Grid Extractor

NTv2 Distortion Grid Extraction Software

User's Guide

Queensland Government

Natural Resources and Mines

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1. INTRODUCTION

1.1 Overview

In November 1995, the Intergovernmental Committee on Surveying and Mapping (ICSM) recommended the progressive Australia-wide implementation of a new national geodetic datum to be introduced by January 1, 2000. This datum is known as the Geocentric Datum of Australia (GDA).

In recognition of the vast number of spatial information users across Queensland wishing to transform their data files to the new datum, the Department of Natural Resources and Mines (NR&M) has developed datum transformation software that incorporates bi-linear interpolation from distortion grids in the NTv2 file format. Since the application of bi-linear interpolation is directly related to the region covered by the distortion grid, the software may be used anywhere in Australia provided there is a valid distortion grid file for that area.

In October 2001, the National AGD66 and AGD84 distortion grids were released. The AGD66 grid provides complete coverage across Australia, whereas the AGD84 grid only provides partial coverage supporting Queensland, Western Australia and South Australia.

To ensure that the transformation process is rigorous and repeatable, it is recommended that the National distortion grids be adopted as the definitive source of grid shifts applied with the bi-linear interpolation algorithms. Recognising that the national grids are significantly larger than individual State grids, the Grid Extractor utility has been developed to extract a sub-set of a national grid. Such a subset could then be deployed confident that identical transformation results would be achieved.

1.2 A Note on Bi-Linear Interpolation and Distortion Grids

The recommended approach in Australia for transforming coordinates between AGD66/AGD84 and GDA94 is to use bi-linear interpolation. This approach requires a standard grid of coordinate differences that model the AGD66/AGD84 to GDA94 transformation and AGD66/AGD84 network distortions. The Canadian National Transformation Version 2 (NTv2) is adopted as the standard file format for the grid of coordinate differences.

Appendix A provides a detailed explanation of the NTv2 grid shift file format. For further information relating to the standards for the NTv2 format see the Geodetic Survey Division of Geomatics Canada website:

http://www.geod.emr.ca/products/html-public/GSDapps/English/NTv2_Fact_Sheet.html

For a complete coverage of Australia, you can download the latest national distortion grid files from:

National AGD66 to GDA94:
http://www.anzlic.org.au/icsm/gdatm/zipfiles/national66.zip

National AGD84 to GDA94:
http://www.anzlic.org.au/icsm/gdatm/zipfiles/national84.zip

Information relating to the transformation to GDA94 can be found at the ICSM's GDA website:
http://www.anzlic.org.au/icsm/gda/index.htm

2. GETTING STARTED

2.1 What is Grid Extractor?

Grid Extractor is a program that creates NTv2 distortion grid files for a user defined area or location. Its main function is to copy distortion grid information falling within a set of specified coordinates from an existing grid file. When the data is extracted, the integrity of the original file structure is retained and therefore it maintains the accuracy of the source grid file. Checks are performed throughout the extraction process to ensure that a valid file conforming to the strict NTv2 file format rules is created.

Grid Extractor can be used to create distortion grids for any area in Australia - depending on the source grid file that you use. Since Grid Extractor copies distortion data that falls within the extents of the source grid file only it does not create or calculate new distortion grid information for areas outside the source grid file.

2.2 Why use Grid Extractor?

If certain business needs require you to transport your datum transformation software and distortion grid(s) to remote areas and you do not have the means for distributing large files, you can use Grid Extractor to extract part of your grid file for the area you are working in only. Grid Extractor allows you to control where and how large an area your new distortion grid will cover.

The latest version of the national distortion grids (AGD66 and AGD84) provide complete coverage of Australia, however require approximately 3.2 MB and 8MB of hard disk space respectively. By using Grid Extractor, you can create a new grid file as small as 1KB simply for the area you are working in.

An important note to understand is that the speed to which coordinate transformations using NTv2 grid files are performed is independent of the size of the grid file. Therefore, you do not need to use Grid Extractor to create a smaller grid file for your area if you have sufficient disk space for the national grids.

2.3 System Requirements

Grid Extractor can only be run under 32-bit versions of Windows. You can not run Grid Extractor under 16-bit versions of Windows (ie. Windows 3.1 or Windows 3.11) nor on Macintosh platforms.

Before you can run Grid Extractor, check that your PC meets the following minimum software and hardware requirements:

1. 1 MB of free hard-disk space.
2. 2 MB RAM.
3. 80486 processor or better.
4. Windows95, Windows98, Windows NT 4.0 or Windows 2000.

