# montaj Gravity & Terrain Correction
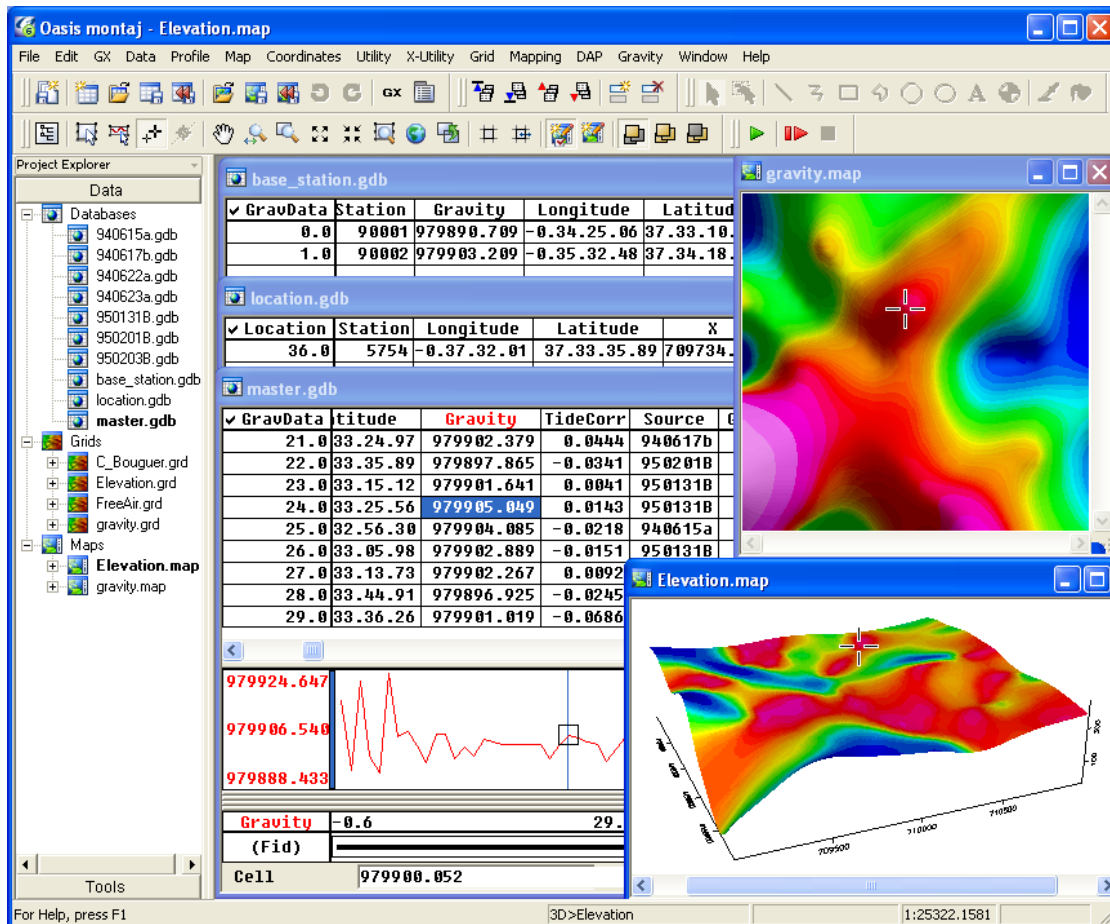
*Gravity Data Processing Extension
for Oasis montaj v7.1*

## TUTORIAL and USER GUIDE





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# Contents

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# Finding Help Information

There are several functions included in the basic **Oasis montaj** help system that may be useful to your work. The entire documentation for the system is available through the online help system. This electronic library of information enables us to constantly update the information and provide you with the most up-to-date information available.

The best way to find information in this system is to use the **Search** tab to perform a full-text search across all help topics. If you still cannot find the information you are looking for, the *Online Books* help system contains complete Geosoft manuals and tutorials in Adobe PDF format.

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# Chapter 1: System Capabilities and Concepts

The **montaj Gravity and Terrain Correction** extension is designed to process gravity data from conventional ground surveys. The information in this manual is intended for geophysicists who understand gravity surveys and data.

## Processing Sequence

The purpose of this section is to provide an overview of the processing sequence. When processing gravity data, the final goal is to produce a map of a gravity field showing the location of the readings. Gravity survey data present a number of challenges that the geophysicist must overcome during the survey process. These challenges include:

- Establishing known gravity values at base station locations
- Instrument calibration
- Reducing the survey data

**montaj Gravity and Terrain Correction** addresses these problems through the tools provided on the *Gravity* menu. Each section of the menu represents a different part of the process. The table below identifies the main processing tasks and describes how you use the software during each step. The procedures for these tasks are described in *Chapter 3: Quick-Start Tutorial*.

| Menu | Description |
|---|---|
| Project Information... | **Project Settings** |
| Processing Parameters... | 1. Set the project information (survey information and comments). Check the database names using the processing parameters option. |
| Base Stations ▶ | **Survey Planning Tools** |
| Calibration ▶ | 1. Import base station locations. |
| Locations ▶ | 2. Import calibration data and create an instrument calibration table. |
| Import ▶ | 3. Import or append location data and merge it with survey data. Create X, Y coordinate channels from long/lat data (and visa-versa). |
| Drift Correction... | **Import and Merge Survey Data** |
| Merge with Master Database... | 1. Import survey data files. |
| Process Repeats... | 2. Correct for instrument drift. |
| Terrain Corrections ▶ | 3. Merge survey data files into a master database. |
| Free Air, Bouguer Anomaly... | **Process Repeats and Apply Corrections** |
| Free air, Bouguer Step by Step... ▶ | 1. Create statistical reports to evaluate repeat readings. |
| Edit File... | 2. Correct for terrain effects on survey data. |
| Sort All by 1 Channel... | 3. Calculate Free Air and Bouger anomaly values. |
| Sort All by 2 Channels... | **Utilities** |
| Channel Math... | • Edit a text file using your default text editor. |
| | • Sort the database rows using one channel as a reference |
| | • Sort the database rows using two channels as a reference. |
| | • Apply a mathematical expression using the Channel Math tool. |

# Chapter 2: Before you begin

This chapter describes how to begin working with the **montaj Gravity and Terrain Correction** system in **Oasis montaj**. Topics discussed in this chapter include:

- Creating a project
- Loading the **montaj Gravity and Terrain Correction** menu

This tutorial uses sample data provided on the **Oasis montaj** CD and installed in your **C:\Program Files\Geosoft\Oasis montaj\data\gravity** directory. Before you begin the tutorial you need to create a working directory to store all your data.

The system enables you to access files anywhere but it is a good strategy to carefully organize your data (project information and files) before carrying out any processing.

To start this tutorial, please create a working directory called **D:\Tutorial**. A general rule to follow in working with Geosoft applications is to avoid working in the Geosoft directory. In these tutorials, we will follow this rule by keeping all the working data, found in **C:\Program Files\Geosoft\Oasis montaj\data\gravity**, in your working directory **D:\Tutorial.**

## Create a project

To work in **Oasis montaj** requires an open project. An **Oasis montaj** "Project" encompasses every item in your working directory; from the data files in your project (databases, maps, and grids), to the tools used (including auxiliary tools such as histograms, scatter plots etc.), to the project setup including the menus you have displayed and whether you are working on a map or profile and the state in which you left it the last time you used it.

The project also controls your working directory. Projects are saved as (*.gpf) files. If you open an existing project from a directory, the system assumes that all your project files are located in the same directory. To streamline your work, as well as keep it organized, you may wish to make sure that your project file is in the same directory as the other files you want to use. We recommend that each project you work on have its own project (*.gpf) file. If you use a number of applications or add-on tools in **Oasis montaj** that have different menus, you can use the project to display only the menus you require.

The *Project Explorer* tool enables you to browse as well as open any project item. The Project Explorer has two tab windows, the *Data* window that includes all data files included in the project and the *Tools* window that organizes and maintains the project tools. To access the *Tools* window click the **Tools** bar on the bottom of the Project Explorer. To return to the *Data* window, click the **Data** bar on the top the Project Explorer.

### TO CREATE A NEW PROJECT:

1. Start **Oasis montaj**.

2. On the *File* menu, select *Project | New.* The *New Project* dialog is displayed.
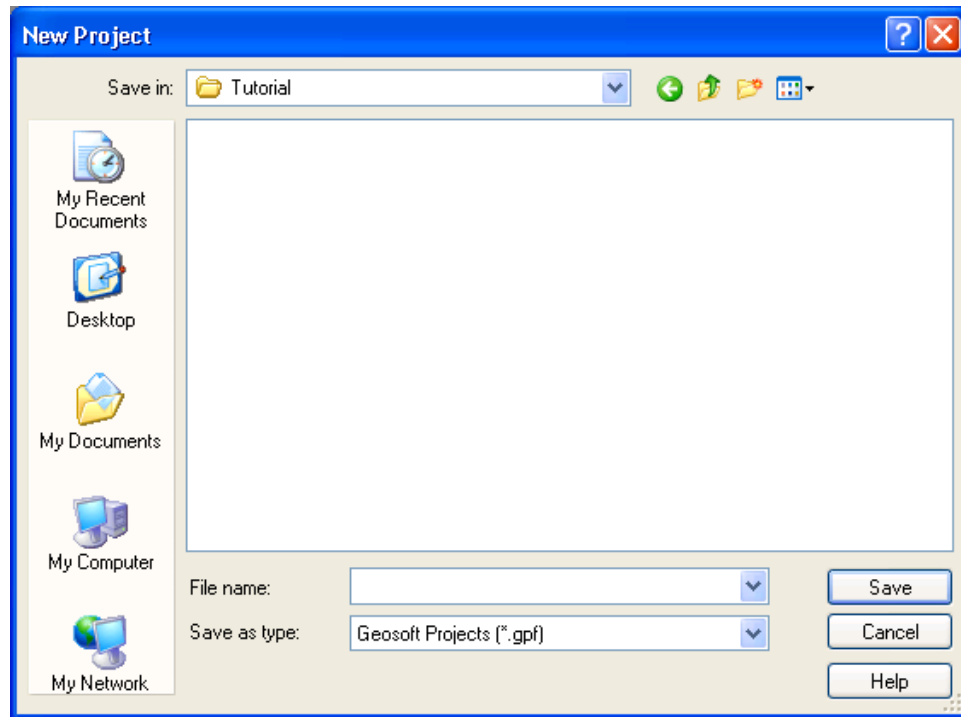


**Note:** **Oasis montaj** assumes that your data is in the directory containing this project (i.e. **D:\Tutorial**)

3. Specify a name and directory for the project. For example, name the project (**Gravity**) and specify the working directory as **D:\Tutorial**.

4. Click the **[Save]** button. The system saves the project and indicates it is open by adding menus to the menu bar, adding buttons to the Standard Short-cut bar and by displaying the *Project Explorer* window. These are visual clues indicating that you are ready to start working with the system.

## Load the Gravity menu

In **Oasis montaj**, menus are saved with projects so you can customise each project with a different set of menus. This is useful if you do several different types of processing and require different menus with each project.

Before you can start working with the system, you have to load the **Gravity** menu in your project. If you require more detailed information on modifying menus, refer to the *Oasis montaj Online Help System* (*Help/Help Topics*).

### To Load the Gravity menu:

1. On the *GX* menu, select *Load Menu* or click the *Load Menu* icon (⊞) on the main toolbar. The *Load Menu* dialog is displayed.

2. Select "gravity.omn" from the list of files and click the **[Open]** button. The system adds the *Gravity* menu onto your menu bar.

