3D RESISTIVITY INVERSION TUTORIAL

Steps: ***Page***

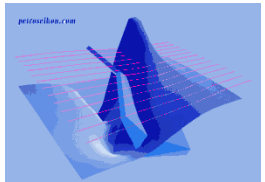
1. **Import data** to new or existing database 2

2. **Examine data** 6

3. **Perform initial forward modeling** 8

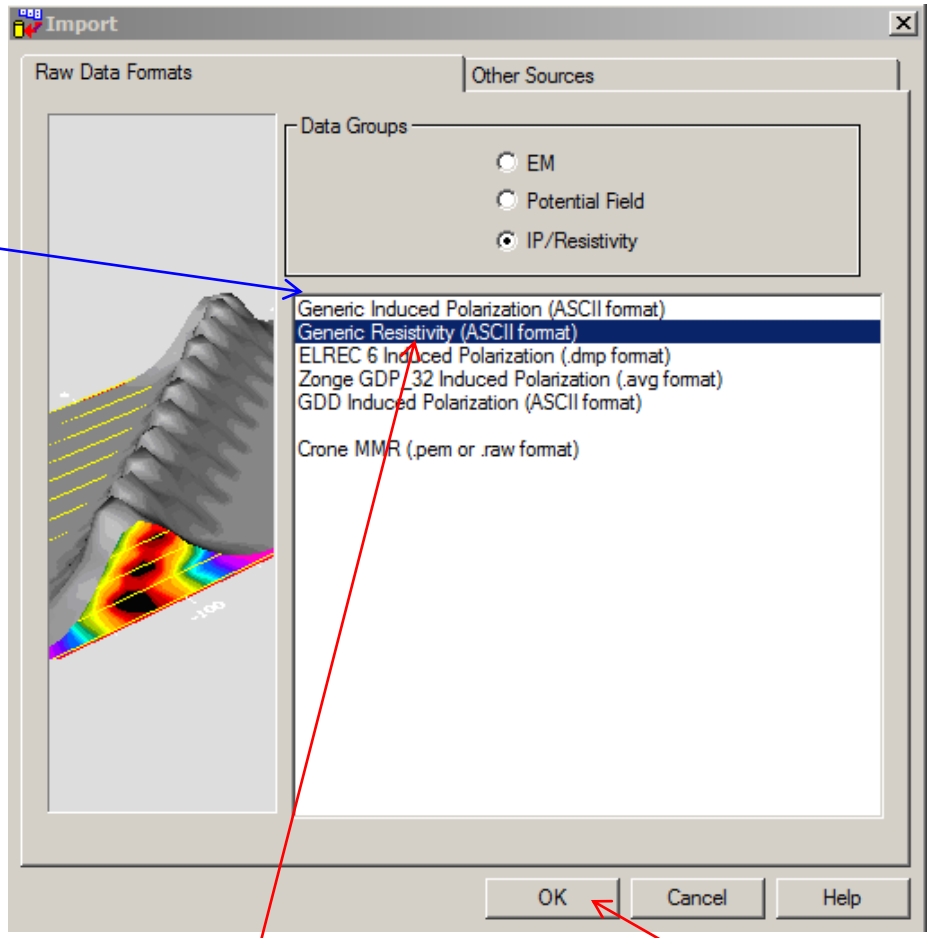
4. **Perform 3D resistivity inversions** 9

5. **Check model and create plots** 16



1. Import data
2. Examine data
3. Perform initial modeling
4. Perform 3D resistivity inversions
5. Check model and create plots

Select “Generic Induced Polarization” if your data is from IP survey



Select “Generic Resistivity” and click “OK” button

1. **Import data**
2. Examine data
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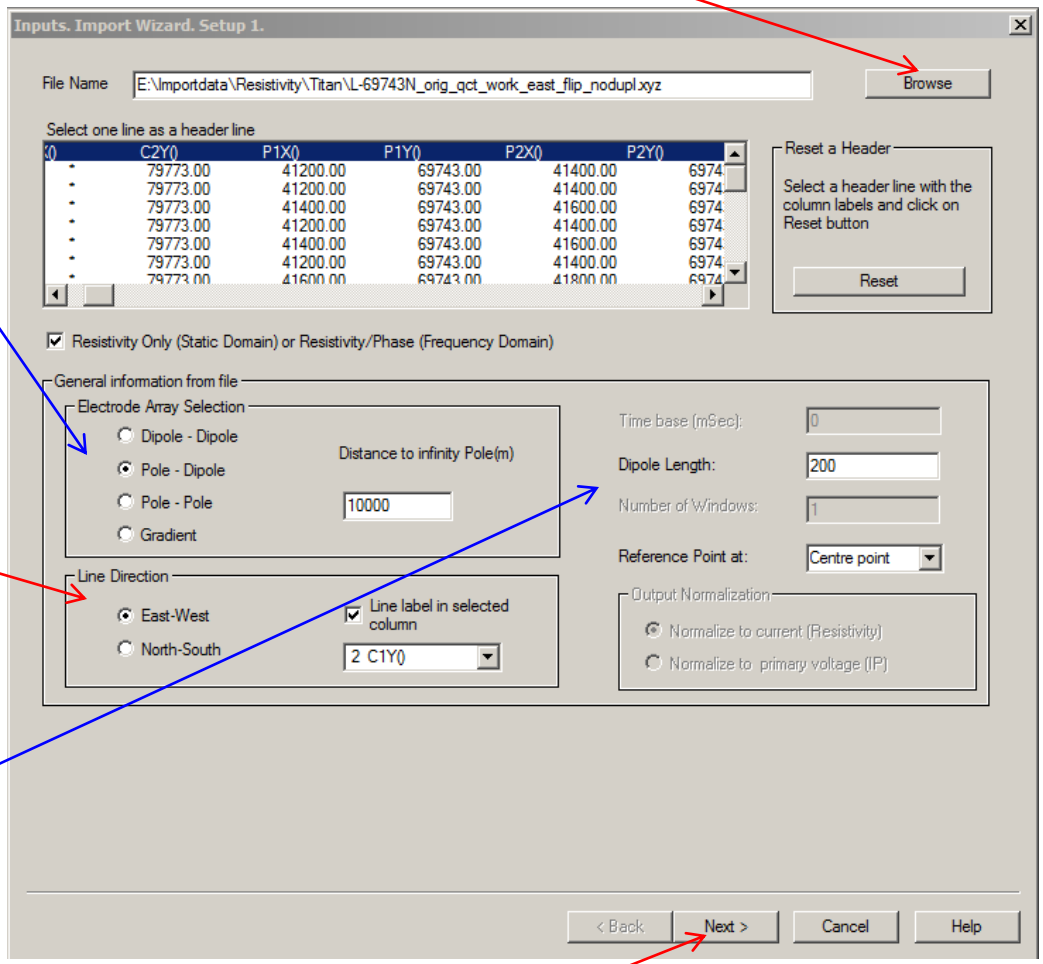
Browse and select data file for import

Select electrode array type and set the distance to infinity pole

Set line direction and select the data column for the line

Set dipole length and reference point position



Click “Next” button to proceed to next step

1. **Import data**
2. Examine data
3. Perform initial modeling
4. Perform 3D resistivity inversions
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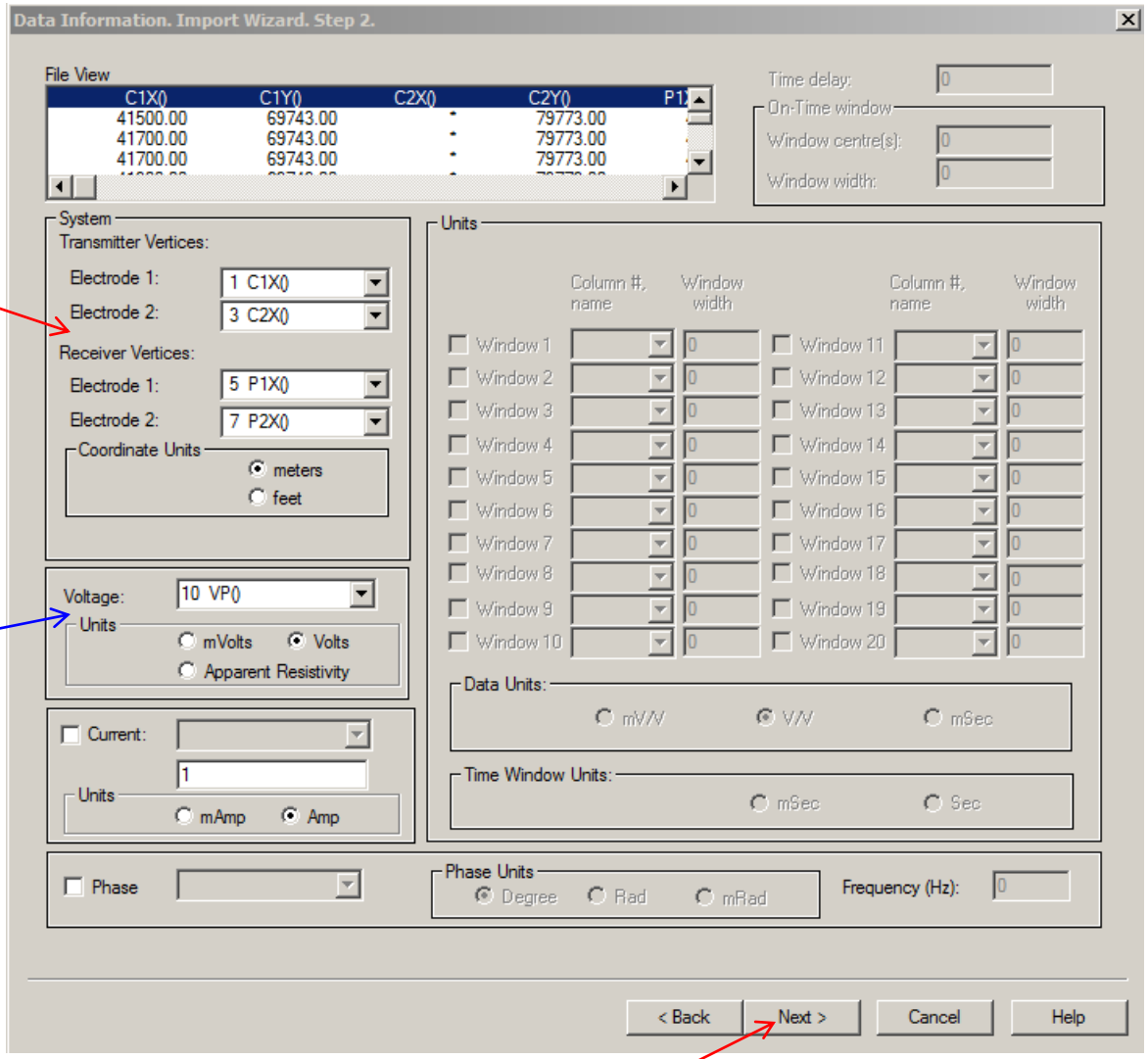
Select vertices for both transmitter and receiver, as well as the units of coordinate

