MRU Heave vs. True Heave vs. RTK Heave

by Pat Sanders

MBMAX-64 has several different option for the treatment of heave. Among these are:

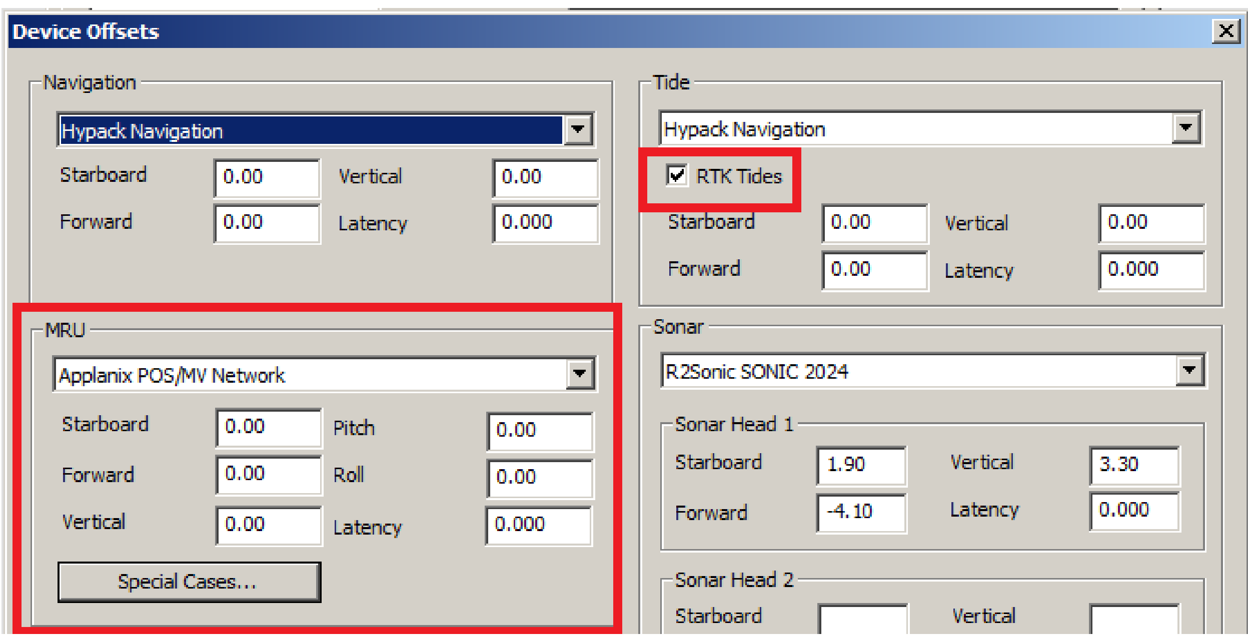
- Using the heave values as reported by an MRU.
- Using reprocessed heave values from POSMV True Heave or Coda iHeave files.
- Computing RTK Heave based on the movement of the GPS antenna.

In this article, we'll take a look at processing the same data set all three ways. The data set used in the test was collected with an R2Sonic multibeam and a POSMV for position-orientation data.

MRU HEAVE

In the Read Parameters window of MBMAX-64 (64-bit HYSWEEP® EDITOR), look at the Device Offsets and the Processing tab. The Device Offsets tab is set up as follows:

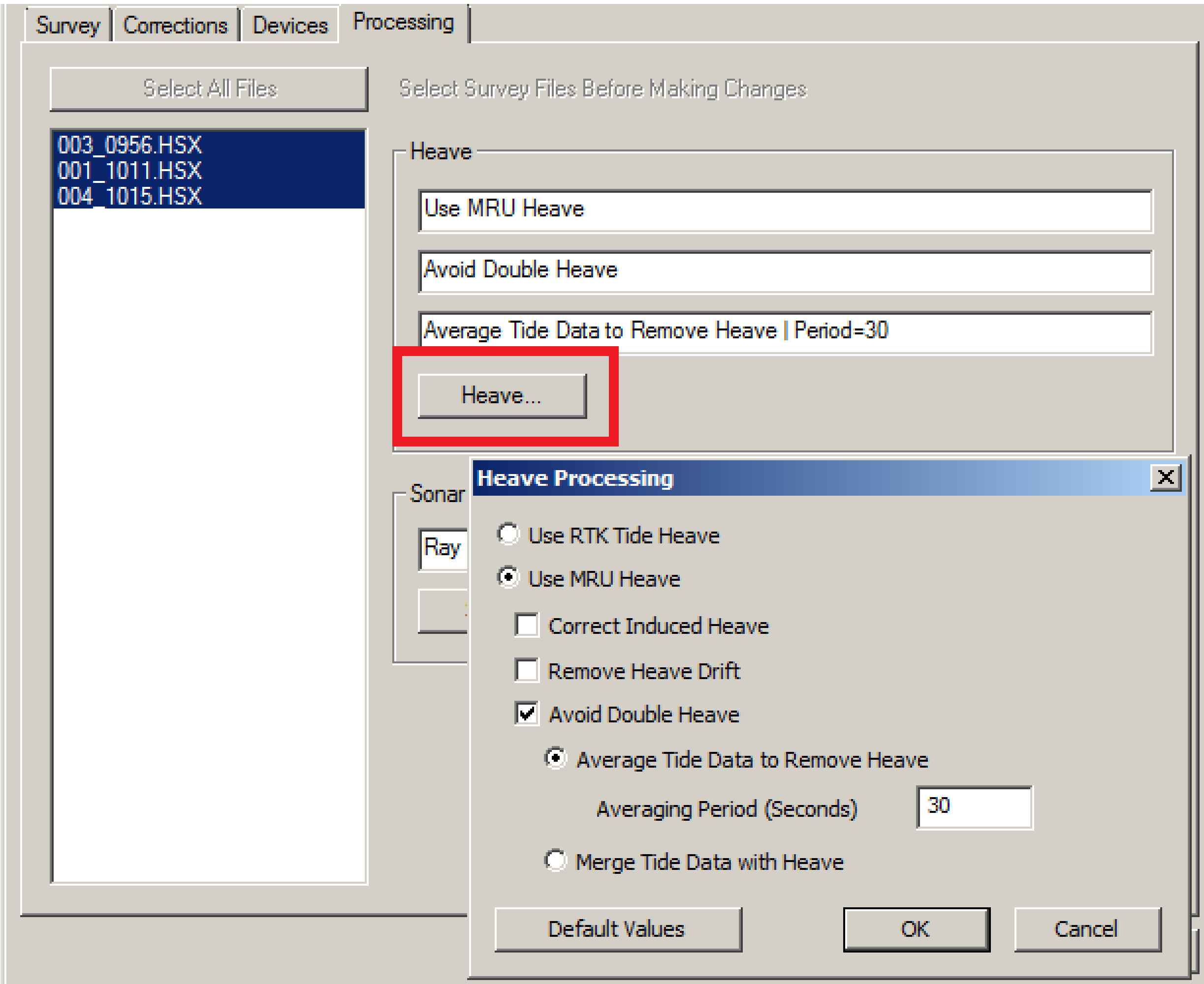
FIGURE 1. Read Parameters—Device Offsets Tab