3. The system will display the *Gravity* menu on the main toolbar.
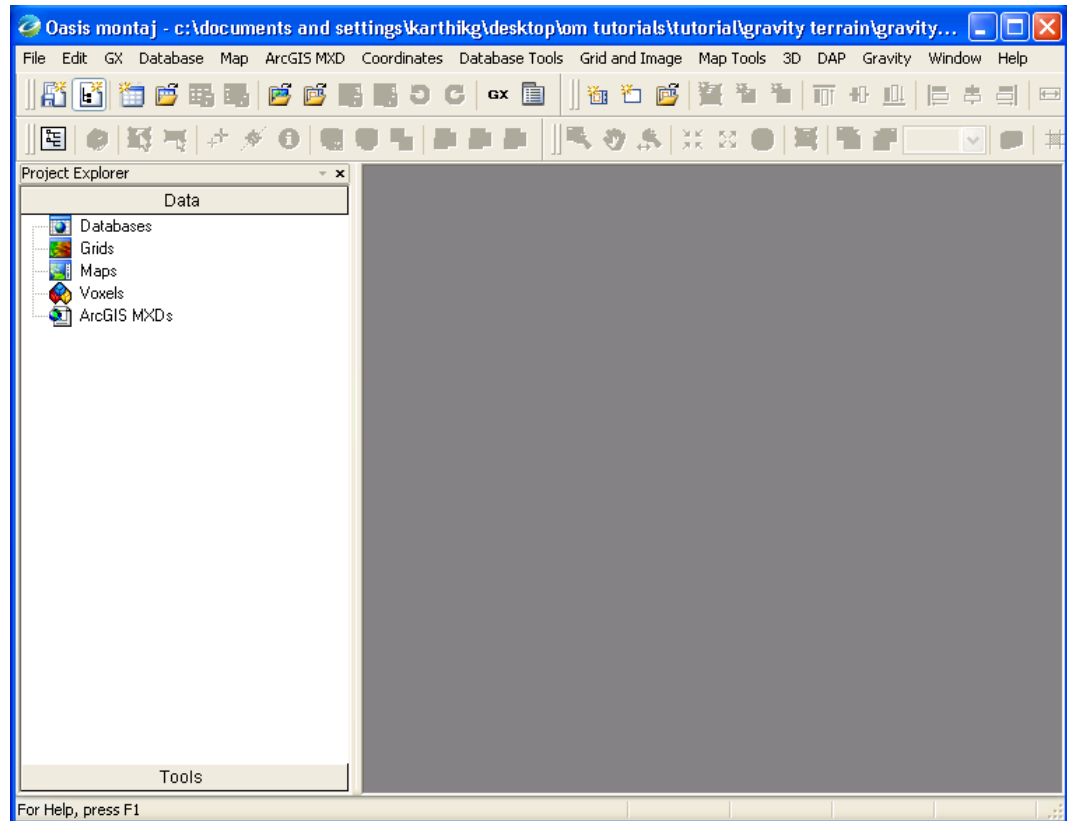
# Chapter 3: Quick-Start Tutorial

This chapter will guide you through a typical gravity processing sequence to produce a gravity field map showing the location readings. The procedures in this chapter will show you how to:
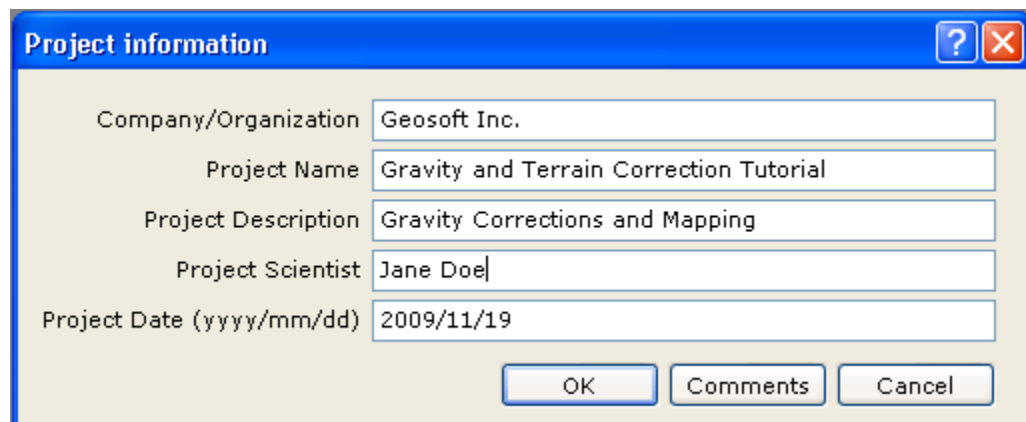
- Set Project Information (page 9)
- Import base station and location data (page 10)
- Import survey data (page 17)
- Remove instrument drift effects (page 20)
- Merge all survey data into a master database (page 21)
- Use Geosoft Script (GS) files to automate processing (page 22)
- Evaluate repeat readings (page 23)
- Apply terrain corrections (page 25)
- Calculate Free Air and Bouger anomaly values (page 28)
- Use the processing utilities (page 31)

## Setting the Project Information

Whenever you begin a new gravity project, you will most likely want to include information about the project with your data and maps. The *Project Information* dialog box enables you to specify information such as: the company, project name, a project description, scientist name, project date, and any comments. This information is stored with the project and is used later for mapping.

### TO ENTER PROJECT INFORMATION:

1. On the *Gravity* menu, select *Project Information*. The *Project Information* dialog box is displayed.



2. Type the project information in the parameter boxes provided. Note that, you can add additional comments to your project by clicking the **[Comments]** button.

3. Click the **[OK]** button when you are finished to save the *Project information* with your current project.

## Setting the Processing Parameters (Optional)

The *Global survey parameters* dialog enables you to view and modify the parameters of your gravity project or of an individual gravity survey database.

### TO SET THE PROCESSING PARAMETERS:

1. On the *Gravity* menu, select *Processing parameters*. The *Global survey parameters* dialog is displayed.



2. The following parameters can be viewed and/or modified; *Base station database*, *Location database*, *Latitude correction* (equation to use), *Earth density*, *Water density*, and *Ice density*. As well, you can select the type of survey (*Ground*, *Shipborne*, or *Airborne*).

3. These parameters are linked to the rest of the dialog boxes and will be filled in as you complete the tutorial. Once you are more experienced with the system, you can use the *Processing parameters* dialog to specify all your files and settings before you start processing. You can also use this dialog as a reference to check what your current settings are. This will save you typing them in later. This information is stored with the project.

4. Click the **[OK]** button to save these parameters with the current project.

## Importing Data

Once you have specified your project, you are ready to import your gravity data into an **Oasis montaj** database for processing. You will need to import three types of data, base station data, survey location data, and instrument survey readings.

**Note:** Any data you want to import into the **montaj Gravity and Terrain Correction** system must be first formatted as a CSV file or an **Oasis** database file (\*.gdb).

## Importing Base Station Data

The first set of data to import is the base station data. This involves two steps. First, you must create a new database or open an existing one. Then import the data from a CSV file to the database. If you need to edit the CSV file before importing, choose the *Edit a Base Station* option on the *Gravity| Base stations* menu.

### TO IMPORT A BASE STATION FILE:

1. On the *Gravity* menu, select *Base Stations | Open/create base station database*. The *Open/create a base station database* dialog is displayed.
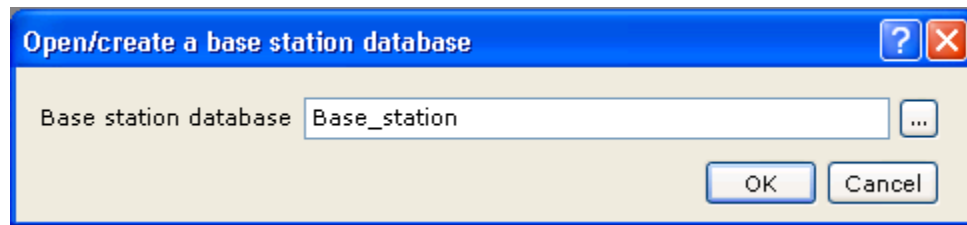


2. Specify a new *Base station database* name as **"base_station."** (Note that, to import data into an existing database, use the  button to locate the database file.)

3. Click the **[OK]** button. The *.\base_station.gdb* dialog will be displayed. This dialog asks you to confirm that you want to create a new database.
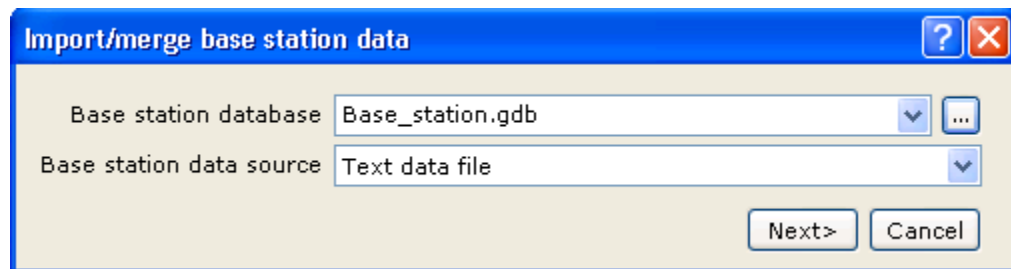


4. To accept the database name, click the **[Yes]** button. The *Load data?* dialog is displayed.
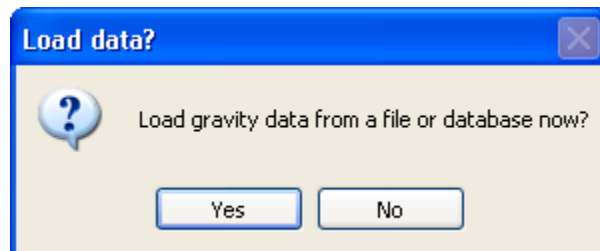
5. This dialog asks if you want to load (import) gravity data from a file or database into the newly created database. Click the **[OK]** button. The *Import/merge base station data* dialog is displayed.



6. Using the […] button, select the *Base station database* file you want to import the data into as **base_station.gdb**. Then, using the *Base station data source* dropdown list, select "Text data file."

7. Click the **[Next>]** button. The *Load base station data from text data file* dialog is displayed.
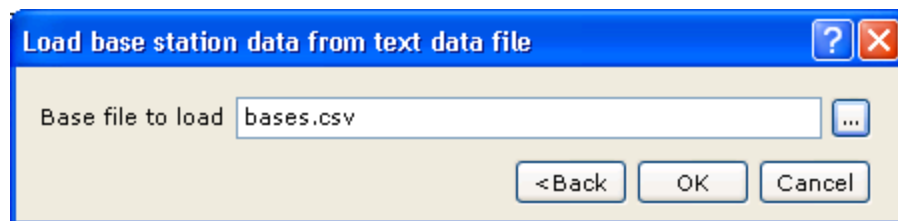


8. Using the […] button, select the *Base file to load* as **bases.csv** and then click **[OK]**. The data is imported into the database and displayed in a spreadsheet window.



## Importing Locations

The survey location data are used to establish the location of the survey on the earth. The system requires location information in both long/lat and XY coordinate systems for merging and mapping procedures. The long/lat values are used for mapping and the XY coordinates are used for merging the gravity survey information.

For this reason, the procedure for importing location data has two objectives. The first is to create a database and import a location data file. The second goal is to generate XY coordinates from long/lat coordinates (or long/lat from XY, depending on the original survey projection). To accomplish these objectives, the process requires three separate procedures.
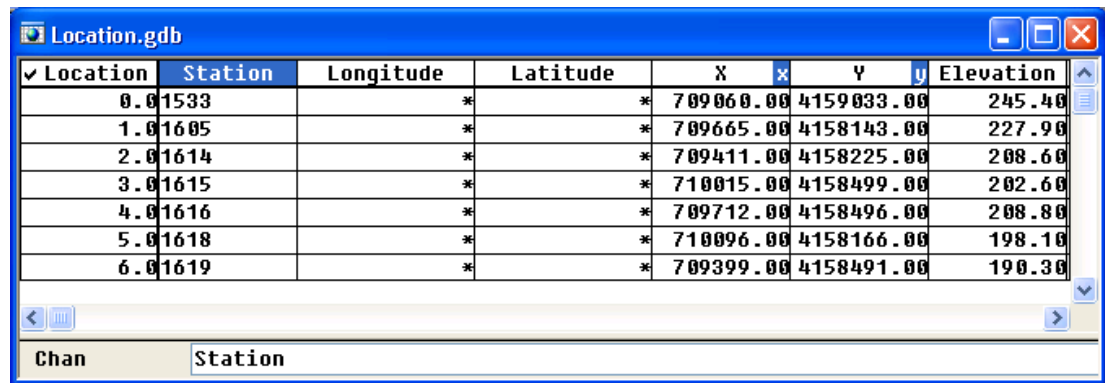
- The first procedure (step 1) is to create a database and import a locations data file.
- In the second procedure (step 2) is to define a starting projection for the database you created in step 1.
- The final procedure (step 3) is to define a destination projection. Together, steps 2 and 3 enable you to generate XY coordinates from long/lat data or long/lat from XY.

