AGS Aarhus GeoSoftware

Importing and using inversion results from Res2DInv and Res3DInv in Aarhus Workbench

This is a guide on how to export inversion results from Res2DIna and Res3DInv for use in Aarhus workbench, and to how the results can be imported and used in Aarhus workbench

Contents

Global coordinates

To make full use of the features in Aarhus Workbench it is necessary to include global coordinates in the .dat files prior to inversion. These coordinates ensure that the inversion results are located correctly on the GIS map, and that the individual inversion results as well as additional information, such as boreholes, are located correctly relatively to each other.

It is recommended to use a coordinate system where the positions are given in meters, such as the UTM system. It is important to note the UTM zone and datum of the coordinates in the .dat files as these must be specified when importing the inversion results in Aarhus Workbench.

Coordinates are included in the .dat files in different ways for Res2DInv and Res3DInv:

Res2DInv

In Res2DInv the coordinates are entered at the end of the file as seen in the example below, see section 7.11 of the Res2DInv manual for further details.

```
4       235.00        4.82       355.00        7.41       305.00        8.33       315.00        8.44      138.0700
4       235.00        4.82       355.00        7.41       315.00        8.44       325.00        8.28      134.3600
4       235.00        4.82       355.00        7.41       325.00        8.28       335.00        8.00      138.9900
4       235.00        4.82       355.00        7.41       335.00        8.00       345.00        7.72      138.6200
0 Indicating no topography information in this case
Global Coordinates present
Number of coordinate points
17 Number of coordinate points
Local Longitude Latitude Header line
   85.00    572088.12   6222426.57 X-coordinate along profile, Longitude/UTMX, Latitude/UTMY
   90.00    572088.28   6222421.58
  110.00    572088.91   6222401.60
  115.00    572089.07   6222396.61
  120.00    572089.23   6222391.62
  125.00    572089.39   6222386.66
  160.00    572090.50   6222351.66
  165.00    572090.66   6222346.67
  170.00    572090.82   6222341.68
  175.00    572090.98   6222336.68
  200.00    572091.77   6222311.72
  205.00    572091.93   6222306.74
  250.00    572093.36   6222261.85
  255.00    572093.52   6222256.88
  260.00    572093.67   6222251.91
  325.00    572098.11   6222187.28
  355.00    572100.26   6222157.44
0 End of file
```

Last data lines, or end of topography section

Header indicating global coordinates

Res3DInv

In Res3DInv there are two options for including global coordinates:

1. Use the actual UTM coordinates in the electrode definitions and data sections of the file. This is the recommended method as is has less possibilities for coordinate transformation errors.
2. Add the coordinates at the end of the file in the same way as for Res2DInv, see the example below.

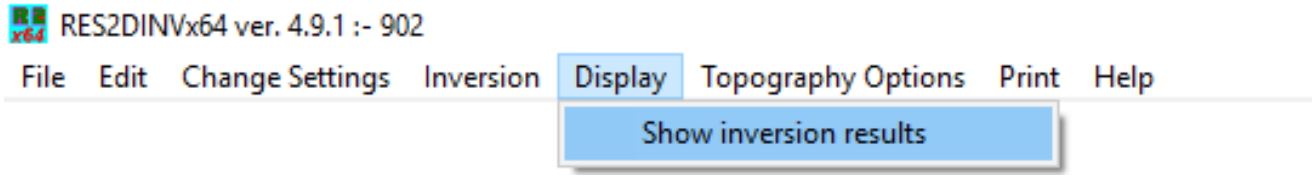
```
   20.000,    6.000   10.000,    6.000   30.000,    6.000   40.000,    6.000    31.263
   12.000,    6.000    0.000,    6.000   24.000,    6.000   36.000,    6.000    27.378
   14.000,    6.000    2.000,    6.000   26.000,    6.000   38.000,    6.000    29.334
   16.000,    6.000    4.000,    6.000   28.000,    6.000   40.000,    6.000    31.759
Global coordinates information present Header indicating global coordinates
Type of global coordinates information (0=point-to-point) Header indication type of global coordinates
0 Currently 0 (point to point) is the only option
Number of points
4 Number of coordinate points
                Local x-y                       Global x-y
         0.0000,         0.0000          2390137.00,       4686631.00 Local X-Y coordinates and
         0.0000,         6.0000          2390137.00,       4686637.00 UTMX-UTMY coordinates
        40.0000,         6.0000          2390177.00,       4686637.00
        40.0000,         0.0000          2390177.00,       4686631.00
0 End of file
0
0
```

Last data lines, or end of topography section

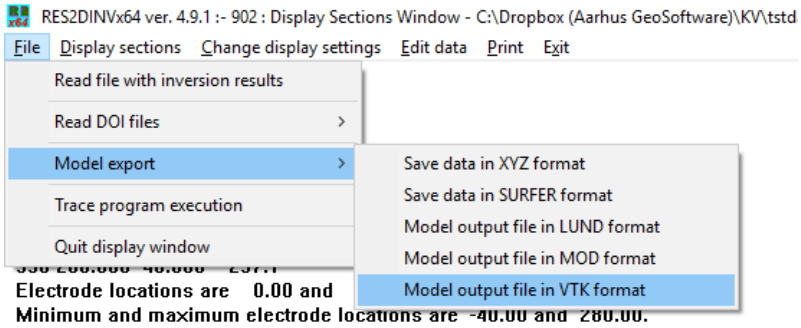
Exporting inversion results from Res2Dinv and Res3Dinv

Res2DInv

The format for transferring inversion results from Res2DInv to Aarhus Workbench is the VTK file. To export a VTK file containing inversion results from Res2DInv, open Res2DInv and select ‘Display -> Show inversion results’:



This will open the Res2DInv display window. Now select 'File -> Read file with inversion results' and select the .inv file created by the inversion. If the inversion has just been carried out the .inv file will be loaded automatically. Once the reading of the .inv file have been completed select 'File -> Model export -> Model output file in VTK format'



You will then be prompted to select which iteration to export, and where to save the files.

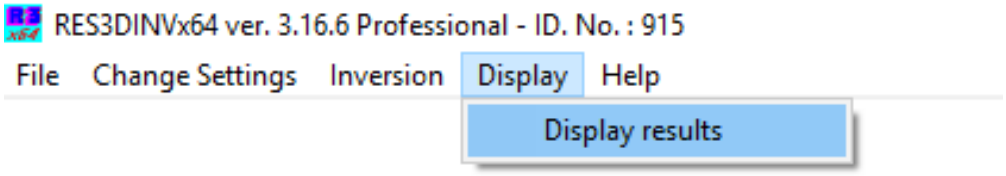
If the inversion result contains global coordinates, four files will be exported: "xxx.vtk", "xxx_Elec.vtk", "xxx_global.vtk" and "xxx_global_Elec.vtk", where xxx is the file name selected by the user (the default is the name of the .inv file).

The "xxx_global.vtk" and ""xxx.vtk" file holds the inversion results and are the ones that are imported into Aarhus Workbench, always use the "_global" version to have the inversion model located correctly.

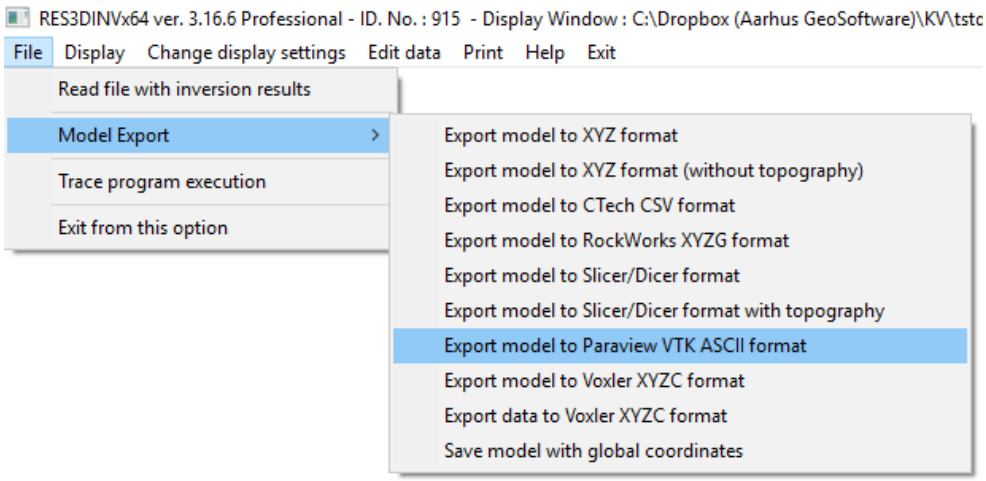
The "xxx_global__Elec.vtk" and "xxx_Elec.vtk" file includes the electrode positions and can also be imported into Workbench for displaying the electrode positions in the 3D Viewer.

Res3DInv

The format for transferring inversion results from Res3DInv to Aarhus Workbench is the VTK file. To export a VTK file containing inversion results from Res3DInv, open Res3DInv and select 'Display -> Display results':



This will open the Res3DInv display window. Now select 'File -> Read file with inversion results' and select the .inv file created by the inversion. If the inversion has just been carried out the .inv file will be loaded automatically. Once the reading of the .inv file have been completed select 'File -> Model Export -> Export model to Paraview VTK ASCII format'



You will then be prompted to select whether to export resistivity or conductivity values, which iteration to export, and where to save the files.

If option one for adding coordinates to 3D .dat files is used two files will be exported: “xxx.vtk” and “xxx_Elec.vtk”, where xxx is the file name selected by the user (the default is the name of the .inv file).

The “xxx.vtk” file is the one that includes the inversion model and is used for import to Aarhus Workbench. The “xxx_Elec.vtk” file includes the electrode positions and can be imported into Workbench 3D Viewer for displaying the electrode positions in the 3D Viewer.

If option two for adding coordinates to 3D .dat files is used four files will be exported: “xxx.vtk”, “xxx_Elec.vtk”, “xxx_global.vtk” and “xxx_global_Elec.vtk”, where xxx is the file name selected by the user (the default is the name of the .inv file). In this case always import “xxx_global.vtk” to Aarhus Workbench.

