University of Oregon - GEOG 485/585 – Remote Sensing 1 – Fall 2021

Lab Assignment #3: Analyzing spectral reflectance curves

Objectives: In this lab, we will develop some of the concepts that we have already covered to reinforce your learning. We will investigate differences in NDVI and spectral reflectance curves between two irrigation districts in Central Oregon in July 2021. We will also apply a spectral transform to a Landsat 8 image of your choice.

Logistics:

Date assigned:	Week 3
Date due:	Before the beginning of Week 4 labs
Points:	100 points
Deliverables:	Post a PDF document on Canvas with all answers and necessary graphics using the answer sheet given to you. Your responses are expected to be in complete, grammatically correct sentences based on knowledge gained from lecture, reading, and lab exercises. Remember that many of the questions have multiple parts so make sure you answer all parts of the questions.

Preface:

The lab instructions will be available on Canvas (canvas.uoregon.edu) and the class network drive (details below). Data used in labs are not posted on canvas and should be accessed through the SSIL network (you can also remotely connect to this network from off campus, following these instructions).

The class data is available at the following path:

`R:\GEOG485_12740_05\Class_Data\Lab3\`

You should store your work in a separate folder for each lab on your local computer. **Note:** I recommend anything you save on your local computer should also be backed up to a USB stick or Google Drive account at the end of each session. Your folder should have the following path (except has your own SSIL username):

`R:\GEOG485_12740_05\Student_Data\Your_Username`

For this lab, create a "`Lab3`" folder in which to store your work inside your user folder. Your lab write-up and any additional materials should be turned in online to the course website on canvas.uoregon.edu. Lab questions are due by the start of the next lab, but it is suggested you do these questions first thing.

1. Import data

First, import all seven Landsat bands from `R:\GEOG485_12740_05\Class_Data\Lab1\data\`, and the `Central_Oregon_Irrigation_District` and `North_Unit_Irrigation_District` shapefiles (i.e. just the .shp file) from `R:\GEOG485_12740_05\Class_Data\Lab3\` into your QGIS workspace.

2. Prepare data

Today we are going to focus on some specific areas of the Landsat image so that our derived statistics are more meaningful. But first we need to prepare our data:

- Produce a *virtual raster* from the seven Landsat layers (HINT: use instructions from Lab 1)
- Display the new *virtual raster* layer as *true color* image using the **Layer Styling** panel
- Produce an *NDVI* layer using bands 4 and 5 and the **Raster Calculator** (HINT: use instructions from Lab 2) and save in your student folder as `NDVI.TIF`

3. Clip data

Now we will clip the `NDVI.TIF` you just produced with both shapefiles.

- Click **Raster** from the top menu → **Extraction** → **Clip Raster by Mask Layer**
- Select `NDVI.TIF` as the *Input Layer* and `Central_Oregon_Irrigation_District.shp` as the *Mask Layer*
- Scroll down to *Clipped (Mask)* and click the three dots (...) next to where it says *[save to temporary file].* Choose **Save to File** option, choose a name and a sensible location for the output file (i.e. "`R:\GEOG485_12740_05\Student_Data\Your_Username\Lab3\NDVI_COID.TIF`"). Make sure **GeoTIFF** is the output format. Then click **OK**.
- Repeat this step for but using the `Northern_Irrigation_District.shp` file as the *Mask Layer*
- Choose a name for this layer and save (i.e. "`R:\GEOG485_12740_05\Student_Data\Your_Username\Lab3\NDVI_NUID.TIF`")

Let's have a look at the histograms for these two clipped NDVI layers.

- Right-click the `NDVI_COID.TIF` layer → **Properties** and select **Histogram** from the menu on the left and **Compute Histogram**
- Change the **Min** and **Max** to 0 and 0.7, respectively and save this plot as a PNG file to your student folder
- Repeat for `NDVI_NUID.TIF`

****

Question 1 (20 points): Add both the histogram PNG files to your answers document and describe: 1) what the histograms show (i.e. x and y axes), 2) the differences between the histograms with respect to NDVI values and reflection in near-infrared and red wavelengths. Finally, can you think of some reasons why the NDVI values are so different between two irrigation districts?

****

4. Spectral reflectance curves

We introduced the concept of spectral reflectance curves in Lecture 2.2. Now let's put this knowledge into practice. But first we will need to change the **Symbology** of the two irrigation district shapefiles to make identifying pixels within these districts easier.

- Right-click the `Central_Oregon_Irrigation_District.shp` layer → **Properties** and select **Symbology** from the menu of the left
- Click **Simple fill** at the top
- Change the **Fill color** to **Transparent Fill**, change the **Stroke color** to a color of your choice, and set the **Stroke width** to 1
- Repeat for the `Northern_Irrigation_District.shp` layer but use a different **Stroke color**

Make sure that only the shapefile layers and virtual raster layer is selected and that the two shapefile layers overlay the virtual raster layer. All other layers can be deselected.

- Use the **Identify Features** tool to click on some pixels within the both irrigation districts
- The **Identify Results** panel should pop up with values of all the bands in the image at that pixel for whichever layer you have on top.
- At the bottom of the **Identify Results** panel, for **View** select **Graph.** The X-axis in this graph is for the number of bands and the Y-axis shows the pixel brightness value.

