Geog 580: Digital Remote Sensing

Lab Assignment 3: Image Enhancements

The purpose of this lab assignment is to let students to get familiar with techniques for image enhancements. In your report, you need to provide required contents and answer questions given at the end of this assignment.

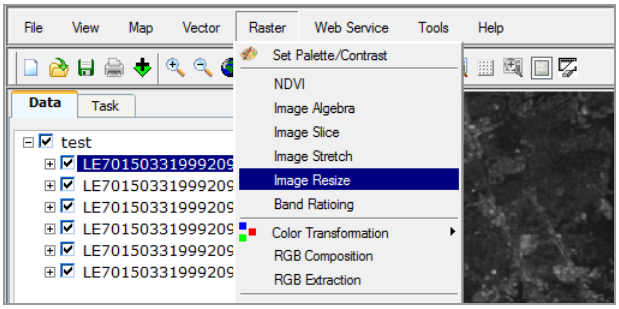
If you have any problem with GeoBrain system, please E-mail Dr. Weiguo Han (whan@gmu.edu, (301)345-3271) and cc to me (ldi@gmu.edu) for technical support.

1. Select an area of interests (AOI) and obtain data for your exercise

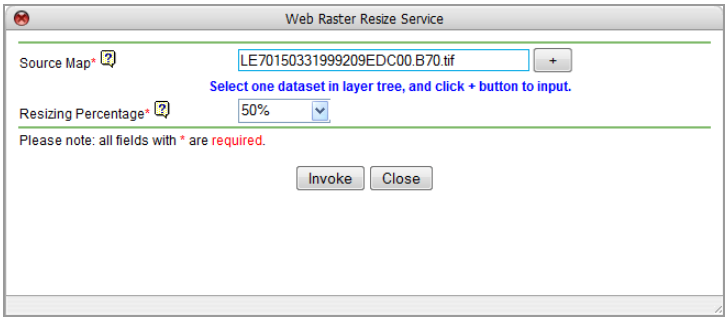
Please follow the same steps as the previous assignments to select AOI and obtain the data. Please use Landsat ETM or TM images for this assignment.

2. Image Reduction and Magnification

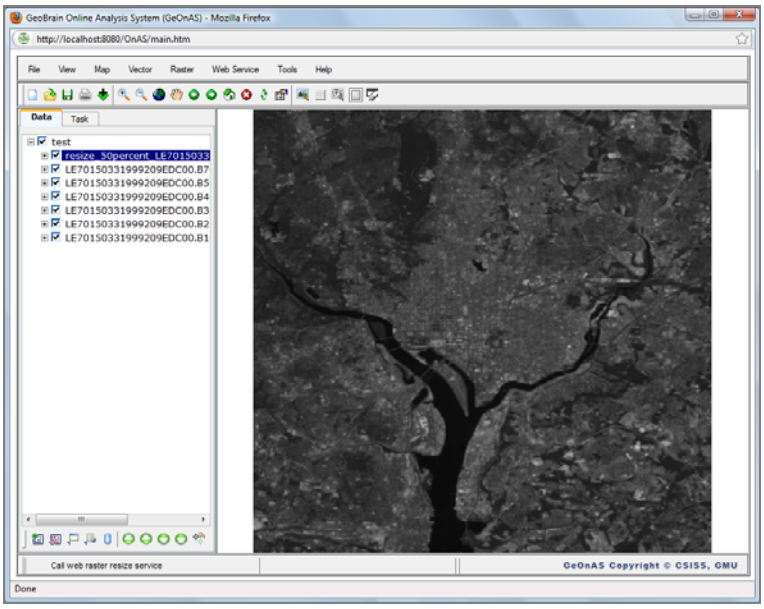
1) Click *Raster->Image Resize*.



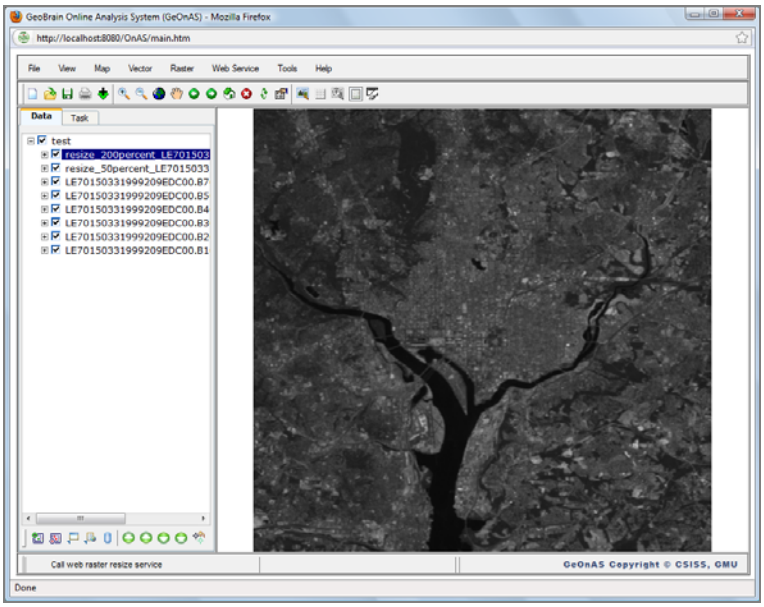
2) Select the dataset on the left panel, and click + button to add it; select or input *50%* (or other ratio) as the resizing percentage, click *Invoke*;



3) Wait a moment for it to complete, when it is finished, the reduced image will be added in the project and displayed.



4) Execute the similar operation of image magnification; select or input 500% (or other ratio) as the resizing percentage, the magnified image is shown as the following.



5) Execute the similar operations and answering question 2.

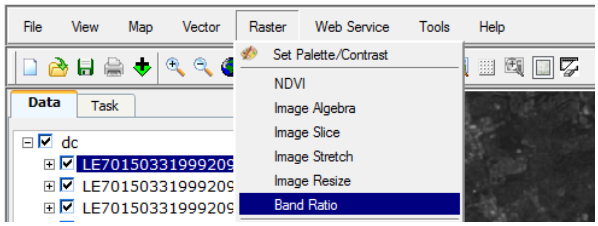
3. Band Ratio

The following is the equation of band ratioing:

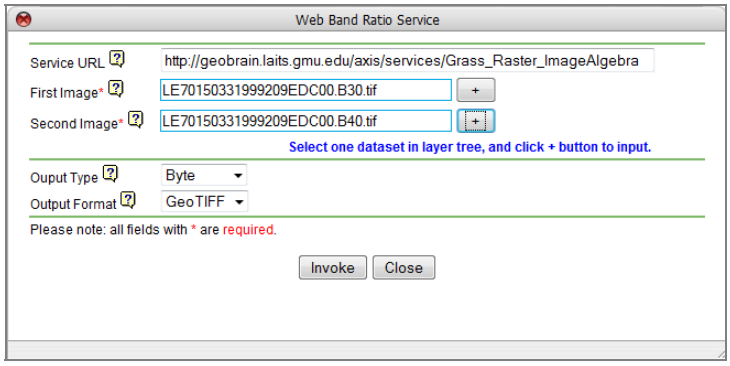
$$BV_{i,j,ratio} = \frac{BV_{i,j,k}}{BV_{i,j,l}}$$

Where $BV_{i,j,k}$ stands for the original input brightness value in band *k*, $BV_{i,j,l}$ is the original input brightness value in band *l*, $BV_{i,j,ratio}$ is the ratio output brightness value.