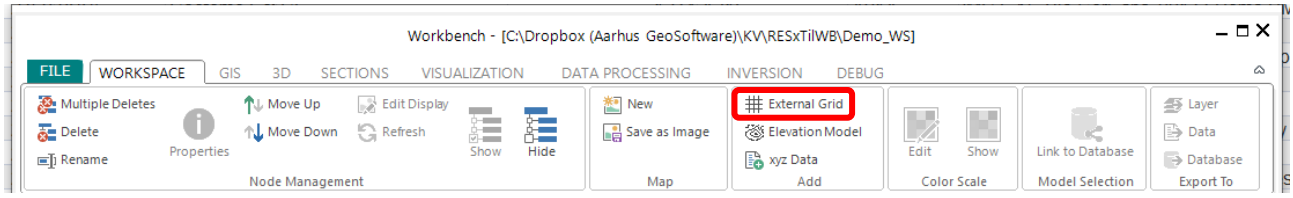
Importing and using Res2Dinv and Res3DInv inversion results in Aarhus Workbench

Aarhus Workbench help pages

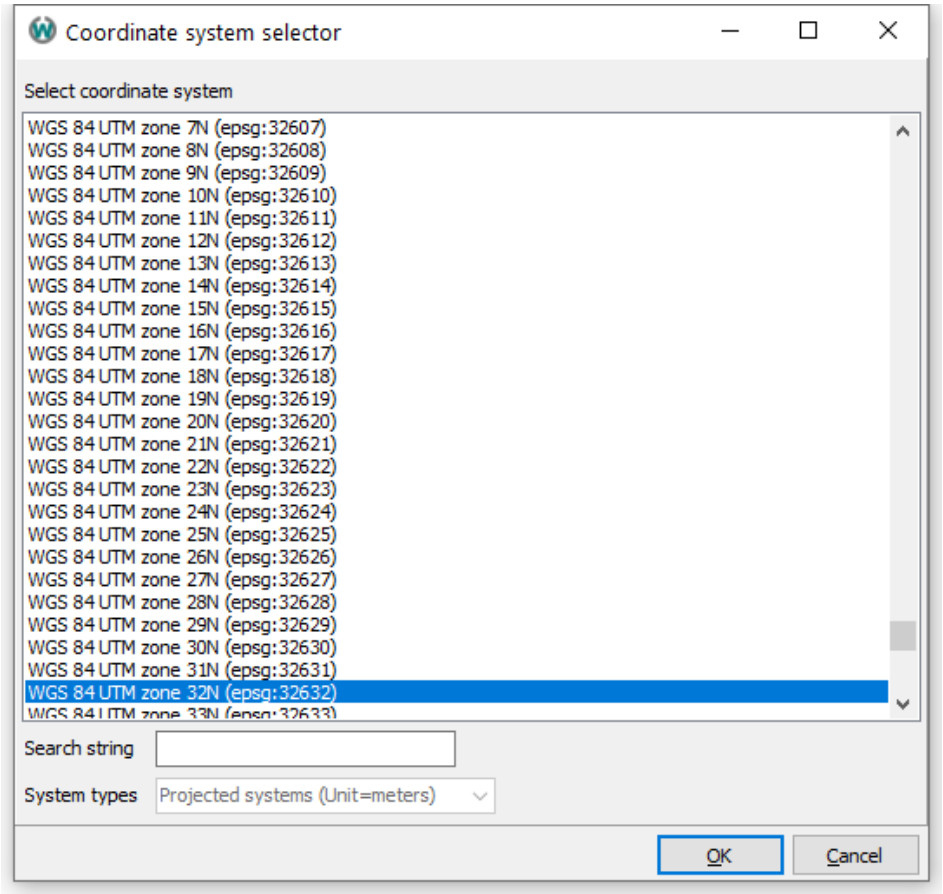
Note that in most parts of Aarhus Workbench it is always possible to press the “F1” key to be taken to the relevant page in the online help wiki: http://www.ags-cloud.dk/Wiki/Workbench

Importing inversion results

After opening the workspace navigate to the ‘WORKSPACE’ ribbon and select ‘External Grid’

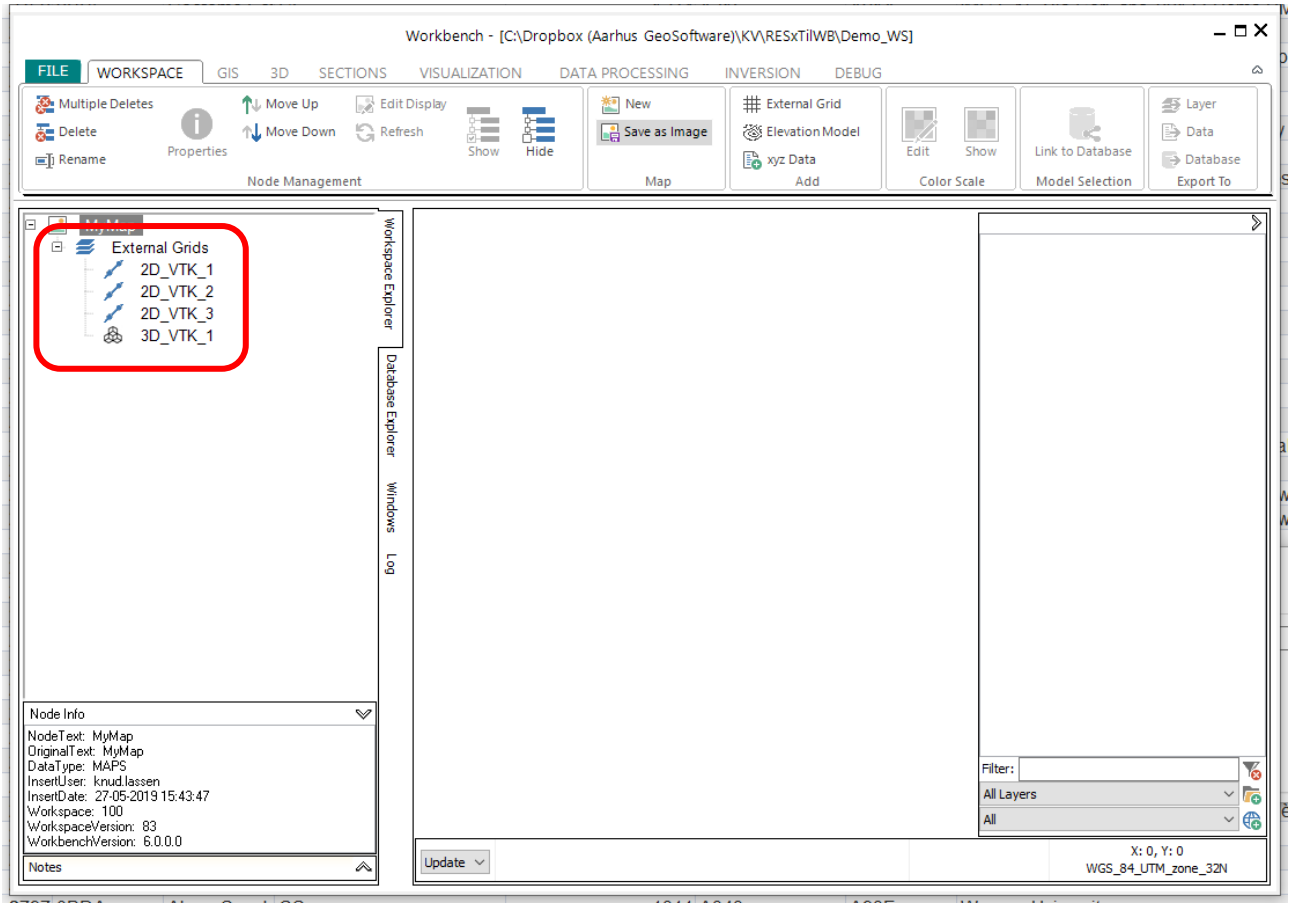


Select the VTK file from Res2/3DInv and select ‘Open’, provide at name for the imported inversion result when prompted and select ‘OK’, select the coordinates system when prompted:



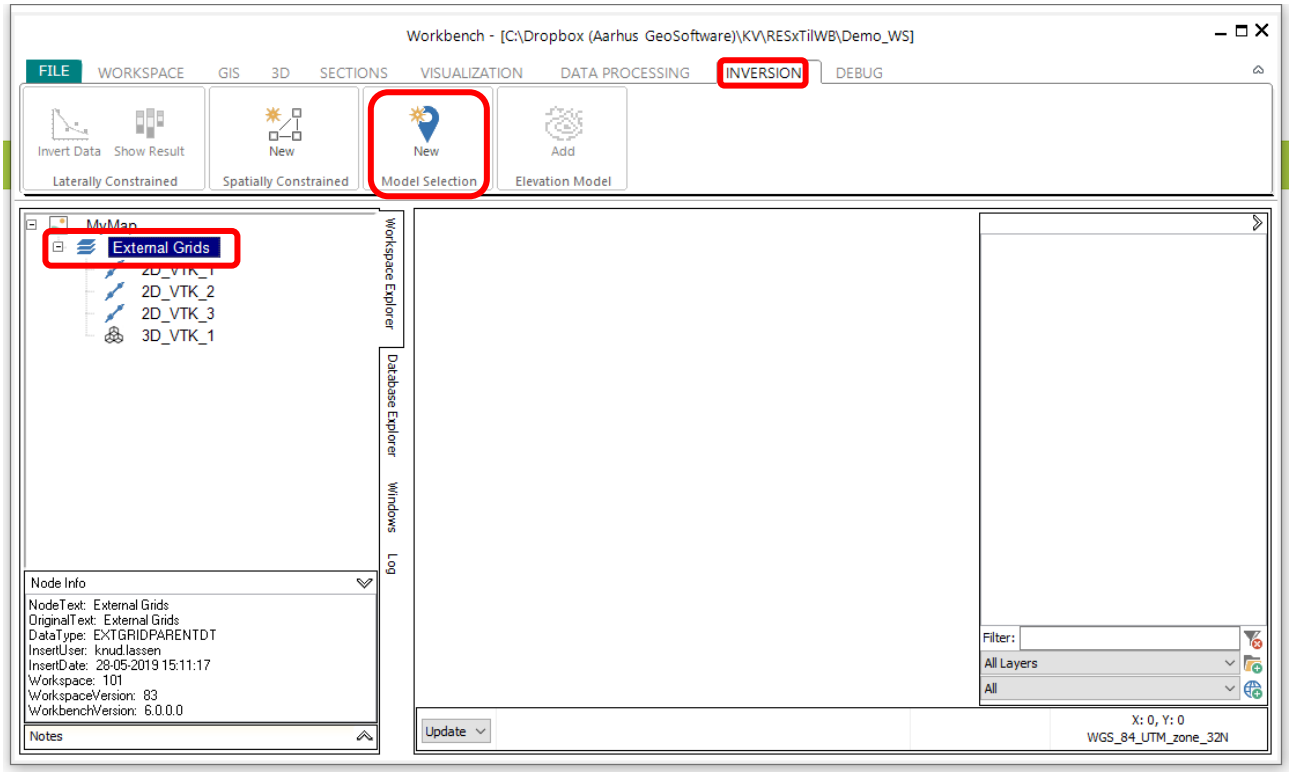
This must be the same as coordinate system as the global coordinates entered in the .dat file prior to inversion. Repeat this for all the VTK files you wish to import in the workspace.

