ModelVision v13.0

December 2013

ModelVision v13.0 contains some powerful enhancements to the already dominant modelling application of previous versions. In this release ModelVision focuses on making it easier to work with imported data, cross-section views and exporting modelled data. Some new tools for modelling remanence, joint inversion and free-air gravity modelling make this version an essential package for all dedicated potential field modelling geoscientists.

These release notes includes sections on the following changes.

- Support for MS Windows 8
- New Remanence Tools
- Multi-Line Joint Inversion Constrained to Line Direction
- Full Tensor Transformation of TMI and Gz
- Multiline Section Scaling and Tiling
- Free Air Gravity Modelling – Backing Off Adjustment
- Automated Display of Imported Data
- Expanded Model CSV File Export
- Expanded Point to Model Conversion from CSV Import
- Base Line and Flight Line Controls
- Documentation and Tutorial Updates
- Improvements and Fixes
- References

It is important to note that there has been a change to the underlying document structure in the ModelVision code which means earlier versions of ModelVision will not read session files created by Release 13. Of course this release will be able to read session files created by earlier version of ModelVision.

New Remanence Tools

The investigation of magnetic remanence with ModelVision has been further improved with the inclusion of departure angles in the body properties dialogue. The angles between the induced, remanent and resultant magnetization vectors are listed in the bottom right corner of the dialogue.

The functionality of the dialogue has been further improved with the addition of a **Remanence** checkbox in the lower right corner that allows the computation and inversion for remanence to be activated from the NRM tab in the body properties dialogue. Previously this capability had to be exclusively activated from the Model>Magnetic Field dialogue which made it a little obscure for new users. Use the **Auto** button to automatically update the body values. This has the same effect as the Apply button, but updates the body each time a field is entered and if Immediate Mode is turned on then all active points will be recomputed.

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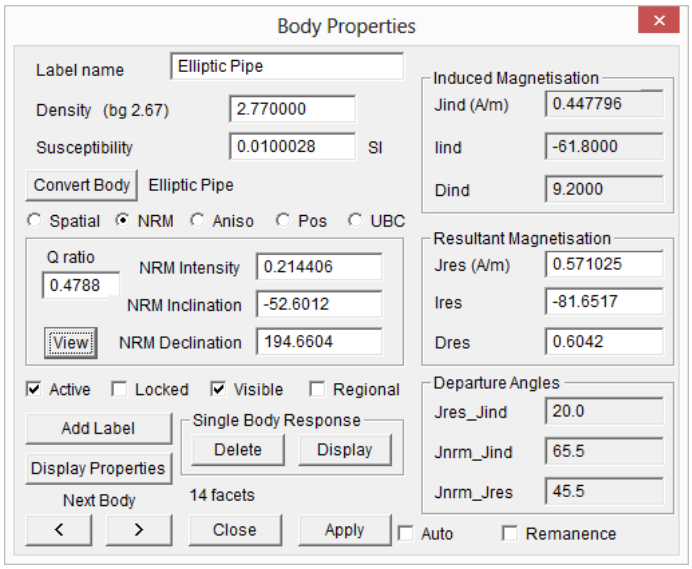
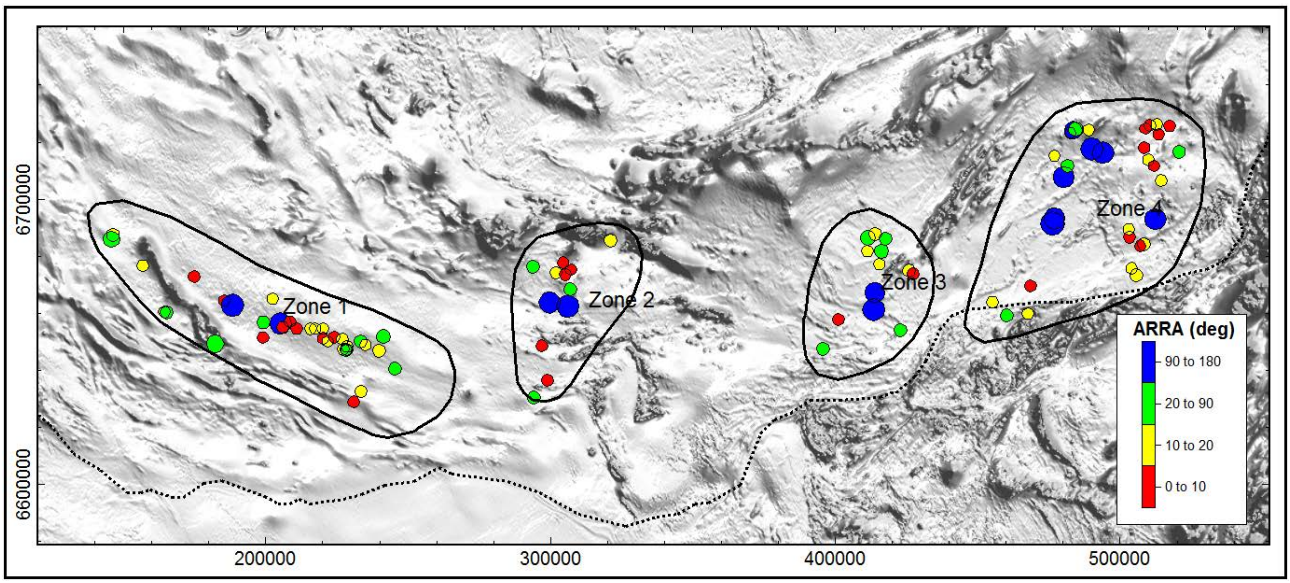


The new body properties dialogue with the NRM tab showing the directly computed departure angles.

If you are inverting on resultant magnetization the apparent resultant rotation angle (ARRA) is an important indicator of the presence of remanent magnetization. The ARRA value is defined by the Jres-Jind field. Refer to Pratt, McKenzie and White (2012) for a more detailed explanation of the use of the resultant magnetization vector.

