

RTK Tides without a Heave Sensor

Pat Sanders

HYPACK-YSI



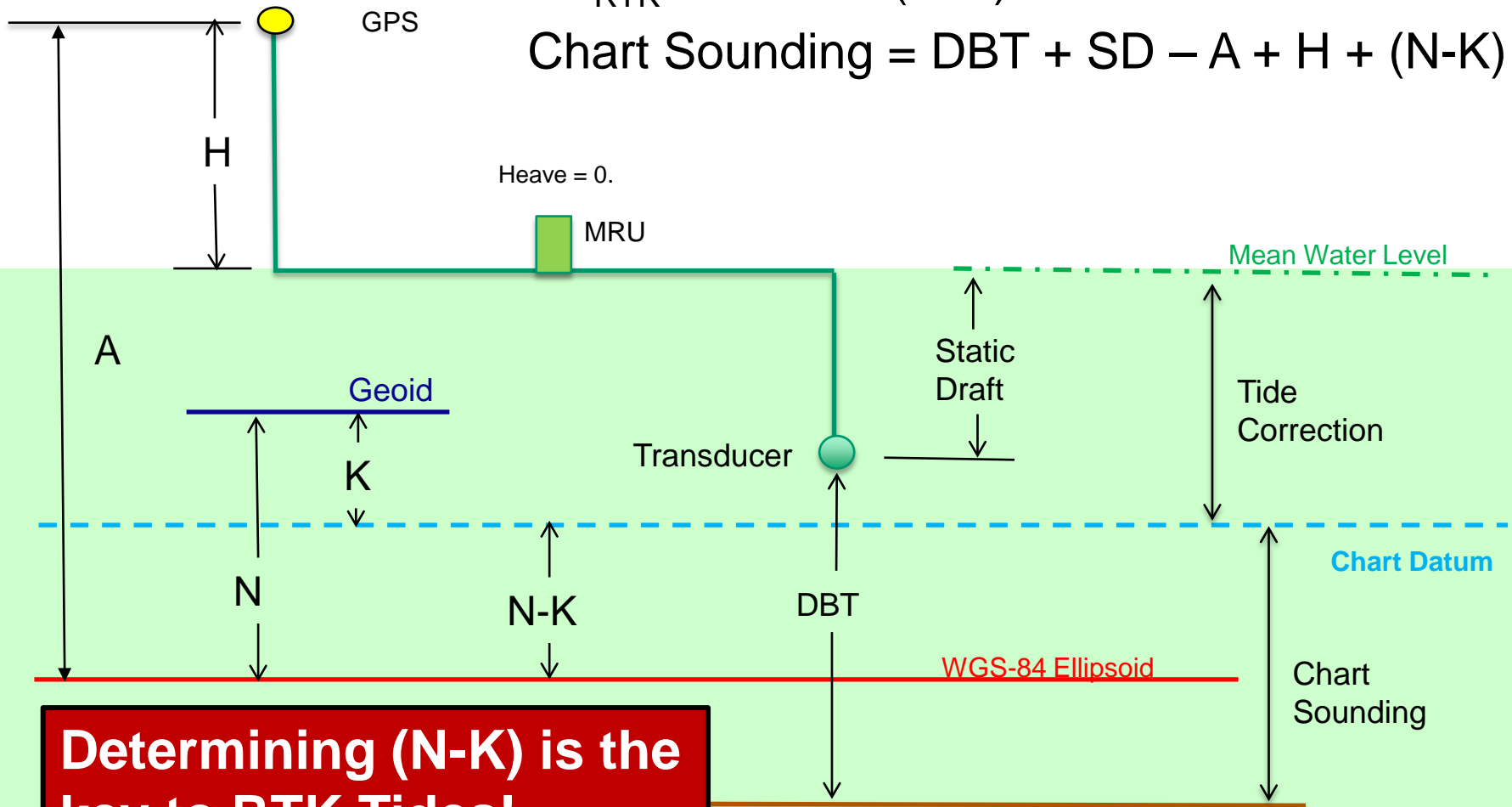
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RTK TIDES: Sitting at the Dock

$$\text{Chart Sounding} = \text{DBT} + \text{SD} - \text{TC}$$

$$\text{TC}_{\text{RTK}} = A - H - (N-K)$$

$$\text{Chart Sounding} = \text{DBT} + \text{SD} - A + H + (N-K)$$



Determining (N-K) is the key to RTK Tides!

