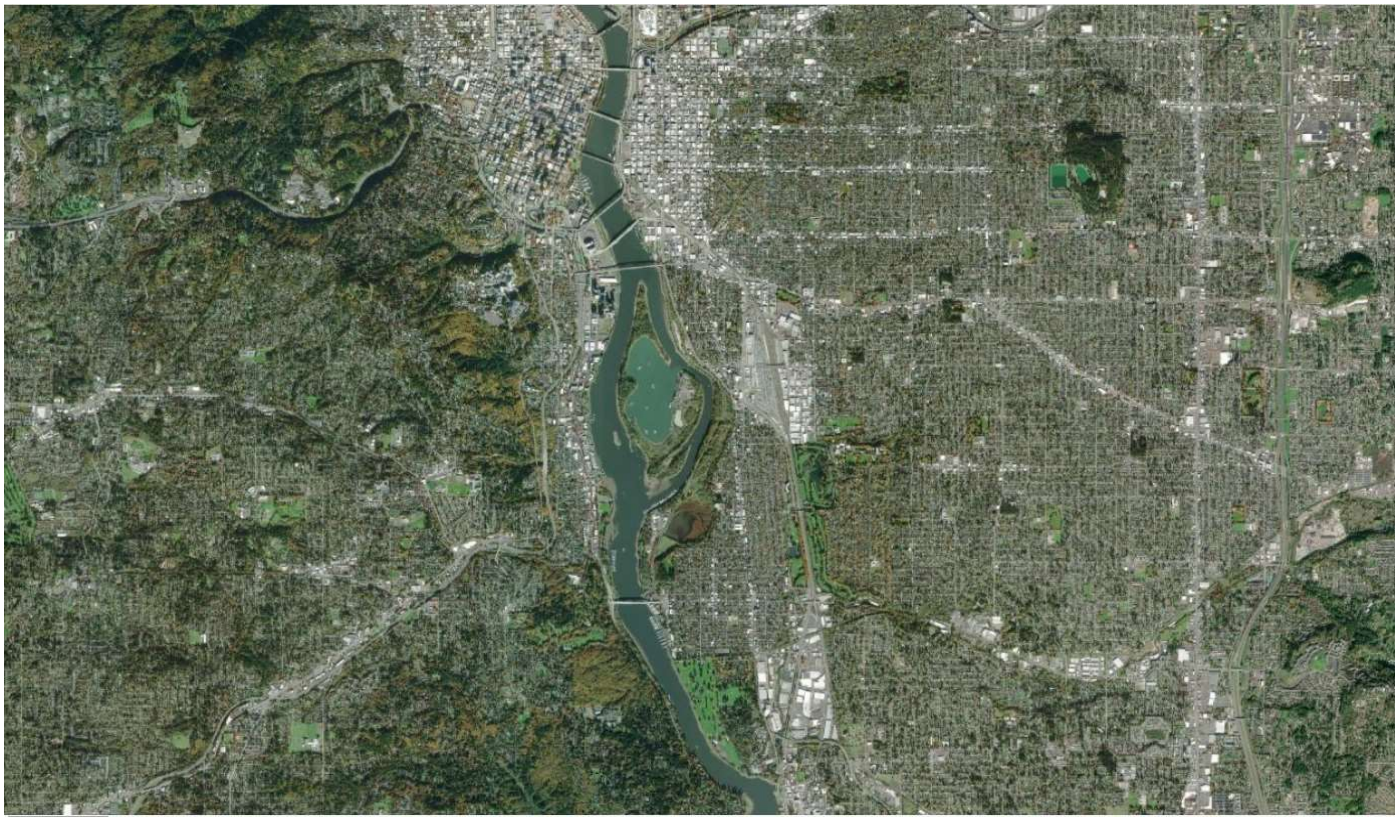
Term Project

GIS_CE_513

Winter_2021

Mapping the color of image



By

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Part I

Problem statement:

The purpose of this report is to classify aerial photos for Ross Island Lagoon (RIL) on the Willamette River, OR. In order to document which year had more harmful Algal Blooms and also to Classify aerial imagery into land-use types in SW Corvallis to determine which parts of the ground are pervious and impervious, as a part of the CE_513 GIS course.

Introduction

A Harmful Algal Bloom (HAB) in Ross Island Lagoon (RIL) on the Willamette River near Portland OR threatens environmental and human health. Beginning in the 1940s the US Army Corps of Engineers constructed an embankment that shut off downstream flow into the lagoon. Following the closure of the upstream end, Ross Island Sand and Gravel (RISG), a private gravel operator, removed millions of cubic yards of material from the lagoon, leaving a very deep (120') hole in the lagoon. These activities have contributed to a HAB at RIL, which has led to the recent ODEQ listing of the lagoon as impaired for cyanobacteria. (1)

Site Description:

Ross Island is the main island of a four-island cluster in the Willamette River in Portland, Oregon, in the United States. The islands, covering a total of about 400 acres (160 ha), are owned mainly by Ross Island Sand and Gravel (RISG), which mined them extensively between 1926 and 2001. The other three islands are Hardtack, East, and Toe. Ross Island was named for Oregon pioneer Sherry Ross.

The islands split the Willamette River into Holgate Slough on the east. They are about 1 mile (1.6 km) south of downtown Portland at river mile 15, the islands are slightly upriver (south) of the Ross Island Bridge between the Springwater Corridor Trail on the eastern shore and the South Waterfront on the western shore and slightly downriver from the Oaks Bottom Wildlife Refuge on the eastern shore and Willamette Park on the western shore. Ross is the longest of the islands, the closest to the western shore, and the closest to the Ross Island Bridge. Hardtack is to its east. East Island lies southeast of Hardtack, and Toe Island lies southwest of Ross. No bridge reaches the islands, which are approached only by boat.