Once imported the grids/VTKs/Inversion results will show up in the workspace explorer under ‘External grids’, in the below example three 2D inversions and one 3D inversion have been imported:



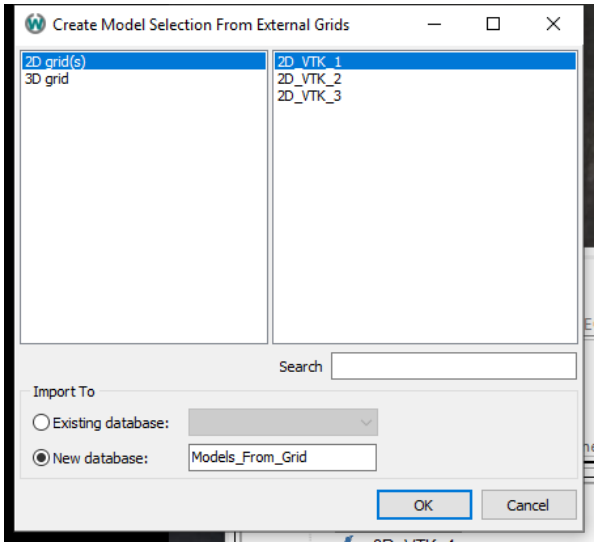
Creating model selections

In order to further work with the imported inversion results they must be turned into model selections. To do this navigate to the 'INVERSION' ribbon, highlight the 'External Grids' group in the workspace explorer and select 'New Model Selection':

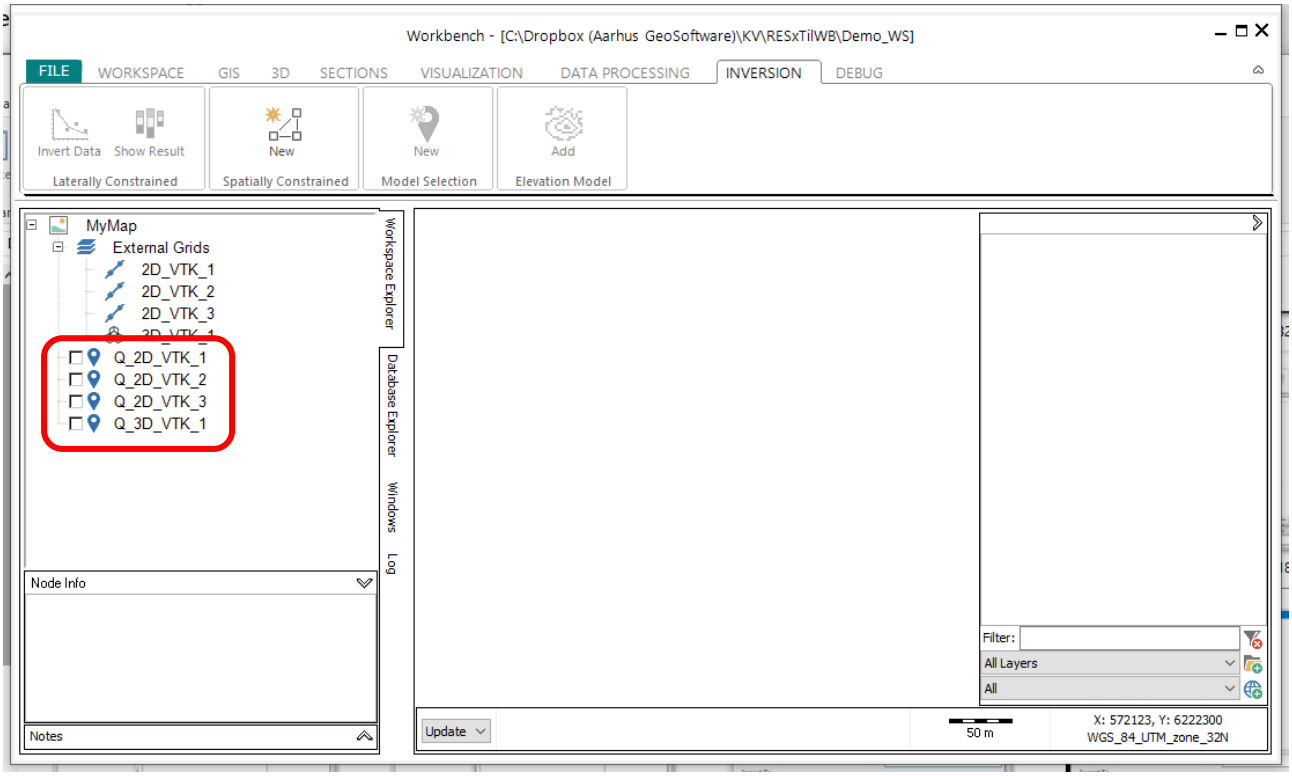


In the new window select which grid to turn into a model selection, it is possible to select more than one grid at a time by holding down the 'Ctrl' or 'Shift' key while selecting the grids.

Whether to create one big model selection for all inversion results, or several smaller model selections for each inversion result, depends on which visualizations are to be made. For drawing profiles, it is easier to have one models selection for each inversion result, but to make horizontal maps, like mean resistivity maps, all results must be in the same model selection. It is usually a good idea to keep all imported inversion results in the same database:



Once the model selections have been created, they are found in the Workspace explorer:

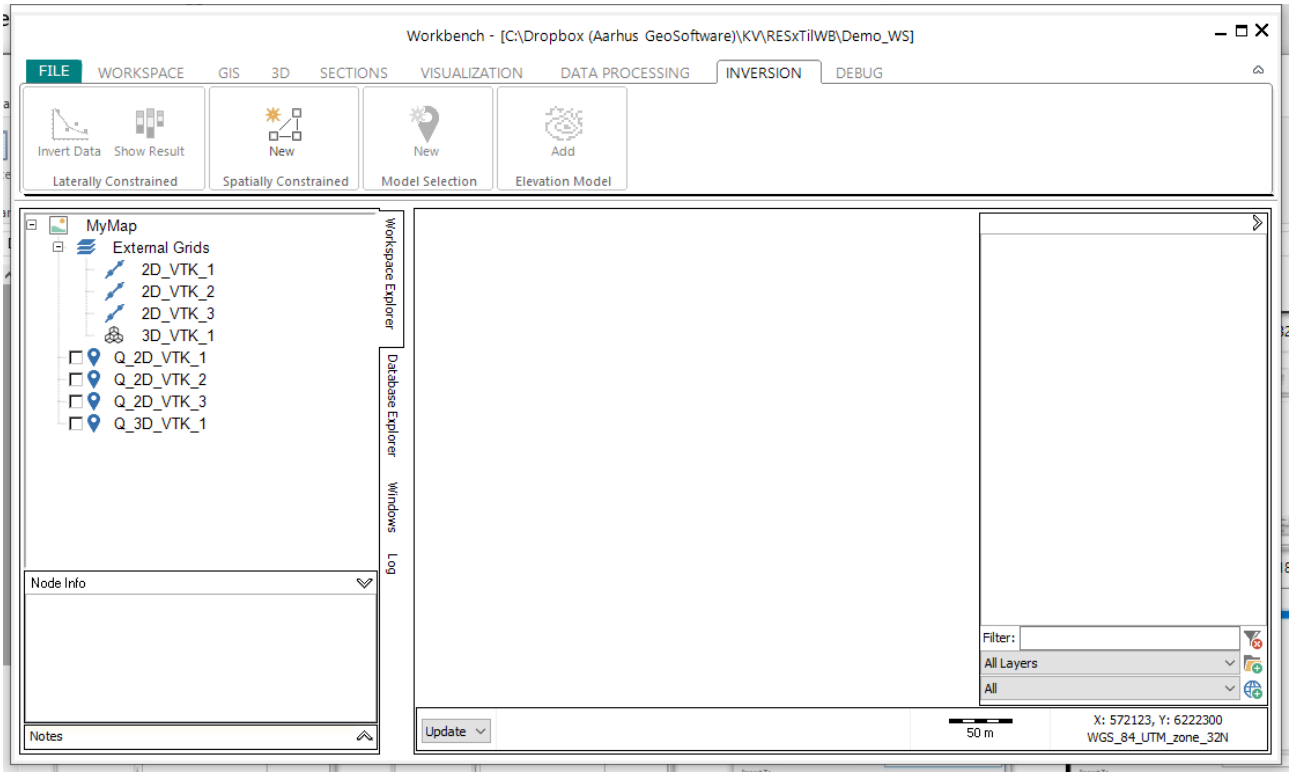


Once model selections have been made for all imported inversion results it is possible to do nearly the same things with the results as with inversions carried out with Aarhus Workbench. It is off course also possible to add more inversion results later. In the following a few examples of what can be done with the inversion results in Aarhus Workbench are demonstrated:

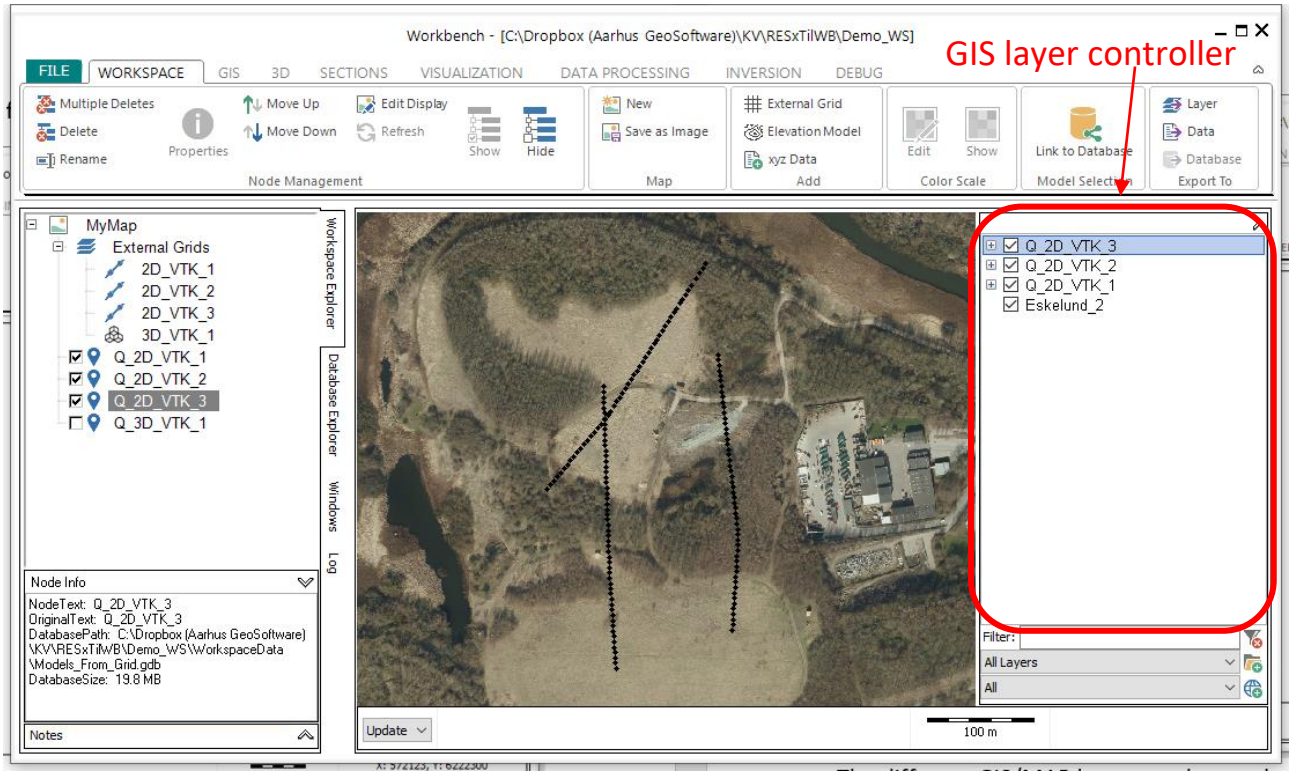
- Adding a background map and plotting the location of inversion results on a map (p. 8)
- Creating profiles showing the inversion results, possibly together with other data types such as borehole data or logs (p. 10)
- Creating horizontal mean resistivity maps, and other horizontal maps based on inversion results (p. 12)
- Visualizing results in the 3D viewer (p. 16)
- Creating PDF reports using the report tool (p. 18)

Adding a background map and plotting the location of inversion results on a map

Background maps and other GIS layers are added by selecting the “open folder” button at the lower right corner and selecting the file in the window that opens, The supported formats
are: .tab, .mif, .shp, .tif, .jpg, .jp2, .ecw and .kml:



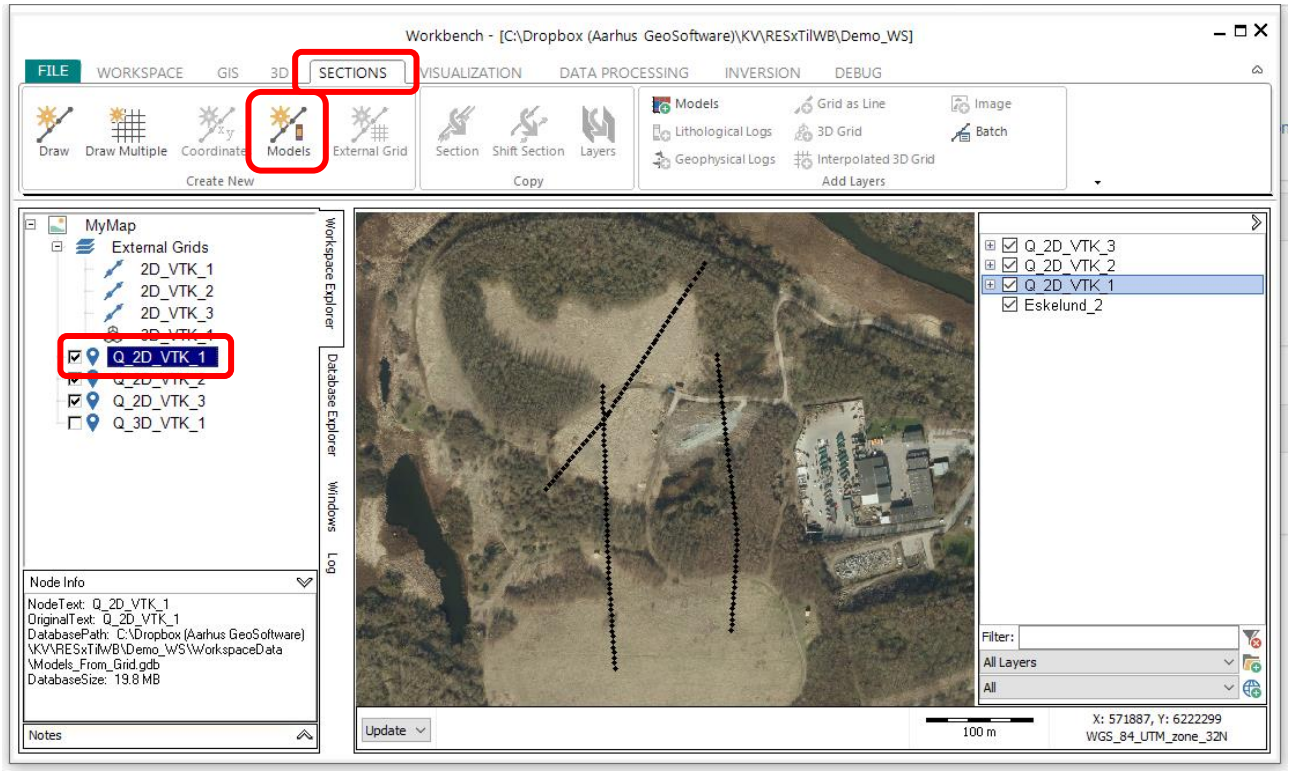
The different GIS/MAP layers can be toggled on and off in the GIS layer controller to the right on the screen, it is also possible to edit the order of the layers by dragging and dropping the layers in the GIS layer control. To add the locations of the models in the model selections to the GIS map check the checkbox next to the model selection in the Workspace Explorer, here an aerial photo and the three imported 2D inversions are shown on the map:



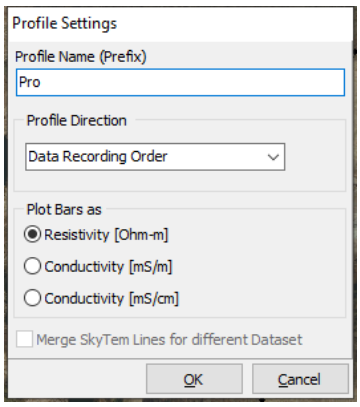
It is also possible to use a web map service (WMS) as a background map instead of an offline image file, to do this select the little globe in the lower right of the screen and either select the default WMS or press "F1" for further instructions.

Creating profiles from inversion results

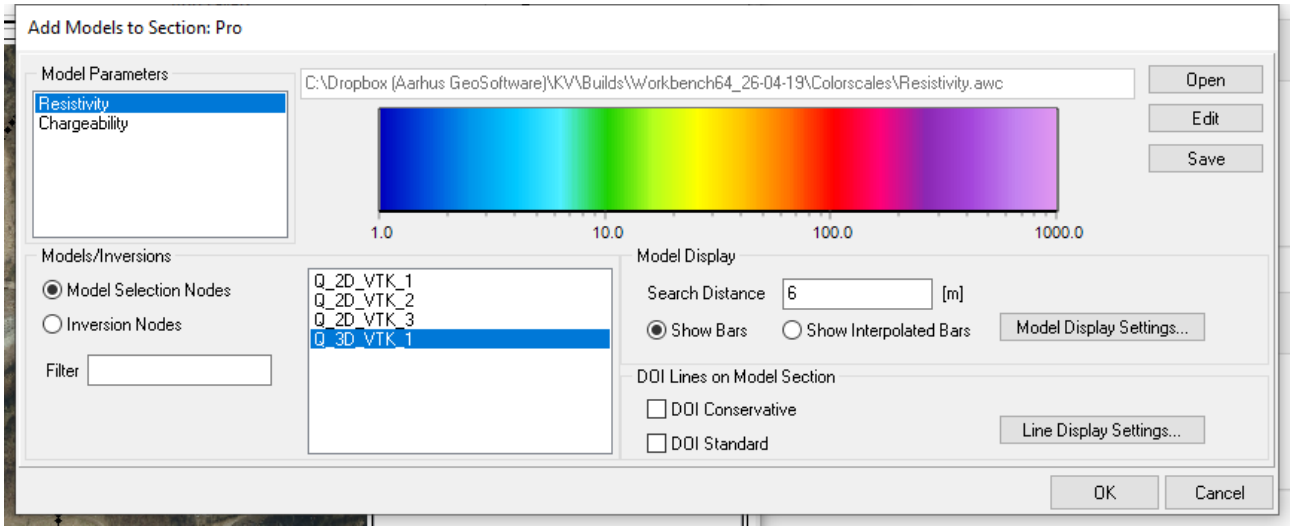
In Aarhus workbench a profile/section is the main way of displaying a 2D inversion result, to create a section from a model selection highlight the model selection in the Workspace Explorer, navigate to the 'SECTIONS' ribbon and select 'Models' in the 'Create New' group:



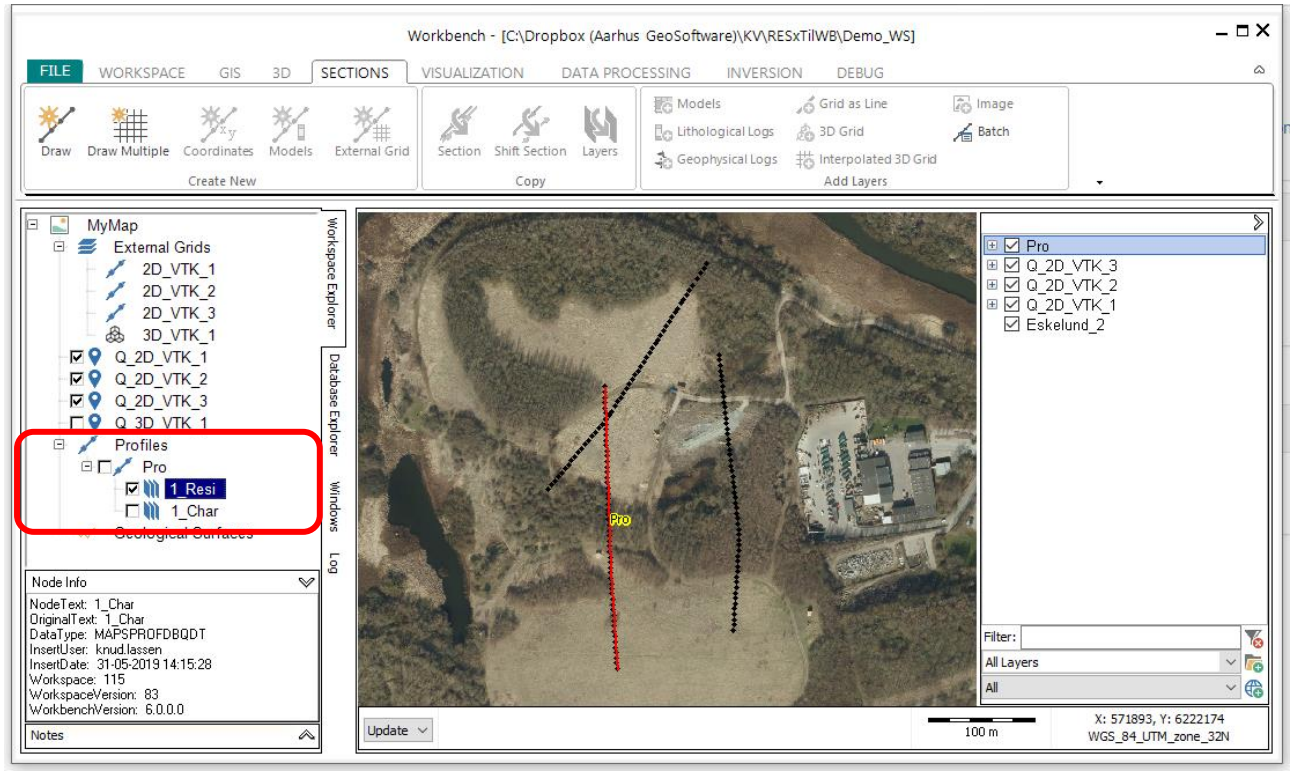
In the new window select the name and direction of the profile, as well as whether to plot results in resistivity or conductivity:



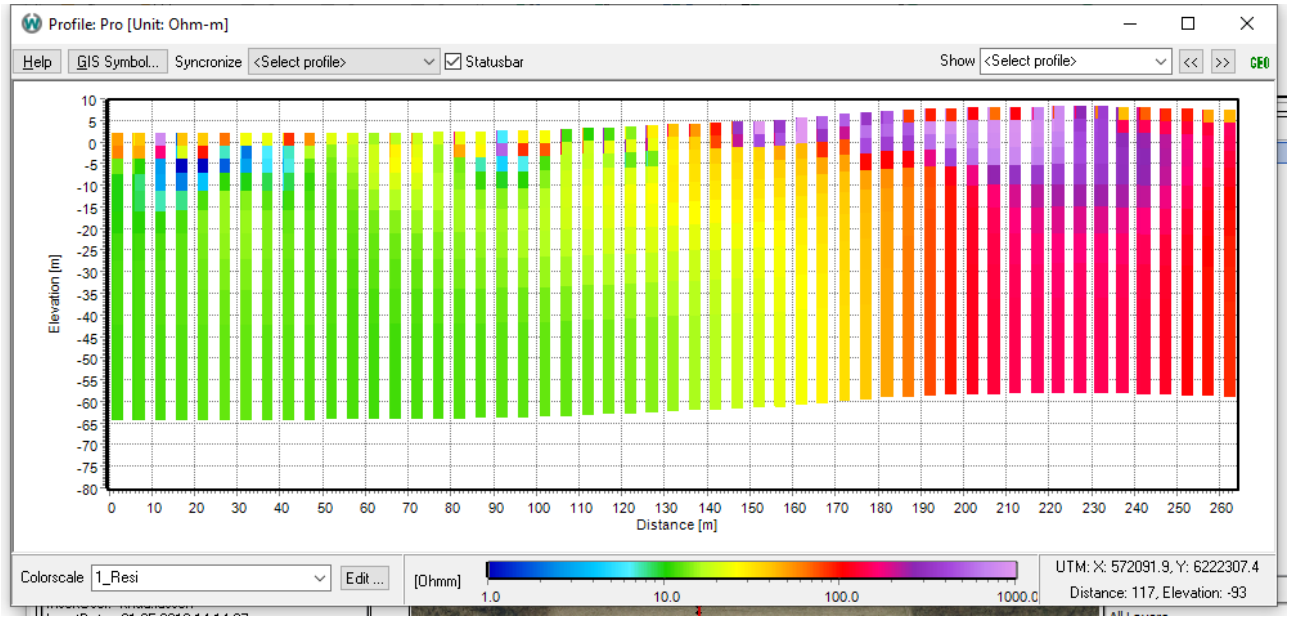
In the next window select from which model selection to add models to the profile, specify the color scale for the different parameters (resistivity and possibly chargeability) and whether to select the models as bars or interpolated sections:



Once the profile is created it can be found in the workspace explorer under 'Profiles', the different parameters can be toggled on and off under the individual profiles:



To display the profile, check the checkbox next to it in the 'workspace explorer':



It is also possible to draw "freehand sections" and adding models, boreholes etc. to them afterwards. To do this select 'Draw' in the 'Create New' group instead of 'models ', and draw the section in the GIS map. To add content to the drawn section, highlight the profile in the 'Workspace Explorer' and select either 'Models', 'Lithological logs' or 'Geophysical Logs' in the 'Add layers' group. It is now possible to select a search radius defining what is added to the profile, this is especially useful for creating 2D profiles from 3D inversion results.

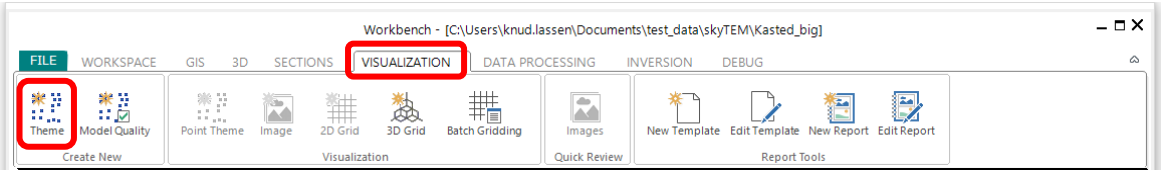
For information about how to import lithological and geophysical logs please refer to the online help pages: http://www.ags-cloud.dk/Wiki/Workbench.

Creating horizontal mean resistivity maps, and other horizontal maps based on inversion results

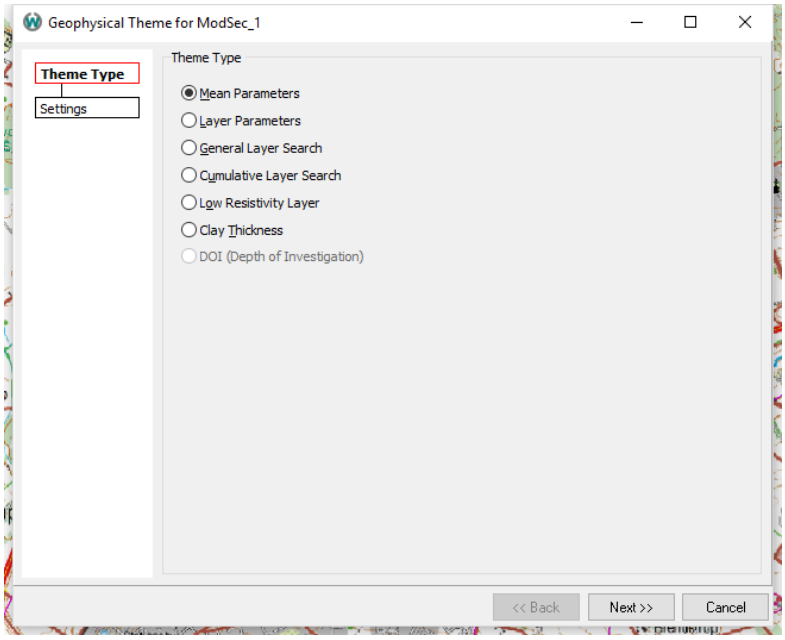
Themes are the tool for visualizing results on the map e.g. the mean resistivity of a given depth interval, the depth to a good conductor, the resistivity of the third layer in the model, or thickness of a body with a given resistivity.

