Earth Imagery at Work MOOC

Exercise

Forest Fires in Australia with ArcGIS Pro

Section 3 Exercise 2

08/2017

THE SCIENCE OF WHERE™

Forest Fires in Australia with ArcGIS Pro

Instructions

Use this guide and ArcGIS Pro to reproduce the results of the exercise on your own.

Note: The version of ArcGIS Pro that you are using for this course may produce slightly different results from the screenshots you see in the course materials.

Time to complete

Approximately 45-50 minutes.

Software requirements

ArcGIS Pro version 2.0.1

Introduction

This exercise uses the Landsat data that you saw in a previous exercise about the Chernobyl nuclear disaster. In this exercise, though, you will identify burn scars in Australia after a series of wildfires that happened in 2013. You'll identify the scope of the burned areas and then use a vegetation index to see how the vegetation has regenerated since the fire.

The purpose of this exercise is to demonstrate how you can use multispectral data at a moderate resolution to better understand how vegetation responds to fire.

You've already seen how satellite imagery can be used to travel back in time to observe remote areas. You can also use it to extend your vision beyond what you can normally see with your eyes. Humans see in what is called the visible portion of the electromagnetic spectrum, which encompasses red, blue, and green energy. A multispectral satellite like Landsat can see beyond these energy wavelengths, from near infrared to shortwave infrared to even thermal energy. These wavelengths are important because certain features on the earth respond differently in these wavelengths.

Vegetation tends to be green because it reflects some of the green energy that it receives from the sun while absorbing blue and red energy. However, it also reflects, to a much greater degree, the amount of near infrared energy it receives. When a plant has strong, healthy cells it can reflect nearly all of the near infrared energy that comes its way. Although humans can't see near infrared, it's not difficult for a satellite to do so. (In fact, it's not hard to hack a personal camera to capture images in near infrared, either.) Scientists use this characteristic of reflecting near infrared while absorbing red energy to identify vegetation and assess how healthy it is.

As you move down the electromagnetic spectrum, shortwave energy is the next range that Landsat collects. While the cell structure of a plant is what enables it to reflect near infrared energy, in this part of the spectrum, it is the amount of moisture held in the plant that allows the plant to absorb short-wave energy. When a plant is drying out, it is unable to absorb this energy. In this exercise, you will take advantage of these characteristics and Landsat's spectral capabilities to identify the extent of burned areas and then watch the vegetation in that area regenerate in the following years.

Exercise scenario

In this scenario, you are using the multispectral bands of Landsat to see beyond what human eyes can observe. Multispectral bands have several environmental uses, depending on what you are trying to observe. Similar to what you did in the Chernobyl exercise, you will identify a baseline and then observe how the environment has changed since then.

In October of 2013, extremely hot and dry conditions were present in New South Wales, Australia, providing ripe conditions for a series of wildfires that were set naturally, intentionally by humans, and by accident. Two people died as a result of the fire, and damages were estimated at nearly $100 million. Some of the causes for the human-induced fires included deliberate arson, an explosives training exercise, sparking power lines, and a subterranean coal mine fire that reignited a previously contained fire.

New South Wales, Australia.

Earth Imagery at Work

Using ArcGIS Pro and Imagery to Identify Burn Scars

Using ArcGIS Pro and Landsat 8 imagery, you will explore the fire burn area in New South Wales, Australia.

Step 1: Create a map for multispectral analysis

In this step, you will create a new map project and add some pre- and post-fire imagery.

a. Start ArcGIS Pro, and create a new Map Project.

   Hint: Use the Map.aptx project template.

b. Name the project **Burn Scars** and save it in the default location.

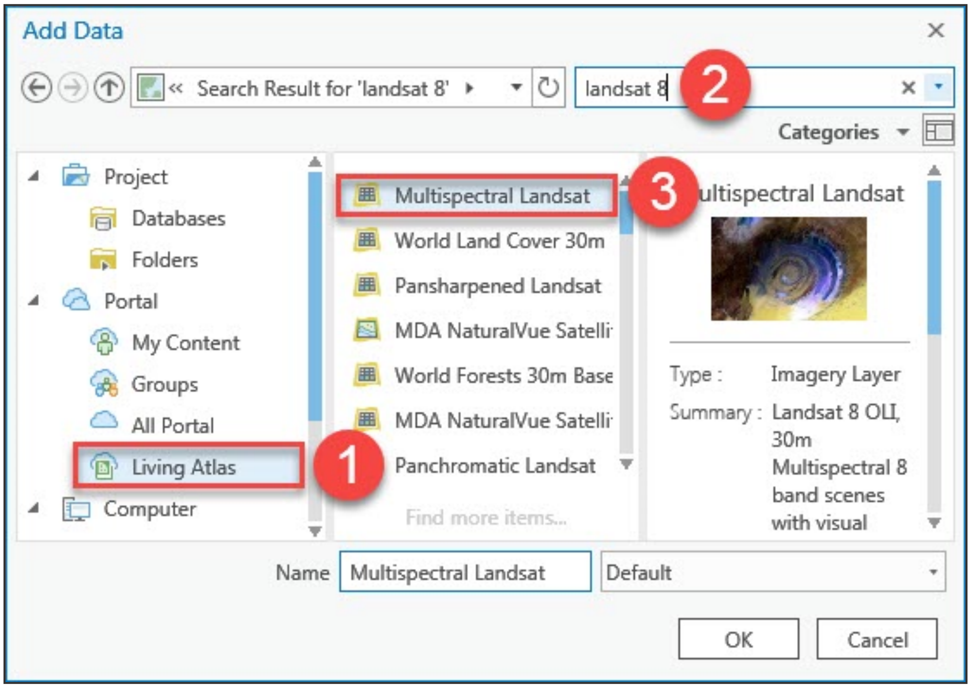
   Note: If you have not already done so, you will need to sign in using your ArcGIS account credentials. If you need to review how to sign in to ArcGIS Pro, refer to the Download and Install ArcGIS Pro exercise in Section 1. If you have trouble signing in, email gistraining@esri.com for assistance.

You will use four Landsat image services of the burn area in this exercise: one shows what the area looked like before the fire, while the other three show the area after the fire and three years later. You will load the four Landsat image services into the map.

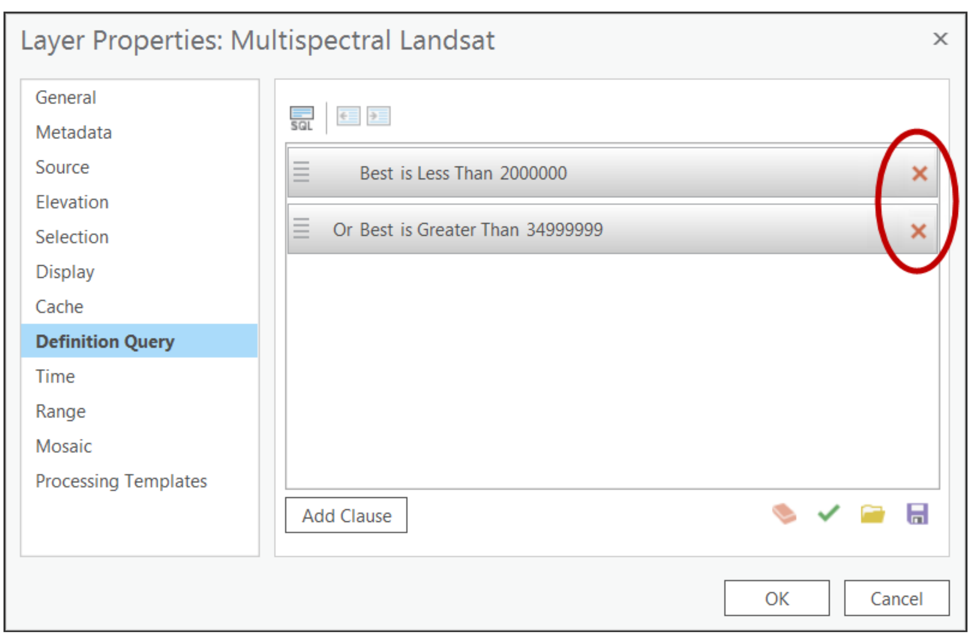
c. From the Map tab on the ribbon, in the Layer group, click the Add Data dropdown, and then click Data.

d. Under Portal, Select Living Atlas, then type **Landsat 8** in the Search window and press Enter.

e. Add the Multispectral Landsat imagery layer to the map by selecting its name, then press OK.

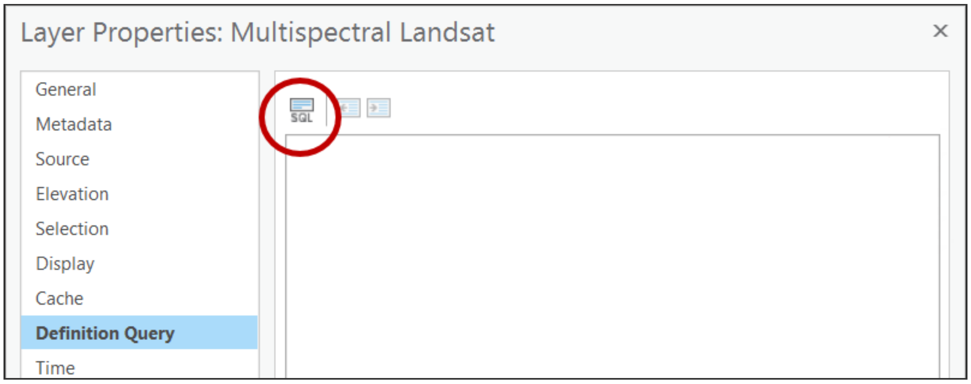


- (f) In the Contents pane, right-click the Multispectral Landsat layer and open the Properties window.
- (g) In the Layer Properties window, from the Definition Query tab, hover the mouse pointer over each clause and click the red X to the right of the clause. Remove both clauses.



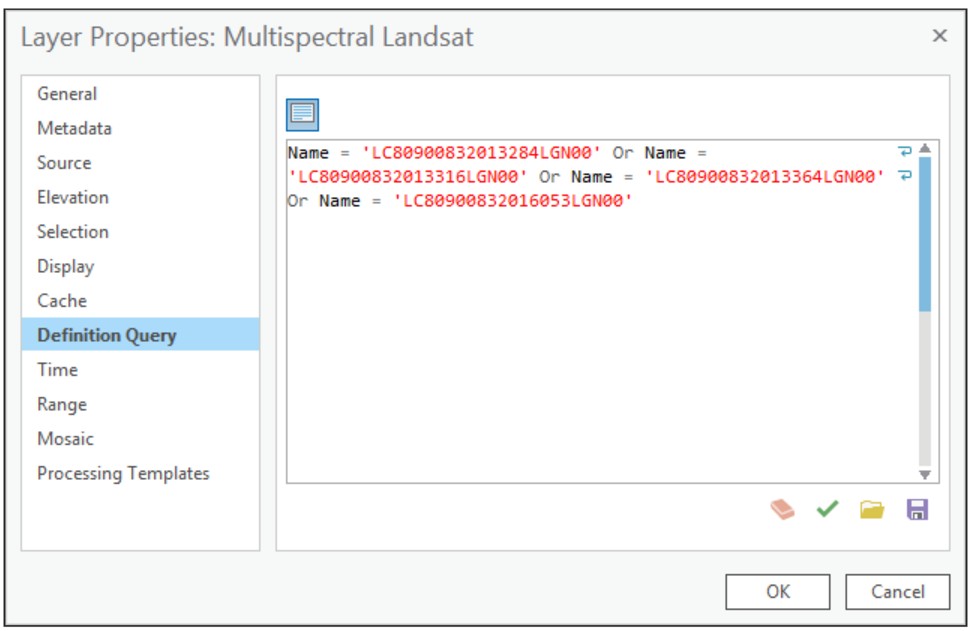
Next, you will add four clauses to select only the images that you need for this exercise by writing a SQL expression.

h. At the top of the Layer Properties window, click the SQL button.



i. Copy and paste the following text into the Layer Properties window:

j. **Name = 'LC80900832013284LGN00' Or Name = 'LC80900832013316LGN00' Or Name = 'LC80900832013364LGN00' Or Name = 'LC80900832016053LGN00'**



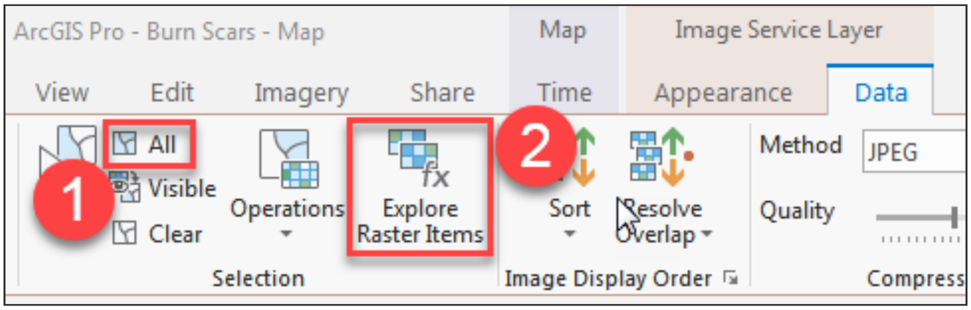
k. Click OK to close the Layer Properties window.

l. In the Contents pane, select the Multispectral Landsat layer, and then open the Data tab of the Image Service Layer ribbon.

m In the Selection group, click All to select all features in the layer.

After you click All, the Explore Raster Items button becomes activated.