### STEP 1: IMPORTING LOCATION DATA INTO A DATABASE

The first step is to import location data (in *.CSV format) into an Oasis montaj database file (*.GDB).

#### TO IMPORT LOCATION DATA INTO A DATABASE:

1. To import location data, you will need the location coordinates in a CSV text file. You can create this file using a text editor or a spreadsheet program like Excel. In this tutorial, you will use the **location.csv** file.

2. On the *Gravity* menu, select *Locations*, then *Open/create location database*. The *Open/create a location database* dialog is displayed. Specify the *Location database* as **locations.gdb** and click the **[OK]** button. The *.\location.gdb* dialog is displayed. This dialog asks you to confirm that you want to create a new database with this name.

3. Click **[Yes]** to confirm. The *Load data?* dialog is displayed. This dialog asks if you want to load location data into the newly created database. Click **[Yes]** to accept. The *Import/merge location data* dialog is displayed. Using the ⬛ button, select the *Location database* as **location.gdb**. Then, using the *Base station data source* dropdown list, select "Text data file."

4. Click the **[Next>]** button. The *Load location data from text data file* dialog is displayed. Using the ⬛ button, select the *Location file to load* as **location.csv**.

5. Click the **[OK]** button to import the data. The new database is displayed showing the station, elevation, long/lat and XY coordinates of the survey. Note that the Long/lat coordinate channels contain dummy values because the data are only projected as UTM coordinates. The next procedure (step 2) will show you how to create long/lat coordinates from XY projected data.

### STEP 2: DEFINING A COORDINATE SYSTEM FOR XY LOCATION DATA

In the previous step we imported the location data into an Oasis montaj database. The next step is to define the projection for the current X, Y database values.

#### TO DEFINE A COORDINATE SYSTEM FOR XY LOCATION DATA:

1.  On the *Gravity* menu, click *Locations | X, Y -> Longitude/ latitude*.  The *Convert map (X,Y) to (Longitude,Latitude)* dialog is displayed.
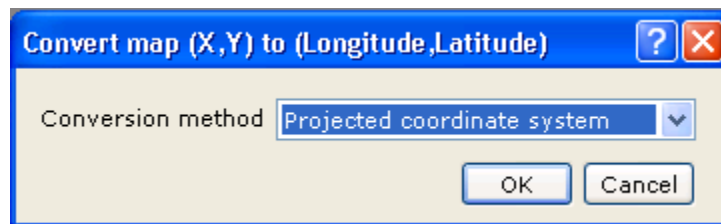


2.  Using the dropdown list, select the *Conversion method* as "Projected Coordinate system." For information on converting data, click on the [?] button.

3.  Click the **[OK]** button. The *Enter existing coordinate channels* dialog is displayed.
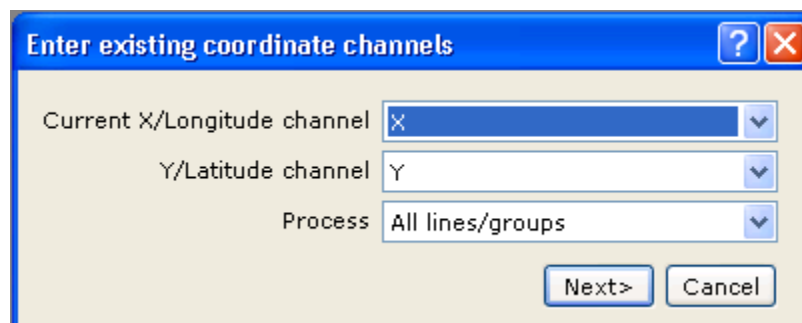


4.  Using the dropdown lists, select (**X**), (**Y**), and "All lines/groups." Click the **[Next>]** button. The *Coordinate System* dialog is displayed showing all the known projection information for the X,Y database.
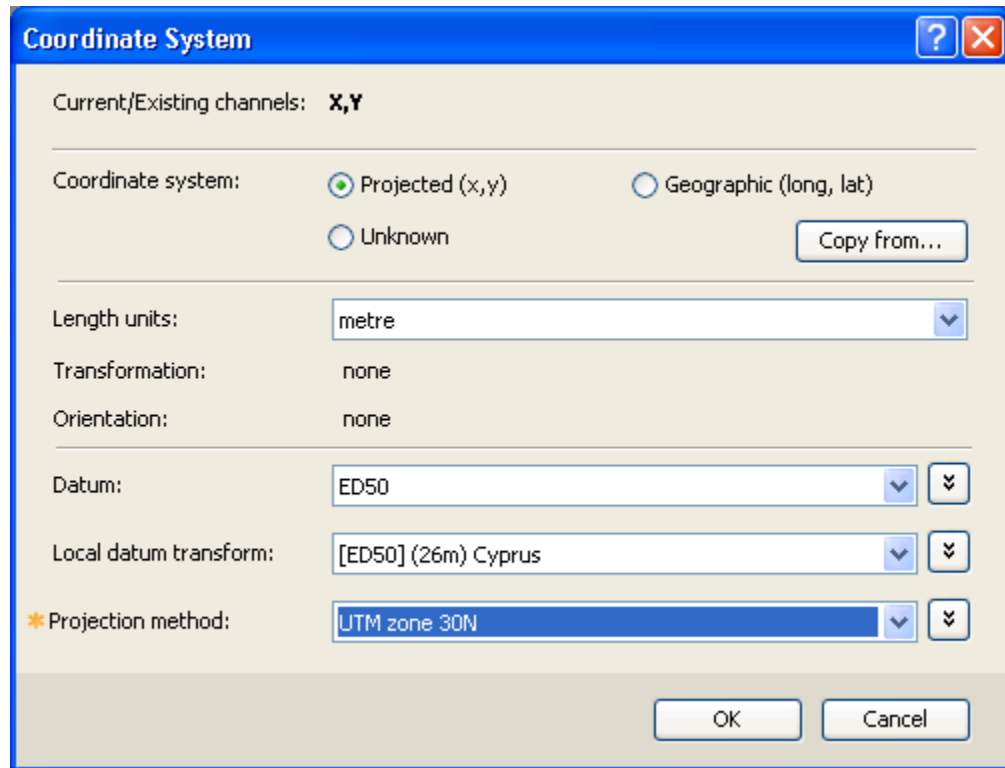
5. In this dialog, you can specify the *Coordinate system*, the units of measurement for *Length*, the *Datum*, the *Local datum transform*, and the *Projection method*. For this tutorial, select *"Projected (x,y)"* as the Coordinate system; the "metre" for Length units; "ED50" as Datum; "[ED50] (26m) Cyprus" as Local datum transform, and "UTM zone 30N" as Projection method. Click **[OK]**. The *Create new coordinate channels* dialog is displayed.

### STEP 3: CREATING LONG/LAT COORDINATES FROM X, Y PROJECTED DATA

In the previous step you defined what the projection is for the current X, Y database values. In this next step you will create new coordinate channels for the Long/Lat coordinates and define the projection information for them. For more information on the *Coordinate System* dialog see, *"Tutorial 11: Coordinate Systems"* in the **Oasis montaj** tutorial.
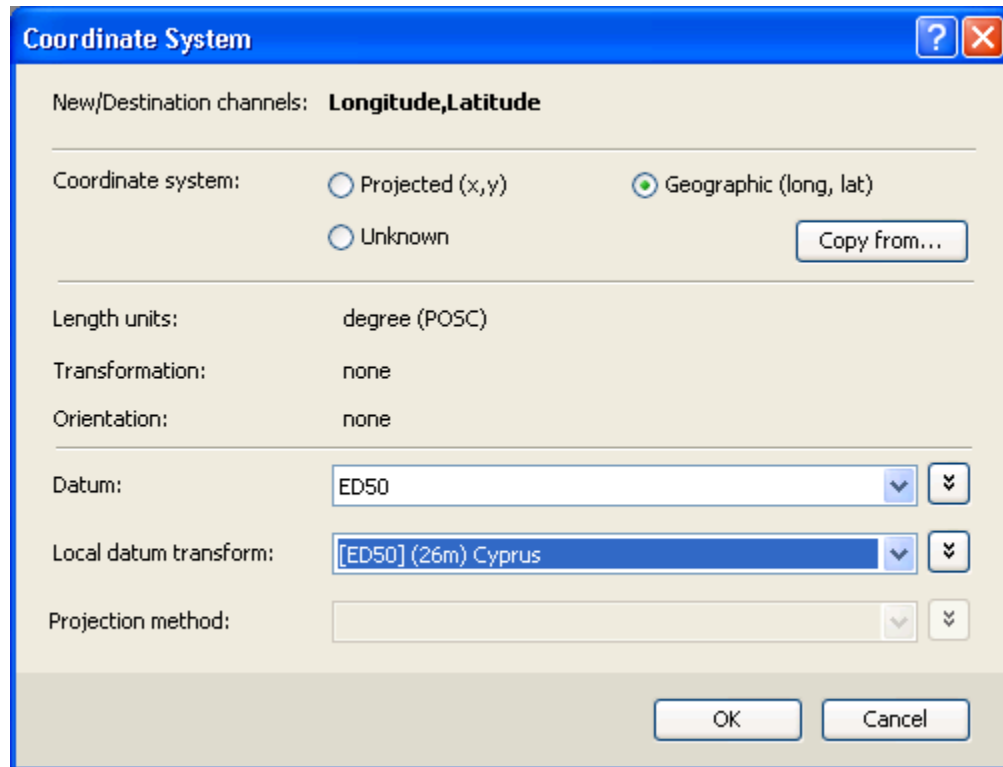
#### TO CREATE LON/LAT COORDINATES FROM X, Y PROJECTED DATA:

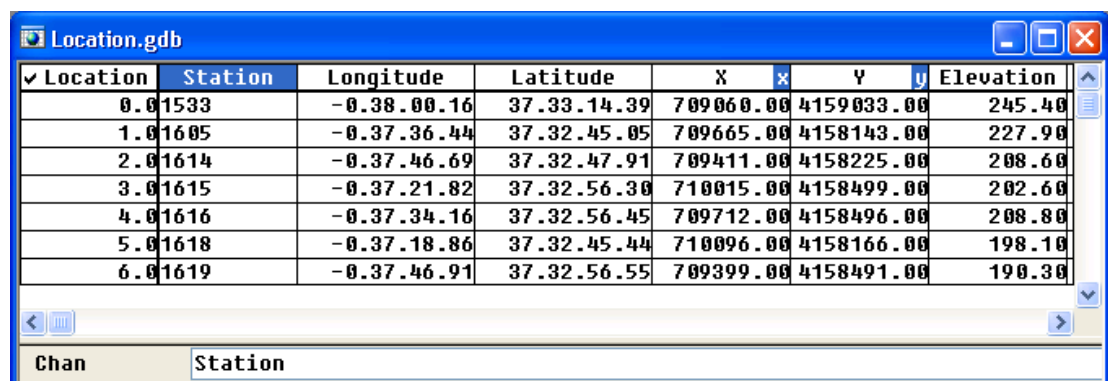1. The system displays the *Create new coordinate channels* dialog.

2.  Using the dropdown lists, select the *New X/Longitude channel* as "Longitude" and the *Y/Latitude channel* as "Latitude." Click the **[Next>]** button. The *Coordinate System* dialog is displayed, showing all the known projection information for the new coordinate channels for the Long/Lat coordinates.



3.  Select the "Geographic (long,lat)" option. Click **[OK]**.

4.  The latitude and longitude coordinates are calculated and displayed in the *Locations* database.



## Saving Database Changes

After importing data into a database, it is always a good idea to save your changes to avoid having to import the data again if something goes wrong.

### TO SAVE DATABASE CHANGES:

1. On the *Data* menu, select *Save database changes* or click the *Save database changes* icon ( ) on the main toolbar. The *Save Changes* dialog is displayed.
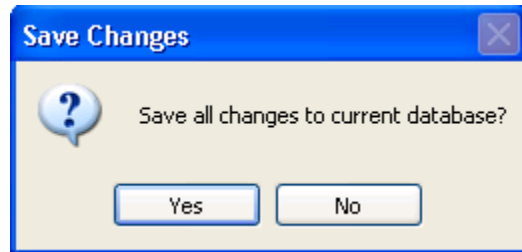


2. Click the **[Yes]** button to save your changes.

**Note:**  You can use the *Data/Discard database changes* menu item or click the *Discard database changes* icon ( ) to revert your database back to the last saved version.

