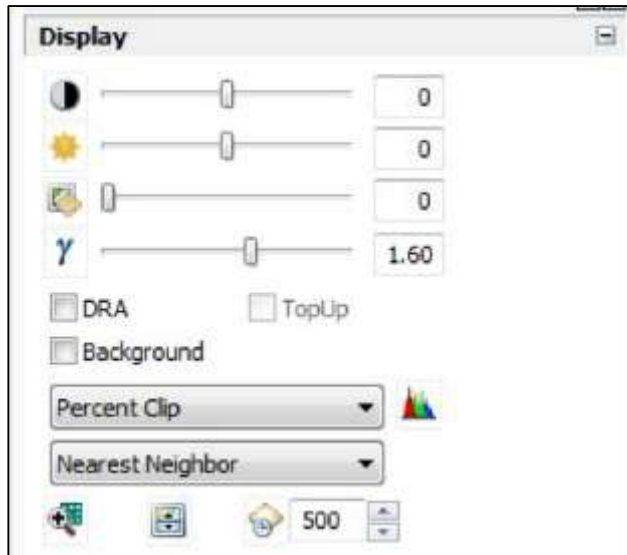


Introduction

While radiometric and spectral enhancements operate on each pixel individually, spatial enhancement deals largely with spatial frequency and modifies pixel values based on the values of its neighbor pixels.

Spatial Enhancement within ArcGIS uses the Image Analysis window and the Spatial Analyst tools for different processes.

Spatial Enhancement Using Image Analysis Window



Open a new map document and add the image we created in the tutorial on sub-setting your Landsat Image. We want the image that we clipped to the spatial extent of the window – the image that contained Roanoke, Blacksburg, and Smith Mountain Lake. We will be working with that image in this tutorial. Make sure your Image Analysis window is open. Set it to false color image.

Remember from the prior tutorial, we deferred discussing one of the drop down lists on the

Image Analysis/Display. As a reminder, this window changes the image on display but does not change the file permanently. This particular list refers to a resampling method.

Click on the down arrow, you see a number of different options. Again, with spatial enhancement, we are neighbors. How it is exactly done, depends on the



changing the individual pixels based on its method. When you change any of these

methods you might not see much change if you are zoomed out, so zoom into the City of Roanoke and specifically on the airport area.

Nearest neighbor – the pixel is assigned the value of the cell closest to it.

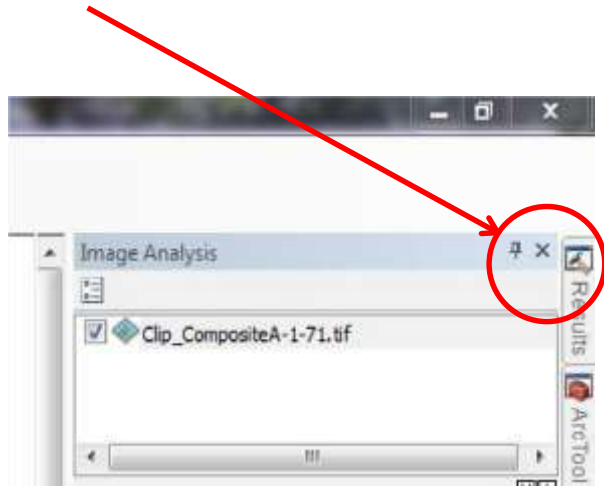
Cubic convolution creates a sharper-looking image.

Bilinear interpolation creates a smooth-looking result.

Majority - the pixel is assigned the most common value within a specific filter window, smoothing the image

