

NAVIEDIT

REMOVING SWELL ARTIFACTS

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1 General

This document is an introduction to how to handle swell in the EIVA offline SW suite.

Swell on bathy generated from surface waves on ROV working in shallow water, cannot be smoother away from bathy directly, as this would also smooth the ROV movements in bathy. If a Doppler is present, Kalman3D filter will use Doppler data in filtering the bathy (and the position) this way removing swell from bathy.

If no Doppler is present **Kalman 3D** will not filter bathy correct, but just smooth it. Instead the swell effect on a pipe or flat seabed can be smoothed, and the difference from before smoothing can be added to the bathy, this way swell is reduced in bathy by means of the expected local straightness of a pipe or the short term seabed flatness.

1.1 By 3D Kalman filter with Doppler Log

Here a 1m swell is overlaying the bathy. (Artificially added)

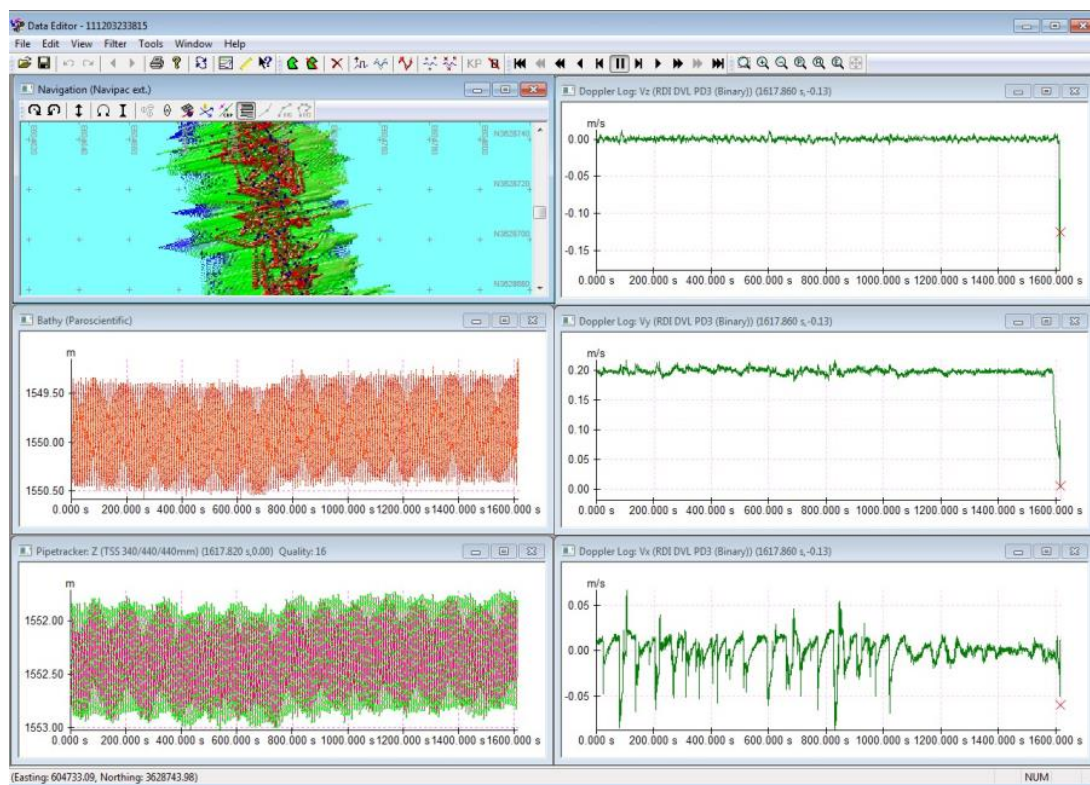


Figure 1 NaviEdit DataEditor dialogue

- Select Filter in the Data Editor

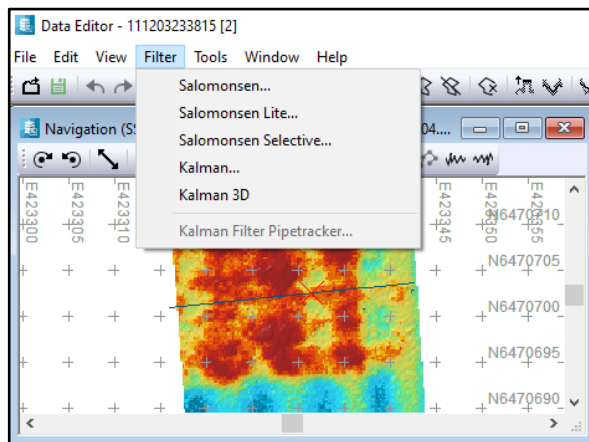


Figure 2 Data Editor: Navigation view with the Filter option

- Enter the observed errors and run **Kalman 3D** filter.
The entered bathy error must reflect the swell artifact in the bathy.