2.4 The Grid Extractor Dialog

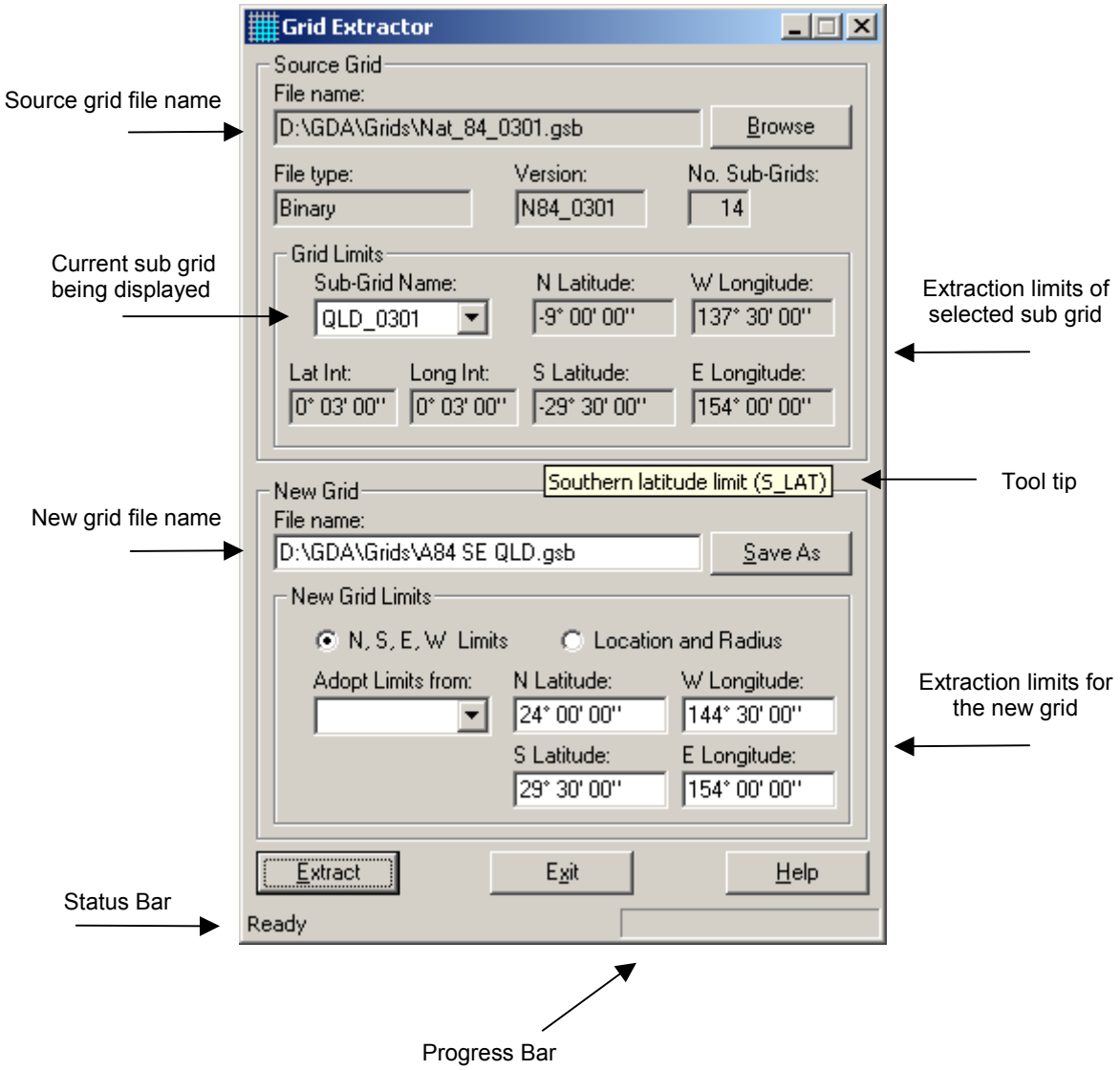
Figure 2.a shows the Grid Extractor dialog. The Grid Extractor dialog is where you perform all extraction activities. The interface contains standard windows components for opening and saving files, entering in data, displaying necessary grid file information and for viewing the On Line Help.

The main window area is arranged into two groups: Source Grid and New Grid. The Source Grid group contains controls for opening and viewing the attributes of a distortion grid file. In this group, you can view the limits of each sub grid contained within the grid file. This will help you define the maximum and minimum limits of your new grid. The New Grid group contains controls for specifying the new grid file name and geographical coordinates for a user defined area or location.

Tool tips are provided to show short descriptions of the various dialog controls. These may be displayed as shown in Figure 2.a by positioning the mouse over a control for a short period.

During the process of extracting a new grid file, the Status Bar will display the name of the sub grid being copied and the current progress of the data being copied.

Figure 2.a The Grid Extractor Dialog



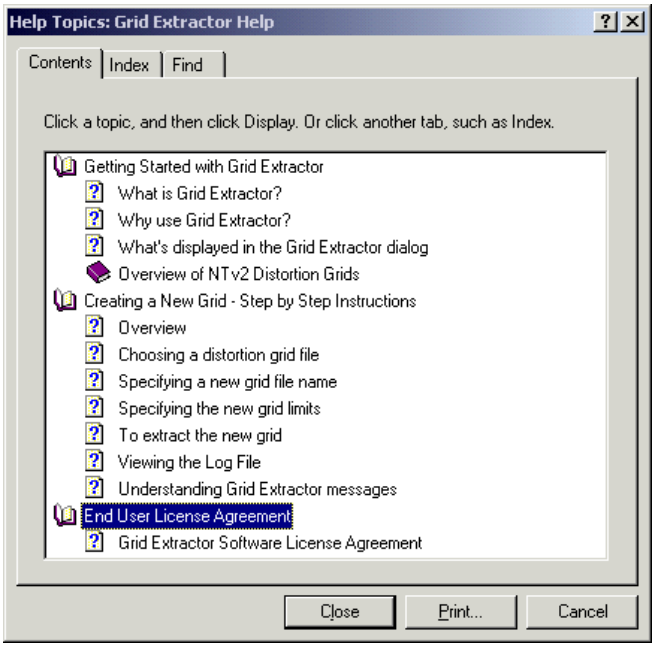
2.5 Using the On-Line Help to Obtain Information