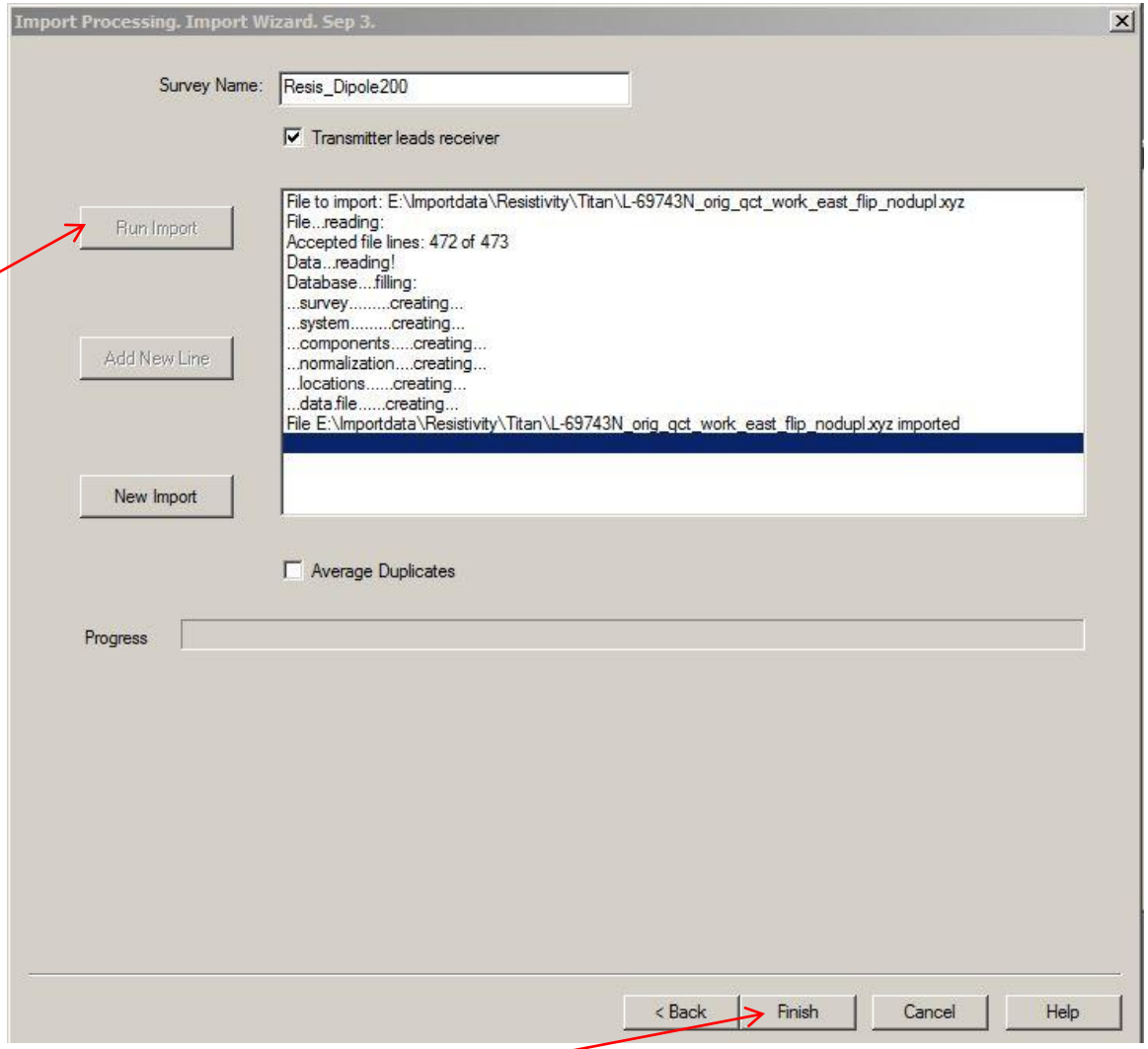
Select the column which contains voltage data and set its units



Click “Next” button to proceed to the next step

1. **Import data**
2. Examine data
3. Perform initial modeling
4. Perform 3D resistivity inversions
5. Check model and create plots

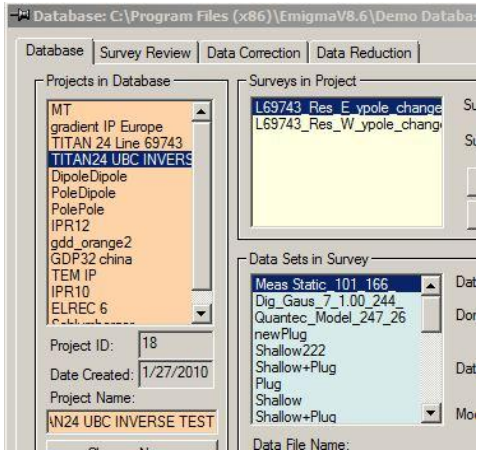
Click “Run Import” button to start importing data into database



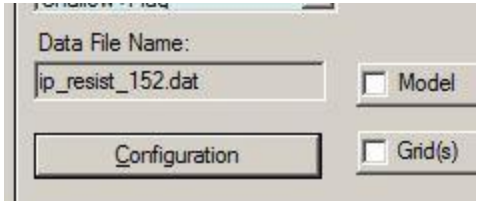
After processing is done, click “Finish” button to complete the import procedure

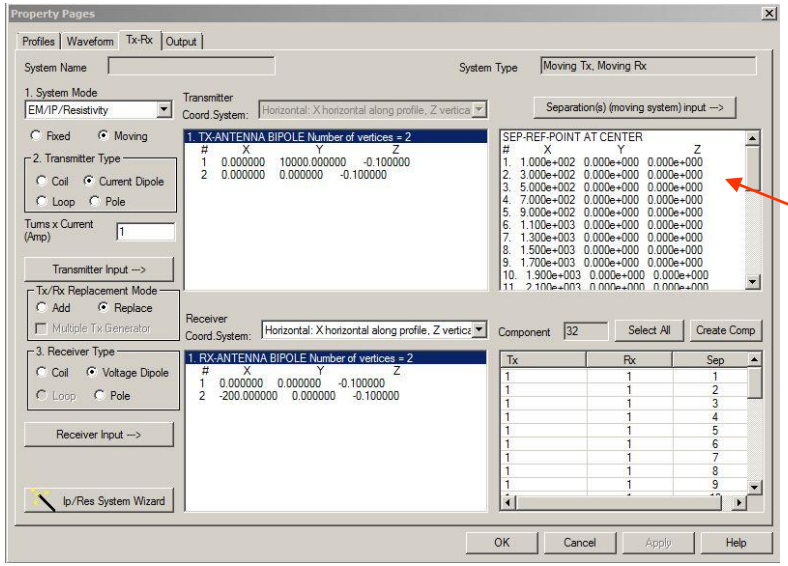
1. Import data
2. **Examine data**
3. Perform initial modeling
4. Perform 3D resistivity inversions
5. Check model and create plots

