3D MAGNETIC INVERSION 三维 磁场数据反演 TUTORIAL 教程

Steps: 步骤： ***Page***

EIKON TECHNOLOGIES

介绍 Introduction

磁场通常被归入“势场”，并被理解为类似于重力场。 但是，磁场与重力场有很大不同。 首先，磁场由与重力场截然不同的方程控制，这些方程实际上类似于直流电阻率。 我们尝试着将这些差异纳入 **EMIGMA**。

Magnetics is often lumped into the term Potential Fields and understood to be like gravity data. But, magnetics differ greatly from gravity. First, the magnetic fields are governed by very different equations than gravity and these equations are actually analogous to DC resistivity. We try to incorporate these differences in EMIGMA.

首先，磁勘测的源场是区域磁矢量场。 然而，重力是由一个几乎均匀的场定义的，它与地面垂直，只由距离地球中心的距离确定。虽然存在区域和局部重力变化，但它们对测量场的影响很小。 磁场受区域和局部结构的影响。为了解决这个问题，**EMIGMA** 考虑了总响应而不仅仅是残差。 因此，在考虑大面积区域场的同时，注意时间变化的修正是很重要的。First, the source field for a magnetic survey is a regional magnetic vector field. Whereas, gravity is defined by a virtually homogeneous field which is only vertical at the surface and defined only by the distance from the center of the earth. While, there are regional and local gravity variations, they affect little the measured fields. The magnetic fields are affected by regional as well as local structures. To deal with this, EMIGMA considers the total response and not just the residual. It is thus important to pay attention to the corrections for temporal variations as well as considering the bulk regional field.

重要的是要考虑修正的第一阶段。通常认为只有日变化校正是重要的，但时间变化包括内部分量(日)和由于大气效应(通常认为是大地电磁源场)引起的外部变化。因此，简单地减去基站测量是有问题的，因为这些变化是由于日变化、外部信号和基站自有的噪声。因此，我们建议首先在**EMIGMA**中处理基站数据以删除明显的噪声，并通过滤波去除外部高频噪声，然后再进行日校正，仅去除如此得到的变化。

It is important to consider the first stage of corrections. It is often thought that only the diurnal variation correction is important but the temporal variations consist of both an internal component (diurnal) as well as an external variation due to atmosphere effects most commonly thought of as the magnetotelluric source field. As such, a simple subtraction of the base station measurement in problematic as these changes are due to the diurnal variation, the external signal and cultural noise at the base station. We thus suggest first processing the base station data in EMIGMA to delete obvious cultural noise and to remove the external high frequency noise by filtering prior to performing the diurnal correction removing only the variation in this final effect.

使用校正后的总场测量可以估计区域源场。虽然这与**IGRF**相似，但在平均场与**IRGF**振幅之间总是存在差异。只有通过测量三分量数据，才能估计出区域磁场的实际倾角和偏角。

Using the total field measurement after corrections allows one to estimate the regional source field. While this will be similar to the IGRF, there will always be a difference in the average field to the IRGF amplitude. Only by measuring three component data can one estimate the actual inclination and declination of the regional field.

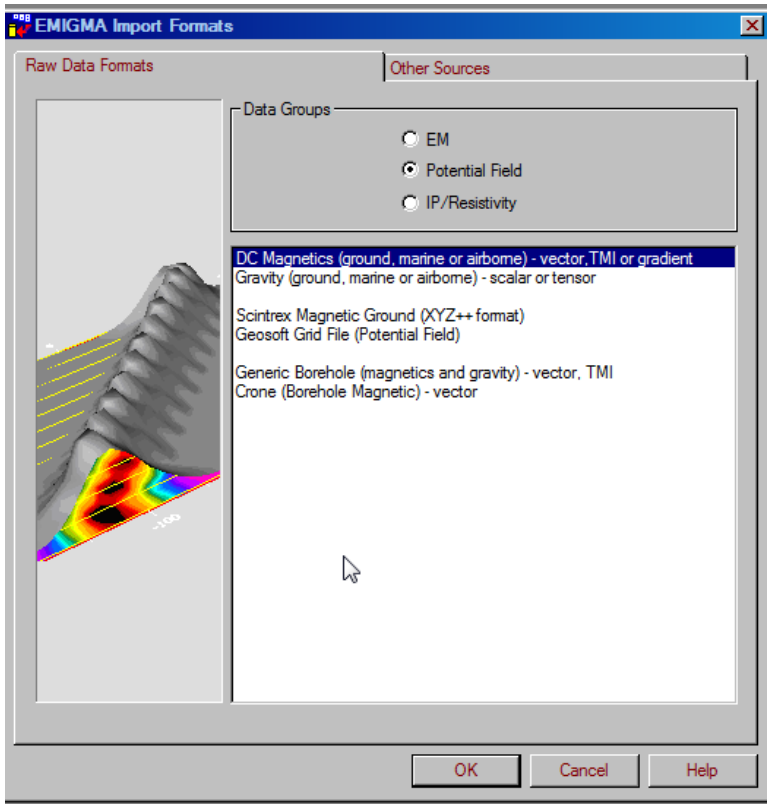
如果您的数据被基站自动减小，我们建议在导入前将您的数据添加基站平均响应。如果仪器制造商无法提供基站值，那么唯一的替代方法是确定**IGRF**，并在导入数据之前将其添加到数据中。

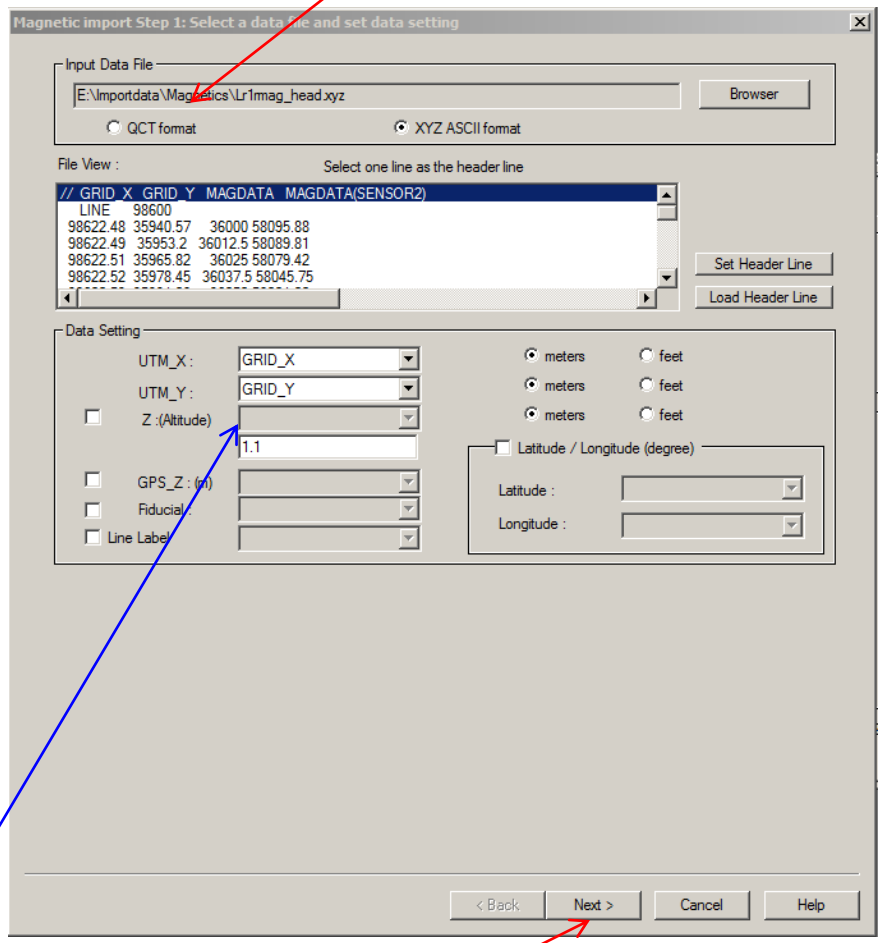
If your data is automatically reduced by the base station, we suggest to add the average base station response to your data before import. If the base station values are not available from the instrument manufacturer then the only alternative is to determine the IGRF and add this to your data before import.

1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. 检查模型并创建绘图 Check model and create plots

浏览并选择 .qct 或 .xyz 数据文件进行导入。 第一个示例是网格上的旧数据集，没有 GPS 或纬度/经度信息。

Browse and select .qct or .xyz data file for import. This first example is an older data set on a grid without GPS information or Latitude/Longitude.





选择坐标轴对应的数据文件列，并指定其单位

Select data file columns corresponding to coordinate axis, and specify their units as well

单击“下一步”按钮继续下一步

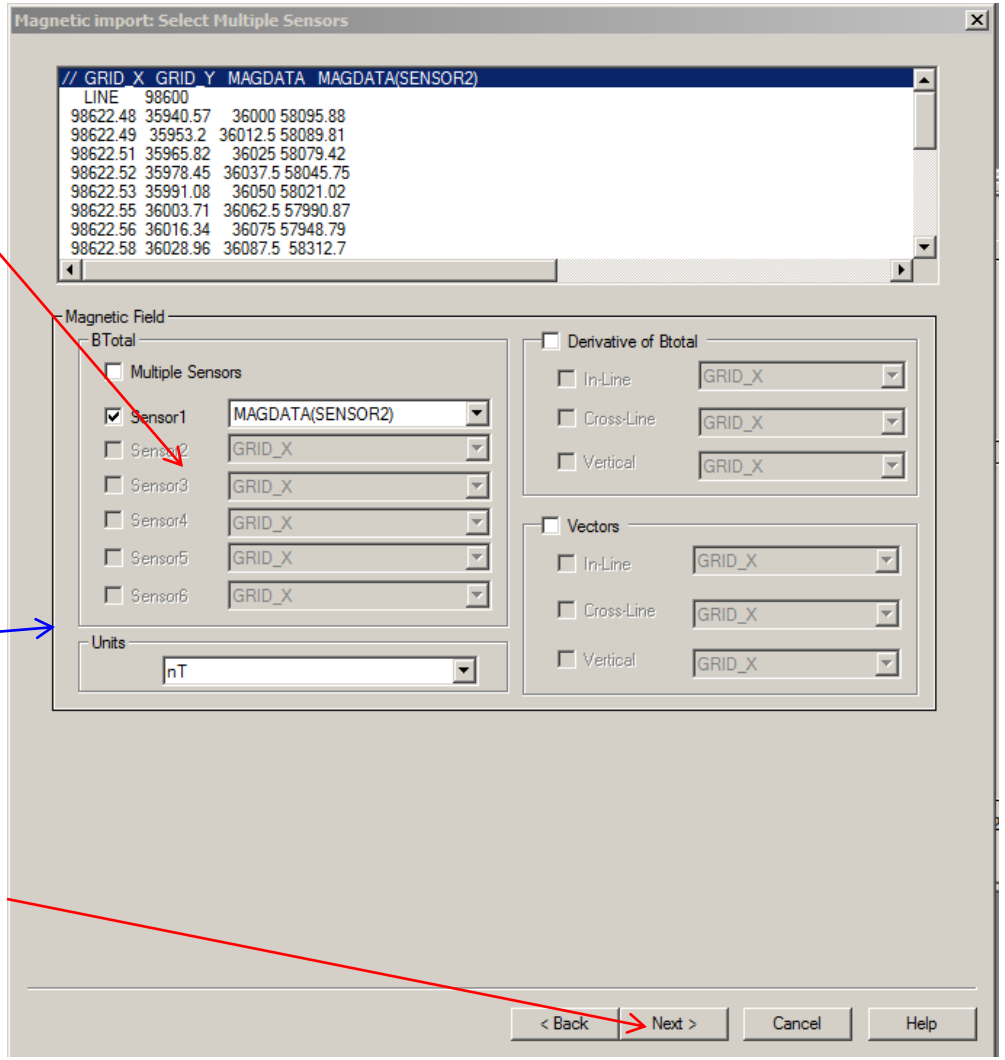
Click “Next” button to proceed to the next step

1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. 检查模型并创建绘图 Check model and create plots

选择磁性数据的列名称。
这个例子，只有总场数据和 1 个传感器
Select column name for magnetic data.
In this case, there is only total field data and 1 sensor.

选择导入数据的单位
Select units for imported data

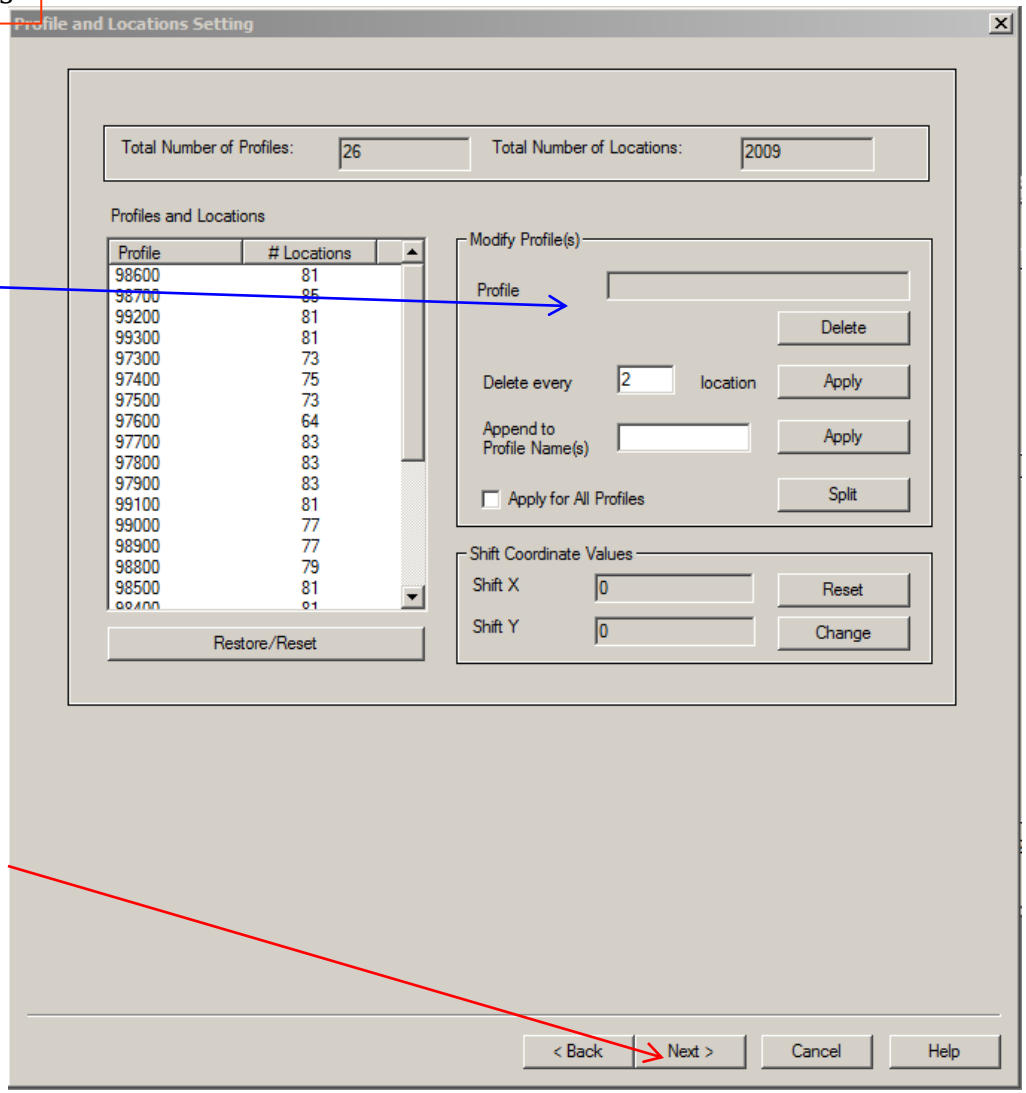
单击“下一步”按钮
Click “Next” button



1. 导入数据 **Import data**
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. 检查模型并创建绘图 Check model and create plots

显示测线信息，用户可以在该对话框中对测线进行删除/减少/移动操作。 一旦数据进入数据库，这些工具就都可用了。

Show profile information, users can perform delete/reduction/shift operations on profiles in this dialog. But these tools are available once the data is inside the database.



