



Office of Coast Survey

National Oceanic & Atmospheric Administration

SOP: Manual Bathymetry Processing

Revision History			
Rev	Description of Change	Author & Unit	Date
1	Created	LT Taylor Krabiel, FA	26JUN2024
2	Updated: light reformatting and updating for 11.4. Added .all	Harper Umfress, HSTB	3FEB2025

Contents

[Contents](#)

[Purpose & Applicability](#)

[Data transfer and concatenation](#)

- [1. Copy files from transfer drive into raw and processed folders on the network](#)
- [2. SVP File Management: Concatenate Sound Speed Casts](#)

[Importing data into CARIS](#)

- [1\) Open CARIS HIPS and SIPS 11.x.](#)
- [2\) Import raw data](#)
- [3\) Import Auxiliary Data](#)
- [4\) Georeference](#)

[Line Report](#)

[Creating a Surface/Rough Cleaning](#)

[Resources & References](#)

Purpose & Applicability

This SOP covers:

- Using CARIS 11.4
- Converting .kmall & .all multibeam to HDCS
- Importing .000 POS MV data
- Importing SBETs

This SOP describes the process of manual CARIS HIPS & SIPS bathymetry processing. The first course of action is to transfer all files created during acquisition into their appropriate folders on the network per your vessel's organization. Then, the raw data will be imported into CARIS. After the import of the raw data, auxiliary data will be applied to the imported raw files. SBETs and RMS files may need to be manually created if they do not exist already. Georeferencing the data will be the final step in CARIS.

For the purpose of this SOP:

- RD = Raw storage location
- PD = Processed Storage location
- TD = Transfer Drive
- VV_VESSL_EMXXX = Vessel Initials_Platform name_Sonar ex: FA_2806_EM2040 or TJ_2902_EM2040

Data transfer and concatenation

Files created during acquisition that are stored on the transfer drives will need to be transferred onto the network. Then, SVP files will need to be combined or concatenated.

1. Copy files from transfer drive into raw and processed folders on the network. Use the table below as a rough guide, but refer to your unit practice and the HSSD for details.

File	From	To
Kongsberg (SIS) (*.kmall)	TD:\OPR-XXXX-VV-YY\HXXXXX\X\Data\MB\VV_VESSL_EMXX X\YYYY-DDD	RD:\20YY_Data\OPR-XXXX-VV-Y Y\HXXXXX\Raw\MB\VV_VESSL_E MXXX\YYYY-DDD
GNSS Data - POSMV files (*.000-*.00#)	TD:\OPR-XXXX-VV-YY\HXXXXX\X\Data\Positioning\VV_VESSL _EMXXX\YYYY-DDD	RD:\20YY_Data\OPR-XXXX-VV-Y Y\HXXXXX\Raw\Positioning\ VV_VSSL_EMXXX\YYYY-DDD

Sound Velocity Raw (*.m1 for the ship, *.HEX and *.cnv for the launches)	TD:\OPR-XXXX-VV-YY\HXXXXX\Data\SVP\VV_VESSL_EMXX\Raw\YYYY-DDD	RD:\20YY_Data\OPR-XXXX-VV-Y\HXXXXX\Data\Raw\SVP\VV_VSSL_EMXXX\Raw\YYYY-DDD
Sound Velocity NODC files (*.nc Files)	TD:\OPR-XXXX-VV-YY\HXXXXX\Data\SVP\VV_VESSL_EMXX\NODC\YYYY-DDD	RD:\20YY_Data\OPR-XXXX-VV-Y\HXXXXX\Data\Raw\SVP\VV_VSSL_EMXXX\NODC\YYYY-DDD
Sound Velocity (*.svp files)	TD:\OPR-XXXX-VV-YY\HXXXXX\Data\SVP\VV_xxxx_EM2040\SVP\YYYY-DDD	PD:\20YY_Data\OPR-XXXX-VV-Y\HXXXXX\Processed\SVP\VV_VSSL_EMXXX\SVP\YYYY-DDD
Acquisition Logs to (excel file)	TD:\OPR-XXXX-VV-YY\HXXXXX\Data\Acquisition_Logs\VV_VESSL_EMXXX\YYYY-DDD	PD:\20YY_Data\OPR-XXXX-VV-Y\HXXXXX\Data\Raw\SVP\VV_VSSL_EMXXX\NODC\YYYY-DDD

