

EIVA GEOCALC

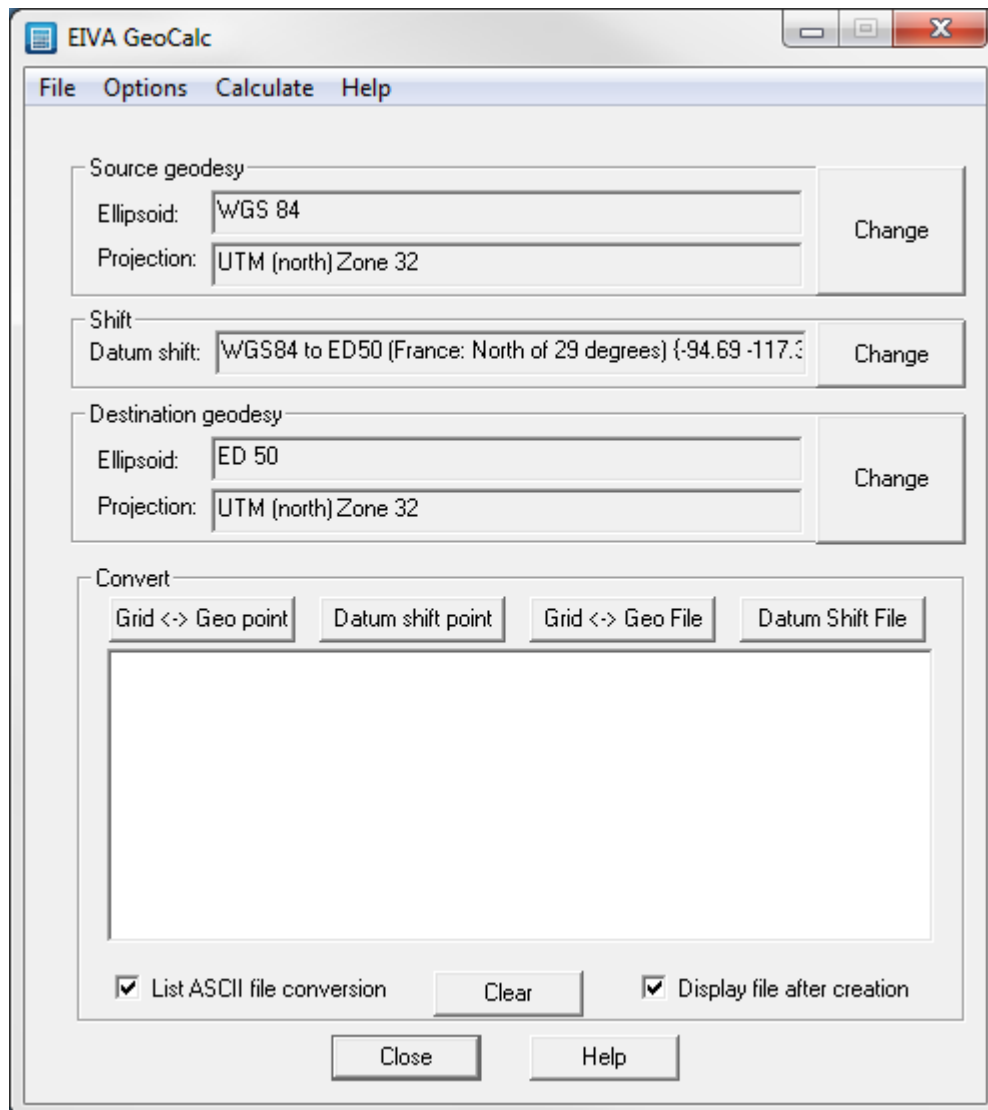
A GEODETIC TOOLBOX

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1 Introduction



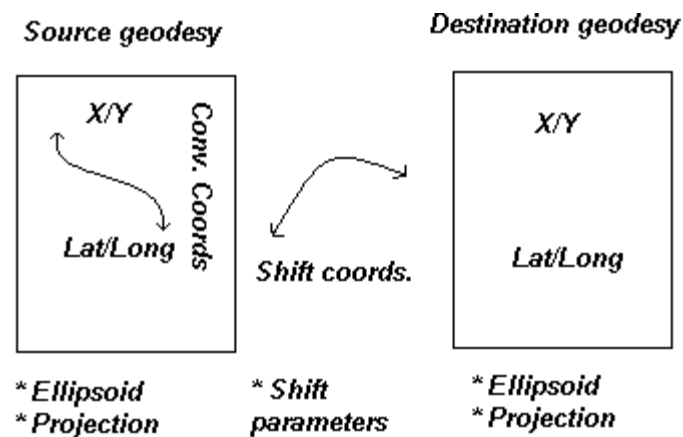
GeoCalc is a toolbox with utilities to convert between geographical and external coordinates, to perform datum shifts, etc.

The main window lists the actual setting (source geodesy, datum shift and destination geodesy), includes buttons and menu entries to change geodesy and buttons and menus to perform various calculations.

The lower part of the window is a result list box containing a listing of all calculations. Pressing the Clear button can empty this list. If having the system display file based calculations is undesirable, then deselect the List ASCII file conversion tick box.

2 Geodesy

The calculator is based on a rather advanced geodesy setting (as known in a.o. NaviEdit).

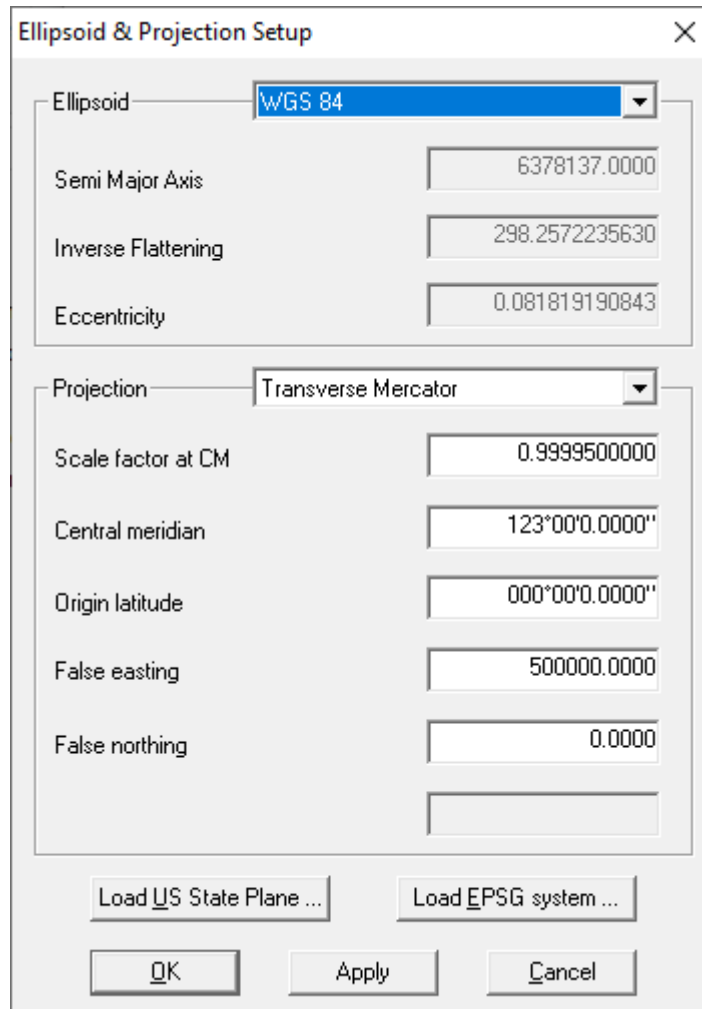


The operator must define a source geodesy (ellipsoid and projection), a set of datum shift parameters (method and 7 parameters) and a destination geodesy (ellipsoid and projection) as illustrated above.

