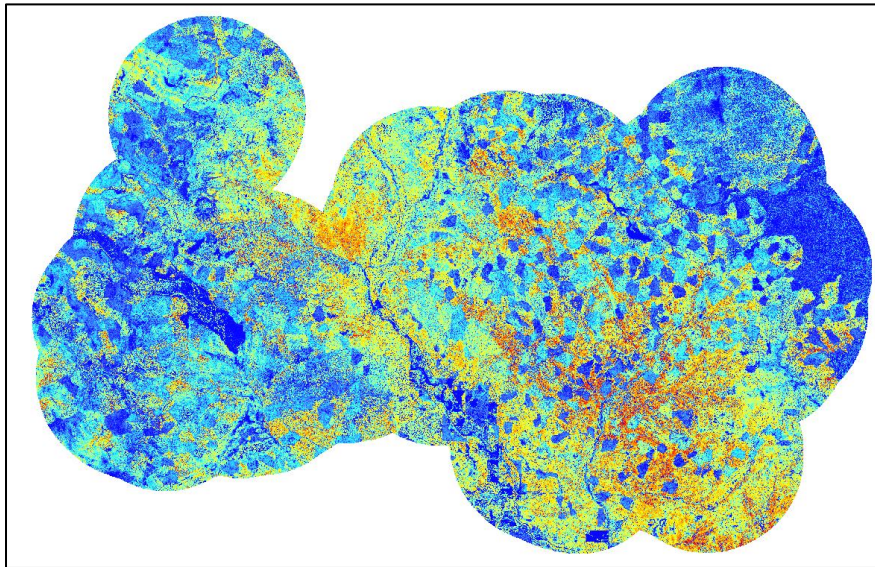


EXERCISE 1

Prepare Data for Landing Zones Workflow



Introduction

Lidar is becoming increasingly integral to remote sensing activities in the US Forest Service, especially as the applications of this technology continue to expand. Lidar's ability to measure both vegetation and the bare earth surface in heavily forested areas means that land managers in the Forest Service can use it to study vegetation dynamics and identify patterns on the earth's surface. One of the main obstacles to lidar applications has been the cost of acquiring lidar data at a large scale. However, the Pacific Northwest region (R6) of the Forest Service has made acquiring lidar data for all forests in the region a priority, which has encouraged Forest Service personnel to investigate new applications of lidar data, one of which is communicated in this set of exercises. The following exercises walk you through the process of using lidar derivatives (i.e., digital elevation model [DEM], canopy height model) to identify suitable sites for landing helicopters that are involved in logging activities on the Gifford Pinchot National Forest in Washington. This first exercise is focused on the initial processing of lidar derivatives that you will use throughout these exercises.

Objectives

- Create study area shapefile



- Clip lidar DEM and Canopy Height data
- Calculate slope layer

Required Data

- **CandidateStands.shp**—a shapefile with a collection of candidate logging stands that will be used to create a study area.
- **CanopyHeight.tif**—a half-meter canopy height raster clipped to study area.
- **CanopyCover.tif**—a 10-meter canopy cover raster (or closure) clipped to the study area.
- **DEM.tif**—a 1-meter digital elevation model clipped to the study area.
- **If using data from T drive (T:\FS\Reference\GIS\r06\LayerFile\ImageryAndClassifiedImagery):**
 - **LiDAR_BareEarth_DEM_Gray.lyr**—a 1-meter lidar-derived digital elevation model that covers all Region 6 lidar acquisitions.
 - **LiDAR_CanopyHeights_Gray_meters.lyr**—a half-meter canopy height raster that covers all Region 6 lidar acquisitions.
 - **LiDAR_CanopyClosure_Gray.lyr**—a 10-meter lidar-derived canopy cover (or closure) raster that covers all Region 6 lidar acquisitions. This layer is referred to as CanopyCover in the data that was provided in the LandingZones folder.