2. OPTIONAL: concatenate Sound Speed Casts

- a. Charlene concatenates individual SVP files into a single text file. When manually processing, this is a labor intensive process with few benefits. I recommend just leaving SVP data as individual files in the SVP directory, and selecting the SVP top level directory when georeferencing (e.g., PD:\20YY_Data\OPR-XXXX-VV-YY\HXXXXX\Processed\SVP).
- b. If you'd really like to concatenate the daily files, open the daily .svp file and the master vessel file in edit notepad. Then, simply copy and paste the daily file's casts to the end of the master vessel file. It should look something like what is shown below. Notice the headers that separate each cast from each other. This part of the header is all that is needed out of the daily file.

```
5498.570000 1551.277525
5499.570000 1551.277525
5500.000000 1551.277525
Section 2024-138 07:28 57:07:32 -150:58:15
2.780000 1472.760000
2.880000 1472.780000
3.070000 1472.790000
```

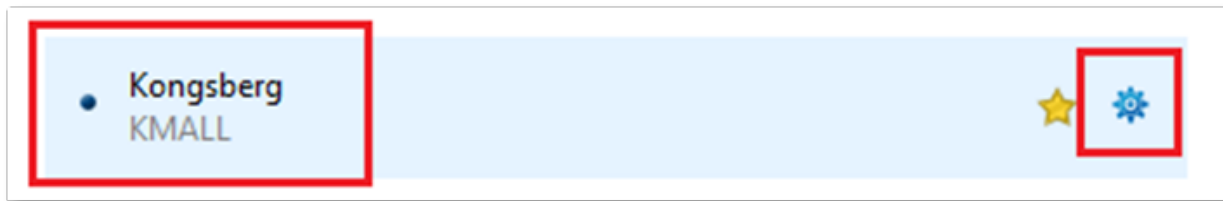
Converting Multibeam Data to CARIS HDCS

- 1) Open CARIS HIPS and SIPS 11.x.

If this is the first time opening CARIS 11.x, you will likely need to set up the correct mapping environment. See the following SOP:

[WORKING_OCS SOP CARIS 11.X First Time Setup.docx](#)

- 2) Import raw data
 - a) Select File > Import > Sensor Data
 - b) In the Import Sensor Data window, select Kongsberg KMALL (or Kongsberg ALL if applicable, see step d) and the blue settings button:



- c) For the [Import Options – Kongsberg KMALL](#) window, ensure the following settings are correct:

Import Options - Kongsberg Kmall

- Options
 - Convert Navigation into HDCS Format ☒
 - Convert Vehicle Depth ☐
- Devices
 - Navigation Automatic
 - GPS Height Device Automatic
 - Heading Automatic
 - Heave Automatic
 - Delayed Heave Automatic
 - Pitch Automatic
 - Roll Automatic
- Timestamps
 - GPS Timestamps GPS
 - Time Shift 0
- Input
 - Input Coordinate Reference System NAD83 / UTM zone 5N [NA83]
 EPSG:26905
 - Carry Over Raw Data Files ☐
- Advanced Options
 - Overwrite
 - ☐ Bathymetry
 - ☐ Navigation
 - ☐ Motion
 - ☐ Backscatter
 - ☐ Sidescan
 - Filter Extent Type ☐
 - Extent
 - ☐ m
- Filter Data
 - Filter Data
 - ☐ Minimum m
 - ☐ Maximum m
- Input
 - Extract SVP ☐

OK Cancel

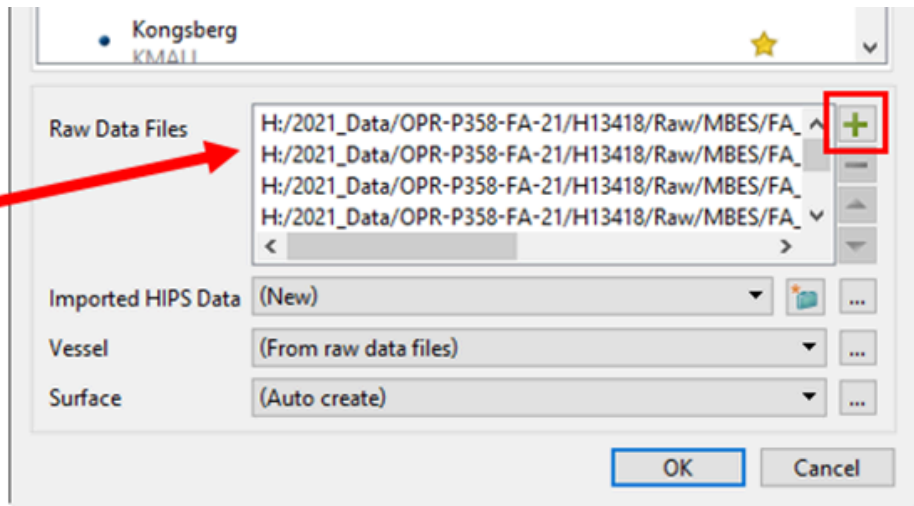
- d) If using Kongsberg .all, all remains the same as .kmal except for the device configuration. See image below. For GPS Height Device and Surface Sound Speed, Automatic is not an option for .all