Underway: Dynamic Draft

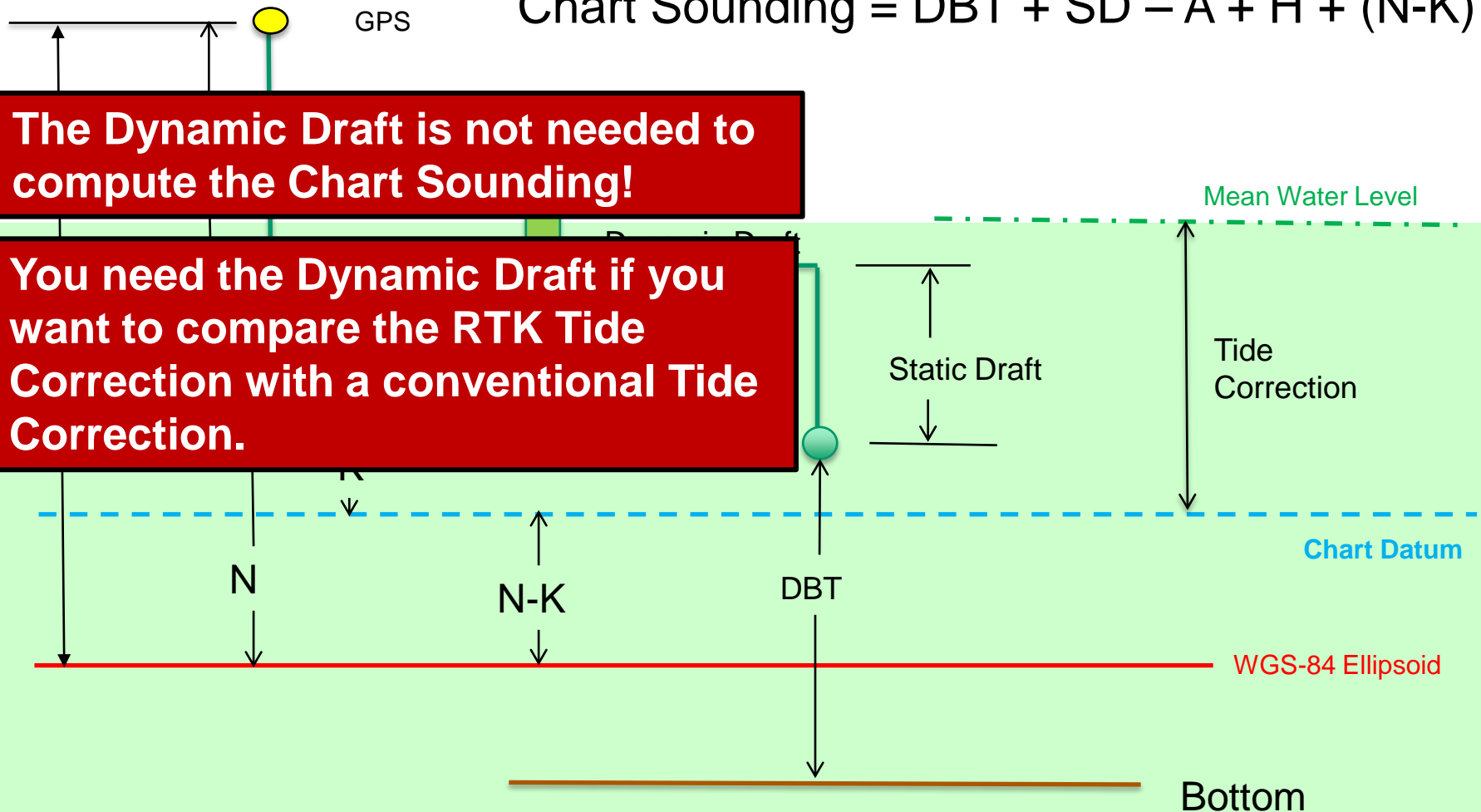
$$\text{Chart Sounding} = \text{DBT} + \text{SD} + \text{DD} - \text{TC}$$

$$\text{TC}_{\text{RTK}} = A - H - (N-K) + \text{DD}$$

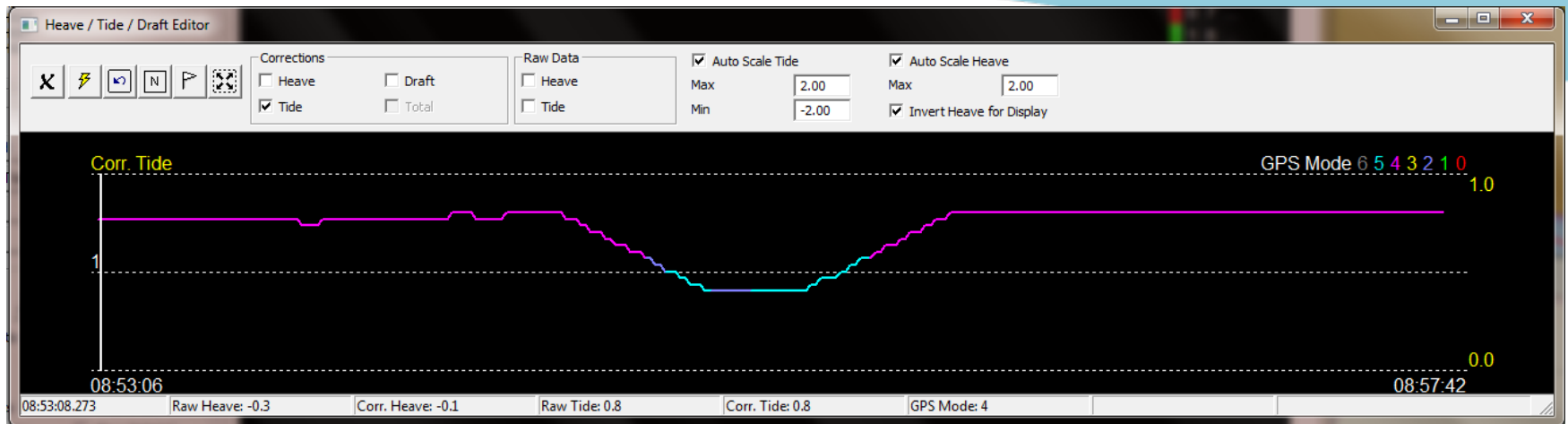
$$\text{Chart Sounding} = \text{DBT} + \text{SD} - A + H + (N-K)$$

The Dynamic Draft is not needed to compute the Chart Sounding!

