

Displaying and Rotating WindNinja-Derived Wind Vectors in ArcGIS Pro 3.3.1

Gabriel Abreu Vigil

RMRS, Fire Sciences Lab, Missoula, MT,

gabriel.abreuvigil@usda.gov

Mason Willman

RMRS, Fire Sciences Lab, Missoula, MT, mason.willman@usda.gov

Chuck McHugh

RMRS, Fire Sciences Lab, Missoula, MT, 406-829-6953,

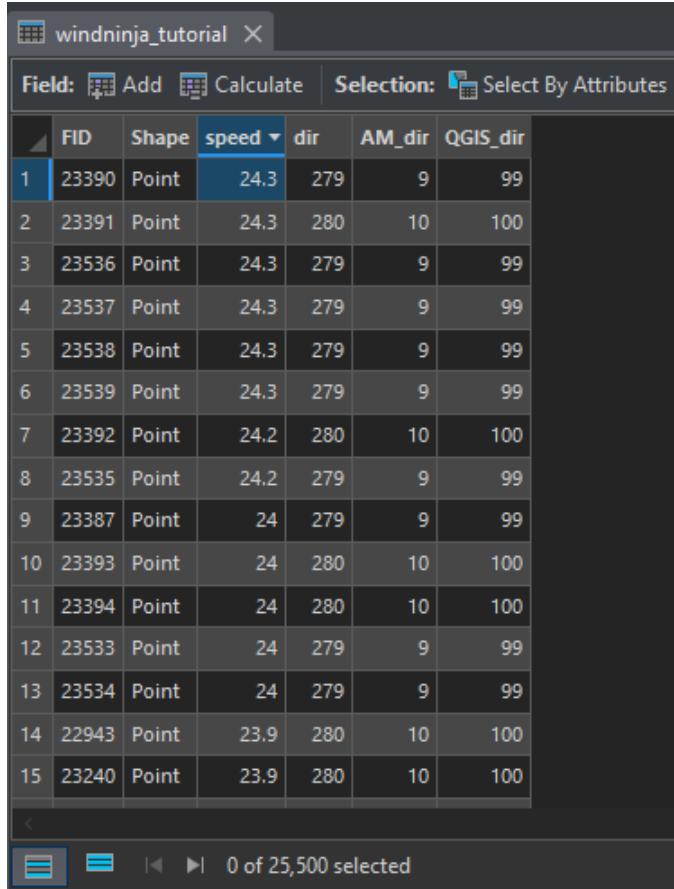
cmchugh@fs.fed.us



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Displaying WindNinja-generated gridded wind vectors

Data requirements are a Shapefile Feature Class format. The shapefile generated during the WindNinja process will contain five data fields in the associated .DBF file (Figure 1).



	FID	Shape	speed	dir	AM_dir	QGIS_dir
1	23390	Point	24.3	279	9	99
2	23391	Point	24.3	280	10	100
3	23536	Point	24.3	279	9	99
4	23537	Point	24.3	279	9	99
5	23538	Point	24.3	279	9	99
6	23539	Point	24.3	279	9	99
7	23392	Point	24.2	280	10	100
8	23535	Point	24.2	279	9	99
9	23387	Point	24	279	9	99
10	23393	Point	24	280	10	100
11	23394	Point	24	280	10	100
12	23533	Point	24	279	9	99
13	23534	Point	24	279	9	99
14	22943	Point	23.9	280	10	100
15	23240	Point	23.9	280	10	100

Figure 1: Attribute table for WindNinja-generated shapefile as displayed in ArcGIS Pro.

- (a) **FID:** Feature ID, a unique number assigned to that point by ArcGIS Pro.
- (b) **Shape:** Point indicates that the feature type for the shapefile is a point
- (c) **speed:** WindNinja-generated wind speed at the specified output height and in the specified output units.
- (d) **dir:** WindNinja-generated azimuth direction the wind is coming from in degrees (e.g., 0 degrees is wind from the north).
- (e) **AM_dir:** WindNinja-manipulated value required for use in ArcGIS Pro for display purposes.
- (f) **QGIS_dir:** WindNinja-manipulated value required for use in QGIS for display purposes

Steps:

1. Open ArcGIS Pro and load any data coverages and fire perimeter files of interest.
2. Load the ArcGIS Pro WindNinja shapefile for the fire of interest. The wind vector grid will appear on the coverage as individual points (Figure 2).

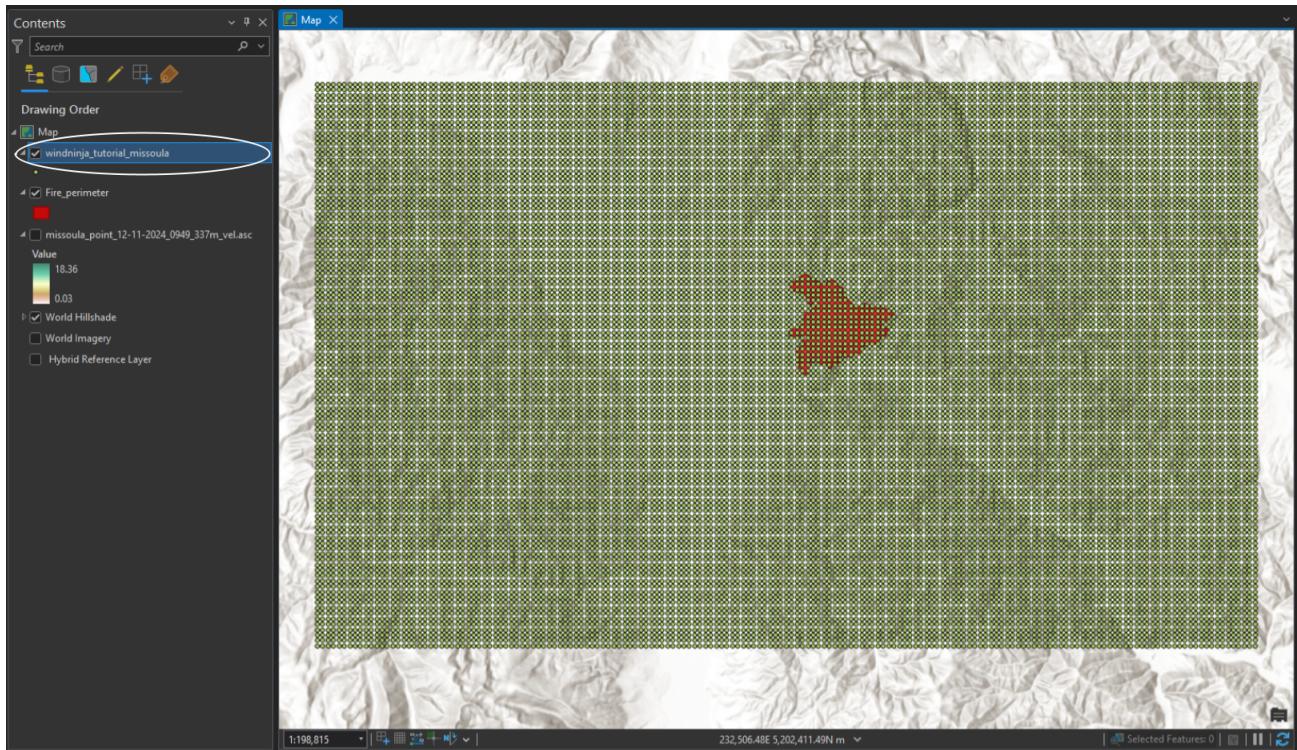


Figure 2: Example ArcGIS Pro project with WindNinja-generated shapefile as displayed in ArcGIS Pro prior to scaling and rotation of the WindNinja-generated vectors.

