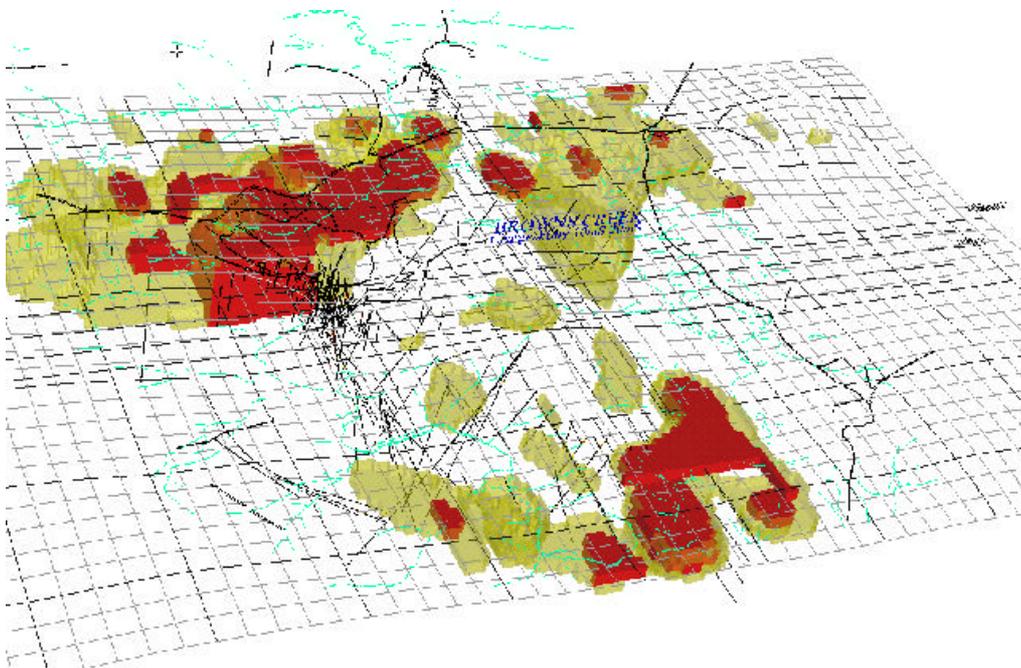


IP 3D Inversion and Visualisation



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1. INTRODUCTION	4
2. 3D VIEWER	4
3. AVAILABLE PROGRAMS	5
3.1 STR2INV(A)	5
3.2 IPQC	5
3.3 GSFDECUP	5
3.4 GSF2INV3	5
3.5 RES3DINV	5
3.6 INV2SENS	5
3.7 INV2BLK	5
3.8 IPEXT	5
3.9 DXF2MASK	5
3.10 BLKMASK	5
3.11 BLKGRECT	6
3.12 BLMERGE	6
3.13 BLKLIMIT	6
3.14 BLKHIST	6
3.15 BLK2VRML	6
3.16 GRIDVRML	6
3.17 DXF2VRML	6
3.18 BLKH2V	6
3.19 BLKV2H	6
3.20 UNBLK	6
3.21 FINDROWS	7
3.22 ROWSTOPO	7
3.23 ELECT	7
3.24 DAT2XYZ	7
3.25 BLK2MM	7
3.26 HOLVRML	7
3.27 INV2MOD	7
3.28 MOD2INV	7
4. PROGRAM USAGE	9

5.	<i>PROGRAM DESCRIPTION</i>	9
5.1	STR2INV3	9
5.2	IPQC	10
5.3	GSFDECUP	11
5.4	GSF2INV3	11
5.5	RES3DINV	12
5.6	INV2SENS	12
5.7	INV2BLK	12
5.8	IPEXT	13
5.9	DXF2MASK	13
5.10	BLKMASK	13
5.11	BLKGRECT	13
5.12	BLKMERGE	14
5.13	BLKLIMIT	14
5.14	BLKHIST	14
5.15	BLK2VRML	14
5.16	GRIDVRML	15
5.17	DXF2VRML	15
5.18	BLKH2V	15
5.19	BLKV2H	15
5.20	UNBLK	16
5.21	FINDROWS	16
5.22	ROWSTOPO	16
5.23	ELECT	16
5.24	DAT2XYZ	17
5.25	BLK2MM	17
5.26	HOLVRML	17
6.	<i>GLOSSERY</i>	18
6.1	FILE TYPES	18

1. INTRODUCTION

This manual describes some of the programs that are available to create 3 dimensional model from IP and other data. The 3D display engines used are generally available free and attach to web browsers. They use Virtual Reality Modeling Language (VRML) as their input. The programs described below allow the creation of various 3D Models.