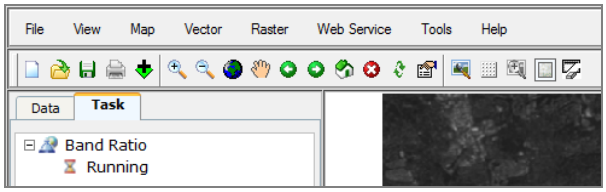
1) Click *Raster->Image Ratio*.



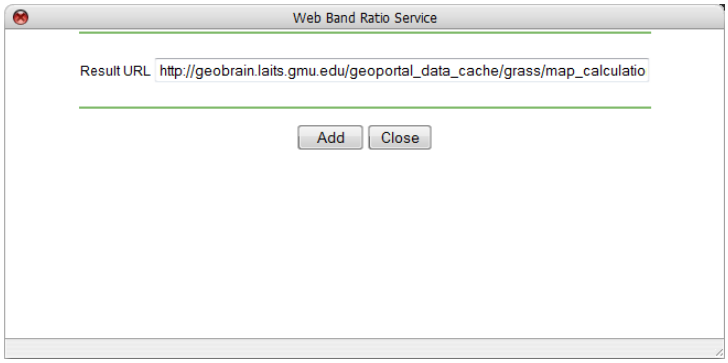
2) Here, take the ratio of Band 3 and Band 4 as an example, select the layer of Band 3 on the left panel, click + button to add it; same operation on Band 4; click *Invoke*;

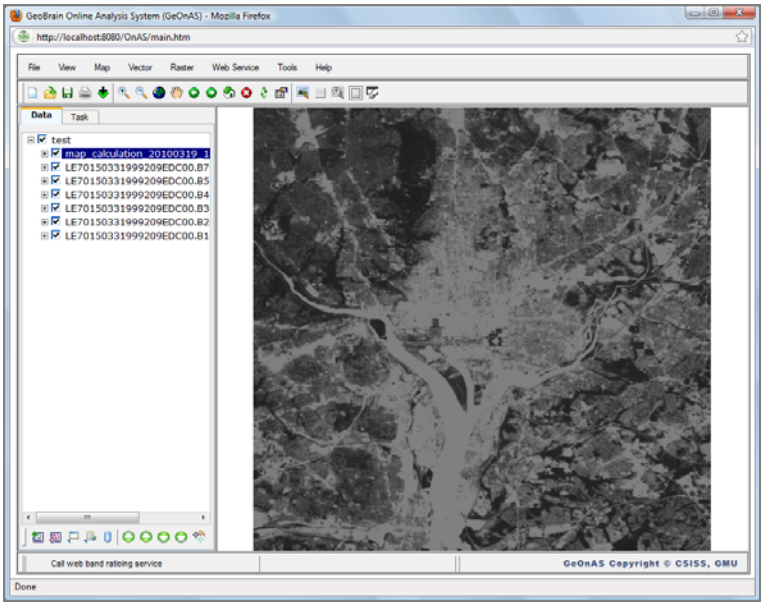


3) Wait a moment for it to complete.



4) When it is finished, the result URL of image ratio will be shown in the form, click *Add* to add and display it in the project.



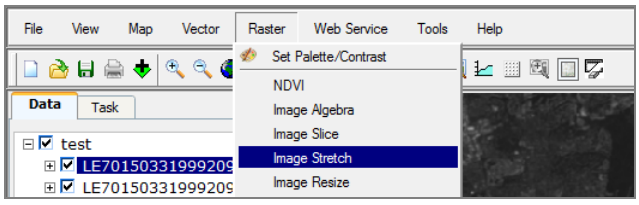


5) Execute the similar operation for other bands and answering question 3

4. Image Stretch

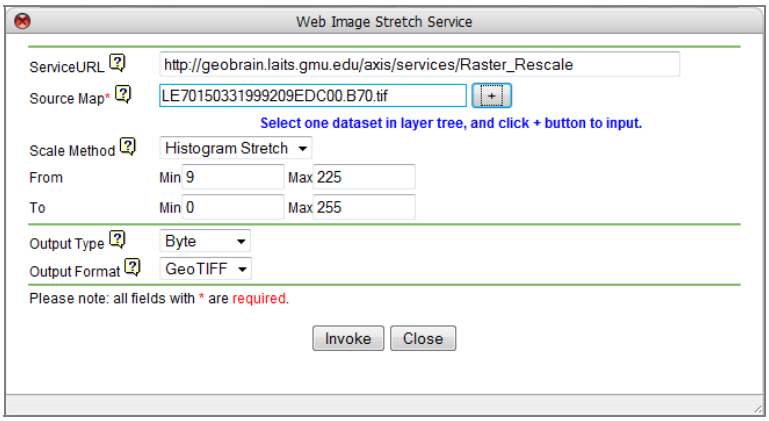
1) Select the dataset on the left panel, and calculate the histogram. (we did that in Lab assignment 2)

2) Click *Raster->Image Stretch*.

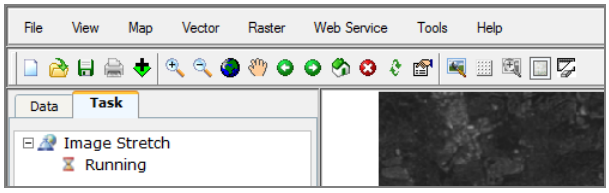


3) Select the dataset on the left panel, and click + button to add it; select *Histogram Stretch*, and input the *From Min* and *Max* and *To Min* and *Max*, (Hint: based on

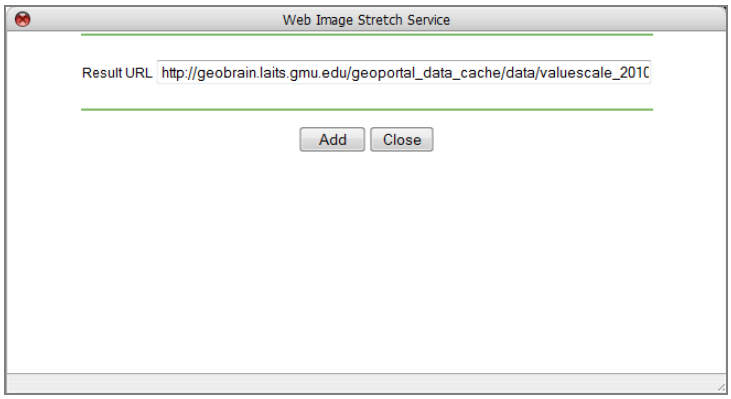
the histogram to determine *From Min* and *Max* , and set *To Min* to 0 and *Max* to 255). click *Invoke*;