On-Line Help is provided for information related to using Grid Extractor. When using Grid Extractor, there are two ways to access the On-Line Help facility:

1 When using Grid Extractor, you can press F1 to obtain the Grid Extractor Help Topics.

2 From the dialog, click the **Help** button. This will display a context sensitive Help.

Figure 2.b The Grid Extractor Help Table of Contents



3. CREATING NEW GRIDS WITH GRID EXTRACTOR

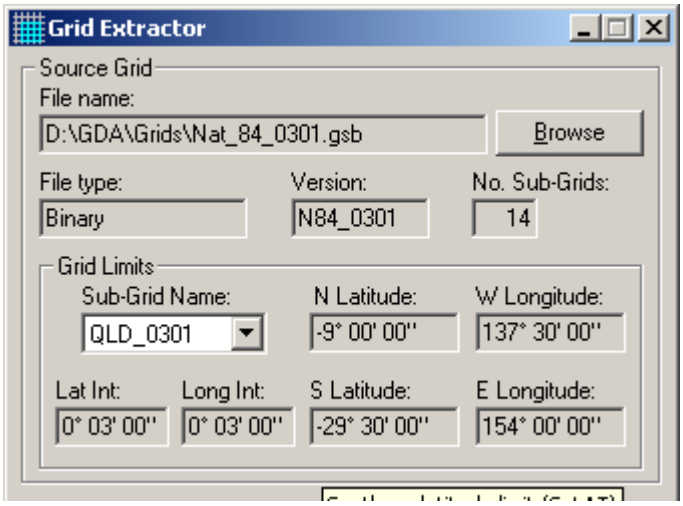
3.1 Choosing a Distortion Grid file

To select a new distortion grid file

1. Click **Browse**.
2. In the **Look in** box, click the drive or folder that contains the distortion grid file.
3. In the **Files of type** box, choose the appropriate grid file-type or format. Note that the only available types are ASCII (*.asc) and Binary (*.gsb) files).
4. In the folder list, double-click folders until you open the folder that contains the file.
5. Double-click the distortion grid you want to use.

When a valid distortion grid is selected, the **Source Grid** group edit boxes will be populated with the grid's attributes. Figure 3.a shows the edit boxes in the Source Grid group after a valid grid file has been opened.

Figure 3.a The Source Grid group



A description of the edit boxes is as follows:

File name: file name and path for the source distortion grid
File type: grid file format, which can be either Binary or ASCII
Version: grid computation version / release name
No. Sub-Grids: number of sub grids contained within the grid file

Sub-Grid Name: the sub-grid currently displayed. Where there are multiple sub grids within the selected grid file, you may scroll through this drop down list to view each sub grid's limits. The displayed sub grid's attributes are:
N Latitude: northern limit
S Latitude: southern limit
W Longitude: western limit
E Longitude: eastern limit
Lat Int: latitude interval or north-south grid node separation
Long Int: longitude interval or east-west grid node separation

When the latest version of GDAy is installed, each time you run Grid Extractor the default distortion grid used in GDAy will be opened and displayed in the Source Grid group. If an invalid grid file is opened, all edit boxes and the Save As and Extract buttons on the Grid Extractor dialog will be disabled.

3.2 Specifying a New Grid File Name

To specify a new grid file name, type in the full file path and name directly into the File name edit box, or alternatively perform the following steps:

1. Click **Save As**.
2. In the **Save in** box, click the drive or folder that you want to save the file in.
3. In the **Save as type** box, note that the only available types are ASCII (*.asc) and Binary (*.gsb) files).
4. In the folder list, double-click folders until you open the folder that contains the file. To create a new folder, click the **Create New Folder** icon and then type a name for the new folder in the Name box.
5. In the **file name** box, type in the name of the file you want to save as the new grid file. Otherwise, select an existing grid file from the list to be overwritten.
6. Click **Save**.

If an unrecognised file type is entered for the new grid file, the new grid file will be saved in the default Binary format. Note that you can not create a new grid file with the same file name and path as the source grid file.

3.3 Specifying the New Grid Limits

The **New Grid Limits** group is where you define the size and location of your new grid file. When deciding how large an area and where your grid file should cover, there are two options you can choose from:

- North, South, East and West grid limits, or
- Location and radius

To toggle between these two options, select the appropriate radio button.

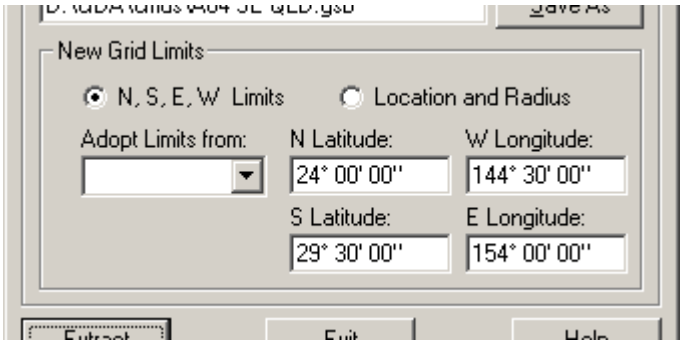
For both options, Grid Extractor requires geographic coordinate values in degrees minutes and seconds. For example, to specify a latitude value of 27° 36’ 25.16” enter in 27.362516. Note that when entering in coordinates, it doesn’t matter if you enter in negative or positive values as Grid Extractor will force all positive latitude values to negative and negative longitude values to positive.

