

Freeware

The software is distributed as Freeware for educational and non-commercial use. Refer to **VI. End-User License Agreement** for complete terms and conditions.

Table of Contents

I. Program.....	1
II. User Interface.....	2
III. File Formats.....	6
IV. FAQ.....	7
V. References.....	10
VI. End-User License Agreement (EULA).....	11

I. Program

A. Description

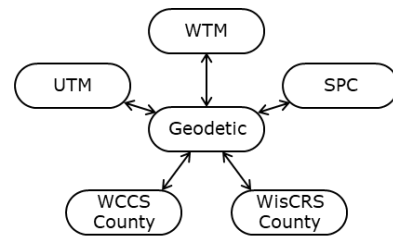
ConCoord (Converting Coordinates) is used to convert positions between different Wisconsin spatial reference systems on the same datum and adjustment. It *does not* transform between data/adjustments.

B. Supported Systems

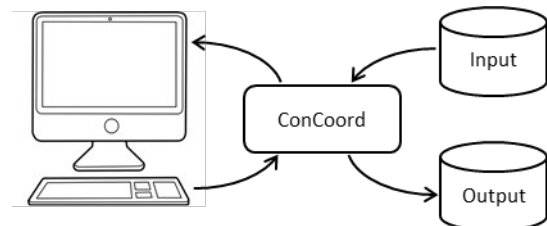
- Geodetic (Latitude and Longitude)
- State Plane Coordinates (SPC)
- Universal Transverse Mercator (UTM)
- Wisconsin County Systems
 - WCCS (**W**isconsin **C**ounty **C**oordinate **S**ystems)
 - WisCRS (**W**isconsin **C**oordinate **R**eference **S**ystems)
- Wisconsin Transverse Mercator (WTM)

C. Conversions

- Direct - Geodetic to Grid
- Inverse - Grid to Geodetic
- Grid to Grid



ConCoord can convert individual points interactively or a point file.



D. Projections

All SPC, UTM, WTM, WCCS systems use either the Transverse Mercator cylindrical (TM) or Lambert Conic (LC) projection equations.

WisCRS County systems use either the TM or a special Wisconsin Conic (WC) projection. The WC is a single-parallel non-intersecting conic projection.

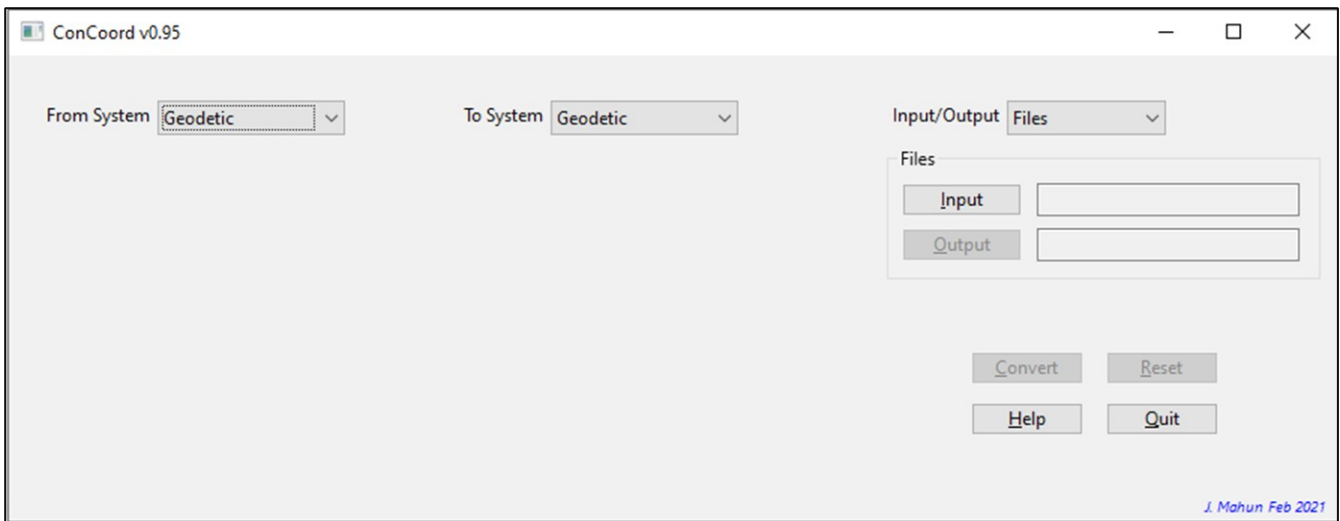
Projections, equations, and system parameters are detailed in the documents listed in the **Reference** section at the end of this document.

