

SOP 4: Hydrographic Survey version 2

1 Field Preparations

Be aware that both a primary and a separate backup CTD are maintained, as explained in SOP 1. Under normal circumstances only the primary CTD is taken on a cruise. In case of equipment failure in the field, staff typically must return to port and prepare the backup instrument for completing the cruise. Before entering the field, staff should review the safety documentation in Appendix E.

1.1 Supplies to Have Available

Assemble these items: primary CTD; lowering line and hardware; distilled water and Triton X-100 solution containers; wash bottles for cleaning and rinsing the CTD; field log sheets (Appendix B); GPS; laptop computer with serial port adapter, data transmission cable, and appropriate Sea-Bird software; personal protective equipment (e.g., gloves, earmuffs); tool kit; general equipment spare parts kit; and this protocol document. Appendix C details specific equipment needed to complete oceanographic surveys. During transport, always ensure that the CTD is well secured; severe vibrations can result in broken connections or damaged sensors. Please treat the instrument carefully—it is very expensive. The CTD communications, battery, memory, and date/time checks can be done on board or in the office; in any case, make sure that all these checks have been performed prior to leaving the dock (see the following four steps).

1.2 Check Computer-to-CTD Communications

Before deploying the primary and backup CTDs for a particular cruise, check the status of the instruments using the Sea-Bird application SeaTerm.exe running on a laptop connected to each CTD with the proprietary data cable. This is best performed in the office immediately prior to loading the boat for a field survey. See details of communication and operation in SOP 5 and/or the SBE-19 operator's manual for help.

1.3 Check Battery Voltage

Check battery condition using the SeaTerm program. In the SeaTerm window, press F3 or click on the Connect button. If the "Vmain" value displayed is less than 11.5 volts, replace all nine D-cell batteries in that instrument.

1.4 Check Memory and Clear

Ensure that both CTD memories are empty (previous cast data was cleared after the last download to storage). When connected, the SeaTerm display should show cleared memory (nsamples = 0, memory = 0). If the memory still needs to be cleared, issue the InitLog command in SeaTerm. *Note that although CTD #5 (Sea-Bird 19-plus) has a very large memory, CTD #1 (Sea-Bird 19) has a relatively small memory (~43,300 "samples," or only 10 casts' worth of Glacier Bay station data). Consequently, it is imperative that all cast data from CTD #1 be copied and transferred every 10 casts or less so that the memory can be initialized back to zero (empty); otherwise, valuable data will be lost.*

1.5 Check Date and Time

Check to see that the time and date are current for Greenwich Mean Time (GMT). Note that GMT is either eight or nine hours away from Alaska local time, depending on whether daylight savings is in effect (eight hours when daylight savings is in effect; nine hours when it is not). If the CTDs are not synchronized to GMT, enter the “ST” command in SeaTerm. The program will prompt for the correct date, then the correct time. Synchronizing your watch with CTD time will help avoid mistakes when entering information in the Field Log (GMT can also be displayed on the GPS). It is important that GMT time be employed so that future analyses can accurately relate the timing of the tidal signal to the timing of the CTD cast. Tidal analyses are carried out with respect to GMT, so avoiding the use of local time will help avoid errors introduced by switching in and out of daylight savings.

1.6 Verify Vessel is Prepared

- Ensure the GPS used for the chosen vessel has the station coordinates recorded.
- Verify the vessel is fitted with a properly working power block and davit.
- After the instrument is loaded onto the vessel, be sure to secure the end of the cast line to the CTD using metal locking carabiner(s) or shackle (wired or cable-tied), with the opposite “bitter” end secured to the vessel.

1.7 Soak the Dry Conductivity Cell

When removed from storage, the dry conductivity cell needs to be hydrated before being deployed. Using the syringe/tubing assembly, fill the cell with 0.1% Triton X-100 solution for at least one hour. When ready to use, drain the Triton X-100 solution and rinse with fresh water. Do not allow Triton X-100 solution to flow through to the dissolved oxygen sensor, which may be adversely affected.

1.8 Confirm System Operability with the First Cast

After the first cast of each survey day, connect the CTD to the laptop with the proprietary data transmission cable. Download the first cast using the process explained in SOP 5. Visually inspect the data string for missing and/or unusual-looking “samples” or characters. Then plot the data to confirm that all sensors are working properly.

