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GRAMA
An Interactive 2.5–Dimensional Gravity and Magnetics Modeling Program
Version 1.3

Developed at the Pacific Geoscience Centre
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Sidney, B.C. Canada

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ABSTRACT

GRAMA is an interactive 2.5-dimensional **GRA**vity and **MA**gnetics modeling program for use on an IBM or compatible personal computer that has at least 640 kbytes of memory. This forward modeling program is menu driven and has been specifically designed to be easy to learn and operate. Data can be entered via keyboard, mouse or digitizing pad. The program can accommodate models containing up to 300 points. There are no restrictions on the size or number of bodies other than the 300 point limit. Bodies are defined by their vertical cross section and strike extent.

For full graphics capability the program requires a colour monitor and either an IBM colour display card, an IBM enhanced display card (EGA,VGA), or a generic IBM display card. As an alternative, one can also use a monochrome monitor and a Hercules monochrome graphics card. The program is written in Microsoft Fortran, version 4.1 and is best used with a math co-processor. Interactive graphics are handled by the **Halo'88** graphics library (not included). **Plot88** software (also not included) produces plots on the Epson family of printers and on a variety of Hewlett-Packard plotters.

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INTRODUCTION

The program GRAMA uses the concept of forward modeling as its approach to problem solving. As with other modeling routines of this type, a body is defined by entering the X (horizontal) and Z (vertical) coordinates of its corner points along with relevant density and/or magnetization parameters and strike extent (body dimension normal to the X,Z plane). A computed anomaly profile is generated and compared to a previously entered observed anomaly profile to determine how well the model fits. The model parameters are adjusted until a reasonable fit is obtained between the calculated and observed profiles.

In 1986, a University of Victoria co-op engineering student, Mike Brandys served a four month work term at the Pacific Geoscience Centre developing an interactive user-friendly 2-dimensional gravity modeling program. The computational core was taken from a mainframe algorithm written by Desso Nagy (Geological Survey of Canada, Ottawa). In 1987 another University of Victoria co-op engineering student, David Perks, made the program 2.5-dimensional and added magnetic modeling capability. These later improvements were derived from MAGRAV2, a PC routine written by John Broome (Geological Survey of Canada, Ottawa) which was released as GSC Open File 1334, August 1986. Further improvements to GRAMA editing functions and output displays were made by Douglas Reid in 1989 and Dan MacDonald in 1990.

For information regarding the GRAMA program, contact David Seemann: Pacific Geoscience Centre, Box 6000, Sidney, B.C., Canada V8L 4B2 (604-356-6589); or Jack Sweeney: Geological Survey of Canada, 100 West Pender, Vancouver, B.C., Canada V6B 1R8 (604-666-1131).

DISCLAIMER

The Geological Survey of Canada provides this software 'as is' without warranty of any kind either expressed or implied and accepts no responsibility for its accuracy or utilization.

1.0 HARDWARE REQUIREMENTS

The program GRAMA is designed to operate on an IBM PC/XT or AT, and on most IBM-compatibles. In its simplest state, the program requires the following hardware:

1. 640 kbytes of memory
2. A hard drive and one floppy drive.

To fully use all of the features of the program, the following hardware is required:

1. Colour monitor and graphics card or monochrome monitor and Hercules type graphics card
2. Two serial communication ports
3. Hewlett-Packard plotter
4. Dot matrix printer (Epson format)
5. HIPAD digitizing tablet with four button cursor
6. Math co-processor chip
7. Mouse with two buttons

Although the program will operate without all of this additional hardware, data input and especially output will be limited as follows:

Without Graphics Capability
-the interactive mode (SCREEN GRAPHICS EDITOR) will not be available to the user.
-the user will be unable to display either the model or profiles on the monitor.

Without a Printer or Plotter
-observed and calculated anomaly profiles, body points and parameters etc. can only be displayed on the monitor (no hard copy).

Without a Digitizing Tablet or mouse
-the entry/editing of body information can only be performed via the keyboard.

2.0 COMPILING AND LINKING

The GRAMA program is provided as Fortran source code. Before the program can be used it first must be compiled and linked with other libraries. Three commercial software packages are required:

1) Microsoft Fortran compiler, version 4.1.