Ross Island is connected to Hardtack Island by an artificial levee built in 1926 by the U.S. Army Corps of Engineers in order to form a lagoon between the two islands. The lagoon made dredging easier for RISG and diverted water west of the islands, where it deepened a shipping channel. (2)

Figure 1. General view Ross Island Lagoon (RIL) on the Willamette River near Portland OR.

Data Description:

The USGS Earth Explorer were used in this project to download Landsat Remote Sensing Data. First, we need to define the study area then define the data that we want to download and finally view results & select data to download them. Then I used ArcGIS to map the Algal blooms.

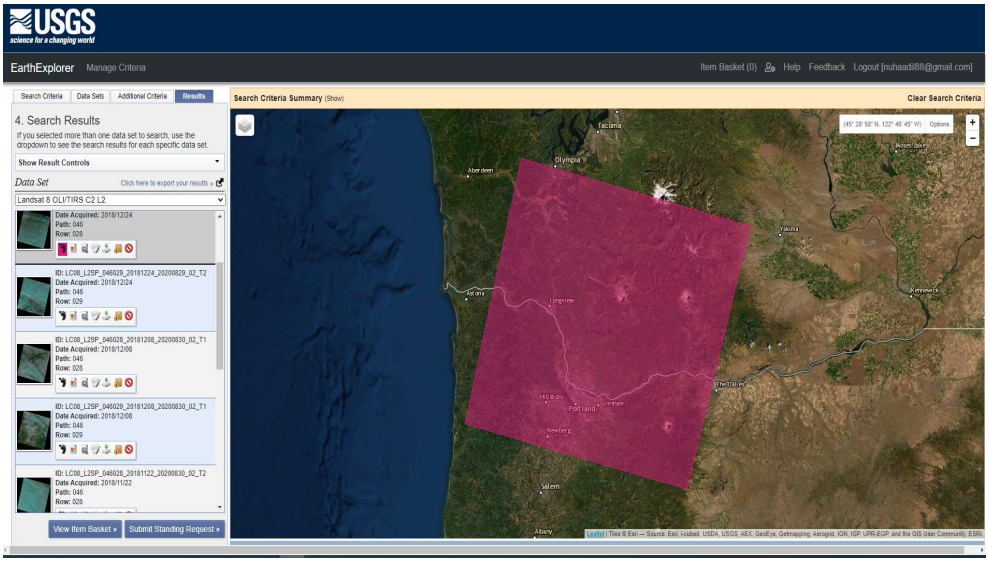


Figure 2. Earth Explorer Website

Methodology:

The Landsat 8 images exported to ArcGIS. Then Normalized Difference Vegetation Index or NDVI maps were used to detect HABs. By using these steps:

1. **Extract by mask:**
   Extract the image to the area of study using Extract by mask from the geoprocessing.

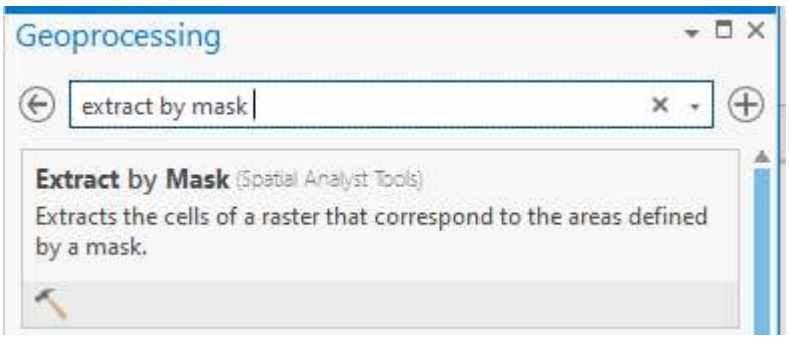


Figure 3. Snippet from ArcGIS

2. **Raster Functions:**
   On the ribbon, click the Imagery tab. In the Analysis group, click Raster Functions.

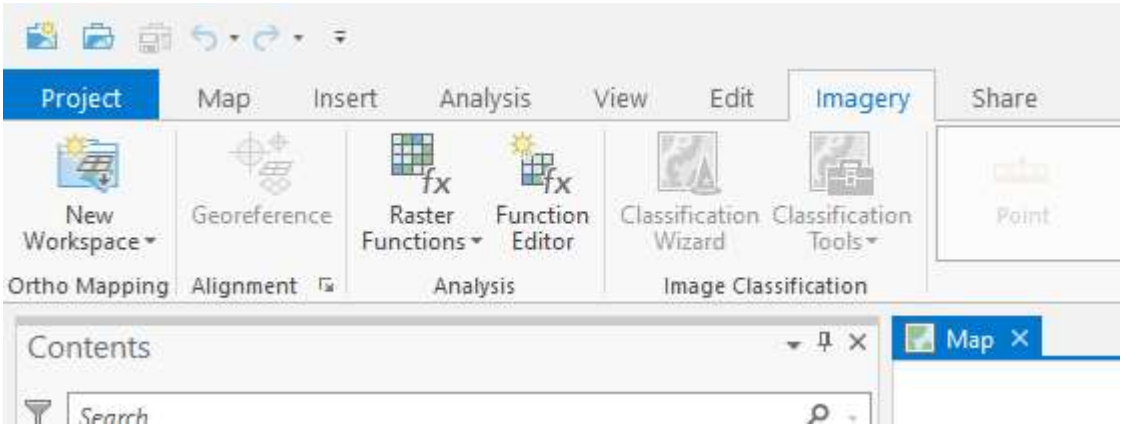


Figure 4. Snippet from ArcGIS

3. **Click the NDVI Icon:**
   Under system, Select the NDVI icon which looks like a leaf.