The data conversions (single point, ASCII file or XTF file) are all performed in the source geodesy as it is simple a conversion between X/Y and Lat/Long.

The data shift routines (single point or ASCII file) operate between source and destination and it utilizes the defined datum shift parameters.

2.1 Defining Geodesy



The dialog box titled "Ellipsoid & Projection Setup" contains the following fields and buttons:

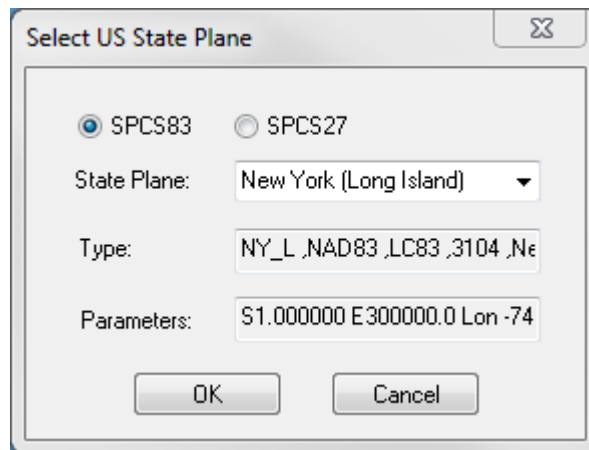
Field	Value
Ellipsoid	WGS 84
Semi Major Axis	6378137.0000
Inverse Flattening	298.2572235630
Eccentricity	0.081819190843
Projection	Transverse Mercator
Scale factor at CM	0.9999500000
Central meridian	123°00'0.0000"
Origin latitude	000°00'0.0000"
False easting	500000.0000
False northing	0.0000

Buttons at the bottom: Load US State Plane ..., Load EPSG system ..., OK, Apply, Cancel.

Press the Change button and the above pop-up dialogue opens. The system uses a DLL that is shared across various EIVA products for this functionality.

It is possible to select between a series of available ellipsoids and projections. Depending on the type, it is possible to enter various parameters (e.g. UTM zone in the above sample).

When operating in the US; it is possible to use a set of pre-defined zones via the Load US State Plane button:



Select US State Plane

☒ SPCS83 ☐ SPCS27

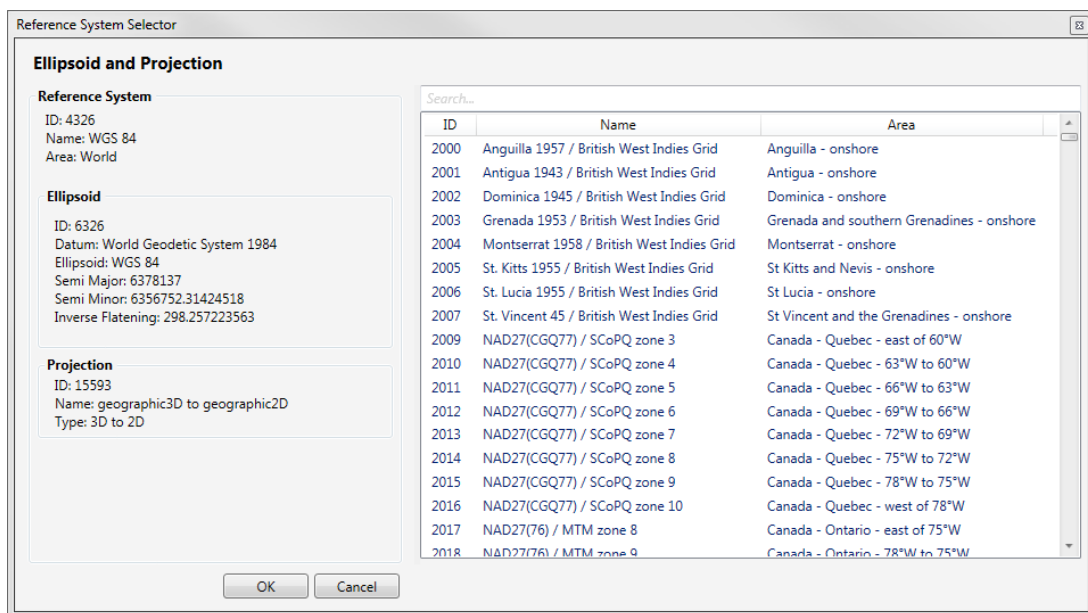
State Plane: New York (Long Island) ▼

Type: NY_L_NAD83_LC83_3104_Ne

Parameters: S1.000000 E300000.0 Lon -74

OK Cancel

Alternatively, the Load EPSG System button allows access to the European Petroleum Survey Group's (EPSG) defined set of coordinate reference systems:



Reference System Selector

Ellipsoid and Projection

Reference System

ID: 4326
Name: WGS 84
Area: World

Ellipsoid

ID: 6326
Datum: World Geodetic System 1984
Ellipsoid: WGS 84
Semi Major: 6378137
Semi Minor: 6356752.31424518
Inverse Flatenig: 298.257223563