2) Halo graphics library with Microsoft Fortran 4.1 support (Halo88, version 1.0 used).

3) Plot88 graphics library with Microsoft Fortran 4.1 support.

2.1 Halo Graphics Library

The Halo software package is marketed by Media Cybernetics. It is a collection of subroutines which enable the user to produce high quality computer generated graphics.

The following Halo files are used by the GRAMA program:

1) Halodvxx.obj
   -object file connecting HALO and the graphics device driver
2) Halokbdi.com
   -keyboard locator device driver
3) Halohipi.com
   -digitizing pad locator device driver (HIPAD)
4) Haloibm.dev
   -IBM colour display device driver
5) Haloherc.dev
   -Hercules monochrome graphics device driver
6) Haloibmg.dev
   -IBM generic device driver
7) Haloibme.dev
   -IBM enhanced graphics adapter (EGA) device driver
8) Halovpln.dev
   -IBM enhanced graphics adapter (VGA) device driver
9) Halof.lib
   - Fortran library interface

NOTE: .... Halo supplies device drivers for most of the popular graphics boards on the market. The device drivers listed above are built into the program; the user may add more with minimum modifications.

2.2 Plot88 Library

The Plot88 software library package is marketed by Plotworks Inc. It produces dot matrix printer and CRT raster displays using an IBM-PC/XT system. The package also provides direct compatibility with plotter software.

2.3 GRAMA Files

The accompanying 360 kbyte floppy disk contains the Fortran source code and accompanying command files necessary to construct an executable GRAMA file. The disk also contains a file (TEST.DAT) with sample data and source bodies, and a file (MANUAL.WP5) with the text of this manual in Word Perfect version 5.1 format.

Files contained on the GRAMA disks:

1) GRAMA.FOR
2) CALC.FOR
3) DATAST.FOR
4) MENU.FOR
5) MENU.FOR
6) VISED.FOR
7) SWINDOW.FOR
8) GRAMA.MKE
9) PGC.LIB
10) LOAD.BAT
11) TEST.DAT
12) MANUAL.WP5

2.4 Setting Up Using a Hard Disk

1) Create a GRAMA directory on your hard disk.
2) Copy the contents of the GRAMA disk onto the directory.
3) Copy the required Halo files onto the directory.
4) Copy the file PLOT88.LIB onto the directory.

2.5 Executing the Make File

The file GRAMA.MKE is a make description file. This file was used to compile and link the Fortran source code to create an executable GRAMA file.

The Microsoft Program Maintenance Utility **MAKE** is particularly useful during program development for it is able to discern whether changes were made to source or object files and will automatically update the executable file.

To run the make file type "MAKE GRAMA.MKE"

NOTE: The above make description file assumes that the DOS environment variable used by MS-Fortran , LIB, has been defined and that the compiler and linker (FL and LINK) are in the DOS path. The file also assumes that the MS-Fortran run-time library, LLIBFOR7, is available.

3.0 INTRODUCTION TO THE PROGRAM

The GRAMA program is menu driven for ease of operation. From the main menu, the user has a choice of options as depicted in the following diagram:

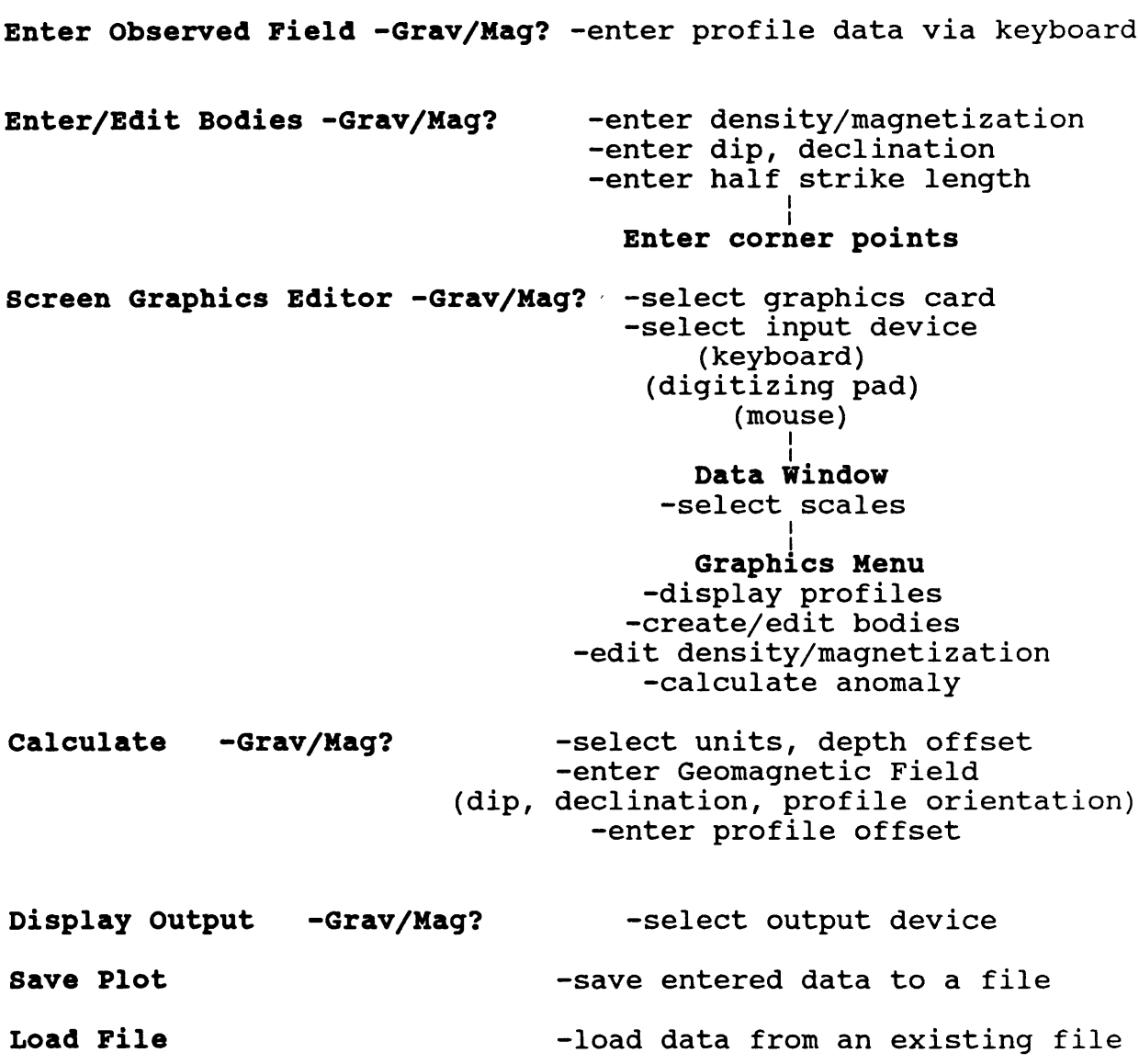

Figure 1. Flow diagram of available options

3.1 Important Keys

The menus within the program are self explanatory, some of the terminology used in the manual however may require explanation as follows:

DATA FIELD	-the highlighted area on the screen in which data are entered.
FIELD BAR	-the highlighted area on the screen for selecting a menu option.
ENTER KEY	-executes the **field bar** option within a menu OR enters the value within a **data field**
SPACE BAR	-moves the **field bar** within a menu OR moves the cursor right within a **data field** (blanking the location)
ARROW KEYS	-moves the **field bar** in the direction of the arrow within a menu
DEL	-moves the cursor right within a **data field**
INS	-moves the cursor left within a **data field**
BACK SPACE	-moves the cursor left within a **data field** (blanking the location)
ESC	-terminates any process and returns to the previous menu

3.2 Data Entry

Keyboard entry of data is easily performed using the spreadsheets within the program. The following rules apply to spreadsheets:

1) For negative values, the minus sign can ONLY be entered in the first (left hand) space within the data field.
2) The position of the decimal point within the data field is fixed. If the decimal point is entered the cursor will automatically relocate to the tenths position.
3) To change from one data field to another, use the ARROW KEYS or the ENTER key.
4) Blank spaces within the data field are ignored.
5) Within a spreadsheet, when the last data item has been entered, the curser will normally jump to the data field at the start of the following line. This is a potential ERROR CONDITION as the program will take this line as an unintended extra data point (value = 0.00). To remove the unwanted line, depress F7, then hit ESC to exit the spreadsheet. To avoid this problem, when the final data field is filled, depress the F8 key or the ESC key and <u>not</u> the ARROW KEYS or the ENTER key.

