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

<i>Steps: 步骤:</i> 0.Introductions 简介	Page 1
 将数据导入新的或现有的数据库 Import data to new or existing database 	3
2. 检查数据 Examine data	7
3. 执行初始正演建模 Perform initial forward modeling	9
4. 执行 三维磁反演 Perform 3D magnetic inversions	10
5. 检查模式并创建绘图 Check mode and create plots	22



Magnetic Inverse 1



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.

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。

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

4. 执门 二维 磁反衡 Perform 3D magnetic inversions 5. 检查模型并创建绘图 Check model and create plots	Browse and select .qct or .xyz data file for import. This first example is an olde
Image: Section 1.1 Construction Image: Section 1.1	Import Step 1: Select a data de and set data setting
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 12/13/2022	▲ Back Next > Cancel Help ● as well 単击"下一步"按钮继续下一步 Click "Next" button to proceed to the next step

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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

Magnetic Inverse 5

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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



< Back

Finish

Cancel

Help

单击"下一步"按钮 Click "Next" button 12/13/2022

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Magnetic Inverse 7



Gravity

VTEM AeroTem

Gravity

ip example

Project ID:

mag_airbome

Project Name

4. 单击"勘测编辑器"按钮以检查测线和测点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 Check lines and stations by clicking "Survey Editor" button analyzing, editing and mapping tool. Profiles may be deleted, modified, 菾 renamed, datapoints moved, deleted, and maps may be underlain or 12/13/2022 constructed

Magnetic Inverse 9

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
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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.

lata Created 6/24/2016 4 58 47 P

tofile Data Set

Change Name

98312125

1 100000238

Export to Geosoft (grd) Export to sys-file

ce of grids Export to got file

2

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.

> Model Nam Model



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 2ⁿ x 2ⁿ, 单元格不必为正方形 Selecting "For FFT" ensures the grid is 2ⁿ by 2^m, cells need not be square

插值后,	网格附加到数据库中的数据集	ļ.,	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

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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.



			1
Attached Grid 0 NatNeighbour, 3 Deriv128x32_clean	Components 1 Bt	Grid information Nx: 128 Nu:	ndary Min (m): -557.406 Max (m): 549.77
Note: Only one grid can be be elected.	Note: Multi components can ne selected.	32 YI	Min (m): 1091.34 Max (m): 1067.63
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Use Wave Number Filter	Reduce to <u>P</u> ole Method	Store dal Success Progress	a to database. ful completion.

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.

导入数据 Import data 检查数据、网格化和绘图 Examine data, gridding and mapping

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

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



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.

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
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实例2:导出导数用于三维反演

	- Grid Data	Set Informatio	n			
Data Set(s)	Orthogo	nal local dimen	sions:			Data Type:
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	C Centro	oid of Grid	Countercle	ockwise	Components:	
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2831 Delete Grid					3. Tx - BEARTH	
elated to:					Rx - BTotaly	
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Permous Eutrapolated Points	Euro	at Grid				E.A
nemove Extrapolated Points	Expo	on and			. 🛃 🖾	EXX
Difference of grids	Exp	port Derivatives	to Original Stat	ions		Help
山寸奴						

12/13/2022

Magnetic Inverse 12

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

Case 2: Export derivatives for use in 3D

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

Export
Close

• 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.

导入数据 Import data 检查数据、网格化和绘图 Examine data, gridding and mapping 执行初始建模 Perform initial modeling

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Magnetic Inverse 13

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

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



1. 导入数据 Import data 2. 检查数据、网格化和绘图 Examine data, gridding and mapping

For Help, press F1

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在测线之间切换

Database:C: \Program Files (x86) \Emigma V8.6 \Demo Databases \MiningDatabase \mining_training.mdb

在绘图仪中加载数据集 Load data set in plotter

Toggle between profiles - 0 × Configure Settings Defaults Draw Tools View _ 8 × 🔮 📽 🖪 🖪 🖻 🛤 🥑 🍀 🔛 🗤 🎟 🗱 🖙 🔤 🔛 😂 🔜 🦯 🛄 🔟 💷 🗤 🗟 🍬 2 ? 1 🔶 🔂 🕈 Mag Response LINE97300, Plot # 1, Tot(I M) Bt 58391 58291 58191 Response (nTesla) 58091 57991 57891 57791 57691 36000 36100 36200 36300 36400 36500 36600 36700 36800 36900 37000 Absolute Y (m)

Examiner

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Magnetic Inverse 15

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.*



Magnetic Inverse 16



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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.

洗定的数据集

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.

<u>单击使用</u>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.

