Grid InQuest II

Coordinate Transformation Software

for Great Britain and Ireland

Land & Property Services.

osi Ordnance Survey Ireland

Ordnance Survey

Contents

Introduction

Welcome to Grid InQuest II

The Grid InQuest II desktop application and command line tools provide a means of transforming coordinates between globel geodetic coordinates (ETRS89/WGS84) and the national systems of Great Britain and Ireland. It provides a fully three dimensional transformation incorporating the latest geoid model (OSGM15) and the appropriate polynomial transformation model (OSTN15 or OSi/OSNI) for each of the projected coordinate systems.

This document is a reference forinstalling and using the Grid InQuest II package. It is intended as a help to getting started with the software and to implement the preferred methods and procedures involved in accurate coordinate conversions within Britain and Ireland.

The following text is divided into four sections. The first two contain general user information. Section one explains how to install and use the main Grid InQuest II desktop application. It contains a description of all the menu items, options and forms used to operate it's interactive and file processing modes. The second section introduces the more advanced utilities intended for command line and internet use.

The last two sections contain information intended for programmers and other technicians. The first of these describes how to re-use the system's components within other scripts and programs. The final section contains reference information related to the supported coordinate systems and transformations used within Great Britain, Northern Ireland and the Republic of Ireland.

The Grid InQuest II project was jointly developed by the Land and Property Service of Northern Ireland, the Ordinance Survey of the Republic of Ireland and the Ordinance Survey of Great Britain.

Desktop Application

Overview

The Grid InQuest II desktop application has been designed to be as simple as possible to operate and install. It is a graphical program that can be run on any reasonably modern Microsoft Windows computer, Apple Macintosh computer or Linux desktop system.

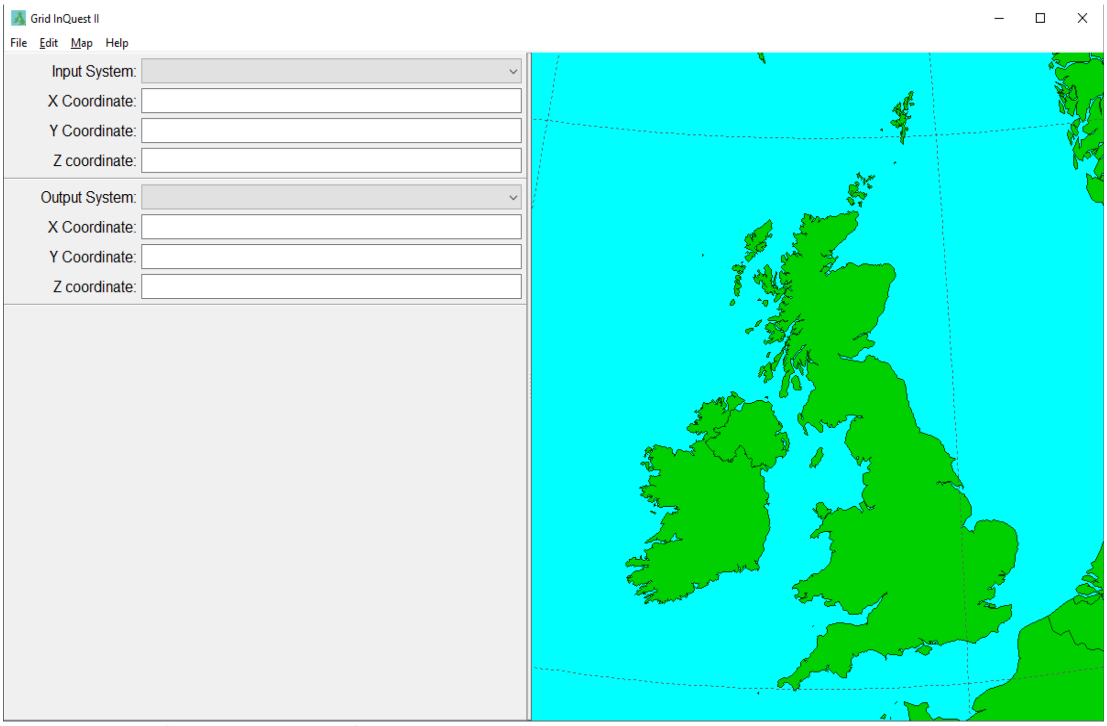


Image 1: Grid InQuest II Application

Installation

The application is available for download from the internet as a compressed archive file in zip format. There are individual archives for each of the supported operating systems:

- Microsoft Windows (32 bit Windows XP or later)
- Apple Macintosh OS X (32 bit Snow Leopard or later)
- Linux (32 and 64 bit with GTK2, tested on Ubuntu 12.04+)

Once downloaded, the zip file can be extracted to any folder. The only requirement is that the user has permission to execute programs from that location. The default folder name is GridInQuestII, but this is not essential. However, files within this folder must be kept together for the proper operation of the application, otherwise Grid InQuest II will not be able to perform the national coordinate system transformations.

On Windows there are no special considerations, beyond the permission requirement to execute programs. Grid InQuest II does not make any use of the Windows registry database, nor does it depend on any other software libraries or configuration files. If the software is being installed for the use of all users on a machine, the convention is to copy the GridInQuestII folder into the "Program Files" or the "Program Files (x86)" folders. A link to the application can then be added to the menu or desktop if desired.

On Macintosh systems, the zip archive contains an Apple disc image file (.dmg) this can be mounted to show the Grid InQuest II application. This can be run directly from the disc image, or the application can be installed by dragging it's icon from the disk image into the OS X Applications folder. Once copied there, the program will be available in the Launch Pad and the dmg and zip files may be safely deleted as they are no longer required.