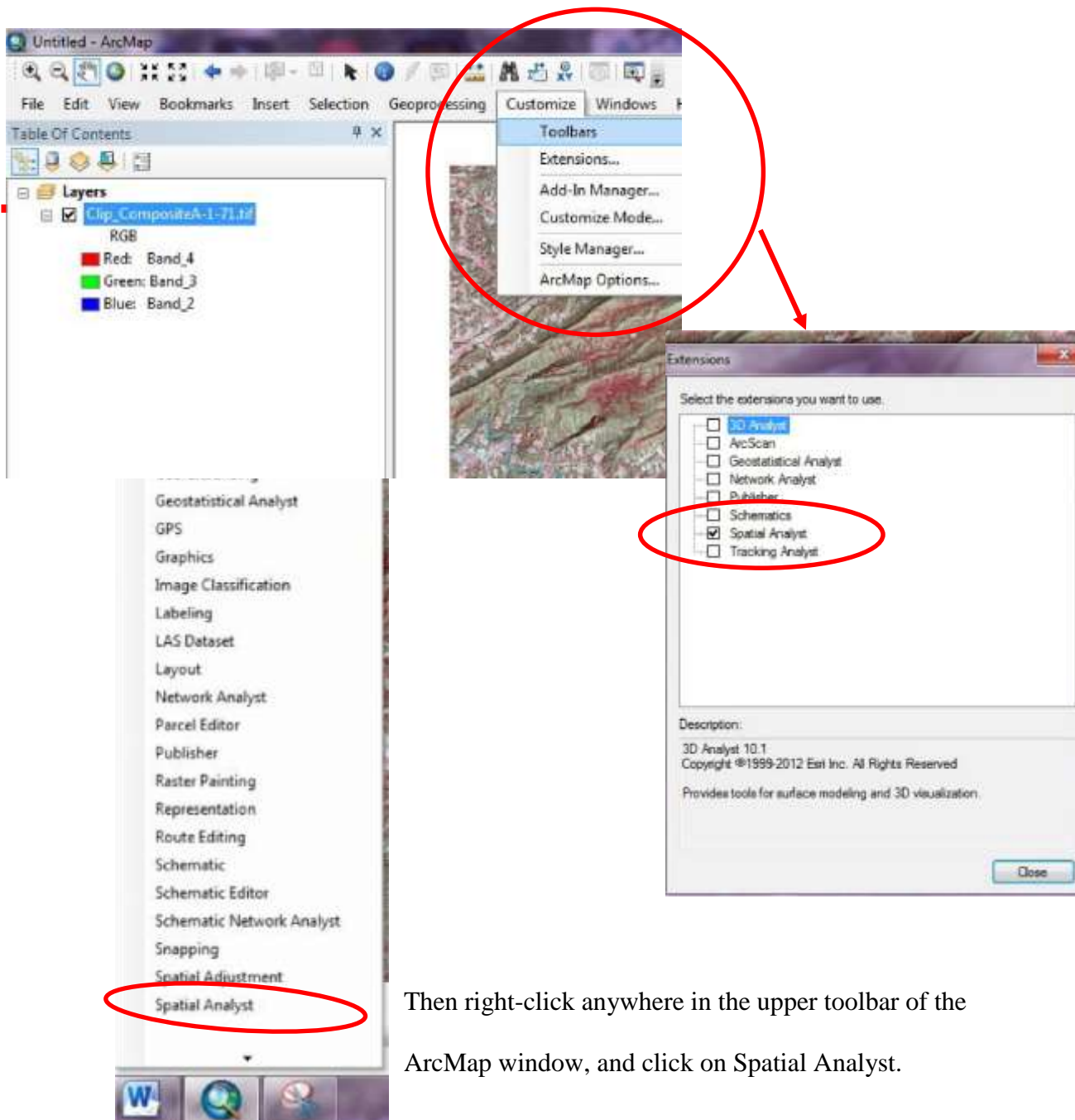
The method you choose to enhance your image will depend on the purpose of your project.

Reset your image to the default – nearest neighbor and close your **Image Analysis** window by clicking on the X in the top of the window (be sure you do the Image Analysis X and not the ArcMap X



Spatial Enhancement Using Spatial Analyst Tools

First, we need to turn on the *Spatial Analyst Extension* and open the *Toolbox*. Left-click on *Customize*, then *Extensions*, and then click in the box next to *Spatial Analyst*.



Then right-click anywhere in the upper toolbar of the ArcMap window, and click on Spatial Analyst.

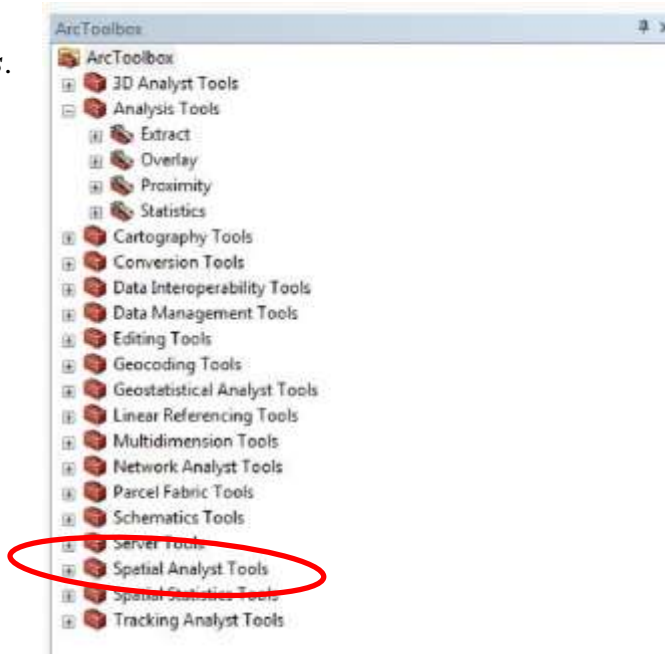
Finally, left-click on the Toolbox icon in the upper toolbar and it opens the Toolbox. The tools

we want are found under



the *Spatial*

Analyst Tools.