2. 3D VIEWER

The programs described produce VRML files. These are an ASCII description language designed to allow the viewing of 3D data. The viewers allow the user to rotate, Pan Zoom and “walk through” the data. The language was set up for 3D web page display by a number of companies. It allows the attachment to objects of sound, video and images. For a full description see 3D WEB Consortium on the web.

Being ASCII files they can be edited and joined. Many of the programs produce parts of the total image, which can be assembled to realise the finished object.

The 3D viewer we use is Cosmo, available on the web from xxxxxxxx

3. AVAILABLE PROGRAMS

3.1 STR2INV(A)

Used to convert Strider format D-D data (X,Z,Dat) to input format for 3Dinversion Program. >.DAT

3.2 IPQC

Program to check and graphically edit the IP data before processing. GSF>GSF

3.3 GSFDECUP

Program to remove the effects of EM coupling from IP Data before inversion.. GSF>GSF.

3.4 GSF2INV3

Program to convert Scintrex GSF for pole dipole array to input format for the inversion program. .GSF > .DAT

3.5 RES3DINV

Inverts IP/Resistivity data to create a 3D Block Model .DAT >.INV>.XYZ

3.6 INV2SENS

Combines data from .INV and .XYZ files to make a new XYZ file containing sensitivity information. .INV+.XYZ > XYZ.

3.7 INV2BLK

Converts the output of 3D Inversion program to 3D GXF grid files. Needs to be run for the Chargeability and the Resistivity .XYZ >.ZXF

3.8 IPEXT

Extracts N=1 coordinatess from 3D inversion input file (created with **STR2INV3**). This data is then imported into MapInfo/Autocad and a poly line drawn around the data set limits. The poly line is exported as a DXF file. .DAT >.DXF

3.9 DXF2MASK

Produces a GXF masking file to mask the .ZXF file. Used to create a mask of the survey boundary. Use the .ZXF file as the Prototype file. .GXF+.ZXF>.GXF

3.10 BLKMASK

Use the output of **DXF2MASK** to mask the .ZXF files before creating the 3D VRML files. Used to limit the model to survey boundaries in odd shaped surveys. GXF+ZXF >.ZXF.

3.11 BLKGRECT

This program takes data from .ZXF file and transforms it to another based on scaling, rotation, translation and stretching. Using this you can move from say a local grid to AMG. ZXF>ZXF(moved).

3.12 BLMERGE

This program takes data from several ZXF files and re-grids them onto user specified limits and spacings. Used if Inversion done in several bits or different grids or data types. ZXF+ZXF>ZXF

3.13 BLKLIMIT

To limit depth extent of model when interpolating smaller blocks. Used in steep terrain.

3.14 BLKHIST

Creates a histogram of the 3D Model used in selecting cutoff levels in VRML models. .ZXF > screen

3.15 BLK2VRML

Used the .ZXF files to create 3D VRML files. The program can read block sensitivity models and the block data models to create a combined model in which the data colour intensity is proportional to the sensitivity .ZXF (& .ZXF) >.WRL

3.16 GRIDVRML

Is used to create a grid to overlay the 3D VRML model. It can use a GXF file to create an elevation surface or put magnetic, TEM, geochem data over the VRML image. .GXF >WRL.

3.17 DXF2VRML

Creates VRML files from 2D DXF files. If elevation data is available as GXF files, the program will create 3D data ie drape the DXF over the elevation data. Used for adding cultural information. DXF > .WRL

3.18 BLKH2V

SC

Extract vertical slices from horizontal block file. .ZXF >.YXF or .ZXF >.XXF

3.19 BLKV2H

SC

Extract horizontal slices from vertical block file. .ZXF >.YXF or .ZXF >.XXF

3.20 UNBLK

Create individual .GXF files from block files to draw up plans or sections. .ZXF, XXF or YXF >.GXF

3.21 FINDROWS

This program reads through an input file for Loke's 3D inversion package and makes a list of all the valid row and column numbers. This file can then be used to correct the .DAT input file header for non uniform grid spacing. DAT > (any)