1. Check database for the survey

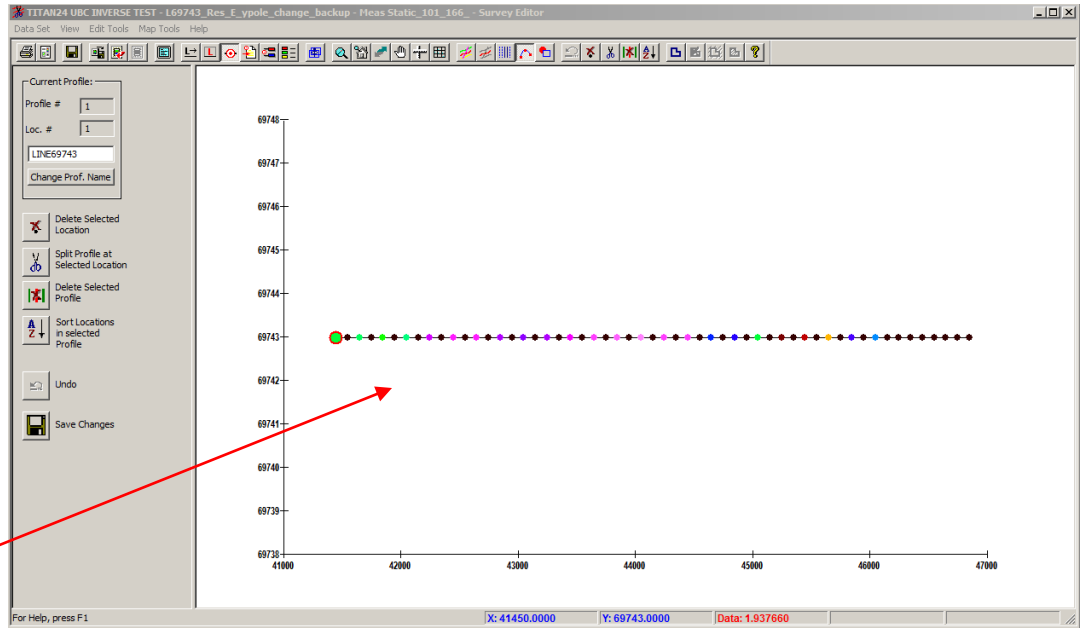


2. Click configuration





3. Check separations

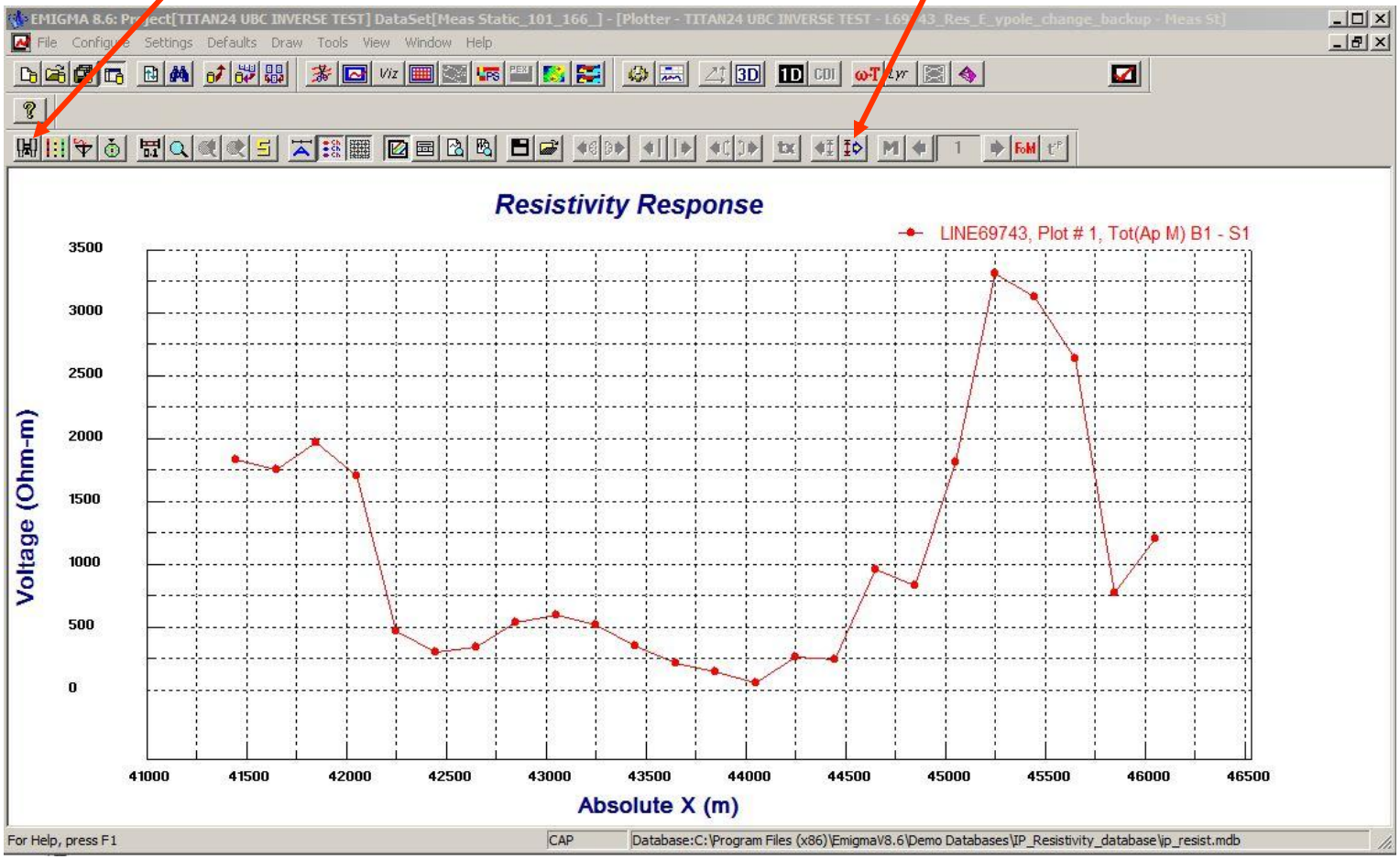


4. Check lines and stations by clicking "Survey Editor" button 

1. Import data
2. **Examine data**
3. Perform initial modeling
4. Perform 3D resistivity inversions
5. Check model and create plots

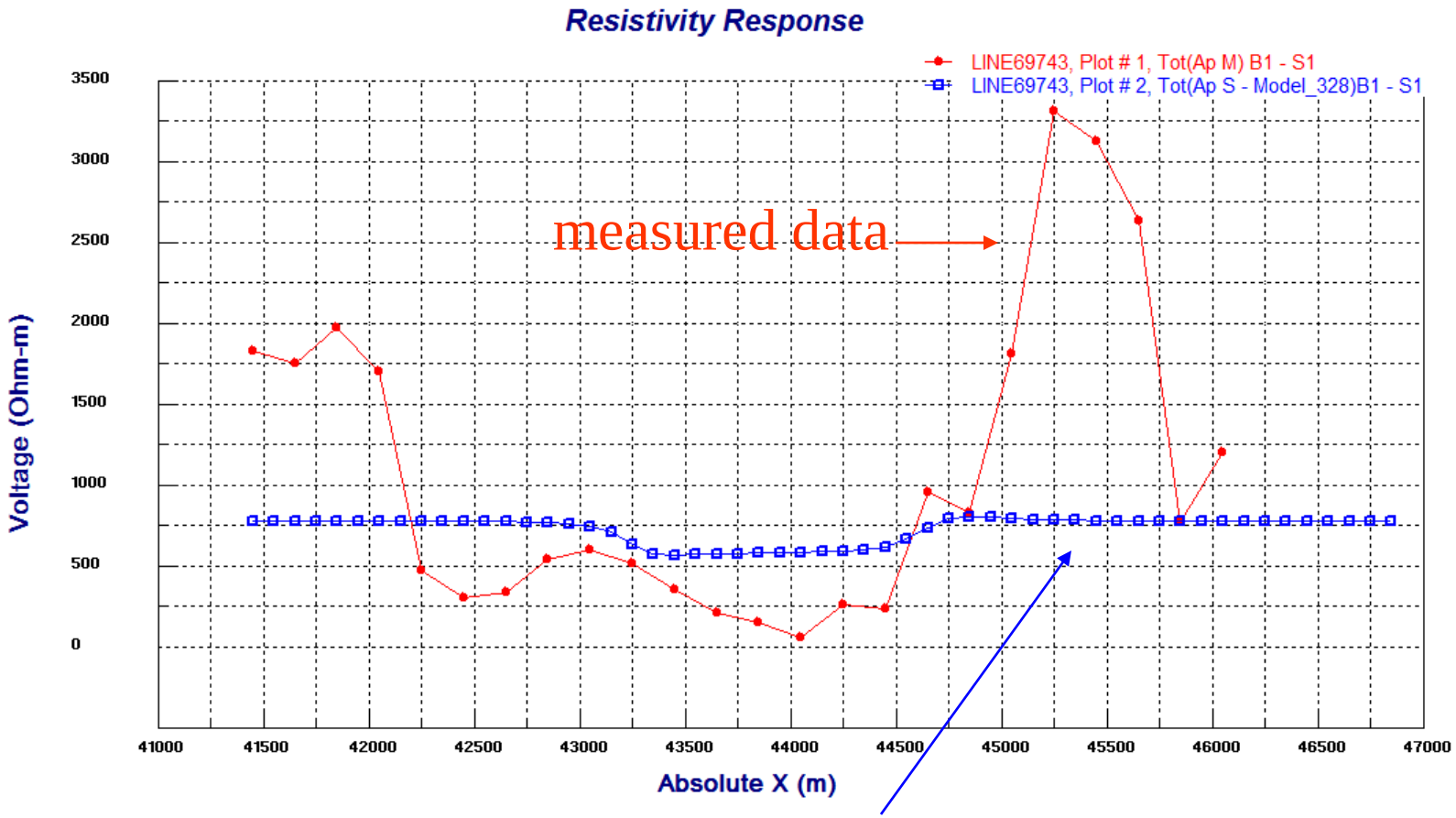
Load data set in plotter

Toggle between separations

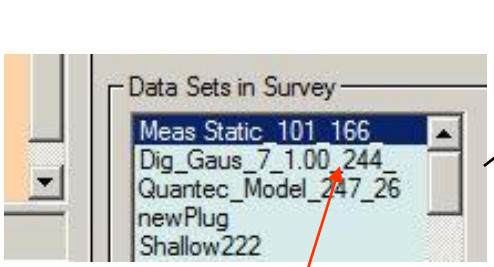


1. Import data
2. Examine data
3. **Perform initial modeling**
4. Perform 3D resistivity inversions
5. Check model and create plots

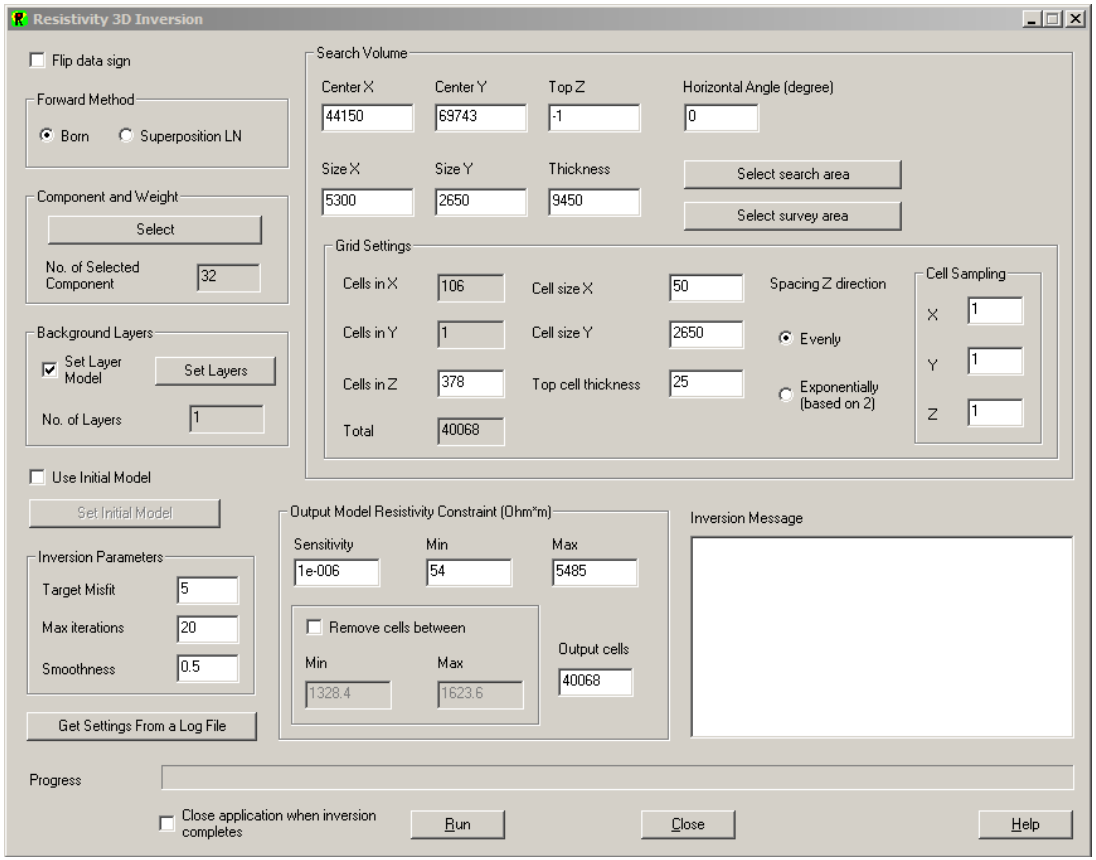
Note: *Performed some initial modeling to get a "feel" of the background resistivity and estimate parameters of initial model for inversion.*



