

Main news of the REFLEXW version 9.5 from 01.07.2020

I. 2D-dataanalysis

1. Data Import:

new suboption **flip sorting** for import format MALA RD6 - the option has been introduced because it may happen dependent on the type for the Mala CX system that the data have not been stored sequentially scan (channel) after scan (channel) but first trace of all cuts, then second trace of all cuts. If this holds true you must activate the option. In most cases the option must only be activated for one scan direction.

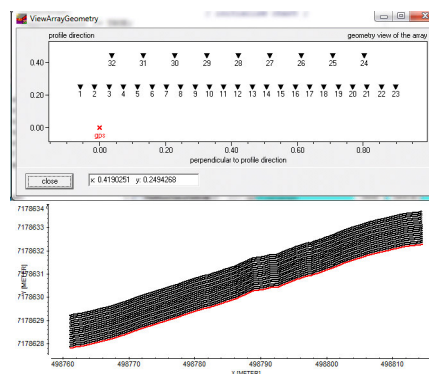
automatisation of the **geometry import** of **multichannel** channel: REFLEXW allows to handle GPR array data from different manufacturers as:

- MIRA from Mala
- Stream from IDS
- Utsi
- Raptor from Impulse Radar
- 3D Radar

The import from the different array data formats is performed in a similar way. In each case the resulting Reflexw files are 2D-files each containing the corrected (based on the antenna geometry) gps, utm or local coordinates stored within the traceheaders.

The standard automatic import procedure is the following:

1. Convert the original data to 2D-lines
2. Load the gps-data from an external file (one file for the whole swath)
3. Correct the gps-data depending on the antenna position relative to the GPS device



RADAN import: new suboption **read coordinates** - if activated the local coordinates stored within the dzx file will be used for the definition of the fileheader coordinates.

Example:

```
<WayPt>
  <scan>0</scan>
  <distance>0.000000</distance>
  <localCoords>0.000000,0.300000,0.000000</localCoords>
</WayPt>
<WayPt>
  <scan>231</scan>
  <distance>2.310000</distance>
  <localCoords>2.310000,0.300000,0.000000</localCoords>
```

The program extracts the start/end coordinates 0/2.31 and 0.3/0.3 from the local coordinates. The profile direction and constant will be automaticall updated based on the coordinates.

Proceq SEGY import:the traceincrement as well as the source/receiver distance are imported from the csv file if available.

SARA DRM: new import format from the drm-files of Sara electronics. The following header words are read in:

sps: samples per second

numero campioni: number of samples

shot x - shot position

coordinata x - receiver position

The fileheader is assumed to have a size of 50000 bytes. The original data are saved as 32 bit integer values.

2. Interactive choice:

new option **InterchangeXY** for the **DXFExport** - if activated the xy-coordinates will be interchanged for the export. This might be usefo for example if the latitude has been stored on the x-coorindate and no utm conversion shall be done.

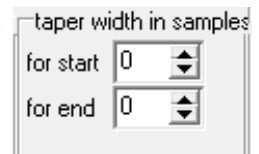
2. Dataprocessing:

new processing group **deconvolution/shaping** which includes the processing steps deconvolution, deconvolution/shap., spectral whitening, differentiation, integration, shaping and extract wavelet.

option **spectral whitening**: new radiogroup with the options **add derivatives** and **norm frequ.bands**. With add derivatives activated the spectral enhancement is done by adding the second, fourth and sixth-order derivatives as well as a smoothed trace.

Sequence processing: new option **several processing flows** - if activated several processing flows may be applied in addition to the actual one consecutively. Depending on the number of additional processing flows a corresponding number of processing files will be produced. The entered processing label is used for the actual processing step for all chosen lines. The label for the additional processing flows is incremented by 1 each time. The option might be useful if a special processing step must stay at the first position within the processing flow, e.g. the normalize profiles option. The option is only available for the sequence processing of several lines (option StartSeveralLines).

background removal and **sub. average: taper** has been changed. Now the taper width for the start and end of the filter range must be entered independently.



new processing option **average 3D-filter** under processing/2D-filter: the filter acts on a 3D-file and performs averaging in all 3 directions. The option nr. of voxels in time controls the number of voxels in z(time)-direction for determining the average, nr. of voxels inline controls the number of voxels in inline direction and nr. of voxels crossline controls the number of voxels in crossline direction.