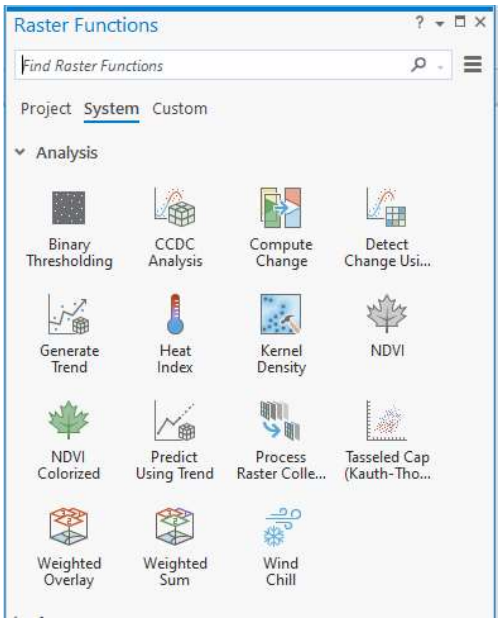


Figure 5. Snippet from ArcGIS

This will create a temporary layer in the table of contents. Bright green indicates high NDVI. Whereas red has low NDVI. NDVI is calculated as a ratio between the red (R) and near infrared (NIR) values in traditional fashion:

$$\frac{Band\ 5 - Band\ 4}{Band\ 5 + Band\ 4}$$

Results:

At this stage, I was unsuccessful, but this is something that I have learned, and I have now known I am aware of Landsat, different bands, different lengths and how to put them together.
Here is an example from esri in Madison, Wisconsin 2018.
Three satellite images are necessary from three different dates (within a similar time frame).

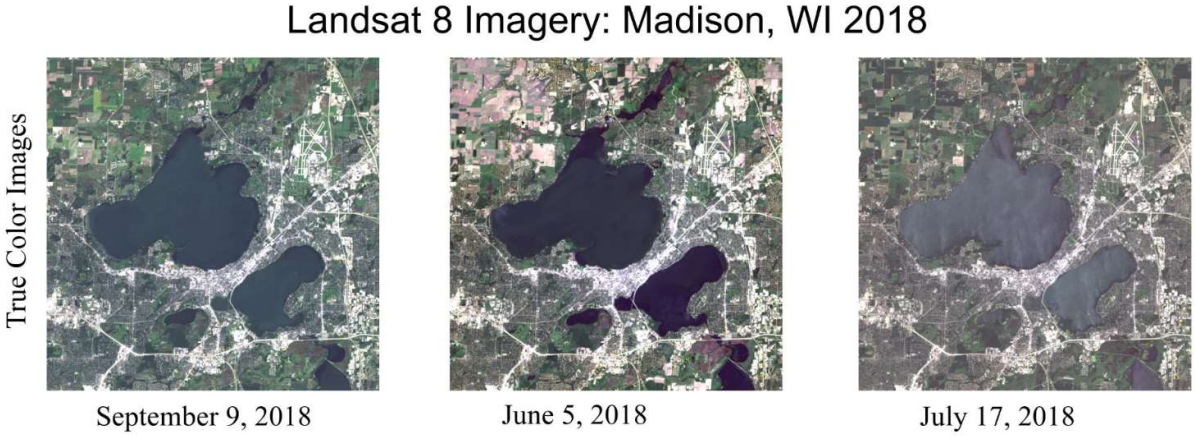


Figure 6. Snippet from eseri, showing the Landset8.

An NDVI index is calculated for each image by using ArcGIS. These three NDVI images are then stacked together to create one image. The layer that has the algal bloom is set to the green band and the other two images are set to either the red or blue band (preference is personal).

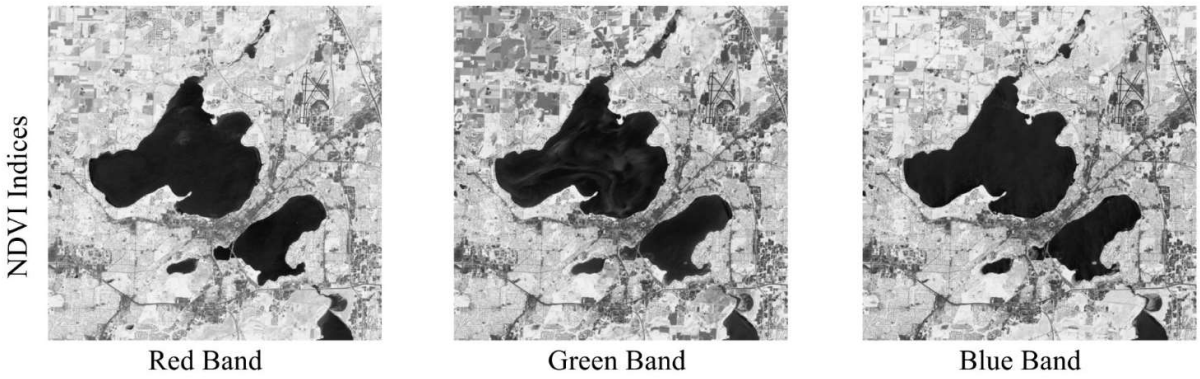


Figure 7. Snippet from eseri, showing the NDVI Indeces.

The results can be seen in here where the algal bloom is highlighted in a bright green.