Examples of data entry:

as entered	value in memory
- 1.20	-1.20
12.20	12.20
. 2	.20

4.0 EXECUTING THE PROGRAM

Before executing the program, ensure that the plotter, if available, is connected to COM PORT 1, and the digitizing pad, if available, is connected to COM PORT 2. A mouse, if available, will normally have a dedicated port.

NOTE: .... If you wish to re-configure the ports while running the program, change the INPORT numerical code in the PLOT PARAMETERS list that is part of the DISPLAY OUTPUT option within the Main Menu.

i.e. port 1 (com1) ----- 9600
port 2 (com2) ----- 9650
parallel port ----- 0

4.1 Loading the Program

1) Enter the batch file LOAD.BAT - this loads and executes the Halo drivers and the GRAMA program.

2) If GRAMA is exited, re-entry is achieved by typing GRAMA.EXE (Halo drivers need not be reloaded).

4.2 Main Menu

After loading GRAMA, a title block is displayed on-screen. To display the Main Menu shown below, depress any key.

MAIN MENU

ENTER OBSERVED GRAVITY FIELD
ENTER OBSERVED MAGNETIC FIELD
ENTER/EDIT BODIES
SCREEN GRAPHICS EDITOR
CALCULATE
DISPLAY OUTPUT
SAVE FILE
LOAD FILE
CLEAR MEMORY
QUIT

USE ARROWS OR SPACE BAR TO SELECT,
USE ENTER TO EXECUTE

5.0 ENTER OBSERVED FIELD

The Observed Field spreadsheets are used to enter and/or edit observed data. There are spreadsheets for gravity and for magnetics. Each spreadsheet consists of two columns. In the first column the user enters the horizontal distance, positive or negative from a zero point, along the profile. In the second column is entered the observed anomaly value.

To enter, go to ENTER OBSERVED ... FIELD in the Main Menu using the ARROW KEYS or the SPACE BAR and depress the ENTER key.

NOTE 1: .... In order to generate a calculated profile, an observed profile must first be entered. If an observed profile is not available, the user must enter a fictitious profile by entering a series of horizontal distances in the DISTANCE column. It is not necessary to enter anomaly values in the second column.

NOTE 2: .... If entering both gravity and magnetic profiles, neither the observation points nor the profile lengths have to coincide.

Within the Observed Field spreadsheets, a number of automatic functions are available to facilitate data entry. The following Help Menu is displayed on screen:

FUNCTION KEYS

F1	REPEAT	-repeats the value in the data field directly above the cursor
F2	AUTO INCREMENT	-after entering at least two lines of data, the horizontal distance increment can be automatically repeated by depressing this key instead of typing in a value
F3	RECOVER	-recovers the last deleted line and inserts it immediately **above** the current line
F4	RECOVER AFTER LINE	-recovers the last deleted line and inserts it immediately **below** the current line
F5	INSERT LINE	-inserts a data line with 0.00 initial values immediately **above** the current line
F7	DELETE LINE	-deletes the current data line
F8	ENTER ONLY	-similar to the ENTER key except that it enters data into memory without exiting from the current data field
ESC	RETURN TO MAIN MENU	-exits the spreadsheet and returns to the the Main Menu

NOTE: .... Read item (5) in Section 3.2

6.0 ENTER/EDIT BODIES

The Body spreadsheet consist of two modules. In the first, the user enters the physical properties of each body such as density or magnetization, dip and declination (depending on the mode) and a half-strike length (explained below). In the second module, the corner points of each body are entered.

Strike length is the body dimension normal to and centred about the profile line or X,Z plane. For 2-dimensional bodies the strike length is infinite and any large number, say STRIKE = 9999.00, will do. For bodies with finite strike length, say STRIKE = 4.0 km, the calculation assumes that the body extends for 2 km on each side of the profile line. In this example the body's half-strike length = 2 km.