You need the Dynamic Draft if you want to compare the RTK Tide Correction with a conventional Tide Correction.



Loss of RTK Fixed:



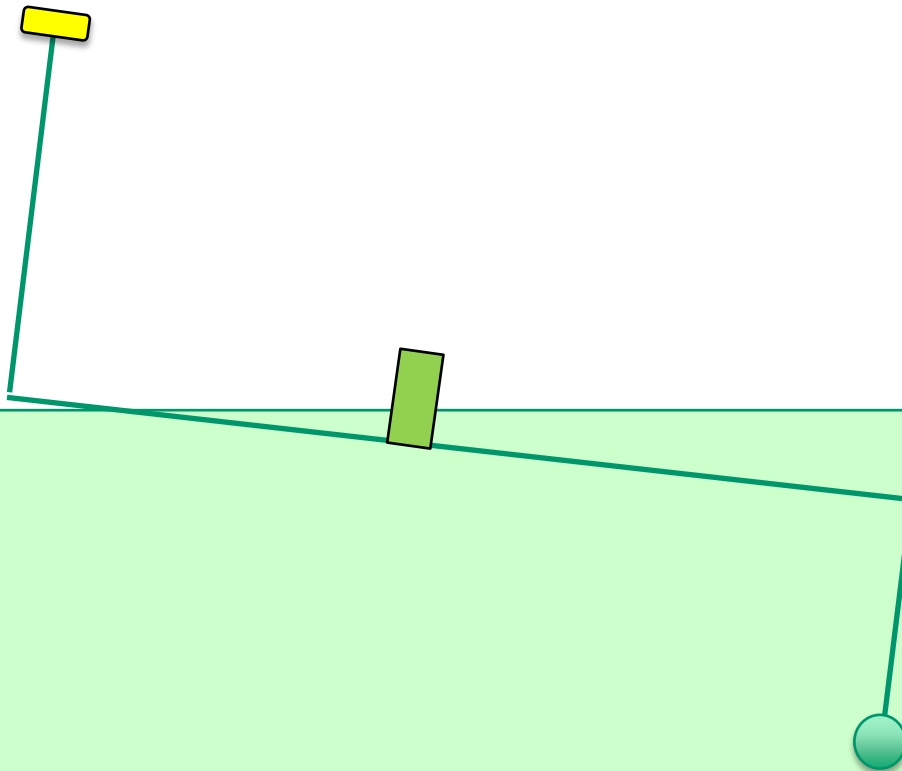
Raw RTK Tide going under a bridge.



Since we've separated the tide component, it's easy to smooth the tide value!

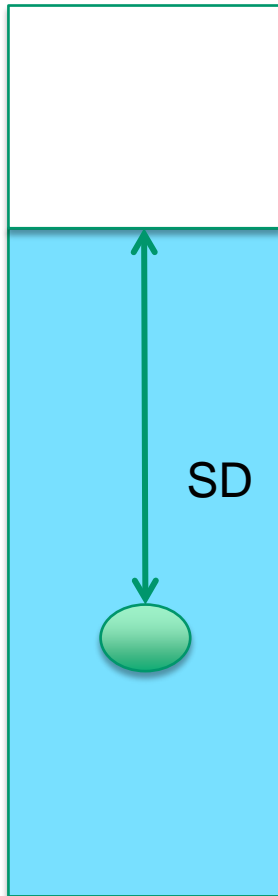
Let's Start Heaving, Rolling & Pitching

Things are going to get complicated....