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Set Earth Field Intensity
Intensity
Intensity in the dataset
C Average of data
C Average of data within 1SD (about 68% around mean)
○ Average of data within 2SD (about 95% around mean)
O User defines
Earth field intensity (nT) 58157
<u>O</u> K <u>C</u> ancel

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 、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。月	车。 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 defin Average of data - the value will be calculated data values used for the calculation depends of User define - simply enter a new value in the

<u>Coefficient settings</u> 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 后用。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.

ned in the selected survey.
d from the data. The amount of
on the option chosen.
e field intensity box.
-

coefficienc seconds for Derivative	· <u> </u>
Relative contribution between the d	lerivatives
dBt/dx contribution	1
dBt/dy contribution	1
dBt/dz contribution	1
ОК	Cancel

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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.



<u>o</u>K

Cancel

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	Grid Cell Settings (ald	ong grid axis)			
	Cells in X 18	87 Cells in Y	29	Cells in Z 25	Total 135575
	Cell Size X	0 Cell Size Y	100	Top cell thickness (m)	36
	Spacing Z direction		Ο Δ;	Define	Cell Sampling
Edit the search grid cell thickness	×				
Note: Depth displayed here is relative to the ground level.		Crid Settings 团枚	心罟		
Total thickness 900 To	op Depth	在网格设置区域中	<u>以高</u> 确认要在反演	何中使用的网格点的	数量和布局。单元
Total thickness after modification 858 0		格将在 x 和 y 方向	上均匀分布。	Confirm the number	and layout of grid
Search grid cell thickness		evenly spaced in the	x and y direct	ions.	area. The cens will be
Index Thickness Bottom Depth			-		
1 10.0000 -10.0000		Vertical Grid Spacin	gs: 垂直网格	间距:	
3 10.0000 -20.0000		为z方向上均匀分	布的点选择∆	,或为指数分布的,	点选择 Δ·2ⁱ⁻¹ 。 您可
4 36.0000 -66.0000 5 36.0000 -102.0000		以通过选择∆ _i 来指	定自定义间即	E。 然后可以通过单	自击"定义"来修改您
6 36.0000 -138.0000 7 30.0000 174.0000		的自定义设置。Ch	loose Δ for eve	enly spaced points in	the z direction or
8 36.0000 -174.0000 8 36.0000 -210.0000		$\Delta \cdot 2^{i-1}$ for exponentia	ally spaced poi	nts. You may specify	v a custom spacing by
9 36.0000 -246.0000 10 36.0000 -282.0000		selecting Δ_i . Your cu	stom settings	can be later modified	l by clicking Define .
11 36.0000 -318.0000 12 26.0000 254.0000					
Thickness (m) 10 Insert Index	1	编辑网格单元厚度	F Editing the	e Grid Cell Thicknes	s
Modify the selected Insert a thick	ness	界面显示编辑前后	的总厚度以	○日本	<u>。</u> 单元格大小列在编辑
		搜索网格单元格国	夏度部分中。]	The interface display:	s the total thicknesses
Delete the selected		before and after ed	iting as well as	s the topmost z value	The cell sizes are
Note: Multiple thickness items can be selected.		listed in the Edit th	ne Search grid	l cell thickness secti	on.
<u>D</u> K <u>C</u> ancel	Help		0		
					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
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<u>反演方法</u> 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.

Magnetic Inverse 22

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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

<u>目标函数</u> 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: 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

$$H_{ext}(r) = \int G(r,r')M(r')dr'$$
$$M(r') = (m(r') - m_0)H_{ins}(r') = \chi(r')H_{ins}(r')$$

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Trust Region Non-Linear CG	
Inversion Parameters	

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

$$\boldsymbol{\phi}_{\mathbf{m}}(\mathbf{m}) = \boldsymbol{\alpha}_0 \int \mathbf{w}^2(\mathbf{z}) \left[\mathbf{m}(\mathbf{r}) - \mathbf{m}^0(\mathbf{r}) \right]^2 d\mathbf{v} +$$

 $\sum_{i=x.v.z} \alpha_i \int [w(z) \nabla_i (m(r)-m^0(r))]^2 dv$

 α_I - 权重因子 weighting factors w(z) - 深度加权 depth weighting

Inversion parameters	×
Linear CG Fast Inversion	
Susceptibility constraint	Search parameters
Output sensitivity Xs: 0.0001	Maximum iterations 25
Cells with susceptibility between Xs and Xs will not be output to susceptibility distribution (.mag) file.	Scattered field misfit (%)
Xmin -0.2	Smooth parameters
Susceptibility smaller than Xmin will be set to Xmin.	Alpha s 0
	Alpha x 0
Xmax 0.2	Alpha y 0
Susceptibility greater than Xmax will be set to Xmax .	Alpha z 0
<u><u> </u></u>	<u>C</u> ancel <u>H</u> elp