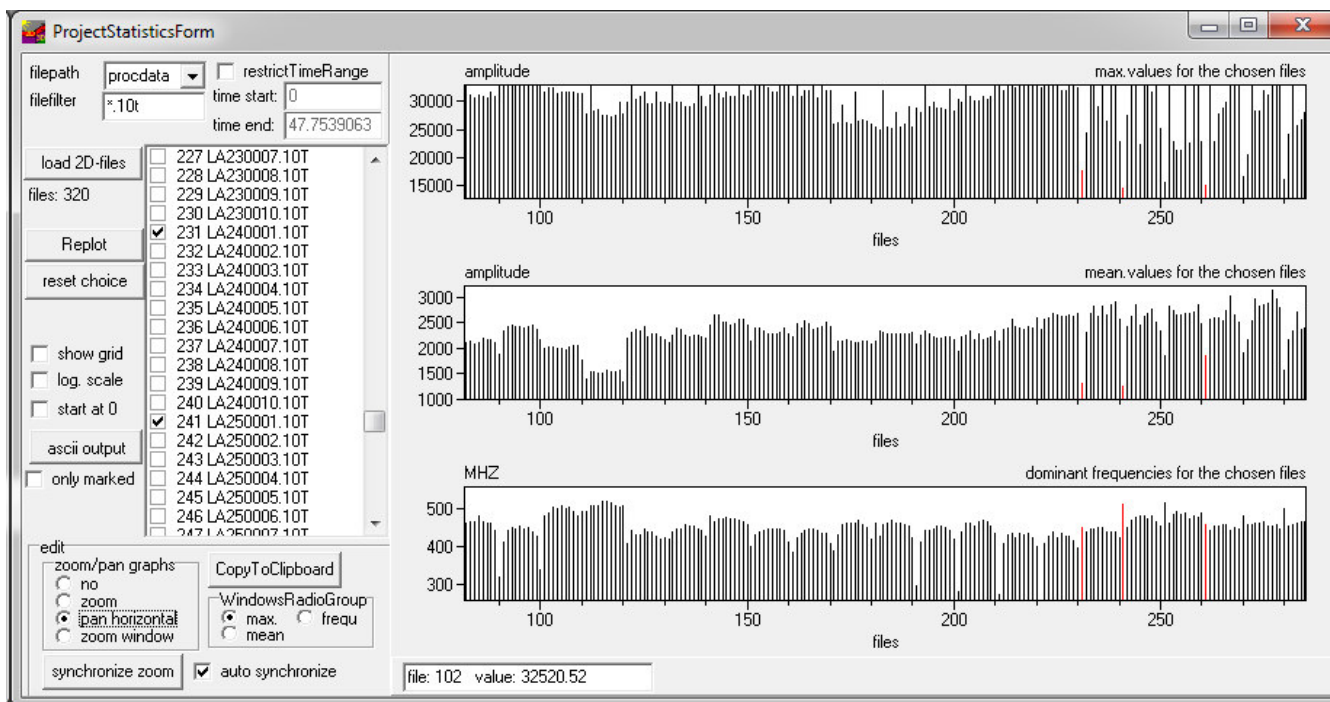
New option **batch start** - starts a batch processing of the actual processing step for a selectable number of profiles. The actual settings are used for the processing. Some processing steps which need the loading of secondary files are not supported equivalent to the sequence processing. Exceptions where only one secondary line will be needed:

processing step **insert profile**, **mix profile** and **replace**: here an additional character(s) is asked which will be automatically added to the actual filenames for the creation of the secondary lines which shall be inserted, mixed or replaced. Example:

actual filename: data_gps.00t - additional characters: _insert -> secondary file: data_gps_insert.00t

3. Analyse:

new option **2D-lines statistics** which opens a new window where a set of 2D-lines may be analysed in different ways. The window is also available from the 3D-datainterpretation module within the Generate 3D-file from 2D-lines menu. One useful application of the option might be a check of the energy homogeneity between the different 2D-lines, e.g. if an antenna array has been used for acquiring parallel 2D-lines. It also may serve as an overall overview about the amplitude distribution, e.g. before generating a 3D-datafile for which the datavalues should not exceed a value of 32000 (16 bit integer limitation).



The option allows to analyse the maximum and the mean of individual 2D-lines as well as the dominant frequency. The values will be displayed in different windows and may be marked either with the list box or by using the right mouse key in any of the value windows. The marked lines will be displayed in red in all windows and are checked within the listbox. The option **reset choice** resets all markings.

Zooming and panning is available. With **zoom** activated enables both to increase and to decrease the magnification factor of the graph. With the left mouse button pressed and held down moving to the left and/or bottom decreases the magnifications and moving to the right and/or top increases the magnification. With **pan horizontal** activated the data display can be panned by pressing and holding the left mouse button. The data image will then follow the mouse movement. The panning is only done in x-direction (file number). With **zoom window** activated a zoom range may be defined. For this purpose press and hold down the left mouse button at one of the corners of the intended region. Thereafter a rectangle follows the mouse cursor indicating the region to be zoomed. Releasing the left button selects this region and the zoom region has been defined. A zooming in y-direction (amplitude) will be automatically reset when marking any line. Activating **no** resets all zooming and panning.

The analysis of the files may be exported to an ASCII file using the option **ascii output**. With the option **only marked** activated only the analysis of the marked files will be saved.

