Miscellaneous Applications

Sea-Bird Scientific University Module 6

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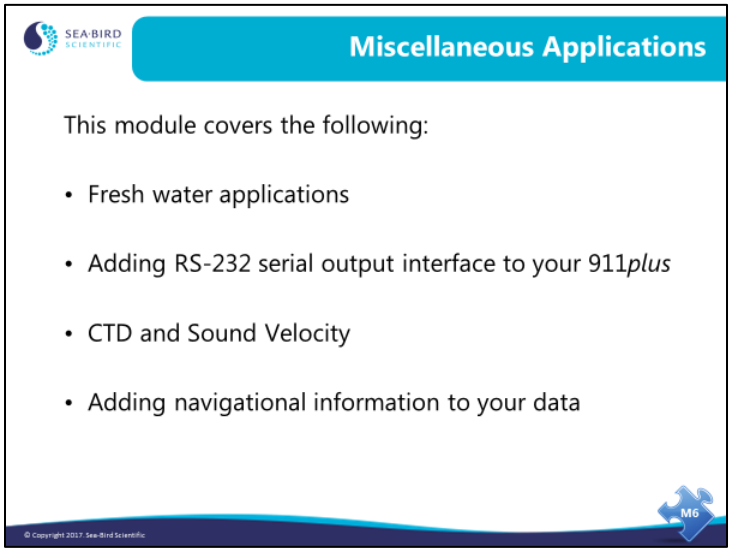
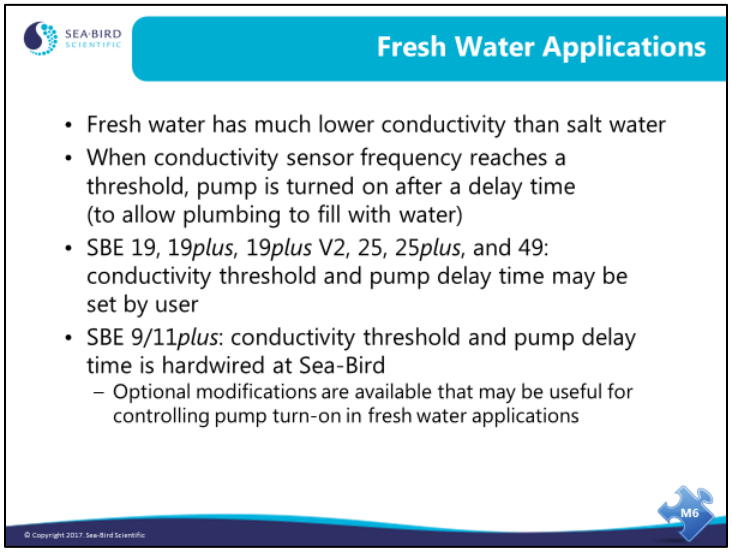
Overview



In this module we will discuss somewhat less common applications. By the end of this module you should be able to:

- Operate your CTD in fresh water.
- Output serial data from 911 plus.
- Speak knowledgeably about techniques of measuring sound velocity.
- Add navigational information to your CTD data.

Fresh Water Applications



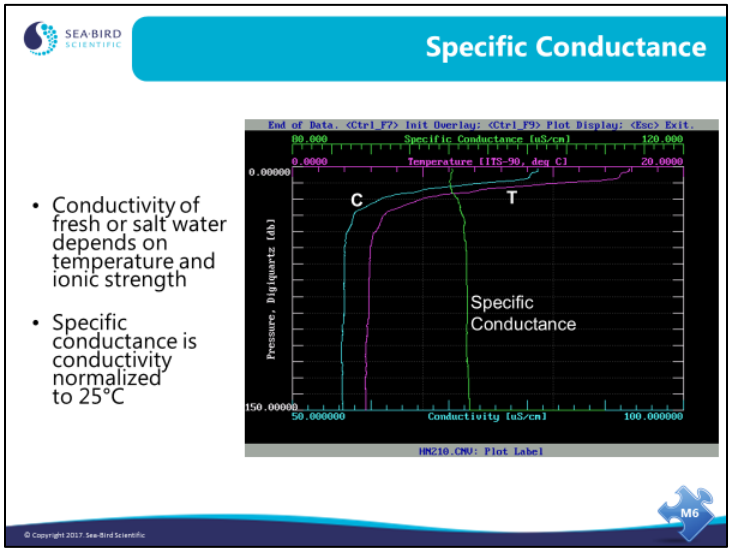
Using a CTD in fresh water requires some modification of the instrument setup for internally recording instruments or of hardware for the 9*plus*. The issue is the pump turn-on signal. As delivered, Sea-Bird instruments are configured for use in saltwater. They sense the rising conductivity frequency associated with immersion in saltwater, and turn on the pump after a short delay that allows the air in the plumbing to escape.