## Importing Gravity Survey Data Files

Once you have your base station and location data imported into a database, you are ready to import your gravity survey files. The procedure below will lead you through importing a gravity instrument dump file from a Scintrex CG3 gravimeter.

### TO IMPORT A SURVEY FILE:

1. On the *Gravity* menu*, select Import | Import gravity survey*. The *Import a gravity file into a new database* dialog is displayed.
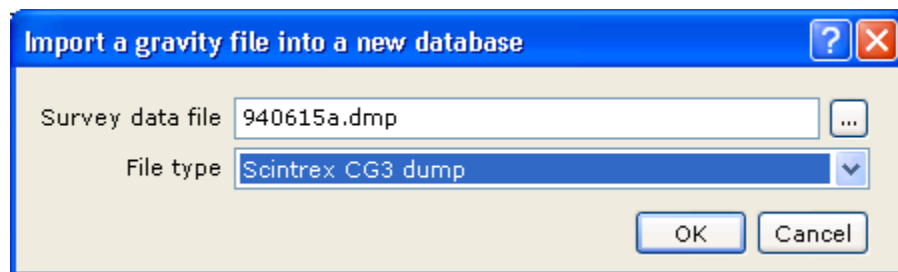


2. To select the *Survey data file* for import, click the  button. The *Survey data file* dialog is displayed. Using the *Files of type* dropdown list, select "Files (*.dmp)" and then select the dump file **"940615a.dmp"** from your project directory and click the **[Open]** button to return to the *Import a gravity file into a new database* dialog.

3. Using the *File type* dropdown list, select "Scintrex CG3 Dump."

  **Tip:**  If you want to download a CG3 file directly from the instrument, select the *Download CG3 file* option on the *Gravity* menu.

4.  Click the **[OK]** button. The survey information from the dump file is imported to a new database named **940615a.gdb**. The *Survey parameters* dialog is also displayed.



**Note:** The *Processing Parameters* dialog box includes information about the survey you just imported as well as global settings such as the base station and location databases. The project remembers all of the information in this dialog box. If an import file is missing information, the project will use this stored information to fill in the default values.

You can view the global project parameters at any time by selecting the *Processing Parameters* option on the *Gravity* menu.
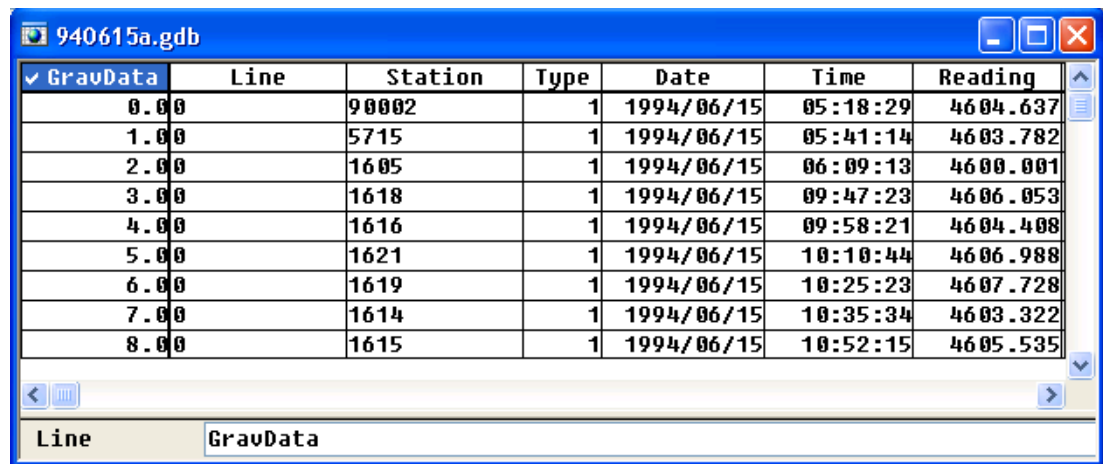
5.  If your survey data were collected using an instrument that requires a *Instrument scale factor* for calibration, you can specify this information in the *Instrument scale factor* box as the name of a file (must be a CSV file) or as a number. The default setting is "1.0" — this means no scale factor is applied and is the same as leaving this box empty.

Since the data you are using in this tutorial were recorded on a **CG3** instrument, no calibration file is required and the box can be left blank.

6.  If you want, you can specify the time difference *Hours to GMT (+ in W)* between the time recorded in the survey database and GMT. Note that, this is a positive number in the Western Hemisphere.  If this field is left blank, no correction is applied. For this example, leave the default value "0.0."

7.  The *Latitude correction* box enables you to select the gravity formula you want to use for the latitude and free air corrections. Select a formula from the dropdown list.

    These formulas are stored in a *list file* called **Gravity_Formulas.lst**. Instructions for modifying list files are provided in the ***Editing Text Files*** topic in ***Chapter 4*** (page 31).

8.  Click the **[OK]** button. The system displays the imported data in the database.

| 940615a.gdb | | | | | | |
|---|---|---|---|---|---|---|
| ✓ GravData | Line | Station | Type | Date | Time | Reading |
| 0.00 | | 90002 | 1 | 1994/06/15 | 05:18:29 | 4604.637 |
| 1.00 | | 5715 | 1 | 1994/06/15 | 05:41:14 | 4603.782 |
| 2.00 | | 1605 | 1 | 1994/06/15 | 06:09:13 | 4600.001 |
| 3.00 | | 1618 | 1 | 1994/06/15 | 09:47:23 | 4606.053 |
| 4.00 | | 1616 | 1 | 1994/06/15 | 09:58:21 | 4604.408 |
| 5.00 | | 1621 | 1 | 1994/06/15 | 10:10:44 | 4606.988 |
| 6.00 | | 1619 | 1 | 1994/06/15 | 10:25:23 | 4607.728 |
| 7.00 | | 1614 | 1 | 1994/06/15 | 10:35:34 | 4603.322 |
| 8.00 | | 1615 | 1 | 1994/06/15 | 10:52:15 | 4605.535 |
| Line | GravData | | | | | |

## UNDERSTANDING THE SURVEY DATABASE

Now that you have imported survey data into a database and displayed it in a spreadsheet window, you will notice that there are several channels other than your station, date, time, and reading channels.

The *Line* channel contains zeros in it because this gravity uses only station numbers to identify reading locations. We recommend that you do **not** use line information to organise your survey data. However, if you are importing line data, the system will try and match the line and station information correctly.

The *Type* channel is only used for merging survey databases into a master database. Only type one channels are included in the master database. You can exclude specific stations from being merged into the master database by changing their type to 0. Base stations are not imported into the master database.

The *Height* channel represents the distance of the instrument above the target, measuring the distance of free air between the ground and the instrument.
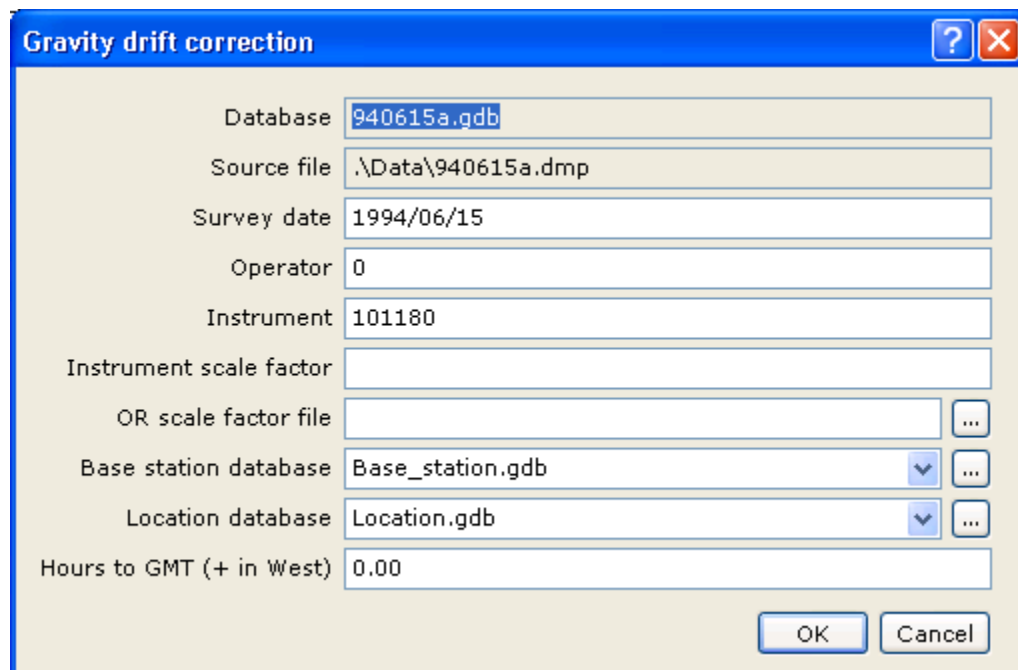
# Drift Correction

After importing your survey data into a database, you will want to correct for instrument drift. The procedure below will remove the effects of drift from your data in order to get the *absolute gravity* values.

When you apply the drift correction to a survey database, the system performs the following actions on the database:

- Modifies the *Type* channel to change the base station types to 0. This ensures that only the survey readings and not the base stations are imported.
- Creates a *Closure* channel in the database that shows the amount the instrument drifted from the first base station reading to the second reading. The amount of drift will tell you if the survey values are accurate to within survey specifications.
- Calculates the absolute gravity value (in mgals) for each reading and displays this value in the *Gravity* channel of the database.
- Applies a tide correction and records this value in the *tide* channel.
- Imports the X,Y and long/lat coordinate values from the locations database.
- Creates blank channels for height, water, ice, terrain, and slope values (to be filled in later).

### TO APPLY A DRIFT CORRECTION TO SURVEY DATA:

1. Select (highlight) the survey database **940615a.gdb**.

2. On the *Gravity* menu, select *Drift Correction*. The *Gravity drift correction* dialog is displayed.

**3.** The current survey information is displayed for you to verify. If this information is correct, click the **[OK]** button. The system calculates the tide correction, drift correction, and absolute gravity value, for each reading and places these values in their respective channels. Also, *Type* settings for the base stations are changed to zero and the *Closure* channel is created showing the base station drift. Blank channels are created for height, water, ice, terrain, and slope values (to be filled in later).

| ✔ GravData | Water | Ice | Terrain | Slope | _Gscale | Gravity | TideCorr | Closure |
|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.000 | 0.000 | 0.000 | 0.000 | 4604.648 | 979903.209 | 0.0109 | 0.000 |
| 1.0 | 0.000 | 0.000 | 0.000 | 0.000 | 4603.791 | 979902.353 | 0.0087 | * |
| 2.0 | 0.000 | 0.000 | 0.000 | 0.000 | 4600.006 | 979898.568 | 0.0046 | * |
| 3.0 | 0.000 | 0.000 | 0.000 | 0.000 | 4606.025 | 979904.595 | -0.0283 | * |
| 4.0 | 0.000 | 0.000 | 0.000 | 0.000 | 4604.380 | 979902.950 | -0.0280 | * |
| 5.0 | 0.000 | 0.000 | 0.000 | 0.000 | 4606.961 | 979905.531 | -0.0272 | * |
| 6.0 | 0.000 | 0.000 | 0.000 | 0.000 | 4607.702 | 979906.273 | -0.0259 | * |
| 7.0 | 0.000 | 0.000 | 0.000 | 0.000 | 4603.297 | 979901.869 | -0.0246 | * |
| 8.0 | 0.000 | 0.000 | 0.000 | 0.000 | 4605.513 | 979904.085 | -0.0218 | * |
| 9.0 | 0.000 | 0.000 | 0.000 | 0.000 | 4602.644 | 979901.216 | -0.0202 | * |

Chan · Gravity

# Merging Survey Data into a Master Database

Now that you have imported survey data and applied drift and tide corrections to it, you are ready to create a master database. A master database contains data from several survey databases.

### TO MERGE A SURVEY DATABASE WITH A MASTER DATABASE:

**1.** On the *Gravity* menu, select *Merge with master database*. The *Merge survey data to a master database* dialog is displayed.

**Merge survey data to a master database**

Gravity survey database: 940615a.gdb

Master gravity database: master

OK    Cancel

**2.** The *Gravity survey database* box should already contain the name of the active (selected) survey database **940615a.gdb**. In the *Master gravity database* box, specify the name of the master database as **master.gdb**.

**3.** Click **[OK]** to continue. If the master database does not exist, the program will ask you if you want to create a new database with this name. Click **[Yes]** to create the new database.