Prerequisites

- **Install Esri ArcMap on computer and have basic understanding of how to use the software.**





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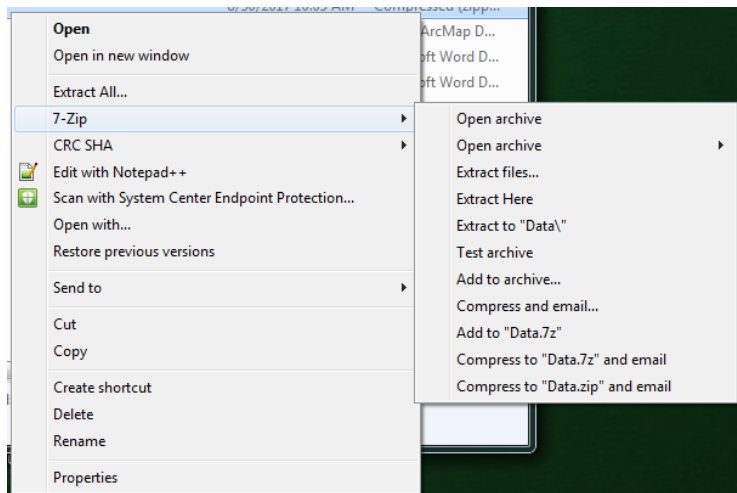
Part 1: Set Up ArcMap

A. Start ArcMap

1. Open ArcMap by clicking the Start button and navigating to **All Programs, ArcGIS, and then ArcMap 10.x.**

B. Unzip LandingZones Folder

1. Open a Windows Explorer window and navigate to the **C Drive**.
2. Click the **New Folder** button at the top of the window and name the new folder **LandingZones**.
3. **Copy** (Ctrl+C) the data folder you were provided and paste the folder into this new folder.
4. Next, right click **LandingZones.zip**, hover over **7-Zip** and select **Extract Here** (see below).



C. Add Data

1. Click the **Add Data** button (see below).



2. Navigate to the location of the **LandingZones** folder (**C:\LandingZones**) that was provided to you and add **CandidateStands.shp** from the **Shapefiles** folder. Also add **DEM.tif**, **CanopyCover.tif**, and **CanopyHeight.tif** from the **Rasters** folder.
 - i. If you are planning to use this workflow for your own study area, then you can add the below rasters to ArcMap from this T drive location:
T:\FS\Reference\GIS\r06\LayerFile\ImageryAndClassifiedImagery
 - (a) LiDAR_BareEarth_DEM_Gray.lyr
 - (b) LiDAR_CanopyHeights_Gray_meters.lyr
 - (c) LiDAR_CanopyClosure_Gray.lyr (This is synonymous with canopy cover)
 - ii. Instruction for clipping this data is detailed in **Part 4**.

D. Activate Spatial Analyst Extension

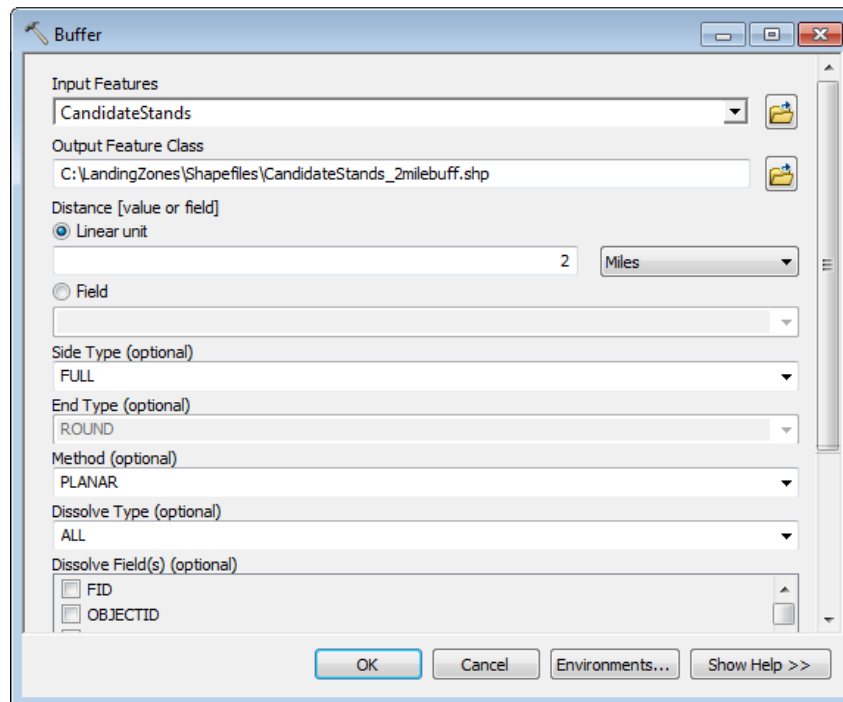
1. Click on the **Customize** drop down at the top of the ArcMap window and select **Extensions**.
2. In the Extensions window, click the box next to **Spatial Analyst** to turn it on and click **Close**.
 - i. You can now access and use all of the tools in the Spatial Analyst toolbox.