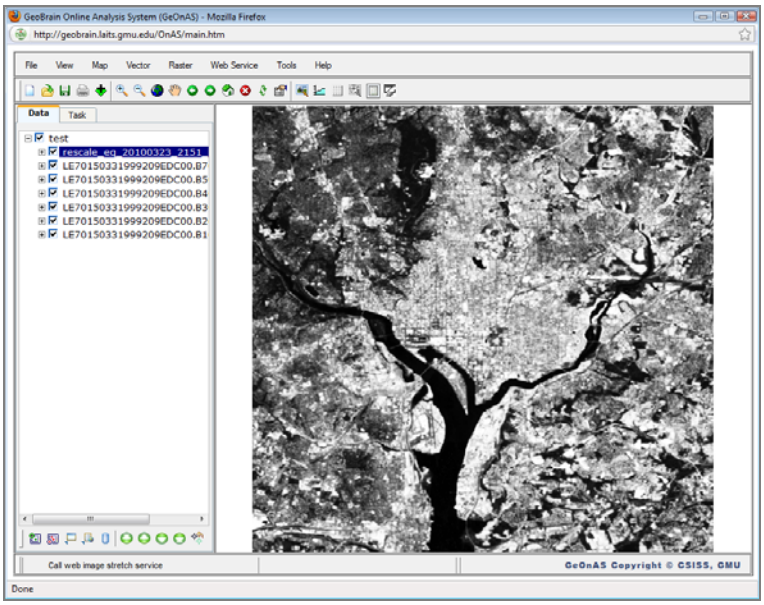


4) Wait a moment for it to complete.

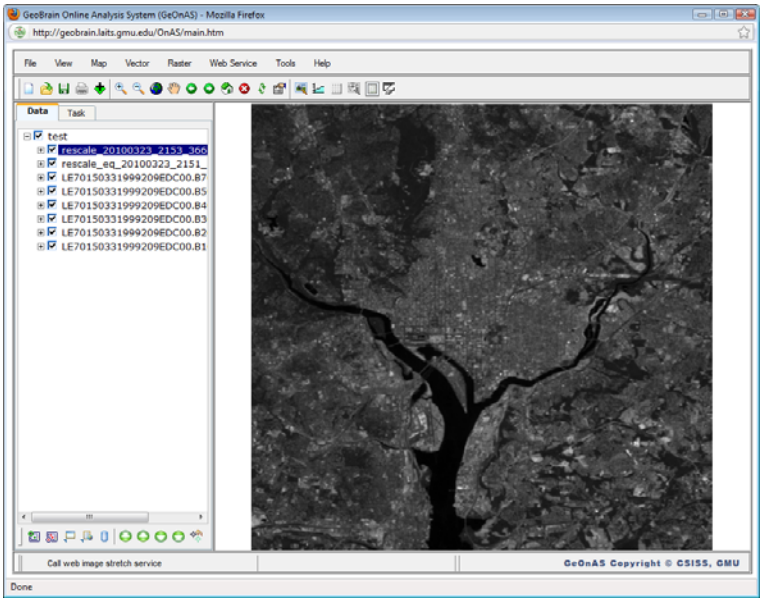


5) When it is finished, the result URL of *Histogram Stretch* will be shown in the form, click *Add* to add and display it in the project.





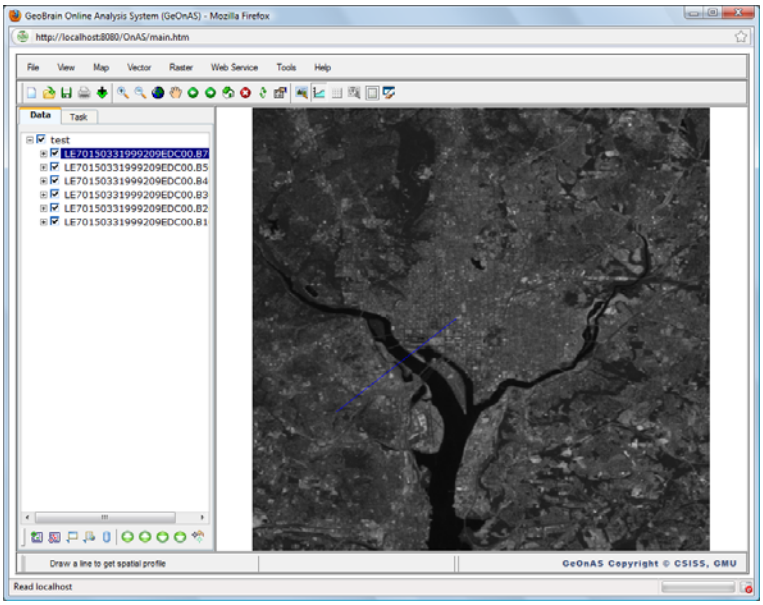
6) Execute *Linear Stretch* following the same process, the output is shown as the following figure.



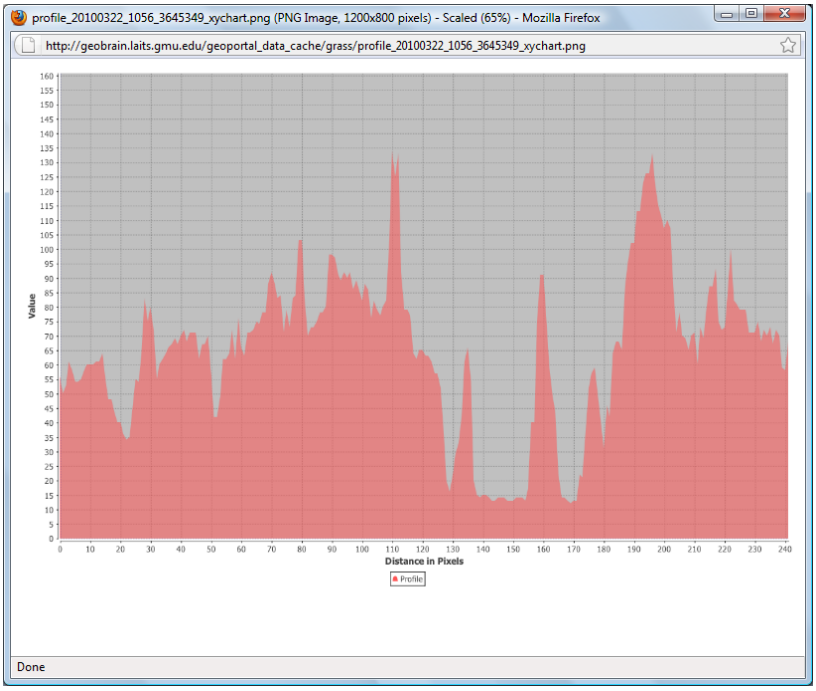
5. Spatial Profile

1) Click on the *Toolbar*, when mouse is moved in the map display area, the cursor will be changed from to , drag a blue line to get spatial profile of the top layer.

