Collecting and Processing ADCP Current and Discharge Data in Rivers

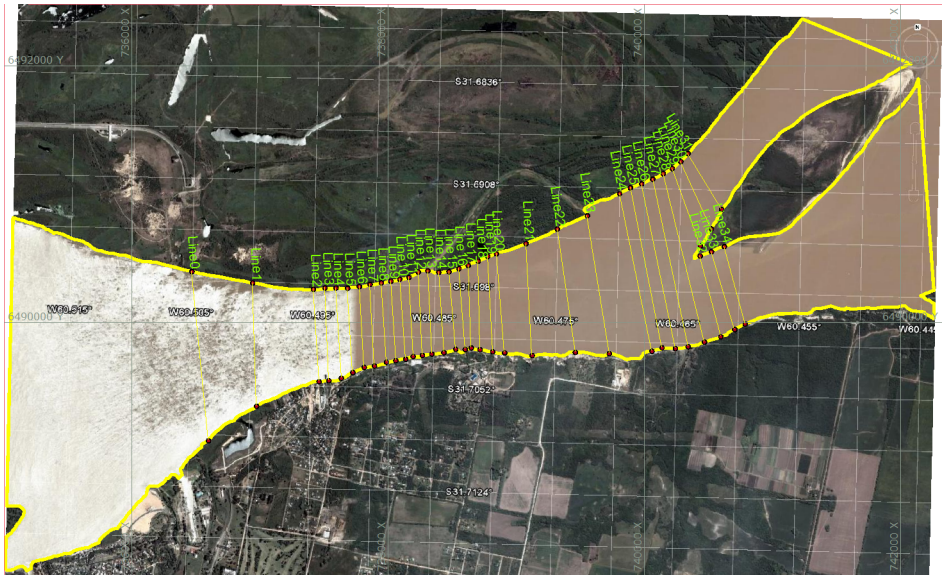
By Carlos Tejada

As with any other sensor, HYPACK can help you design, collect, process and obtain final products of your data, in this case ADCP data. In this article I will give you some tips to use your ADCP with HYPACK®, although some of the procedures presented here pertain only to TRDIs ADCPs and the Rio Grande ADCP especially.

DESIGN

Besides defining the geodetic parameters and usage of the visual reference that you may have, we recommend that you specify the cross section lines that you want to follow to determine the discharge. Remember that it is always desirable to run reciprocal lines, as you would do if you were conducting a Latency Test.

FIGURE 1. *Defining your lines in HYPACK® Shell*



COLLECTION

Besides your ADCP, remember that you will need a GPS, a device to measure your distance to the bank and a device to measure the water temperature on the surface.

The GPS is to use the HYPACK® navigation tools and correctly position all your measurements, the water temperature will be to determine the speed of sound during the calibration process, and the distance measuring device will be used to determine the distance from the starting or ending point to the water bank.

1. **Measure the sound velocity or the superficial temperature**, so you can calibrate your system. The principle behind any ADCP is Doppler and it's calculated by this equation:
   $V = f_D/2f_S*C$, so you need to know the speed of sound.

V = Velocity

f_D = Frequency shifted by Doppler effect

f_S = Frequency of the source

C = Speed of Sound.

2. **Calibrate your compass**, preferably using the procedures available in the manufacturer's data collection software. You will need to turn your boat around, slowly and at a constant speed, for the system to calibrate itself. At the end of the test, it will give you the result of your calibration. Any value less than a degree is acceptable. A value between 1 and 2 is also OK, but normally it's an indication that the compass calibration may not be as accurate as desired.
3. **Check for moving bed conditions**. There are two types of moving bed tests: the stationary and the loop moving bed test.

   Stationary moving bed tests need to be conducted in several points of your cross section for approximately 5 minutes. It is important that you use your navigational tools in HYPACK® to help you maintain your position. After you finish collecting your data, you will need to look at it using the bottom-tracking option. If you see an apparent movement of the boat when you know you have been on the same spot, that will be an indication that you have a moving bed. Your ADCP program will incorporate that correction to your discharge and velocity values.

   More information on moving bed tests and ADCP measurement procedures is available at http://pubs.usgs.gov/tm/3a22/.

   If you have good positioning (DGPS at least), and you are only interested in mapping, this procedure is less important.