II. User Interface

A. Layout

The main screen is divided into four areas.

- From System
- To System
- Input/Output
- Action Buttons



Buttons and list boxes are used to make selections or initiate actions. Other controls or input areas appear based on specific selections.

Some of the buttons have shortcut keys, indicated by the underlined letter in its name. To execute the button hold the **[Alt]** key and press the shortcut key. For example **[Alt] + H** opens the Help window. See the **FAQ** if the shortcuts do not appear.

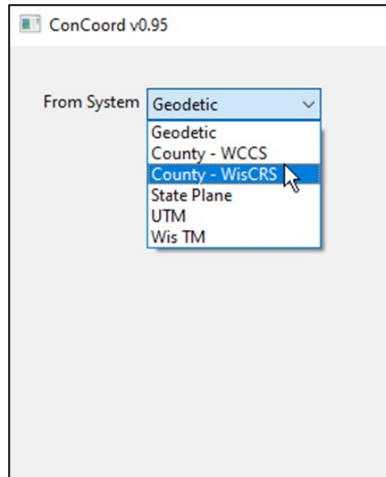
B. From/To Systems

From are positions to be converted, *To* are the conversion results.

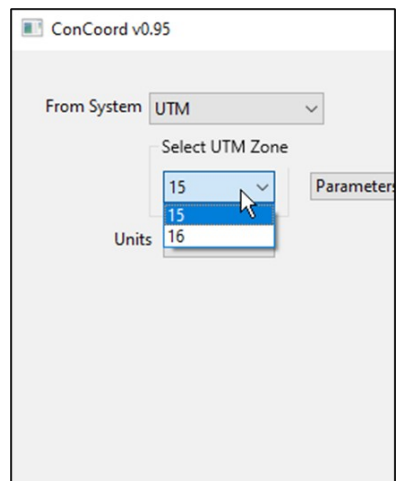
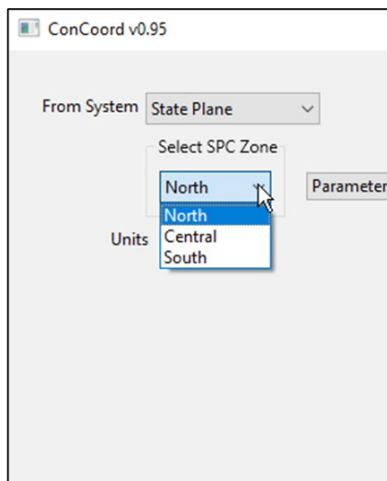
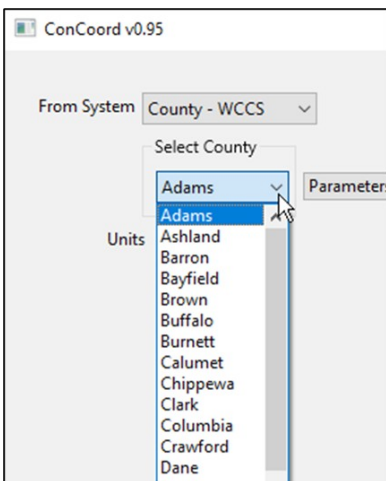


Both areas use similar list windows to select a coordinate system, zone or County, and units (if not Geodetic).