It is possible to restrict the time range for the analysis using the option **restrict TimeRange** and by entering the wanted time start and end values.

By default the y-axis starts at the minimum value. Activating **start at 0** sets the starting point for all windows to 0. The option **show grid** allows to display a grid. If **log. scale** is clicked a logarithmic scale will be used for the y-axis.

The option **CopyToClipboard** enables you to copy any of the windows to clipboard. The WindowsRadioGroup controls which window will be copied.

The option **synchronize zoom** enables to synchronize the actual zoom of one window for the other windows. The WindowsRadioGroup controls which window will be used for the synchronization. If the option **auto synchronize** is active the synchronization is automaticall done for zooming and panning (not for zoom window).

4.view

profile line (traceheader coord.): new option **view single points** - if activated the profile line will not displayed as a line but as single points. Activating the option might be useful in order to check for irregularities within the traceheader coordiantes, e.g. looking for jumps due to an inaccurate gps signal.
new option **InterchangeXY** for the **DXFExport** - if activated the xy-coordinates will be interchanged for the export. This might be usefo for example if the latitude has been stored on the x-coorindate and no utm conversion shall be done.

Core data - now also available as speed button named core together with an option named **auto** which allows analogous to the option within the global settings menu to automatically load a corefile with the same filename as the primary file except the extension saved under ASCII under the project directory..

5. Edit fileheader:

Now the **time range** will be displayed within the time specification panel.

The **utm zone** which has been automatically used for the UTM-conversion will be displayed and may also be changed within the coordinates panel.

6. Edit several Fileheaders:

new options **smooth xy-coord.** and **smooth z-coord.** - if activated the xy- and/or z-traceheader coordinates are smoothed over the range given within the **smooth** parameter.

Option **topography (x,z values)** now also available within the edit several fileheaders menu under UpdateTraceHeadersBox.

7. traceheader menu

new update types IDS-GEC and DB-GPS

IDS-GEC - xyz local or utm coordinates for the whole swath. Example:

```
<VERSION>
07.00.000
<OFFSET_GPS_ARRAY_XYZ>
0.13,0.42,0
<UTM_ZONE>
32,1
<REFERENCE_XYZ> converted longitude, converted latitude
```

```

512941.685563995,5290630.10008273,433.657
<REFERENCE_LLA>
0,0,0
<XCELL>
0.0416389
<VALID_MARKERS_SWEEP>
69
1,0,0,512941.685563995,5290630.10008273,433.657,32,1
8,0,1.59999999999854,512941.370795237,5290630.019358,433.667,32,1
.....

```

DB-GPS example:

```

TimeTick-Korrekturwerte:      63629766824000000    10000
km          Scan  Latitude Longitude      Höhe  TimeTick
85,805  1      5211,6893871  842,4050947  109,361 63629766825500000
85,815  204    5211,6865581  842,3970449  109,354 63629766832100000
85,825  402    5211,6839247  842,3895242  109,353 63629766834700000
.....

```

8. CMP processing:

geometry: new suboption **meandering** - activate this option if the receivers are acquired meandering - start and end coordinates are flipped for each 2. shot

9. Pick:

new option **auto** belonging to the option **control** - if activated double picks will be automatically ignored.

10. Layershow:

create report:

new buttons "s" and "g" which allow to save and load the actual settings on the file LayerShowReportParameters.txt stored under the program directory.

Option **only construction data** available together with activated option **summary comment data**.

New option **for several lines** in combination with the option batch create - if activated the batch create is done for several profile lines using the layershow with the same filename like the profile.

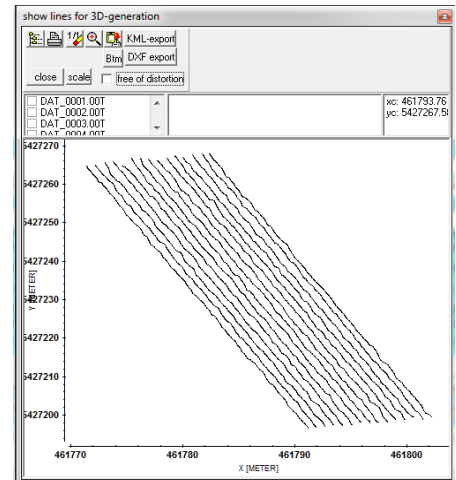
11. Velocity analysis:

core: now also the **thicknesses** may be changed. These are displayed within the edit box named angle for the other types of interactive velocity analysis. Changing the thicknesses might be useful for updating a core data file for topographically corrected data.

