NORTEK MANUALS

Nortek VM Review

N3015-043 | V3.0

Contents

1 Introduction

This manual is intended for users of the Nortek Vessel Mounted (VM) system who want to get familiar with post processing using the Nortek VM Review software.

Nortek VM Review is meant to be used for initial inspection of data recorded using the Nortek VM system. It allows users to study the data, adjust processing parameters and export to various export formats for further processing and reporting.

Our recommendation is to quickly read the sections in the Getting started 8 chapter to get an overview of the general workflow in Nortek VM Review. The other chapters in this manual are mainly to be used as a reference. Using the software is the best way to get familiar with its features. You can learn more about what certain options do using the mouse-over tooltips.

1.1 Licensing

Nortek VM Review can only be used to open files from Nortek instruments that are licensed to be used with Nortek VM Review. If you find that Nortek VM Review cannot open a .SigVM file due to license restrictions, it is still possible to acquire a license after the fact. Please contact your local sales representative for more information.

To make sure you have the latest license installed, please do a software update before contacting Nortek.

1.2 Nortek online

On the Nortek website (nortekgroup.com) you will find technical support, user manuals, and the latest software and firmware. General information, technical notes, FAQ and user experience can also be found here.

1.3 Feedback

If you find errors, omissions or poorly explained sections in this manual, please do not hesitate to contact us. We appreciate your comments, and your fellow users will as well.

1.4 Revision history

Version	***Date***	***Supports software version***	***Notes***
V3.0	26-02-2025	3.0	Licensing based on Nortek instrument serial number, lever arm corrections
V2.10	3-09-2024	2.10	Minor performance enhancements, option to manually check for updates
V2.9	10-07-2024	2.9	Splitting and merging .SigVM files, echosounder improvements
V2.8	18-04-2024	2.8	File association
V2.7	01-09-2023	2.7	Layer
V2.6	26-04-2023	2.6	Spectrum, missing Review features
V2.5	01-01-2023	2.5	Renewed Review software

Version	*Date*	*Supports software version*	*Notes*
V2.4	01-07-2022	2.4	
V2.3	23-02-2022	2.2	
V2.2	25-03-2021	2.1	
V1	11-04-2018	1.5	Initial release

Table 1: Revision history

1.5 Contact

We recommend first contacting your local sales representative before the Nortek main office. If you need more information, support or other assistance, you are always welcome to contact us or any of our subsidiaries by email, phone or fax.

Email:

support@nortekgroup.com (for technical support questions)

Phone:

+31 88 6543700

2 Getting started

In this chapter you will find information on installing the software and a quick overview of common scenarios using Nortek VM Review.

2.1 Installation

Nortek VM Review is designed for Microsoft Windows. It is runs on Windows 10 and Windows 11.

The software has automatic update detection that is installed with the Nortek VM software package. It checks every 30 days and will show a notification when an update is available. Alternatively, a manual update check can be performed from the Home menu.

2.2 Windows

The Nortek VM Review application consists of several moveable and resizable windows. These windows can either be docked in the main application window or be floated in their own window. Windows can also be tabbed in other windows. Tips on manipulating windows are shown in Table 2 below.

Action	How to
Docking and floating	• Dragging the top bar of the window • "Float" and "Dock" in the arrow menu on the top right of each window.
Resizing	Dragging the edges of windows
Close	Cross ("Hide") button in the top right of each window
Open	"View" section in the "Home" menu

Table 2: Window handling

2.3 Opening a file

Files can be loaded into Nortek VM Review in a number of ways. They are listed below.

- By double clicking on a .SigVM or .VMDiag file in the Windows Explorer
- By dragging a .SigVM or .VMDiag file from the Windows Explorer into Nortek VM Review
- By double clicking files in the file browser 9

When both Nortek VM Acquisition and Nortek VM Review are installed, it might be necessary to choose the default option for opening .SigVM and .VMDiag files. This can be done by right clicking the file and selecting "Open with". See Figure 1 below.

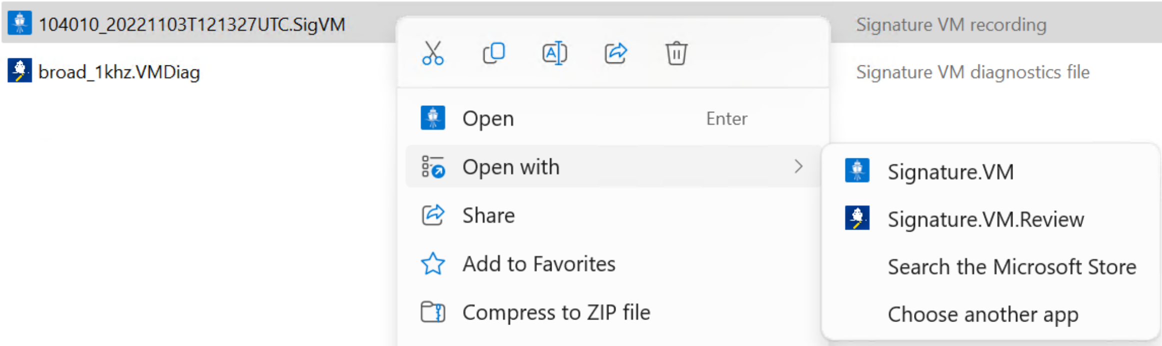


Figure 1: Open file with Nortek VM Review

2.3.1 File browser

Nortek VM Review has a build-in file browser. In the default layout [43] "Horizontal map", the browser is located in a window on the left side of the application. The same browser is also located in the File menu.

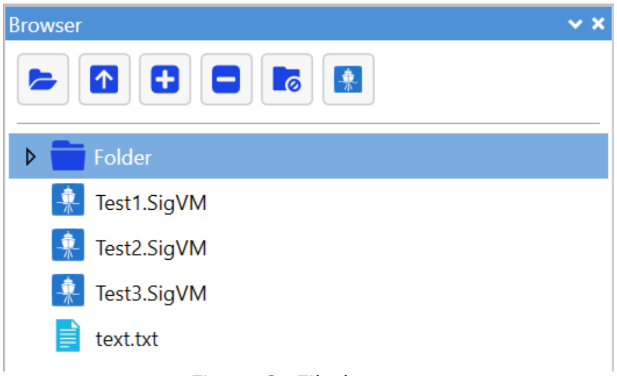


Figure 2: File browser

2.3.2 Working directory

When starting up Nortek VM Review for the first time, select an initial directory to display in the file browser by clicking the first icon on the top of the browser and select a working directory containing some .SigVM files. This will populate the browser with the contents of the directory.

2.3.3 Loading files

Any file can be opened by double clicking it. Opening a non-.SigVM file will open it in its default application. When opening a .SigVM file, a progress bar will be shown in the bottom left of the application indicating a file is being loaded. After the file is processed, data will be displayed in the different windows of the application.

Alternatively, files can also be loaded by dragging them from the Windows Explorer into Nortek VM Review. Keep in mind that this will change the working directory to the directory containing the file.

2.3.4 Appending files

Multiple files with matching configurations can be loaded into Nortek VM Review by using the append functionality found in the context menu in the folder browser. This functionality is intended for merging files that are automatically split by Nortek VM Acquisition when the maximum recording length is reached.

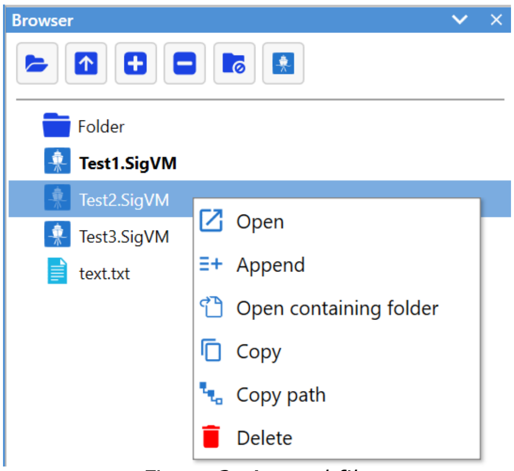


Figure 3: Append file

This functionality can be useful in combination with the export to .SigVM 33 feature. This allows for the merging of two or more .SigVM files.

Keep in mind that files need to be appended in chronological order. Also, it is not possible to change processing options 21 of multiple loaded files at once. Changing the processing options of a merged .SigVM file is possible however.

2.4 Displaying data

After loading a .SigVM file, the entire track will be displayed in the different windows of the application.

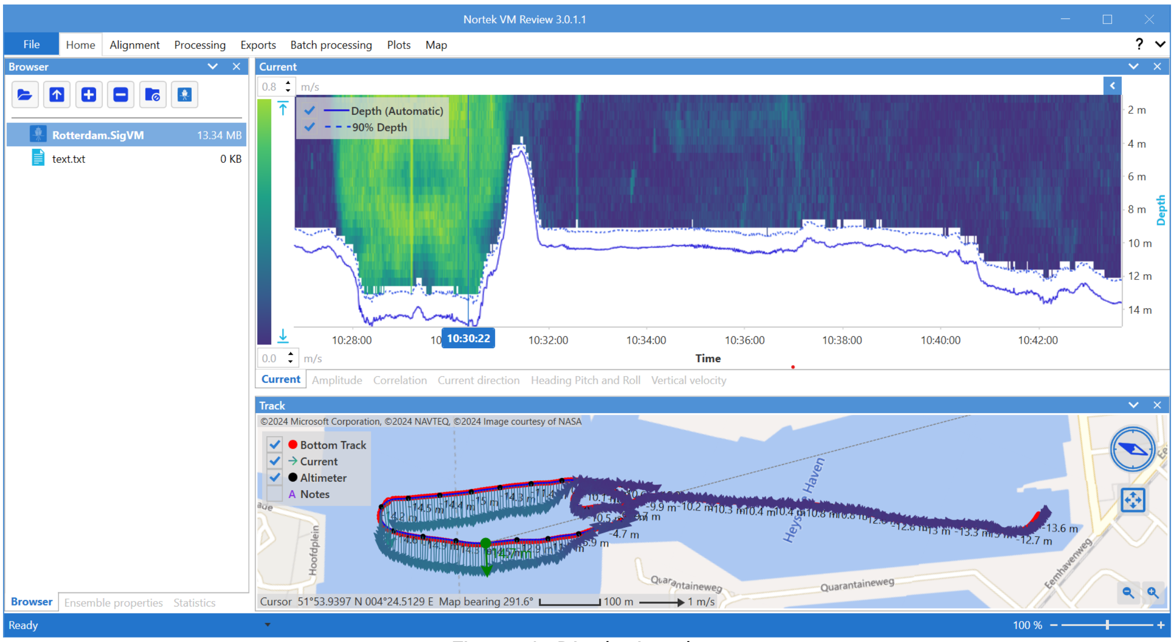


Figure 4: Displaying data

2.4.1 Track selection

The selection of the track being displayed can be changed in several ways. Table 3 below shows the options.

Action	How to
Heatmaps and plots	• Change by dragging the horizontal axis or zooming using middle mouse button. • Reset using "Reset zoom" in the right-click context menu
Track	• Change by clicking and dragging the left mouse button along the blue GPS track. • Reset using "Select full track" in the right-click context menu

Table 3: Track selection

2.4.2 Fitting data ranges

To get the color maps of the different heatmaps to fit the range of data values, the right click menu "Set to limits" can be used. This can further be adjusted using the edit boxes above and below the color bar. The map again has a similar feature.

2.4.3 Layer

In the Processing menu there is an option to enable a horizontal layer. When enabled, the layer is visible in the current plot, use the two sliders to adjust the top and bottom of the layer. Current data from the selected layer is shown on the map14, in properties17 and statistics18 windows and in some of the export formats.