3.3.1 N, S, E, W Limits

This option allows you to directly enter in the geographical coordinates for the north, south, west and eastern limits, using the **N Latitude**, **S Latitude**, **W Longitude** and **E Longitude** edit boxes respectively. Figure 3.b shows the **Source Grid** group when the **N, S, E, W Limits** radio button is selected.

Alternatively, where there are multiple sub grids within the source grid file, you may scroll through the **Adopt Limits from:** drop down list and select one of the sub grids to copy the limits of that grid into the limit edit boxes. This will allow you to extract the contents of that sub grid only. To clear the edit boxes, select the empty item from the drop down list of sub grids.

Figure 3.b The Source Grid group using N, S, E, W Limits

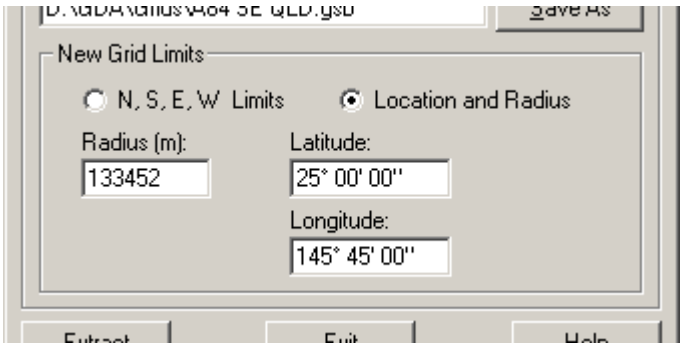


3.3.2 Location and Radius

This option allows you to specify the geographical coordinates of a known location you a working near and the radius distance to which the four limits of the grid should extend. Whilst the term radius is used to indicate the minimum distance from the known location, the distortion grid can only be created as a regular four sided grid.

Figure 3.c shows the **Source Grid** group when the **Location and Radius** radio button is selected.

Figure 3.c The Source Grid group using Location and Radius

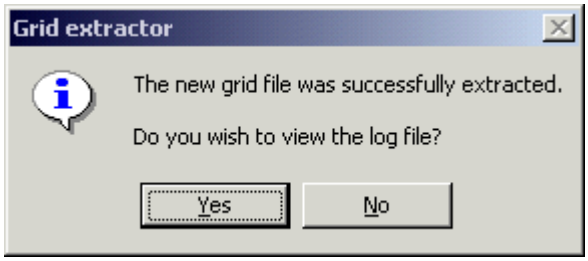


3.4 Extracting the New Grid

Once you have specified the file path and name and the new grid limits, click **Extract**. During the process of extracting a new grid file, the Status Bar will display the name of the sub grid being extracted and the current progress of the data being copied.

When the new grid has been successfully extracted, or if any errors were found during the extraction process, you will be prompted with a message asking you to view the Log File. Figure 3.d shows the message box.

Figure 3.d Standard Message Box displaying grid file extraction success



3.5 Viewing the Log File

Each time you extract a new distortion grid, a log file is created for that grid. The log file is a simple ASCII text file and is saved with read-only access. Figure 3.e shows the contents of a typical log file.

Figure 3.e Sample Log File

```
//////////////////     NTv2 Grid Extractor Log File      ////////////////////////

Created:   Thursday, 06 December 2001, 12:48:13 PM.

Version 1.0   © Natural Resources and Mines, QLD.
////////////////////////////////////////////////////////////////////////////////

NTv2 Grid file:    D:\GDA\Grids\Nat_84_0301.gsb  (Binary)

Overview Header Block:

  NUM_OREC 11
  NUM_SREC 11
  NUM_FILE 14
  GS_TYPE SECONDS
  VERSION N84_0301
  SYSTEM_FANS
  SYSTEM_TGRS80
  MAJOR_F  6378160.000
  MINOR_F  6356774.719
  MAJOR_T  6378137.000
  MINOR_T  6356752.314

Extract to file:   D:\GDA\Grids\A84 SE QLD.gsb  (Binary)

Extraction Limits:

  N Latitude:        -24.0000000
  S Latitude:        -29.5000000
  E Longitude:       154.0000000
  W Longitude:       144.5000000

Successfully created sub grid header blocks.

Extracting sub grids...

  SUB_NAME:     QLD_0301
  N_LAT:      -24.000000d
  S_LAT:      -29.500000d
  W_LONG:     144.500000d
  E_LONG:     154.000000d
  LAT_INC:          180s
  LONG_INC:         180s
  GSCOUNT:         21201

Extracted 1 sub grid(s).

The new grid file was successfully extracted.
```

You will be prompted to view this log file once the new grid file is complete. If any errors occur during the extraction process, they are written to the log file and the user is prompted with a brief error message, similar to that shown in Figure 3.d.

The name of the log file will be the same as the grid file you just created, but will have a “log” file extension. For example, if you created a grid file called “agd84_seqld.gsb”, the log file created will be called “agd84_seqld.gsb.log” and will be saved in the same directory as the new grid file.

To locate and view the log file manually

1 Open **My Computer** and navigate to where you saved the new grid file.

2 Double click the text file with the same name as the new grid file having a “.log” file extension.

4. GRID EXTRACTOR ERROR MESSAGES

Messages are displayed using a warning message box similar to that shown in Figure 3.d to notify the user when the grid file has been successfully created or if a problem was found in the extraction process. Depending on which error has occurred, some messages are printed to the log file.