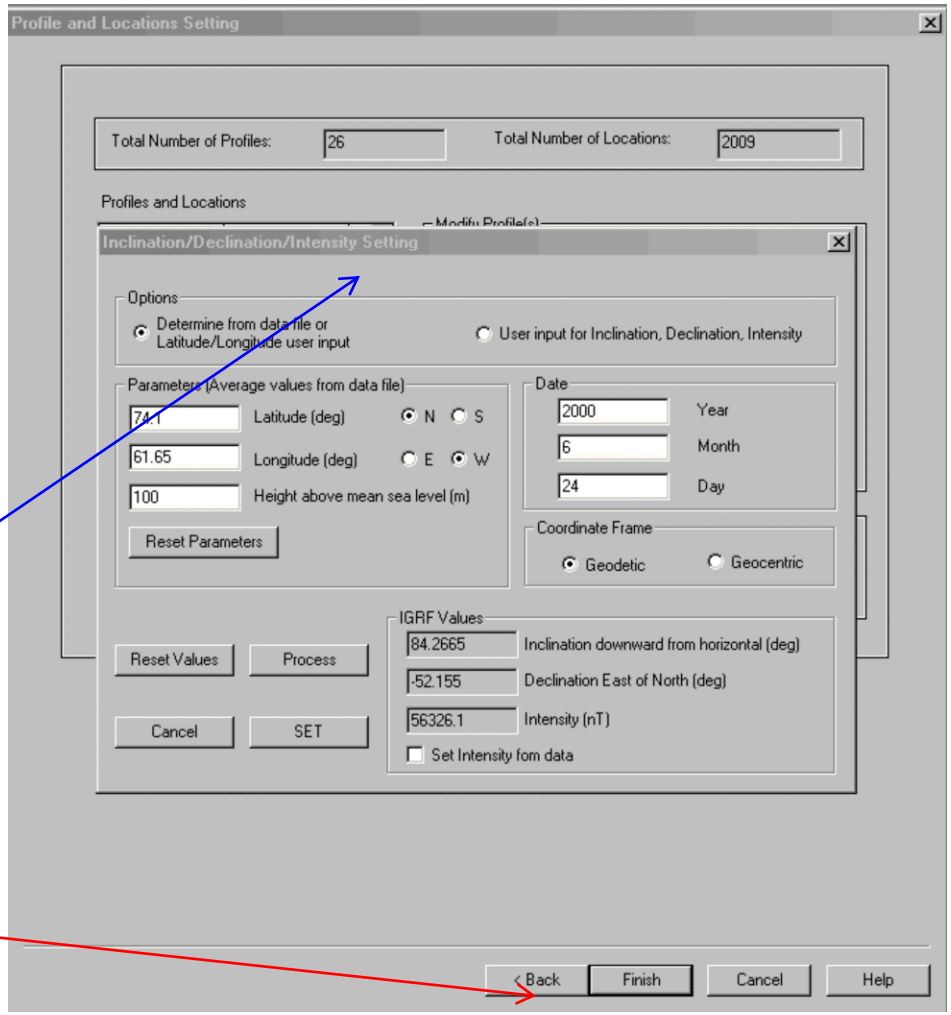
单击“下一步”按钮
Click “Next” button

1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. 检查模型并创建绘图 Check model and create plots

您必须确定勘测区域中地球磁场的性质。 虽然可以根据您的数据估计区域磁场的大小，但磁场的角度确定磁化结构的内部磁化强度。 区域场由 IGRF 模型描述。
You must determine the nature of the earth's magnetic field in the area of your survey. While the magnitude of the regional field may be estimated from your data, the angle of the field defines the internal magnetization of the susceptible structures. The regional field is described by the IGRF model.

如果您的数据文件没有纬度/经度信息，请将其近似值及 GPS 海拔高度一起输入到显示的字段中。 由于地球磁场不是静止的而是缓慢变化的，因此您应该输入测量日期。
If your data file did not have Lat/Long information, enter it into the fields shown along with approximate GPS elevation. As the earth's field is not stationary but is slowly varying, you should enter the date of the survey.

点击处理然后设置 Click Process then Set



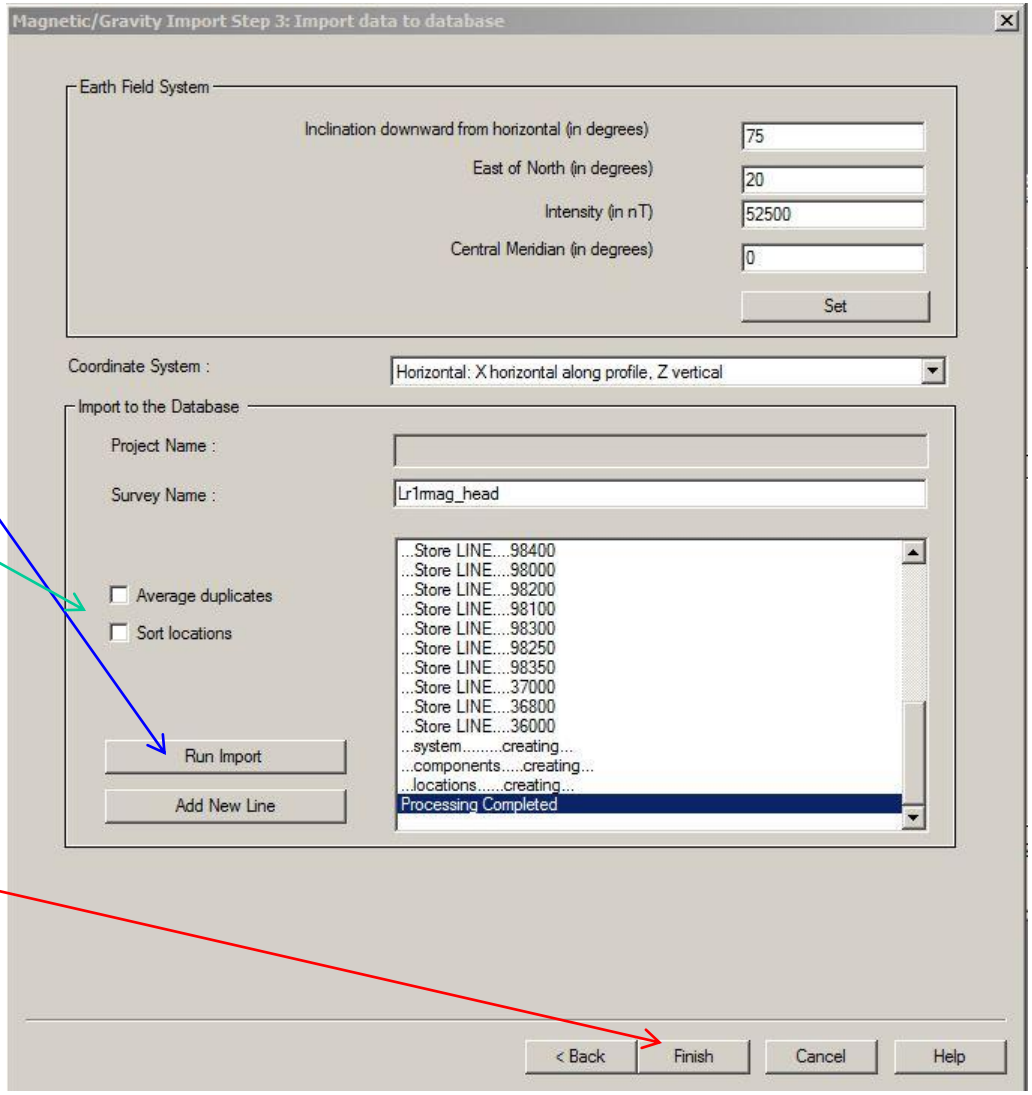
单击“下一步”按钮
Click “Next” button

1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. 检查模型并创建绘图 Check model and create plots

单击“运行导入”按钮开始将数据导入数据库
Click “Run Import” button to start importing the data into the database

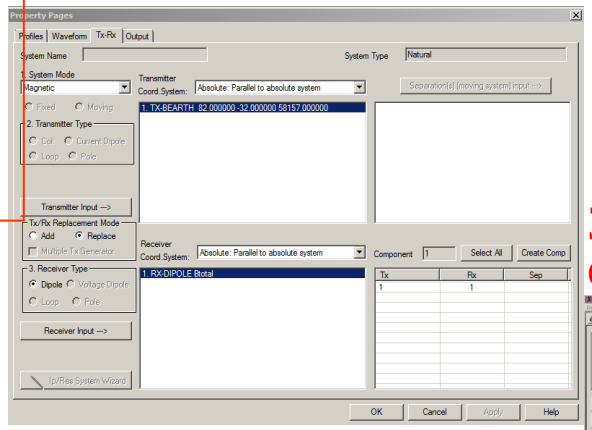
导入数据后，可以进行平均和排序
Averaging and sorting may be carried out later once the data is imported

处理完成后，点击“完成”按钮完成程序
After processing is done, click “finish” button to complete the procedure

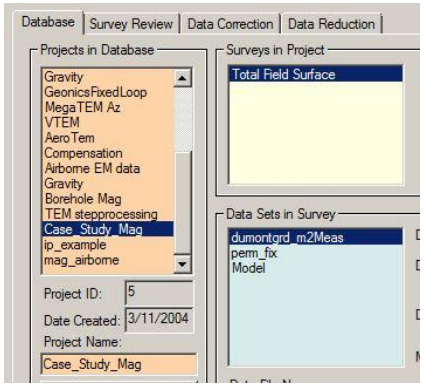


1. 导入数据 Import data
2. **检查数据 Examine data**
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. 检查模型并创建绘图 Check model and create plots

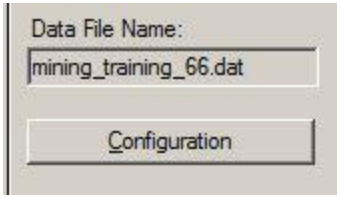
Magnetic Inverse 8



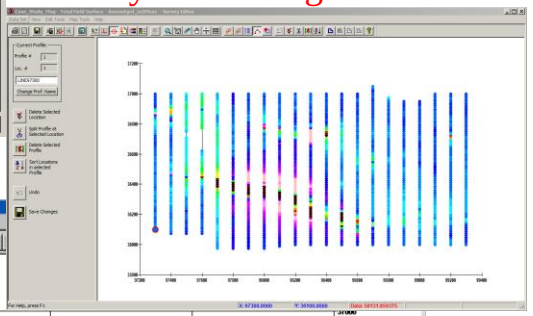
1. 检查勘测数据库
Check database for the survey

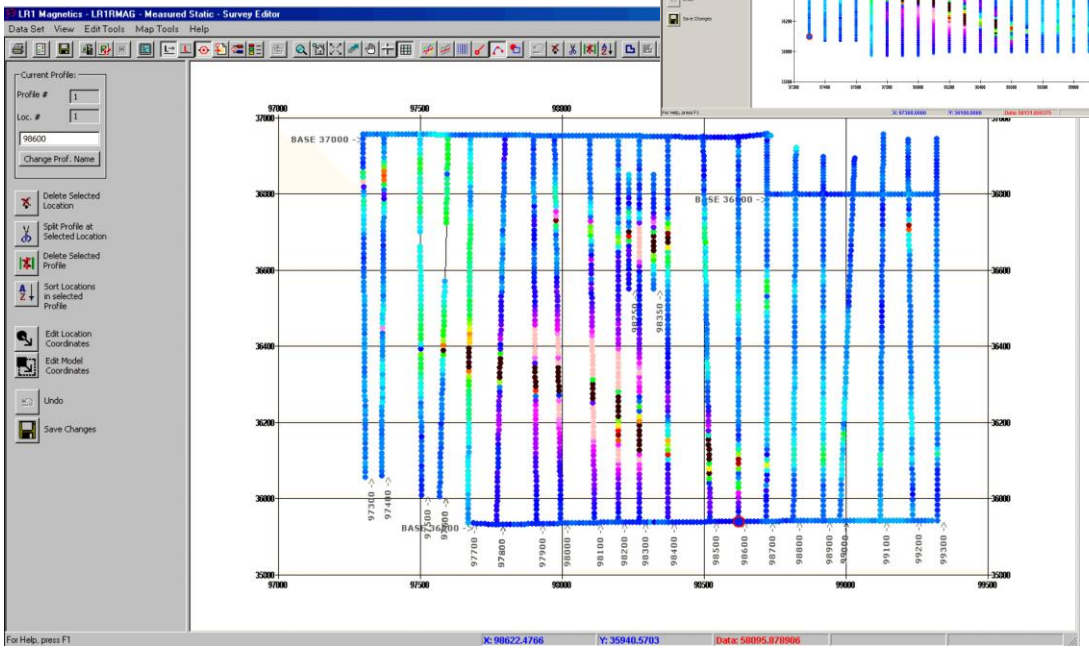


2. 点击配置 Click configuration



3. 检查系统配置
Check system configuration





4. 单击“勘测编辑器”按钮以检查测线和测点
Check lines and stations by clicking “Survey Editor” button