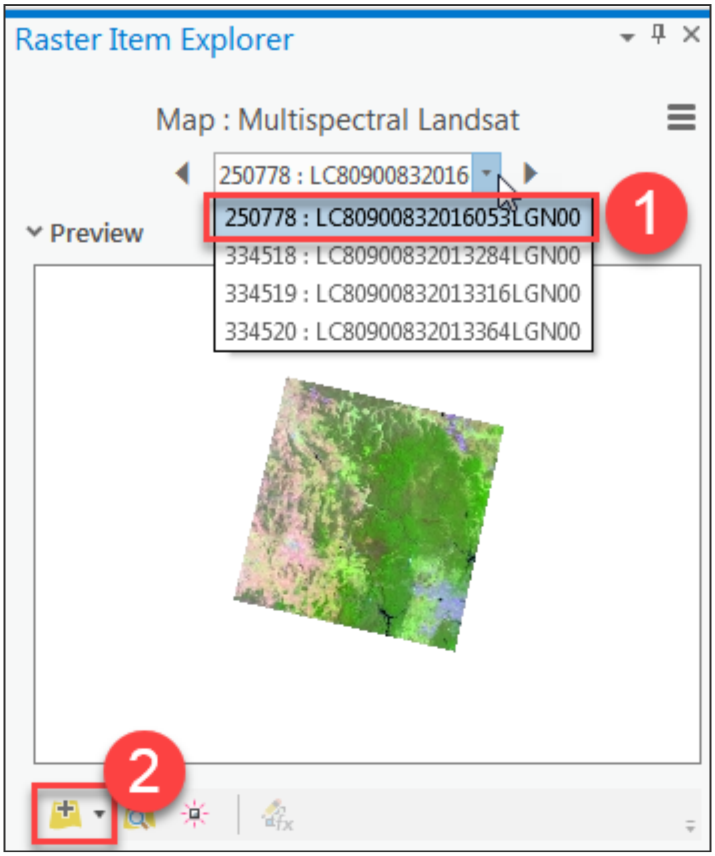
n Click the Explore Raster Items button.



The Raster Item Explorer pane has a Preview window and a drop-down list that has each of the Landsat images you have selected.

o From the drop-down list, choose the first scene, and then click Add To Current Map.

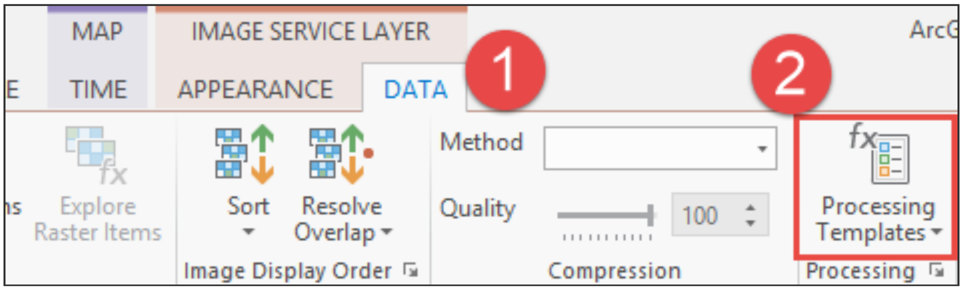
p Repeat this process for each of the other three images so that all four images are added to the map.



q Close the Raster Item Explorer pane.

r For each of the images that were just added to the map, perform the following actions:

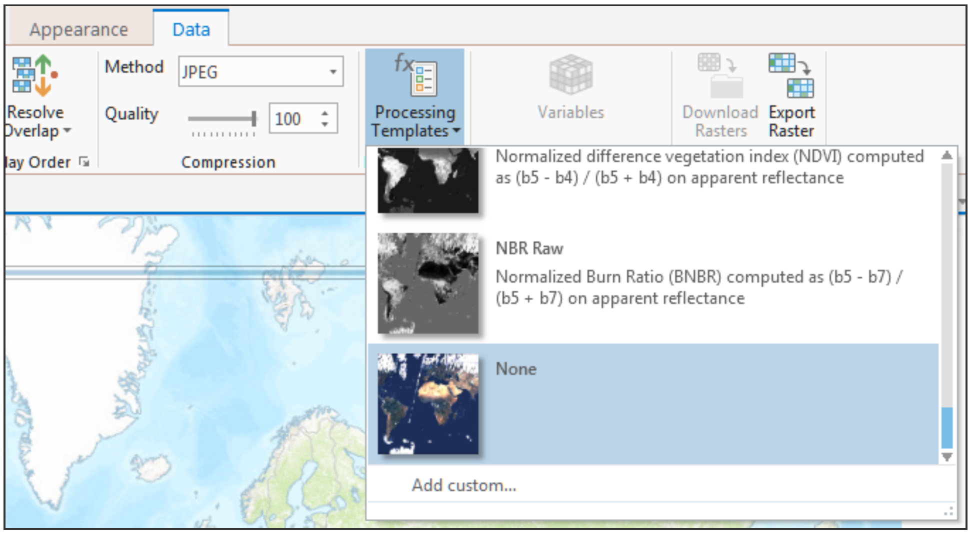
- In the Contents pane, select the image.
- In the Image Service Layer section of the ribbon, click the Data tab.



On the Data tab, you'll see a section for Processing Templates. These templates are like layers that display imagery using different bands or indexes.

- From the Processing Templates drop-down list, choose None.

Note: This is the last item in the list, so you will have to scroll down to find it.



Hint: Perform these same actions on each of the four images to ensure processing templates are removed.

Step 2: Rename imagery layers

The names for Landsat images can be difficult to read if you're not used to seeing them. To make this exercise easier to follow, you will change the names of each image to match the date when they were acquired.

a. For each of the four Landsat images, right-click the image name, and from the drop-down list, click Properties.

b. In the Layer Properties dialog box, select the General tab.

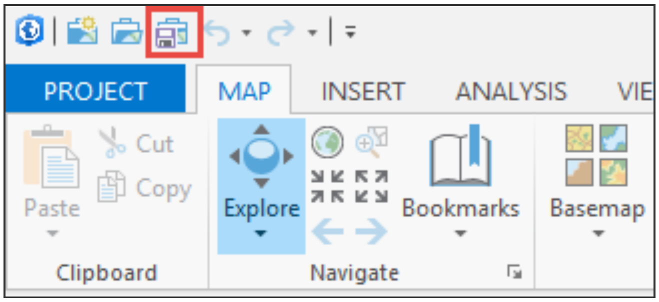
c Under Name, type the new name, as indicated below:

- For LC80900832013284LGN00, type **11Oct2013PreFire**.
- For LC80900832013316LGN00, type **12Nov2013**.
- For LC80900832013364LGN00, type **30Dec2013**.
- For LC80900832016053LGN00, type **22Feb2016**.

Hint: You can also select an image, press F2 on your keyboard, type in the new name, and press Enter or Tab to exit.

d Click OK to close the Layer Properties window.

e After renaming the four images, click Save to save your project.



Step 3: Explore pre- and post-fire imagery

Now, you will look at the pre-fire imagery.

a In the Contents pane, remove the Multispectral Landsat image, and turn off all images except the 11Oct2013PreFire image.

Hint: To remove an image, right-click the image, and from the drop-down, choose Remove. To turn off a layer, in the Contents pane, uncheck the box to the left of the layer name.

b Select the 11Oct2013PreFire image and zoom to it by right-clicking the image and choosing Zoom To Layer.

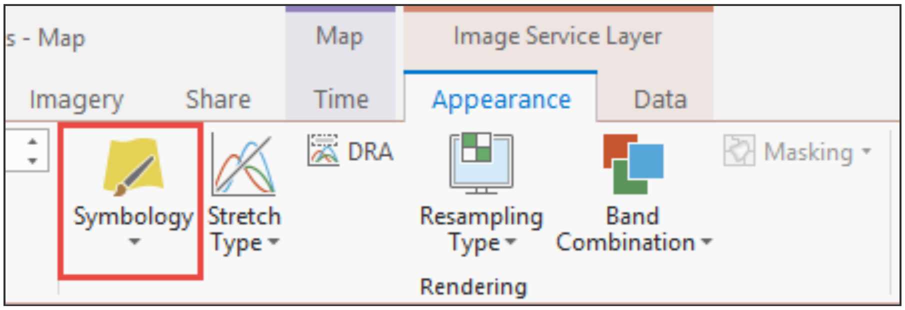
c Use the scroll wheel on the mouse to zoom into the southeast corner of the image.

Although the burn scars are in the eastern part of the image, it is important to understand the entire context of the image.

d Ensure that the 11Oct2013PreFire image is selected in the Contents pane, and then under the Image Service Layer, click the Appearance tab.

On the Appearance tab, in the Rendering section, you'll see a suite of tools for controlling how your imagery is displayed.

e Open the Symbology pane.



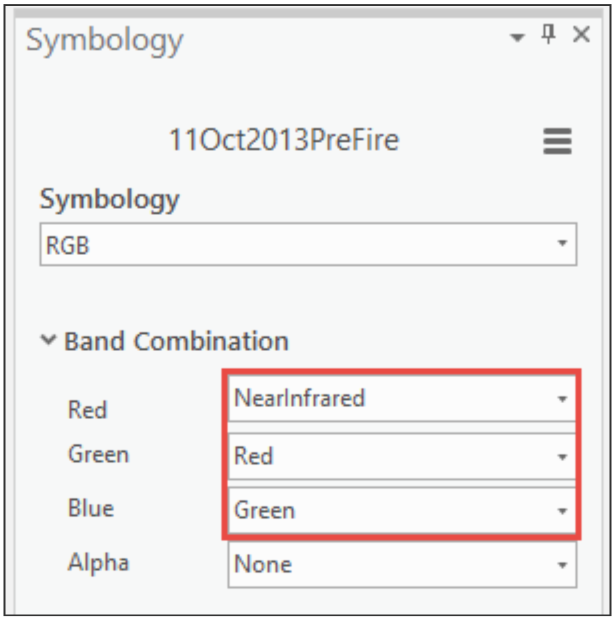
Band combinations allow people to visualize multispectral imagery using parts of the electromagnetic spectrum that are invisible to human eyes. When you combine different bands, certain features will contrast greatly with their surroundings, enabling you to better understand them.

From the Symbology pane, we have total control over how the imagery is displayed. Here we are going to change the band combination to highlight vegetation.

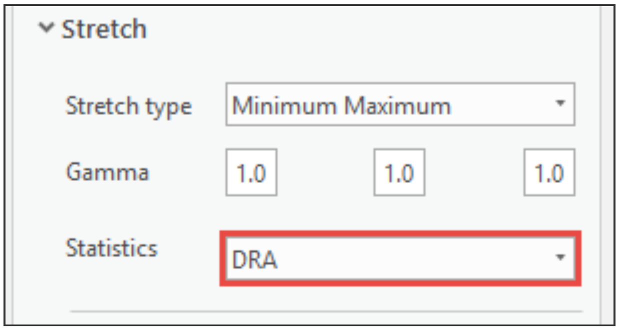
f Under Band Combination, change the dropdown for Red, Green and Blue as follows:

- For Red, select NearInfrared.
- For Green, select Red.
- For Blue, select Green.

g The Band Combination for the 11Oct2013Prefire layer should look like this:



h. Then, under the Stretch section of the Symbology pane, make sure that Statistics is set to DRA.



i. From the Contents pane, select the 30Dec2013 layer and repeat the steps to change the band combination and set the statistics to DRA. Then, do the same for the other two layers.

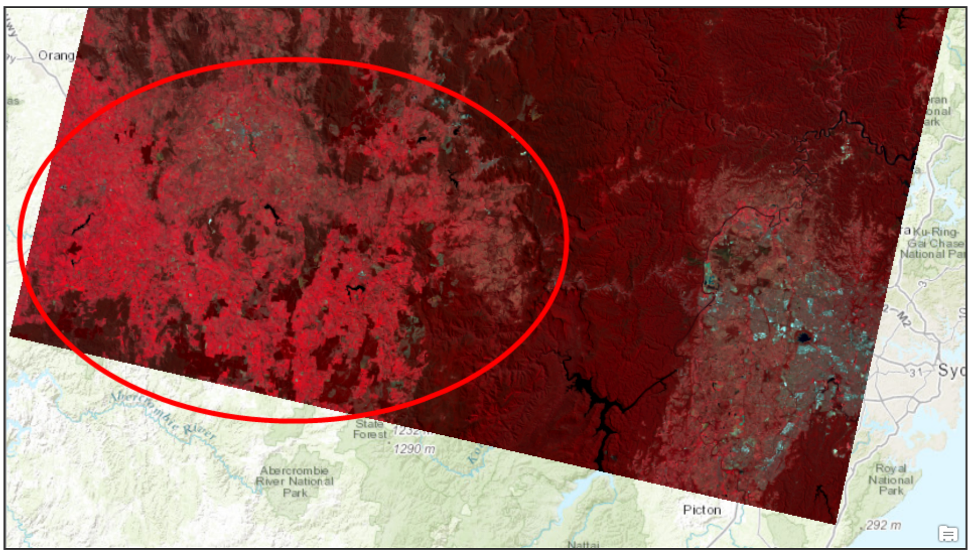
This band combination, commonly referred to as Color Infrared, shows contrast in vegetation, which will be useful in understanding what burned and where there is vegetation regeneration.

DRA stands for dynamic range adjustment. This next part is a little technical, but to give you a general idea of what's going on, all images need some basic descriptive statistics in order to be rendered on your screen. These include the minimum value, the maximum value, the mean, and standard deviation. Traditionally, analysts either use the statistics based on the values of every single pixel or sample some of the pixels. With DRA, only the pixels that are on the screen are used. The result is that as you zoom in and pan around the image, it recalculates the statistics dynamically and renders your image accordingly (hence the name dynamic range adjustment). All right, let's get back to the burn scars.

j In the Contents pane, right-click the 11Oct2013PreFire image, and from the drop-down list, choose Zoom To Layer.