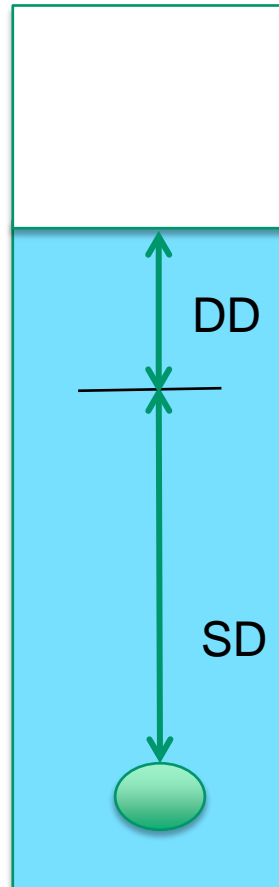
Transducer Movement

SD = Static Draft

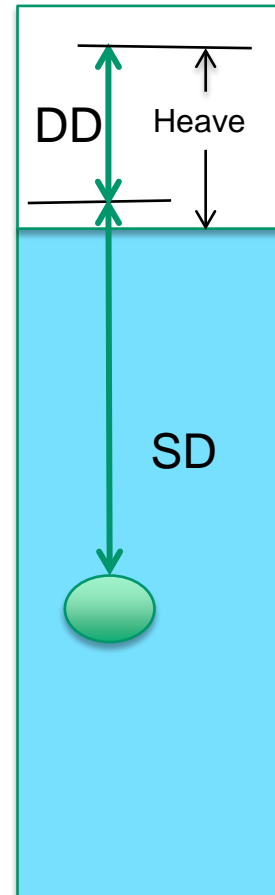


Static Draft

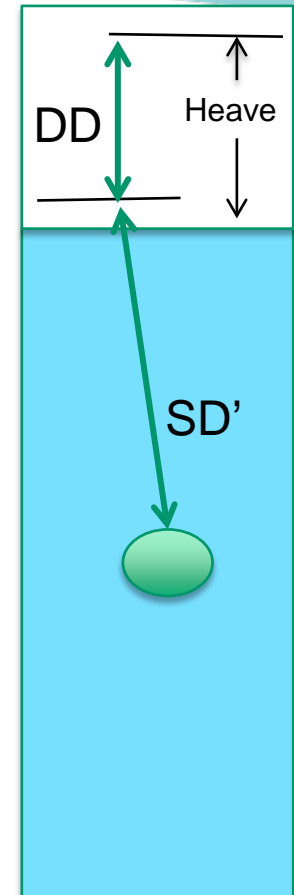
DD = Dynamic Draft



With Dynamic Draft



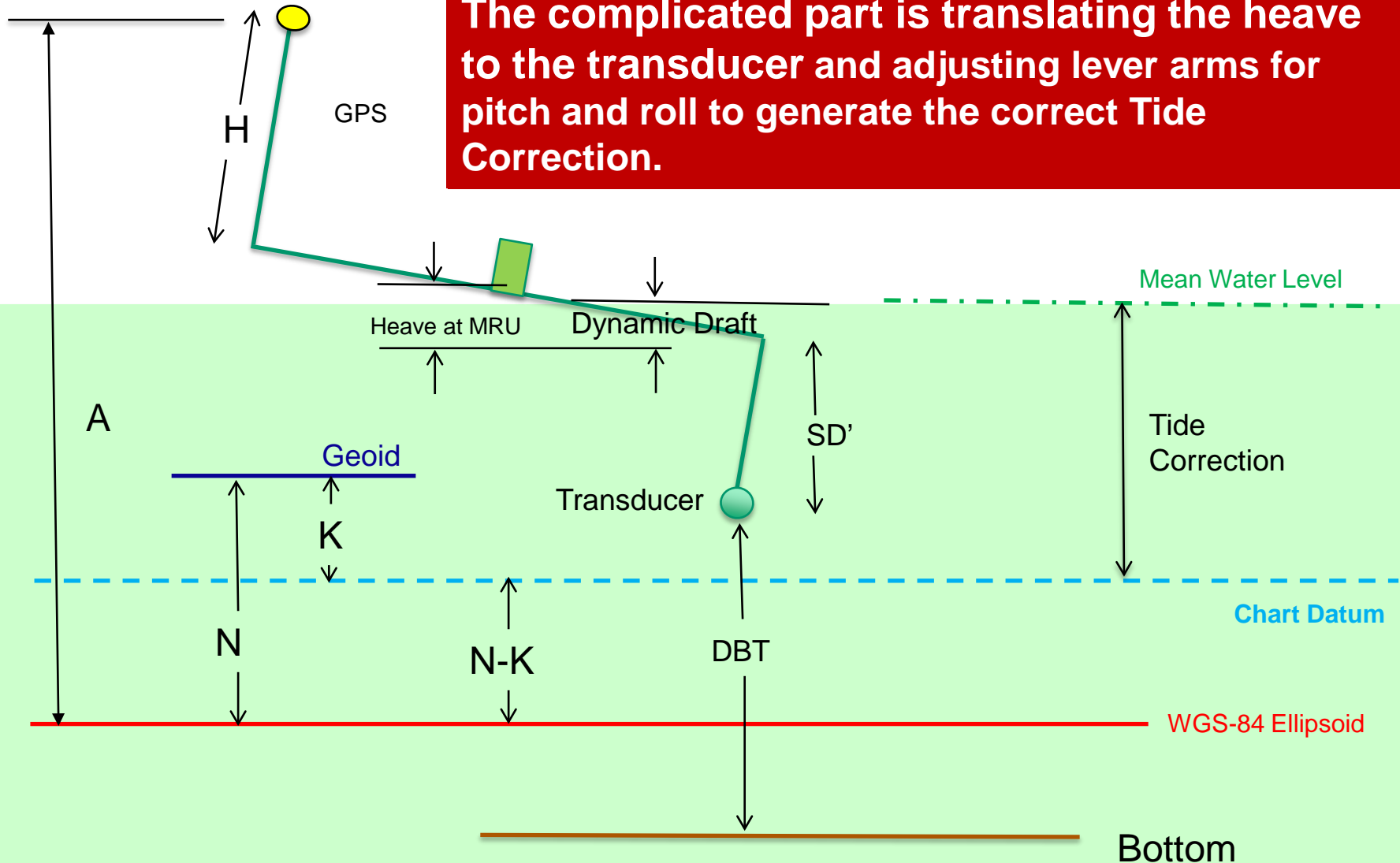
With DD and Heave



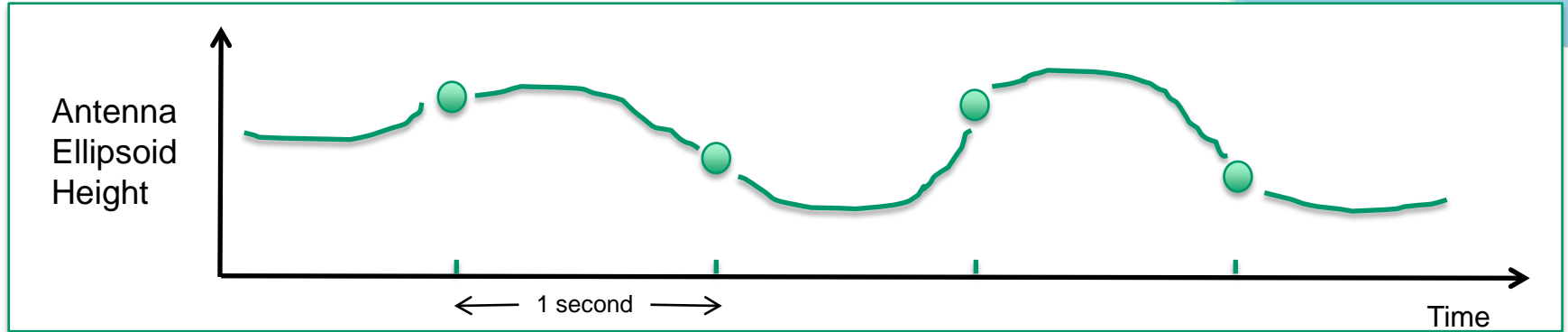
Add pitch and roll.

