Processing Magnetometer Data in the SINGLE BEAM EDITOR

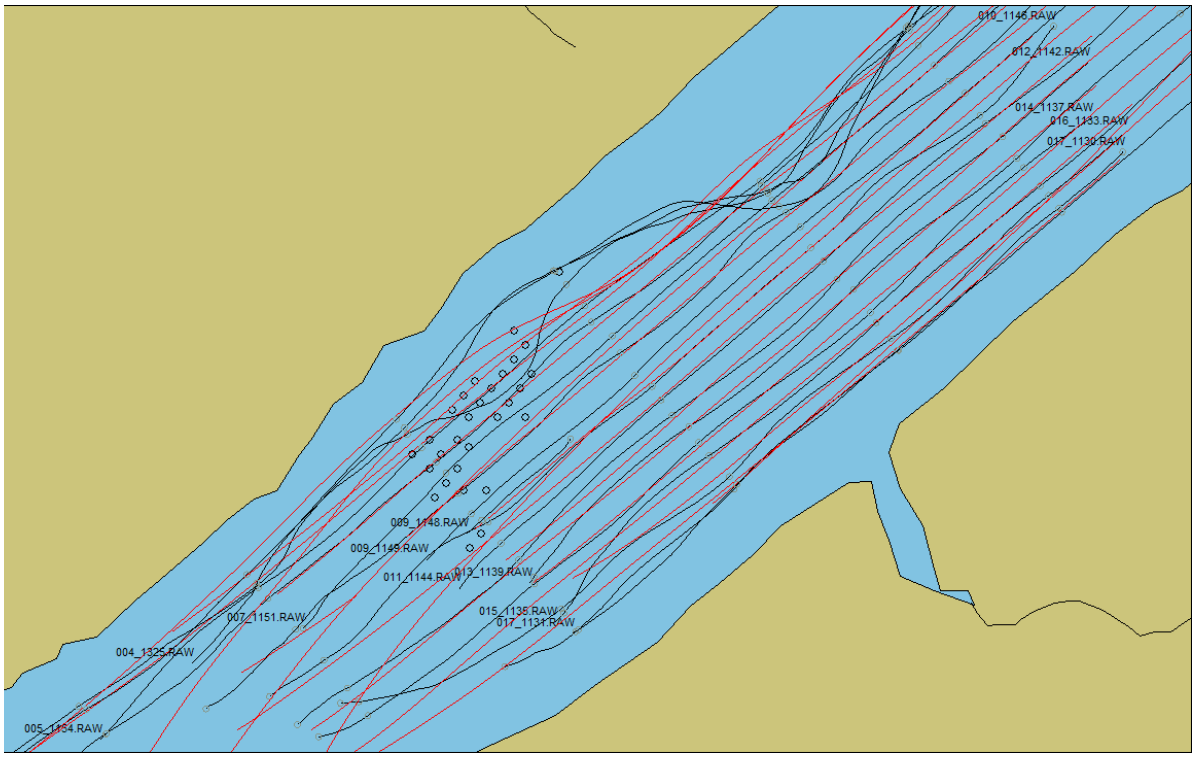
By Jerry Knisley

Many changes have been made to the processing of Magnetometer data in HYPACK®. A customer showed me a unique trick to normalize the numbers when it comes to processing magnetometer data. The only problem was that it wasn't easy unless you already had done it a thousand times like they had.

Basically, they took the data into Microsoft EXCEL and copied the gamma data so they had HYPACK® RAW records with both depth1 and depth2 as gamma readings. Once this was accomplished, they opened the file in the SINGLE BEAM EDITOR and turned off one of the depths. They removed all of the spikes in the data, subtracted depth 1 from depth 2 and they had a reading with values around normalized to remove diurnal effect. Like I said, "pretty neat trick". I asked Pat if we could make this easier and here are the results. I am very pleased with the changes but as always, if you have an idea how to make this better, please email me at Help@HYPACK.Com.

To utilize the features described in this article, you will need an update to the HYPACK® 2011 release because we were unable to complete the changes in time to have it included.

FIGURE 1. *The Area in Which the Survey was Conducted*

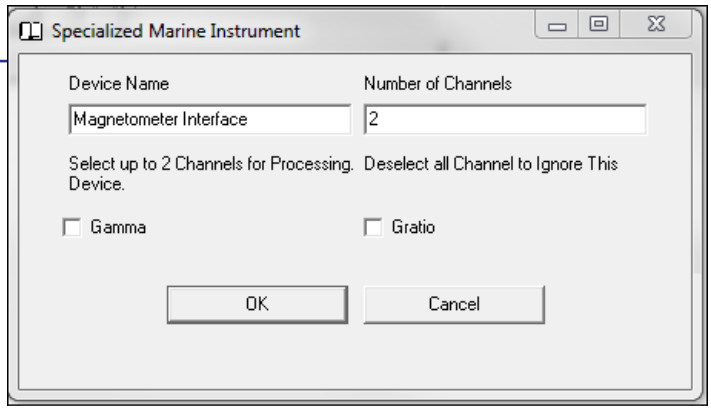


1. **Open Raw data file in Single Beam Editor**.