Note: To get the spatial profile of another layer, select it and click on the toolbar which lies at the bottom of left panel to move it top, and then perform above operation.



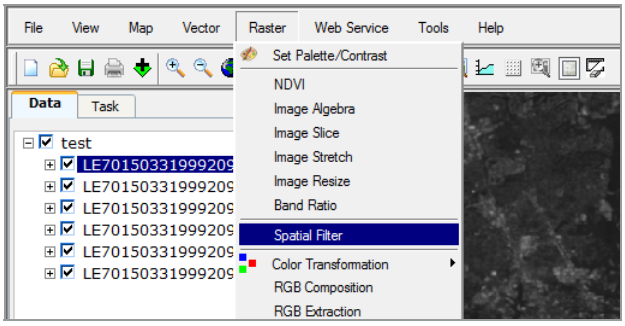
2) The Spatial Profile window will be shown after a few seconds.
Note: If the profile window could not be pop-up in Firefox browser, please click *Options* button and then select *allow pops-up for geobrain.laits.gmu.edu*, then redraw the line to obtain the spatial profile.



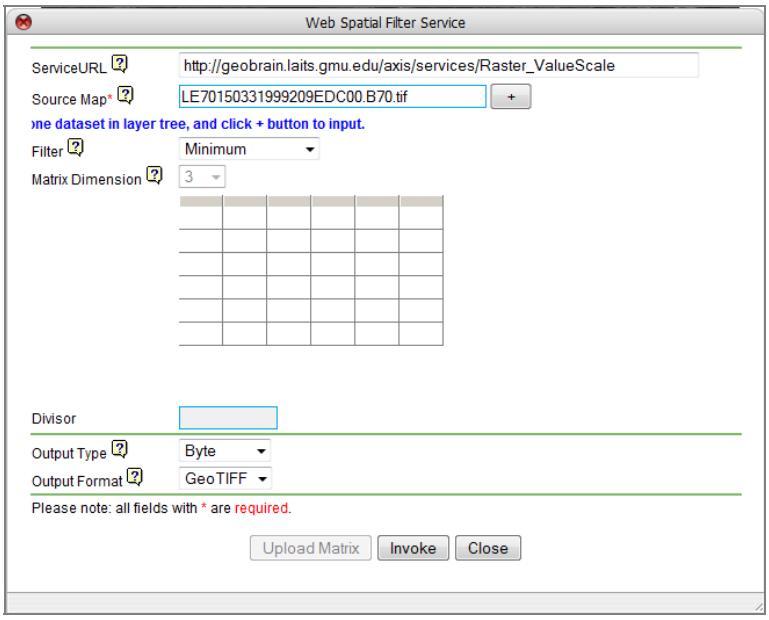
3) Click  on the *Toolbar* to remove the blue line.

6. Spatial Filtering

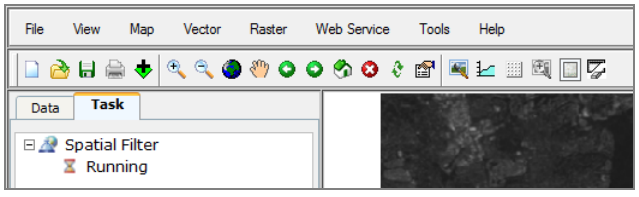
1) Click *Raster->Spatial Filter*.



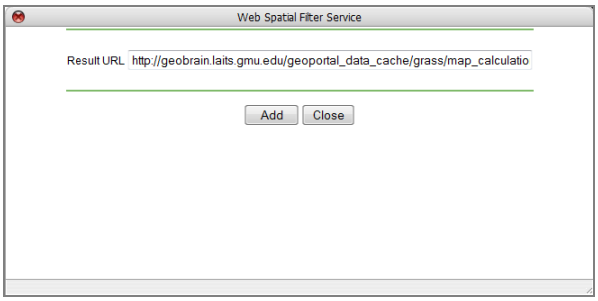
2) Select the dataset on the left panel, and click + button to add it; select *Minimum* Filter, click *Invoke*;

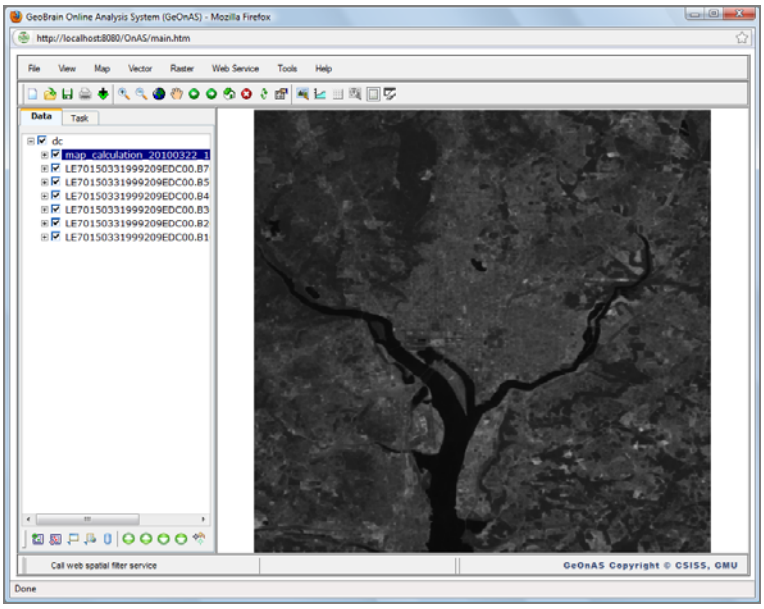


3) Wait a moment for it to complete.

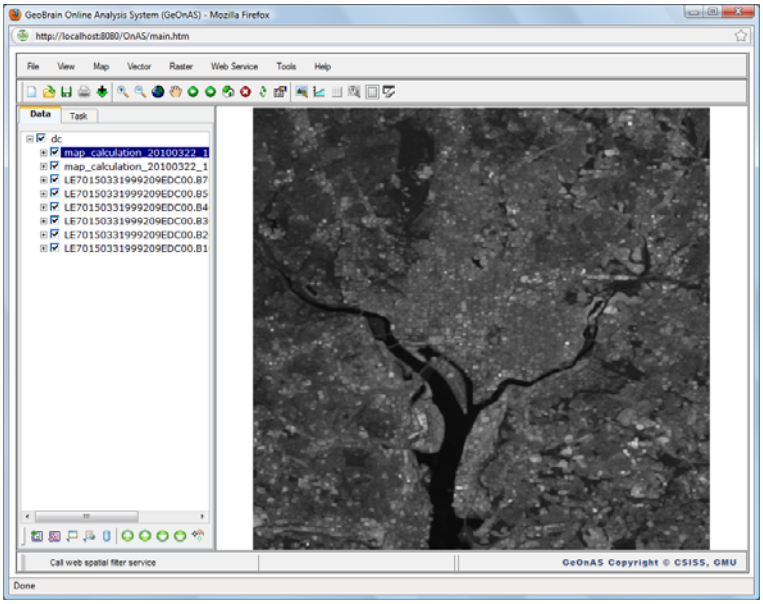


4) When it is finished, the result URL of *Minimum Filter* will be shown in the form, click *Add* to add and display it in the project.