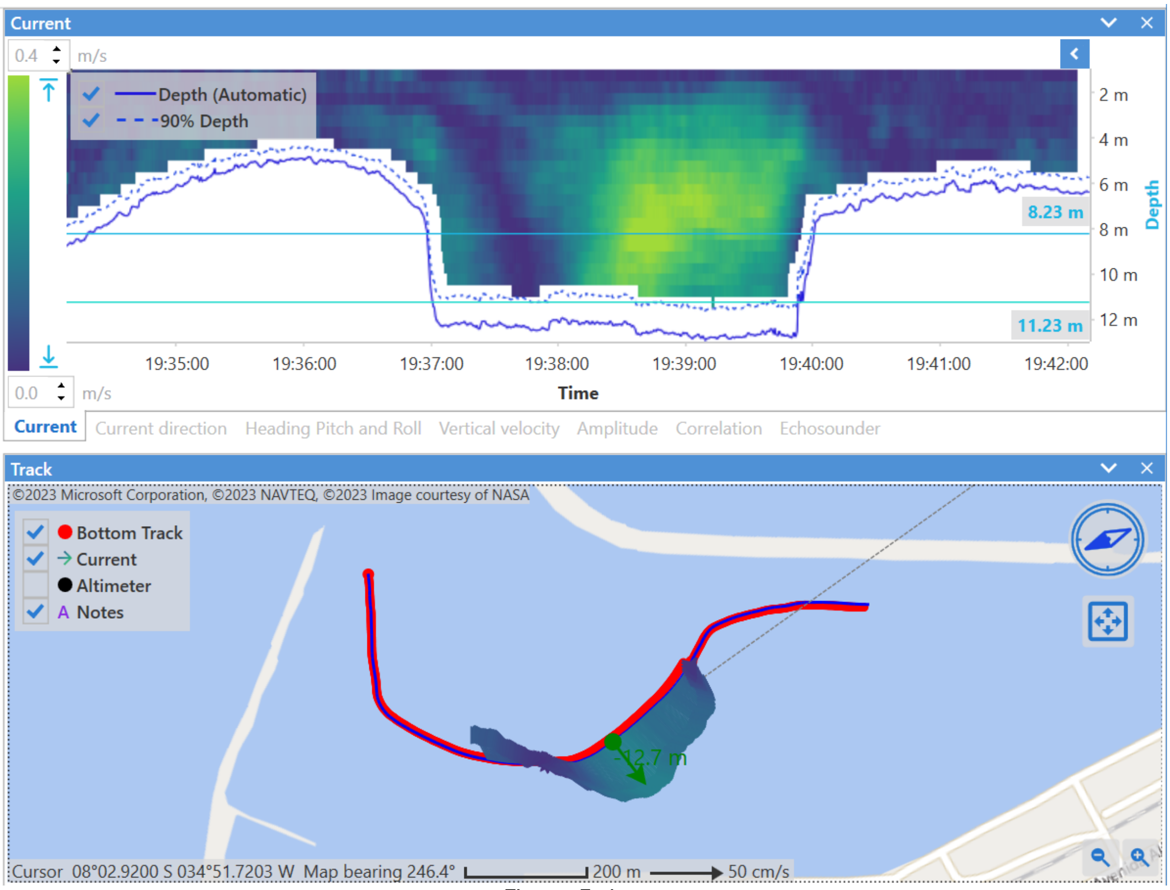


Figure 5: Layer

Figure 5 shows current vectors from the selected layer on the map. Note that only the part of the track where there is current data in the configured layer is displayed.

2.4.4 Processing configuration

If there are issues with the displayed data, parameters in the "Processing" menu at the top left of the application can be adjusted. After changing a value, the software will reprocess the data and update the displays in the different windows The progress of the reprocessing can be seen in the progress bar on the bottom left of the main window.

2.5 Exporting data

In the Exports menu there are options to export the track data to a number of formats including CSV 34, MATLAB 35, QRev 30 and KML.

The "Export" button will become available when a track is loaded and any export checkbox is selected. There is an option to export either the entire track, the section of track currently displayed or transects 30.

Note that:

- For any export, the current processing settings will be used.
- When processing multiple recordings it might be worth considering using the "Batch processing 33" feature.

2.5.1 Location

By default, the resulting file will be exported to a folder with the name of the .SigVM file and "_Data" added to it. The file name will be the same as the .SigVM file, with a different extension based on the export type. The export folder and file name can be changed by clicking the "Choose file" button next to each export type.

2.6 Exporting images

The Nortek VM Review software includes options to copy, print and export images of the plots and the Track.

2.6.1 Track

The map can be exported as an image using the "Copy", "Save" and "Save as Geotiff" right-click menu options, for more information see the Export section 15. There is also an option to export the GPS track in KML format in the "Export" 12 menu.

2.6.2 Plots

Plots can be copied, printed and exported using the "Image Export" section in the "File" menu, see Figure 6 below. In this menu you can select which plots to export. Other options include changing the size of the individual plots. A preview is shown on the left hand side.

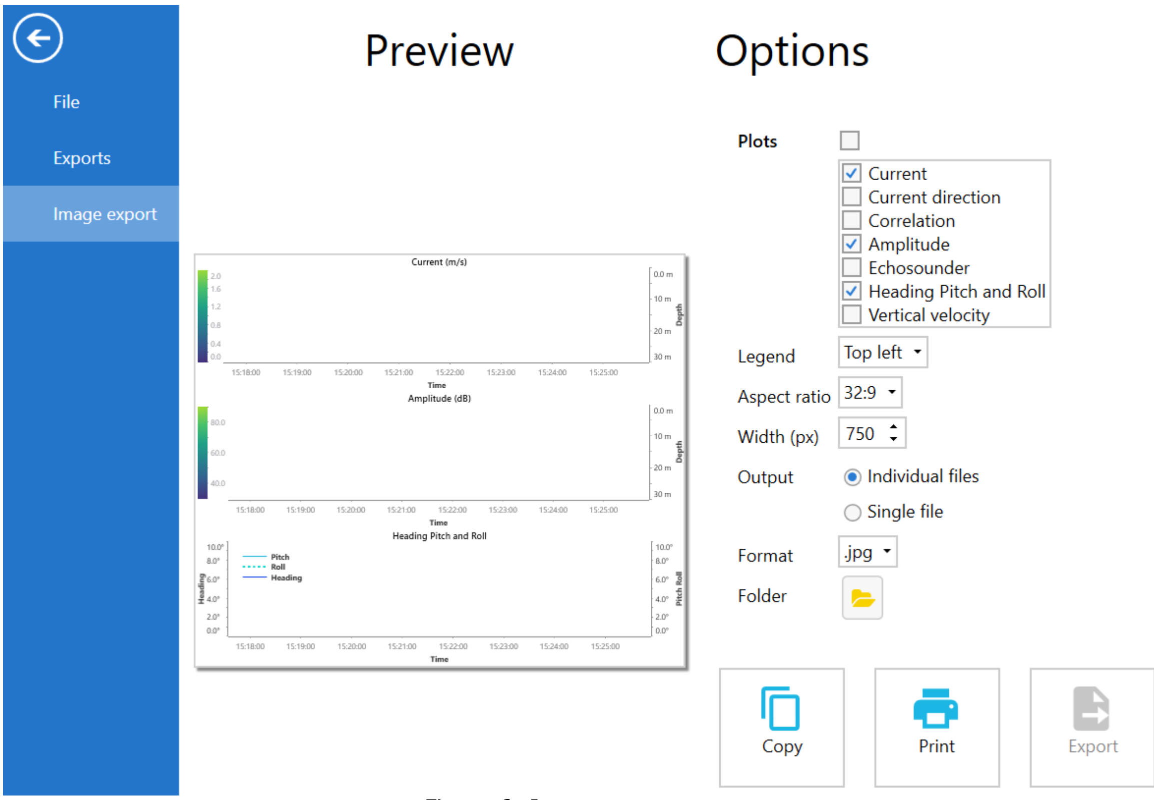


Figure 6: Image export menu

Note that for each of the amplitude, correlation, and echosounder plots (if available), only a single plot is exported, of the beam or channel currently selected for that plot in the main screen.

When a folder is selected it is possible to export the currently displayed image to either one single file or multiple files, depending on the option selected.

The default file names for the plots are simply the names of the plots (they don't include the full SigVM filename).

As a quick alternative to the "Image export" menu, the different plot windows have a right-click context menu containing an option to copy a screenshot of what is displayed.

3 Components

This chapter is a in depth overview of all the functionality in the Nortek VM Review software. It provides a reference to the software's features.

3.1 Track

The Track window shows current vectors and other data on a map. This section will explain the various options and functions of the Track.

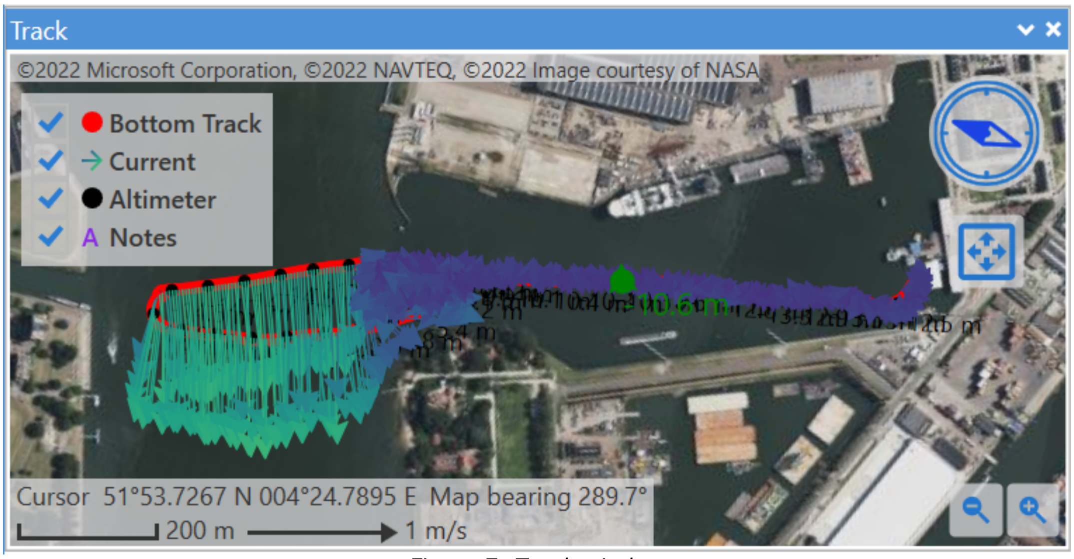


Figure 7: Track window

3.1.1 Interaction

In general, interacting with the map is done using the mouse. This is similar to interaction with maps in other systems. There are also shortcuts to zoom in and out (+ and - keys) as well as for panning (arrow keys).

3.1.1.1 Section selection

Selecting a track section is done by moving the cursor close to the blue GPS track and then dragging the mouse until the desired section of the track is highlighted. This is only possible when "Allow selection" in the "Map" menu is enabled.

3.1.1.2 Rotation

The map can be rotated using the compass on the top right side of the "Track" window. To rotate, click and drag the cursor over the compass. Double-click to switch to "North up".

3.1.1.3 Fitting the track

By default, when a track is loaded, the map will pan and zoom to fit the GPS track within the bounds of the "Track" window.

After selecting a new track section, clicking the "Fit track selection to screen" button below the compass will fit the current selection to the window.

There is an option to disable rotation on fit in the "Map" menu, unchecking this option will keep north up when loading tracks and fitting the track to the screen.

3.1.2 Data

The map shows different data based on what data is available and enabled. If available, bottom-track, current, altimeter and notes are displayed.

3.1.2.1 Current vectors

The current vectors can be adjusted in the "Map" menu. The interval can be changed, they can be resized using the "Scaling" option and there are options to fit the color bar to the maximum and minimum current values. For fitting the color scale, there is also a "Set current to limits" option in the right-click menu of the Track.

The current vectors displayed on the map are the average current over the full water column by default. When a depth layer 11 is setup in the Processing menu, the current vectors on the map are from this layer.

N.B. The maximum number of vectors on the map is 1000 for performance reasons. This means that for large tracks, not all vectors are displayed. Selecting a sub-section of the track may display more of the vectors that the software did not show for the larger or full track section.

3.1.2.2 Export

The track can be exported to a file or copied using the corresponding options in the right-click context menu of the Track. Selecting "Save" exports the map as an image, "Save as Geotiff" exports the map as a georeferenced .tiff file. The context menu for the track is shown in Figure 8 below.

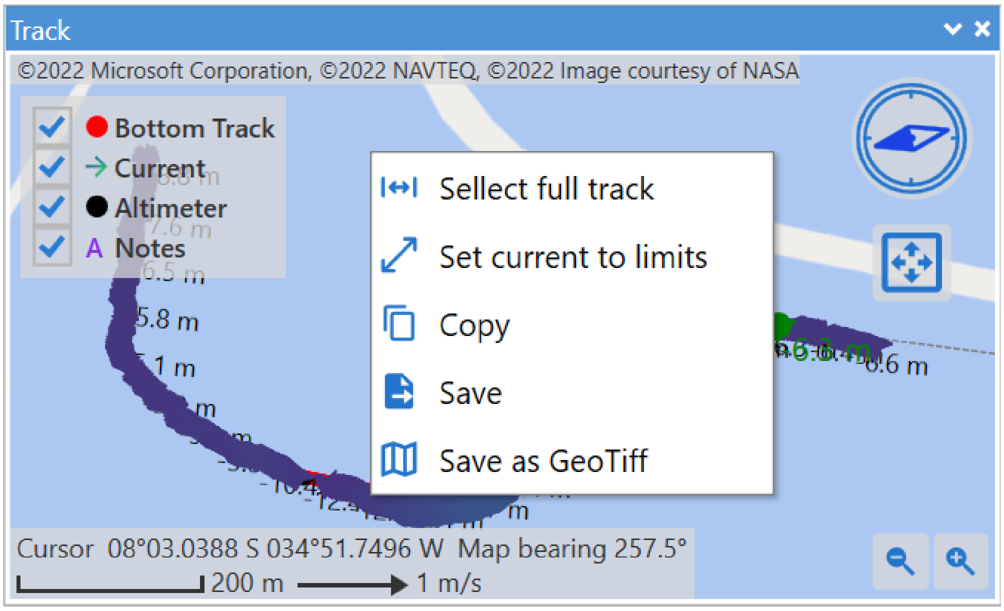


Figure 8: Track export options

When exporting to Geotiff you should keep in mind that the map will be rotated to north up if it is rotated 14. Exporting a map without any markers involves turning off all the map components and disabling "Show cursor" and "Allow selection" in the "Map" menu.

There is also an option to export the GPS track in KML format in the "Export" 12 menu.

3.1.3 Custom maps

The track window supports various different map providers by default. The map provider can be changed in the "Map" menu by changing "Source".