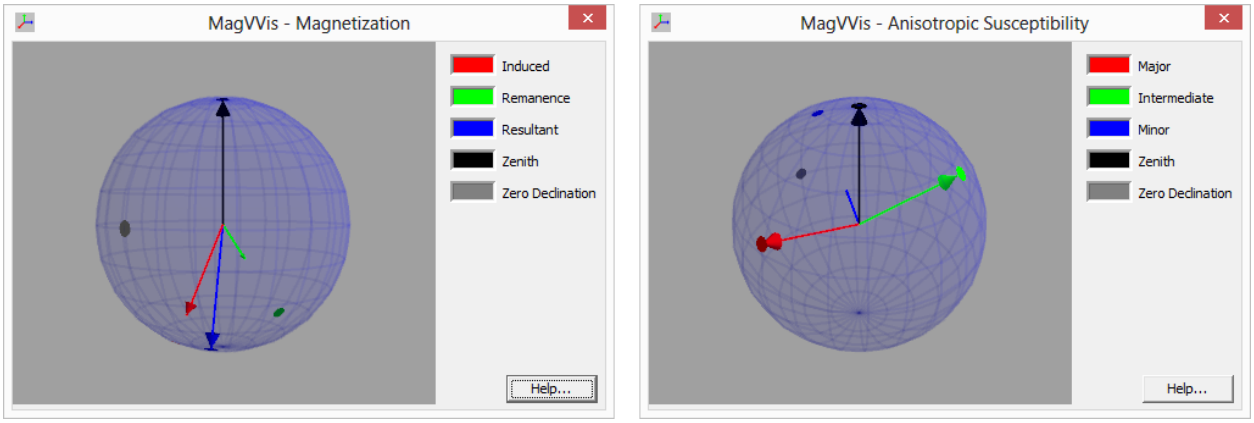
The distribution of ARRA values in a project area can help better understand the existence of remanence within a range of target types. The example below (Pratt, 2013) shows a map created from the Jres-Jind values exported from ModelVision for display in Discover PA. The numerical values were colour modulated and size modulated as a function of the ARRA value. Use the **Model>Export>CSV Export** menu option to create a file containing all the remanence parameters so that you can use the results in other mapping packages.



This image was created in Discover PA from ARRA values calculated in ModelVision for 100 intrusive pipes. The blue circles indicate reversed magnetization.

You can also use the point modulation display in ModelVision map views to visualise the ARRA distribution.

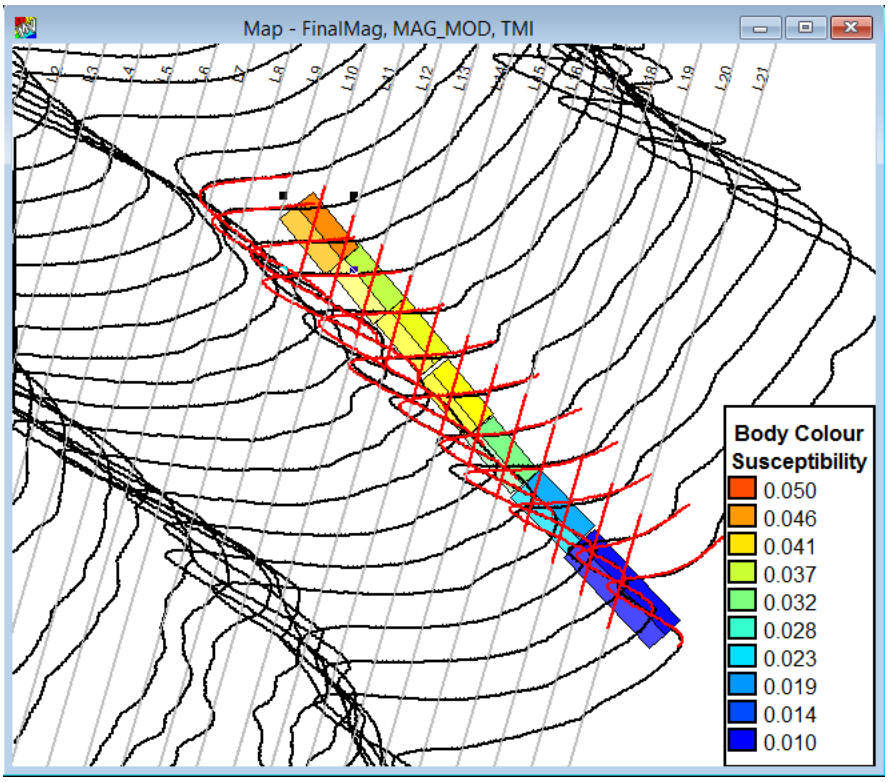
The 3D Vector visualisation graphic MagVVis for remanence and anisotropy has been updated. The black vector previously shown as north is in fact the zenith for that location.



*Example of the Magnetization and Anisotropy 3D vector graphic dialogues activated from the **View** button.*

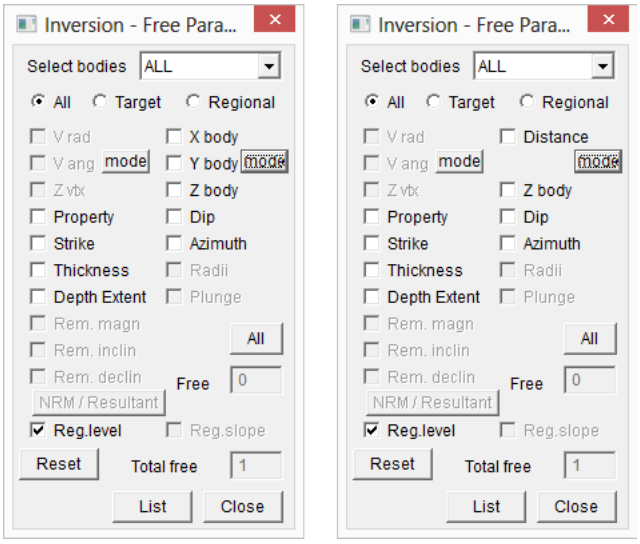
Multi-Line Joint Inversion Constrained to Line Direction

This new feature allows you to do complex multi-segment model inversion more easily because this mode allows bodies to be constrained to move only along the line of data collection. Previously this could only be done in the x or y direction. In this mode, you can analyse changes in property along strike. If you use a tabular body series as shown in the image below, you can map changes in magnetic susceptibility, magnetization or thickness depending upon the geological problem.



Example multi-segment model where each body is constrained to move along the flight line while maintain its azimuth and strike length.

Only the tabular body type is supported in this mode of operation using joint inversion. A new mode button is provided to switch between distance and X, Y modes of inversion where distance means position along the line.