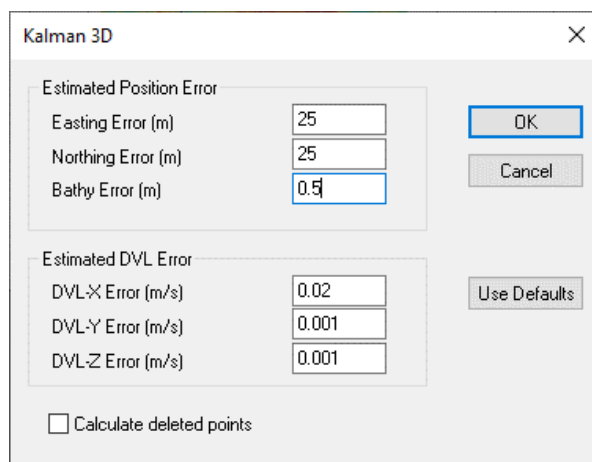


Figure 3 Kalman 3D dialogue

- Now bathy and pos are adjusted by the Kalman3D filter, and the swell has disappeared

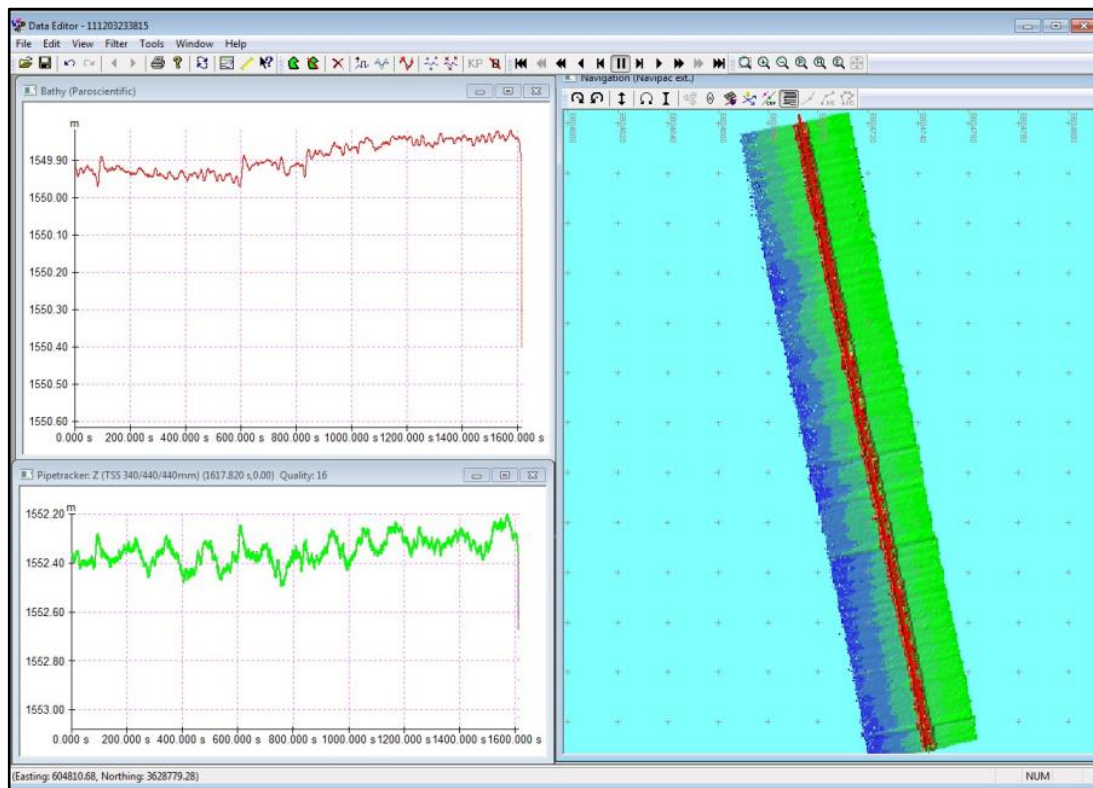


Figure 4 DataEditor dialogue

1.2 By pipetracker

- If a pipe tracker (with decent quality) is present, the z value must be shown as absolute depth thereby showing the top of pipe.
- First open pipetracker Z view in Show absolute depth mode and delete eventual outliers.
- Then press right menu Remove swell by pipe...

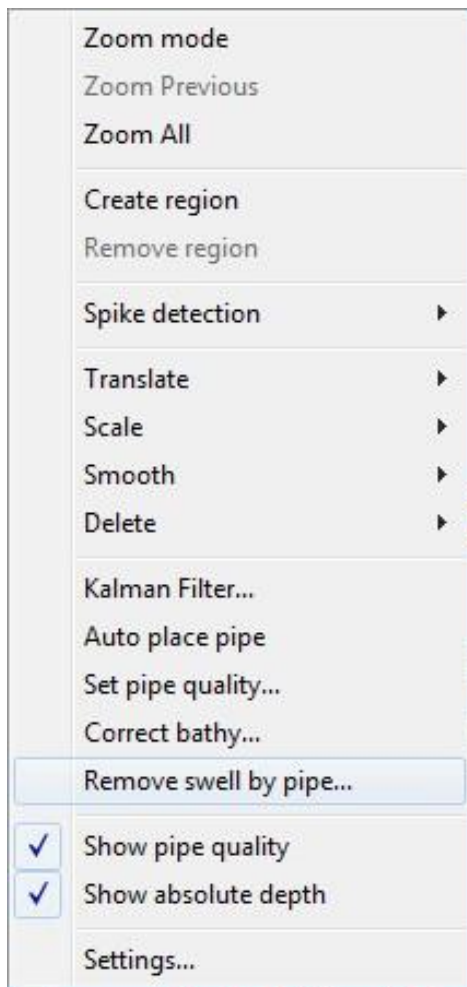


Figure 5 DropDown menu / Remove swell by pipe

- Then select a wavelength in time greater than the swell wavelength which is wanted smoothed, but not so big that pipe will be more straight than natural, e.g. select 20-30 sec.