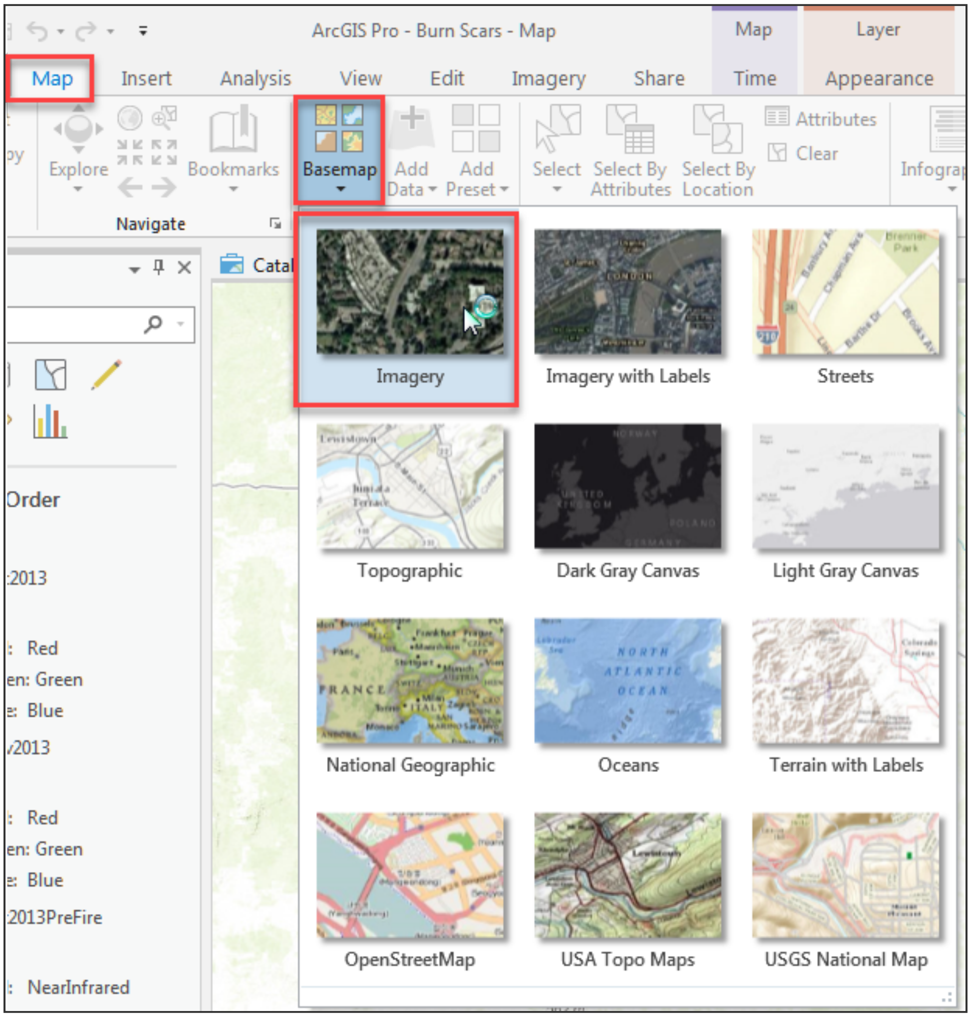
This developed area is the outskirts of the Sydney, Australia metropolitan area. The dark green areas are a series of mountainous national parks. Blue Mountain National Park is the closest to Sydney and was the site of the most severe fires that happened in 2013.

The patterns in the west of the image are interesting because they are patchwork. You might be wondering why there are bright red areas and dark red areas.

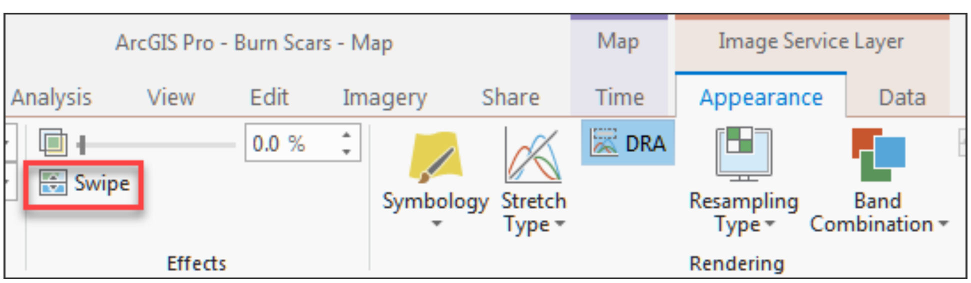


You'll see that the dark red areas correspond with parks, which presumably have restrictions on agriculture. These are forests or other denser vegetation. The bright red areas are agricultural or grazing areas.

k From the Map tab, click Basemap, and from the drop-down list, choose Imagery.



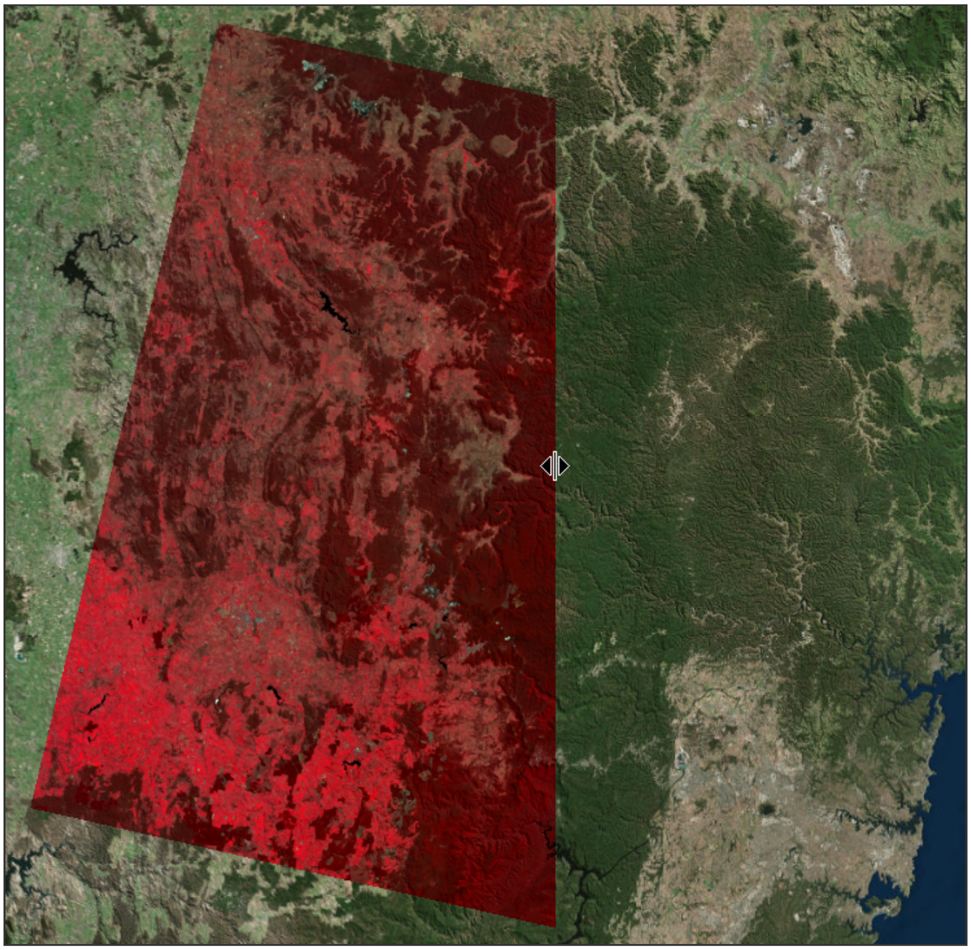
l In the Contents pane, select the 11Oct2013PreFire image again, and from the Appearance tab, in the Effects group, click the Swipe button.



The Swipe tool lets you peel back the image that you have selected to reveal the high-resolution Imagery basemap underneath.

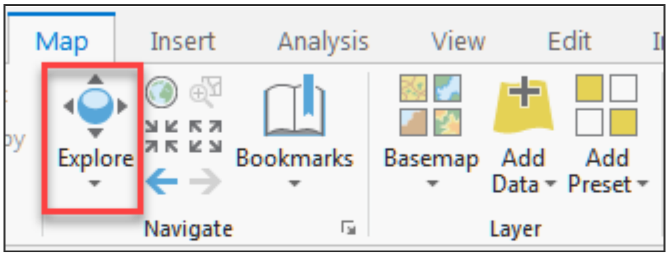
m Click and drag the map to peel back the Landsat image.

Note: You can drag left, right, up, or down.



The patterns in the agriculture and parks that you saw in the Landsat imagery align with the higher-resolution imagery.

n To turn off the swipe capability, from the Map tab, click the Explore button.



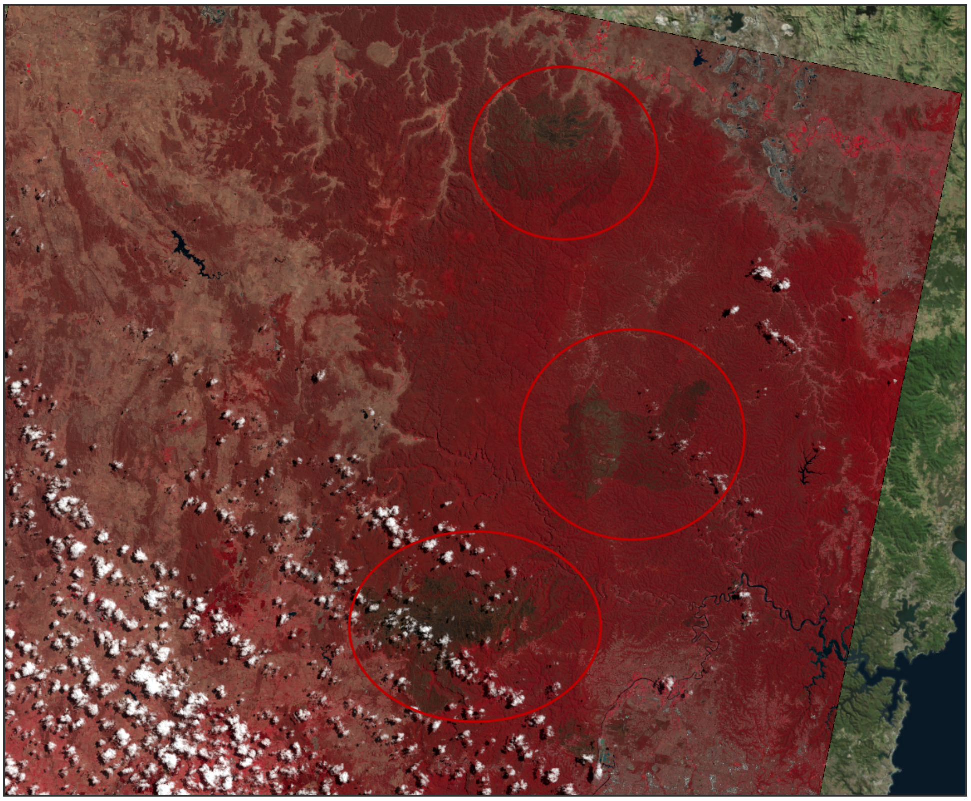
o In the Contents pane, select and turn on the 12Nov2013 image and turn off the other images.

Hint: If it is taking a long time to load, you can turn off the Imagery basemap, as well.

Although it's not readily apparent, there have been major fires in the time between the capture date of this imagery and the date associated with the first dataset.

p In the Contents pane, select the 12Nov2013 image.

The burn scars are somewhat visible with this band combination. They are the dark brown spots that you see. You can swipe this image to compare it with the previous image.



From the introduction you know that shortwave and infrared are important in detecting burn scars. Landsat 8 has two shortwave infrared bands and a near infrared band, so you will use these three to see if you can make the burn scars more apparent. Because these bands have longer wavelengths, they can penetrate through some haze, which should give you a clearer image.

Band combinations are a way to visualize the information in the bands. You could say that this is a qualitative approach. You're taking what you know about how a feature responds in different bands, comparing that with what surrounds it, and trying to maximize the contrast between the feature you're interested in and the background; you want it to stand out.

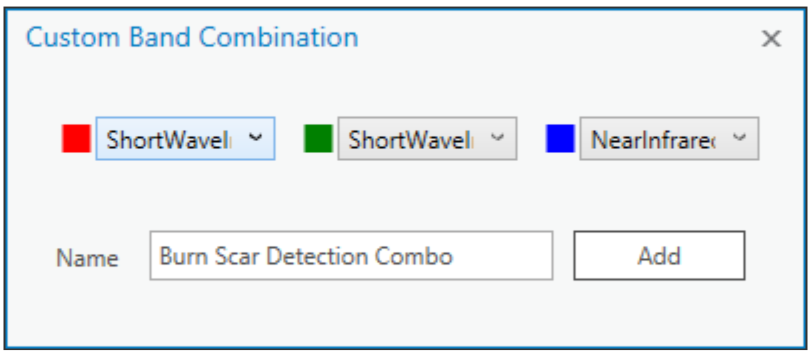
Step 4: Create a custom band combination

You will create a custom band combination using the shortwave infrared and near infrared bands.

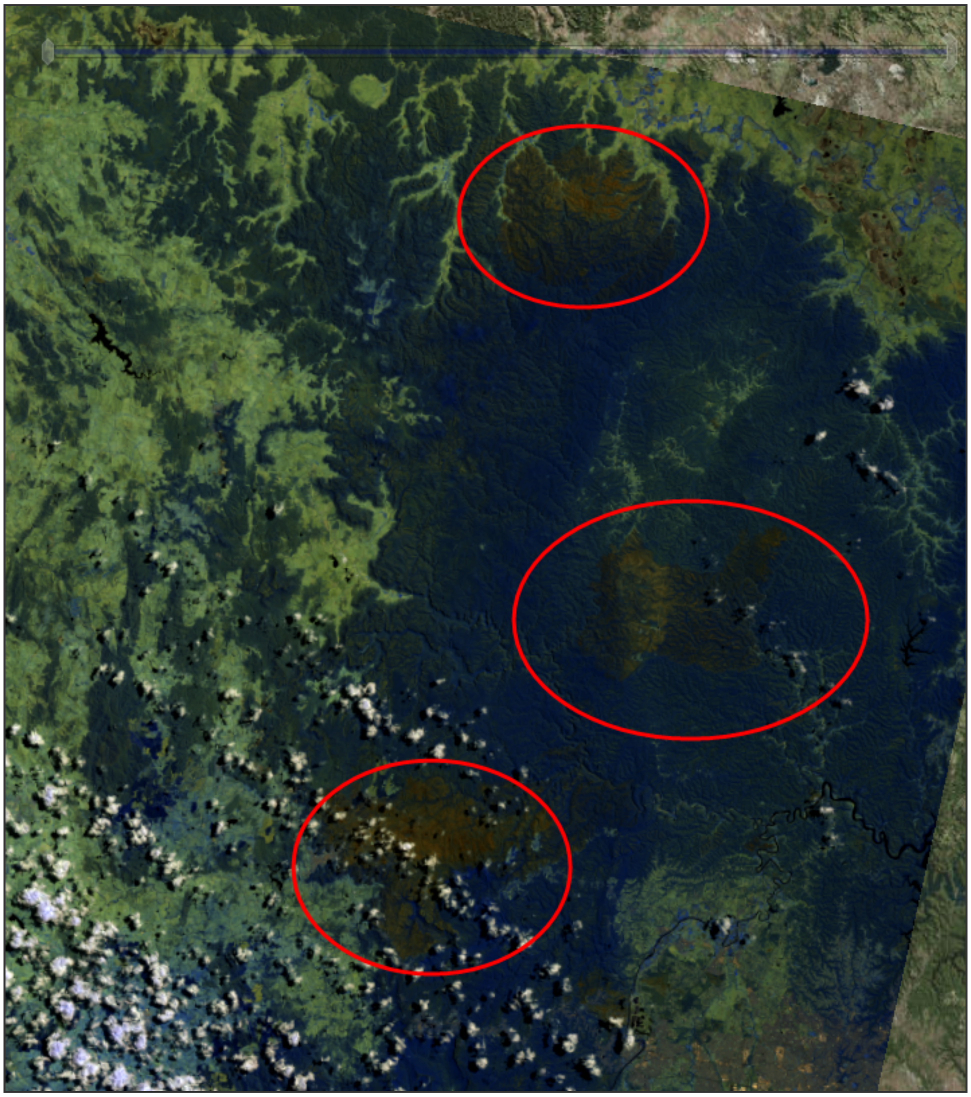
a With the 12Nov2013 image still selected in the Contents pane, on the Appearance tab, from the Band Combination drop-down list, click Custom.

b Set the bands as follows:

- Red to ShortWaveInfrared_2
- Green to ShortWave_Infrared_1
- Blue to NearInfrared



c In the Name field, type **Burn Scar Detection Combo** as the name for your custom band combination, and click Add.