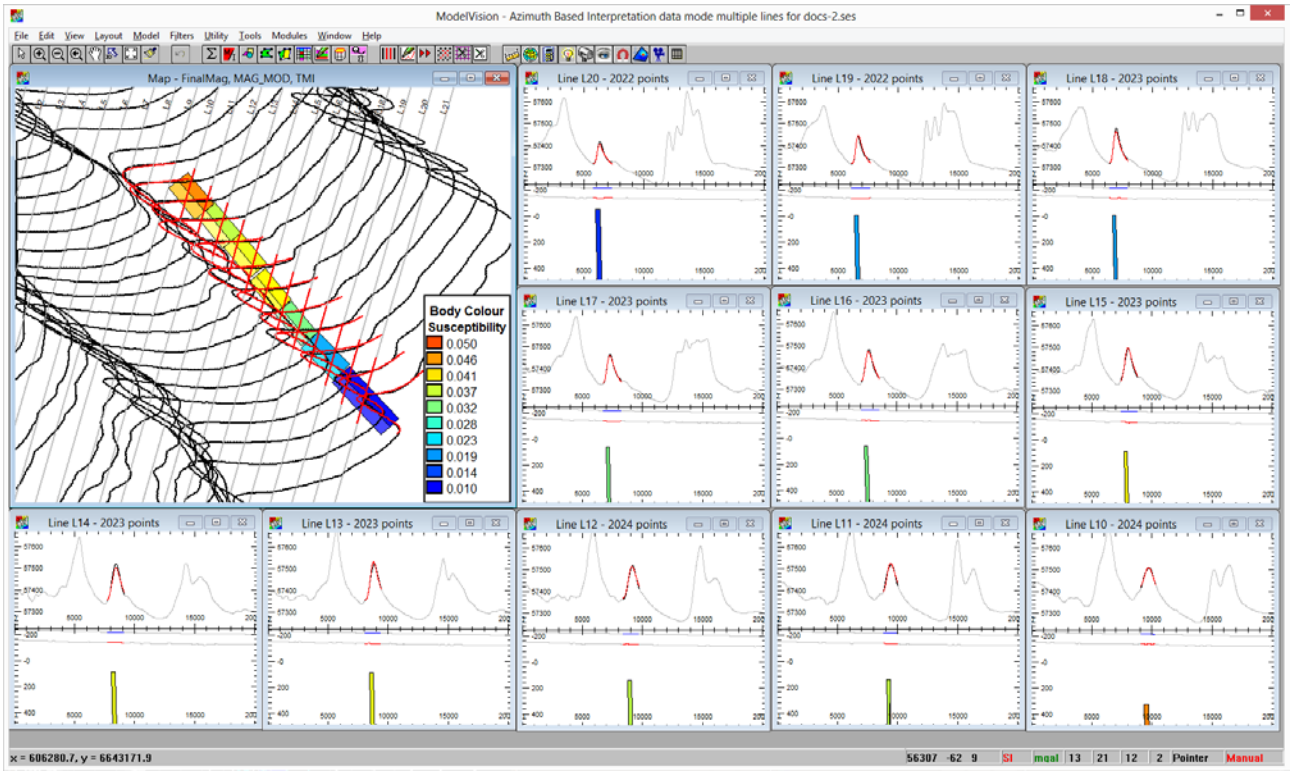


Dialogue examples where the MODE button toggles between X,Y inversion and Distance inversion.

In this example we used the along strike body split function to create a series of tabular body segments from a single tabular body that we had previously inverted. We used a split length equal to twice the line spacing.

We then used the active line toolbar button to select the cross-section for use during modelling. The new windows tiling option helped to organise the sections in line order which makes it easier to understand the progressive results during inversion. The active points button was used to limit the data to the anomaly over the model segments. Note the progressive change in magnetic susceptibility along strike. In this case, the target thickness and depth below sensor are

similar so it is important to trial a thickness based inversion with constant magnetic susceptibility to see which is the more plausible solution.

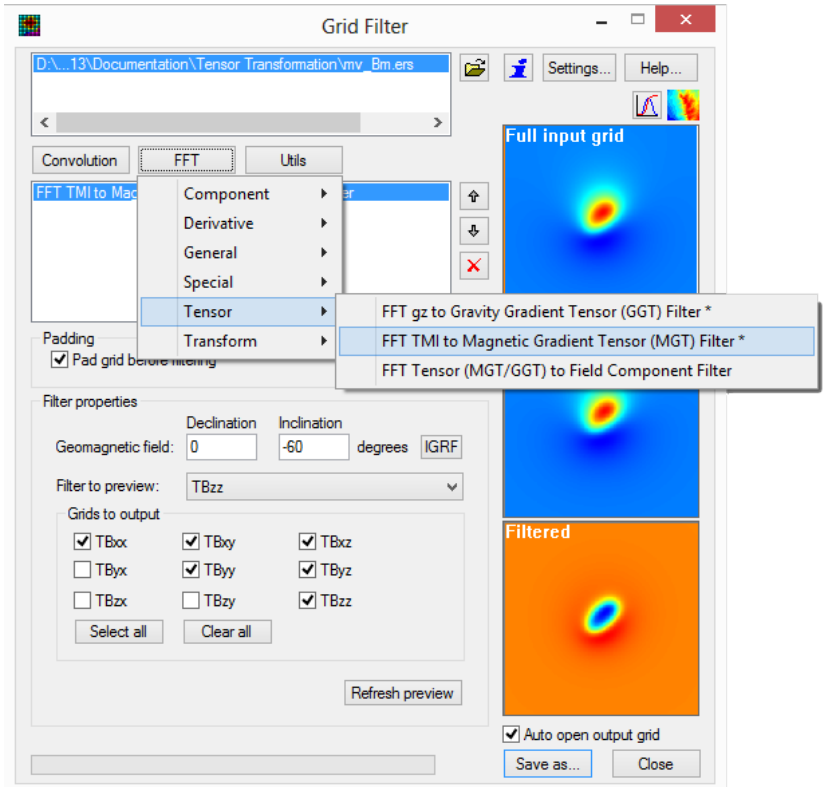


Example of multi-segment tabular body joint inversion with tiled cross sections and stacked profile map window.

Full Tensor Transformation of TMI and Gz

It is possible to compute the magnetic tensor grids from the total magnetic field intensity grid using the fast Fourier transform and the equivalent can be computed from a grid of gravity (Gz). The full tensor of the magnetic field can be used for computing many useful parameters for further interpretation such as the invariants I1, I2, dimensionality and more advance functions such as those introduced by Beiki, Clark, Austin and Foss (2012). The gravity tensor transformation is useful for the conversion of a gravity survey grid to a tensor to see what it looks like as a tensor or for testing different geological models to determine their response characteristics of a gravity gradiometer survey. There is a lot of 3D spatial information in tensor data that cannot be resolved from the primary field or vertical gradient.