Linux installation can be performed in three ways. The first two use a downloadable zip files as with the Windows and Mac versions. This will only work for Intel CPU based systems and there are two versions of the archive, one for 32 bit systems and the second for 64 bit systems. In both cases the zip file is expanded to create the GridInQuestII folder that contains the application. This folder can be moved anywhere in the user's home folder. The user must grant execute permissions for the programs before they can be run. They should be able to run on any graphical desktop that can support the GTK2 library. Additional operating system packages may be needed depending upon the distribution being used. Ubuntu 12.04 and later will have these pre-installed and so it should run here without any further configuration. The last method of installation on Linux is to perform compilation from the source code. In this way it would be possible to support other platforms (such as the Arm based Raspberry Pi's). Instructions for this procedure are beyond the scope of this manual and should only be attempted by a sufficiently knowledgeable technician.

Getting Started

Once initialised, the Grid InQuest II application will open it's main window and start in interactive mode. In this mode the main window is split into two sections with the left being the interactive coordinate conversion interface and the right being an interactive map of the globe that will pinpoint the coordinate the user has entered.

The application is primarily controlled from it's main menu located just below the application's title bar. The first item on this is the File menu. These commands are used in the file I/O mode when processing the contents of a text file except the last, the Exit command, which is used to quit Grid InQuest II. The second Item is the Edit menu. These commands mostly apply to the interactive mode, except for the Options command, which opens the application's global settings form. The Map menu gives commands for basic control over the map display. Lastly the Help menu gives access to this manual if it can be found in the application's folder and the About box which displays the copyright details and other information about the application.

In addition to the Map menu commands the map display can be repositioned by dragging the mouse on the map and the zoom level can be adjusted with the mouse scroll wheel. Also note that many of the menu commands also have keyboard short-cuts. These are displayed on the menu following the menu's name. For example, the About box has a short-cut of 'Ctrl+A'. This means that holding down the Control key and then pressing A will display the About box as well.

Interactive Coordinate Transformation

The interactive mode of the program is used to perform individual coordinate transformations. The input and output coordinate systems are arranged vertically on the left side of the program window allowing you to easily enter the values you wish to transform and immediately view the corresponding point within the target system.

The first step is to select the input coordinate system type from the drop down list of all the available coordinate systems. Once selected, the appropriate coordinate values may be entered into the coordinate text boxes. Note that the text labels will change to display the usual coordinate names for that system. It is not possible to enter values into the text boxes until an input system has been selected and if the system is changed the text boxes will be cleared.

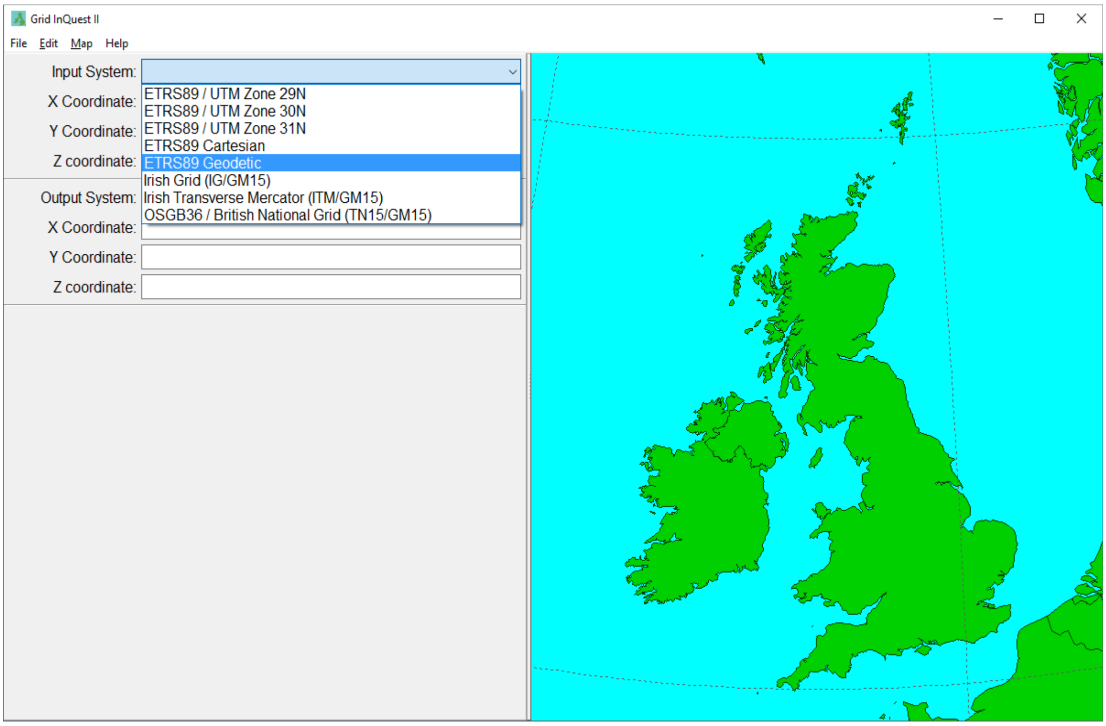


Image 2: Selecting a Coordinate System

Coordinate values themselves can be entered as free text in a format that is appropriate to the type of coordinate system selected. For geodetic systems, this would be values of latitude and longitude in decimal or sexigesimal degrees and altitude in metres. Cartesian systems require X, Y and Z coordinates in decimal metres. All projected systems expect values of Eastings, Northings and Elevation all in metres.