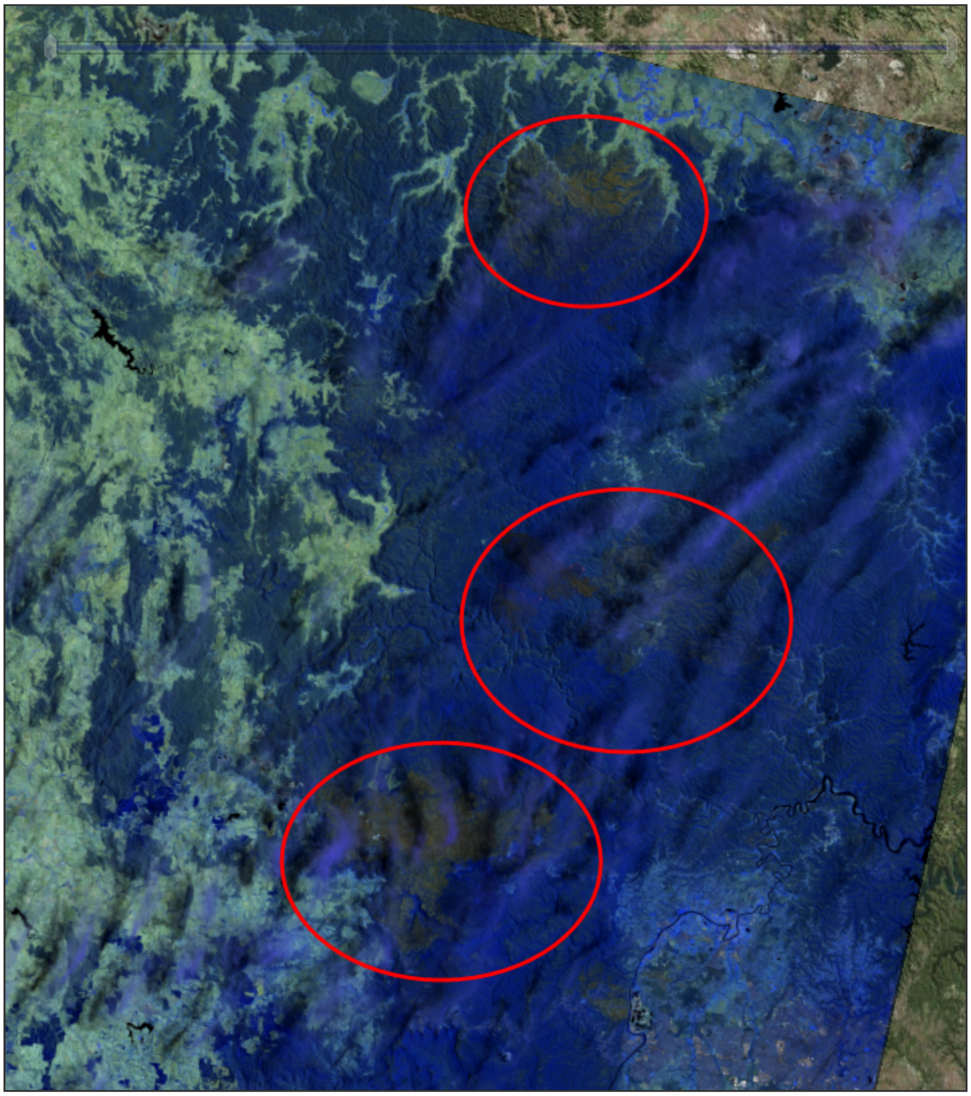
Now, the forest is blue and the burn scars have a range of copper colors that gives you a sense of how the intensity of the burn varied. In the middle fire, you can see how the mountain ridge affected the fire where it burned intensely up one side, and not as hot on the way down the other side. This is typical of fires in mountainous areas. They burn quickly and hot going up a mountain, but do not burn as well going down a mountain.

d In the Contents pane, select and turn on the 30Dec2013 image and turn the others off.

This image is cloudy, which is typically a challenge when you are trying to see what's on the ground.

e Select and turn on the Burn Scar Detection Combo custom band combination that you previously created.

Hint: *In the Contents pane, select the 30Dec2013 image. On the Appearance tab, from the Band Combination drop-down list, choose Burn Scar Detection Combo.*



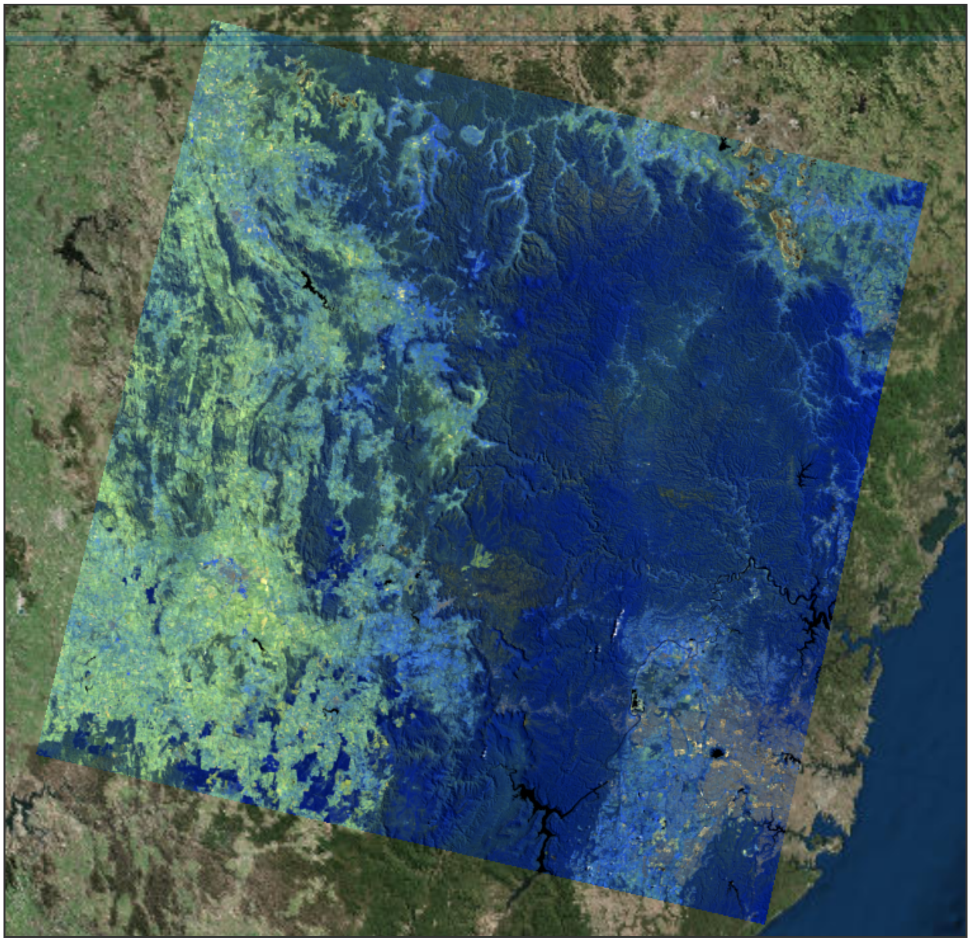
Although the clouds are still present, it's easier to see what's on the ground. This is because the bands used here have longer wavelengths than what is used in the visible portion of the electromagnetic spectrum (what humans see). These longer wavelengths can penetrate through the clouds to some extent, revealing the ground underneath. Although you have a clear image from after the fire, if this were the only one available, you could still work with it. This is a good example of how you can use multispectral imagery to extend your vision beyond what you normally see.

f Turn on the 22Feb2016 image and turn any other images off.

This imagery is from 28 months after the fire.

g Turn on the band combination for Color Infrared, and examine the area.

h Turn on the Burn Scar Detection band combination, and examine the area again.



Can you see the burn scars anymore? It appears that the forest has regenerated; however, this is a mountainous area that is prone to long periods of drought and bursts of rain. If the forest were still growing back, you would want to know because the forest is necessary to prevent mudslides when it does rain. You see this phenomenon in many cities around the world that are near mountainous areas. Droughts lead to fires, which lead to mudslides when rains come.

Next, you will create an analytical model to see to what extent the vegetation in the forest has regenerated.

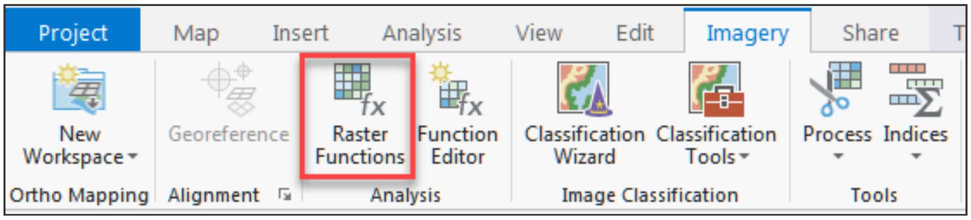
Step 5: Create a burn index ratio

Scientists use ratios between bands to create indexes that quantify a feature of interest. An index is different from a band combination because it's a way to quantify the state of the feature you are interested in. So far, you have used band combinations to identify where the burn scars are. However, what you're really interested in is understanding how well the vegetation within the burn scar has regenerated. An example of a simple index is to divide the near infrared band by the red band to understand vegetation. This ratio was one of the first instances of using this kind of band arithmetic. Over time, the number and complexity of band indexes has evolved. The most common is the normalized difference vegetation index (NDVI), which has the following equation:

(Near Infrared - Red) / (Near Infrared + Red)

You will use a similar formula to create a burn index ratio.

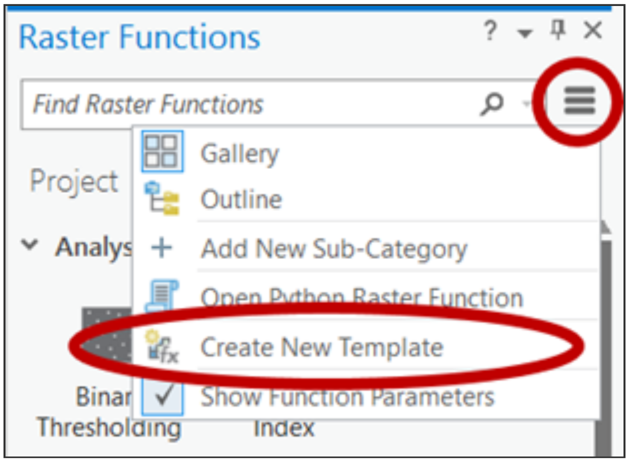
a From the Imagery tab, open the Raster Functions pane.



You can use this set of raster functions for image analysis. They are similar to geoprocessing tools, but they work in-memory, whereas geoprocessing tools write the output to disk.

Note: If you need clarification on what this actually means, let us know by posting a question in the Q&A tab in Udemy.

b From the Options menu, choose Create New Template.



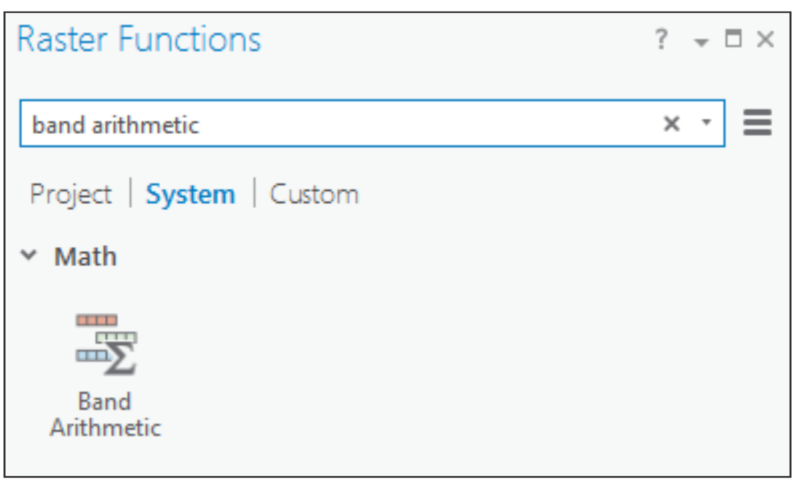
This opens the Raster Function Editor. The Raster Function Editor allows you to visually chain multiple functions together to set up the burn ratio and then apply it to the imagery.

c Click the icon for a raster variable to add it to the function editor.

d In the function editor, right-click the raster variable and rename it **Pre-fire imagery**.

e Add another raster variable and name it **Post-fire imagery**.

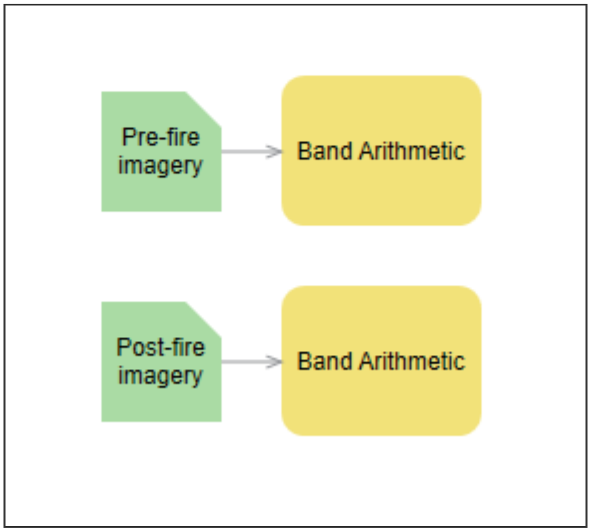
f In the Search field at the top of the Raster Functions pane, search for **band arithmetic**, and drag it onto the Raster Function Editor.