**4.** The system merges the survey data from the **940615a** database into the master database. In the master database a new channel called *Source* is created that identifies the survey associated with each station reading.

**Tip:** To import more survey files into the master database you must repeat the steps above. However, this task can be quite tedious if you have a large number of survey files. You can automate this process using a *Geosoft Script* file (\*.gs). Follow the instructions in the following section to use a sample script to merge the rest of the survey files into the master database automatically.

# Using Script Files to Automate Tasks

A master gravity database may contain a number of survey data files. Merging all of these files one by one is very time-consuming. A sample script file **"load.gs"** is included with the tutorial data which automates this task. The script creates a database for each of the survey files the project directory, apply a drift correction to each one, and then merge them all into the master database.

The procedures below describe how to run the **Load.gs** file and how to record and edit your own script. More detailed instructions on recording, viewing, and editing script files, are provided in the ***Creating Scripts in Oasis montaj*** technical note which can be found in the **Oasis montaj** Online Books (*Help/Manuals and Tutorials*) or can be found on Geosoft's web site (www.geosoft.com/resources/technotes/).

**Note:** If the *Script Bar* is not displayed, you can access it via the *Tools* tab in the "Project Explorer" window. Right-click on the *Script Bar* and from the popup menu, select *Show*. The *Script Bar* ( ▶ | ▐▶ ■ ) will be displayed.

### TO RUN A SCRIPT FILE:

**This procedure is part of the gravity tutorial**:

**1.** Click the *Run Script* button ( ▶ ) on the *Script Bar*. The *Run a script with parameters* dialog is displayed.

**2.** Using the [...] button, select the *Script* as **load.gs**. Click **[OK]** to run the file. The script will create six more survey databases for all the survey files in the project directory (**940617b.gdb**, **940622a.gdb**, **940623a.gdb**, **950131B.gdb**, **950201B.gdb**, **950203B.gdb**) and merge them into the master database.

### TO RECORD A SCRIPT (OPTIONAL):

This procedure is for your information only and <u>not</u> part of the gravity tutorial.

**1.** To start recording a script, click the *Record* button ( ▐▶ ) on the *Script* toolbar.

**2.** Specify a file name for the script **"test.gs"** and click **[Save]**.

**Note:** From this point on, all of you actions in the program are recorded until you click the *End Record* ( <span style="color:red">■</span> ) button.

Geosoft Scripts are saved as ASCII files with a **\*.gs** extension. If you want to view a script, you can do so by opening the script file in a text viewer such as Notepad. This procedure is for your information only and <u>not</u> part of the gravity tutorial.

1. On the *Gravity* menu, select *Edit file*. Use the ⊡ button to locate the file you want to open (i.e. **test.gs**).

**Note:** If you do not a have a default text editor specified, **Oasis montaj** will ask you to define one.

2. The text of the script file is displayed in the window of the text editor. You can now edit and save this file. For more detailed instructions on editing script files, refer to the ***Creating Scripts in Oasis montaj*** technical note which can be found in the **Oasis montaj** Online Books (*Help/Manuals and Tutorials*) or can be found on Geosoft's web site (www.geosoft.com/resources/technotes/).

# Processing Repeat Readings

**montaj Gravity and Terrain Correction** provides the ability to create statistical reports to evaluate repeat readings. There are two scenarios where a statistical report is required:

- To determine the statistical quality of the data in surveys where 5% of the readings are repeated.
- To improve statistical accuracy of the data in hi-resolution surveys where all the readings are repeated.

1. On the *Gravity* menu, select *Process Repeats*. The *Calculate repeat differences* dialog is displayed.
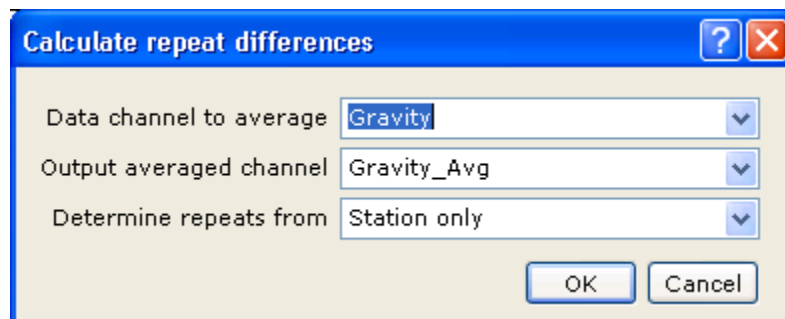


2. Using the dropdown lists, select *Data Channel to average*, as "Gravity," *Output averaged channel* as "Gravity_Avg**"** and *Determine repeats from* as "Station only."

> **Note:** When determining repeats use the "Station only" setting if the station numbers in your database uniquely identify gravity stations. However, if there is a "Line" channel and the line and station number must be used to uniquely identify a station then use the "Line and Station" option.

**3.** Click the **[OK]** button and the *Survey repeat statistics* dialog is displayed.



**4.** This dialog displays the statistics for the repeat readings. Click the **[Report]** button to save this information in a text file **Repeat_Report.txt** and display it in your default text editor *or* click **[OK]** to close the dialog box without saving the text file.
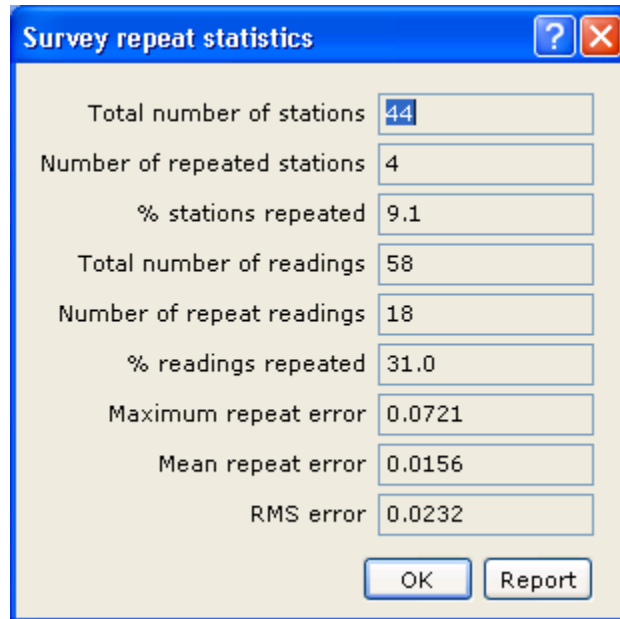
**5.** The system creates two new channels in the database when it calculates the statistics for the repeat values. These channels are the **Repdiff** channel and the **Gravity_Avg** channel.

- The *Repdiff* channel represents the difference between a reading and the average value of all the readings at that station. This channel is useful if you are repeating all the readings in a survey and want to determine whether the readings are acceptable or not.

- The *Gravity_Avg* channel shows average value of all the readings at a specific station.

| ✔ GravData | Gravity | TideCorr | Source | Gravity_Avg | RepDiff |
|---|---|---|---|---|---|
| 0.0 | 979894.180 | 0.0030 | 940617b | 979894.180 | * |
| 1.0 | 979898.568 | 0.0046 | 940615a | 979898.568 | * |
| 2.0 | 979901.869 | -0.0246 | 940615a | 979901.869 | * |
| 3.0 | 979904.085 | -0.0218 | 940615a | 979904.085 | * |
| 4.0 | 979902.950 | -0.0280 | 940615a | 979902.950 | * |
| 5.0 | 979904.644 | 0.0346 | 950201B | 979904.624 | 0.020 |
| 6.0 | 979904.638 | 0.1753 | 940622a | * | 0.014 |
| 7.0 | 979904.625 | 0.0954 | 940623a | * | 0.001 |
| 8.0 | 979904.621 | -0.0419 | 950203B | * | 0.003 |

| Chan | RepDiff |
|---|---|

**Tip:** By default, these channels are not automatically displayed in the spreadsheet window of the database. To view these channels in the spreadsheet, right-click the mouse on a empty header cell and from the popup menu, select *List*. Select a channel from the list and click the **[OK]** button. The channel will be displayed in the spreadsheet window.

# Terrain Correction

The terrain corrections are calculated from the gravity survey database, plus (if used) the regional terrain corrections grid, which can be calculated using the *Terrain Corrections/Create Regional Correction Grid* option, see below.

The terrain correction results will be placed in the *Output Terrain Correction Channel* (by default "Terrain" channel).

### Creating a Regional Correction Grid

A regional correction grid contains correction values for the area surrounding the survey. To create a regional correction grid, you require regional and local DEM (digital elevation model) grids. Note that the processing time to create a regional correction grid takes around 10 minutes, using a Core 2 Duo 3 Ghz machine. If time is a factor, a regional correction grid called **terrain.grd** has been created for you to use, enabling you to skip the process of creating a correction grid.

The methods and algorithms used in the terrain correction procedures are described in more detail in the *Gravity Formulas* chapter of this manual.

#### TO CREATE A REGIONAL CORRECTION GRID:

**Note:** This is only an example of how to create a regional correction grid. If you are doing the tutorial, you can skip this procedure since a regional terrain correction grid, named **terrain.grd**, is included with the data files. The procedure below describes the settings you would use if you chose to create the grid.

1. On the *Gravity* menu, select *Terrain Corrections | Create regional correction grid*. The *Regional terrain correction grid* dialog is displayed.



2. Using the  buttons, select the *Region DEM grid* as **dtm45m.grd** and the *Local DEM grid* as **dtm5m.grd**. Then, specify a filename for the *Output( terrain correction) grid*, as **"terrain2.grd."**

3. The *Outer correction distance* can be left blank. The system calculates an appropriate regional correction distance using the regional DEM grid.

4. The default value for *Terrain density*, measured in g/cc is "2.67."

5. Specify the *Inner (local) correction distance* as "1000" metres.

6. From the *Optimisation* dropdown menu, select "faster." The optimization option accelerates the calculation by desampling the outer zones to coarser averaged grid and using a 4x4 point Qspline interpolation to obtain the elevation from the grid. The optimization option improves performance 10 times at the loss of 3% accuracy compared with no optimization.

7. The remaining parameters (*Survey min x, min y, max x, max y*) are used to specify the region over which regional terrain corrections will be calculated. For our purposes we will leave all four boxes blank.

   **Tip:** You can click the **[Scan XY]** button to scan the master database to determine the current limits of the database.  Note however, that the region should be expanded if more stations are to be added to the survey

later.  If a region is not specified, the regional terrain grid will cover the area of the Local DEM grid.

8.  Click the **[OK]** button to begin creating the local correction grid.

## Applying Terrain Correction

**Note:**   The Local DEM grid should not be gridded to a cell size very much smaller than the original sampling accuracy of the DEM data. For example, if the local DEM is gridded from the gravity survey elevations, the grid cell size should be about one-half the nominal gravity station interval.

TO APPLY TERRAIN CORRECTIONS:

1.  Select (highlight) the database file **master.gdb**.

2.  On the *Gravity* menu, select *Terrain Corrections | Terrain Corrections*. The *Terrain corrections* dialog is displayed.
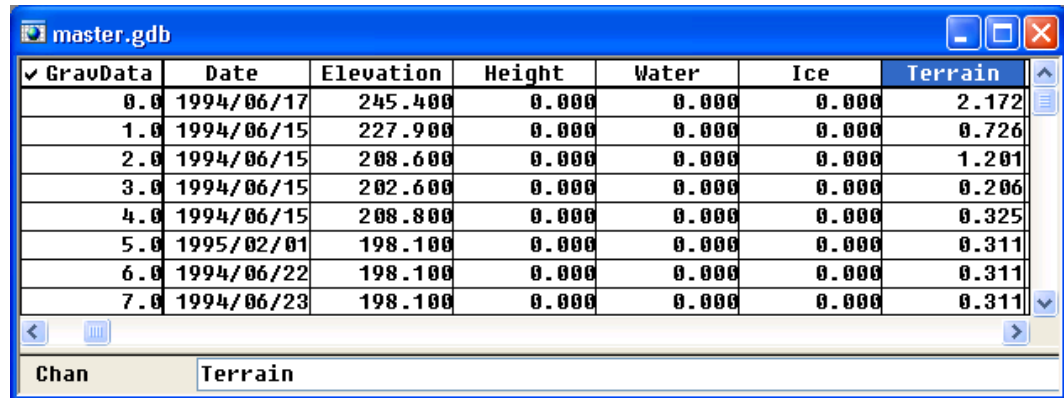


3.  Using the dropdown menus, select the *X channel* as (**X**), the *Y channel* as (**Y**) and the *Elevation channel* as (**Elevation**). Note that, if you do not have a channel that contains local slope values (elevation) information then leave this box empty and the program will apply the data from the DEM instead.

