



TPU Updates in MBMAX64

By Mike Kalmbach

More surveyors are using TPU these days so we've made improvements for HYPACK 2023 Q2. We've added a wide variety of TPU updates including new display, filtering, export, and accuracy standard options.

BACKGROUND

First off, what exactly is TPU? TPU (Total Propagated Uncertainty) are the calculations that give:

- TVU: Total Vertical Uncertainty
- THU: Total Horizontal Uncertainty
- Target Detection Size: The minimum detectable target size

TVU and THU are uncertainty values. For example, TVU = 20 cm means depth uncertainty = 20 cm. Likewise for horizontal. When an accuracy standard is selected, TVU and THU pass / fail testing can be performed with the following results:

- 0 = uncertainty greater than standard, test fails.
- 1 = uncertainty less than or equal to accuracy standard, test passes.

Pass / fail also applies to TPU:

- 0 = TVU or THU greater than standard, test fails.
- 1 = TVU and THU both less than or equal to accuracy standard, test passes.

Note that we do not currently work with detection size in MBMAX64.

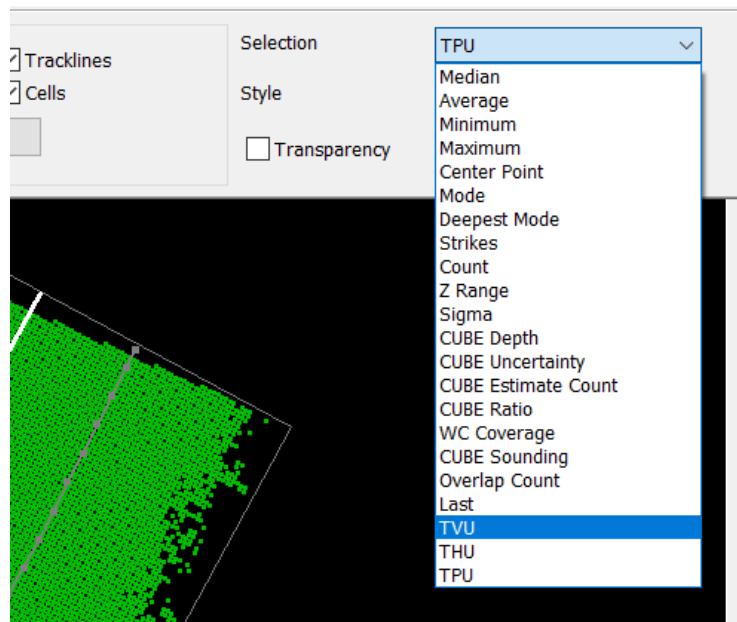
TPU parameters are entered in our TPU editor. The editor is accessed via HYPACK Shell -> Preparation -> Editors -> TPU Editor, or with the [TPU Editor...] button in the MBMAX64 Read Parameters windows.

THE UPDATES:

- Options to show uncertainties in the matrix display.
- Auto-filter soundings outside TPU limits.
- Save options for XY, THU and XY, TVU output.
- Add the IHO Exclusive Order accuracy standard.

OPTIONS TO SHOW UNCERTAINTIES IN THE MATRIX DISPLAY

We've added three new pass / fail selections to the Selection drop down in the MBMAX64 window:



The new options are:

- TVU: Green/pass if one or more soundings in a cell meets uncertainty limits. Red/fail otherwise.
- THU: Green/pass or red/fail color coding as with TVU.
- TPU: Green/pass if both TVU and THU meet uncertainty limits, red/fail if either exceeds limits.

The options also apply when saving one point per cell to MTX and XYZ files. 0/1 coding replaces Z.

Of course an accuracy standard must be selected for this to work, otherwise the coloring is all red. Check the Calculate TPU box and choose the accuracy standard from the MBMAX64 Read Parameters window.

TPU

☒ Calculate TPU

☐ Use Uncertainty Reported by Sonar

Accuracy Standard

USACE Soft

TPU Editor...

Reload TPU

AUTO FILTER SOUNDINGS OUTSIDE TPU LIMITS

The new TPU filter can automatically remove soundings outside TPU limits. Filter preview (yellow X's) is available. Undo is available for mistakes.