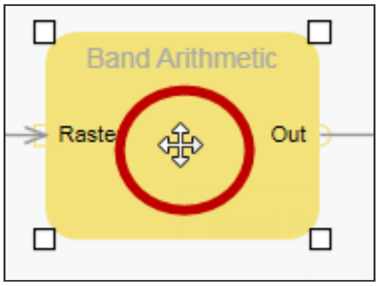
g In the Editor, click the Post-fire imagery square and hold down on the mouse to click and drag a line to connect it to Band Arithmetic.

h Drag another instance of Band Arithmetic into the editor, and connect this one to Pre-fire imagery.

It should look like this:



Hint: If you need to move things around in the function editor, click in the center of an item so that the mouse pointer changes to a four sided arrow. Then you can click and drag the function to move it.



i Double-click the Band Arithmetic connected to Pre-fire to set the parameters for this function.

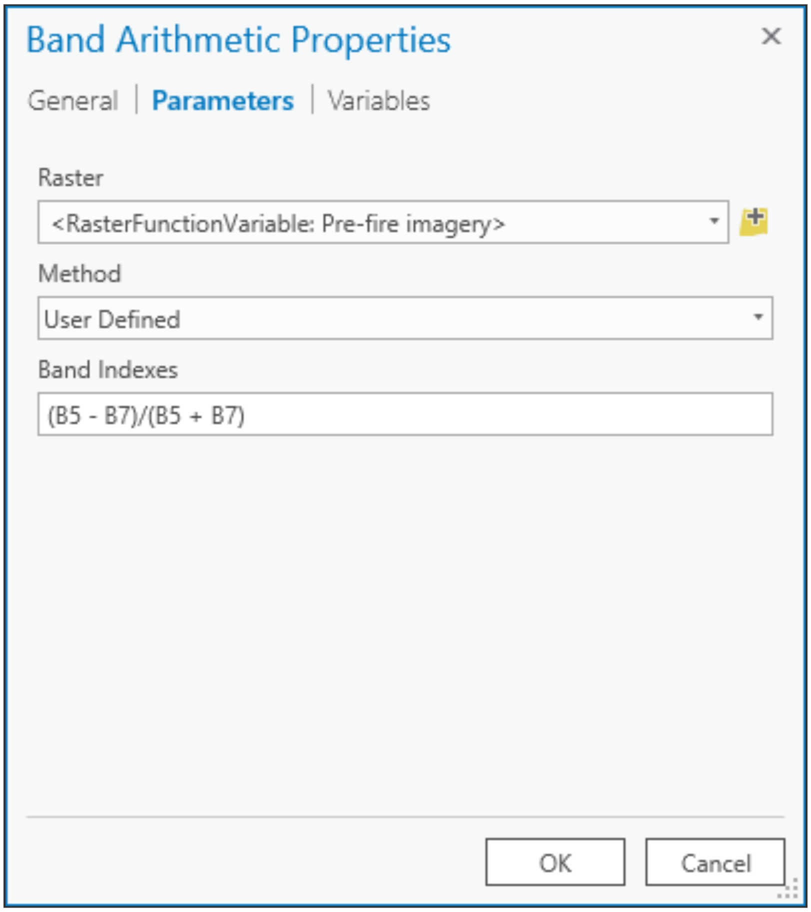
With Landsat, Band 5 is the Near Infrared band and Band 7 is the Shortwave band. You will use this information to set up the normalized burn ratio (NBR) equation to quantify the feature of interest-in this case, the burn scars.

j From the Parameters tab, change the Method to User Defined.

k In the Band Indexes field, type the following text:

(B5 - B7)/(B5 + B7)

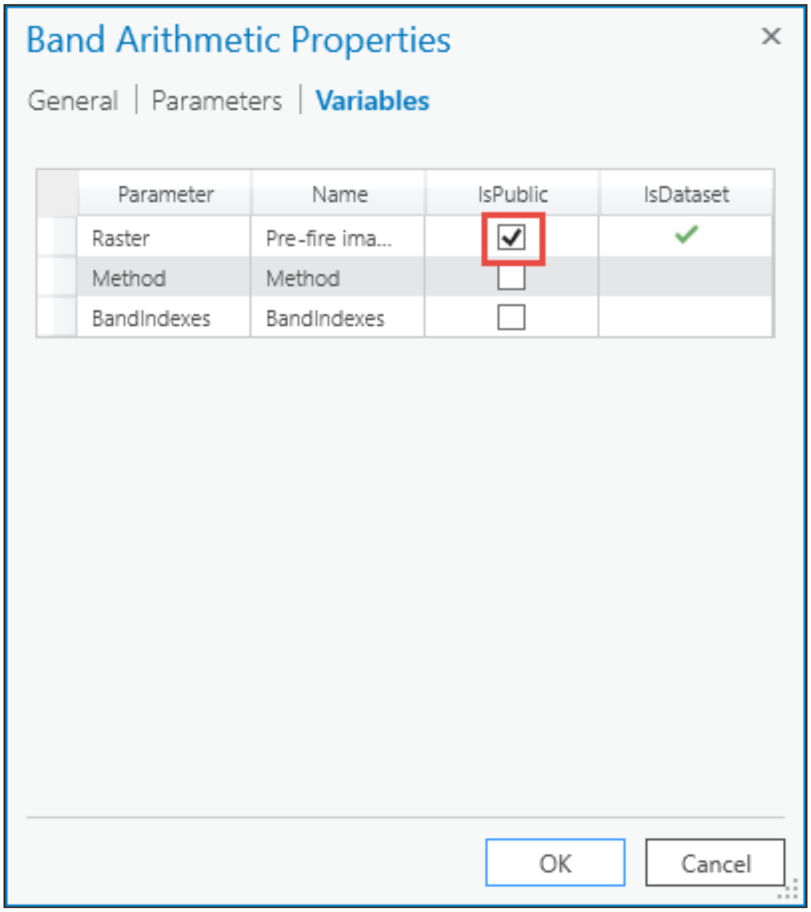
Hint: Type the expression rather than copying and pasting.



The NBR equation mathematically compares the Near Infrared and Shortwave Infrared 2 bands (bands 5 and 7) to determine band severity. Another way to think of this is:

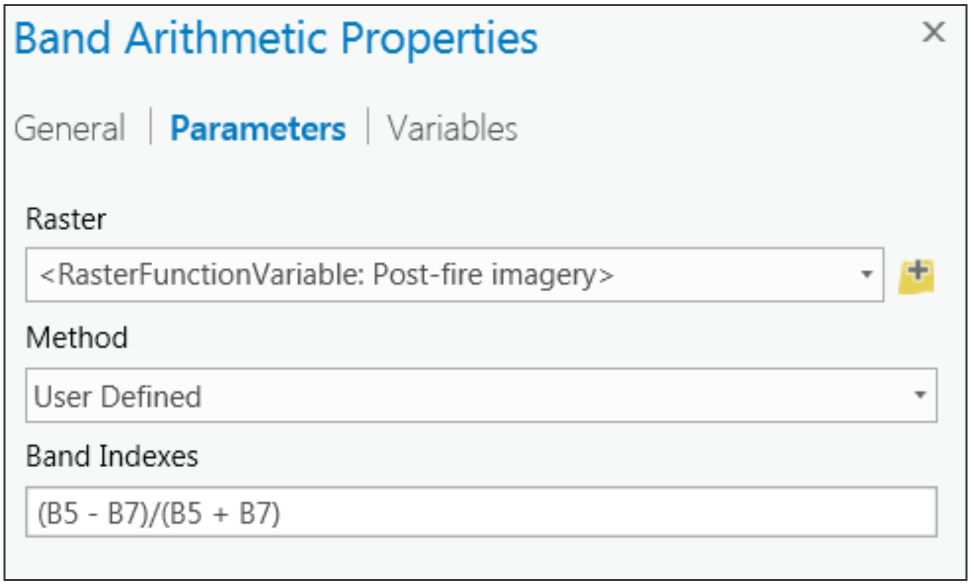
(Near Infrared - Shortwave Infrared)/(Near Infrared + Shortwave Infrared)

I From the Variables tab, check the box for isPublic on the Raster row.



m) Click OK to close the Band Arithmetic Properties window.

n) Repeat steps i through k for the Band Arithmetic connected to Post-fire so that on the Parameters tab, the Method is User Defined and the Band Index is **(B5 - B7)/(B5 + B7)**.

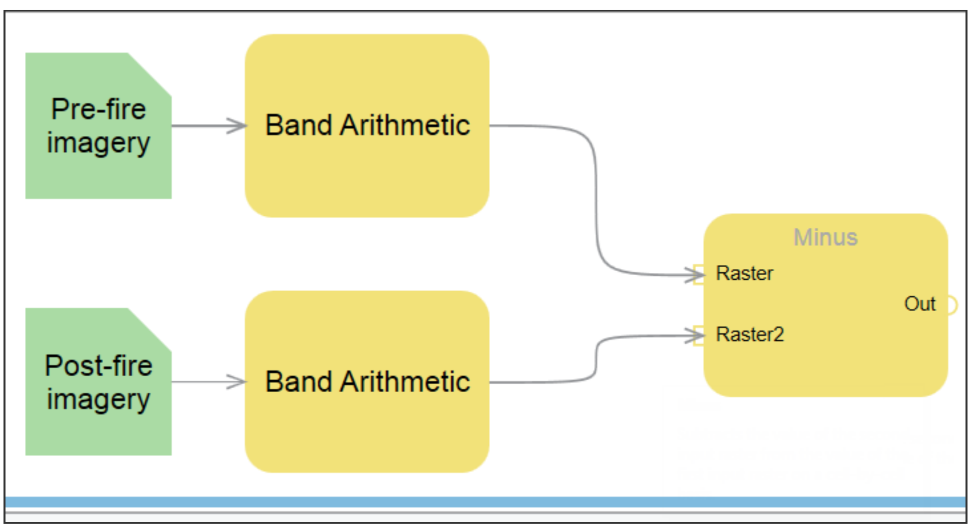


o. On the Variables tab, check the box for isPublic on the Raster row and click OK to close the Band Arithmetic Properties window.

p. In the Raster Functions pane, search for **Minus**.

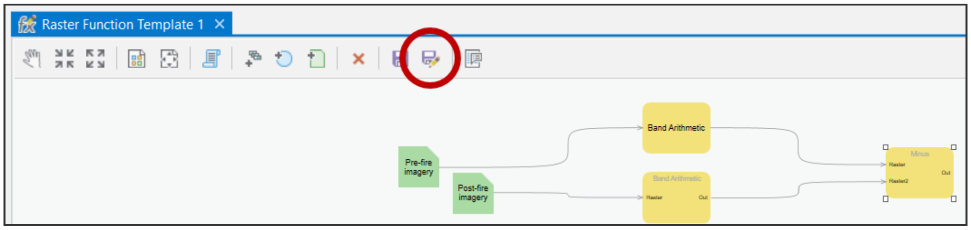
q. Drag it into the editor, and connect each of the Band Arithmetic squares to the Minus.

Hint: *Make sure that the Pre-Fire part of the chain goes in as Raster and that the Post-Fire part of the chain goes in as Raster2.*



The Minus function subtracts the value of the second input raster from the value of the first input raster on a cell-by-cell basis. You will see how this works in the next step.

r Click Save As and type **dNBR** for the name.

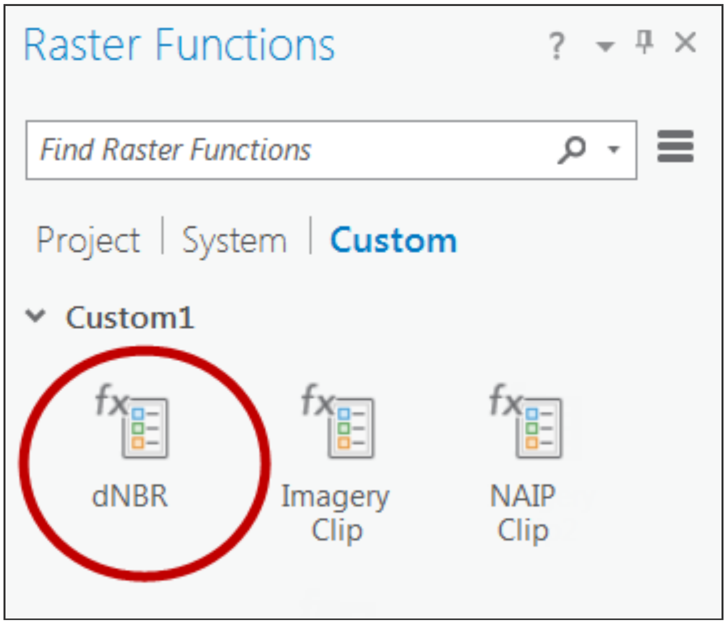


s For the Description, type **differenced normalized burn ratio**, and then click OK to close save your function chain.