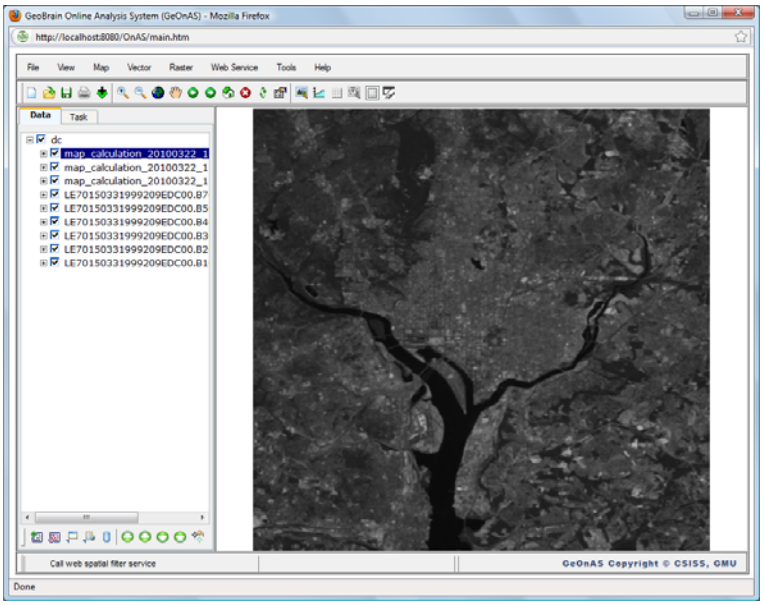




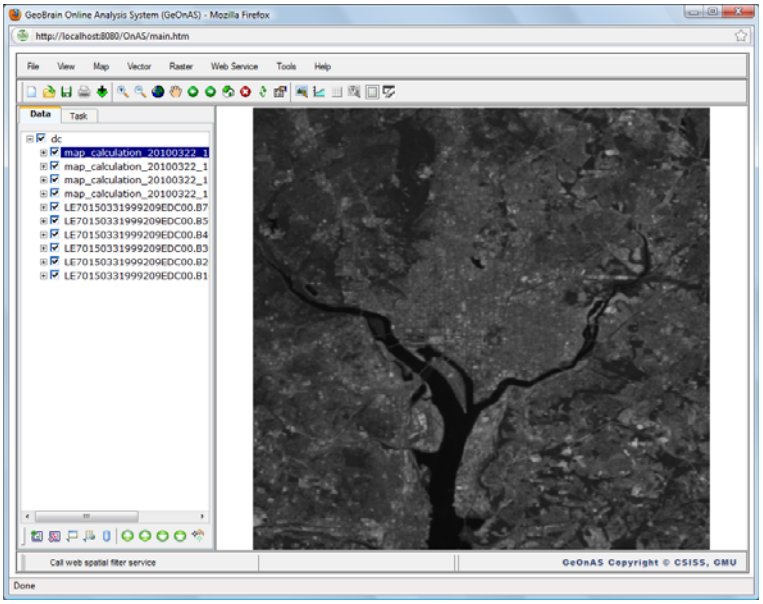
5) Execute *Maximum*, *Median*, *Low Frequency*, and *High Frequency* following the same process, the following are the outputs display.



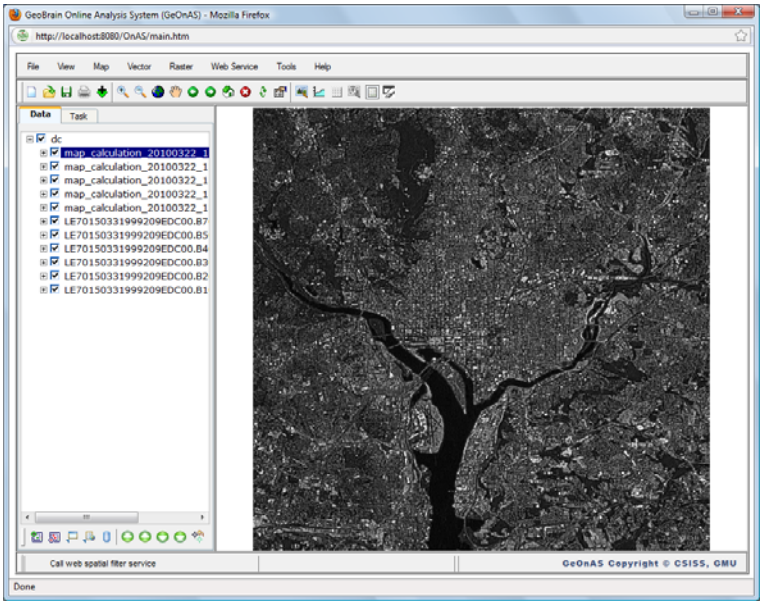
Maximum Filter



Median Filter



Low Frequency

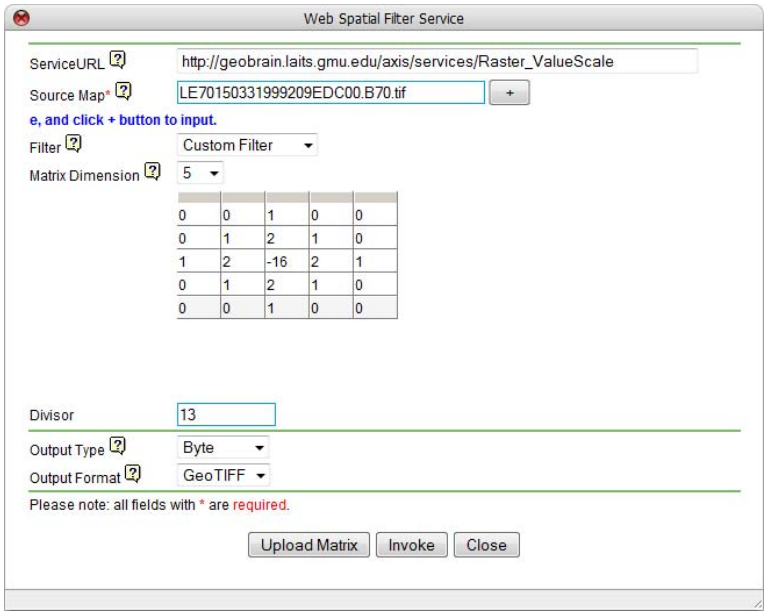


High Frequency

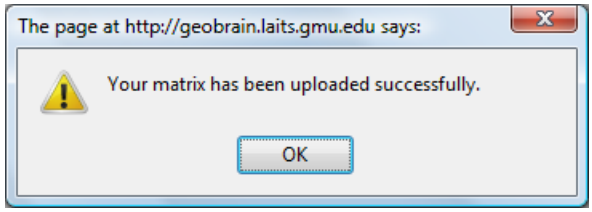
6) You also could specify the filter matrix by selecting *Custom Filter*, here take *Laplacian Filter* as an example: choose 5 as the matrix dimension, double click each cell of matrix grid to input the following values:

0	0	1	0	0
0	1	2	1	0
1	2	-16	2	1
0	1	2	1	0
0	0	1	0	0

Input *13* as the *Divisor*, and click *Upload Matrix* to upload the specified matrix.

