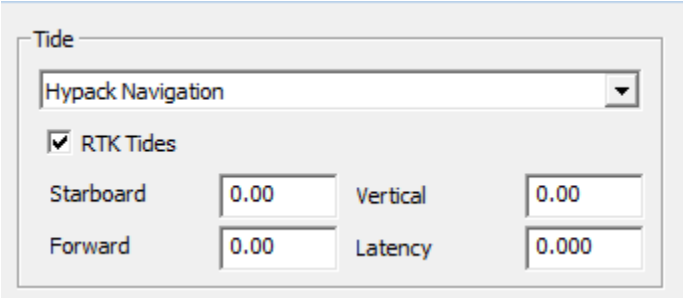
An Explanation of Heave Options when Computing RTK TIDES in MBMAX64

by Pat Sanders and Mike Kalmbach

This article attempts to explain the different options available for using heave data when computing RTK TIDES.

In the Read Parameters window of MBMAX64 (64-bit HYSWEEP® EDITOR), the hydrographer has several choices with regard to RTK tides and how heave data is integrated with the data. Under the Devices tab, you can elect to compute RTK tides by clicking [Edit] to get to the device selection and offsets and then checking the “RTK Tides” box located in the Tide frame.

FIGURE 1. *Opting to Calculate RTK Tides*

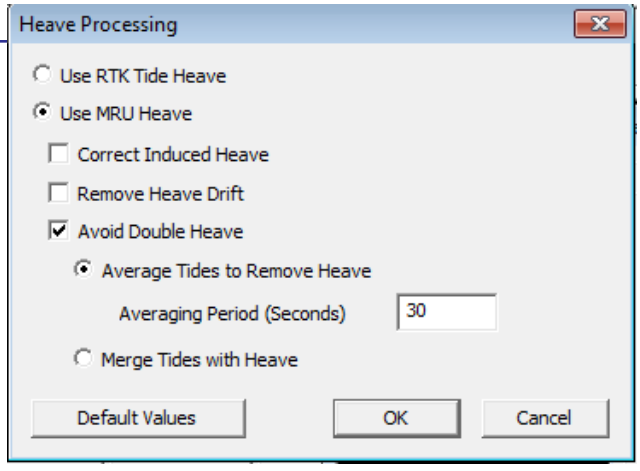


HYPACK® SURVEY can generate tide corrections from several sources, including manual entry, telemetry gauges and RTK GPS. All of these corrections are saved as “TID” records in the RAW and HSX data files. Checking the RTK Tides box tells MBMAX64 that the TID records were generated by RTK GPS. Those records need to be corrected for antenna motion (sway and surge).

Checking the RTK Tides box instructs MBMAX64 to accept the RTK Tide records contained in the HSX files and incorporate them into your corrections. There are still important options that are used to specify how to integrate the heave data from your heave-pitch-roll sensor.

In the Processing tab of the Read Parameters, click [Heave]. In the Heave Processing window that appears, you have several options on how to treat the raw heave data.

FIGURE 2. *Heave Processing Dialog*



There are three basic options on how to integrate heave data with your RTK TIDES.

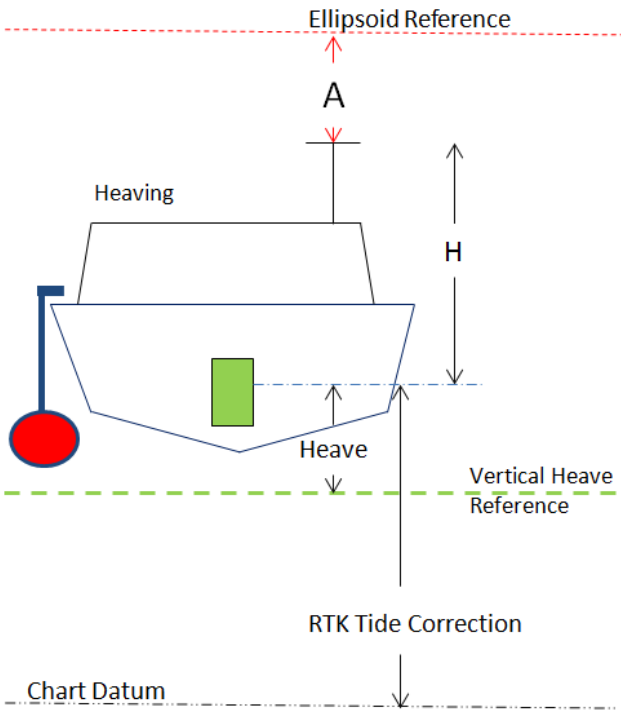
- Use RTK Tide Heave
- Use MRU Heave and Average Tides to Remove Heave
- Use MRU Heave and Merge Tides with Heave

Based on your selection, your heave and tide corrections will vary, as may your results.