3. After loading the file into the ArcGIS Pro project, right click on the layer name in the **Table of Contents** then select **Symbology** (Figure 3). This will open the symbology panel in (Figure 4).

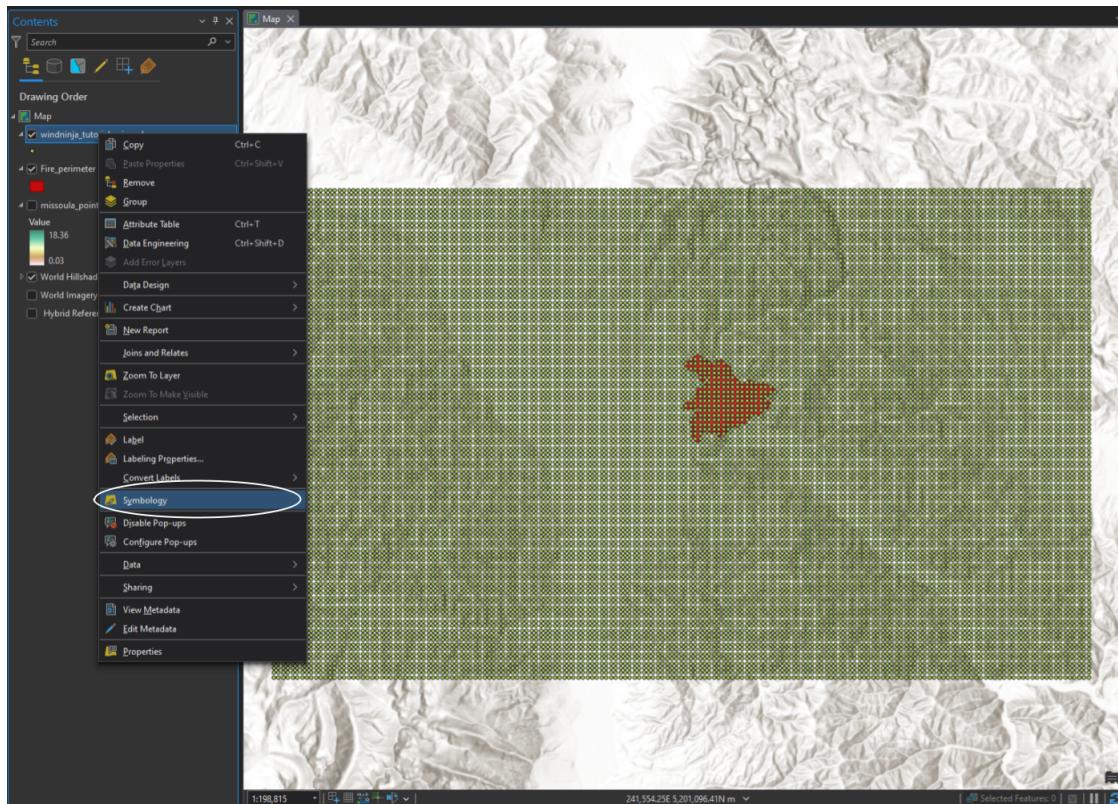


Figure 3: Layer Properties dialog box as displayed in ArcGIS Pro.

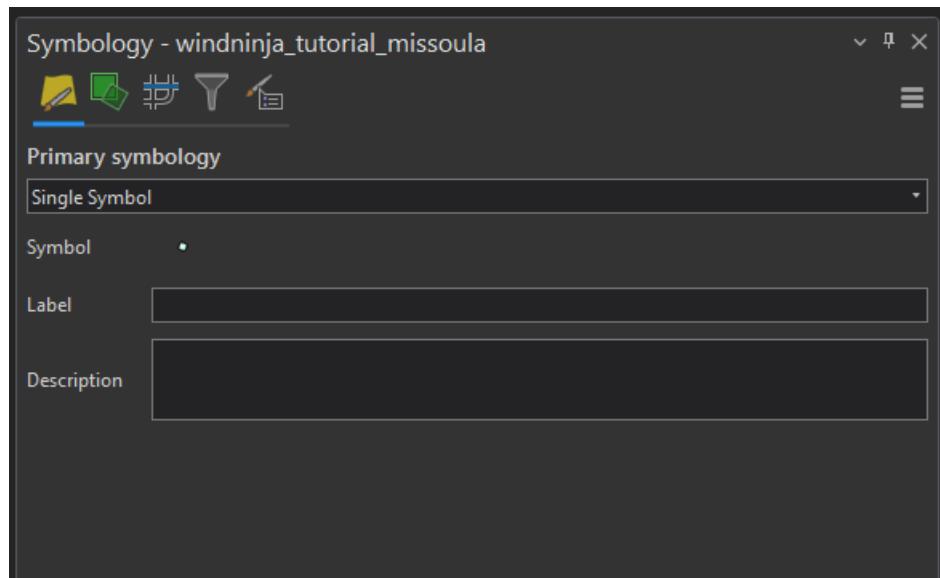


Figure 4: Symbology panel as displayed in ArcGIS Pro

4. Under **Primary Symbology**, select **Graduated Symbols** (Figure 5).

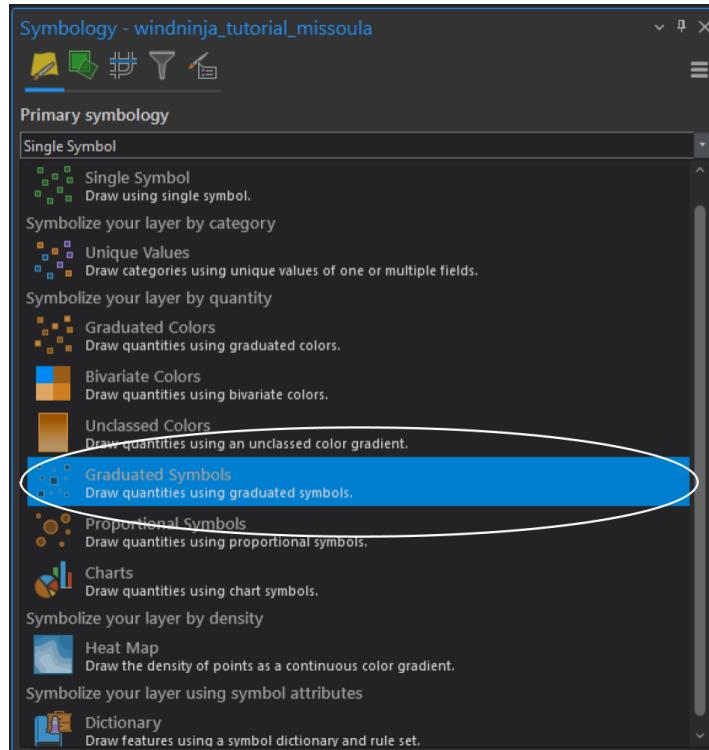


Figure 5: Selecting Graduated Symbols from Primary Symbology.