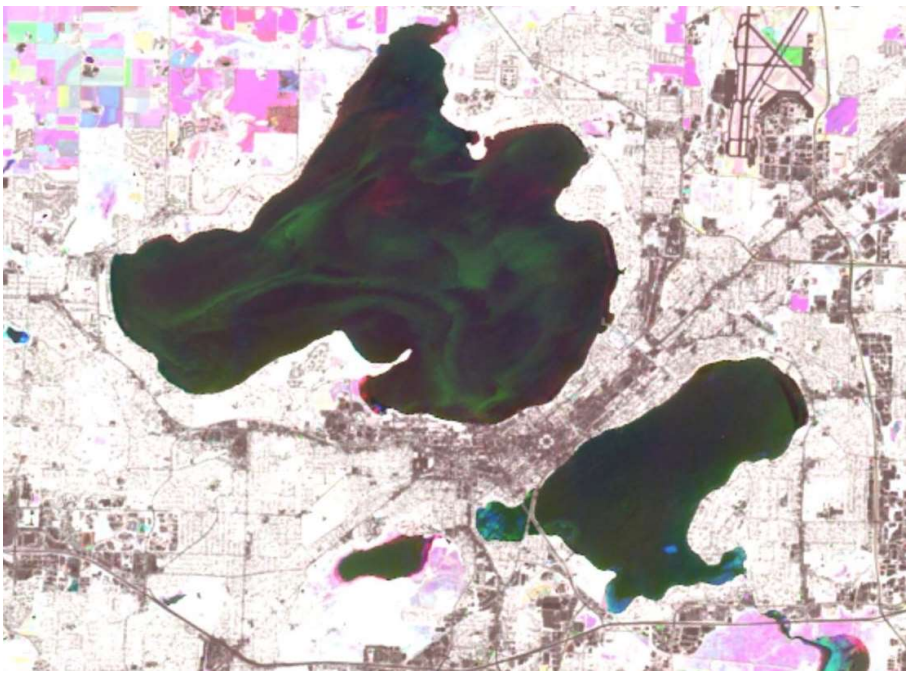


Figure 8. Snippet from eseri, showing the Algal Blooms.

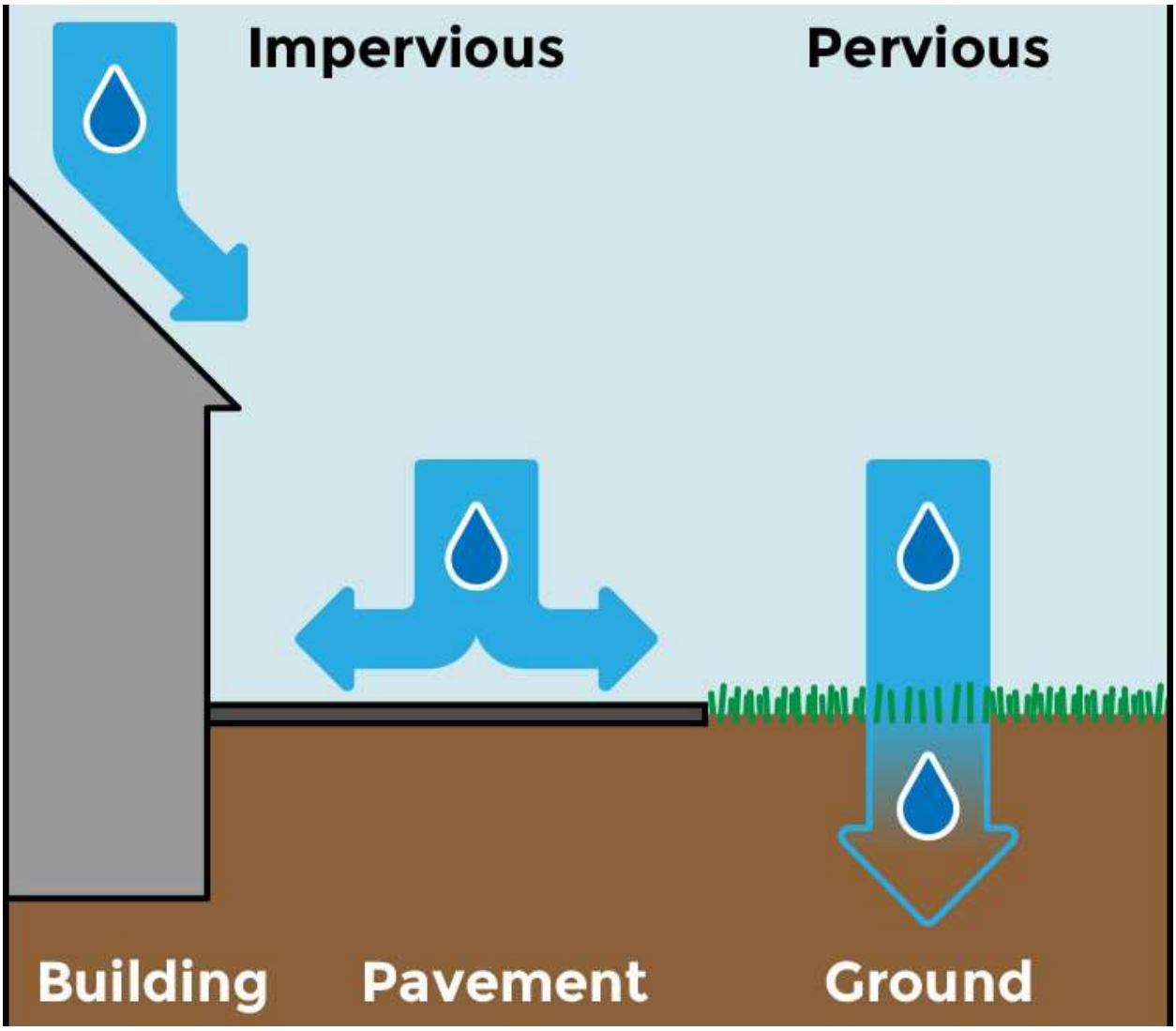
Discussion:

Limitations for successful implementation of mapping Harmful Algal Blooms include satellite resolution and sensing capabilities. Unfortunately, the satellites resolution is not

able to detect all type of HABs. Lower resolution satellites capture less than 1 percent of waterbodies and only 33 percent of drinking water intakes according to USGS.

Part II

Impervious Surfaces



This is another example of ways to apply Landsat imagery with this example I was successful with classification. I classified the imagery into land-use types to determine which parts of the ground are pervious and impervious.