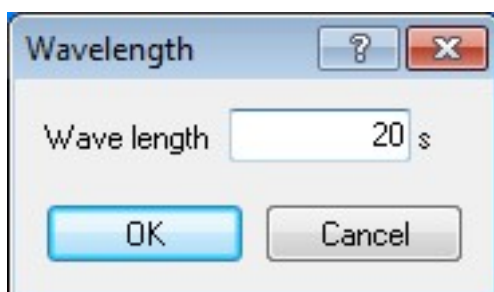


Figure 6 Wave length dialogue

- This way the selected bathy is added with the difference of a swell smoothed absolute pipe Z (for smoothing the swell waves away) and the observed absolute pipe Z.
To undo this operation, move focus to bathy view and press Ctrl Z, then update all.

When pressing update button, all data derived from the bathy, will be updated with the now swell reduced bathy.

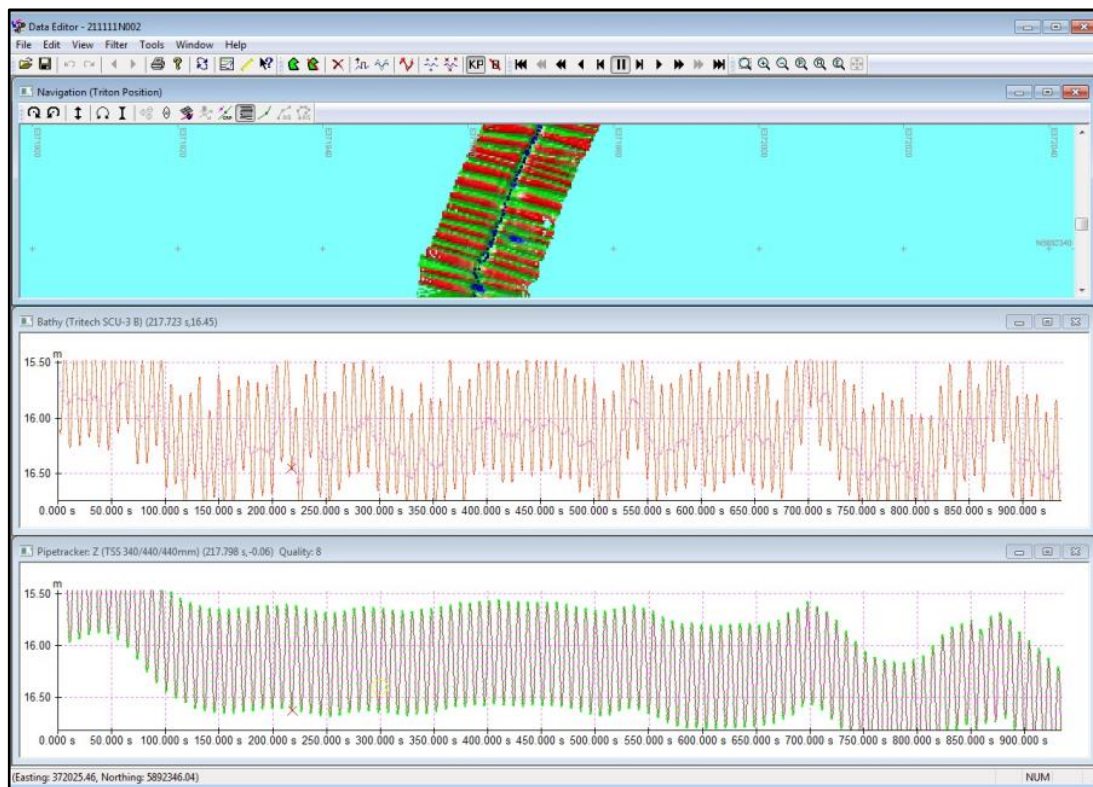


Figure 7 Data Editor: 1m artificial swell on bathy, before reduction

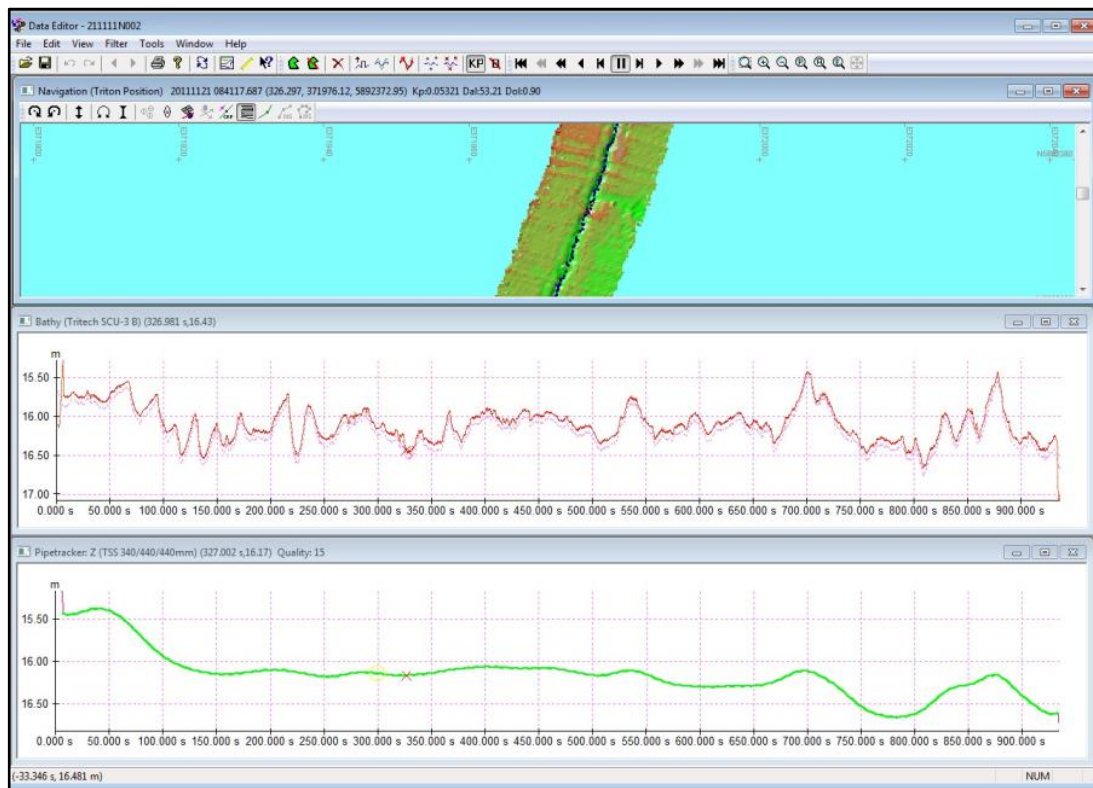


Figure 8 Data Editor: 1m artificial swell on bathy, after reduction

1.3 By long profile

If seabed or a feature like an exposed pipe found at a fixed offset and window from nadir, is expected to be flat, but overlaid with swell artefact, the expected flatness can be used to remove the swell artefact.