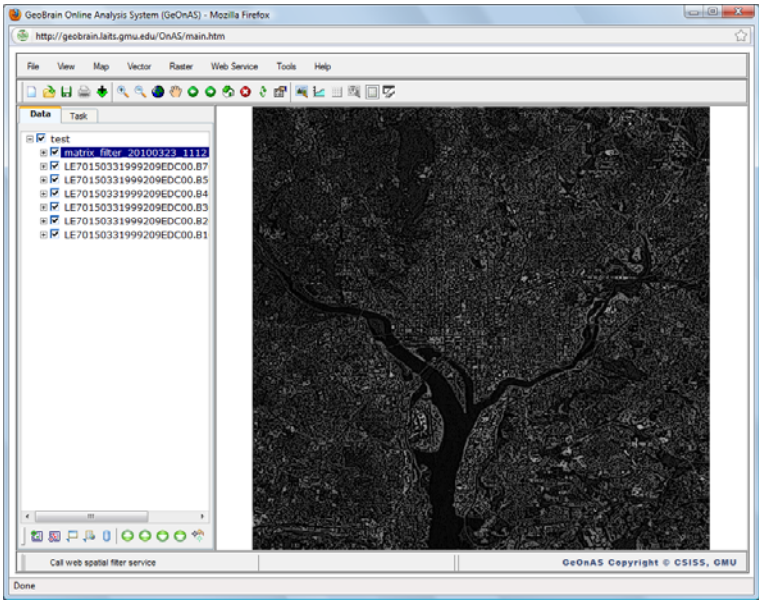


If the matrix is uploaded successfully, the following message box will be displayed.



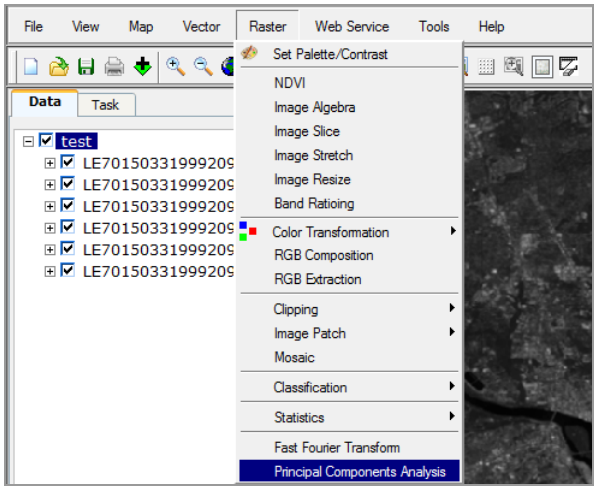
Next, click *Invoke*.

7) Wait a moment for it to complete. Finally, add and display the result in the project.

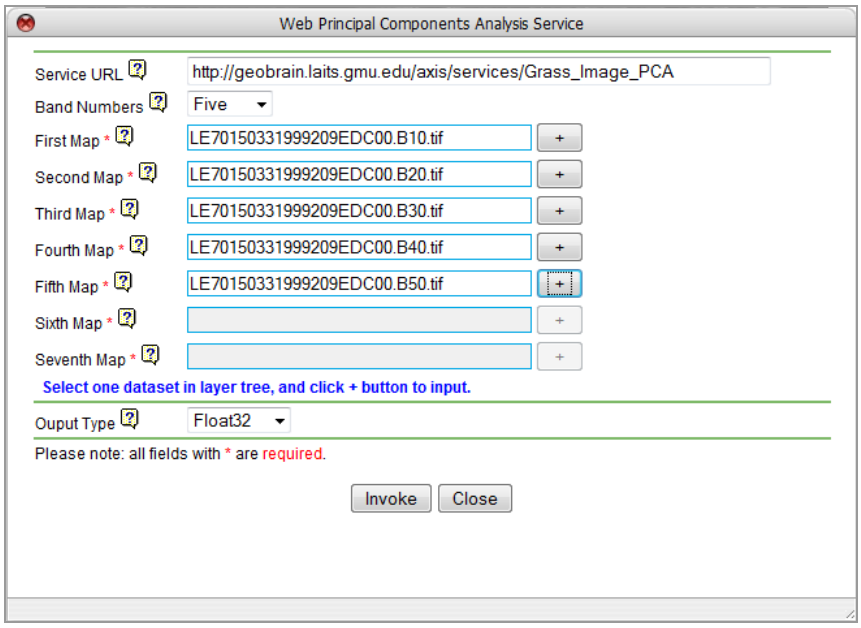


7. Principal Components Analysis

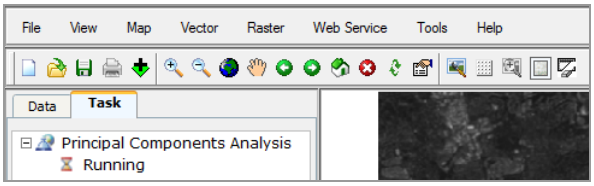
1) Click *Raster->Principal Component Analysis*.



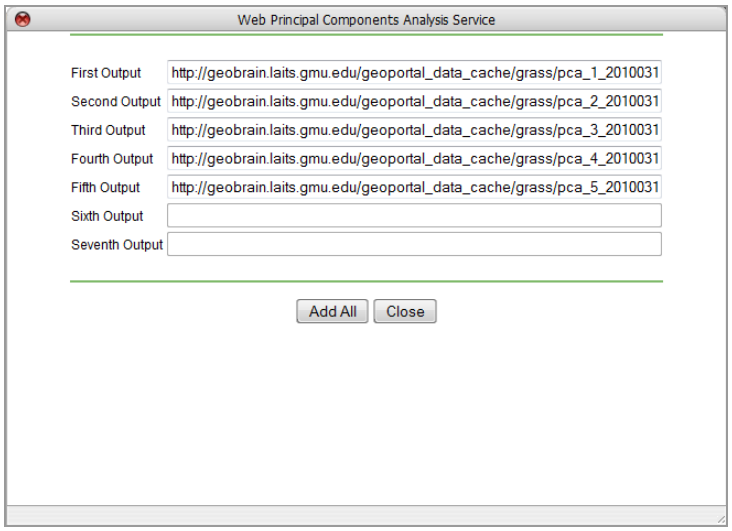
2) Choose the band number, here is 5; Select the dataset on the left panel, and click + button to add it, *First Map* will be the 1st row and column of the output matrix, *Second Map* for 2nd, and so forth; click *Invoke*;