Part 2: Create Study Area

The study area for these exercises centers on a set of candidate logging sites on the Gifford Pinchot NF that are represented by a set of 146 polygons that range from 4 to 153 acres in area. Since one of the primary parameters for selecting a helicopter landing zone is proximity to the logging site, you will buffer these candidate stands by 2 miles, which is the maximum distance that a landing zone should be from the logging site. This buffered area will provide you with a study area that you use in this and in following exercises.

A. Buffer Candidate Logging Stands

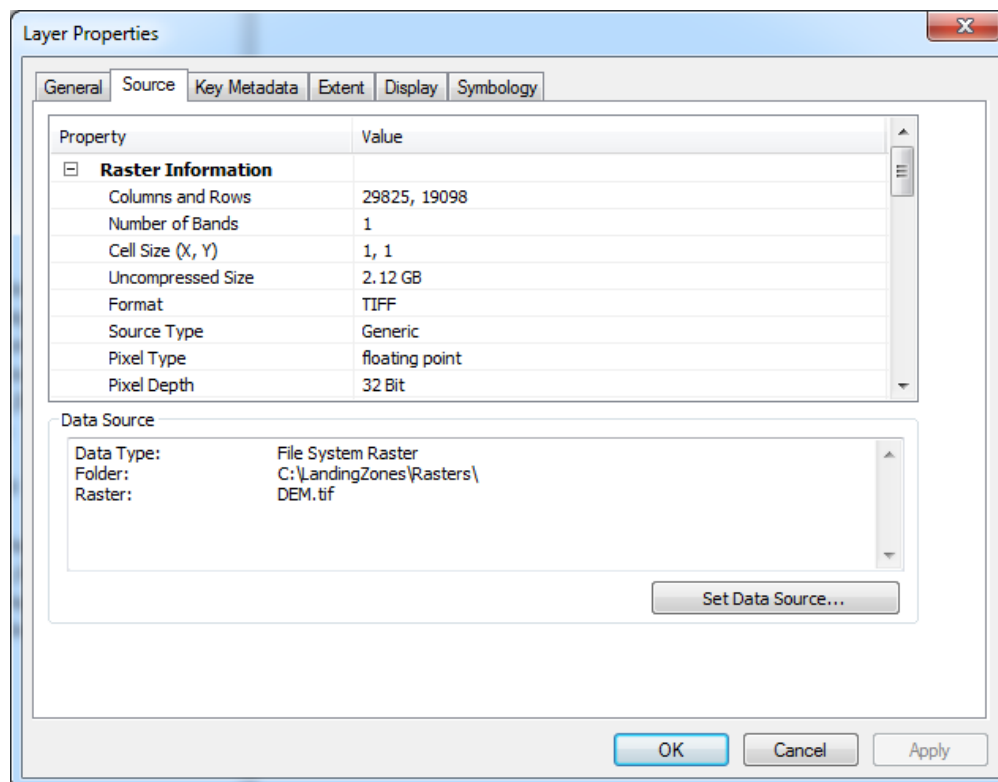
1. Click the **Geoprocessing** drop down at the top of the **ArcMap** window and select **Buffer**.
2. In the Buffer window that opens, set the Input Feature as **CandidateStands**.
3. Click the folder next to the Output Feature Class and navigate to the location of the **LandingZones** folder.
4. In the Shapefiles subfolder, name the output **CandidateStands_2milebuff.shp** and click **Save**.
5. Type **2** into the **Linear Unit** parameter and change the dropdown to the right from Meters to **Miles**.
6. Change the **Dissolve Type** to **ALL** and leave the other parameters as their default.
7. Click **OK** to run the Buffer tool (see below).