We have the RTK Tides box checked, because we will also compute RTK TIDES. Other than that, there is nothing special about the Device Offsets when using the MRU Heave.

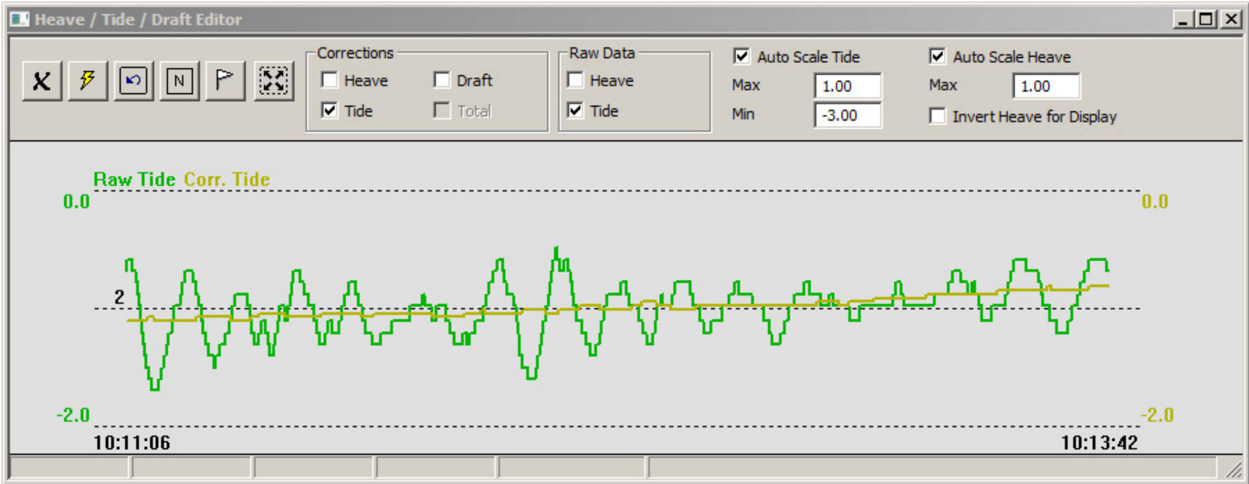
In the Processing Tab, we access the Heave Processing by clicking on the Heave button. Since we are running RTK TIDES, we have set it up to Avoid Double Heave and set an Averaging Period of 30 seconds. That is pretty standard when using RTK TIDES in MBMAX.

FIGURE 2. Read Parameters—Processing Tab



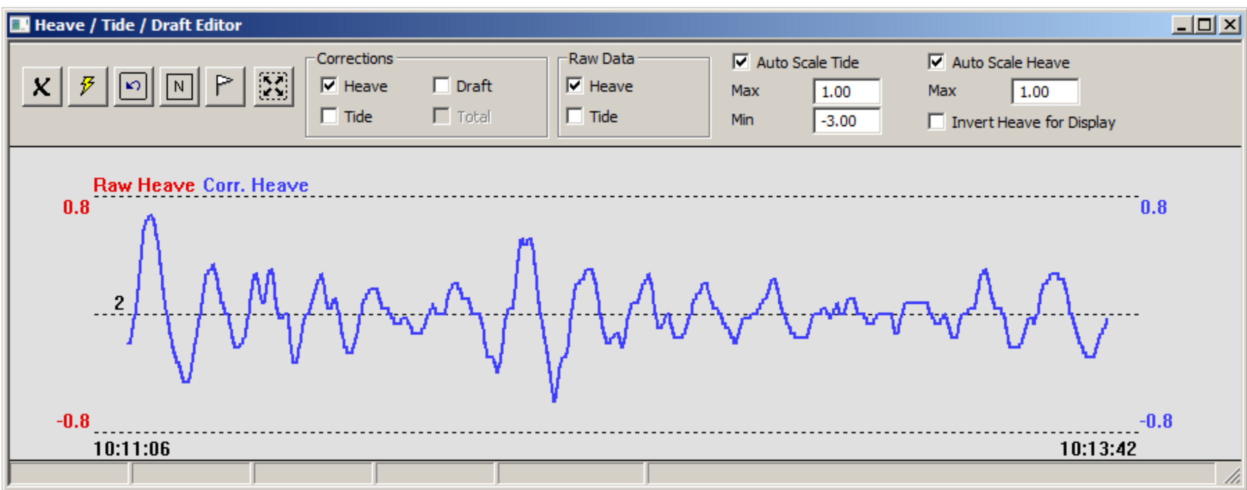
With the read parameters all set, we click OK to take us to Stage 1 processing in MBMAX-64. During this phase, we can take a look at the Heave and Tide time series window.