3.22 ROWSTOPO

This program creates the topographic data needed for the 3D inversion program from a GXF file. The program reads the rows/columns required from a file created with FINDROWS. GXF+ (output FINDROWS) > (any)

3.23 ELECT

Program to plot the current and receiver positions from the input files to Loke's 3D inversion program. The output is a mid file for Mapinfo. You can then export to a DXF if you want to put them onto a VRML model. The program will extract the topo data from the .DAT file, if it exists, to a GXF file. .DAT > .MIF & GXF

3.24 DAT2XYZ

Program to extract a receiver line from Loke's .DAT input file for plotting pole-dipole, dipole-pole pseudo sections. For offset arrays the program presumes the Tx is on the Rx line. This is used to check what points have been deleted. .DAT > .PD & .DP

3.25 BLK2MM

Program to convert 3D .ZXF block model files to MicroMine 3D block model files. .ZXF > .DAT

3.26 HOLVRML

Creates 3D VRML files from Drill Hole data. The Drill Hole data needs to be in Strider format. >WRL

3.27 INV2MOD

Takes the xyz output from loke's 3d inversion and creates an input stream of the final model for his 3d modelling program. The idea is to be able to modify the final inverted model and see what effect this has on a further inversion. This is useful for creating a "Dummy" or blank model that can be modified ready for modeling.

.XYZ > .MOD

3.28 MOD2INV

Program takes an existing input stream for res3d and the pole-pole res3dinv output from res3dmod to create a new input stream for res3dinv which has the model results instead of the original data.

Useful for modeling Pole Dipole arrays.

.DAT + .DAT > .DAT

4. PROGRAM USAGE

These program are designed to run in a DOS window to produce a series of outputs that can then be viewed with a browser. Apart from Loke's RES3DINV program the programs are simple command line driven programs.

The sequence of programs to create a model is

1. Convert your IP data into a format for the 3D inversion program.
2. Run the 3Dinversion program.
3. Convert the output of the inversion program to 3D ZXF files, Resistivity, Chargeability and Sensitivity.
4. If the IP survey is an irregular shape create a DXF file of the survey outline and use this to mask the 3D ZXF files
5. Create the VRML files of the chargeability and the resistivity data.
6. Create and add the other VRML files such as drill holes, topo and culture.

5. PROGRAM DESCRIPTION

5.1 STR2INV3

This program converts IP data stored in separate section files in XYZ format and puts them into a format for Loke's 3D inversion package. The data files contain the station the distance under the station. Below is an example of the data input format for 100m.dipoles. The format is 3F8.0 or free read, ie space delimited.

```
4400.00-150.000 248.311
4450.00-100.000 218.686
4750.00-200.000 360.872
4800.00-250.000 325.018
4850.00-300.000 237.993
4900.00-350.000 299.502
4450.00-200.000 251.896
4500.00-150.000 214.257
```

The program will ask for the names of the resistivity and the chargeability file for each line. The program allows you to transform IP data sets that were surveyed on different grids. The program asks for the Bearing of +X with respect to model north? Data easting of common point , Data northing common point, Model easting of common point and Model northing. It also asks for a Factor to multiply IP effect so you can "adjust" different surveys to common levels. The program then requires a line easting or northing.

The program loops asking for the next lines until all are entered.

After all the required lines have been input, the program sets up a basic inversion model. In general do not make the block size smaller than the data spacing since for large data sets the inversion will take a long time (weeks) especially if you have topographic data. You can interpolate the inverted model onto smaller blocks later.

Version STR2INV3A reads line name inputs from a file called "LIST". The format for the file is Resis file name, then Charg, then line number. If the resistivity file name is the line number preceded by a letter the program removes the letter and decoded what's left as a line number. If this fails, it gets assigned a ZERO line number. If you enter a line number in the file it will use it, if blank it will use the calculated one. The file terminates with an upper case END. The program will ask for the angle etc still. The input file will be similar to below.

R7100
C7100

R7300
C7300

R7500
C7500

END

5.2 IPQC

Program displays each IP decay curve and allows the user to graphically edit readings. Individual readings can be marked for deletion. The program automatically marks readings opposite TX positions for deletion but these can be unmarked if required. This program reads a GSF file containing 2 Rx positions on the same side of a single Tx line. The program displays the current Tx-Rx position on a plan in relation to the other electrodes from that setup as well as the position on a pole-dipole/dipole-pole pseudo sections. The pseudo section is drawn up as if the Tx is on the same line as Rx's' The current position is highlighted and deleted readings are grayed out. The user can step through the data. The data can be sorted by Tx position then Rx or by Rx then Tx as it is read in.

