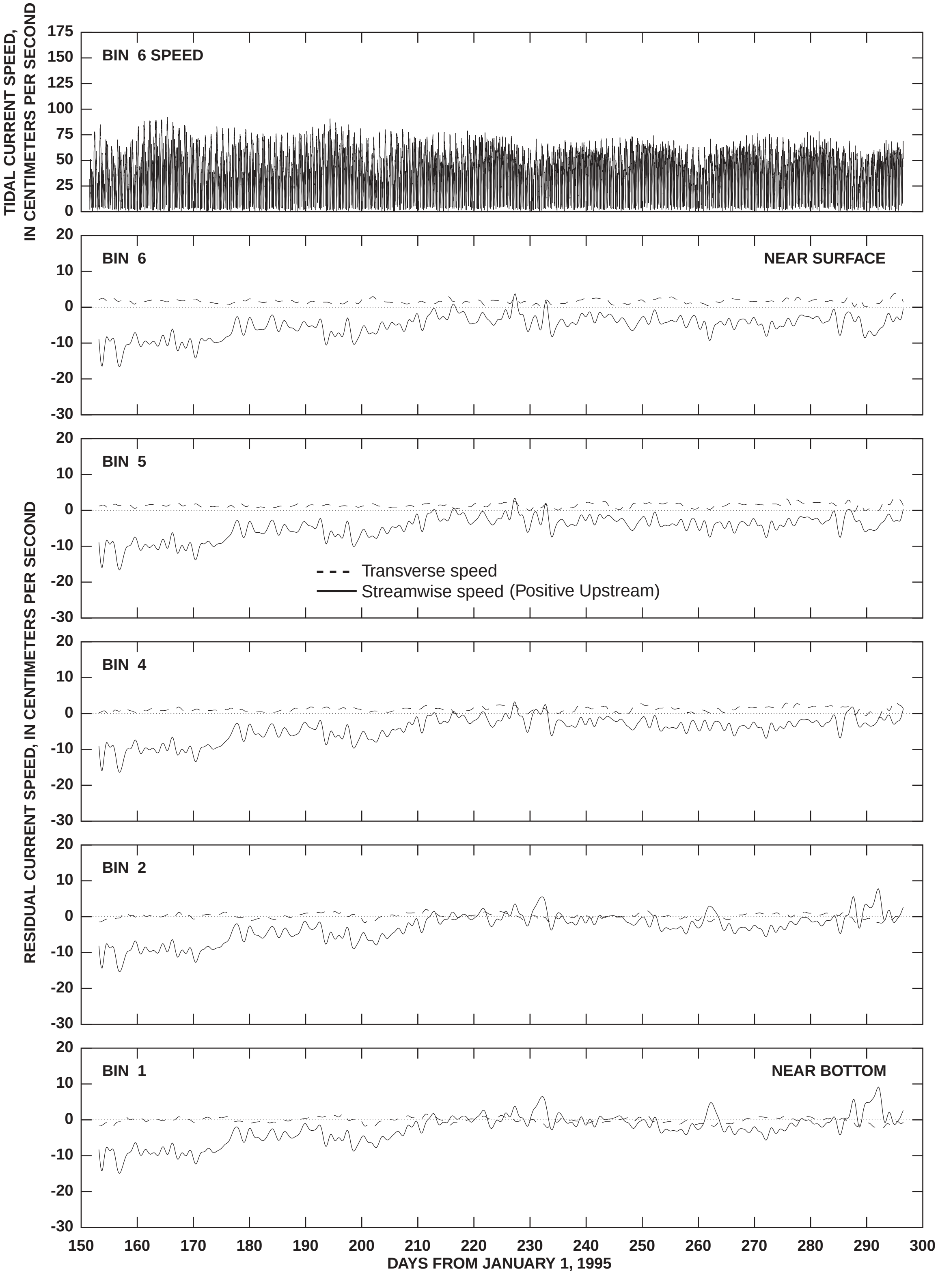

Figure F9. Longitudinal and transverse residual currents, Station CUT, May 31 through October 23, 1995, Suisun Bay, California. Tidal current speed at BIN 6 near-surface BIN is shown in the top panel for reference. BIN refers to a discrete measurement location in the vertical. Principal direction is 136 degrees true.