FIGURE 3. Raw (green) and Corrected (yellow) Tides in the Heave/Tide/Draft Editor



The green line shows our Raw Tide values and the yellow line shows our “averaged tide” that has removed the heave by averaging the raw values over the user-defined time period.

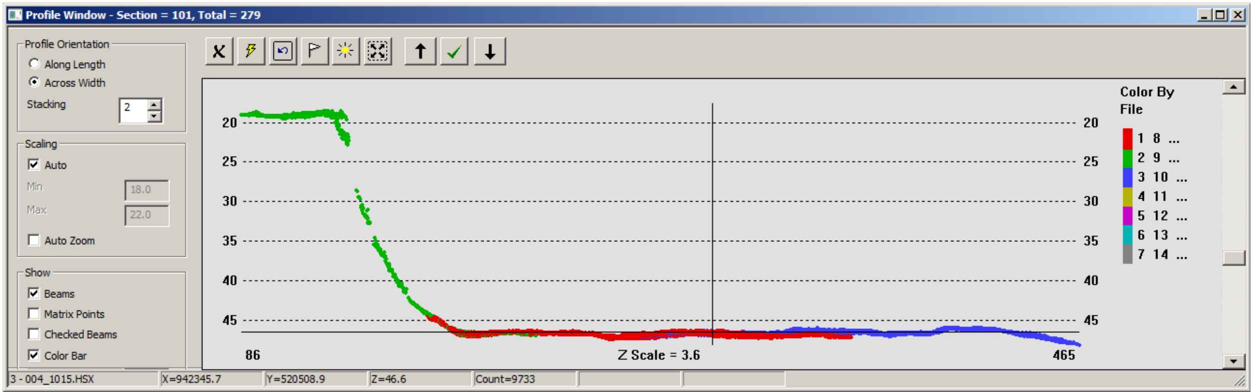
FIGURE 4. Heave in the Heave/Tide/Draft Editor



The Raw Heave data is exactly the same as our final Heave Data. We haven’t made any changes to it in this method.

We can now tell MBMAX-64 to run the beam calculations and apply some basic filters to get rid of the outliers. For comparison purposes, I’m going to save the resulting points to an XYZ data file (All Data). For this data set, I named it “RTK Tides Avg at 30.xyz”.

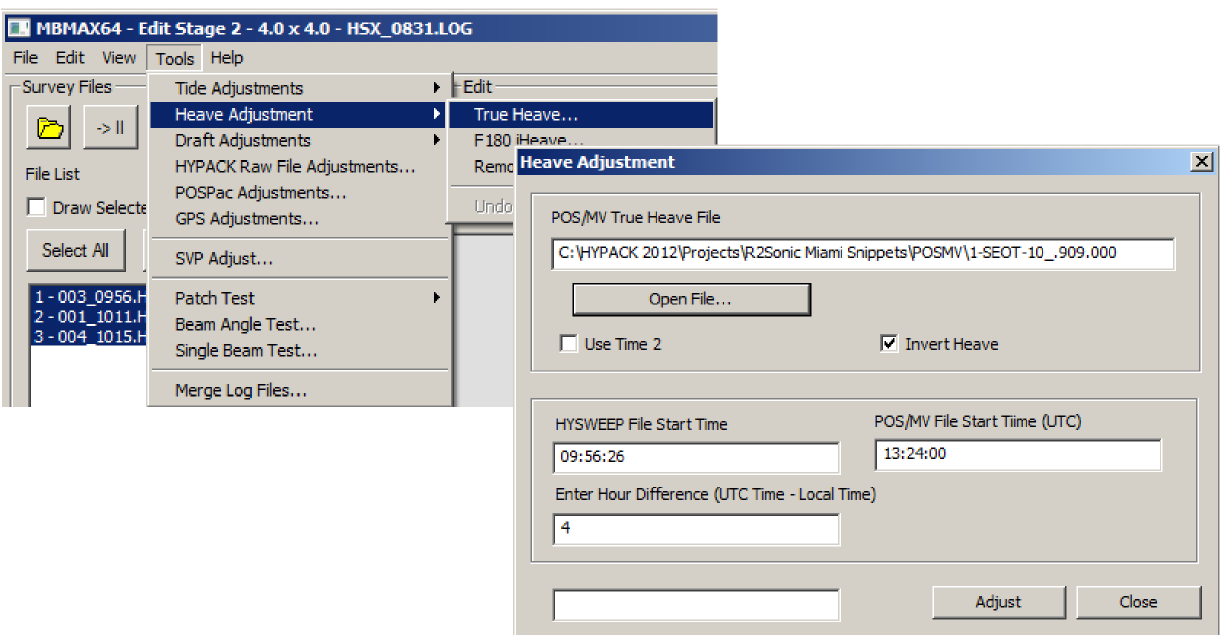
FIGURE 5. A Sample Profile from the Data with each Survey Line Shown in a Separate Color.



HEAVE FROM TRUE HEAVE FILE

In this example, the user generated a True Heave file, using software provided with the POSMV. MBMAX-64 can read that True Heave data and then substitute it for the beam calculations.