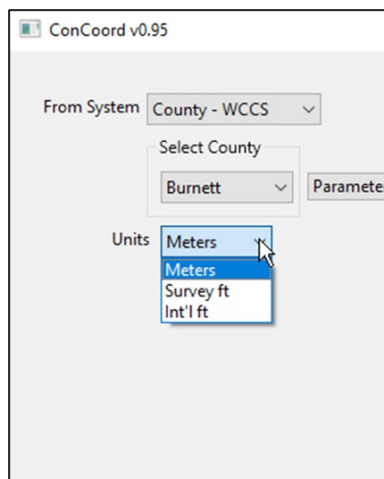
System selection



If a Grid system is selected, two additional list windows are shown. One is for *Zone* or *County* selection...



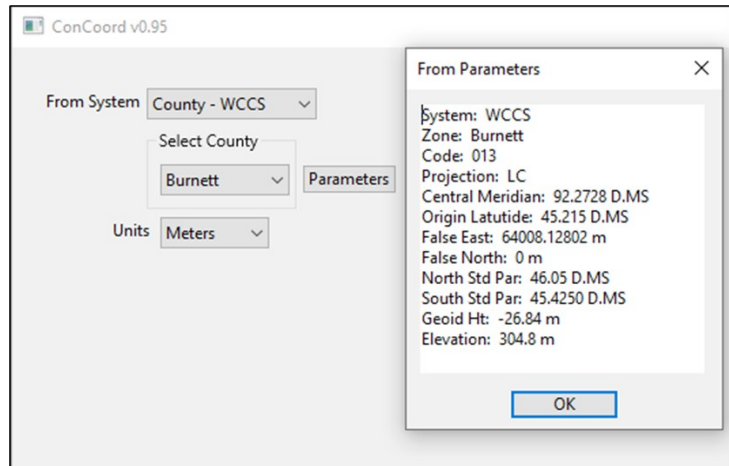
...the other for *Units*.



Conversions can be

- Geodetic to Grid
- Grid to Geodetic
- Grid to Grid

When a Grid system is selected for either *To* or *From*, a **Parameters** button appears. Clicking it will open a windows showing the parameters for the *System* and *Zone* or *County*.



C. Input/Output

Choices are *Files* and *Manual Entry*.

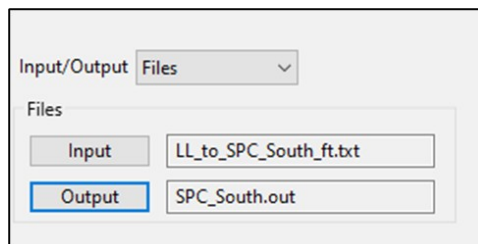
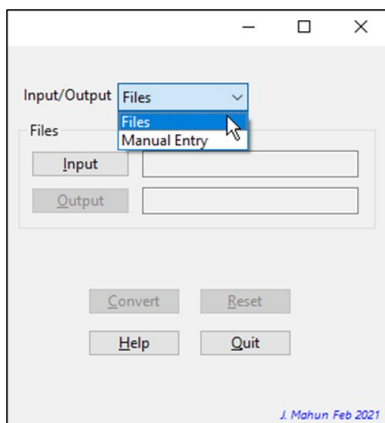
Files

Input and **Output** buttons are used to specify the respective files. Each will open a file dialog box.

Input requires an existing file, **Output** will allow new file creation or overwriting an existing one.

The file names will be displayed next to each button.

File formats are described in **Section III**.



Manual Entry

When selected, the *From System* area will display input areas for Geodetic or Grid coordinates; the *To System* area will display output fields based on the conversion type.

Geodetic coordinates are entered in D.MS format.

For example, 42°18'24.56253" is entered as 42.182456253

Longitude is entered as a positive value.

Grid coordinates may be entered with or without commas.