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

Magnetic Inverse 24

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roject		Survey			Dataset	Note:	e: Only the datasets that have model are liste			
Name	ID 🔺	Name		ID	Mode	el Name				
Ground Mag	32	Total F	ield Surface	141	perm fix	528		arredino.		
Air Man	29	Inversi	on and Filtering	142	3DIny TrustBegion	n	1606	Trus	t 3779	
Near Surface - Mag	15	Exporte	ed Grid	143	3DInv TrustRegion	n.	1607	Trust	10102	
Near Surface - Shell B6	14				3DInv TrustRegion	n	1609	Trust	ust 38502	
Near Surface - Concrete	13				Model target		2841	Mode	el target	
Case Study Mag	39 🖵									
4										
nomalies									,	
Name Type	e k	(SI)	Top X (m)	Top Y (m)	Top Z (m)	Strike Lengt (m)	h	Dip Extent (m)	Thickness (m)	
Name Type arget Prise	e k	(SI) 0.1	Top× (m) 98100.0000	Top Y (m) 36312.0000	Top Z (m) -0.5000	Strike Lengt (m) 800.000	h	Dip Extent (m) 400.000	Thickness (m) 40.000	
Name Typ arget Prisn	e k	(SI) 0.1	Top X (m) 98100.0000	Top Y (m) 36312.0000	Top Z (m) -0.5000	Strike Lengt (m) 800.000	h	Dip Extent (m) 400.000	Thickness (m) 40.000	
Name Typ arget Prisr	e k	(SI) 0.1	Top X (m) 98100.0000	Top Y (m) 36312.0000	Top Z (m) -0.5000	Strike Lengt (m) 800.000	h	Dip Extent (m) 400.000	Thickness (m) 40.000	
Name Typ arget Prisr	e k	(SI) 0.1	Top X (m) 98100.0000	Top Y (m) 36312.0000	Top Z (m) -0.5000	Strike Lengt (m) 800.000	h	Dip Extent (m) 400.000	Thickness (m) 40.000	
Name Typ rget Prist		(SI) 0.1	Top X (m) 98100.0000	Top Y (m) 36312.0000	Top 2 (m) -0.5000	Strike Lengt (m) 800.000	h	Dip Extent (m) 400.000	Thickness (m) 40.000	

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.

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	M Magnetic 3D Inversion	
	Selected dataset(s) to do inversion	Inversion Method
	# Dataset Survey Project 1 dumontgrd_m2Meas Total Field Surface Case_Study_Mag Weights	Linear Fast CG (Matrix) Linear Slow CG Non-Linear CG Inversion Parameters
设置完成后,按运行按钮开始反演	Inclination Component List Survey area information 82 # Receiver Item Value Declination Image: Im	Use Initial Model Set Initial Model Use known geological structure Set Structure
过程 After settings are complete, press the	Set Intensity Coefficient settings Select Survey Area Search Volume	Use topography information Remove Grid Cells Distance (m) 87.5
Run button to start the inversion process	Horizonta Angle (degree) Anti-clockwise (rom East 90 Select Search Area Cell Sampling Grid Settings Cells in X 111 Cells in Y 30 Cells in Z 5 Total 16650	Inversion Message Prepare data Start inversion. # Data utilized in inversion is 1665 # Gird Cells 16650 Getting Initial Model
	Spacing Z direction C A 2FI C A 1 Define Top cell thickness (m) 18.75 Set Output Log File Name Get Settings From a Log File Progress Close application when inversion Bun Cancel	Initial model misfit

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执行反演

Executing the Inversion

M Magnetic 3D Inversion			
Selected dataset(s) to do inversion	Inversion Method		
# Dataset Survey Proje 1 dumontgrd_m2Meas Total Field Surface Case_Stur	etAddLinear Fast CG (Ma Mag	ameters	
Inclination Component List Survey area information 82 # Receiver Item Declination Image: Transity Image: Transity Center X (m) 32 Intensity Size X (m) Intensity Size Y (m) 58157 Set Intensity Coefficient settings	Value 98300.0000 36512.5000 1075.000 2000.000 90.000 cations (m) 12.599 Set Structur Survey Area	el 二 示 wi ical structure sh	侧窗口(白色)显 数据误差。The right ndow (in white) ows data misfit.
Search Volume Center X (m) 98300.000001639 Center Y (m) 36512.499997814 To Size X (m) 1200 Size Y (m) 2400 Th Horizontal Angle (degree) 90 Select Search Area Grid Settings 90 Select Search Area Grid Settings 90 Cells in Z 5 Spacing Z direction \triangle \triangle \triangle Define To Set Output: Log File Name Get Settings From a	p Z (m) Image: Cell Sampling ckness (m) 581.25 Cell Sampling Inversion Message Cell Sampling Least Squares Misfit Iteration 6 Total 16650 p cell thickness (m) 18.75 Least Squares Misfit Iteration 8 Data Misfit 81.65 Least Squares Misfit Iteration 4 Data Misfit 81.65 Least Squares Misfit Iteration 8 Data Misfit 81.655 Least Squares Misfit Iteration 8 Data Misfit 81.655 Least Squares Misfit Iteration 8 Data Misfit 81.655 Least Squares Misfit Initial model misfit	87.5 48.37000 48.37000 48.37000 48.37000 48.37000 48.37000 48.3700	进度"栏显示了此反演 总进度。The Progress" bar shows e total progress of this version.
Progress Close application when inversion Bun	<u>C</u> ancel	Help	