5. In the Field drop down, make sure that **speed** is selected from the available options.

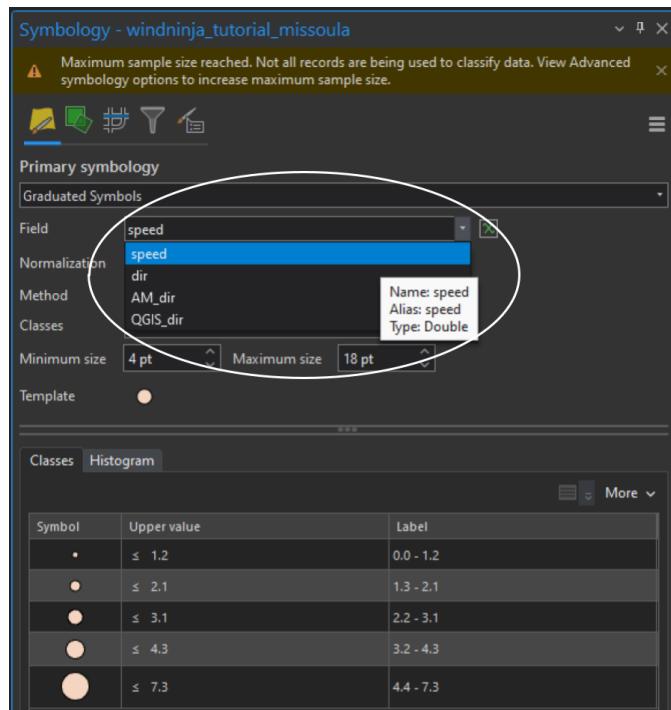


Figure 6: Selecting speed from the Field drop down.

Note: The following Warning Message (Figure 7) may appear depending on the number of records in the WindNinja shapefile. Click on the X to make the message disappear. To change the number of records in ArcGIS Pro refer to the [Appendix](#) of this document.

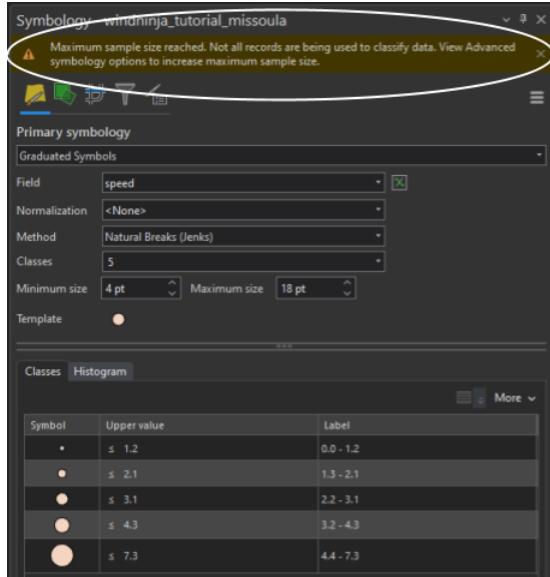


Figure 7: Warning Caption

6. Select a symbol to represent the wind vectors (Figure 8). In the symbol **Gallery**, either search arrow or scroll down to find the arrow symbols under **ArcGIS Pro 2D**. Arrow markers **5**, **6**, and **20** are recommended.

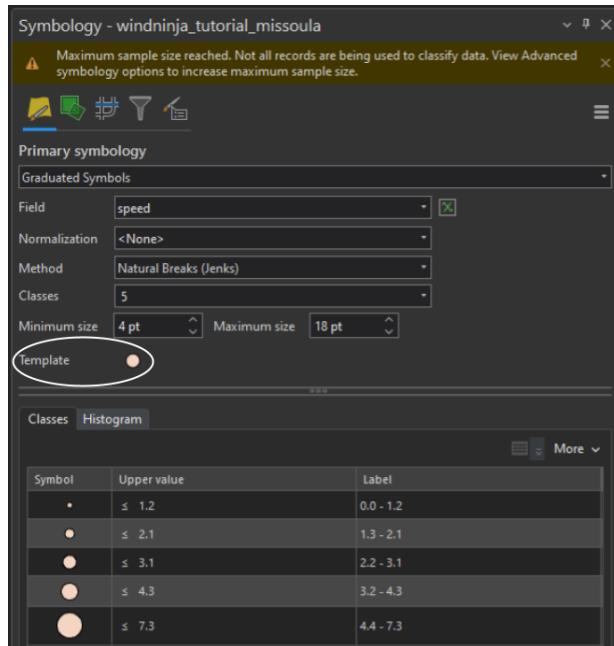


Figure 8: Select the template symbol to access available symbol sets.