4.  Using the **[Browse]** button, select a *Regional correction grid* as (**terrain.grd**) and a *Local DEM grid* as (**dtm5m.grd**).

5.  Specify the *Local correction distance* as **1000** metres. This is the distance in which to calculate a local terrain correction.  If a *Regional correction grid* is

specified, then the regional correction grid will define this distance. Beyond this distance, the regional correction grid is used.

**Note:** If a regional correction grid is not specified, specify the distance to which to calculate the terrain effect. If not specified, this distance will be the half the size of the DEM grid.

6. Using the *Optimization* dropdown list, select (**faster**).

7. Click the **[OK]** button and the terrain correction results are placed in the *Terrain* channel in the **master.gdb**.

| ✓ GravData | Date | Elevation | Height | Water | Ice | Terrain |
|---|---|---|---|---|---|---|
| 0.0 | 1994/06/17 | 245.400 | 0.000 | 0.000 | 0.000 | 2.172 |
| 1.0 | 1994/06/15 | 227.900 | 0.000 | 0.000 | 0.000 | 0.726 |
| 2.0 | 1994/06/15 | 208.600 | 0.000 | 0.000 | 0.000 | 1.201 |
| 3.0 | 1994/06/15 | 202.600 | 0.000 | 0.000 | 0.000 | 0.206 |
| 4.0 | 1994/06/15 | 208.800 | 0.000 | 0.000 | 0.000 | 0.325 |
| 5.0 | 1995/02/01 | 198.100 | 0.000 | 0.000 | 0.000 | 0.311 |
| 6.0 | 1994/06/22 | 198.100 | 0.000 | 0.000 | 0.000 | 0.311 |
| 7.0 | 1994/06/23 | 198.100 | 0.000 | 0.000 | 0.000 | 0.311 |

Chan    Terrain

# Reducing Gravity Data

The next step in the process is to carry out the following components of a gravity reduction:

- Latitude correction
- Free Air anomaly calculation
- Bouguer anomaly calculation
- Complete Bouguer anomaly (Bouguer anomaly + terrain correction)

To simplify the reduction process these data reductions are accessed through a single dialog box and applied at the same time to the master database. The formulas for each of these data reductions are available in the *Online Help system* by clicking the **[Help]** button on the *Gravity Free Air and Bouguer anomaly* dialog box.

<u>**To Apply Latitude, Free Air, and Bouguer Anomaly Corrections:**</u>

1. On the *Gravity* menu, select *Free air, Bouguer anomaly*. The *Gravity Free Air and Bouguer anomaly* dialog will be displayed.
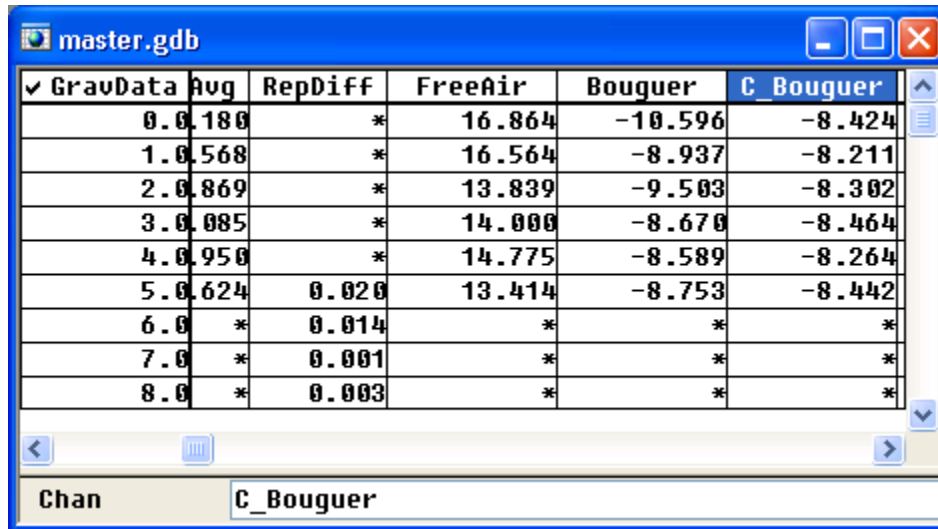


2. Using the dropdown lists, select the following; for *Absolute gravity channel*, select **Gravity_Avg**, for the *Terrain correction channel*, select "Terrain," for the *Output Bouguer Anomaly channel*, select "Bouguer," for the *Latitude correction*, select "1967 Simplified" and for the *Curvature (Bullard B) correction?*, select "Yes."

3. We will accept the default values for the *Free-air correction* as "0.308596 mGal/m)," *Earth density g/cc* as "2.67," *Water density g/cc* as "1.0" and for the *Ice density g/cc* as "0.95. "

4.  Click the **[OK]** button to reduce the data. The program creates new channels containing the *Free air*, *Bouguer*, and *Complete Bouguer* values.

| ✔ GravData | Avg | RepDiff | FreeAir | Bouguer | C_Bouguer |
|---|---|---|---|---|---|
| 0.0 | .180 | * | 16.864 | -10.596 | -8.424 |
| 1.0 | .568 | * | 16.564 | -8.937 | -8.211 |
| 2.0 | .869 | * | 13.839 | -9.503 | -8.302 |
| 3.0 | .085 | * | 14.000 | -8.670 | -8.464 |
| 4.0 | .950 | * | 14.775 | -8.589 | -8.264 |
| 5.0 | .624 | 0.020 | 13.414 | -8.753 | -8.442 |
| 6.0 | * | 0.014 | * | * | * |
| 7.0 | * | 0.001 | * | * | * |
| 8.0 | * | 0.003 | * | * | * |

Chan                C_Bouguer

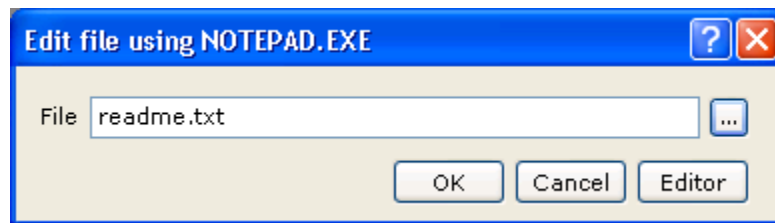# Chapter 4: montaj Gravity & Terrain Correction Utilities

This chapter describes how to use the file editing, sorting, and math expression utilities in the **montaj Gravity and Terrain Correction** system.

## Edit a Text File

The edit file utility enables you to specify a file to open and edit using your default text editor. You can also change your text editor by clicking the **[Editor]** button. The following procedure shows you how to open the gravity formula list file that contains the latitude correction formulas used by the **montaj Gravity and Terrain Correction** system.

### TO EDIT A FILE:

1.  On the *Gravity* menu, select *Edit file*. The *Edit file* dialog is displayed.



2.  Using the [...] button, locate the *File* to edit.
3.  Click the **[OK]** button and your default text editor will display the file for you to view or edit.

## Sorting Channels

To assist you in organizing your data, the **montaj Gravity and Terrain Correction** system, provides the options to sort your data based on either one or two reference channels.

### Sort by 1 Channel

This utility enables you to sort all channels based on a reference channel. If a channel is not sampled at the same rate as the reference channel, the reference channel is resampled to match the channel being sorted.

### TO SORT BY 1 CHANNEL:

1.  On the *Gravity* menu, click *Sort all by 1 Channel*. The *Sort all channels based on a reference channel* dialog is displayed.
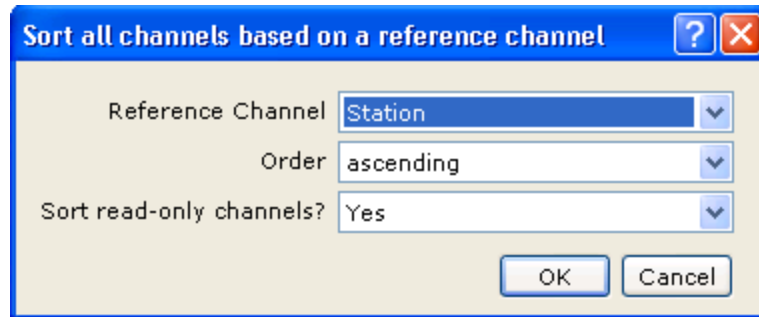
2.  Using the dropdown list, select the *Reference channel*, *Order* and *Sort read-only channels?* Note that, if protected channels are **not** sorted, the fiducial relationships will be lost, and data integrity is lost.

3.  Click the **[OK]** button. The rest of the channels are sorted based on the values in the reference channel.

## Sort by 2 Channels

This utility enables you to sort all channels based on two reference channels. The data are sorted using a primary reference channel, then for data with the same value in the primary reference channel, the data is sorted by the secondary channel.
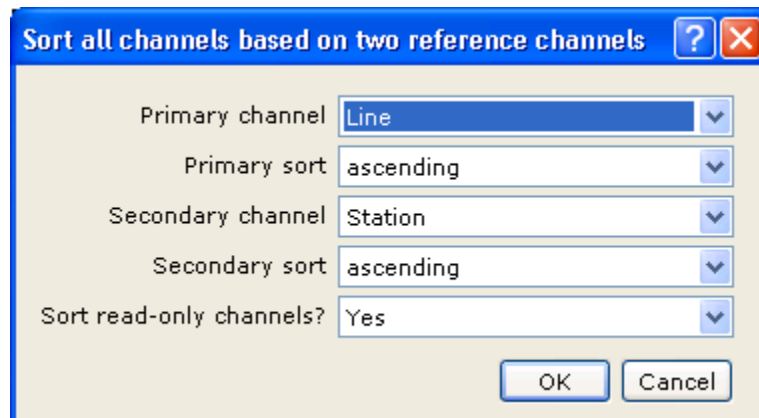
### TO SORT BY 2 CHANNELS:

1.  On the *Gravity* menu, select *Sort all by 2 Channels*. The *Sort all channels based on two reference channels* dialog is displayed.



2.  Using the dropdown list, select the *Primary and Secondary channels* and whether to sort the channels in an **ascending** or **descending** order. Then select to include *Read-only channels?* in the sort. Note that if protected channels are "not" sorted, the fiducial relationships will be lost, and data integrity is lost.

3.  Click the **[OK]** button and the channels will be sorted.

# Math Expressions

In **Oasis montaj**, you can use an expression to define any channel, or part of a channel in the database. Expressions are combinations of keywords, such as functions, and operators, that calculate values or change the values of variables (channel data). Expressions use normal algebraic notation and channel names as the variables. The system always evaluates expressions in double precision, and converts channel values before and after evaluation of the expression as needed. For information on the *Channel Math Expression Builder* dialog, see *"Using the Channel Math Expression Tool"* section in *"Tutorial 2: Working with Data"* in the **Oasis montaj** tutorial. For more information on math expressions, see the **MATH GX** and **MATHFILE GX** in the Online Help system (*Help/Help Topics*).

The system enables you to define and apply mathematical expressions:

- Interactively in the Spreadsheet window
- From a file

### TO APPLY A MATHEMATICAL EXPRESSION IN THE SPREADSHEET WINDOW:

1. Select the data cells you want to apply a math expression to. This can include a section of a channel, an entire channel on a single line, or the same channel on all lines of the database).

2. On the *Gravity* menu, select *Channel Math*. The *Channel Math Expression Builder* dialog is displayed.

3. Build the *Expression:* by first assigning channels in the Step 2: *Assign channels* box. For example, to add 100 to each cell in the "elevation" channel and put the sum in another channel called "test," you would equate the name of the new "sum" channel "test" to *C0*. You would then select the "elevation" channel from the drop-down list and equate that to *C1*. This would display in the *Expression:* field as:

   **C0 = C1 + 100**

4. Click **[Enter]**. The result of the expression is placed in the currently specified channel.

You can also create a math expression file as an ASCII text file in a text editor. The math expression file must have either a *.txt or a *.exp extension. To run the math expression file, click *Expression file* on the *Channel Math Expression Builder* dialog.