   When HYPACK® stores more than two values from a device as depths, it records an SMI record, which can be processed in the SINGLE BEAM EDITOR two values at a time. The Specialized Marine Instrument dialog enables you to specify the device and which two of its recorded values you wish to process. In Figure 2, the magnetometer was recorded

using the MAGNET.DLL with Gamma and Gratio recorded. (The Gratio value is the current gamma reading subtracted from the previous gamma reading.) If there were more values recorded there would be more check boxes and the editor will load only the first two chosen in the list order.

FIGURE 2. *Specialized Marine Instrument Dialog*

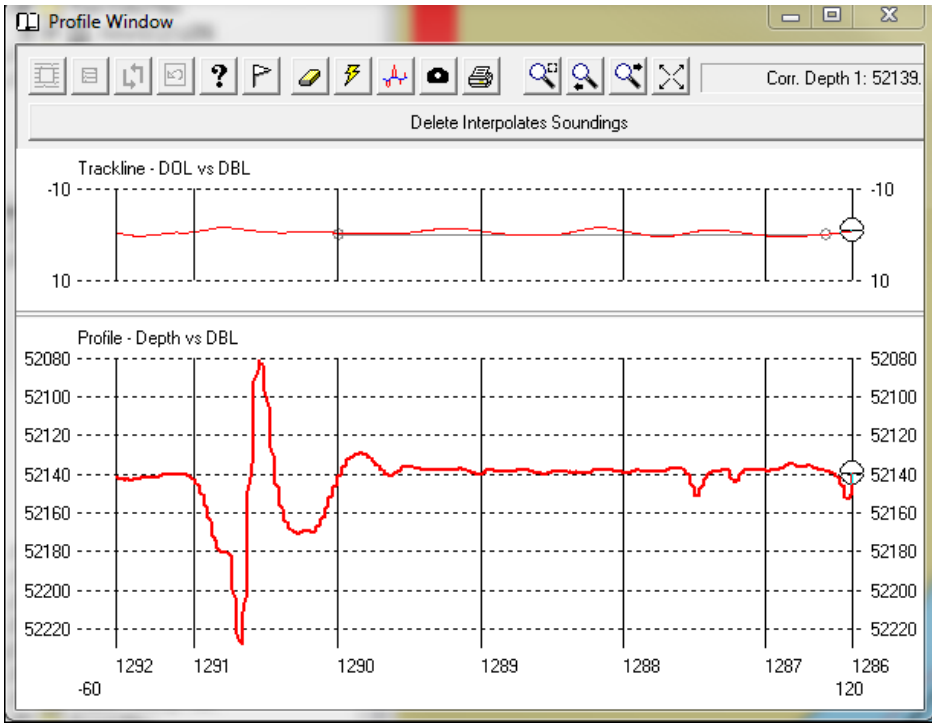


In the previous version of the SINGLE BEAM EDITOR, the Specialized Marine Instrument dialog appears first. This is changed in the required, updated version so that the READ PARAMETERS dialog appears before the SMI dialog.

Note: If the survey was conducted with an echosounder and you want to process its data, you can advance to the normal READ PARAMETERS and select the depth device by cancelling the SMI dialog.

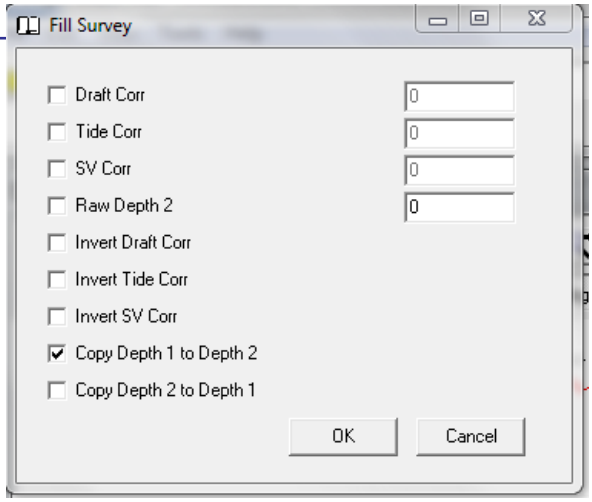
Once the data is loaded in the SINGLE BEAM EDITOR the profile will appear as it does in Figure 3. Notice that the gamma readings are in the range of 52,000. The dipolar target between events 1290 and 1291 has a minimum reading of 52080.82 and a maximum reading of 52228.23. The size of that target is not very intuitive, but we will soon get to that point.