Options:-

X=eXit and will save the file if edited.

B=Back will scroll backwards in the data file

F=Forward will scroll forwards in the data file

N=Name of line to jump to (a line number) in the data file

E=Edit invokes the edit screen which allows you to move a point on the current line and or select the current line and delete all other duplicates.

A=Auto will automatically scroll through the data

T=Time will control the cycle time, in secs.
D=Delete marks the current reading for deletion
U=UnDelete undeletes the current reading
R=Range allows the decay ranges to be set (from auto scale)
at fixed ranges. If set will reset to auto scale.

GSF>GSF

5.3 GSFDECUP

This program removes the EM coupling from the IP readings before IP inversion.
GSF>GSF.

5.4 GSF2INV3

This program converts Scintrex .GSF files to a format for Loke's 3D inversion program .GSF files are the required format for GSF2INV3.

When you get these files from Scintrex you may find that the second column (line co-ordinate for the Tx electrode) is a '*' or zero (depending on which program they create it with). the .DMP file has this co-ordinate if you don't already know it. It is a simple matter to put the correct line co-ordinate with a global replace of '*' with the line co-ordinate, or you can insist that they use the right co-ordinate, I just change them with an editor. If they tell the IPR12 they are collecting Dipole-Dipole data it puts the correct info in the file. This may put the wrong resistivity values in the .GSF file but GSF2INV3 recalculates them anyway.

The program allows you to filter the .GSF file for bad readings such as very noisy readings and very low VP's. The deleted points are written to a file with the reason for their rejection. Statistics on the rejected points are also collated.

Program DAT2XYZ will extract points for a line that can be used in plotting a pseudo section to check that this automatic editing has not put a big hole in your input data for inversion.

Note in the data file that the program GSF2INV3 created an input stream which assumes that the data are on uniform lines but it is often more efficient to use a non uniform mesh. If you run the program FINDROWS on the .DAT output from GSF2INV3 it will make the appropriate input lines to copy into the .DAT file instead of the number of rows and columns and spacings.

The output of FINDROWS can also be put into a GXF file of the topography to make the topographic input stream, on the assumption that the topographic GXF file actually contains data for all the lines (it just selects values, it doesn't interpolate. .GSF > .DAT

5.5 RES3DINV

This is Loke's 3D inversion program. See his manual for more details. The program produces 2 output files, a .INV and a .XYZ file. The .XYZ file contains the information to create a 3D model of the resistivity and chargeability data. The sensitivity data is contained in the .INV file. You will need to run INV2SENS to create another .XYZ file containing the sensitivity data in a format for creating the 3D model.

```
RES3DINV +.DAT >.INV+ .XYZ
```

5.6 INV2SENS

Loke's 3D inversion program produces sensitivity parameters, which are useful when analysing the 3D block inversion models. Unfortunately these parameters are output in the .INV files and are not in a suitable format for creating a block model. INV2SENS converts the data into a file that has the same format as the .XYZ files. The program uses the .XYZ file and the .INV file to create a new .XYZ file. This can then be used to create a block model of the sensitivities. Combines data from .INV and .XYZ files to make a new XYZ file containing sensitivity information. INV +.XYZ > XYZ

The program asks for the name of the .XYZ and .INV files produced by RES3DINV and outputs a .XYZ file. Make sure that the .XYZ and .INV files were produced by the same inversion session since the coordinates are extracted from the .XYZ file and merged with the sensitivity parameters extracted from the .INV file.

When producing the 3D block model (INV2BLK) of this data it is best to convert the values to logs. Use BLKHIST to examine the distribution of values.

```
INV2SENS +.INV+.XYZ > XYZ.
```

5.7 INV2BLK

This program converts Loke's .XYZ files to multi-layer GXF files. It creates a .ZXF file, which is a compressed ASCII grid file containing a GXF file for each layer or depth. The header contains the Z or depth for each layer. These files are a 3D block model of the data. A separate file needs to be created for each parameter, ie resistivity, chargeability and sensitivity, the program needs to be run for each parameter.