Introduction:

Impervious surfaces are mainly artificial structures such as pavements (roads, sidewalks, driveways and parking lots, as well as industrial areas such as airports, ports and logistics and distribution centers, all of which use considerable paved areas) that are covered by water-resistant materials such as asphalt, concrete, brick, stone, and rooftops. Soils compacted by urban development are also highly impervious. (3)
Impervious surfaces can cause serious environmental problems, including flooding and contaminated runoff. Because impervious surfaces are such a danger, many governments charge landowners with high amounts of impervious surfaces on their properties.

Site Description:

Corvallis is a city and the county seat of Benton County in central western Oregon, United States. It is the principal city of the Corvallis, Oregon Metropolitan Statistical Area, which encompasses all of Benton County. As of the 2010 United States Census, the population was 54,462. Its population was estimated by the Portland Research Center to be 58,856 in 2019. Corvallis is the location of Oregon State University and Good Samaritan Regional Medical Center. Corvallis is the westernmost city in the contiguous 48 states with a population larger than 50,000. (4)
Corvallis is at river mile 131–32 of the Willamette River. Corvallis is bordered on the northwest by the foothills of the Oregon Coast Range, with Bald Hill providing a view of the town.
According to the United States Census Bureau, the city has a total area of 14.30 square miles (37.04 km2), of which 14.13 square miles (36.60 km2) are land and 0.17 square miles (0.44 km2) is covered by water. (5) This project was applied to a neighborhood in south west Corvallis.

Figure 9. Snippet from ArcGIS, showing a neighborhood in SW Corvallis.

Data Description:

The USGS Earth Explorer were used in this project to download Orthoimage for city of Corvallis. By using the same steps as described above.

Methodology and Results:

The aerial image exported to ArcGIS. Before classifying the imagery, the band combination has to be changed to distinguish features clearly. Then, we will group pixels into segments, which will generalize the image and significantly reduce the number of spectral signatures to classify. Once we segment the imagery, we will perform a supervised classification of the segments. we will first classify the image into broad land-use types, such as roofs or vegetation. Then, we will reclassify those land-use types into either impervious or pervious surfaces. Those steps were applied on ArcGIS as follow:

1. **Raster Function and Extract Band:**
   On the ribbon, click the Imagery tab. In the Analysis group, click Raster Functions. Then, in the Raster Functions pane, search for and click the Extract Bands function. The extract Bands function will create a new image with only three bands to distinguish between impervious and pervious surfaces. The bands I used here are 4 1 3.

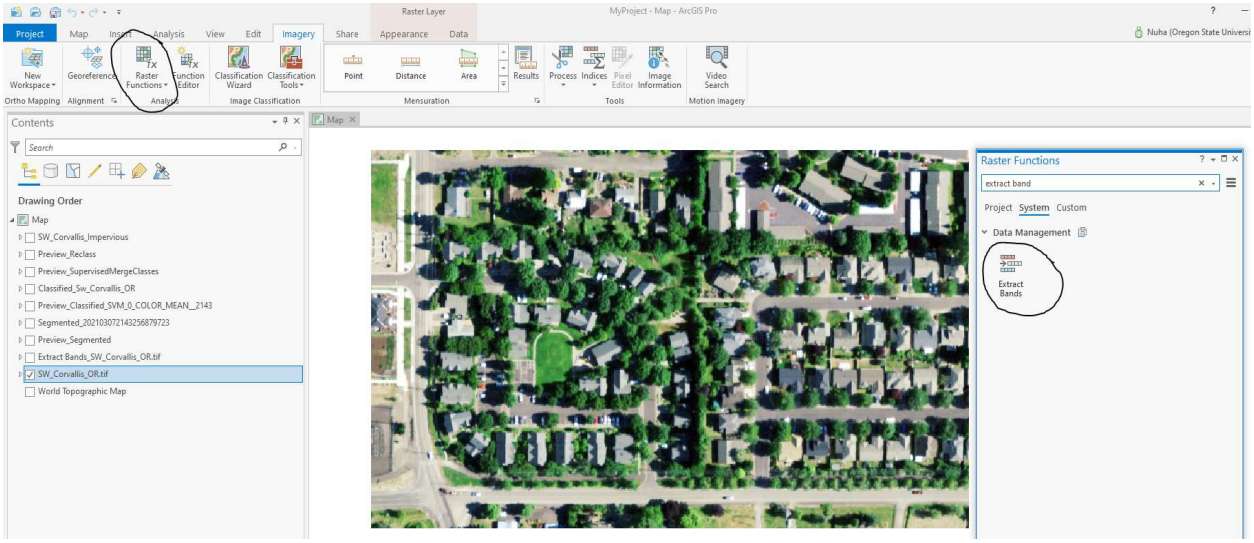


Figure 10. Snippet from ArcGIS

2. **The Extract Bands layer:**
   The Extract Bands layer added to the map and shows the imagery with the band combination that you chose (4 1 3). Vegetation appears as red, roads appear as gray, and roofs appear as shades of gray or blue. By emphasizing the difference

between natural and human-made surfaces, we will be able to classify them later more easily.