Below are the messages displayed by Grid Extractor:

The new grid file was successfully extracted.

This message is displayed when the extraction process is complete.

The specified grid file could not be opened for reading.

This message is displayed if the grid file could not be found in or opened from the specified directory.

The specified grid filetype is not supported.

This message is displayed when a source grid file with an unknown file type is opened. The only grid file formats supported are NTv2 Binary and ASCII, having a “gsb” and “asc” extension respectively.

The specified grid file is corrupt.
The specified grid file contains errors.

These messages are displayed if the source grid file contains errors or does not conform with the NTv2 file format.

The grid shifts could not be read from the specified Binary file.
The grid shifts could not be read from the specified ASCII file.

These messages are displayed when the data could not be read from the source grid file.

The output grid file could not be opened for writing.

This message is displayed if the new grid file can not be saved.

The output grid filetype is not supported.

This message is displayed when an unknown file type is entered. In this instance, the new grid file will be saved in the default Binary format.

The input and output file names can not be the same.

This message is displayed when the new grid file name is the same as the source grid.

No sub grids were found within the specified extraction limits.

This message is displayed if the specified extraction limits for the new grid define an area outside the limits of the source grid file.

Please enter a northern latitude limit that is north of the southern latitude limit.

This message is displayed when the specified north latitude limit further south, or below, the specified south latitude limit.

Please enter a western longitude limit that is west of the eastern longitude limit.

This message is displayed when the specified west longitude limit is to the east of the specified east longitude limit.

Invalid north latitude limit. Enter in a valid geographic coordinate value.
Invalid south latitude limit. Enter in a valid geographic coordinate value.

These messages are displayed when either of the specified latitude limits extend beyond the south pole, such as a value greater than 90 degrees, forcing it to lie in the southern hemisphere on the other side of the earth.

Invalid west longitude limit. Enter in a valid geographic coordinate value.
Invalid east longitude limit. Enter in a valid geographic coordinate value.

These messages are displayed when either of the specified longitude limits extend beyond the International Date Line, such as a value greater than 180 degrees, forcing it to lie to the west of Greenwich Meridian.

Invalid location and radius. Either reduce the radius distance or specify location coordinates that are further within the limits of the Map Grid of Australia.

This message is displayed when the new limits calculated from the location and radius values define too large an area over the earth. This will occur when the north and south limits extend north beyond the equator and south beyond the south pole respectively, or when the east or west limits extend beyond the International Date Line or Greenwich Meridian respectively.

APPENDIX A NTv2 Grid Shift File Format

The Grid Shift file used by Grid Extractor contains coordinate shift values at nominated grid nodes in a format known as NTv2 (National Transformation Version 2). This format was developed by the Geodetic Survey Division of Geomatics Canada, to implement the transformation of coordinates between NAD27 and NAD83 in Canada. Australia recognised the advantages of this format and decided to adopt NTv2 as a standard format.

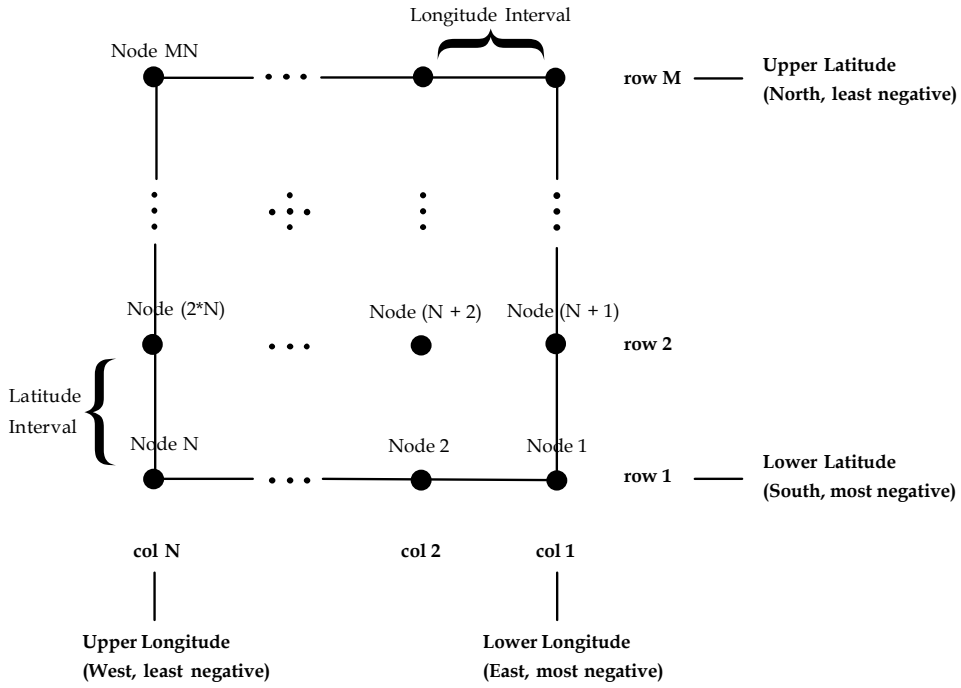
The following sections describe the Specifications of the NTv2 file format and the considerations for its usage in Australia.