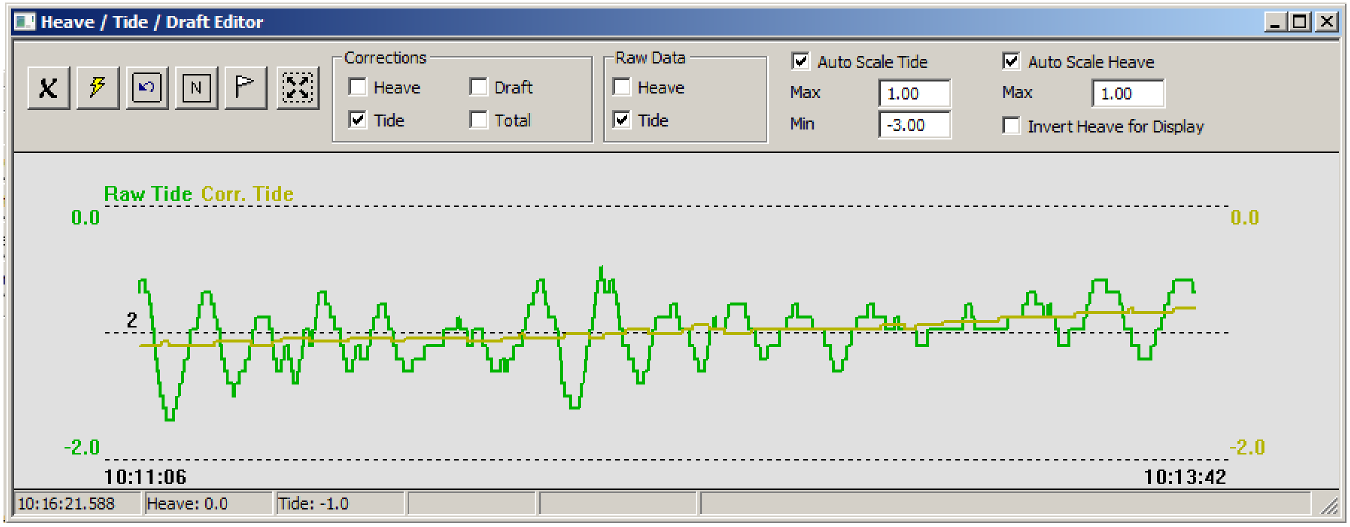
FIGURE 6. Heave Adjustment Routine



The Heave Adjustment window for True Heave is opened from the Tools menu. We have entered the name of the True Heave file, along with the Time Zone offset (4 hrs). When we click the 'Adjust' button MBMAX reads the True Heave file and inserts the updated values. We can then examine the Stage 1 Heave and Tide time series to see what has changed.

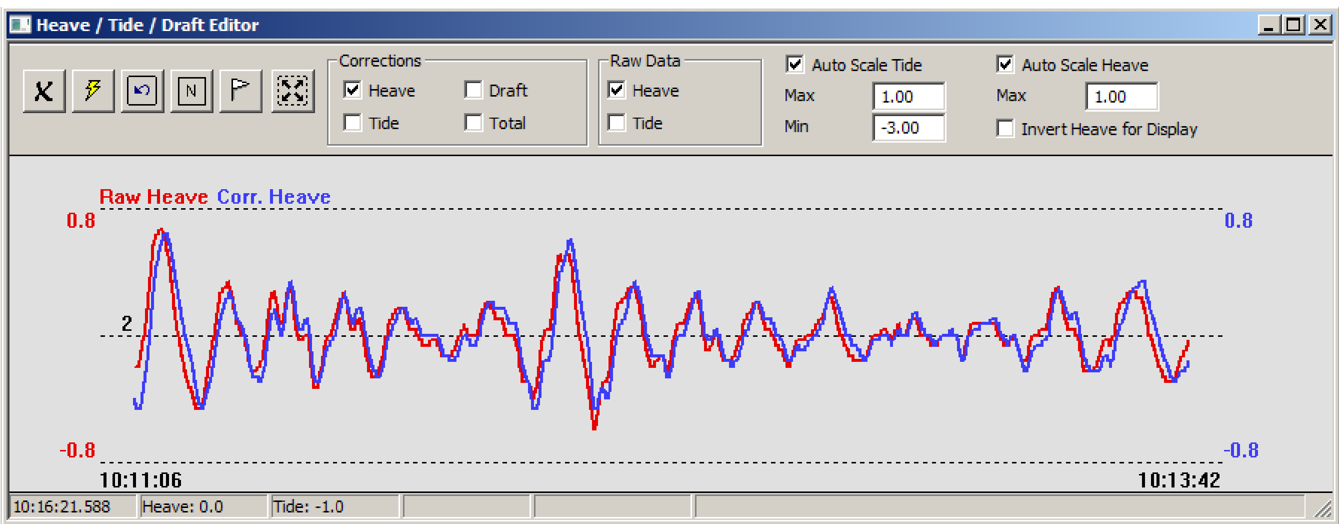
Looking at the Raw and Corrected Tide graph, we'll find no change from the MRU Heave example (Figure 3). All we have done is substituted the True Heave values for the original heave values. The RTK Tide values should not be affected.

FIGURE 7. Raw (green) and Corrected (yellow) Tides



When we examine the Raw and Corrected Heave values, we can now see the differences! The Raw Heave shows the values from the MRU, and the Corrected Heave shows the values from the True Heave file. When we go forward and do the beam calculations, MBMAX-64 will use the Corrected Heave values from the True Heave file when doing the beam calculations.

FIGURE 8. Raw MRU Heave (red) vs POS MV True Heave (blue) in the Heave/Tide/Draft Editor