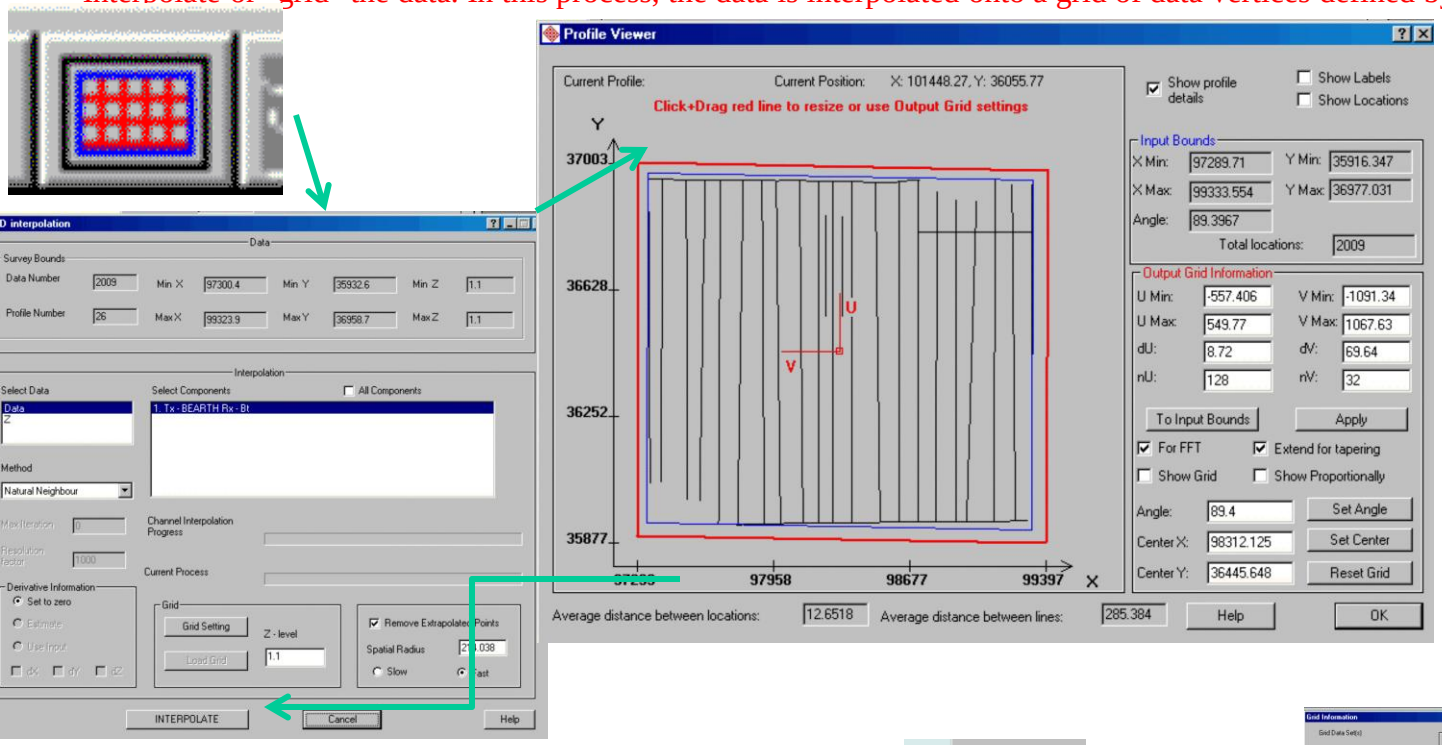
该工具是一种数据分析、编辑和插图工具。 **可以**删除、**修改、重命名**测线，**移**动、删除数据点，**并且可以叠加或构建插**图。 This tool is a data analyzing, editing and mapping tool. Profiles may be deleted, modified, renamed, datapoints moved, deleted, and maps may be underlain or constructed

12/13/2022

1. 导入数据 Import data
2. **检查数据、网格化和绘图**
Examine data, gridding and mapping
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. 检查模型并创建绘图 Check model and create plots

势场分析的一个重要方面是通过 FFT 分析完成的，通过它您可以开始了解结构的性质，从而更好地控制反演过程
An important aspect of potential field analyses is done via FFT analyses by which you are able to begin to understand the nature of the structures and thus better to control the inversion process.

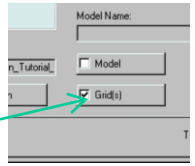
1. 对数据进行插值或“网格化”。 在此过程中，数据被插值到由矩形单元格定义的数据顶点网格上。
Interpolate or "grid" the data. In this process, the data is interpolated onto a grid of data vertices defined by a rectangular cell.

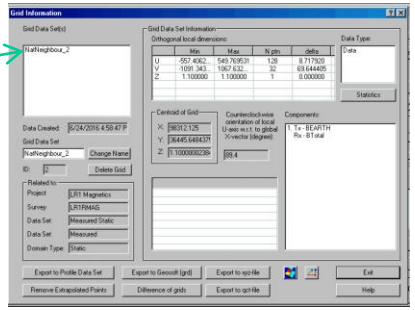


用于定义网格大小的控件和 dx,dy 分辨率
controls for defining the grid both in size and dx,dy resolution

选择“用于 FFT”确保网格为 2^n x 2^n，单元格不必为正方形
Selecting “For FFT” ensures the grid is 2^n by 2^m, cells need not be square

插值后，网格附加到数据库中的数据集，如复选标记所示，因为此处存储网格以便于访问
After interpolating, the grid is attached to the dataset in the database as indicated by a check mark as here grids are stored for easy access

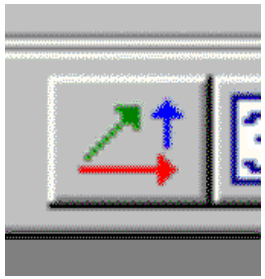


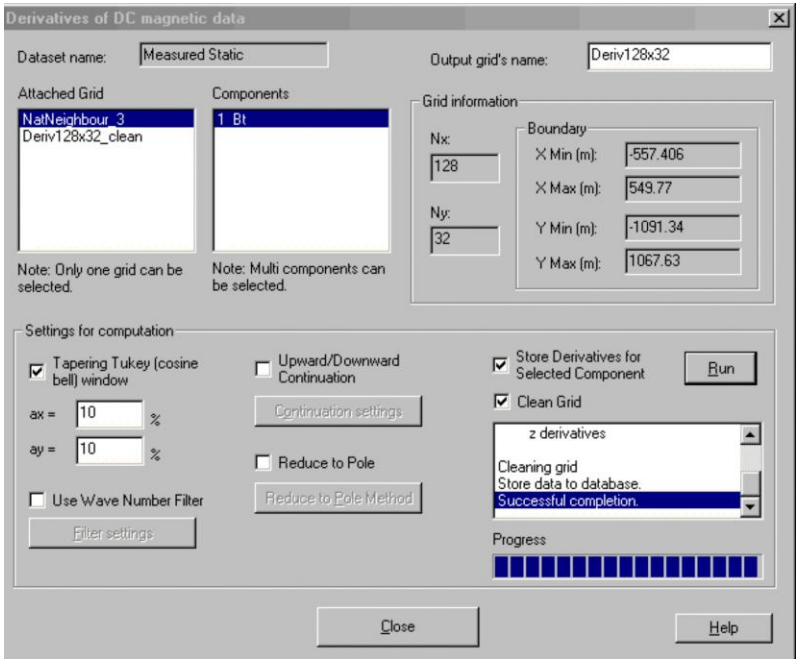


1. 导入数据 Import data
2. **检查数据、网格化和绘图**
   Examine data, gridding and mapping
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. 检查模型并创建绘图 Check model and create plots

创建导数和其他 FFT 处理及其在反演中的作用
Creating Derivatives and other FFT processing and their role in inversion.

将数据插值到 2^N x 2^M网格后，我们现在可以处理导数并使用这些导数执行其他处理功能
Having interpolated the data to a regular 2^N x 2^M grid, we may now process derivatives and with these derivatives and perform other processing functions.



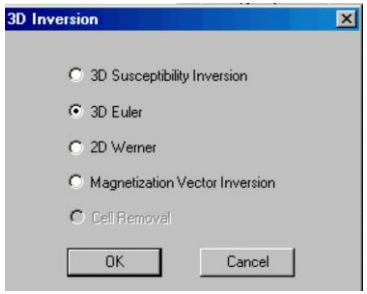


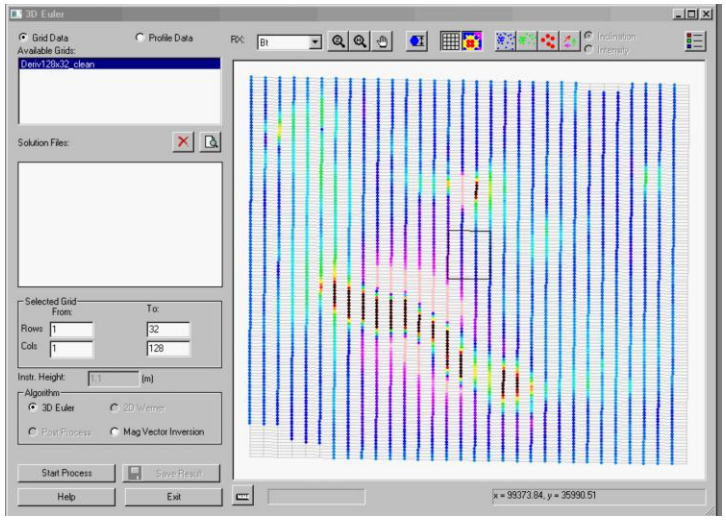
左上角显示了可能用于FFT处理的网格，旁边的方框中显示了这些网格的内容。 这里可能会进行各种不同的处理，这里我们只是简单的展示总场的3个导数的生成。 这些导数以后可以以多种方式用于反演过程。Grids which may be utilized for FFT processing are displayed in the upper left hand and the contents of these grids in the box beside. Various different processing may be carried out here, but here we simply show generation of the 3 derivatives of the total field. These derivatives may later be utilized in the inversion process in a variety of ways.

1. 导入数据 Import data
2. 检查数据、网格化和绘图
Examine data, gridding and mapping
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. 检查模型并创建绘图 Check model and create plots

导数在反演中的使用——3 个例子。
Use of Derivatives in Inversion – 3 examples.

实例 1：使用导数网格求三维 欧拉解。
Case 1: Use the derivative grids to perform 3D Euler solutions.





通过此接口，您可以执行 三维 Euler求解的各个方面。 然后在 GridPresentation 或 Visualizer 中查看结果。 这些工具允许您确定 三维 结构的类型以及进行深度估计。 Through this interface, you may perform various aspects of the 3D Euler solutions. Results are then viewed in either GridPresentation or the Visualizer. These tools allow you to determine the types of the 3D structure as well as depth estimates.

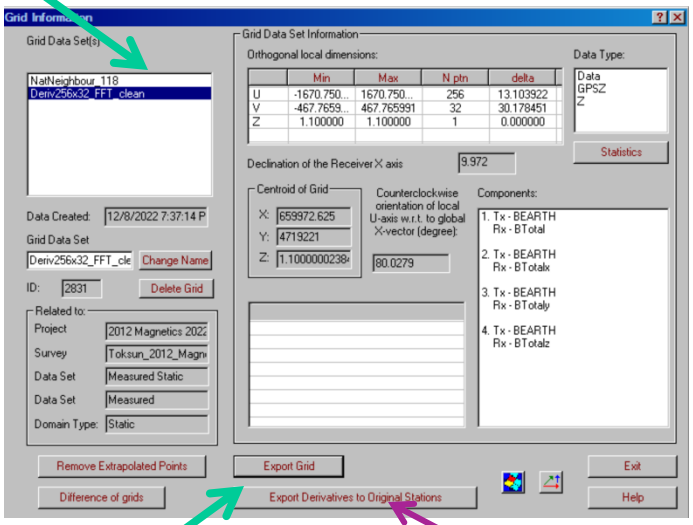
1. 导入数据 Import data
2. **检查数据、网格化和绘图**
Examine data, gridding and mapping
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. 检查模型并创建绘图 Check model and create plots

导数在反演中的使用——3 个例子。
Use of Derivatives in Inversion – 3 examples.

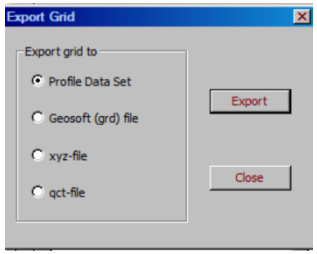
实例 2：导出导数用于 三维 反演 inversion

Case 2: Export derivatives for use in 3D

导数网格 derivative grid



将总场和导数导出到一组测线
Export TMI and derivatives to a set of profiles



导出导数
Export derivatives .

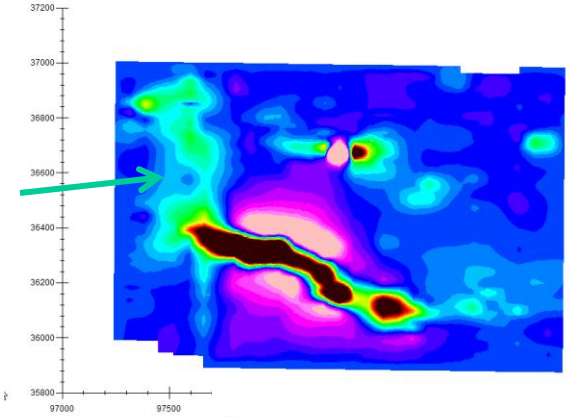
或通过插值导出导数，作为附加数据添加到您的原始数据中。
or Export derivatives by interpolation to be added as additional channels to your original data.

1. 导入数据 Import data
2. 检查数据、网格化和绘图
Examine data, gridding and mapping
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. 检查模型并创建绘图 Check model and create plots

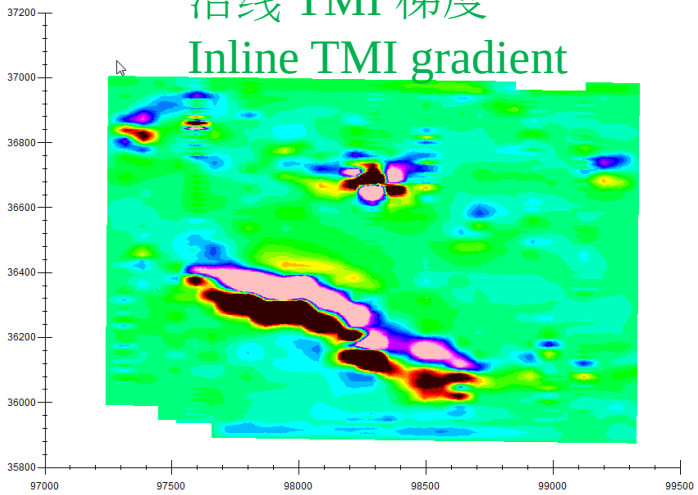
导数在反演中的使用——3 个例子。
Use of Derivatives in Inversion – 3 examples.