FIGURE 3. *Profile of Data in the SINGLE BEAM EDITOR*



2. **Mirror the data in the file**.
   a. **Access the Fill Survey dialog by selecting EDIT-FILL SURVEY.**

FIGURE 4. *Fill Survey Dialog*

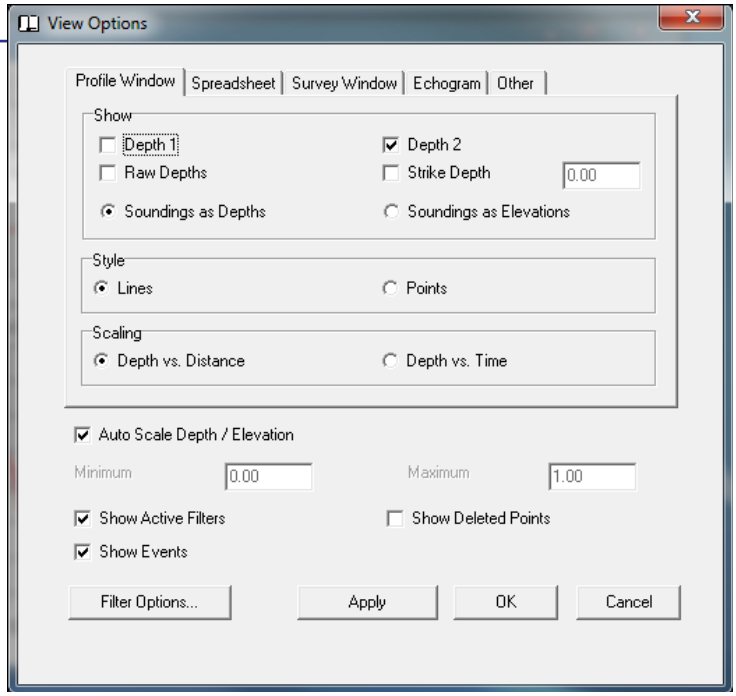


This is typically used to fix corrections like the draft and tide. Then Dave Maddock added the '**Copy Depth 1 to Depth 2**' and the '**Copy Depth2 to Depth1**' options. In most cases you will want to copy depth 1 to depth 2 so that both values are the Gamma readings.

   b. **Check the 'Copy Depth1 to Depth2' box and click [OK]**.

3. **Check to be sure that the changes were made**.

FIGURE 5. Enabling Only Depth2



   a. **Right-click on the Profile window and choose 'Display Options'.**
   b. **Disable the Depth 1.**
   c. **Enable Depth 2.**
   d. **Click [OK].**

      The profile should now be showing the same profile but it is blue, and actually it is Depth 2 data (Figure 6)

4. **Make sure that the delete operation interpolates the soundings**. If the DELETE REMOVES SOUNDINGS is visible in the profile window, click on that phrase to change modes to 'Delete Interpolates Soundings'. (If you fail to do this, you will have to redo this entire procedure.)
5. **Highlight and delete the targets**. (Figure 6) This is only going to delete them from Depth 2. It will actually generate a flat line in the editor.

   After dragging a box around the data, CTRL-I removes the data and creates a flat line of data but within the average of the readings. This is the diurnal part of the data. You may have to do this on small sections based upon the interference during the survey line.

   I chose an easy one for this example. I dragged a box around all of the data leaving a little outside on both ends. I could not go all the way to the end due to a change in gamma. I'll have to edit that manually later.