Part 3: Examine Raster Data

A. Examine Layer Properties

1. In your table of contents (TOC), double click **DEM.tif** to open the **Layer Properties** window.
2. Select the **Source** tab and scan the **Raster Information** and **Spatial Reference** sections to get a grasp on the type of information that is contained in the layer properties.
3. Now, focus specifically on the **Cell Size (X, Y)**, **Uncompressed Size**, **Pixel Type** and **Pixel Depth** properties (see below).



- i. The **Cell Size (X, Y)** is 1, 1, which means that the data has a spatial resolution of 1 meter.
 - ii. The **Uncompressed Size** is 3.22 GB, which is pretty cumbersome. One of the main reasons the size is so large is due to the high spatial resolution.
 - iii. The **Pixel Type** is floating point, which means the data values are in decimal format. The other potential pixel type is integer, which is important to know for a later exercise.
 - iv. The **Pixel Depth** is 32 Bit, which refers to the radiometric resolution.
4. The last two properties (pixel depth & type) are a couple basic data characteristics that you should keep an eye on as you process the data, because you will want to maintain consistent properties throughout the workflow.
 5. Next, double click the **CanopyHeight** layer in the TOC.
 6. Notice that the **Cell Size (X, Y)** is smaller: 0.5, 0.5.
 7. As expected, with the higher resolution (smaller cell size) comes an increased data size.

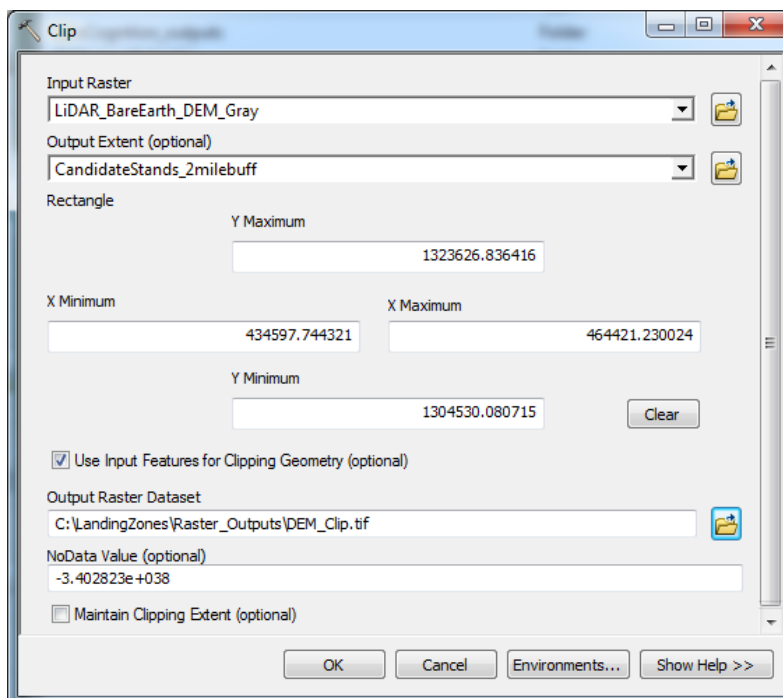
8. The **Pixel Type & Depth** properties are the same as they were with the **DEM** raster.
 - i. The **Spatial Reference** properties are also the same for the two datasets. This is something you want to ensure is consistent across all datasets, including shapefiles and rasters.

Part 4: Clip Rasters to Study Area (optional)

If you are using the .lyr data from the T drive, then you will need to clip the DEM, canopy height and canopy cover data to the study area before you begin assessing areas that could be potential landing zones. The below instructions will use the buffered candidate stands shapefile created in Part 2. If you are using a different study area, then simply substitute your own shapefile with the CandidateStands_2milebuff.shp. The .lyr files on the T Drive are extremely large datasets, so this clipping process could take over an hour to complete. **If you are using the data provided in the LandingZones folder, you can skip this part.**