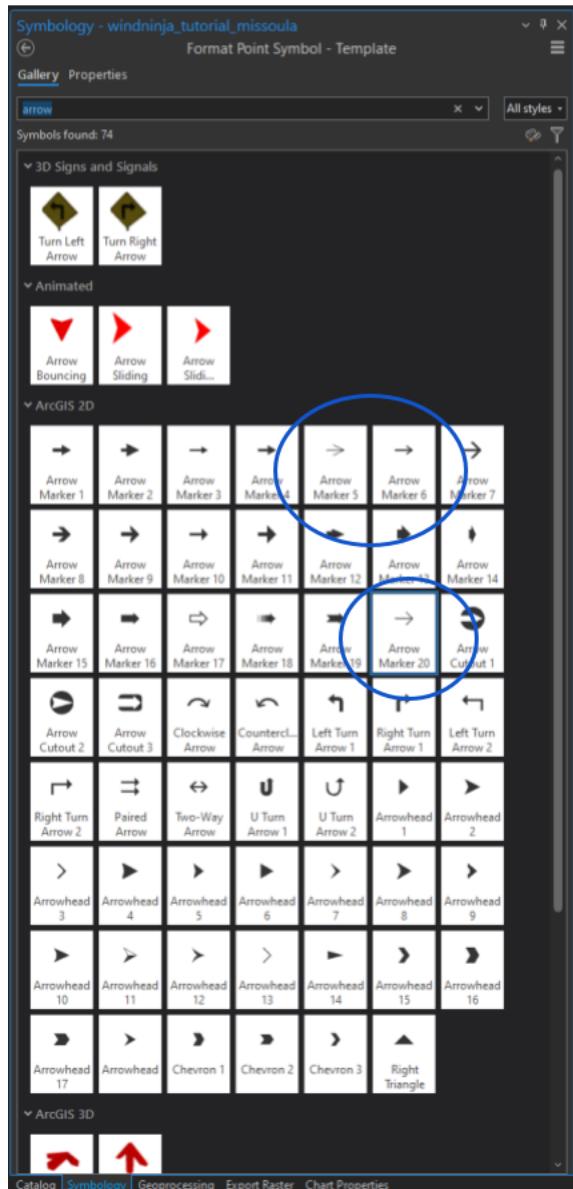


Figure 9: Symbol selector dialog box

7. Select an arrow symbol to represent the wind vectors, and the symbols on the map will be updated. Now return to the **Symbology Panel**.
8. Click on the **Vary Symbology By Attribute** tab, then click on **Rotation** which will open the **Rotation** drop down (Figure 9). In the drop down, select **AM_dir** to rotate the points from the available options and select **Geographic** for **Rotation Style** (Figure 10).

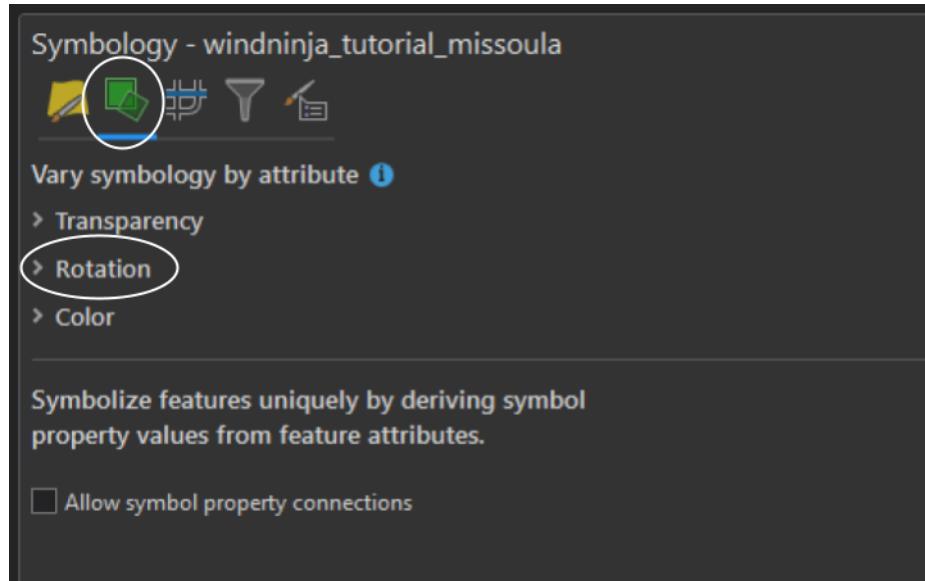


Figure 10: Selecting the Vary Symbology by Attribute and Rotation drop down.

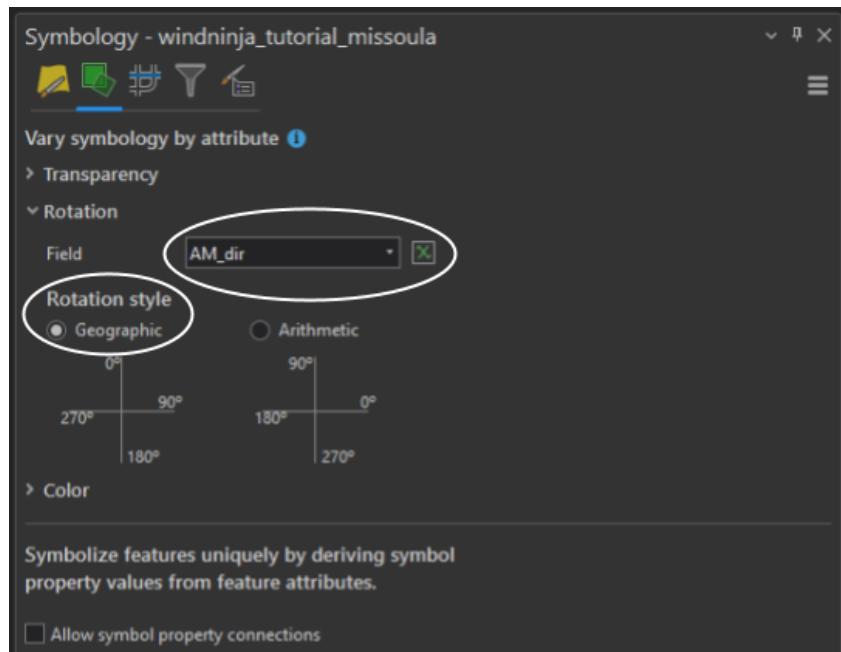


Figure 11: Rotation Field and style options.

9. **Optional:** Set a color ramp for the arrows based on wind speed by clicking the **Color** drop down. In the **Field** dropdown, select **speed** and select a **Color scheme** (Figure 12).



Figure 12: Color dialog box options.