Projection

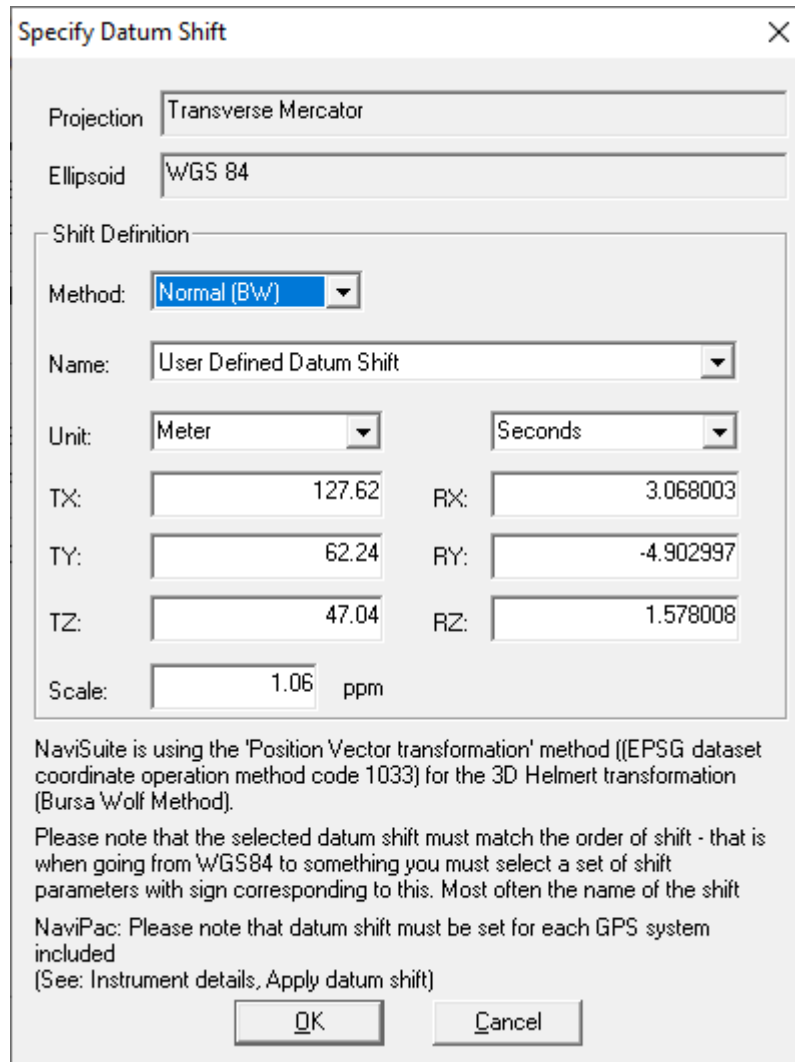
ID: 15593
Name: geographic3D to geographic2D
Type: 3D to 2D

Search...

ID	Name	Area
2000	Anguilla 1957 / British West Indies Grid	Anguilla - onshore
2001	Antigua 1943 / British West Indies Grid	Antigua - onshore
2002	Dominica 1945 / British West Indies Grid	Dominica - onshore
2003	Grenada 1953 / British West Indies Grid	Grenada and southern Grenadines - onshore
2004	Montserrat 1958 / British West Indies Grid	Montserrat - onshore
2005	St. Kitts 1955 / British West Indies Grid	St Kitts and Nevis - onshore
2006	St. Lucia 1955 / British West Indies Grid	St Lucia - onshore
2007	St. Vincent 45 / British West Indies Grid	St Vincent and the Grenadines - onshore
2009	NAD27(CGQ77) / SCoPQ zone 3	Canada - Quebec - east of 60°W
2010	NAD27(CGQ77) / SCoPQ zone 4	Canada - Quebec - 63°W to 60°W
2011	NAD27(CGQ77) / SCoPQ zone 5	Canada - Quebec - 66°W to 63°W
2012	NAD27(CGQ77) / SCoPQ zone 6	Canada - Quebec - 69°W to 66°W
2013	NAD27(CGQ77) / SCoPQ zone 7	Canada - Quebec - 72°W to 69°W
2014	NAD27(CGQ77) / SCoPQ zone 8	Canada - Quebec - 75°W to 72°W
2015	NAD27(CGQ77) / SCoPQ zone 9	Canada - Quebec - 78°W to 75°W
2016	NAD27(CGQ77) / SCoPQ zone 10	Canada - Quebec - west of 78°W
2017	NAD27(76) / MTM zone 8	Canada - Ontario - east of 75°W
2018	NAD27(76) / MTM zone 9	Canada - Ontario - 78°W to 75°W

OK Cancel

2.2 Defining datum shift



Specify Datum Shift [X]

Projection: Transverse Mercator

Ellipsoid: WGS 84

Shift Definition

Method: Normal (B'w)

Name: User Defined Datum Shift

Unit: Meter Seconds

TX: 127.62 RX: 3.068003

TY: 62.24 RY: -4.902997

TZ: 47.04 RZ: 1.578008

Scale: 1.06 ppm

NaviSuite is using the 'Position Vector transformation' method ([EPSG dataset coordinate operation method code 1033] for the 3D Helmert transformation (Bursa Wolf Method).

Please note that the selected datum shift must match the order of shift - that is when going from WGS84 to something you must select a set of shift parameters with sign corresponding to this. Most often the name of the shift

NaviPac: Please note that datum shift must be set for each GPS system included
(See: Instrument details, Apply datum shift)

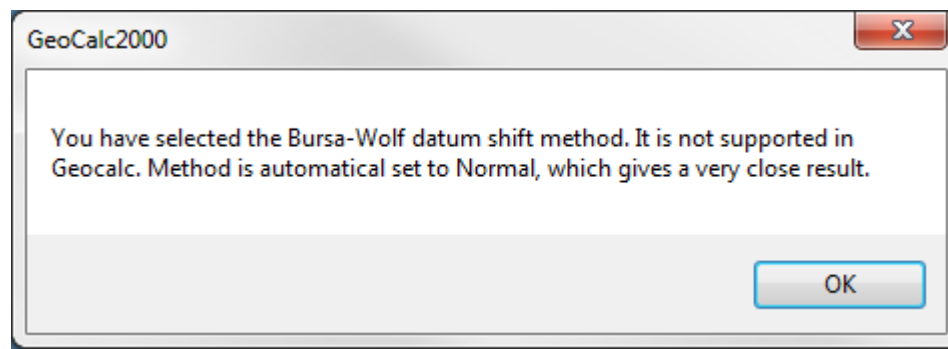
OK Cancel

Press the Change button and the above pop-up dialogue opens. The system uses a DLL that is shared across various EIVA products for this functionality.

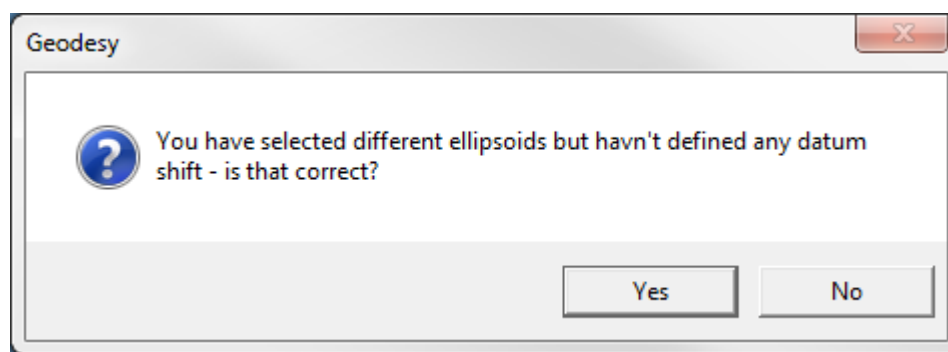
It is possible to select between a series of predefined shifts or to select a user defined shift whereby a 7 parameter custom shift can be entered.