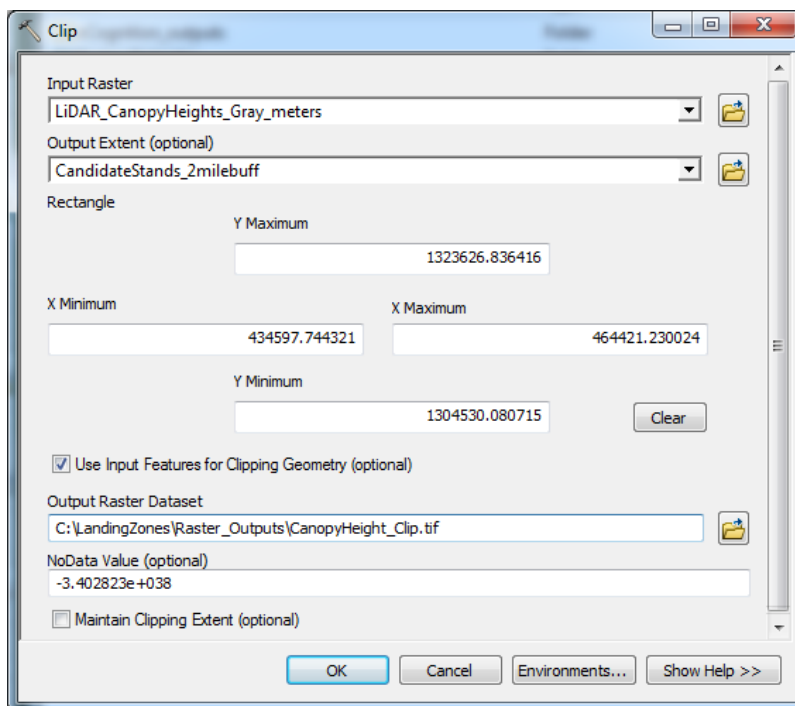
A. Clip DEM

1. Open the **Clip (Raster)** tool by opening ArcToolbox and navigating to **Data Management Tools, Raster, and then Raster Processing**.
2. Click the drop down arrow under **Input Raster** and select **LiDAR_BareEarth_DEM_Gray**.
3. For the **Output Extent**, select **CandidateStands_2milebuff.shp** (or your own study area .shp).
4. Click the box next to **Use Input Features for Clipping Geometry** to check it.
5. Click the folder icon next to **Output Raster Dataset** and navigate to the **Raster_Outputs** subfolder within the **LandingZones** folder.
6. Name the output **DEM_clip.tif** and click **Save**.
7. Click **OK** (see below).