RTK Tides with Heave, Pitch and Roll

The complicated part is translating the heave to the transducer and adjusting lever arms for pitch and roll to generate the correct Tide Correction.



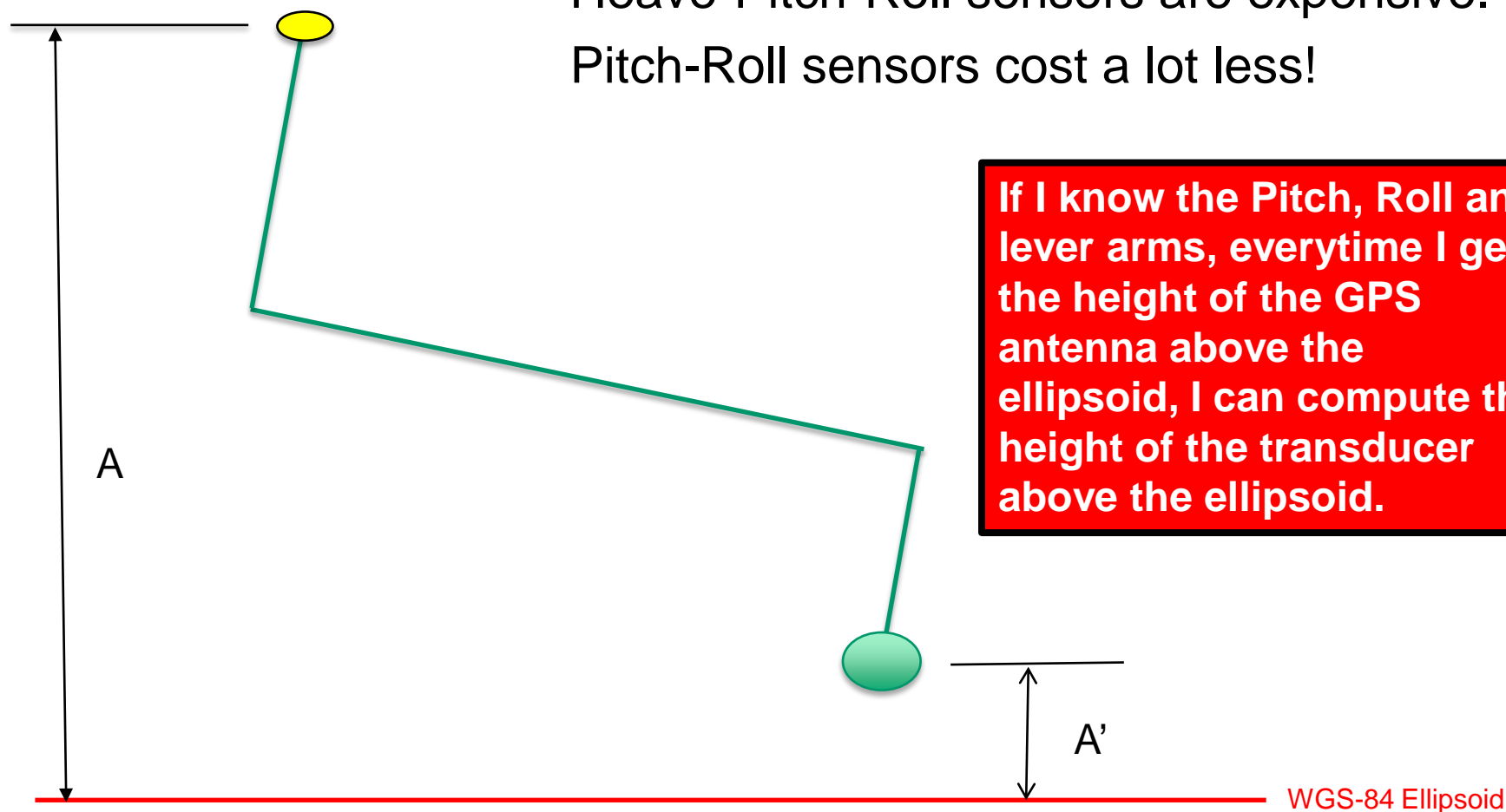
RTK Updates



Early RTK update rates of 1Hz required an MRU to determine the antenna/transducer motion between RTK updates.