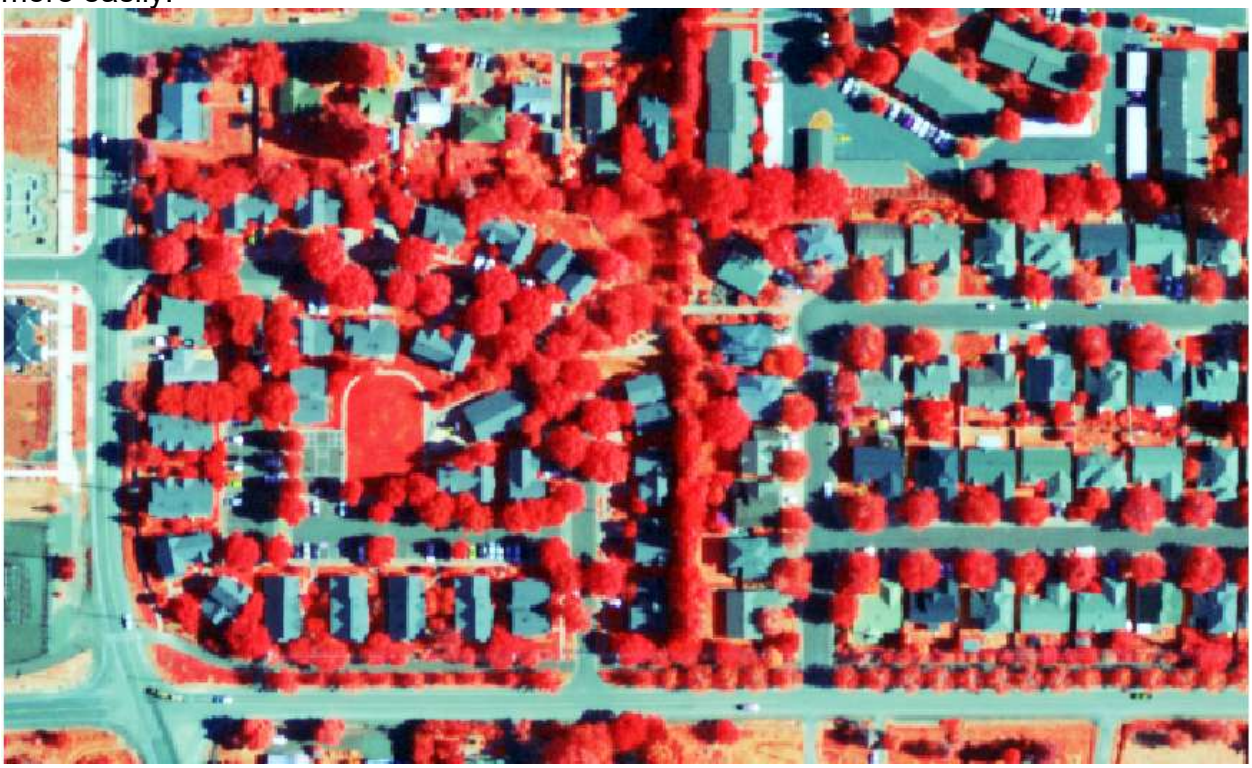


Figure 11. Snippet from ArcGIS showing the Extract Band Layer.

3. **The Classification Wizard:**

In the Contents pane, we have to make sure that the Extract layer is selected. Then, on the Imagery tab, in the Image Classification group, we click the Classification Wizard button.

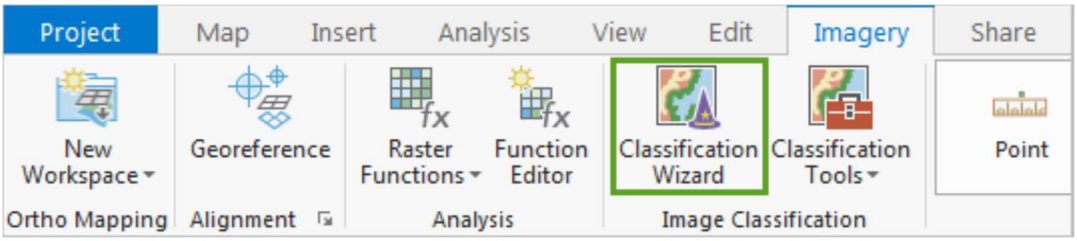


Figure 10. Snippet from ArcGIS showing the Classification Wizard.

Then we have to confirm that classification method is set to supervised and that classification type is set to object based.

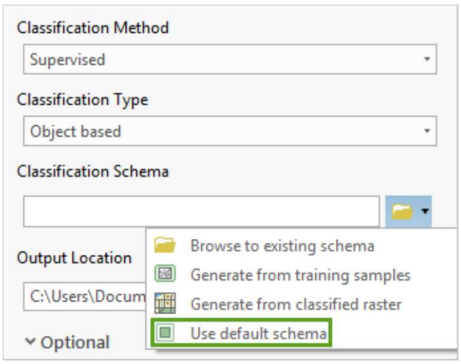


Figure 11. Snippet from ArcGIS showing the Classification method.

4. **Segment the image:**
   We will group adjacent pixels with similar spectral characteristics into segments. Doing so will generalize the image and make it easier to classify and a preview of the segmentation is added to the map.

Figure 12. Snippet from ArcGIS showing a preview of the segmentation.

5. **Classify the imagery:**
   Previously, we segmented the imagery to simplify it for classification. Next, we will perform a supervised classification of the segments. A supervised classification is based on user-defined training samples, which indicate what types of pixels or segments should be classified in what way. (An unsupervised classification, by contrast, relies on the software to decide classifications based on algorithms.) we will first classify the image into broad land-use types, such as vegetation or roads.

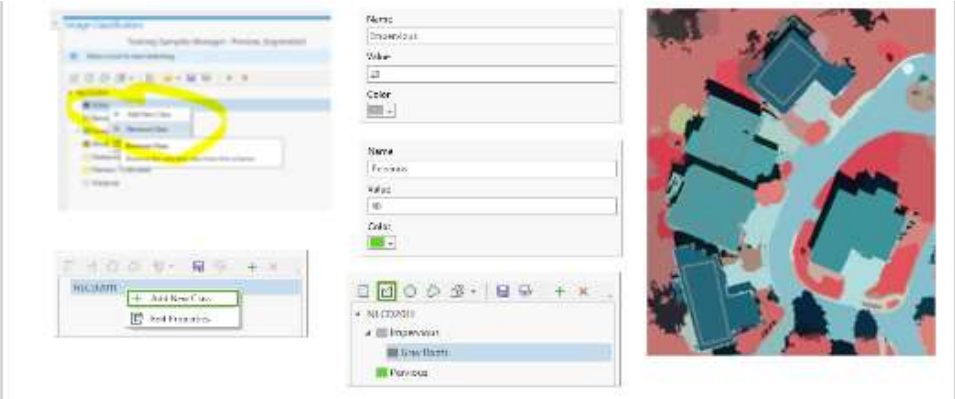


Figure 13. Snippet from ArcGIS showing the steps of classify the image.