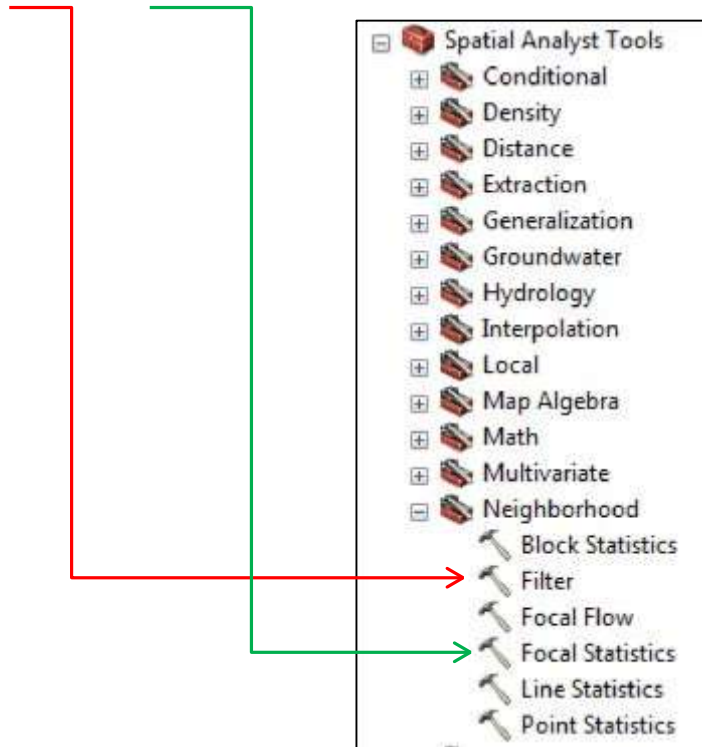


Convolution Filtering in ArcGIS

Convolution filtering is the process of averaging small sets of neighboring pixels across an image, and it is used to change the spatial frequency characteristics of an image. A *convolution kernel* is a matrix of numbers that assigns a weight to each cell (Choosing the kernel defines the

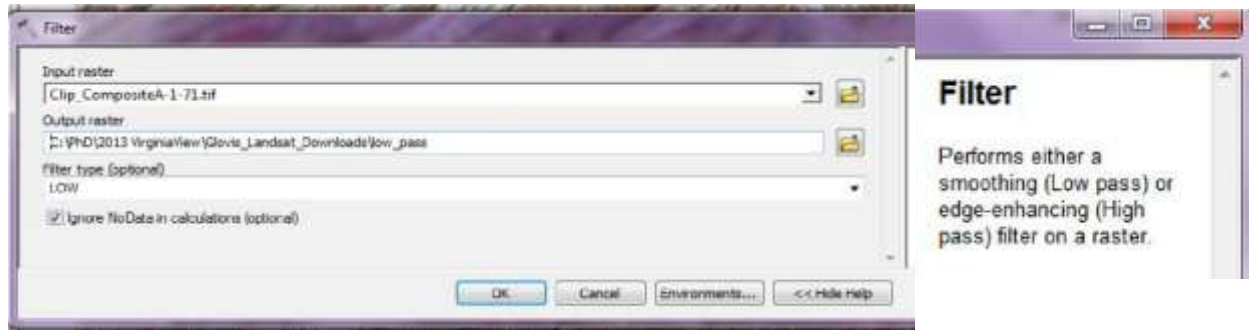
neighborhood size.). As the kernel moves across the image, the values in each neighborhood are multiplied by the weights, and averaged. The resulting value is then assigned to the center pixel and the kernel moves on to the next neighborhood.

When using the Spatial Analyst Tools in ArcGIS, a new permanent file will result. Your original unaltered file will still be available and the new file added to ArcMap. We will be using two different tools – *Filter* and *Focal Statistics*. These are located in your Toolbox:



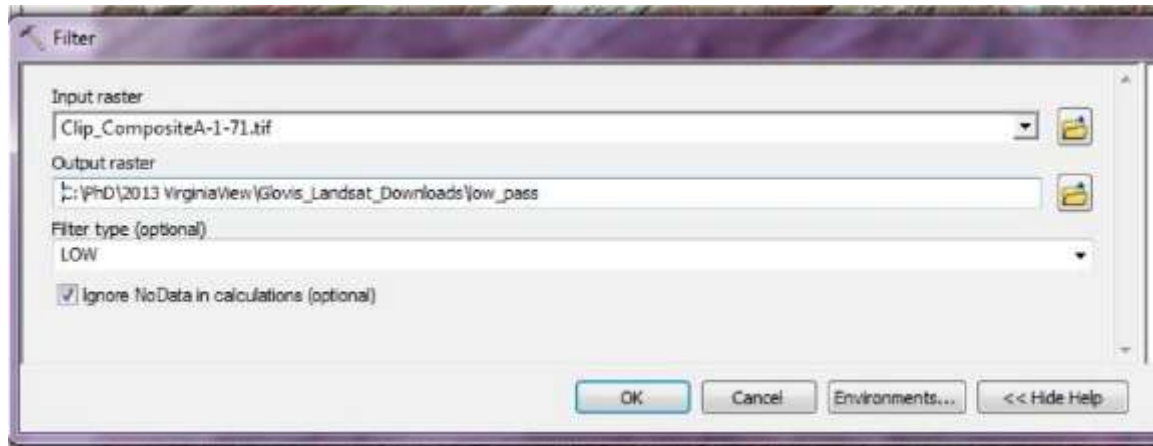
Using the *Filter* Tool

Double left-click on **Filter** and you open the following window:



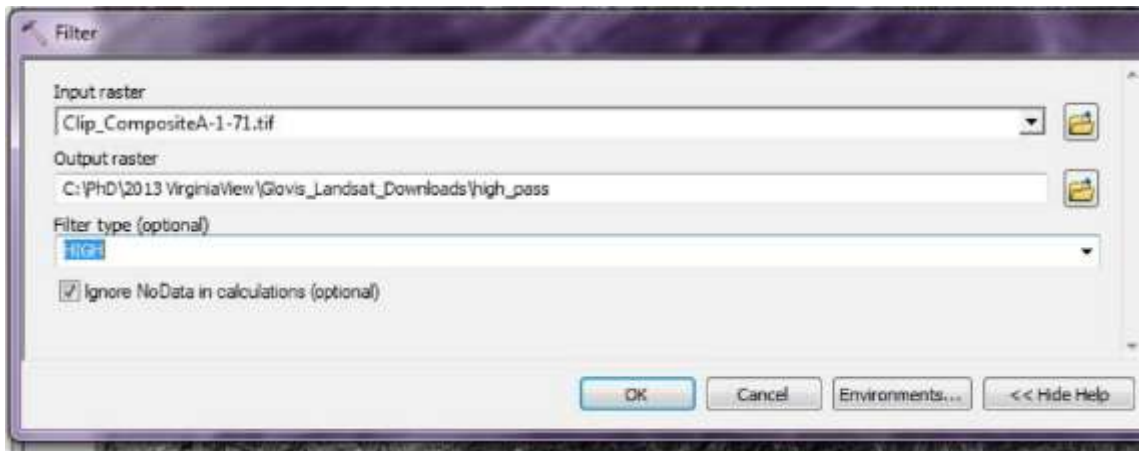
As you can see from the **Filter Help** information window on the right, **Low pass** smoothes and **High pass** enhances edges. (Note – if your help window is not display, just click on the **Help** button at the bottom.) Perform both methods and then let's compare them.

Your input raster is the clipped composite image, just click on the down arrow at the end of the row and your image will be in a list, click on it and it populated the field. Name your output raster, but also make sure that your workspace is listed. If it is not, click on the file folder and navigate to the folder. (Note – when saving raster images, you cannot put any spaces between words, use the underscore key in place of a space.)

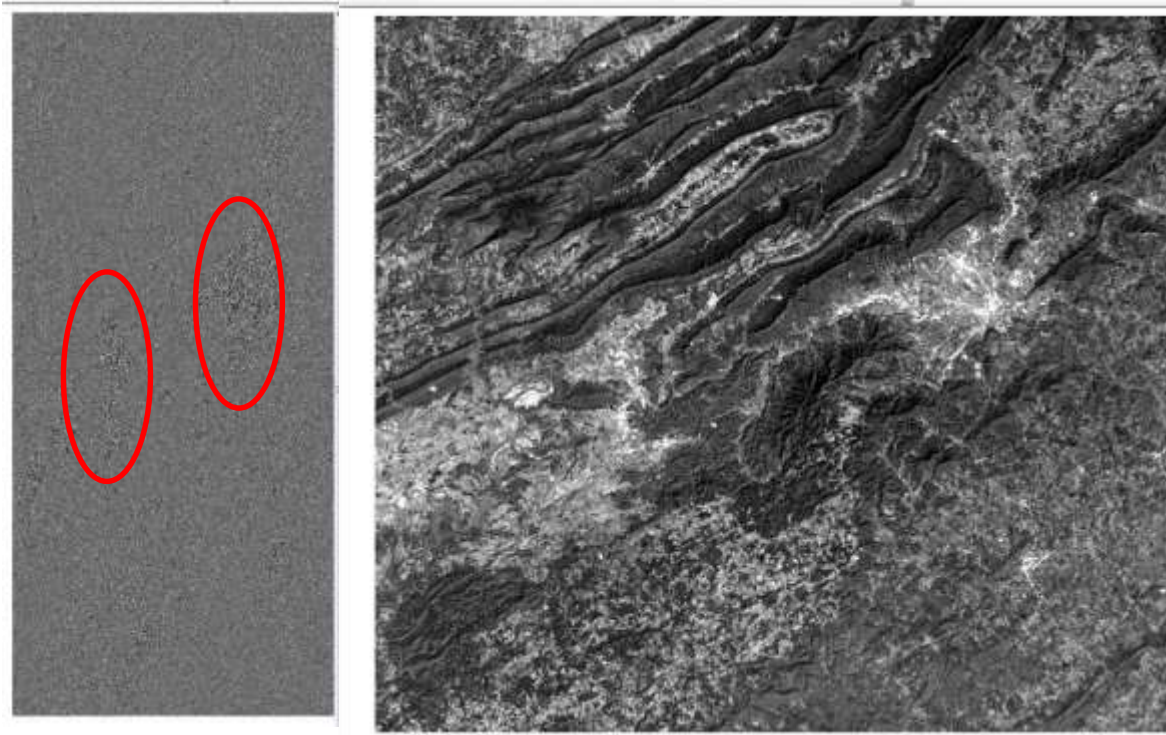


When doing the high pass, the only change is the name of your new file and the Filter

type:



15. Spatial Enhancement of Landsat Imagery



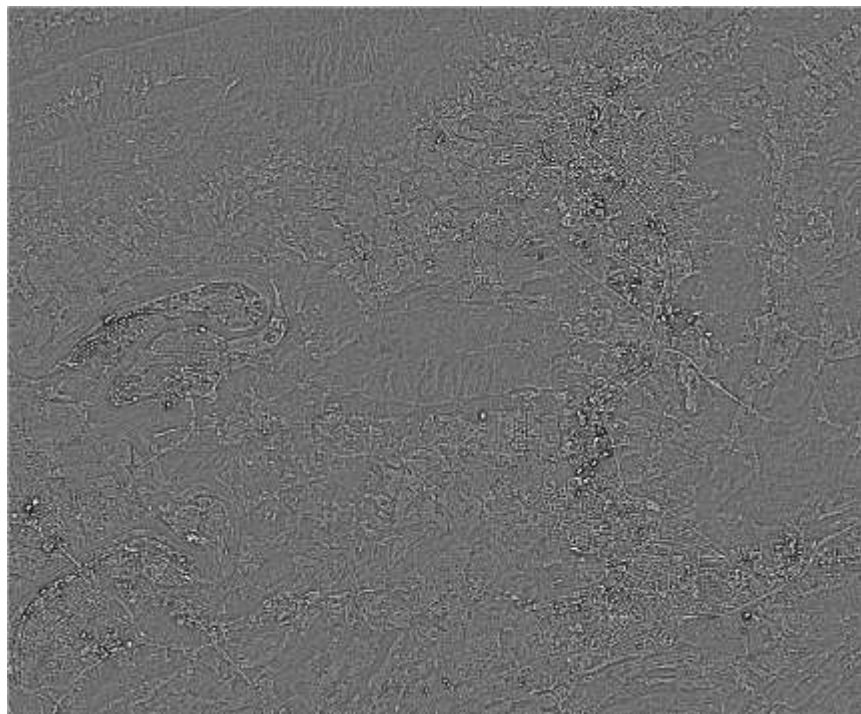
Results: Low Pass

High Pass

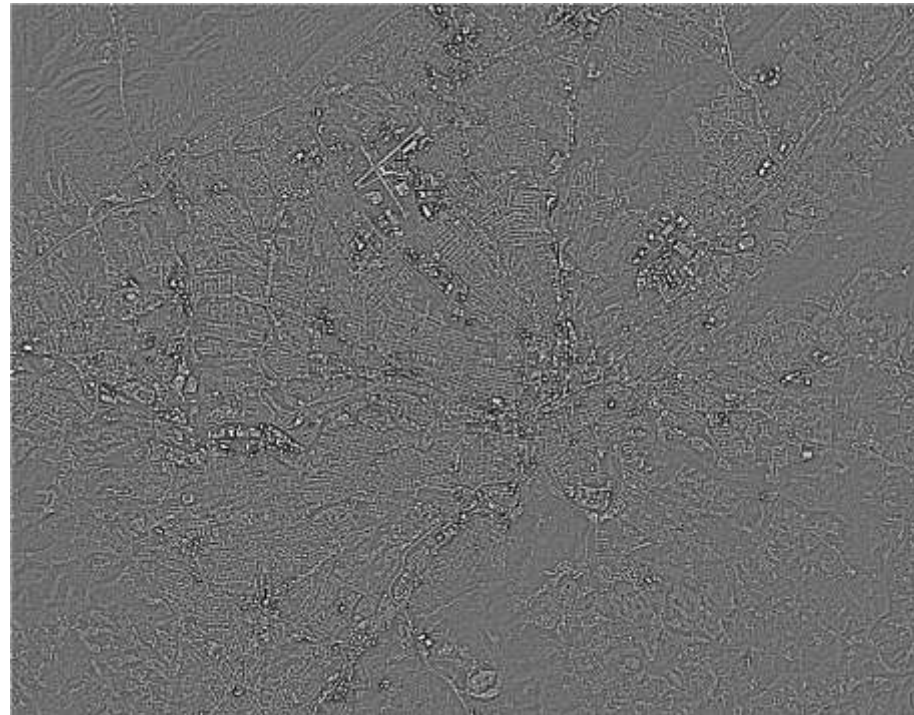
The results of the low pass, smoothing of the image. Within the low pass image, what can you clearly see? On the high pass image, the tool seems not to have enhanced the image; you can see something has changed in a couple of areas (red circles). Let's zoom in to these areas.