6.1 Body Parameters

In order to enter the physical properties of a body, select the ENTER/EDIT BODIES option on the main menu by either using the ARROW KEYS or the SPACE BAR and depress the ENTER key. The mode menu will be displayed. Select either the gravity or magnetics mode by highlighting it and depress the ENTER key. Enter the physical properties of each body under the appropriate headings. When entering densities, do not enter actual values, enter contrasts (differences from some standard value).

If in the magnetics mode, enter magnetization in cgs units of 0.00001 emu/cc as well as the dip and declination of the magnetization for each body. For most modeling purposes an induced field is assumed. That is, the dip and declination of a body's magnetization vector = the dip and declination of the Earth's field (entered in the CALCULATE option, Main Menu). If remanent magnetization is present, the direction entered should be the vector sum of the remanent and induced magnetization vectors. The actual magnetization value entered will therefore be the amplitude of the vector sum.

As in the Observed Field spreadsheets, the Physical Properties spreadsheets contain a similar set of automatic editing functions. The following Help Menu is displayed on-screen:

FUNCTION KEYS

F1	REPEAT	-repeats the value in the data field directly above the cursor
F5	INSERT BODY	-inserts a data line with 0.00 initial values immediately **above** the current line
F7	REMOVE BODY	-deletes the current data line
F8	ENTER ONLY	-similar to the ENTER key except that it enters data into memory without exiting from the current data field

F9 ENTER/EDIT BODY POINTS
-exits Body Parameters spreadsheet and enters the Body Corner Points spreadsheet
ESC RETURN TO MAIN MENU
-exits Body Parameters spreadsheet and returns to the Main Menu

NOTE: .... Read item (5) in Section 3.2

6.2 Body Corner Points

To enter the Body Corner Points spreadsheet from a Body Parameter spreadsheet, select the desired body by highlighting it and depress the F9 key. This spreadsheet consists of two columns; a 'X' coordinate (horizontal distance) column and a 'Z' coordinate (depth) column. Corner points must be entered in a **clockwise** direction and the user must not close the body. That is, do not repeat the starting corner point.

FUNCTION KEYS

F1 REPEAT -repeats the value in the data field directly above the cursor
F3 RECOVER -recovers the last deleted line and inserts it immediately **above** the current line
F4 RECOVER AFTER LINE
-recovers the last deleted line and inserts it immediately **below** the current line
F5 INSERT LINE -inserts a data line with 0.00 initial values immediately **above** the current line
F6 GLOBAL CHANGE -changes the corner point (X,Z) value in all bodies that contain the point
F7 DELETE LINE -deletes the current line
F8 ENTER ONLY -similar to the ENTER key except that it enters data into memory without exiting from the current data field
ESC LEAVE POINT EDITOR
-exits the Body Corner Points spreadsheet and returns to the Body Parameters spreadsheet. Depress ESC twice to return to the Main Menu

NOTE: .... Read item (5) in Section 3.2

7.0 SCREEN GRAPHICS EDITOR

The Screen Graphics Editor is used to interactively add, delete or change bodies on the screen. This is where most of the work of building a model normally will be done.

To enter the Screen Graphics Editor select the option on the Main Menu using either the ARROW KEYS or the SPACE BAR and depress the ENTER key.

A menu is displayed that gives graphics card/colour options. Select the appropriate card by using the ARROW KEYS or the SPACE BAR and depress the ENTER key. If your computer is not equipped with one of the specified graphics cards you will not be able to continue further in this mode and you should return to the Main Menu by depressing the ESC key. Otherwise continue below.

The next menu requests the type of input device. The options are:

a) mouse
b) keyboard
c) digitizing pad

Highlight and select the desired device using either the ARROW KEYS or the SPACE BAR and depress the ENTER key.

The next menu, DATA WINDOW, displays the dimensions of the model and the anomaly field. The program automatically scales these values to fit the screen. The values can be changed as described in Section 7.1, item F8.