In internally recorded instruments and the SBE 49, the user can set the pump turn-on threshold frequency. For fresh water, this should be set to 5 Hz above the frequency at zero conductivity (wet cell rinsed with deionized water). However, values closer to the zero frequency may be needed; check your data carefully to ensure the pump is turning on properly. The user can also set the pump delay time (delay *after* pump turn-on frequency is reached and before the pump turns on, allowing time for the plumbing to fill with water).

For the SBE 9*plus*, Sea-Bird hardwires the pump turn-on frequency and pump delay time (60 sec). However, one of the following optional modifications of the 9*plus* electronics may be useful for controlling pump turn-on in fresh water applications:

- Operator control via manual turn-on / turn-off of the pump from the computer keyboard, sent through the *Modem Channel* connector in the 11*plus* Deck Unit.
- Automatic turn-on of the pump 60 seconds after a water contact pin (on special dummy plug that connects to JB6 on 9*plus* end cap) enters the water. Automatic turn-off of the pump when water contact pin leaves the water.

Specific Conductance



The conductivity of fresh or salt water is strongly dependent on temperature, as shown above by the similarity in the shape of the C and T plots. Specific conductance is typically used for fresh water applications, where the salinity equation is out-of-range. It allows us to visualize the conductivity without the temperature dependence, providing some indication of the amount of salts in the water.

The equation shown below has the effect of normalizing the conductivity to 25° C.

$$\text{Specific Conductance}\left(\mu mhos/cm\right) = \frac{\left(C \times 10{,}000\right)}{\left(1 + A \times \left(T - 25\right)\right)}$$

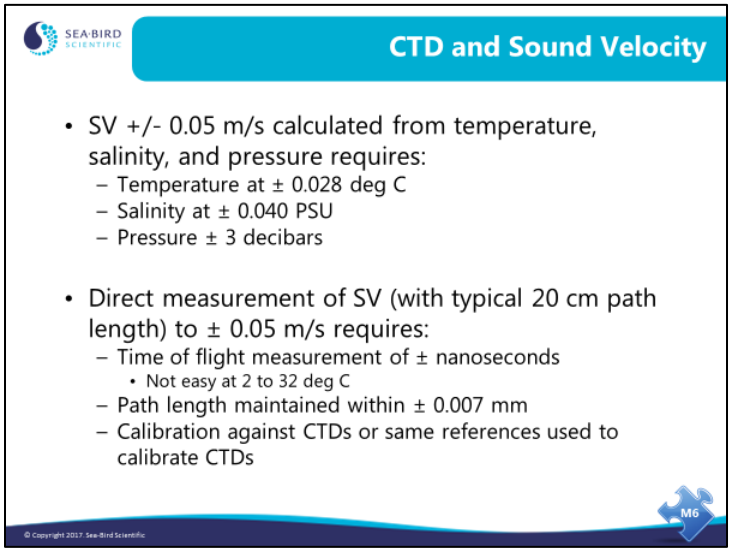
where:

A = 0.019 to 0.020 = thermal coefficient of conductivity for natural salt ion solutions (Seasoft uses this formula with A = 0.020)

C = conductivity [S/m]

T = temperature [°C]

Sound Velocity



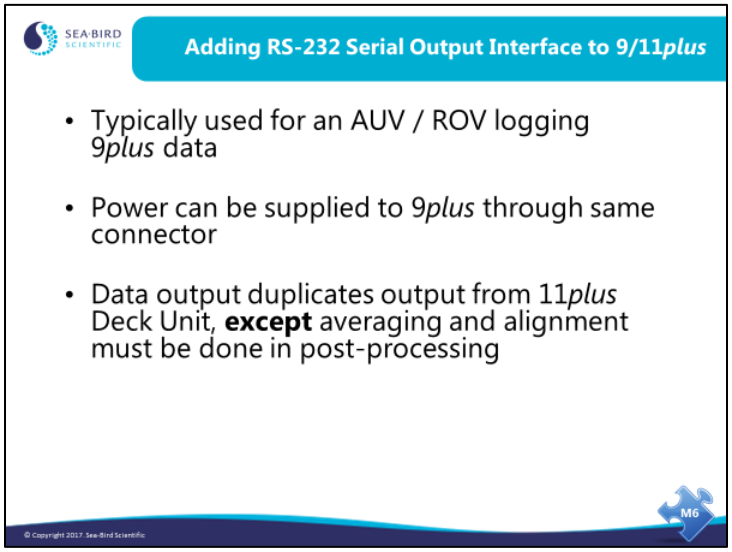
Sound velocity (SV) sensors measure the flight time of a pulse of sound between transducers. To meet the ± 0.05 m/s specification of a typical 20 cm path SV sensor, the time of flight must be measured to within about 4 nanoseconds. The electronics to perform this are difficult but feasible; however, the time delays associated with the acoustic transducers cannot be maintained over pressure and temperature.