1. Import data
2. Examine data
3. Perform initial modeling
4. **Perform 3D resistivity inversions**
5. Check model and create plots



Select measured data



1. Import data
2. Examine data
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4. **Perform 3D resistivity inversions**
5. Check model and create plots

Set search volume and grid:

User can input the search volume's center position (X, Y), top Z position and horizontal angle with the coordinate, also the volume's regime on X and Y axis as well as its thickness. User can also manually select the search area on the graphic tool by clicking the "Select search area" button

User can set grid by input cell size on X, Y and Z axis as well as number of cells in Z (can be evenly or exponentially spaced). The sampling rate of cells for all axes can be set in "Cell Sampling" area

Choose "Flip data sign" option if it is not in accordance with system

Select forward simulation method: Born approximation or Superposition LN

Select components for inversion and assign weights on them

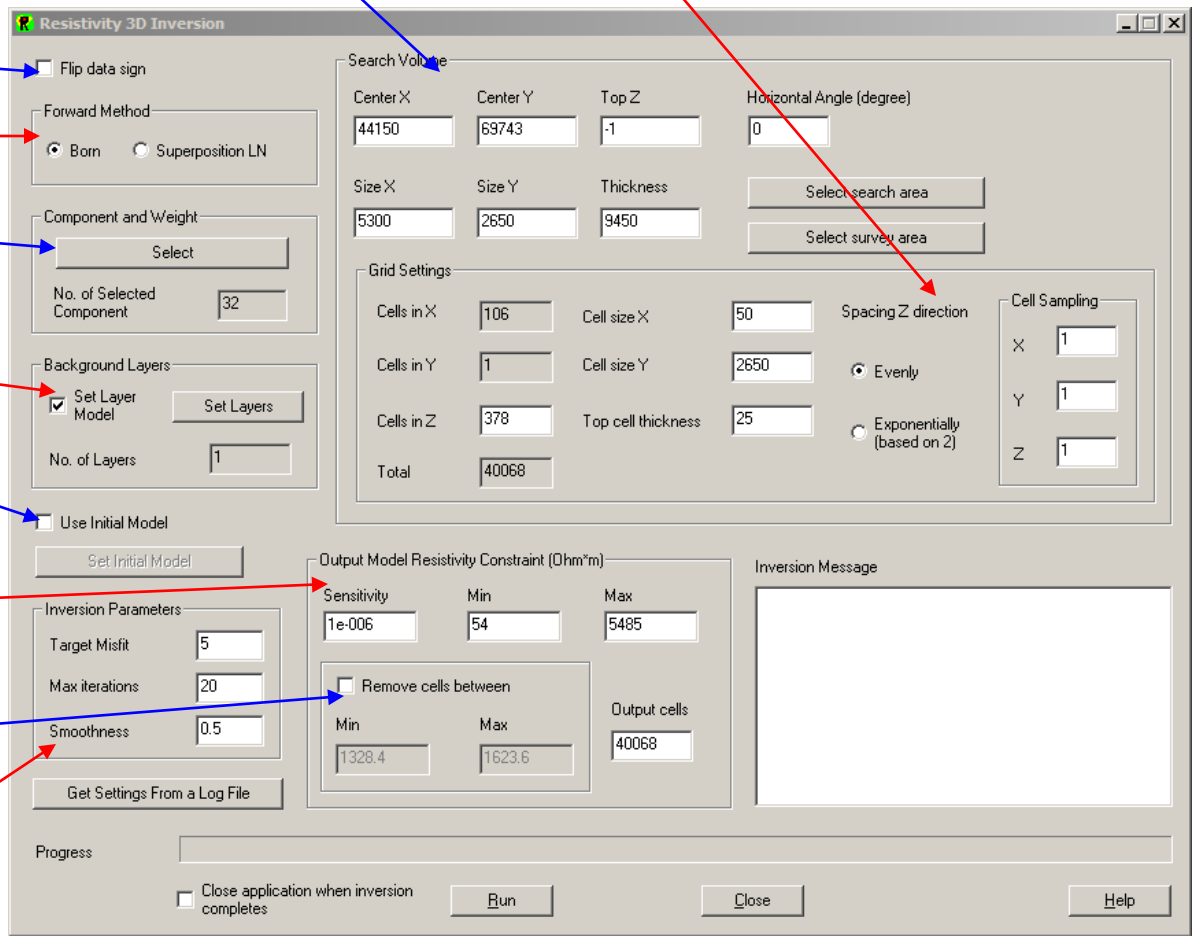
Set background layers parameters (resistivity and thickness) within which the model situated

Create or import initial model for inversion in the pop-up dialog

Set constraint for output model's resistivity to exclude inverted models with unwanted resistivity values

User can also remove model cells whose resistivity values are within a certain range to accelerate processing

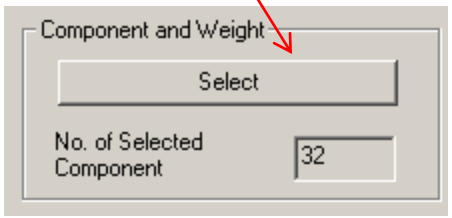
Set inversion parameters: tolerant data error (Target Misfit), maximum number of iterations (Max iterations) and Smoothness of the model

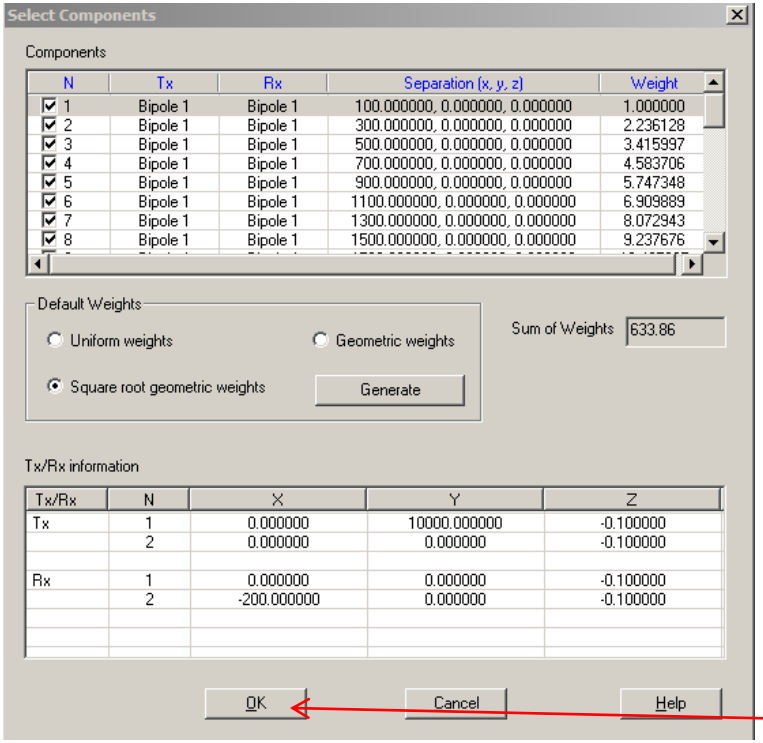


1. Import data
2. Examine data
3. Perform initial modeling
4. **Perform 3D resistivity inversions**
5. Check model and create plots

Selection of components

Click “Select” button



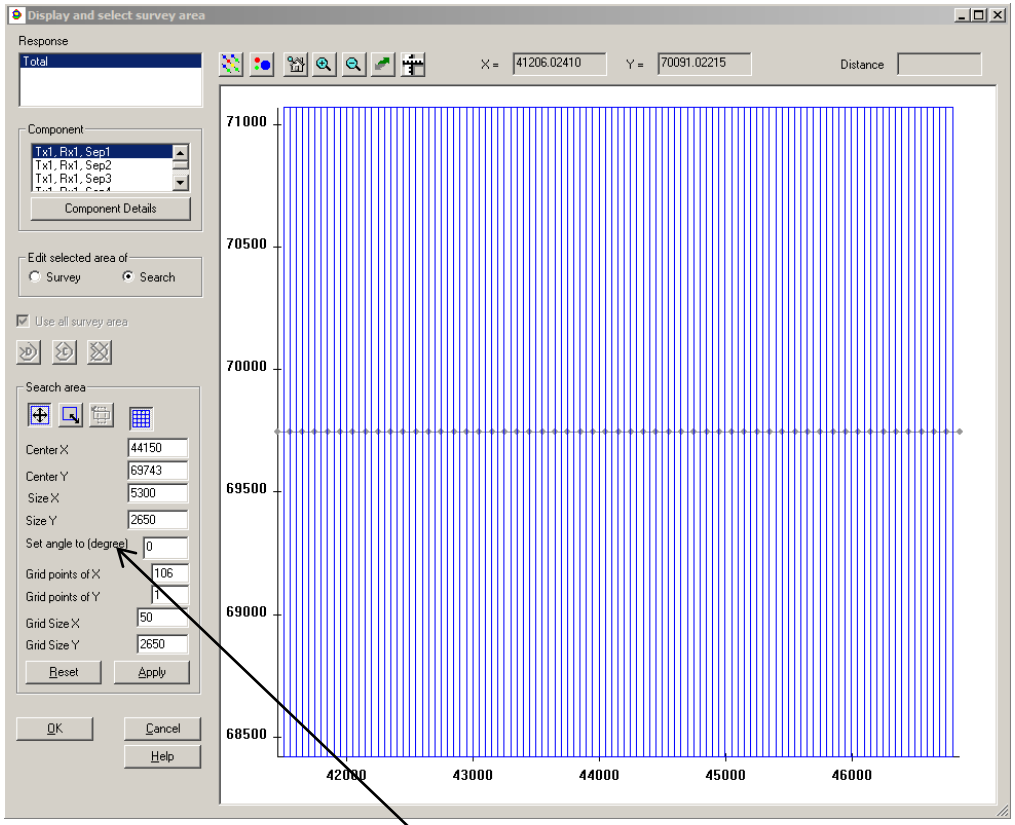


Click “OK” button after it is done

Users can select components involved with inversion. For the case of 3D resistivity inversion, different components are actually different separations. Users can also give weightings to different components. Use more components in inversion will make the inverted model more accurate

1. Import data
2. Examine data
3. Perform initial modeling
4. **Perform 3D resistivity inversions**
5. Check model and create plots

Clicking either the **Select Search Area** or **Select Survey Area** buttons launches the same window. But search area means the area of data which the inversion algorithm works on, while survey area is the whole part of the imported data.