FIGURE 2. *Moving Bed Effect*

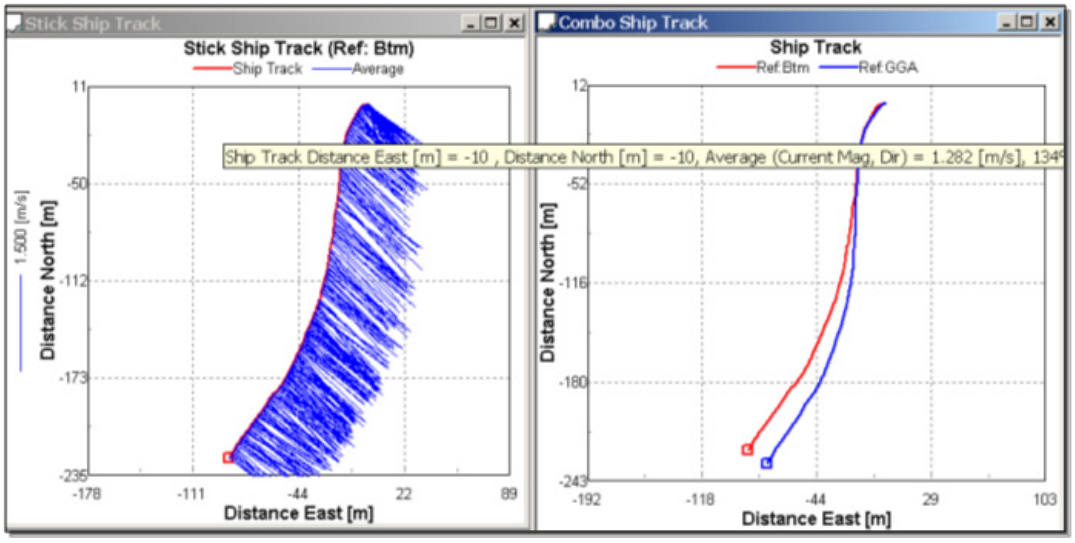
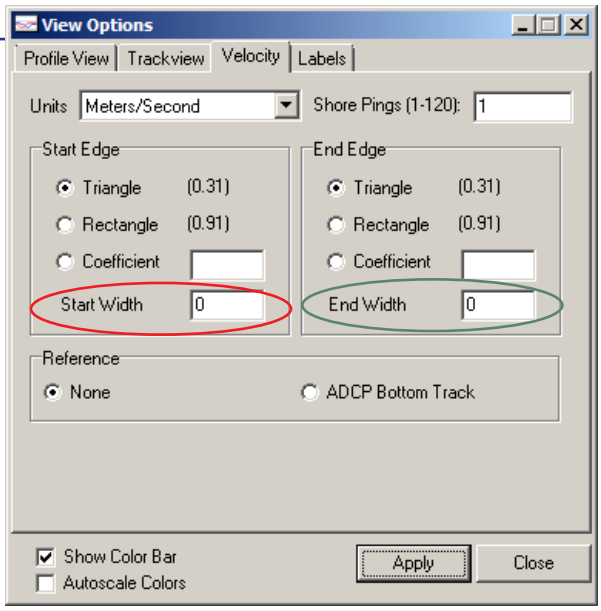


Figure 2 is a screen capture of a transect collected with an TRDI ADCP using an Differential GPS. The stick ship track illustrates the measured movement of the boat referenced to the bottom tracking (red line) and GPS (blue line). Notice on the illustration on the right that the bottom tracking boat path is shifted in the upstream direction relative to the GPS ship track. This is a result of a moving bed at the site.

Once you finish this test, you are ready to collect your data.

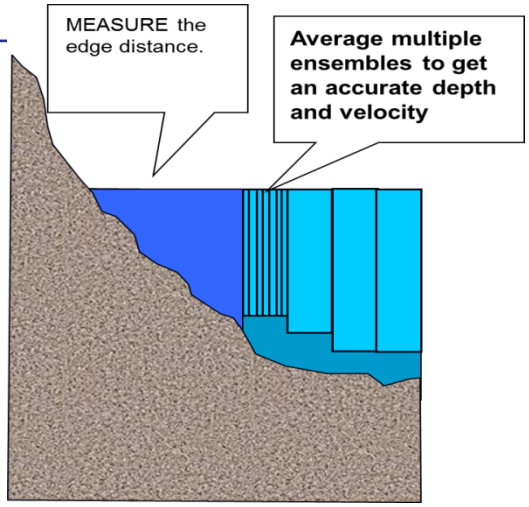
1. **Measure the distance of your boat to the bank and input that information in the tap shown** in Figure 3. The program will use this data to calculate the discharge at the starting edge of water.