Only the Normal method or the North Sea method should be selected – the other two are not supported in this utility module. Selecting the unsupported methods results

in the following error message:

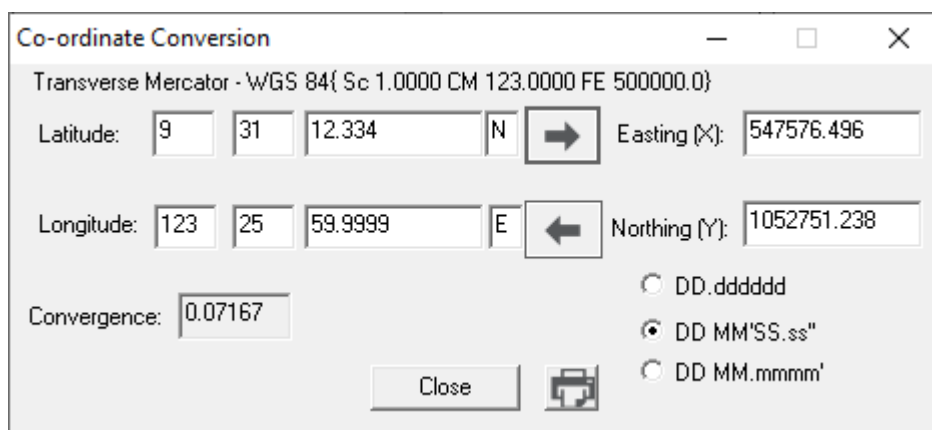


GeoCalc supports most combinations of shifts between settings. Some requested shift combinations are illogical. Some illegal combinations are caught by the module and will yield a warning similar to the following:



3 Convert a point

Press the convert point button or activate the menu Calculate -> Convert point menu entry and the following pop-up dialogue opens:



The dialog box titled "Co-ordinate Conversion" contains the following fields and controls:

- Source Geodesy: Transverse Mercator - WGS 84 (Scale: 1.0000 CM 123.0000 FE 500000.0)
- Latitude: 9 31 12.334 N → Easting (X): 547576.496
- Longitude: 123 25 59.9999 E ← Northing (Y): 1052751.238
- Convergence: 0.07167
- Output Format:
 - ☐ DD.ddddddd
 - ☒ DD MM'SS.ss"
 - ☐ DD MM.mmmmm'
- Buttons: Close, Print

It is now possible to convert between X/Y and Lat/Long in the selected source geodesy (see the top line). Entering the coordinates and pressing the left/right arrow buttons performs the conversion.

The geographical coordinates may be entered/displayed in three formats:

- DD.ddddddd
Decimal degree with an unbounded number of digits (Eg. 12.345678°)
- DD MM SS.ssss
Degree, minutes and seconds with an unbounded number of digits (Eg. 12°20' 44.4408")
- DD MM.mmmmm'
Degree and minutes with an unbounded number of digits (Eg. 12°20.74068')

The sign (+/-) of the geographical coordinates are defined by E/W or N/S.

It's possible to print (always on default printer) the result by pressing the printer icon. The printing functionality is based on a freeware printer utility, and the result is a bitmap similar to the following:

UTM (north) - WGS 84{ Zone 27}

Latitude:

72

4

N

→

Easting (X):

482843.390

Longitude:

21

29.95338

W

←

Northing (Y):

7996439.749

Convergence:

-0.47497

☐ DD.dddddd
 ☐ DD MM'SS.ss"
 ☒ DD MM.mmmm'

Close

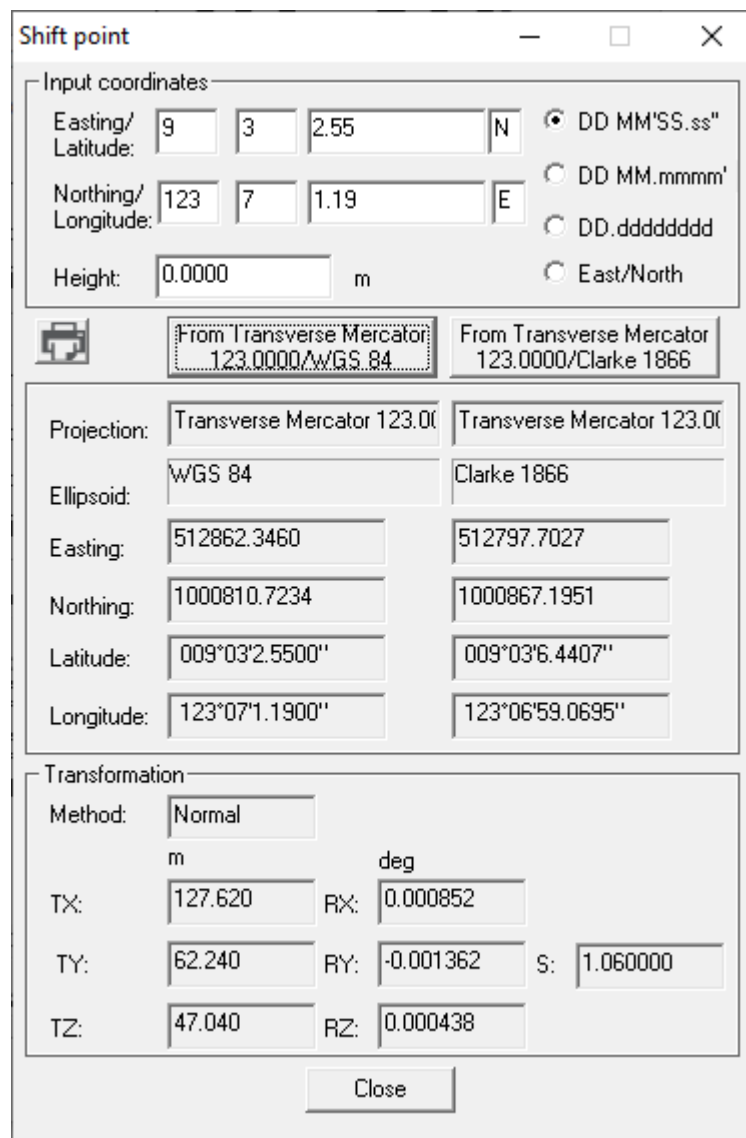


The printer functionality only works if the screen colour resolution is set to either 32 bit true colour or 256 colours.

The result of each conversion will further be displayed in the main window list box.

4 Shift a point

Click the shift point button or activate the menu Calculate -> Shift point menu entry and the following pop-up dialogue opens:



Input coordinates	
Easting/ Latitude:	9 3 2.55 N
Northing/ Longitude:	123 7 1.19 E
Height:	0.0000 m

From Transverse Mercator 123.0000/WGS 84	From Transverse Mercator 123.0000/Clarke 1866
Projection:	Transverse Mercator 123.00
Ellipsoid:	WGS 84
Easting:	512862.3460
Northing:	1000810.7234
Latitude:	009°03'2.5500"
Longitude:	123°07'1.1900"