Custom maps can be added in either the GeoTIFF (georeferenced .tif(f) files) or MBTiles format. Any of the two formats can be used, but the MBTiles format has some advantages over the GeoTIFF format. MBTiles supports different zoom levels, is quicker to import and supports large map areas.

3.1.3.1 GeoTIFF

To add a georeferenced .tif map, add your .tif file(s) to a designated folder and then change the "Map files" path in the "Map" menu to the folder containing the .tif files. After selecting the folder the software will start processing the .tif files, a progress bar is shown on the bottom left of the software. When the processing is complete the custom map(s) can be found in the "Source" dropdown in the "Map" menu.

In the background the Nortek VM Review has convert GeoTIFF files to the MBTiles format, the .mbtiles files will be visible in the folder containing the .tif files.

3.1.3.2 MBTiles

To add a MBTiles map, simply add the .mbtiles file to a designated folder and then change the "Map files" path in the "Map" menu to the folder containing the .mbtiles files. You should then be able to select the added map in the "Source" dropdown.

Open source MBTiles files for various regions can be found online. For instance, the United States National Oceanic and Atmospheric Administration (NOAA) has a page where MBTiles files can be downloaded for US coastal regions. Additionally, various open source projects provide MBTiles files for Europe and other regions.

Take note that only image based .mbtiles files are supported, vector based files will not work.

3.2 Plots

This section will explain the features of the various heatmaps and line plots, as well as the options present in the "Plots" menu.

3.2.1 Heatmaps

The heatmaps display current, beam amplitude and echosounder amplitude data, among others. The different heatmaps types are separated into windows 8 . Some heatmaps contain different views to, for instance, display data for the different beams. These views can be accessed by clicking the round buttons (if present) on the left side of the heatmap.

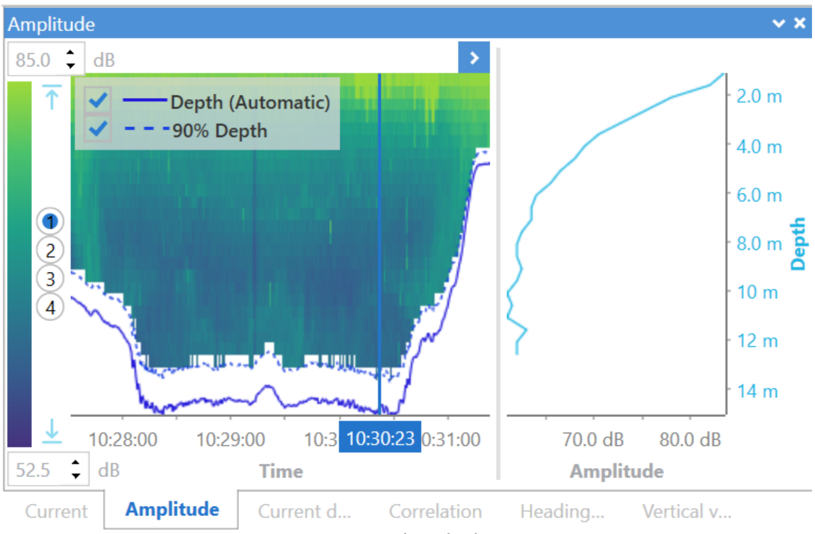


Figure 9: Amplitude heatmap

3.2.1.1 Fitting color bar

In most circumstances the default range for the color bar does not fit the data. To auto fit the color bar range to the data range, use the buttons next to the top and bottom of the color bar. To manually adjust the maximum and minimum, use the text boxes located above and below the color bar.

For heatmaps with different views, the limits can be synced across the views using the "Sync heatmap limits" check box in the "Plots" menu.

3.2.1.2 Unprocessed Echosounder

Sometimes there is a need to see raw echosounder data.

For echosounders, that can be achieved with the "Unprocessed echosounder" check box in the "Plots" menu.

3.2.1.3 Color palette

There are various color schemes available for the different types of heatmaps. They can be changed in the "Palette" section of the "Plots" menu shown in Figure 10 below.

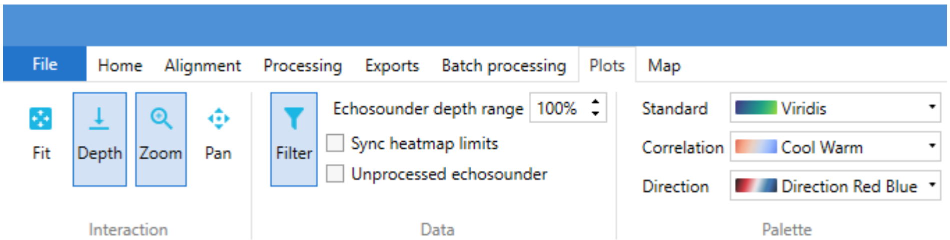


Figure 10: Heatmap color palette settings

3.2.1.4 Cross section slice

A vertical cross section of the heatmap can be shown by either using the arrow button just above the right top corner of the heatmap, or by using the "Insert slice" context menu. When the cross section is visible, the position of the cross section can be changed by dragging the slice cursor along the x-axis. See Figure 9 showing the vertical slice on the right-hand side.

3.2.1.5 Auto depth scale

In the "Plots" menu, there is a toggle button to enable auto fitting the detected depth to the bottom of the heatmaps. Auto fitting is done using the "Fit" button in the "Plots" menu or the "Reset zoom" right-click option of the heatmap.

3.2.1.6 Filter

The "Plots" menu contains a "Filter" toggle button for removing data below the detected water depth.

To show data below the detected water depth, the filter can be disabled, making all data up to the last cell visible. Keep in mind that this data should only contain the echo reflected from the bottom.

3.3 Properties

The "Properties" window displays information about objects currently selected. Selecting files in the "Browser" window will show information about the file. For .SigVM files, basic recording information is shown.

When a recording is loaded, moving the cursor over any of the plots or the "Track" shows details of the currently selected measurement point (ensemble) in the "Properties" window.

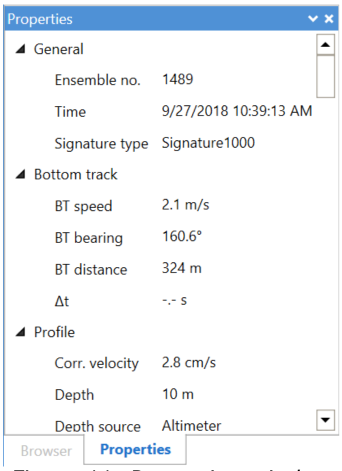


Figure 11: Properties window

3.4 Statistics

The "Statistics" window displays information on the currently selected track section. For several metrics, minimum, maximum and average values are calculated.

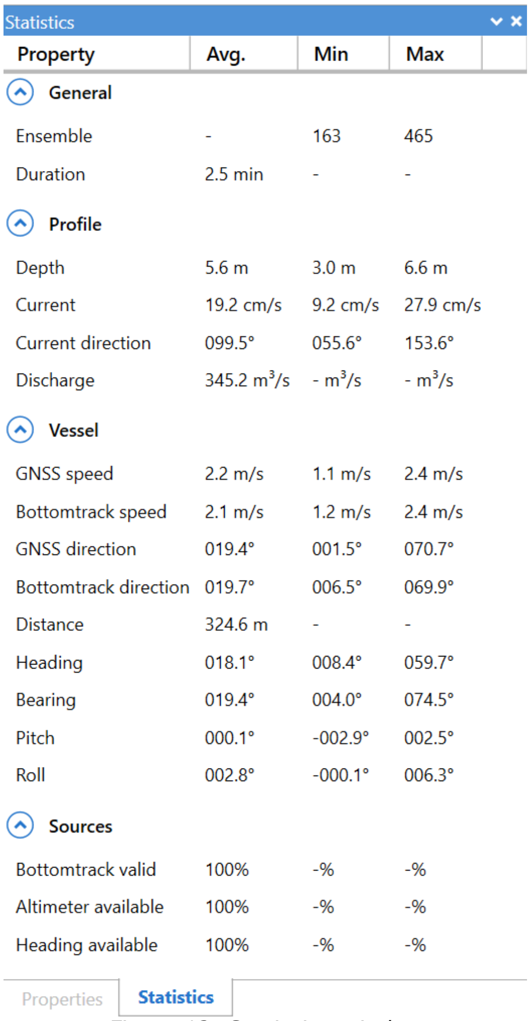


Figure 12: Statistics window

Some of the metrics might be useful during the alignment [19] procedure.

3.5 Alignment

To correctly align the VM-ADCP and gyro (GNSS) you can use the "Alignment" menu. After setting up the vessel for measurement, this should be one of the first things you do.

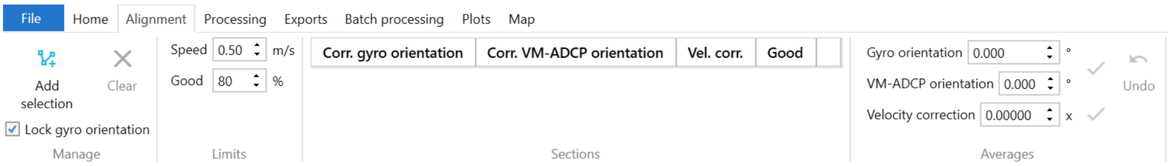


Figure 13: The alignment menu

A correct alignment of the VM-ADCP and gyro is important since in many cases, data from the GNSS is used to correct velocity measurements from the VM-ADCP. The most important factor is the orientation (compass rotation) of the VM-ADCP with respect to the gyro. In ideal situations, the gyro orientation is zero and the VM-ADCP is mounted with a -45° angle. In the real world there usually is a small deviation from these values. This can be corrected using the tools in the "Alignment" menu.

3.5.1 Data collection procedure

For a good offset check, it is best to sail some lines specifically for this purpose. For the best results, the effect of the local currents and wind must be eliminated. Since the currents and wind cannot be assumed to be zero, it is advisable to sail two straight tracks in opposite directions. In areas with strong currents the calibration tracks should be into or with the currents to minimize the effect of "crabbing", i.e., large differences between track course and ship heading.

Requirements:

- Two straight sections (can be in either one or two separate files).
- Direction into the current and wind direction for one section, away for the other.
- Length at least 500 meters or 2-3 minutes of sailing, longer tracks yield better results.
- Vessel speed similar to planned survey speed.

Corrections can be done with only one section, but results may vary depending on circumstances (moving bed).

3.5.2 Alignment correction

When a set of track sections as described in Data collection procedure [19] has been collected, load the file(s) containing the section(s) into Nortek VM Review and select the sections one by one before clicking "Add selection" in the "Alignment" menu. Note that when the gyro orientation has been found manually [20], "Lock gyro orientation" should be checked to not overwrite the gyro orientation.

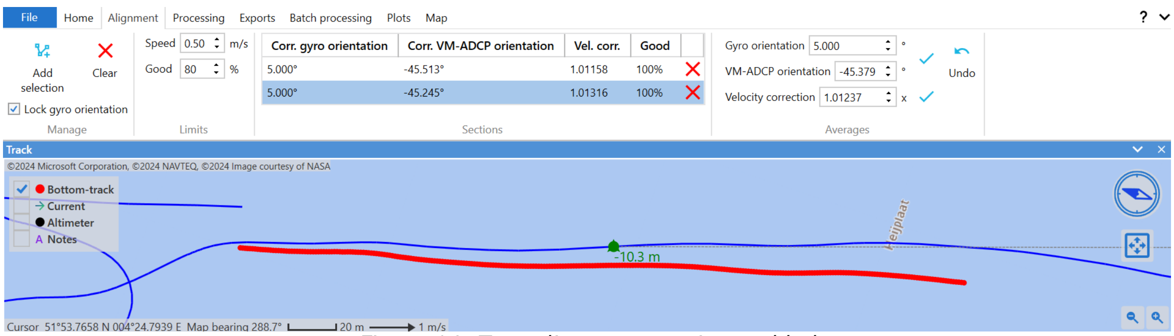


Figure 14: Two alignment sections added

In Figure 14, two sections have been added. After adding a section a new row appears in the table in the middle of the "Alignment" menu. This row contains values for the corrections calculated based on the data selected for that section.

Corrected gyro orientation	Calculated based on the difference between the heading and bearing of the gyro. The heading and bearing should be equal when sailing straight without influence from wind or current.
Corrected VM-ADCP orientation	Calculated from the difference in angle between the bottom-track velocity and GNSS velocity.
Velocity correction	Ratio of GNSS speed to bottom-track speed.

Table 4: Properties in the Alignment menu

In the "Averages" section of the menu on the right, the average for each column in the "Sections" table is calculated. These values can be directly applied by pressing the buttons next to them. Applying the gyro and VM-ADCP orientation from Figure 14 results in the alignment shown in Figure 15 below.