The filter setup is simply a checkbox. Soundings outside TVU or THU limits are filtered out. As with matrix coloring, the TPU filter requires an accuracy standard to be selected in the MBMAX64 Read Parameters window.

To use this new filter, from MBMAX64 click Edit -> Search and Filter Options -> Sweep.

Search and Filter Options

Actions Basic GPS Sweep Matrix Search Only

Beams

☐ Over / Under Filter

☒ TPU

☐ Minimum Beam Quality 1

☐ Remove Beams

☐ Remove Detections

Median

☐ Enable Gate Size 1.0

Pings 3 # Beams 5

Savitsky-Golay Filter

☐ Enable Gate Size 1.0

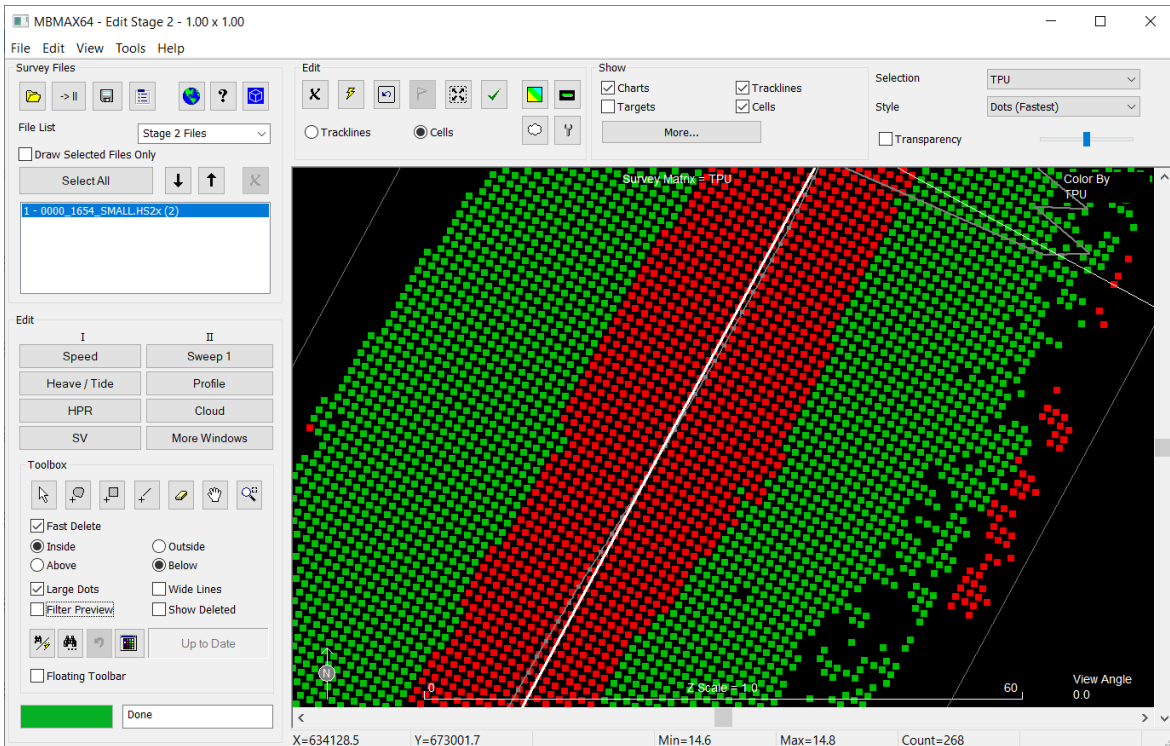
Order 2 Window Size 7

Beam Intensity Limits

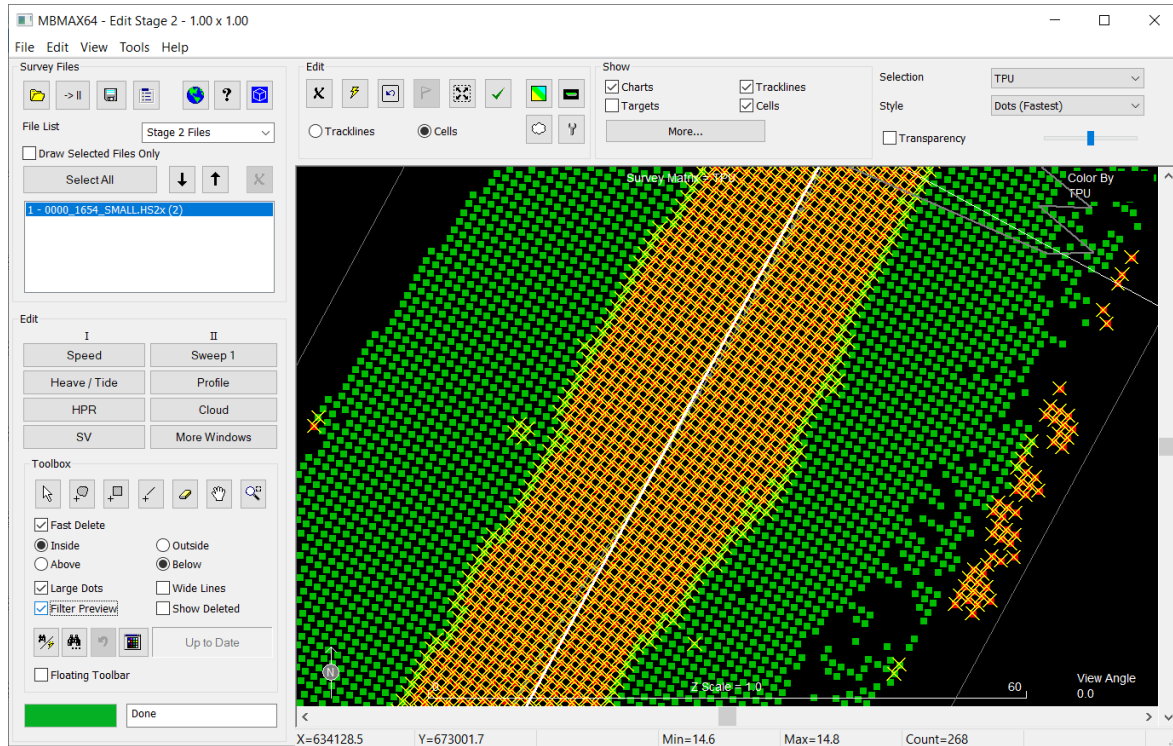
☐ Minimum 1 ☐ Maximum 32767

Update Filter Preview

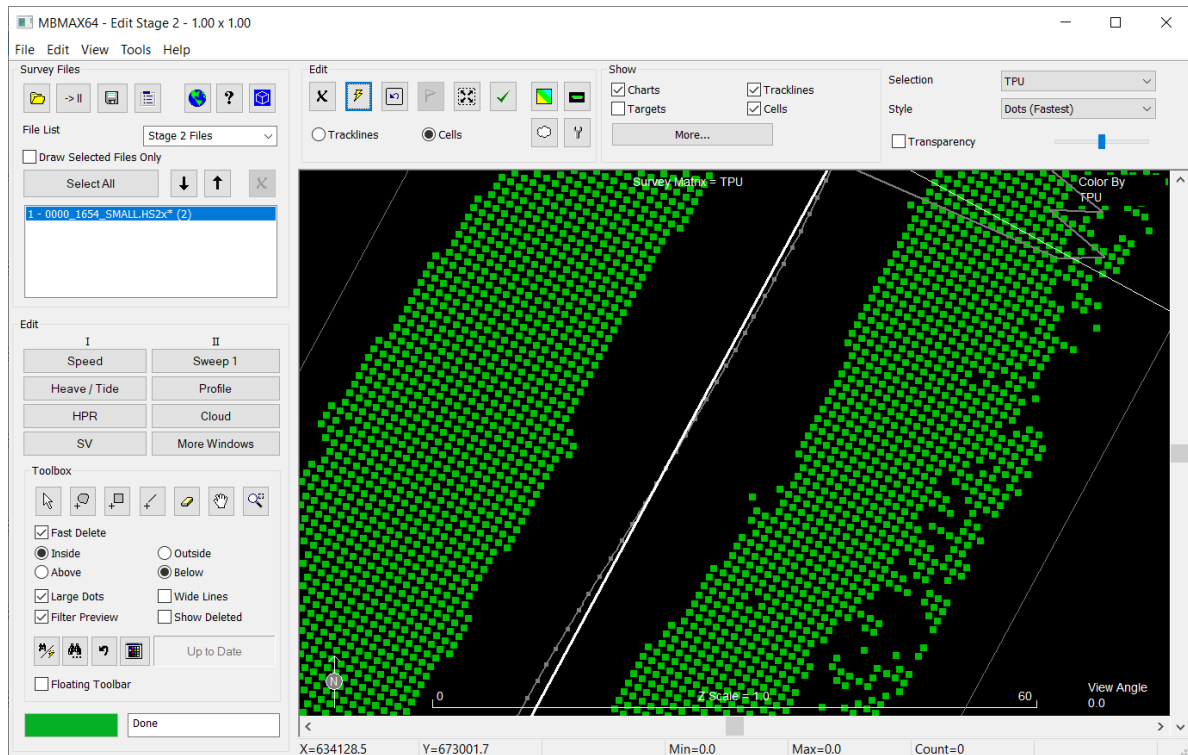
Here's an example of borderline TPU in the new matrix display. Out to 20 or so degrees from the nadir, red shows that TVU exceeds limits. At edge of the swath, THU exceeds limits.