Import Options - Kongsberg ALL

- Options
 - Convert Navigation into HDCS Format ☒
 - Convert Vehicle Depth ☐
- Devices
 - Navigation Automatic
 - GPS Height Device GGK
 - Heading Automatic
 - Heave Automatic
 - Pitch Automatic
 - Roll Automatic
 - Surface Sound Speed Depth

- e) In the Import Sensor Data window, next to Raw Data Files select the green plus sign and add all of your raw MBES files that you want to process.

MBES files will appear here

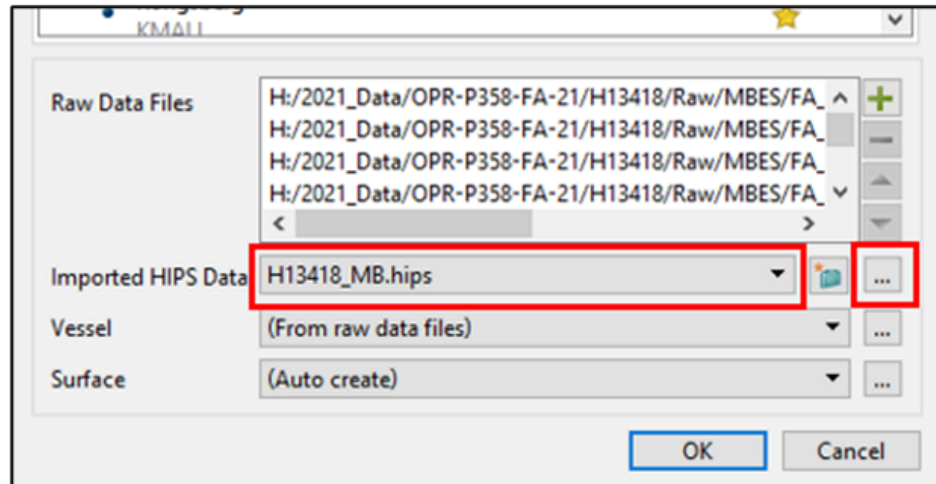


- f) In the Import Sensor Data window, next to Imported HIPS Data, create a new project if it is the first day of processing (). If it is not the first day of processing, skip this step and go to the next step to select the .hips file already created. Select the Show Options dropdown in the left corner and adjust the following settings:

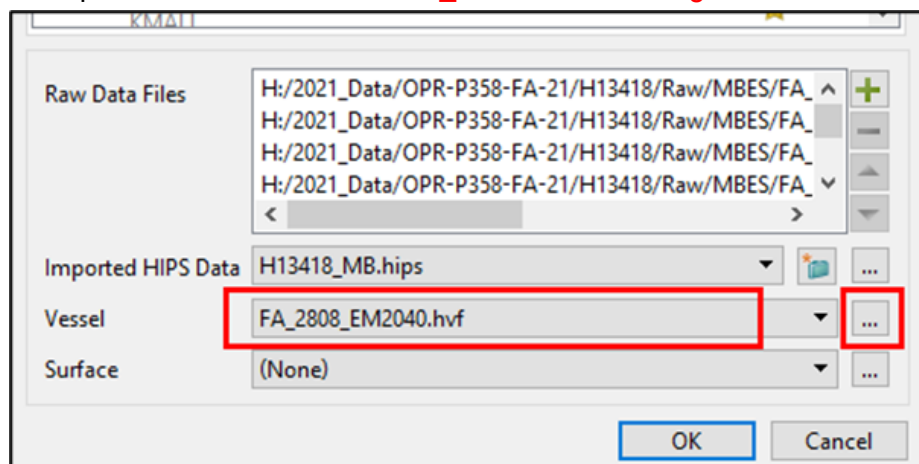
Name: HXXXXX_MB

Coordinate Reference System: Check project instructions

- g) Skip this step if you did not already have a .hips file and generated one in step e. If it is not the first day of processing and a .hips file was already created, in the Import Sensor Data window, next to Imported HIPS Data, select the three dots button and navigate to the .hips file.