Step 6: Apply the burn ratio to assess vegetation regeneration

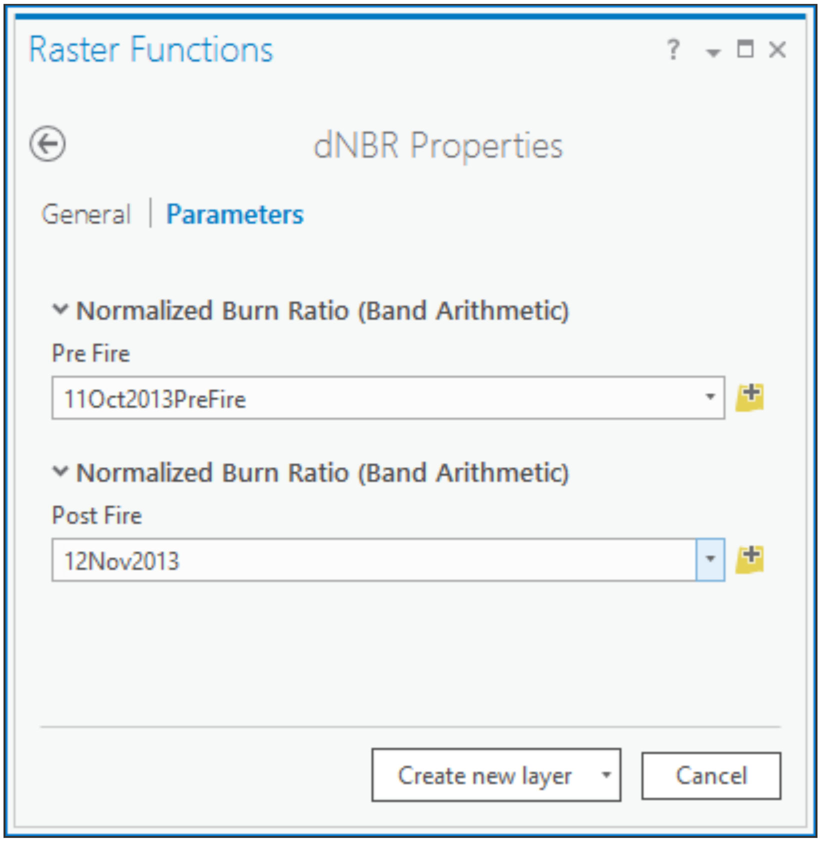
In this step, you will apply the burn ratio index formula on the pre-fire image and then again on the images from after the fire. When you subtract one of the post-fire images, your result will tell you how well the forest has regenerated.

a In the Raster Functions pane, clear any text in the Search box, and open the Custom section. Your dNBR function chain should be here.



b Click your dNBR function chain to open it and view its properties, then use the drop-down list next to each field to select the following parameters:

- Pre-fire imagery: 11Oct2013PreFIre
- Post-fire imagery: 12Nov2013

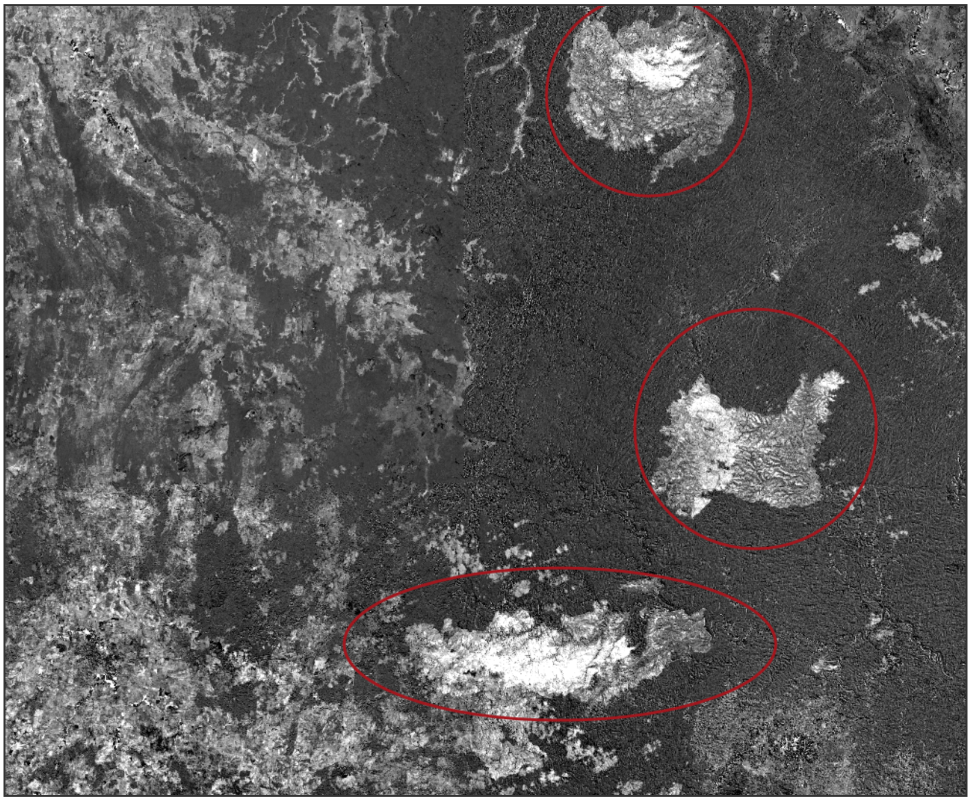


c Click Create New Layer.

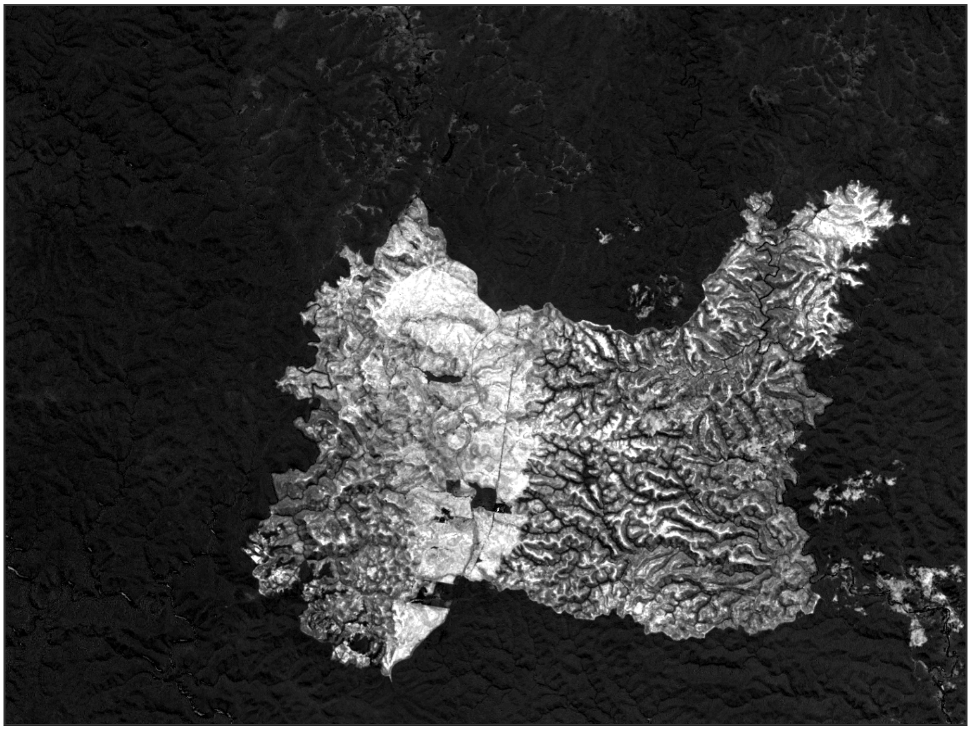
It may take a minute or two for this to process, depending on the number of students who are using the service at the same time.

> *Hint: When it finishes rendering, you may see a completely gray image. If so, turn on DRA from the Appearance tab.*

The imagery that is created is a grayscale image where the bright white areas are the deepest burns. There is a lot of noise in this image. There were clouds in the second image, which are being interpreted as heavily burned areas in the output. It is very important to visually inspect your imagery with the tools you have available so that you do not get confused by these kinds of erroneous artifacts. However, you know generally where the burn scars are, so you can ignore the clouds.



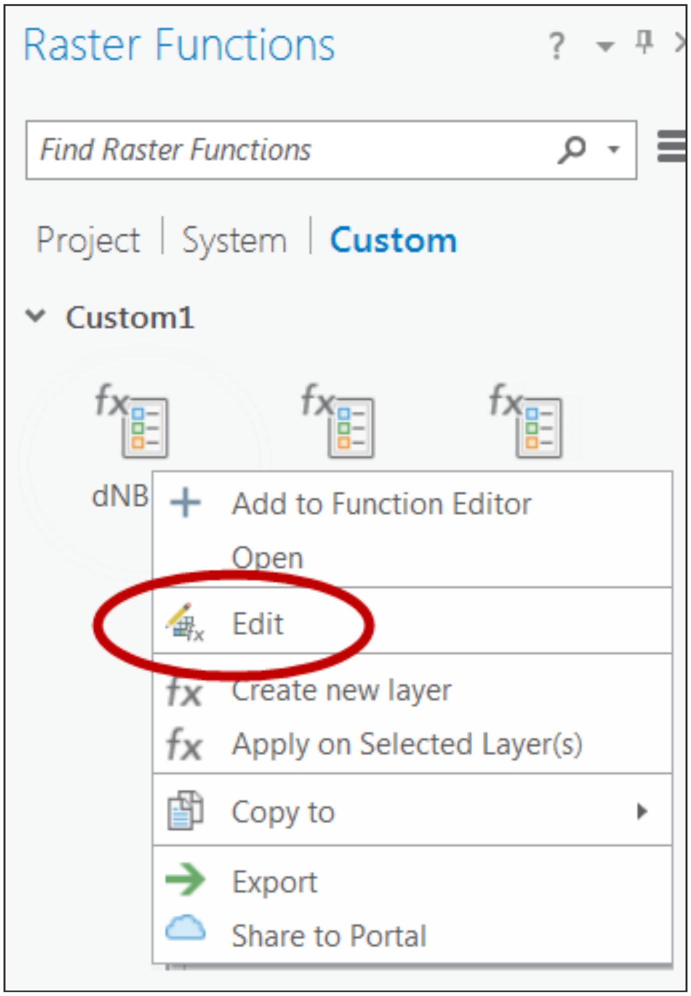
If you zoom into the middle burn scar, you can see how the fire matches the pattern of the terrain. There's a road that runs down the middle of it that was unburned, as well.



What this doesn't tell you, however, is how the vegetation is affected in any quantifiable sense. To do this, you need to return to the model that you created and add one more step. The benefit of this particular index is that you can remap the values according to the following table:

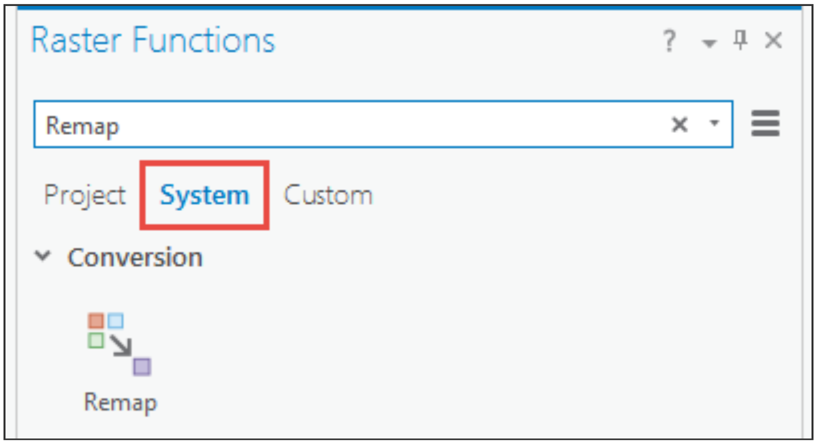
Severity Level	NBR Range
Enhanced Regrowth, High	-500 to -251
Enhanced Regrowth, Low	-250 to -101
Unburned	-100 to 99
Low Severity	100 to 269
Moderate-low Severity	270 to 439
Moderate-high Severity	440 to 659
High Severity	660 to 1300

d From the Raster Functions pane, right-click the dNBR function chain and choose Edit.

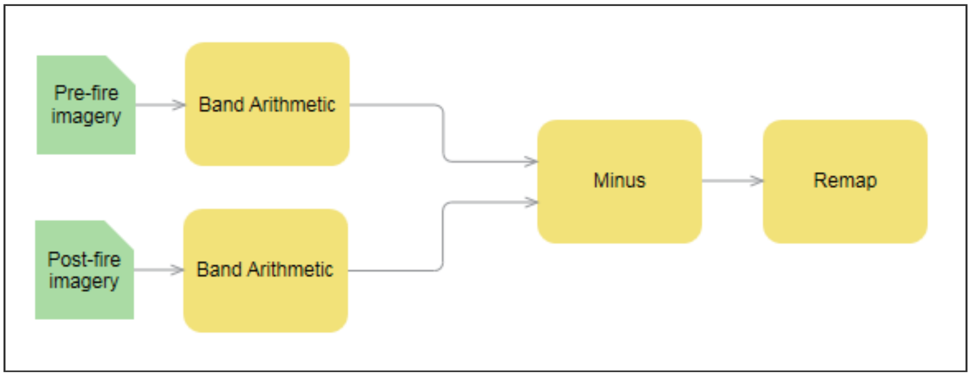


The function chain opens up in the editor.

e. In the Raster Functions pane, from the System tab, search for **Remap** and drag it on to the editor.



f Select and hold down on Minus to drag a connector to Remap.



g Double-click Remap to open up its parameters.

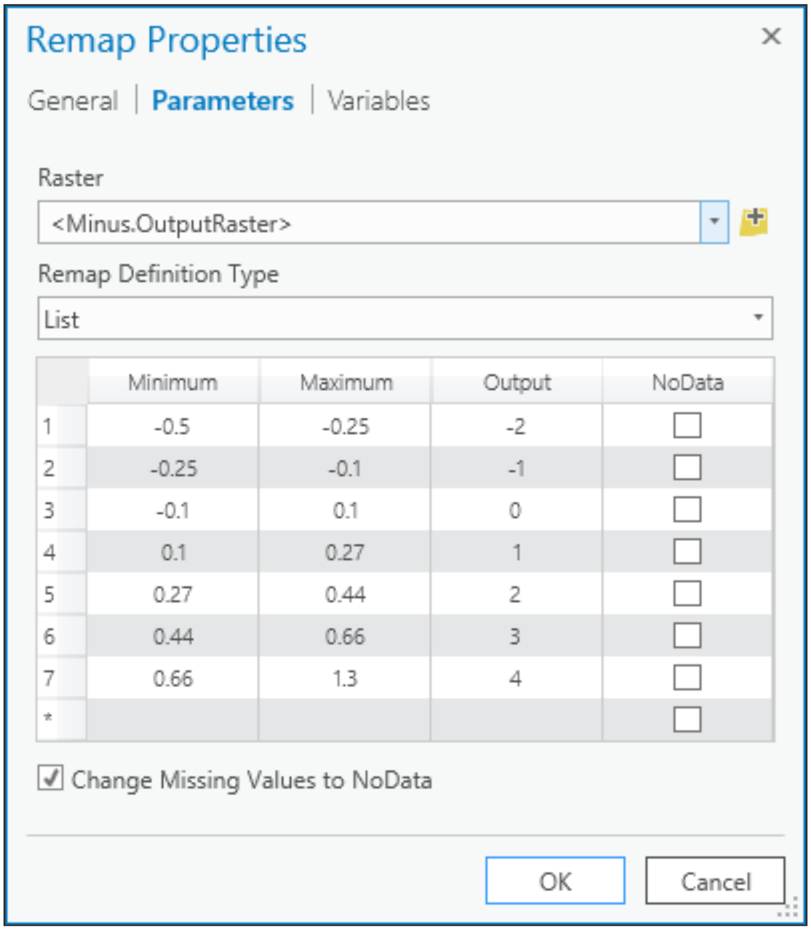
To remap the dataset values according to the burn severity level, you will enter new values into the Remap table.

h In the Remap Properties window, click in the Minimum, Maximum, and Output fields and type the values listed below.