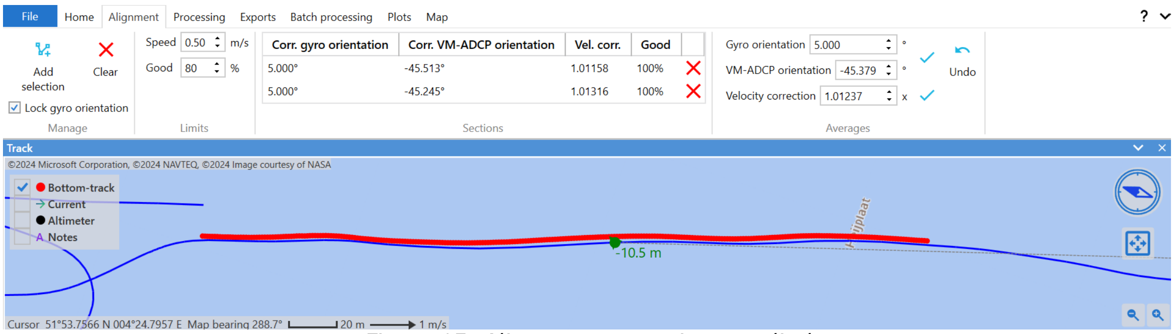


Figure 15: Alignment corrections applied

Applying the corrections should cause the black heading line to align with the track and shift the bottom-track on top of the GNSS track.

Note that:

- Undo will restore the correction to the previous one.
- The correction applied are saved to the configuration, they are also visible in the "Processing" menu.
- If the gyro orientation in the "Processing" menu is valid, it can be locked before adding sections by checking "Lock gyro orientation".
- Loading a new track does not clear the alignment data, this allows for applying the same alignment settings to multiple files.
- Clicking on a section will bring that section in to view and invalidates the current selection.
- Data in the "Statistics18" window might give more insight in the values shown in the "Sections" table.

3.5.3 Manual gyro alignment

For more reliable results compared to the automated version described in the following sections, the Gyro alignment can be set manually. This is done manually before data acquisition using the map in Nortek VM Acquisition:

- While in port locate an object (landmark) straight over the bow of the vessel that is several km away
- Locate the same object on the map and adjust the Gyro offset so that the heading line on the map passes straight over the object

Alternatively use two track segments in opposite direction and let the system calculate the alignment. This assumes the leeway in both tracks is the same but in opposite direction. This procedure is described in the Alignment correction 19 section.

A misalignment of the Gyro will not cause major problems as the VM-ADCP alignment is relative to the gyro, not to the bow of the vessel.

3.6 Processing options

In order to correctly visualize data, it might be necessary to change some of the processing parameters in the "Processing" menu.

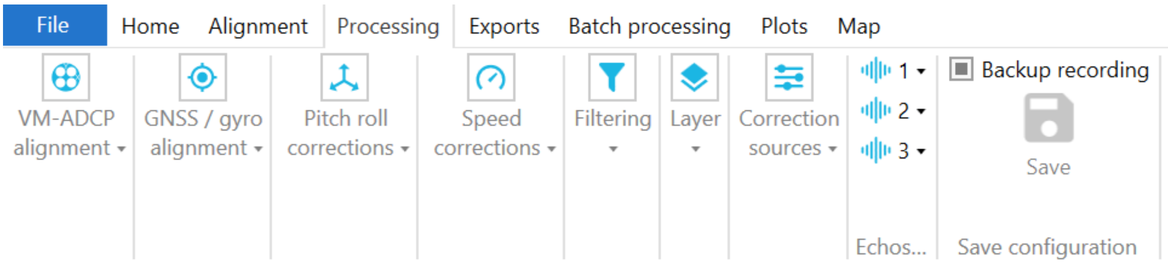


Figure 16: Processing menu

After changing any value in the "Processing" menu, the software will reprocess the data and update the displays in the different windows. For large files, this can take a while. If processing is still ongoing while another parameter is changed, the current processing task will be canceled and processing will restart. This means that you do not need to wait for processing to finish when adjusting multiple parameters.

The progress of the current processing task is shown in a progress bar on the bottom left of the application. There is also a dropdown containing simple log messages with information on file loading, processing and exporting.

3.6.1 Alignment

When a recording is loaded and both the GPS and bottom-track is displayed on the map, the bottom-track can deviate from the GPS track. In many cases this deviation can be corrected by changing the "Orientation" of either the VM-ADCP or the gyro. Ideally, this is done before doing the measurement in Nortek VM Acquisition. See the "Alignment 19 " section.

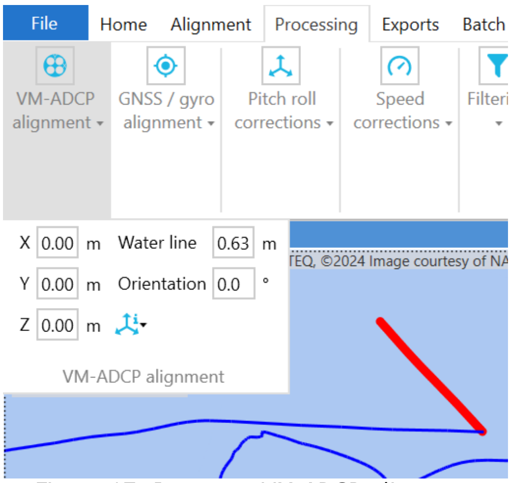


Figure 17: Incorrect VM-ADCP alignment

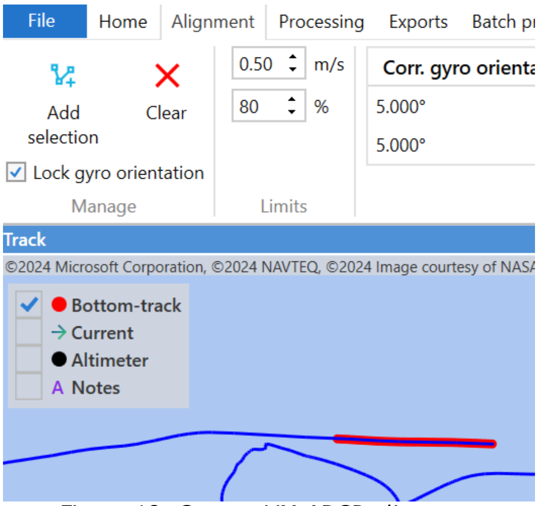


Figure 18: Correct VM-ADCP alignment

3.6.1.1 VM-ADCP alignment

The VM-ADCP alignment settings can be found in "Processing". Use "X", "Y" and "Z" to change the mounting offset in cases the center of gravity of the vessel is the reference point. In most cases the VM-ADCP is the reference point, therefore "X", "Y" and "Z" can be zero. In this case the water line should be set to the distance between the bottom of the VM-ADCP and the water surface. In general the water line is the vertical distance between the reference point and water surface. The orientation is usually set to 45° or -45° since this is how the VM-ADCP should be mounted.

To learn more about setting up for measurements, please refer to the "Nortek VM Acquisition Software Manual".

In the case that the bottom-track is not aligned with the GPS track, the orientation can be adjusted until both tracks overlap.

3.6.1.2 GNSS alignment

If the heading line on the map deviates from the track, the gyro alignment might be off. Checking the gyro alignment can be done by looking at a straight track section with little cross current and cross wind. Moving the cursor over the track will display the heading line. This line should be aligned with the track, this can be adjusted by changing "Orientation" in the "gyro alignment" section of the "Processing" menu.

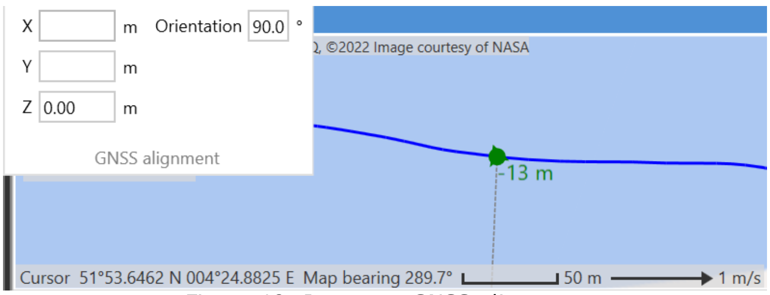


Figure 19: Incorrect GNSS alignment

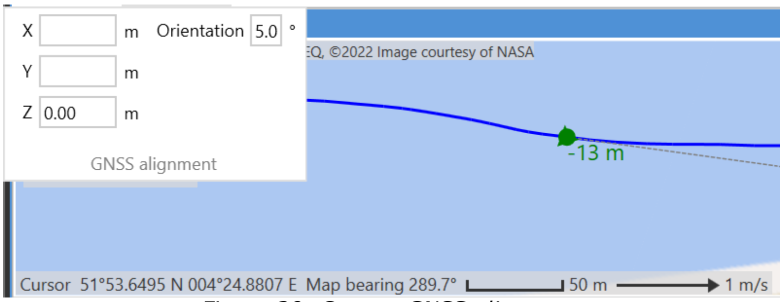


Figure 20: Correct GNSS alignment

3.6.1.3 Diagram

For visualizing the offsets and orientation of the instruments there is a diagram available in the alignment sections in the Processing menu. Make sure to reference this diagram when setting up the instrument to verify that everything is correct. A most basic setup is shown in Figure 21 below, here the VM-ADCP is set as the reference point by leaving X, Y and Z zero. The water line is set to 60 cm above the VM-ADCP and the GNSS is positioned 2.41 m above the VM-ADCP as can be seen in the "Left view". The "Top view" shows the orientation of the instruments in the XY plane, the beams of the Signature 1000 are offset to -42.5° and the GNSS has a small offset of 1°.

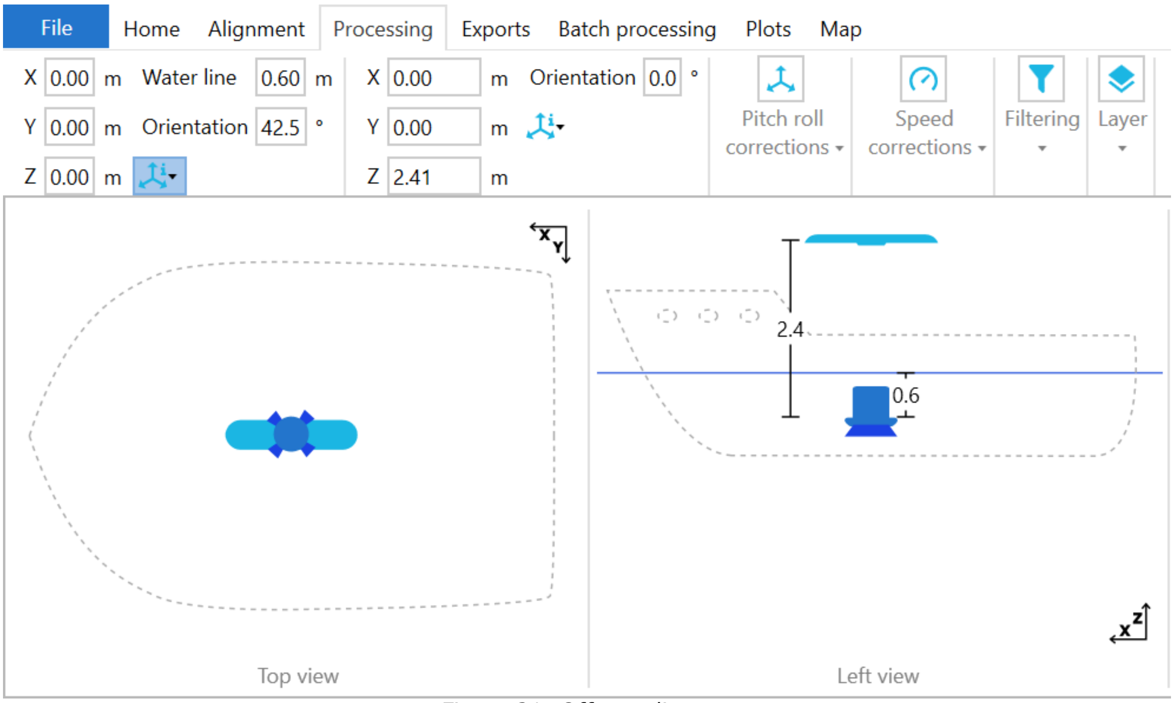


Figure 21: Offsets diagram

Note that the vessel outline in the offsets diagram shown in Figure 21 is drawn in approximate dimensions and is most likely not representative of your vessel. The labeled distances however are to scale, when a distance does not have a label it is zero.

3.6.2 Pitch and roll corrections

When using an external pitch and roll sensor, there can be a misalignment between the Z axis of the VM-ADCP and the Z axis of the external sensor. This misalignment will produce a current vector that is not true "ENU".

Any misalignment as described above can be corrected in the "Pitch and roll" section of the "Processing" menu. Keep in mind that when using the internal pitch and roll sensor of the VM-ADCP, these values should be set to "0" as the internal sensor is correctly aligned with the VM-ADCP head.

3.6.3 Speed corrections

Sometimes it may be necessary to apply a global correction to all velocities. The most likely example of this is when the speed of sound in water was not known or entered incorrectly when collecting the data. The velocity correction can be adjusted using the "Velocity correction" factor in "Speed corrections". This factor can also be automatically calculated, see the "Alignment 19" section.

There is no option to change the speed of sound itself in Nortek VM Review (directly or indirectly by changing the salinity). The reason is that the speed of sound is used internally in the VM-ADCP to correct cell sizes and velocities, therefore it should be set up before starting the measurement in Nortek VM Acquisition. The effect of having a wrong speed of sound (or salinity) is small, the speed of sound of sea water varies between 1,450-1,570 m/s, resulting in a maximum error of around 8% in depth and cell size. Velocities can be compensated using the speed correction setting mentioned above, this however does not affect the cell sizes.