If a typed value cannot be recognised as valid input for that coordinate the text will be coloured red. Once the value entered is correct the text will turn black. Units do not need to be specified and are assumed for the different value types. Angles may be entered in decimal degrees; degrees and decimal minutes or degrees, minutes and decimal seconds. The program also understands +/-, N/S and E/W to indicate the sign of angle values. Geodetic and projected input systems may be used without entering the vertical component. In which case, it is assumed to be zero and is not displayed in the results.

Underneath the input system display, the output coordinate system can be selected from the output drop down list. This list is filtered to display only the systems which are valid outputs from the selected source system. The new output coordinates will be automatically converted once you have chosen the output system, provided all of the supplied input values are valid. The output values are displayed in blue to indicate that they are valid, but read-only. In addition, a red pinpoint marker will be displayed on the map to the right of the main window indicating the actual point location.

Finally, by using the Copy commands available on the Edit menu it is possible to transfer both the input and output values, as formatted on the display, to the operating system's clipboard. These values can then be pasted directly as text into other applications. The formatting of the output is controlled by the interactive settings available on the Options form as described below.

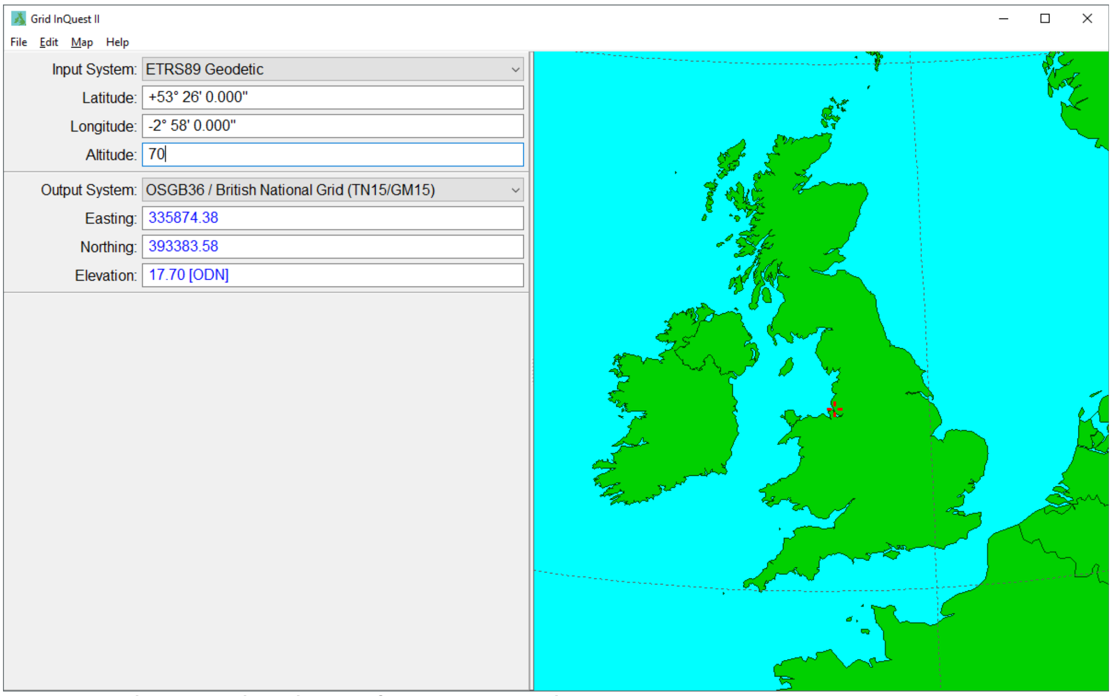


Image 3: The Completed Transformation Display

Step-by-Step Example:

A reading from a GPS receiver (GPS values can be used as ETRS89 geodetic coordinates) is to be converted to the British National Grid. With the “Input System” drop down list, select ETRS89 Geodetic, then enter the Latitude, Longitude and Altitude taken from the GPS receiver. Grid InQuest II can accept most text formats commonly used for geodetic coordinates, and in this example the following values have been entered:

N 53 26	(North 53 degrees, 26 minutes)
-2 58	(West 2 degrees, 58 minutes)
70	(70 meters)

Next select “OSGB36 / British National Grid (TN15/GM15)” from the “Output System” drop down list since the point is within the UK mainland. It will automatically be converted into British National Grid eastings, northings and elevation:

335874.381m E

393383.579m N

17.70m [ODN]

The optional [ODN] suffix on the altitude only applies British National Grid coordinate values and indicates the vertical datum in use. In this case ODN stands for Ordinance Datum Newlyn, since this is the system used to express heights above sea level on the British mainland.

Changing Application Options

The various settings used to control the output formatting of Grid InQuest II can be changed on the Options form. This form is displayed by selecting 'Options' from the Edit menu. It is arranged into two tabbed sections, one for the interactive mode and one for the file output mode. These two sets of settings have identical values but govern the output of the two modes of operation of the application. This form is also where Irish users can set their preferred vertical datum for performing conversions to and from Irish projections.