FIGURE 3. RTK Tide Calculation Diagram

CASE 1: USE RTK TIDE HEAVE

In this selection, MBMAX64 ignores the heave data from your MRU and calculates a tide correction that includes the heave correction. This technique requires rapid updates from your GPS system. 10Hz is a recommended minimum update rate.

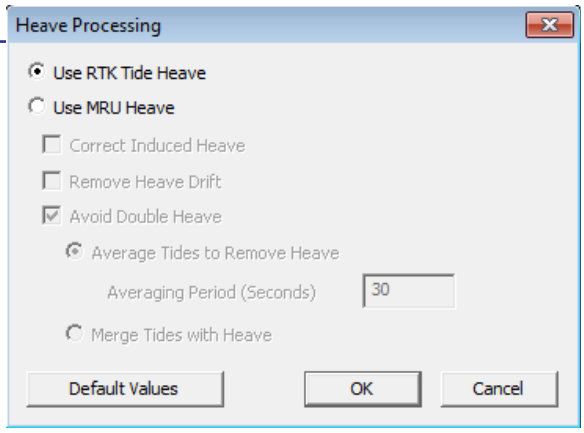


In the figure (right), the vessel is heaving upward. The vertical change in the GPS antenna will be reflected in the height of the antenna above (or below) the reference ellipsoid.

HYPACK® SURVEY will compute an RTK Tide correction by taking the height of the Reference Ellipsoid above the Chart Datum and subtracting the vertical offset of the GPS antenna (H) and the height of GPS antenna above (or below) the Reference Ellipsoid (A). MBMAX64 uses those values as the starting point for its calculation. If instructed, MBMAX64 can recalculate RTK tide values from postprocessed GPS positions (e.g. POSPac) and HYPACK® Raw File Adjustments).

The heave measurement (Heave) from the MRU is ignored and not used. The pitch and roll data from the MRU is used with the device offset information in order to determine the exact boat origin and transducer positions relative to the GPS antenna. The computation gets more technical as you apply the pitch and roll motion measurements, but the principle is the same.

FIGURE 4. Case 1 Heave Processing Settings



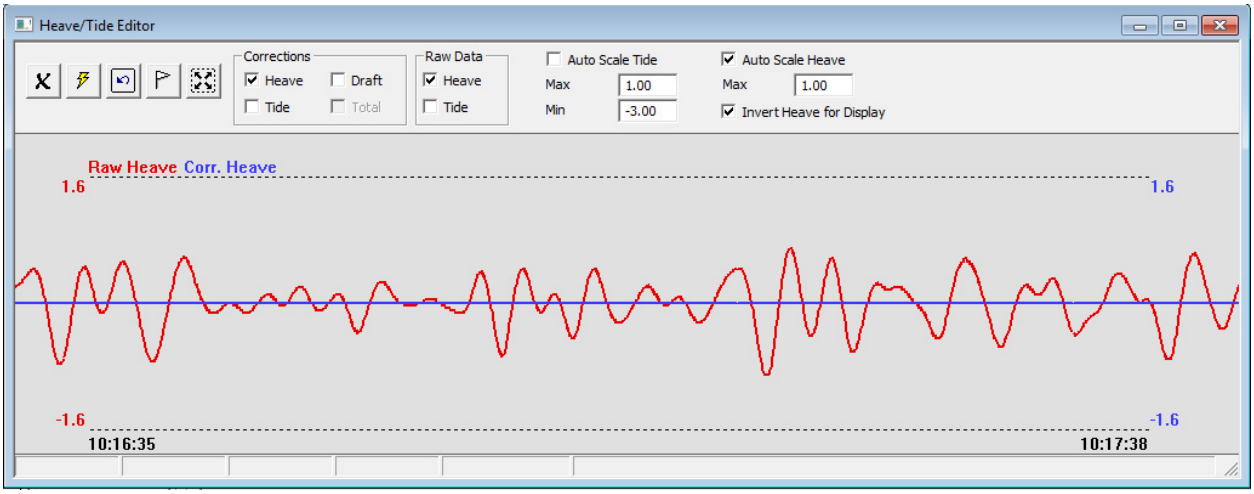
So, with the settings shown to the right, let's read the data into MBMAX64 and examine the Heave/Tide window in Phase I.