Remote Sensing in an ArcMap Environment
15. Spatial Enhancement of Landsat Imagery

Remember, high pass enhances edges. What edges do you see?



New River Valley (Town of Blacksburg in upper right,
New River on the left side)

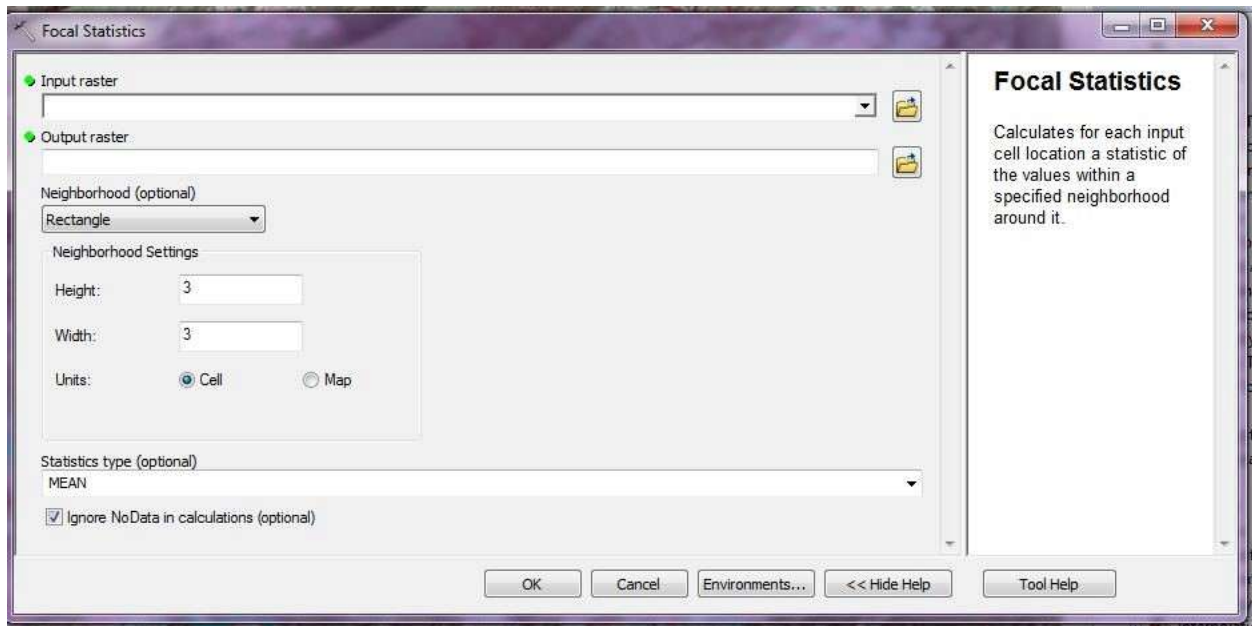


City of Roanoke

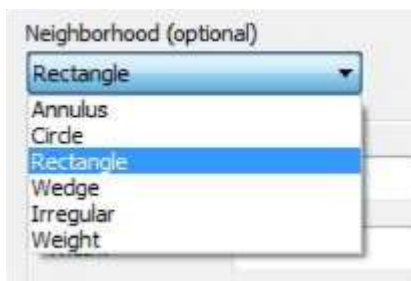
Remote Sensing in an ArcMap
15. Spatial Enhancement of Landsat Imagery

Using the *Focal Statistics* Tool

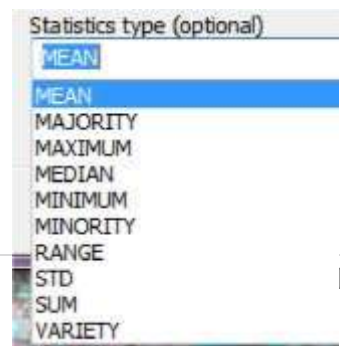
Using the *Focal Statistics* tool is similar to the *Filter* tool – the input raster and you have to name your new file -- except you have more decisions to make for the methodology.



Your first decision is the shape of the neighborhood to use. You can leave the default – *Rectangle* – but don't have to. Once of the choices is *Weight*, which gives you the *convolution kernel* option (page 6 above). You do need to have a .txt file with the weights assigned to use this function.



Your next decision is how big to make the neighborhood – this means the number of pixels. The default is 3.

