



Create Terrain Indices

RSAC

Remote Sensing For Ranger Districts Using Image Analysis For ArcGIS



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Assumption of Creating Terrain Indices:

- Your DEM covers your area of interest.
- Your DEM is in a GRID format.



*Ensure the Spatial Analyst extension and toolbar are enabled: 1) Select **Tools | Extension** from ArcMap's Main Menu and check **Spatial Analyst**, 2) select **View | Toolbars** from ArcMap's Main Menu and check **Spatial Analyst**, and 3) dock the **Spatial Analyst** toolbar if necessary.*



What is an Aspect Index?

An Aspect Index identifies the steepest slope direction of each pixel. A pixel's value represents an azimuth direction measuring from 0 - 360; 0 & 360 = North-facing aspects, and -1 = No aspect (i.e., flat terrain).



Identify

Objective

- To create terrain indices (aspect, slope, and curvature) from a DEM (Digital Elevation Model).

Required Data

- A DEM (in a GRID format)

Introduction and Overview of Procedure Steps

Terrain indices attempt to model different properties of the Earth's surface. Terrain indices are useful for environmental modeling. This document describes how to create three types of terrain indices—aspect, slope, and curvature. The major topics are:

1. Set-up ArcMap
2. Create an Aspect Index
3. Create a Slope Index
4. Create a Curvature Index
5. Classify Your Curvature Image

I. Set-up ArcMap

1. Launch **ArcMap** from the **Start** menu (**Start | Programs | ArcGIS | ArcMap**).
2. Select the **Add Data** button from **ArcMap's Standard** toolbar.
3. Navigate to and select a **DEM**.
4. Select **Add** to load the **DEM** into **ArcMap's Table of Contents**.
5. Create pyramid layers if you wish (Note: At this point, a Pixel Type Warning dialog may appear. Simply click OK to dismiss it).
6. Ensure the **Spatial Analyst** toolbar and extension are enabled (see note to left).

II. Create an Aspect Index

1. Select **Spatial Analyst | Surface Analysis | Aspect** from the **Spatial Analyst** toolbar to open the **Aspect** dialog. Set the following parameters in the **Aspect** dialog:
 - **Input Surface:** *your DEM*
 - **Output Cell Size:** *will automatically populate when you set your Input Surface*
 - **Output Raster:** *select the Yellow Folder button, navigate to an appropriate output directory, ensure the **Save As Type** is set to **ESRI GRID**, type in the Output File **Name**, and select **Save**.*
 - Select **OK** to run the process. Your **Aspect Image** will automatically display in the **Data View** once finished (Note: At this point, a Pixel Type Warning dialog may appear. Simply click OK to dismiss it).



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What is a Slope Index?

A Slope Index identifies the percent rate of change from a flat surface of each pixel. A pixel's value is calculated as the percent rate of elevation change over the distance from neighboring cells [(Rise/Run) *100].



Z-factor. The Z-Factor is used to convert Z units to the units of X and Y. For example, if your X and Y units are in meters, and your Z units are in feet, use a Z-Factor of 0.3048 to convert feet to meters. **If X, Y, and Z units are the same, then set the Z-Factor to 1.**



What is a Curvature Index?

A Curvature Index identifies the surface curvature of each cell—concave (curved inward), convex (curved outward), or flat.

2. Select the **Identify** button from **ArcMap's Tools** toolbar and click pixels on your **Aspect Image** in the **Data View**. Ensure the **Pixel Values** seem correct.

III. Create a Slope Index

1. Select **Spatial Analyst | Surface Analysis | Slope** from the **Spatial Analyst** toolbar to open the **Slope** dialog. Set the following parameters in the **Slope** dialog:
 - **Input Surface:** *your DEM*
 - **Output Measurement:** *enable Degree or Percent*
 - **Z Factor:** *set so that your Z units are the same as your X and Y units* (see comments to the left)
 - **Output Cell Size:** *will automatically populate when you set your Input Surface*
 - **Output Raster:** *select the Yellow Folder button, navigate to an appropriate output directory, ensure the Save As Type is set to ESRI GRID, type in the Output File Name, and select Save*
 - Select **OK** to run the process. Your **Slope Image** will automatically display in the **Data View** once finished.
2. Select the **Identify** button from **ArcMap's Tools** toolbar and click pixels on your **Slope Image** in the **Data View**. Ensure the **Pixel Values** seem correct.