The program will ask for the search distance and block size as well as the column the data is stored in. The resistivity is in column 4, the conductivity in column 5

and chargeability in column 6. The sensitivity is in a separate file (see INV2SENS) in column 4. It is best to convert the sensitivities to log values.

```
INV2BLK + .XYZ >.ZXF.
```

5.8 IPEXT

This program extracts the coordinates for N=1 from the inversion input file. These points can then be plotted up with a program such as Mapinfo or Acad. This drawing will show the extents of the IP survey. If the survey is an odd shape, such as an “L” the inversion program will interpolate on a rectangular grid so you get numbers where there is no data. A mask can be fitted to the 3D model to remove these readings.

Draw a polyline around the plotted points and export the polyline as a DXf Acad Version 12 file.

```
IPEXT +.DAT > XY points
```

5.9 DXF2MASK

Produces a 2D grid file (GXF) used in masking the 3D model .ZXF file. The data is set to 1 inside the DXF area and zero outside. The program asks for the name of the DXF file and the name of a prototype grid. Use the grid that is to be masked, ie a .ZXF file. The output file is a .GXF file.

```
DXF2MASK +GXF+.ZXF>.GXF
```

5.10 BLKMASK

Use the output of **DXF2MASK** to mask the .ZXF files before creating the 3D VRML files. Used to limit the model to survey boundaries in odd shaped surveys. The program asks for the masking file and the model file and produces a masked model file. This program should be run on all the model files including the sensitivity model if the IP grid is not rectangular.

```
BLKMASK + GXF + ZXF >.ZXF
```

5.11 BLKGRECT

This program takes data from a ZXF file and transforms it to another based on scaling, rotation, translation and stretching. Using this you can move from say a local grid to AMG.

The rectification can be done by entering a known value to be added to the easting and northing and a rotation angle or entering a series of control points to a file, old east, old north, new east, new north, one per line, space separated. The program will then work out the translation parameters to be applied. The program re-grids the file down to a smaller grid size then translates the grid and re-grids back to the original spacing.

The program also allows you to re-grid a ZXF file to a smaller (or larger) cell size and to extract only part of the block model. By specifying minimum and maximum co-ordinates to be re-gridded (in terms of the new grid?? ...ask SC)

ZXF>ZXF

5.12 BLKMERGE

This program takes data from several ZXF files and regrid them onto user specified limits and spacings. Used if Inversion done in several bits or different grids or data types. The program asks for the name(s) of the data file and multiplying correction factor for this file, then the next file till all have been merged. It also asks for the limit of the final grid and the Radius of feathering circle? (0=Average).

ZXF + ZXF > ZXF

5.13 BLKLIMIT

SC to finish

To Limit depth extent of model when interpolating smaller blocks. Used in steep terrain.

5.14 BLKHIST

Creates a histogram distribution of the 3D model. This can be used in selecting cutoff levels for VRML models.

.ZXF > screen

5.15 BLK2VRML

This program creates a 3 dimensional VRML file of the IP (or any) block data. The program uses the .ZXF file(s) created with INV2BLK. The program creates a series of shells at different cutoffs to create the model. The cutoff value, colour and transparency of each shell is specified. The cutoffs can be above the specified values or below the values. If a sensitivity block file is available then the model colour intensity can be made proportional to the sensitivity so that the least sensitive blocks fade to white.

Use BLKHIST before running BLK2VRML to examine the distribution of values and set cutoff limits.

.ZXF (sensitivity .ZXF) >.WRL

5.16 GRIDVRML

GRIDVRML creates a grid to overlay the 3D VRML model. The program asks for the grid spacing, including spacing of highlighted lines, and the elevation of the grid. If a GXF file containing the topography (elevation) is available a 3D surface can be created.

Other data such as magnetics, TEM, geochem can also be used and “suspended” over the IP model. The vertical exaggeration and base level of the data sets can be specified.

.GXF >WRL.

5.17 DXF2VRML

This program creates VRML files from 2D DXF files. This is useful for adding cultural information to 3D IP models. If elevation data is available as GXF files, the program will create 3D data ie drape the DXF over the elevation data. If no elevation data is available the user can specify an RL for the data. The user can also specify the colour of the lines. The input file can be clipped to a specific area if required.

The output file can be a full VRML file or created without the header. The data needs to be appended to the IP model VRML file. The program allows for vertical exaggeration if required.

DXF > .WRL

5.18 BLKH2V

SC

Extract vertical slices from horizontal block file.