This window shows the filter preview with yellow X's,



This window shows the soundings after the filter is applied.



SAVE OPTIONS FOR XY, THU AND XY, TVU OUTPUT

We've added two new save options for XYZ file formats: XY, THU and XY, TVU. The Z-multiplier may be used to scale small TVU and THU values upward if that is useful.

The output files can be loaded elsewhere for contouring, analysis, or whatever. Although depth is not included in output, the files are saved as *.XYZ, with actual TVU or THU (not pass/fail) replacing depth Z.

Save Survey

File Format

☐ HS2x - HYSWEEP Edit 64 Bit ☐ HS2 - HYSWEEP Edit 32 Bit ☒ XYZ

☐ MTX - HYSWEEP Matrix ☐ Export ☐ GSF

☐ LAS ☐ BAG - Bathymetric Attributed Grid

☐ Append to File Names Save Reminder / Auto Save HS2x...

XYZ Options

☒ Save All Points ☐ Use Actual XY (Where Possible) ☐ Save Zoom Area Only

☐ Save One Point per Cell ☐ Use Cell Center XY ☐ One File Per Survey Line

☐ eHydro Naming ☐ _A Suffix ☐ Use Project Rounding Rules

☐ _FULL Suffix ☐ Append Golden Soundings

MTX Selection **XYZ Selection** **Export Selection**

TPU XY, TVU NHO - Test Format

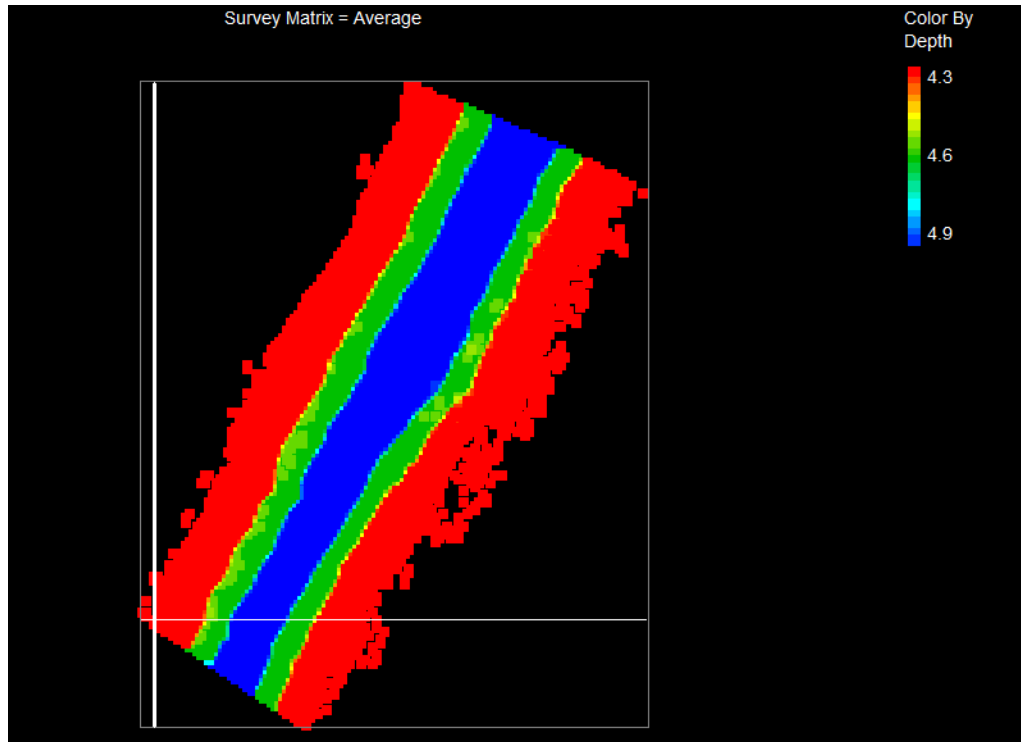
Minimum # Points for Average Z Multiplier