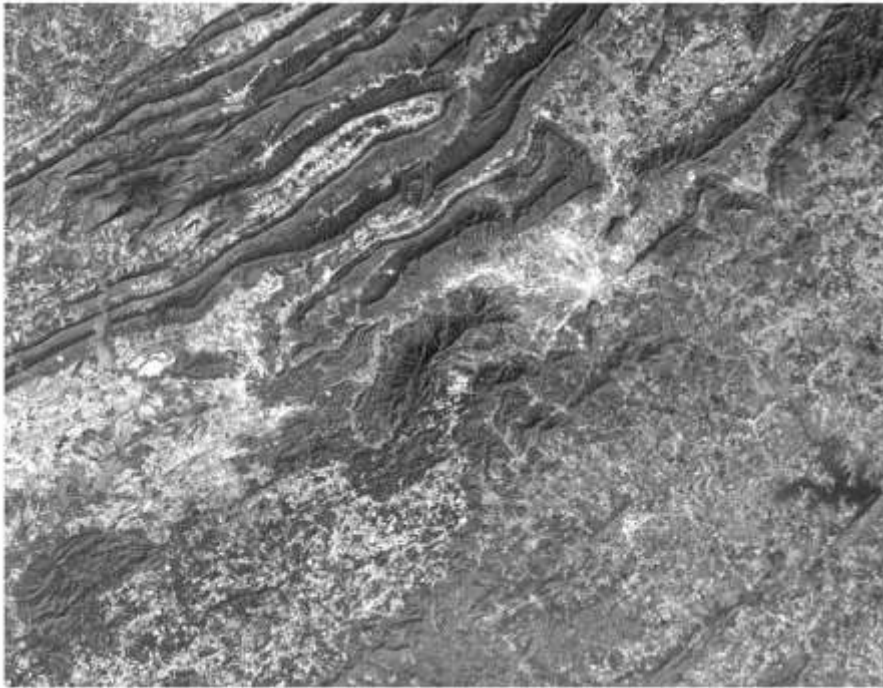


3 by

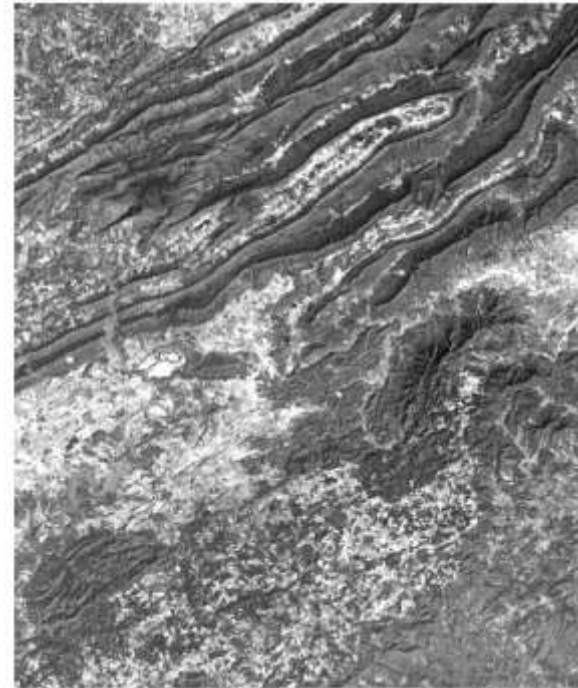
Environment

The final decision is what statistic to use. When clicking on the *Statistic type* line, the Help window will explain what each statistic in the list means.

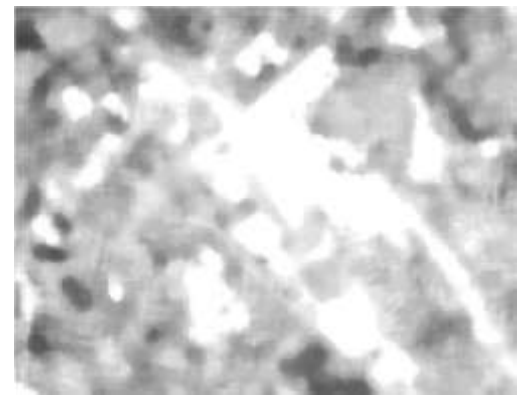
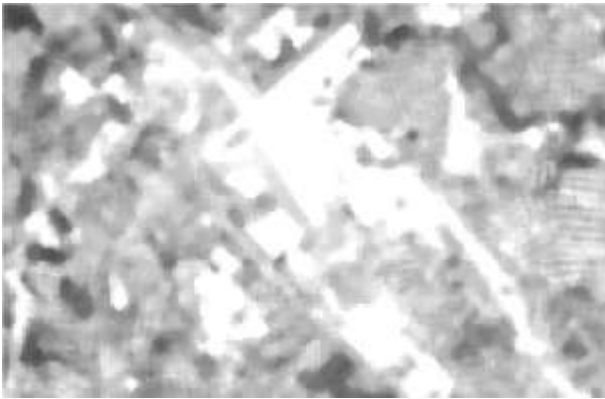
Okay, let's do a couple.