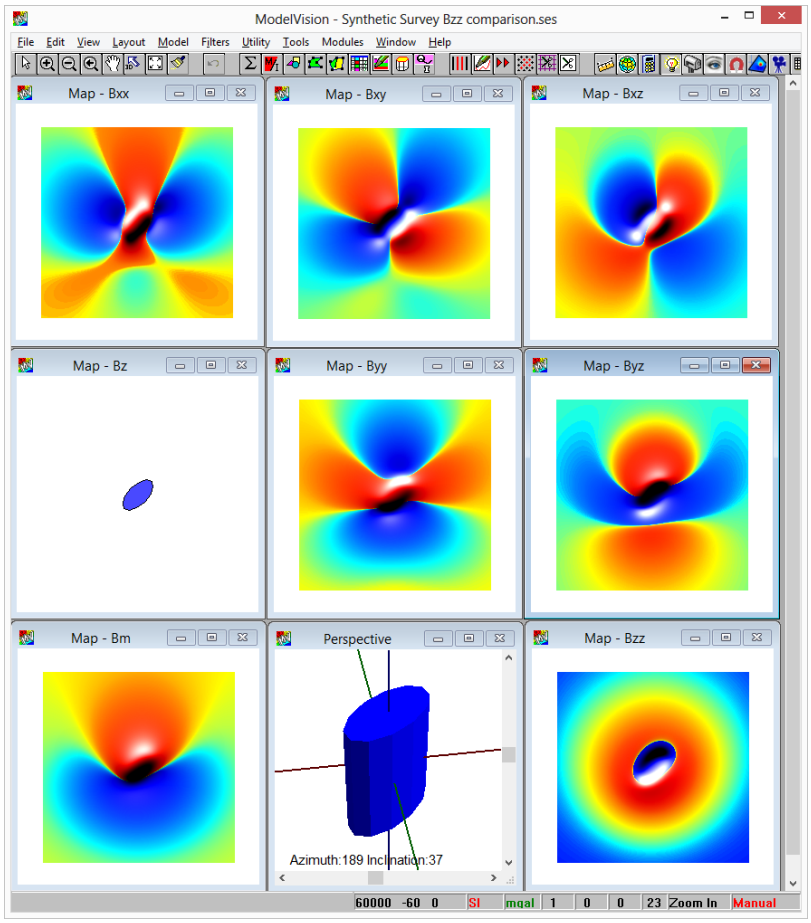
These two new filters have been added to the Grid Filter dialogue and are accessed from the **FFT>Tensor** menu selection.



The new Grid Filter Tensor transformation selection options.

In the magnetic case you need the IGRF inclination and declination as well as a selection of the tensor components. This is normally limited to the upper diagonal matrix, but the symmetric terms can be selected as well. In the gravity case you just need to select the tensor components. Don't forget to set the padding amount that best suits your data.

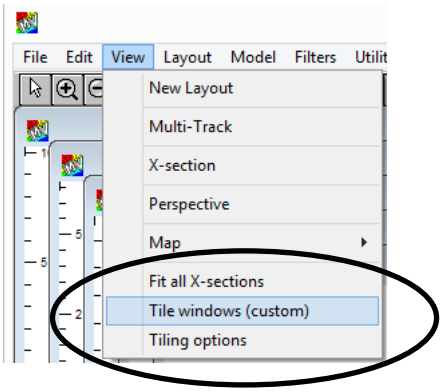
The following example image displayed in ModelVision shows images of the original total field grid (Bm) generated from a vertical, elliptic pipe model and the FFT transformed tensor grids. Also shown is a map view of the upper surface of the pipe and a 3D perspective view of the pipe.



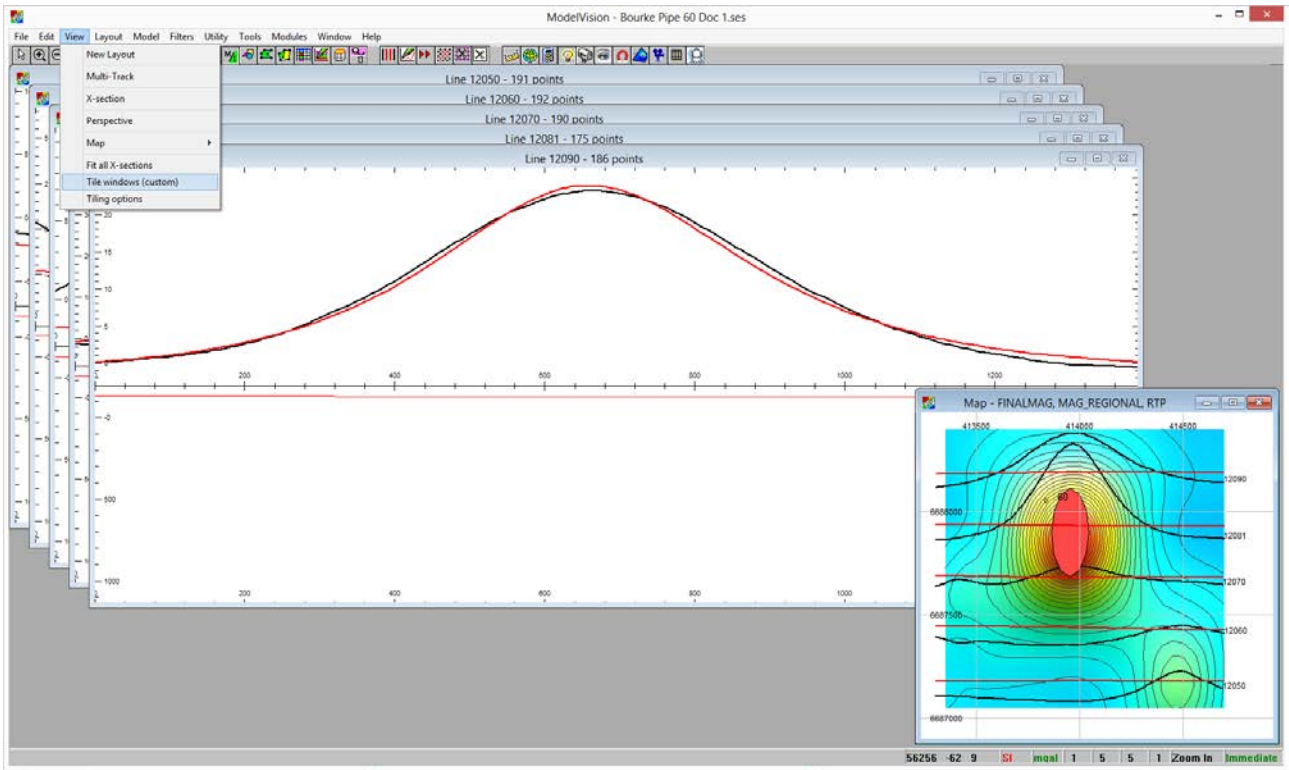
Example display of the upper diagonal matrix elements of the magnetic gradient tensor generated from the transformation of the Bm grid shown in the lower left corner.