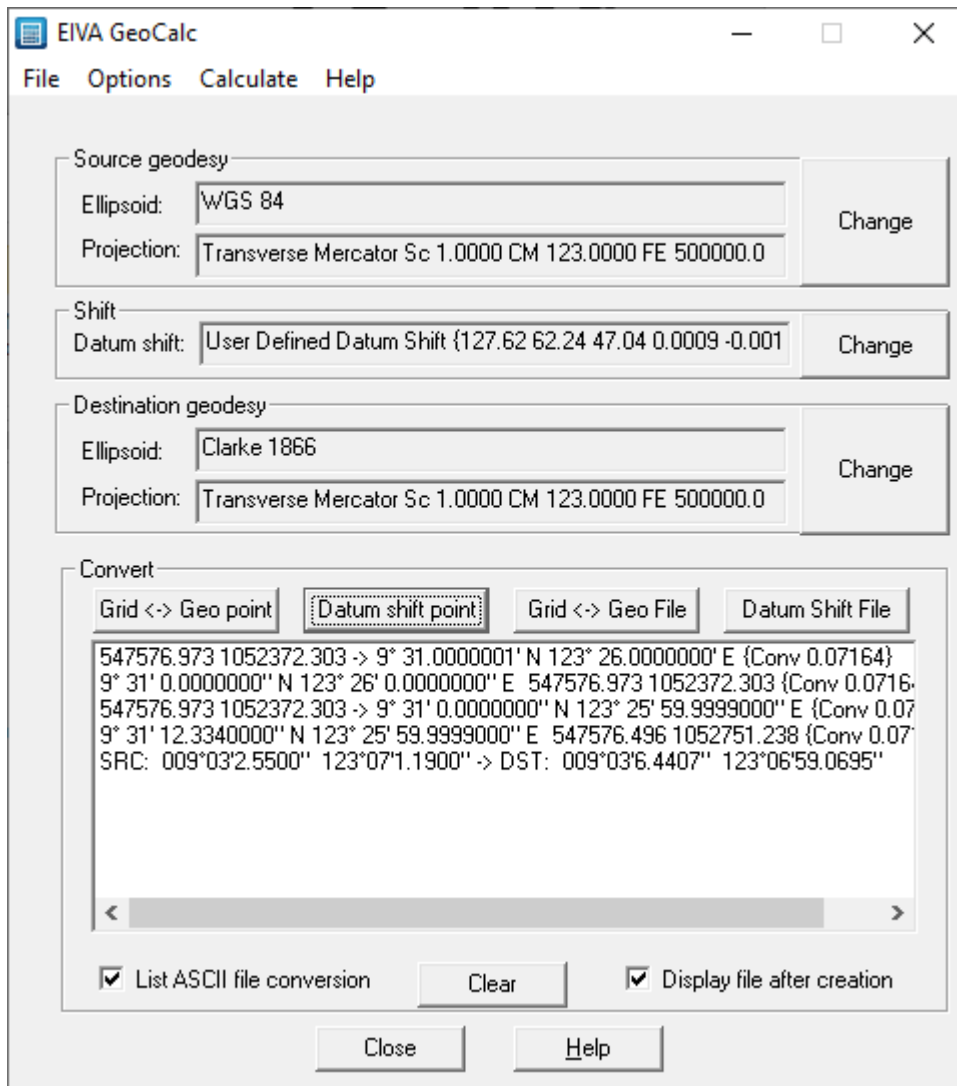
Transformation	
Method:	Normal
TX:	127.620
TY:	62.240
TZ:	47.040
RX:	0.000852
RY:	-0.001362
RZ:	0.000438
S:	1.060000

Close

Here it is possible to shift coordinates between a source and destination geodesy. The upper part of the window allows entry of the coordinates as either X/Y or Lat/Long (DD.ddddd, DD MM.mmmm or DD MM SS.sssss). Having entered the values, they may be shifted by clicking the From <source> or From <destination> buttons. The results will be displayed in the middle portion of the dialogue. The left side gives results in source geodesy and right side in destination geodesy.

The 7 parameters used in the calculated shift are included in the lower part of the dialogue.

The dialogue can be printed using the printer icon and the result are displayed in the main window list box:



EIVA GeoCalc

File Options Calculate Help

Source geodesy

Ellipsoid: WGS 84 Change

Projection: Transverse Mercator Sc 1.0000 CM 123.0000 FE 500000.0

Shift

Datum shift: User Defined Datum Shift {127.62 62.24 47.04 0.0009 -0.001} Change

Destination geodesy

Ellipsoid: Clarke 1866 Change

Projection: Transverse Mercator Sc 1.0000 CM 123.0000 FE 500000.0

Convert

Grid <-> Geo point **Datum shift point** Grid <-> Geo File Datum Shift File

547576.973 1052372.303 -> 9° 31.000000' N 123° 26.000000' E {Conv 0.07164}
 9° 31' 0.000000" N 123° 26' 0.000000" E 547576.973 1052372.303 {Conv 0.0716
 547576.973 1052372.303 -> 9° 31' 0.000000" N 123° 25' 59.999900" E {Conv 0.07
 9° 31' 12.334000" N 123° 25' 59.999900" E 547576.496 1052751.238 {Conv 0.07
 SRC: 009°03'2.5500" 123°07'1.1900" -> DST: 009°03'6.4407" 123°06'59.0695"

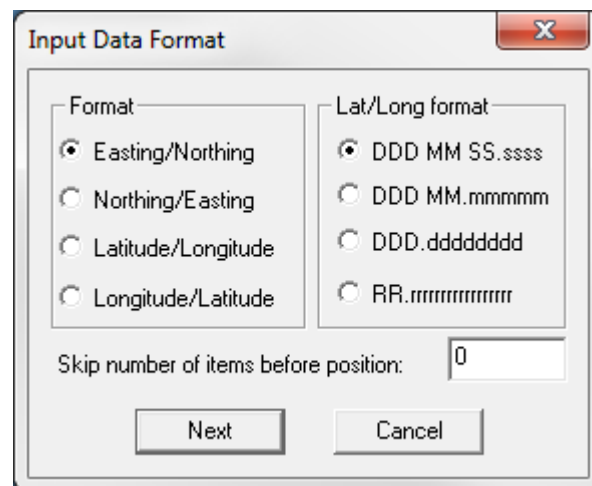
☒ List ASCII file conversion Clear ☒ Display file after creation

Close Help

5 Convert a file

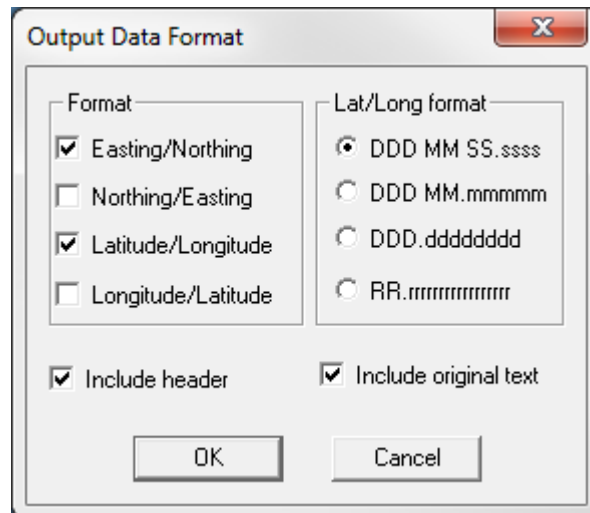
It's possible to convert an entire ASCII file between X/Y and Lat/long.