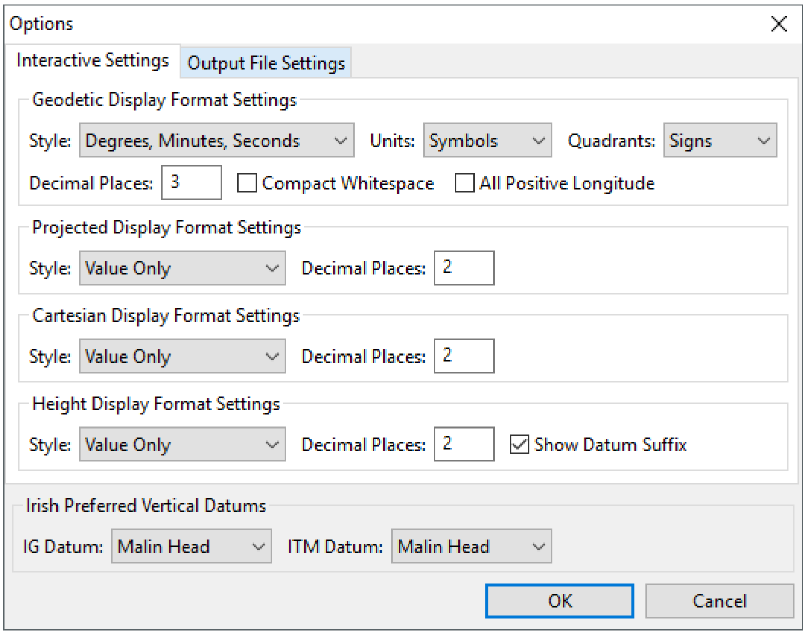


Image 4: The Options Form

Using Output Settings

The settings are divided into sections that apply to the system's coordinate types. The first section controls the format of geodetic (angular) latitude and longitude type coordinates with the following values:

Style – Simple decimal or sexigesimal type numeric representation.

Units – If conventional symbols, letter suffixes or no units used.
Quadrants – Use of plus and minus or hemisphere letters to indicate signs.
Decimal Places – The number of decimal places displayed.
Compact Whitespace – Tick to remove the spacing between sexigesimal values.
All Positive Longitude – Tick to display longitudes in the range of 0-360°.

The second section controls projected (horizontal) eastings and northings type coordinates with the following values:

Style - Options for including axis suffix or prefix characters.
Decimal Places - The number of decimal places displayed.

The third section controls cartesian (three dimensional) X, Y and Z type coordinates with the following values:

Style - Options for including axis suffix or prefix characters.
Decimal Places - The number of decimal places displayed.

The fourth section controls height (vertical) Altitude or Elevation type coordinates with the following values:

Style - Option to including a unit suffix.
Decimal Places - The number of decimal places displayed.
Show Datum Suffix – Tick to add a datum abbreviation suffix in parenthesis.

Irish Border Vertical Datum Options

For the areas which are close to the border between Northern Ireland and the Irish Republic, it is possible to select the preferred Vertical Datum to be used to express height values. This can be selected independently for both the Irish Transverse Mercator (ITM) and the Irish Grid (IG) coordinate systems.

Transforming Text File Coordinates

In addition to the program's interactive mode, Grid InQuests II's is capable of performing bulk transformations on data points stored in standard text files. This is the applications file mode. This mode is engaged by opening a data file with the 'Load Data Points' command found on the File menu. Once a file is open the interactive controls on the left side of the main window are replaced with a display grid containing the data from the loaded file. Also additional menu items on the File Menu are enabled to permit setting up the parameters required to perform a bulk translation and the command to perform the translation itself. Closing a data file will return the system to interactive mode.

Loading Data Files

Text file formats, using file open dialogs

settings

menu options

transform column names.

Data Settings

In Grid InQuest II you also have the option to Load several data points into the program by going in the File menu and selecting “Load Data Points”. This will allow you to navigate to your chosen set of data. Grid InQuest II accepts the data files only in text file format e.g. Comma Separated Values (.csv), Delimited Text (.txt) and Fixed Width (.txt). Once you have selected the data you want to load, a Data Settings window will then appear. This is where you can select all of the parameters you want for this set of data.