If change the value in “Set angle to (degree)” box, the angle between search area and survey area will be changed accordingly

Survey Area

Click the Select survey area button to launch the graphical tool which enables you to specify the data points that will be used in the inversion calculations.

Search Volume

The default parameters in the **Search Volume** section will create a grid that covers the entire survey. You can modify the search area parameters by entering new values or by using the graphical tool

1. Import data
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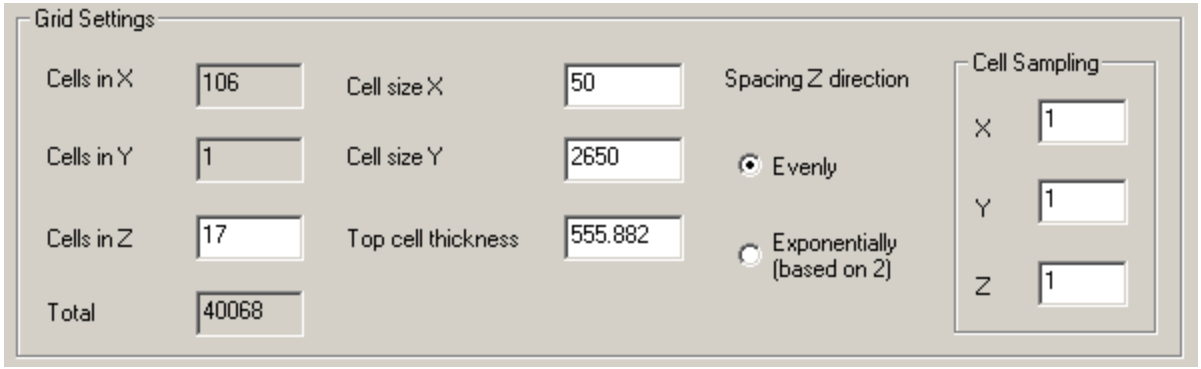
4. **Perform 3D resistivity inversions**
5. Check model and create plots



Grid Settings

Confirm the number and layout of grid points to be used in the inversion in the **Grid Settings** area. The points will be evenly spaced in the x and y directions. Choose **Evenly** for evenly spaced points in the z direction or **Exponentially (based on 2)** for exponentially spaced points.

Cell Sampling

Grid cells can be divided into smaller units when calculate the simulated data. Type your values in the **X**, **Y** and **Z** boxes to specify the number of samples in the X, Y and Z directions

1. Import data
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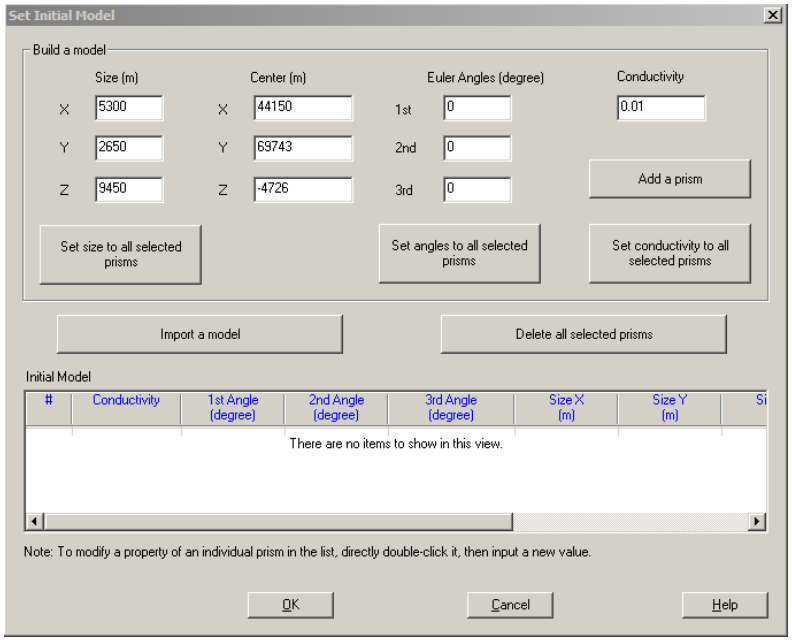
5. Check model and create plots



Initial Model

Click the checkbox labeled **Use Initial Model** to specify an initial model. Return to the initial model window by clicking the **Set Initial Model** button.

The starting model is described by a list of prisms with various properties in the box labeled **Initial Model**.

add a prism to the model list

Specify the conductivity, size, position and orientation of the new prism in the **Build a model** section.
Click the **Add a prism** button.

modify an existing prism in the model list

Select the number of the prism to be modified in the anomaly list, and double-click the parameters to make modification directly.

delete prisms from the model list

Select the prisms to be deleted in the anomaly list.
Click **Delete all selected prisms**

apply the same values for a group of selected prisms

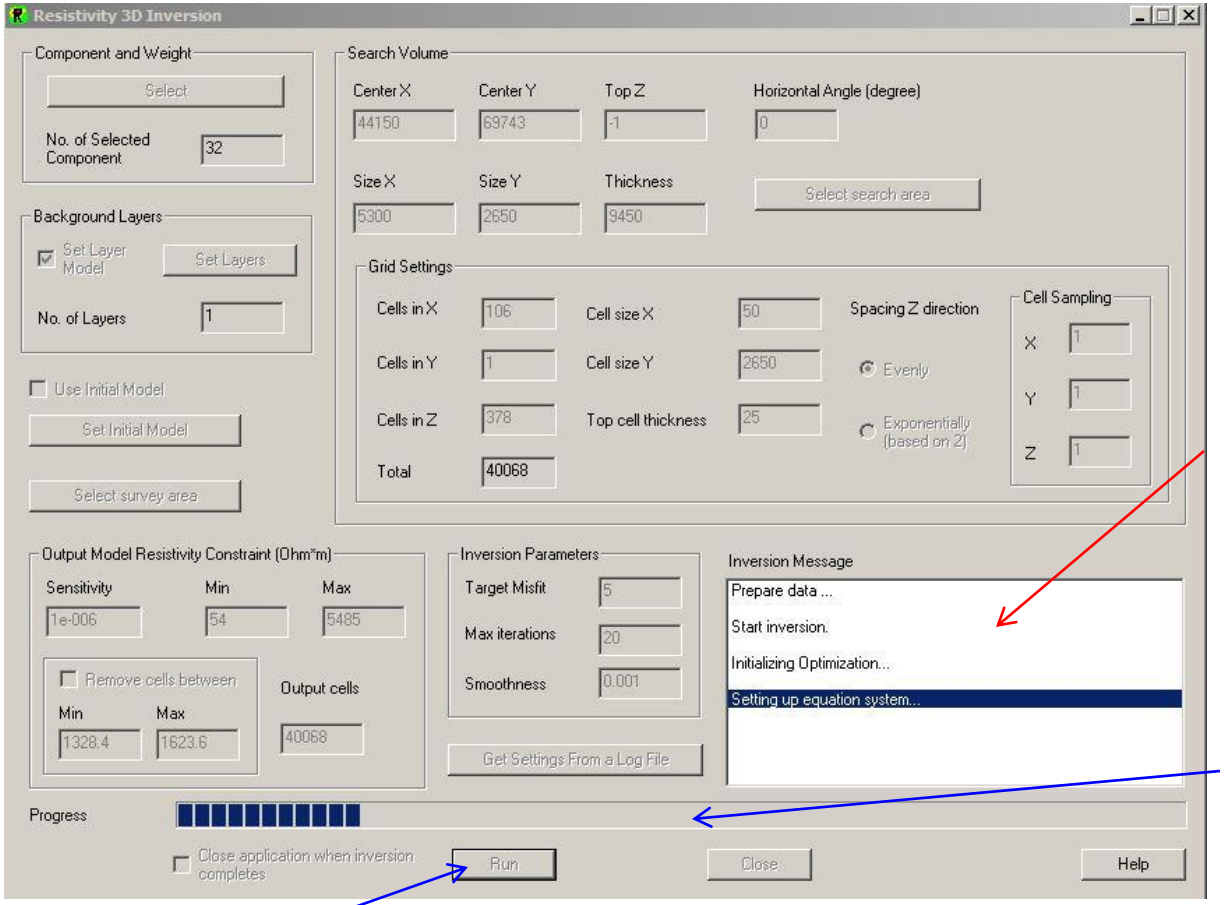
Click the **Set conductivity to all selected prisms** button to modify the conductivity.
Click the **Set angles to all selected prisms** button to modify the angles.
Click the **Set size to all selected prisms** button to modify the size.

import a model from another data set in the current database

Click **Import a model**.
Select the project, survey, and data set with the desired model
Click **OK** and the model will appear in the **Initial Model**.

1. Import data
2. Examine data
3. Perform initial modeling
4. **Perform 3D resistivity inversions**
5. Check model and create plots

Executing the Inversion



The right window (in white) shows each data point's progress.

The "Progress" bar shows the total progress of this inversion.

Click "Run" button to start inversion

1. Import data
2. Examine data
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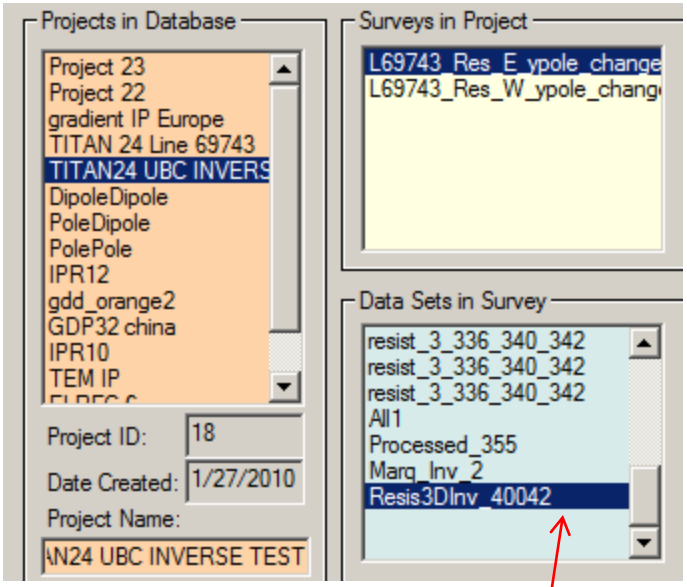
4. Perform 3D resistivity inversions
5. **Check model and create plots**