Multiline Section Scaling and Tiling

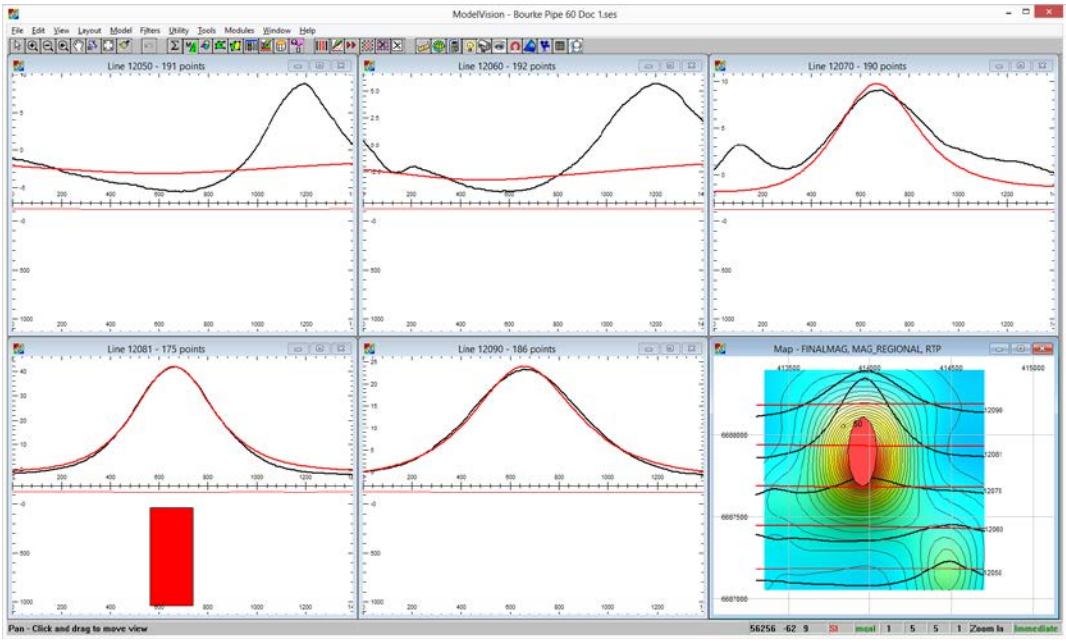
The new multi-window tiling and scaling makes it much easier to work with multiple views when doing complex multi-line 3D modelling. The new features allow you more control over window tiling and placement and improves productivity and data comparison across windows. The new features have been added to the **View** menu.



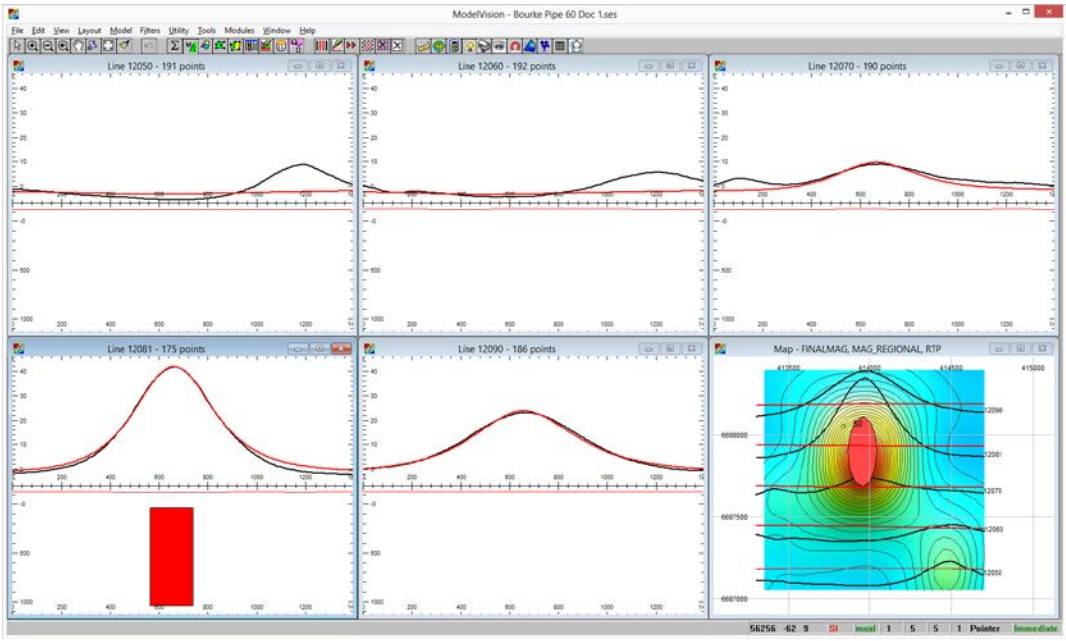
The following images show a sequence whereby you open multiple cross-sections from a map view, tile the cross-sections in line order and then match the cross-section data and depth tracks to a common reference section.



Initial cascaded cross-section windows open from the map view.

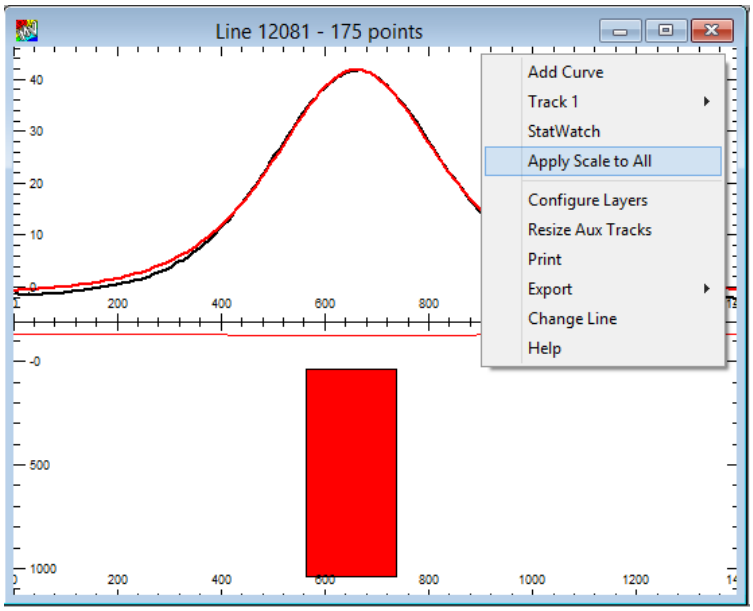


Tiled window view of the sections after using the menu View>Tile Windows (custom) feature.