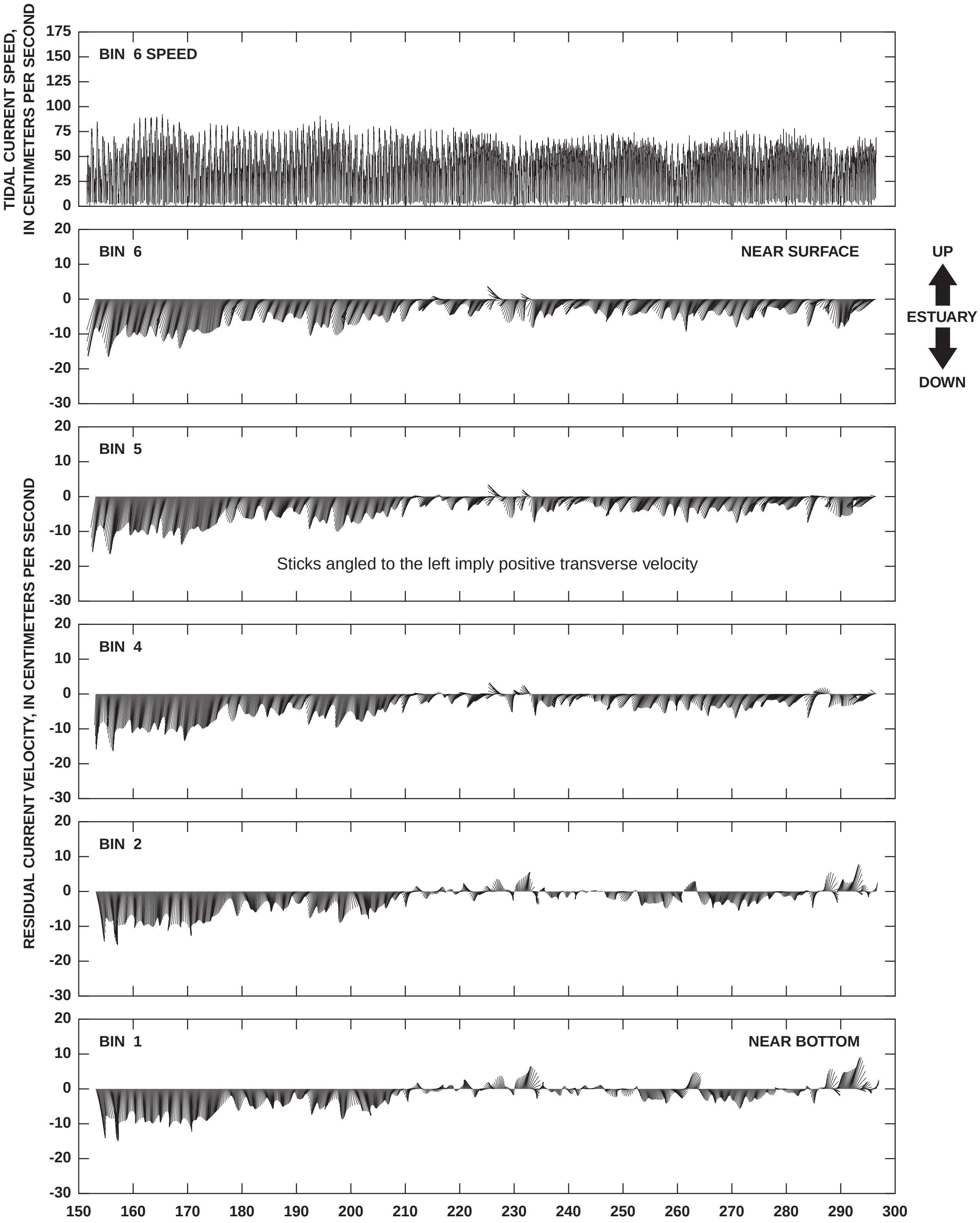

Figure F10. Residual currents, Station CUT, May 31 through October 23, 1995, Suisun Bay, California. Tidal current speed at BIN 6 near-surface BIN is shown in the top panel for reference. BIN refers to a discrete measurement location in the vertical. Principal direction is 136 degrees true.