FIGURE 6. *Dragging a Box Around Data to be Deleted .*

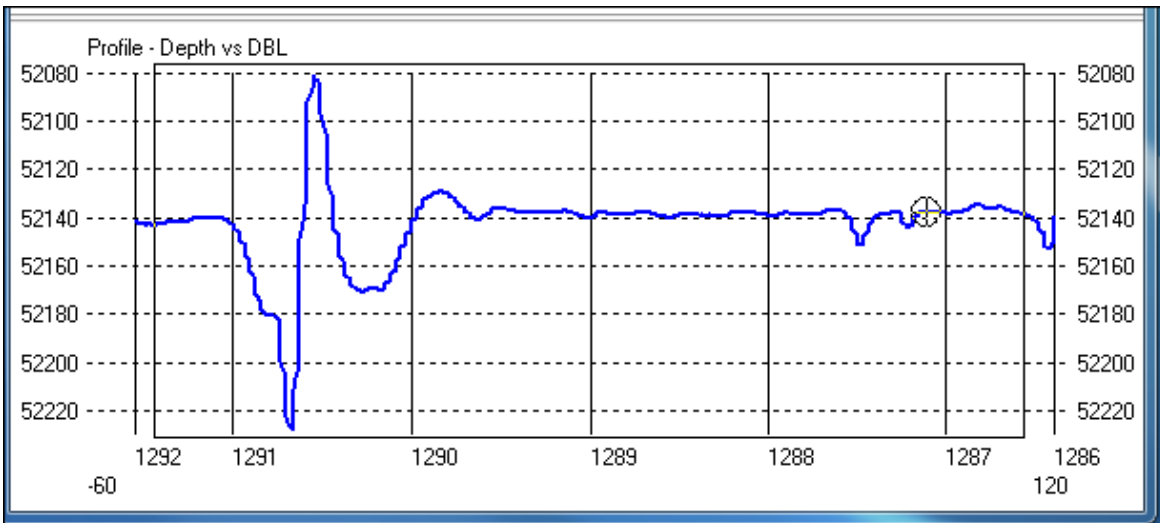
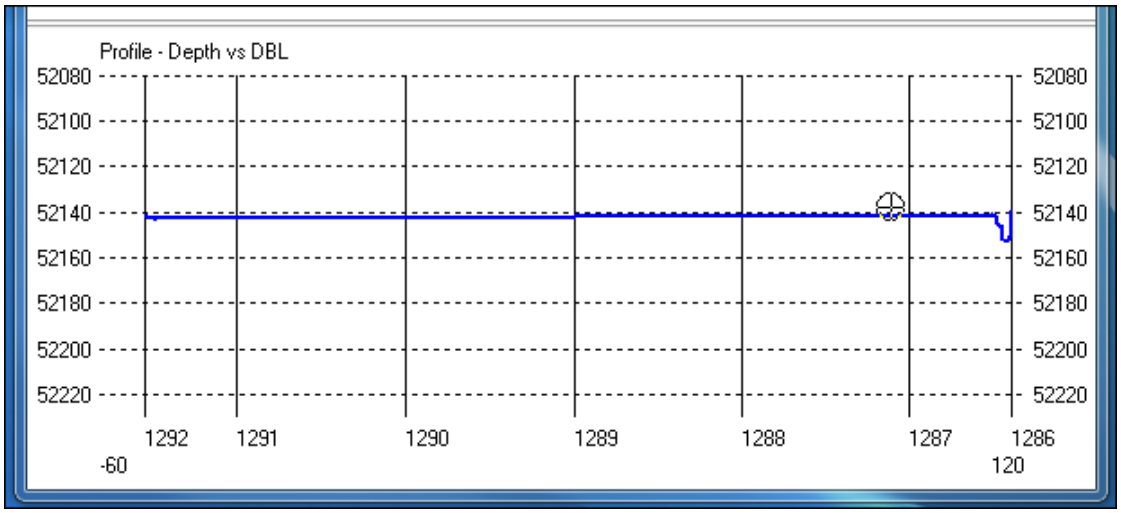