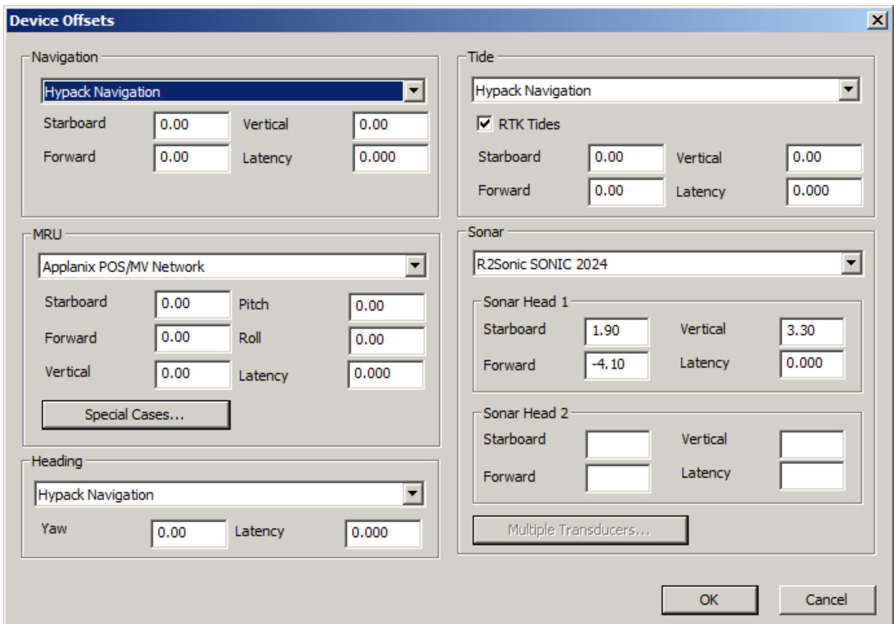
When we look at the profile window, we don't see any real difference, but there are small differences we'll examine when we look at all of the XYZ data sets.

We then saved the XYZ points to a file named "RTK Tides Avg 30 with True Heave.XYZ".

RTK HEAVE

Computing RTK Heave values in MBMAX-64 is a little bit different than MBMAX-32. The configuration of the Read Parameters is simpler.

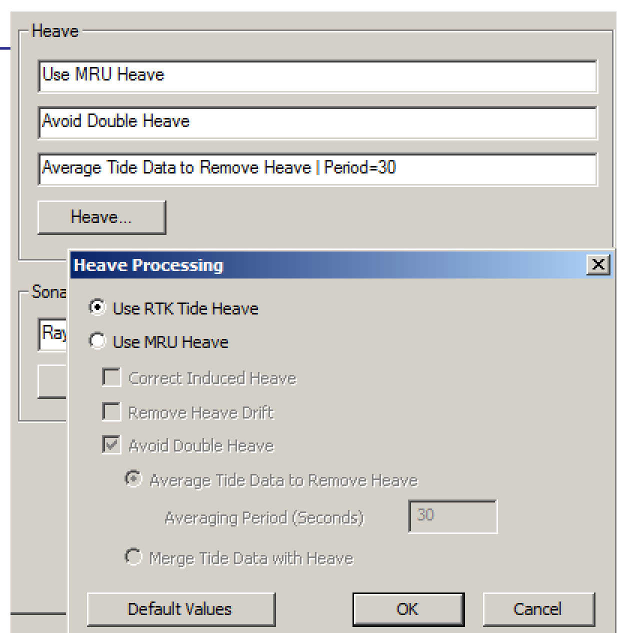
FIGURE 9. Device Offsets in MBMAX-64



In MBMAX-32, we had to set the Heave Device = None.

In MBMAX-64, there is no difference in the Device offsets, regardless if you are using an MRU, or a True Heave file, or RTK Heave. So, no changes here!

FIGURE 10. Read Parameters—Processing Tab



In the Processing Tab of the Read Parameters, we'll click the Heave button and then just check the "Use RTK Tide Heave" radio button.

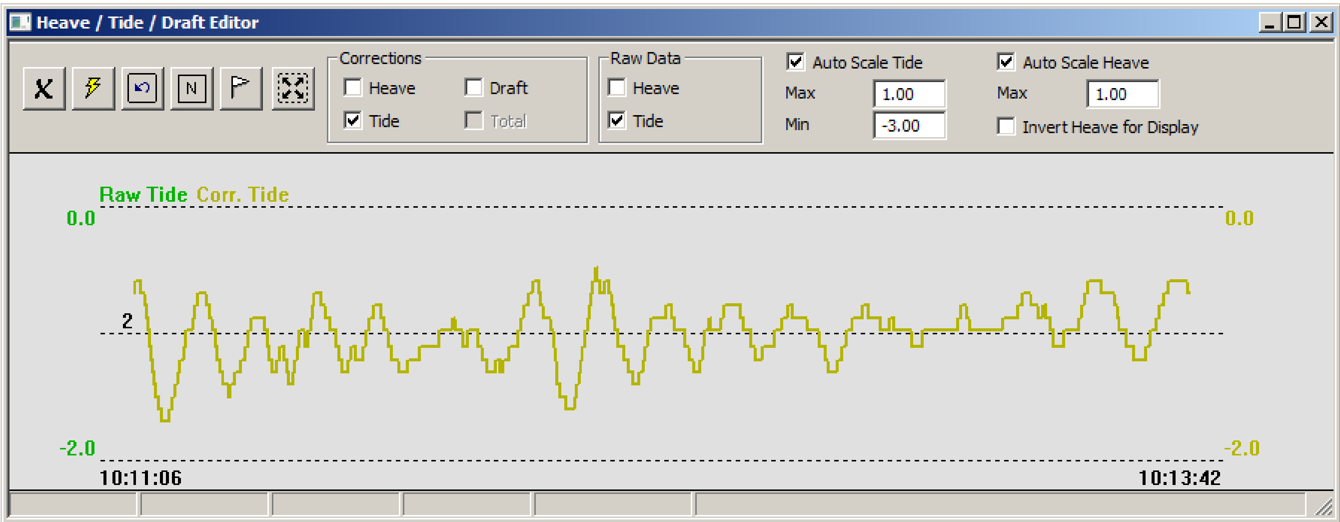
THERE ARE NO OTHER SETTINGS THAT NEED TO BE MADE!

Once again, this is different from the MBMAX-32 version, where you would have to configure both the RTK HEAVE and set the Averaging Period to 0 seconds.