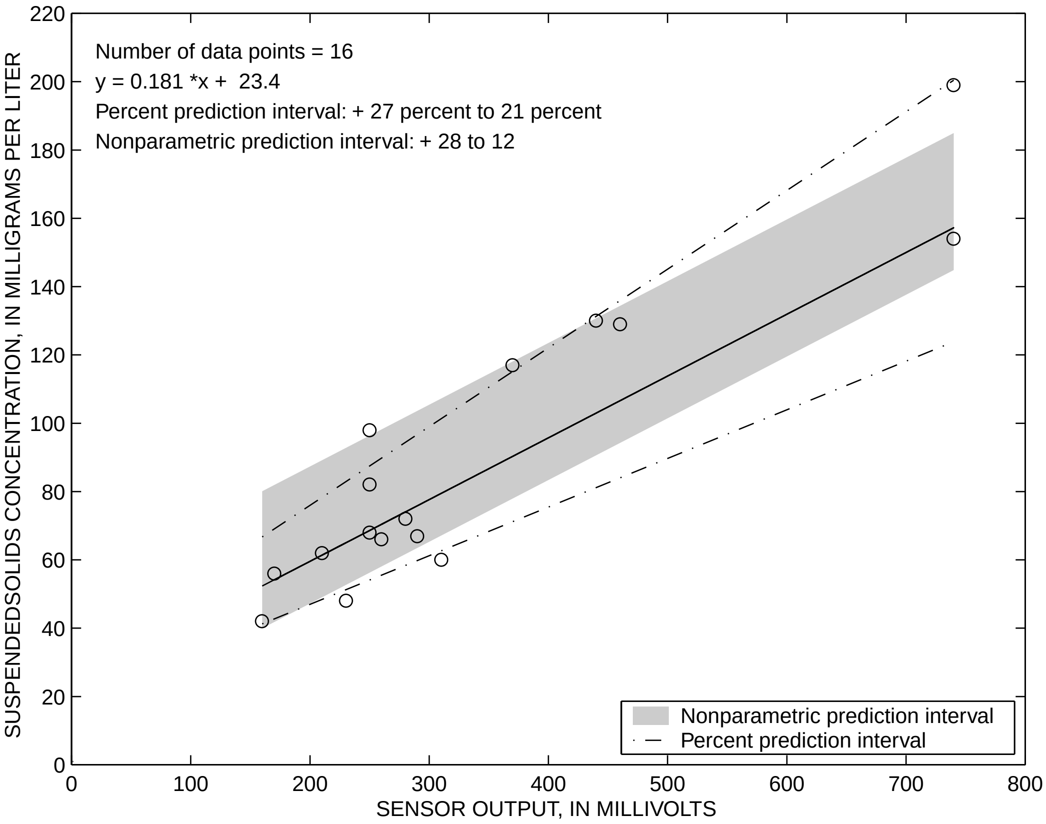

Figure F11. Calibration curve for optical backscatterance sensor at Station CUT, July 7 through October 23, 1995, Suisun Bay, California. Near-bed sensor.

Table F1. Harmonic analysis results from depth measurements, Station CUT, July 7 through October 23, 1995, Suisun Bay, California. Near-bed sensor

```
Station: CUT
Time series mean:   8.21041
Standard deviation:   0.42388
Harmonic constants: After tidal inference

                        Mean        Local     Modified
Tidal   Cycles       amplitude      epoch       epoch
symbol (per day)     (meters)    (degrees)   (degrees)
Q1      0.89324      0.03119    202.29968   217.11597
O1      0.92954      0.16076    144.34285   154.80411
M1      0.96645      0.01141     85.91867    91.95068
P1      0.99726      0.06638     36.25812    38.59222
K1      1.00274      0.20055     27.49448    29.17148


Mu2     1.86455      0.01276    260.18448   280.44992
N2      1.89598      0.12795    150.62823   167.12152
Nu2     1.90084      0.02482    168.01697   183.92743
M2      1.93227      0.53155    280.39508   292.53339
L2      1.96857      0.01488     50.16193    57.94519


S2      2.00000      0.15450    300.60568   304.61676
K2      2.00548      0.04202    302.24274   305.59674
M4      3.86455      0.04359    157.35849   181.63501
Mk3     2.93501      0.04292    258.09647   271.91174
```

Table F2. Harmonic analysis results for velocity, Station CUT, May 31 through October 23, 1995, BIN 1 near-bottom BIN, Suisun Bay, California