Rescaled cross-sections matched to the bottom, left active section.

The dramatic change in the magnetic intensity scale of the off-target sections is very important when trying to understand the sensitivities associated with each line of data. The scale matching is activated using the right mouse click in the active section followed by selection of the **Apply Scale to All** option.

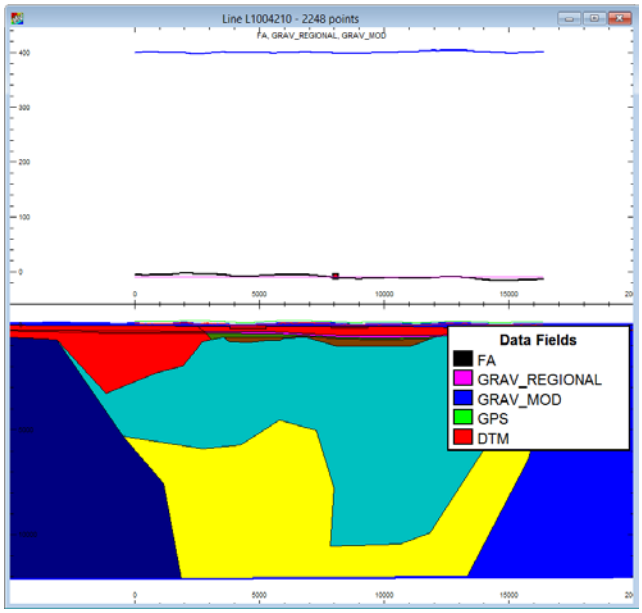


Access the cross-section global scaling via the right-mouse button menu.

Free Air Gravity Modelling – Backing Off Adjustment

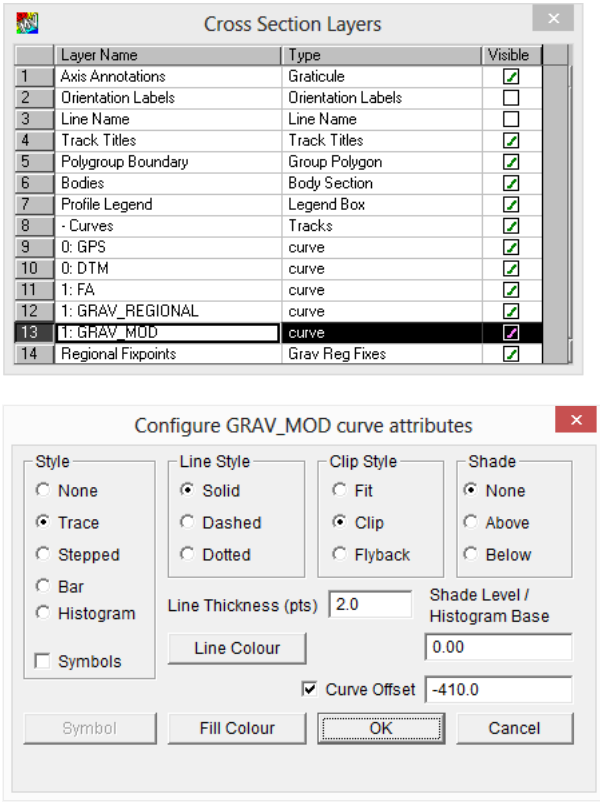
Gravity modelling can be applied to Free Air gravity data when it may be important to model the full influence of the terrain using the true densities of the surface rocks. With Free Air modelling, the lateral extent of the models is often large and the background contribution of the model creates a large offset between the data and the model as shown in the figure below. When you fit a regional to the field data this does not help with the matching of the large offset.

As a result, when you display both sets of data together, you cannot see the finer detail in either the Free Air data or model response.



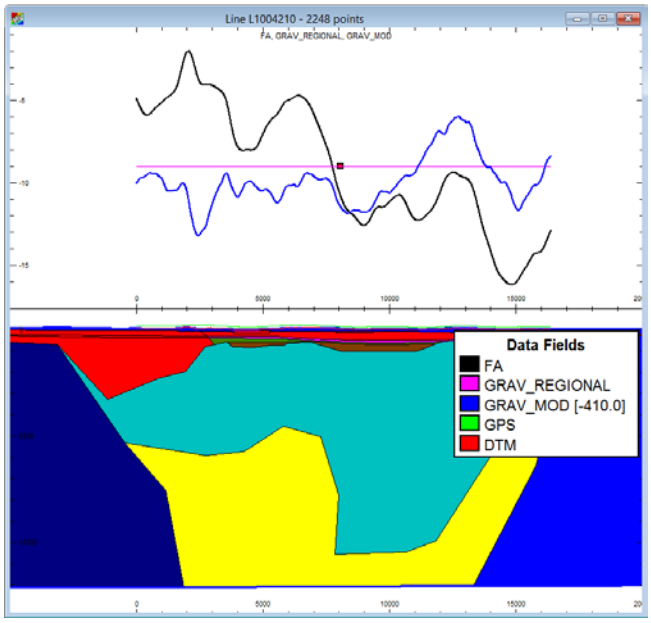
Preliminary view of the Free Air gravity data and computed model response showing the large dc offset between the two curves.

You can now apply a visual dc offset in the curve configuration dialogue that will shift the model response to more closely match the field data. In this context you select the GRAV_MOD model curve in the cross0-section configuration dialogue and then apply a curve offset value (-410 here). This offset is purely visual and the data is not modified in any way, but it does allow the curves to be rescaled using the automatic fit capability that is accessed via the right mouse click.



Configuration dialogue for the GRAV_MOD field.

Once entered, you can refit the data in the upper track and you can compare the two curves in detail.