A.1 NTv2 Grid Shift File Concept

The NTv2 grid format is a structured rectangular region of evenly spaced rows of latitude and columns of longitude. The intersection of a row and column is referred to as a grid node. Each node consists of a shift value for both latitude and longitude, as well as a value for the accuracy of each shift as determined in the least squares modelling process.

To provide for a structured means of extracting the values at each node from a digital file, the nodes are consecutively indexed in rows and columns starting at the south east (lower right) corner, finishing at the north west (upper left) corner. The fundamental concept of the grid and node index structure is shown in figure B.1.

Figure A.1 Grid Node Order



In its simplest form (Figure B.2), the grid shift file contains a single “sub grid” bound by unique values for each of the following: lower latitude, upper latitude, lower longitude, and upper longitude. The size of the file is directly related to the area it covers and is therefore governed by the number of nodes (file records) contained within the file. The order of these nodes within the file is critical and must be adhered to for accurate grid interpolation.

The ordered grid-node structure within the file allows for direct computation of the location of the file records containing the interpolated shifts. Since, the size of the file is independent of the retrieval

method the data retrieval is almost instantaneous. All information required to compute the position of each node within the file is contained within a block of header information at the beginning of the file. The structure and format of NTv2 grid shift file header information is explained in section B.2.

Figure A.2 - Grid Shift file with a single sub grid

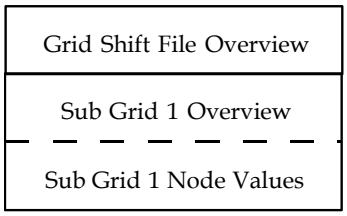
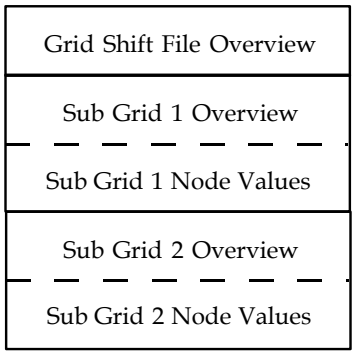
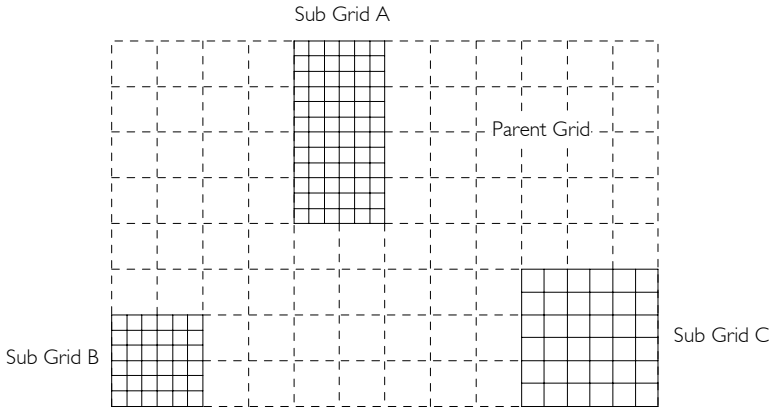


Figure A.3 - Grid Shift file with multiple sub grids



The grid shift file may also contain many sub-grids (Figure B.3) of greater densities that cover designated areas within the parent grid area. Figure B.4 illustrates the concept of densified sub-grids within a parent grid. In these instances, the grid shift file contains an extra block of header information for each densified sub grid, which are each followed by the interpolated shifts for the nodes within the sub grid.

Figure A.4 Densified sub grid structure



The order of these sub grids with in the file is of no importance, since the method of retrieval of data from the file follows a logical method based on the concept of a simple hierarchical tree. For example, each time the grid shift file is opened an index (or array) of sub-grids and their parent grid is built and stored in memory.

To conform with the NTv2 format, a set of rules must be followed when combining two or more grid areas within the one file. These rules ensure that a unique sub grid is selected for subsequent interpolation. For more information on the rules regarding the NTv2 format, see "NTv2 Developer's Guide" (Junkins and Farley, 1995).

A.2 NTv2 File Format

An NTv2 Grid Shift file can be written as an ASCII or binary file. The binary format described in the *NTv2 Developer's Guide* (Junkins and Farley, 1995) gives the impression of being FORTRAN specific but it is actually a pure byte dump. The *NTv2 Developer's Guide* (Junkins and Farley, 1995) does not specify whether the format of a binary is Little or Big Endian. In Australia all NTv2 binary grid shift files will be distributed as Little Endian binary files.

The following sections describe the format of each component of a Grid Shift file. In describing the format, the data types used are given in Table B.1 along with the byte size required for each type. This table relates to a binary Grid Shift file, the format of fields in an ASCII version will vary so they are specified in the Format columns of Tables B.2 to B.4. If an identifier is specified, both the *Identifier* and *Value* are written to file otherwise only the *Value* is written. An *Identifier* is written to the Grid Shift file as a *string*. The important thing to note here concerns how integer values are dealt with in a binary file. Each header record must be 16 bytes long so to make a record containing an integer value be 16 bytes, 4 bytes of padding are inserted. The padding used is 4 NULL characters (ASCII character 0).

Table A.1 - Grid Shift File Data Types

Type	Bytes	Comment
Integer	4	Followed by 4 NULL characters of padding in binary version of file, ie 8 bytes in total.
Float	4	
Double	8	
String	8	8 characters

A.2.1 Grid Shift File Overview

Table B.2 specifies the format of the Overview section of a Grid Shift file and a sample is given in Figure B.5. This section contains eleven records which give general information about the sub grids within the file. The NUM_FILE record is the most useful as it specifies how many sub grids the Grid Shift file contains.