[BIN refers to a discrete measurement location in the vertical; cm/s, centimeters per second; deg.T, degrees true; deg, degrees; E, equilibrium argument]

```
BIN number:  1
Station: cutof
Start time of the series (local time): Year, 1995; Month, 5; Day,31; Hour,12:10
Time meridian: 120 W
Station position: 38- 5-22N 122- 0-21W
Record length: 280  M2 cycles: 20867 data points

 Tidal   Major axis  Minor axis  Direction  Phase     E    Rotation
 Symbol    (CM/S)      (CM/S)     (deg. T)  (deg)   (deg)
   Q1        1.29        0.25       138.7    113.4   126.2  Counter-clockwise
   O1       10.05        0.13       135.4    113.0   324.4  Counter-clockwise
   M1        0.64        0.09       126.6    275.0   169.4  Clockwise
   P1        6.91        0.23       136.5    104.5    24.0  Clockwise
   K1       19.51        0.00       133.6    117.2   346.5  Counter-clockwise
   J1        0.15        0.04       118.8    261.3   187.5  Counter-clockwise
   MU2       2.59        0.10       142.6    224.1   261.2  Clockwise
   N2        9.59        0.04       134.0     21.5   115.5  Counter-clockwise
   NU2       2.71        0.20       139.1     28.7    99.3  Counter-clockwise
   M2       53.65        0.85       133.6     44.4   313.7  Counter-clockwise
   L2        4.88        0.34       136.3     76.0   331.3  Counter-clockwise
   T2        1.10        0.31       139.2    358.0   219.4  Clockwise
   S2       10.17        0.17       133.2     50.3     5.1  Clockwise
   K2        3.61        0.22       127.6     36.0   152.1  Counter-clockwise
   M4        1.91        0.37       123.2     53.1   267.4  Counter-clockwise
   MK3       4.45        0.36       126.6    161.0   300.2  Counter-clockwise

Root-mean-square speed (cm/s):              43.75
Standard deviation, U series (cm/s):         6.20
Standard deviation, V series (cm/s):         5.99
Tidal form number:                           0.46
Spring tidal current maximum (cm/s):        93.38
Neap tidal current maximum (cm/s):          34.01
Pricipal current direction (deg. T):       133.73
```

Table F3. Harmonic analysis results for velocity, Station CUT, May 31 through October 23, 1995, BIN 6 near-surface BIN, Suisun Bay, California

[BIN refers to a discrete measurement location in the vertical; cm/s, centimeters per second; deg.T, degrees true; deg, degrees; E, equilibrium argument]

```
BIN number:  6
Station: cutof
Start time of the series (local time): Year, 1995; Month, 5; Day,31; Hour,12:10
Time meridian: 120 W
Station position: 38- 5-22N 122- 0-21W
Record length: 280  M2 cycles: 20846 data points

 Tidal   Major axis  Minor axis  Direction  Phase     E    Rotation
 Symbol    (CM/S)      (CM/S)     (deg. T)  (deg)   (deg)
   Q1       1.83        0.06       135.6    115.7   126.2  Clockwise
   O1      11.82        0.10       140.3    108.7   324.4  Clockwise
   M1       0.84        0.06       140.3    266.3   169.4  Clockwise
   P1       7.84        0.08       136.2    106.9    24.0  Counter-clockwise
   K1      23.02        0.24       138.4    114.7   346.5  Clockwise
   J1       0.39        0.07       123.7    260.0   187.5  Clockwise
   MU2      3.37        0.01       134.6    225.9   261.2  Counter-clockwise
   N2      11.14        0.20       137.8     20.4   115.5  Clockwise
   NU2      2.86        0.00       134.0     35.6    99.3  Counter-clockwise
   M2      64.82        0.87       137.5     46.0   313.7  Clockwise
   L2       6.18        0.21       136.9     81.2   331.3  Clockwise
   T2       1.74        0.16       142.0     13.5   219.4  Counter-clockwise
   S2      12.84        0.01       139.0     50.0     5.1  Clockwise
   K2       4.42        0.30       139.5     43.8   152.1  Clockwise
   M4       3.28        0.56       117.6     83.1   267.4  Counter-clockwise
   MK3      5.79        0.21       132.0    171.3   300.2  Counter-clockwise

Root-mean-square speed (cm/s):               52.64
Standard deviation, U series (cm/s):          6.30
Standard deviation, V series (cm/s):          6.57
Tidal form number:                            0.45
Spring tidal current maximum (cm/s):        112.49
Neap tidal current maximum (cm/s):           40.78
Pricipal current direction (deg. T):        138.15
```