Magnetic Inverse 28

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反演评估 Inversion Evaluation

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.

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

1. 导入数据 Import data 2. 检查数据 Examine data 反演评估 3. 执行初始建模 Perform initial modeling **Inversion Evaluation** 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 🔈 Data Processing × Select a processing tool from a list 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 3D Inversion Model Processing **3D Inversion Model Processing** ٠ 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 Average Duplicates Convert Units 范围内的单元格将被删除) Coordinate System Translate and Rotate Users can use "3D Inversion Model Processing" tool to remove cells in inverted model. Follow the routine Data Decimation Data Interpolation shown in this page and arrive "Cell Removal" dialog. Choose the removal range of cells: "Low Limit" and Data Outlier Removal Diurnal Correction "High Limit" (any cell within this range will be removed) Export Depth Slices from Inversion Model X Extract Survey 3D Inversion Mod Filters Gradient Remo X Line Lenath Ca **Profile Mergin** Cell Removal Set No-Data V Case_Study_Mag - Total Field Surface - Mag3DInv_FastCG C Cell Adjustment Inversion File: mining training 859.mag - Impedance Data S C Apply for all c Model: FastCG 12471 OK. Cancel Data Set ID: 859 C Apply for Imp Distribution of Values Select Help -0.201 -> -0/121: 0.0400% 12471 # of Cells -0.121 -> (0.040; 0.5292% 完成后点击"应用"按钮 -0.040 /> 0.040: 97.9552% -0.2 Minimum. k(SI) Click "Apply" button when it is done 0.040 -> 0.121: 1 2348% 0.2 Maximum. k(SI) $0.1/21 \rightarrow 0.201$ 0.2405% 因此,用户可以在反演之前(通过选择搜索区域)或反演之后 Remove cells in this range: (通过单元格移除)缩小模型范围。 Therefore, users can reduce the range of model either before inversion High Limit 0.2 ow Limit I-0.2 (by Select Search Area) or after inversion (by Cell Removal) Reset Cancel Apply

Magnetic Inverse 29



Magnetic Inverse 31

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点击 Click <u>₩</u> 打开 Visualizer 工具查看三维反 演模型

反演评估

Inversion Evaluation

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

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反演评估 Inversion Evaluation

Magnetic Inverse 32

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.



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反演评估 Inversion Evaluation

Magnetic Inverse 33

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.

× Susceptibility Unit: k(SI) 0.1437 -0.1323 Max value Min value Sensitivity is absolute value. Note: The cells with the value < -(max sensitivity) or > +(max sensitivity) will not be displayed. The cells with the value > -(min sensitivity) and < +(min sensitivity) will not be displayed. 0.1437 Max Sensitivity Apply .001 Default Min Sensitivity Update Color Range Close

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

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

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反演评估 Inversion Evaluation

Magnetic Inverse 34

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.

7 🗖	3	Viz	
	PI	otter]

Load Data Set		×
?	Do you want to compare with other Data Sets?	
Yes	No Load Settings Cancel Help	

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

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Magnetic Inverse 35

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"

														Survey Selection										
	经区										Projec	t: Case_S	tudy_M	ag										
												Data Sets in Survey: 2						Selected Data Sets to plot:		2				
	PLOTTING								Nam perm Mode	e _fix 		Model Name	Type S S	Data Units: nTesla	Name Mag3DInv_FastCG dumontgrd_m2Me	Model Name FastCG_12471	Type S M							
然后将所有 绘图显示第	「选定 第一条	的数 测线	据集的机	集加 莫抄	1载3 人数1	到 Plo 居。	otter	应用	程月	序,¦	出現	见的	J						Add to> Add All to>					
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Magnetic Inverse 37



Absolute Y (m)

nTesla