GIS Tips & Tricks

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Which Way is "Up"?

"Which way is up?" may sound like a really simple question to digital cartographers. Of course "up", in our typical American/European culture, on a map is "North". However, as was pointed out by Kelsey Leonard (Esri, ArcNews: Winter 2021), when the indigenous people around the Great Lakes made their highly detailed maps, "up" was the direction that the sun rose; East to us digital map makers! Then even when "up" is "North", the question arises… which North? We frequently forget that North has three separate and distinct meanings and directions.

1. Celestial North (aka "True North"): The north (and south) celestial pole(s) is/are the **(two) point(s) in the sky** where Earth's axis of rotation, indefinitely extended, intersects the celestial sphere. That is, North is defined by the extension of the Earth's axis of rotation. These points shift with the "wobble" or axial precession of the Earth's spin axis every 26,000 years,

2. Magnetic North (aka "Compass North"): This is a **point on the surface** of the Earth's Northern Hemisphere at which the planet's magnetic field points vertically downward. This point is constantly "wandering" as the Earth's rotation and core move, and

3. Grid North: This "North" refers to a navigational (survey) term describing the **direction northwards along the "grid lines" of a map projection** (a whole other topic). This "North" is neither Celestial North nor Magnetic North, but may align with either or neither.

In most GIS Programs (Esri, GlobalMapper, QGIS) the North Arrow is connected to the map layout. If the map layout is rotated, the arrow follows. ***TIP***: Did you know that you can rotate the entire layout? In an ArcGIS Pro Layout Window, all you need to do is click on any of the handles, move off it a little bit to see the rotate icon and move the entire dataframe. In a Map Window, it is even easier, simply use the "a" key to rotate the frame clockwise, and the "d" key to rotate it counter-clockwise.

Inserting a North Arrow is a fairly simple and straightforward task in GIS mapping programs. It usually just involves finding the Insert North Arrow icon, selecting your favorite arrow (or rosette) from a dropdown choice or list, then resizing/repositioning the selected style and you're done! Or are you? Which "North" is it when you put a "North Arrow" onto a map?

Here is an example in ArcGIS Pro (v2.92) on how to control and specify the North Arrow.

Step 1. Insert a North Arrow: From the Insert Tab on the Ribbon select New North Arrow

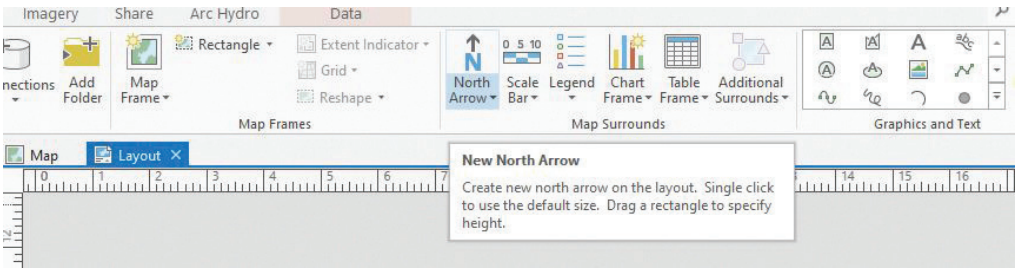

Figure 1. The Project Tab on the Ribbon when a Layout is active.

Step 2. Select the style from the dropdown choices, click and drag/size a box on the layout for the arrow. Using the graphic handles on the display box, move/resize the North Arrow as needed.

Now comes the fun part…

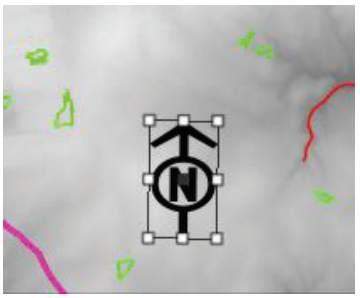

Figure 2. A North Arrow showing graphic handles as displayed after selected from the optional arrows and the graphic box was dragged on the Layout.

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Step 3. With the North Arrow selected, on the North Arrow Tab on the Ribbon (which you will see once you inset a North Arrow), select the "Design" tab:

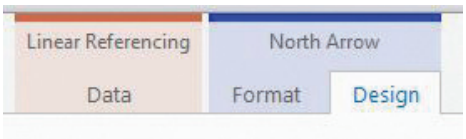

Figure 3. The Design Tab on the North Arrow Tab appears when the North Arrow is selected.

Step 4. On the Design Tab, select the "North" that you want for your map. The Default is Celestial (True) North with a Calibration Angle of "0". Remember… never just accept the defaults without knowing what it is.

Figure 4. The North Arrow Design tab showing the user-selected options.

The dropdown arrow (next to True North) will let you select Magnetic (as below) and/or Map (Grid North) and calculates a calibration angle, that in the case of Magnetic North shows the magnetic declination (deviation) from Celestial (True) North, and you will see the North Arrow rotate to that position, in this case, -7.03 degrees (counterclockwise) from "up".

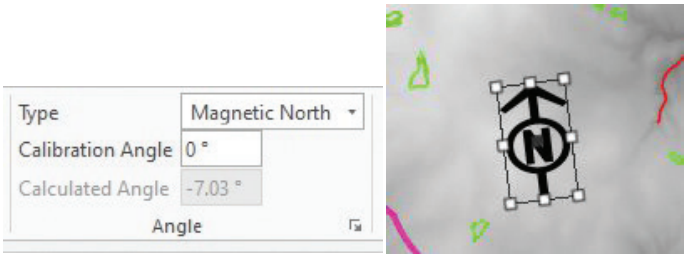

Figure 5. The North Arrow Design Tab after selecting "Magnetic North" and the results showing the rotated North Arrow.

Note: The Calculated Angle value shows the rotation angle of the north arrow based on the orientation and calibration angles. This value cannot be edited by the user.

Of course, if you change the North Arrow to Magnetic North (or Grid North), you should put a note on the map that "North" is Magnetic (or Grid) North), as well as, indicating that declination angle.

There are multiple ways that you can indicate north on your maps, but it is always a good idea to tell your users which North you are displaying on the map and which way is "up".

Send your questions, comments, and tips to GISTT@ASPRS.org.

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