Inversion Evaluation

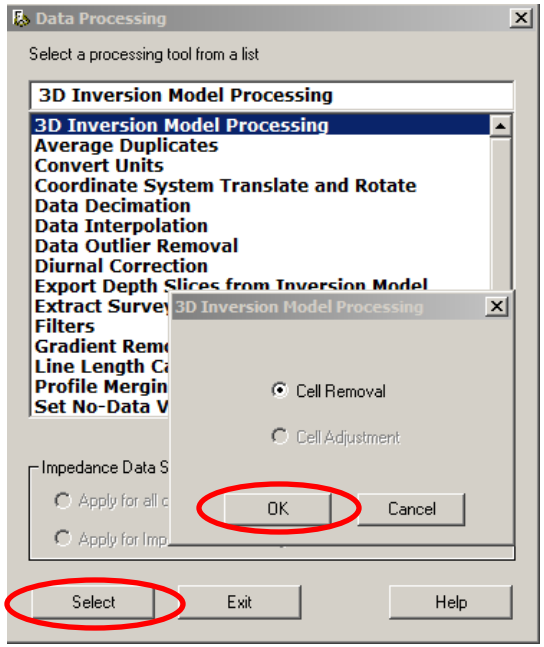


Our 3D inversion model dataset

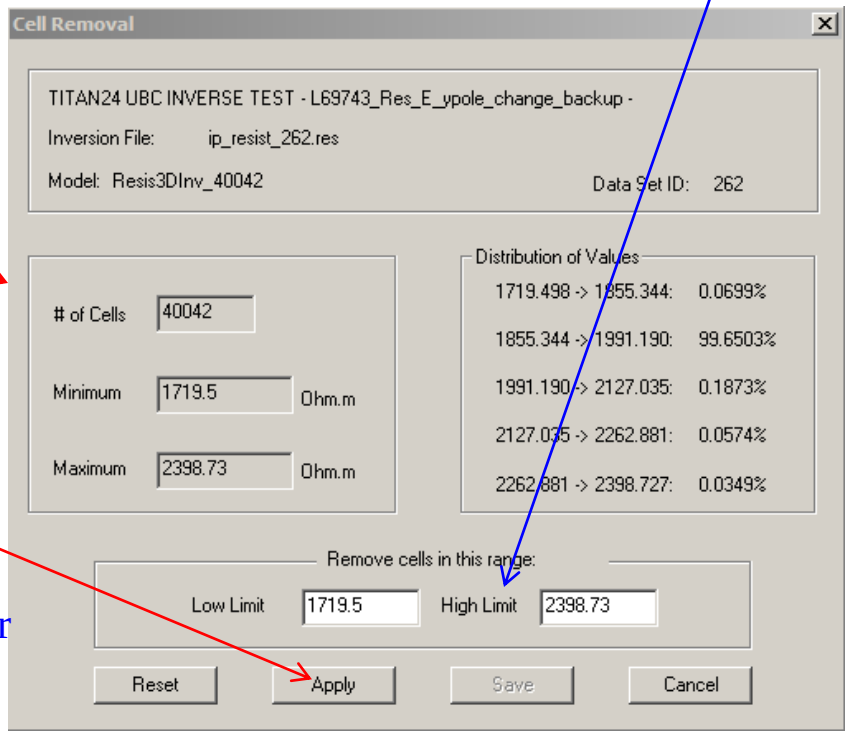
In each survey, there will be several data sets after modeling, inversion and processing. In this case, we have several forward models, one 1D inversion model (Mar_Inv_2, achieved from 1D inversion) and one 3D inversion model (Resis3DInv_40042, as highlighted). Each forward model has a new data set containing the simulated data under the model. Similarly, each inversion contains a new dataset containing the simulated data set under the inversion model (for each point) and attached to that data set is the inversion model.

1. Import data
2. Examine data
3. Perform initial modeling
4. Perform 3D resistivity inversions
5. **Check model and create plots**

Inversion Evaluation



Users can use “3D Inversion Model Processing” tool to remove cells in inverted model. Follow the routine shown in this page and arrive “Cell Removal” dialog. Choose the removal range of cells: “Low Limit” and “High Limit” (any cell within this range will be removed)



Click “Apply” button when it is done

Therefore, users can reduce the range of model either before inversion (by Select Search Area) or after inversion (by Cell Removal)

1. Import data
2. Examine data
3. Perform initial modeling
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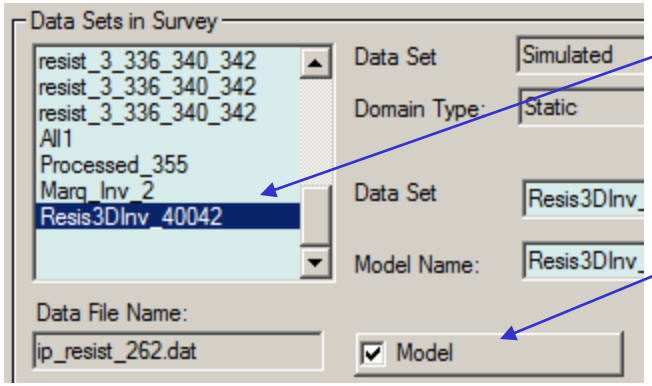
5. **Check model and create plots**

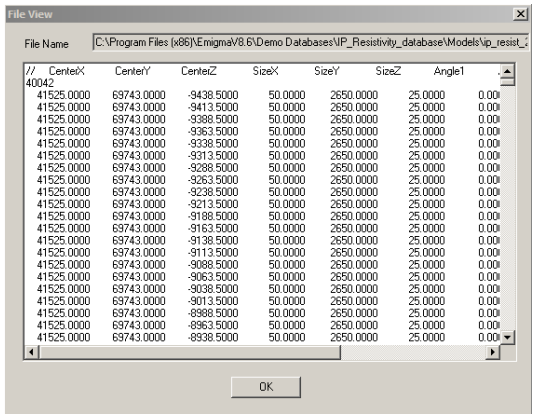
Inversion Evaluation

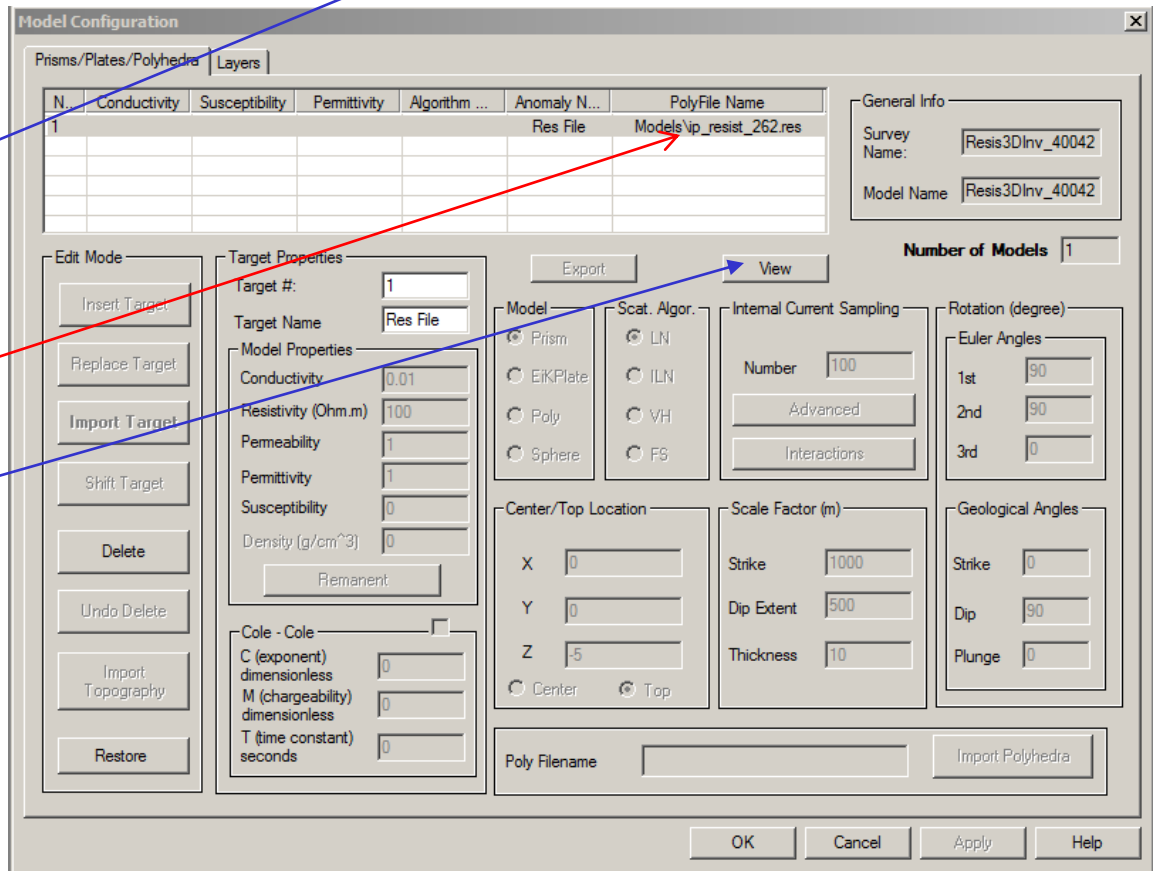
An inversion is selected. You will note the "Model" button is checked. If the "Model" button is clicked…



The model will be saved as a "Res File" with its name and folder shown in the "PolyFile Name" column of the table