FIGURE 7. *Gamma Readings After Spikes are Removed*

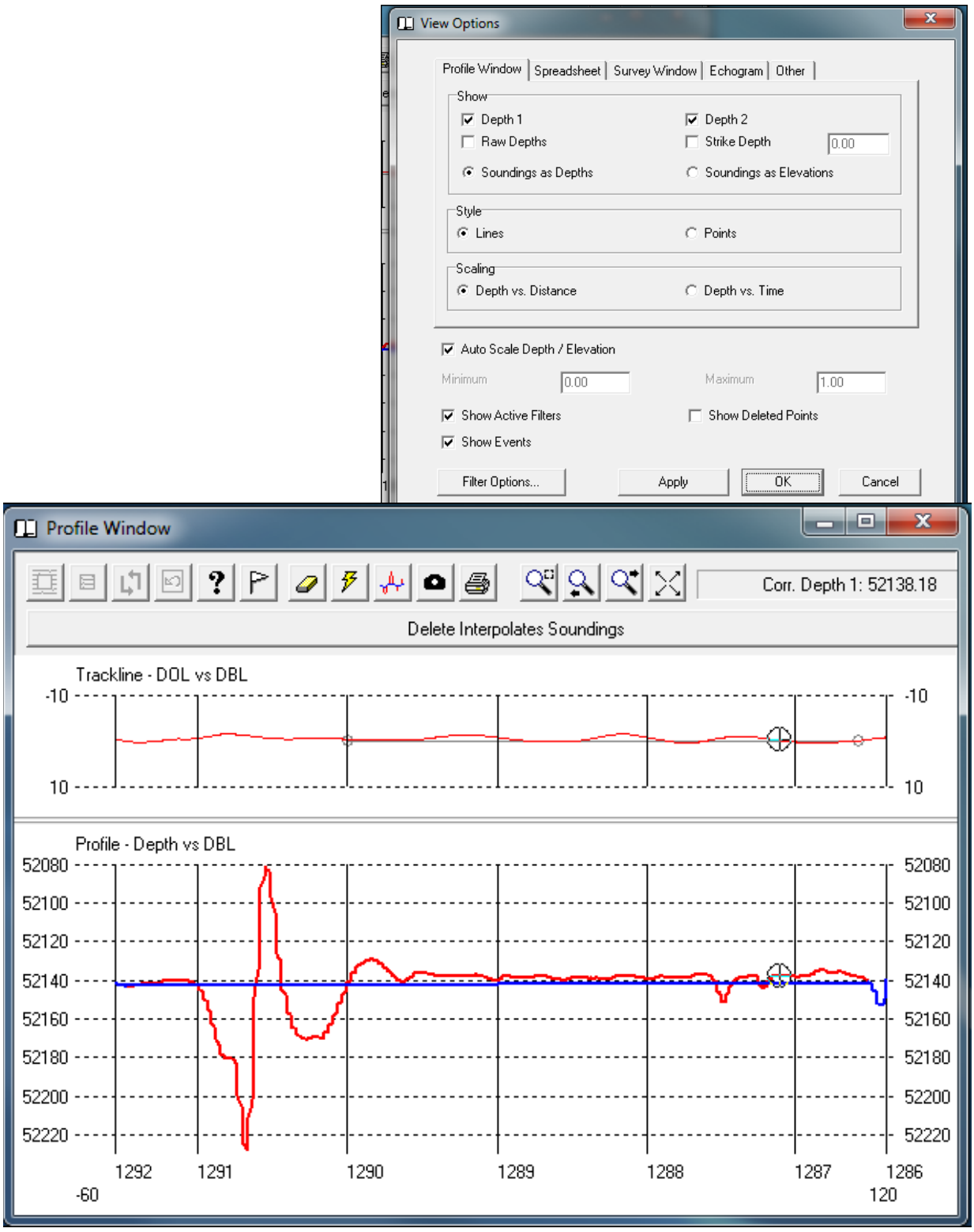


At first, I thought the same could be accomplished using -52140 as a tide value. Unfortunately, that only removes an average gamma that does not include an interference in the background.

You may find that a straight subtraction of an average Gamma reading as tide works with your data, but I have found using this other method does a much better job of removing interference and highlighting targets.

6. **Return to the View Options and re-enable the Depth 1 data.** Once the spikes have been removed we want to see the DEPTH 1 data as well as the DEPTH 2 data. In this screen shot I am showing the settings to show both sets of gamma readings, the one with spikes and our second set without them. The screen should look similar to Figure 8. The difference between the red and blue lines is the values that we are looking for.

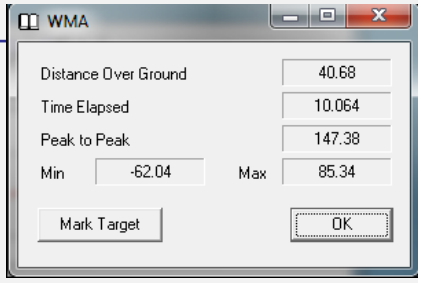
FIGURE 8. *Enabling Both Depths 1 and 2*



Whole Magnetic Analysis Tool:

There is one last trick. The Profile window has a new tool that is useful at this point. The [?] on the icon bar is a new tool to determine the **Whole Magnetic Analysis** (WMA). The idea behind this tool was given to me years ago in Mamma Brown's Restaurant by Ralph Wilbanks. If you truly understand magnetometer targets, this is a tool you will use often.