To ensure valid echosounder amplitudes, the "Salinity" value in the "Speed corrections" section should be accurate for the measurement location. If the salinity is unknown, an approximation can be found in Table 5.

Water	Salinity (ppt)	Sound speed (m/s)
Fresh water	0	1481
Seawater	35	1500

Table 5: Salinity and speed of sound

The value of "Salinity" affects just the amplitudes of the echosounder.

3.6.4 Filtering

The "Filtering" section in the "Processing" menu contains a set of criteria for what data is processed and displayed. Using these options, bad data can be excluded. The next sub-sections explain this in details.

3.6.4.1 Averaging

The processing of the data visible in the heatmaps can be averaged using "Averaging" in the "Filtering" section of the "Processing" menu. When the averaging is set to a value larger than 0, each ensemble is reprocessed to be an average of the surrounding ensembles within the averaging time.

3.6.4.2 Depth range

Use the maximum depth in the "Filtering" section of the "Processing" menu to adjust the percentage of depth that is included in the calculation of average current and velocity. Depending on the bottom geometry and circumstances, the measured velocities close to the bottom may be noisy and could thus be excluded from the calculation and further processing.

Similar to the maximum depth percentage, there is a minimum value in meters to exclude a section starting at the water level. This might be useful when the vessel influences the current measurements.

3.6.4.3 Correlation

Correlation is calculated for each cell and is a measure for the quality of the velocity measurement in this specific cell. It is expressed as a percentage and in general a correlation of 50% or more is considered good.

Changing the value for minimum correlation will influence the outcome of the average velocity calculation as cells that do not meet the minimum will be excluded. The calculated velocity for a certain vertical is the average magnitude of the average velocity over the full depth, calculated using all valid cells in this vertical.

When cells do not meet the minimum requirement for correlation, they appear the same color as the background of the plot.

3.6.4.4 Amplitude

Amplitude is the signal strength of the reflected sound waves for each cell and is a measure for the quality of the velocity measurement in this specific cell. It is expressed dB and should be at least 30 dB for a good measurement. Changing the setting for minimum amplitude, which can be found in the "Filtering" section of the "Processing" menu will influence the result in a similar way as with setting the minimum correlation.

3.6.5 Correction sources

In Nortek VM Review there are certain options for changing what sources are used for the different data streams. These options can be changed in the "Correction sources" section in the "Processing" menu.

Take note that in some cases the correction sources cannot be changed, this is due to the original measurement circumstances and available data sources.

3.6.5.1 Depth

There are several methods for calculating where the bottom is located. Depending on the situation, one might work better than the other. The "Depth" correction source can be found in the "Correction sources" section of the "Processing" menu.

When choosing "Automatic", the software will choose a most realistic value for each individual ensemble. To see what correction source was used for a specific ensemble, see the "Depth source" field in the "Properties" window.

3.6.5.2 Correction

Since the current velocities are measured relative to the vessel, the raw current velocities need to be corrected with a vessel velocity. There are a few correction sources available for this velocity correction, they are listed below.

Correction option	*Description*
GNSS	GPS velocity data
Bottom-track XYZ	Bottom-track before internal rotation in instrument coordinates
Bottom-track ENU	bottom-track in East Nort Up coordinates (preferred, as it has the highest resolution)
None	Current velocity is not corrected, this could only be useful for a stationary vessel

Table 6: Velocity correction options

Using the bottom-track as a velocity correction is preferred since it is more accurate than a GNSS. For ensembles without bottom-track, the system will fall back to GNSS velocity correction if bottom-track was selected.

3.6.5.3 Lever arm Correction

The lever arm correction uses angular velocities to compensate the movement of the GNSS antenna. The angular velocities and the mounting position of the GNSS are used to calculate the horizontal and vertical speed of the antennae due to the angular velocity. This is then subtracted from the antenna speed.

This option can at this moment only be used when an Advanced Navigation GNSS is present.

3.6.5.4 Other

For the correction sources other than "Depth" and "Correction", the selection contains options to choose between the different channels. These channels refer to the different devices that were connected during the measurement. The different options are listed below.

Correction source	***Description***
Internal	Data recorded by the VM-ADCP
Advanced Navigation	Data recorded by the Advanced Navigation GNSS
Primary channel	Data recorded by the first additional navigation device
Secondary channel	Data recorded by the second additional navigation device

Table 7: Correction sources

3.6.6 Echosounders

If echosounder data is present in a .SigVM recording, it will be available in the "Echosounder" window. This window may contain several views 16 depending on how many echosounders were set up during the measurement.

3.6.6.1 Background information

When a VM-ADCP has the Echosounder option enabled (which requires a separate license), it will collect high resolution echosounder data. This data may be used to detect for example fish, biomass or suspended sediments. VM-ADCP sensors can collect echosounder data with three different sets of transmit and receive parameters simultaneously. In general, the Nortek VM system will collect two types of echosounder data: one with a "standard", and one with a "pulse compressed" transmit pulse. (See the Nortek Manual - "Principles of Operation - Signature" for details on the different echosounder modes).

The data shown in the Echosounder heatmaps is relative volume backscattered data. This is corrected for attenuation and distance based on methodologies presented in http://www2.dnr.cornell.edu/acoustics/SuggestedSOP.html ("*Acoustics Unpacked*"). As described on this website, the intensity of a returned echo sounder signal is dependent on signal strength, transmission losses (spreading of the sound wave and absorption by water), the reflective properties of the target (target reflectivity), the position of the target in the beam (equivalent beam angle), and instrument losses. These form the echo sounder backscatter correction, Se, which is added to the raw echo sounder backscatter to obtain Relative Volume Backscatter, Sv. The variable Sv is available in MATLAB output files, for example, for the Signature 1000 echo sounder 1, it is stored under the structure A.Echo1_1000kHz.volumeBackscatter_dB. The raw, uncorrected backscatter is also available in the Nortek VM Review exported MATLAB file. For Signature 1000 echo sounder 1, this would be found in A.Echo1_1000kHz.amplitudeRaw_dB.

Note that the term "relative volume backscatter" is applied because instrument calibration is not incorporated into correction calculations. To obtain the "corrected volume backscatter", the instrument calibration data would be required. Instrument calibration data is not processed by Nortek VM Review but can be measured and stored by the user for reference (see to Nortek Manual - ‘Principles of Operation - Signature’ for details).

In addition, relative volume backscatter may contain a thin, low intensity band in the layers nearest the transducer. This is caused by the "near field effect". The transducer near field region is described in the "*Acoustics Unpacked*" page mentioned above as being characterized by non-parallel wave fronts with oscillatory intensity. To quantify the near field range, they provide a methodology, a sample calculation, and a recommendation to exclude these results. Nortek VM Review does not quantify the limits of this region or exclude it from relative volume backscatter. The user should perform the calculation and adjust results according to preference.

3.6.6.2 Options

The "Echosounders" section in the "Processing" menu contains options to adjust the data displayed in the Echosounder window.

The "Noise level" can be used to filter out noisy data, filtered out data will have no color in the echosounder heatmap.

3.6.7 Saving processing settings

The "Save configuration" section in the "Processing" menu contains an option to save the current processing settings to the loaded .SigVM file. Depending on requirements, the "Backup recording" checkbox can be checked in order to keep a backup of the original unmodified .SigVM file in a subfolder with the name of the recording with "_Data" added to it.

Figure 22: Saving the configuration

3.7 Spectrum

The Nortek VM Acquisition software allows for recording spectra that can be used to study noise issues. The files recorded in Nortek VM Acquisition are saved with a .VMDiag extension and can be opened in Nortek VM Review. Opening a .VMDiag file works just like opening 8 any other file.

3.7.1 Spectrum layout

When double clicking a .VMDiag file will cause the software to change to a layout[43] specifically for viewing spectra. An example is shown in Figure 23 below.

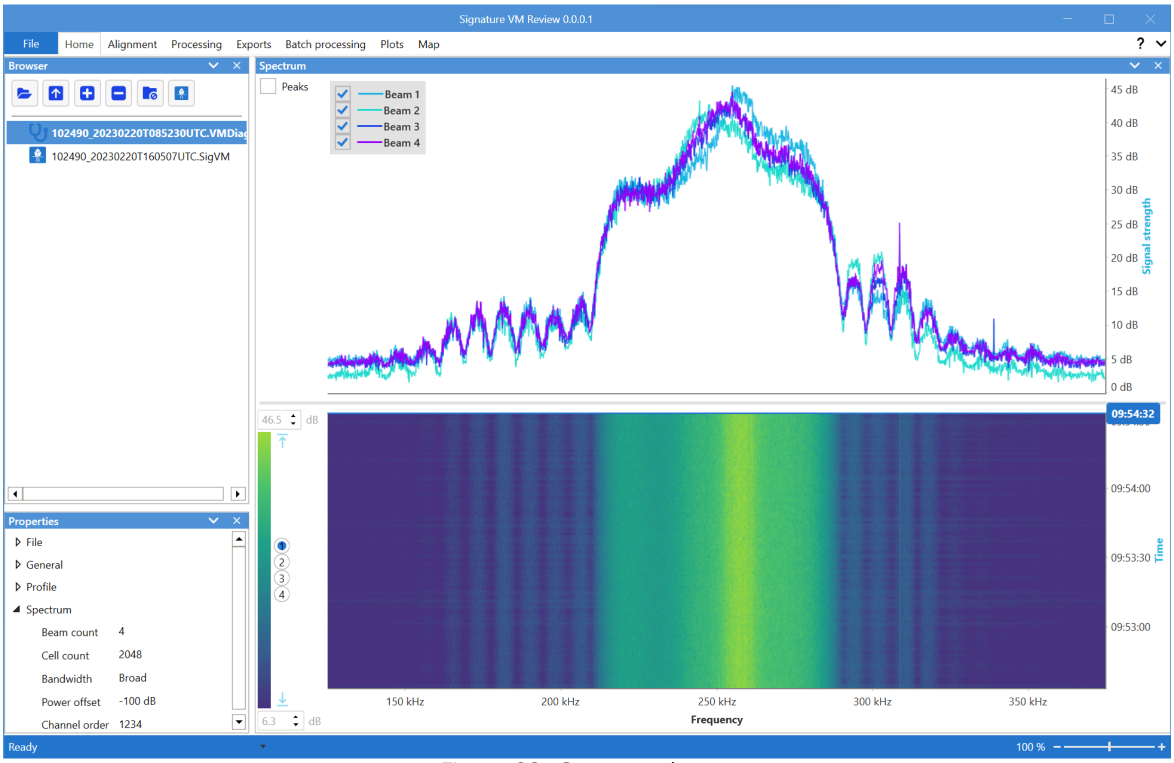


Figure 23: Spectrum layout

Opening a standard .SigVM recording will change the layout back to the old layout.

3.7.2 Analyzing a spectrum

Analyzing noise issues using a frequency spectrum can be a difficult task since the spectrum is influenced by a lot of different parameters. In general, a narrow, broad or ultra bandwidth spectrum should have a well defined single center peak around its main instrument frequency with a width increasing with the bandwidth. The full bandwidth spectrum is over a much wider frequency range and shows a drop-off after the peak around the main instrument frequency.

In the time domain, the spectrum should not change significantly, this means that there should be no horizontal lines or dots in the heatmap shown in the bottom of the "Spectrum" window.

Some examples of what clean and noise polluted spectra look like are shown in Table 8 below. The noisy spectra are polluted with a 50kHz square wave from about halfway the through the recording, the clean spectra show little pollution.