Click "View" button to open this file…





1. Import data
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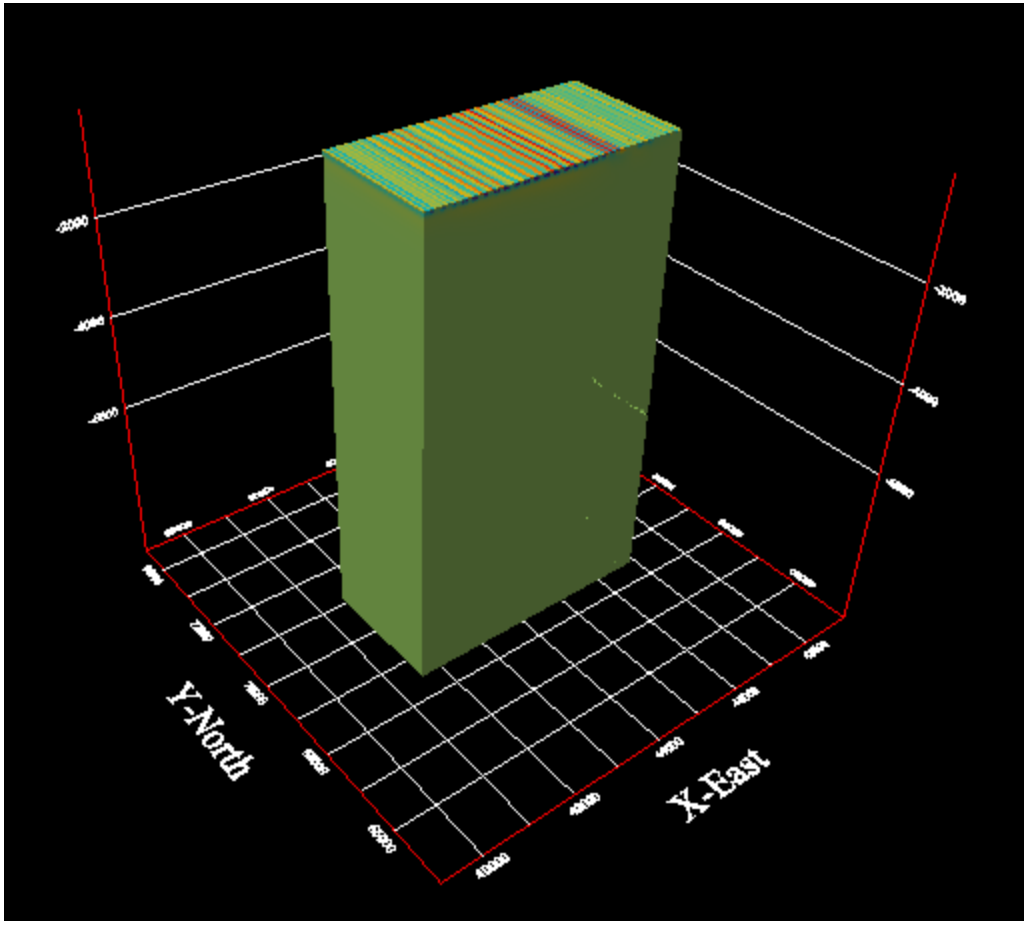
5. **Check model and create plots**

Inversion Evaluation

Click Viz button to open Visualizer tool to view the inverted 3D model…



1. Import data
2. Examine data
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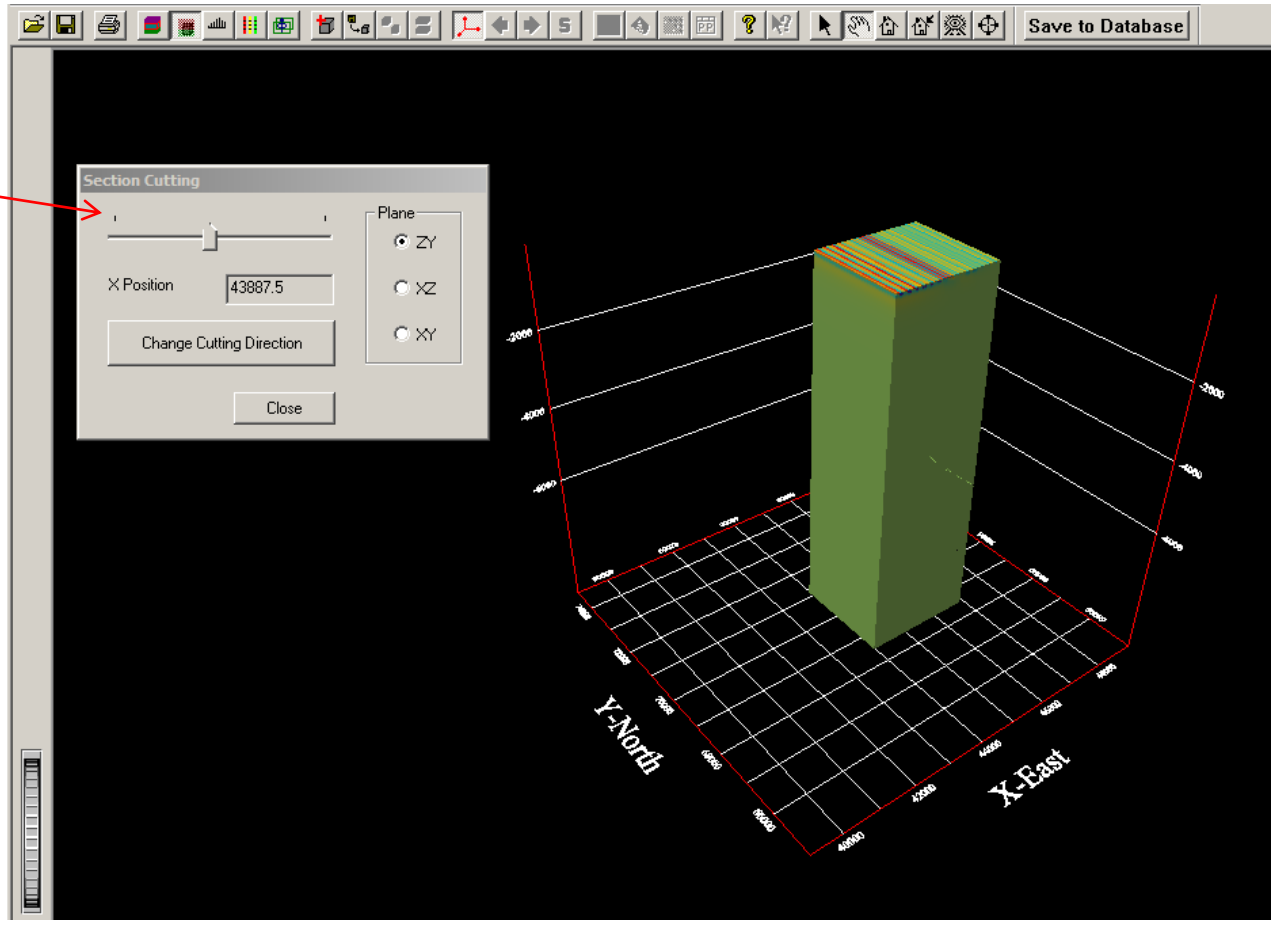
5. **Check model and create plots**

Inversion Evaluation

Select from menu “Model -> Mag/Grv/Res File -> mag/grv/res Cutting” to open the Section Cutting tool.

By adjusting the bar…

User can view sections of the 3D model from XY, XZ and ZY planes with any penetration depth



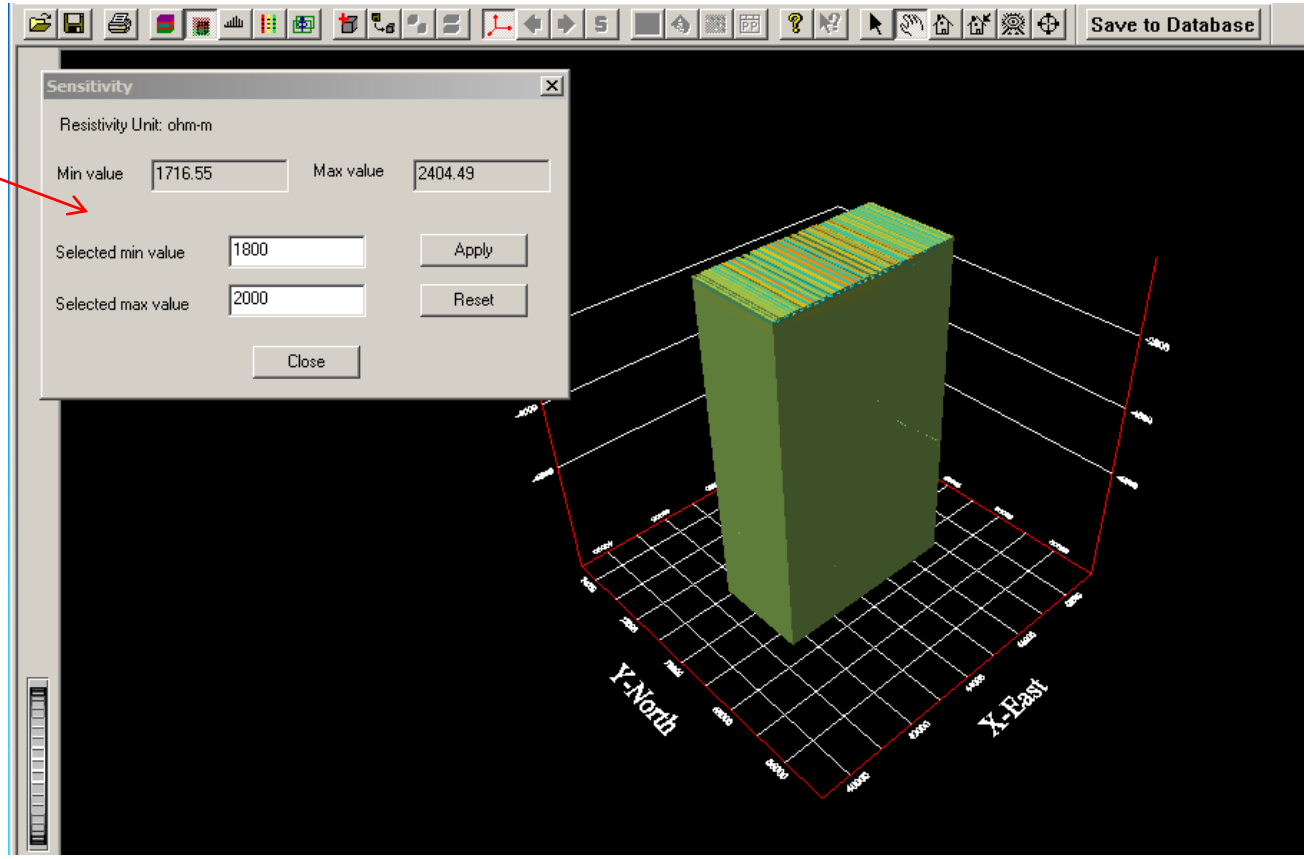
1. Import data
2. Examine data
3. Perform initial modeling
4. Perform 3D resistivity inversions
5. **Check model and create plots**

Inversion Evaluation

Select from menu “Model -> Mag/Grv/Res File -> Sensitivity” to open the Section Cutting tool.