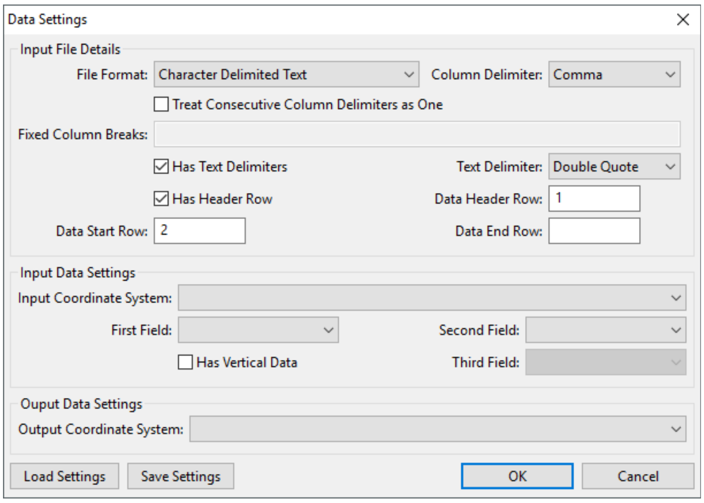


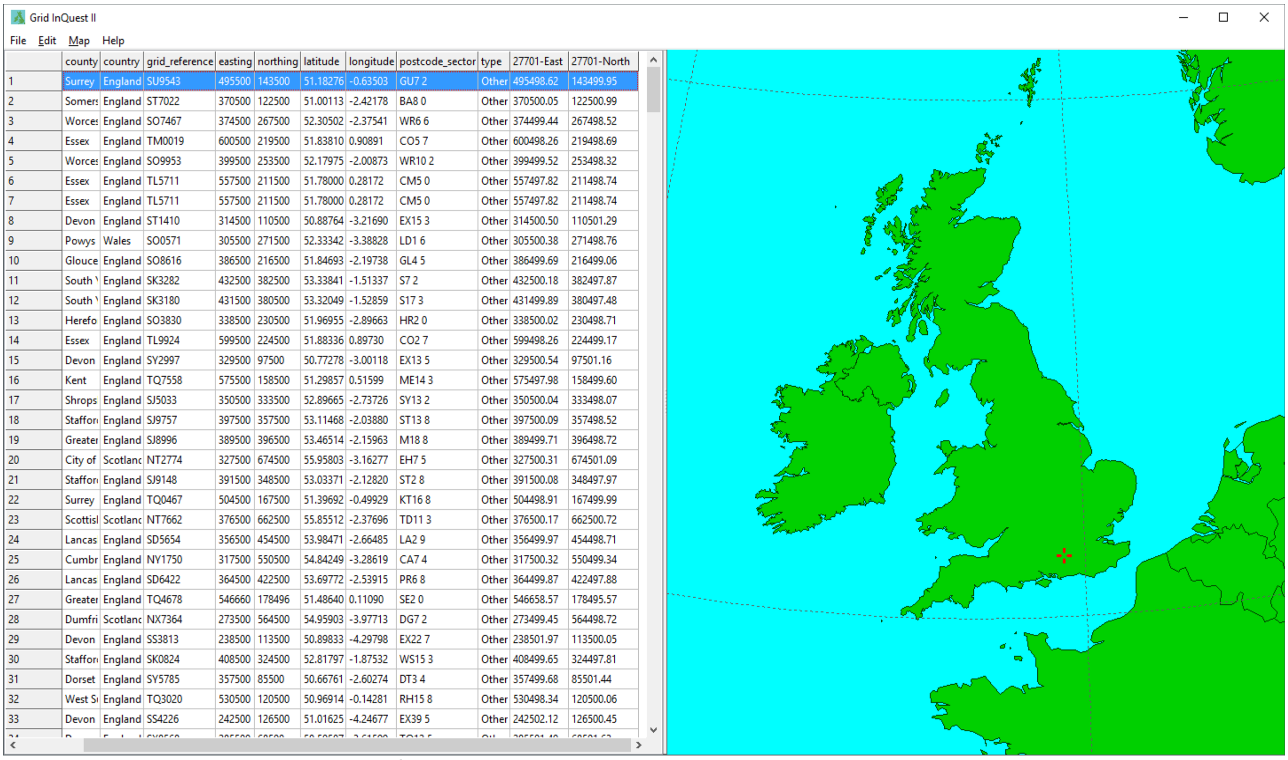
Image 5: The File Data Settings Form

If you want to keep a certain set of parameters for future use, you have the option to save them as a .set file. Which you can then load into Grid InQuest II to quickly convert the group of data (useful if the same type of data file is being used to load the data points. You do have the option to save more than one set of settings if need be.

If you wish to remove the current set of data you can go to the file menu and Unload Data Points from the table, clearing it for reuse.

To transform the data, you need to fill in the input and output settings in the Data Settings window (File menu; Data Settings). Once you have chosen the appropriate input coordinate system you then need to tell the program which fields to use as its latitude, longitude, XY, etc... If the data has Vertical data in it you can tick the box required and select what the altitude, elevation or Z is. When you click on OK to continue, you are now ready to transform the data. To transform it, go to the File menu and click on Transform Data.

Additional Columns will appear at the end of the table showing you the converted coordinates for each data entry there is. If you click on any of these points, it will pinpoint the location on the interactive map confirming that the transformation has worked.