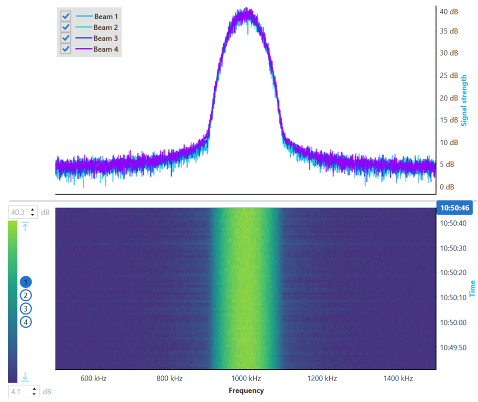
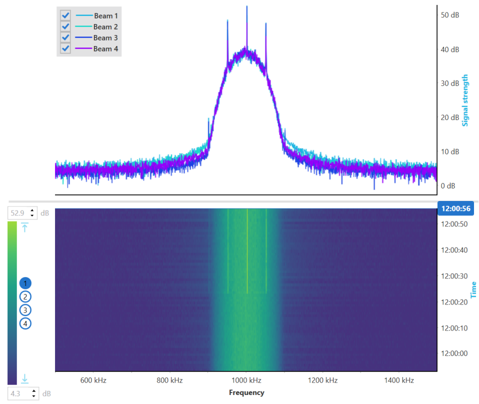
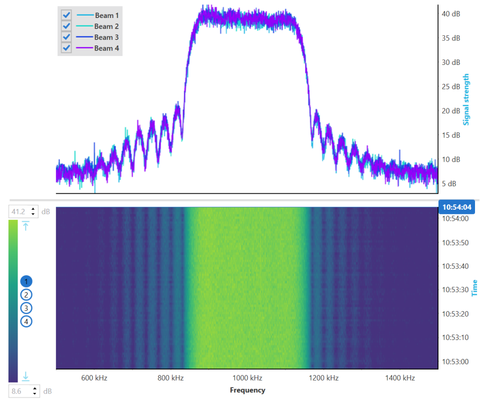
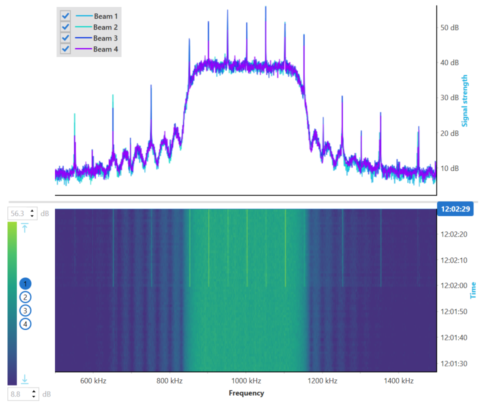
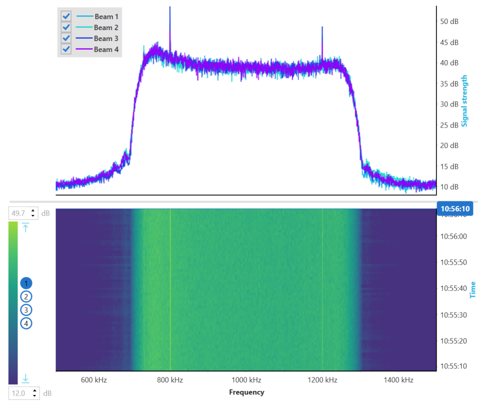
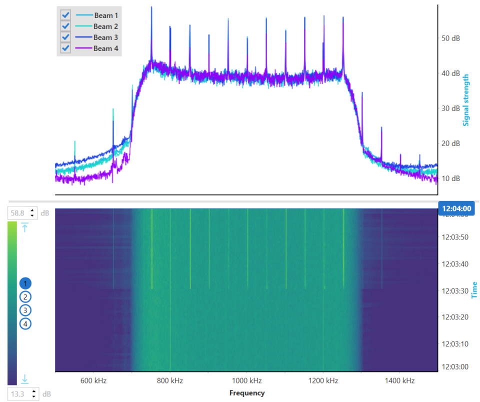
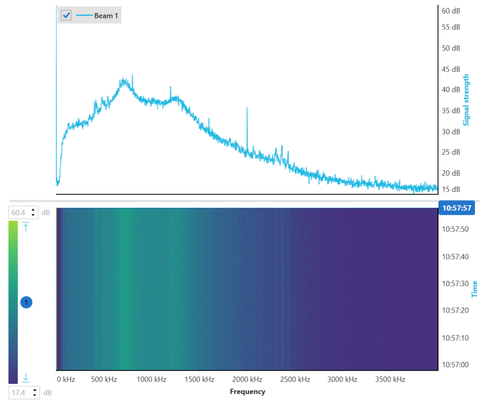
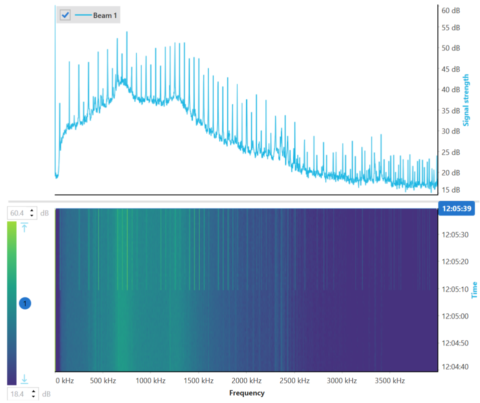
Bandwidth	Clean	Polluted
Narrow		
Broad		
Ultra		
Full		

Table 8: Spectrum examples

3.8 Exports

Exporting data is done using the "Exports" menu. In this menu you will find options on what data to export, where to export it to and some format specific options. A preview of the "Export" menu is shown below in Figure 24.

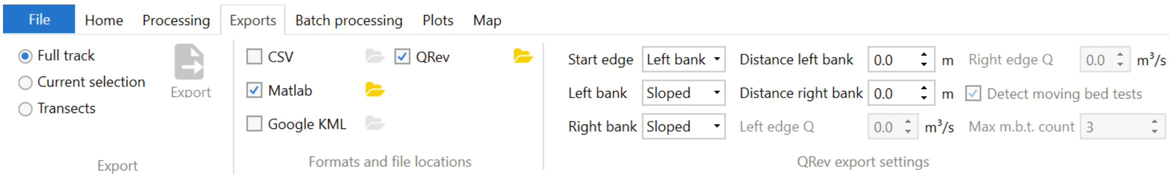


Figure 24: Exports menu

For all export formats one can choose between "Full track", "Current selection" and "Transects". "Full track" exports the entire track from start to end regardless of the track section currently selected. "Current selection" export what is currently selected[11].

The "Transects" option can useful when several transects of for example a river are recorded into a single file. When exporting transects, the software will attempt to cut the currently selected track section into transects. These transects are cut at points where the heading of the vessel crosses the average current, which is usually where the vessel turns to start a new transect. Exporting transects works best when the track is sailed in and "8" shape or a shape resembling a circle or rectangle, results may vary with differing track shape and average current strengths. A common use case is exporting transects to the QRev software where they are automatically detected and validated with limited user input.

3.8.1 Exporting to QRev

QRev is a useful tool when calculating discharge from vessel mounted systems like the Nortek VM system. Nortek VM Review supports exporting to QRev and contains options to make exporting multiple transects convenient.

When "QRev" is selected as output format in the "Export" menu, see Figure 24, the QRev export sections become available. For manual exporting manually select a transect, select "Current selection" and fill in the available settings in the "QRev export settings" section. These settings will show in QRev when importing the exported file.

When exporting from a recording containing multiple transects, select "Transects" to split the track into transects. The software will automatically detect the starting edge and distance to the banks for each transect. To get correct distances it is required to fill in the shortest distance to the left and right bank in the current selection in the corresponding fields. An example is given in Figure 25 below. Here the estimated shortest distance to the left bank is 9 meters, for the right bank this it is 8 meters.

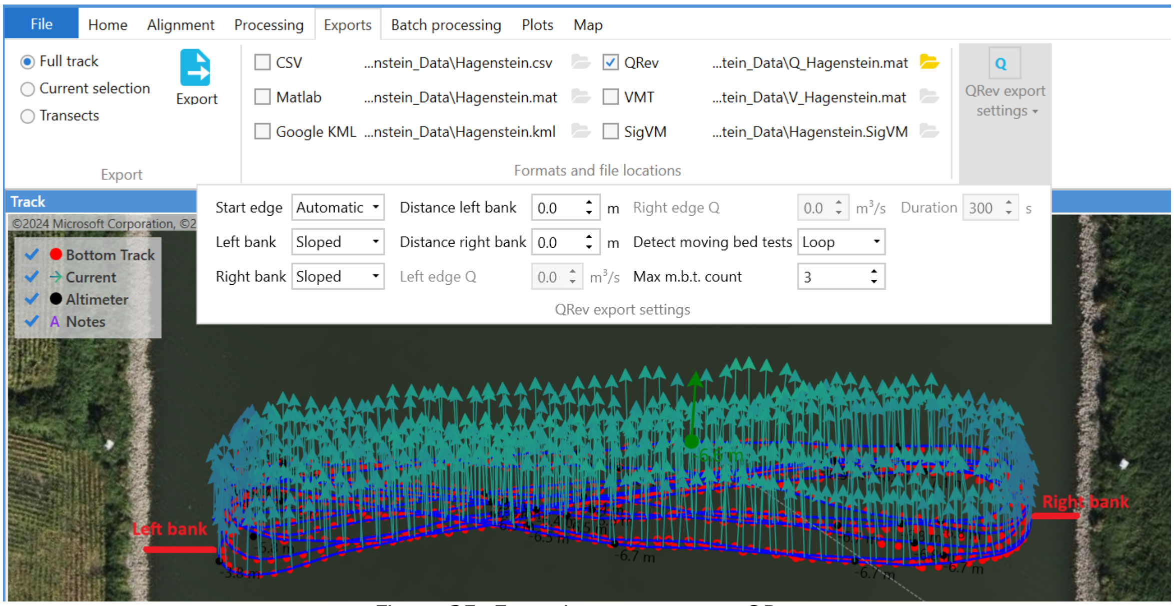


Figure 25: Exporting transects to QRev

As can be seen in Figure 25, there is also an option to detect moving bed tests. Both the loop and stationary type of tests are supported. The software will automatically detect the chosen type of test in the currently selected track section and then export the "Max m.b.t. count" number of tests.

For loop tests, the detected loops with the largest number of ensembles are exported first. The loops are stored in QRev files with a "loop_" prefix in their name.

For stationary tests, the duration must be specified. Only sections with exactly the specified duration will be detected. Stationary tests are exported to files with a "smba_" prefix in their name. The most stationary tests are exported first, if distance traveled is too high, no stationary tests can be detected.

As loop tests can be detected in the transects sailed, as shown in the example in 25, we recommend using loop tests for convenience and accurate results.

Transects are stored in files with a "Q_transect_" prefix. The files produced by exporting with the settings shown in Figure 25 produces the files shown in Figure 26 below.

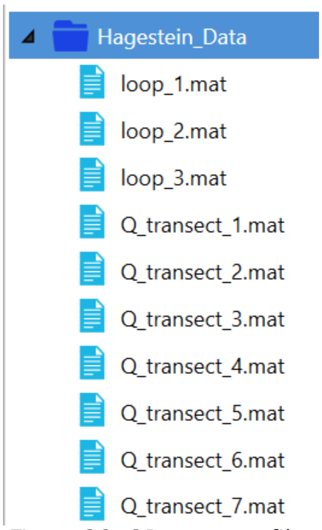
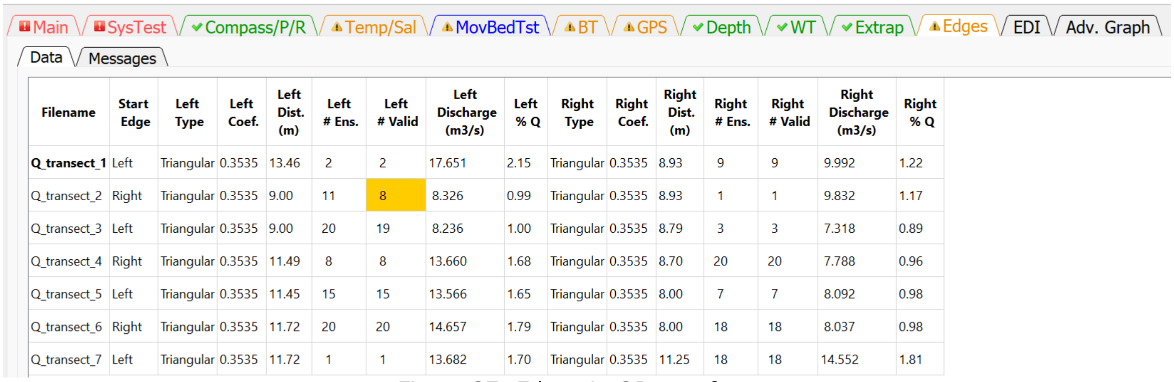


Figure 26: QRev export files

When opening all transects in QRev, the moving bed tests are also automatically opened. Transects show a distance to bank calculated using the distance to the shortest bank. The edges from the above example as shown in QRev V4.31 are shown in Figure 27 below.



Filename	Start Edge	Left Type	Left Coef.	Left Dist. (m)	Left # Ens.	Left # Valid	Left Discharge (m3/s)	Left % Q	Right Type	Right Coef.	Right Dist. (m)	Right # Ens.	Right # Valid	Right Discharge (m3/s)	Right % Q
Q_transect_1	Left	Triangular	0.3535	13.46	2	2	17.651	2.15	Triangular	0.3535	8.93	9	9	9.992	1.22
Q_transect_2	Right	Triangular	0.3535	9.00	11	8	8.326	0.99	Triangular	0.3535	8.93	1	1	9.832	1.17
Q_transect_3	Left	Triangular	0.3535	9.00	20	19	8.236	1.00	Triangular	0.3535	8.79	3	3	7.318	0.89
Q_transect_4	Right	Triangular	0.3535	11.49	8	8	13.660	1.68	Triangular	0.3535	8.70	20	20	7.788	0.96
Q_transect_5	Left	Triangular	0.3535	11.45	15	15	13.566	1.65	Triangular	0.3535	8.00	7	7	8.092	0.98
Q_transect_6	Right	Triangular	0.3535	11.72	20	20	14.657	1.79	Triangular	0.3535	8.00	18	18	8.037	0.98
Q_transect_7	Left	Triangular	0.3535	11.72	1	1	13.682	1.70	Triangular	0.3535	11.25	18	18	14.552	1.81

Figure 27: Edges in QRev software

3.8.2 Exporting to VMT

Despite it being a relatively dated tool, the Velocity Mapping Toolbox can be useful for generating certain plots. Nortek VM Review supports exporting to VMT through the "Exports" or "Batch processing" menus.