- 1 If all results of the ASCII file point conversions should be displayed in the main list box, then select the "*List ASCII file conversion*" check box.
- 2 If the post-conversion file should be opened, then select the "*Display file after creation*" check box.
- 3 Click *Convert ASCII File* or select Calculate -> Convert ASCII File in the menu
- 4 Select the file(s) to convert.
- 5 The format of the input file must be specified for each converted file:

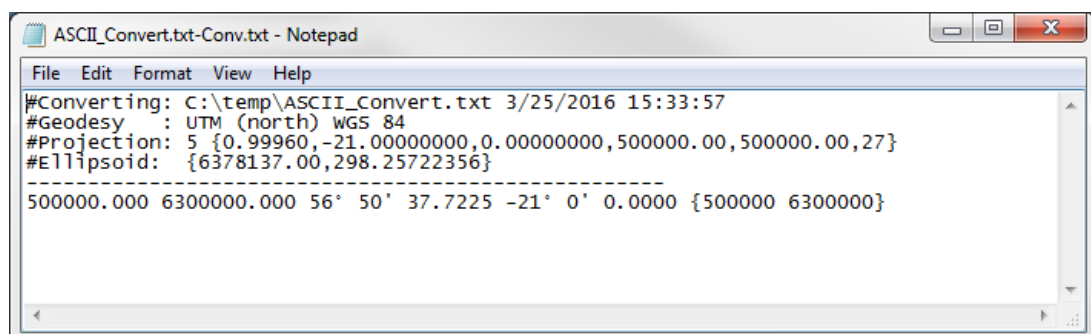


If the file is in Lat/Long, then the format of the fields must be specified. A selection can be made between decimal degrees (DD.dddd, DD MM.mmmm or DD MM SS.ssss) or radians (RR.rrrr). For additional details on these formats, refer to a later section below.

6 Next, specify the output file format:



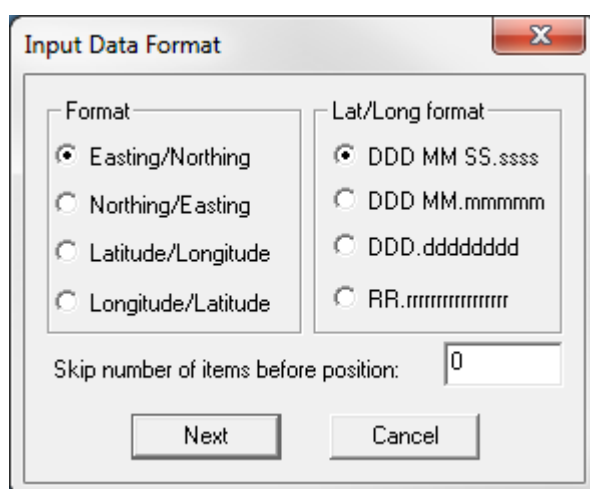
- In the left section, select position format. Multiple formats may be selected.
 - In the right section, specify the format of the Lat/Long output coordinates (required).
 - If a date, time, and exported geodesy header should be included in the output file, then select the Include Header checkbox.
 - If the original data contained in the input file should be included in the output, then select the Include Original Text checkbox.
- 7 The system now creates a new file named as the original but with the added extension “-Conv.txt”:



6 Shift a file

It's possible to convert an entire ASCII file between X/Y and Lat/long.

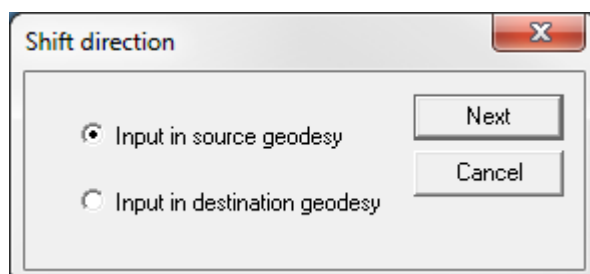
1. If all results of the ASCII file point conversions should be displayed in the main list box, then select the “*List ASCII file conversion*” check box.
2. If the post-conversion file should be opened, then select the “*Display file after creation*” check box.
3. Click the *Shift ASCII File* button or activate *Calculate -> Shift ASCII File* in the menu
4. Select the file(s) to convert
5. For each file the format of the input file must be specified:



The **Input Data Format** dialog box contains two sections: **Format** and **Lat/Long format**. In the **Format** section, the **Easting/Northing** radio button is selected. In the **Lat/Long format** section, the **DDD MM SS.ssss** radio button is selected. Below these sections is a text field labeled "Skip number of items before position:" with the value **0**. At the bottom are **Next** and **Cancel** buttons.

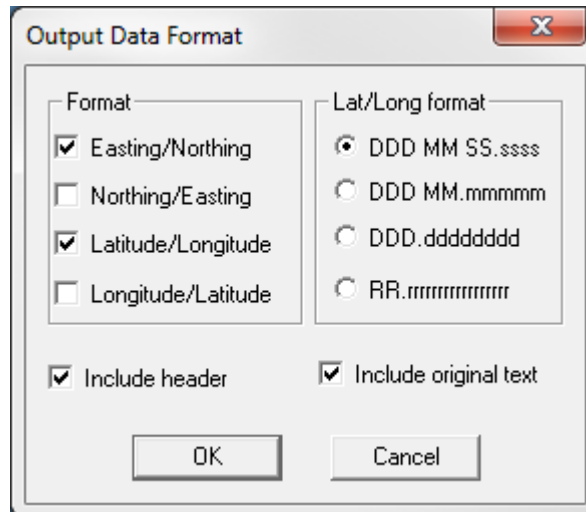
If the file is in Lat/Long, then the format of the fields must be specified. A selection can be made between decimal degrees (DD.dddd, DD MM.mmmm or DD MM SS.ssss) or radians (RR.rrrr). For additional details on these formats, refer to a later section below.

6. Next, specify whether the shift is forward or backward, i.e. from source or from destination:



The **Shift direction** dialog box contains two radio buttons: **Input in source geodesy** (selected) and **Input in destination geodesy**. To the right of the buttons are **Next** and **Cancel** buttons.

7. Next, specify the format of the output file:



The dialog box is titled "Output Data Format". It contains two main sections: "Format" and "Lat/Long format".

Format section:

- ☒ Easting/Northing
- ☐ Northing/Easting
- ☒ Latitude/Longitude
- ☐ Longitude/Latitude

Lat/Long format section:

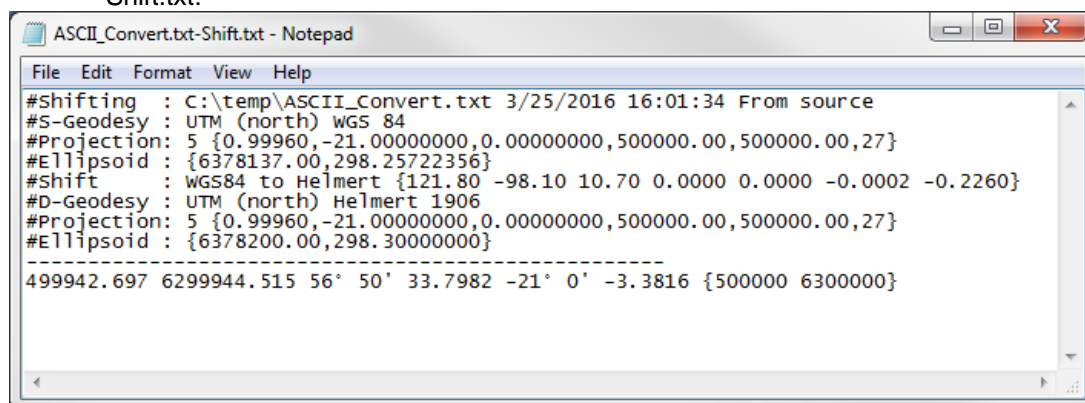
- ☒ DDD MM SS.ssss
- ☐ DDD MM.mmmmm
- ☐ DDD.dddddddd
- ☐ RR.mmmmmmmmmmm