Plotting is accomplished by double-clicking the icon named either “#1_Hex_Plot in Field” (for CTD #1) or “#5_Hex_Plot in Field 2014 and later” (for CTD #5). You must provide the cruise year and the name of the CON file to use. The CON file must already be stored on the laptop in directory C:\oceanography\YYYY\CON_calibration\, where YYYY is the cruise year (see SOP 5). Also be sure there is a directory present named C:\oceanography\YYYY\Plot\Hex\temp\; it need not contain any files, but it must exist. Typical invocation of the hex plot is shown in Figure SOP 4.1.

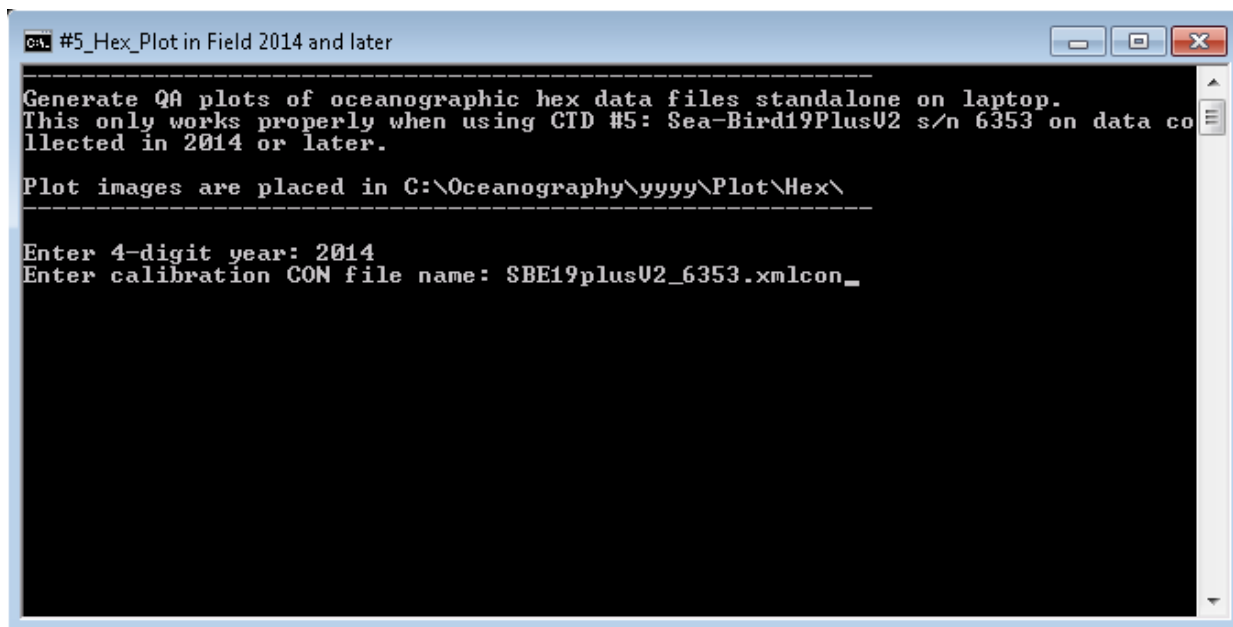


Figure SOP 4.1. Screen appearance when calling up a hex plot in the field.

Two plots are generated for every cast present on the laptop for the cruise year. They may be viewed using the Windows Explorer application. Scroll to the pair of JPG files that reflect the first cast of the day and double-click their names. If any signals appear abnormal, the equipment should be diagnosed for faults before performing additional casts.

2 Field Operations

2.1 Select Sampling Sequence

The Vessel Operator and Project Leader will work together to determine the order in which to occupy stations. Consideration for efficiency, personnel, and vessel and equipment safety should be taken into account when assessing weather conditions and the short-term forecast. It is desirable to occupy stations south of Station 04 on the incoming tide for data collection consistency purposes, but it is more important that all target stations are occupied.

2.2 Navigate to Station

The Vessel Operator will navigate to each station in turn using GPS navigation and ensure that the CTD cast is initiated within 200 m of the predefined station location.