Exporting to VMT works similar to the other export formats. By default, the generated MATLAB files get a "V" prefix to show they are meant to be opened in VMT, unlike the files with a "Q" prefix produced by exporting to QRev. To open the .mat file(s) in VMT, select the second option in the File -> Open menu, see Figure 28 below.

*Bear in mind that in order to successfully open with SonTek Mat Files option, name of the file must contain at least 8 characters.

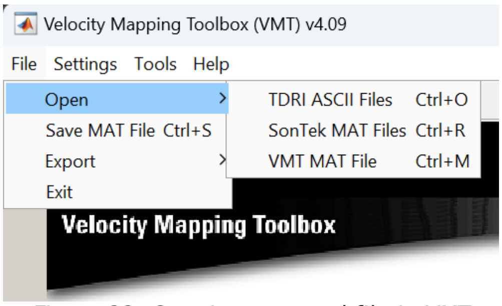


Figure 28: Opening exported file in VMT (second option)

To create a plot containing the track and vectors as shown in Figure 29 below, first create a GeoTiff[15] and then select "Add Background" in the "Plan View Plot" before you click "Plot Plan View" in VMT. You will then be asked to supply the created .tif(f) file.

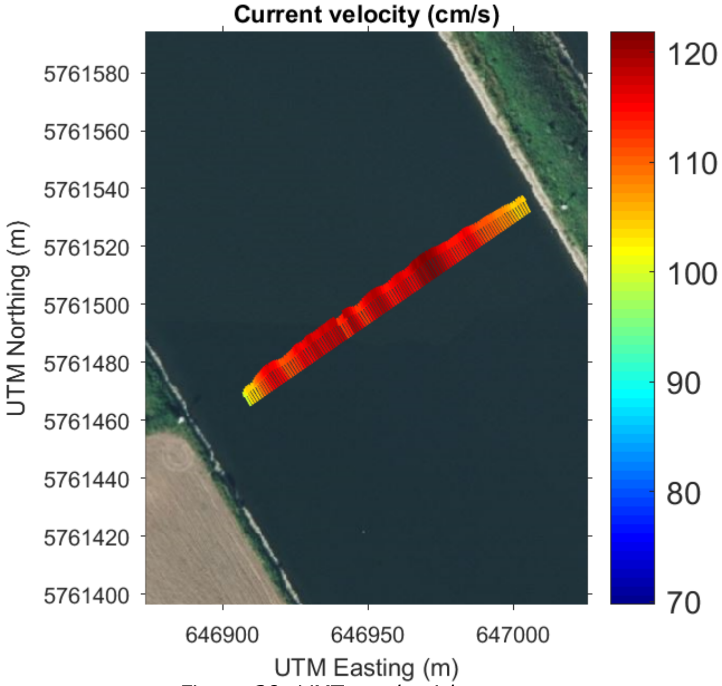


Figure 29: VMT track with current vectors

3.8.3 Exporting to SigVM

To facilitate splitting and merging of .SigVM recordings, an export to .SigVM is available. Exporting to .SigVM works like any other export. Exporting a selection of a .SigVM file can be useful when only part of a recording is of interest. In combination with the append functionality 9 , multiple files can be merged into one .SigVM file.

3.8.4 Batch processing

There is a "Batch processing" menu for situations where several files need to all be exported to any of the supported export formats. The "Batch processing" menu is shown in Figure 30 below.

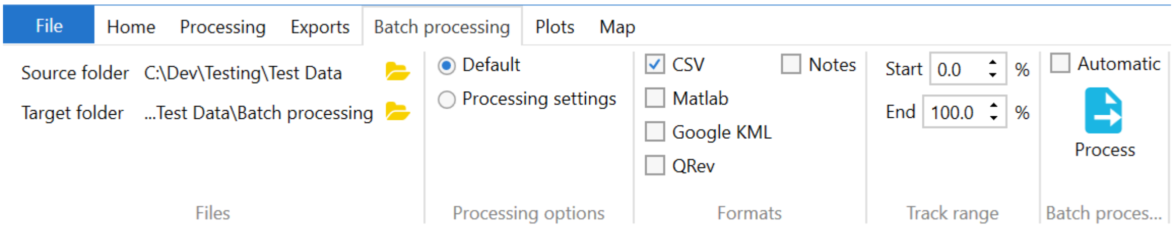


Figure 30: Batch processing menu

The menu contains options to select input and output folders. Next to this there is an option to either use the "Default" processing settings that are included in each .SigVM file or to use the "Processing settings" from the currently loaded recording. These settings can be seen in the "Processing 21 " menu. The "Start" and "End" in "Track range" allow for exporting a certain range of all .SigVM files in the "Source folder".

Notes from all recordings are collected in a single .csv file. For each of the other selected export formats, one file is created for each recording.

Above the "Process" button there is a toggle to switch to "Automatic" batch processing. This will detect newly added files and export these. This can be useful when it is required that recordings are exported as they are created. With automatic processing off, clicking "Process" will export all .SigVM files in the "Source folder".

3.8.5 Export formats

This section will explain the different export formats in detail.

3.8.5.1 Comma separated - .CSV

The .CSV file contains comma delimited data in ASCII format that can be imported in any spreadsheet program.

Header	Description	Units
Date_Time	Date and yime in standard ISO8601 format e.g. 2019-03-15T11:22:16.93	-
EnsNo	Ensemble number	-
BT1Depth	Bottom-track depth as measured on beam 1	m
BT2Depth	Bottom-track depth as measured on beam 2	m
BT3Depth	Bottom-track depth as measured on beam 3	m
BT4Depth	Bottom-track depth as measured on beam 4	m
BTDepth	Average depth as measured during the bottom-track measurements	m
AltiDepth	Depth as measured by the altimeter	m
AltiDepthQ	Quality number for the altimeter measurement	-
BeamDepth	Depth as measured using the amplitudes on all four beams	m
DEPTH	Depth as used in the calculation	m
D_Source	Source of the above-mentioned depth value:1= altimeter, 2= bottom-track, 3= beam amplitudes	-
VEast	Current velocity, east vector	m/s
VNorth	Current velocity, eorth vector	m/s
Vel_avg	Speed of water flow, averaged over the full range	m/s
Dir_avg	Direction of water flow, averaged over the full range. In degrees north.	DegreesN
LayerVEast	Current velocity in layer, east vector	m/s
LayerVNorth	Current velocity in layer, north vector	m/s
LayerVel_avg	Speed of water flow in layer, averaged over the full range	m/s
LayerDir_avg	Direction of water flow in layer, averaged over the full range. In degrees north.	DegreesN
Range	Range of valid cells as used in the velocity calculation	-
BTEast	Bottom-track velocity, east vector	m/s
BTNorth	Bottom-track velocity, north vector	m/s
GPSEast	GNSS velocity, east vector	m/s
GPSNorth	GNSS velocity, north vector	m/s
LAT	Latitude (dd.dddd)	Degrees
LON	Longitude (dd.dddd)	Degrees
GPSHeading	Heading according to the GNSS compass	DegreesN

Header	Description	Units
GPSBearing	Bearing as calculated from the GNSS positions	DegreesN
DistTravelled	Total distance traveled	m
SHeading	Heading as measured by the VM-ADCP magnetic compass	DegreesN
SPitch	Pitch as measured by the VM-ADCP	Degrees
SRoll	Roll as measured by the VM-ADCP	Degrees
STempC	Temperature as measured by the VM-ADCP	Degrees Celsius
fom1	Figure Of Merit for bottom-track calculation on beam 1 (0-65535, smaller is better)	-
fom2	Figure Of Merit for bottom-track calculation on beam 2	-
fom3	Figure Of Merit for bottom-track calculation on beam 3	-
fom4	Figure Of Merit for bottom-track calculation on beam 4	-
SoundSpd	Speed of sound through water	m/s
Valid	Validity of the data: 0 = invalid, 1 = valid	-
CorrSrc	What is used to correct the measured velocities: 0 = GNSS, 1= bottom-track XYZ, 2= bottom-track ENU, 3= none	-
BT1Vel	Raw bottom-track velocity as measured on beam 1	m/s
BT2Vel	Raw bottom-track velocity as measured on beam 2	m/s
BT3Vel	Raw bottom-track velocity as measured on beam 3	m/s
BT4Vel	Raw bottom-track velocity as measured on beam 4	m/s
Note	Note taken at this timestamp	-

Table 9: CSV export format

3.8.5.2 MATLAB

The MATLAB export creates file that contains several structures in a format as used by the Velocity Measurement Toolbox.

It fills a structure 'A' with the following structures:

Structure	Details
A.Sup	Supporting data
A.Wat	Water data (velocity and direction for each cell)
A.Nav	Navigation data including GNSS and bottom-track speed and velocity.
A.Sensor	Sensor data like temperature, roll and pitch
A.Q	Discharge related data (not available from a Nortek VM system)

Structure	Details
A.Echo1	Echosounder data – (Only when enabled in the instrument)
A.Echo2	Echosounder data – (Only when enabled in the instrument)

Table 10: MATLAB export structure

Echosounder data is only available if data was collected with an instrument that has echosounder capabilities.

3.8.5.2.1 A.Sup Structure

'noe' = Number Of Ensembles

''bins' = Number Of Bins

Field name	Matrix format	Description
note1	(1)	Software information
note2	(1)	Instrument type, serial and firmware information
serialnr	(1)	Serial number
frequency_kHz	(1)	Instrument main transducer frequency (kHz)
samplerate_hz	(1)	Sample rate in ensembles per second
bins	(1)	Default number of bins
nBins	(noe,1)	Number of bins in the ensemble per ensemble
binSize_cm	(bins,noe,1)	Size of each bin in cm
blank_cm	(1)	Blanking in cm
draft_cm	(1)	Draft in cm
mounting_depth_m	(1)	Mounting depth in meters
mounting_angle	(1)	Mounting angle in degrees
binSize_m	(1)	Size of each bin in meters
blanking_m	(1)	Blanking in meters
draft_m	(1)	Draft in meters
ensNo	(noe,1)	Ensemble number
npings	(noe,1)	Number of pings as averaged for this ensemble
noEnsInSeg	(noe,1)	Number of ensembles in the whole segment
noe	(1)	Number of ensembles
averaging_time_sec	(1)	Averaging window size in seconds
intScaleFact_dbpcnt	(1)	Scaling factor for counts to dB conversion
intUnits	(1)	Internal units - “counts”
vRef	(1)	“NONE” <not used>
wm	(1)	0 <not used>

Field name	Matrix format	Description
units	(1)	Units as used for output “m” or “cm”
year	(noe,1)	
month	(noe,1)	
day	(noe,1)	
hour	(noe,1)	
minute	(noe,1)	
second	(noe,1)	
sec100	(noe,1)	
timeElapsed_sec	(noe,1)	Seconds since start of measurement
timeDelta_sec100	(noe,1)	0 <not used>
avg_vEast	(noe,1)	Average velocity east
avg_vNorth	(noe,1)	Average velocity north
avg_vMag	(noe,1)	Average velocity magnitude
avg_vDir	(noe,1)	Average velocity direction
layer_avg_vEast	(noe,1)	Average velocity east in layer
layer_avg_vNorth	(noe,1)	Average velocity north in layer
layer_avg_vMag	(noe,1)	Average velocity magnitude in layer
layer_avg_vDir	(noe,1)	Average velocity direction in layer
altimeter_depth	(noe,1)	Depth as measured by the altimeter (m)
altimeter_q	(noe,1)	Quality of the altimeter depth measurement
bottomtrack_timestamp	(noe,1)	Timestamp of the bottom-track measurement
bottomtrack_ensemble	(noe,1)	Ensemble nr of the bottom-track measurement
bottomtrack_avgDepth	(noe,1)	Averaged depth as measured using bottom-track
bottomtrack_lat_deg	(noe,1)	Bottom-track latitude
bottomtrack_long_deg	(noe,1)	Bottom-track longitude
amplitudeBeam_avgDepth	(noe,1)	Averaged depth as measured using Amplitudes of the four beams
valid_data	(noe,1)	Validity of the data: 0 = valid (any non zero value means invalid data), 1 = no bottom-track, 2 = no bottom detected, 4 = no velocity
FOM1	(noe,1)	Figure Of Merit for beam 1
FOM2	(noe,1)	Figure Of Merit for beam 2
FOM3	(noe,1)	Figure Of Merit for beam 3
FOM4	(noe,1)	Figure Of Merit for beam 4
first_bin	(noe,1)	First bin in the vertical as used for the average
last_bin	(noe,1)	Last bin in the vertical as used for the average

Field name	*Matrix format*	*Description*
soundspeed	(noe,1)	Speed of sound through water in m/s

Table 11: MATLAB Sup structure

Example:

```
Sup =

   scalar structure containing the fields:

     absorption_dbpm =

        0.50100
        0.50100
        0.50100
        0.50100
        0.50100

     bins =

        75
        75
        75
        75
        75

     binSize_cm =

        20.000   20.000   20.000   20.000   20.000
        20.000   20.000   20.000   20.000   20.000
        20.000   20.000   20.000   20.000   20.000
        20.000   20.000   20.000   20.000   20.000
        20.000   20.000   20.000   20.000   20.000
        20.000   20.000   20.000   20.000   20.000
        20.000   20.000   20.000   20.000   20.000
        20.000   20.000   20.000   20.000   20.000

        20.000   20.000   20.000   20.000   20.000
   nBins = 75
   blank_cm = 25
   draft_cm = 12
   ensNo =

       4676
       4677
       4678
       4679
       4690
```

3.8.5.2.2 A.Sensor structure

Data from the internal sensors like temperature, roll and pitch.