- h) In the Import Sensor Data window, next to Vessel, navigate to the following location and select the correct HVF for that launch or ship used.
Example HVF location: **PD:\20YY_Data\ VesselConfig**



- i) If you have additional processing to do (importing SBETs, SVC, etc), select surface None. If you want a preliminary surface computed, there's no harm in creating one at this step, other than the fact that it will take longer to process.

Importing Auxiliary Data

At this point in the process you will need to apply correctors or “auxiliary data” to the soundings. Auxiliary data includes delayed heave, smoothed best estimate of trajectory (SBET), and (root mean square) RMS.

- 1) Apply Delayed Heave. With your lines selected, select File > Import > Auxiliary Data > Applanix POSMV and browse to your POS files:

Example POSMV Location:

RD:\20YY_Data\OPR-XXX-VV-YY\HXXXXX\Raw\Positioning\VV_VESSL_EMXXX\20YY-XXX

Import HIPS From Applanix POS MV

Input source: Selected Track Lines

Options:

Options

Time Offset: 0.00 sec

Time Buffer: 0.00 sec

Maximum Allowed Gap: 2.00 sec

Allow Partially Covered: ☒

Reference Week: ☐ 5/8/2024

Input Coordinate Reference ...: NAD83 / UTM zone 5N [NA83] EPSG:26905

Sensors

Navigation: ☐

Gyro: ☐ sec

Pitch: ☐ sec

Roll: ☐ sec

GPS Height: ☐ sec

Delayed Heave: ☒ 0.00 sec

Navigation RMS: ☐ sec

Gyro RMS: ☐ sec

Pitch RMS: ☐ sec

Roll RMS: ☐ sec

GPS Height RMS: ☐ sec

Heave RMS: ☐ sec

Delayed Heave RMS: ☒ 0.00 sec

OK Cancel

Be sure to select only the lines to which delayed heave is applied

Check the Project Instructions for the correct coordinate system

- 2) Apply SBETs and RMS

- a) To complete this step, you will need to an SBET and RMS file. SBETS/RMS are created using another program (POSPac). If you need to create an SBET/RMS file, follow the steps in the POSPac_RTX_SOP located here:

[WORKING OCS SOP Manual POSPac 9.1 SBET Creation](#) . Once you have created the SBET, you may continue onto the next step in this SOP.

- b) Select *only* the tracklines to which you intend to apply an SBET. This will likely be a single vessel and single day of data.
- c) Import SBET

- i) Click File > Import > Auxiliary Data > Applanix SBET
- ii) Navigate to the location of the processed SBET. The SBET file will probably look like this: **HXXXXX_SBET_VV_VESSL_EMXXX_YYYY_DDD_NAD83(2011).out**
- iii) Fill out the parameters in the window. Remember, for Input Source, select only the lines to which you wish to apply SBETs.

Import HIPS From Applanix SBET

Input source: Selected Track Lines

Options:

Options

Time Offset 0.00 sec

Time Buffer 0.00 sec

Maximum Allowed Gap 2.00 sec

Allow Partially Covered ☒

Reference Week ☐ 6/8/2021

Input Coordinate Reference System NAD83 / UTM zone 10N [NA83] EPSG:26910

Sensors

Navigation ☒

Gyro ☐ sec

Pitch ☐ sec

Roll ☐ sec

GPS Height ☒ 0.00 sec

OK Cancel

- j) Import the associated RMS
 - i) Click File > Import > Auxiliary Data > Applanix RMS
 - ii) Navigate to the location of the processed RMS. The RMS file will look something like this: **HXXXXX_smrmmsg_VV_VESSL_EMXXX_YYYY_DDD_NAD83(2011).out**

- iii) Fill out the parameters in the window. Remember, for Input Source, select only the lines to which you wish apply SBET RMS data.