.ZXF >.YXF or .ZXF >.XXF

5.19 BLKV2H

SC

Extract horizontal slices from vertical block file.

.ZXF >.YXF or .ZXF >.XXF

5.20 UNBLK

Create individual .GXF files from block files to draw up plans or sections of the IP data. If the Model file is a .ZXF the program can produce a series of slices through the data. These are output as a number of 2D grid files (.GXF) at various depths. If sections are required run BLKH2V on the .ZXF file to produce a .XXF file or a .YXF file. These latter 2 files are a series of GXF files that run vertically through the data rather than horizontally. The user can produce nominated or all of the sections or plans.

.UNBLK +ZXF or XXF or YXF >a number of .GXF

5.21 FINDROWS

This program reads through an input file for Loke's 3D inversion package and makes a list of all the valid row and column numbers. If you run the program FINDROWS on the .DAT output from GSF2INV3 it will make the appropriate input lines to copy into the .DAT file instead of the number of rows and columns and spacings.

The output of FINDROWS can also be used in conjunction with a GXF file of the topography to create the topographic input stream, on the assumption that the topographic GXF file actually contains data for all the lines and points (it just selects values, it doesn't interpolate). .DAT > (any)

5.22 ROWSTOPO

This program takes a GXF file containing the topographic data and extracts the data ready for input into the 3D inversion program. This is useful when dealing with non standard mesh/grids sizes.

The program reads the rows/columns required from a file created with FINDROWS. GXF + (output FINDROWS) > (any)

5.23 ELECT

Program to plot the current and receiver positions from the input files to Loke's 3D inversion program. This is useful in monitoring the progress of your survey and also useful when displaying the final data as often there are anomalies generated where there is no or little data due to odd grid layouts. The program currently handles Dipole-Dipole, Pole-Dipole and Mixed array data types.

The program dumps out the first 24 lines of the data file then asks for the data type, the number of electrode positions and the starting line of the electrode data.

The output is a MIF file for Mapinfo. You can then export to a DXF if you want to put the electrode positions onto a VRML model.

The program will also extract the topographic data from the .DAT file, if the topographic data exists, to a GXF file. The program detects if Topographic data exists in the input file and gives the user the option of extracting it to a .GXF file and hence using this as a topographic grid draped over the 3D model (see GRIDVRML). After extracting the data you can run GXFREGRD to make a finer grid/mesh if required.

```
.DAT > .MIF (&..GXF)
```

5.24 DAT2XYZ

Program to extract a receiver line from Loke's .DAT input file for plotting pole-dipole, dipole-pole pseudo sections. For offset arrays the program presumes the Tx is on the Rx line. This is used to check what points have been deleted.

The program asks for the name of the .DAT file and the receiver line number. For presentation it presumes the TX data is on the Rx line. Two files are produced a pole-dipole file and a dipole-pole line. From these you can check if there is a major hole in the input information for the inversion program.

```
.DAT > .PD & .DP
```

5.25 BLK2MM

Program to convert 3D .ZXF block model files to MicroMine 3D block model files. The program takes a 3D .ZXF file and converts it to a MicroMine ASCII 3D block modelling input file. You may need to re grid the .ZXF file, INV2BLK, to a larger block size or it will be slow in MicroMine. The program allows you to adjust the block model RL by a fixed amount during conversion.

```
.ZXF > .DAT
```

5.26 HOLVRML

Creates 3D VRML files from Drill Hole data. Contact Bob White (rwhite@tooronga.com) for format and programs to create drill hole files compatible with this program.

```
>WRL
```

6. GLOSSERY

6.1 FILE TYPES

DAT ASCII input files for Loke's inversion programs or MicroMine 3D block model format files.

DP & PD These are pseudo section type data files being station number, depth and data value.

DXF Autocad (and other programs) ASCII vector output file.

GSF These are Geosoft formatted files from Scintrex containing the Pole Dipole data.

GXF ASCII grid file compatible with Geosoft. They can be compressed format, ie 3 byte integers to power 90.

INV ASCII output files from Loke's inversion programs.

XXF A compressed ASCII 3D grid file in X direction vertical slices.

XYF A compressed ASCII 3D grid file in Y direction vertical slices.

XXY ASCII output files from Loke's inversion program.

ZXF A compressed ASCII 3D grid file in horizontal slices.