At the bottom, there are two checkboxes:

- ☒ Include header
- ☒ Include original text

Buttons: OK, Cancel

8. In the left section, select the format to display the position (multiple choice).
9. In the right section, specify the format to display lat/long
10. If a date, time, and exported geodesy header should be included in the output file, then select the Include Header checkbox.
11. If the original data contained in the input file should be included in the output, then select the Include Original Text checkbox.
12. The system will create a new file named as the original but with the extension – Shift.txt:

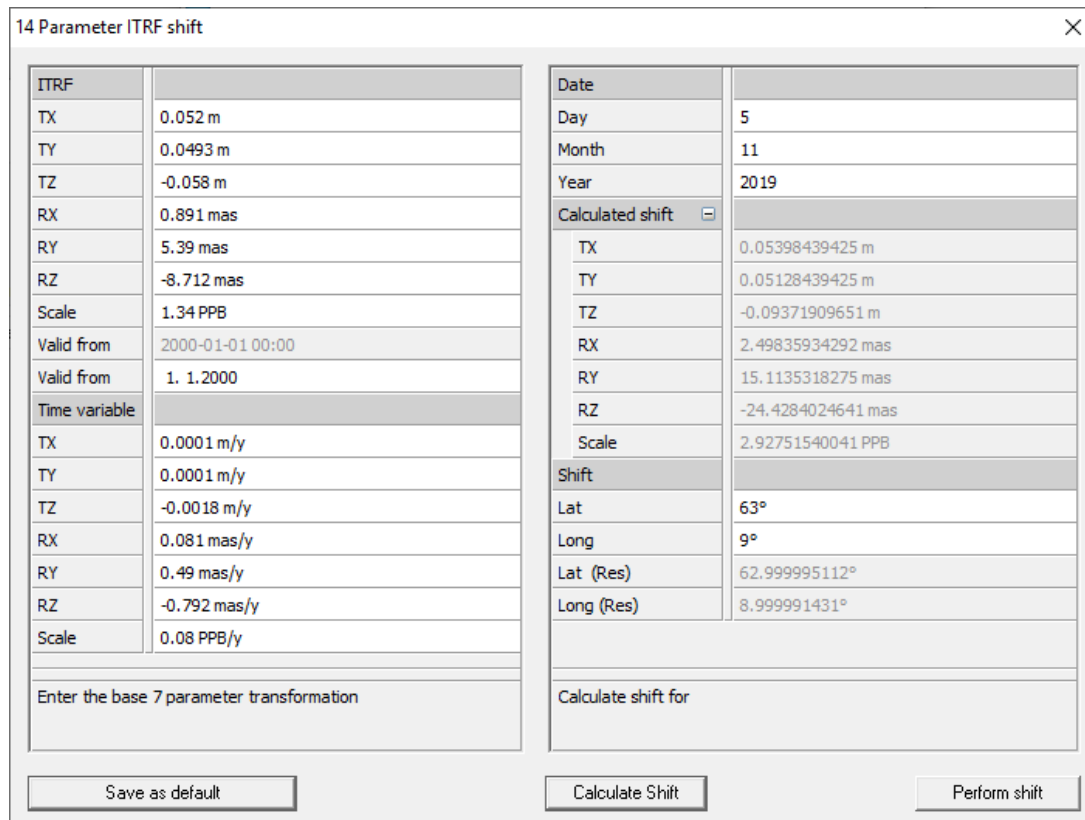


```

ASCII_Convert.txt-Shift.txt - Notepad
File Edit Format View Help
#Shifting : C:\temp\ASCII_Convert.txt 3/25/2016 16:01:34 From source
#S-Geodesy : UTM (north) WGS 84
#Projection: 5 {0.99960,-21.00000000,0.00000000,500000.00,500000.00,27}
#Ellipsoid : {6378137.00,298.25722356}
#Shift : WGS84 to Helmert {121.80 -98.10 10.70 0.0000 0.0000 -0.0002 -0.2260}
#D-Geodesy : UTM (north) Helmert 1906
#Projection: 5 {0.99960,-21.00000000,0.00000000,500000.00,500000.00,27}
#Ellipsoid : {6378200.00,298.30000000}
-----
499942.697 6299944.515 56° 50' 33.7982 -21° 0' -3.3816 {500000 6300000}
  
```


7 14 parameter shift

GeoCalc version 4.3 and onwards supports the time based 14 parameter shift (as seen in a.o. NaviPac and NaviScan). The tool is activated via the Calculate menu;



14 Parameter ITRF shift	
ITRF	
TX	0.052 m
TY	0.0493 m
TZ	-0.058 m
RX	0.891 mas
RY	5.39 mas
RZ	-8.712 mas
Scale	1.34 PPB
Valid from	2000-01-01 00:00
Valid from	1. 1.2000
Time variable	
TX	0.0001 m/y
TY	0.0001 m/y
TZ	-0.0018 m/y
RX	0.081 mas/y
RY	0.49 mas/y
RZ	-0.792 mas/y
Scale	0.08 PPB/y
Enter the base 7 parameter transformation	
Save as default	
Date	
Day	5
Month	11
Year	2019
Calculated shift	
TX	0.05398439425 m
TY	0.05128439425 m
TZ	-0.09371909651 m
RX	2.49835934292 mas
RY	15.1135318275 mas
RZ	-24.4284024641 mas
Scale	2.92751540041 PPB
Shift	
Lat	63°
Long	9°
Lat (Res)	62.999995112°
Long (Res)	8.999991431°
Calculate shift for	
Perform shift	

The left side of the dialogue is the shift definition, where you enter the base shift, the time variant and the definition date. See eg <http://etrs89.ensg.ign.fr/memo-V8.pdf>

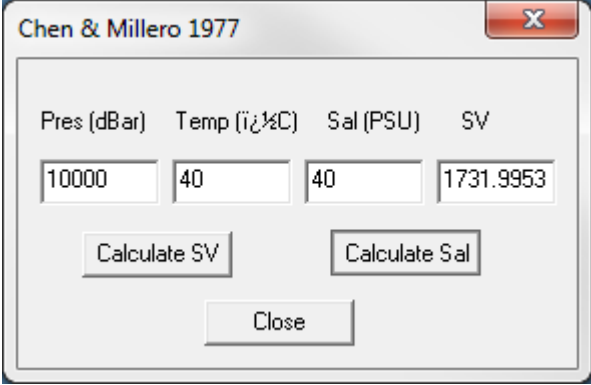
The parameters can be saved for later use by the *Save as default* button

Right side of the dialogue is the calculator part.