10. You can now exit the **Symbology** panel.
11. The wind vectors will appear over the existing layers (Figure 13)

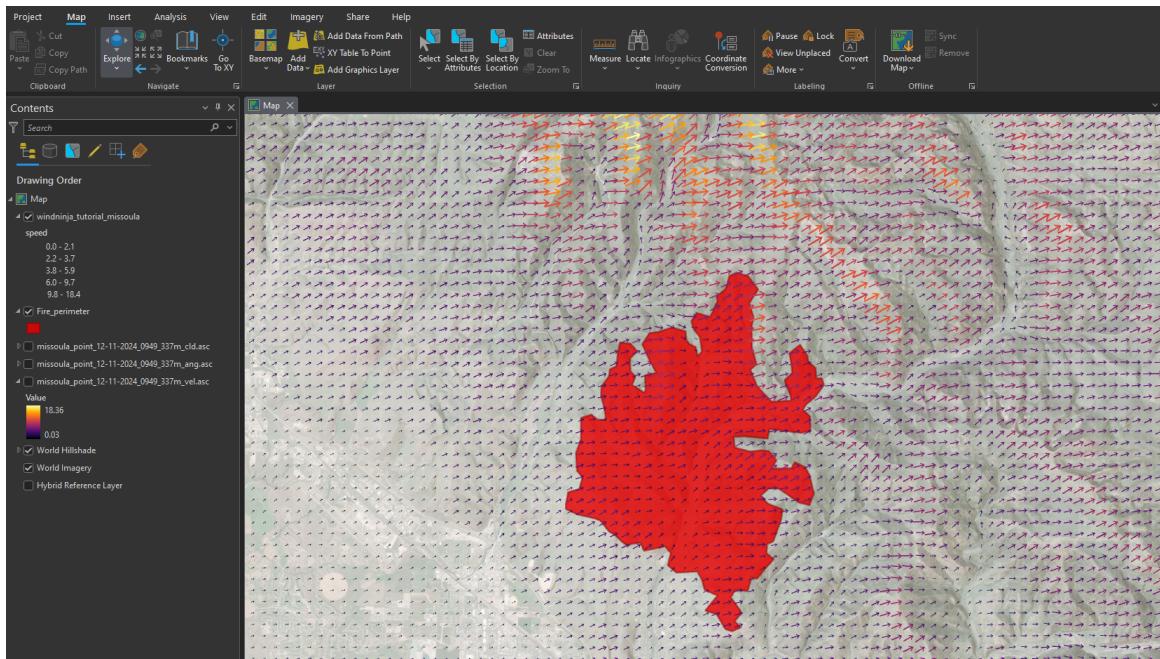


Figure 13: Rotated WindNinja vectors displayed in ArcGIS Pro.

Query the Gridded Wind Output in ArcGIS Pro

To correctly rotate the arrows in ArcGIS Pro, ensure that you are using the display data generated by WindNinja. In Figure 14, the query information for the circled arrow shows the wind speed as 11.3 mph with an AM_dir of 345. The AM_dir value for wind direction in the shapefile **IS NOT** the same value as the actual wind direction generated by WindNinja; it is for rotation and display purposes only. For this point, the wind has a speed of 11.3 mph (speed) and is coming from 255 degrees (Dir). The values for speed and dir are the WindNinja-derived values that should be used in any analysis using this shapefile.

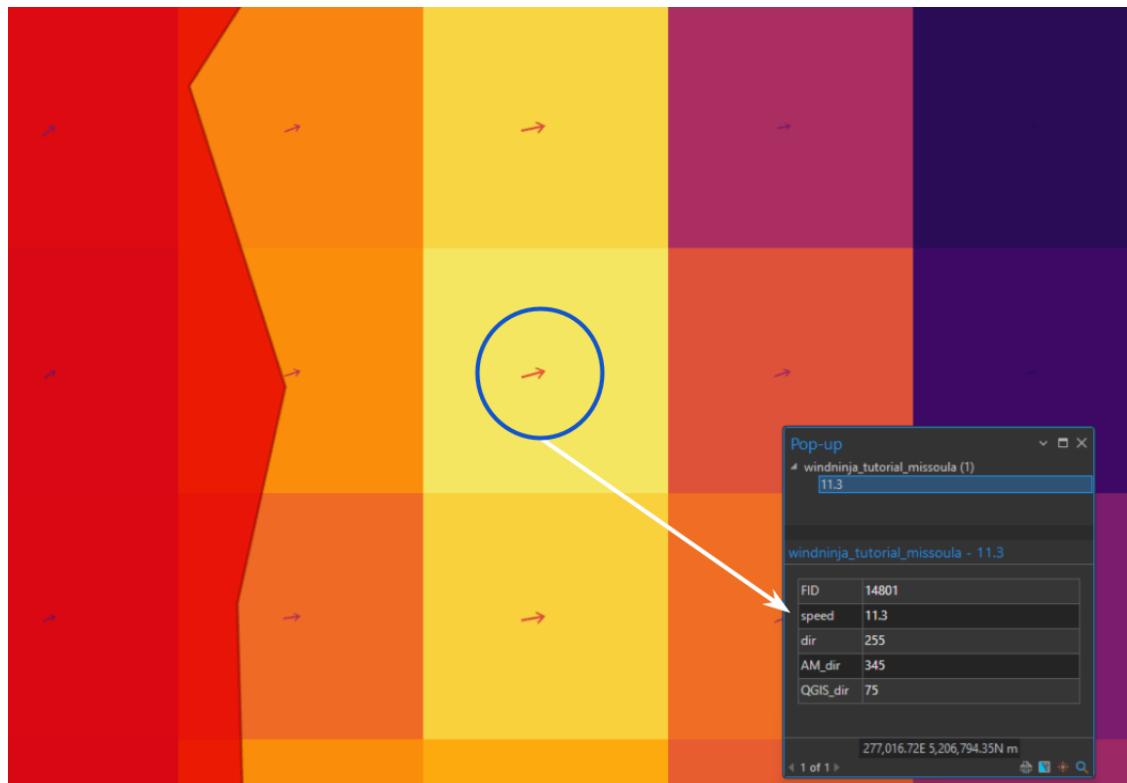


Figure 14: The shapefile overlaid with an ASCII grid. Queried results of the shapefile show the difference in values between wind direction (dir) and the rotation angle (AM_dir). Query done after the shapefile has been rotated following previous steps.

The ASCII file output from WindNinja will have three separate files: filename_ang.asc, filename_cld.asc, and filename_vel.asc. These represent the wind direction, cloud cover percentage, and velocity (wind speed) respectively. Using the same point in the landscape, Figure 15 shows the shapefile overlayed on the ASCII GRID of wind speed generated by WindNinja. Based on the values from Figures 14 and 15, the ASCII grid values of vel and ang are equal to the shapefile values of speed and dir. This provides another visualization option for these values as well as a way to check if your queried shapefile data is correct.

Note: To display the .asc files as shown in Figure 15, navigate to the **Map** tab and click the **Explore** dropdown. Then, select the **Selected in Contents** option. Finally, before clicking on the grid, select all three .asc files in the left panel.