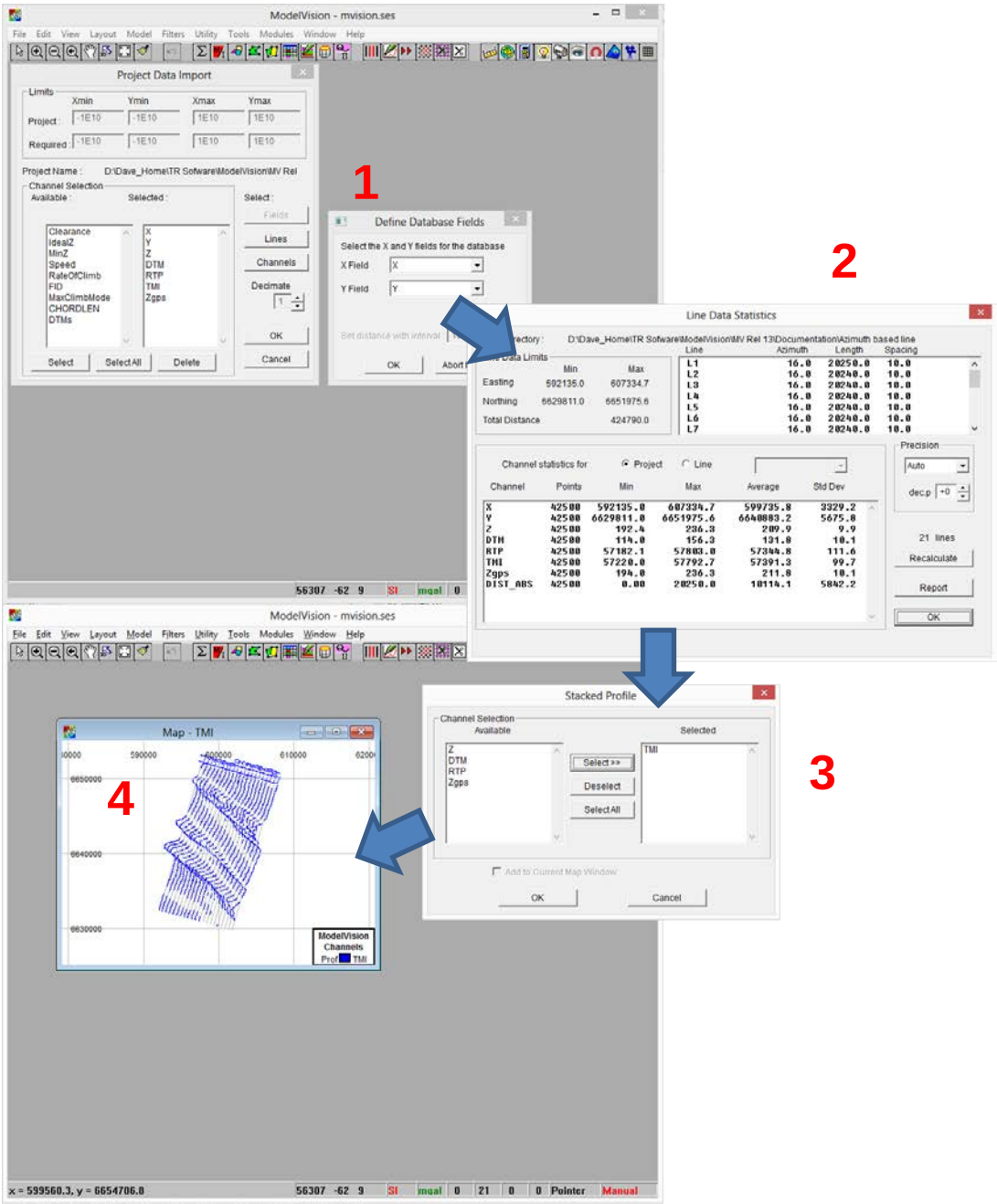


Free Air and GRAV_MOD curves after application of the visual offset.

Note also that the offset is shown in brackets after the channel name in the section data legend. The offset applies only to the selected line so you can use different offset on other lines.

Automated Display of Imported Data

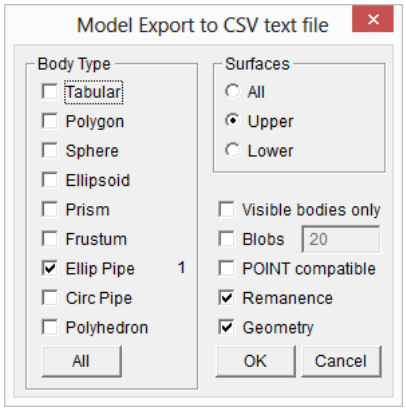
This release includes a popular request for the automatic display of data immediately following the import process. In the case of line data, the line statistics summary will appear immediately after loading and once you exit the dialogue, you will see a request for a channel that will appear in a stacked profile map. If you import a grid, a pseudo-colour image will be generated upon import. In the case of data points, the location of the data points will be displayed after the statistics report is closed.



Example of the automated display of a line data channel following import which first shows the line statistics dialogue and then a channel selection dialogue for the stacked profile map.

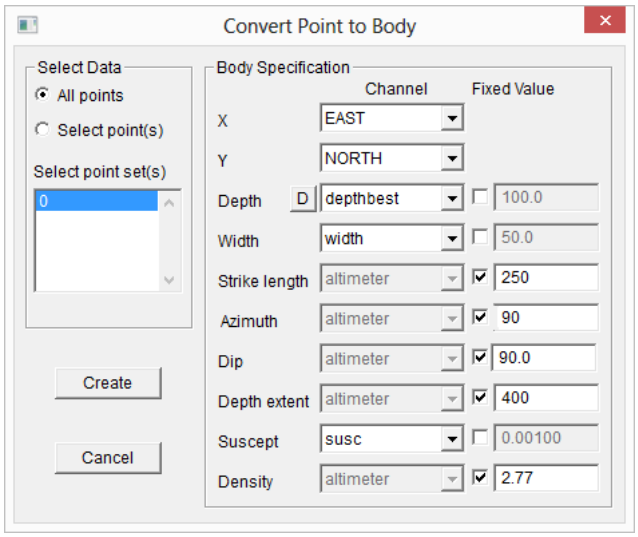
Expanded Model CSV File Export

The model export capability has been expanded by popular request to include more geometry options as well as remanence magnetic properties. The latter are discussed in more detail in the section on Remanence tools.



Expanded Point to Model Conversion from CSV Import

The point to model conversion facility in the **Model>Import>Bodies** from Points includes an extension that makes it easy to select a depth or elevation field to define the Z value for the model.