Once in the graphics mode, the model is displayed on the screen in the X,Z plane. Above the model, the following menu is also displayed:

```
-------------------------------------------------------------------
F1 CALCULATE PROFILE   F4 REMOVE BODY      F7 CHANGE INPUT DEVICE
F2 VIEW PROFILE        F5 CHANGE DENSITY   F8 CHANGE DATA WINDOW
F3 MAKE BODY           F6 CHANGE BODY(S)   F9 MODE : GRAV

Arrows or Space  -Sel. Body    ESC  EXITS

 BODY NUMBER 1   RHO =   .000   P)RECISION : OFF   S)MOOTH : OFF
-------------------------------------------------------------------
```

7.1 Screen Graphics Functions

The following section describes the options available in the SCREEN GRAPHICS EDITOR. Most functions are self explanatory and the user has only to follow the prompts.

F1 CALCULATE PROFILE

-This routine calculates the gravity or magnetic field of the on-screen model, as described in Section 8.0. The user is then returned to SCREEN GRAPHICS EDITOR at the DATA WINDOW menu.

F2 VIEW PROFILE

-This routine displays and compares the observed (dashed white line) and calculated (solid blue line) anomaly profiles. The Screen Graphics menu is restored by depressing any key.

F3 MAKE BODY

-This routine adds a body to the model. The user is prompted to:

a) Move the cross hairs, initially at the top left corner of the model, using the ARROW KEYS, digitizing pad or mouse (see Section 7.3). The X,Z coordinates of the cross hairs are displayed in the top right corner of the screen. The user can create a body point by depressing the # 1 key, grab an existing body point with the # 2 key, or exit this mode with the # 3 key.

NOTE: .... GRAB POINT (#2 key) selects the nearest existing body point in the model. To select a particular body point, position the cross hairs close to that point.

When the first point of the new body is placed, the normal procedure is to use the ARROW KEYS, digitizing pad or mouse to draw body segments and the # 1 key to set body points. Do not use the ARROW KEYS to repeat the first point. Use instead the # 3 key to close and complete the body.

b) After drawing the body, the user will be prompted to enter the density or magnetization, dip and declination, depending on the mode. Enter these values then depress the ENTER key.

c) Enter the strike extent and depress the ENTER key. This will return you to the Screen Graphics menu. The body just created will be highlighted on the screen. Each body in the model can be highlighted in sequence by depressing the SPACE BAR or ARROW KEYS.

F4 REMOVE BODY

- This routine removes a body from the model. After selecting (highlighting) the target body on-screen using the SPACE BAR or ARROW KEYS, the body can be deleted by depressing F4. A prompt will appear on the screen asking the user to confirm the intention to delete.

F5 CHANGE DENSITY/CHANGE MAGNETIZATION

- This routine sets or changes body physical properties. After selecting (highlighting) the target body using the SPACE BAR or ARROW KEYS, body density contrast (RHO), magnetization contrast (MAG), dip, declination and strike

extent can be changed by depressing F5. Enter the new values by over-writing the old ones, using either the SPACE BAR or the BACK SPACE key to cursor within the data field.

F6 CHANGE BODY(S)

- This routine changes an existing body(s) by inserting, deleting or moving a corner point. The user can change the shape of a particular body or group of bodies sharing a common point or line by depressing F6. Three options are displayed:

a) F1 **Insert Point**
To insert a point, the user is prompted to GRAB (see NOTE in F3(a) above) the beginning and end points of the line segment to be changed. The user is next asked what bodies containing that line segment are to be changed. The position of the new point is chosen by placing the cross hairs at the desired location using the ARROW KEYS, digitizing pad or mouse. If the point is incorrectly placed or if additional points are to be inserted, the next prompt allows a repeat of the process - or an exit from the routine.

b) F2 Delete Point
To delete a point, the user is prompted to GRAB the desired point and identify the bodies to be changed. After the deletion, the process can be repeated or the routine exited.

c) F3 **Move Point**
To move a point, the user is prompted to GRAB the desired point and identify the bodies to be changed. The new position of the point is chosen by placing the cross hairs at the desired location using the ARROW KEYS, digitizing pad or mouse. If the point is incorrectly placed or additional points are to be moved, the next prompt allows for a repeat of the process - or an exit from the routine.

NOTE: .... Forward modeling normally involves changing body geometry to achieve a fit between observed and calculated potential fields. Hence, it is anticipated that the **F6 CHANGE BODY(S) routines will be the user's chief interactive tool.**

F7 CHANGE INPUT DEVICE

- This routine allows the user to redefine the input device. The keyboard is the default device.