ConCoord v0.95

From System To System Input/Output

Select County Parameters

Units

Convert...
Latitude
Longitude
Format: DDD.MMSSsssss

Results...
North
East
Convergence
Scale

J. Mahun Feb 2021

ConCoord v0.95

From System To System Input/Output

Select County Parameters

Units

Convert...
North
East

Results...
Latitude
Longitude

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ConCoord v0.95

From System To System Input/Output

Select County Parameters

Units Parameters

Convert...
North
East

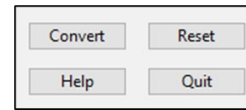
Results...
North
East
Convergence
Scale

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D. Action Buttons

Convert: Initiates the conversion process. The button be active when

- Files I/O - Input and Output files are specified
- Manual Entry - Both *From* coordinates are entered



Reset: Resets the program to default values.

Help: Opens a window with some basic help information.

Quit: Terminates the program.

A point can be converted to multiple grid systems by selecting a different *To System* and *Zone* or *County* after a conversion. *From* coordinates need not be re-entered, but **Convert** must be clicked to perform the conversion.

III. File Formats

A. Input

1. Grid

Three elements per line: Point (P), North (N), East (E)

Comma delimited

Element order: P, N, E

2. Geodetic

Three elements per line: Point (P), Latitude (Lt), Longitude (Ln)

Comma delimited

Element order: P, Lt, Ln

Lt and Ln elements format is D.MS

Examples

Element	D.MS Format
42°18'24.56253"	42.182456253
89°00'00.97365"	89.000097365

B. Output

1. Grid

Five elements per line: Point (P), North (N), East (E), Convergence (C), Scale (S)

Comma delimited

Element order: P, N, E, C, S

C format is D.MS

2. Geodetic

Three elements per line: Point (P), Latitude (Lat), Longitude (Lon)

Comma delimited

Element order: P, Lat, Lon

Lat/Lon format is D.MS

IV. FAQ

Q: ConCoord doesn't show the shortcut keys. Why not?

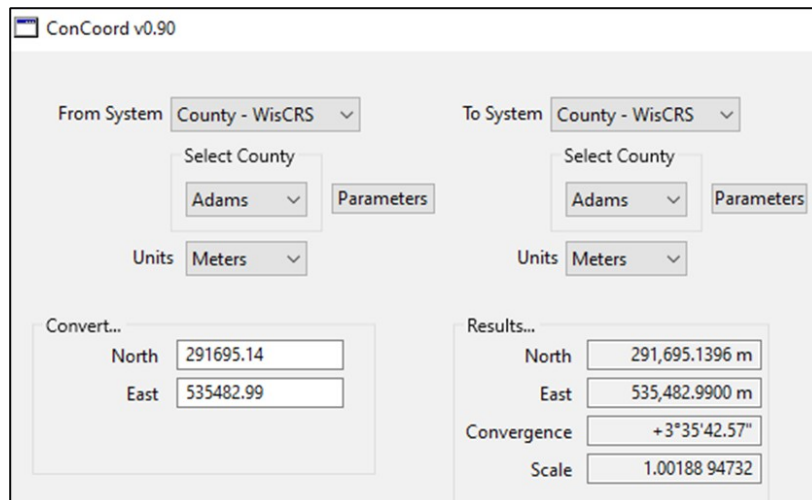
A: **Windows** by default generally doesn't show shortcut keys in many applications. There are two ways around this:

1. Simple - Pressing the **[Alt]** key will display the shortcut letters on the respective controls.
2. Less simple -
 - Open **Windows' Control Panel**
 - Select *Ease of Access Center*
 - Select *Make the keyboard easier to use*
 - Select *Underline the keyboard shortcuts and access keys*
 - click **Apply**
 - You may need to restart **ConCoord** to apply the change

This will turn on the shortcut keys for all applications.

Q: I have grid coordinates for a point but not its convergence nor scale. How do I get these in **ConCoord**?

A: Use the same *System* and *Zone* or *County* for the *From* and *To*. When you perform the conversion, the *Results...* area will show the same coordinates along with the convergence and scale.



Q: What's the difference between WCCS and WisCRS County Coordinate Systems?