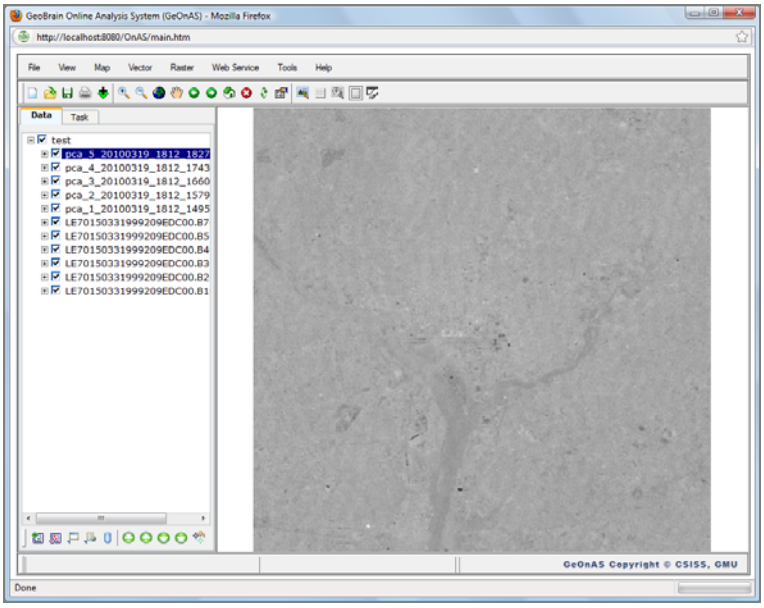


3) Wait a moment for it to complete.



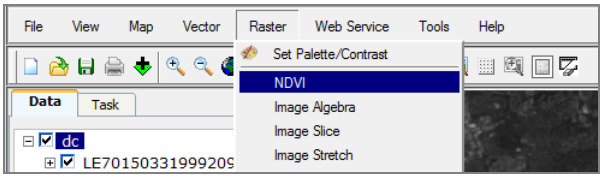
4) When it is finished, the result URLs of principle component analysis will be shown in the form, click *Add All* to add and display them in the project.



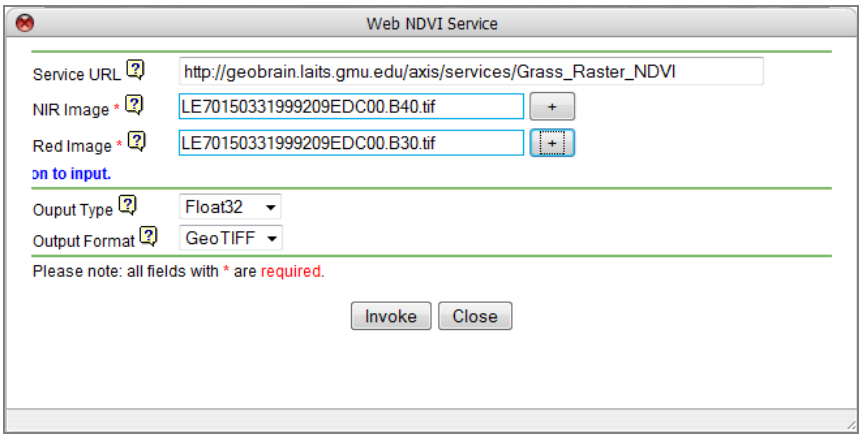


8. Vegetation Indices

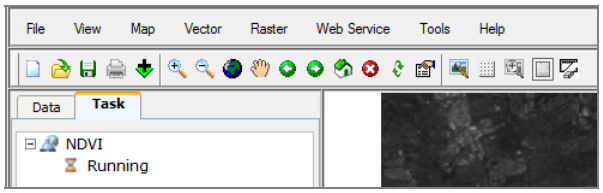
1) Click *Raster->NDVI*.



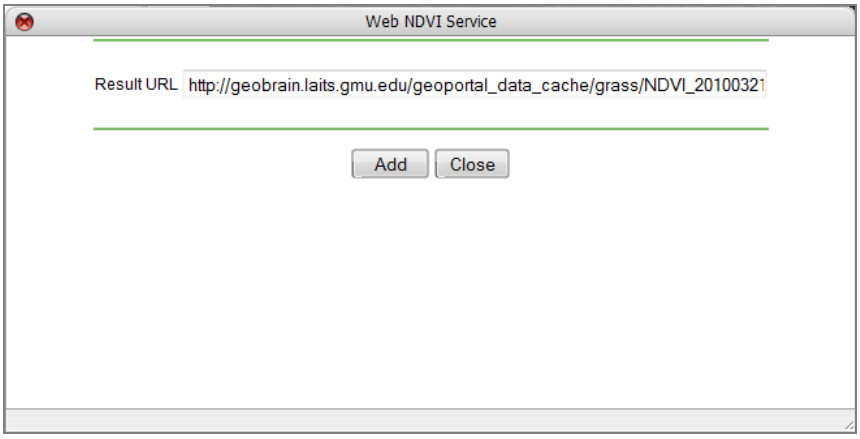
2) Select *NIR Image* (Band 4) and *Red Image* (Band 3) on the left panel and click + button to add them one by one, click *Invoke*;

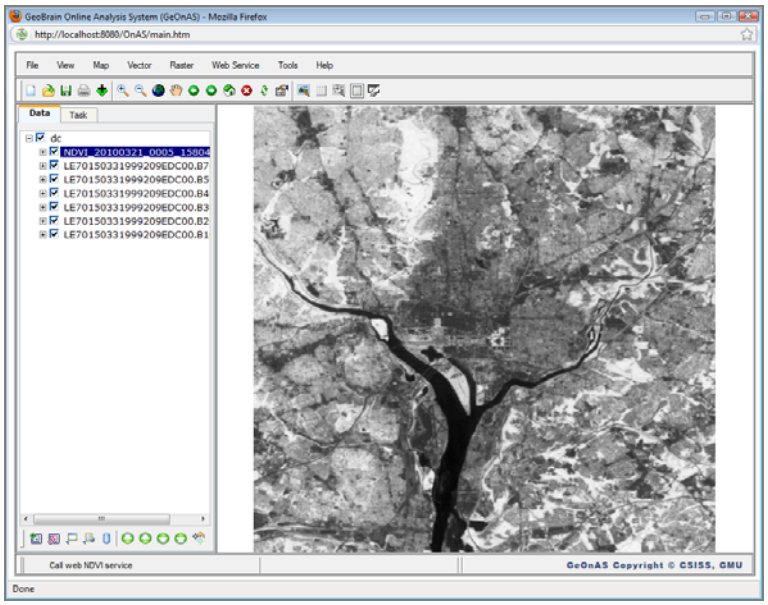


3) Wait a moment for it to complete.