FIGURE 3. *View Options in ADCP Profile*



2. Enter the coefficient that best describes your initial side slope.
3. Run your cross section at the minimum possible boat speed, collecting at least 180 ensembles to get a good discharge value.
4. When you get to the other edge of water, measure the distance to the bank and enter that as the End Width value.
5. Enter the appropriate coefficient for this edge.
6. Enter the number of Shore Pings you want to use to calculate the discharge in this edge areas—10 seems to be a good number to produce this calculation.

FIGURE 4. *Section Edges*



7. Once you calculate the total discharge for this section, review your results and make sure you got a logical value.

We suggest that you run a reciprocal line, following the same procedure and comparing the new discharge value, with the first one. Those two values have to be in agreement within 5%. If there is a greater difference, you need to look for a possible explanation, or you will need to run another pair of lines to make sure you obtain the most accurate value (USGS requirements are not described here. We require you to sample the flow for a minimum of 720 sec and have at least 2 transects, assuming that the flow is steady).

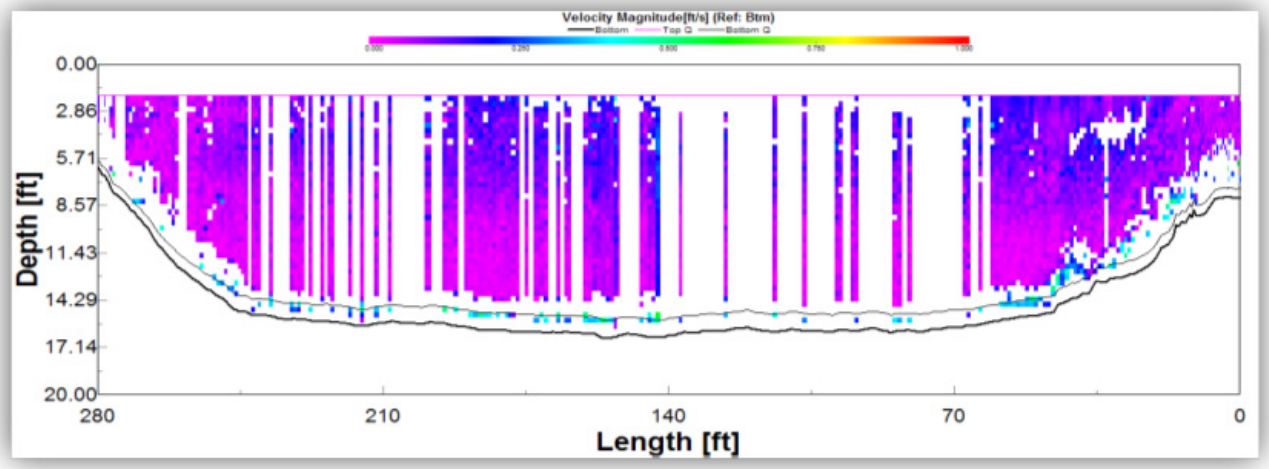
PROCESSING

We highly recommend that you process your data while you are at the project area and that can be done very easily with the software.

Be aware of the bad ensembles or the lost ones. If you get several of those in the deepest area of your cross section that also is the one with the highest current, that fill surely affect

your measurements, but if you have isolated bad ensembles, it won't have a big effect on the measurement. They will appear on your screen as white spaces (columns).

FIGURE 5. *Too many bad ensembles will affect your measurements*



At the moment we don't have a filtering tool in HYPACK®, so if you decide that you need to screen out your data, you will need to use the ADCP software to do that.

The other step that you should consider is to review your error velocity. This is calculated by the ADCP and shown by HYPACK® as a measure of the quality of your data. Look at your instrument manual for tables that will indicate the accepted values.

As you can see, the error velocity value will depend on the frequency of your sensor and the mode of operation. Also the smaller the cell, the higher error velocity.

FINAL PRODUCTS:

Once you have processed your data, you can print a report, by using the 'print' option in the 'File' menu.

Also you can plot your data and look at it in HYPACK® Shell, or export it to DXF format and have a 2D or 3D representation of your currents.

Be aware that you will have a current value for different vertical levels, so if you decide to plot them all, you will have one value on top of the other. In this case, you may want to define the with level you want to plot. The program will allow you to select one of several specific level values.

FIGURE 6. *ADCP data presented in HYPACK SHELL, you can select 2D or 3D vectors and also which level (depth) you want to display. It is also possible to define the colors.*