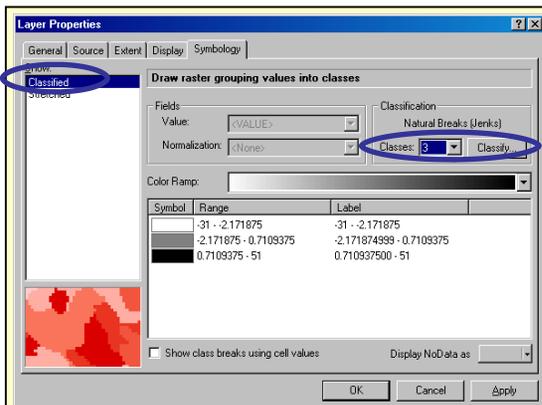
IV. Create a Curvature Index

1. Select **Spatial Analyst | Options** from the **Spatial Analyst** toolbar, and ensure that the **General** tab is displayed in the **Options** dialog.
2. Select the **Yellow Folder** button associated with the **Working Directory**, and navigate to an appropriate output directory to set the **Working Directory** (the **Working Directory** is where outputs from the **Raster Calculator** will be saved).
3. Select **OK** to close **Choose a Working Directory** dialog.
4. Select **OK** to close the **Options** dialog.
5. Select **Spatial Analyst | Raster Calculator** from the **Spatial Analyst** toolbar to open the **Raster Calculator**.
6. Type in the following expression in the **Formula Area** of the **Raster Calculator**:

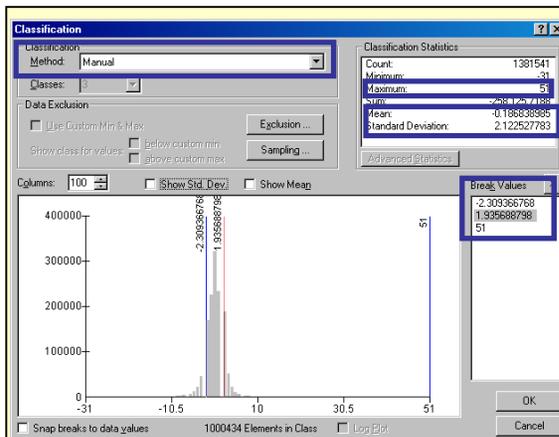
$$\text{curve_image}^a = \text{curvature}([\text{your DEM}]^b)$$
 - ^a = Type your output file name here
 - ^b = Type in the file name of your **DEM**
7. Select the **Evaluate** button from the **Raster Calculator**.
8. Select **OK** to dismiss the **Pixel Type Warning**. Your **curve_image** should automatically display in the **Data View**.



Create Terrain Indices



This graphic illustrates the **Symbology** tab of your **Curvature Image**. Please note the circled options for classifying the image.



This graphic illustrates the **Classification** dialog. Please note the location of the highlighted options specified in the instructions.

V. Classify Your Curvature Index

- Double-click your **curve_image** in the **Table of Contents**, and select the **Symbology** tab from the **Layer Properties** dialog. Set the following parameters in the **Symbology** tab:
 - Show:** *Classified*
 - Classes:** *3*
 - Select the **Classify** button
- Select **Manual** from the **Classification Method** pulldown menu in the **Classification** dialog.
- Write down from the **Classification Statistics** section of the **Classification** dialog your:
 - Maximum:** _____
 - Mean:** _____
 - Standard Deviation:** _____
- Subtract your **Standard Deviation** from your **Mean**. Write your answer here: _____
- Add your **Standard Deviation** to your **Mean**. Write your answer here: _____
- Single-click the first number from the **Break Values** section of the **Classification** dialog, and type your answer from **Step 4**. This is your first *break value* (or class).
- Press the **Enter** key (on the Keyboard).
- Type your answer from **Step 5**. This is your second *break value*.
- Press the **Enter** key.
- Type in your **Maximum** value. This is your third *break value*.
- Verify your *break values*, and then select **OK** to close the **Classification** dialog.
- Note the three classes (and their associated data ranges) you have created in the **Symbology** dialog. All values within the first standard deviation are classified as **flat or gently curving**, values less than the first standard deviation are classified as **concavely curved**, and values greater than the first standard deviation are classified as **convexly curved**.
- Double-click on the **Color Box** associated with each **Class** to change the **Class's** color (if you wish).
- Select **Apply** and then **OK** to close the **Layer Properties** dialog.
- Inspect the results of your **Curvature Classification** in the **Data View**.
- Feel free to experiment with your break values to produce a curvature classification more suitable for your project. The classification method we have described here is designed to get you started.