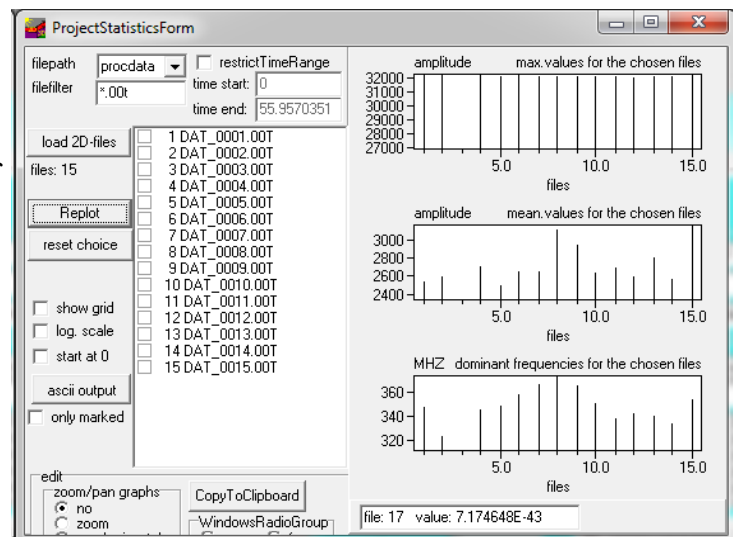
II. 3D-datainterpretation

New options **2D-lines statistics** and **show lines** within the Generate 3D-file form 2D-lines menu.

Show lines: displays the xy-geometry of 2D-lines currently loaded



2D-lines statistics: opens a new window where the currently loaded 2D-lines may be analysed in different ways. One useful application of the option might be a check of the energy homogeneity between the different 2D-lines, e.g. if an antenna array has been used for acquiring parallel 2D-lines. It also may serve as an overall overview about the amplitude distribution, e.g. before generating a 3D-datafile for which the datavalues should not exceed a value of 32000 (16 bit integer limitation).



Now the **data scaling** value which will be used for the 3D-file generation will be saved within the project parm.tsl file.

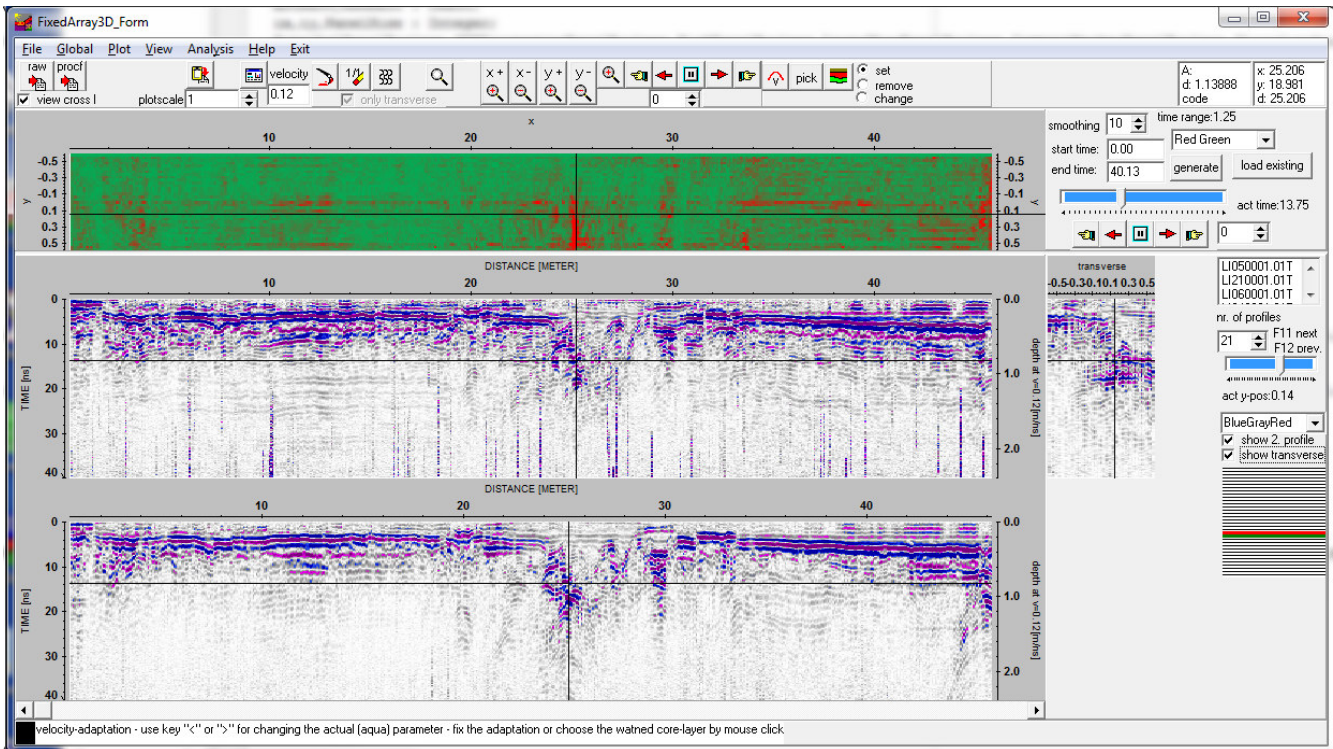
Shift palette for slices: new option - if activated the amplitude range for the color assignment of the point mode will be shifted to only positive values starting from 0 for slices and for the 3D-cube display. Thereby the full actual color palette is available for slices if these have been created using the envelope. The option is also active for the 3D-cube display. In this case the shifted color palette will be used for all cuts.