# Chapter 5: Gravity Formulas

The following Gravity formulas are provided below:

## 1. Instrument Scale Factor

The instrument scale factor corrects a reading to a relative milligal value based on an instrument calibration.  The correction can either be constant throughout the instrument range, or it can be derived from a user supplied calibration table.

$$r_c = r \cdot S(r)$$

where,

$r_c$      corrected reading in milligals

$r$        instrument reading in dial units

$S(r)$    scale factor (dial units/milligal), which may be a function of the reading

## 2. Tide Correction

If a relative time difference to Greenwich Mean Time is provided on the constants line (via the **gm=** parameter), all readings are corrected for earth tides due to the position of the sun and the moon at the time and location of the observation.  The full formula is too complex to list here, but can be obtained from the Dominion Observatory of Canada.

$$r_t = r_c + g_{tide}$$

where

$r_t$       tide corrected reading

$r_c$       scale corrected reading from equation 1.

$g_{tide}$    tide correction

## 3. Instrument Height

Each reading is corrected for the height of the instrument above the station or base at which the elevation is measured:

$$r_h = r_t + 0.308596h_i$$

where

$r_h$      instrument height corrected reading

$r_t$      tide corrected reading from equation 2.

$h_i$      instrument height in metres

Note that all readings in the following formulas are assumed to be corrected for the instrument scale factor, optional tide correction and instrument height.

## 4. Drift Correction

A drift is calculated based on the closure error between the first and last base reading in each loop:

$$d = \frac{(r_{B2} - r_{B1}) - (g_{B2} - g_{B1})}{t_{B2} - t_{B1}}$$

where,

$d$      drift in milligals/hour

$r_{B1}$      base 1 reading

$t_{B1}$      base 1 time

$g_{B1}$      base 1 absolute G in milligals

$r_{B2}$      base 2 reading

$t_{B2}$      base 2 time

$g_{B2}$      base 2 absolute G in milligals

## 5. Absolute Gravity

The absolute gravity is the earth's gravitational attraction at the observed station.

$$g_a = g_{B1} + (r_h - r_{B1}) - (t - t_{B1})d$$

where

$g_a$      absolute gravity in milligals

$g_{B1}$  base 1 absolute G in milligals

$r_h$  instrument height corrected station reading from equation 3.

$r_{B1}$  base 1 reading

$t$  reading time

$t_{B1}$  base 1 reading time

$d$  drift from equation 4 (in milligals/hour)

# 6. Latitude Correction

The latitude correction requires the theoretical gravity at the station location on the earth's spheroid.  There are three optional formulas for the theoretical gravity:

**1930 formula:**

$$g_l = 978049 \cdot \left[ 1 + 0.0052884 \sin^2(l) - 0.0000059 \sin^2(2l) \right]$$

**1967 formula:**

$$g_l = 978031.846 \cdot \left[ 1 + 0.005278895 \sin^2(l) + 0.000023462 \sin^4(l) \right]$$

**1980 formula:**

$$g_l = 978032.7 \cdot \left[ 1 + 0.0053024 \sin^2(l) - 0.0000058 \sin^2(2l) \right]$$

where

$g_l$  theoretical gravity in milligals (latitude correction)

$l$  latitude of the station

For local surveys, only the gradient due to latitude is important:

$$g_l = 0.000812132 \sin(2l) \cdot y_s$$

where

$g_l$  latitude correction

$l$  latitude of station

$y_s$  station distance north of the grid origin in metres.

# 7. Free Air Anomaly

The free air correction is calculated by subtracting the latitude correction (theoretical gravity) from the absolute gravity and adding a correction for the station elevation:

$$g_{fa} = g_a - g_l + 0.308596 h_s$$

where

$g_{fa}$      free air anomaly in milligals.

$g_a$      absolute gravity from equation 5.

$g_l$      latitude correction from equation 6.

$h_s$      station elevation in metres

## 8. Bouguer Anomaly

The Bouguer anomaly corrects the free air anomaly for the mass of rock that exists between the station elevation and the spheroid:

$$g_{ba} = g_{fa} - 0.0419088 \cdot \left[ \rho h_s + (\rho_w - \rho) h_w + (\rho_i - \rho_w) h_i \right] + g_{curv}$$

where,

$g_{ba}$      Bouguer anomaly in milligals

$g_{fa}$      free air anomaly from equation 7.

$\rho$      Bouguer density of rock in g/cc.

$\rho_w$      Bouguer density of water g/cc.

$\rho_i$      Bouguer density of ice in g/cc.

$h_s$      station elevation in metres

$h_w$      water depth in metres (including ice)

$h_i$      ice thickness in metres

$g_{curv}$      curvature correction

The purpose of the curvature correction as a step in producing the Bouguer anomaly is to convert the geometry for the Bouguer correction from an infinite slab to a spherical cap whose thickness is the elevation of the station and whose radius (arc length) from the station is 166.735 km. We use LaFehr's formula for the curvature correction (LaFehr, 1991).

## 9. Complete Bouguer Anomaly

The Complete Bouguer anomaly corrects the Bouguer anomaly for irregularities of the earth due to terrain in the vicinity of the observation point.

$$g_{cba} = g_{ba} + g_{tc}$$

where

$g_{cba}$      Complete Bouguer Anomaly in milligals

$g_{ba}$      Bouguer Anomaly from equation 8.

$g_{tc}$      supplied terrain correction in milligals
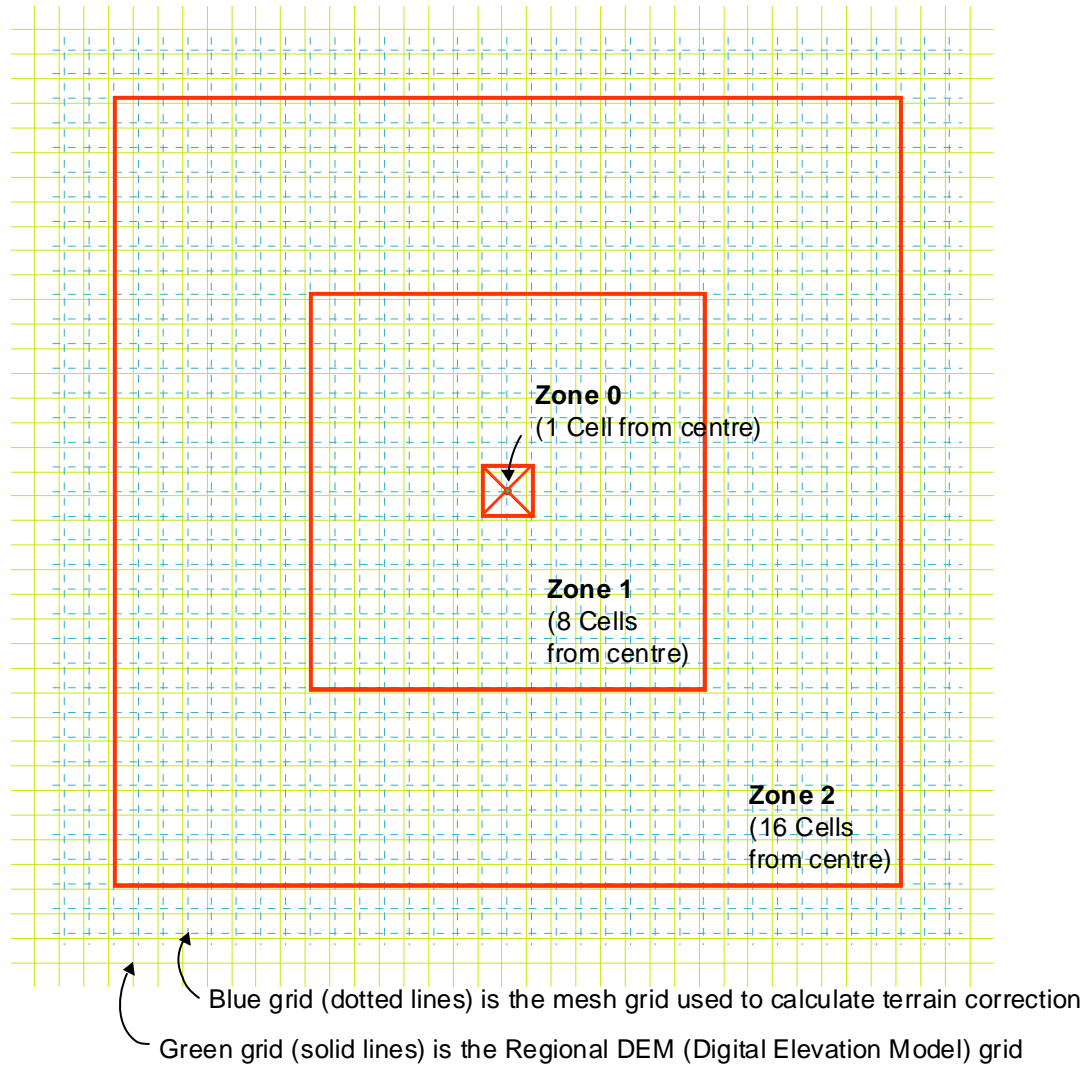
# 10. Terrain Correction

The calculation of the regional correction (beyond 1000m) has been identified as the most computationally expensive component of terrain correction calculations. The **montaj Gravity and Terrain Correction** system addresses this by calculating the regional terrain correction from a coarse regional Digital Elevation Model (DEM) draped over a more finely sampled local DEM model that covers a survey area. This produces a "regional correction grid" that represents terrain corrections beyond a local correction distance and this can be re-used to calculate detailed corrections at each observed gravity location.

The GRREGTER GX creates a Regional Terrain Correction Grid for a survey using a Geosoft compatible grid of the terrain elevations, for example, a regional Digital Elevation Model (DEM). The regional terrain correction grid is created once to cover the area extent of the study and can be re-used to calculate new terrain correction beyond the Local Correction Distance (this distance could be zero for the full terrain corrections). This correction is added to the local correction calculated from the local DEM. The grid data units in milligal/(g/cc) are multiplied by the terrain density when the full terrain correction is calculated by the GRTERAIN GX.

The GRTERAIN GX calculates the full terrain corrections at each station by extracting the regional corrections from the Regional Terrain Correction Grid (generated by the GRREGTER GX) and adding the local terrain correction (within the Local Correction Distance using the Local DEM grid).

Digital gridded terrain models are often available from government sources and can be used to simplify the application of regional terrain corrections. Also, with a sufficient number of known elevation points (X, Y and Elevation), a gridded terrain model can be produced by using the Geosoft RANGRID or BIGRID programs.

Terrain corrections are calculated using a combination of the methods described by Nagy (1966) and Kane (1962). The diagram on the following page illustrates the technique that is implemented in **montaj Gravity and Terrain Correction**.

**Zone 0**
(1 Cell from centre)

**Zone 1**
(8 Cells
from centre)

**Zone 2**
(16 Cells
from centre)

Blue grid (dotted lines) is the mesh grid used to calculate terrain correction

Green grid (solid lines) is the Regional DEM (Digital Elevation Model) grid

To calculate local corrections, the local DEM data is "sampled" to a grid mesh centred on the station to be calculated. The correction is calculated based on near zone, intermediate zone and far zone contributions. In the near zone (0 to 1 cells from the station), the algorithm sums the effects of four sloping triangular sections, which describe a surface between the gravity station and the elevation at each diagonal corner.

If a slope is provided for each station in the input data file, the slope of the triangular sections is assumed to be the same as the station slope, regardless of the grid topography values. This is reasonable since topography grids may not be as accurate as a locally measure slope.

In the intermediate zone (1 to 8 cells from the station), the terrain effect is calculated for each point using the flat topped square prism approach of Nagy (1966).

In the far zone, (greater than 8 cells), the terrain effect is derived based on the annular ring segment approximation to a square prism as described by Kane (1962). Also, with using the "faster" Optimization option to reduce processing time, the size of each prism is doubled to 2x2 cells and beyond 16 cells is doubled again to 4x4 cells, and so on.

During the terrain correction, some special treatments are applied. The DEM grid is reflected on its edges to ensure corrections are applied out to the required radius. Any dummy values in the DEM grid are interpolated by adjacent non-dummy values before calculating the terrain correction. The system uses the grid average elevation to compensate for terrain effects in the area past the outer (regional) correction distance.

An edge correction is calculated to account for the distance between the station elevation and the grid average elevation beyond the DEM grid edge.