A theme contains these values in the discrete points at which the models are located, they can be visualized either as colored icons at these points (See: Point themes) or as surface covering interpolated grids (See: 2D grids).

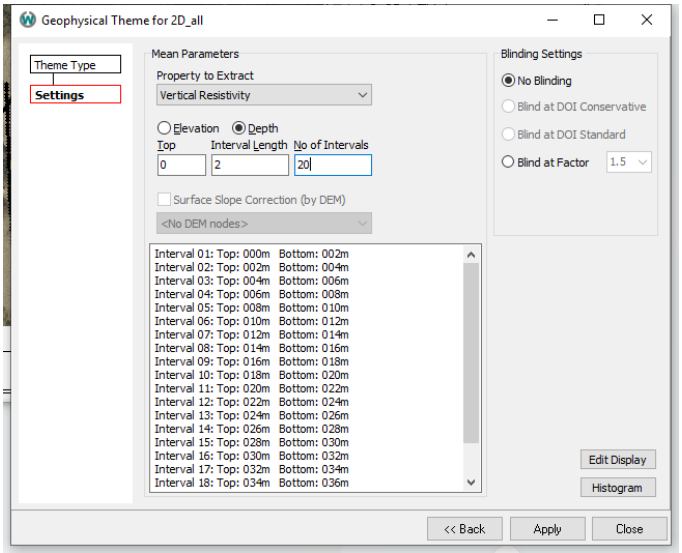
A theme is created from a model selection. After creating the model selection, the actual theme can be created by highlighting the model selection in the workspace explorer and selecting "Theme" in the "Visualization" ribbon:



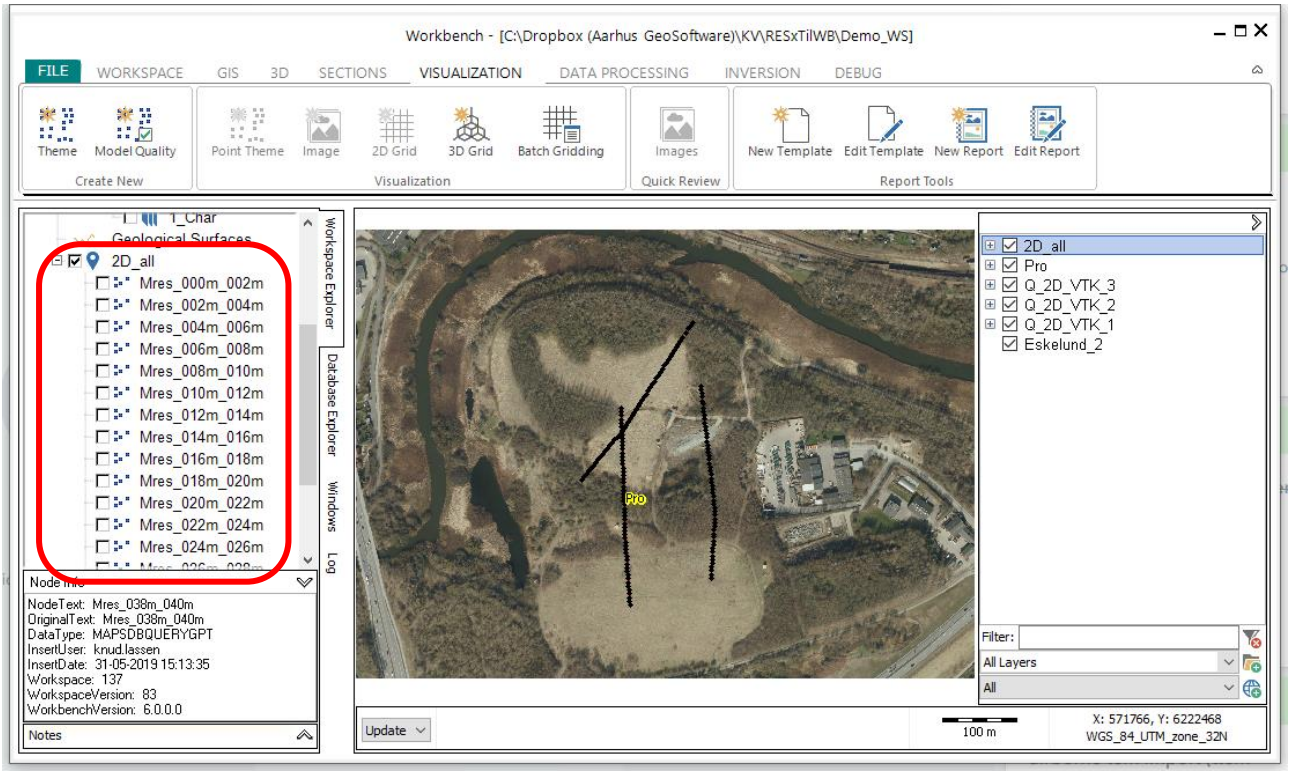
The following dialog box will then appear:



From this list the type of theme must be selected, the simplest theme is the “Layer Parameters” theme, this theme simply contains the value of the selected layer at the different positions, we will continue by creating a mean resistivity theme by selecting “Mean Parameters”. For a comprehensive walkthrough of the different types of themes use the F1 help from this window. In the next menu the property to be extracted, the number of intervals and the thickness of the layers must be specified:



The themes are created by selecting “Apply” and providing a name for the theme, once created the theme can be found under model selection in the Workspace Explorer:



The themes can now be visualized as points or 2D grids.

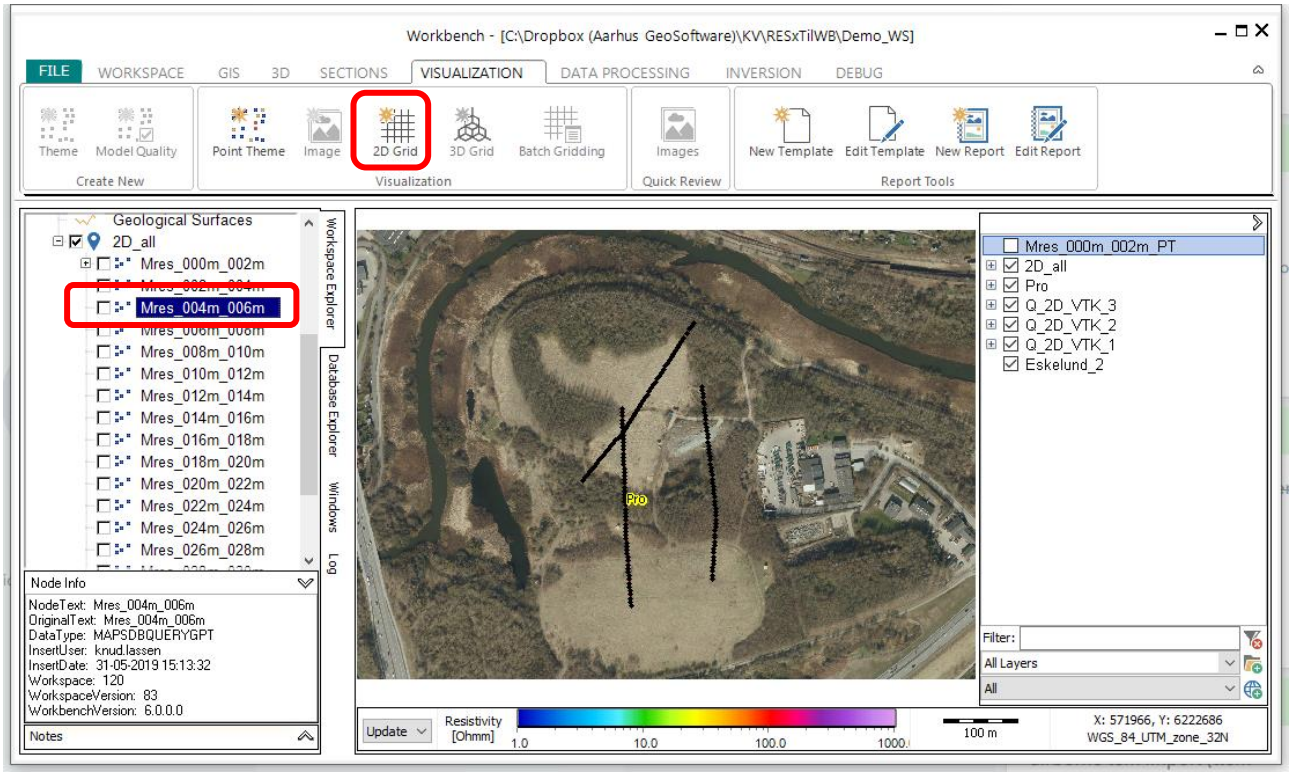
Visualizing themes

Points

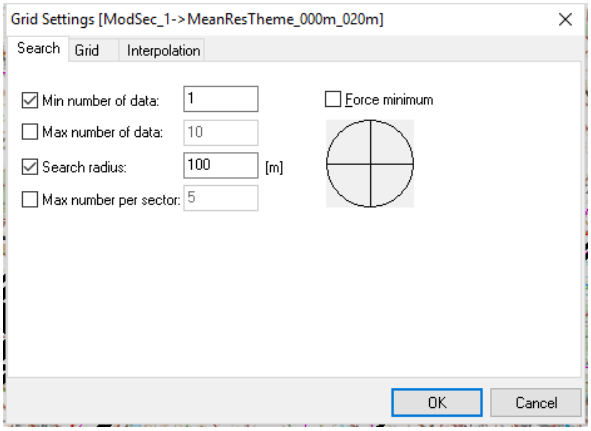
To plot the gridded values as colored points in the GIS window highlight the theme and press “Point Theme”. Select the color scale, point size and point shape in the dialog box and press “OK” and select the name of the theme, the point theme can now be found in the workspace explorer under the theme, and can be plotted in the GIS map by checking the checkbox next to it.