NOTE: ....Changing the input device from mouse to keyboard is not possible with this version of GRAMA.

F8 CHANGE DATA WINDOW

- This routine changes the horizontal and/or vertical scale of the model or anomaly field, including the ability to zoom in on any part of the model and its associated anomaly field. This is useful for adjusting vertical exaggeration, for examining specific model features, for inspecting degree of fit between observed/calculated anomaly fields and for viewing the model at different scales.

Depressing F8 displays the DATA WINDOW parameters currently in use. If you wish to accept these default values, depress the ENTER key and continue on to the next screen. Parameters requiring change are selected with the SPACE BAR or ARROW KEYS. Changes are made by over-writing the old values, then depressing the ENTER key to enter the change. To preserve the initial or a modified data window, select SAVE PARAMETERS IN MEMORY option and depress the ENTER key. To recover a saved data window, select the LOAD PARAMETERS FROM MEMORY) option. If you wish to update the data window, i.e. you have generated a calculated profile that does not fit within the current window, or if you have modified (using the body or profile editors) the bodies or profiles so that they now exceed the current window settings , select the RESCALE FROM DATA option. Enter CONTINUE to return to on-screen displays.

F9 CHANGE MODE

- This routine changes between the gravity mode and the magnetics mode. After selecting the mode, the program returns to the DATA WINDOW menu where parameters can be changed as described above.

7.2 Special Features

P KEY -(P)RECISION MODE, enables the user to fine tune the placement of the cross hairs to the nearest 0.01 distance unit. This feature can be turned off or on by depressing the "P" key.

S KEY -(S)MOOTH CURVE, enables the user to smooth both the observed and calculated anomaly profiles by fitting a spline function to the profile points. This feature can be turned off or on by depressing the "S" key.

SPACE BAR/ARROW KEYS

-enables the user to select a particular body for editing. The body that appears highlighted on-screen is the designated body.

7.3 Digitizing Pad/Mouse

In addition to keyboard editing of potential field models, a digitizing pad or mouse can be used for selected functions. The #1, #2 and #3 keyboard keys are represented by buttons on a digitizing pad cursor or mouse. In its present configuration, the program expects a Microsoft two-button mouse; when in this mode, the #3 keyboard key must be used. Other two or three button mouse devices besides the Microsoft mouse can be used, for more information refer to your Halo88 manual.

The program is also configured to use the Houston Instrument's Hipad Tablet. The operation of the tablet's four bottom keypad (used in stream mode) is very similar to that of the mouse. Other digitizers besides the Hipad model can be used (refer to Halo88 manual) by replacing the present locator device driver (Halohipi.com) with another driver.

NOTE: .... The digitizing pad and mouse can ONLY be used to enter/edit bodies, they cannot be used to enter profiles.

8.0 CALCULATE

This option performs the computations required to generate the calculated profile. The user is prompted to select GRAVITY or MAGNETICS mode. The next menu prompts choice of units for computation and display (default units are kilometres). Select the desired units by depressing the SPACE BAR or ARROW KEYS, then depress the ENTER key.

In the CALCULATE mode, the user is prompted for a depth constant, a value that is added to the depth coordinate of each body point in the model. This is useful when modeling aeromagnetic data, as the depth constant can be set equal to the flight elevation so that body depths in the model represent their true depth of burial. The default depth constant is zero. Depress the ENTER key to accept this value; otherwise type in an alternate value.

When in the MAGNETICS mode the user will also be prompted for the DIP and DEClination of the Earth's magnetic field and XTON. XTON is the orientation of the profile line in degrees clockwise from geographic North.

When calculations are completed, a profile offset value is highlighted at the lower left on-screen. This is the average difference in anomaly level between the observed and calculated profiles. It is added to or subtracted from the calculated field in order to allow it's comparison with the observed field. Depress the ENTER key to accept the calculated profile offset; otherwise type in an alternate value and ENTER. This returns the program to its point of entry: Main Menu or SCREEN GRAPHICS EDITOR at the DATA WINDOW menu.

9.0 DISPLAY OUTPUT

In DISPLAY OUTPUT, a menu lists several output devices. Select an output device using the SPACE BAR or ARROW KEYS, then depress the ENTER key. If a smoothed anomaly profile is desired, activate S)MOOTH CURVE by depressing "S" before selecting an output device.