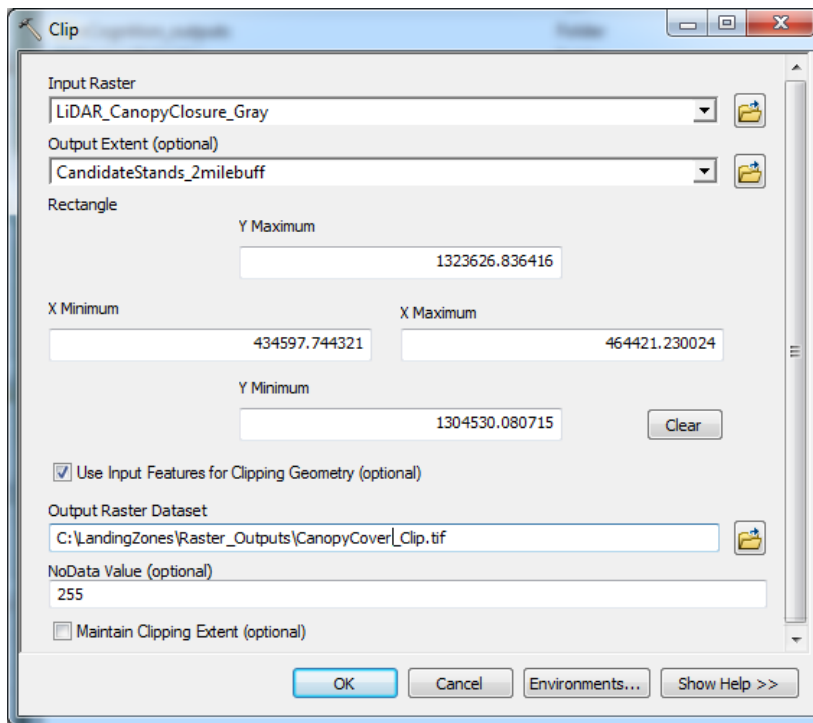
B. Clip Canopy Height

1. Open the **Clip** (Raster) tool by opening ArcToolbox and navigating to **Data Management Tools, Raster, and then Raster Processing**.
2. Set **LiDAR_CanopyHeights_Gray_meters** as the Input Raster.
3. For the Output Extent, select **CandidateStands_2milebuff.shp**.
4. Click the box next to **Use Input Features for Clipping Geometry** to check it.
5. Click the folder icon next to Output Raster Dataset and navigate to the **Raster_Outputs** subfolder within the **LandingZones** folder.
6. Name the output **CanopyHeight_clip.tif** and click **Save**.
7. Click **OK** (see below).



C. Clip Canopy Cover

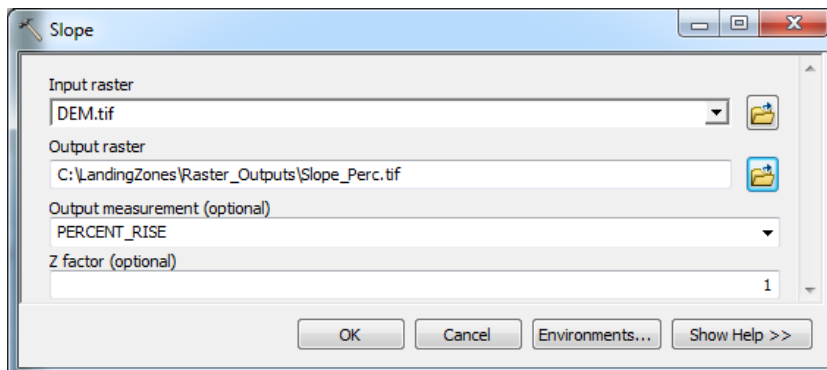
1. Open the **Clip** (Raster) tool by opening ArcToolbox and navigating to **Data Management Tools, Raster, and then Raster Processing**.
2. Set **LiDAR_CanopyClosure_Gray** as the Input Raster.
3. For the Output Extent, select **CandidateStands_2milebuff.shp**.
4. Check the box next to **Use Input Features for Clipping Geometry** to check it.
5. Click the folder icon next to **Output Raster Dataset** and navigate to the **Raster_Outputs** subfolder within the **LandingZones** folder.
6. Name the output **CanopyCover_clip.tif** and click **Save**.
7. Click **OK** (see below).



Part 5: Calculate Slope

A. Open Slope Tool

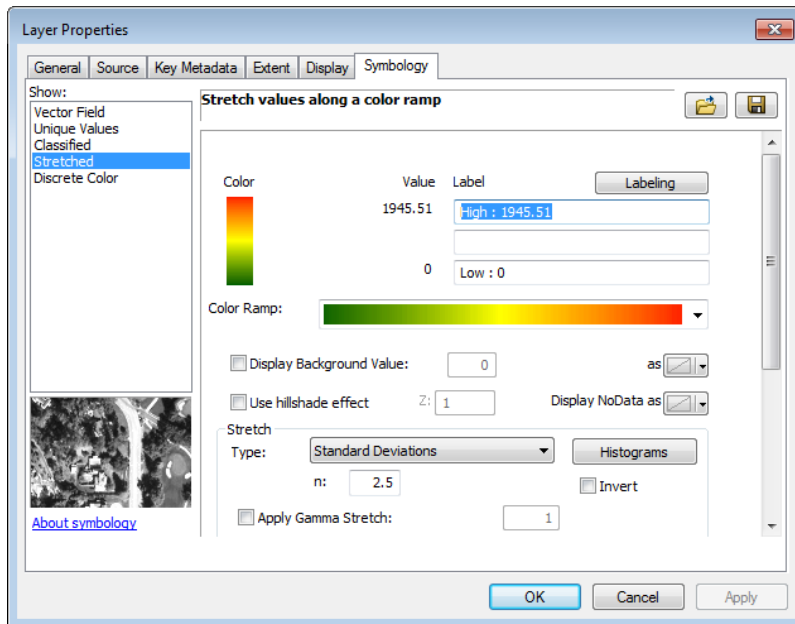
1. Open the **Slope** tool by opening the ArcToolbox and navigating to **Spatial Analyst Tools**, and then **Surface**.
2. Set **DEM.tif** as the Input raster, or **DEM.clip.tif** if you used the data from the T Drive.
3. Click the folder icon next to Output raster and navigate to the **Raster_Outputs** subfolder within the **LandingZones** folder.
4. Name the output **Slope_Perc.tif** and click **Save**.
5. Ensure that the Output measurement is set to **PERCENT_RISE** and click **OK** (see below).