Table A.2 - Grid Shift File Overview Information

Record	Identifier	Value	Description	ASCII format
1	NUM_OREC	Integer	# header records in overview	%8s%3d
2	NUM_SREC	Integer	# header records in sub grid	%8s%3d
3	NUM_FILE	Integer	# of sub grids	%8s%3d
4	GS_TYPE	String	Shift type (SECONDS)	%8s%-8s
5	VERSION	String	Distortion model	%8s%-8s
6	SYSTEM_F	String	"From" ellipsoid name	%8s%-8s
7	SYSTEM_T	String	"To" ellipsoid name	%8s%-8s
8	MAJOR_F	Double	"From" semi major axis	%8s%12.3f
9	MINOR_F	Double	"From" semi minor axis	%8s%12.3f
10	MAJOR_T	Double	"To" semi major axis	%8s%12.3f
11	MINOR_T	Double	"To" semi minor axis	%8s%12.3f

Figure A.5 - Sample Grid Shift file Overview

```
NUM_OREC 11
NUM_SREC 11
NUM_FILE  1
GS_TYPE SECONDS
VERSION MAY98V20
SYSTEM_FANS
SYSTEM_TGRS80
MAJOR_F  6378160.000
MINOR_F  6356774.719
MAJOR_T  6378137.000
MINOR_T  6356752.314
```

A.2.2 Sub Grid Format

A sub grid consists of a Sub Grid Overview section followed by the values of the nodes in the sub grid. The Overview section specifies the sub grid extents, the grid spacing, the name of the sub grid and the name of the parent sub grid if there was one. A sub grid will have a parent if its extents fall within another sub grid. The format of the Sub Grid Overview is given in Table B.3 and a sample is given in Figure B.6.

Table A.3 - Sub Grid Overview Information

Record	Identifier	Value	Description	ASCII format
1	SUB_NAME	String	sub grid name	%8s%-8s
2	PARENT	String	Parent sub grid name	%8s%-8s
3	CREATED	String	Date	%8s%-8s
4	UPDATED	String	Date	%8s%-8s
5	S_LAT	Double	Lower latitude	%8s%15.6f
6	N_LAT	Double	Upper latitude	%8s%15.6f
7	E_LONG	Double	Lower longitude	%8s%15.6f
8	W_LONG	Double	Upper longitude	%8s%15.6f
9	LAT_INC	Double	Latitude interval	%8s%15.6f
10	LONG_INC	Double	Longitude interval	%8s%15.6f
11	GS_COUNT	Integer	Grid node count	%8s%6d

Figure A.6 - Sample Sub Grid Overview

```
SUB_NAMEMELB
PARENT  NONE
CREATED 7/1998
UPDATED 7/1998
S_LAT    -138780.000000
N_LAT    -134406.000000
E_LONG   -526104.000000
W_LONG   -519354.000000
LAT_INC       54.000000
LONG_INC      54.000000
GS_COUNT 10332
```

Table B.4 specifies the values at each grid node and a sample is given in Figure B.7. The number of nodes in this section of the file is specified in the Sub Grid Overview value GS_COUNT. At each node, only the four values specified are stored, i.e. no identifier or coordinate information is stored.

(**Note:** The shift values at each node consist of a conformal transformation component and a distortion component. If the distortion component at the node can not be modeled, e.g. because of insufficient data, then the shift value at the node contains the conformal component only. When this occurs, both of the accuracy values are set to -1 to denote this. These nodes can still be used in the interpolation of shift values, however it is not possible to interpolate the accuracy of the shifts).

Table B.4 - Sub Grid Node Values

Record	Identifier	Value	Description	ASCII format
1		Float	Latitude shift value	%10.6f
2		Float	Longitude shift value	%10.6f
3		Float	Latitude shift accuracy	%10.6f
4		Float	Longitude shift accuracy	%10.6f

Figure A.7 - Sample Sub Grid Node Values

```
5.414650 -4.727520  0.002171  0.000617
5.413610 -4.728820  0.001615  0.000235
5.413050 -4.729720  0.001563  0.000233
.....
```

A.3 Necessary Considerations for NTv2 Usage

As previously discussed, the NTv2 file format was adopted for use as a standard format for transforming coordinates from AGD to GDA94 within Australia. Since the initial implementation of the NTv2 file format for Australian use, there has been a revised NTv2 file format (Canadian Binary file) produced which will supersede the original Australian Binary file. The following sections clarify the differences between the revised Canadian Binary file and the original Australian Binary file, and note the necessary considerations for the usage of the NTv2 format outside Canada.

A.3.1 Difference Between Australian and Canadian Binary Files

NTv2 files can exist in two forms, binary and ASCII. In Australia the only version of a grid shift file that strictly adheres to the NTv2 file format is the ASCII version (States only distribute the binary form, but the ASCII equivalent is easily obtained from utilities such as GDAit). The differences in the binary form are minor but the consequence is that there are two binary forms of an NTv2 file that aren't compatible: an Australian version and a Canadian version. Only the Canadian version is a true NTv2 file. The following explains the difference between the two binary forms and outlines the reason why it occurred.