The last line on the menu, the PRINTOUT option, generates a printout of the observed and calculated anomalies and their difference, (residual anomaly). The printout continues with a list of each model body's corner points and physical properties.

For all other output options, a DATA WINDOW is displayed. The user can over-write the given values or accept them by depressing the ENTER key. Some reasons for over-writing initial DATA WINDOW parameters are suggested in Section 7.1, item F8. Altering the PAGE LENGTH and PAGE HEIGHT values (units in inches) will reduce or enlarge the physical size of the display.

NOTE 1: .... The default values have been set to optimize the display area on a given output device. Changing these settings can result in crashing the program.

NOTE 2: .... To generate graphics on the screen, an IBM graphics monitor (or equivalent) and a colour graphics board are required.

NOTE 3: .... The AXIS COLOUR and BODY COLOUR options do not function in this version of GRAMA.

10.0 SAVE FILE

SAVE FILE copies the current model to a file on the default drive. To save a model, position the cursor to the SAVE FILE line and depress the ENTER key. The user will be prompted for a file name. Type in the desired file name and depress the ENTER key to execute. If the file already exists, a prompt invites the user to over-write the file currently in memory or to disregard the request.

NOTE 1: .... It is IMPORTANT to save most working models as they are generated. When an undesired change is made to a model under development, the change often cannot be undone. The ability to reload an advanced working model, rather than having to recreate it from initial data, spares the user much time and frustration. Completed models representing alternate interpretations can also be preserved in this way.

NOTE 2: .... A model thus saved, cannot be destroyed within GRAMA. The user must exit GRAMA and delete files under DOS command.

11.0 LOAD FILE

LOAD FILE retrieves a model previously written to a file using the SAVE FILE option. To load a file, depress the ENTER key. The user will be prompted for a file name. Type in the desired drive/directory (if not the default) and the file name, then depress the ENTER key. If the file does not exist, (because the file name has been mistyped or the file resides in another directory), a prompt invites the user to retype the file name.

NOTE: .... File sizes vary. Loading a new file may not always completely replace the file currently residing in GRAMA. To avoid potential problems, first execute CLEAR MEMORY (see Section 12.0), then go to LOAD FILE.

12.0 CLEAR MEMORY

CLEAR MEMORY erases the model presently residing in GRAMA, including all DATA WINDOW parameter settings. A prompt will appear asking the user to confirm the intent. CLEAR MEMORY deletes only the internal model, external files are unaffected (see Section 10.0, Note 2).

13.0 USING THE TEST FILE

A test data file (TEST.DAT) is included on the GRAMA disks. The file contains hypothetical gravity and magnetic models and observed profiles. After loading the GRAMA program (see Sections 4.0 to 4.2), go to LOAD FILE in the Main Menu and type in TEST.DAT (see Section 11.0). If the host computer contains a graphics card, select the SCREEN GRAPHICS EDITOR option. Follow the prompts as explained in Section 7.0. In the lower window a model consisting of three bodies will be displayed. Try the VIEW PROFILE option by depressing the F2 function key. The screen should display an observed anomaly profile (dashed line) and a straight-line zero-value calculated anomaly profile. Return to the Screen Graphics menu by depressing any key. To enter the CALCULATE mode depress the F1 function key. Follow the prompts as in Section 8.0 and eventually return to the Screen Graphics

menu. Both the observed and calculated anomaly profiles can now be displayed by depressing the F2 function key.

Create a new body by selecting the F3 function key and follow the prompts as described in Section 7.1, item F3. When building a body (in a clockwise direction), be sure not to connect the last point to the first. Use the # 3 key or button to close and complete the body. If in the gravity mode (default mode), answer the prompts for density and strike extent. Re-calculate and display the profiles as described above.

Experiment with the remainder of the Screen Graphics options, or exit to the Main Menu by depressing the ESC key. By selecting the CLEAR MEMORY option, you may start again, this time constructing your own model. Enter an observed profile using one of the Observed Field spreadsheets (Section 5.0), and body data using the Body Parameter and Body Corner Points spreadsheets (Section 6.0) or SCREEN GRAPHICS EDITOR functions (Section 7.0).