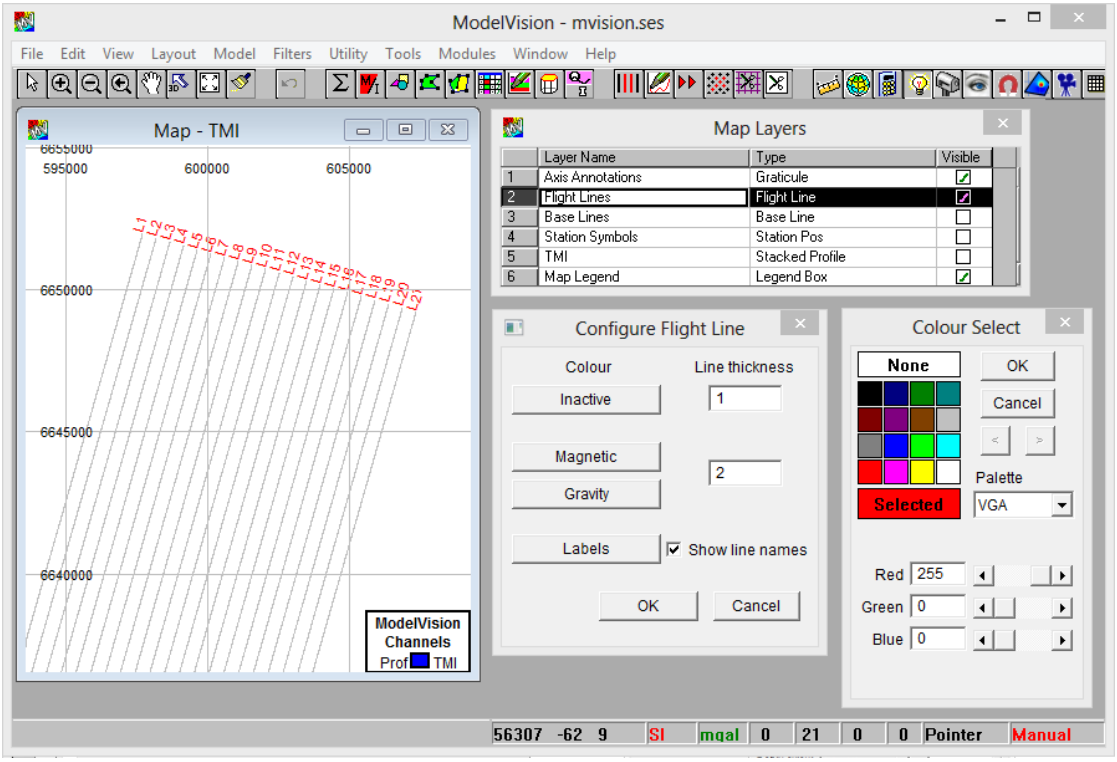


Updated dialogue for conversion of imported points to tabular bodies.

Note this conversion capability allows you to import solutions from other packages and convert the results to a fully attributed model.

Base Line and Flight Line Controls

You now have more control over the appearance of flight lines during standard display and modelling. The new controls provide the ability to change the line thickness of flight lines and base lines and importantly, you can now add the flight line name from this control. Previously, this was only accessible from the stacked profile map control.



Dialogue controls for thickness, colour and line name configuration of the flight line.

Note that the flight line shows the full path of the sensor, whereas the base line joins the first and last points of the line.

Improvements and Fixes

In addition to the major improvements listed above, we have improved a number of ModelVision features and fixed problems with others. The following table lists most of the improvements and fixes.

ID	Brief Description of Improvement or Fix
5	Request for geometric parameters to be exported by Model export to CSV.
60	MV crash while printing x-section with colour modulation applied
61	AutoMag Strike Filter hangs ModelVision.
72	Magnetization body parameters - result was not in SI units.
75	Inversion Revert button could be slow with immediate mode turned on.
86	Polygon grid clip toolbar button failed to crop the grid to the new data limits
97	Field offset problem. Added curve offset and switch to curve configuration dialog. Offset values get displayed in the profile legend.
98	Inversion is not handling nulls in the elevation channel & maybe other channels. All channels are now tested for nulls.
106	Import Bodies from Points sometimes crashes without a “Z” channel. Extended to use "Depth" or "Elevation".
107	New options added to Startup dialog.
113	Cannot turn remanence on while in body properties dialog. Enabled a checkbox to turn it on from the NRM page with a warning that this affects all bodies.
117	Topology checker problem resolved with complex 3D extrusions.
123	Resultant checkbox should be switch only.
138	A negative azimuth causes model import from points to crash.
146	QuickInvert crashes if a map is active.
152	Base line and flight line thickness and colour control.
153	3D extrusion wizard and QuickInvert dialogs clipped. This is fixed for 125% fonts but is still not handled properly for 150% fonts .
156	North label in MagVVis vector display should be labelled "Zenith".
162	Crash caused by selecting in blank area of configuration table dialog.
168	Point annotation symbol selection field is too narrow.
172	Automag filter does not remove the filtered points correctly. It often removes many visible points.
176	ARRA and related angle export name changes + document.
187	Automag Toolbar: Kill Bodies function causes multiple updates for multiple bodies if in Immediate Mode. It now produces just one update.
188	Menu crash when accessing Modules>AutoMag>Configure.
189	3D Extrusion Wizard & LUT does not run without a Discover PA licence.
190	Single Body Response button in body properties renamed from Associated Channels. This feature allows you to add tracks to the cross-section where individual body contributions can be tracked.

References

Clark, D.A., 2012. New methods for interpretation of magnetic vector and gradient tensor data I: eigenvector analysis and the normalised source, Exploration Geophysics, 43 no.4, 267-282. doi:10.1071/EG12020.

Pratt, D.A., McKenzie, K.B. & White, A.S., 2012. The remote determination of magnetic remanence: 22nd International Geophysical Conference and Exhibition, 26-29 February 2012 - Brisbane, Australia, Extended Abstracts.

Pratt, D.A.. 2013. The potential of remote remanence estimation (RRE) for kimberlite exploration – A case history from the Thomson Fold Belt: 23rd International Geophysical Conference and Exhibition, 11-14 August 2013 - Melbourne, Australia. Extended Abstracts from the Forum on The Application of Remanent Magnetisation and Self-Demagnetisation Estimation to Mineral Exploration.

Copies of Tensor Research papers can be found at the www.tensor-research.com.au Resources page. Other useful references can be found at www.magresearch.org which list many useful papers on potential fields from CSIRO and associated authors.