Settings:

- RTK Tides = On
- Use RTK Tide Heave = On

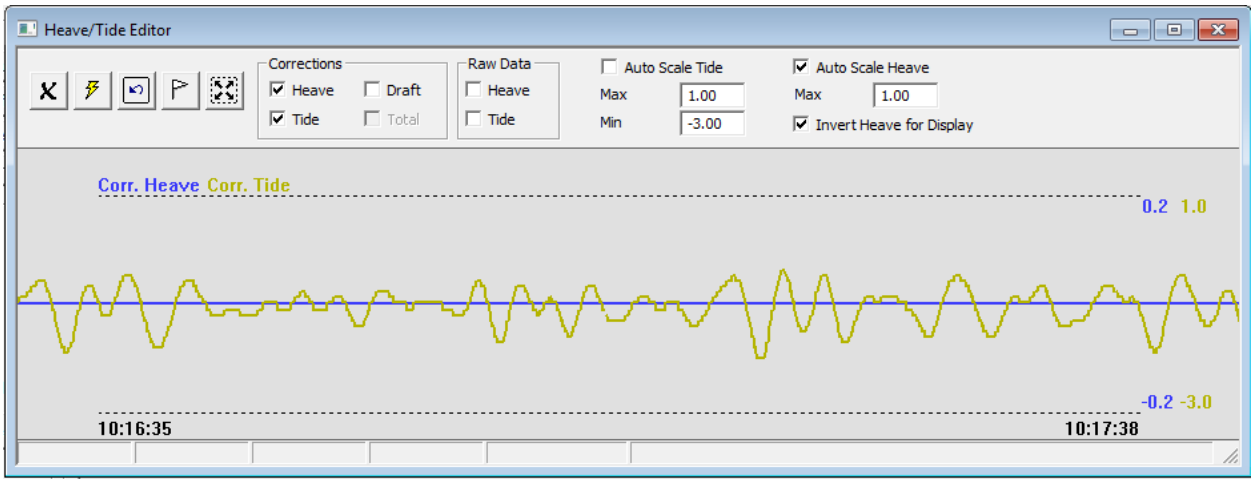
The Raw heave values are shown by the red line. The final Heave Correction values used by MBMAX64 are shown by the blue line. They have all been set to 0.00! This is because the heave values will be incorporated directly into the RTK Tide correction.

FIGURE 5. *Raw Heave (red) and Corrected Heave (blue)*



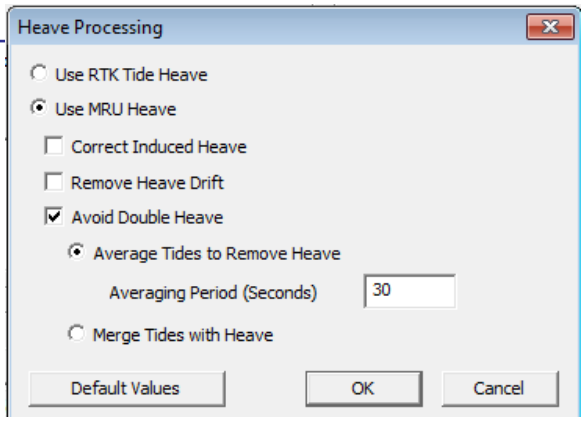
Our final tide correction values are equal to the Raw Tide values and are shown in the below graph. Notice how the final heave values (blue) have been set to zero, as the actual heave is now incorporated into the Tide Correction value.