Import HIPS From Applanix RMS

Input source: Selected Track Lines

Options:

Options

Time Offset: 0.00 sec

Time Buffer: 0.00 sec

Maximum Allowed Gap: 2.00 sec

Allow Partially Covered: ☒

Reference Week: ☐ 7/5/2021

Sensors

Navigation RMS: ☒ 1.00 sec

Gyro RMS: ☐ sec

Pitch RMS: ☐ sec

Roll RMS: ☐ sec

GPS Height RMS: ☒ 1.00 sec

OK Cancel

Georeference Bathymetry

- 1) In the Active Track Lines window, select the Track Lines you want to georeferenced. This will just be the Day's data for whichever vessel you are processing. Then, select the

Georeference Bathymetry button: 

2) In the Georeference Bathymetry window that pops up, set the following parameters

The screenshot shows the 'Georeference Bathymetry' window with the following settings and annotations:

- Input source:** Set to 'Selected Track Lines'. An annotation box points to this dropdown with the text: 'Can select "All Track Lines" if that's what you want to do'.
- Sound Velocity Correction:** Checked.
- Total Propagated Uncertainty:** Checked.
- Vertical datum reference:** Set to 'GPS'.
- GPS vertical components:** Set to 'Use default system settings'.
- Options:**
 - General:**
 - Vertical Offset:** Checked, value '0.0', unit 'm'.
 - Heave Source:** Set to 'Delayed'.
 - Refraction Coefficients:** Unchecked.
 - Depth Corrections:** Unchecked.
 - Delta Draft/Subsea Depth:** Unchecked.
 - Smooth Sensor:** A list of checkboxes: Gyro, Heave, Pitch, Roll, SOW. All are currently unchecked.
 - Shift:**
 - Type:** Set to 'None'.

Below the 'Options' section, there is a 'File' button and a text input field.

The **Sound Velocity Correction** section is expanded, showing:

- Sound Velocity Profile(s):** Checked. A list box contains the path 'I:/2021_Data/OPR-P358-FA-21/H13418/Process...'. To the right of the list box are three buttons: a folder icon (selected), a file icon, and a plus icon. Two annotation boxes point to these buttons:
 - The top box points to the folder icon: 'Use this button to select individual SVP files (or a single master concat)'.
 - The bottom box points to the plus icon: 'Or use this button to select a directory that contains SVPs files.'.
- Use Surface Sound Speed as Backu...:** Unchecked.
- Profile Selection Method:** Set to 'Nearest in Distance Within Time'.
- Nearest in Distance Hours:** Set to '4'.
- Use Surface Sound Speed:** Checked.
- Steered Beam Angle Recomputation:** Unchecked.

Total Propagated Uncertainty

GPS Height Source	Realtime
GPS Sounding Datum	0.2 m
Measured Sound Velocity	2.00 m/s
Surface Sound Velocity	0.05 m/s
Sweep Maximum Heave	0.0 m
Sweep Maximum Roll	0.00 deg
Sweep Maximum Pitch	0.00 deg

Navigation Source: Realtime
 Sonar Source: Realtime
 Gyro Source: Realtime
 Pitch Source: Realtime
 Roll Source: Realtime
 Heave Source: Delayed

GPS Vertical Adjustment

Compute GPS Vertical Adjustment	<input checked="" type="checkbox"/>
Sounding Datum Offset	<input checked="" type="checkbox"/> 0.0 m
Model File	<input checked="" type="checkbox"/> -MLLW\CCOM_DriX_VDatum_WGS84-MLLW.csar
Band Name	<input checked="" type="checkbox"/> NAD83_MLLW
ASCII Format Information File	<input type="checkbox"/>
Coordinate Reference System	<input checked="" type="checkbox"/> NAD83(2011) / UTM zone 6N EPSG:6335
GPS Datum Uncertainty Model File	<input type="checkbox"/>
GPS Datum Uncertainty Band	<input type="checkbox"/>
Smooth GPS Height	<input type="checkbox"/>
Output Components	<input type="checkbox"/>

These values will depend on project instructions and systems in use.

VDatum separation model for project.

Confirm band name! It may be different in your model.


Select appropriate CRS for your project

Typical VDatum Location

PD:\20YY_Data\OPR-XXXX-VV-YY\HXXXXX\Processed\ Vertical_Datum_Correction \ERTDM or VDATUM

- Once Georeferencing is complete, check the Output log in CARIS. Take note of any lines with any issues and/or error messages.

Surface Creation (Variable Resolution)

1. Zoom out to make sure you can see in your display all the data you want to process.
2. Click the  icon in the toolbar.

