Monitoring Tidal Fluctuations with Level TROLL® 700 and Aqua TROLL® 200 Instruments

November 2008

Overview

Tidal datums are base elevations that are used as references from which to calculate water heights or depths (NOAA, 2000). They are defined in terms of a certain phase of the tide at a specific location and are referenced to fixed points known as bench marks.

Need for tidal monitoring data

Construction of and navigation through shallow ports, waterways, and bridges requires knowledge of the time and height of the tides. Additionally, scientists monitor tides when tracking the movement of pollutants or the life cycles of animals and plants that depend on tides (NOAA, 2008). Finally, altered sea levels, such as those brought about by climate change, can affect local tides and necessitate monitoring (NCCOS, 2008).

To meet these needs, researchers can use one or more Level TROLL® 700 instruments or Aqua TROLL® 200 instruments to continuously monitor and report tidal fluctuations.

Choosing the proper instrument

Use the Level TROLL 700 instrument with Linear Average logging in applications where the specific gravity of the water is not likely to change, such as oceans or large lakes.

Use the Aqua TROLL 200 with Linear Average logging and Dynamic Density Compensation (In-Situ, 2008) in applications where the specific gravity of the water may change due to tides, or in estuaries where the interface between fresh and brackish water fluctuates. Dynamic Density Compensation allows the Aqua TROLL 200 instrument to dynamically compute specific gravity based on water density measurements and the local gravitational factor.
**Configure the Level TROLL 700 or Aqua TROLL 200 instrument**

**Equipment needed**
- Level TROLL® 700 or Aqua TROLL® 200 instrument
- Win-Situ® 5 PC software or Win-Situ® Mobile software
- External power supply such as a solar panel or TROLL® battery pack
- Vented RuggedCable® System
- Large desiccant
- TROLL® Com communication cable
- Modified PVC or protective casing for the instrument
- Survey equipment

**Configure the software**
1. Install Win-Situ 5 software to the local hard drive from the In-Situ® software CD or web site.
2. Attach a direct connect TROLL Com to the Level TROLL 700 or Aqua TROLL 200.
3. Connect the TROLL Com into a USB or serial port on a desktop/laptop PC, or into the serial port on a RuggedReader® handheld PC.
4. Open Win-Situ 5 or Win-Situ Mobile software and establish communication with the instrument.

*Hint: On first connection, be sure to select the correct COM port for a USB or serial connection, then connect to the device.*

5. Synchronize the PC and instrument clocks, if necessary.
6. To set up a data log, follow the steps in the Logging Setup Wizard, accessed under the Logging tab.
7. Select the Site where this set of data will be logged and supply a name for the log.
8. Select the parameters to measure. (Make sure to choose Level/Depth option.) Choose the measurement units, and specify the order in which the selected parameters will be logged.
9. When prompted to choose a logging method, choose Linear Average¹.

*Note: This method of data collection 1) takes a user-specified number of measurements at a user-specified interval, 2) averages the measurements, and 3) logs the average to the instrument’s memory at a user-specified frequency.*

10. Configure the log interval.²
   a. Select the number of samples to average:
      - Minimum: 2
      - Maximum: 600
   b. Specify how far apart the fast samples for averaging should be:
      - Minimum interval (fastest sampling): 1 sec
      - Maximum interval (slowest sampling): 6 min
   c. Specify the logging interval—how often measurements will be averaged and stored:
      - Minimum interval (fastest logging): 1 min
      - Maximum interval (slowest logging): 40 days

¹ The Aqua TROLL 200 instrument requires external power when running in Linear Average mode. External power is also recommended for the Level TROLL 700 running in Linear Average mode.

² The U.S. Naval Oceanographic Office protocol requires its devices to take measurements at 1-second intervals for 6 minutes, and average the measurements and log the average every 15 minutes. The screen above shows how the inputs would be entered into the software to achieve this result (6 minutes x 60 measurements per minute = 360 measurements).
11. Select the start condition, stop condition, and specify how to handle a full device memory.
   a. A manual start will initiate the sample measurement immediately after the user presses the start button. The software will store the first averaged data point based on the input values.
   b. With a scheduled start, the logged value in the report is an averaged value. Therefore, the instrument will begin logging before the scheduled start time entered here so that it can compute and log an averaged value.

12. Select Surface Water Elevation or Surface Water Gauge Height/Stage as an output type for the level data.

13. Upon determining the value of the Level Reference, choose an option to select when the Level Reference is applied:
   a. Set new reference now: With this option, the current probe reading is set equal to the Level Reference to create the “offset” that takes effect at the start of the data log. The log header will show the probe reading at the time that the Level Reference is entered. Choose this option if you are in the field with an instrument that:
      • Is deployed on a communication cable
      • Has an active software connection when the device is installed in its final position in the water
   b. Set first logged reading to any value (e.g., a staff gage): Choose this option if you are deploying the instrument on a wire hanger because communication will not be possible when it is submerged.
   c. Remind me to set reference later: Use this option if you are deploying the instrument on a communication cable and want to postpone entering the Level Reference until later. (Do not use this option with a scheduled start.)

14. Enter the specific gravity.
   a. For the Aqua TROLL® 200, select Dynamic density with gravitational compensation.
   b. Click the Configure button.
   c. Enter the latitude and elevation of the site. Click OK.
   
   Hint: Latitude and elevation data will be automatically pulled if they are in the site record.

15. Review the Summary screen and click OK if everything is correct. Click Back to modify entries.

16. Install the TROLL® instrument in its monitoring location. You may place the instrument inside a traditional crest stage gage casing. Secure it so that it does not move during the test period.
Surveying the site

Upon securely installing your instrument, conduct a thorough site survey that relates the sensor to a known datum, or bench mark. A bench mark is defined by National Oceanic and Atmospheric Administration (2000) as “A fixed physical object or mark used as a reference for a vertical datum.” As the land-water interface is constantly in flux, one or more permanent bench marks, tied to an accurate field survey, are an integral part of every gaging station. NOAA (2000) recommends The User’s Guide for the Installation of Bench Marks and Leveling Requirements for Water Level Stations as a reference for bench mark installation and leveling. Before removing the sensor from the site, repeat the survey to determine whether the sensor shifted during its deployment.

Conclusion

The Level TROLL® 700 and Aqua TROLL® 200, featuring Linear Average sampling, are valuable tools in applications such as tidal monitoring, where constant water level movement and changing specific gravity hinders precise level measurements.

Field engineers should remember the following points:

1. Linear Average sampling can quickly deplete the internal battery. Use an additional battery pack or telemetry system solar panel to prevent outages.
2. Evaluate the deployment site to determine whether the Level TROLL 700 is optimal (in situations where specific gravity is constant) or if the Aqua TROLL 200 is preferred (in situations where the specific gravity is constantly in flux).

For a very detailed explanation of Linear Averaging, see the Linear Averaging technical note at www.in-situ.com. This document contains in-depth explanations of measurement intervals, time stamps, and power requirements.

Finally, the Level TROLL and Aqua TROLL instruments offer standard Modbus (RS485), SDI-12 and 4-20 mA outputs and are easily connected to a TROLL® Link or third-party telemetry system for remote data acquisition.

References


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