When you click OK and move into Phase 1, you can now see how the Heave and Tide time series graphs are affected:

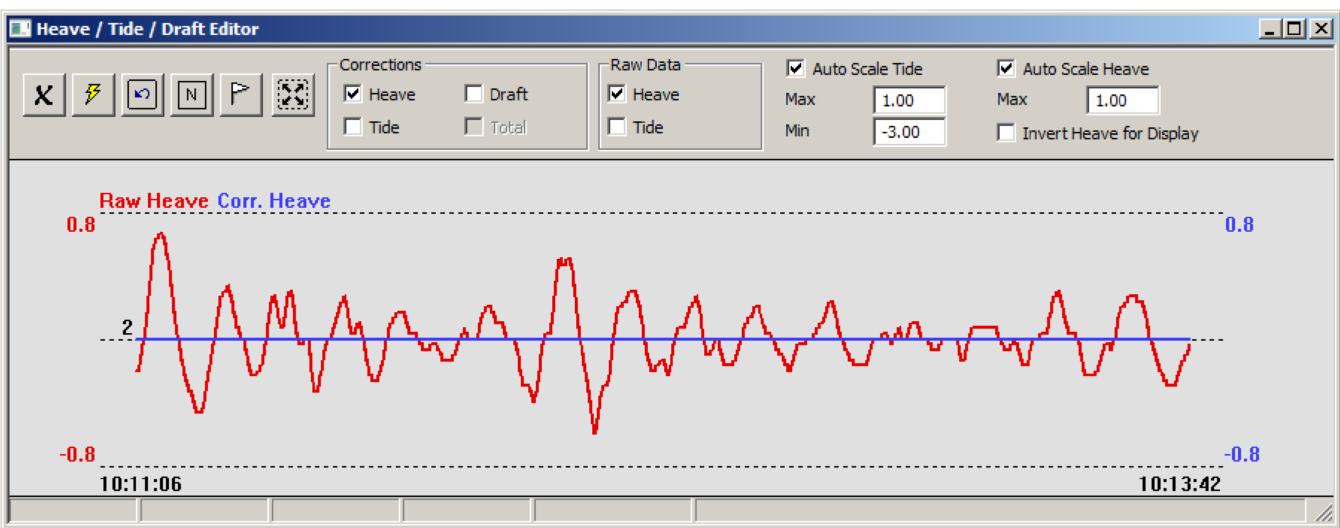
The Tide Graph now looks different, as the Corrected Tide is the same as the Raw Tide! It has not averaged across the time series. The RTK Heave information is now incorporated directly into the Tide time series.

FIGURE 11. *RTK Tides*



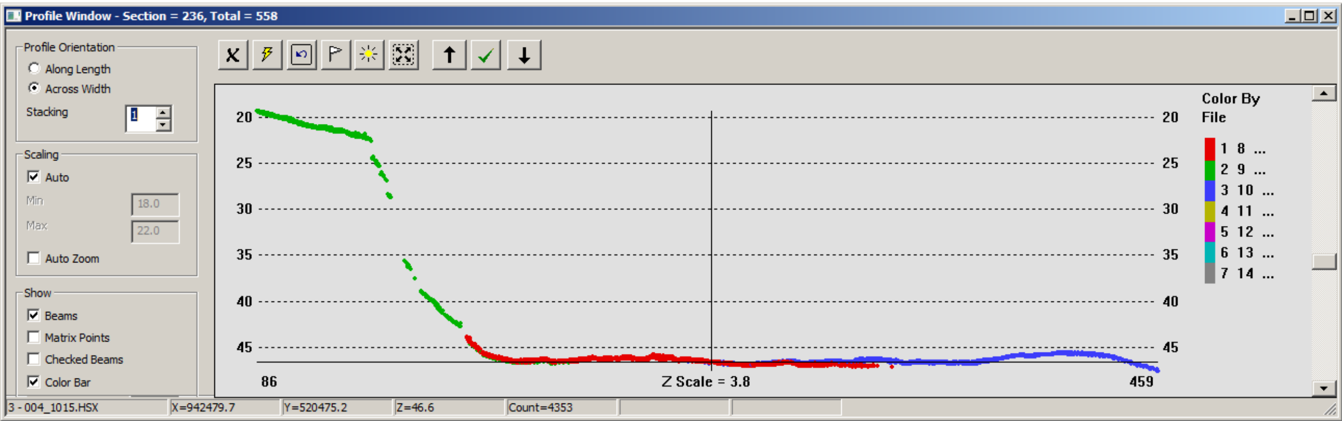
The Raw Heave data (red) is displaying the values read from the MRU. The Final Heave data (blue) has been zeroed out, as the Heave is now incorporated into the RTK TIDE information. This is normal, and exactly what we need! We can now move forward with our beam calculations and perform our normal editing.

FIGURE 12. *Raw Heave (red) is Set to Zero (blue) When it is Incorporated into the RTK Tide*



The resulting profile window is shown in Figure 13. We can’t tell much from that. We’ll save the data to a file named “RTK Heave.XYZ”, then we’ll examine some ways to compare the data sets.