FIGURE 6. *Corrected Heave (blue), Raw Tide (yellow)*



CASE 2: USE MRU HEAVE, AVERAGE TIDE TO REMOVE HEAVE (30 SECONDS)

FIGURE 7. Case 2 Heave Processing Settings

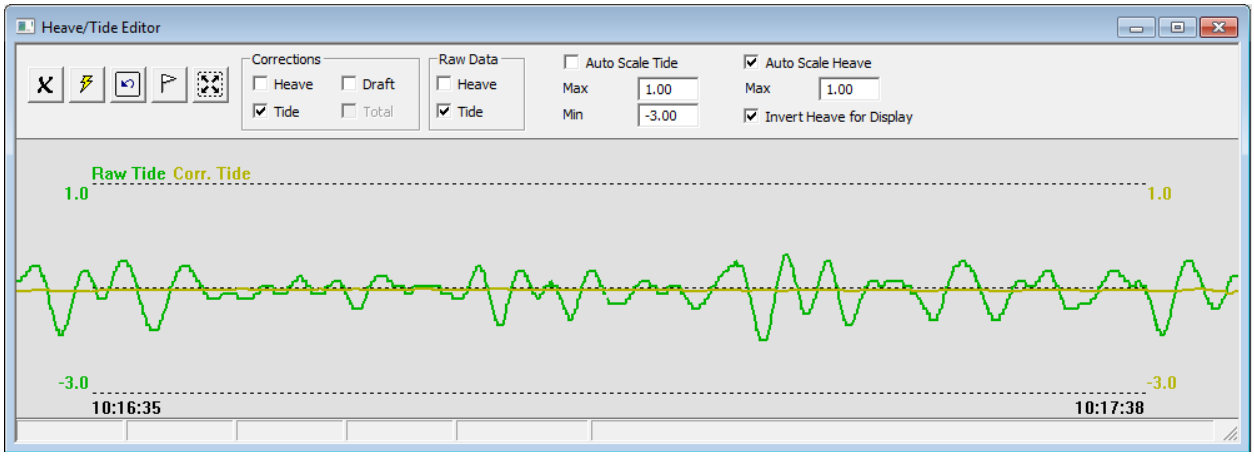


I have modified the Heave Processing settings and instructed MBMAX64 to “Use MRU Heave” and to Avoid Double Heave by Averaging the Tides over a 30 second time period.

We saw in Case 1 where the heave is included in the RTK Tide computation. This method attempts to remove the influence of the heave on the computed tide by averaging the results over a user-specified time period.

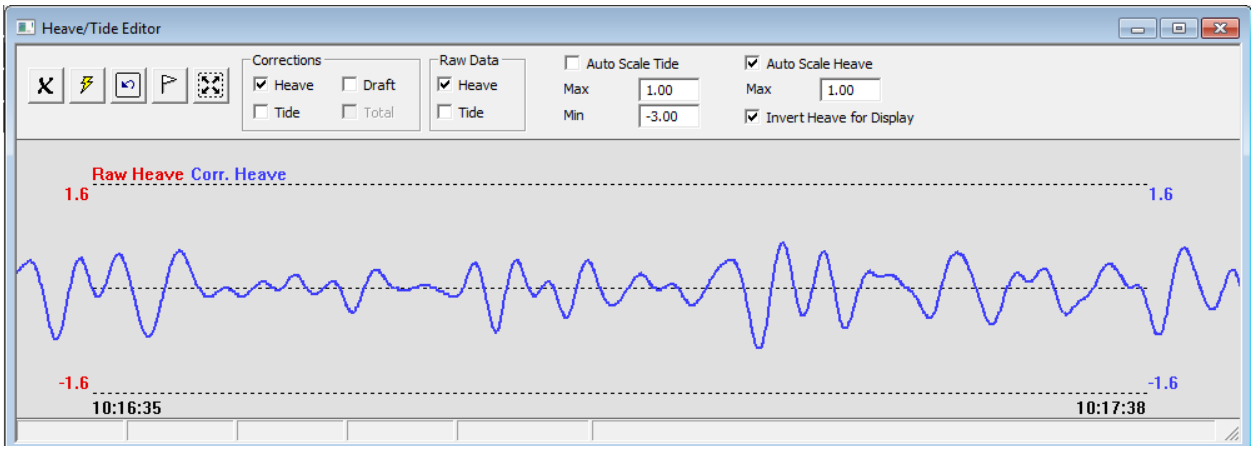
The Heave/Tide graph shows the raw RTK Tide values in green. These tides contain the heave component. By averaging the RTK tide values over a 30-second period, we get a smoothed tide correction, as shown by the yellow line.