2D Grids

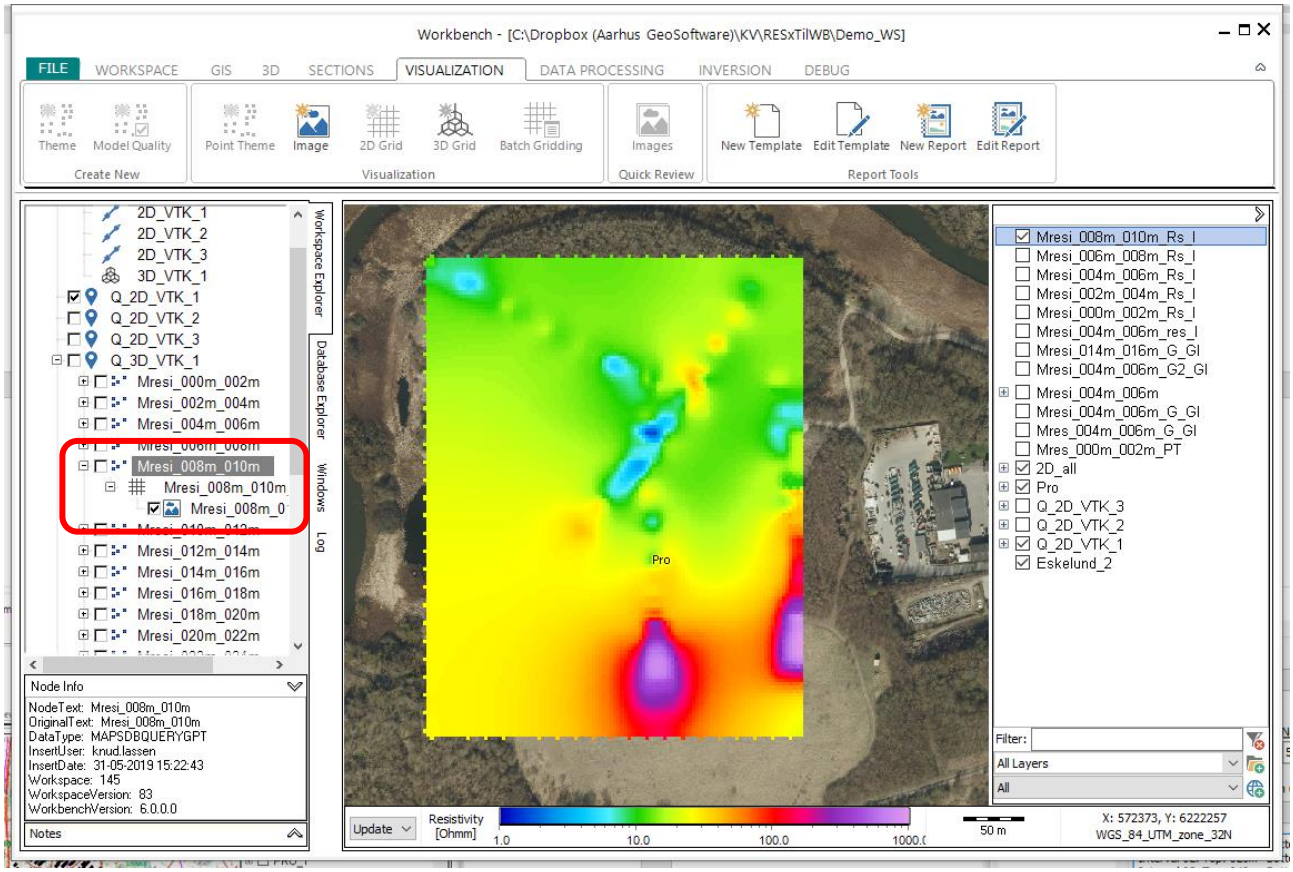
The other way of presenting themes are as surface covering interpolated grids, these are created by highlighting the theme and pressing “2D Grid” :



The following menu box will appear:



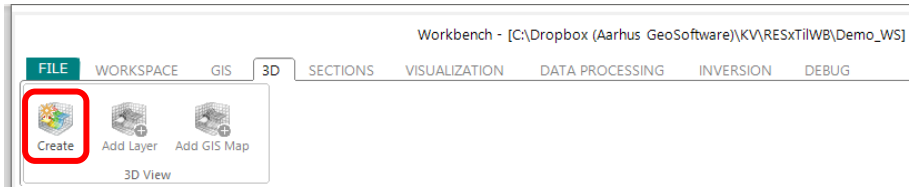
In this the search radius, grid spacing, and interpolation routine must be selected, refer to the F1 help for further specification, after pressing “OK” the grid must be named, after the grid is calculated an image must be created to display the grid. The first image is automatically created after calculating the grid, the color scale and name for the image must be selected and the image can then be found in the workspace explorer. Subsequent images e.g. with different color scales can be created by highlighting the grid and selecting “Image” in the visualization ribbon. Once created the grid and image can be found in the workspace explorer, and be to the map by checking the checkbox:



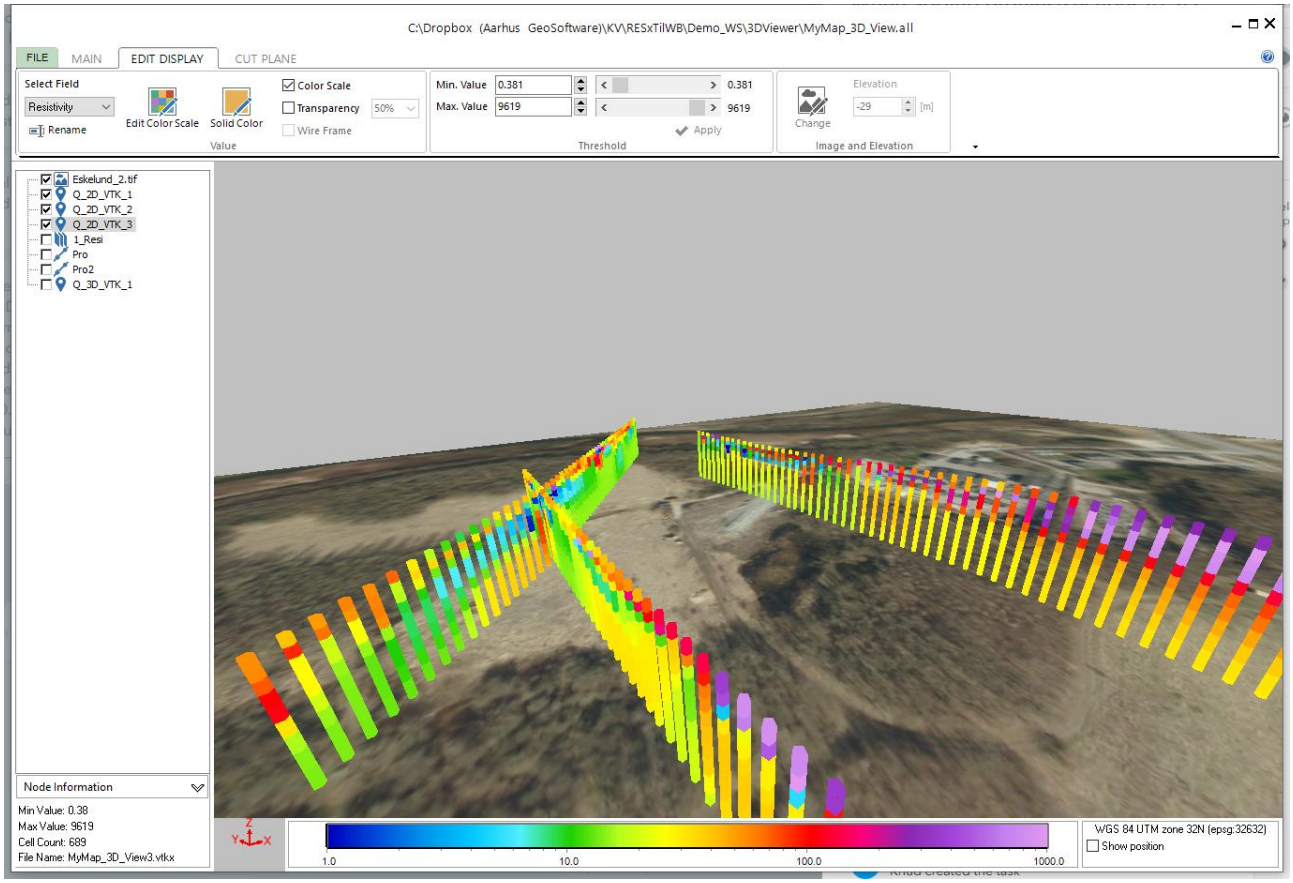
It is also possible to make 2D grids and images for several themes in a model selection in one go by highlighting the model selection and selecting “Batch Gridding”.