Scan3D:

new option **parallel y-scans with 2 diff. Polarizations** and new option **old IDS-system** for data format dt (IDS fixed array).

New import format **iprb (Impulse Radar)**

III. 3D-fixed array



New module which allows the interactive interpretation of multichannel data with a fixed lateral offset of the individual channels based on relative coordinates. The target of this module is the interpretation of data consisting of many traces into one direction, e.g. along a road and a relatively small number of datapoints perpendicular to it (number of parallel lines). An easy and fast calculation of timeslices without interpolation but including smoothing in time direction is incorporated. A fast interactive switch between the different lines and timeslices is possible either using the mouse (pressed right mouse key or using the scroll wheel) or using the trackbars.

Precondition for the use is:

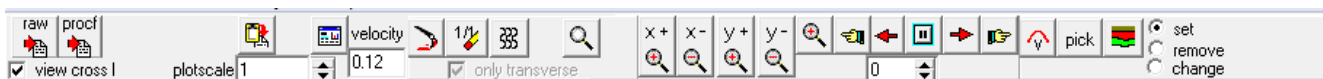
- identical timeincrement and number of samples of the individual 2D lines
- start time must be identical
- identical traceincrement and number of traces of the individual lines in profile direction
- the start coordinate in profile direction may be different for the individual 2D-lines
- energy normalization if necessary must have been performed before
- the filecoordinates must have been set correctly (start and end coordinates in profile direction and constant coordinate). This must have been done within a previous step, e.g. within the the 2D-dataanalysis module.

The program uses the constant perpendicular coordinate (start and end should be identical) in order to sort the chosen datafiles after ascending coordinates (perpendicular to the profile direction). The perpendicular coordinates do not need to be equidistant but the calculation of the timeslices does not take into account any different increments because no interpolation is done.

The max. number of parallel profiles is restricted to 128. The lines do not need to have been acquired within one step but these can even be acquired using a single channel system. The only need is that the coordinates have been set correctly before, e.g. within the 2D-dataanalysis.

In addition to these relative coordinates the traceheaders may contain the real, e.g. GPS-coordinates which may be distributed arbitrarily (see option view/profile line and view/gps map).

The options within the uppermost panel allow a fast access to the data.



caption raw: open REFLEX raw data (see also File MenuItem)

The second button changes according to the last settings to

caption proc: open REFLEX processed data (see also File MenuItem)

caption prof: open REFLEX processed data with filter (see also File MenuItem)

The caption is automatically updated when using one of the following options within the File MenuItem: open rohdata, open procddata, open procddata filter, import, open Second Line/rawdata or procddata or procddata filter



copy to clipboard



enter PlotOptions

plotscale: enter multiplication factor for the color-amplitude assignment or for the wiggle size

velocity: enter a velocity for the transformation of the time scale to a depth scale for the depth axis and for the layer image.



replot current line with current zoom parameters



resets the x- and y-scale values (zoomvalues) to 1 and replots the current line



enable magnifying glass function

Zooming may be done by the manual zoom or by stepwise zoom in x- or y-direction (options x+, x, y+ and y-). The zooming in time-(y-)direction is restricted to the upper part, this means the zoomed lines always starts at the overall start time. The timeslices will only be zoomed in x- (profile) direction.



enable zoom - The option x+ increases the zoom in x-direction by a factor of 2. The option x- decreases the zoom in x-direction by a factor of 2. The x-zoom acts both on the profile display and on the display of the timeslice. The option y+ increases the zoom in y-(time)direction by a factor of 2. The option x- decreases the zoom in y-direction by a factor of 2. The y-zoom only acts on the profile display and not on the display of the timeslice. With the option ZOOM an arbitrary area of the data set can be selected and plotted in full screen size. The area to be enlarged, a rectangle, has to lie within a data set. Pressing the left mouse button you determine a corner of this rectangle and by moving the mouse with pressed button the desired area is opened.



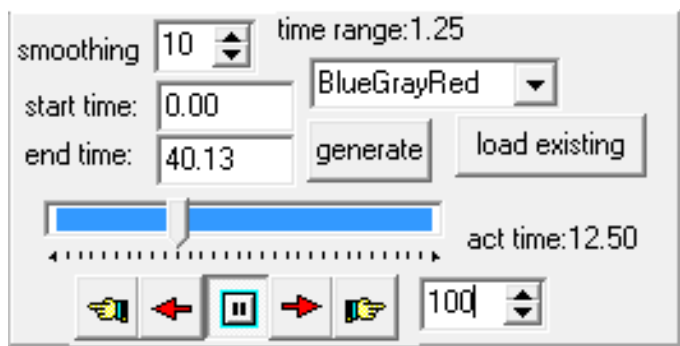
These options allow an automatic scrolling of the profile and the timeslice in x-direction if a zoom has been activated (scroll to the left, stop scrolling, scroll to the right). The spin

button located beneath the autoscroll options defines a delay factor in order to slow down the scrolling. Value 0 no delay - value 500 max. delay.