APPENDIX G—STATION GARN

Station Name: **GARN**
(Garnet Point)

Position: Lat. 38°05'44"
Long. 122°01'32"
Depth: 6.1m (MLLW)

	Manufacturer	*Serial Number*	*Deployment Dates*
CT_t	Seabird	Seacat 415	7/5/95(186) - 10/22/95(295)
CT_b	Seabird	Seacat 413	7/5/95(186) - 10/22/95(295)

Serviced: 7/5/95(186), 9/20/95(263), 10/22/95(295)

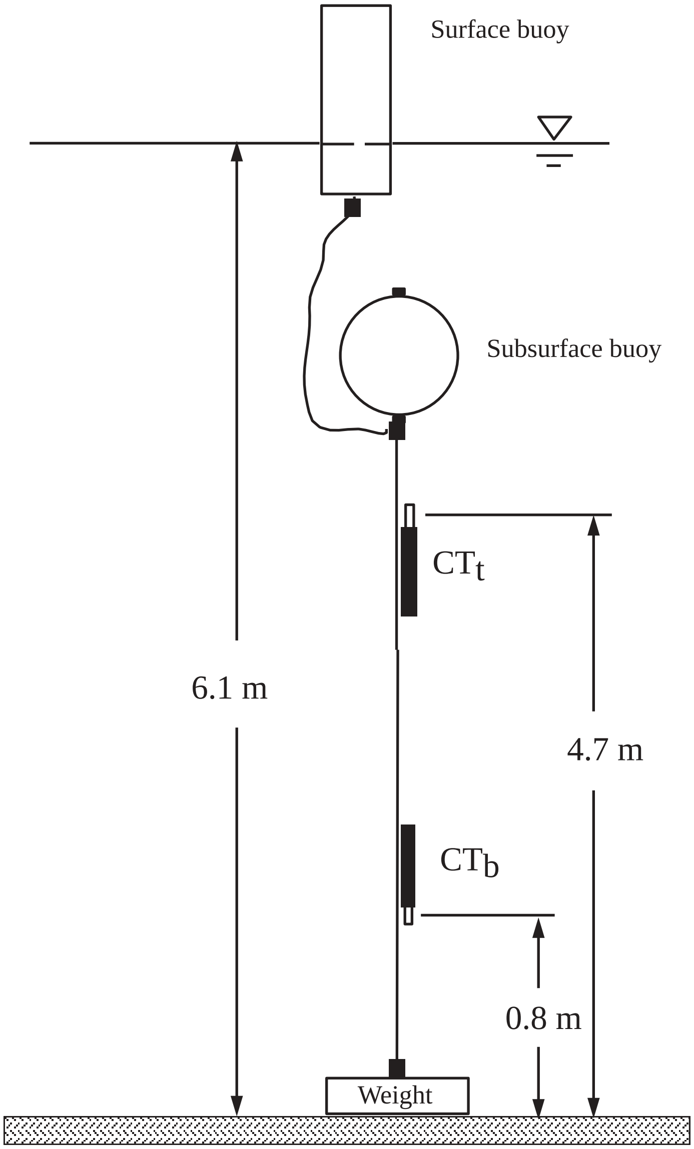

Figure G1. Configuration of instrument deployment, Station GARN, July 5 through October 22, 1995, Suisun Bay, California. m, meters; MLLW, mean lower low water; CT, conductivity-temperature.