实例三： 导数与向上延拓的检验 Case 3: Examination of Derivatives and Upward Continuation

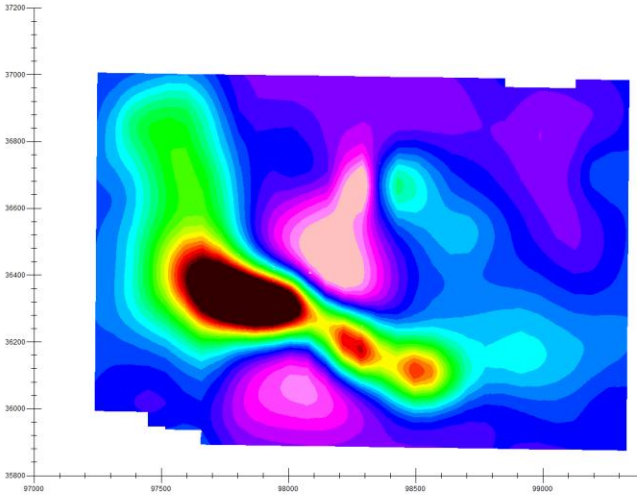
TMI网格
TMI grid



沿线 TMI 梯度
Inline TMI gradient



向上延拓TMI网格
Upward Continued
TMI grid

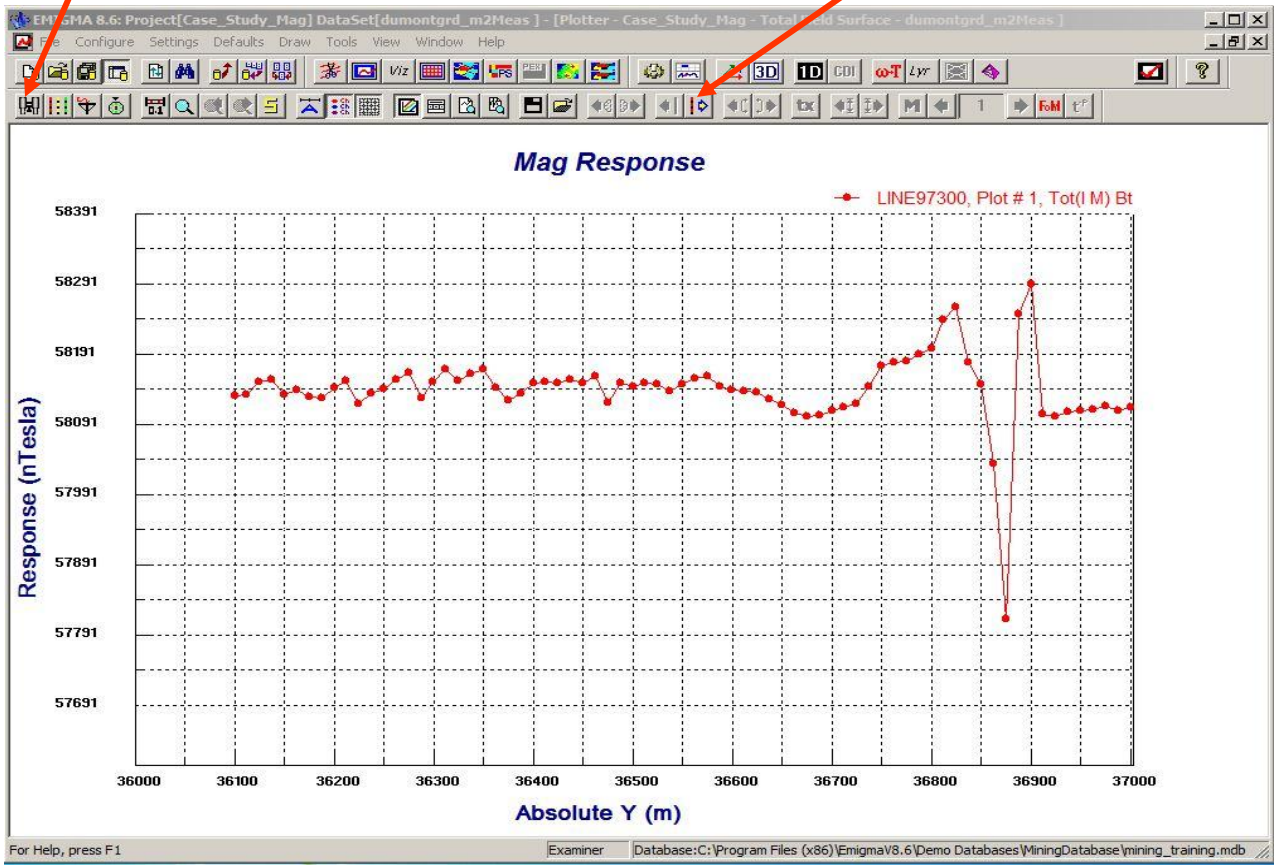


1. 导入数据 Import data
2. 检查数据、网格化和绘图
Examine data, gridding and mapping
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. 检查模型并创建绘图 Check model and create plots

点击“绘图仪”...
Click “Plotter”…

在绘图仪中加载数据集
Load data set in plotter

在测线之间切换
Toggle between profiles

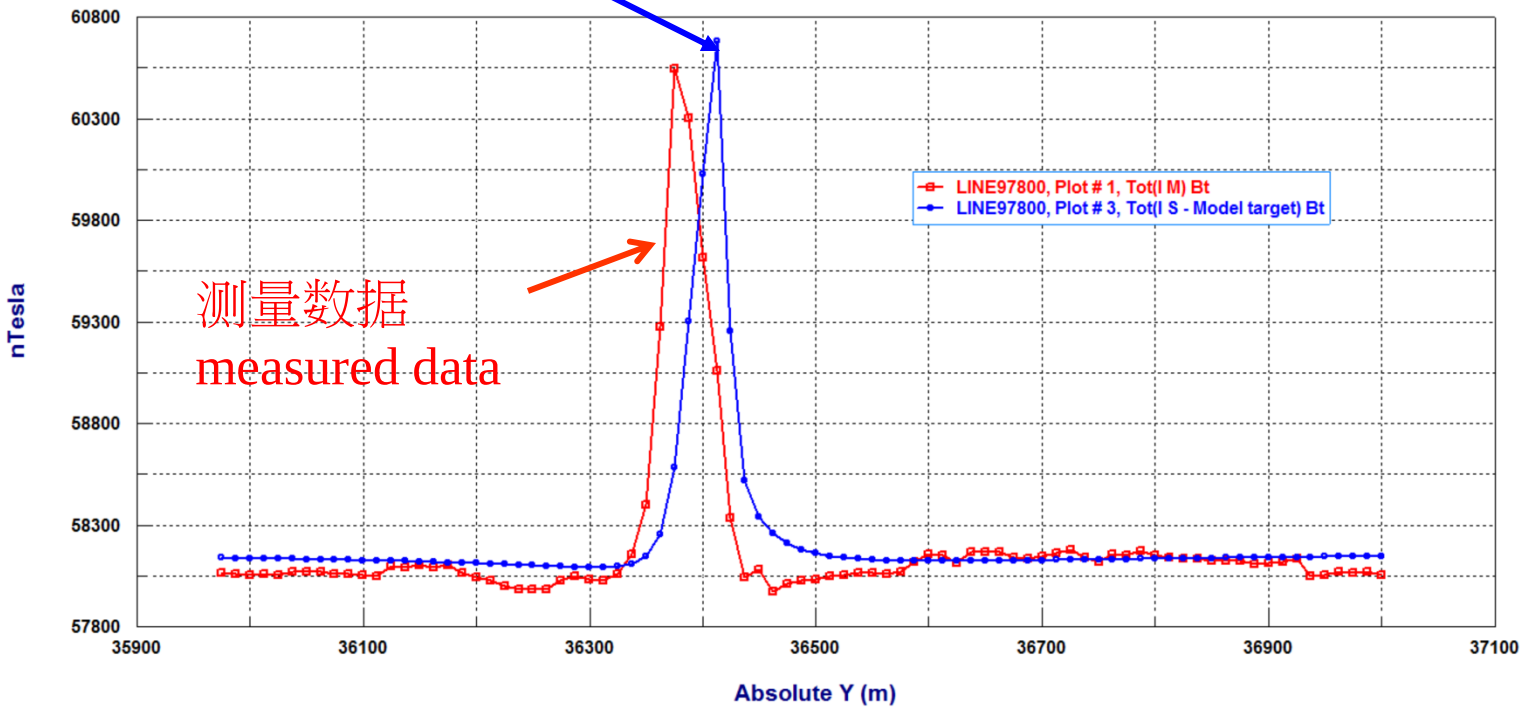


1. 导入数据 Import data
2. 检查数据 Examine data
3. **执行初始建模 Perform initial modeling**
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. 检查模型并创建绘图 Check model and create plots

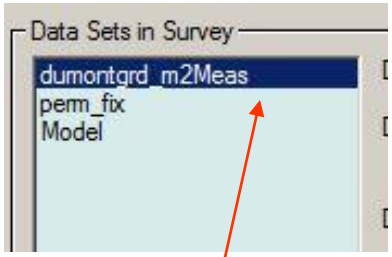
注意：执行一些初始建模以获得数据的“感觉”并估计反演初始模型的参数

Note: *Perform some initial modeling to get a “feel” of the data and estimate parameters of initial model for inversion.*

模拟数据到正演模型 Simulated data to a forward model

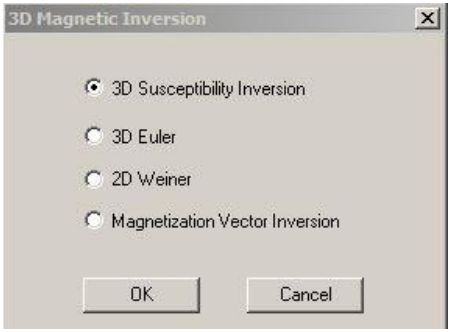


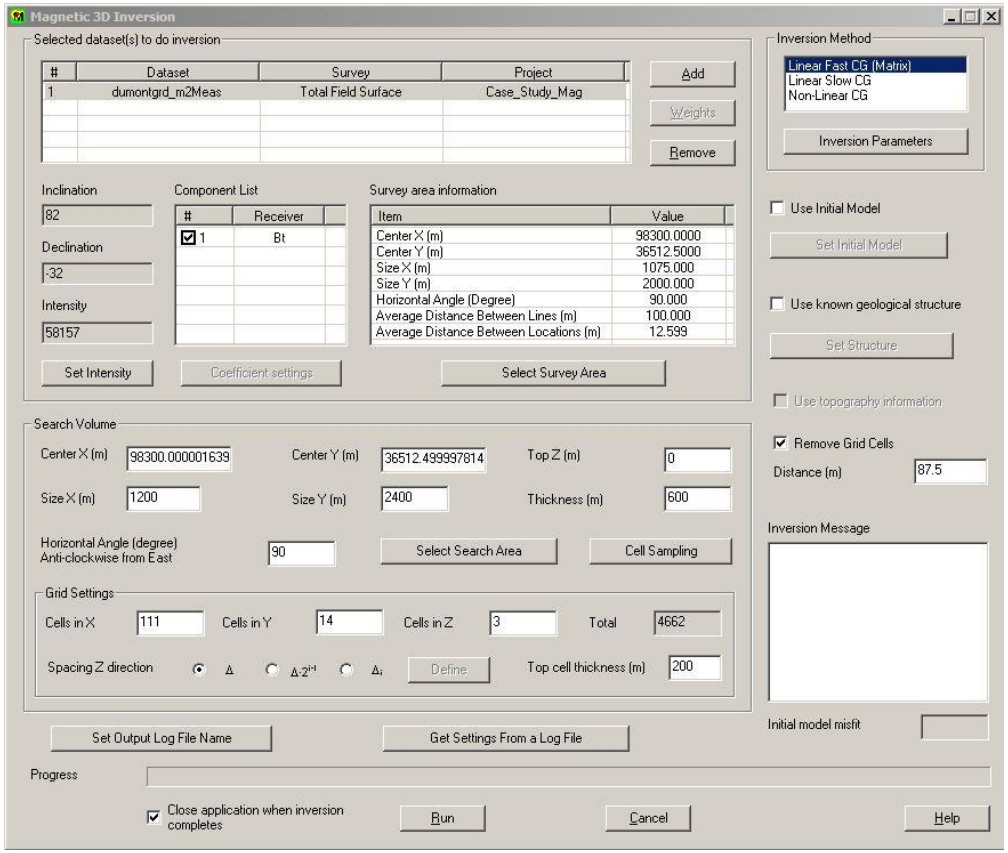
1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. **执行 三维 磁反演 Perform 3D magnetic inversions**
5. 检查模型并创建绘图 Check model and create plots



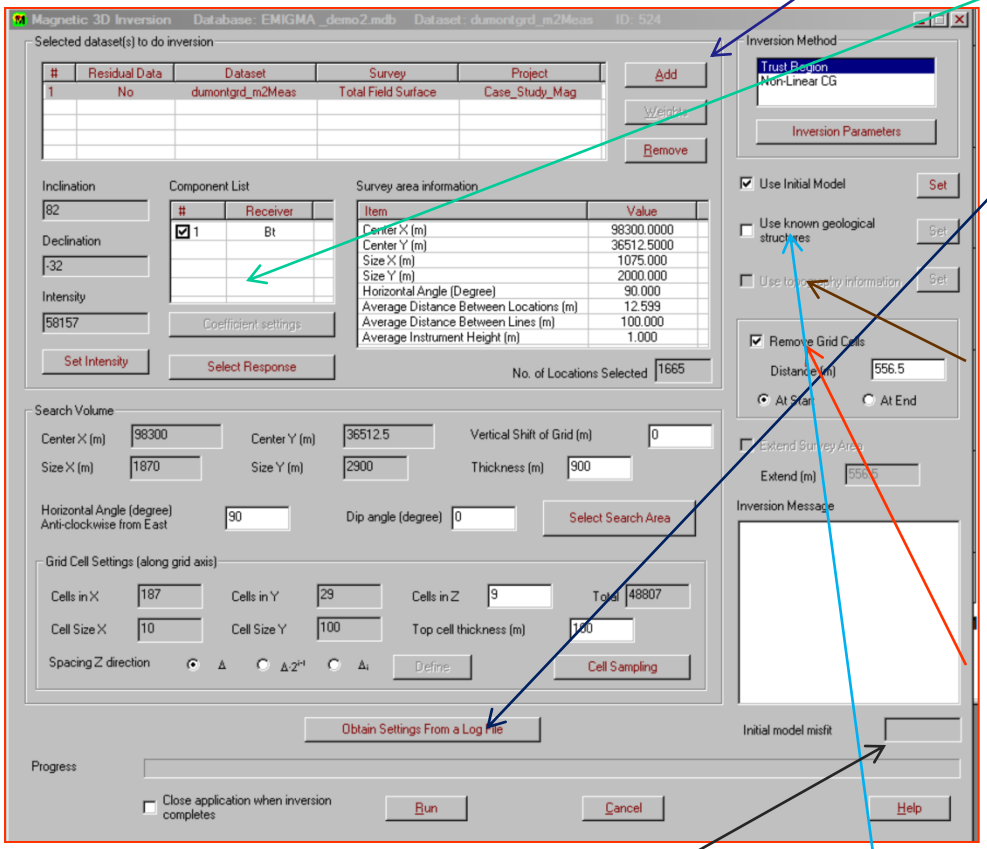
选择勘测数据

Select survey data





1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. **执行 三维 磁反演 Perform 3D magnetic inversions**
5. 检查模型并创建绘图 Check model and create plots



选定的数据集
单击添加可以添加数据集以用于反演。 默认情况下，每个数据集都具有相同的权重。 这可以通过单击权重来更改。

Selected Data Sets
A dataset may be added for use in the inversion by clicking **Add**. Each dataset is given equal weight by default. This can be changed by clicking **Weights**.

组件：将在反演中使用的组件显示在这里

Components: Components that will be used in the inversion are displayed here.

日志文件
每次运行反演时都会创建一个日志文件。 可以通过单击“设置输出日志文件名”来指定日志文件的名称和位置。 单击从日志文件获取设置以使用先前反演的设置。

Log File
A log file is created each time an inversion is run. The name and location of the log file can be specified by clicking **Set Output Log File Name**. Click **Get Settings From a Log File** to use the settings from a previous inversion.

使用地形信息
如果您使用 gps z 通道导入数据，此选项将被启用。 选择此选项，将在执行反演时使用 gps z 值。 将反演结果加载到 Visualizer 时，将出现一个窗口，要求根据 z 或 gps z 显示勘测。 选择 gps z 以查看带地形的反演结果。

Use topography information
This option will be enabled if you imported your data with a gps z channel. Select this option and the gps z values will be used when performing the inversion. When loading inversion results to the Visualizer, a window will appear asking to display the survey according to z or gps z. Select gps z to see the inversion results with topography.

删除网格单元格
距最近数据点超出指定距离的任何单元将从反演结果中移除。

Remove Grid Cells
Any cells that are beyond the specified **Distance** from the closest data point will be removed from the inversion result.