The profiles may also be displayed using the wiggle mode. The option **only transverse** restricts the wiggle display to the transverse profile.

After having loaded the 2D-lines the chosen filenames will be displayed within the listbox using the order of the sorting after the profile constant coordinates. The 2D-lines are also displayed within an image. The actual 2D-lines is marked in red, a possible secondary line in green. The actual 2D-lines may be changed using the trackbar, the spin edit or the keys F11 and F12 as well as the right mouse button within the timeslice window.

The neighbouring parallel profile may be viewed in addition (option **show 2. Profile**) as well as the the actual transverse line (option **show tranverse**). Within this panel there is also the possibility of changing the color palette for the 2D-lines.



The **timeslices** may be created once by entering the start and end time and a smoothing parameter (option **generate**). The increment between successive slices is identical to the timeincrement multiplied by the smoothing factor. The number of slices depends on the start/end time and this increment. The timeslices do not need to be generated for a further access if the same lines will be loaded for which the slices had been generated

before. For this purpose the option **load existing** must be pressed after having loaded the parallel lines.

A **scrolling** through the timeslices may be manually done using the arrow bars:

scroll one step to the lower or higher slices, autoscroll to smaller slices, stop scrolling, autoscroll to higher slices. A delay value may be entered in order to slow down the automatic scrolling.

The color palette for the timeslices may be chosen independently from that used for the profile display.

After having loaded the files and the timeslices there are several interactive possibilities to switch between the individual lines. The actual position within the profile and the timeslices and optionally within the 2. and tranverse profile are indicated by a large cross (option **view cross** activated).

A fast interactive change of the cuts is done by several mouse actions:

- the mouse wheel can be used in order to go through the lines or through the timeslices. For this purpose the right mouse button must be pressed once either within the timeslice or within the profile in order to set the focus to the timeslice or profile trackbar. The actual nr. of profile and the actual perpendicularar position (act y-pos) will be displayed as well as the act. time for the timeslice.

- Moving the mouse with pressed right button allows a direct synchronization of the related profile or timeslice.

The key F11 may be used to switch to the next profile and F12 to the previous one. This might be useful for picking within the 3D-picks mode (see below).



enters the velocity adaptation MenuItem. The left mouse button is used for the interactive velocity adaptation. The interactive velocity adaptation is analogous to that one of the 2D-dataanalysis except the missing of reflection, intercept time and vsp adaptation.

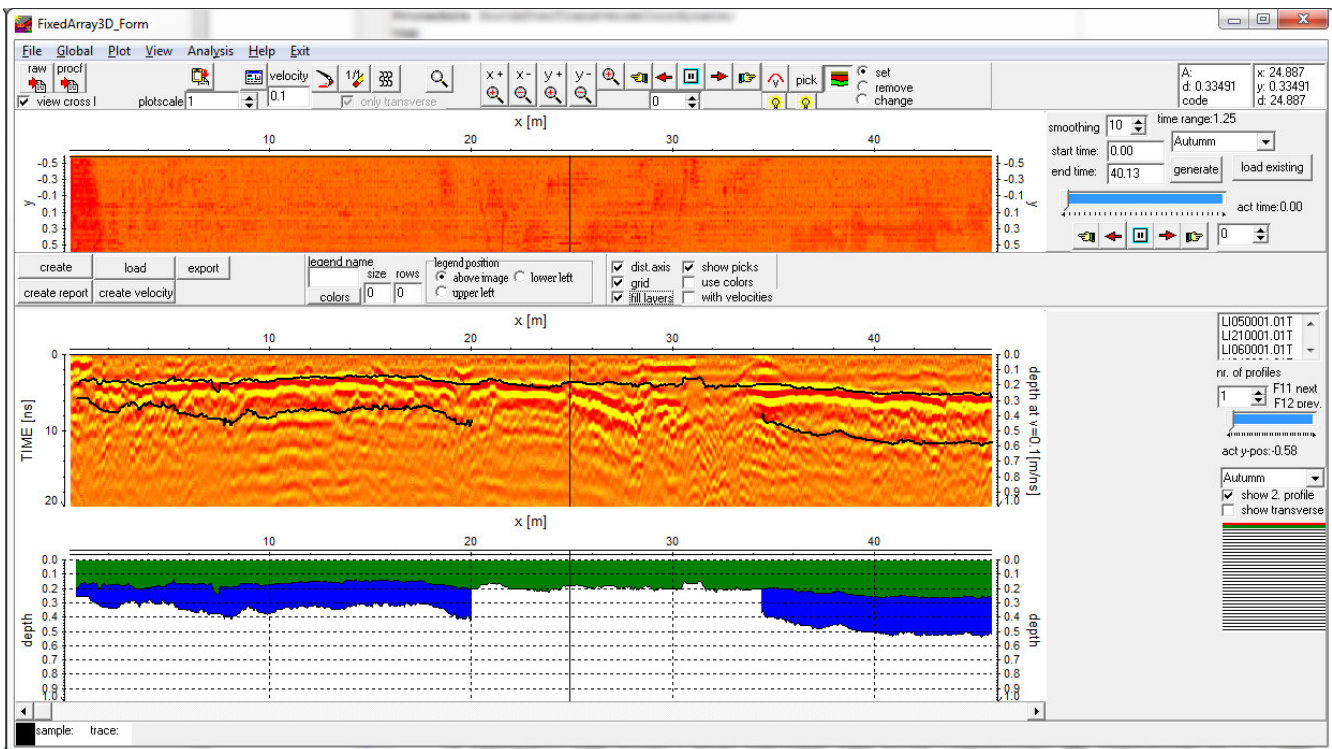
pick button:

Activating this option enters the Pick MenuItem. The picking is possible for one profile analogous to the 2D-dataanalysis. Picking is only possible within the working profile. For each profile a separate pickfile and layershow may be generated or one single pickfile for all parallel lines.

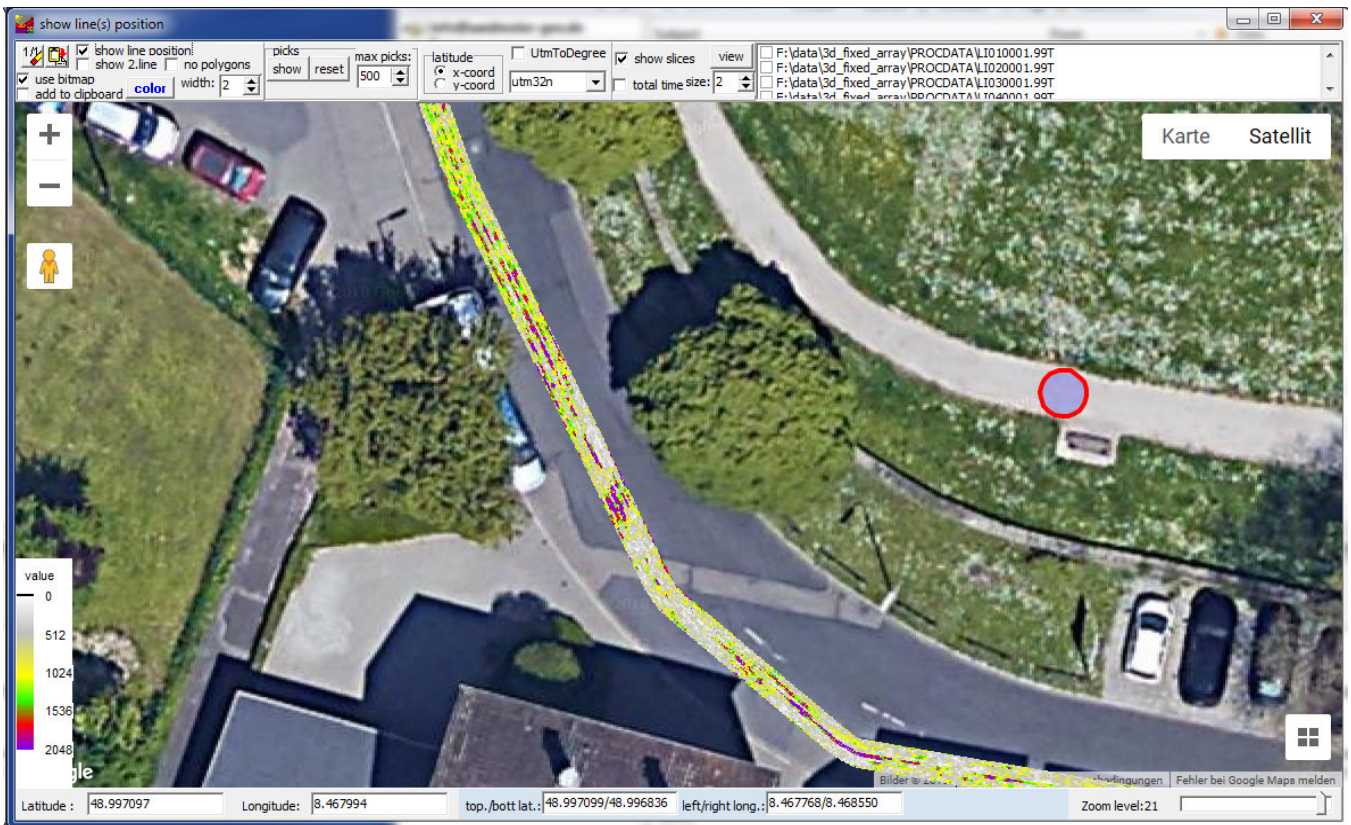
For the second case the option **3D-picks** should be activated. If this option is activated the picks are also displayed within the timeslice and only these picks belonging to the corresponding 2D-lines and to the actual timeslice will be displayed. Any change of the picks can only be done for the visible picks within the working profile window. The radio group **view all** allows you to display all picks either only within the timeslices (option slices active) or within the timeslices and the profiles (option all active). Analogous to the picking within the 2D-dataanalysis menu the code may be used for a distinction of picks belonging together. The keys F11 and F12 may be used for a fast switch between the different 2D-lines.