A: How much time do you have?

WCCS systems used a raised version of the GRS80 ellipsoid for each county. Changing the ellipsoid basically created a new datum which caused problems for some software. WisCRS systems were designed using the GRS80 ellipsoid and to maintain 3 mm accuracy with their WCCS counterparts. This required redefining county parameters and, in the case of conic-based systems, using a different set of projection equations.

It's a bit more complicated than that. Detailed information is available on the *Coordinate Reference Systems* page at the Wisconsin State Cartographer's Office (SCO) (website (<https://www.sco.wisc.edu/coordinate-reference-systems/>)).

Q: How accurate are **ConCoord**'s results?

A: **ConCoord** uses rigorous projection equations and parameters which are fully detailed in **V. References** documents. The program has been checked using the *Test Point Data - NAD 83* on the same SCO *Coordinate Reference Systems* web page in the previous question. No measurable conversion error was introduced.

BUT converted results are only as accurate as the coordinates being converted. Weak Coordinates In = Weak Coordinates Out. See the next question.

Q: What's the compatible accuracy between geodetic and grid coordinates?

A: This is an important question and needs a bit of explanation.

ConCoord will always show four decimal places for grid (feet or meters) and six decimal on seconds for geodetic coordinates. That doesn't mean all converted coordinates are accurate to those resolutions.

In Wisconsin, 1 sec of Lat is approximately 100 ft and 1 sec of Long is approximately 70 ft. They differ because of meridian convergence: 1 sec of Lat is longer than 1 sec of Long in Wisconsin. The following table shows compatible accuracy using a general rule of 1 sec = 100 ft.

Geodetic, sec	Grid, ft
1	100
0.1	10
0.01	1
0.001	0.1
0.0001	0.01

For property survey quality, grid coordinates are typically expressed to 0.01 feet, so geodetic coordinates should be to 0.0001 seconds. Grid coordinates interpolated to ±100 feet on a paper map shouldn't be expressed any more accurately than the nearest second.

Accuracy can also be determined using a *sensitivity analysis*. This involves varying the last digit in the numbers being converted and examining which digits change in the result. The variance is half the magnitude of the last digit.

For example: What are Sauk County WisCRS coordinates, in feet, of 43°20'10.2" Lat and 89°31'17.4" geodetic coordinates scaled from a map? Because the geodetic coordinates are good to 0.1", vary them by 0.05". The table below shows the converted grid coordinates as displayed by **ConCoord**.

	Lat	Long	North	East
-0.05"	43°20'10.15"	89°31'17.35"	188,566.1052	709,710.9635
Scaled	43°20'10.2"	89°31'17.4"	188,571.1511	709,707.2452
+0.05"	43°20'10.25"	89°31'17.45"	188,576.1970	709,703.5268

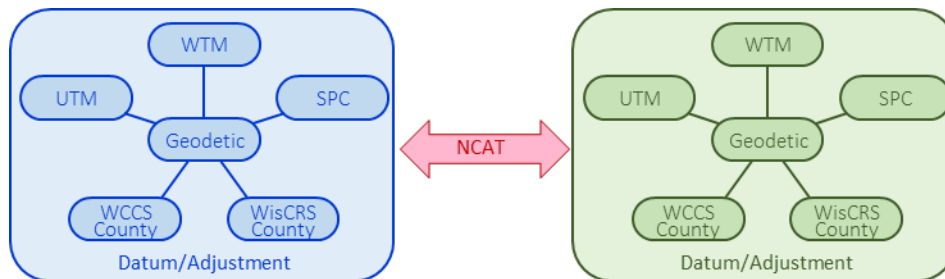
In all cases, the grid coordinates are the same down to the hundreds place; they change (are *sensitive*) in the tens place. That means compatible grid coordinates are good the nearest 10 ft: 188,570 ft N and 709,710 ft East. The results are also consistent with the general rule.