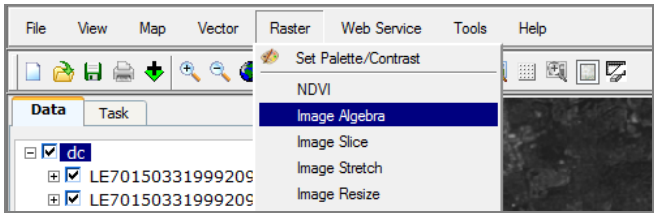


4) When it is finished, the result URL of NDVI will be shown in the form, click *Add* to add and display it in the project.

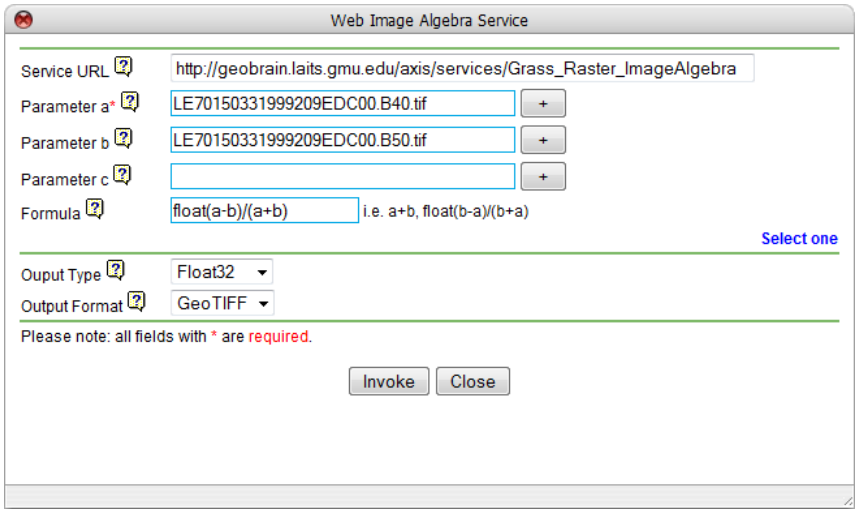




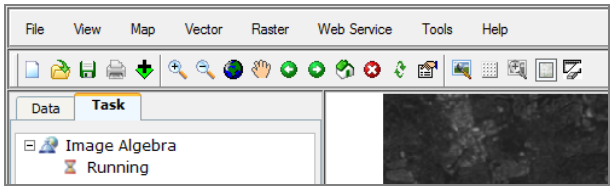
5) You also could calculate Infrared Index (II) by calling *Image Algebra*, click *Raster->Image Algebra*.



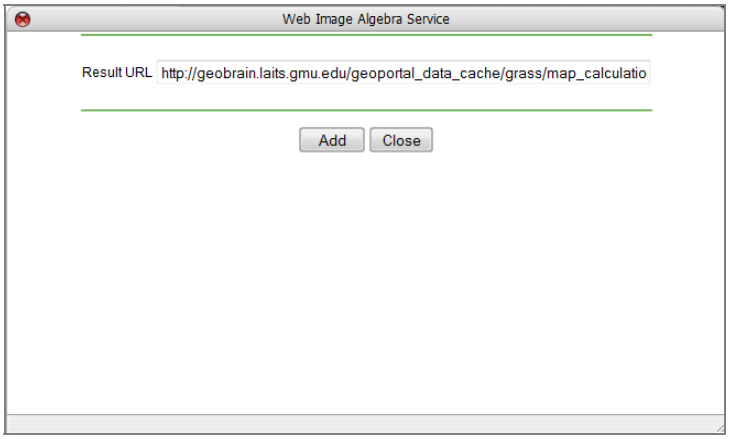
6) Select *NIR Image* (Band 4) on the left panel and click + button to add it as parameter, then *SWIR Image* (Band 5) as parameter b; input *float(a-b)/(a+b)* as the formula and select *Float32* as the *Output Type*, click *Invoke*;

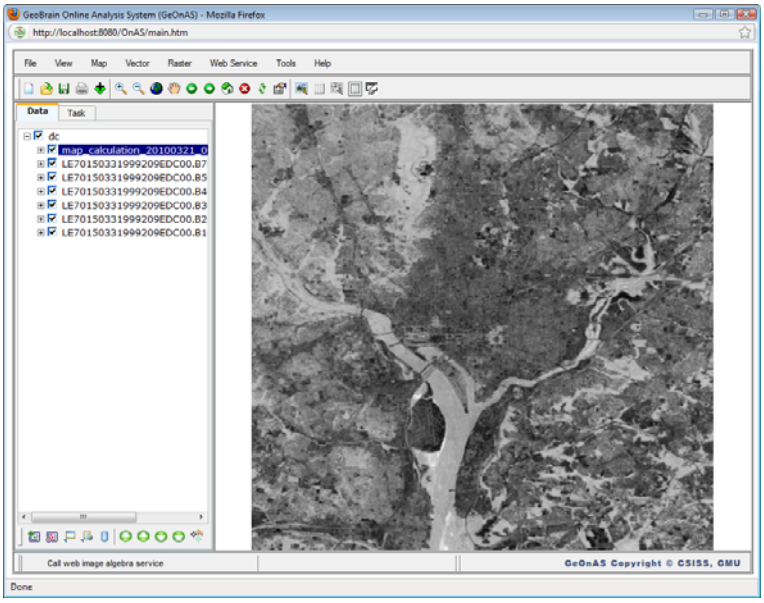


7) Wait a moment for it to complete.



8) When it is finished, the result URL of Image Algebra will be shown in the form, click *Add* to add and display it in the project.





Report contents and questions:

1) Tell which AOI you have selected for this assignment, and describe why you select this specific AOI for the assignment. Attach one image of AOI in your lab report.
2) For image resize, if I want to pixel to pixel co-register 250-meter resolution MODIS images with 30-meter resolution Landsat TM image, what resizing percentage should be applied, to which image, and why?
3) If I want to enhance the vegetated area through simple band ratioing, which two land bands are you going to use and why? Has the vegetated area high values or low values in the ratio image?
4) How do you determine *from Min* and *Max* value for the histogram? Describe the visual difference between histogram equalized and linear stretch images. Attach the histogram in your report.
5) Attach a profile in your report.
6) Spatial filtering: Design a 3 * 3 spatial filtering mask that can enhance the edge of north-south direction. Provide the mask's weights in report and attached the edge enhanced image. (Note: the resulted image should be the original image + enhanced edge, not just the edge itself).
7) Attach first component image and the fifth component image in the report. Describe the difference between the two images and explain why they are different.
8) Attach the NDVI image in your report. Compare the vegetation ratioing image (in question 3) with the NDVI image and describe any difference.