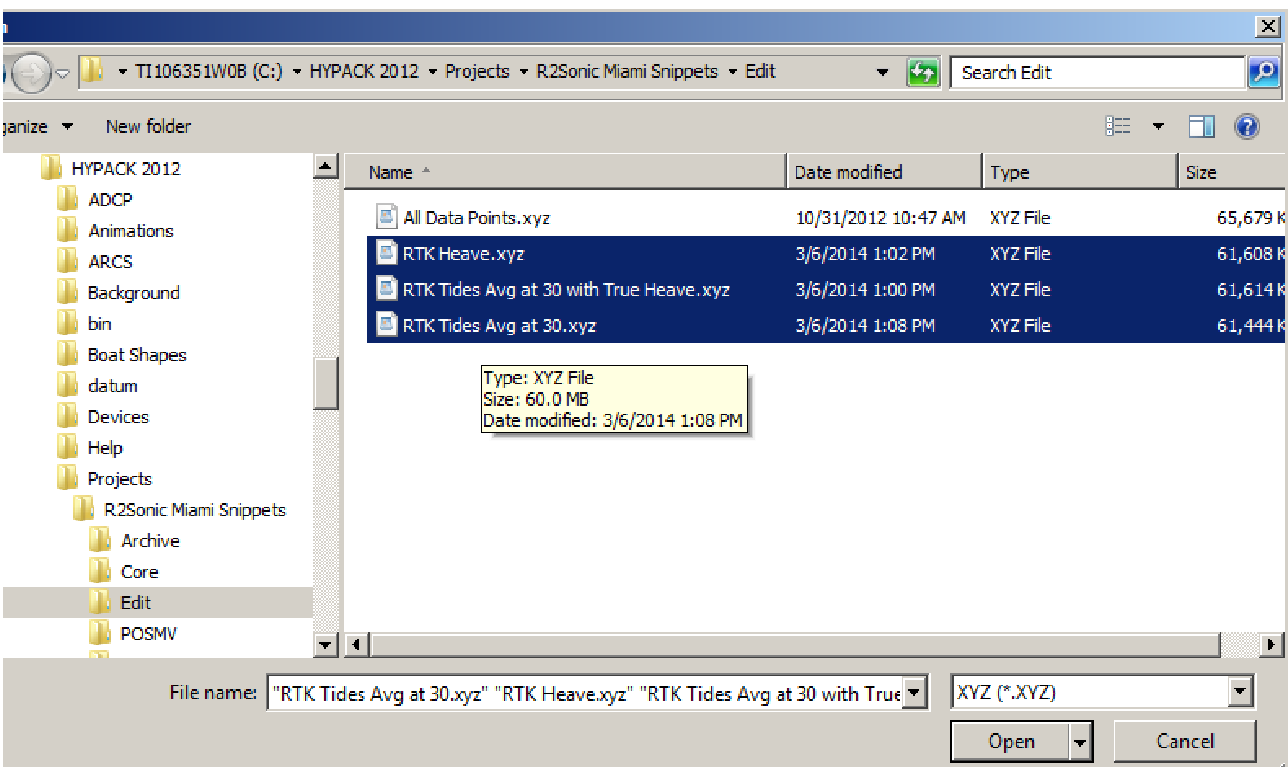
FIGURE 13. Resulting Data Profile Merging Heave with RTK Tides



COMPARING XYZ DATA SETS IN MBMAX-64

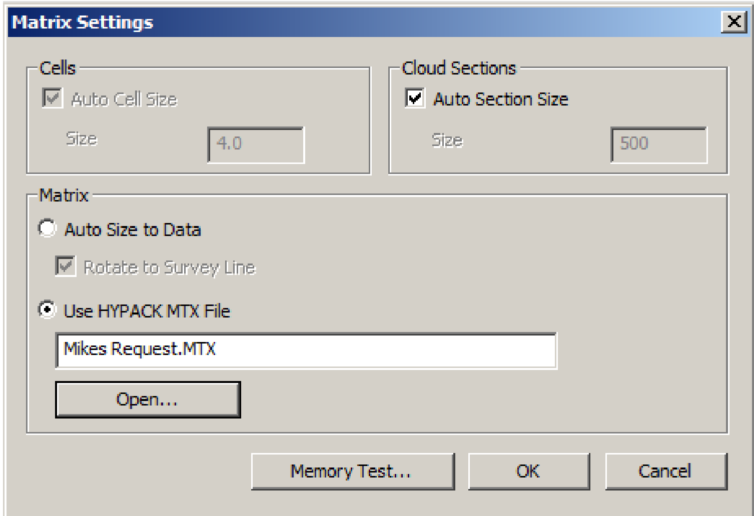
We can load each of the resulting XYZ data files into MBMAX-64, then take a look at the cross sectional profile through the data set to see if there are any difference in the resultant files.

FIGURE 14. Loading the Data Sets, One from Each Heave Processing Method



When we start up MBMAX-64, we load all 3 XYZ data files (Figure 14). The program then asks me the settings for the Cloud window and Matrix creation.

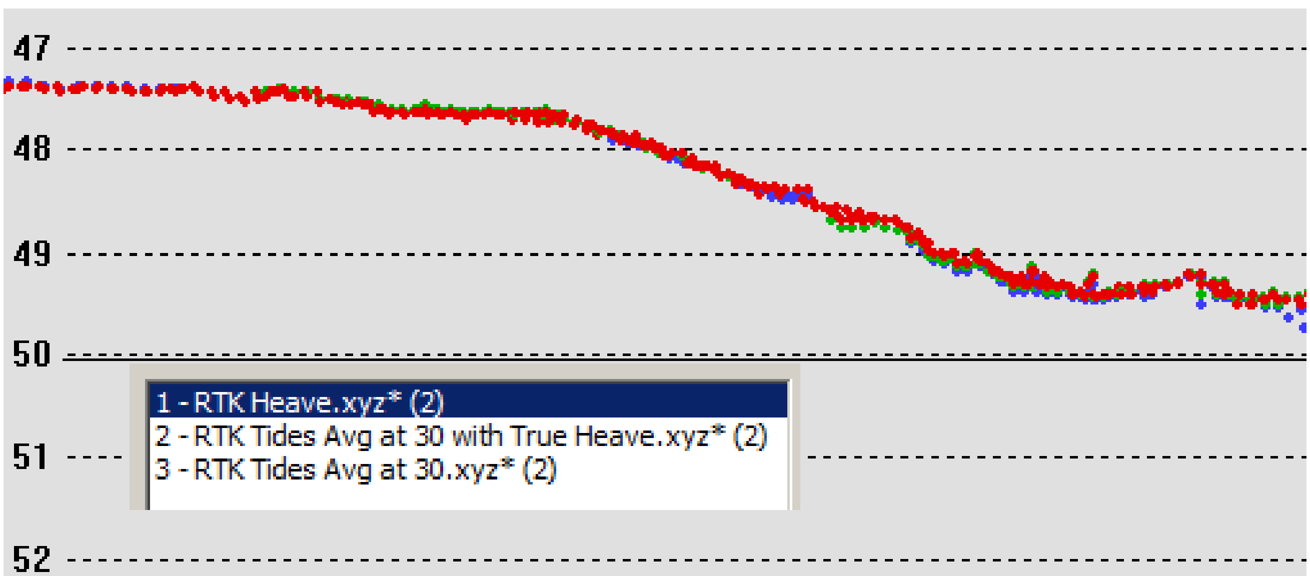
FIGURE 15. Matrix Settings



In this case, we have made our own matrix file, aligning it with our survey data and making cells that are 1' x 1'.