1 1.000

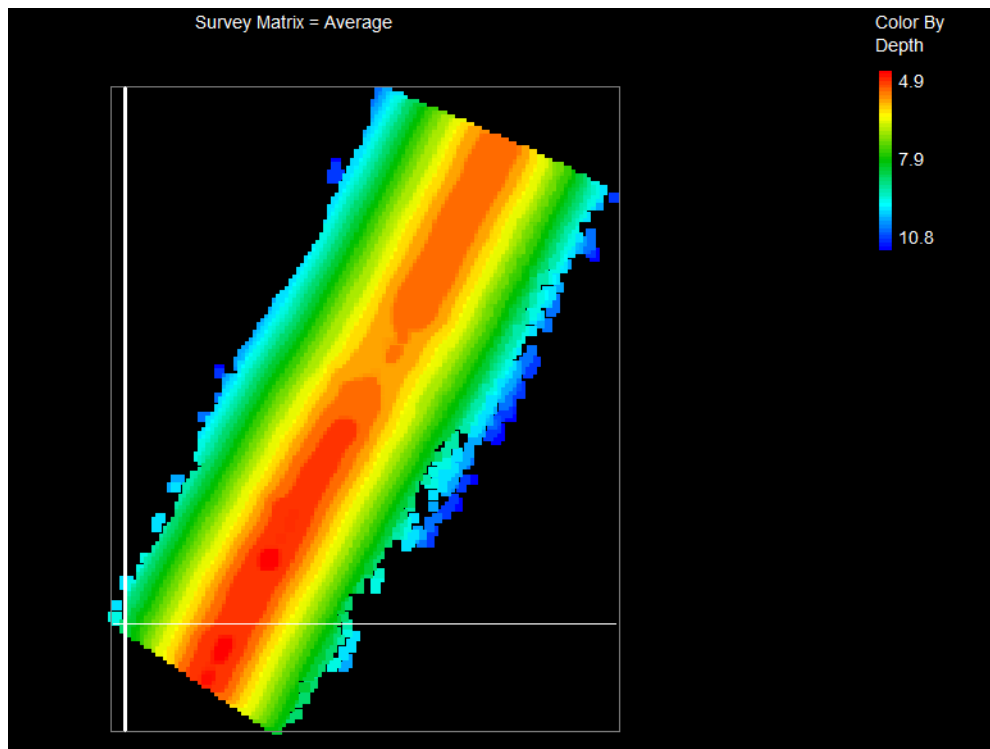
Default Values Save Selected Files... Close

Deleted to Date

Here is an example using only MBMAX64. First, an HSX file is loaded with TPU calculations. XY,TVU and XY,THU are then output with the Z multiplier = 10.



Reloading the TVU file into MBMAX64 shows a distinctive pattern with greater TVU in the center beams.



Reloading THU shows the opposite pattern, with THU increasing with distance from the center beams.

ADDED IHO EXCLUSIVE ORDER ACCURACY STANDARD

We've added the IHO Exclusive accuracy standard, which is a new S-44 standard for areas of minimal under keel clearance. This standard requires approximately twice the vertical and horizontal accuracy of IHO special order.

Select IHO Exclusive Accuracy Standard in Read Parameters.

TPU
☒ Calculate TPU
☐ Use Uncertainty Reported by Sonar
Accuracy Standard

IHO Exclusive

TPU Editor...

Reload TPU