A long profile can be generated at any offset from nadir, as the median of the values within a given window. Then median can be modified to take the sorted value at any point, where

50% is the real median and 100% is the deepest point and 0% is the least depth of the window samples. Median filter default 50% will best remove outliers, but if a top of a pipe within the window is searched selecting a lower value eg 10% will help find a more top point, but still remove a few eventual outliers, and 0% will give the most top but this could include outlier noise.

First open long profile (time) view and move all shown profiles to hidden.

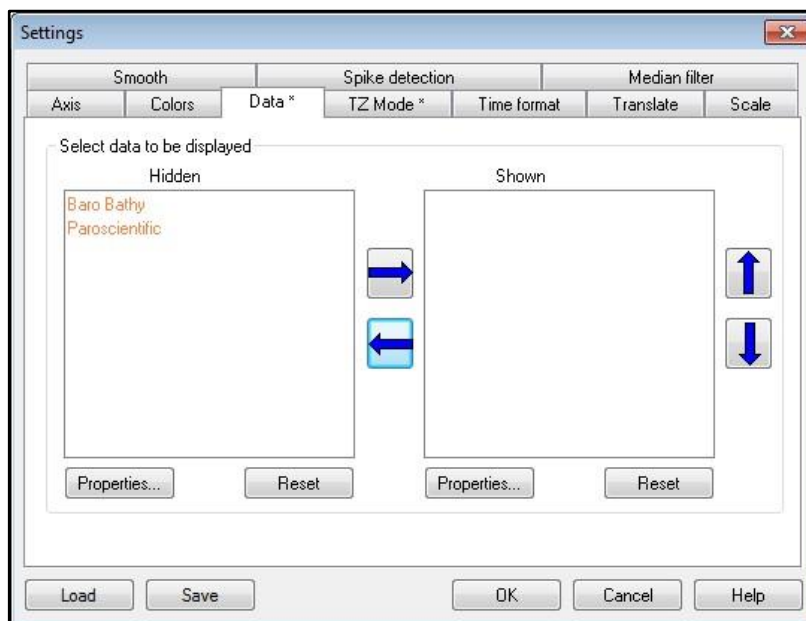


Figure 9 Settings

Then generate the wanted long profile, (right menu: Add profile...) and make sure it is selected as the active profile, and eventually delete extreme outliers from it.