	county	country	grid_reference	easting	northing	latitude	longitude	postcode_sector	type	27701-East	27701-North
1	Surrey	England	SU9543	495500	143500	51.18276	-0.63503	GU7 2	Other	495498.62	143499.95
2	Somers	England	ST7022	370500	122500	51.00113	-2.42178	BA8 0	Other	370500.05	122500.99
3	Worces	England	SO7467	374500	267500	52.30502	-2.37541	WR6 6	Other	374499.44	267498.52
4	Essex	England	TM0019	600500	219500	51.83810	0.90891	CO5 7	Other	600498.26	219498.69
5	Worces	England	SO9953	399500	253500	52.17975	-2.00873	WR10 2	Other	399499.52	253498.32
6	Essex	England	TL5711	557500	211500	51.78000	0.28172	CM5 0	Other	557497.82	211498.74
7	Essex	England	TL5711	557500	211500	51.78000	0.28172	CM5 0	Other	557497.82	211498.74
8	Devon	England	ST1410	314500	110500	50.88764	-3.21690	EX15 3	Other	314500.50	110501.29
9	Powys	Wales	SO0571	305500	271500	52.33342	-3.38828	LD1 6	Other	305500.38	271498.76
10	Glouce	England	SO8616	386500	216500	51.84693	-2.19738	GL4 5	Other	386499.69	216499.06
11	South \	England	SK3282	432500	382500	53.33841	-1.51337	S7 2	Other	432500.18	382497.87
12	South \	England	SK3180	431500	380500	53.32049	-1.52859	S17 3	Other	431499.89	380497.48
13	Herefo	England	SO3830	338500	230500	51.96955	-2.89663	HR2 0	Other	338500.02	230498.71
14	Essex	England	TL9924	599500	224500	51.88336	0.89730	CO2 7	Other	599498.26	224499.17
15	Devon	England	SY2997	329500	97500	50.77278	-3.00118	EX13 5	Other	329500.54	97501.16
16	Kent	England	TQ7558	575500	158500	51.29857	0.51599	ME14 3	Other	575497.98	158499.60
17	Shrops	England	SJ5033	350500	333500	52.89665	-2.73726	SY13 2	Other	350500.04	333498.07
18	Staffor	England	SJ9757	397500	357500	53.11468	-2.03880	ST13 8	Other	397500.09	357498.52
19	Greater	England	SJ8996	389500	396500	53.46514	-2.15963	M18 8	Other	389499.71	396498.72
20	City of	Scotland	NT2774	327500	674500	55.95803	-3.16277	EH7 5	Other	327500.31	674501.09
21	Staffor	England	SJ9148	391500	348500	53.03371	-2.12820	ST2 8	Other	391500.08	348497.97
22	Surrey	England	TQ0467	504500	167500	51.39692	-0.49929	KT16 8	Other	504498.91	167499.99
23	Scottisl	Scotland	NT7662	376500	662500	55.85512	-2.37696	TD11 3	Other	376500.17	662500.72
24	Lancas	England	SD5654	356500	454500	53.98471	-2.66485	LA2 9	Other	356499.97	454498.71
25	Cumbr	England	NY1750	317500	550500	54.84249	-3.28619	CA7 4	Other	317500.32	550499.34
26	Lancas	England	SD6422	364500	422500	53.69772	-2.53915	PR6 8	Other	364499.87	422497.88
27	Greater	England	TQ4678	546660	178496	51.48640	0.11090	SE2 0	Other	546658.57	178495.57
28	Dumfri	Scotland	NX7364	273500	564500	54.95903	-3.97713	DG7 2	Other	273499.45	564498.72
29	Devon	England	SS3813	238500	113500	50.89833	-4.29798	EX22 7	Other	238501.97	113500.05
30	Staffor	England	SK0824	408500	324500	52.81797	-1.87532	WS15 3	Other	408499.65	324497.81
31	Dorset	England	SY5785	357500	85500	50.66761	-2.60274	DT3 4	Other	357499.68	85501.44
32	West S	England	TQ3020	530500	120500	50.96914	-0.14281	RH15 8	Other	530498.34	120500.06
33	Devon	England	SS4226	242500	126500	51.01625	-4.24677	EX39 5	Other	242502.12	126500.45

Image 6: A Completed File Transformation

Saving Data Files

Save as csv.
Import into spreadsheets.
Conversion to other gis formats QGIS. Gdal.

Command Line Programs

Overview

GIQTrans File I/O Mode Operation

GIQTrans CGI Mode Operation

OSGMUpdate Operation

Settings File Format

FME Point Transformer

Installation

Programming with Grid InQuest II

Introduction

The Grid InQuest II dll and DAT files
can be used with any programming language.

OS Script

CGI Programming

Dynamic Link Library Interface

Python

Visual Basic Example

Can also be used from C/C++ or any other language that can interface with DLLs.

Library Source Code Reuse

Lib can be built for other platforms, but not officially supported.

Units can be compiled to GCC compatible objects for static linking.

The Free Pascal units can be directly incorporated into programs written in Free Pascal.

Technical Information

Overview

Grid InQuest II implements the most commonly used coordinate systems for representing location within Great Britain and Ireland. This section will describe these coordinate systems and the transformation methods used to convert to and from the national projection systems.

Grid InQuest II's Supported Coordinate Systems

This software is capable of bi-directional conversion between the following coordinate systems:

ETRS89 / UMT Zone 29N

ETRS89 / UMT Zone 30N

ETRS89 / UMT Zone 31N

ETRS89 Cartesian

ETRS89 Geodetic

Irish Grid (IG/GM02)

Irish Grid (IG/GM15)

Irish Transverse Mercator (ITM/GM02)

Irish Transverse Mercator (ITM/GM15)

OSGB36 / British National Grid (TN02/GM02)

OSGB36 / British National Grid (TN15/GM15)

In addition, depending on where the coordinates are located, it will convert between ETRS89 ellipsoidal heights and the following orthometric height datums when the conversion involves one of the national projected coordinate systems:

Ordnance Datum Newlyn [ODN]
St Mary's [MAR]
Douglas02 [DOU]
Stornoway [STO]
St Kilda [KIL]
Lerwick [LER]
Newlyn [NEW]
FairIsle [FAI]
Flannan Isles [FLA]
North Rona [NRO]
Sule Skerry [SSK]
Foula [FOU]
Malin Head [MAL]
Belfast [BEL]
Offshore [OFF]

NB: The conversions to Ordnance Survey local vertical datums are only valid for mainland Great Britain, Northern Ireland and the Republic of Ireland. However, for convenience, OSGM15 now incorporates an additional code, not available in OSGM02, to support approximate height values for locations offshore in British coastal waters. This is the purpose of the Offshore [OFF] datum code.

ETRS89 UTM Coordinates

The European Terrestrial Reference System 1989 can be projected using the Universal Transverse Mercator system into various zones of longitude. Three of which cover the British Isles and Ireland, Zones 29N, 30N and 31N. When working in Northern Ireland and the Republic of Ireland the only available zone will be 29N. Heights are ellipsoidal and refer to height above the GRS1980 ellipsoid.

ETRS89 Cartesian Coordinates

The European Terrestrial Reference System 1989 locations can be expressed as 3D Cartesian coordinates, where the individual axis values are expressed in metres from the origin which is located at the Earth's centre of gravity. The Z axis is defined as passing through the Earth's rotational North pole. The X axis passes through the equator on the Greenwich Meridian and the Y axis is orthogonal to these.