The terrain grid should ideally cover an area as large as the gravity survey plus a reasonable distance beyond which the terrain effect is negligible. This distance depends on the severity of the terrain, and the detail of anomalies under investigation. A distance of 20 kilometres is considered extreme.
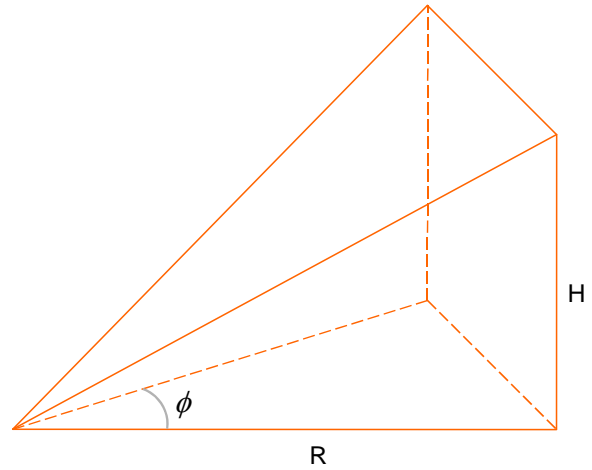
For more information on terrain corrections, see the GRREGTER GX and GRTERAIN GX online help topics (run the GX and click the  button).

## Terrain Correction Formulas

This section contains illustrates and lists the equations used to calculate terrain correction in each zone.
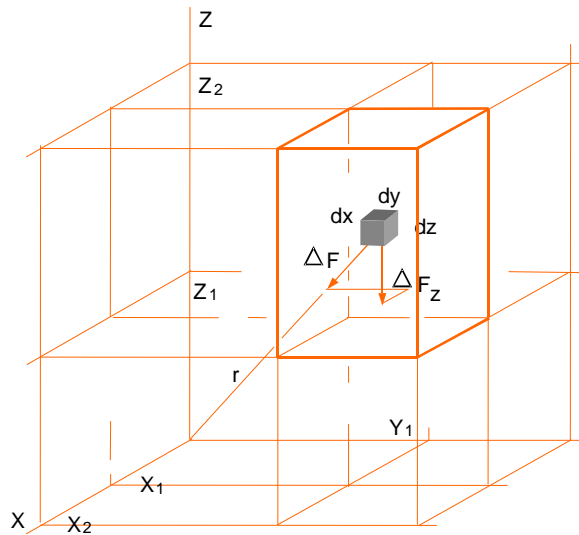
### ZONE 0: SLOPED TRIANGLE

$$g = GD\phi\left( R - \sqrt{R^2 + H^2} + \frac{H^2}{\sqrt{R^2 + H^2}} \right)$$

### ZONE 1: PRISM

$$g = -GD\left| \left| \left| x \bullet \ln(y + R) + y \bullet \ln(x + R) + Z \arctan\frac{Z \bullet R}{x \bullet y} \right|_{Z_1}^{Z_2} \right|_{Y_1}^{Y_2} \right|_{X_1}^{X_2}$$

The Gravitational Attraction of a Right Rectangular Prism

### ZONE 2 (AND BEYOND): SECTIONAL RING

$$g = 2GDA^2 \frac{(R_2 - R_1\sqrt{R_1^2 + H^2} - \sqrt{R_2^2 + H^2}}{(R_2^2 - R_1^2)}$$

where,

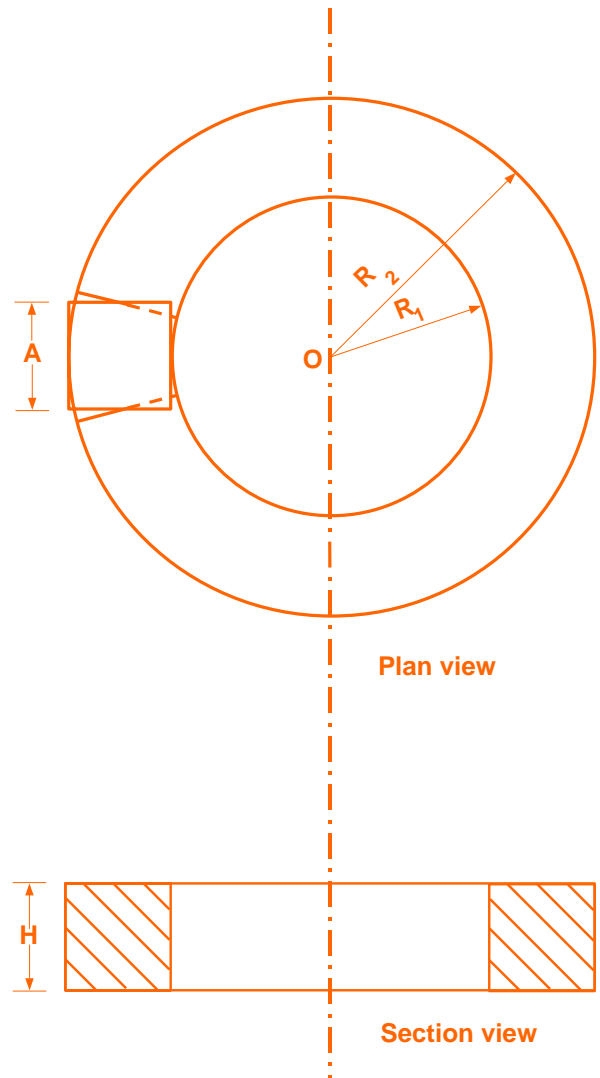$g$ = gravity attraction

$G$ = gravitational constant

$D$ = density

$A$ = length of horizontal side of prism

$R_1$ = radius of inner circle of annular ring

$R_2$ = radius of outer circle of annular ring

$H$ = height of annular ring or prism

**Plan view**

**Section view**

# References

Hammer, S., 1939. Terrain corrections for gravimeter surveys, Geophysics, vol. 9, no. 3

Bible, J.L., 1962. Terrain Correction Tables for Gravity, *Geophysics*, vol. 27, p.715.

Kane, M. F., 1962. A comprehensive system of terrain corrections using a digital computer, *Geophysics*, vol. 27, no. 4.

LaFehr, T.R. 1991, An exact solution for the gravity curvature (Bullard B) correction: *Geophysics*, v56, pp1179-1184

Nagy, D. 1966. The gravitational attraction of a right rectangular prism, *Geophysics*, vol. 31, no 2.

# Sample Gravity Data Files

This table below provides a description of the sample data files provided with the **montaj Gravity and Terrain Correction** system. These data files are located in the **data\gravity** directory on the **Oasis montaj** CD-ROM.

| | |
|---|---|
| **bases.csv** | Base station data for base stations 90001 and 90002 |
| **location.csv** | Location data (station, X,Y and elevation). The projection is "ED50 / UTM zone 30N" |
| **dtm45m.grd** | Regional digital terrain model, 45 metre cell size |
| **dtm5m.grd** | Local digital terrain model, 5 metre cell size |
| **terrain.grd** | A regional correction grid calculated using regional terrain effect, 1 to 50km. |
| **load.gs** | A script that loads all data files applies a drift correction and merges them with the master database. |
| **940615a.dmp** <br><br> **940617b.dmp** <br><br> **940622a.dmp** <br><br> **940623a.dmp** <br><br> **950131b.dmp** <br><br> **950201b.dmp** <br><br> **950203b.dmp** | CG-3 survey dump files. |

# Glossary

| | |
|---|---|
| **Absolute gravity** | The absolute gravity at the base station in milligals. This value is determined either from some other source (perhaps you are using government established base stations), or by performing a base station survey (See Base Station Surveys below for information on establishing your own base stations), or the gravity is given an arbitrary value. |
| **array channels** | Special channels in columns of the spreadsheet that contain multiple channels of data. Array channels are represented graphically by a curve in the spreadsheet. See also c*hannels, sub-array channels.* |
| **Base station database** | The name of the base station database. If the database does not exist, it will be created with channels of "Station", "Gravity", "Longitude", "Latitude" and "Elevation". You will also have the option to load existing base station data from another database or a text file. |
| **channels** | In the **Oasis montaj** spreadsheet, a channel is essentially a column that contains a specific type of data. |
| **column** | In the **Oasis montaj** spreadsheet, a vertical line of cells that contain data. |
| **database** | See *Oasis database* |
| **desktop** | Background area in the **Oasis montaj** project. You can open and display a virtually unlimited number of Spreadsheet, Profile and Map windows in this area. |
| **Elevation Units** | The elevation units of the DEM grids (Metres or Feet). |
| **fiducials** | Points accepted as fixed bases of reference. Marks indicating the order in which each reading or sample reading was taken. |
| **Geosoft Database (GDB)** | A proprietary binary database architecture that stores spatial data in a format that enables rapid access, processing and analysis of high volume data (tested up to 10 gigabytes). |
| **Graphical User Interface** | Interactive software environment where functions are performed by selecting graphic objects. |
| **grid** | Collection of points along rows and columns that define a two-dimensional rectangular area on some plan, usually a ground plan. |
| **Grids or Grid file** | Files containing location (X and Y) and data (Z) values. Values are typically interpolated to create a regular and smoothly sampled representation of the locations and data. |
| **groups** | A set of graphics elements that make up a graphic component of the map. For example, a line path plot, a contour plot or a profile plot would all be separate graphics groups within the Data View. |

| | |
|---|---|
| **GX or Geosoft eXecutable** | Programmed process (identified by the *.GX file extension) used to process data in **Oasis montaj**. |
| **Images or Image file** | Files containing location (X and Y) and color values. The values are not interpolated. Standard PC file types created using imaging or electronic photo-editing techniques. |
| **Inner (local) correction distance** | This is the distance beyond which the regional correction will be calculated. This distance must match the Local correction distance used in the GRTERAIN GX.  The terrain correction inside this distance is calculated from the local terrain grid when running GRTERAIN.  The local correction distance will be rounded up to match an even number of grid cells in the regional grid. |
| **line** | Linear array of observation points. |
| **Local DEM grid** | This is the most detailed local digital elevation model (DEM) grid available. This grid must cover the survey area plus, ideally, the Inner (local) correction distance.   The regional terrain correction grid will have the same grid cell size as the Local DEM grid.  If the local survey limits are not specified, the area of the Local DEM grid is used. This grid is used to get a station elevation for terrain correction. |
| **Main window** | Primary tool used to create and maintain databases, display data and process data. **Oasis montaj** is a Graphical User Interface (GUI) system that provides all functionality required to process and display virtually any type of Earth Science data. |
| **Map (*.MAP)** | Geosoft-developed file that integrates all graphics elements (lines, polygons and text) and layers (base maps, data, grids, plots and images) constructed in **Oasis montaj**. |
| **menu (*.OMN)** | Graphical list of commands or functions that a user may choose from. |
| **Oasis montaj** | **Oasis montaj** is the core software platform that provides all functionality required to manage, manipulate, visualize and map spatially located Earth Science data. |
| **Optimization** | For large regional grids, the terrain calculation can be quite slow.  The optimization option accelerates the calculation by de-sampling the outer zones to coarser averaged grid and using a 4x4 point Qspline interpolation to get the elevation from the grid.  In the test grid dimension of 2500x2500 cells, optimization improves performance 10 times at the loss of 3% accuracy comparing the one with no optimization option. |
| **Outer (regional) correction distance** | The distance to which to calculate a regional correction.  This is normally significantly greater than the Local correction distance, but not larger than can be sampled from the Regional DEM.  By default, this distance will be the half the size of the regional grid.  It is generally accepted that 300 km is a reasonable maximum. |
| **Output (terrain correction) grid** | This is the name of terrain corrected (output) grid. |

| | |
|---|---|
| **Project (\*.GPF)** | Binary file that defines a desktop environment. It is essentially an "electronic briefcase" that helps organise data and the activities related to a data processing project. |
| **random XYZ data** | Located XYZ data that cannot be grouped naturally into separate lines. For example, regional gravity surveys or geochemical surveys are commonly considered random data because the locations appear somewhat random in nature. |
| **Regional DEM grid** | This is the name of a regional DEM grid that extends significantly beyond the boundaries of a survey. This grid is normally compiled from more detailed government DEM data sets, and will have been created specifically for this survey. It should include all known local elevation data. A typical grid cell size might be 250m. |
| **row** | In the **Oasis montaj** spreadsheet, a horizontal line of cells that contain data. |
| **Sub-array channels** | Individual channels of data from an array channel. |
| **template** | A file used to manage data in a particular format. |
| **View** | Stored snapshot of the screen settings, current line, displayed channels and displayed profiles in **Oasis montaj**. |

# Index