Can we do RTK GPS with just a Pitch-Roll Sensor?

Heave-Pitch-Roll sensors are expensive.
Pitch-Roll sensors cost a lot less!

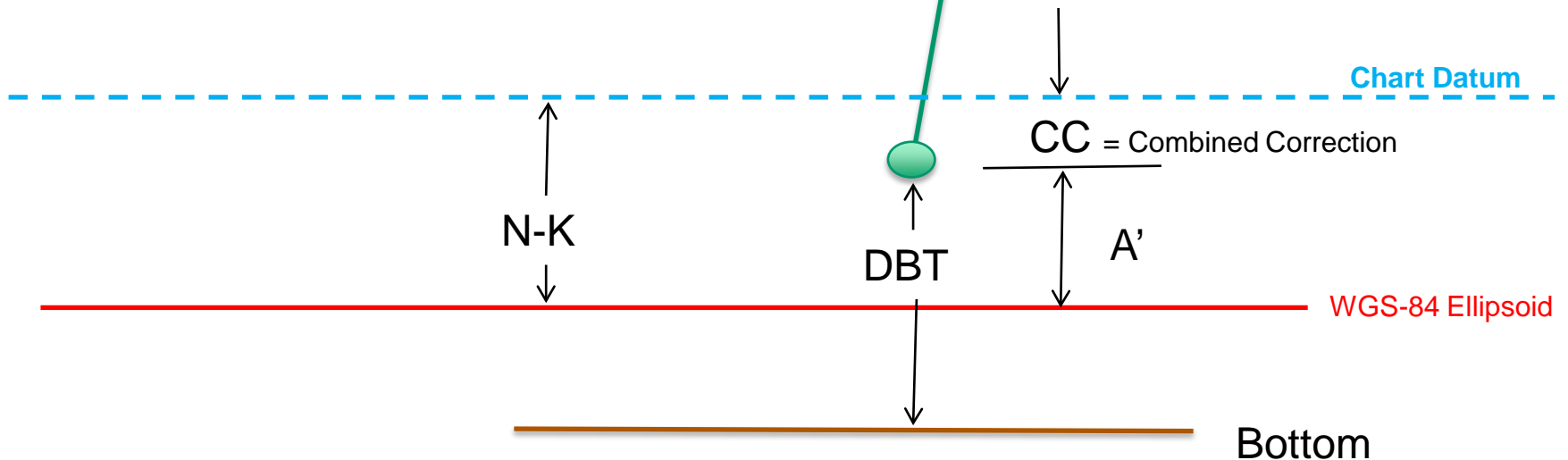


Simplified RTK

If we don't worry about separating the raw components...

$$\text{Chart Sounding} = \text{DBT} + \text{CC}$$

$$\text{Combined Correction (CC)} = (\text{N-K}) - A'$$



Putting it to the test!

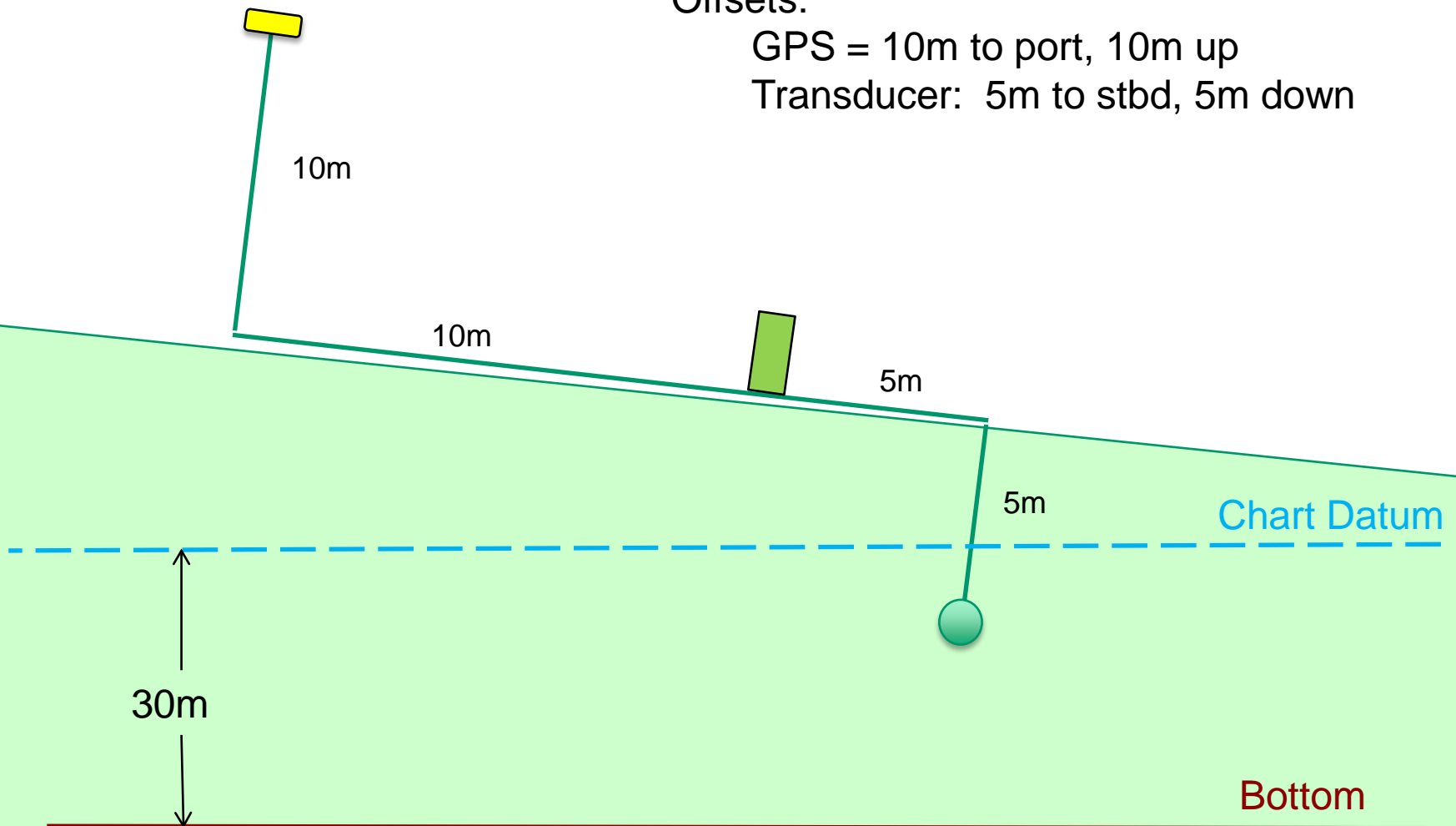
Roll: -10° to $+10^\circ$ every 8 secs.