ETRS89 Geodetic Coordinates

The European Terrestrial Reference System 1989 locations can be expressed in geodetic coordinates, where the latitude and longitude are given in degrees and the altitude as the height above the GRS1980 ellipsoid in metres.

Irish Grid Coordinates

This system is also a Transverse Mercator projection, but one using the Airy Modified ellipsoid which gives a closer fit to the actual figure of Earth for Ireland than that used for the ETRS89 UTM systems. It also has a central meridian positioned along the middle of the Irish landmass to minimize distortion. Vertical elevations are expressed with respect to the Malin Head datum for the Republic of Ireland and Belfast Lough for use within Northern Ireland. These elevations are now determined by an extension of the OSGM15 geoid model to cover the island of Ireland.

Irish Transverse Mercator Coordinates

The Irish Transverse Mercator projection is a new system, intended to supersede the Irish Grid as it's definition was directly based upon GPS compatibility. This makes it simpler to integrate with modern systems, whilst at the same time preserve many of the characteristics of Irish Grid that make it ideally suited for use within the island of Ireland. To avoid confusion with the older system though, the false origin has been moved further into the Atlantic so as to create substantially different co-ordinates for any given location. As with Irish Grid, the vertical datum in Northern Ireland is fixed to Belfast Lough and to Malin Head within the Republic and it also employs the OSGM15 geoid model to determine elevation values.

OSGB36 / British National Grid Coordinates

The British National Grid was originally defined through classical survey techniques but in 2002 a new definition was introduced that employed direct conversion from ETRS89 to OSGB36 coordinates called the National Transformation OSTN02. In 2015 this method was updated to improve the accuracy and the newer version OSTN15 now replaces OSTN02 as the definitive horizontal transformation for British National Grid. A similar method for determining height values relative to local sea level was also developed. This was known as the National Geoid Model OSGM02. This has similarly been replaced by a newer version in 2015 and this is known as the OSGM15.

British and Irish Transformation Systems

National transformations For Great Britain and Northern Ireland and the Republic of Ireland have been developed to facilitate accurate large scale mapping for each area. Within Great Britain, the National Transformation OSGM15 is used for horizontal positioning. For Northern Ireland and the Republic of Ireland, the OSi/OSNI polynomial transformation is required for horizontal positioning. For both areas the Geoid Model OSGM15 is used for vertical positioning. It should be noted that these transformations are not valid in the Channel Islands as they lie outside the extents of both the British National Grid and the National Geoid Model.

National Transformation Models: OSTN02 and OSTN15

The Ordnance Survey of Great Britain developed a horizontal transformation method in 2002 known as OSTN02. This transformation consists of a 1,250km by 700km grid of translation vectors at 1km resolution. These translations are applied directly to the ETRS89 projected coordinates. To achieve precise values for any location, the corner values for the 1Km grid square containing the position are interpolated. This provides a direct translation between the GPS coordinate system ETRS89 and the OSGB36 National Grid. In 2015 this system was updated to improve the current accuracy and the newer version OSTN15 now replaces OSTN02 as the definitive horizontal transformation for British National Grid.

OSi/OSNI Polynomial Transformation

Ordnance Survey Ireland and Ordnance Survey of Northern Ireland recommend the OSi/OSNI polynomial transformation for all horizontal transformations in the Republic of Ireland and Northern Ireland. This transformation has been developed in association with the Institute of Engineering Surveying and Space Geodesy, University of Nottingham. The transformation is based on 183 points evenly distributed throughout Ireland and Northern Ireland. The precise ETRS89 and Irish Grid coordinates of these points ere determined by GPS and terrestrial survey methods, and a one-dimensional 3rd order polynomial individually fitted to the latitude and the longitude. The resulting polynomial allows calculation of the coordinate differences at additional points. The polynomial transformation has an accuracy of 0.4m (95% data).

Ordnance Survey Geoid Models: OSGM02 and OSGM15

To provide the third dimension for the two previous transformations, the Ordnance Surveys have, with others, developed the Geoid models OSGM02 and OSGM15. These models are derived from precise gravity surveys across UK, Ireland, and surrounding waters. Alignment to each regional vertical datum is based on precise GPS observations at Ordnance Survey levelling marks. Within Great Britain these include the Ordnance Survey fundamental benchmark network. The Geoid model consists of a 1km grid with geoid-ellipsoid separation values covering all of Great Britain, Ireland and Northern Ireland. This model can be used with GPS determined positions to establish height above mean sea level, as defined by the respective vertical datums. The Ordnance Surveys now recommend the use of the Geoid Model OSGM15 and the active GPS network to produce orthometric height compatible with national mapping systems. Within the Republic of Ireland and Northern Ireland, OSGM15 returns orthometric heights relative to the Malin Head and Belfast Lough datums respectively.

Transformation Accuracy

Within Great Britain, OSTN15 is the definitive OSGB36/ETRS89 transformation. OSTN15 in combination with the ETRS89 coordinates of the active GPS Network stations, rather than the fixed triangulation network, now define the National Grid. This means that, for example, the National Grid coordinates of an existing OSGB36 point, refixed using GPS from the National GPS Network and OSTN15, will be the correct ones. The original archived OSGB36 National Grid coordinates of the point (if different) will be wrong, by definition, but the two coordinates (new and archived) will agree on average to better than 0.1m standard error.