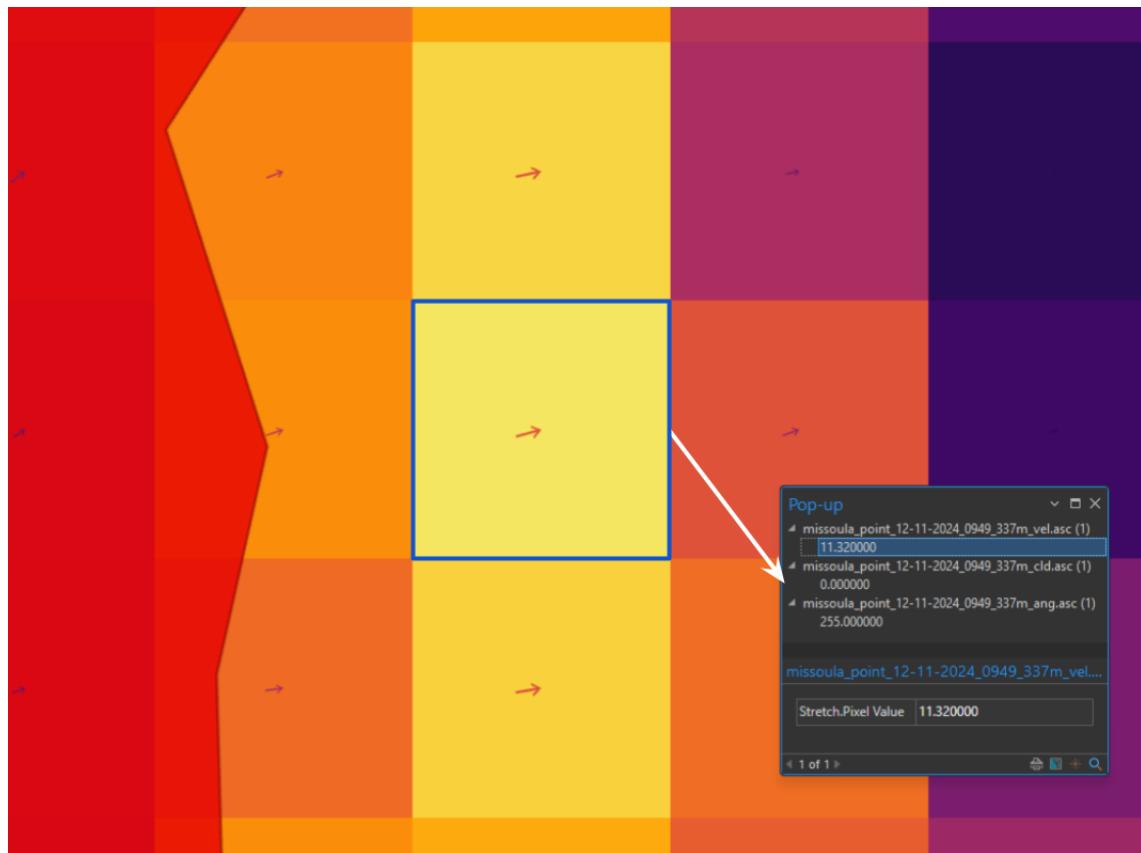


Figure 15: The shapefile overlayed with an ASCII grid. Queried results of the ASCII Grid show the connection between the values in the .asc files (vel and ang) and the values in the shapefile (speed and dir).

Appendix

How to Change the Number of Records Used In ArcGIS Pro when Displaying WindNinja Shapefile Output

Gabriel Abreu Vigil, RMRS, Fire Sciences Lab, Missoula, MT, gabriel.abreuvigil@usda.gov.

When displaying the WindNinja-derived wind direction-speed shapefile information in ArcGIS Pro, the warning displayed in Figure 1 will often occur. This is because the default number of records to be displayed in ArcGIS Pro is the **first 10,000** regardless of the distribution and spatial location of the data. Depending on the output file resolution size selected in WindNinja and the landscape extent, this number can easily be exceeded. As a consequence, not all records in the shapefile will be used during display of the wind speed values. Additionally, within ArcGIS Pro, your choice of **Classification Method** and the number of **Classes** will also affect the displayed ranges of information.

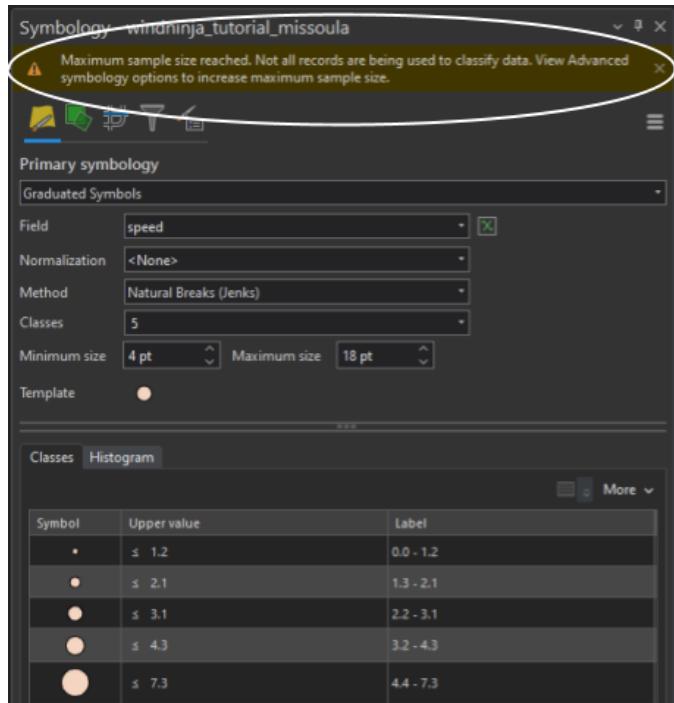
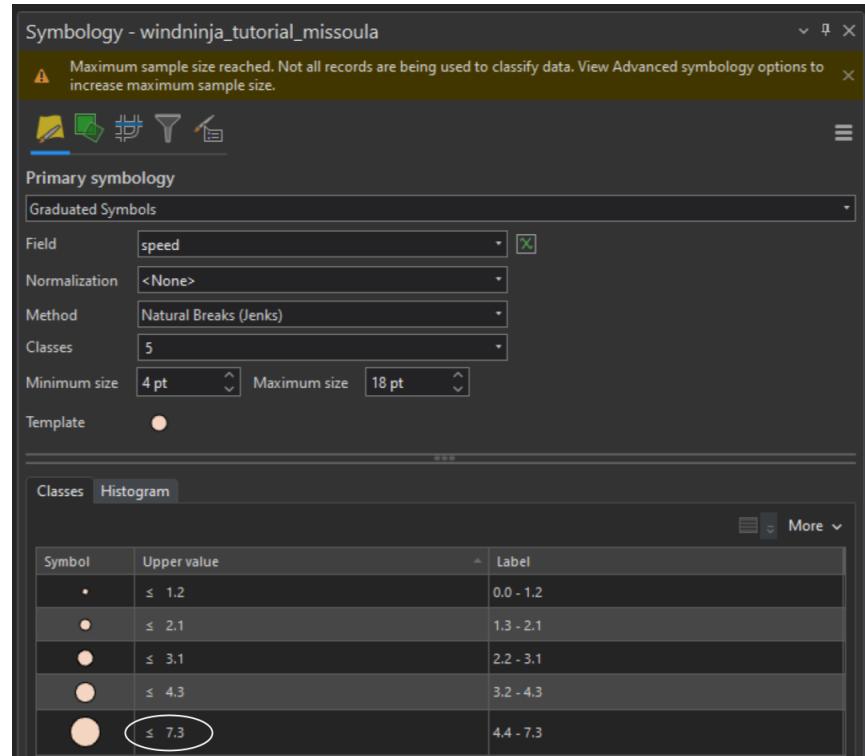
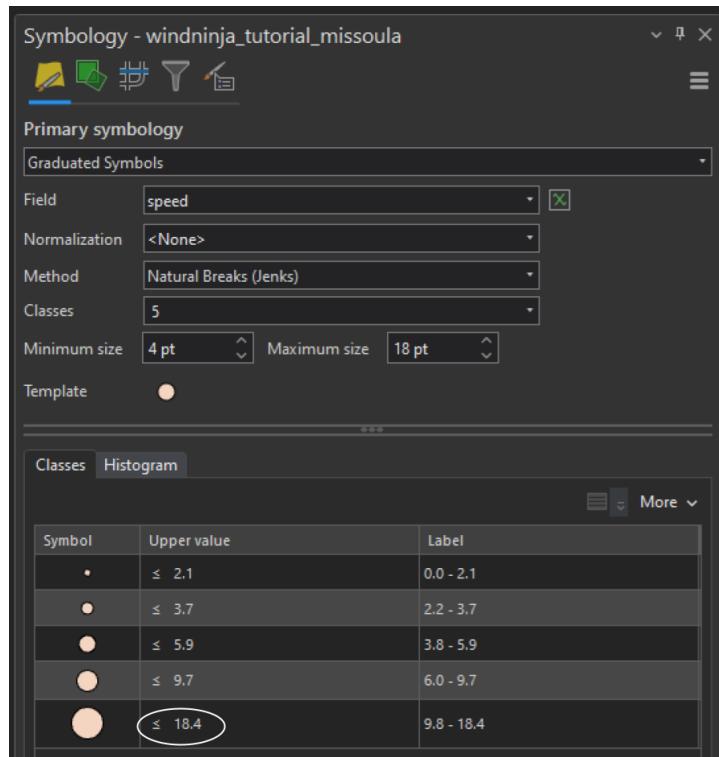