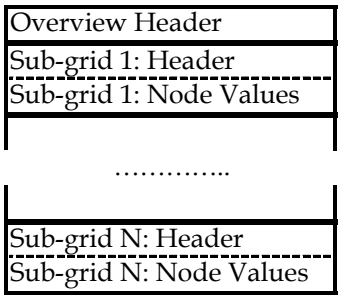
What is the difference?

The simple answer is that any integer value in a Canadian NTv2 binary file must be read as a 4 byte number followed by 4 bytes of padding. Australian binary files DON'T contain this padding, Canadian

binary files do. This affects three records in the Overview Header (NUM_OREC, NUM_SREC and NUM_FILE), and one record in each of the Sub-grid Headers (GS_COUNT).

Considering this in more detail, an NTv2 file is comprised of an Overview Header and is followed by one or more Sub-grids. This is represented in Figure B.8.

Figure A.8 NTv2 File Structure



The Overview Header and each Sub-grid Header consist of 11 records of 16 bytes, i.e. each header is 176 bytes long. The first 8 bytes of each record is a string identifier, the last 8 bytes contain the value of the identifier. The value can be one of three data types: an integer, a double or a string. A representation of how each data type is stored in an NTv2 header record is shown in Figure B.9 with the number of bytes required being given in brackets.

Figure A.9 Data storage in a Header record

Double:	Identifier (8)	Value (8)	
String:	Identifier (8)	Value (8)	
Integer:	Identifier (8)	Value (4)	Padding(4)

The padding used for integer values is 4 NULL characters (ASCII character 0). The only purpose of the padding is to make a record with an integer value 16 bytes long, all other data types will automatically have records 16 bytes long. The records affected in the Overview Header (see Table B.2) are NUM_OREC, NUM_SREC and NUM_FILE. The record affected in the Sub-grid Header (see Table B.3) is GS_COUNT.

The format of the "Node Values" in a Sub-grid is identical for both Australian and Canadian binary files, i.e. no padding is used. For more information about the NTv2 file format refer to *Appendix B.2 NTv2 File Format*.

Why did the difference occurr?

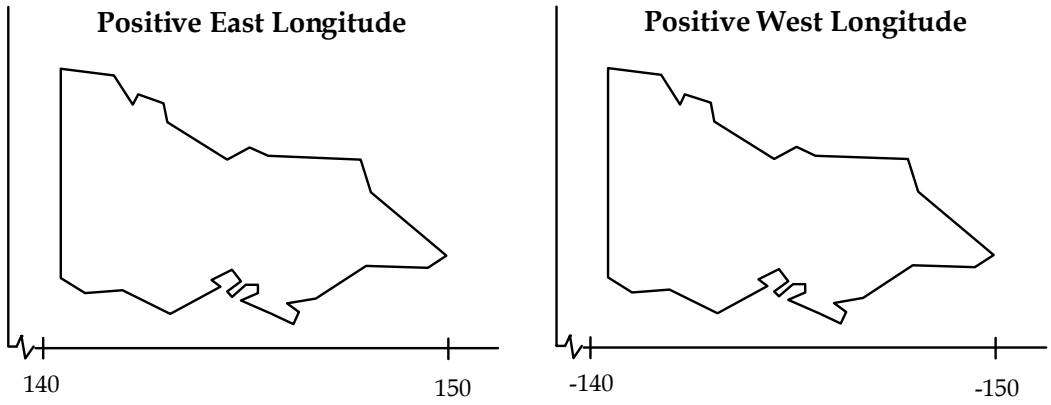
Australian binary came into existence because it was believed that NTv2 binary was compiler dependent. The Canadians had implemented it with FORTRAN and information at the time suggested that the use of records within a FORTRAN binary file would create a file that other development environments would have difficulty reading and writing. Given that most software development today is done in a language other than FORTRAN, the decision was made to format the file as specified in Appendix B of the *NTv2 Developer's Guide* (Junkins and Farley, 1995), but to ignore any auxiliary record identifiers that FORTRAN used. At the time this was not considered to be a major issue. A FORTRAN version of the grid file could easily be created for those who required it by using a FORTRAN utility to convert an ASCII version of the grid file to the binary form.

However it has now become apparent that NTv2 binary is not compiler dependent. The justification for having an Australian version of the binary is no longer valid and retaining it will lead to further confusion in the future. Ultimately, the best option is to abandon this version and adopt the Canadian implementation.

A.3.2 Implications of Using NTv2 Outside Canada

NTv2 was developed for use in Canada and therefore regards longitude as increasing *Positive West*, which is opposite to the convention used in Australia of *Positive East* longitudes. The implication of this is that longitude values that are east of Greenwich (all Australian longitudes), must be made negative to be compatible with a *Positive West* system. (Latitude values do not need to be modified as they are considered as *Positive North* in NTv2 which is the standard convention).

Figure A.10 – Longitude Axis Orientation



The sign reversal of the longitude axis explains why the sub grid parameters Upper and Lower Longitude in Figure B.10 appear in the order they do. The Lower Longitude value is the smallest or most negative longitude, Upper Longitude is the largest, or least negative value.

References

Collier P. and Mitchell, D., 2000, *GDAit (GDA94 InTerpolation) Users Guide*, Department of Geomatics, University of Melbourne.

Collier P. and Mitchell, D., 2000, *GDAit (GDA94 InTerpolation) Software Documentation*, Department of Geomatics, University of Melbourne.

Junkins, D.R. and Farley, S.A., 1995, *NTv2 Developer's Guide*. Geodetic Survey Division, Geomatics Canada, 27pp.

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