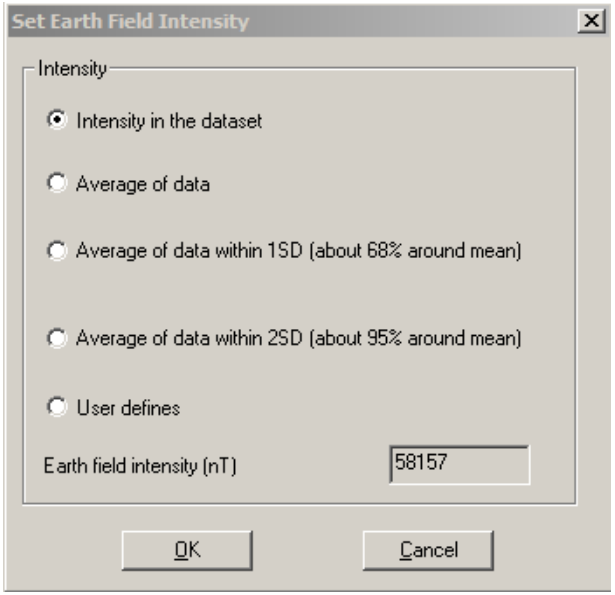
初始模型失配
定义初始模型与数据的拟合程度。值越接近 0，拟合越好。

Initial model misfit
Defines how close the initial model fits the data. The closer the value is to 0, the better the fit.

地质构造
单击使用已知地质结构将对反演进行约束。

Geological Structure
Click **Use known geological structure** to define a structure that will apply constraints to the inversion result.

1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. **执行 三维 磁反演 Perform 3D magnetic inversions**
5. 检查模型并创建绘图 Check model and create plots



Earth's Background Field 地球背景场

您可以通过单击"设置强度"在多种方法之间进行选择以获得背景字段的值。

数据集中的强度 - 使用选定调查中定义的值。
数据平均值 - 该值将从数据中计算得出。 用于计算的数据值的数量取决于所选的选项。
用户定义 - 只需在场强框中输入一个新值。

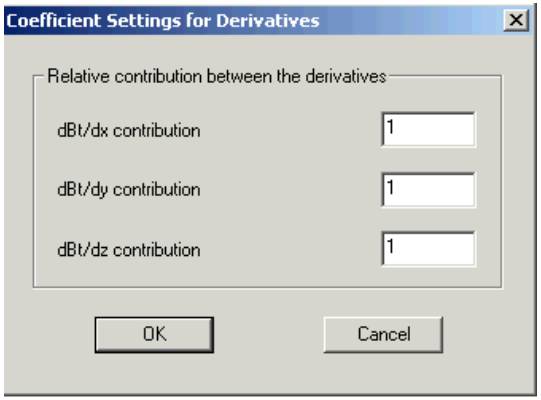
You can choose between various methods to obtain a value for the background field by clicking **Set Intensity**.

Intensity in the dataset - uses the value defined in the selected survey.
Average of data - the value will be calculated from the data. The amount of data values used for the calculation depends on the option chosen.
User define - simply enter a new value in the field intensity box.

Coefficient settings 系数设置

当梯度数据可用并且选择了多个导数时（本例中没有），此按钮将被启用。 它启动以下窗口，可以在其中为每个可用的衍生品分配权重

This button will be enabled when gradient data is available and more than one derivative has been selected (not in this example). It launches the following window where a weight can be assigned to each available derivative.

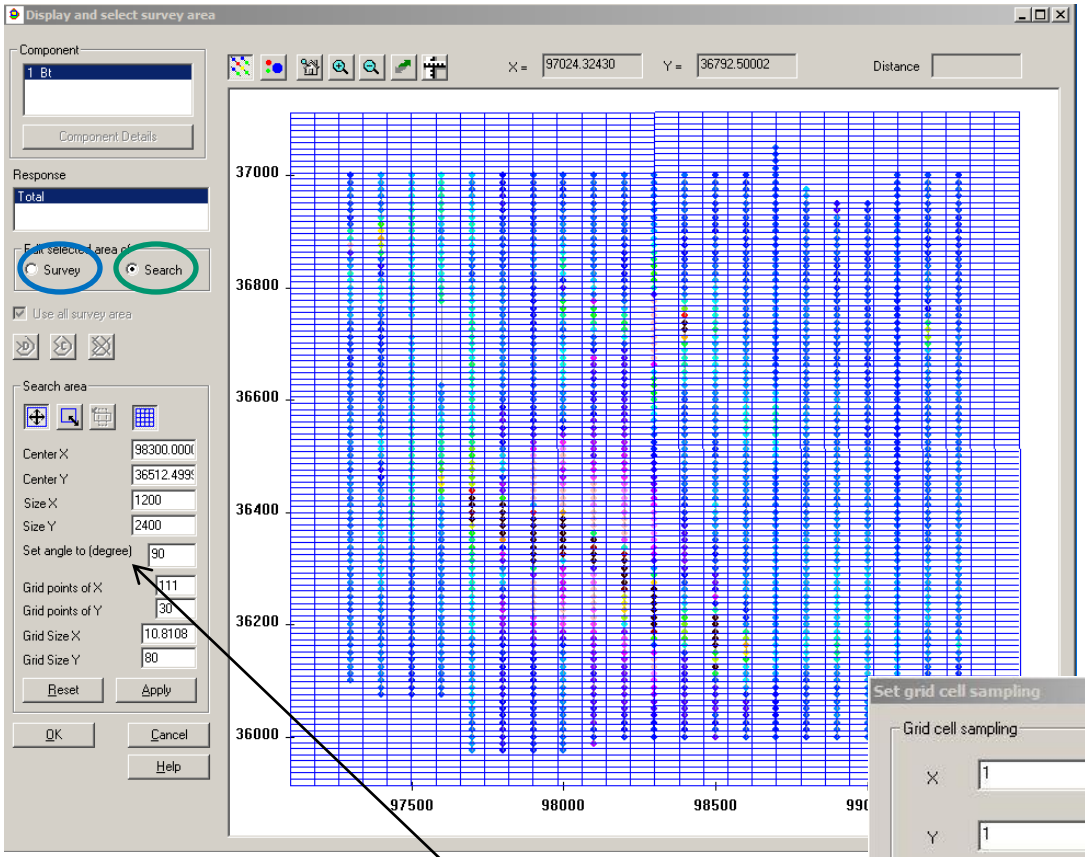


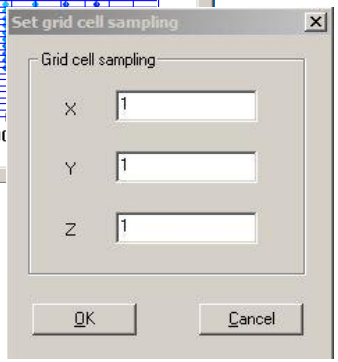
12/13/2022

1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. **执行 三维 磁反演 Perform 3D magnetic inversions**
5. 检查模型并创建绘图 Check model and create plots

单击 Select Search Area 或 Select Survey Area 按钮将启动相同的窗口。 但搜索区域是指反演算法所处理的数据区域，而勘测区域是导入数据的整体。

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.





勘测区 Survey Area

单击选择测量区域按钮启动图形工具，使您能够指定将在反演计算中使用的数据点。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.

搜索区域（搜索磁源）

Search Volume (search for magnetic sources)

搜索量部分中的默认参数将创建一个覆盖整个勘测的网格。 您可以通过输入新值或使用图形工具来修改搜索区域参数

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

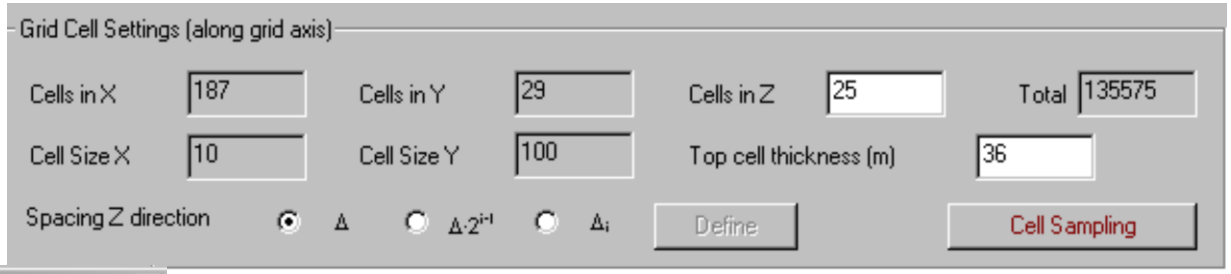
“设置角度（度）”框：反演网格的水平角度。“Set angle to (degree)” box: the horizontal angle of the inversion grid.

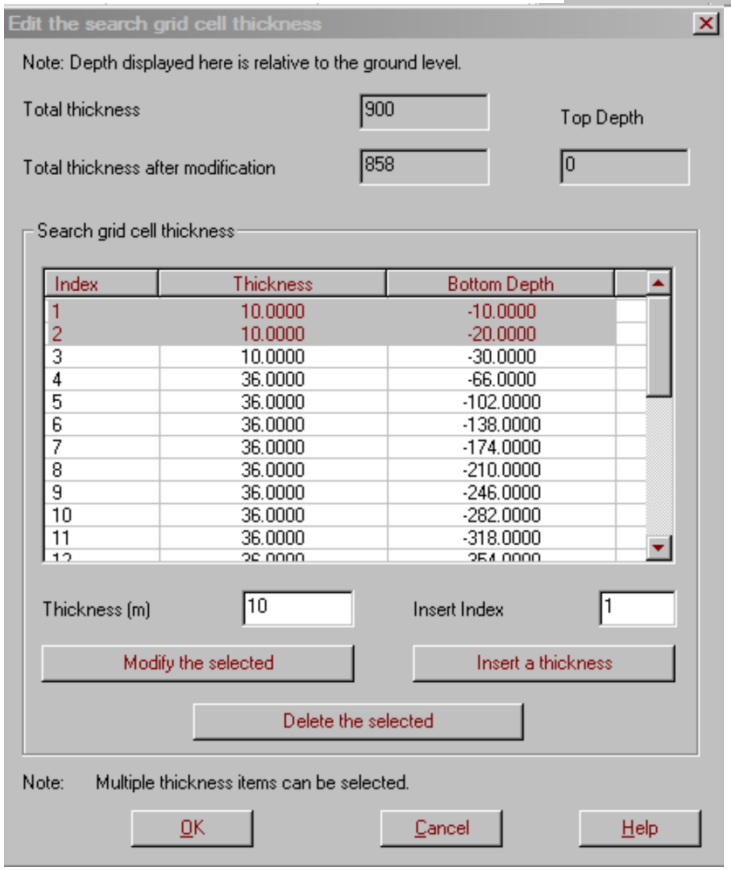
单元取样 Cell Sampling

在计算模拟数据时，可以通过单击 Cell Sampling 将 搜索区域中定义的网格单元划分为更小的单元。 在 X、Y 和 Z 框中键入您的值以指定 X、Y 和 Z 方向的样本数。

Grid cells defined in **Search Volume** can be divided into smaller units when calculating the simulated data by clicking **Cell Sampling.** Type your values in the **X**, **Y** and **Z** boxes to specify the number of samples in the X, Y and Z directions

1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. **执行 三维 磁反演 Perform 3D magnetic inversions**
5. 检查模型并创建绘图 Check model and create plots





Grid Settings 网格设置

在网格设置区域中确认要在反演中使用的网格点的数量和布局。 单元格将在 x 和 y 方向上均匀分布。Confirm the number and layout of grid points to be used in the inversion in the **Grid Settings** area. The cells will be evenly spaced in the x and y directions.

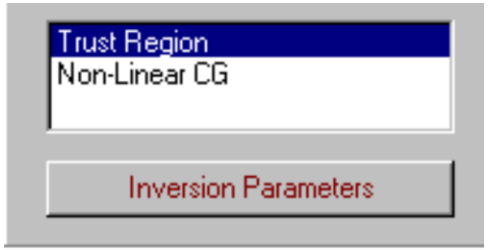
Vertical Grid Spacings: 垂直网格间距：

为 z 方向上均匀分布的点选择 Δ，或为指数分布的点选择 $\mathbf{\Delta \cdot 2^{i-1}}$。 您可以通过选择 $\mathbf{\Delta_i}$ 来指定自定义间距。 然后可以通过单击“定义”来修改您的自定义设置。Choose **Δ** for evenly spaced points in the z direction or $\mathbf{\Delta \cdot 2^{i-1}}$ for exponentially spaced points. You may specify a custom spacing by selecting $\mathbf{\Delta_i}$. Your custom settings can be later modified by clicking **Define**.

编辑网格单元厚度 Editing the Grid Cell Thickness

界面显示编辑前后的总厚度以及最上面的 z 值。 单元格大小列在编辑搜索网格单元格厚度部分中。The interface displays the total thicknesses before and after editing as well as the topmost z value. The cell sizes are listed in the **Edit the Search grid cell thickness** section.

1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. **执行 三维 磁反演 Perform 3D magnetic inversions**
5. 检查模型并创建绘图 Check model and create plots



反演方法
Inversion Methods

有两种反演方法可供选择。 通过单击“反演参数”按钮为您选择的方法设置参数
There are two inversion methods to choose from. Set parameters for your chosen technique by clicking the Inversion Parameters button.

信赖域法- 比非线性 共轭梯度法更快，并且可以更好地处理模型约束。 它是一种带约束最小优化方法，可以有效地处理大量数据点和反演网格单元。 Faster than Non-Linear CG and has better handling of model constraints. It is a constrained minimization technique and can efficiently process large number of data points and inversion grid cells.

非线性共轭梯度法- 从初始模型开始，然后通过使用迭代过程为指定函数来寻找最佳拟合模型。 它是一种不带约束的最小优化方法，对界面的约束条件在反演后应用。The general concept is to start with an initial guess and then search for the best fitting model by minimizing a given function using an iteration process. It is a unconstrained minimization technique with the constraints on the interface applied as a post-process.