FIGURE 8. Raw RTK Tides (green), Corrected Tides (yellow)



The raw heave values can now be applied as the final corrections. Figure 9 shows the final heave correction (blue) superimposed on top of the Raw heave corrections (red). If we had corrected for induced heave or for heave drift, you might see some separation between the two. In this case, we did not correct for either, so the two lines are the same.

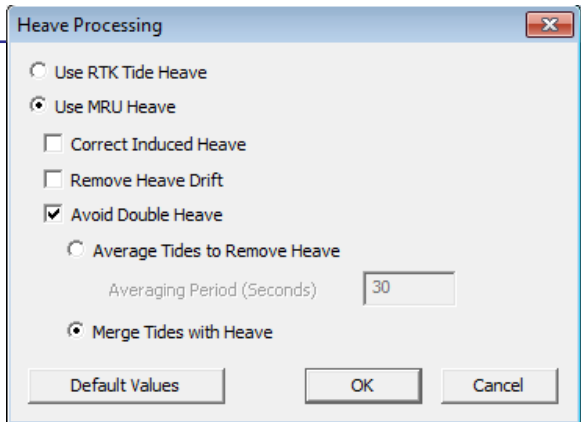
FIGURE 9. Raw Heave (red) and Corrected Heave (blue)



CASE 3: USE MRU HEAVE, MERGE TIDES WITH HEAVE

In this case, the antenna position at the RTK GPS update is used as an 'anchor' and the MRU data is used to determine the movement of the antenna between RTK GPS updates.

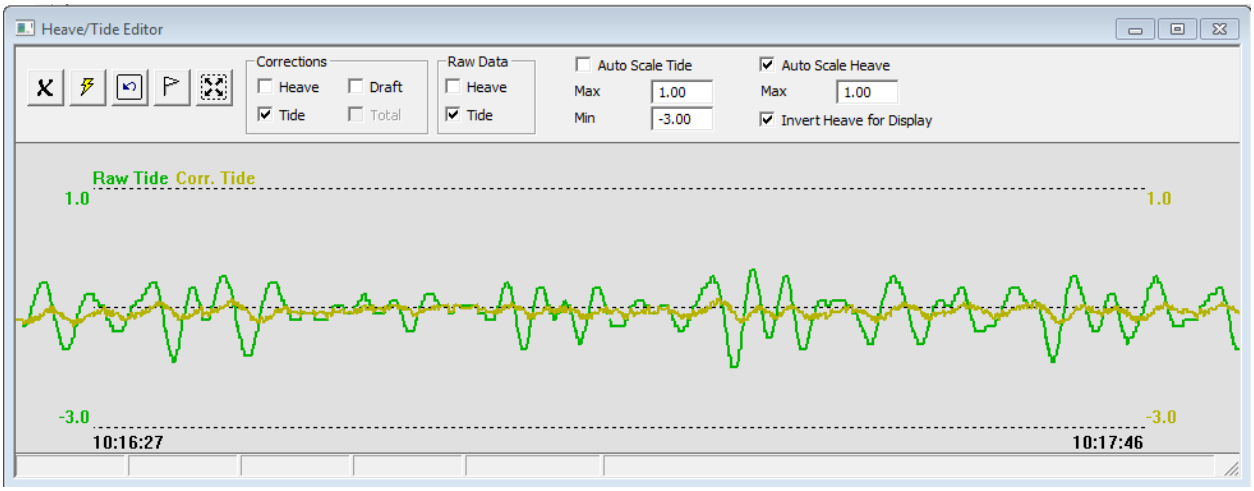
FIGURE 10. Case 3 Heave Processing Settings



This method was very useful in the early days of RTK GPS where most units provided a position update at a rate of 1Hz. With most RTK GPS systems now updating position information at rates of 10Hz or greater, this method is not normally recommended.

The raw tide values are shown in green and the final tide correction values are shown in yellow.

FIGURE 11. Raw Tides (green), Corrected Tide (yellow)



At each RTK GPS update, we can interpolate what the heave value was at that time. We can then remove the heave component from that measurement by subtracting that heave value from the computed RTK tide. Those become our adjusted anchor points in our Final Tide Correction graph. We then can use the intervening heave-pitch-roll data to determine the movement of the sensors between RTK GPS updates.

In a perfect world, the yellow line would be almost flat.