FIGURE 1. *Whole Magnetic Analysis*

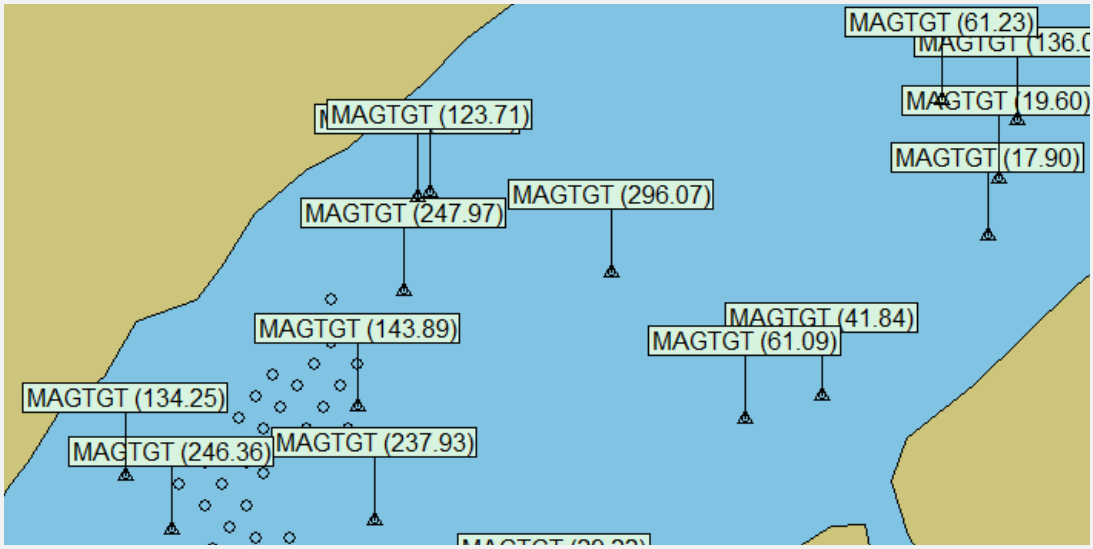


When you choose the tool, it changes the cursor. Place the cursor at the beginning of the target you wish to measure. Click and drag the mouse to the end point for the target. A new dialog appears with specific information about that target.

This tool can be used on straight gamma data without processing it in the manner I have described here. The values will be much larger but the Peak-to-Peak, Distance and time will all be the same.

On the WMA dialog there is a button to mark a target. This target is placed in a new target file, you can name the first time a target is created in SINGLE BEAM EDITOR for this session. The targets placed in the file using the WMA Mark Target button have a name of `MAGTGT (XXX.XX)`. The XXX.XX will be the Peak-to-Peak value for that target.

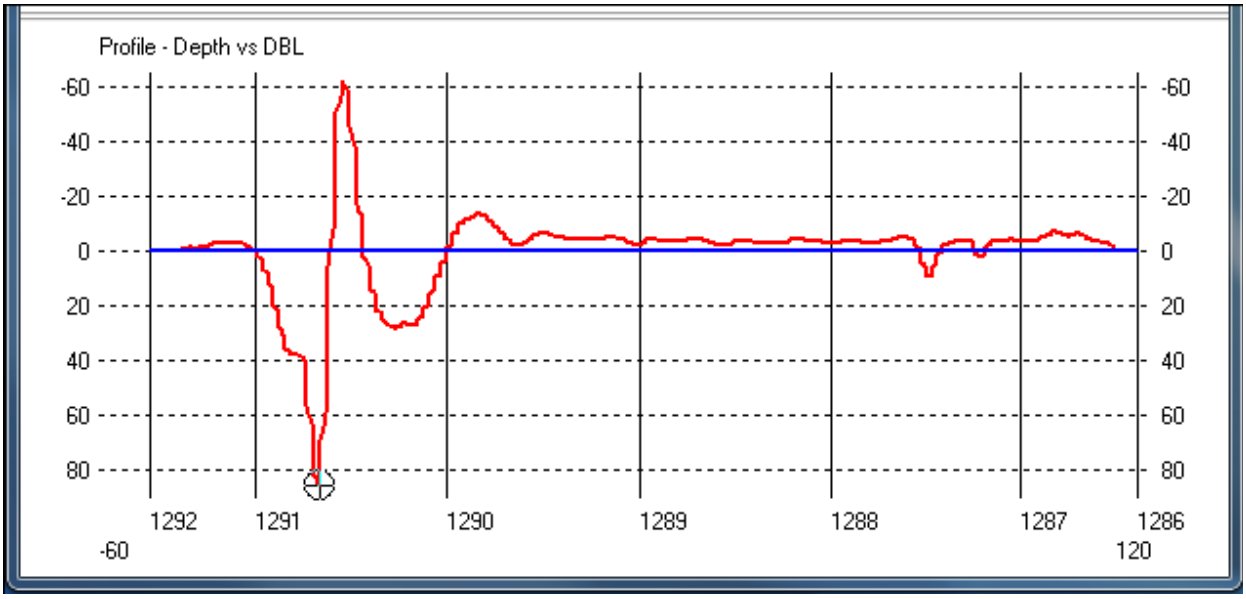
FIGURE 2. *Targets Marked in the WMA Dialog*



In Figure 1, the targets that we recorded in the SINGLE BEAM EDITOR are easily identifiable as suitable for further investigation or not. Also clusters of targets from separate passes with the magnetometer become readily available.

7. **Select EDIT -> DEP1-DEP2.** This subtracts the two values and replaces depth 1 with the difference. The DEPTH2 values will all be set to 0.