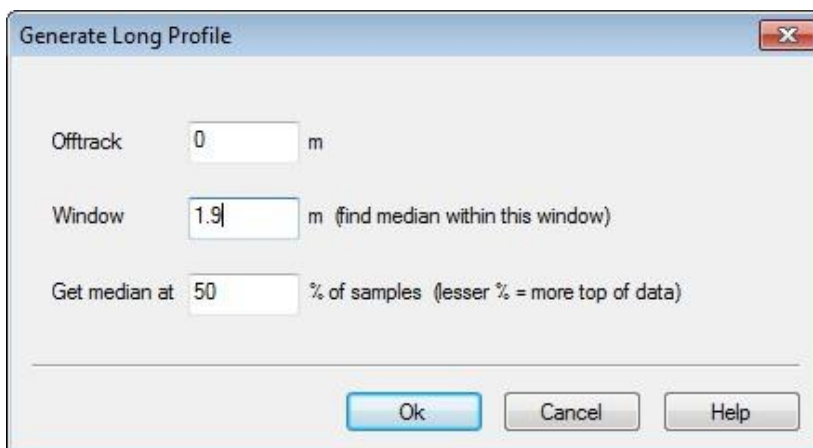


Figure 10 Generate Long Profile

If you want to preserve some true bottom movements with a shorter wavelength in time than the swell, a smoothing of the long profile with a shorter time wavelength than the swell artefact can be applied first. (eg wavelength 2 sec)

Then press right menu **Remove swell by profile**.

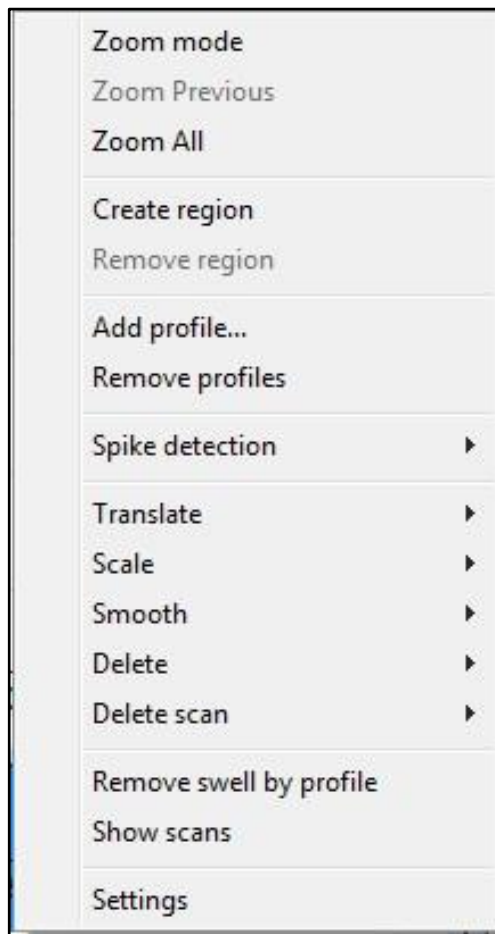


Figure 11 Option Remove swell by profile

Then select a wavelength in time greater than the swell wavelength which is wanted smoothed, but not too big as seabed will be smoothed with this too, eg 10 or 20 sec.

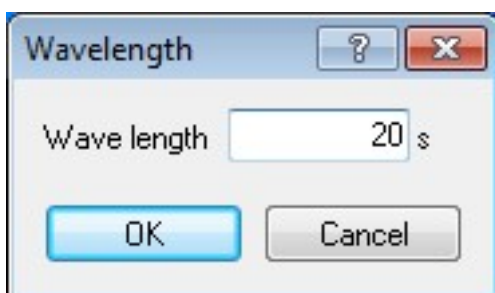


Figure 12 Wavelength settings

This way bathy is added with the difference of a smoothed absolute long profile (for smoothing the swell waves away) and the original observed long profile.

To undo this operation, move focus to bathy view and press Ctrl Z, then update all.

When pressing update button, all data derived from the bathy, will be updated with the now swell reduced bathy.

To see the effect in the long profile a new long profile needs to be generated now.