****

Question 2 (10 points): Click on some of the green fields in the Central Oregon Irrigation District with the **Identify Features** tool. Describe and explain the spectral reflectance curve with respect to the Landsat 8 bands from the link below and expected reflectance properties of vegetation in Figure 1.
https://www.usgs.gov/faqs/what-are-best-landsat-spectral-bands-use-my-research?qt-news_science_products=0#qt-news_science_products

****

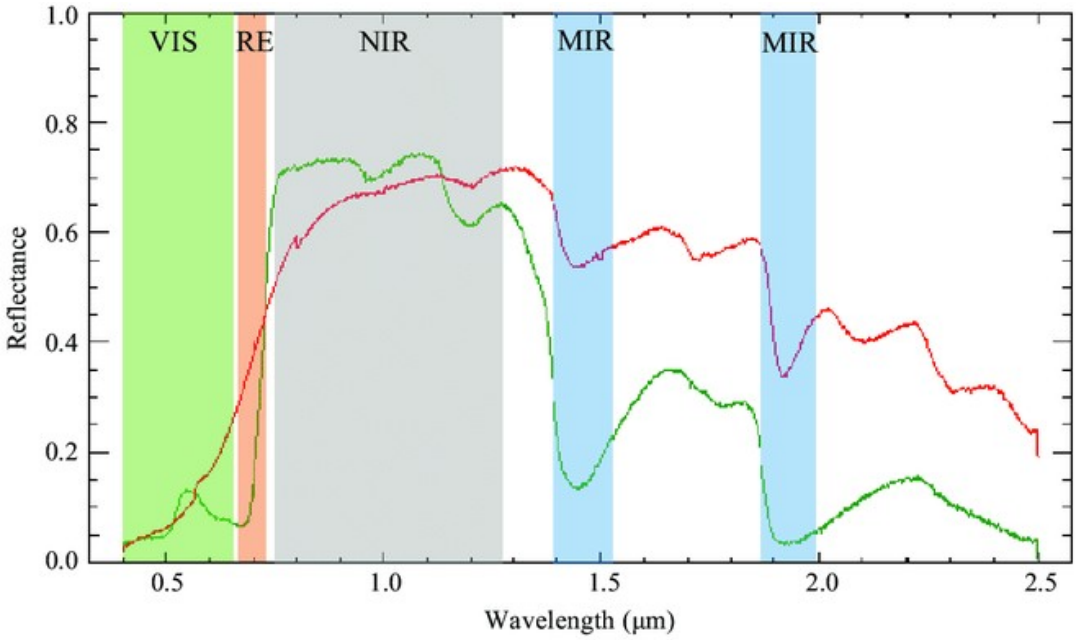

Figure 1. Idealized spectral reflectance curves for healthy (green) and stressed (red) vegetation

****

Question 3 (20 points): Click on some of the yellow fields in the North Unit Irrigation District with the **Identify Features** tool.

1) Describe and explain the spectral reflectance curve with respect to the Landsat 8 bands from the link below and expected reflectance properties of vegetation in Figure 1.
2) What are the largest differences between the green and yellow fields? Which band changes the most? What does that tell us about crops in Central Oregon vs. North Unit irrigation districts?

https://www.usgs.gov/faqs/what-are-best-landsat-spectral-bands-use-my-research?qt-news_science_products=0#qt-news_science_products

****

****

Question 4 (10 points): Click on the brown-colored field in the upper left of the North Unit Irrigation District bounding box with the **Identify Features** tool. Describe and explain the differences in spectral reflectance compared to the yellow-colored fields nearby.

****

You have now basically mastered the basics of remote sensing with Landsat 8. The last step of this lab will let you show-off some of your own creativity.

Download a Landsat image of over an area of your choice, you will first have to register for a new account at: https://ers.cr.usgs.gov/register

- Go to http://earthexplorer.usgs.gov/ and make sure you are logged in
- In the **Search Criteria** tab, under **Feature Name** type in a place (e.g. "*Santa Barbara")* and select the right **State** (e.g. "California") and click **Show**. This will bring up a list of features that matches, and now click on the feature (e.g. "*Santa Barbara*") to show the location on the map and add coordinates to the Area of Interest Control directly below.
- For the **Data Range** section, select the period of your choice (e.g. "**January 1, 2018** and **January 31, 2018**")
- Now click **Data Sets >>** at the bottom to take you to the next tab.
- Expand the **Landsat** category and **Landsat Collection 2 Level-2.** Select "*Landsat 8 OLI/TIRS C2 L2*".
- Now click on **Results >>**
- You should now see some images in the **Search Results** (two in my case for Santa Barbara). Click on the small thumbnail image to browse image and metadata.
- NOTE: Don't choose an image with too much cloud cover.
- You can download an image by clicking on **Download Options** which is just next to the image thumbnail. In the **Download Options** window, click on **Product Options,** and then download only the Landsat bands that you need for your spectral transform.

- Add the Landsat raster layers to a new QGIS workspace and apply a spectral transform using **Raster Calculator** (remember brackets!) and the link below as a guide

https://www.usgs.gov/core-science-systems/nli/landsat/landsat-surface-reflectance-derived-spectral-indices?qt-science_support_page_related_con=0#qt-science_support_page_related_con

- Save an image of your workspace as a PNG file by right-clicking your new spectrally transformed layer and selecting **Zoom to Layer**, then click **Project** from the top menu → **Import/Export** → **Export Map to Image…**

****

Question 5 (40 points): Add the PNG file you just produced to your answer sheet.

1) Describe where this Landsat 8 image is and why you picked it
2) Describe which spectral transform you chose and why
3) Describe what the spectral transform emphasizes in your image

****

This concludes Lab 3! Remember to type up all answers on your word document, convert files to PDF and upload it to Canvas by the deadline.