Field name	*Matrix format*	*Description*
sensor_type	(1)	A letter code indicating the type of sensor. Not used for Nortek sensors
pitch_deg	(noe,1)	Average pitch in degrees
roll_deg	(noe,1)	Average roll in degrees
heading_deg	(noe,1)	Average heading in degrees north
temp_degC	(noe,1)	Average temperature in degrees Celsius

Table 12: MATLAB Sensor structure

3.8.5.2.3 A.Wat structure

Velocity, direction, backscatter etc. for each cell.

Field name	*Matrix format*	*Description*
backscatter	(bins,noe,4)	Backscatter per bin for each of the 4 beams
correlation	(bins,noe,4)	Correlation per bin for each of the 4 beams
noiseFloor	(bins,noe)	Amplitude of last cell in decibels
binDepth	(bins,noe)	Depth per bin in meters
vMag	(bins,noe)	Magnitude of the velocity in cm/s
vMag_ms	(bins,noe)	Magnitude of the velocity in m/s
vDir	(bins,noe)	Direction
vEast	(bins,noe)	Velocity in east in cm/s
vEast_ms	(bins,noe)	Velocity in east in m/s
vNorth	(bins,noe)	Velocity in north in cm/s
vNorth_ms	(bins,noe)	Velocity in north in m/s
vVert	(bins,noe)	Velocity in vertical in cm/s
vVert_ms	(bins,noe)	Velocity in vertical in m/s
vError	(bins,noe)	Estimated error velocity in cm/s
vError_ms	(bins,noe)	Estimated error velocity in m/s
beamFreq	(bins,noe)	Beam frequency in kHz
percentGood	(bins,noe)	Percentage of good measurements in this ensemble
velocity_correction_source	(noe,1)	Correction source for water current velocities, 0 = GNSS, 1 = bottom-track XYZ, 2= bottom-track ENU, 3 = None

Table 13: MATLAB Wat structure

Backscatter and Correlation are written as an array of 4 matrices. Each matrix contains backscatter or correlation for a specific beam.

3.8.5.2.4 A.Nav structure

All data related to Position and movement, both from GNSS and bottom-track.

Field name	Matrix format	Description
bvEast	(noe,1)	Bottom-track velocity east in cm/s
bvError	(noe,1)	Bottom-track velocity error in cm/s
bvNorth	(noe,1)	Bottom-track velocity north in cm/s
bvVert	(noe,1)	Bottom-track velocity vertical in cm/s
bvEast_ms	(noe,1)	Bottom-track velocity east in m/s
bvError_ms	(noe,1)	Bottom-track velocity error in m/s
bvNorth_ms	(noe,1)	Bottom-track velocity north in m/s
bvVert_ms	(noe,1)	Bottom-track velocity vertical in m/s
depth	(noe,4)	Depth as calculated from bottom-track beams, one for each beam
dsDepth	(noe,1)	Depth sounder depth
dmg	(noe,1)	Distance Made Good
length	(noe,1)	Length of the total track
totDistEast	(noe,1)	Total Distance traveled East
totDistNorth	(noe,1)	Total Distance traveled North
altitude	(noe,1)	Altitude as reported by the GNSS
altitudeChng	(noe,1)	0 <not used>
gpsTotDist	(noe,1)	Total distance traveled from GNSS
gpsVariable	(noe,1)	Combined HDOP and VDOP
gpsVeast	(noe,1)	Velocity East
gpsVnorth	(noe,1)	Velocity North
gpsHeading	(noe,1)	True heading as recorded by the GNSS Compass
gpsBearing	(noe,1)	Bearing as recorded by the GNSS. (Course Over ground)
gpsSOG	(noe,1)	Speed over ground recorded by the GNSS Compass
lat_deg	(noe,1)	Latitude in degrees
long_deg	(noe,1)	Longitude in degrees
nSats	(noe,1)	Number of satellites in view
hdop	(noe,1)	Horizontal Dilution of Position
depthSource	(noe,1)	Source of water depth value used, 0 = automatic, 1 = altimeter, 2 = bottom-track distance, 3 = velocity amplitude, 4 = last cell
preferredDepthSource	(noe,1)	Preffered depth source, 0 = Automatic, 1 = Altimeter, 2 = Bottom-track distance, 3 = Velocity

Field name	Matrix format	Description
		amplitude, 4 = Last cell
bvBeam1	(noe,1)	Raw bottom-track velocity from beam 1
bvBeam2	(noe,1)	Raw bottom-track velocity from beam 2
bvBeam3	(noe,1)	Raw bottom-track velocity from beam 3
bvBeam4	(noe,1)	Raw bottom-track velocity from beam 4
gnssHeave	(noe,1)	Heave motion in meters, as recorded by the GNSS
timestamp	(noe,1)	MATLAB compatible timestamp. A number that represents the whole and fractional number of days starting from a fixed, pre-set date (January 0, 0000).

Table 14: MATLAB Nav structure

3.8.5.2.5 A.Echon_xxxkHz structure

Echosounder data. Only available when enabled in the instrument.

The name shows which Echosounder mode is used for this dataset. The *n* is the number of the specified echosounder settings in the start-up configuration. The *xxx* is the frequency.

An echosounder setting that uses pulse compression can output process the result using 5 different frequency bands. So, this gives a number of virtual echosounder data files, each having a different frequency. When for example a Signature 100 is used with dedicated echosounder the output may contain Echo1_74kHz, Echo1_82kHz, Echo1_91kHz..etc.

The exact center frequency used to process a single band is available in the data itself, and this may be slightly different from the one as shown in the title of the set. For example, the '74 kHz' is actually 73.8 kHz.

Field name	Matrix format	Description
noe	(1)	Number of ensembles
index	(1)	Echosounder index (0 based)
binSize_m	(1)	Size of each bin in m
blanking_m	(1)	Blanking distance in m
xmit_ms	(1)	Transmit length in milliseconds.
noiselevel_dB	(1)	Echosounder noise level in decibels
powerlevel_dB	(1)	Echosounder transmit power level in decibels
pulsecomp	(1)	Pulse compression (0 is off, 1 is on)
bins	(1)	Number of bins
frequency_kHz	(1)	Transmit frequency in kHz
amplitudeRaw_dB	(bins,noe)	Return in dB, uncorrected
amplitudeCorrected_dB	(bins,noe)	Return in dB, with range correction
volumeBackscatter_dB	(bins,noe)	Volume backscatter strength dB
pointBackscatter_dB	(bins,noe)	Point backscatter strength dB

Field name	Matrix format	Description
firstCellDepth_m	(1)	Depth of first cell in m, corrected for speed of sound, including mounting depth.
lastCellDepth_m	(1)	Depth of last cell in m, corrected for speed of sound, including mounting depth.
binDepth_m	(bins,1)	Distance of this cell/bin to the sensor.
ensNo	(1,noe)	Ensemble number
lat_deg	(1,noe)	Latitude in degrees
lon_deg	(1,noe)	Longitude in degrees
Timestamp	(1,noe)	MATLAB compatible timestamp. A number that represents the whole and fractional number of days starting from a fixed, pre-set date (January 0, 0000).

Table 15: MATLAB Echo structure

3.8.5.3 Signature VM File Format

Data is recorded in a file with the SigVM extension. This is a zipped file containing several individual files with data from the VM-ADCP (Signature) sensor, GPS, compass and settings. To view the individual files, use a standard tool for opening zip archives. Figure 31 below shows the extracted files present in a zipped .SigVM file.

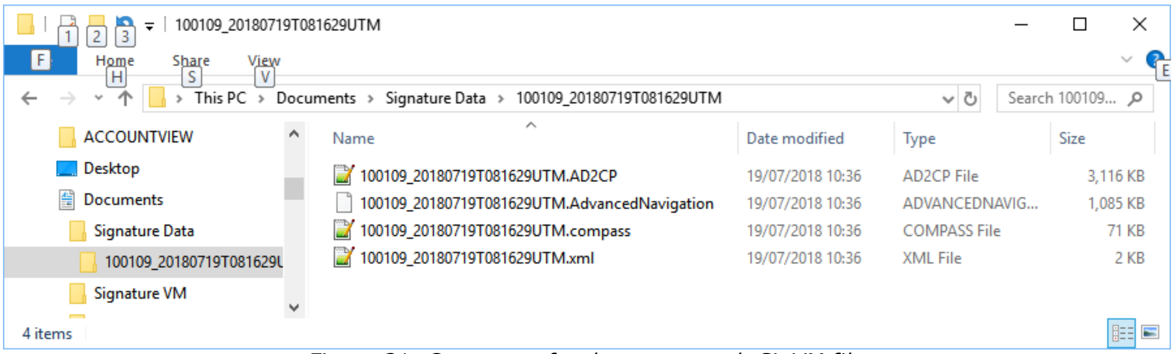


Figure 31: Contents of a decompressed .SigVM file

The file with the extension .AD2CP contains the raw data as collected from the VM-ADCP in the standard format that is used on all Nortek AD2CP instruments. Details are available in the document N3015-007-Integrators-Guide-AD2CP. This data can be read and processed in other Nortek software packages like OceanContour.

The *.XML file contains all settings of the instrument and the software that were used while collecting the data. Navigation data is stored in the *.gps, *.compass and / or *.AdvancedNavigation (or .anpp) files. The .GPS and *.compass files (if present) contain navigation data in standard, readable, NMEA format. A *.AdvancedNavigation or .anpp file will contain binary data in the ANPP format as described in the Advanced Navigation 'GNSS Compass Reference Manual'.

4 Personalization

Nortek VM Review has various options for personalization including themes, different layouts and various other settings.

4.1 Layout

Changing the layout of the different windows that make up the application can be done using the "Home" menu.

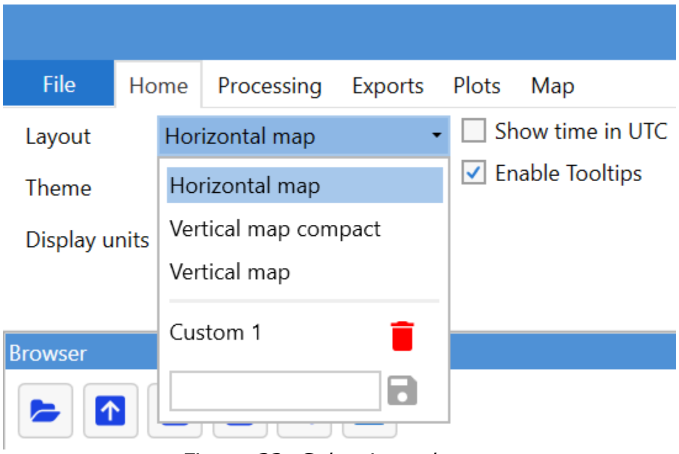


Figure 32: Selecting a layout

4.1.1 Switching layout

There are a number of default layouts that can be loaded by selecting them in the "Layouts" drop down (this can take a few seconds).

4.1.2 Creating layouts

After adjusting a certain layout 8 by resizing, moving, hiding or unhiding windows, custom layouts can be saved. This is done by typing a name for the layout in the text box on the bottom row of the "Layouts" drop down and clicking the save button.

Custom layouts can be removed by clicking the bin button next to each custom layout below the divider in the "Layouts" drop down.

When exiting the application any unsaved changes to layouts will be discarded. The choice of default or saved layout will be remembered when restarting the application.

4.1.3 Menu bar

The menu bar of Nortek VM Review is a so called "Ribbon" menu, similar to what Microsoft uses in its Office suite applications. The ribbon can be be left expanded if required. This is either done by double clicking any menu label, or by clicking the down arrow on the top right of the application and selecting "Expand the ribbon".

4.2 Theme

Changing the theme can be done using the "Theme" drop down in the "Home" menu.

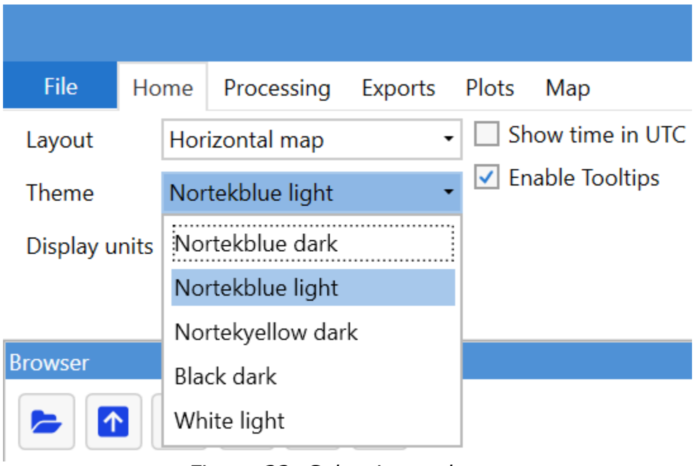


Figure 33: Selecting a theme

When changing a theme, the color scheme of the heatmaps also changes to a color scheme fitting the theme. Heatmap color schemes can be adjusted separately 17 .

Figures

Tables