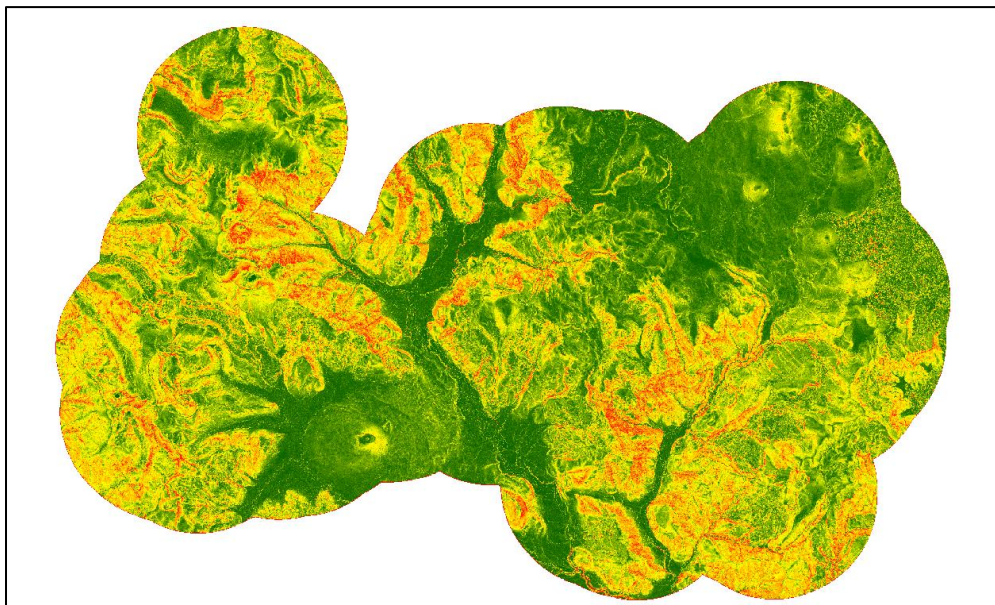
Note: The Z factor should be set to 1 unless the Z units in your DEM are different from the X, Y units. If, for instance, the X, Y units are meters and the Z units are feet, you would need to enter the conversion

factor for meters to feet (0.3048). This sort of information about X, Y and Z units should be outlined in the metadata that is provided with every lidar acquisition. Typically, all of the data has the same units, and in the case of the Region 6 data, the X, Y & Z units are indeed in meters.

6. When the Slope tool is done processing, the new **Slope.tif** layer is added to your TOC.
7. Change the symbology by double clicking on **Slope_Perc** in the TOC.
8. Select the **Symbology** tab and choose the **Stretched** option in the column on the left.
9. Click the **Color Ramp** drop down and select the ramp shown in the image below.



10. The map should now look similar to the below image.





- i. If you'd like, use the same inverted color ramp for the **CanopyHeight_clip.tif** layer. This will accentuate the patchiness of the study area caused by tree harvesting.

B. Save ArcMap

1. Click the **Save** button at the top left of your ArcMap session.
2. In the **Save As** window that pops up, navigate to the **LandingZones (C:\LandingZones)** folder and name the file **LandingZones**.
3. Click **Save**. This will allow you to open the same workspace for later exercises when you need to continue working in ArcMap.

Congratulations! You have successfully completed this exercise. You are now familiar with the basic steps required to prepare your lidar derivatives for this workflow. Now you have the necessary data to create segments using eCognition software.