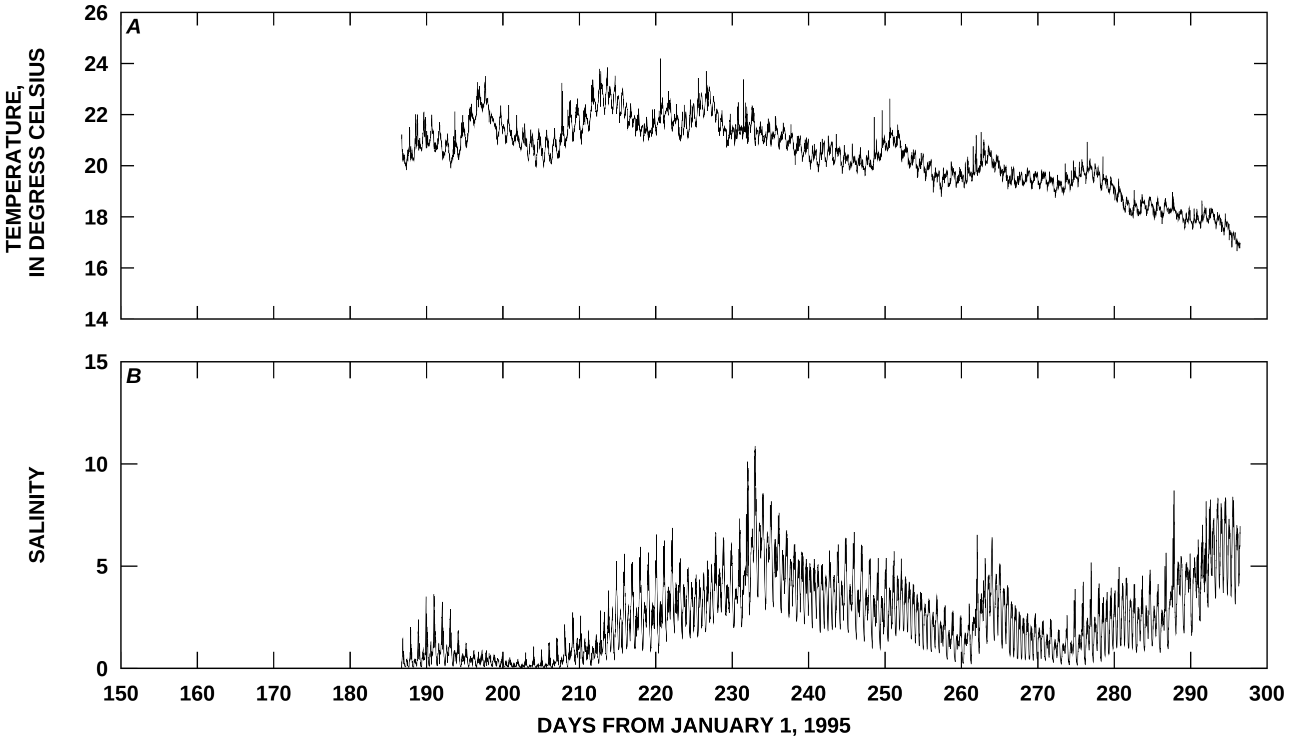

Figure G2. Time-series plots of *A*, temperature; and *B*, salinity, Station GARN, July 5 through October 22, 1995, Suisun Bay, California. Near-surface sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