1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. **执行 三维 磁反演 Perform 3D magnetic inversions**
5. 检查模型并创建绘图 Check model and create plots

目标函数
The objective function

假设正演函数可以线性化。
Assumes that the forward function can be linearized.

d= F m

d: N维向量
F: N×M 维矩阵
m: M维向量
N: 观测点数
M: 反转网格单元数

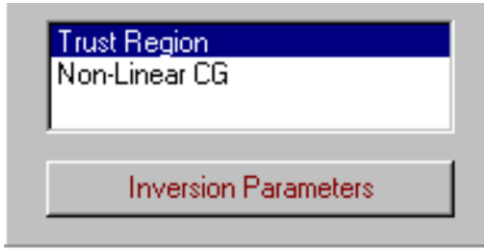
d= F m

d: vector of N dimension
F: matrix of N×M dimension
m: vector of M-dimension
N: number of observation points
M: number of inversion grid cells

$$H_{ext}(r)=\int G(r,r')M(r')dr'$$

$$M(r')=(m(r')-m_0)H_{ins}(r')=\chi(r')H_{ins}(r')$$

1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. **执行 三维 磁反演 Perform 3D magnetic inversions**
5. 检查模型并创建绘图 Check model and create plots



信赖域技术
Trust Region Technique

- 快速收敛速度且带约束条件
- 可以高效处理大量数据点和单元
- fast convergence rate and constrained
- can efficiently process large number of data points and cells

带约束条件信赖域方法 Constrained Trust Region Technique

在迭代中，当定义一个区域时，将检查该区域内的二次模型是否很好表示目标函数。 如果可以在区域内实现目标函数的显着降低，则认为该模型很好地表示了原始目标函数，将扩大区域。 如果改进太微小，则不应认为该模型很好地表示该区域内的原始目标函数，则将该区域收缩。

At an iterate, when a region is defined, a quadratic model within this region is checked for an adequate representation of the objective function. If a notable decrease of the objective function can be achieved within the region, then the model is believed to be a good representation of the original objective function and the region is expanded. If the improvement is too subtle, then the model is not to be believed as a good representation of the original objective function within that region and the region is contracted.

$$\phi(m) = \lambda \phi_d(m) + \phi_m(m)$$

$\phi(m)$ - 目标函数被最小化 functional to be minimized

$\phi_d(m)$ - 数据误差data misfit

$\phi_m(m)$ - 模型误差model misfit

λ - 拉格朗日乘数 - 正则化权重

Lagrangian multiplier - regularization weight

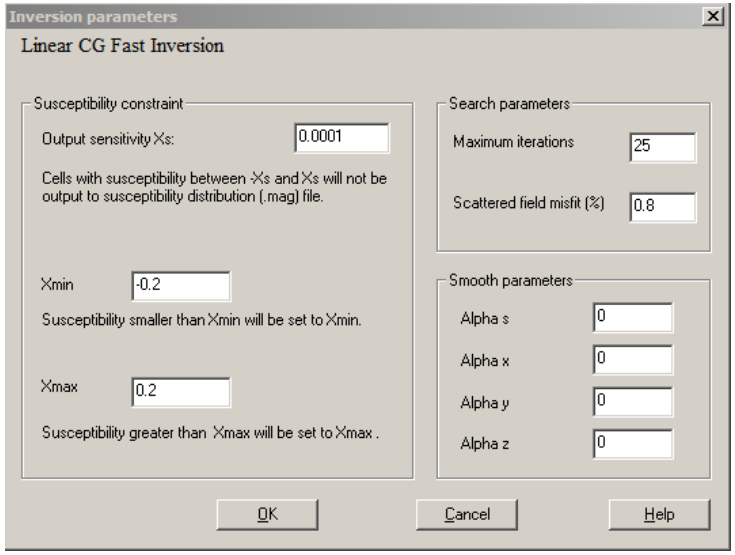
光滑模型误差函数
Smooth model misfit function

$$\phi_m(m) = \alpha_0 \int w^2(z) \, [\, m(r) - m^0(r) \,]^2 \, dv \quad + \quad \sum_{i=x,y,z} \alpha_i \int [\, w(z) \, \nabla_i (\, m(r) - m^0(r) \,) \,]^2 \, dv$$

α_I - 权重因子 weighting factors

$w(z)$ - 深度加权 depth weighting

1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. **执行 三维 磁反演 Perform 3D magnetic inversions**
5. 检查模型并创建绘图 Check model and create plots



搜索参数 Search Parameters

最大迭代次数 Maximum Iterations

用户指定程序将运行以生成最终解的迭代次数。 通常，以默认值 40能较好地进行反演。

User defines the number of iterations the program will run to generate the final solution. In general the default 40 is sufficient for the inversion.

散射场误差 Scattered field misfit

当测量散射场与模拟散射场之间的差异落在测量值的一定百分比内时，为迭代的“停止”标准。Defines the “stop” criteria for an iteration when the difference between the measured and simulated scattered field falls within a certain percentage of the measured value.

光滑参数 Smooth parameters

较大的值会增加反演结果的光滑度。 Alpha s 用来减小磁化率值的范围。 Alpha x、y 和 z 分别用来减小了相邻单元在 x、y 和 z 方向上的磁化率差异。

Larger values will increase the smoothness of the inversion result. **Alpha s** decreases the range of all the susceptibility values. **Alpha x, y and z** decreases the difference between the susceptibility of two neighboring cells in the x, y and z directions respectively.

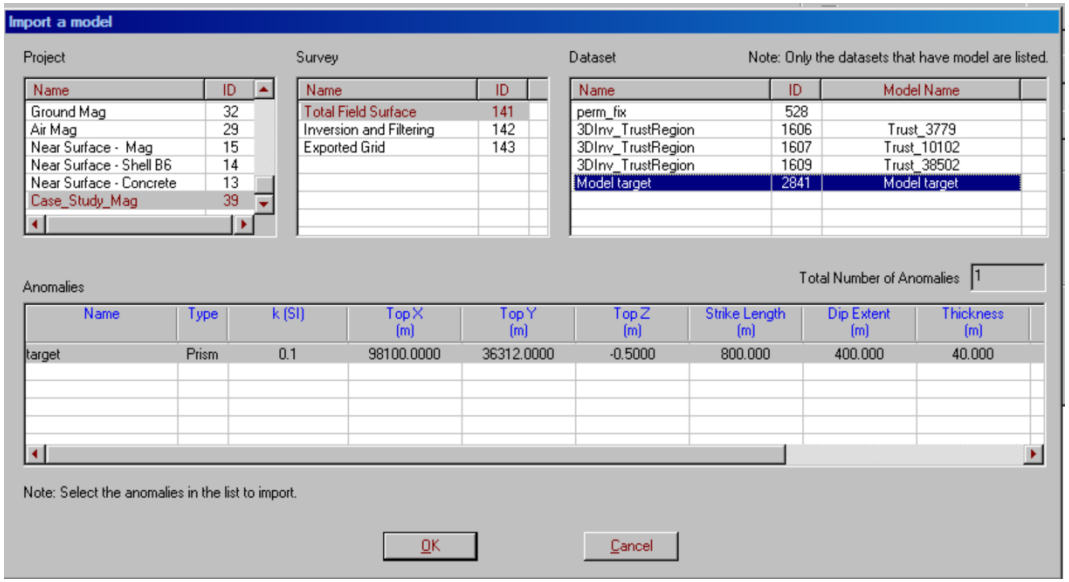
磁化率约束 Constraint of Susceptibility

磁化率敏感度：当单元磁化率接近 0 -（用户定义接近程度）在反演结束后被除去， 不会输出到磁化率分布 (.mag) 文件。

Output Sensitivity：Cells with susceptibility |D| (close to 0 - where the user defines how close) are thrown out after inversion and will not be output to the susceptibility distribution (.gmag) files.

Xmin:磁化率下界
Xmin： lower bound of susceptibility
Xmax:磁化率上界
Xmax: upper bound of susceptibility

1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. **执行 三维 磁反演 Perform 3D magnetic inversions**
5. 检查模型并创建绘图 Check model and create plots



初始模型（**Starting Model**）

Initial Model (Starting Model)

单击标记为使用初始模型的复选框以指定初始模型。 单击“设置初始模型”按钮返回初始模型窗口。

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.

起始模型由标有“初始模型”的框中的具有各种属性的棱柱列表描述。

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

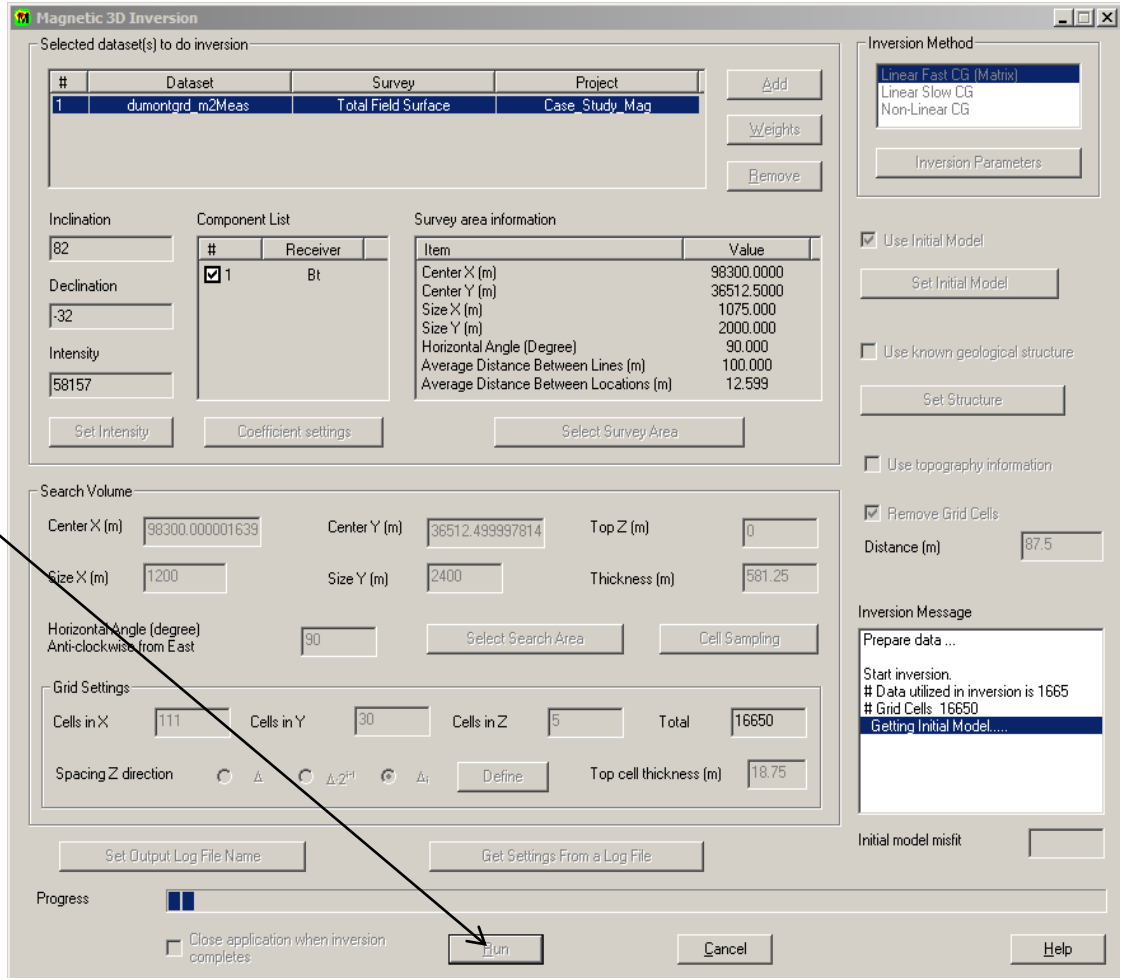
从当前数据库中的另一个数据集中导入模型
import a model from another data set in the current database

单击导入模型 Click **Import a model**.
选择具有所需模型的项目、勘测和数据集。 单击确定，模型将出现在初始模型中。
Select the project, survey, and data set with the desired model. Click OK and the model will appear in the Initial Model.

1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. **执行 三维 磁反演 Perform 3D magnetic inversions**
5. 检查模型并创建绘图 Check model and create plots

设置完成后，按运行按钮开始反演过程

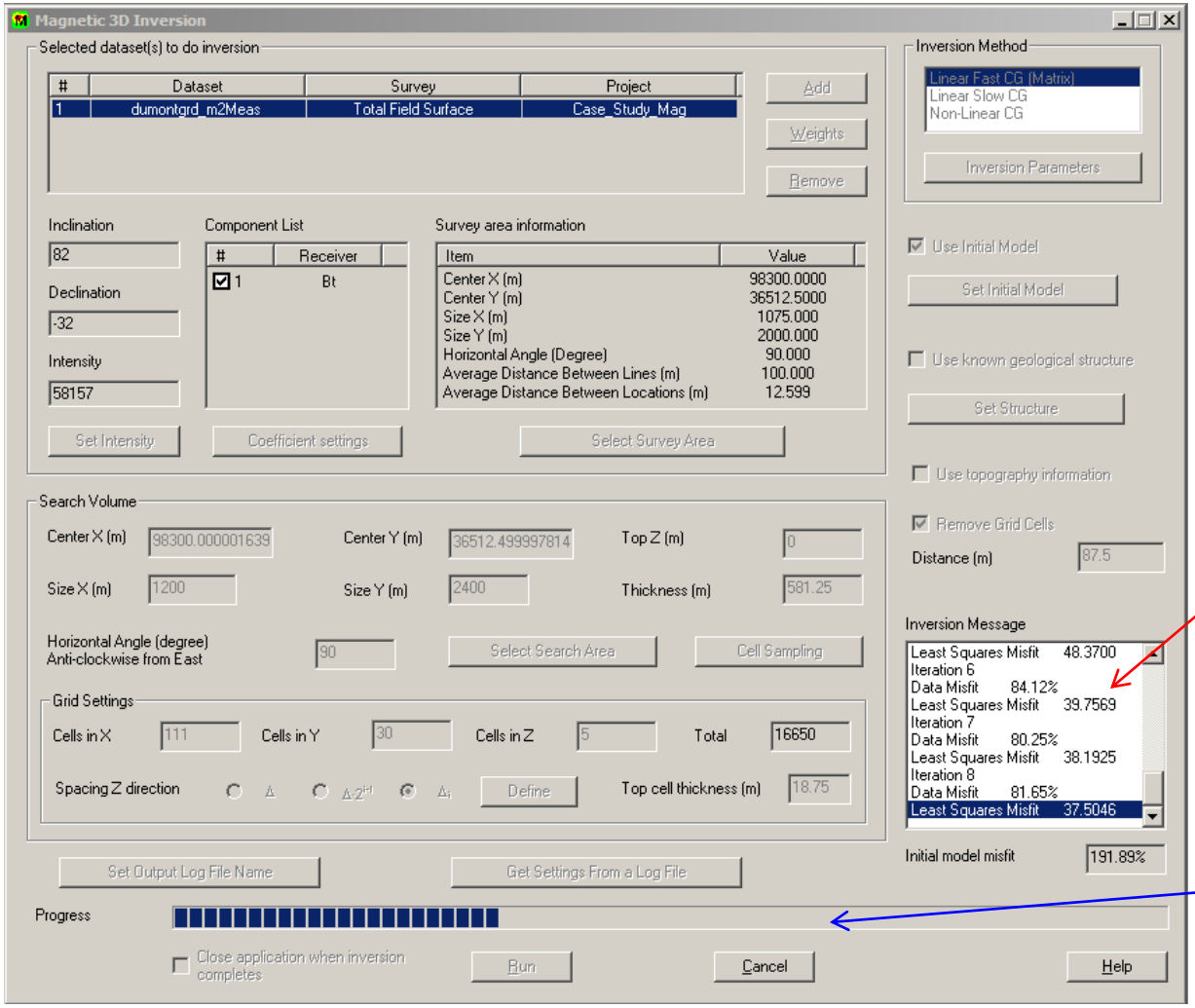
After settings are complete, press the **Run** button to start the inversion process



1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. **执行 三维 磁反演 Perform 3D magnetic inversions**
5. 检查模型并创建绘图 Check model and create plots

执行反演

Executing the Inversion

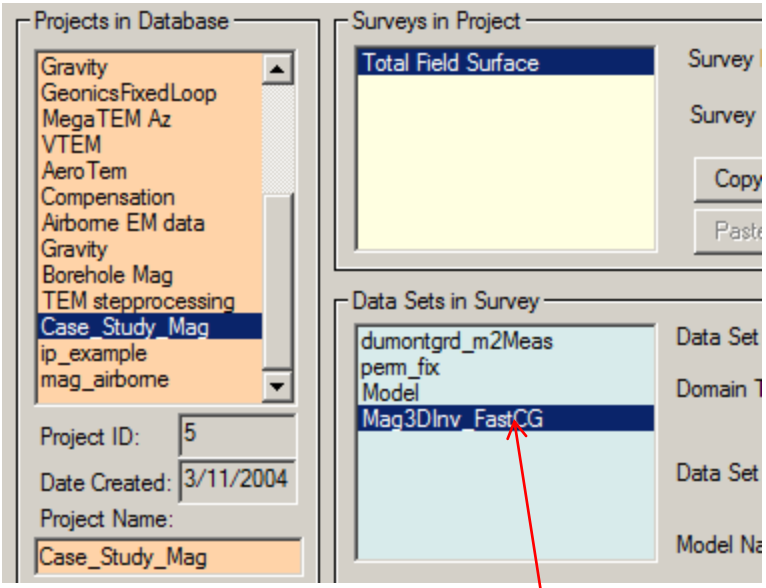


右侧窗口（白色）显示数据误差。The right window (in white) shows data misfit.