2.3 Complete CTD Station Log

See Appendix A for a listing of the nominal station locations and depths. See Appendix B for a copy of the standard log form. At the start of a new field log sheet, fill out the top header information, including:

1. Vessel name
2. Cruise identifier (e.g., "March 2014")
3. The CTD number employed (CTD number is local to the NPS SEAN system and defined in Appendix F)

4. The data dump number (sequential number for download. Check previous data dump log for current number to use. Also see Appendix B)
5. The names of observers responsible for conducting the CTD cast

At the beginning of the CTD cast, record on the field log sheet:

1. The sequential cast number (01, 02, 03, 04, ...). Be aware that CTD #1 firmware starts numbering with cast 00, while CTD #5 starts numbering with cast 01.
2. The station identifier (01, 04, 07, ...).
3. The latitude and longitude of the cast location, using decimal degrees in WGS 84 datum. (Alternatively, mark a waypoint on the GPS and record the waypoint number in the logbook. See Section 2.10, below.)
4. The GPS waypoint number for future reference on the cruise.
5. The date and time at the station. Record time as GMT date and time; note there are different offsets for Alaska Standard Time (add nine hours) and Alaska Daylight Savings Time (add eight hours).
6. The bottom depth as measured by the fathometer (or the previously known depth for that station if the fathometer is not operating reliably).
7. The target depth for the CTD (i.e., the amount of line to pay out).
8. Comments documenting any item of note associated with this cast. Use extra room on the bottom or the back of the field log sheet if needed.

2.4 Prepare the CTD

1. Remove the syringe assembly from the temperature/salinity intake duct fitting.
2. Remove the DO sensor closed tubing loop and securely reconnect the sensor to the in-line CTD tubing.
3. Remove any sensor protective caps (e.g., PAR sensor and fluorometer).
4. Check to make sure the dummy plug is securely attached to the end of the data transmission connection.

2.5 Initiate Data Logging

Slide the magnetic switch all the way to the “ON” position. See Figure SOP 4.2 for details of the CTD sensor layout and on/off switch location.

2.6 Equilibrate the CTD Just Below the Surface

Lower the CTD into the water, just below the surface, to equilibrate for a minimum of two minutes. Record the time “on” in the field log sheet. Employ a stopwatch with timer alarm to ensure a full 120-second soak period is observed. This equilibration time will allow 45 seconds for the pump to turn on, time for the instrument to adjust to ambient temperature, and time for the conductivity cell to flush. Be aware the data processing program is configured to remove the first 90 seconds of data collected from the time the switch is set to on, so short soaks will cause lost data points. During this

two-minute soak period, fill out the rest of the information for that cast on the field log sheet (cast number, station number, latitude/longitude, waypoint, date and time, fathometer, and target depth).

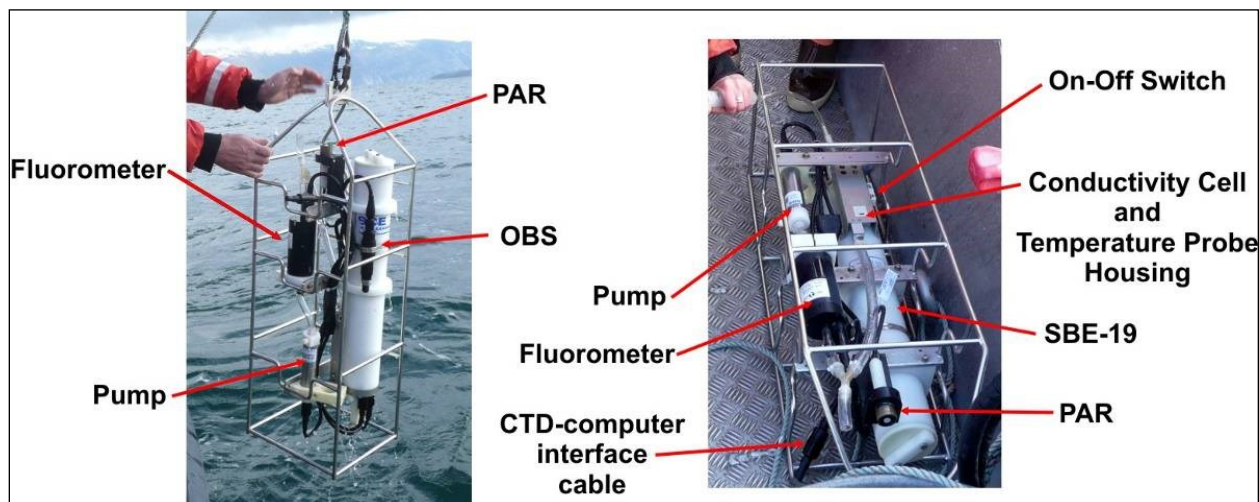


Figure SOP 4.2. Typical location of SBE-19 CTD sensors and on/off switch. CTD #1 is illustrated. Other CTDs may have somewhat different physical configurations.