FIGURE 9. *Gamma (red), Averaged Data (blue)*

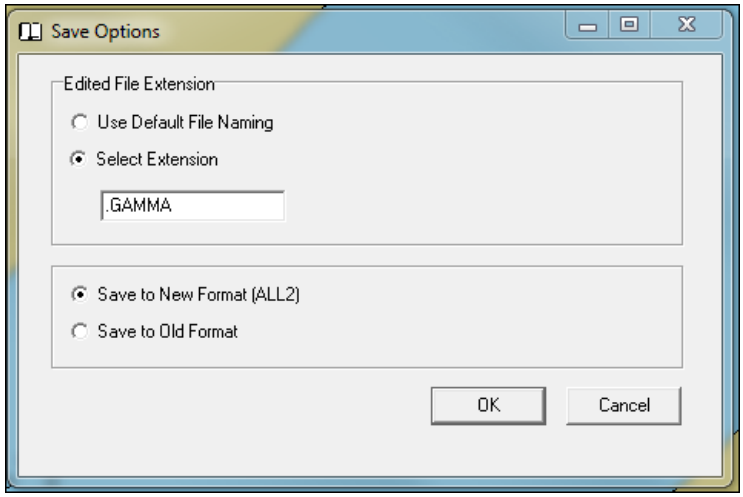


That same dipolar target that was a minimum of 52080.82 and a maximum reading of 52228.23 now has a minimum of -62.04 and a maximum of 85.34. It is a lot easier to see how big that target is--147 gammas peak to peak.

At this point, I usually go in and disable depth 2 so that I am only looking at the data for the gamma readings.

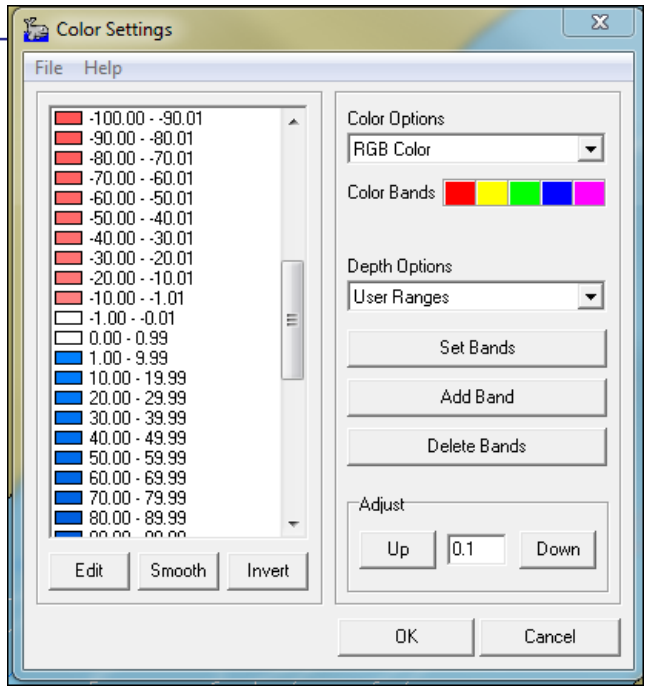
8. **Save the edited Magnetometer data**.

Another feature that I like to use in the SINGLE BEAM EDITOR when working with magnetometer data is the SAVE OPTIONS. This allows you to specify the extension of the data you are saving. Instead of the default '*.EDT*' extension I like to make it '*.GAMMA'* so I can distinguish magnetometer data from sounding data. To access this option, select FILE->SAVE OPTIONS. Then just save the data as normal.



9. **Use TIN MODEL to create a 2D contour for plotting.** The final steps to processing the data are to TIN the data and create contours. This is another area that is enhanced when processing the magnetometer data in the manner described above. (I am not going to go through all of the steps to model the data using the TIN MODEL program. If you have questions send an email to Help@HYPACK.com and we will point you in the correct direction.)

FIGURE 10. *Setting Colors for Mag Data*



I change the color settings when I do a TIN model of the data produced with these steps. The data is both negative and positive according to whether the gammas were above or below the background data. Since we know if the data is negative or positive, I set all of the colors for negative values to red and all colors for the positive values to blue.

This creates a nice contrast when the data is output to a contour DXF file. White is the color of zero so that, in Figure 11, you can easily see dipolar targets.