By adjusting minimum value and maximum value shown in the figure…

The model in this figure will only exhibit cells with values specified in this range



1. Import data
2. Examine data
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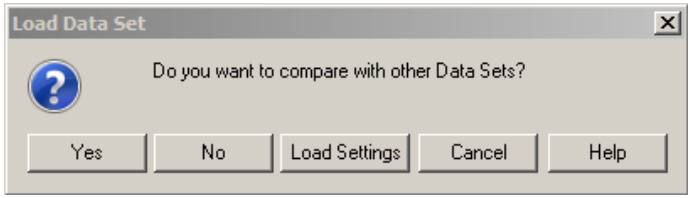
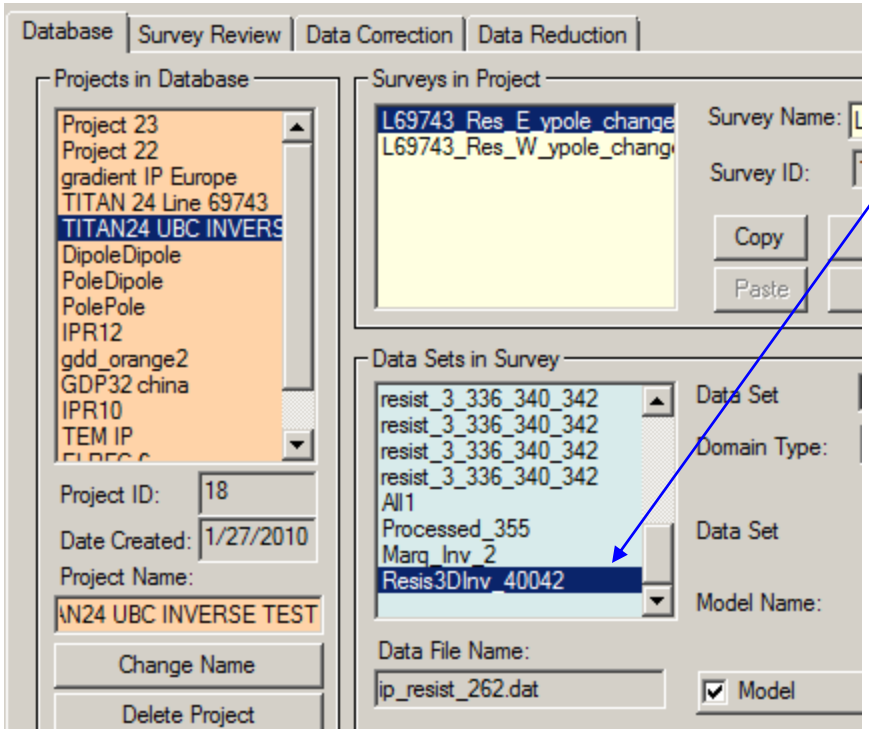
5. **Check model and create plots**

Inversion Evaluation

To assess how well the inversion model fits the data at each station, select the inversion data set and then select the plotter.



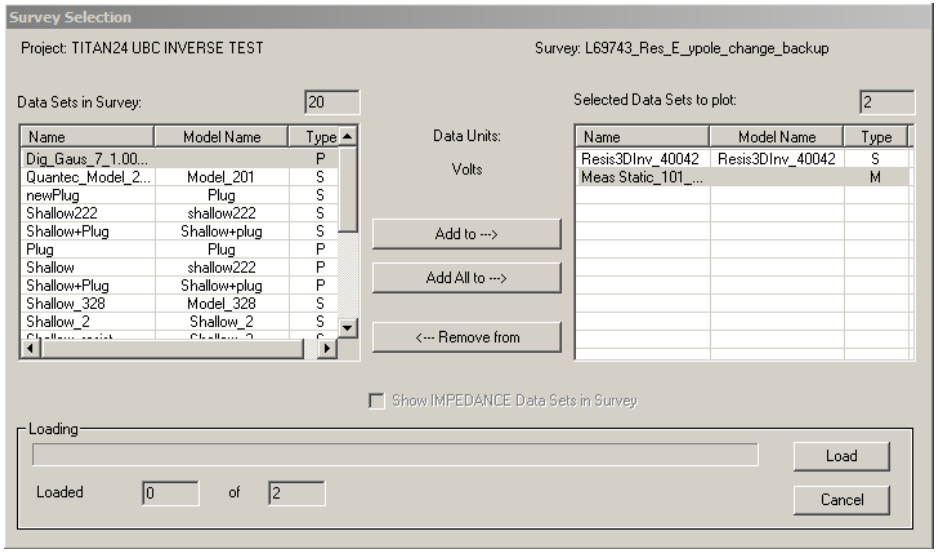
Select “Yes”, if this dialog is appeared



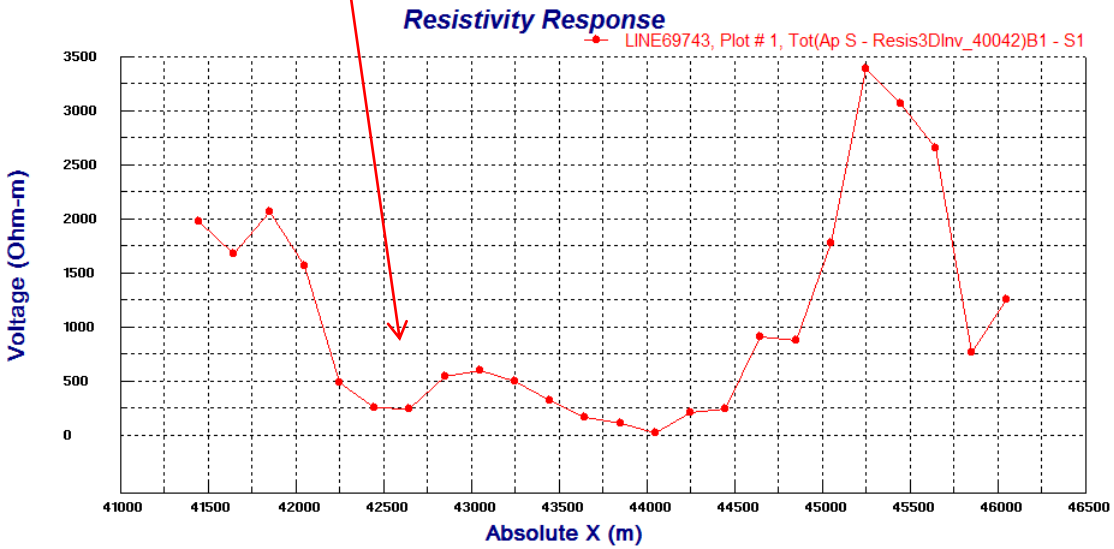
1. Import data
2. Examine data
3. Perform initial modeling
4. Perform 3D resistivity inversions
5. **Check model and create plots**

Inversion Evaluation

Select the data sets required for comparison and then click “Load”



All selected data sets are then loaded to the Plotter application and the plot appears showing the simulated data of the first separation.



1. Import data
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3. Perform initial modeling
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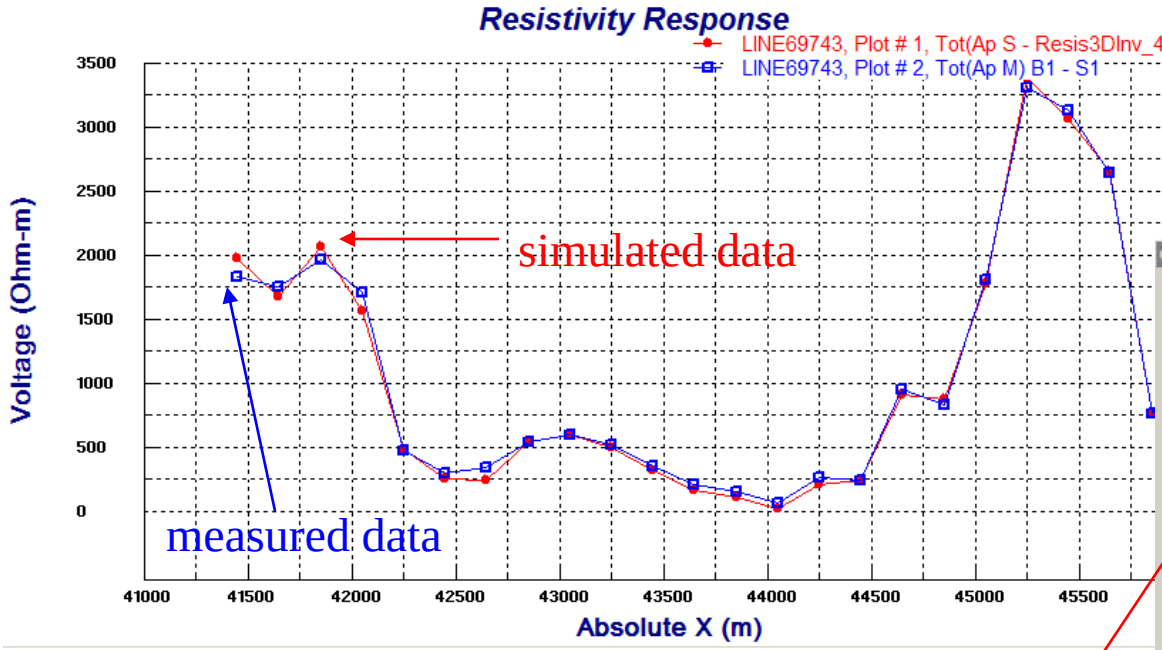
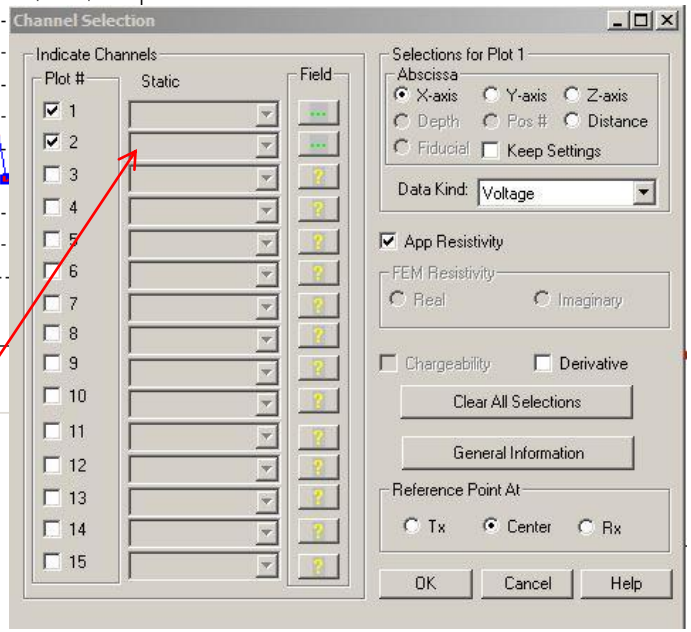
5. **Check model and create plots**

Inversion Evaluation

The user may select other data sets to plot by simply double clicking on the plot





Select for the 2nd plot on measured data

1. Import data
2. Examine data
3. Perform initial modeling
4. Perform 3D resistivity inversions
5. **Check model and create plots**

Inversion Evaluation

Multiple plots can be shown for various inversions and models in "Static" mode. The user may step through different separations by simply clicking the arrow.