	Minimum	Maximum	Output
1	-0.5	-0.25	-2
2	-0.25	-0.1	-1
3	-0.1	0.1	0
4	0.1	0.27	1
5	0.27	0.44	2
6	0.44	0.66	3
7	0.66	1.33	4

i Check the box next to Change Missing Values to NoData.

When you are finished, the Remap table should look like this:



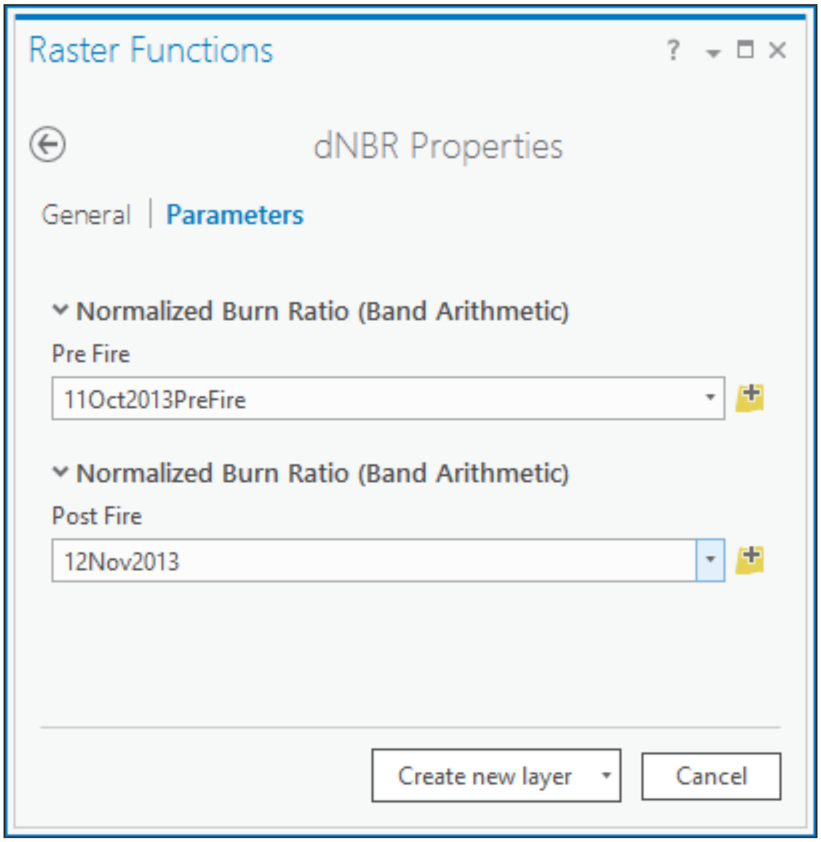
j Click OK to close the Remap Properties window, and then save your function chain.

Next, you will run the function chain on each of the post-fire images.

k In the Raster Functions pane, clear any text in the Search field.

l In the Custom tab, click your dNBR function chain to open it, and then use the drop-down list next to each field to select the following parameters:

- Pre-fire imagery: 11Oct2013PreFire
- Post-fire imagery: 12Nov2013



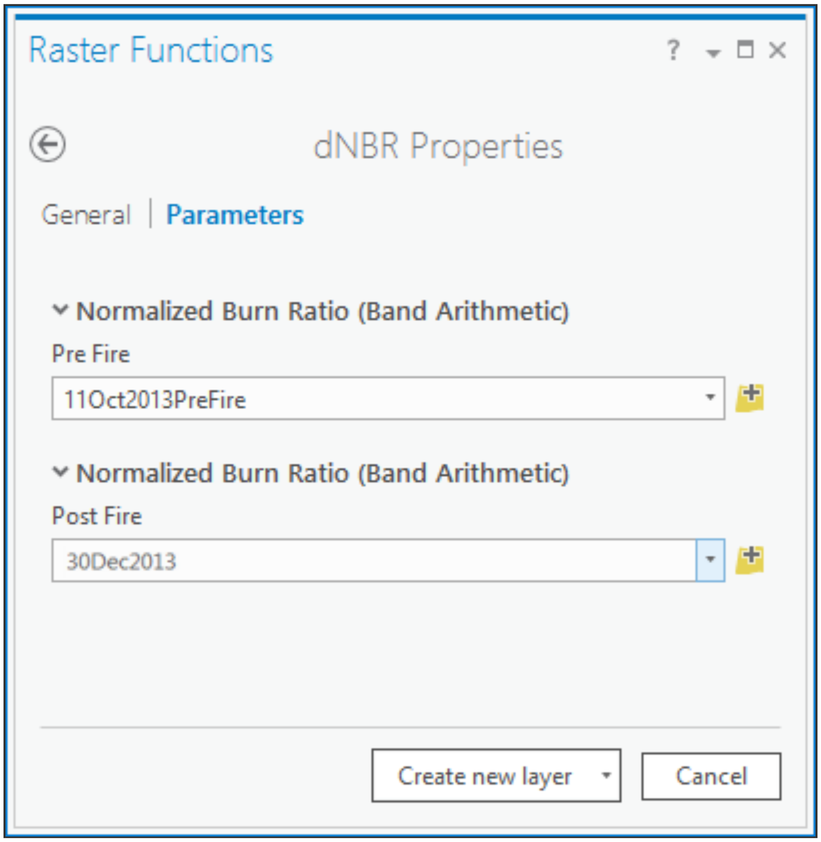
m. Click Create New Layer.

n. In the Contents pane, click once on the dNBR layer name to select and once again to make that text editable. Type **dNBR12Nov2013** as the new name for the layer.

Next, you will run the function chain on the imagery from December of 2013.

o. In the Custom tab, click your dNBR function chain to open it, and then use the drop-down list next to each field to select the following parameters:

- Pre-fire imagery: 11Oct2013PreFire
- Post-fire imagery: 30Dec2013



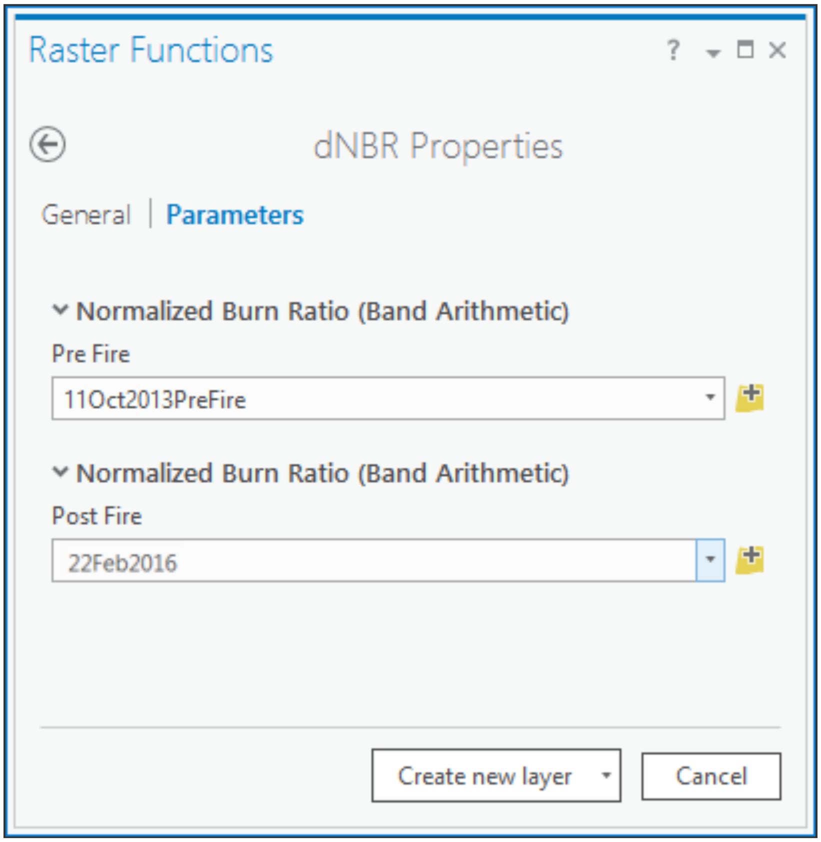
p. Click Create New Layer.

q. In the Contents pane, click once on the dNBR layer name to select and once again to make that text editable. Type **dNBR30Dec2013** as the new name for the layer.

Finally, you will run the function chain on the imagery from 28 months after the fire.

r. In the Custom tab, click your dNBR function chain to open it, and then use the drop-down list next to each field to select the following parameters:

- Pre-fire imagery: 11Oct2013PreFire
- Post-fire imagery: 22Feb2016



s. Click Create New Layer.

t. In the Contents pane, click once on the dNBR layer name to select and once again to make that text editable. Type **dNBR22Feb2016** as the new name for the layer.

u. Close the Raster Functions pane and the Function Editor.

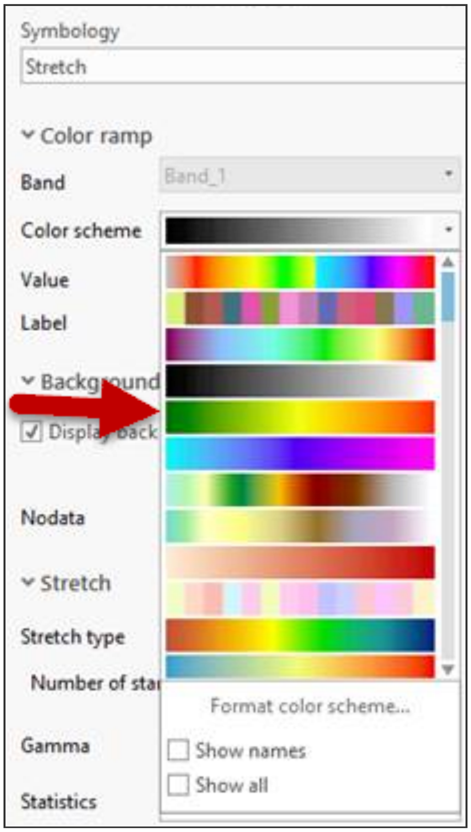
You need to make this imagery stand out so that your audience can immediately see what's important at these different points in time.

Step 7: Modify symbology

In this step, you will use a red, yellow, and green color scheme to indicate the level of vegetation regeneration in an area.

a. In the Contents pane, select the dNBR12Nov2013 image, and from the Appearance tab, open the Symbology pane.

b. In the Color Scheme drop-down list, select the green to red color ramp. (It should be the fifth one from the top, just below the black to white color ramp.)



c After it is selected, open the drop-down list again and click Format Color Scheme.

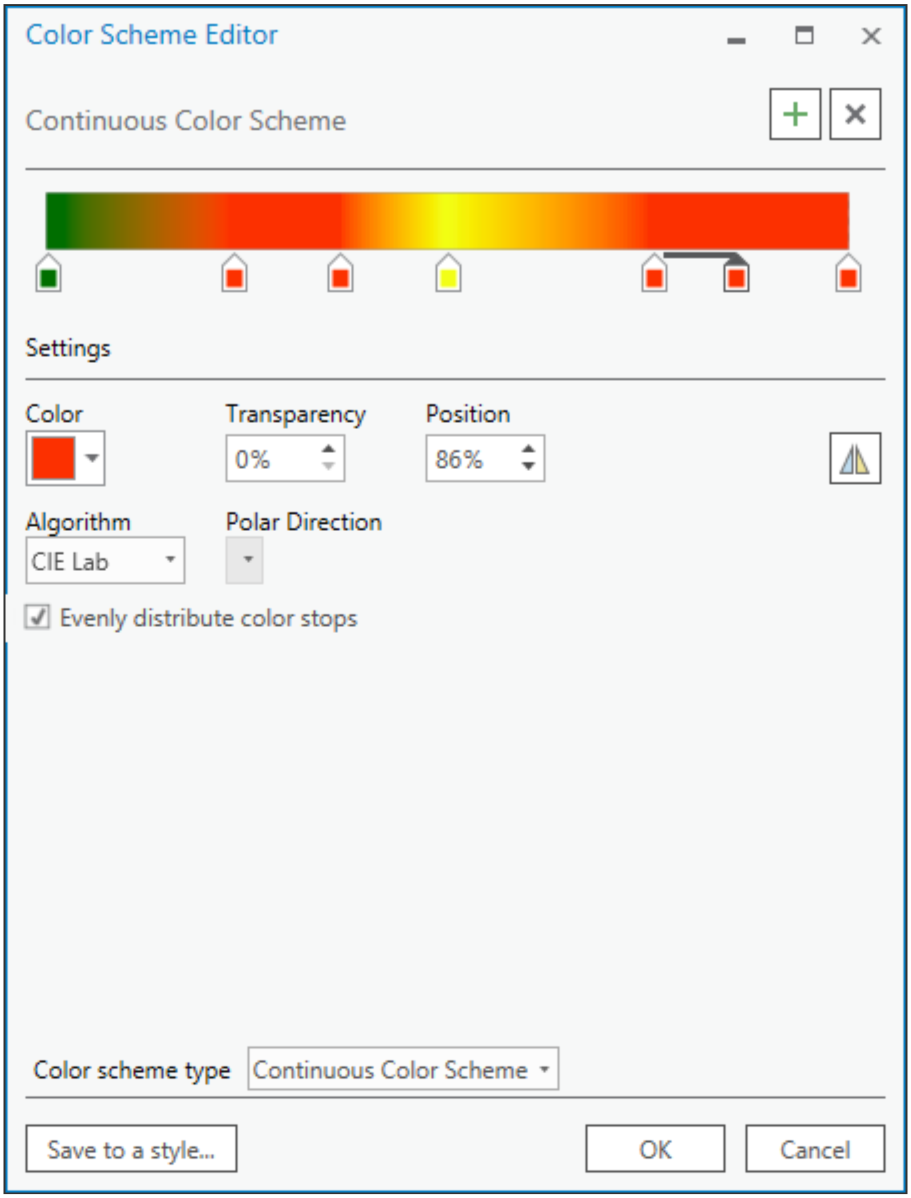
First, you will add a break for each one of your classes.

d In the Color Scheme Editor, click the red color stop and drag it to the left. (It doesn't matter where you drop it because you will line the stops up perfectly in the following step.)