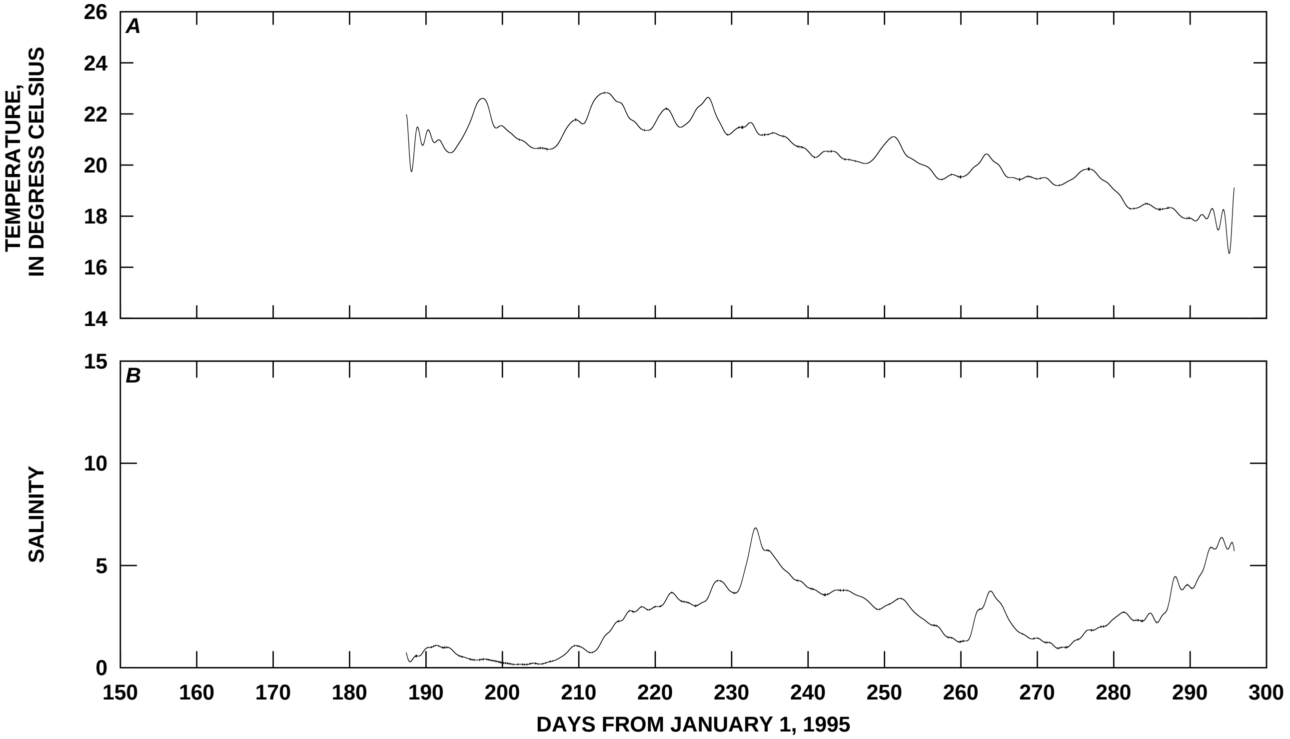

Figure G3. Time-series plots of low-pass-filtered *A*, temperature; and *B*, salinity, Station GARN, July 5 through October 22, 1995, Suisun Bay, California. Near-surface sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