“进度”栏显示了此反演的总进度。The “Progress” bar shows the total progress of this inversion.

1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. **检查模型并创建绘图 Check model and create plots**

反演评估
Inversion Evaluation



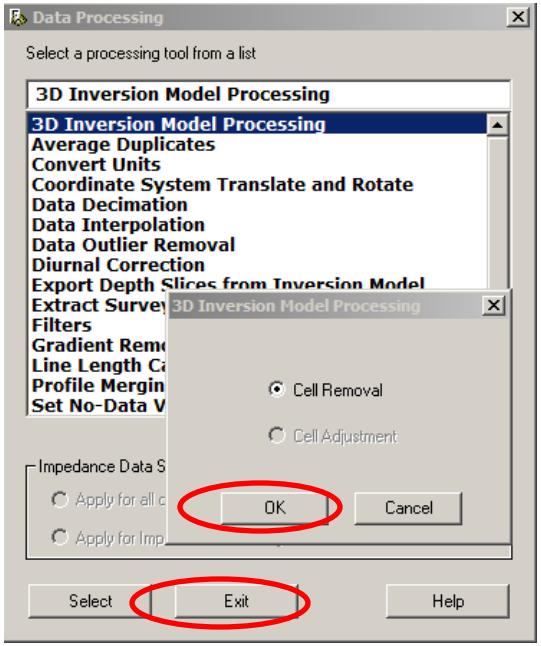
三维磁反演模型数据集
3D magnetic inversion model dataset

在每次勘测中，经过正演建模、反演和处理后，都会有若干个数据集。 在这种情况下，我们有两个正演模型和一个反演模型。 每个正演模型都有一个新的数据集，其中包含模型下的模拟数据。 类似地，每个反演包含一个新的数据集，其中包含反演模型下的模拟数据集（对于每个点），并且反演模型也附加到该数据集。

In each survey, there will be several data sets after modeling, inversion and processing. In this case, we have two forward models and one inversion model. 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.

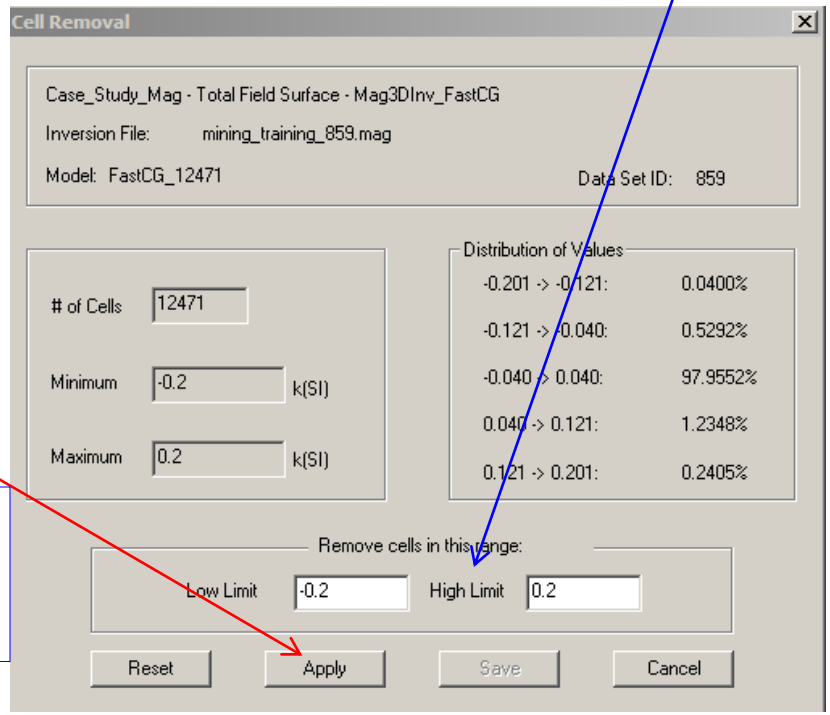
1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. **检查模型并创建绘图 Check model and create plots**

反演评估
Inversion Evaluation



用户可以使用“三维反演模型处理”工具去除反演模型中的单元格。 按照本页所示的程序，到“Cell Removal”对话框。 选择单元格的删除范围：“下限”和“上限”（该范围内的单元格将被删除）

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)



完成后点击“应用”按钮
Click “Apply” button when it is done

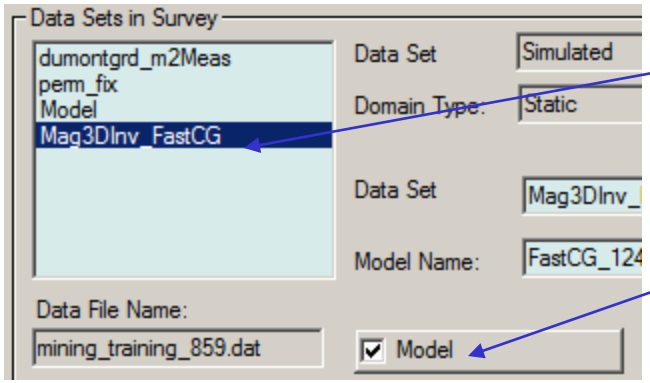
因此，用户可以在反演之前（通过选择搜索区域）或反演之后（通过单元格移除）缩小模型范围。

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

1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. **检查模型并创建绘图 Check model and create plots**

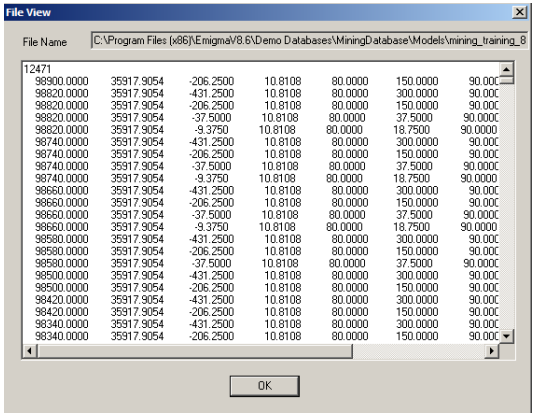
反演评估
Inversion Evaluation

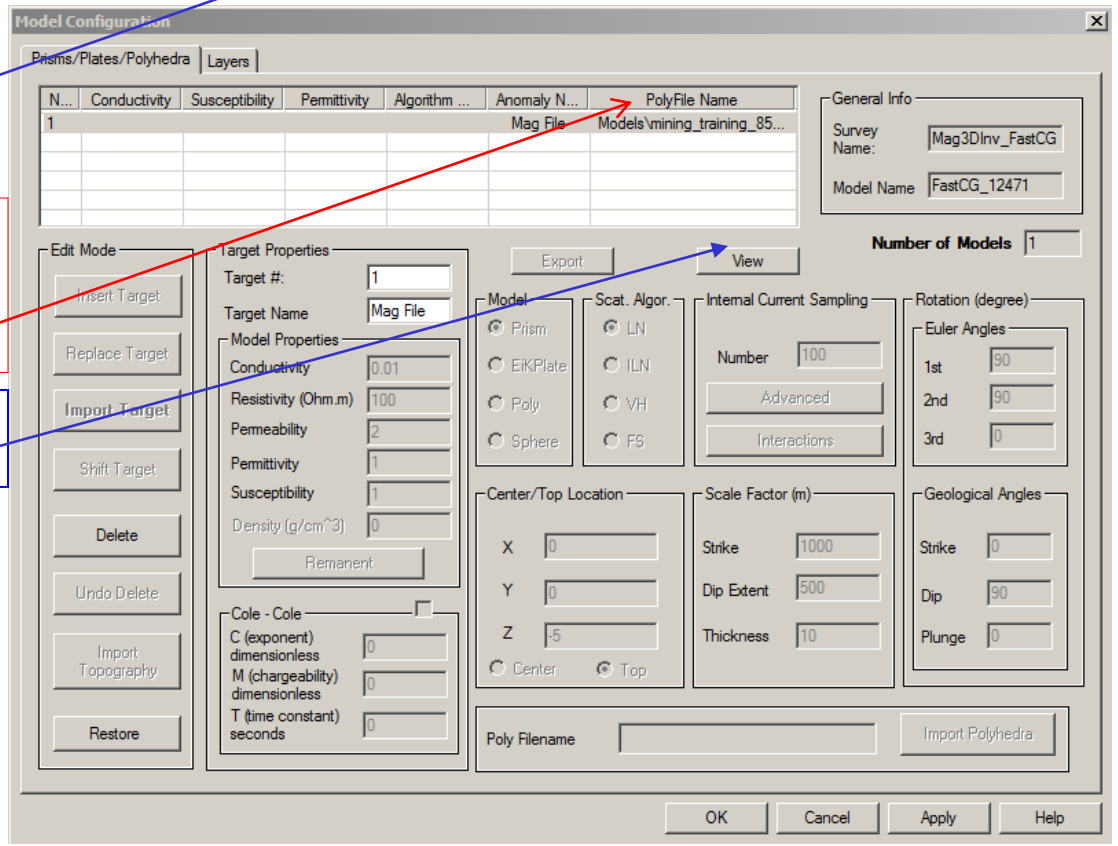
选择反演数据集。 您会注意到“模型”按钮已选中。 如果单击“模型”按钮…
An inversion is selected. You will note the “Model” button is checked. If the “Model” button is clicked…



模型将保存为“Mag 文件”，其名称和文件夹显示在表格的“PolyFile Name”列中。The model will be saved as a “Mag File” with its name and folder shown in the “PolyFile Name” column of the table.

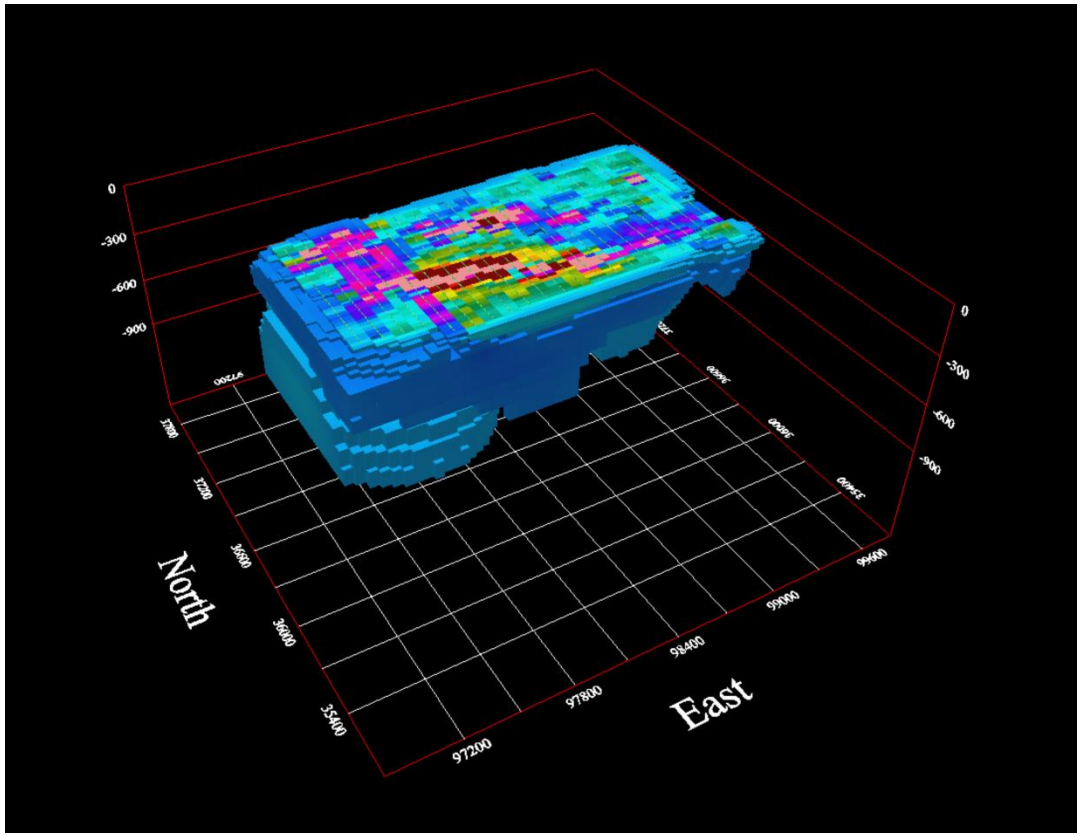
单击“查看”按钮打开此文件...
Click “View” button to open this file…





1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. **检查模型并创建绘图 Check model and create plots**

反演评估
Inversion Evaluation



点击 Click Viz
打开 Visualizer 工具查看三维反演模型

to open Visualizer tool to view the inverted 3D model…

1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. **检查模型并创建绘图 Check model and create plots**

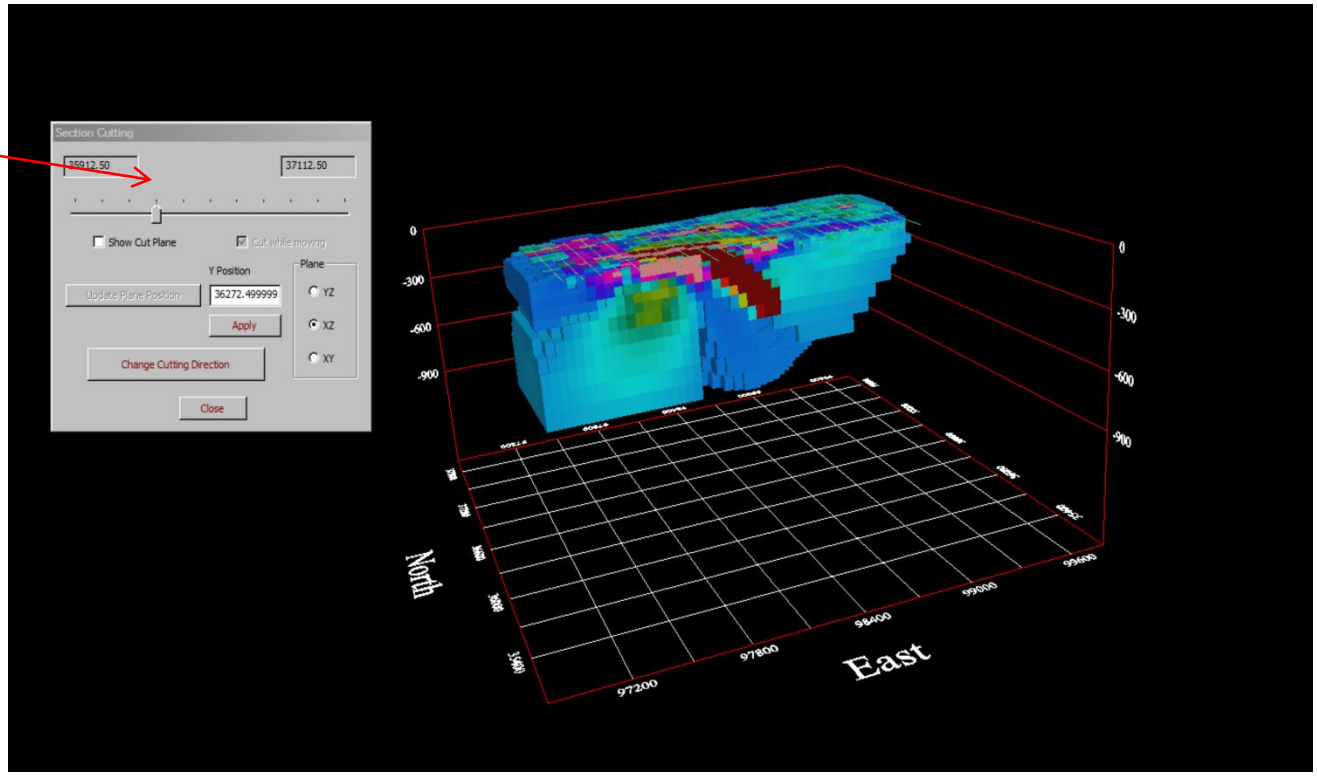
反演评估
Inversion Evaluation

从菜单“Model -> Mag/Grv/Res File -> mag/grv/res Cutting”中选择打开截面切割工具。
Select from menu “Model -> Mag/Grv/Res File -> mag/grv/res Cutting” to open the Section Cutting tool.