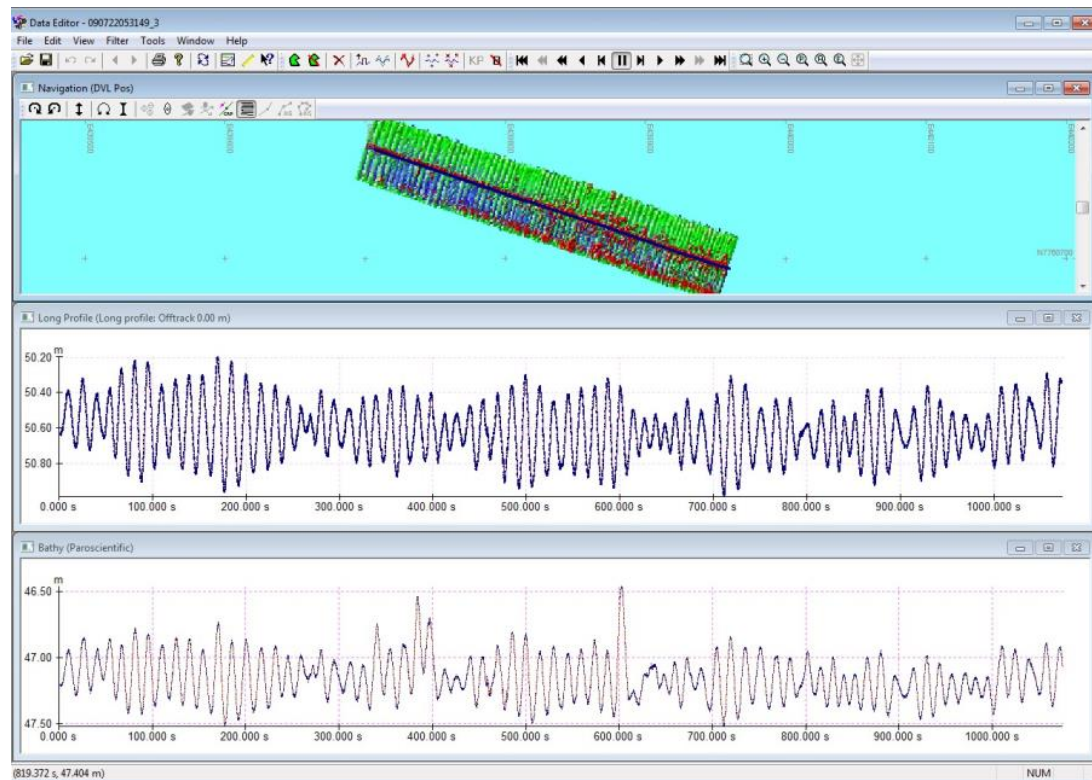


Figure 13 Data Editor: Profiles generated before the operation, together with the bathy and DTM.

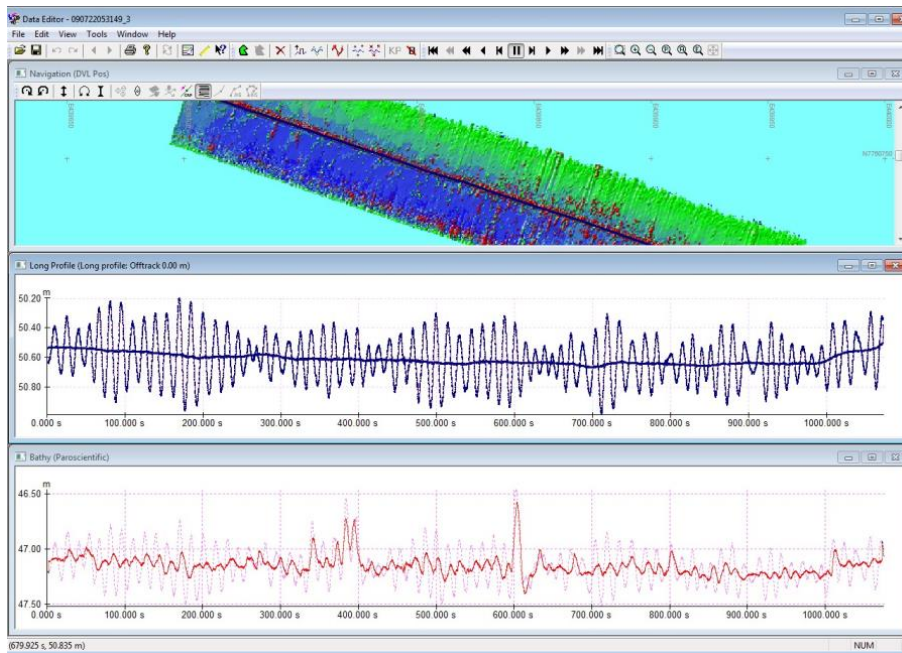
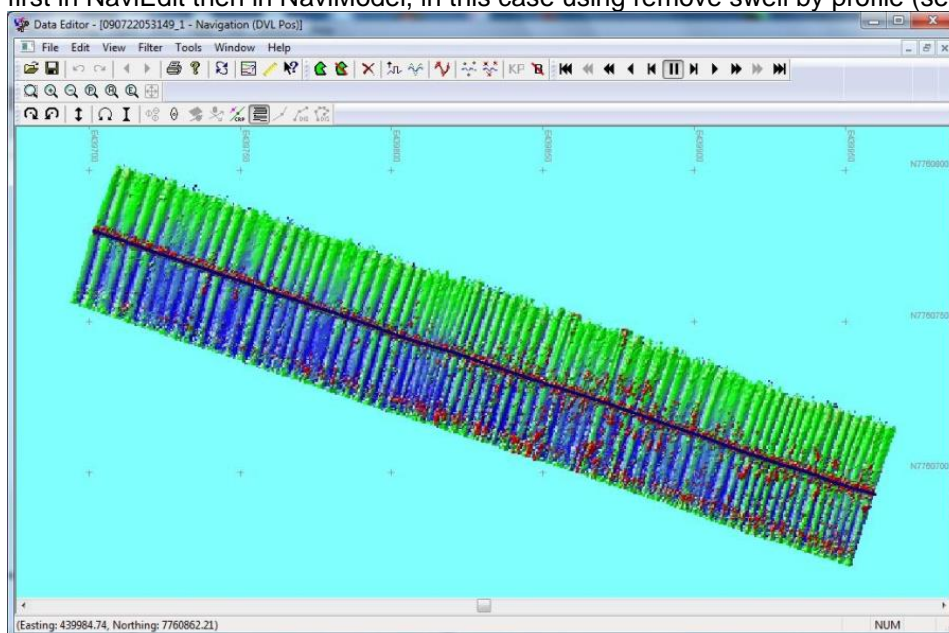


Figure 14 Data Editor: Profiles generated after the operation, together with the bathy and DTM.