2.7 Lower CTD to Target Depth

Lower the CTD using 3/8" nylon three-braid line marked at 10-m intervals. The lowering speed should be 30 m per minute (.5 m per second) for the uppermost 50 m and can be increased to 60 m per minute (1 m per second) below 50 m depth. This allows higher resolution (more data samples) for the upper portion of the water column that is most dynamic seasonally, most important to determining water column stability, and of greatest interest regarding primary productivity. Blue tape markers indicate 10-m intervals, red tape indicates 50-m intervals, and green tape indicates 100-m intervals. The instrument should be lowered to no more than 90% of the fathometer depth measured at the station or 10 m above the bottom, whichever is greatest, and never more than the rated maximum depth of 600 m. As a safety precaution, the CTD is never lowered to more than 550 m.

An experienced Project Leader is afforded some discretion with regard to the amount of line paid out in order to achieve the desired cast depth. This is quite straightforward in conditions of no wind or current (merely pay out an amount of line equal to the target depth); however, local conditions frequently cause the vessel and deployed CTD to drift away from each other, resulting in an apparent line angle (from vertical) at the surface, meaning the CTD will not reach the target depth. Based on experience, and using an abundance of caution, the Project Leader may release additional line in order to allow the CTD to more closely approach the station target depth.

2.8 Haul CTD Back to Surface

Retrieve the CTD with a power block/davit or a longline drum. Note that data are collected by the CTD on both the down- and up-casts. The up-cast data are not typically used for analysis (down-cast data are more accurate because the sensors are receiving and measuring a nearly undisturbed water column on the way down). However, occasionally up-cast data may need to be used if there are problems with the down-cast or its resulting data. CTD retrieval speeds are the same as for the down-

cast: 1 m per second up to 50 m depth, then 0.5 m per second from there to the surface. Be careful as the instrument nears the surface, taking care to control the power block so the CTD is not jerked up out of the water and into the davit block or against the side of the boat (watch for the red warning tapes). Be particularly careful when swinging the instrument and davit over the rail and lowering the CTD onto the deck.

2.9 Terminate Data Logging

Turn the instrument off with the magnetic switch (slide all the way to the “OFF” position).

2.10 Complete CTD Station Log

Record any irregularities about the cast on the field log sheet. Include comments about such events as the magnetic switch arriving at the surface in the “OFF” position (forcing a repeat of that station’s cast), information about obvious surface conditions (turbidity, evidence of phytoplankton bloom), situations resulting in significant line angle and causing additional line to be added to achieve the target cast depth, etc. If you marked a GPS waypoint for the cast’s initial location and time, enter those coordinates onto the form now in case the waypoint is lost when others use the GPS later.

2.11 Triton X-100/Freshwater Rinse

Using the wash bottle, rinse the optical sensors (PAR, fluorometer) with distilled water. Flush the conductivity cell with Triton X-100 solution followed by distilled fresh water as explained in SOP 1. The syringe/tubing assembly should be left attached to the cell to avoid drying out between casts (except for in freezing weather: see SOP 1, Section 1.1).

2.12 Stow CTD for Transit

Secure the CTD for transit to the next station, using special care for rough sea conditions. When air temperature is greater than 5 °C, the CTD may remain on deck. In freezing and near-freezing conditions, bring the CTD into the vessel cabin between stations and during transit to avoid freezing and damage to the conductivity cell.

2.13 Download CTD Data to Laptop

At the end of the day, download the CTD cast data to a local computer using the process described in SOP 5.

3 Postcruise Operations

3.1 Long-term Storage (Between Surveys) of the CTD and Associated Hardware and Spares

Stow CTD until the next field effort. For long-term storage procedures, see SOP 1.

For overnight short-term storage, the CTD may be left on board the survey vessel. Bring the CTD into the cabin to avoid freezing and damage to the conductivity cell.

3.2 Data Transfer to Network

After each cruise, transfer accumulated data from the laptop to the network according to details of SOP 5.

3.3 *Plot Data*

Once the cruise data have been transferred to the network, plot each cast for quality assurance purposes using SOP 7.