Within the Republic of Ireland and Northern Ireland, the OSi/OSNI polynomial transformation is recommended for coordinate transformations between ETRS89 and the Irish Grid. Transformed ETRS89 coordinates will agree with Irish Grid coordinates derived from traditional survey control to within 0.4m (95% data).

The heights output by precise GPS positioning in the ETRS89 coordinate system are geometric distance above the WGS84 (GRS80) reference ellipsoid. Note that GPS heights are typically two to three times less precise than horizontal positions. OSGM15 converts ETRS89 ellipsoidal heights to orthometric heights above mean sea level.

In mainland Great Britain, the datum (origin Point) representing mean sea level is Ordnance Datum Newlyn, defined at Newlyn Harbour in Cornwall. In the Republic of Ireland, Northern Ireland and the islands surrounding the British mainland, mean sea level is defined by specific independent vertical datums which are all incorporated into OSGM15 and hence OSGM15 is compatible with the products from each of the Ordnance Surveys. Other Geoid models may give mean sea level heights that are incompatible with the Ordnance Surveys products.

The estimated accuracies of OSGM15 for each regional vertical datum varies by region but are all less than 0.1m standard error and in the case of the British mainland 0.02m. Any discrepancy found between an Ordnance Survey levelled bench mark (OSBM) and a OSGM15 computed orthometric height is likely to be due to bench mark subsidence or uplift and, assuming precise GPS survey has been carefully carried out, the orthometric height given by OSGM15 should be considered correct in preference to archive bench mark heights.

Glossary

A

Accuracy:
The degree of closeness or conformity of an observation to its true value.

D

Datum:
The survey reference system used in a specific country or region. All geographical coordinates will be referenced to a chosen datum. Two principle datum types exist, namely global datums and astrogeodetic datums. A datum is created when a reference spheroid is tied to the earth at a particular point and coordinates are defined for that point. See spheroid, WGS84

E

Ellipsoid:
A closed quadric surface that is a three-dimensional analogue of an ellipse. The standard equation of an ellipsoid centred at the origin of a Cartesian coordinate system and aligned with the axes is.
(See Spheroid)

ETRS89:
The European Terrestrial Reference System 1989, used as the standard precise GPS coordinate system throughout Europe. In 2000, the difference between the WGS84 and ETRS89 coordinates was about 25 cm, and increasing by about 2.5 cm per year. ETRS89 has been officially adopted as a standard coordinate system for precise GPS surveying by most national mapping agencies in Europe.

G

Geoid:
A model of the level surface which is closest to MSL over the oceans. This surface is continued under the land and acts as the fundamental reference surface for height measurement, as an approximation of MSL on land.

GPS:
Global Positioning System. A satellite based navigation system which in the last five years has become the industry standard survey tool for positioning and navigation.

I

IG:
Irish Grid - The standard two-dimesional grid reference for Irish coordinates. Divided into 25 squares (each measuring 100 square kilometres) they are all represented by letters in

alphabetical order excluding 'I'. The letters A, E, P, K, U, Y and Z do not cover any landmass in Ireland.

ITM:
Irish Transverse Mercator - The geographic coordinate system for Ireland. It was implemented jointly by the Ordnance Survey Ireland (OSI) and the Ordnance Survey of Northern Ireland (OSNI) in 2001. The name is derived from the Transverse Mercator projection it uses and the fact that it is optimised for the island of Ireland.

N

National Grid:
The primary coordinate system used in Great Britain.
(See OSGB36)

O

ODN:
Ordnance Datum Newlyn is the national standard vertical reference system for measuring height above MSL in GB. ODN is measured relative to a value taken at Newlyn, Cornwall.

Orthometric height:
Height above mean sea level

OSGB36:
The national standard coordinate system for topographic mapping, including all Ordnance Survey mapping, and for geographically referencing many kinds of information in relation to Ordnance Survey mapping.

OSGM02:
Ordnance Survey National Geoid Model 2002. A gravimetric model used to convert from ETRS89 to ODN heights.

OSGM15:
Ordnance Survey National Geoid Model 2015. A gravimetric model used to convert from ETRS89 to ODN heights.

OSTN02:
Ordnance Survey National Grid Transformation 2002. A horizontal transformation converting from ETRS89 to OSGB36 coordinates and vice versa.

OSTN15:
Ordnance Survey National Grid Transformation 2015. A horizontal transformation converting from ETRS89 to OSGB36 coordinates and vice versa.

P

Precision:
The degree of repeatability or closeness that repeated measurements of the same

quantity display. Precision is used to describe the quality of data with respect to random errors. Measurements that are closely grouped are said to have a high precision because their random errors are small.

<u>S</u>

Spheroid:
A mathematical figure used to closely model the geoidal surface of the earth. The figure is described by the semi-major axis (a), semi-minor axis (b) and inverse flattening. Many spheroids are used to describe the figure of the geoid on different parts of the earth. The spheroid will be intrinsically tied to the geodetic datum and once a datum is used in a particular country or region it is unlikely to be changed.

<u>T</u>

Transformation:
A procedure to change from one coordinate system to another. GridInquest II's primary function.

<u>U</u>

UTM:
Universal Transverse Mercator. Special case of the Transverse Mercator projection where by the earth is divided into 60, 6 degree zones. All the zones have identical characteristics with the exception of their central meridians which increase by a factor of 6 degrees between adjacent zones. UTM projections are used extensively in oil exploration and particularly favoured for their easy of use. One down side is that they are not preferable when mapping large extents in an east-west direction.

<u>W</u>

WGS84:
The spheroid and datum used to model the geoidal surface for the entire globe. It is the principle datum for GPS since January 1987.