Heave: -2m to $+2\text{m}$ every 5 secs.

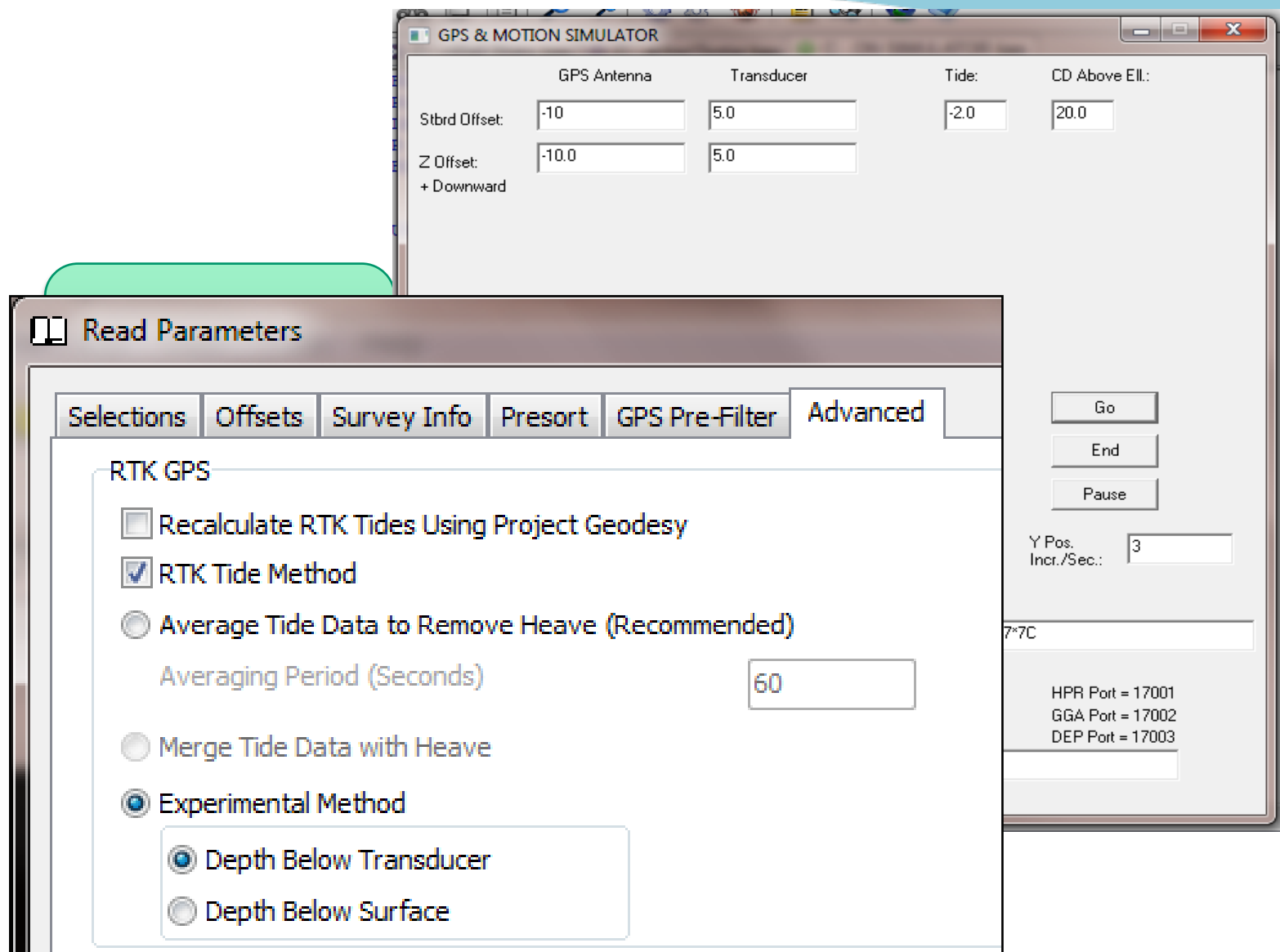
Offsets:

GPS = 10m to port, 10m up

Transducer: 5m to stbd, 5m down



HYPACK 3D Simulator



The Test Results: Simulation

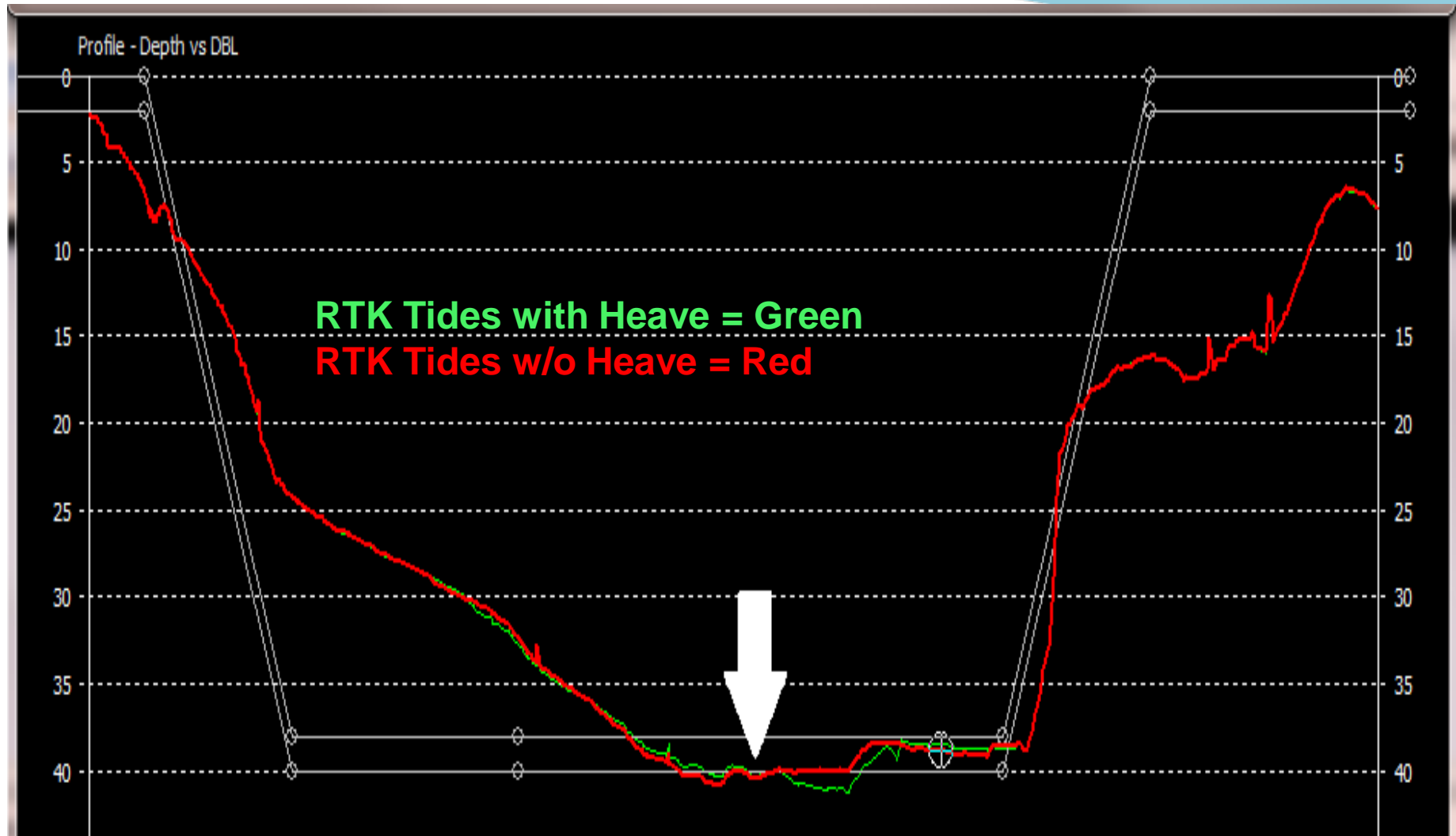
Method	Average Depth	Standard Deviation
Truth	30.00m	
Conventional RTK Tides	30.09m	0.22m
RTK Tides without Heave	30.02m	0.22m

- The new, simplified method of RTK TIDES without HEAVE performed slightly better than the older method.
- The somewhat large standard deviation might be attributable to heavy network traffic during the test.
 - We looked data with Wireshark to examine the time of receipt of the datagrams and found slight variations in the arrival times.

Then Results: Actual Survey Data



Victory Declared Until.....



The new method has problems when you lose RTK Fixed!

Conclusions:

- You can use RTK TIDES without a Heave sensor, provided you DO NOT lose RTK FIXED mode.
 - If you lose RTK FIXED modes, there is no recovery!
- The new method simplifies the calculation and provides slightly better results than the original method, provided you are in RTK FIXED mode the entire time.
- The conventional RTK TIDE method in HYPACK can recover from short periods of RTK FIXED loss by interpolating the computed tide across those periods.



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