Settings – *Rectangle, 5x5, Median*



Rectangle, 7x7, Median

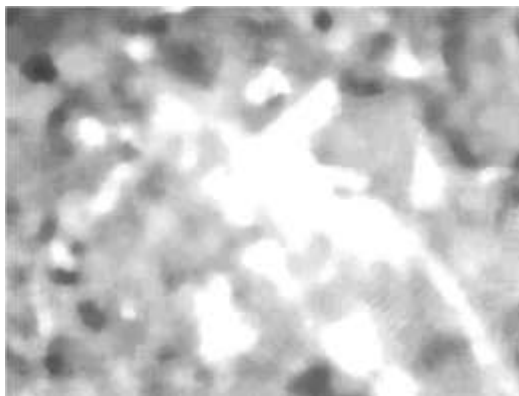
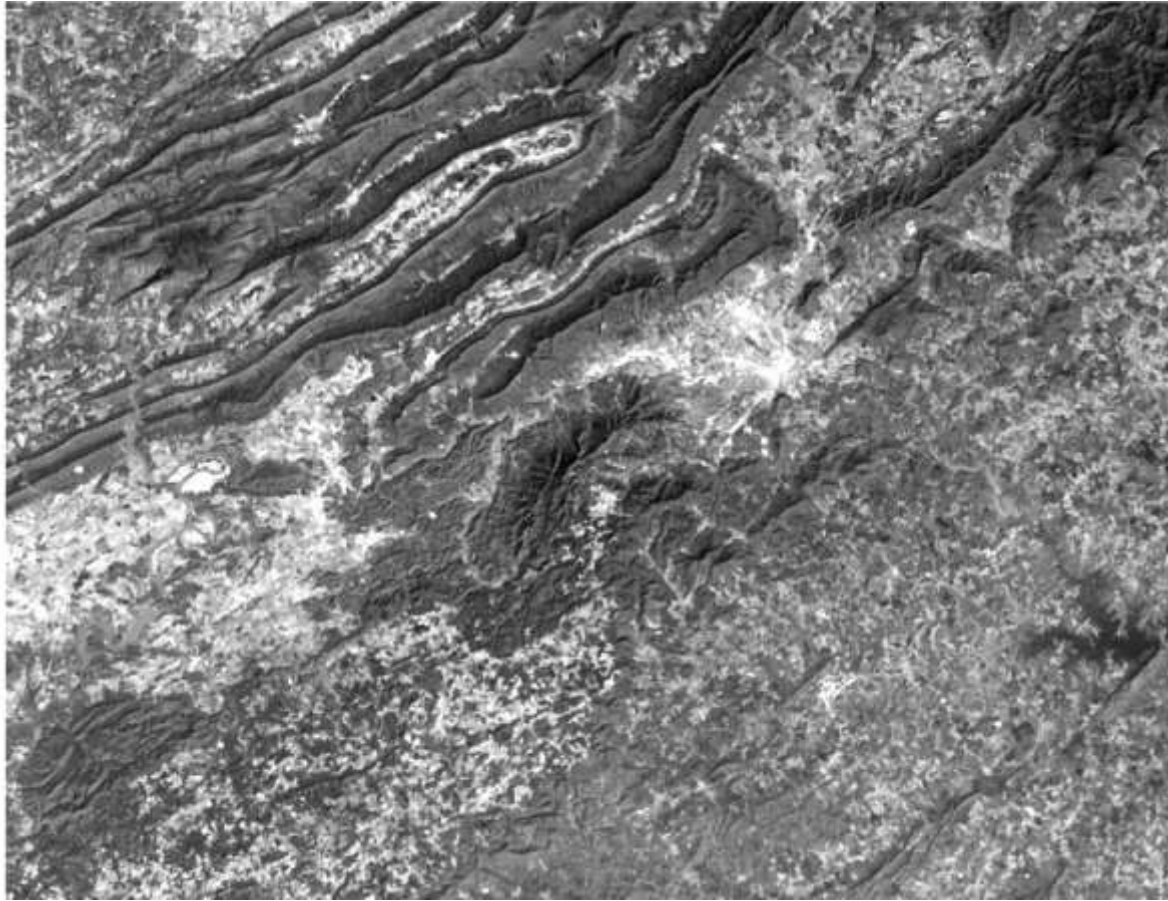


5. Spatial Enhancement of Landsat Imagery

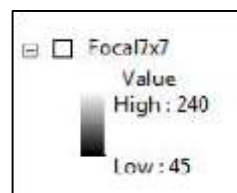
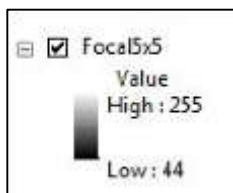
Remote Sensing in an ArcMap

15. Spatial Enhancement of Landsat Imagery

Settings: *Circle, 5, Median*



Do you see any differences? Why is the image sharper for the 5x5 rectangular neighborhood than the others? If you used a 3x3 neighborhood, would the image be sharper than the 5x5? Why? Why would the rectangular produce sharper images than using a circle neighborhood?



Also, look at your *Table of Contents*:

The range of DN's is different for each result.
Why?