FIGURE 11. *Diurnal targets in data of an early 19th century ship wreck*

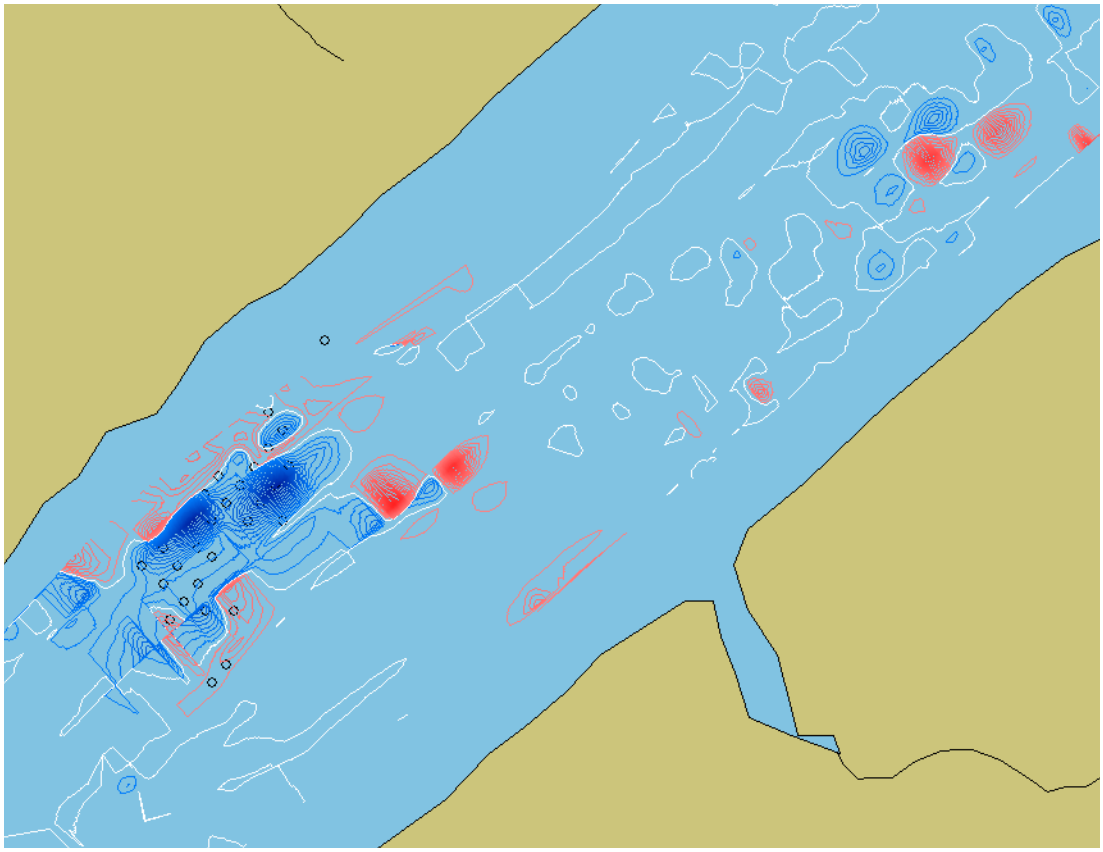


FIGURE 12. *TIN MODEL of different gamma data (25 square miles) in 3D*

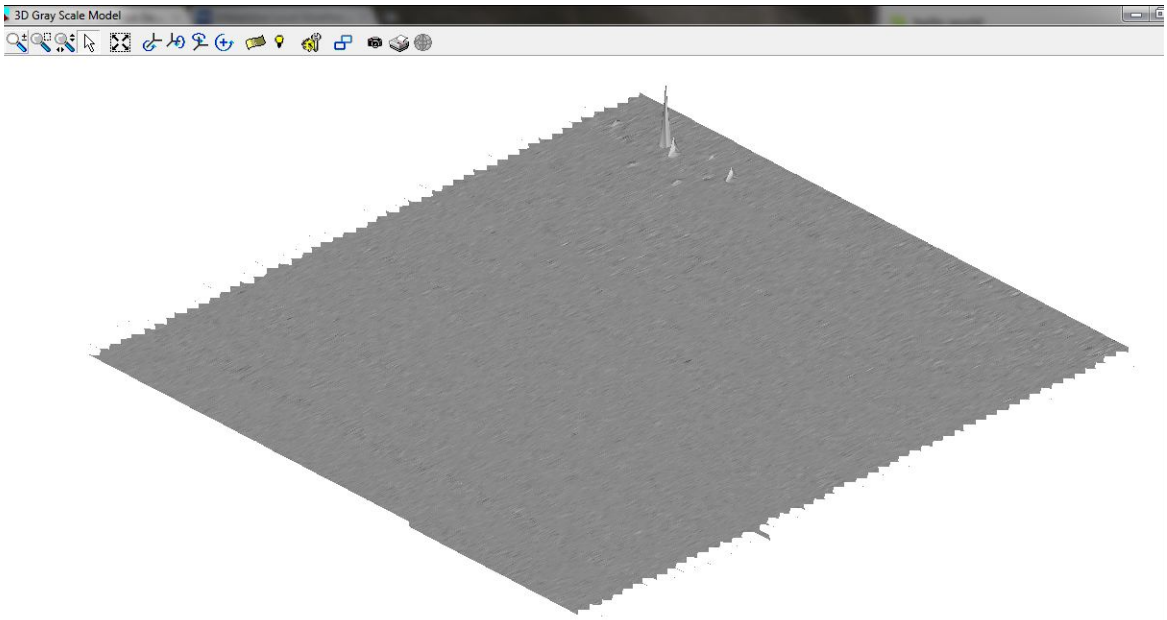


FIGURE 13. *Contours of the Data in Figure 12*