Figure 1: Error message when the number of records in the WindNinja ArcGIS Pro shapefile exceeds the default settings.

Because only **10,000 records** are used, not all of the information will be used in defining the ranges of wind speed during the rotation process. This can lead to a misunderstanding of what the actual maximum and minimum wind speed values are. For example, in Figure 2a the maximum wind speed value displayed is 7.3 mph while in Figure 2b the maximum wind speed value displayed is 18.4 mph. This happens because these statistics are based on the **total number of records**.



(a) Using default setting of 10,000 records



(b) Setting Maximum Sample size so all records are used

Figure 2: Displayed ranges of wind speed values based on Maximum Sample Size. (2a) Using default setting of 10,000 records and (2b) Setting Maximum Sample size so all records are used

To change the number of records used for the shapefile is easy. This is not a universal change to the ArcGIS Pro settings and only applies to the shapefile while active in the view. Thus, every time you add this file to another ArcGIS Pro project you will have to repeat this step. To show the statistics, click on **More** and select **Show Statistics**. Then, to show the histogram, select the **Histogram** tab next to the **Classes** tab. This will display a histogram of the classes with their statistics, as seen in Figure 3.

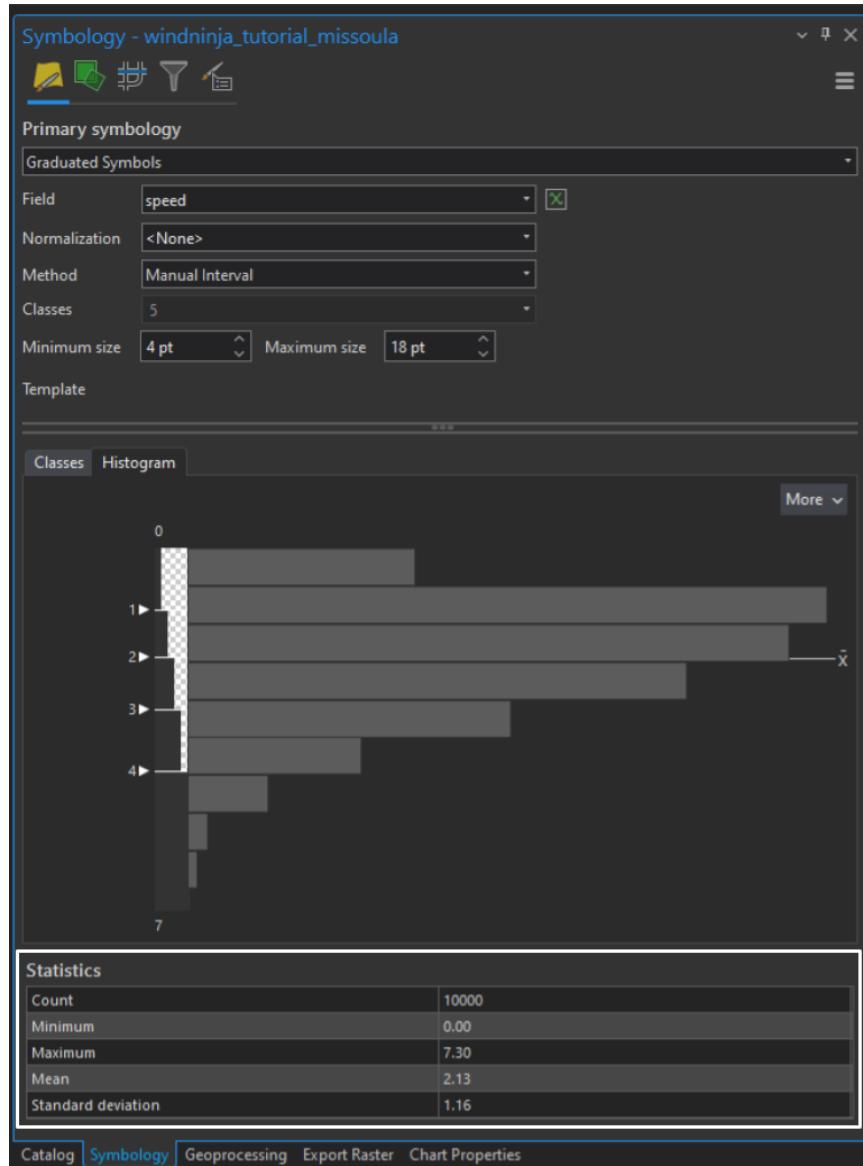


Figure 3: Histogram with the statistics option selected as displayed in ArcGIS Pro.

In the **Statistics** table you can see the number of records used (Count), minimum and maximum, mean, and standard deviation. All of these values will change based on the **Data Sampling** method selected; in this case, Count is the default value of 10,000.

Note: The number of records or sampling method chosen here does not affect summary

or statistical operations performed on the data fields within the shapefile attribute table. Operations performed on the shapefile attribute table will use all of the records available for the selected data field unless a subset of the records has been selected.

To change the **Maximum sampling size**, select the **Advanced Symbology Options** tab. This will open the window seen in Figure 4 where you will then click on the dropdown for **Sample size**.