While the dependence of SV on time and distance implies that calibration is not required, in practice the distance (within necessary accuracy of 20 cm * [0.05 m/sec/1500 m/sec] = 0.0007 cm = 0.007 mm, at nominal 1500 m/s SV) cannot be established from a physical measurement of path length. This is not caused by uncertainties in mechanical dimensions; but by uncertainties in how deep into the acoustic transducer the sound pulse is when the electrical signal is generated. Accordingly, all direct SV sensors are bath-calibrated (against a CTD or the usual references used to calibrate CTDs - SPRT, Autosal, etc.).

To meet a 0.05 m/s specification, a CTD can be wrong in temperature by 0.028 °C; in salinity by 0.04 PSU; and in pressure by 3 decibars.

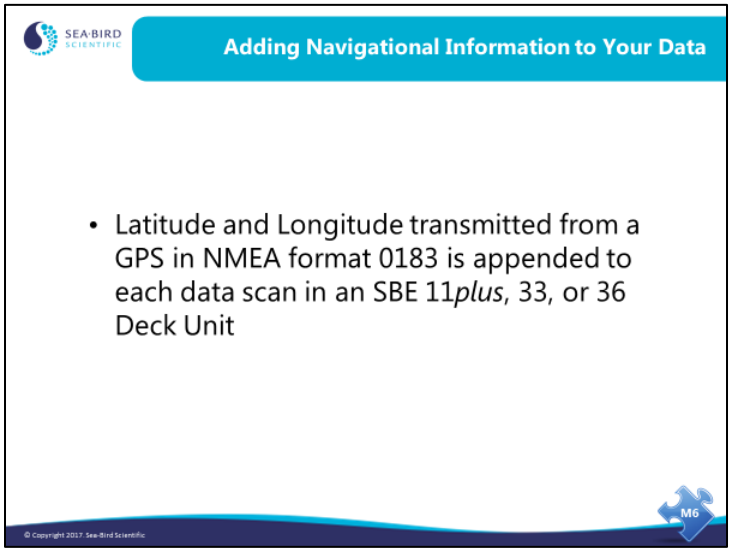
The linkage between CTD and SV (Chen and Millero) is part of the equation of state 1980. This international usage and recognition not only leads to the highest level of accuracy, but ensures that CTD-based SV measurements are intercomparable no matter where and when taken.

Adding RS-232 Serial Output Interface to 911*plus*



As an option, an RS-232 Serial Output interface can be installed in the 9*plus*, in place of the interface for the G.O. 1015 Rosette. The 9*plus* transmits the serial data through the 3-pin JT4 connector on the top end cap, at 19200 baud, 8 data bits, no parity.

Adding Navigational Data



NMEA = National Marine Electronic Association.

In Seasave, navigational data transmitted in NMEA format 0183 is appended to real-time data if you select *NMEA position data added* in the instrument configuration (*.con* or *.xmlcon*) file dialog box. Navigational data is also added to the file header at the start of the cast. And, it can be written to a separate .nav file at user-selected points in the cast.

A NMEA interface is available in all Sea-Bird deck units – SBE 11*plus*, 33, and 36. The *Seacat/Sealogger RS-232 and Navigation Interface Box* (sometimes called NMEA Interface Box or Opto-Box), used with internally recording instruments or the SBE 21 thermosalinograph, also has a NMEA interface. The NMEA interface in these deck units / interface boxes require data in one of the formats shown above. In addition, the NMEA data must meet the specific baud, data bits, and parity requirements of the deck unit / interface box (see deck unit / interface box manual).

Recent changes to Seasave allow acquisition of data from a NMEA device connected directly to the computer (instead of to a deck unit / interface box) for many of our instruments. The selection of connection via computer or deck unit / interface box is made in the instrument configuration file. Seasave appends the NMEA data to the CTD data stream in the same way, regardless of which acquisition method was used.