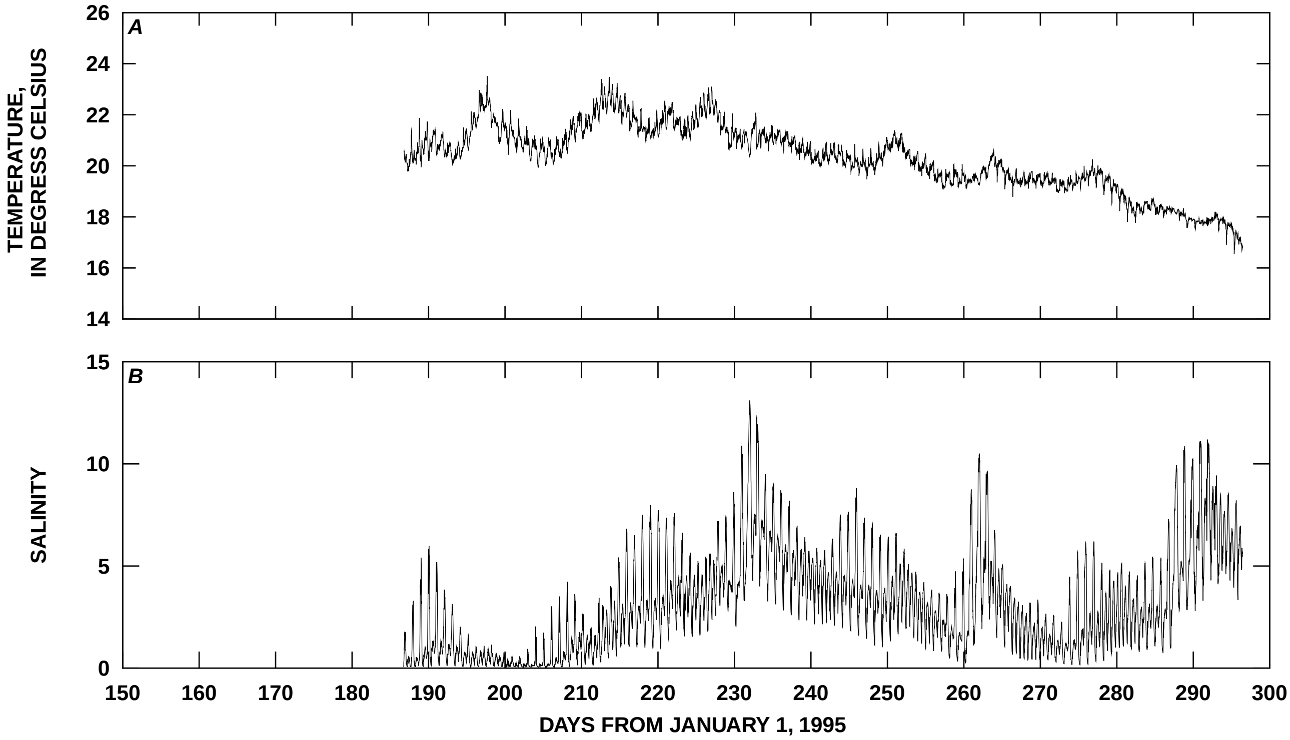

Figure G4. Time-series plots of *A*, temperature; and *B*, salinity, Station GARN, July 5 through October 22, 1995, Suisun Bay, California. Near-bed sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).

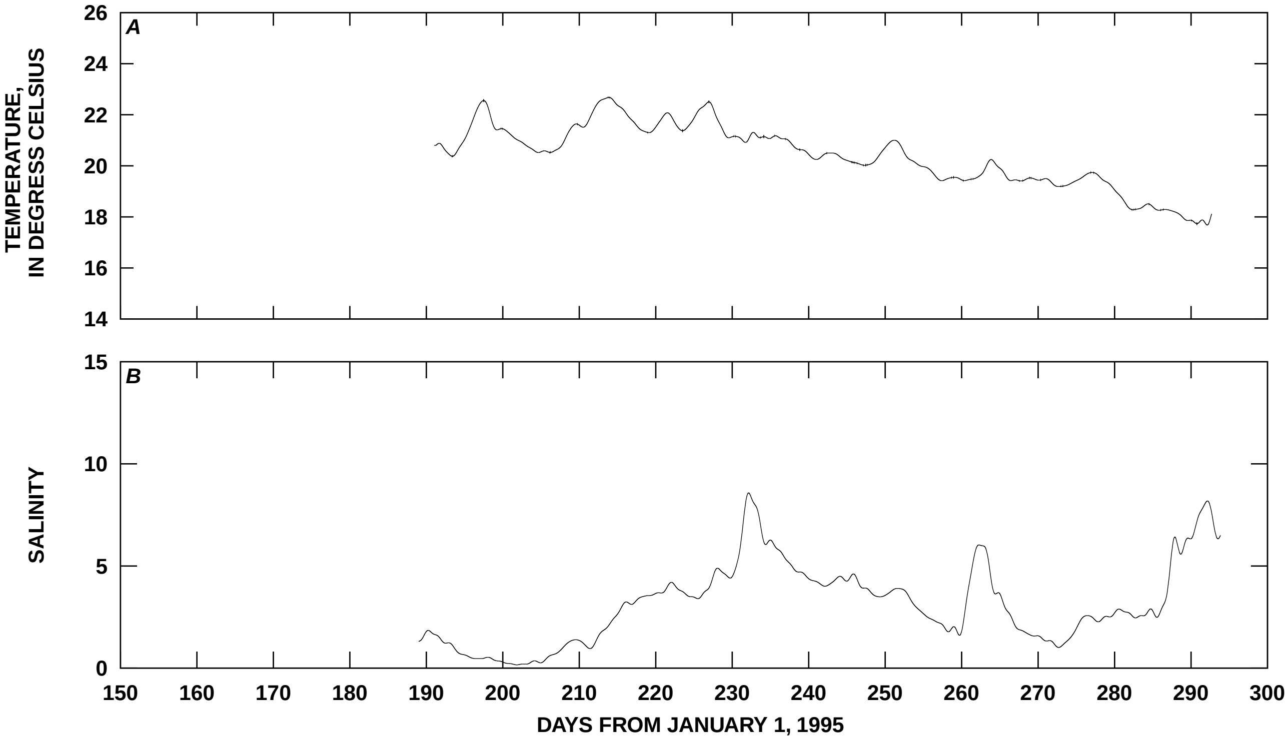

Figure G5. Time-series plots of low-pass-filtered *A*, temperature; and *B*, salinity, Station GARN, July 5 through October 22, 1995, Suisun Bay, California. Near-bed sensor. Salinities in this report are presented without units because salinity is a conductivity ratio; therefore, it has no physical units (Millero, 1993).