enter the LayerShow. The layer show options are analogous to those of the 2D-dataanalysis. The picks should have been generated for one single profile (pick option 3D-picks deactivated).



View/gps map:

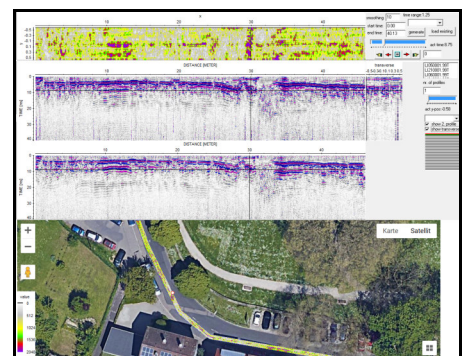


Activating this option allows to view the location of the profile lines and the actual timeslice within a Google Map. The **color** and the **width** of the lines may be adapted. Activating the option **show line position** allows to continuously show the actual mouse position by a red circle when dragging over the line. The option **UTMToDegree** allows to convert UTM-coordinates to degree values based on a given utm zone. The option **latitude** defines where the latitude coordinates have been stored within the traceheaders (x- or y-position). **Zooming** and **copy to clipboard** possibilities are included. The option **1/1** resets and centers the display.

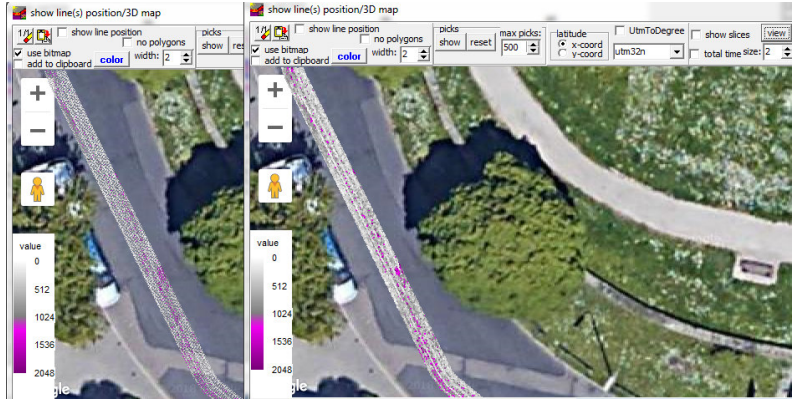
The display will also be automatically centered when using the zoom-option or when scrolling through the zoomed profile. The actual profile center will be displayed by a red circle.

The actual **picks** may be displayed (option **show**) using a red-green-blue color scheme for the icons with red corresponding to the smallest traveltime values and blue to the largest traveltime values. With picks activated only the outer profile lines will be displayed. The parameter **max. picks** controls the max. picks to be displayed. If the actual number of picks exceeds this number only every n. pick will be displayed. **Reset** resets the pick display. The option **use bitmap** will be automatically activated and the color scheme for the pick traveltimes will be displayed at the left lower border. With the pick option continuous pick activated the picks will be updated each time the continuous pick is interrupted (mouse button released).

add to clipboard: if activated the gpsmap will be added to the clipboard if started within the Fixed3DArray. For this purpose the option **use bitmap** must be active. This option generates an internal bitmap copy of the gps map which is necessary for any superposition of other bitmaps like the actual timeslice.



The actual **slice** may also be displayed within the gps map (option **view** within the slice panel). The option **use bitmap** will be activated automatically. The slice will be displayed using the traceheader coordinates. Each datapoint will be represented by one pixel. The option **size** allows to increase the size of the display. This is necessary if the zoom level is too high in order to ensure a complete filling.



IV modelling

New processing status window when a statistically distributed model will be displayed using the option fill.

New option **Resize based on free of distortion** under plot - changes the window size in such a way that the x- and z-axis of the model are free of distortion.

New option **repl.by.ad.** within the edit current layer box which allows to replace the actual layer with the same layer of the loaded additional model.