Then, we will reclassify those land-use types into either pervious or impervious surfaces.

Figure 14. Snippet from ArcGIS showing the result of image classification.

Discussion:

To check my result to ensure accuracy of classification I edited layer Transparency, we can see that the road here is covered by trees therefore this is not a perfect representation

of the two different surface classes We can improve the accuracy of representation with higher resolution imagery.

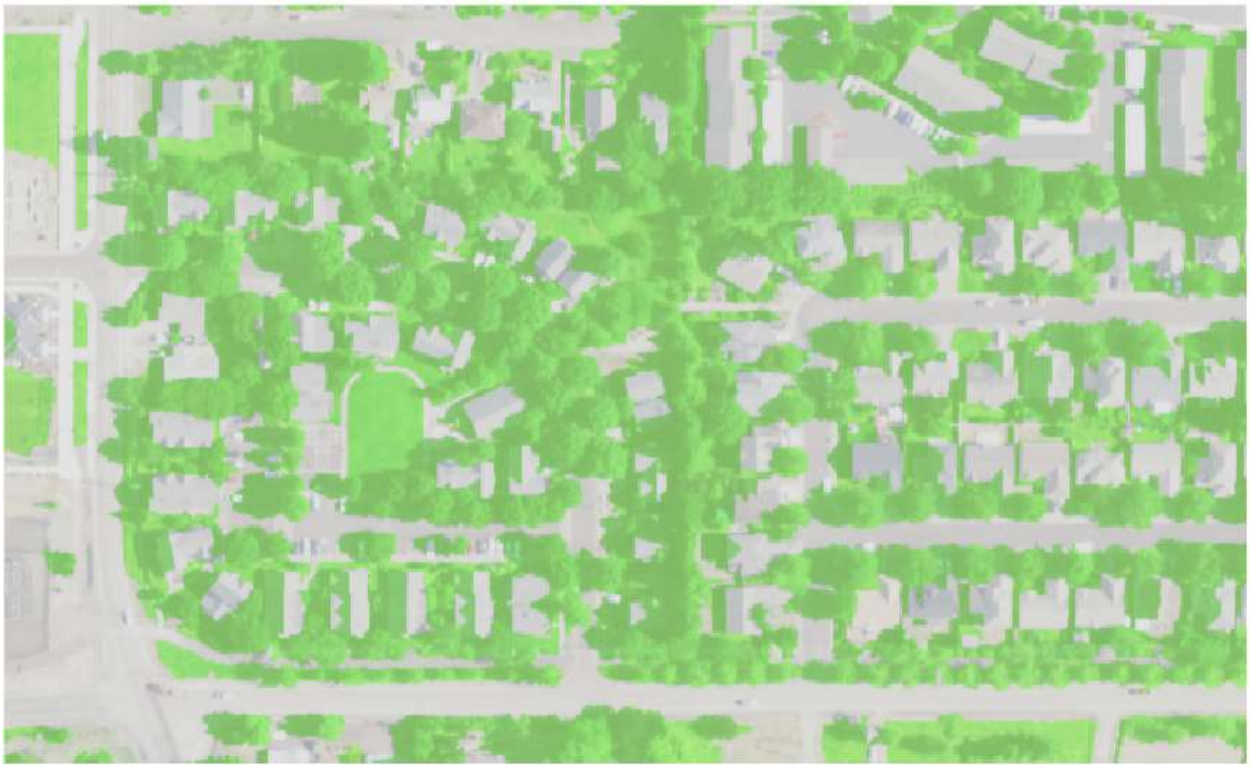


Figure 15. Snippet from ArcGIS showing the Transparency.

Conclusion:

In this report, we focus on image classification because classification results are the basis for many environmental and socioeconomic applications like measurement of crop health, detect HABs, monitor drought, forecast agricultural production, assist in forecasting, and flood management.
For a successful classification, some factors must be considered like the availability of quality Landsat imagery, different bands, and how to put these bands together. A sufficient number of training samples and selection of a suitable classification method are also important and effect the successful of classification.

Bibliography:

1. Fahad Alawadi "Detection of surface algal blooms using the newly developed algorithm surface algal bloom index (SABI)", Proc. SPIE 7825, Remote Sensing of the Ocean, Sea Ice, and Large Water Regions 2010, 782506 (18 October 2010); https://doi.org/10.1117/12.862096.
2. Igor Ogashawara, Lin Li, and Max Jacobo Moreno-Madriñán "Slope algorithm to map algal blooms in inland waters for Landsat 8/Operational Land Imager

images," Journal of Applied Remote Sensing 11(1), 012005 (28 December 2016). https://doi.org/10.1117/1.JRS.11.012005.
3. Tatsuya Koga, Akira Kawamura, Hideo Amaguchi, Hiroto Tanouchi. (2016) Assessing impervious area ratios of grid-based land-use classifications on the example of an urban watershed. Hydrological Sciences Journal 61:9, pages 1728-1739.