1.4 DTM results

See below for the DTM effect before and after the operations on dataset with heavy swell, first in NaviEdit then in NaviModel, in this case using remove swell by profile (seabed)



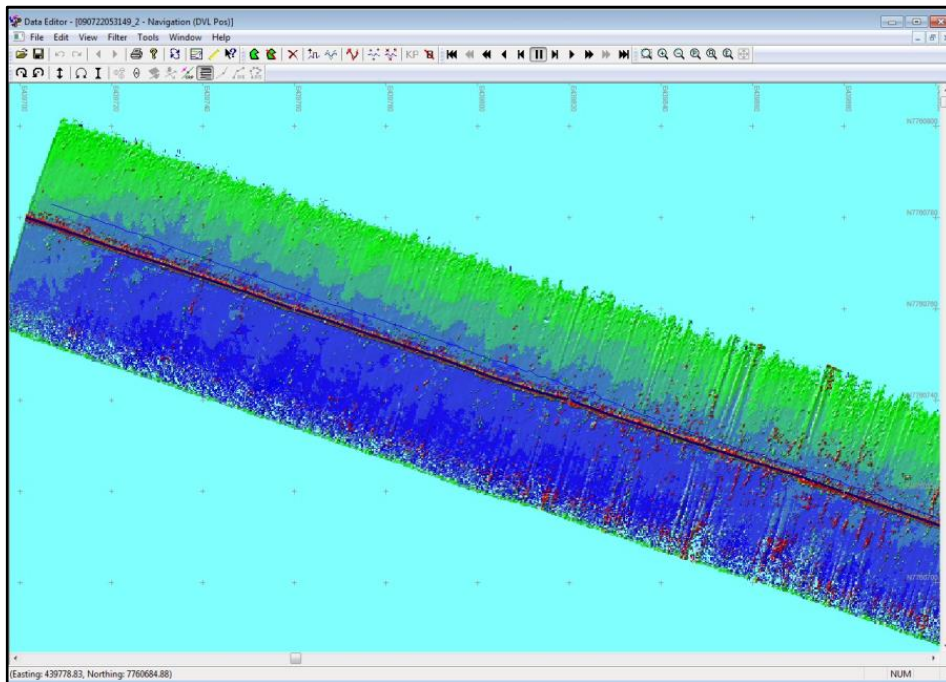


Figure 15 Data Editor: DTM before and after applying the option **Remove swell by profile**