New Variable Resolution Surface

Input

Sources: All Track Lines, H12961_Bekah Track Lines, Selected Track Lines

Include Status Flag: ☒ Accepted, ☐ Rejected, ☒ Outstanding, ☒ Examined

Options

Estimation Method: Ranges

Options

Range/Resolution File: ☒ PS/11.4/System/NOAA_DepthRanges_General1_2024.txt

Range Estimation Method: Percentile

Range Percentile: 50

Input Band: ☒ Depth

Output Vertical Coordinate Reference S...: ☒ None selected

Advanced

Keep Partial Bins: ☒

Maximum Grid Size: 64

Minimum Grid Size: 4

Population Method: CUBE

Options

Input Band: ☒ Depth

Primary Band: ☐

Vertical Uncertainty Band: ☒ Depth TPU

Horizontal Uncertainty Band: ☒ Position TPU

IHO Order: ☒ S44 Order 1a

IHO Limits: ☐ IHO Limits A Value, ☐ IHO Limits B Value

Disambiguation Method: Density and Locale

Comments:

Advanced

Keep up to Date: ☐

Display Bias: Highest

CUBE Configuration: ☒ NOAA_VR

Use CHGF Mean Distance: ☐

Output

Extent: Custom

Output Coordinate Reference System: NAD83 / UTM zone 17N [NA83] EPSG:26917

Output File: 234-FA-19/H12345/Working_Surfaces_Mosaics/H12691_MB_VR_MLLW.csar

OK Cancel

Input: Sources > All Track Lines or Selected Tracklines if you only want a subset of your data, depending on needs.

Estimation Method > Ranges

Options: Range/Resolution File > navigate to the appropriate file based on survey requirements (General1, Exception)

Population Method > CUBE

Options: Input Band > Depth

Vertical Uncertainty Band > Depth TPU
Horizontal Uncertainty Band > Position TPU

IHO Order > S44 Order 1a

Disambiguation Method > Density and Locale

Advanced:

Uncheck **Keep up to Date** (otherwise surface will try to update after every point cloud edit)

Check CUBE Configuration > NOAA VR


Output

Extents will default to whatever data is in view on your screen. Make sure you are zoomed out far enough to see all your data.

Output File > Select the Ellipsis, browse to S:\YYYY\OPR-XXXX-FH-YY\HXXXXX\Working_Surfaces_Mosaics\Bathymetry and save the surface as HXXXXX_MB_VR_MLLW.

Click ok and you're finished!

Surface Creation (Single Resolution)

1. Zoom out to make sure you can see in your display all the data you want to process.
2. Click the New Single Resolution Surface icon  in the main toolbar.

New Regular Gridded Surface

Input

Source: Selected Track Lines

Include Status Flag: ☒ Accepted, ☐ Rejected, ☒ Outstanding, ☒ Examined

Options

Resolution: ☒ 4.000000 m

Gridding Method: CUBE

Options

Compute Band: ☒ Shoal, ☒ Deep, ☒ Density, ☒ Mean, ☒ Standard Deviation

Keep Up to Date: ☐

Comments: ☐

IHO Order: S44 Order 1a

IHO Limits: ☐ IHO Limits A Value, ☐ IHO Limits B Value

Disambiguation Method: Density and Locale

CUBE Configuration: ☒ NOAA_4m

Output Vertical Coordinate Reference S...: ☒ None selected

Filter Data:

Minimum: ☐ 0.000000 m

Maximum: ☐ 0.000000 m

Output

Extent: 526582.81, 3537615.58, 537013.56, 3532649.32 m

Output Coordinate Reference System: NAD83 / UTM zone 17N [NA83] EPSG:26917

Output File: Modules/Training_Data/Processed/Surfaces/H12691_MB_4m_MLLW.csar

OK Cancel Help

Input: Sources > All Track Lines or Selected Tracklines if you only want a subset of your data, depending on needs.

Set your resolution based on your depth.

Uncheck Keep up to Date (otherwise surface will try to update after every point cloud edit)

CUBE Configuration: Ensure it matches resolution and is drawing from NOAA Support files.

Output

Extents will default to whatever data is in view on your screen. Make sure you are zoomed out far enough to see all your data.

Output File > Select the Ellipsis, browse to S:\YYYY\OPR-XXXX-FH-YY\HXXXXX\Working_Surfaces_Mosaics\Bathymetry and save the surface as HXXXXX_MB_VR_MLLW.

Click ok and you're finished!

Resources & References

CARIS 11.4 manual, existing ship SOPs.