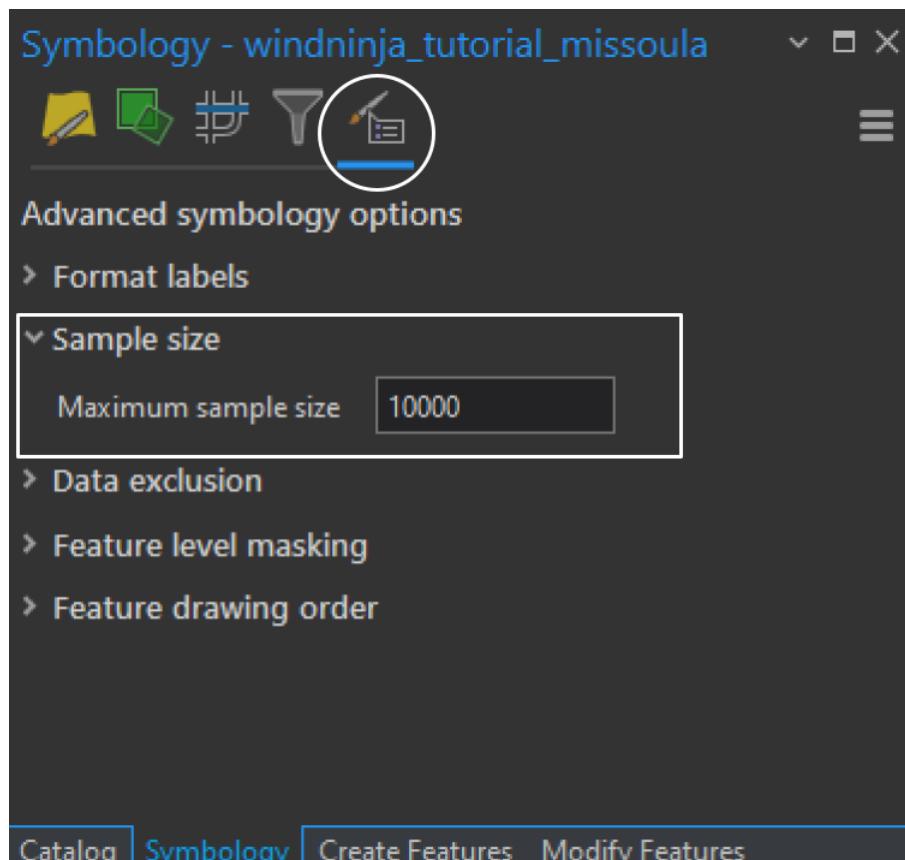
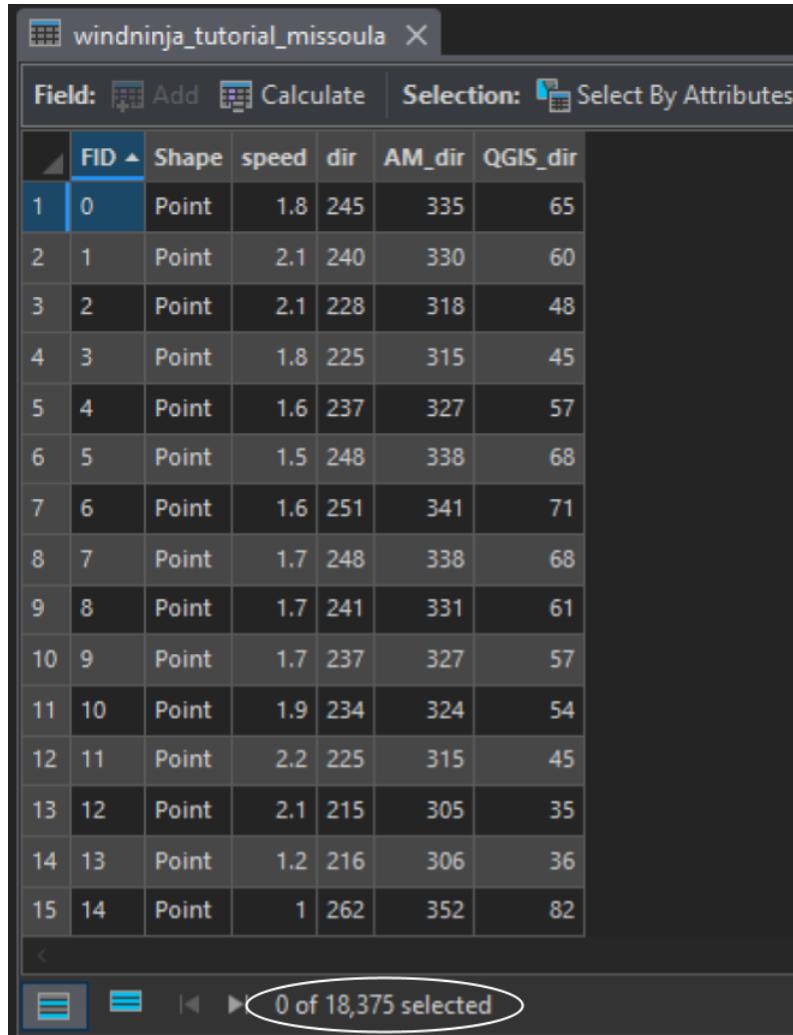


Figure 4: Input box for specifying the maximum sample size for the shapefile in ArcGIS Pro

Under **Sample Size**, you will need to change the **Maximum sample size** input used from 10,000 to a larger value (Figure 4). After changing the **Maximum Sample Size**, you should be able to exit the **Symbology** tab. For most shapefiles, changing this value to 100,000 should ensure that all records are being used. However, the number of records included in any one shapefile is determined by the size of the landscape as well as the output resolution selected in WindNinja. You may need to set this value higher in specific cases.

To see how many records are in the shapefile, you can do the following.

1. In the **Table of Contents** pane right-click on the shapefile of interest.
2. Select **Attribute Table**.
3. On the bottom of the window will be the statement “Records (0 out of ## Selected). The ## will be the total number of records in the shapefile (Figure 5). If a subset of the total number of records has been selected, this can be determined too. The number of selected records would show up where the 0 is for this example.



The screenshot shows the ArcGIS Pro Attribute Table window titled "windninja_tutorial_missoula". The table has columns: FID, Shape, speed, dir, AM_dir, and QGIS_dir. The first few rows of data are:

FID	Shape	speed	dir	AM_dir	QGIS_dir
1	Point	1.8	245	335	65
2	Point	2.1	240	330	60
3	Point	2.1	228	318	48
4	Point	1.8	225	315	45
5	Point	1.6	237	327	57
6	Point	1.5	248	338	68
7	Point	1.6	251	341	71
8	Point	1.7	248	338	68
9	Point	1.7	241	331	61
10	Point	1.7	237	327	57
11	Point	1.9	234	324	54
12	Point	2.2	225	315	45
13	Point	2.1	215	305	35
14	Point	1.2	216	306	36
15	Point	1	262	352	82

At the bottom of the table, there is a status bar that says "0 of 18,375 selected".

Figure 5: Attribute table for WindNinja-generated shapefile in ArcGIS Pro.