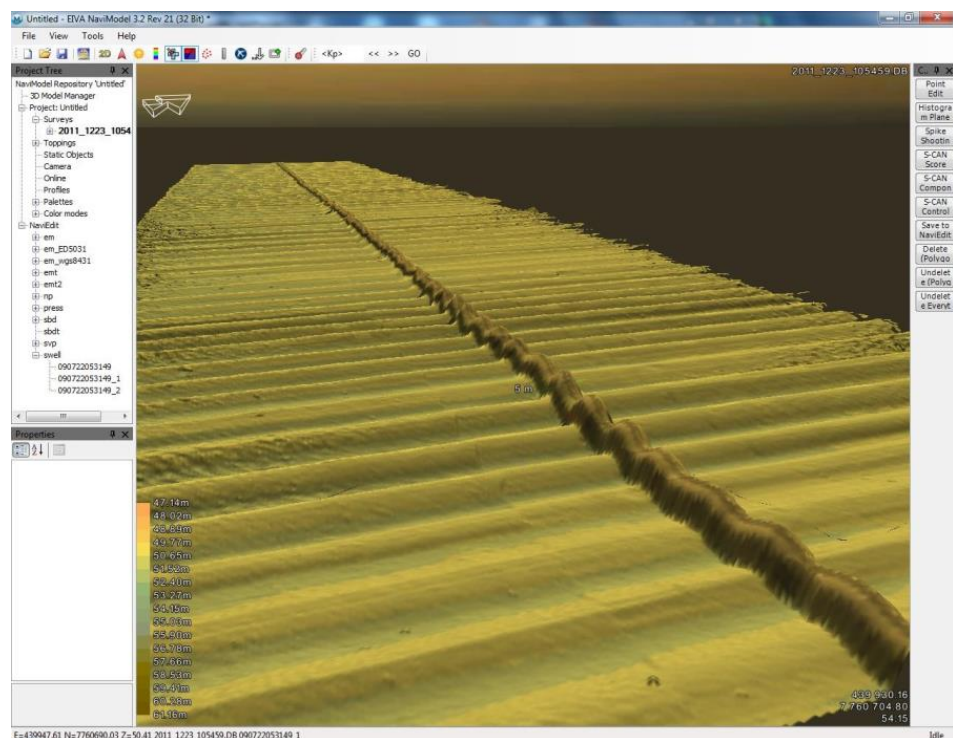


Figure 16 NaviModel/3D Online view

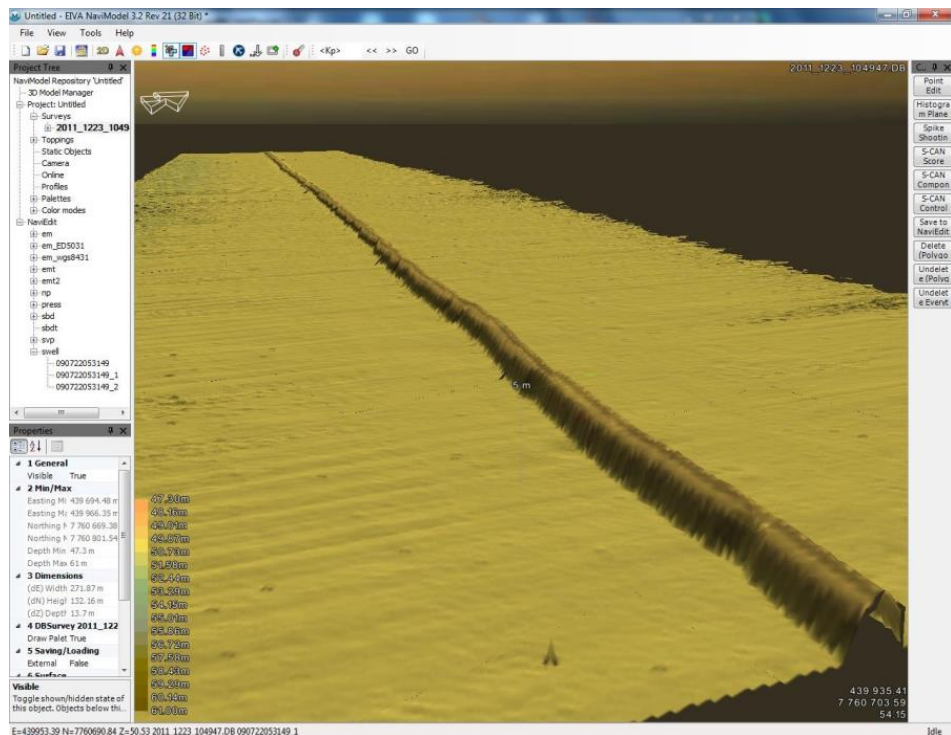


Figure 17 NaviModel 3D Map view with pipeline

In the last picture long profile of top of pipe is used, as pipe was found at nadir always within a window of 2 meter, and median 10% was used to seek the most top points.

As the pipe at fixed intervals had no coating and reduced diameter, this resulted in an artefact on the seabed at the size of the reduced coating, as the system expected the pipe to be local straight with smooth surface., this problem was not seen above where the seabed beside the pipe was used as basis for the long profile.

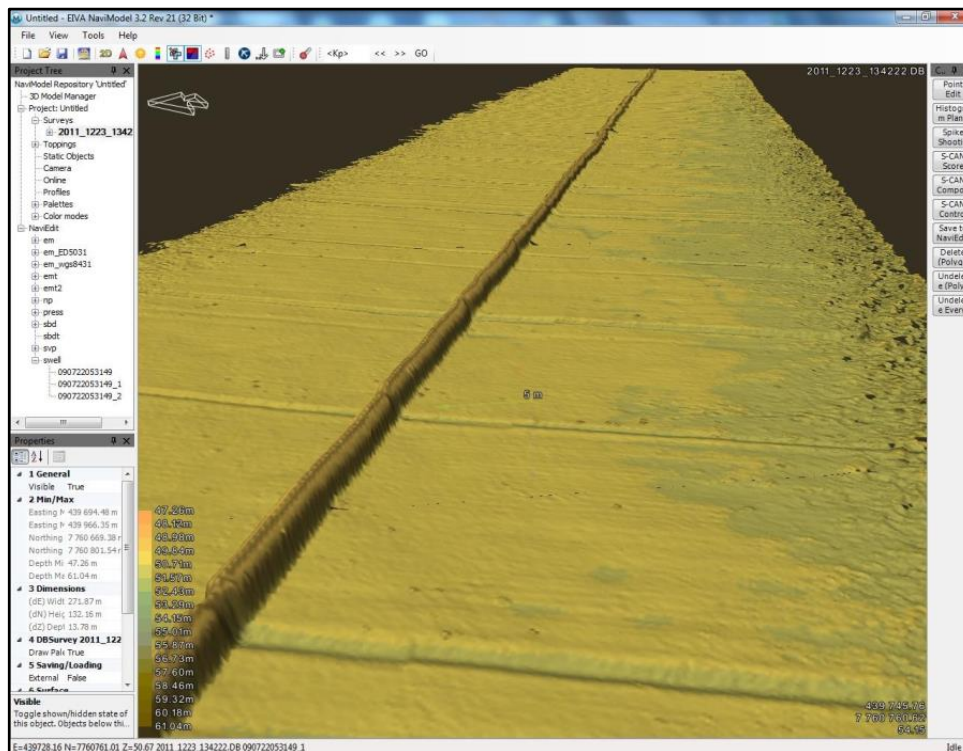


Figure 18 NaviModel with pipeline

1.5 Conclusion

Depending on presence of doppler log, pipetracker and its eventual quality, and presence of exposed pipe, and possible local flatness of the seabed, and the wavelength of the swell that is wanted reduced, user can select different methods.

Experimenting with different noise and wavelength values, by means of undo or not saving the result, can lead to better reduction of swell artefacts.

The result is applied to the selected bathy values, which was initially disturbed by the swell, and will hereafter be used everywhere in data editor, and if saved, in exports and NaviModel.

2 Version descriptions

Version	Date	Author	Description
1	02.01.2012	AFA	Created.
8.0	20.04.2016	ANS	Reviewed