ConCoord doesn't know the accuracy of the coordinates it's converting - it just converts the numbers you give it. It's up to you to intelligently interpret the results. If you're not sure, either perform a sensitivity analysis (quick to do with **ConCoord**) or use 1 second geodetic = 100 feet grid for ballpark accuracy levels.

Think of **ConCoord** as a calculator which returns raw results with extra digits to minimize rounding error. It's up to you to determine which digits are significant.

Q: Can I use **ConCoord** to convert from NAD27 SPC to NAD83 SPC?

A: No. **ConCoord** only converts coordinates on the same datum and adjustment. To transform from one datum/adjustment to another requires different software like NGS' **NCAT** (<https://www.ngs.noaa.gov/NCAT/>).



Conversions within a datum using software based on rigorous projection equations will not introduce error. However, there is no exact transformation from one datum/adjustment to another so any software, even **NCAT**, will introduce positional uncertainty. The uncertainty may be relatively large (eg, NAD 27 to NAD 83 (1986)) or small (NAD 83 (2009) to NAD 83 (2011)), but it will exist. The most accurate way to convert positions from one datum/adjustment to another is to adjust the same original survey observations in both systems.

Q: What's all this stuff about a new datum coming soon?

A: This one requires more time to answer than the WCCS v WisCRS question and "soon" is pretty fuzzy.

NGS will replace NAD 83 and NAVD 88 with the North American Terrestrial Reference Frame of 2022 (NATRF2022) and the North American-Pacific Geopotential Datum of 2022 (NAPG2022). NGS policy on coordinate systems is to develop and support for each state a statewide system, a set of SPC zones, and a limited number of regional Low Distortion Projection (LDP) systems. Initially, Wisconsin's County systems, our existing LDP systems, would not be supported by NGS.

The Wisconsin Spatial Reference 2022 (WSRS2022) Task Force was created to address technical, educational, legislative, and software issues for the upcoming systems. It also serves as Wisconsin's interface to the NGS and has been instrumental in convincing the agency to include and provide support for LDP systems.

There is **much** more information on the State Cartographer's website *WSRS2022* webpage:

<https://www.sco.wisc.edu/community/wsrs2022/>.

Oh, the survey foot will go away, too.

Q: Will future versions of **ConCoord** include other grid systems?

A: Probably not. **ConCoord** was created to support the cornucopia of existing Wisconsin coordinate systems. The only other formal system covering the state is the National Grid and it won't be included unless there's tremendous demand for it.

Q: How about NARTF2022?

A: Again, probably not. The WSRS2022 Task Force is working on developing conversion tools for the new systems as well as incorporating **NCAT** to transform between data. Visit the aforementioned *WSRS2022* webpage for more information.

Q: What about other file formats?

A: Depends on user feedback.

Q: *Will* there be future versions of **ConCoord**?

A: Again, depends on user feedback.

Q: What does **ConCoord** cost?

A: Nada. It's freeware and distributed at no cost. I do not solicit nor accept financial remuneration, neither in dollars nor any other forms of good and valid consideration.

Q: Can I sell **ConCoord** on its own or bundled with other software?

A: Nope. That's not in the spirit of the Freeware concept. See the **VI. End User's License Agreement (EULA)** for more information.

Q: What happens if I have questions or feedback?

A: Please submit questions, comments, or corrections to me at jerry.mahun@gmail.com.

V. References

Equations and parameters in **ConCoord** are taken from two documents:

Document *Equations and Parameters for Wisconsin Coordinate Systems*, WLIA Wisconsin County Coordinate System Task Force, Nov 2004

Web link <https://www.sco.wisc.edu/wp-content/uploads/2015/03/WisEqnParams.pdf>

For Systems SPC, UTM, WTM, WCCS-Counties

Document *WisCRS: Redesign of the WCCS*, A.P. Vonderohe, Mar 2006

Web link https://www.sco.wisc.edu/wp-content/uploads/2015/03/WISCRS_Final_Report_Oct06.pdf

For Systems WisCRS-Counties

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