通过调整栏…
By adjusting the bar…

用户可以从XY, XZ和ZY平面查看任意穿透深度的三维模型截面

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



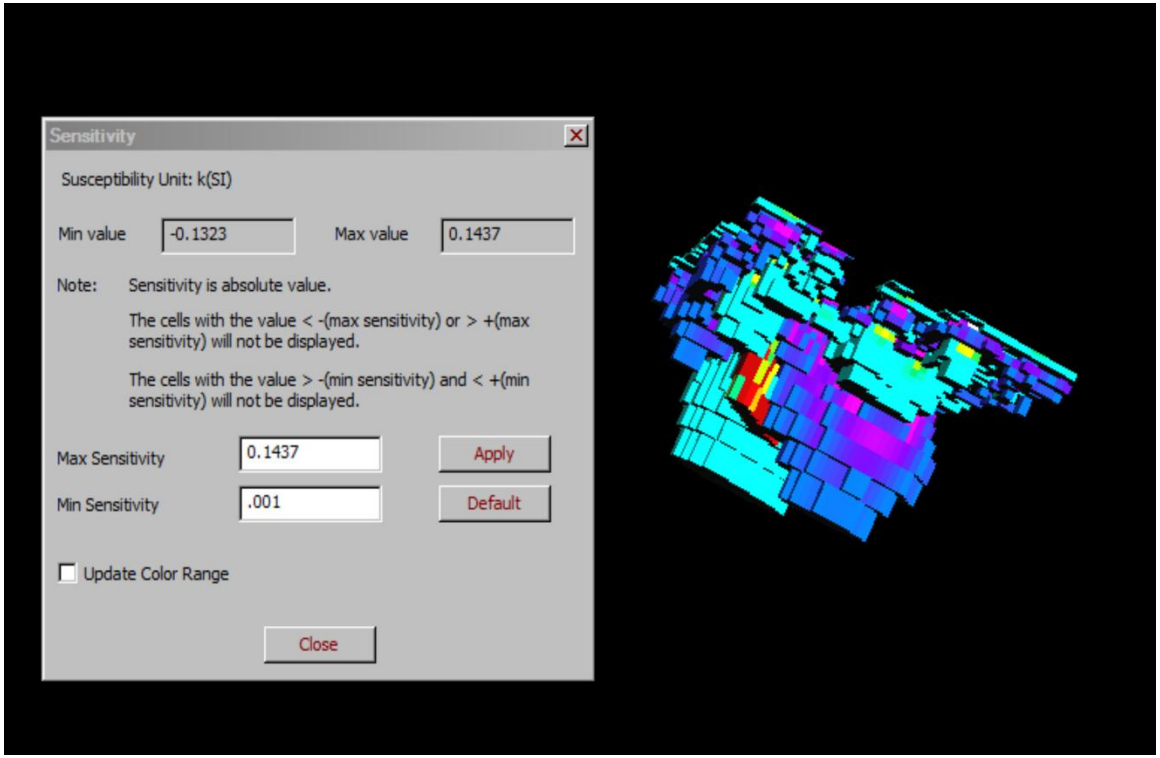
1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. **检查模型并创建绘图 Check model and create plots**

反演评估
Inversion Evaluation

从菜单“Model -> Mag/Grv/Res File -> Sensitivity”中选择打开截面切割工具。
Select from menu “Model -> Mag/Grv/Res File -> Sensitivity” to open the Section Cutting tool.

通过调整图中所示的最小值和最大值……
By adjusting minimum value and maximum value shown in the figure…

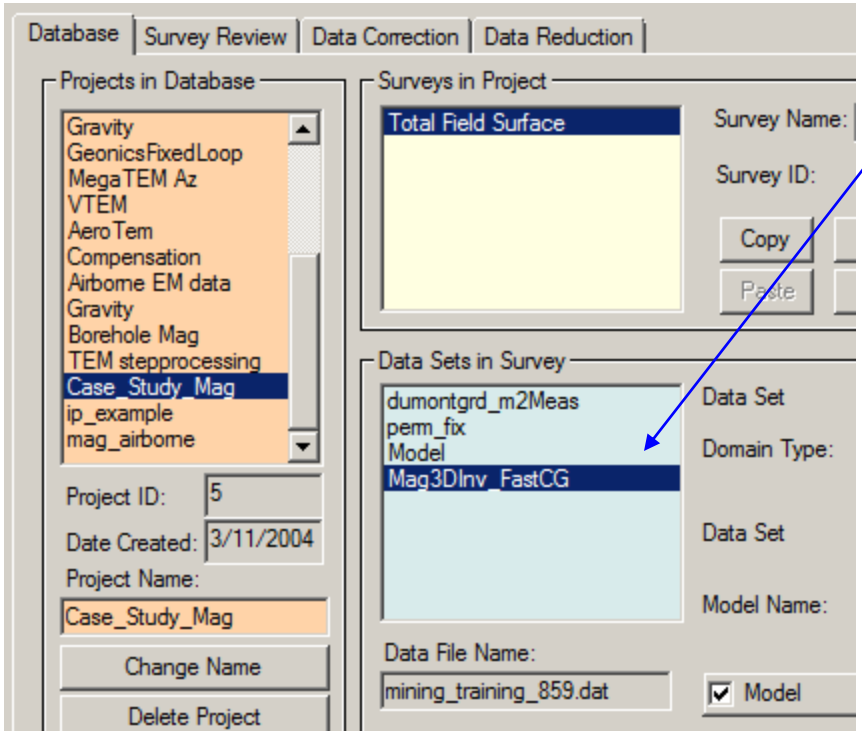
此图中的模型将仅显示具有在此范围内指定值的单元格
The model in this figure will only exhibit cells with values specified in this range

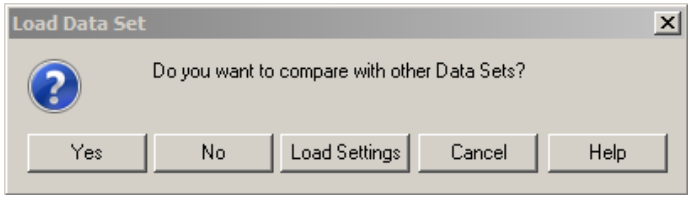


1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. **检查模型并创建绘图 Check model and create plots**

反演评估
Inversion Evaluation

要评估反演模型对每个站点数据的拟合程度，请选择反演数据集，然后选择绘图仪。
To assess how well the inversion model fits the data at each station, select the inversion data set and then select the plotter.





出现这个对话框时选择“是”
Select “Yes”, when this dialog appears

1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. **检查模型并创建绘图 Check model and create plots**

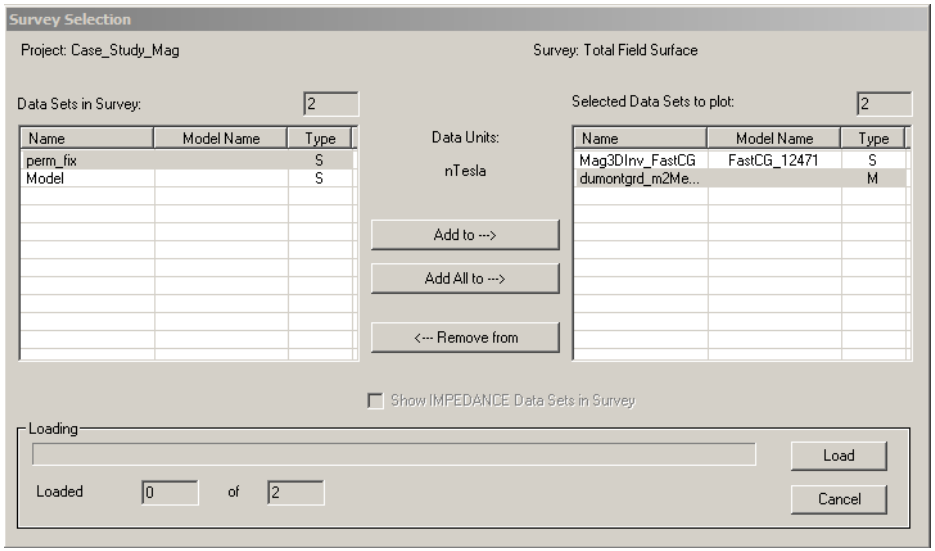
反演评估
Inversion Evaluation

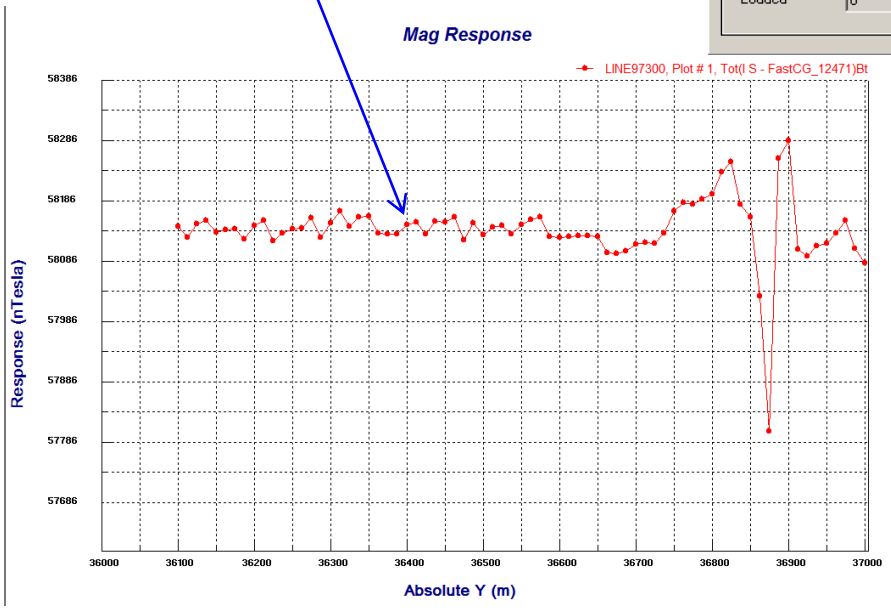
选择需要比较的数据集，然后点击“加载”
Select the data sets required for comparison and then click “Load”

绘图
PLOTTING

然后将所有选定的数据集加载到 Plotter 应用程序，出现的绘图显示第一条测线的模拟数据。

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





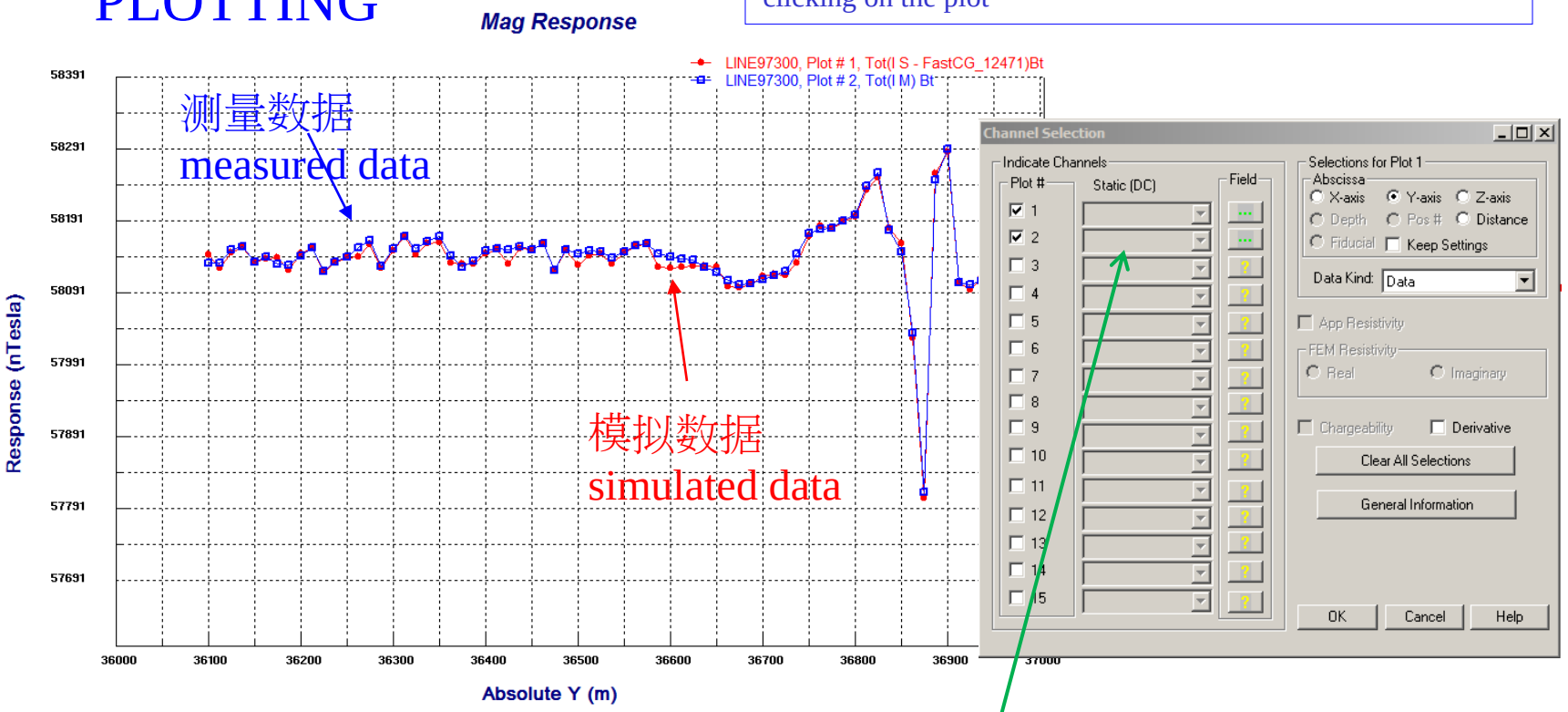
1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. **检查模型并创建绘图 Check model and create plots**

反演评估
Inversion Evaluation

用户可以通过简单地双击绘图来选择其他数据集进行绘图

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

绘图
PLOTTING



选择测量数据为第二个图

Select for the 2nd plot on measured data

1. 导入数据 Import data
2. 检查数据 Examine data
3. 执行初始建模 Perform initial modeling
4. 执行 三维 磁反演 Perform 3D magnetic inversions
5. **检查模型并创建绘图 Check model and create plots**

反演评估
Inversion Evaluation

在“静态”模式下，可以为多个反演和模型显示多个图。 用户可以通过简单地单击箭头逐步浏览不同的测线。
Multiple plots can be shown for various inversions and models in “Static” mode. The user may step through different profiles by simply clicking the arrow.