Visualizing results in the 3D viewer

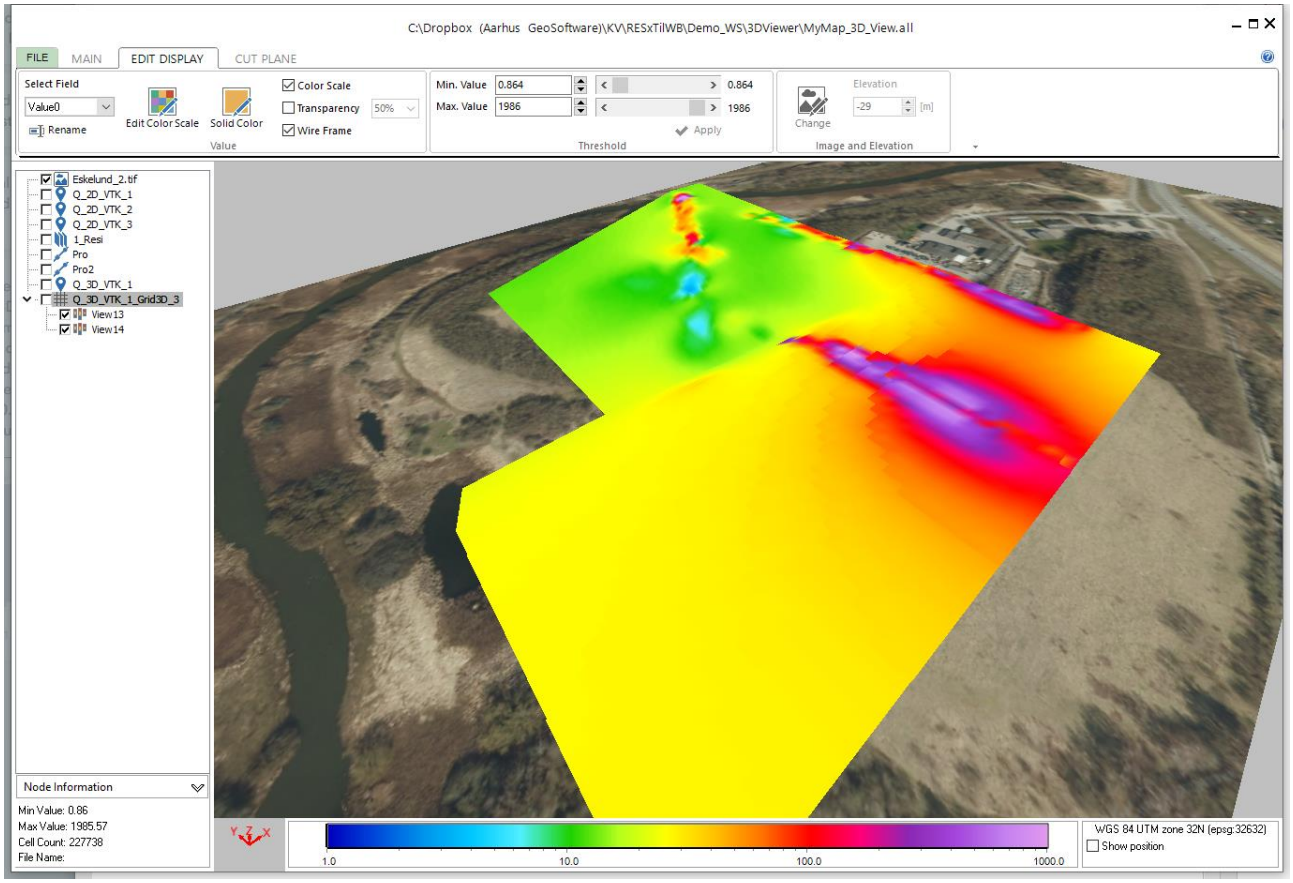
Most of objects created in Aarhus Workbench can be added to the 3D viewer for intuitive visualization in 3D. To create a 3D view, navigate to the ‘3D’ ribbon, select ‘Create’, and provide a name for the 3D view when prompted:



The new 3D view can be found in the Workspace Explorer and opened in a separate window by checking the checkbox next to the name. Objects from the workspace can be added by highlighting them in the Workspace Explorer, navigating to the 3D ribbon and selecting ‘Add GIS Map’ (for GIS maps) or ‘Add Layer’ for everything else. In the below example the background map and 3 model selections have been added to the view:



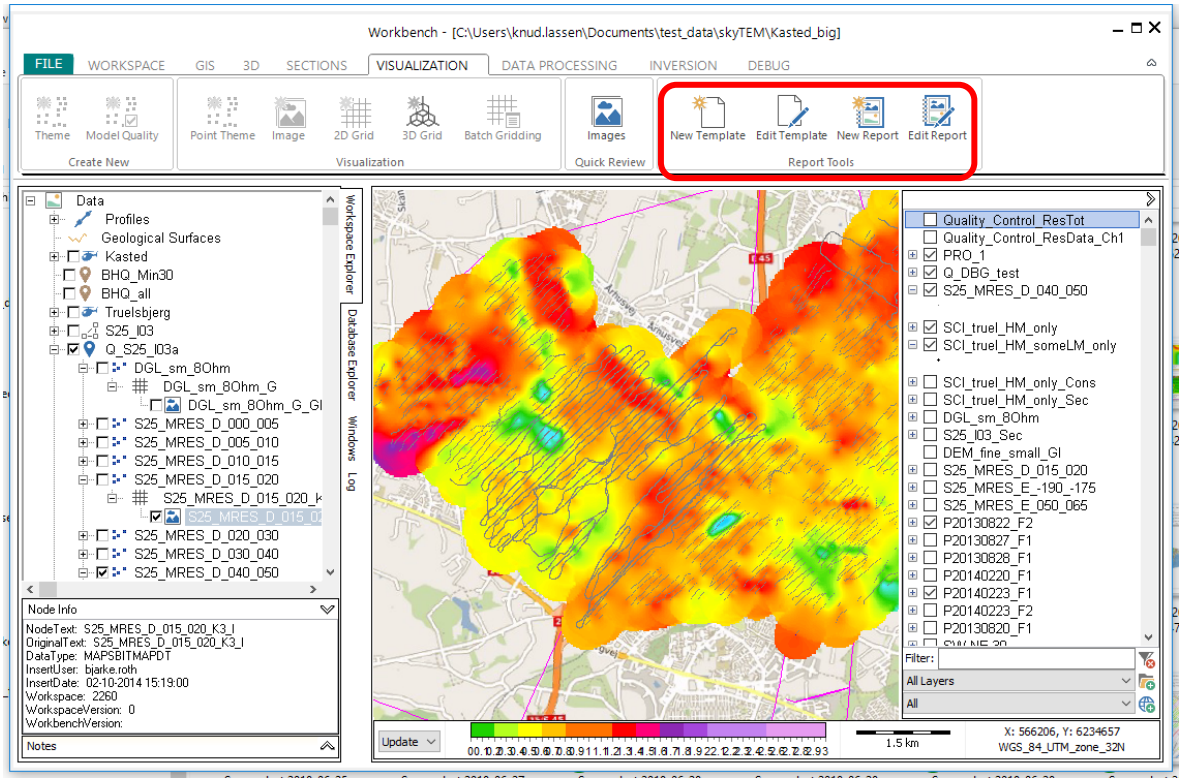
In the example below an inversion result from Res3DInv have been gridded in 3D (Visualization -> 3D grid), added to the 3D viewer and two dipping cut planes have been added. For a full walkthrough of the features of the 3D viewer please visit our online help by pressing “F1” within the 3D viewer or by following this link: http://www.ags-cloud.dk/Wiki/WH_3DViewerOverview.



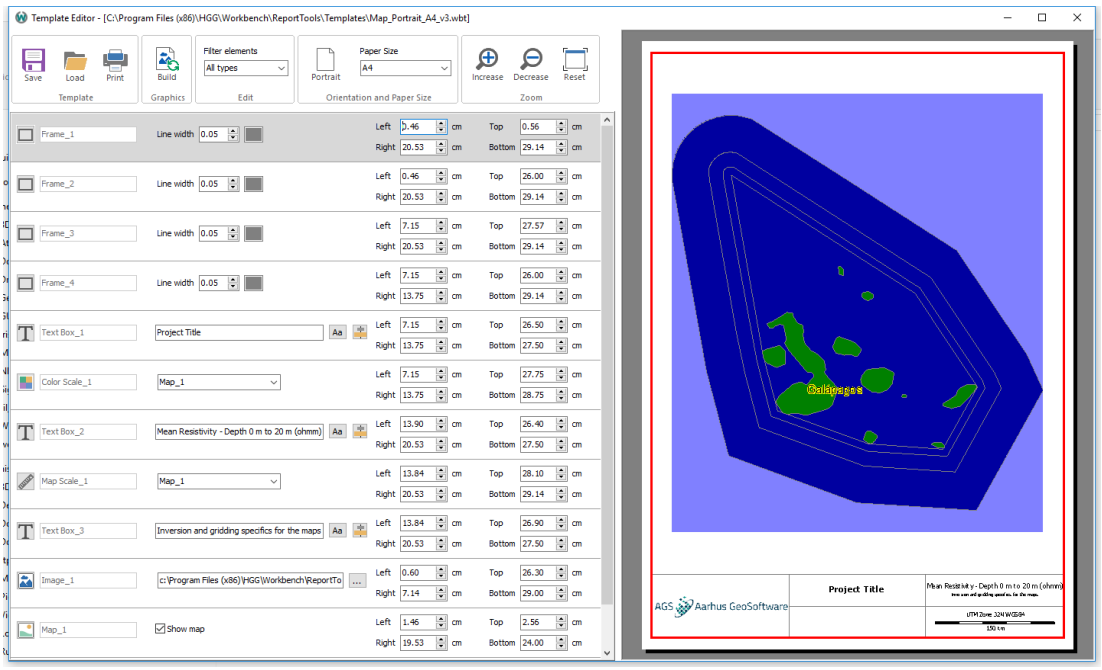
Creating a PDF report from template

The report tool is a tool to create high resolution, professional looking reports from the different data found in the workspace, the reports can include maps, profiles, themes etc. The reports are generated from predefined templates that defines the layout of the report e.g. paper format, location of logos, overview maps, profiles and other objects. Once a template is created it is easy to recreate reports of the same type for surveys at different locations, or to e.g. make a daily report from a long field campaign.

Templates and reports can be created and edited from the Visualization ribbon in the report tools box:



Each report page is built from the following elements: frames, text boxes, maps, legends, map scales, north arrows, images, profiles and color scales. By selecting either new template or edit template the template editor is opened:



To the left the editor is shown, to the right a preview is displayed. It is possible to edit the size, location and appearance of each element. New elements are added by selecting the icon to the left of an element and selecting “Copy item”. It is also possible to change the type of the element or to delete elements in this

way. The preview is updated by pressing “Build.” For further explanation of the different options use the “F1” help. To use the template to create a report, save the template and select “New Report”.

The report editor is very similar to the template editor, but instead of editing the type and location of the object it is now possible to edit the content e.g. which profiles are displayed and the text in the textboxes. Changes take effect once “page” of “all pages” is selected in the “Build graphics” menu. It is also possible to add or remove pages. A report can be saved and edited later. To create a PDF of the report, select “print” and print the report to a PDF printer. Use the “F1” help for explanation of the individual features.