- In the top part you enter the date you want to check
- The middle part is the resulting 7 parameter shift
- The lower part is input and output position

8 Chen and Millero 1977

The Calculate -> Chen and Millero menu selection allows calculations on CTD data:



Pres (dBar)	Temp (°C)	Sal (PSU)	SV
10000	40	40	1731.9953

Calculate SV Calculate Sal

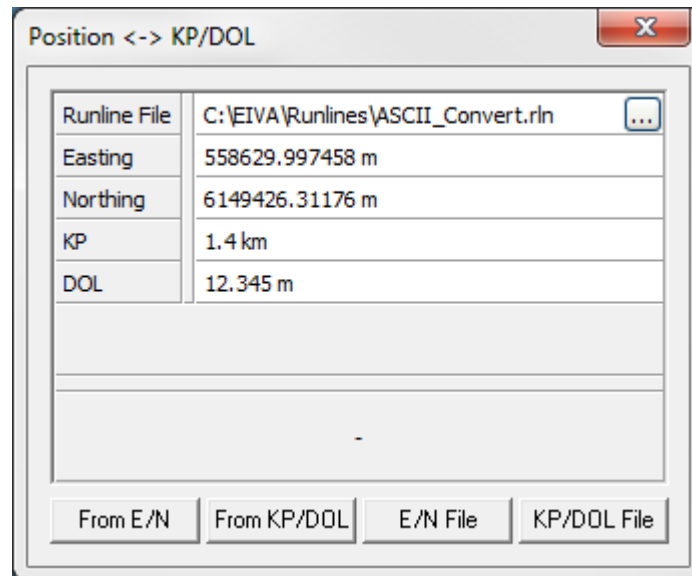
Close

If pressure (in deci bar), temperature (degree Celsius) and salinity (PSU) are entered and the Calculate SV button is clicked, then the sound velocity based on the official UNESCO formula will be calculated.

If pressure, temperature and sound velocity are entered instead and the Calculate Sal button is clicked, then an iterative calculation will be performed to determine the corresponding salinity. This is done in a cyclic process searching for the salinity value that gives the best fitting sound velocity.

9 Position vs KP/DOL

The program includes a calculator in the Calculation menu that allows data conversion between position (Easting, Northing) and runline data (KP and DOL)²



Runline File	C:\EIVA\Runlines\ASCII_Convert.rln
Easting	558629.997458 m
Northing	6149426.31176 m
KP	1.4 km
DOL	12.345 m

From E/N From KP/DOL E/N File KP/DOL File

In the Runline File field, a runline file must be selected. Runline files that are supported are RLX and RLN from the NaviPac format library.

After specifying the runline file, position or kp/dol values can be entered and converted using the two left-most buttons (From E/N, From KP/DOL).

The two right-most buttons allow this process to run against one or more ASCII input files.

The files must be very simply formatted and must have either easting, northing or kp, dol as the first two items depending on the desired process.

² KP is Kilometer Point and DOL is Distance Off Line

10 File formats

The reader for ASCII files is intelligent and will search for the correct data in the input files.

The search is performed after the following simple rule check:

- All lines starting with a '#' are considered to be comments and will be ignored.
- All non-comment lines must include exactly one position
- The selected position format can start at any number, as specified in the input dialogue – e.g. XY file will search for the no-skip + two numerical fields in a line
- All non-numerical characters are ignored, eg. " xyz 123.45 XXX 2345.68" results in the two numbers 123.45 and 2345.68.
- The reader is limited to the following fixed separators:

',' ':' ';' '|'

After a delimiter the reader will always read a number or fail (i.e. " xy:z 123.45 XXX 2345.68" will fail as it contains a ':' followed by a non-number).

10.1 XY

The file contains positions as easting and northing (or the opposite) with as many digits as required.

Sample:

519999.9973,5999999.9052, 54.146556, 9.306175

10.2 Decimal degree

The file contains positions as latitude and longitude (or the opposite) represented as decimal degree with as many digits as required.

Sample:

decimal degree 54.146556, 9.306175

Western and southern values must be defined with a negative sign (-).

10.3 Degree and minutes

The file contains positions as latitude and longitude (or the opposite) represented as degree and decimal minutes with an unbound number of digits. The reader will search for 4 numbers in each line.

Sample:

dd mm_mmmmmmmmmmmmm 054°08.793345' 009°18.370483'

Western and southern values must be defined with a negative sign (–) in front of both degree and minutes.

10.4 Degree, minutes and seconds

The file contains positions as latitude and longitude (possibly in opposite order) represented as degree, minutes and decimal seconds with an unbound number of digits. The reader will search for 6 numbers in each line.

Sample:

Lat and long in dd mm dd 54°08'47.60072" 9°18'22.22899"

Western and southern values must be defined with a negative sign (–) in front of degree, minutes and seconds. Eg:

54° 8' 51.7705" -20° -41' -37.7968"

10.5 Radians

The file contains positions as latitude and longitude (possibly in opposite order) represented as radians with an unbound number of digits. The reader will search for 2 numbers in each line.

Sample:

XXX__ZZZ 0.945036, 0.162423

11 XTF Converter

GeoCalc contains a special XTF converter module that reads XTF files (Simrad based) and converts positions in lat/long to X/Y coordinates using the source geodesy.

Select Calculate-> Convert XTF file and select the file to be converted. A new file is created with the original name plus an extension ".XY.XTF".

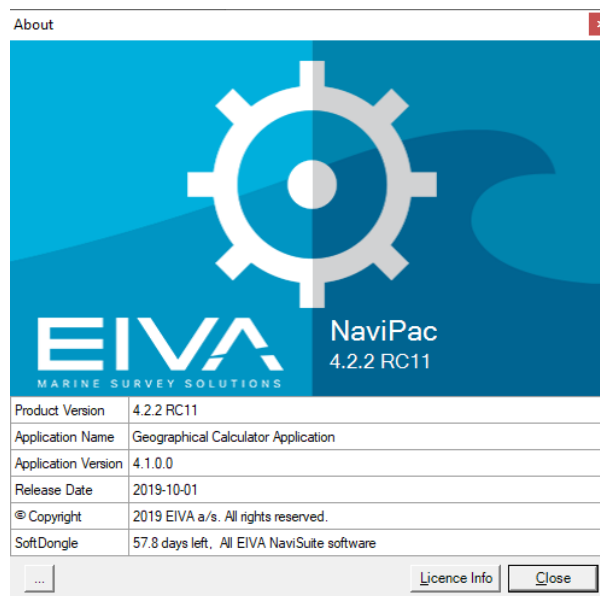
During the conversion some errors might occur:

The file has a flag (XTFFILEHEADER.NaviUnits) that must be 3 if positions are in lat/long. The above example with 0 is a file already in X/Y co-ordinates.

The file header format (XTFFILEHEADER.FileFormat) should always be 123. If the above happens, please check if the file is in XTF format.

12 About

The Help -> About menu results in the following dialogue:



In case of problems, please note version number and release data and contact EIVA a/s (support@eiva.com)