When you drop it, another color stop is added to the ramp.

e Repeat this until you have seven total stops.

Here is an example graphic, with some stops dragged beyond the original yellow color stop.

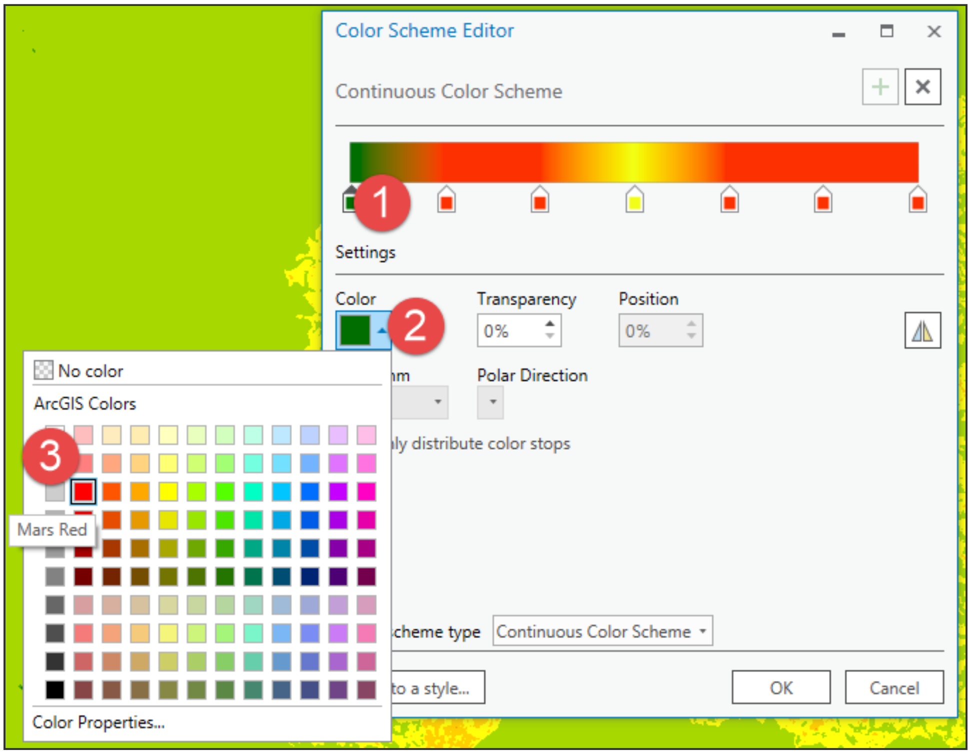


f Check the box next to Evenly Distribute Color Stops.

Now, you need to change the colors so that they reflect the burn ratio images.

g Click the green color stop, and use the Color drop-down list to change this stop to Mars Red.

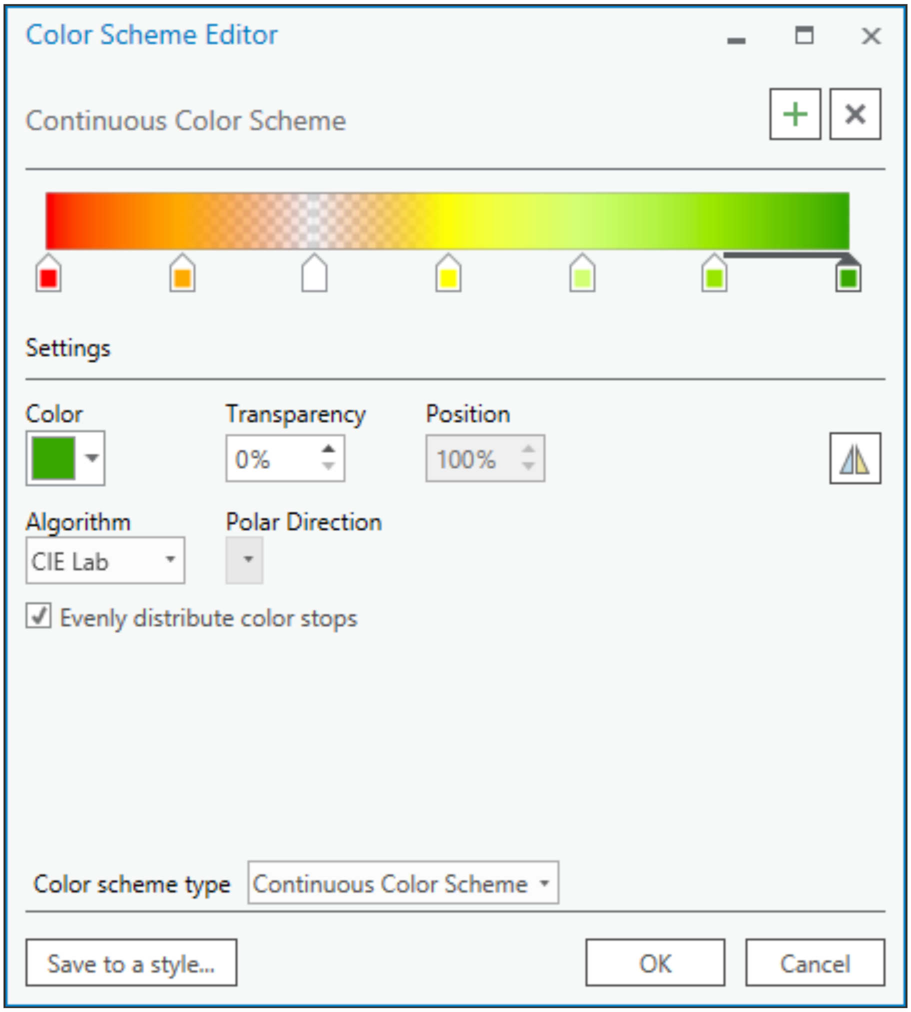
Red will be used to indicate the areas that were extremely burned, where no vegetation has regenerated.



h Now, change the other color stops (going from left to right) as follows:

- Second to Electron Gold (orange)
- Third to No Color
- Fourth to Solar Yellow
- Fifth to Light Apple (light green)
- Sixth to Quetzel Green (moderate green)
- Seventh to Leaf Green (deep green)

i Your final color stops should look similar to the following graphic:



You can save the new color scheme as a style for future use.

j Click Save To A Style.

k For the name, type **dNBR**, and then click OK twice to close the Color Scheme Editor.

It will now be one of the options in your color ramps.

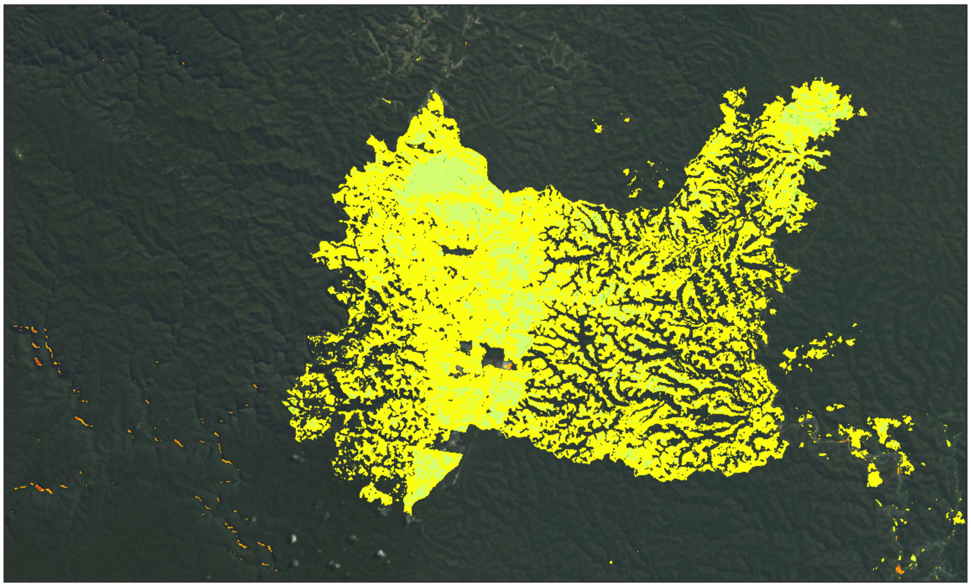
l To apply this color ramp to the other dNBR images, click them individually in the Contents pane, and then in the Symbology pane, under Color Scheme, select the dNBR color ramp you just created.

When you're finished, here is what each image should look like (graphics are zoomed in to the middle burn scar).

Note: Turn off all images except the one you are viewing.

dNBR12Nov2013

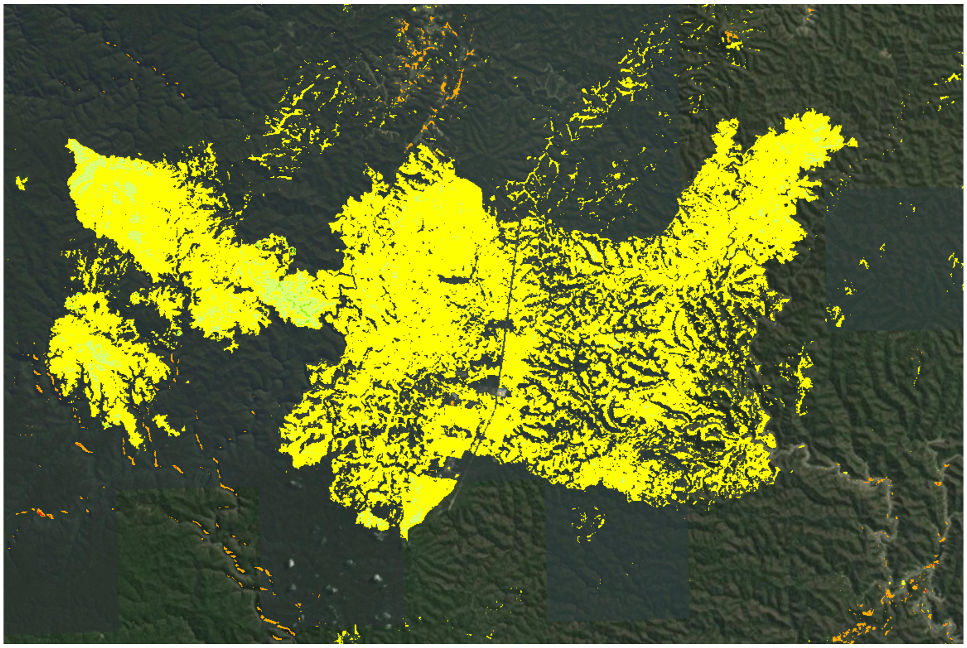
This image shows the extent of the burn scars between the pre-fire image and the first image taken on 12 November 2013.



The burn does not appear to have been very intense, and some vegetation is beginning to regenerate. After seeing this image, it would be important to send people out to inspect this area and to verify that the ranges you have identified for each level of burn and regeneration are accurate. The scale that you are using is a general scale and may need to be adjusted depending on the situation on the ground.

dNBR30Dec2013

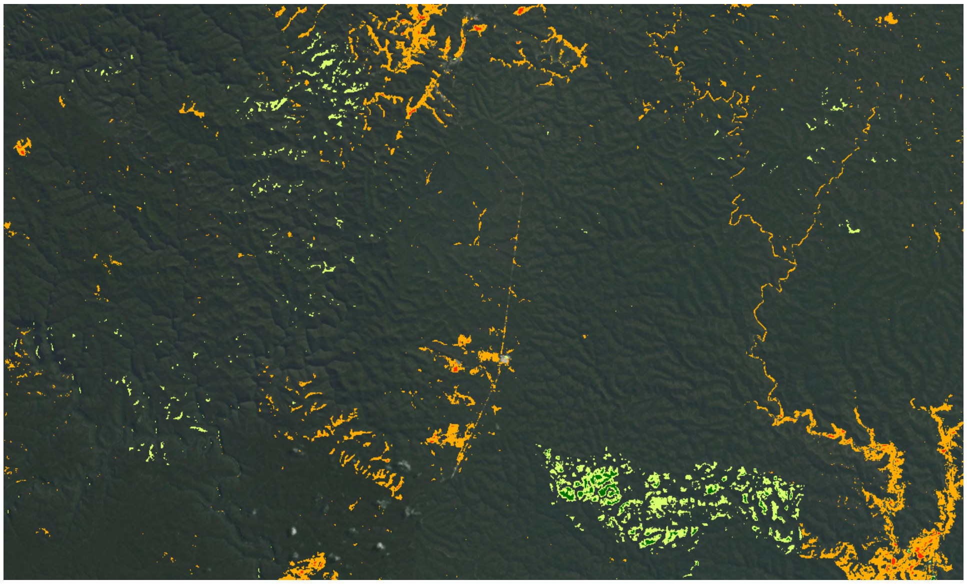
This image shows the extent of the burn scars between the pre-fire image and the second image taken on 30 December 2013.



The middle burn scar has actually increased in size. This could be due to another fire or a slow-moving smoldering burn.

dNBR22Feb2016

This image shows the extent of the burn scars between the pre-fire image and the last image taken on 22 February 2016, almost three years after the fires.



The part of the color ramp that you set to No Color was for areas classified as unburned. As you can see, the burn scars are non-existent, meaning that the vegetation has regenerated and blends in with the surrounding areas. The reddish areas here follow bodies of water and are not actually burn scars associated with the 2013 burn that you've been studying.

Conclusion

In this exercise, you created three images of post-fire analysis using multispectral analysis. By 2016, it is apparent that the vegetation where the burn scars were has regenerated. However, if you compare the two 2013 images, you will notice that in the second image, the burn scar had gotten larger. Why do you think this is?

Hint: Go back and compare the imagery for each date.

This type of analytical model is a useful tool for understanding vegetation regeneration after a devastating fire. It's also important to remember to analyze your imagery visually first so that you know where clouds or other forms of vegetation are affecting your final result. If you were to run this analysis without having inspected the imagery first, you might think that the area of yellow and red in the southwest corner of the image was a massive burn scar. However, you know that this is actually a patchwork of farms, grasslands, and forests.