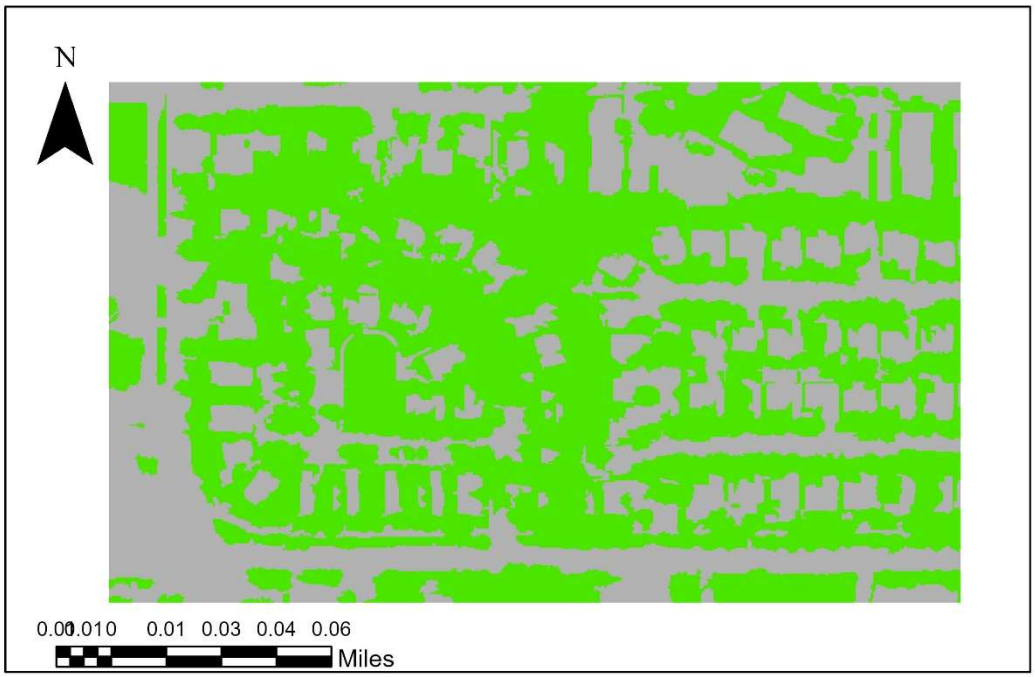
References:

4. ODEQ. (2011). Oregon DEQ Harmful Algal Bloom (HAB) Strategy (Issue June). Retrieved from http://www.deq.state.or.us/wq/algae/docs/AppendixD.pdf
5. https://en.wikipedia.org/wiki/Ross_Island_(Oregon).
6. https://en.wikipedia.org/wiki/Impervious_surface#:~:text=Impervious%20surfaces%20are%20mainly%20artificial,resistant%20materials%20such%20as%20asphalt%2C
7. "Find a County". National Association of Counties. Archived from the original on 2011-05-31. Retrieved 2011-06-07.
8. "US Gazetteer files 2010". United States Census Bureau. Archived from the original on 2012-07-02. Retrieved 2012-12-21.

Classified Imagery of A Neighborhood in SW Corvallis,OR,USA

Final Term Project
GIS_CE_513
Winter_2021

Nuha Alagaidi



A classified imagery of a neighborhood in Corvallis to determine land cover that is pervious and land cover that is impervious. Impervious surfaces can cause serious environmental problems, including flooding and contaminated runoff.

A preview of the image segmentation of a neighborhood in Corvallis, OR, USA

Final Term Project
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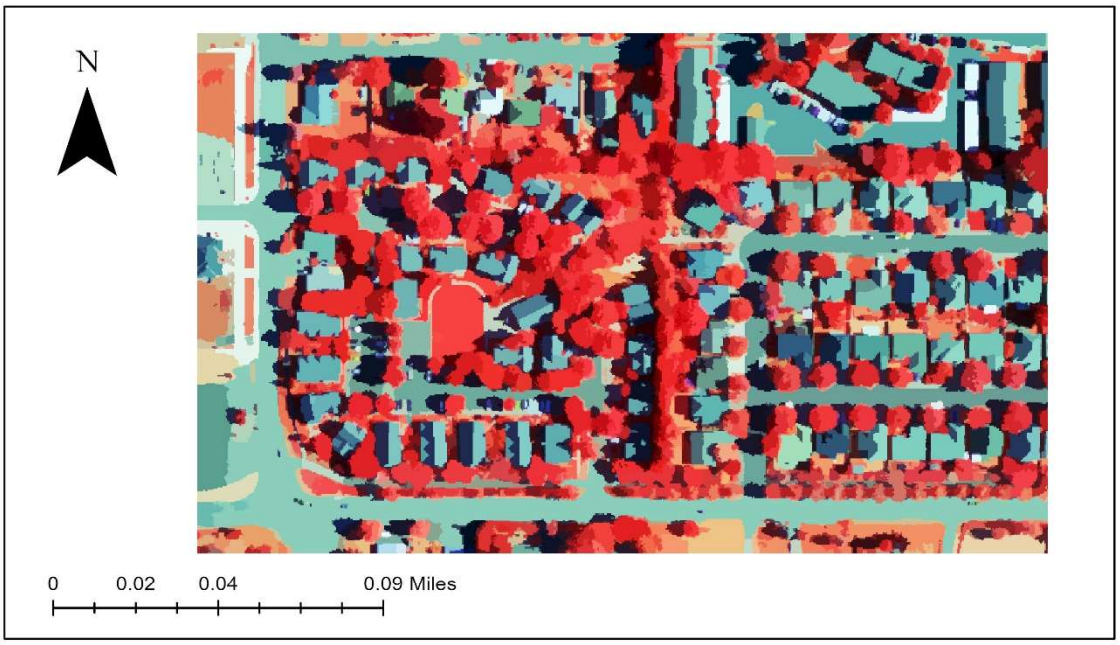

Preview_Segmented
RGB
Red: Band_4
Green: Band_1
Blue: Band_3

This image was generated on the fly, which means the processing will change based on the map extent. At full extent, the image is generalized to save time. With a smaller map extent, the segmentation more accurately reflects the parameters we used, with fewer segments and smoother outputs.