Since there are no raw parameters, MBMAX-64 will take us directly to Stage 2, where we can examine the XYZ data sets in the Profile window:

FIGURE 16. Comparing the Three Data Sets—the RTK Heave data (red), True Heave file (green) and MRU Heave file (blue)— in the Profile Window.



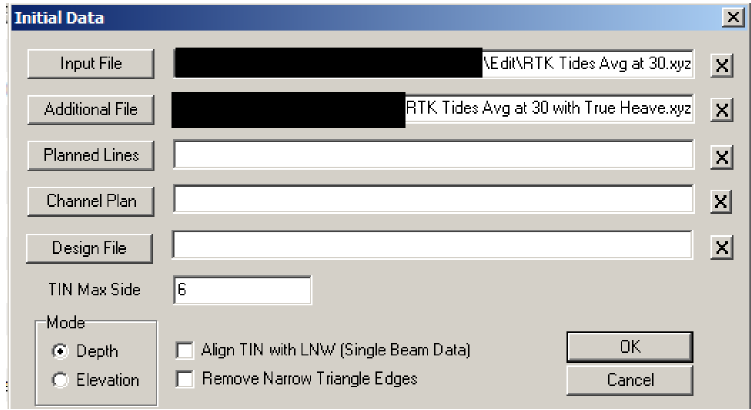
What can we tell from this?

- There are slight differences from the resultant XYZ surfaces.
- Overall, they track along pretty nicely with each other.

Other than that, we can't tell too much from comparing the data sets in MBMAX-64.

TIN MODEL COMPARISON

As another test, we can take the data sets (2 at a time) into TIN MODEL and generate statistics on the differences between the two models. This will take about five minutes to generate the two models. The most time-consuming part is where TIN MODEL has to merge the two models to determine where they overlap each other. Once it has generated the models, we are ready to compute the XYZ Differences and examine the statistics.



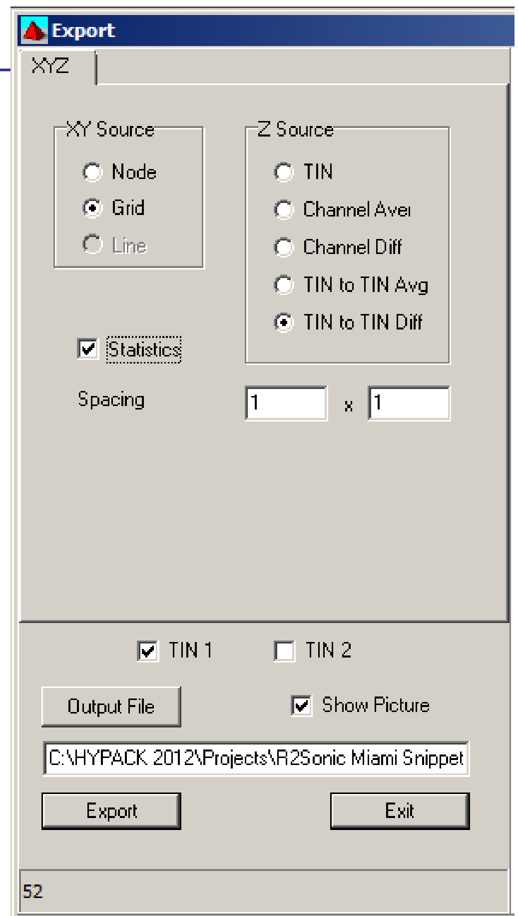


***FIGURE 17.** Exporting a TIN Difference File—the Z value represents the depth difference between the data sets.*

We've selected EXPORT – XYZ and set the program to export a 1' x 1' grid, computing the TIN-to-TIN Difference (in Z-values) at each node. We have also checked the Statistics checkbox to report the average and standard deviation in the computed differences in the TIN MODEL Report.

Our results when we compare the data from the MRU with the data from the True Heave shows only 0.01' average difference, with a standard deviation of 0.20'

MRU Heave vs. True Heave Statistics:

Arithmetic mean: -0.01'

Standard deviation: 0.20'

We can then repeat the same process, comparing the MRU Heave with the RTK Heave.

MRU Heave vs. RTK Heave Statistics:

Arithmetic mean: 0.00'

Standard deviation: 0.17'

…and to complete the comparison of our 3 data sets:

RTK Heave vs. True Heave Statistics:

Arithmetic mean: -0.02'

Standard deviation: 0.13'

CONCLUSIONS

- The peak-to-crest heave was 1.5’. That’s not a lot of heave, but it’s enough to make some programmers turn green…
- There is negligible difference in the resulting 3 data sets. You can notice some areas where one data set is a smidgen above another data set, and other areas where the same data set is a smidgen below. On average, there was less than 0.02’ difference in the computed soundings.
- The slight inconsistencies when performing some manual edits could contribute to the increased standard deviation.
- Standard deviations between the three data sets were less than 0.20’. Considering that most of the data was collected in 45’ of water, this represents less than 0.5% of the total depth.
- **The results are encouraging towards the usage of RTK HEAVE.** I would like to see some comparisons in rougher seas!